City of Philadelphia / WATER DEPARTMENT

BIENNIAL REPORT.... July 1, 1971 to June 30, 1973

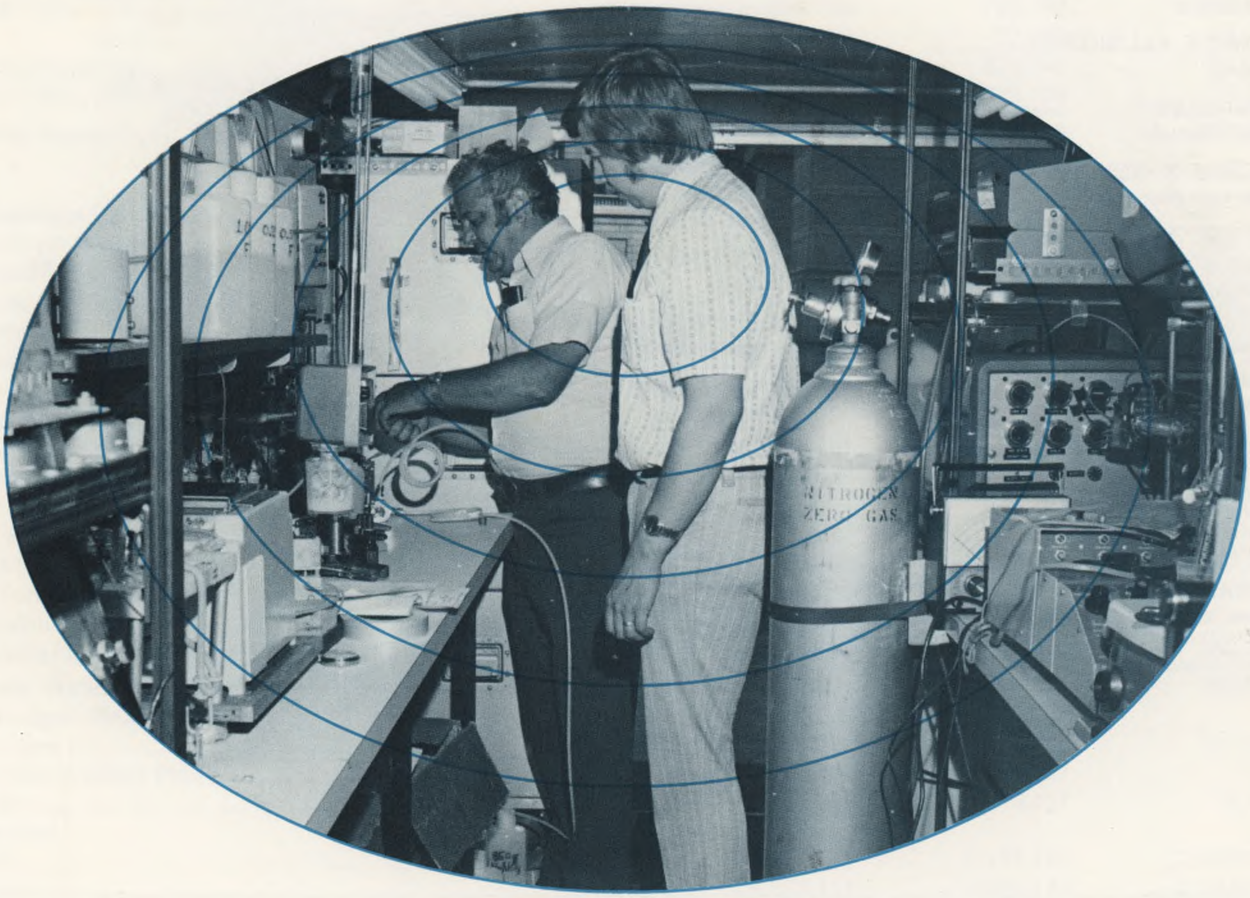
Front Cover: *Historical Fairmount Water Works (built 1812-23) with Museum of Art in background.* *See pages 24-25.*

FRANK L. RIZZO
Mayor

HILLEL S. LEVINSON
Managing Director

THOMAS C. PICCOLI
Deputy Managing Director

City of Philadelphia
WATER DEPARTMENT
BIENNIAL REPORT
For the Two Fiscal Years from
July 1, 1971 to June 30, 1973



CARMEN F. GUARINO
Water Commissioner

water department

CARMEN F. GUARINO*
Commissioner

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Deputy Commissioner
Water Operations

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Chief
Water Operations

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VICTOR A. PAGNOTTO
Load Control

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Pumping

ALAN HESS**
Water Treatment

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Water Main Records

AZAD ATTARIAN
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Water Operations Services

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Customer Service

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Automotive Maintenance

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Plant and Building Maintenance

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KENNETH J. ZITOMER†
Deputy Commissioner
Engineering

Division Chiefs
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WALTER H. CLARK
Construction

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Materials Testing

JULIAN A. RICHTER
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Administrative Services Manager

Assistants
FLOYD PLATTON
Personnel Officer

JACOB BALK
Meter Shop

JOSEPH A. DUFFY
Management Studies

JOHN T. CAPPIO
Safety Officer

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MICHAEL D. NELSON
Acting Chief

GEORGE W. CARPENTER††
Wastewater Treatment and Interceptors

RICHARD S. STARR
Sewer Collector System

WALTER YOKA
Sewer Maintenance

FAULKNER EDMONDS
Drainage Information

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Director

LEIGH B. HEBB
Chief

COMMISSIONER'S STAFF
SAMUEL J. SCHWARTZ
Assistant

RAYMOND J. HARRIS
Administrative Assistant

ROBERT F. WALKER
Executive Assistant

JOSEPH V. RADZIUL
Chief
Research and Development

* Succeeded Samuel S. Baxter on January 3, 1972.

** Sub Chiefs: Edward Shervin, Torresdale Plant; Frank Coulter, Belmont Plant; Bruce Aptowicz, Queen Lane Plant; and Water Quality Control and Research, Charles I. Pierce (Schuylkill) and Gerald Creighton (Delaware).

† Appointed deputy commissioner July 1, 1972.

†† Sub Chiefs: William Wankoff, Northeast Plant; Charles Grandy, Southeast Plant; Robert Sharpe, Southwest Plant; Stanley Cywinski, Maintenance; William Barnes, Interceptors; and Frank Ferrara, Electrical Services.

contents

highlights of 1971-73

Philadelphia took another step into the space age in 1973. It began transmitting stream data to a satellite orbiting the earth.

The data, which was relayed from monitoring stations along the rivers, passed from satellite to ground center and then to a teletype receiver in the city's Water Department.

For Philadelphians, this linkage to a U.S. Government satellite was another step in a continuing story of water progress.

In a brief 20 years, Philadelphia had modernized its old water and wastewater systems, and it had created one of the finest water services in America.

Treated in modern plants, pumped by automated stations, stored in capacious reservoirs, the city's water flowed clear and abundant. It was rated as one of America's purest treated waters.

This water was drawn from streams that were protected by an efficient wastewater system, collecting sewage from Philadelphia and outlying communities. In 1971-73, the city's three "water pollution control" plants kept 206,000 tons of suspended solids out of the rivers.

Despite these achievements, Philadelphia's Water Department had little time to look backward. It had set its sights on new and exciting goals.

WATER SERVICE

One goal, in particular, lured the city's water planners. This was the automation of the water system. Automation, it was believed, would reduce operating costs, increase efficiency, and provide still better water.

To realize these benefits, the department hired several consultant firms in May, 1973, to draw up a basic automation plan. Encompassing treatment plants, reservoirs, and pumping stations, this plan will make Philadelphia the first city in the world to *control* the treatment and delivery of water by computer.

Other improvements were also under way. From January 1, 1946 to June 30, 1971, the community had invested $195 million of capital funds in the water system, and it spent nearly $8 million more for this purpose in 1971-73.

During the biennium, two notable works were completed. These included—

- A 6,000-ft. tunnel to carry up to 150 million gallons of river water daily from the Schuylkill River to the Queen Lane Water Treatment Plant, and
- A new, covered reservoir, which holds 50 million gallons of purified water, at the Queen Lane Plant.

Built at a combined cost of $6.9 million, the new tunnel and reservoir will provide a more reliable water supply for most of Philadelphia lying between Broad Street and the Schuylkill River.

Less spectacular, but just as essential, were these other new services. The department—

- Constructed 30 miles of water mains to supply homes and industries in all parts of the city,
- Installed new pumps with a combined capacity of 107 million gallons in two water pumping stations,
- Installed ammoniation equipment at the Torresdale Water Treatment Plant.

It is expected that all of the city's finished water will be treated with ammonia in 1974, thus destroying the last traces of chlorinous tastes and odors.

STREAM PROTECTION

A nagging question troubled the nation's cities in 1973. Could they afford the staggering cost of cleaner lakes and streams?

In Philadelphia, this question was being quietly answered. The Water Department moved steadily ahead with plans for greater protection of the Delaware and Schuylkill Rivers.

The department planned to upgrade and "regionalize" its water pollution control plants at a cost of $300 million. The expanded plants would provide more thorough treatment of wastewater, and discharge a cleaner effluent to streams. Removal of pollutants from wastewater (as measured by biochemical oxygen demand) would rise from 55% to 92%.

Capacious enough to treat the wastes of additional outlying communities, the new plants will be shaped to a modern design. They will be operated by computer.

In the winter of 1973, the Water Department asked for 75% federal financing of the eligible project costs of the plant expansion. Though this would net the city close to $225 million, there were some uncertainties about the timing of federal financing.

Despite the uncertainties, the city had already agreed to an Environmental Protection Agency request that it shave a year off completion dates for two of its plants.

Subject to federal financing, all expansion will be carried out between 1973 and 1977.

While working on these ambitious plans for the future, the Water Department continued to improve its wastewater system. During 1971-73, it spent $24.8 million in capital funds for wastewater plants, pumping stations, and sewers. In the previous 25 years (1946-71), the city had spent nearly $311 million for such facilities.

During the biennium, the department built—

- 23 miles of sewers to collect wastewater from homes and industries,
- 272 feet of replacement line for the big Mill Creek Sewer, which collects storm water from West Philadelphia.
- A new Sewer Maintenance Yard in West Philadelphia, and an Automotive Maintenance Garage at the Northeast Plant.

Non-polluting incinerators, which will burn grease and oil removed from wastewater, were under construction at the Southeast and Southwest Water Pollution Control Plants. The incinerators, costing $1.85 million, will eliminate some plant odors.

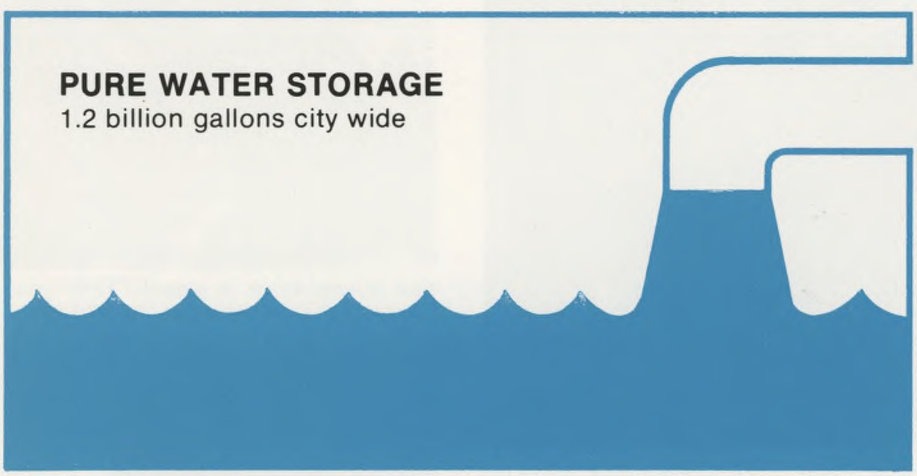
Ocean disposal of the city's digested sewage sludge continued during the biennium. Although a Franklin Institute study (in 1972) showed that the city's sludge was having no harmful effect on the ocean, the Environmental Protection Agency required Philadelphia to move its disposal site farther out to sea. In May, 1973, the department began to barge its sludge to a point 50 miles southeast of Delaware Bay. Urging the lower cost and ecological safety of ocean disposal, the department asked EPA to regulate, but not to ban, such disposal in the future.

OTHER DEVELOPMENTS

With the change of City Administration on January 3, 1972, new emphasis was placed on savings. To carry out this policy, the department cut overtime sharply and made other savings on manpower. In the 18 months up to June 30, 1973, overtime costs were $247,000 below the preceding 18 months.

Savings from previous years were also piling up. Newly instituted procedures—the result of a manpower study (1967-72)—netted the

Final Inspection: City officials inspect a new water tunnel that stretches for more than a mile. River water began to flow through the tunnel to the Queen Lane Plant.



New Water Storage: A new covered reservoir, which holds 50 million gallons of filtered water, went into service at the Queen Lane Plant. In the past decade, filtered-water storage has risen by 232 million gallons.

highlights of 1971-73 (continued)

New Sewers: Twenty-three miles of new sewers were built during the biennium in all parts of the city.

department $2.3 million in operating savings up to mid-1973.

To extend these savings, the department studied management practices in a number of its units in 1973, and it laid the groundwork for the introduction of an incentive system among sewer inlet cleaners.

During the biennium, the department also—

- Carried out various studies of stream pollution, storm water overflow, new wastewater treatment methods, water quality, and sewer inlet design,
- Increased the use of its digital computer for engineering and management reports,
- Provided or sponsored a variety of technical, orientation, public relations, engineering, and college training for its personnel,
- Prepared changes in the city's plumbing code to eliminate health hazards from cross connections in private property,
- Issued plastic sprinkler caps to the public for use on certain fire hydrants in the summer, while placing thousands of locking devices on other hydrants,
- Provided summer jobs, under a federal program, for high school students,
- Won 17 safety awards from the Safety Council of the Greater Philadelphia Chamber of Commerce. ■

From Abroad: Engineers and public officials came from all over the world to visit the city's modern water plants. This group, representing nine European countries, is touring the Torresdale Plant.

New Supply Valve: A gigantic valve goes into place to improve water flow in a main.

For Flood Control: The giant Mill Creek Sewer, which dates from the 1880's, was rebuilt for 272 feet in West Philadelphia.

New Incinerators: Non-polluting incinerators at the Southwest Water Pollution Control Plant will burn grease and oil skimmed from sewage.

facts in brief

	Fiscal 1972-73	Fiscal 1971-72	Calendar 1962
POPULATION	1,948,609 (a)	1,948,609 (a)	2,002,572 (b)
WATER SYSTEM:			
Meters in system	522,165	521,852	522,632
Unmetered accounts	3,863	3,998	2,599
Total services	526,028	525,850	525,231
Consumption of filtered water			
• Per person on average day (gals.)	190.5	182.5	163.7
• Average day (million gals.)	372.8(c)	359.9(d)	327.8
• Maximum day (million gals.)	563.8(e)	474.3(f)	430.5
• Total annual (billion gals.)	136.1	131.7	119.6
Total annual raw water pumped (billion gals.)	143.4	138.9	125
Pipelines (miles)	3,240	3,234	3,108
Fire hydrants	25,568	25,479	24,325
Valves	77,511	76,976	69,325
WASTEWATER SYSTEM:			
Wastewater treated on average day (million gals.)	448.7	442.9	347.2
Total wastewater treated in year (billion gals.)	163.8	162.1	126.7
Sewers (miles)	2,544	2,539.1	2,404
HIGH PRESSURE FIRE SYSTEM:			
Pipelines (miles)	64.5	63.5	63
Fire hydrants	1,070	1,050	1,050
Valves	1,930	1,887	1,870

Notes: (a) U.S. Census figure for 1970.
(b) U.S. Census figure for 1960.
(c) Includes 367.7 M.G.D. used in Philadelphia and 5.1 M.G.D. delivered to Bucks County.
(d) Includes 355.6 M.G.D. used in Philadelphia and 4.3 M.G.D. delivered to Bucks County.
(e) Tuesday, July 18, 1972—temperature 90 degrees F.
(f) Friday, June 25, 1971—temperature 92 degrees F.

the water system

MOVING TOWARDS AUTOMATION

For 20 years, change has swept over the city's water system, and each passing year has brought new improvements.

Major change still dominated the Water Department in 1971-73, and its water planners were pressing towards another master goal. That goal was the automation of the water system.

This was a new and imaginative goal, for automation had not yet been tried by any water utility. Although a few communities had used computers to log data on water flow, none had used the computer to *control* the treatment and distribution of water independently of human operators. To employ the computer for full "process control" was the objective of the Philadelphia Water Department.

There were many reasons for the department's interest. Computers could save money, speed up response to emergencies, and provide better control of water quality. More functions could be regulated centrally by fewer employees.

The Water Department had already taken, or was in the process of taking, a number of steps to prepare for automation:

1. It had built modern treatment plants operated by automatic or semi-automatic equipment, and a microwave system that remotely controlled pumping stations and reservoirs.

2. Studies from 1967 to 1971 by General Electric Company, acting as a private consultant, showed that computerization of the water treatment plants was feasible.

3. In May, 1973, the department appointed an experienced consulting team* from private industry to draw up a comprehensive plan. Working under a $628,000 contract, the consultants will have up to 15 months to—

- Prepare a general automation plan for the water treatment plants and distribution system,
- Survey existing controls and equipment in the treatment plants for adaptation to automation, and for updating where necessary,
- Design contract plans and specifications for initial automation of the Queen Lane Plant and the East Park and Oak Lane Reservoirs.

The control of water purification by computer will be introduced at the Queen Lane Plant first to obtain operating experience. Later, it will be extended to the Torresdale and Belmont Plants, and to the microwave system.

The computer (or possibly computers) will (1) monitor the flow, condition, and chemical treatment of water in the plants, (2) analyze information transmitted to it by monitoring devices located in the plants and on the rivers, and (3) then issue "orders" to plant equipment. All of this will be done without intervention of a human operator.

4. As its plant equipment wore out, the department was buying new equipment that would be compatible with future automation. Pneumatic instruments, for example, were being replaced with electronic, and new monitoring devices were being installed or developed.** These devices transmitted data by electrical signal to operators' or chemists' panels. Eventually, such signals will be transmitted to a process control computer.

5. Although it did not regulate processes, a digital computer was in service at the Microwave Center. From mid-1970 onward it received and digested an unending stream of data on water flow rates, pressures, elevations, and other conditions at pumping stations and reservoirs. This data was used by center operators, who regulated those facilities by microwave.

Transistorization of the microwave system was extended in 1973. Microwave equipment of the vacuum-tube type was replaced with solid-state equipment at two pumping stations,*** thus assuring more trouble-free control by a future computer. To date, 10 pumping stations had been transistorized, and only three had not.

6. At the department's request, General Electric Company made several studies of water pressure districts. The data from these studies, digested by the G.E. computer, was used to determine "control strategies" for supplying water to the districts at least cost. These "strategies" will be put on the department's process control computer when automation is achieved.

* Black, Crow, and Eidness, consulting engineers, of Gainesville, Fla., head the team, which includes the General Electric, Hercules Powder, and Foxboro Companies.

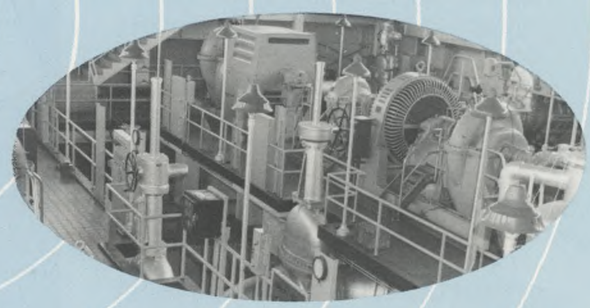
** Thus during the biennium the Torresdale Plant installed (1) six instruments to monitor the "pH" of the river water and to pace (eventually) the application of lime, (2) four turbidimeters to measure turbidity, (3) new level gauges on dry chemical bins, and (4) new electronic controls on a wash water tank. At the Queen Lane Plant, new equipment was making it possible to pace automatically for the first time the application of caustic soda and fluoride.

*** East and West Oak Lane Stations.

BY 1980 . . . THE CITY'S WATER SYSTEM WILL BE FULLY COMPUTERIZED

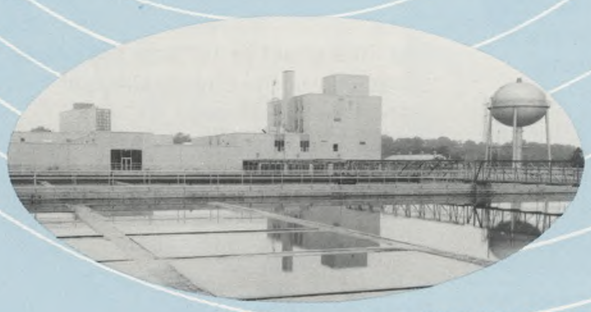
. . . . WITH PLANT AUTOMATION

RESERVOIRS



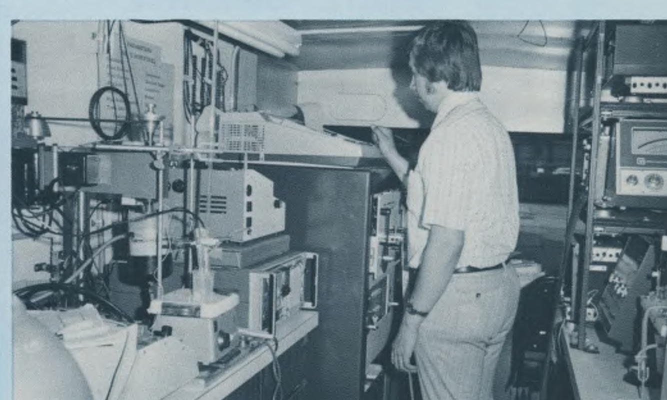
PUMPING STATIONS

Philadelphia may become the first city in the world to control the treatment and delivery of water by computer. Treatment plants, pumping stations, and reservoirs will be linked to a master computer (or computers). The city hopes for savings, more efficiency, and better water.

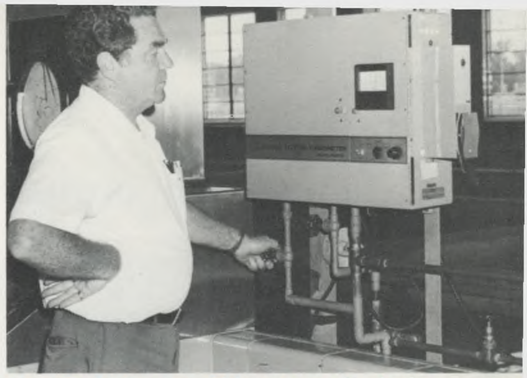


TREATMENT PLANTS

. . . . AND ELECTRONIC LABORATORIES ON WHEELS



The National Science Foundation developed this mobile laboratory to test water as it reaches consumers. The all-electronic laboratory, with minicomputer and analyzers, can tie into any neighborhood main and monitor continuously. Philadelphia plans to acquire such laboratories to ensure good water for its citizens.



New Turbidimeter: This automatic device measures water turbidity at the Torresdale Plant. It is one of several new sensing devices that will report eventually to computers.

THE CHALLENGE OF RISING CONSUMPTION

The need for increased capacity was another challenge facing the water system. This was because of growing demand for water.

Philadelphians used more water in fiscal 1973 than at any time in 18 years. Their average daily consumption was 367.7 million gallons.* This was only slightly below the city's historic high . . . 370 million gallons a day in 1953.

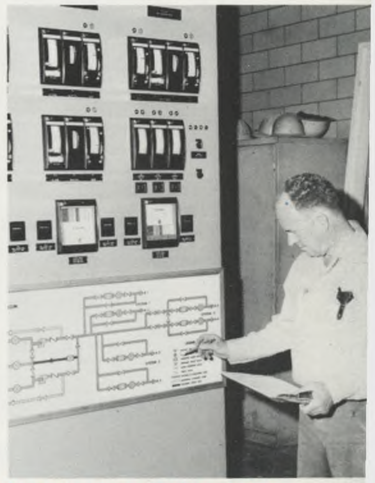
In addition, the city supplied an average of 5.1 million gallons a day to Bucks County in 1972-73, raising total water use to 372.8 M.G.D.—the highest output since the public water system was founded in 1801.

The increased water use was not a passing development. Despite many open fire hydrants on hot summer days, the use reflected a well established trend.

The long-term curve of water use has gone down and then up in Philadelphia during the last 25 years. In the decade 1948-57, water use averaged 357 million gallons a day. Consumption sank in the 10 years that followed, as the Water Department corrected leakage from old mains and put a water meter into every home. From 1958 through 1967, it averaged only 333 million gallons daily.

Water use within the city turned upward in 1968, and in the years since then a small population increase, greater industrial demand, and improved standards of living have held it at a higher level. Water consumption for the period 1968-73 has averaged 363 M.G.D.

Although the rising consumption had little effect in 1973 on the ample capacities of the city's treatment plants, there was need for strengthening the pumping, piping, and storage of water. For this purpose, the Water Department made important changes.



For Better Water: An operator checks the control panel (right) of a new ammoniation system at the Torresdale Plant. Ammonia will be used to remove chlorinous tastes and odors from finished water. Photo at left shows ammonia applicators.

A GIANT WATER TUNNEL FOR QUEEN LANE

A great cascade of water ushered in a vital change in April, 1973. Rushing up a 120-ft. high shaft, the water plunged into an open reservoir at the Queen Lane Plant.

The water came from the Schuylkill River through a 6,000-ft. tunnel, that will carry up to 150 million gallons of river water daily.

The new pipeline—the first water tunnel to be built by the city since 1904—will assure a more constant supply of river water for the plant, and help it meet future growth in consumer demand. It replaces three smaller-capacity water lines, two of which will be reconditioned and retained on stand-by.

There was urgent need for the new water tunnel. Twice in 1972 the old supply mains broke, partially disrupting service to the Queen Lane Plant.

Cut by a boring machine through underlying rock, the new tunnel is 11 feet in diameter and contains an 8-ft. diameter concrete tube. It runs 50 to 100 feet below the surface, shooting east from Ridge Avenue along Schoolhouse Lane to Cresson Street; then bends south along Cresson Street to Bowman Street, where it turns east again, ending at the Henry Avenue reservoir of the Queen Lane Plant.

Largely finished on June 30, 1973, was a steel pipeline loop which connects the tunnel to a riverside pumping station at Ridge Avenue and Schoolhouse Lane. By August this

*** This was 12.1 million gallons more a day than in fiscal 1972 when a temporary drop occurred. Water use soared to 563.8 million gallons on July 18, 1972—the highest use for any day on record. Again it exceeded 500 million gallons daily on several days in June, 1973.**

For Water Supply: Steel pipe, four feet in diameter, awaits placement at the Queen Lane Plant. It will carry water to consumers from a new reservoir.

loop had been linked to all the station pumps.

The loop includes 1,160 feet of 5-ft. steel pipe, three huge valve chambers, and two magnetic flow meters. The meters measure water flow rates and transmit the data to a panel in the station.

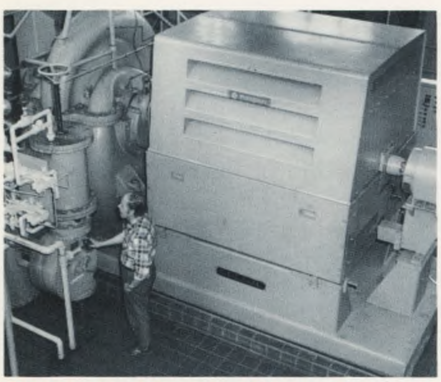
Together, the tunnel and pipeline loop were built at a cost of $3.4 million. The Federal Government underwrote 44% of the cost.

A NEW RESERVOIR FOR PURIFIED WATER

There was a welcome improvement of water pressures in some neighborhoods west of Broad Street, as a new reservoir went into service. Formed from 22 abandoned filter beds at the Queen Lane Plant, the reservoir could hold 50 million gallons of purified water.

During the biennium, sand and gravel spewed from the old filter beds as workmen cleared and interconnected them. New piping, roof drainage, roof support columns, chlorinators, and flow and elevation gauges were installed.

The first half of the reservoir went into service in May, 1971, and the second half in September, 1972.



For Increased Pumping: Two new pumps at the Lardner's Point Station will help to meet high summer demand for Torresdale Plant water. Above, motor and pump.

The Queen Lane reservoir was the last in a series of covered basins to be created at the treatment plants in the past decade. These added 232 million gallons to the city's purified-water storage, raising this to nearly 1.2 billion gallons.

Protected from algae and contamination, the covered storage helps to preserve the quality of the finished water.

The cost of the Queen Lane reservoir was $3.5 million, with the Federal Government paying 40%.

THE EXPANSION OF PUMPING

The constant hum of pumps was another sign of rising water use. In the face of high summer demand, some pumping stations were strained to capacity. To relieve this strain, several pumps were replaced with larger units under contracts totaling $700,000.

Thus the Lardner's Point Station, which supplies purified water to much of Philadelphia east of Broad Street, received two electric pumps. With a combined capacity of 80 million gallons daily, the pumps increased the station capacity from 210 to 240 M.G.D.

Service to the far northeast was also boosted by a new 27 M.G.D. pump at the Torresdale Filtered Water Station. The high-service capacity of the station rose from 42 million gallons daily to 63 million.

The three raw-water stations pumped a daily average of 379.6 million gallons to the water treatment plants in fiscal 1972, and 393 million gallons in fiscal 1973. Of the water which reached consumers, about two-thirds was pumped by distribution stations and the rest flowed by gravity.

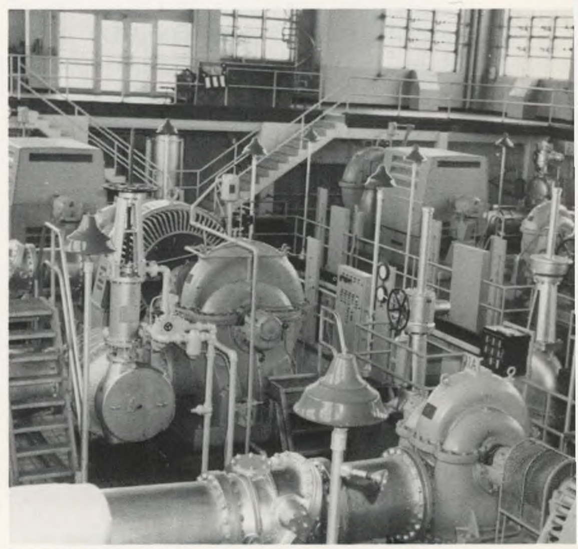
The high demand and rising electric rates boosted the cost of water pumping. In fiscal 1973, the power cost for pumping a million gallons of water to consumers was $18.03, a jump of $6.61 in three years.

To achieve economies, the department removed personnel from one of its two high-pressure stations, and put the station on stand-by. These stations, which operate only during fires, supply water for fire fighting in the central and north central areas of the city. They provided 50.3 million gallons of water for 61 fires during the biennium.

MORE MAINS TO SUPPLY CONSUMERS

To move more water to consumers, 30 miles of mains were laid in all parts of the city. These mains were intended to service new houses and industries, reinforce water supply, and replace old pipelines.

Because of continuing construction,



Pumping: Ten distribution stations pumped or repumped two-thirds of the city's purified water to consumers. All of these were remotely controlled by microwave from a central point.

the water main network was growing steadily "younger". Of the 3,240 miles of mains on June 30, 1973, over 20% had been built in the preceding 20 years.

Replacement: The replacement of old mains was the key to this rejuvenation, and since 1953 the city had replaced from 10 to 20 miles of mains annually. Despite this, Philadelphia still had over 600 miles of mains that antedated the year 1890.

Unlined and frequently corroded, the old pipes were constantly breaking. Of 1,425 breaks during the biennium, two-thirds occurred in small mains built before the turn of the century.

To avert such breaks, the Water Department relaid 19 miles of mains in 1971-73, and it planned to spend $2.3 million annually for further replacements during the next six years.

Where possible, the department reconditioned mains that were still serviceable. It cleaned and cement-lined over 17 miles of mains in Wissinoming, West Philadelphia, and Roxborough. The cleaning and lining improved water flow, restored carrying capacity, and reduced water discoloration.

New Development: In Eastwick, which is being redeveloped, two more miles were added to the 21 miles of mains built there since 1964. Other mains were placed in other newly developed or redeveloped areas, in the north central, northeastern, and western reaches of the city.

To increase the reliability and flexibility of distribution, the department replaced many valves in supply mains. This included the installation of seven 4-ft. valves in two large mains that run from the Lardner's Point Pumping Station to Frankford. The work was done under a $550,000 contract.

New Materials: Since the early 19th century, cast iron mains have been the backbone of the city's water system, and they still form 93% of city mileage. In recent years, however, ductile iron, a more flexible, durable, and shatter-resistant material, has been used for most new pipelines. Steel and reinforced concrete have been employed where necessary.

In September, 1972, the Water Department turned to another promising material. As part of a small contract to replace an existing main, the department installed plastic service pipes to connect a number of houses to the main. This experiment was repeated several months later in another street.

The new plastic pipe, of ultra-high molecular weight polyethylene, may replace existing cast iron, or copper service pipe eventually. Among its apparent advantages: It won't freeze, will resist corrosion, is as durable as copper, provides 20% more carrying capacity, is easier to handle than metal pipe, and won't cause water taste or discoloration.

NEW STEPS TO ACHIEVE BETTER WATER

While moving towards automation and more capacity, the department pressed eagerly towards another goal. This was the further improvement of water quality.

Modern plants had already done much to improve this quality. Treated with purifying chemicals, settled in large basins, polished by filter beds, the city's water flowed clear and fresh to consumers. Most of the tastes and odors of the past had vanished.

Philadelphia's drinking water had a coliform organism count that was only 2% to 4% of what is permitted by the U.S. Public Health Service for interstate carriers. It was one of the purest treated waters in America.

By every test, this water met or surpassed the 30 quality standards set by the U.S. Public Health Service, and it met most of the quality goals established by the American Water Works Association.

Despite this past success, the department had other visions. Automation, ammoniation, and other controls were part of its plans for still better water.

Ammoniation: With automation a few years away, the treatment of water with ammonia offered the quickest improvement. Ammonia was already in use at the Belmont Plant in West Philadelphia. There it eliminated chlorinous tastes and odors from the finished water. The ammonia, applied in minute, precisely measured doses, also provided a longer lasting disinfectant (chloramine) by combining with chlorine.

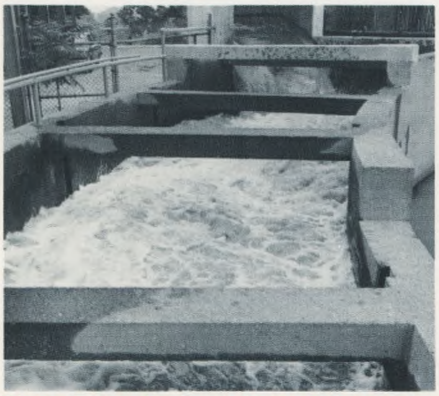
This treatment had not yet been extended to the rest of the city. In fiscal 1973, however, an ammoniation system was almost completed at the Torresdale Plant under contracts totaling $259,900. This system, equipped with application and control units, chlorine residual analyzers, storage tanks, pumps and chambers, will go into service early in 1974. A similar system previously installed at the Queen Lane Plant, and modified in 1973, will go into operation at the same time.

These new systems will improve the taste and odor of water flowing to 1.6 million consumers living between the Delaware and Schuylkill Rivers.

A NEW WATER TUNNEL ASSURES WATER ABUNDANCE

Pouring Concrete: Workmen lower a pipe, which will carry concrete to the tunnel 80 feet below. The concrete will spread behind tunnel liner plates to form a tube.

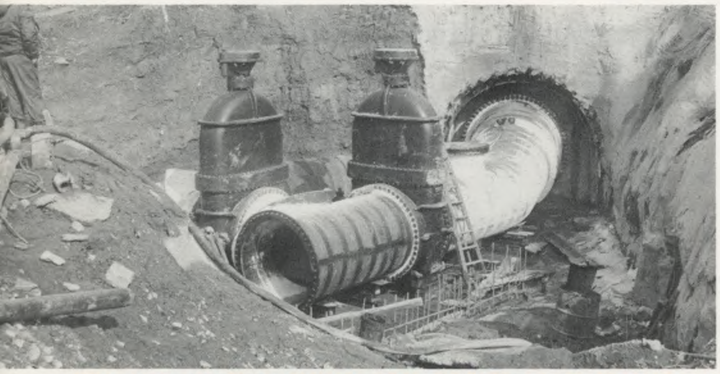
Engineering Marvel: Cut by boring machine through solid rock at depths of 50 to 100 feet, the new tunnel runs for 6,000 feet from the Schuylkill River. No blasting was necessary to cut the huge tube.



Water Cascade: Tunnel water rises up a 120-ft. shaft and plunges into an open flume at the Queen Lane Plant. Tunnel went into service in April, 1973.

Tunnel Construction: Liner plates are ready for pouring of concrete. Plates can be moved from spot to spot.

Water Abundance: The new tunnel will carry up to 150 million gallons of river water daily, assuring plenty of water to meet growing demand.



Connecting to Tunnel: At the Schuylkill River a steel pipeline is connected to the tunnel and will be extended to the riverside pumping station.

Lime Treatment: Because of improvements in the feeding of lime, the application of metaphosphates to the finished water was discontinued at the Torresdale and Belmont Plants in 1972, and at the Queen Lane Plant in 1973. Phosphates had been used to prevent the corrosion of distribution mains by slightly acidic water.

Use of lime at earlier stages of treatment enabled the plants to produce a non-corrosive and fairly stable water. Thus Torresdale water reached a "pH" of 8.3 during the biennium, while Belmont and Queen Lane water hovered midway between 7 and 8.*

To improve the unloading, storage, feeding, and slaking of lime, the Torresdale Plant planned to replace its lime equipment. Two contracts, totaling $138,750, were awarded in June, 1973, for new lime handling equipment in fiscal 1974. The new equipment will eliminate lime dust, prevent grit settlement, and increase storage capacity.

The use of other chemicals in treatment fluctuated during the biennium. Because of the condition of the Schuylkill River, large amounts of carbon were used at the Queen Lane and Belmont Plants to control tastes and odors. River conditions also increased the use of other chemicals at Queen Lane.

The chemical cost for treating a million gallons of water changed little at the Torresdale Plant from previous years, but was somewhat lower at Belmont. At the Queen Lane Plant, there was a marked jump in fiscal 1973 over fiscal 1972 (see table on page 17). All plants made an effort to hold down costs.

To ensure good water, plant employees endeavored to get the most from plant equipment. Because some plant equipment was growing older, maintenance problems were increasing. Maintenance forces, however, kept equipment functioning and made numerous modifications in it. Four sedimentation basins were gunited and repaired under a $133,000 contract at the Queen Lane Plant.

Water Surveillance: Sanitary engineers and chemists kept a constant eye on water going through the system. They collected water samples daily from the plants, mains, reservoirs, and rivers throughout the city. On these samples the laboratories performed 750,000 wet chemical tests and the equivalent of hundreds of thousands more with electronic instruments.

To learn more about tastes and odors, the laboratories did a comprehensive study of "organics" (dead bacteria, etc.) in the finished water. They were seeking better methods for determining the presence of organics and extracting them.

The laboratories also studied electronic instrumentation for checking water quality, zeta-floc as a coagulant in treatment, and calcite coatings for water mains.

In January, 1973, the Water Department and Drexel University started a cooperative study of tastes and odors. The $62,500 study, which will last a year, will learn (among other things) how automated instruments can be used to determine "profiles" for tastes and odors and the substances that cause them. These profiles would then enable similar instruments, or a computer, to predict, detect, measure and deal with tastes and odors in water flowing through the plants.

Customer complaints about water quality were relatively few during the biennium. The flushing of mains cleared up some water discoloration. Tastes and odors were often traceable to home plumbing, and not to the public water system.

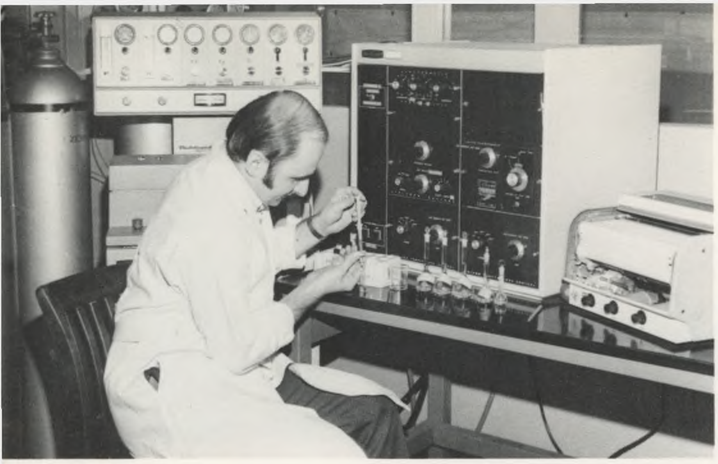
WATER SYSTEM MAINTENANCE

Distribution: Problems were almost a way of life for the distribution crews. To keep the water flowing to homes and industries, they grappled with broken water mains, frozen service pipes, open fire hydrants, and icy storms.

Of all their problems, however, open fire hydrants were the most persistent. On hot summer days, hundreds of illegally open hydrants caused water pressures to plummet.

* "pH", accompanied by a number, is a form of chemistry shorthand to express the relative proportions of acidity and alkalinity in water.

For Improved Distribution: Huge valves were replaced in several big supply mains to improve control of water flow.



Research: Better methods for studying water quality were of constant interest to plant laboratories. The gas chromatograph (photo) is being used to determine "profiles" of dead bacteria and other organics in finished water.

Towards Automation: Plant laboratories experimented with new types of automated testing devices, in order to reduce time-consuming wet chemical tests. The new devices were proving fast and efficient.

Central Control: Automatic and semi-automatic equipment requlates the treatment of water in all the city's plants. This panel controls filter beds at the Belmont Plant.

To preserve the pressures, the crews continued to experiment with special locking devices. In the summers of 1972 and 1973, more than 2,000 security bonnets and locking nuts were placed on the most abused hydrants. Though not completely tamper-proof, the locks stood up well against most vandalism.

Anxious to solve this problem, the department developed a third locking device—a special cap, which, by means of a spring mechanism, will lock into the fire hydrant nozzle. This device is being further modified.

As a further measure to cut water waste, the department supplied free plastic sprinkler caps to the public. These caps, which reduce hydrant flow from 2,000 gallons to 36 gallons a minute, were issued to responsible adults at police stations.

To keep the fire hydrants functioning, the crews inspected them more frequently than in previous years. They also repainted the green high pressure hydrants red, to facilitate identification.

Disappearing cast iron caps were costing the department $20,000 a year. Because of this, it began replacing the smaller cap on two-nozzle hydrants with an unremovable cap.

Among the thousands of jobs performed by the crews were the following:

	1971-72	1972-73
Water Mains Repaired	672	753
Ferrules:		
Installed	3,647	4,189
Drawn or Shut off	2,759	3,095
Pipeline Valves:		
Inspected	24,625	27,397
Repaired	4,032	4,027
Installed	544	437
Fire Hydrants:		
Inspected	55,751	67,464
Repaired	11,618	11,658
Renewed	421	264
Installed First Time	9	21
Painted	17,324	11,370
Valve Chambers Built or Rebuilt	8	23
Fire and Supply Connections Made	154	156
Joint Leaks Repaired	174	168
Complaints Investigated	15,876	17,740
Water Services:		
Shut off for Delinquency	5,914	4,522
Restored	1,366	751
Reinspected	10,055	6,069

Building Maintenance: A changing social climate was posing new problems for building maintenance crews. Vandals struck outlying facilities again and again. As a result, the crews spent many hours and much material on repairs to fences, doors, windows, roofs, and gutters.

Pure Water: Philadelphia's drinking water was one of the purest treated waters in America. To preserve its purity, two or three laboratory tests were made on it every minute.

Maintenance: Thousands of vital jobs were performed by Building Maintenance men, ranging from ventilation to piping work.

To check the depredations, four additional security guards were hired, bringing the total force to 17. Spot checks, patrols, and investigations were increased, and coverage by security men was extended beyond the water system to the wastewater system.

To tighten security, perimeter fencing was erected around additional portions of the Queen Lane and Torresdale Plants.

Among more than 4,000 jobs performed by building crews were: Repairs to a reservoir roof at the Torresdale Plant; installation of Kathabar equipment, a console enclosure, and partitions at the Queen Lane Plant; repainting of pumps, tanks, and buildings; and placement of piping in treatment plants.

Machine Shop: The Machine Shop turned out metal pieces for pumps, trucks, meters, fire hydrants, testing devices, and other equipment, and its personnel frequently installed these. In addition, the shop modified numerous trucks, vactors, and jets used in the cleaning of sewers and sewer inlets. Many old pieces of metal were salvaged at a saving of $60,000.

Logan Garage: Performing over 70,000 jobs during the biennium, the Logan Garage kept the department's vehicles rolling. The garage processed 35,000 work orders for trucks, passenger cars, and off-the-road equipment. In late 1972, it opened a small branch garage at the Northeast Water Pollution Control Plant (see page 32).

A HALF-MILLION METERS

To make sure that Philadelphians paid only for the water they used, the Meter Shop maintained a feverish pace. It handled over 48,000 water meters yearly, resetting, reconditioning, and replacing them.

These represented about 9% of the 523,000 meters in the system.

The shop continued the systematic and periodic rotation of meters, whether or not they needed repair. Over 24,000 meters were removed annually under this program, overhauled in the shop, and then replaced.

As a result of this and past rotation, most of the city's meters were in good working order. The number of non-registering or otherwise malfunctioning meters barely exceeded 9,000 each year. Cold weather, however, froze many meters in unheated cellars and the shop forces had to repair or replace 3,800 of these each winter.

During the biennium, shop personnel repaired 13,700 meters in the field, including 364 industrial "giants". More than 3,500 meters were installed in new houses or other unmetered properties.

Because of a work incentive program and improved organization, the Meter Shop has reduced its personnel by half in the past dozen years. ■

Plastic Service Pipe: Polyethylene pipe was laid in several blocks to bring water from mains to homes. Free of corrosion and freezing, such pipe may replace metal in many future home "services".

1. Raw Water Pumped to Plants (in millions of gallons daily)

	1970-71	1971-72	1972-73
TORRESDALE	218.1	208.7	220.7
QUEEN LANE	97.3	106.0	105.3'
BELMONT	72.8	64.9	67.0
	388.2	**379.6**	**393.0**

2. Filtered Water Output (in millions of gallons daily)

	1970-71	1971-72	1972-73
TORRESDALE	213.9	203.2	216.0
QUEEN LANE	94.6	104.3	102.5
BELMONT	65.9	61.8	65.5
	374.4	**369.3**	**384.0**

Note: Water distributed to consumers averaged 359.9 M.G.D. in fiscal 1971-72 and 372.8 M.G.D. in fiscal 1972-73. Differences between these figures and plant output are represented by wash water use, etc. in the plants. Similarly, evaporation from basins largely accounts for differences between plant output and raw water pumped to plants.

3. Chemical Costs for Treatment (per million gallons)

	1970-71	1971-72	1972-73
TORRESDALE	$ 9.20	$ 9.53	$ 9.68
QUEEN LANE	14.15	14.08	15.36
BELMONT	11.96	10.88	10.72

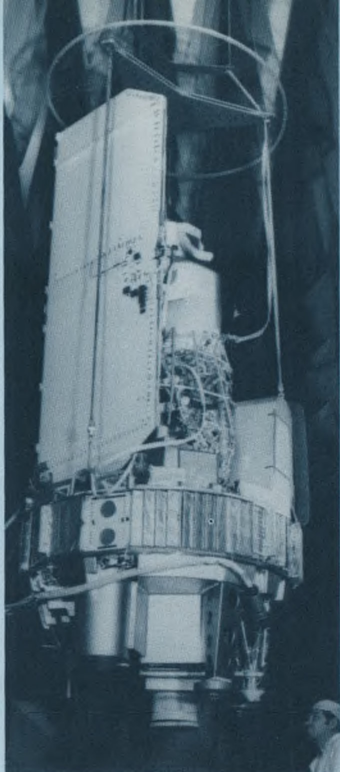
Note: The total cost of chemicals used in water treatment plants and reservoirs was $1,575,000 in fiscal 1971-72 and $1,639,000 in fiscal 1972-73.

4. Electric Power Consumption for Treatment (in millions of kilowatt hours)

	1970-71	1971-72	1972-73
TORRESDALE	6.35	4.78	5.89
QUEEN LANE	2.11	2.51	2.67
BELMONT	1.91	2.88	2.98

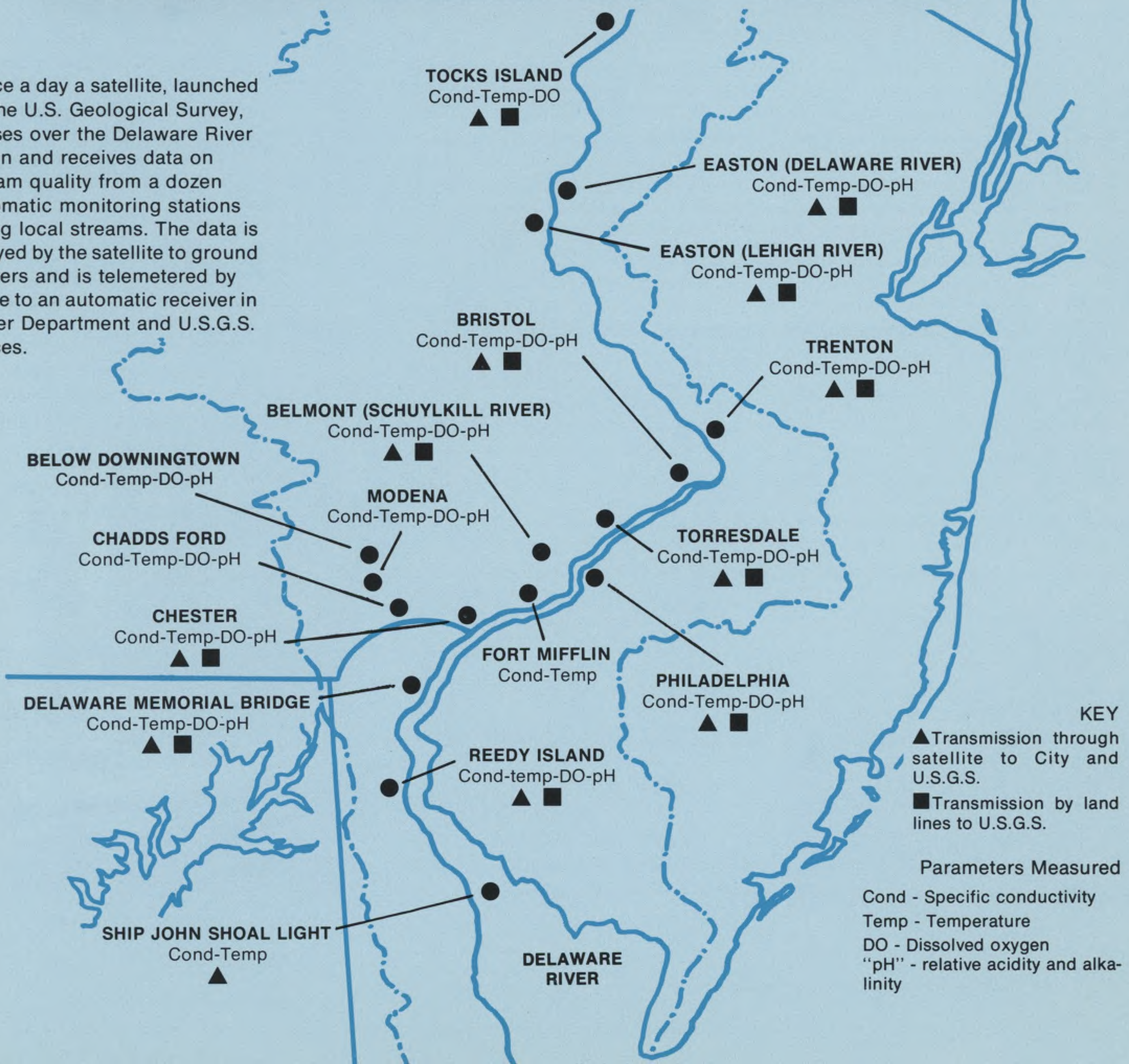
5. Electric Power Costs for Treatment (per million gallons)

	1970-71	1971-72	1972-73
TORRESDALE	$0.92	$0.95	$1.04
QUEEN LANE	0.82	0.89	0.99
BELMONT	0.88	1.69	1.74



A SPACE SATELLITE MONITORS DELAWARE BASIN STREAMS

Twice a day a satellite, launched by the U.S. Geological Survey, passes over the Delaware River Basin and receives data on stream quality from a dozen automatic monitoring stations along local streams. The data is relayed by the satellite to ground centers and is telemetered by these to an automatic receiver in Water Department and U.S.G.S. offices.



KEY

▲ Transmission through satellite to City and U.S.G.S.

■ Transmission by land lines to U.S.G.S.

Parameters Measured

Cond - Specific conductivity

Temp - Temperature

DO - Dissolved oxygen

"pH" - relative acidity and alkalinity

MONITORING OUR STREAMS FROM SPACE

An historical "first" came to the Delaware River Basin in the spring of 1973. For the first time in history, a satellite orbiting the earth was monitoring the basin streams.

Philadelphia, indeed, was one of the first cities in the country to be linked to the communications satellite, because the city had been monitoring its rivers for 13 years. It had a network of electronic analysis stations already in place.

Launched by the U.S. Geological Survey, the satellite passed over the Delaware River Basin twice a day. As it passed, local sending platforms encoded data from the city's monitoring stations and transmitted this data in bursts to the satellite. The satellite retransmitted the data to two ground centers, where it was decoded by computer and then transmitted by land wire to teletype receivers in U.S.G.S. and Water Department offices.

Seventeen automatic stations, scattered from the Lehigh River to the Delaware Bay, will be eventually linked to the satellite. These include eight that are operated jointly by the U.S.G.S. and the Water Department.*

The link to space will offer several advantages. Collecting data twice a day, the satellite will give the city earlier warning of upstream pollution or flooding. City personnel too will make fewer data collection visits to monitoring stations, and, ultimately, stream data could be transmitted rapidly (via satellite) to the computers which will operate the city's water treatment plants.

The Monitoring Program: Linkage to the satellite was another step in the city's ambitious stream surveillance. Since the early 1960's, its electronic stations have monitored the Delaware and Schuylkill Rivers 24 hours daily, providing a continuous record of dissolved oxygen, chlorides, temperature, turbidity, "pH", flow rates, water height, and other conditions. In 1971-73, the stations and a cabin cruiser collected data on 30 stream "parameters", or conditions.

The cabin cruiser, equipped with laboratory, made weekly runs on the Delaware River, collecting water samples for 56 miles. It also made monthly runs across the river for U.S.G.S.

A new "auto-analyzer" made possible the continuous and rapid analysis of water pumped to the on-board laboratory. Testing the water for a variety of chemical constituents,** the electronic analyzer produced a constant chart record. A digital printer converted the readings into a form suitable for use on a minicomputer.

Sampling was also done monthly on the Schuylkill River, and the sampling was extended by car or canoe as far northwest as Reading. Analyses were often performed on the spot with portable electronic equipment.

Philadelphia, in fact, was obtaining a growing knowledge of its rivers. By mid-1973, the Water Department had piled up a mountain of data, based on more than 20 years of stream study.

To gain a long range picture of river patterns, the department prepared this data for computer analysis. A large filing system was developed to store the data, and computer systems were written around the files. The programs will load, check, and selectively retrieve data.

The department continued to share its stream data with other governmental agencies. In 1972, it began to distribute a weekly sheet to agencies in Harrisburg, Trenton, Dover, Philadelphia, and Washington.

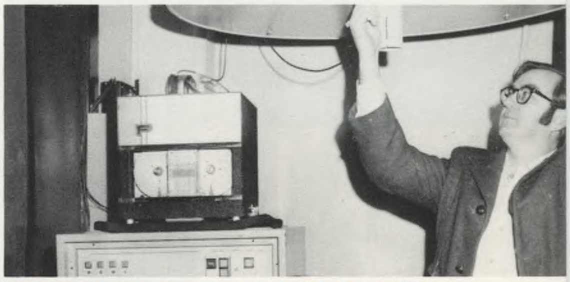
TRACING SOME SOURCES OF STREAM POLLUTION

Federal and state agencies are moving to regulate storm water overflow to streams.

Because of this, the city's sanitary engineers took a fresh look at the sources of overflow. These included (1) storm water discharges from sewers, and (2) the runoff from newly urbanized areas.

Storm Overflows from Sewers: Although storm overflow from the city's sewers accounts for only a small percentage of stream pollution, the Water Department began two studies to learn more about it. These studies were focused on two different types of sewers that carry Philadelphia's storm flows.

One of these was the *combined* sewer, which carries both sanitary sewage and storm water in the same



Link to Space: An engineer checks a disk antenna which relays data on the quality of river water to a space satellite. Stream monitoring unit at left.

* The Delaware Basin program is part of a larger environmental program begun by the U.S. Geological Survey. The U.S.G.S. hopes to monitor river basins, offshore ocean waters, and volcanoes from the United States to Central America. It will install up to 300 ground "sending platforms", equipped with disk antennae, for this purpose, and launch a second satellite.

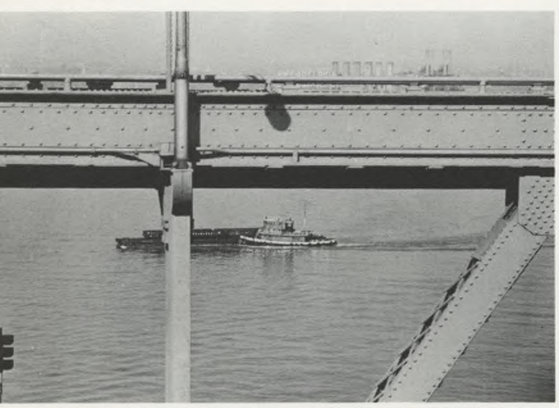
** Initially, the auto-analyzer is testing for nitrates, nitrites, ammonia, total phosphates, orthophosphates, and chlorides. Additional cells (or "modules") can be added, however, to test for other parameters. Cost of auto-analyzer and printer: $27,000.

pipe, and the other the *storm* sewer, which bears only storm runoff. During rains, the storm sewer discharges its entire flow to rivers and creeks, but the combined sewer only a small percentage of what it carries.

1. To determine how much pollution they contribute to streams, a private consultant (Watermation, Inc.) studied six combined sewers from May to July, 1972.

Electronic instruments were installed to measure sizes and velocities of flows, collect wastewater samples, and transmit data to a minicomputer at the Northeast Water Pollution Control Plant. Samples were tested by the plant laboratory, and flow data was correlated with rainfall.

This study resulted in a number of reports that may lead to a future plan to reduce combined sewer overflow. Cost of the study: $50,000.



2. The amount of stream pollution by storm sewers was the subject of the second study. The $34,000 cost of this three-year study was being financed equally by the Water Department and the U.S. Geological Survey.

In fiscal 1973, U.S.G.S. developed a number of automatic instruments, which will measure storm water overflow, time-correlate flow with precipitation, and collect flow-proportional samples.

This equipment had been fully installed in a chamber at Tustin and Bustleton Avenues by September, 1973, and two years of field study began. Data from the instruments will be relayed to the teletype receiver in the department's downtown offices.

Suburban Runoff to Creeks: To learn more about the polluting effect of suburban development, department engineers studied water quality in six local creeks.*

Inflow and outflow gauges provided data on the size of flows, and the engineers collected water samples monthly.

At the same time, mathematical models were being developed for all the creek basins, and these models will eventually relate varying degrees of urbanization to precipitation and runoff.

During the biennium, special sanitary surveys were made on a half-dozen creeks near or across from the Torresdale Plant intake, and six similar surveys of creeks between Trenton and Easton were carried out.

Microstraining: To find new ways of removing wastes from storm flows, a 1969 study was resumed with federal aid. Storm water was passed through a revolving microstrainer and then was treated with ozone, chlorine, or polyelectrolytes. Microstrainers, if successful, might be adapted to large storm water overflow systems in the future.

TWO YEARS OF LARGE RIVER FLOWS

The rains fell heavily during the biennium, bringing larger and cleaner stream flows.

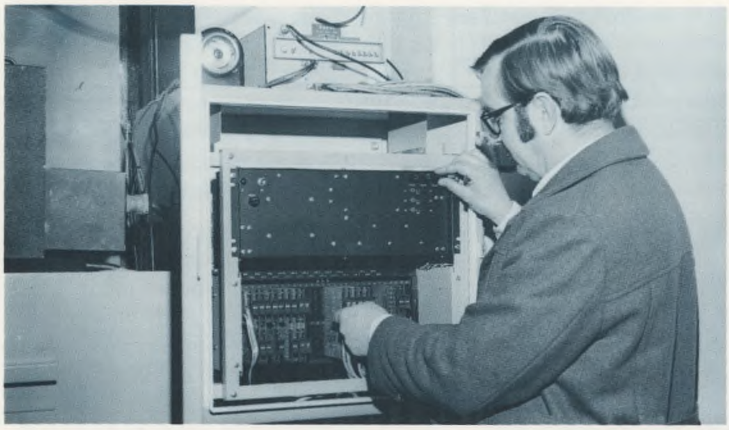
The flows washed away the wastes that came downstream, and held the salt line miles away from the city. Freshening the rivers, they raised the dissolved oxygen to an average of eight or nine parts per million at the city's water intakes. Other stream conditions also improved.

The large river volume lowered the hardness of the Schuylkill River in fiscal 1972, and helped to maintain the normal softness of the Delaware. In the following year, however, temporary low flows (from August to November) raised the hardness of the Schuylkill. Measured in grains per gallon, the average annual hardness of the two streams was as follows:

	1970-71	1972-73	1972-73
Delaware River	3.9	3.6	3.7
Schuylkill River	8.5	7.6	8.4

* Poquessing, Pennypack, Tacony-Frankford, Wissahickon, and Cobbs Creeks, and Wooden Bridge Run.

Stream Monitoring: Electronic equipment at eight stations keeps 24-hour vigilance over the Delaware and Schuylkill Rivers for the Water Department. This equipment analyzes and records dissolved oxygen, "pH", temperature, and other conditions of the river water.

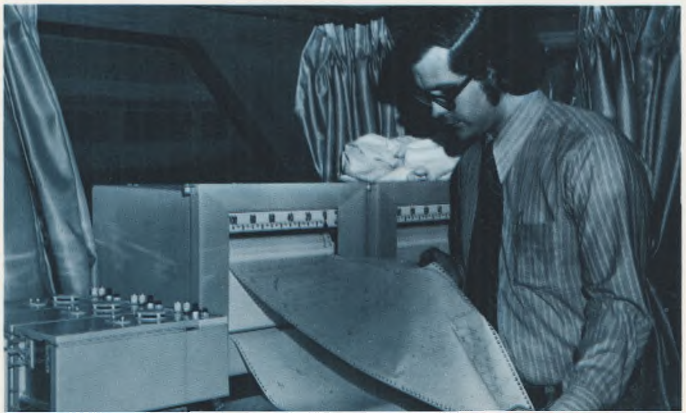


Monthly hardness averages fluctuated during the biennium from 2.7 to 4.4 grains per gallon in the Delaware, and from 6 to 13 grains in the Schuylkill.

On the Delaware, where the estuary is exposed to the tides, chloride averaged only 10 to 15 parts per million at the city's intake. Turbidity remained low on both rivers.

Despite the improving rivers, the excessive rainfall brought its problems. Hurricane Doria dumped eight inches of rain on the city in August, 1971, and Hurricane Agnes four inches in June, 1972. Total precipitation for fiscal 1972 was 54.8 inches and for fiscal 1973 it was 54.6 inches.* These annual downfalls were more than 12 inches above the long-term averages.

Though the heavy rains had little effect on the water treatment plants,



River Boat: In the onboard laboratory of the department's river boat, a new auto-analyzer sped up the analysis of river water. As the boat moved across the stream, water was collected into tiny flasks of a sampler (photos 1 and 2) and then was pumped to a module unit (photo 3). A colorimeter measured the constituents by intensity of color and the chart (photo 4) recorded the results.

* Based on records at Philadelphia International Airport. Long-term averages: 40.91 inches for the period 1872-1966; 42.48 inches for 1931-60; and 39 inches for 1958-67.

they flooded river drives and washed out old sewers. Hurricane Agnes raised the Schuylkill River at Fairmount Dam to 14.67 feet—the second highest level in 102 years. The peak flow at 95,560 cubic feet per second, was more than 30 times normal.

Upstream, the rising Schuylkill swept eight million gallons of waste oil into its waters, staining river banks and trees for years to come. Fortunately, at Philadelphia the Wissahickon Creek helped to push some of the oil slick into mid-river, and the effect on water drawn through the city's intakes appeared negligible.

Other wastes were spilled into the rivers from private sources during the biennium, but these too had minor effect on water treatment.

Because of the increased rainfall, the river volumes were well above the long-term averages. Flows* for the water years, as measured at Trenton and Fairmount Dam, were as follows:

	Water Year Oct., 1971- Sept., 1972	Water Year Oct., 1972- Sept., 1973	1931-60 Average
Delaware River	15,380 C.F.S.	17,190 C.F.S.	12,200 C.F.S.
Schuylkill River..................	4,070 C.F.S.	4,569 C.F.S.	2,975 C.F.S.

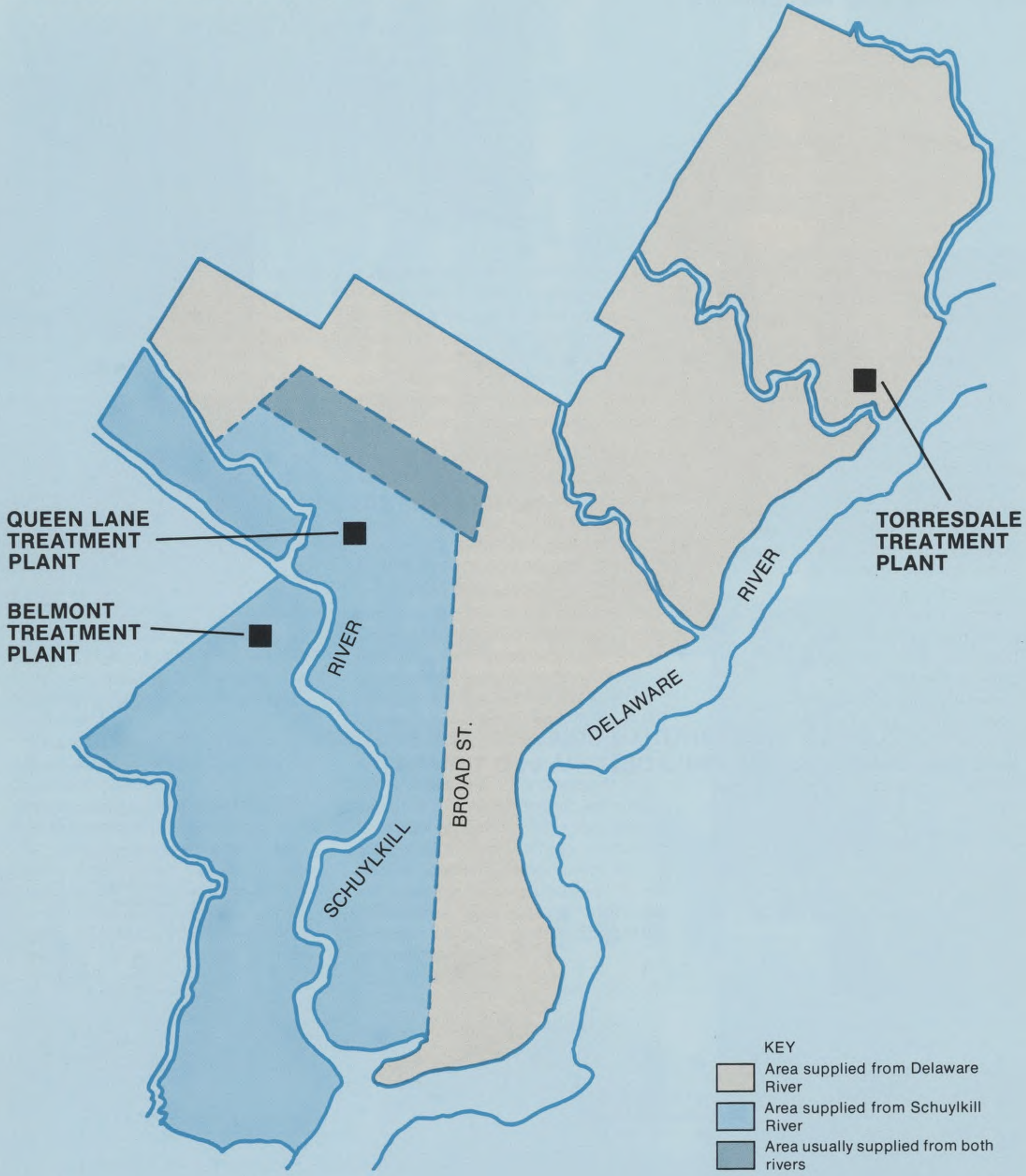
C.F.S. - cubic feet per second

None of the rainfall escaped recording and analysis by the Water Department. With 23 rain gauges scattered through the city and four in the suburbs, the department obtained hourly data on rainfall patterns. Supplemented by flow gauges on local streams, this network provided information for future control of flooding and pollution.

Fairmount Dam received its first full inspection since it was rebuilt in 1923. A private engineering firm made test borings along the crest and sent a diver below in the autumn of 1972, at the request of the department. The dam was found to be in good condition.■

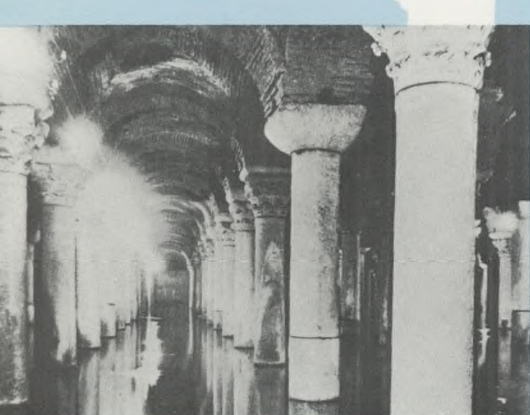
* All flow figures for the Delaware River at Trenton are unadjusted for upstream diversions. Flow figures for the Schuylkill River at Fairmount Dam have been adjusted to reflect withdrawals of water by Philadelphia.

SOURCES OF PHILADELPHIA WATER



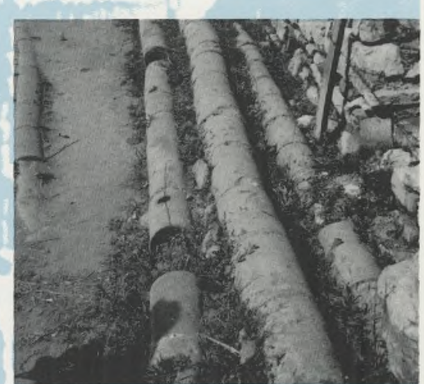
Note: The water distribution boundaries are approximate only. Waters from the two rivers move across boundaries according to need. Schuylkill water is supplied by the Belmont Plant to areas west of that river, and by the Queen Lane Plant to areas east. Delaware water is supplied by the Torresdale Plant.

PUBLIC WATER SYSTEMS BEGAN IN ANCIENT TIMES WITH RESERVOIRS AND AQUEDUCTS



This columned reservoir, built by Emperor Justinian, was one of many in Constantinople.

From Segovia, Spain (above) to the cities of the East, great aqueducts supported Greco-Roman civilization. Carrying water by gravity, or occasionally by siphon, they filled fountains and cisterns in cities and towns. Fine techniques of piping and storage had been developing in the Mediterranean world since 3,000 B.C.

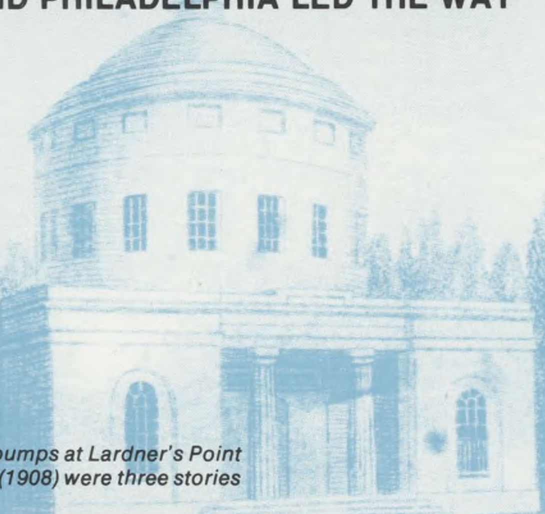


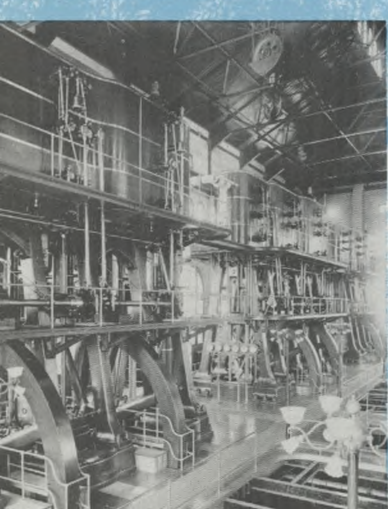
Pipelines of baked clay brought water into ancient Ephesus.

King Herod built this aqueduct to supply Caesarea.

STEAM POWER AIDED THE REBIRTH OF PUBLIC WATER SYSTEMS IN THE 19th CENTURY, AND PHILADELPHIA LED THE WAY

Spring Garden Station (1844) supplied a district outside the city.

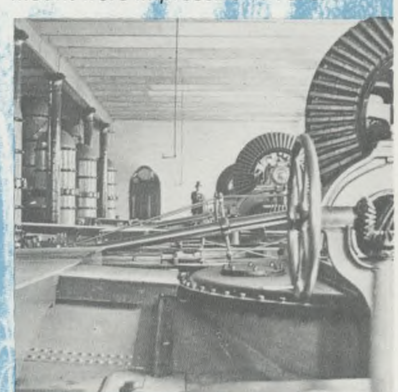




Steam pumps at Lardner's Point Station (1908) were three stories high.

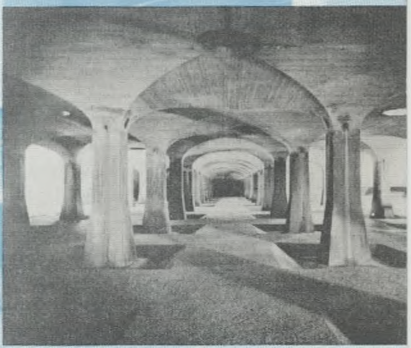
Steam pumping stations grew bigger. Belmont (1872).

Water turbine pumps at Fairmount were impressive in 1876.



Philadelphia's Centre Square Works (at center above) represented the first large-scale application of steam to water pumping in America in 1801. Philadelphia went on from this to revolutionary water turbine pumping at its Fairmount Works in mid-century. Electric pumps are now used at all stations.

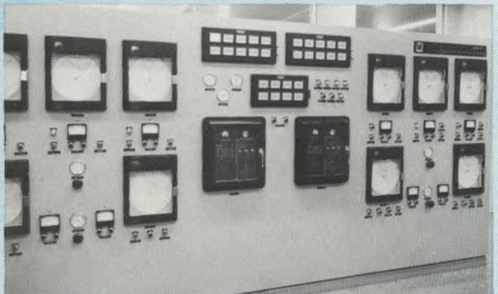
IN THE 20th CENTURY, PHILADELPHIA HAS LED IN WATER PURIFICATION



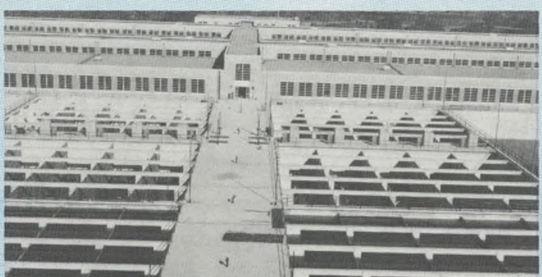
Sand filters of old Torresdale Plant were underground, but present filters are in a modern gallery (shown at left).

Philadelphia was one of the first cities in America to filter its water. Between 1901 and 1909, it built five filtration plants of the slow-sand type—the largest in the world. It replaced these in the 1950's and 1960's with three modern rapid-sand plants, equipped with semi-automatic controls. It has treated its water chemically since 1913.

When completed in 1959, Torresdale was the biggest push-button water plant in America.



Automated controls are omnipresent in city water plants.



Covered filter beds extended over 60 acres at original 1905 Torresdale Plant.

Filter beds are washed semi-automatically at the modern Torresdale Plant.

the wastewater system

A $300 MILLION PLAN FOR CLEANER STREAMS

Despite the uncertainties of federal aid, the Water Department had ambitious plans for the local streams.

Desirous of reducing stream pollution, the department vigorously pushed the planning for a $300 million expansion of its water pollution control plants. As the biennium passed, salient features of the new plants emerged on the drawingboards, important planning deadlines were met, new treatment methods were studied, and the department agreed to cut a year off completion dates for the plants.

The New Plants: Within a tight time table set by regulatory agencies,* Philadelphia was planning to build the most technically advanced plants that the existing state of the engineering art would permit.

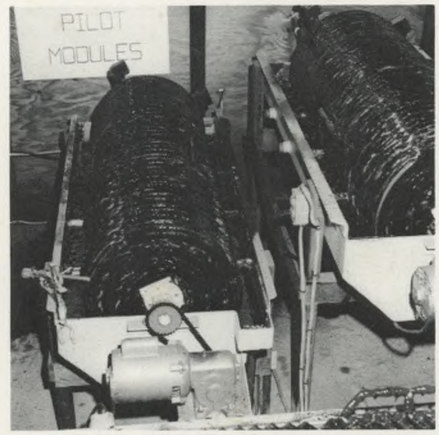
When completed, the new facilities will greatly improve the treatment of the city's wastewater. They will remove up to 92% of pollution, as measured by biochemical oxygen demand (B.O.D.).** This compares with a 56% to 58% three-plant average in 1971-73.

The expansion will—

- Upgrade the Southeast and Southwest Plants from "primary" to "secondary" treatment, and the Northeast Plant from an "intermediate" to a full secondary status,
- Incorporate into the plants more treatment stages, more retention time for wastes, more chemical treatment, and full computer control of all processes (automation),
- Reduce the pollution carried by plant effluents into the rivers to 131,500 pounds of carbonaceous oxgyen demand daily—a reduction of one-third in the present load.

To meet rising wastewater flows, the expansion will increase plant capacities. New aeration, settling and chlorination tanks will raise capacity from 175 million gallons a day to 250 million at the Northeast Plant, and from 136 million to 210 million at Southwest. There will be a minor increase at Southeast from 136 to 140 M.G.D.

Measured in millions of gallons, the total retention capacities of the *new* tanks will be:



An Experiment: City wastewater may be treated in the future with bio-surf discs, which rotate through the flow. City pilot tests show that the discs remove most pollutants.

Tanks	Northeast Plant	Southwest Plant	Southeast Plant
Primary Settling	9.3	2.8	
Aeration (Oxygen Reactors)	14.1	17.3	12.0
Final Settling	21.3	37.0	19.5
Chlorination	6.1	***	***

Thanks to increased treatment capacity, the city will accept larger flows from suburban communities. The Southwest Plant, for example, will receive up to 50 million gallons of wastewater daily from fresh areas of Delaware County. The treatment of more suburban flow—under contracts that fully compensate the city—will ensure greater protection of Delaware Basin streams.

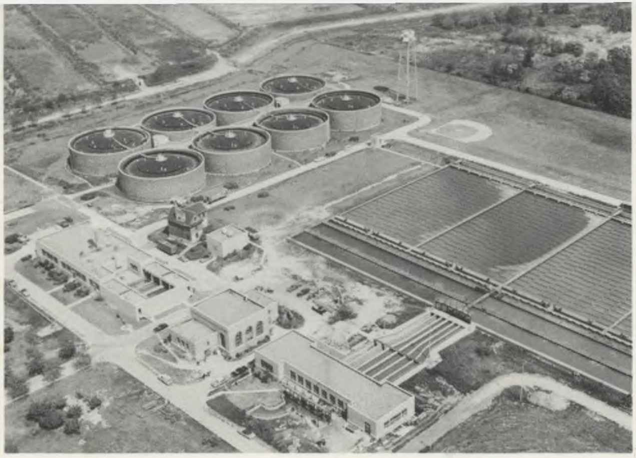
PLANT EXPANSION: A TIME TABLE IN JEOPARDY

Although the Water Department was meeting every deadline set by regulatory agencies, it agreed in June, 1972, to speed up the expansion of its plants. A new schedule, proposed by the Environmental Protection Agency, was jointly approved by E.P.A., the Delaware River Basin Commission, and the Pennsylvania Department of Environmental Resources.

* The Delaware River Basin Commission, Federal Environmental Protection Agency, and Pennsylvania Department of Environmental Resources.

** Pollution is measured by the quantity of oxygen used by certain bacteria to convert wastes into stable or harmless materials.

*** Chlorine will be applied to effluent in effluent conduits.



A Regional Plant: Expansion of the Southwest Water Pollution Control Plant in the mid-1970's will enable it to treat wastewater from more outlying communities. See map below.

Under this schedule, the new facilities must be operable at the Southwest Plant by December 31, 1975, and at the Southeast Plant one year later. This would be a year earlier than originally planned for each plant.

New facilities would be completed at the Northeast Plant on December 31, 1975 as previously planned, but modification of that plant's existing facilities would be stretched out to December 31, 1977.

Despite E.P.A. interest in a faster time table, there was—and is—serious doubt about this schedule. Delays in federal financing, together with new state and federal requirements, may slow down plant completion until nearly 1980.

Delays in Federal Aid: In the autumn of 1972, the Congress liberalized federal aid, making it possible for communities to obtain 75% funding for the eligible costs of new sewage plants. The President, however, directed that funds be allocated at a slower pace than Congress intended, and the Congress delayed appropriations.

Because of the resulting uncertainty, the Pennsylvania Department of Environmental Resources (which will administer federal funds) asked Philadelphia to submit amended applications. The Water Department requested full 75% funding, but D.E.R. could promise such funding initially only for the Northeast Plant and for part of the Southwest Plant.

This delay threatens the new time table. The agreement between the city and the regulatory agencies makes the table "expressly contingent" upon maximum federal aid (see adjoining box).

New Federal Requirements: Other federal requirements may also delay plant expansion. In 1973, E.P.A. advanced new regulations that would—

- Require municipalities to eliminate the excessive inflow of storm water into *sanitary* sewers, and the excessive infiltration of ground water into both sanitary and *combined* sewers,
- Force some industries (but not others) to pay a proportionate share of the cost of building new municipal sewage plants,
- Compel many municipalities to impose a system of sewer charges on industry, or, possibly in the case of Philadelphia, revise existing charges.

The new regulations would require complex and costly administrative and physical arrangements by municipalities, as a condition of federal grants. The Water Department began a study of their impact on its future operations.

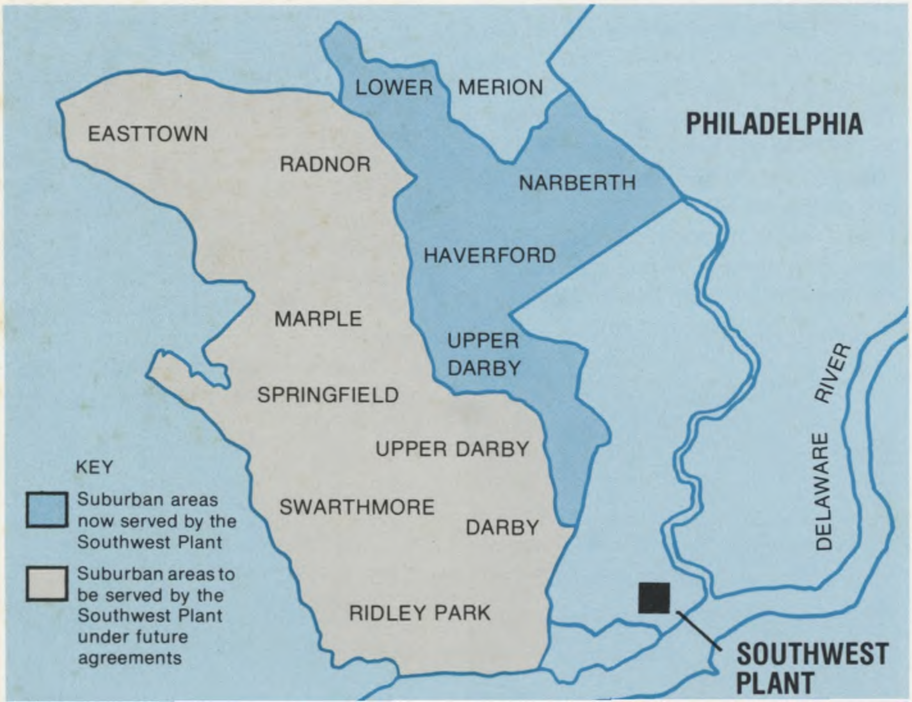
The Knotty Problem of Sludge Disposal: Difficult federal and state restrictions on disposal of the city's digested sewage sludge could further postpone plant construction.

COST OF EXPANDING WASTEWATER PLANTS

During the mid-1970's, Philadelphia will expand its three water pollution control plants. As of January 1, 1974, the combined construction cost for such expansion was estimated at $300,300,000.

Project costs eligible for federal aid would include $113,314,000 for the Southwest Plant, $81,799,000 for the Southeast Plant, and $105,217,000 for the Northeast Plant.

At 75% federal funding (the maximum allowed by law), Philadelphia would be entitled to $225,247,000.



WESTERN SUBURBAN DISTRICTS THAT WILL SEND WASTEWATER TO THE SOUTHWEST PLANT IN THE 1980's

1. In mid-1973, E.P.A. announced new and overly restrictive criteria to limit the mercury and cadmium content of municipal wastes dumped at sea. The new criteria, if applied to Philadelphia's household wastes (which contribute most of the city's mercury and cadmium), may have the effect of banning ocean disposal. Philadelphia would be forced to seek costly alternative disposal methods that would require much time to develop.

2. The clearing of two lagoons, needed for plant expansion, was being delayed at the Northeast Plant because of environmental objections. The State D.E.R. rejected land disposal outside the city and requested on-site disposal at the plant, using some new method. Study of new methods will require many months.

THE WASTEWATER PLANTS: RISING FLOWS

There was urgent need for plant expansion. The flow of wastewater to the plants had been climbing steadily. In fiscal 1973, it averaged 448.7 million gallons daily—the greatest flow in the city's history.

At the Northeast Plant, the flow exceeded the design capacity by 15 million gallons daily. At Southwest, it was almost equal to design, and the margin was uncomfortably small at Southwest.

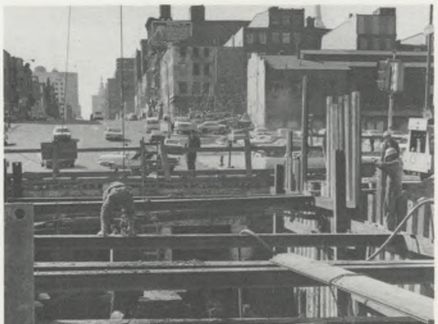
Along with rising plant flows, studies indicated that population and industry will continue to grow in the Delaware River Basin, producing increasing wastes. To handle such wastes, Philadelphia will need more treatment capacity.

The city, however, was more than meeting current requirements for protection of the rivers. In 1971-73, its plants discharged effluents that carried an average of 268,000 pounds of biochemical oxygen demand (B.O.D.) daily. This was 64,000 pounds below the maximum permitted by the State Government for the existing plants.

Though designed to remove only 35% of B.O.D., the two primary treatment plants were removing from 44% to 55%. Industrial wastes that were difficult to treat, however, held the Northeast Plant somewhat below its 75% design level (see table on page 35). During the biennium, the plants kept 206,000 tons of suspended solids out of the rivers.

As a result of improved controls, the cost of treating a million gallons of wastewater fell from $42 in fiscal 1972 to $33 in the following year.

Sewer Replacement: Many miles of old brick sewers were replaced with new concrete lines. Two of the most unusual were century-old storm water sewers with wooden bottoms, emptying into the Delaware River at Market St.



THE WASTEWATER PLANTS: CURRENT IMPROVEMENTS

With major expansion still in the future, the Water Department turned to more immediate needs. During the biennium, it spent $3.6 million for several physical improvements at its plants.

For Grease Burning: To cure a number of stubborn problems, the department planned to burn grease, oil, and other skimmings taken from wastewater.

A small incinerator at the Northeast Plant was already burning the skimmings successfully. Encouraged by this experience, engineers designed larger incinerators for the Southeast and Southwest Plants.

Construction of the new buildings moved rapidly ahead in the second year, and by June, 1973 the building at Southwest was almost finished. Each brick building will house two incinerators.

Together the four incinerators will burn up to 6,000 pounds of grease and oil hourly. Conforming to the city's air management code, they will emit no particulates to the atmosphere and will scrub gases fully. They will be fueled by both natural and sewage gas.

Supporting incineration will be pumps, scrubbers, scum breakers, and electrical control panels.

The burning of grease and oil will (1) help the plants reduce lagoon odors, (2) improve the performance of digester tanks, and, in the case of the Southwest incinerators, (3) provide extra heat for the heating of sewage sludge.

The incinerator construction is being done under contracts totaling $1,847,750.

Sewers for Eastwick: Many huge storm water lines were built to serve new homes in the redeveloped Eastwick area. Photos show construction of a four-cell conduit of reinforced concrete in Bartram Ave. Each cell measures 7 ft. x 11½ ft. in size.

Other Plant Improvements: A new centrifuge building was in operation at the Southwest Plant. Its five steel centrifuges were removing some of the water from digested sludge, thus increasing the solid content of sludge barged to sea. Noise, clogging, inconsistent flows, and other problems plagued the initial operations, but these problems were gradually solved.

Other completed improvements included:

Northeast Plant—installation of two pumps for return sludge ($28,000), seven electrical controls for the sludge heaters ($19,000), and four electrical sluice gate "operators" ($17,000).

Southwest Plant—installation of a wastewater pump ($37,000), and new roofing on digester tanks, valve houses, pump houses, and galleries ($343,000).

Southeast Plant—relocation of pump discharge and wet well metering equipment ($34,000).

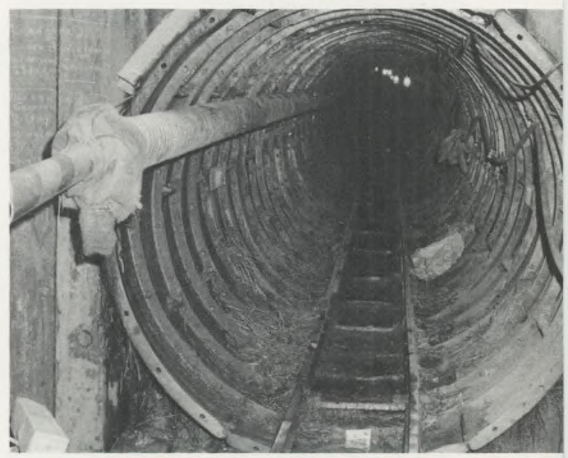
Treatment Studies: While making physical improvements, wastewater engineers studied better treatment methods. During the biennium, they made several pilot studies to provide "design criteria" for the new plants and to solve some immediate problems.

Notable was a study at the Southeast Plant in 1972. There miniature pilot units were set up in three trailers. Running wastewater through the units at the rate of thousands of gallons daily, engineers compared the effjcacy of chemical precipitation, recarbonation, multi-media filtration, carbon adsorption, pure oxygen, and ordinary air, in depolluting wastewater.

Pure oxygen was also tested at the other plants for stimulating the aerobic bacteria which decompose wastewater solids. Disinfection of plant effluents with ozone and chlorine was also tried.

Another small-scale experiment was begun at the Northeast Plant in 1973. There rotating polyethylene discs were removing more than 90% of biochemical oxygen demand from sewage. The long roller-like discs, housed in a trailer, rotated through the flow, picking up a film on which aerobic bacteria grew.

The department continued to experiment with electronic sensing instruments, particularly those that measure dissolved oxygen, carbon dioxide, and suspended solids in wastewater. These devices will become the "eyes and ears" of process control computers that will operate the new plants.



Intercepting Sewer: Another link was added to the city's 150 miles of intercepting sewers. This sewer, built in tunnel beneath the Airport Circle, will carry wastewater to the Southwest Plant.

Vactor Jets: Several "vactor jets" were acquired for the first time to improve the cleaning of sewer inlets. Each vehicle combines a vacuum cleaning tube (left) with a high-pressure water jet hose (right) and related equipment.

From a Solid Past: Cast iron spikes up to three feet long were removed from two old sewers with wooden bottoms in Delaware Ave. at Market St. The spikes date back to the 19th century.

A NEW SITE FOR OCEAN DISPOSAL OF SLUDGE

Barges carried 208 million gallons of the city's digested sewage sludge to the Atlantic Ocean.

This sludge, which had been treated for a minimum of 25 days, was the innocuous final product of wastewater purification. It averaged 90% water, 5% earth and sand, and 5% organic matter which had been fully stabilized. Unlike some communities, Philadelphia was not dumping, and had never dumped, *raw* sewage into the ocean.

Despite the safety of its sludge, the Water Department faced increasing pressures because of its barging program.

At the request of the Environmental Protection Agency, the department moved its disposal site farther out to sea. In May, 1973, it abandoned a site 11½ nautical miles off Cape May, New Jersey, and sent its barges 50 miles southeast of Delaware Bay. For the new site E.P.A. issued a six-months' permit, pending a federal study of oceanic disposal.*

As the barges traveled farther out to sea, the city's costs rose sharply. The annual barging bill jumped by 50%—from a rate of $580,000 to $870,000.

Meanwhile, E.P.A. asked the Water Department to investigate alternative methods of sludge disposal, and report by July 23, 1973. Though the department made haste to comply, the cost outlook was grim. Land disposal, it was estimated, would cost up to $9 million a year.

There was no apparent need for such huge outlays, for a study by Franklin Institute had already shown that ocean dumping of *digested* sludge was safe. To learn more about the effect of its sludge on the ocean, the Water Department had hired Franklin Institute Research Laboratories to make an ecological study of the Cape May site in 1971. Thomas Jefferson University and the Marine Sciences Consortium, representing four universities, cooperated in this $70,000 undertaking.

As part of the study, Franklin Institute sampled 13 ocean points monthly, at various depths, for a year, while Jefferson University made laboratory tests of the collected samples.

In a final report submitted in February, 1972, the Franklin Institute noted that, despite 10 years of dumping by Philadelphia, the disposal site showed no evidence of contamination, fish and plant life were vigorous, and the oceanic water was so bacteria-free as to meet U.S. Public Health Service standards for drinking water. To all appearances, the chain of ocean life was recycling and thriving on the nutrients in the city's digested sludge.

IMPROVEMENT OF WASTEWATER COLLECTION

As flows mounted to the treatment plants, the department made new efforts to improve its collector system. This system of sewers, pumping stations, and intercepting chambers, stretched into all parts of the community, picking up both sanitary wastes and storm water.

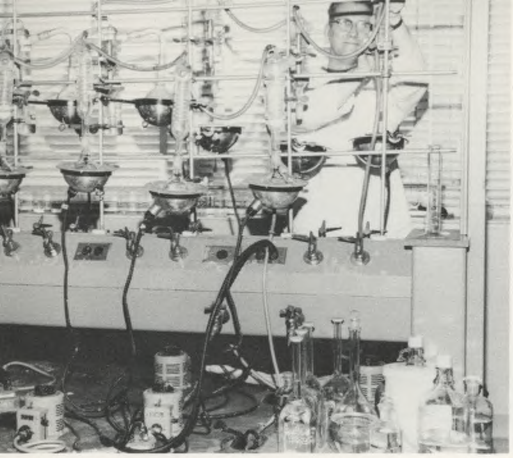
Wastewater Pumping Stations: To improve flows, several changes were under way at two wastewater pumping stations.

At the Neill Drive Station, in Fairmount Park, a contractor began a small building to house new switchgear and metering equipment. The equipment will correct electrical problems, which periodically interrupt the functioning of the station. Cost: $106,750.

The department was also upgrading a small underground station at Milnor Street southwest of Grant Avenue. The station will receive a third pump, and new electrical equipment. The $57,000 improvement will make it possible for Northeast Plant operators to monitor the station by remote electrical signal.

For Improved Maintenance: A new garage was erected at the Northeast Plant to maintain veheicles used in the cleaning and repair of sewers and inlets.

* On October 23, 1973 this permit was extended for an additional four months.



Wastewater Tests: Plant laboratories kept careful control over wastewater treatment in 1971-73, making 400,000 tests on waste samples.

Sanitary and Storm Sewers: For better collection, Philadelphia built 23 miles of sewers during the biennium. The new lines were intended to service new houses, eliminate insanitary conditions, reduce storm flooding, aid industry, or replace old sewers in the system.

1. Some of the biggest storm sewers in the city were completed in Eastwick, as part of the redevelopment of that area. These included 14,000 feet of multi-cell conduits in Bartram Avenue and Mario Lanza Boulevard. The individual cells, of reinforced concrete, measured up to 7 ft. × 11½ ft. in size. In all, contractors built 6.7 miles of new sewers in Eastwick, and did $9.4 million of work there.

Nearly 5.6 miles of sewers to serve new houses and industries were built in other parts of the city, particularly in the northeast.

2. The replacement of old sewers was still a major need of the city, for nearly 40% of its sewers had been built before 1910. Dozens of breaks were occurring in these old sewers each year.

This need was underlined in August and September, 1971, when heavy rains carried away a portion of the huge Mill Creek Sewer in West Philadelphia. Swallowing a tree and weakening two houses, the cavity extended for 70 feet. The old brick sewer had been built in the 1880's.

By February, 1973, the Water Department had replaced 272 feet of the Mill Creek line, in 43rd Street between Sansom and Walnut Streets. A new, reinforced concrete box (17 ft. × 18 ft.) now carried the heavy storm flow. Its cost was $1,183,000.

In the last decade, the department has replaced over two of the five miles in the Mill Creek Line.

In the spring of 1973, another unusual replacement job began in Delaware Avenue at the foot of Market Street. There workmen removed two brick sewers with wooden bottoms, resting on 228 timber piles. The sewers, which carry storm water overflow to the Delaware River, were being replaced with twin lines of reinforced concrete, resting on a concrete cap that was fitted over the timber piles. Measuring 8 ft. × 8 ft. each, the new sewers wll cost $375,000.

In all, the department replaced 7.5 miles of old sewers in all parts of the city, and it scheduled $4 million a year for such work during the next six years.

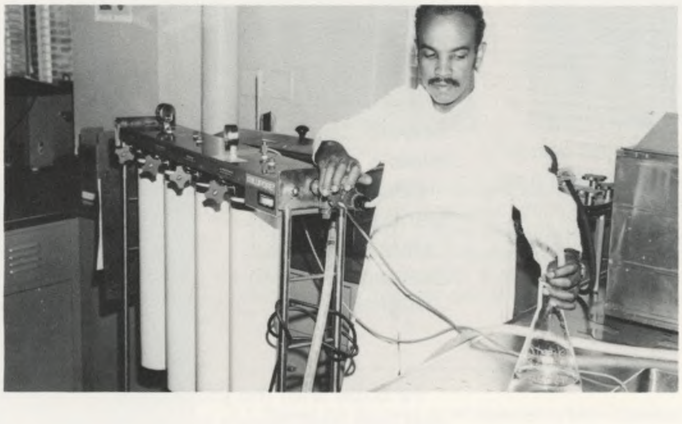
3. Sewer service came to some Philadelphia homes for the first time, as the department constructed 3.5 miles of lines to relieve insanitary conditions. The longest line extended for 4,500 feet over Livezey, Fowler and Pawling Streets in the northeast. Only a few hundred of Philadelphia's homes are unconnected to municipal sewers.

4. To collect sewage from Eastwick and the International Airport area, a 3-ft. diameter intercepting sewer was being built in open cut along Tinicum Avenue and in tunnel under the Airport Circle. The 2,100-ft. long sewer will cost $762,000.

Fluidic Regulators: For better control of storm overflow to streams, the department was planning an unusual experiment. This involved the use of fluidic regulators in intercepting chambers.

The chambers, which by-pass the flow of *combined* sewers, were posing a nagging problem: the fixed chamber settings were diverting unalterable flows to the rivers in time of storm.

To correct this problem, the department planned to test a new principle . . . fluidics. Used to some extent in private industry, fluidics embodies the use of fluids at varying pressures to operate mechanical devices. A fluidic mechanism would



Automated Tests: Increasingly, plant laboratories were using automated equipment to speed up testing. At left, wastewater is deionized and filtered. Above, it is analyzed for total organic carbon.

For Less Odor: This new building at the Southwest Water Pollution Control Plant will incinerate grease and oil skimmed from sewage, thus reducing plant odors.

alter chamber settings automatically, according to need, and thus reduce the pollution of streams.

To test this idea, fluidic regulators were installed in two chambers in 1973. Located in Cobbs Creek and Tacony Creek Parks, the regulators will be studied extensively in 1974. The Federal Government is paying for the $57,829 study.

Other plans were also made to improve the functioning of the intercepting chambers. In 1974, experimental sensors will be installed in several chambers. The sensors will send back signals to a central location when chambers are inoperative or overflowing.

SEWER SYSTEM MAINTENANCE

To keep wastes flowing through city sewers, the Water Department has adopted new techniques in recent years. Television cameras peer into sewers; high-pressure water jets cut through blockages; special machines vacuum-clean inlets; a computer records inlet cleaning jobs.

Thanks to these and other developments, maintenance crews were able to perform over 20,000 jobs in fiscal 1973—the highest level in a number of years.

New Facilities: Fortunately, too, some new facilities were keeping crews and vehicles on the streets for longer periods. Thus—

1. In January, 1973, a Sewer Maintenance Yard opened just south of Paschall Avenue between 49th and 50th Streets. The $355,000 yard immediately reduced the travel time of some work crews and made it possible to store materials and vehicles closer to West Philadelphia job sites. The yard includes a garage, lumber shed, parking area, and small office building.

2. Finished in August, 1972, was a small maintenance garage at the Northeast Water Pollution Control Plant. The $256,000 garage, of pre-fabricated steel, services those inlet cleaning and sewer maintenance trucks which are normally stationed at the plant.

Improved Maintenance: Because the city has hundreds of miles of old sewers, the maintenance crews trudged or peered through many a mile of pipeline. During the biennium, they inspected, on foot or by television camera, 262 miles of sewers, and recommended that more than five miles be replaced. Despite this effort, crews had to repair sewer breaks at 119 locations.

To keep the lines open, the crews cleaned 161 miles of small pipe sewer by high-pressure water jet, and seven miles of large brick sewer by mechanical bucket. In addition, they rodded six miles of choked sewers and inlets.

Jobs performed by the crews on the inspection, repair, cleaning or reconstruction of sewers, inlets, laterals, manholes, and drainage rights-of-way included the following:

Jobs	1971-72	1972-73
Sewers	5,117	7,000
Inlets (repairs only).....	11,670	12,207
Manholes	370	676
Laterals	99	31
Drainage Rights-of-way....	352	399
	17,608	20,313

To cope with the increasing theft of cast iron inlet covers by the public, the department bought a new type of cover that could be locked into place. Nearly 400 of these covers were installed in the spring of 1973.

For easier maintenance and cleaning, work crews also began to use a new type of inlet frame, an open mouth grate.

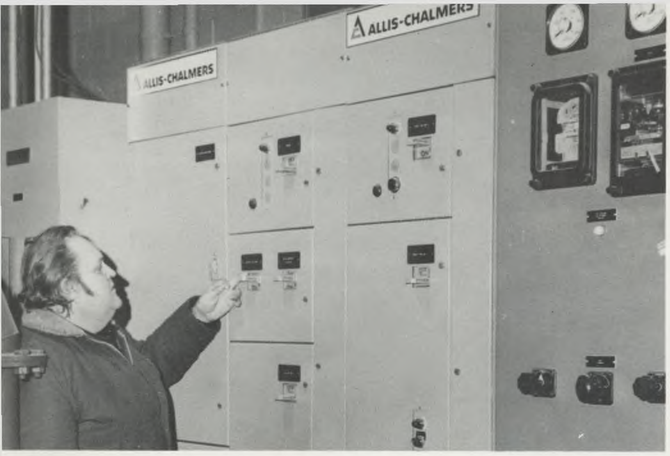
Sewer Inlet Cleaning: Gone was the backlog of thousands of uncleaned sewer inlets that had plagued the city in an earlier year. With more funds, personnel, and equipment, the department was able to clean most inlets as rapidly as they refilled.

Cleaning 82,000 inlets yearly, the crews removed an average of 1.9 million cubic feet of debris each year. They responded to nearly all of the 53,000 complaints received from the public, while maintaining a regular cleaning schedule.

The frequent breakdown of old vehicles, however, forced the crews to do more manual cleaning. Because of this, the department purchased a number of new mechanical cleaners, in 1973. Three of these were of a new type, combining (1) the method of flushing by high-pressure water jet with (2) the method of vacuum suction, hitherto used separately. Most mechanical cleaning was still being done by trucks equipped with clamshell buckets.

For the first time, records of inlet cleanings were prepared by computer. This valuable tool enabled the department to learn the condition of nearly every inlet in the city, as occasion required.

The duty of cleaning and maintaining 537 inlets in Fairmount Park was transferred to the Water Department in 1972. An updated



Automatic Controls: Operator checks some of the controls at the new Southwest grease incinerators.

census showed 75,000 inlets throughout the city.

CONTROL OF INDUSTRIAL WASTES

To protect its sewers and plants from harmful wastes, the Water Department worked closely with local industry. Its inspectors visited and revisited hundreds of local firms.

Encouraging industries to bottle up or neutralize their wastes, the inspectors offered technical advice as needed. Many industries were finding it increasingly profitable to recapture their wastes and convert them to other uses.

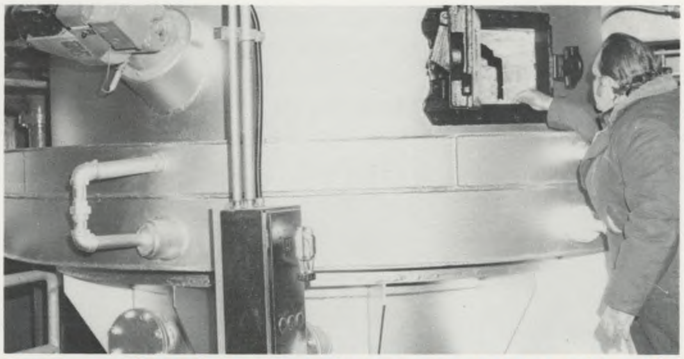
A new surcharge, adopted in 1970, was stimulating some industries to install new equipment for waste recapture. The surcharge was levied on wastes that exceeded a certain strength.

For this and other waste control programs, city engineers collected and analyzed numerous waste samples. To facilitate such collection, some industries began to install sampling chambers that would permit use by city personnel of automatic samplers.

During the biennium, the department's small Industrial Wastes Unit—

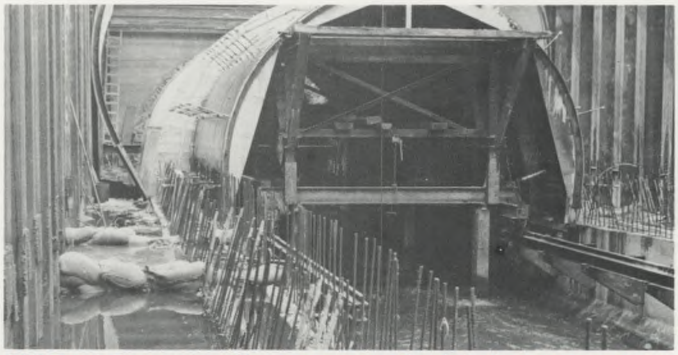
- Visited 1,100 industries to determine either the effectiveness of, or the need for, new grease interceptors, hair traps, oil interceptors, neutralization pits, bucket drains, or other equipment to control industrial wastes,
- Investigated 240 reports of industrial waste spills into sewers or streams, resulting in odors, damage or contamination,
- Revisited 287 industries to make sure that past violations had been corrected or that control equipment was being used properly,
- Interviewed 350 gasoline station managers on the disposal of waste oil,
- Offered advice to 248 industries on how to treat wastes more effectively.

This unit planned a number of industrial waste studies for fiscal 1974, covering heavy metals, cooling waters, and discharges from piers. New equipment will be purchased for more effective clean-up of oil spills into streams. ■



For Grease Incineration: One of two new incinerator units at the Southwest Plant, this furnace will burn up to 1,500 lbs. of sewage grease and oil each hour.

Sewer Collapse: In West Philadelphia, the giant Mill Creek Sewer collapsed for 70 feet. Built in the 1880's, it old bricks have been subject to increasing strains.



Mill Creek Sewer: A perilous reconstruction job, the new sewer was built at depths of 40 feet while maintaining a heavy flow.

Mill Creek Sewer: A new reinforced concrete line takes shape at 43rd and Sansom Sts., where the old brick sewer collapsed. Since 1953, the Water Department has replaced over two miles of the old sewer.

WATER DEPARTMENT MODERNIZATION
JANUARY 1, 1946 to JUNE 30, 1979

	Encumbered-Expended Jan. 1, 1946 to June 30, 1973	Scheduled July 1, 1973 to June 30, 1979
WATER SYSTEM		
Load Control Center	$ 1,321,071	$ 589,502
Torresdale Plant	27,077,561	2,078,853
Queen Lane Plant	13,584,686	1,478,175
Belmont Plant	13,117,730	1,952,245
Water Pumping Stations	15,176,972	2,420,142
Water Mains—Built, Replaced, Cleaned & Lined	100,947,550	27,210,906
Filtered Water Storage	12,918,851	5,324,281
Universal Metering	4,788,064	
Miscellaneous	8,694,695	
High Pressure Fire System	5,360,478	2,032,896
TOTALS	**$202,987,658**	**$ 43,087,000**

	Encumbered-Expended Jan. 1, 1946 to June 30, 1973	Scheduled July 1, 1973 to June 30, 1979
WASTEWATER SYSTEM		
Northeast Water Pollution Control Plant	$ 19,178,829	$ 77,130,556
Southeast Water Pollution Control Plant	7,659,797	75,775,108
Southwest Water Pollution Control Plant	12,582,739	82,207,056
Wastewater Pumping Stations	2,722,344	649,792
Interceptors	54,991,793	2,882,488
Sewers—Built & Replaced	199,058,185	54,908,032
Water Pollution Abatement Program—Engineering & Related	2,435,085	
Miscellaneous	8,657,414	
Storm & Flood Relief	28,158,393	16,354,968
TOTALS	**$335,444,579**	**$309,908,000**

WATER POLLUTION CONTROL PLANTS: OPERATING DATA

	1971-72				1972-73			
	Northeast	Southeast	Southwest	T-Total *Weighted Average	Northeast	Southeast	Southwest	T-Total *Weighted Average
Population equivalent**	1,870,000	1,021,200	811,200	3,702,200	1,921,000	966,300	769,000	3,922,600
Wastewater Flow (in millions of gallons daily)								
Rated plant capacity	175	136	136	T-447	175	136	136	T-447
Total flow treated	180.39	127.29	135.26	T-442.94	190.31	126.23	132.14	T-448.68
Flow from other communities	12.29	2.45	21.75	T- 36.49	14.19	2.57	26.20	T- 42.96
Solids in Wastewater (in parts per million)								
Raw suspended solids	246	178	275	*235	271	183	234	*235
Final suspended solids	78	76	99	*84	80	76	92	*83
Total solids removed	168	102	176	*151	191	107	142	*152
% of solids removed	68	57	64	* 64	70	58	61	* 65
Tons of solids removed daily	126	55.1	99.3	*280.4	152	56	78	T-286
Biochemical Oxygen Demand in Wastewater (in parts per million)								
Raw wastewater B.O.D.	206	161	120	*167	205	169	117	*170
Final effluent B.O.D.	74	91	55	* 74	68	95	53	* 71
Total B.O.D. removed	132	70	65	* 93	137	74	64	* 99
% of B.O.D. removed	64	43	54	* 56	67	44	55	* 58
Lbs. of B.O.D. to river	111,330	96,600	62,000	T-269,930	107,900	100,000	58,400	T-266,300
Gas Production								
Millions of cubic feet daily	1.193	—	1.070	T- 2.263	.948	—	1.021	T- 1.969
Cubic feet per lbs. volatile	7.7	—	5.8	* 6.8	7.0	—	5.9	* 6.4
Electric Power Cost								
Cost per million gallons pumped	$1.96	$2.49	$3.62		$2.07	$2.60	$4.76	
Digested Sludge								
Gallons barged to sea	53,892,000	—	45,674,000		47,835,000		59,265,000	
Average % of solids	13		6.3	* 9.9	11.5		6.9	* 9.1

** Population equivalent is not actual population. It is a technical measure of wastewater strength. It is figured as 0.167 lbs. per person daily.

Waste Monitor: City engineers prepare to check an industry's wastes with an automatic sampler. An electric probe, inserted into a manhole sampling chamber, will trigger readings on the device.

management and engineering services

NEW SAVINGS BY MANAGEMENT

New savings were being achieved throughout the department. The savings resulted from a determined effort by management to tighten controls, eliminate unnecessary operations, and increase efficiency.

As a result, personnel expenditures were cut markedly in the first 18 months of the new City Administration, from January 3, 1972 to June 30, 1973. The Water Department reduced overtime outlays $247,000 below such outlays for the preceding 18 months.*

Early in 1972, the department also eliminated a number of jobs from the water pollution control plants, the Race Street High Pressure Pumping Station, and the Customer Service night shift. The resulting savings exceeded $175,000 in fiscal 1973.

Happily, too, other savings were piling up. The department was still gathering the fruits of a continuing manpower study that dated back to 1967. This study, by a private consulting firm, covered procedures and manpower utilization in several key divisions.

As a consequence of this study, new systems had been adopted by some divisions and 71 jobs had been cut from the department's rolls. Total study savings up to December 31, 1971, were $1,245,000. In the 18 months thereafter, another $1 million was added, bringing the cumulative total to nearly $2.3 million, distributed as follows:

Water Distribution Crews	$1,378,549
Sewer Maintenance Crews	409,617
Administrative Personnel	500,000 (estimated)
	$2,288,166

The consultant, H. B. Maynard and Co., Inc., concluded its manpower study at the close of fiscal 1972. During that year, it studied the Design, Customer Service, Water Treatment, Survey, and Water Pumping Divisions. Procedures recommended by the consultant were gradually implemented by these units in fiscal 1973.

As a follow-up to the Maynard study, department analysts examined management policies and practices of the Fiscal, Construction, Automotive Maintenance, Engineering Computer and Inlet Cleaning Units in 1972-73.

One of the several results was a proposed incentive pay plan to increase the production of the inlet cleaning units. This plan, it was believed, would save the department up to $400,000 a year on its 28 mechanized cleaning crews alone.

Other recommendations included (a) establishment of an internal team to strengthen payroll, inventory, and cost accounting, (b) computerization of I.B.M. accounting, (c) the training of some field personnel to work with the Computer Center, (d) improved cost reporting for construction activities, (e) construction of a new automotive maintenance garage and adoption of an improved reporting system for it.

UPGRADING EMPLOYEE QUALITY

Because of plans for automation and other efficiencies, the *quality* of the employee was becoming vital. The department was selecting and training its employees, therefore, with growing care.

New Engineers: Much of this care was given to the recruitment and development of younger engineers. As older engineers retired, the department recruited vigorously at East Coast colleges, and hired 27 graduates for various engineering jobs. Since 1968, indeed, 71 graduate engineers had entered the department.

Younger engineers were given on-the-job training and were rotated as much as possible to broaden their experience. Within a year or two of hiring, many were assuming important responsibilities.

Under a tuition reimbursement plan provided by the department, many young engineers and chemists were pursuing graduate courses after hours, at local universities and colleges. During the biennium, about two-dozen such employees took 46 approved courses at the master's degree level in engineering or the sciences.

Training Programs: For more experienced engineers and other

Training: 13 water works operators completed a State-approved course in 1972. Sanitary Engineer Nance Kunz receives a certificate issued by Pa. Public Service Institute.

* If overtime costs were adjusted for salary increases during this period, the savings would be $567,000.

Honored Public Servant: Samuel S. Baxter (left) retired on January 3, 1972 after 20 years as water commissioner and 49 years in City service. His successor, Carmen F. Guarino, is at right, and Mrs. Baxter in center.

employees, there were numerous training programs. These were intended to add to specialized knowledge, or to widen the employees' outlook. Thus in 1971-73—

1. Thirty engineers, chemists, and staff employees took a variety of technical courses offered by colleges, professional groups, or industries. The courses included such subjects as statistics, job restructuring, gas chromatography, atomic absorption, water and sewerage planning, particle characteristics, and biological waste treatment.

2. Up to 25 employees studied construction techniques at the Community College each term.

3. Thirteen water works operators completed a 30-hour course in water treatment and plant operations sponsored by two Pennsylvania water works groups.

4. Nearly 500 employees participated in (1) interracial discussion groups, or in (2) public relations "consciousness" sessions. In addition, there were orientation meetings for new employees, and pre-retirement conferences for older employees.

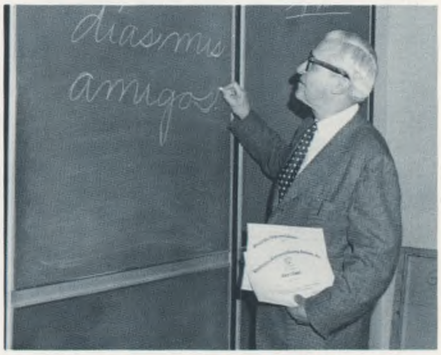
Plans were made to provide training in supervision and skilled trades at a Training Center operated jointly by the Water and Streets Departments. This will take place in fiscal 1974.

Personnel Computerization: While upgrading selection and training, the department improved other personnel programs. Thus computer specialists were working on a new system for computerization of attendance records. By the spring of 1973, a mass of attendance data had been put on the department's digital computer.

25-year Club: Forty-seven employees who completed 25 years of municipal service were inducted into the Water Department's Quarter Century Club.

Safety Record: The Water Department won 17 safety awards from the Greater Philadelphia Chamber of Commerce. These were for reducing its disabling accident frequency rate sharply in 1972.

Awards for Ideas: City Managing Director Hillel S. Levinson (left) presents awards to John Horger (right) of Water Department and Walter Stewart of Recreation Department for money-saving suggestions.



Training: Many Water Department employees attended the City Government's night school to improve their skills. Albert Raiguel holds course certificates he received.

Top Safety Honors: The Load Control Section received the Chamber of Commerce Gold Award –its second highest –for zero disabling injuries during 15 years.

Retirement: Fellow workers honored retiring employees at dinners and other affairs. Popular Samuel Costello (center, with diamond patterned necktie) retired after 43 years with the City.

Simplifying the chores of time keepers, the computer will provide bi-weekly reports on time worked, vacation use, sick leave, overtime, etc., for each employee and indicate both individual and departmental time-use patterns. The new system was ready to go into operation, but could not yet be kept current because of a shortage of machine accounting employees.

One benefit of computerization will be better control of sick leave use. In fiscal 1972, such use amounted to 12.7 days per employee, and in the following year to 13.1 days. This usage was above management goals, and the department strove to tighten sick leave surveillance.

To reduce the number of personnel appeals carried to the Civil Service Commission, a departmental hearing board was established. The new procedure, which does not eliminate the employee's right to appeal to the commission, was received favorably by employees and supervisors.

Employee Recognition: Employees were honored in various ways. Thus 114 employees, who completed 25 years of municipal service, were inducted into the Quarter Century Club. Others were given certificates for completing training courses. In addition, 14 employees were honored for unusual sick leave records; eleven of them had taken no sick leave for 21 years.

Employees gave generously to the United Fund to meet community needs. As a result, the department won "torchlighter" status in both years. Gifts in fiscal 1972 totaled $66,693 and in fiscal 1973, $65,000.

To inform its employees, management revived the departmental house organ, "The Water Department News". This is an illustrated, printed newspaper, professionally prepared.

Personnel Turnover: Several new programs raised the number of permanent full-time employees on the department's rolls from 1,596 to 1,644 in fiscal 1972. A partial freeze on hiring, however, reduced this total to 1,571 by June 30, 1973.

As part of the municipality's assistance program for youth, the department hired 115 high school students for temporary summer jobs in 1972. The jobs were financed by the Federal Government.

Personnel turnover during the biennium included:

	New Appointments	Separations	Promotions	% Turnover
1971-72	217	179	100	11%
1972-73	117	188	124	11.3%

AN IMPROVING SAFETY RECORD

Symbolic of an improving safety record was the winning of 17 safety awards by the Water Department. The awards were presented on May 4, 1973,

The "No Sick Leave" Champ: Victor A. Pagnotto (right), chief of water operations, is congratulated by Deputy Managing Director Thomas C. Piccoli. Mr. Pagnotto completed 26 years without taking a day of sick leave.

Love of the Job: Deputy Managing Director Thomas C. Piccoli (left) shakes the hand of Maintenance Supervisor Edward S. Potts, who finished 21 years without taking a day of sick leave. Ten other Water Department employees did as well.

Citation: Mayor Frank L. Rizzo (left) cites Raymond J. Harris as Water Department "Supervisor of the Year". Harris has directed public relations for the department since 1959 and edited its Annual and Biennial Reports.

by the Safety Council of the Greater Philadelphia Chamber of Commerce.

Among the awards was the chamber's second highest, the "gold award", given to the department's Load Control (or Microwave) Section for completing 15 years without a disabling injury. Awards went also to other departmental units and to the department itself for reducing disabling injuries in the preceding year.

In fact, the number of disabling injuries per million man hours worked had been falling for a year and a half. In fiscal 1973, it was 36.2, compared with 49.9 the year before.

To reduce such injuries, a master safety committee instituted new safety measures, held employee meetings, and increased the use of safety aids. The safety officer conducted a wide ranging educational program, which included a small safety news sheet.

Preventable motor accidents climbed by 17 in fiscal 1973 over the year before, but non-preventable accidents were lower. To lessen the rate, the department put 40 operators of heavy automotive equipment through a safe driver course, and planned to extend such training to all equipment and heavy equipment operators.

On the brighter side, 296 employees, who drove a municipal vehicle for an entire calendar year (1972) without a

The Feminine Touch: Scientifically trained women were playing an increasing role in departmental planning The architect below works on a plant model, while the engineer at left studies computer data.

Engineers: From the inspection of pipe clamps to the checking of plans, the department's engineers filled many functions. They planned, designed, built, and operated millions of dollars worth of new facilities.

Engineering Computer Center: Engineers turned more and more to the department's digital computer to solve complex problems, write reports, and speed up operations. New programs were written for the computer.

Hi-Hat Award: George W. Carpenter (right), chief of wastewater treatment, received the 1973 Hi-Hat Award for special achievement form the Pa. Water Pollution Control Assn.

preventable accident, received "safe driver" awards from the National Safety Council.

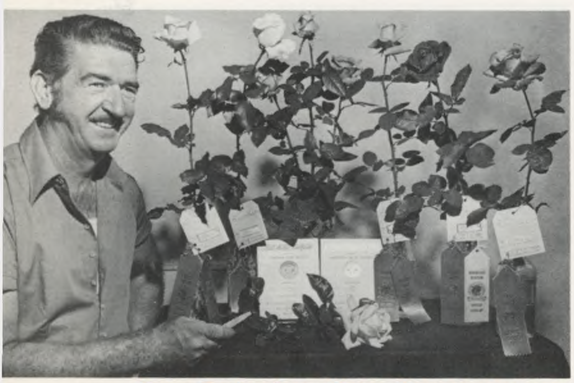
ENGINEERING DEVELOPMENTS

Engineering Computer Center: Engineering units used the digital computer for 3,100 hours in 1971-73. This reflected the growing computerization of engineering programs.

The computer did complex mathematical calculations, sped up many departmental operations, and provided a variety of daily, weekly, and monthly reports.

The reports covered time and costs, manpower utilization, water quality, operating data, wastewater treatment, inlet cleaning, surveys, industrial waste surcharges, maintenance, and many other subjects.

Several new programs were developed for Water Department units. These included one of the biggest to date—a new program (NELOG) for reporting 350 wastewater "parameters" from water pollution control plants. This data will be relayed initially from the Northeast Plant to a teletype receiver in the Computer Center.



Rose Enthusiast: Water Department employees had wide ranging interests. Charles Tongue, a foreman, added new medals to the many he has won at rose shows for his prize roses.

Other municipal agencies used the department's computer for more than 1,900 hours, and Computer Center personnel advised them on programming. A large system was developed for Philadelphia General Hospital.

Design Branch: The computer was being used extensively to solve structural design problems. Of special note was the design of new tanks for expansion of the Northeast Plant.

This work was being guided by engineers of the Design Branch, who worked closely with Computer Center and private consultants.

Design engineers turned out "plans, specifications, and estimates" for a wide spectrum of future construction. The 345 contracts, on which work was done, included 32 miles of sewers, 52 miles of water mains, and many physical improvements at plants and pumping stations. The estimated value of the contracts was $40 million.

As in past years, there was close cooperation with the State Department of Transportation. Design personnel reviewed 80 State plans for the relocation of water mains and drainage affected by new State highways within the city. In addition, engineers prepared 128 reports on drainage, utilities, and other matters related to other community projects.

The Water and Sewer Systems Planning Unit was merged with the Design Branch at the beginning of fiscal 1973. This unit made many hydraulic and drainage studies throughout the city. The studies included a future surge basin for Mingo Creek in Eastwick, improved drainage for International Airport, and future changes in storm water flow in Eastwick and the northeast. Water and sewer needs for newly developed or redeveloped areas were also under study.

To assist contractors in bidding on municipal projects, the Design Branch prepared a small handbook on "Water Standard Details". The booklet describes standardized items such as water pipes, ferrules, manholes, etc., used by the department.

Construction Branch: Construction engineers were the eyes and ears of the department in the field. Trudging through tunnels, examining building materials, and checking on construction techniques, they held the many contractors to contract specifications.

In fiscal 1972, engineers supervised 247 contracts with a combined limit of more than $40 million. This was little changed in fiscal 1973, when field contracts totaled 269, with a value over $38 million.

During the biennium, the Construction Branch completed 159 surveys for future plants and pipelines, and drafted 154 plans.

The many projects supervised by construction engineers are described in other sections of this report.

Materials Testing Laboratory: To help municipal departments obtain full value for their dollars, the Materials

For Generous Giving: Thanks to its employees' concern about community needs, the Water Department won the United Fund's "Torchlighter Award" for two years in a row. The department exceeded its quota.

Civic Awareness: Some Water Department employees took an active part in civic affairs. Water Commissioner Carmen F. Guarino (right) led a fund raising drive for the Boy Scout's Frontier District.

Testing Laboratory made 176,000 tests. The tests were performed on materials purchased by the City or used by contractors in municipal construction.

Handling 10,000 samples, the laboratory made physical and chemical tests on a wide variety of items, including gasoline, oil, coal, asphalt, textiles, paints, soaps, cements, concrete, detergents, chemicals, sands, soils, metals, paper and wood. The testing included:

Clean-up Message: A float in the City's annual "Clean-up, Paint-up, Fix-up" Parade voices the Water Department's concern about cleaner rivers.

	1971-72	1972-73
Samples Tested	4,600	5,400
Physical Tests	32,200	38,700
Chemical Tests	46,800	58,700

About three-fourths of chemical, and one-third of physical, tests were performed for the Water Department. The remainder was done principally for the Procurement, Streets, Commerce, and Public Property Departments. The laboratory tested materials for 43 construction projects that were under way in various parts of the city.

To speed up the analysis of materials, the laboratory continued to stress the use of electro-chemical, photometric, and other instrumental methods. It also refined some of its wet chemical tests to make them more accurate.

Personnel made numerous trips to manufacturing plants to inspect materials and observe proof tests on materials used by the municipality. Physical testing will increase greatly in 1974 as airport, mid-city tunnel, and other large projects begin.

Other Units: The engineering staff of Water Pollution Control made a number of studies. These included the testing of new treatment methods at wastewater plants, and preparation of technical papers on sludge disposal, automation, and other subjects.

The Water Main Records Unit made 6,000 revisions to block plans and plates pertaining to water mains. It also processed 12,000 permits for use of fire hydrants, and 330 permits for making service connections. The unit continued to microfilm contract drawings, block plans, and old records.

The Drainage Unit reviewed numerous plans submitted by engineers, architects and contractors for on-site sewers at large commercial, industrial or public projects. It also reviewed requests to relocate sewer inlets, and followed up these and other reviews with inspections of the field work. It processed 3,700 applications for sewer connection permits, redrew many sewer return plans, and supplied much information to the public, including copies of drainage plates.

Engineers of the Research and Development Unit monitored rivers and creeks and did special studies of storm water overflow (see pages 19 to 20). During the biennium, they also completed a study of cross connections in private property and drew up a proposed ordinance to eliminate such cross connections.

SOLVING 265,000 CUSTOMER PROBLEMS

For the department's interviewers, service to the customer was a daily fact of life. They received nearly 265,000 telephone calls, appealing for information or assistance.

The calls concerned many urgent problems, including broken mains, flooded cellars, discolored water, open fire hydrants, clogged inlets, low water pressures, and ruptured sewers. In response to these calls, the small Customer Service Unit radioed nearly 28,000 complaints to roving field inspectors.

Moving quickly to designated points, the inspectors checked out the complaints and summoned aid when necessary. As a result of their reports, emergency crews were sent to thousands of locations to correct defective water or drainage.

During the biennium, the inspectors performed 175,000 inspections covering permits, billing, leaks, missing meters, fire service connections, charity applications, and water service relays.

The inspections turned up many insanitary or other private violations, which customers were required to correct. Though most customers (in 23,000 violations) readily complied, 295 had to be taken to court.

An increasing number of customers on welfare, however, were unable to make plumbing corrections. In 466 cases, the Water Department did the work and billed the customer, who then arranged with the municipality to pay the bill in installments. Such City Fund work amounted to nearly $63,000 in fiscal 1972 and $87,000 the following year.

Customer Service personnel also investigated or reviewed applications for special water and sewer rates. They approved charity rates for 1,068 old and new applicants, but rejected 113 others. Requests for special rates for vacant properties were approved in 3,344 instances and rejected in 182.

Damage from broken water mains and sewers, overflowing inlets, or other drainage conditions, was the subject of many small claims during the biennium. The Water Department, which administers a small claims ordinance, settled 135 claims at a cost to the municipality of $21,881. Six claims were referred to the City Law Department and 141 claims were pending. ■

PERSONNEL CHANGES

The most significant personnel change was the retirement of Samuel S. Baxter, who served as Water Commissioner from January 1, 1952 to January 3, 1972. He was succeeded by Carmen F. Guarino, then Deputy Commissioner for Water Pollution Control.

Kenneth J. Zitomer, Chief of the Design Branch, was named Deputy Commissioner for Engineering on July 1, 1972 and sworn in on August 16, 1972.

Michael Nelson, Sanitary Engineer III, was named Acting Chief of Water Pollution Control on May 15, 1972, and Rinaldo Luciani became Acting Chief of the Design Branch on June 26, 1972. Mr. Luciani's appointment was made permanent on October 29, 1973.

Other personnel changes in 1971-73 were:

Promotions

In fiscal 1972: Alan Hess (Chief of Water Treatment), from Sanitary Engineer III to IV; Hugh Hanson (Superintendent of the Schuylkill water plants), from Sanitary Engineer II to III; James Kenny, from Assistant Supervisor to Supervisor of the Customer Service Section; John Craney, from Field Representative Supervisor to Assistant Supervisor of Customer Service; Robert Bradstock, from Supervisor to Assistant Superintendent of the Water Distribution Section; William Mahoney, Erwin Huber, and J. Robert Gallagher, from Civil Engineer II to Construction Engineer I.

In fiscal 1973: Warren Bush, from Construction Engineer I to Collector System Coordinator; Domenic Guglielmi, from Public Works Inspector II to Inlet Cleaning Superintendent; Charles Slaughter, from Excavation Foreman to Assistant Superintendent of Inlet Cleaning; Thomas Kulesza, from Sanitary Engineer II to III (Chief of Industrial Wastes Section); William Wankoff, from Civil Engineer I to Sanitary Engineer II (Supervisor of Northeast Plant); and the following to Staff Engineer I . . . . Andrew Peters from Electrical Engineer II, Sandor Kovacs from Mechanical Engineer II, and Maurice Cameron from Mechanical Engineer II.

Retirements

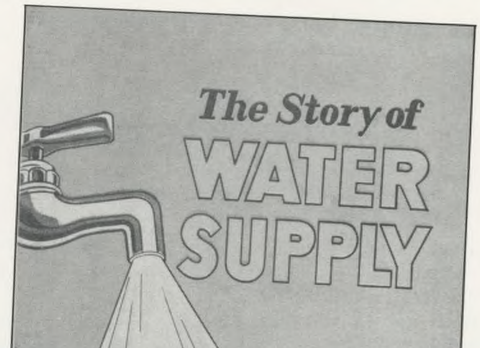
Michael Rocco, Engineering Supervisor II (Assistant Chief of the Design Branch), on July 23, 1972; Donald Randell, Sanitary Engineer II (former Supervisor of the Northeast Plant), on September 12, 1972; Samuel Costello, Civil Engineer II (Construction), on February 16, 1973; Harry Ridge, Civil Engineer II (Construction), on April 1, 1973; and Hugh Ireland, Construction Engineer II, on June 24, 1973.

Resignations

Hugh Hanson, Sanitary Engineer II (Superintendent of Schuylkill water plants), on September 1, 1972.

INFORMATION FLOWS TO TWO MILLION CUSTOMERS

Public Information: As part of a continuing program, the Water Department informed its customers about its activities. During the biennium, it distributed 50,000 brochures and 1,000,000 mail inserts . . . issued news releases . . . set up exhibits . . . held year around "open house" at its plants . . . sent out speakers, and used other informational tools.



financial statements

CAPITAL ACTIVITY - 1973

	Water	Sewer	Storm & Flood Relief	Total
Capital contracts encumbered July 1, 1972	$ 6,082,062.32	$15,744,058.78	—	$21,826,121.10
Add: Capital work initiated in Fiscal 1973	7,684,699.33	9,665,741.34	—	17,350,440.67
Total: Net capital activity in Fiscal 1973	**$13,766,761.65**	**$25,409,800.12**	**—**	**$39,176,561.77**
Less: Capital expenditures in Fiscal 1973	7,892,885.99	15,216,817.27	—	23,109,703.26
Capital contracts still encumbered June 30, 1973...	**$ 5,873,875.66**	**$10,192,982.85**	**—**	**$16,066,858.51**

SUMMARY OF CAPITAL ACTIVITY 1967-1973

	Calendar Year 1967	Fiscal Period 1968-1969(1)	Fiscal Period 1970	Fiscal Period 1971	Fiscal Period 1972	Fiscal Period 1973
Capital contracts encumbered beginning of period .	$15,641,384	$19,720,719	$31,209,172	$25,654,314	$17,933,474	$21,826,121
Add: Capital work initiated	23,094,060	38,720,673	10,574,111	12,848,928(2)	23,017,772	17,350,441
Total: Net capital activity......	**$38,735,444**	**$58,441,392**	**$41,783,283**	**$38,503,242**	**$40,951,246**	**$39,176,562**
Less: Capital expenditures	19,014,725	27,232,220	16,128,969	20,569,768	19,125,125	23,109,703
Capital contracts encumbered end of period	**$19,720,719**	**$31,209,172**	**$25,654,314**	**$17,933,474**	**$21,826,121**	**$16,066,859**

(1) 18 months transition period, ended June 30,1969.

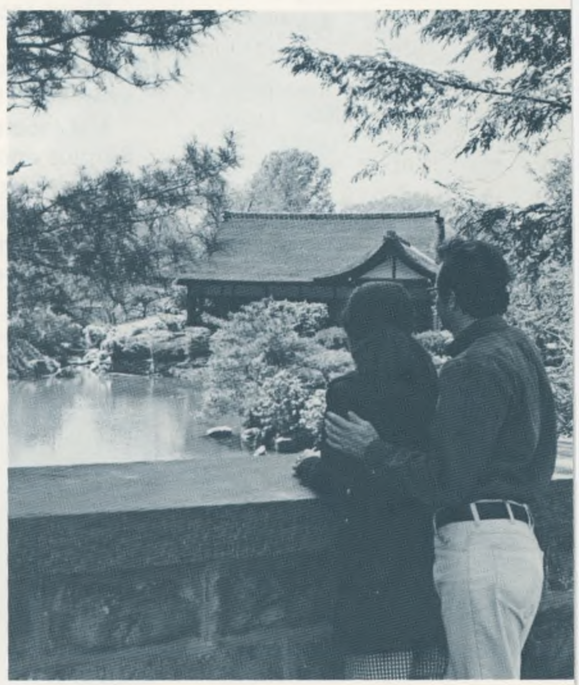
(2) Revised from previous report by elimination of two projects totaling $8,672,000 not in fact initiated.

WATER FUND
BALANCE SHEET
ASSETS AND OTHER DEBITS

	June 30 1973	1972
Utility Plant		
Utility Plant in Service	$315,532,415	$310,859,186
Construction Work in Progress	6,842,278	5,681,079
Unexpended Construction Authorizations	10,595,885	11,722,353
	$332,970,578	**$328,262,618**
Current Assets		
Cash	$ 12,799,342	$ 11,781,063
Accounts Receivable:		
Customers, for Utility Service	8,466,207	8,209,948
Other	399,880	393,477
Estimated Uncollectible Receivables	(2,193,058)	(1,461,799)
Advances to Other Municipal Funds	789,653	1,089,397
Materials and Supplies at Standard Cost	2,182,739	2,144,198
	$ 22,444,763	**$ 22,156,284**
	$355,415,341	**$350,418,902**

LIABILITIES AND OTHER CREDITS

	1973	1972
Long Term Debt and Other Credits		
Bonds Payable	$111,147,197	$116,711,090
Sinking Fund Assets	(3,299,691)	(3,012,394)
Bond Authorizations Unissued	15,000,000	12,900,000
	$122,847,506	**$126,598,696**
Excess of Utility Plant and Fund Accounts over Long Term Bond Commitments	210,123,072	201,663,922
	$322,970,578	**$328,262,618**
Current Liabilities		
Accounts Payable	$ 964,432	$ 836,465
Accrued Payroll	254,398	240,881
Advances from Other Municipal Funds	245,397	642,530
Provision for Indemnities	21,074	—
	$ 1,485,301	**$ 1,719,876**
Surplus and Surplus Reserves		
Reserve for Commitments	$ 2,207,716	$ 1,496,811
Surplus:		
Invested in Materials and Supplies	2,,182,739	2,144,198
Estimated Collectible Receivables	6,673,029	7,141,626
Available for Appropriation	9,895,978	9,653,773
	$ 18,751,746	**$ 18,939,597**
Total Surplus and Surplus Reserves	**$ 20,959,462**	**$ 20,436,408**
	$ 22,444,763	**$ 22,156,284**
	$355,415,341	**$350,418,902**



WATER FUND
STATEMENT OF INCOME AND SURPLUS

	For the Fiscal Year Ending June 30 1973	1972
Operating Revenue:		
Metered Sales	$28,709,806	$28,946,826
Municipal and other Metered Sales	1,111,059	1,214,434
Public Fire Protection	1,207,405	1,218,052
Private Fire Connection	392,115	429,555
Other Operating Revenue	840,775	816,314
Total Operating Revenue	**$32,261,160**	**$32,625,181**
Operating Revenue Deductions:		
Operating Expenses	$20,763,770	$19,290,512*
Charges in lieu of Depreciation	6,918,224	4,468,078
Total Operating Revenue Deductions	**$27,681,994**	**$23,758,590**
Operating Income	4,579,166	8,866,591
Other Income	778,495	679,374
Gross Income	**$ 5,357,661**	**$ 9,545,965**
Income Deductions:		
Interest on Long Term Debt	$ 4,652,939	$ 2,418,622
Net Income	**$ 704,722**	**$ 7,127,343**
Surplus and Surplus Reserves at the Beginning of the Year	20,436,408	13,479,030
Other Adjustments to Surplus (Net)	(181,668)	(169,965)*
Total Surplus and Surplus Reserves at the End of the Year	**$20,959,462**	**$20,436,408**

* Exigencies precluded the availability of some actual accrual basis data. Therefore, some estimates were used for the accrual basis.

WATER FUND

BUDGETARY OPERATIONS—FISCAL 1972 - FISCAL 1973

SUMMARY	Fiscal 1972 (a)	Fiscal 1973 (b)	Change + (−)
Cash surplus, June 30	$ 3,354,933	$ 9,653,773	$ 6,298,840
Add: Adjustments: prior years operations, etc.	669,884	560,586	(109,298)
Fiscal years revenues (c)	35,094,188	35,318,177	223,989
Total Year's resources	**39,119,005**	**45,532,536**	**6,413,531**
(Less): Fiscal years obligations (c)	(29,465,232)	(35,636,559)	6,171,327
Cash surplus, June 30	**$ 9,653,773**	**$ 9,895,977**	**242,204**
Change in year's operations	$ 6,298,840	$ 242,204	(6,056,636)
REVENUES (c)—(by major source of revenue)			
Water service charges			
Collections: current billings	$25,147,859	$24,825,312	(322,547)
past billings	3,248,765	3,871,600	622,835
Total Water service charges	**28,396,624**	**28,696,912**	**300,288**
Miscellaneous:			
Fire service connections	428,031	404,971	(23,060)
Meter installations	130,838	145,733	14,895
Other	711,707	467,871	(243,836)
Total Miscellaneous	1,270,576	1,018,575	(252,001)
Interest earnings	351,399	412,756	61,357
Payments from other City Funds: (c)			
General Fund: water service charges	1,214,434	1,111,059	(103,375)
joint fund expenses	107,898	95,368	(12,530)
Fire protection services	1,218,052	1,207,405	(10,647)
Sewer Fund: joint fund expenses	2,535,205	2,776,102	240,897
Total Payments from other City Funds	5,075,589	5,189,934	114,345
Total Water Fund Revenues	**$35,094,188**	**$35,318,177**	**$ 223,989**
OBLIGATIONS (c)—(by major object of expenditure)			
Water Operations			
Personal services	$ 9,824,613	$10,211,961	$ 387,348
Purchase of services	3,374,267	3,879,267	505,000
Materials and supplies	3,609,266	3,909,842	300,576
Equipment	434,005	310,729	(123,276)
Subtotal	**17,242,151**	**18,311,799**	**1,069,648**
Payments to General Fund: (c)			
Financial services, meter reading, billing, etc.	655,521	673,546	18,025
Other services rendered	1,062,284	963,368	(98,916)
Total Payments to General Fund	1,717,805	1,636,914	(80,891)
Payments to Bond Fund	60,000	60,000	0
Total Water Operations	**$19,019,956**	**$20,008,713**	**$ 988,757**
Capital Budget Financing	500,000	500,000	0
Indemnities (c)	89,824	163,663	73,839
Employees' Welfare Plans	341,756	360,325	18,569
Workmen's Compensation	5,472	6,502	1,030
Department of Collections			
Personal services	1,707,624	1,841,869	134,245
Purchase of services	186,013	182,896	(3,117)
Materials and supplies	25,501	27,184	1,683
Equipment	16,217	18,179	1,962
Refunds	14,188	19,407	5,219
Total Department of Collections	**1,949,543**	**2,089,535**	**139,992**
Debt Service			
Interest	2,418,621	4,652,939	2,234,318
Principal	3,261,460	5,674,978	2,413,518
Total Debt Service	5,680,081	10,327,917	4,647,836
Pensions (c)	**1,878,600**	**2,179,904**	**301,304**
Total Water Fund Obligations	**$29,465,232**	**$35,636,559**	**$ 6,171,327**

(a) Began July 1, 1971 (b) Began July 1, 1972 (c) After adjustments were made from surplus.

SEWER FUND
BALANCE SHEET
ASSETS AND OTHER DEBITS

	June 30 1973	1972
Utility Plant		
Utility Plant in Service	$435,532,557	$425,478,857
Construction Work in Progress	9,655,773	8,396,667
Unexpended Construction Authorizations	22,539,997	29,741,268
	$467,728,327	**$463,616,792**
Current Assets		
Cash	$ 16,773,456	$ 14,944,881
Accounts Receivable:		
Customers, for Utility Service	8,940,279	8,605,698
Other	312,856	237,519
Estimated Uncollectible Receivables	(2,091,350)	(1,176,676)
Advances to Other Municipal Funds	84,583	425,019
Materials and Supplies at Standard Cost	390,521	343,212
	$ 24,410,345	**$ 23,379,653**
	$492,138,672	**$486,996,445**

LIABILITIES AND OTHER CREDITS

	1973	1972
Long Term Debt and Other Credits		
Bonds Payable	$178,101,198	$186,837,847
Sinking Fund Assets	(7,715,234)	(7,043,744)
Bond Authorizations Unissued	37,200,000	21,600,000
	$207,585,964	**$201,394,103**
Excess of Utility Plant and Fund Accounts over Long Term Bond Commitments	260,142,363	262,222,689
	$467,728,327	**$463,616,792**
Current Liabilities		
Accounts Payable	$ 506,027	$ 223,263
Accrued Payroll	117,962	102,116
Advances from Other Municipal Funds	467,024	855,731
Provision for Indemnities	25,240	—
	$ 1,116,253	**$ 1,181,110**
Surplus and Surplus Reserves		
Reserves for Commitments	$ 2,150,056	$ 1,945,682
Surplus:		
Invested in Materials and Supplies	390,521	343,212
Estimated Collectible Receivables	7,161,785	7,666,541
Available for Appropriation	13,591,730	12,243,108
	$ 21,144,036	**$ 20,252,861**
Total Surplus and Surplus Reserves	**$ 23,294,092**	**$ 22,198,543**
	$ 24,410,345	**$ 23,379,653**
	$492,138,672	**$486,996,445**

SEWER FUND
STATEMENT OF INCOME AND SURPLUS

	For the Fiscal Year Ending June 30 1973	1972
Operating Revenue:		
Metered Sales	$27,682,528	$28,050,328
Municipal and Other Metered Sales	1,666,298	1,574,483
Industrial Sewage Surcharge	1,103,905	1,134,357
Other Revenue	730,619	675,624
Total Operating Revenues	**$31,183,350**	**$31,434,792**
Operating Revenue Deductions:		
Operating Expenses	$14,909,327	$12,678,871*
Charges in lieu of Depreciation	10,065,004	6,445,103
Total Operating Revenue Deductions	**$24,974,331**	**$19,123,974**
Operating Income	6,209,019	12,310,818
Other Income	2,405,256	2,165,579
Gross Income	**$ 8,614,275**	**$14,476,397**
Income Deductions:		
Interest on Long Term Debt	$ 7,182,186	$ 3,729,262
Net Income	**$ 1,432,089**	**$10,747,135**
Surplus and Surplus Reserves at the Beginning of the Year	22,198,544	11,629,066
Other Adjustments (Net)	(336,541)	(177,657)*
Total Surplus and Surplus Reserves at the End of the Year	**$23,294,092**	**$22,198,544**

* Exigencies precluded the availability of some actual accrual basis data. Therefore, some estimates were used for the accrual basis.

SEWER FUND

SEWER FUND BUDGETARY OPERATIONS—FISCAL 1972 - FISCAL 1973

SUMMARY	Fiscal 1972 (a)	Fiscal 1973 (b)	Change + (−)
Cash surplus, June 30	$ 3,428,111	$12,243,108	$8,814,997
Add: Adjustments; prior years operations, etc	332,469	202,132	(130,337)
Fiscal year's revenues (c)	32,238,435	32,844,188	605,753
Total Year's resources	**$35,999,015**	**$45,289,428**	**$ 9,290,413**
(Less): Fiscal Year's obligations (c)	(23,755,907)	(31,697,698)	(7,941,791)
Cash surplus, June 30	**$12,243,108**	**$13,591,730**	**$ 1,348,622**
Change in year's obligations (c)	8,814,997	1,348,622	(7,466,375)

REVENUES (c) (by major source of revenue)

	Fiscal 1972 (a)	Fiscal 1973 (b)	Change + (−)
Sewer service charges			
Collections: current billings	$23,866,790	$23,507,995	$(358,795)
past billings	3,385,586	4,113,709	728,123
Total Sewer service charges	27,252,376	27,621,704	369,328
Miscellaneous			
Surcharges	1,193,590	1,142,534	(51,056)
Service charges: other municipalities	703,714	865,039	161,325
Meter installations	82,111	91,782	9,671
Federal grants	252,713	243,605	(9,108)
Other	96,815	100,040	3,225
Total Miscellaneous	2,328,943	2,443,000	114,057
Interest earnings	380,314	531,335	151,021
Payments from other City Funds (c)			
General Fund: sewer service charges	870,769	790,761	(80,008)
joint fund expenses	9,250	32,285	23,035
Total Payments from other City Funds	880,019	823,046	(56,973)
State Aid: Clean streams program	1,396,783	1,425,103	28,320
Total Sewer Fund Revenues	**$32,238,435**	**$32,844,188**	**$ 605,753**

OBLIGATIONS (c) (by major object of expenditure)

	Fiscal 1972 (a)	Fiscal 1973 (b)	Change + (−)
Water Pollution Control Operations			
Personal services	$ 5,576,827	$ 6,010,698	$ 433,871
Purchase of services	2,249,907	2,635,709	385,802
Materials and supplies	441,402	386,624	(54,778)
Equipment	732,753	506,739	(226,014)
Subtotal	**9,000,889**	**9,539,770**	**583,881**
Payments to other City Funds			
General Fund: (c)			
Financial services, meter reading, billing, etc	537,461	558,795	21,334
Other services rendered	438,466	430,958	(7,508)
Total Payments to General Fund	975,927	989,753	13,826
Sewer Fund:			
Joint fund expenses	2,535,205	2,776,102	240,897
Bond Fund:			
Contribution	40,000	40,000	0
Total Payments to other City Funds	**3,551,132**	**3,805,855**	**254,723**
Total Water Pollution Control Operations	**12,552,021**	**13,345,625**	**793,604**
Capital Budget Financing	500,000	500,000	0
Indemnities (c)	80,981	188,630	107,649
Employees Welfare Plans	186,482	188,267	1,785
Refunds	12,550	19,417	6,867
Debt Service			
Interest	3,729,262	7,182,186	3,452,924
Principal	5,663,111	8,996,172	3,333,061
Total Debt Service	9,392,373	16,178,358	6,785,985
Pensions (c)	**1,031,500**	**1,277,401**	**245,901**
Total Sewer Fund Obligations	**$23,755,907**	**$31,697,698**	**$ 7,941,791**

(a) Began July 1, 1971 (b) Began July 1, 1972 (c) After adjustments were made from surplus.

WATER MAINS AND SEWERS BUILT
(in miles)

	Water Mains	Sewers
1953	28.11	35.54
1954	32.62	46.28
1955	36.04	61.15
1956	40.49	46.85
1957	40.07	49.61
1958	45.90	33.02
1959	37.58	43.75
1960	50.58	39.83
1961	43.92	34.01
1962	57.00	40.43
1963	37.30	29.09
1964	41.20	41.61
1965	34.22	30.09
1966	33.47	24.80
1967	28.97	22.67
1968	22.56	30.05
1969 (first six months)	10.53	11.80
1970 (fiscal)	19.80	8.57
1971 (fiscal)	19.62	17.20
1972 (fiscal)	16.75	10.22
1973 (fiscal)	13.06	12.84
	689.79	**669.41**

CONSTRUCTION CONTRACTS—1971-73

Based on partial and final estimates in the field, the Water Department performed construction valued at $32.7 million in the fiscal biennium from July 1, 1971 to June 30, 1973.

Water System

The department spent $2.3 million for water plants, pumping stations, and reservoirs, and did $5.6 million of work under water main and water tunnel contracts. In addition, an undetermined amount of work (probably in excess of $2 million) was done on water mains under sewer contracts.

Other water system statistics: 136 contracts, with a limit of $13.4 million, were completed; 143 contracts, with a limit of $10.1 million, were awarded; 52 contracts, with a limit of nearly $5 million, were in force on June 30, 1973.

Wastewater System

Physical facilities built at water pollution control plants were valued at $3.6 million, while work done under sewer contracts totaled $21.2 million. The latter included some water main work, noted above.

Other wastewater system statistics: 189 contracts, with a limit of $29.7 million, were completed; 118 contracts, with a limit of $20.4 million, were awarded; 87 contracts, with a limit of $16.4 million, were in force on June 30, 1973.

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