DELAWARE RIVER BASIN COMMISSION

Annual Report 1993

Front cover: Residents of Port Jervis, N.Y. are frozen in time as they view ice that rode flood waters from the Delaware River into town on March 17, 1875. The ice is stacked up in the old Delaware & Hudson Canal. *(Photo by Elias P. Masterson, Port Jervis, N.Y. courtesy of David J. Wood, Milford, Pa.)*

Material for this report was generated by the staff of the Delaware River Basin Commission. The report was compiled and edited by Christopher M. Roberts, the Commission's public information officer, with design support from Odette P. Taft, the Commission's graphic artist/illustrator

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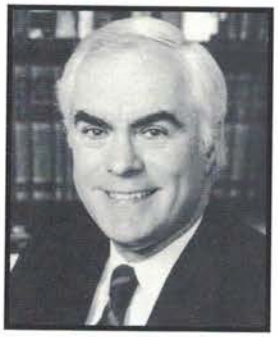
Contents

A French container ship heads west through the Chesapeake and Delaware Canal off Chesapeake City, Md. The canal, which links the Delaware and Chesapeake Bays, is a prime spawning area for striped bass. *(Photo by Chris Roberts)*

The Commission - 1993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Warren R. Huff (237)
Robert C. Kausch (252)
Todd W. Kratzer (261)
Ronald B. Rulon (269)
Paul J. Scally (251)
Paul J. Webber (236)
Robert Wu (266)

Project Review:

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Thomas L. Brand (217)
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Operations:

Richard K. Fromuth (232)
Timothy R. Lazaro (274)
Robert L. Limbeck (230)
Pamela Merritt (228)

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Dorothy L. Golinski (242)
Carolyn M. Hartman (249)
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Joseph Sosi (211)

Directorate/Engineering

Carolyn B. Everett (204)
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Odette P. Taft (241)
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Appointments/Retirements

Changing of the Guard

Three new commissioners were named in 1993, representing the states of Pennsylvania, Delaware and New York.

Christophe A.G. Tulou, secretary of Delaware's Department of Natural Resources and Environmental Control, was appointed by Governor Thomas R. Carper to serve as his alternate to the Commission. He succeeded Edwin H. Clark II, the department's former secretary.

In Pennsylvania, Governor Robert P. Casey named William A. Gast to serve as second alternate, joining Caren E. Glotfelty, a deputy secretary in the state's Department of Environmental Resources. Mr. Gast is chief of the department's Division of Water Planning and Allocations in the Bureau of Water Supply and Community Health.

Mr. Campbell

And in New York, Daniel J. Campbell, assistant director of the Division of Water in the state's Department of Environmental Conservation, was appointed by Governor Mario M. Cuomo to serve as alternate to Thomas C. Jorling, the department's commissioner.

Mr. Campbell succeeds Russell C. Mt. Pleasant, director of the department's Bureau of Water Resources who retired in 1993 after many years of dedicated service to both New York State and the Commission.

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A native of Winchester, Va., Mr. Tulou served as legislative assistant and legislative director for Governor Carper from 1983 to 1991 during Governor Carper's tenure in Congress. During that time he drafted legislation on marine pollution, hazardous substances and low-level radioactive waste management.

Most recently, he served as the staff director for the Subcommittee on Economic Stabilization for the House of Representatives' Committee on Banking, Finance and Urban Affairs. He has authored legislation to promote sound coastal management through the National Flood Insurance Program and establish a national marine mammal health and stranding response program.

Mr. Tulou holds a bachelor's degree in biology from the College of William and Mary, masters' degrees in zoology and marine affairs from the University of Rhode Island and a law degree from Georgetown University Law Center.

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Mr. Campbell, who has worked for New York State's Department of Environmental Conservation since 1966, is actively involved in the supervision of 22 statutory programs which address all significant aspects of the state's waters.

The programs include water quality management, wastewater facilities design and operations, spill prevention and response, and flood protection.

Prior to being named the Division of Water's assistant director in 1989, Mr. Campbell served as director of the division's Bureau of Information and Bulk Storage and the Bureau of Wastewater Facilities Operations.

Mr. Campbell holds a bachelor's degree in civil engineering from Northeastern University in Boston and a master's degree in public health from the University of Minnesota.

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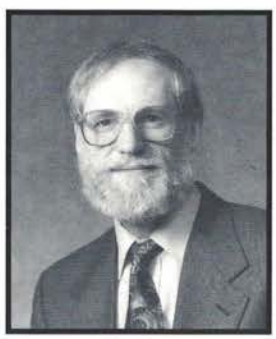
Mr. Gast has been employed in Pennsylvania's Division of Water Planning and Allocations since 1969 and during the 1970s worked actively in developing data management systems for the commonwealth's State Water Plan.



Mr. Gast

He was named chief of the division in 1980, and in that capacity has managed the division's surface water allocation, water planning, and data management programs.

Mr. Gast holds a bachelor of science degree in civil engineering from Lehigh University and is a licensed professional engineer in Pennsylvania.

Richard Gainer, deputy commissioner for the Bureau of Water Supply and Wastewater Collection in New York City's Department of Environmental Protection, was named alternate advisor to New York State with respect to Commission matters. He succeeds Joseph Conway, a former department deputy commissioner who retired in 1992 after more than 38 years of service.

Gone Hunting

Bruce Stewart retired as president of the Water Resources Association of the Delaware River Basin (WRA) in 1993 and with his wife Carol picked up and moved to Arbovale, W. Va. where they are operating a hunting lodge.

Mr. Stewart chaired the Commission's Water Conservation Advisory Committee since it was formed in 1984 and played a key role in the formulation of the Commission's numerous water conservation regulations. Mrs. Stewart served for many years as WRA's administrative assistant.

Mr. Stewart is now a trustee-at-large to the Pocahontas County Free Library and Mrs. Stewart is a member of a quilting club which meets in a cabin on Buffalo Mountain.

They report the loudest sound they hear now "is the gurgle of Buffalo Run (the crick) unless it's the sound of a turkey gobbling in the early morning or an owl hooting at night."

We wish them well.

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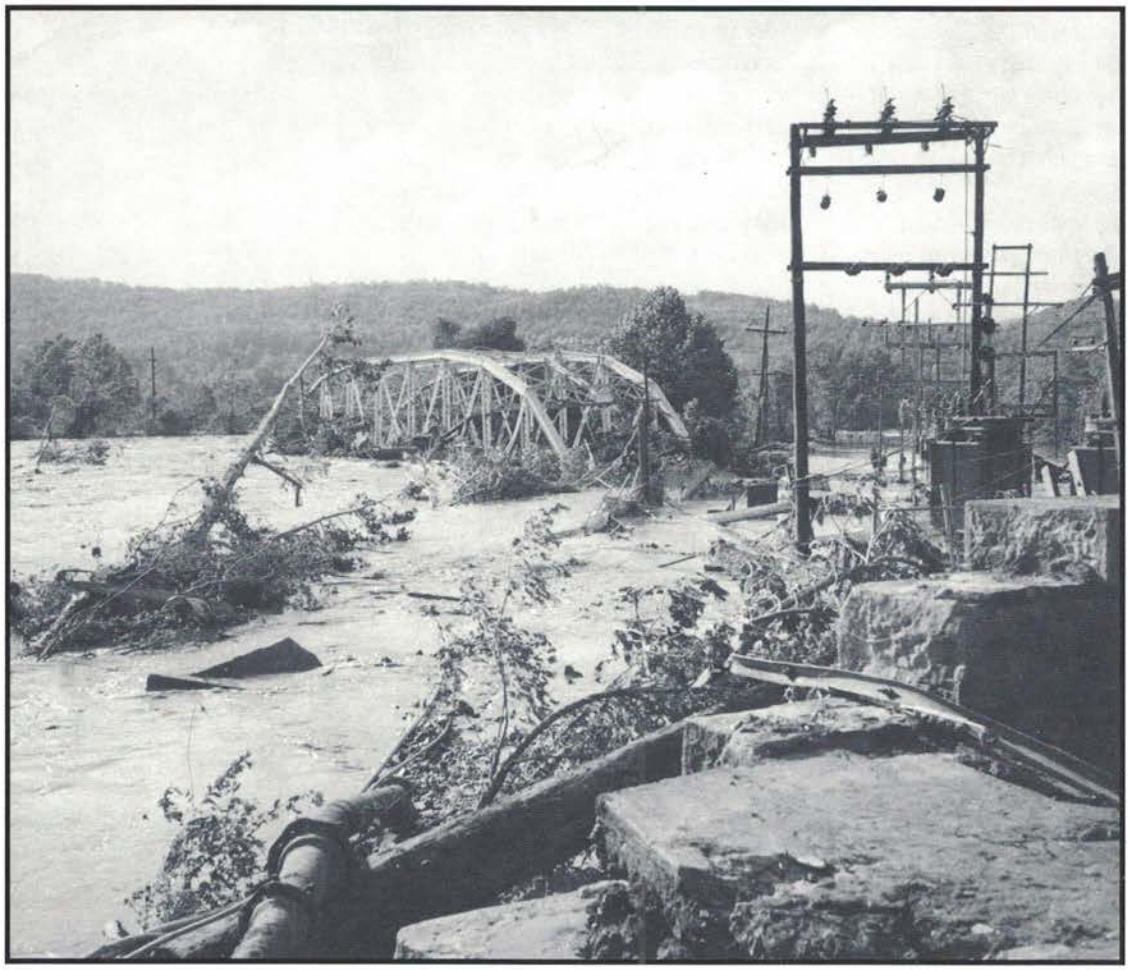
Catherine F. Dougherty, a Commission secretary for 31 years, also retired in 1993. In her latest assignment she served as secretary to the executive director. Her dedication and Irish wit are missed.

Ms. Dougherty

Flood Preparedness: Room for Improvement



Provoked by a one-two hurricane punch, the flood waters of August 1955 smashed a bridge across the Brodhead Creek at Stroudsburg, Pa.

Devastating floods struck the Midwest during the summer of 1993, causing billions of dollars in damage and raising questions about flood control readiness in other parts of the country.

In the Delaware River Basin, the last major flood - the flood of record - occurred in August of 1955 when two trailing hurricanes, Connie and Diane, tracked across the watershed unleashing torrential rains. Bridges along the Delaware were washed out, homes and businesses were destroyed, 99 people died.

The flood stirred a public clamor that prompted Congress to direct the U.S. Army Corps of Engineers to forge a comprehensive physical plan for the basin's waters. Flood control became a top priority.

In the ensuing years, three major flood control dams were built by the Corps: Jadwin and Prompton in the

Lackawaxen watershed and F.E. Walter in the Lehigh watershed. Two water supply reservoirs with flood control capability also were constructed: Blue Marsh in the Schuylkill watershed and Beltzville in the Lehigh watershed. In addition, the Corps has designed and completed numerous channel modifications, levees, flood walls and stream bank protection projects within the basin, including local flood control projects in Allentown and Bethlehem. The estimated cumulative flood damage reduction from the above projects is $97 million through Fiscal Year 1993.

Other steps were taken:

- The Soil Conservation Service built smaller flood control projects in 21 basin watersheds. Flood damage reduction is estimated at at least $10 million;

- The Pennsylvania Department of Environmental Resources constructed local flood protection works, including channel modifications, levees and flood walls;

- The Commission adopted flood plain regulations which restrict development in the 100-year flood plain and prohibit development in the floodway;

- Communities throughout the basin adopted flood plain regulations as part of the Federal Flood Insurance Program;

- The National Weather Service's River Forecast Center in State College, Pa. upgraded its flood warning system. Additional monitoring stations, 24-hour staffing, and the addition of enhanced radar resulted in better flood warning capabilities for the Mid-Atlantic Forecasting Region which includes the Delaware River Basin;

- The Commission completed flood stage forecast maps for the Corps for the main stem Delaware River from Trenton, N.J. upstream to Belvidere, N.J.;

- Flood Hazard Boundary Mapping of the 100-year flood plain was completed for all municipalities in the basin. This mapping shows approximate boundaries of 100-year flooding (a flood of a certain magnitude expected to occur every 100 years) and was prepared under the Federal Emergency Management Agency's (FEMA's) National Flood Insurance Program. Detailed flood insurance studies and mapping showing profiles and flood plain and floodway boundaries for the 100-year flood were completed for urban areas and most rural communities in the basin. The Commission participated in 152 detailed floor insurance studies and one limited detail study;

- The Corps completed studies for automated flood warning systems for the Assunpink Creek in New Jersey and the Lehigh River in Pennsylvania. These systems would be similar to the automated warning system now in place in the Passaic River Basin in northern New Jersey and would make use of remote monitors linked to computer reporting systems via radio transmissions.

This flood mitigation work occurred over a 38-year span, a period when something else was occurring in the basin: major development. Land which once soaked up rain and melting snow was paved over, the impervious surfaces significantly increasing the amount and speed of runoff into rivers and streams.

In some areas, man's efforts to tame floods have been hampered by this changing landscape.

Twenty-nine years after the 1955 flood, with the major flood control projects in place, the Corps concluded in a report titled "The Delaware Basin Study" that a repeat of that record event would cause an estimated $275 million in damages (1984 dollars) along the Delaware River main stem alone. Extensive damage also could be expected on the river's tributaries.

Not only has urbanization made the basin more prone to flooding, there appears, in some cases, to be a lack of familiarity with formal evacuation plans to be used once the floodwaters arrive. In other cases there's a shortage of plans.

The Corps, in its 1984 study, found that only 26% of communities surveyed along the Delaware main stem were aware of any flood warning system and most were not aware of any formal evacuation plan. Only 33 percent of the communities had a flood warning system in place.

Successful evacuation plans hinge on understanding the relationship between the predicted flood crest on a gauged river or stream and the area which will be inundated when that crest is reached. In low-lying areas prone to flooding, this connection is usually well established because of the frequency of flooding events caused by relatively small rises in river and stream levels. Examples include portions of River Road along the Delaware main stem in Bucks County, Pa. and reaches of the Neshaminy, Assunpink and Brandywine Creeks and the Christina River. However, when high flood crests are predicted, it often is not known what additional areas will be under water because of the infrequency of these events. This problem highlights the need for flood stage forecast maps which show areas of expected inundation based on varying river and stream stages.

As noted earlier, the Commission, at the request of emergency management officials in Pennsylvania and New Jersey, has completed flood forecast maps for the main stem Delaware from Belvidere, N.J. downstream to Trenton. Maps also have been completed for portions of the Schuylkill River in Berks County and maps are being prepared by the Corps for the Schuylkill upstream to Port Clinton. The recent completion of two-foot contour interval mapping for New Castle County in Delaware also makes the Christina River Basin a candidate for flood stage forecast mapping.

Additional forecast maps are needed for other river reaches and streams. However, the topographic mapping on which the forecast maps are based often does not exist. And topo maps are expensive to produce, being dependent on aerial photography and digital terrain models. (Satellite images do not provide sufficient precision for the two to four foot contour intervals needed for flood stage forecast mapping.) Geographic Information System (GIS) technology can speed the production of topo maps provided the digital terrain models are available.

Early flood warning in the Delaware River Basin is a joint effort of the National Weather Service, state and county emergency management offices, local communities and cooperating agencies such as the Commission and the Army Corps of Engineers.

All of the basin states are equipped with computer systems and software to coordinate flood emergency response. The Pennsylvania Emergency Management Agency (PEMA) offers an excellent demonstration of this system, especially for the Susquehanna River Basin where most of the flood forecast mapping has been completed. However, a lack of flood stage forecast maps in the Delaware River Basin has impeded flood warning and evacuation programs.

The Weather Service's River Forecast Center in State College issues forecast flood crests for the Delaware River main stem and major tributaries. These forecasts are based on automated precipitation data, reports of volunteer observers, and rainfall and runoff modeling. They are available to state and county emergency officials and to the Commission, which can then disseminate this information to the news media and the general public, especially persons living along waterways which frequently flood.

The Weather Service issues urban and small stream flood watches when heavy rainfall is expected. If flood stages occur, the Weather Service broadcasts flood warnings and the forecasted crest on NOAA Weather Radio. Once the flood warning has been issued, it is up to local communities to respond, closing roads and ordering evacuations if necessary. The success of this system, however, depends on the ability of local officials to relate the forecasted river or stream stage to areas that are expected to be inundated. Again, flood stage forecast maps are a key to the process, and their absence in much of the basin is a missing link in flood preparedness for gauged rivers and streams.

The Weather Service also offers a Flash Flood Warning Assistance Program to counties to deal with flash flooding on smaller ungauged streams. These streams can rise rapidly, thus providing little time to initiate emergency response actions. The Weather Service provides a daily

flood guidance report for each county in the basin. This report lists the amount of rainfall needed to cause small stream and urban flooding and is available through NOAA satellite transmissions and computer modem connections with the Weather Service. This system can work well when communities take an active interest in obtaining daily precipitation forecasts and have a well-publicized and practical local warning system in place. Volunteer rainfall and stream gauge observers or automated monitoring equipment are required for such a system.

The Army Corps of Engineers' Flood Plain Management Branch also provides assistance to communities in flood preparedness planning. However, this planning is dependent on the availability of flood stage forecast maps.

Some Solutions

When the floodwaters in the Midwest finally subsided, river managers tried to figure out what could be done to prevent such death and massive destruction in the future.

In the Delaware River Basin, there are some obvious things to do:

- Pursue alternate funding for the operation and maintenance of automated flood warning systems. Currently, funding is provided on a cost-share basis, with the Army Corps of Engineers paying 75% and the local sponsor (a community or township where the system will be installed) paying 25%. However, operation and maintenance costs, which usually outweigh the capital costs, must be borne solely by the local sponsor. This funding arrangement has proven a serious obstacle to the completion of these programs.

- Continue to use available topographic mapping for the production of flood stage forecast maps and secure funding with which to generate new maps for other areas of the basin. The financing of digital elevation models which define watershed topography also is critical for the completion of this work. Once these maps are distributed to emergency personnel improved evacuation planning can proceed.

- Secure outside sponsorship and funding for the installation, operation and maintenance (O&M) of a NOAA Weather Radio transmitter in the Port Jervis, N.Y. area. Currently, NOAA broadcasts are made from ten transmitters located within or near the basin. However, much of the upper basin (in the Port Jervis area) within 20 miles of the Delaware River's main stem is out of range of existing transmitters. The Weather Service says money is not currently available to fund the construction and pay O&M for this additional transmitter.

- Provide information to the public about the potential for severe flooding in the basin and the value of local flood preparedness planning. Publicize the assistance that is available from the Weather Service and the Corps.

While flood warning systems and evacuation plans alone can not eliminate all flood damage, life and property losses can be significantly reduced.

And it should be underscored that funding for these flood preparedness initiatives would require only a small share of the money routinely paid out for flood disaster relief.

Flash Flooding: Are You Ready?

The Delaware River Basin is prone to flash flooding on smaller streams and rivers. Here's a look at what three Pennsylvania counties have done to deal with the problem:

MONROE COUNTY, Pa. - The county's local flood warning and evacuation plan was developed with assistance from the U.S. Army Corps of Engineers. The system includes 26 rain gauges and 13 stream gauges and communications between observers and a local weather coordinator. The gauge network is activated upon issuance of a flood warning by the National Weather Service. If the coordinator receives heavy precipitation reports from one or more volunteer observers, the stream gauge network is alerted and stage observations are reported at intervals set by the coordinator. Flood forecasts are updated every two hours by the coordinator based on observations and National Weather Service data. The Monroe County Civil Defense Department then advises local authorities of the extent of the flood threat. Four levels of flood warning are tied to forecast stages at upstream gauges. Evacuation plans related to those predicted flood stages are in place.

CHESTER COUNTY, Pa. - The county makes use of available precipitation forecasts and flash flood guidance provided by the National Weather Service. Flood standby alerts and warnings are issued based on forecasts to increase lead time. Volunteer rainfall observers report to the Chester County Department of Emergency Services when precipitation exceeds one inch within a 24-hour period and are then advised of required additional observations. Volunteer radio operators provide site reports to a county base station. Rain gauges supplied by the Pennsylvania Emergency Management Agency (PEMA) are provided to the volunteer observers by the county.

BUCKS COUNTY, Pa. - A network of volunteer observers with PEMA manual rain gauges is maintained for the Neshaminy Creek Basin. The observers are called for precipitation amounts and a forecasting procedure developed for the county by the National Weather Service is used to predict stages for the Neshaminy Creek at Langhorne. The county uses its dispatcher radio system to warn local police departments of expected flooding. The county maintains contact with persons living along the Neshaminy for stream stage reports during flood events.

(EDITOR'S NOTE: The examples cited above are not all inclusive. There are other local flash flood warning systems in place in the basin. However, these examples were given in hopes that counties or communities which are not prepared to deal with rapidly rising waters will seek the assistance available from the federal and state agencies mentioned above in developing their own flash flood warning networks.)

Flood Stage Forecast Mapping

The flood stage forecast mapping project for the main stem of the Delaware River was completed during 1993. The mapping was under contract with the U.S. Army Corps of Engineers and was completed at the request of the New Jersey Department of Environmental Protection and Energy and the Pennsylvania Emergency Management Agency.

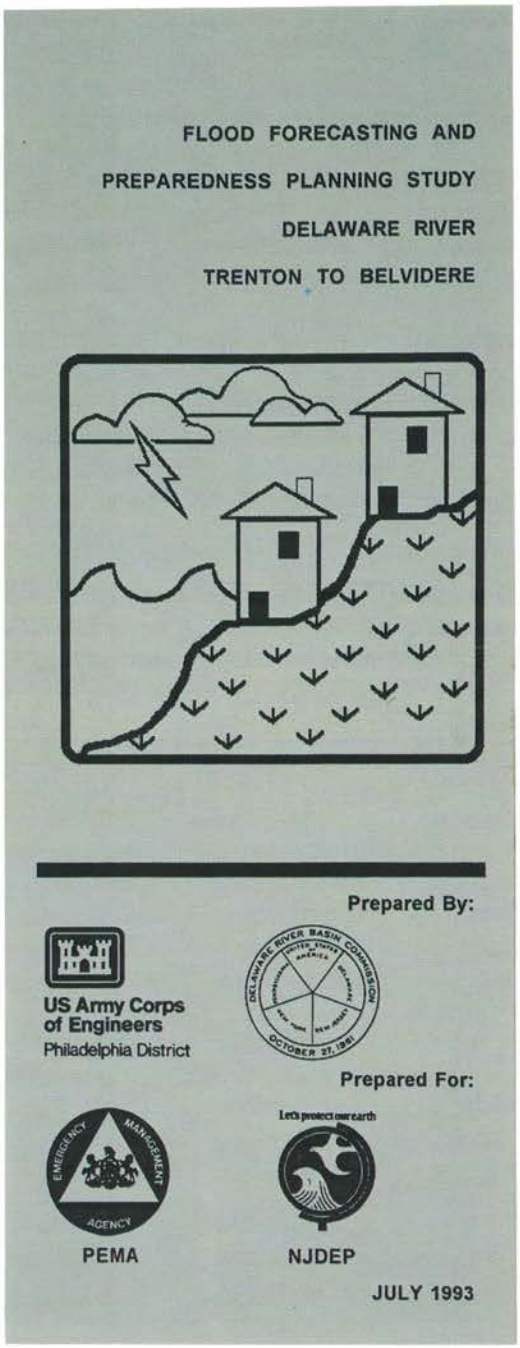
Flood stages were mapped at four-foot intervals for the segment of the river between Trenton and Belvidere, N.J. - a distance of approximately 65 miles. Thirty maps were produced at a scale of one inch equals 400 feet. Mapping for the reach of the Delaware between Trenton and Scudders Falls (River Mile 139.5) was completed by the Corps of Engineers in 1990. The remaining maps through River Mile 198 were completed by the Commission.

The maps make use of topographic mapping and aerial photography completed during the Corps' "Delaware Basin Study" of 1984. They relate flood inundation areas to flood crest forecasts prepared by the National Weather Service. The forecasts are broadcast over NOAA weather radio and communication networks maintained at county and state emergency operations centers.

Flood stage forecast maps can provide emergency personnel with an overview of potential flooding and evacuation needs prior to a flood event. The maps can be digitized for inclusion with computerized information systems at the emergency operations centers in the basin states. The availability of this information can improve communications and coordination of emergency response during flood events.

High Delaware River flows of March 31 and April 1, 1993 provided an opportunity to check the maps at spot locations along the river between New Hope, Pa. and Trenton. Observed flood areas were compared to those shown on the maps and revisions were made to the maps where there were differences. Overall, the maps provided a good indication of where flooding occurred for the observed stages.

Prints of the maps and a brochure describing their use are available. Contact the Commission or the Corps of Engineers, Philadelphia District, for information.



Ice chokes the Delaware River at Port Jervis, N.Y. in February of 1981 after the river rose 14.5 feet in one hour. The river's surface in the area depicted above is estimated to be 20 feet below the ice formation.

Rapidly rising waters heaved huge slabs of ice into Port Jervis during the 1981 flood. The ice punched through cinderblock and brick walls destroying or seriously damaging many structures. *(Courtesy of the Minisink Valley Historical Society, Port Jervis, N.Y.; photos by R.G. Tarbell)*

Ice Jam Flooding

Flooding from ice jams has caused death and destruction along some reaches of the Delaware River. In February of 1981, ice lodged against Mashipacong and Thirsty Deer Islands downstream of Port Jervis, N.Y. creating a frozen dam which backed up the river, its level rising 14.5 feet in one hour. Huge blocks of ice were forced over the river's banks, causing $15 million in damage (1981 dollars) and claiming one life.

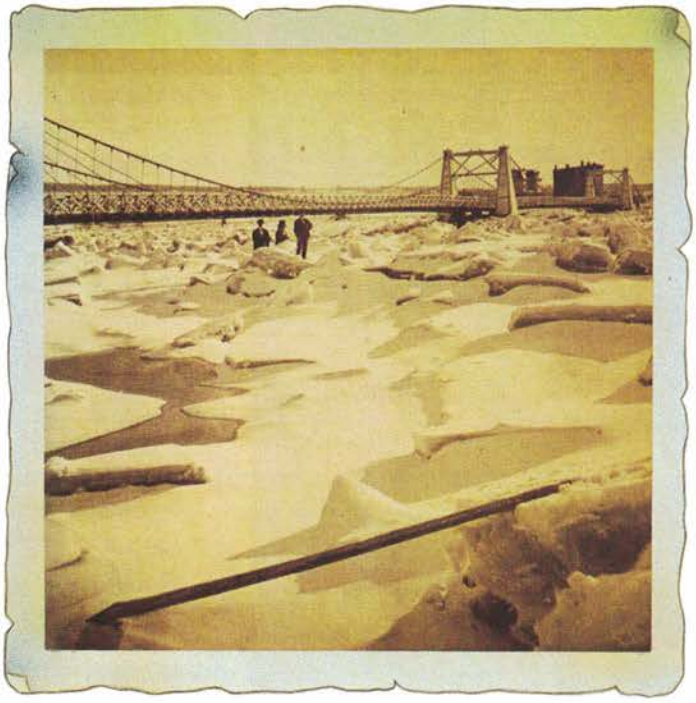
As a result of the flooding, the Commission, through Congress, requested that the U.S. Army Corps of Engineers conduct a study of the problem. The Commission later agreed to act as the project's sponsor after the Corps indicated that the creation of an ice diversion channel on Mashipacong Island was environmentally sound and economically feasible.

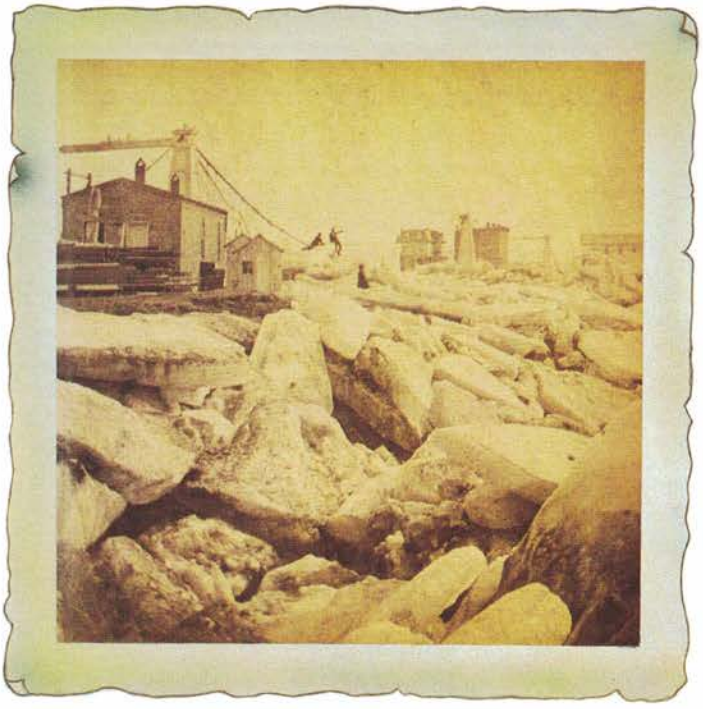
The ice escape chute would be created by clearing trees along a 200-foot wide path along the island's back channel.

Local cooperation agreements needed to secure funding for the project have been signed and the New Jersey Department of Environmental Protection and Energy has issued the necessary stream encroachment and freshwater wetland permits. Contracts for surveying, appraisals and title insurance for easements within the project right-of-way were awarded in 1993.

Acquisition of the easements is expected to take place the following year. The Corps then will finalize project plans and specifications and advertise to contract for the tree-clearing work and creation of a freshwater wetland mitigation area.

Annual maintenance of the project will be performed by Matamoras Borough and Westfall Township in Pennsylvania and the City of Port Jervis. The maintenance will mainly consist of continuing to clear trees greater than four inches in diameter and insuring that an access road to Mashipacong Island is accessible to maintenance vehicles.





Three men, one in a top hat, test the ice on the Delaware River off Port Jervis, N.Y. on February 27, 1875. The Barrett Bridge, linking New York and Pennsylvania, is in the background. A month later rising waters shattered the river's frozen mantle. Large chunks of ice broke free, battering the bridge until parts of the span fell into the river. The photo at right, taken at a slightly different angle, shows the damage; the suspension cables holding the decking which dangles between the still standing towers. *(Photo at left by Elias P. Masterson, Port Jervis, N.Y.; at right by Loudolph Hensel, Port Jervis and Hawley, Pa. Photos courtesy of David J. Wood, Milford, Pa.)*

A Canada goose explores the watery grounds of Washington Crossing State Park where floodwaters on April 2, 1993 put a halt to the popular pastime of viewing the Delaware River from the park's benches. *(Photo by Chris Roberts)*

Spring Floods: Reservoirs Help Out

Heavy rains fell in late March and early April of 1993 as warming temperatures melted heavy snowpack in the upper basin, causing some streams and rivers to top their banks. But the flooding would have been worse if not for basin reservoirs which captured billions of gallons of runoff.

The Delaware River crested on April 2 at 18.65 feet at Trenton, 1.35 feet below the official flood stage of 20 feet. The high water resulted in the flooding of stretches of River Road in Bucks County, Pa. and backed up water in tributaries feeding the river.

The April 2 stage was the highest at Trenton since March 16, 1986 when the river crested at 20.21 feet.

Flooding also occurred on the Christina River in Delaware, the Lehigh River at Walnutport and the West Branch of the Delaware at Hale Eddy.

Runoff into New York City's three Catskill Mountain reservoirs located at the headwaters of the Delaware increased by

some 46 billion gallons during the period from March 28 to April 3. It is estimated that the reservoirs captured enough water to reduce the April 2 crest by about one foot at Trenton and two feet upstream at Riegelsville.

On the Lehigh, the F. E. Walter and Beltzville reservoirs reduced the stage at Walnutport by approximately 0.7 feet, holding the observed crest to 8.0 feet - just equal to flood stage.

Heavy rain also caused the Lehigh to rise on April 10-11. Available storage capacity in the F. E. Walter and Beltzville impoundments reduced the crest at Lehighton by about 2.3 feet and at Walnutport by some 1.8 feet. In both cases crests would have been above flood stage without the reservoirs - 0.4 feet above at Lehighton and 1.8 feet above at Walnutport.

Flooding also occurred on November 28 as the result of a storm that dumped up to four inches of rain in some parts of the basin, causing the Assunpink, Neshaminy and Perkiomen Creeks to top their banks. In addition, unusually high tides, influenced by a full moon and strong southeasterly winds, caused flooding on some Delaware River tributary streams in southern New Jersey.

A week later another storm passed over the basin, causing widespread flooding since the soil was still saturated from the previous week's rain. These streams and rivers crested above flood stage on December 5: the Perkiomen, 3.65 feet above at Graterford; the Brandywine, 2.63 feet above at Chadds Ford; the Neshaminy, 2.92 feet above at Langhorne; the Schuylkill, 1.41 feet above at Philadelphia; and the Christina, 2.2 feet above at Cooch's Bridge, located just south of Newark, Del.

The Delaware River, left, shown on April 2, 1993 when it crested at 110,000 cubic feet per second (cfs) at Trenton. The same reach of river photographed on September 2, 1993 is shown at right when the flow was 2,930 cfs. The flow at Trenton during the height of the record 1955 flood was 329,000 cfs. *(Photos by Chris Roberts)*

Water Conservation: Facing Up to Reality

Water conservation programs often are associated with water shortages caused by temporary weather conditions like droughts. In Cape May County, N.J., water conservation is a year-round endeavor aimed at tackling a problem that refuses to go away.

Notes Ed Lightcap, former chairman of the Southern Cape Regional Water Advisory Commission: "We are presently pumping water out of the ground faster than it is being replenished. As a result, we are rapidly depleting our major freshwater supplies . . ."

Water supply problems are especially critical in the southern portion of the county where saltwater encroachment is occurring in both the shallow and deeper aquifer systems because increased withdrawals from water supply wells have caused groundwater levels to drop well below sea level. This has caused the abandonment and sealing of many formerly productive freshwater wells.

The number of permanent residents in the county has grown to about 100,000. This number is expected to increase to over 150,000 during the next 50 years. Of greater concern is the summer population, estimated at more than 500,000. This figure is projected to approach 650,000 over the same period.

Recognizing that the county faces serious problems, the Southern Cape Regional Water Advisory Commission (SCRWAC), local water purveyors, and city and county officials are actively working together to develop regional plans for the county's water supplies.

The SCRWAC was formed by the various municipalities in southern Cape May County. According to Mr. Lightcap, two things are needed:

- An aggressive conservation program already in place must continue in an effort to reduce the amount of water withdrawn from the county's freshwater aquifer system;

- New sources of freshwater must be developed.

The water conservation initiatives have produced some impressive results:

- The Cape May Water Utility (CMWU) was able to reduce its unaccounted-for losses (through leakage, evaporation, etc.) from about 7% in the mid 1980s to about 2% in 1990.

- The CMWU has adopted a seasonal rate structure whereby customers are charged a much higher rate during peak use periods, such as the summer when outdoor evaporative losses are high.

- The CMWU and the Lower Township MUA (Municipal Utilities Authority) sell directly to any of their customers low flow plumbing devices at wholesale prices.

- The CMWU provides at no cost water audits and consultation to large hotels, motels, restaurants and bars.

- The City of Cape May, the Borough of West Cape May, and the Lower Township MUA passed specific ordinances to conserve water by restricting water use during spring and summer months.

- During 1992 the City of Cape May retrofitted all municipal buildings with low flow toilets, showerheads, and faucets. According to David Carrick, superintendent of the City Water and Sewer Utility, the city saved over $15,000 on its water bill the next year.

- The Cape May County Chamber of Commerce started an awards program honoring two businesses each year at its annual dinner meeting for doing an outstanding job of conserving water.

- The City of Cape May has developed a demonstration garden in which drought resistant plants are featured. In response, gardening clubs in Cape May Point and Lower Township are incorporating water-saving ideas into their own community gardens.

- Several other programs and initiatives have been started over the past several years to conserve water (e.g., planning and zoning laws, use of rain barrels, county mulch programs).

Additional activities are planned for the near future. They include:

- The SCRWAC and water purveyors have initiated discussions with area schools in an effort to educate youth about the need to conserve water.

- The City of Cape May has agreed to retrofit all public housing units with low flow plumbing fixtures.

- Cape May County is planning to reduce outdoor water waste in all county facilities. The Board of Chosen Freeholders has agreed to retrofit all county buildings with conservation plumbing devices.

- The SCRWAC has developed water conservation table placards, and bathroom signs, which are being distributed by purveyors to Cape May's 75-plus restaurants.

"If we all make a conscious effort to conserve water, we can help guarantee a sufficient water supply in the future," says Mr. Lightcap. "Each of us can make a difference. It really is our duty as a responsible generation to do what we can to preserve this precious resource as long as possible so our children and their children will have a reliable supply of reasonably priced water."

Spray from a water cannon, above, evaporates in the air while irrigating a turf farm in southern New Jersey. Below, a farmer tends to a pipe feeding his drip irrigation system which directs water to the roots of the plants, virtually eliminating evaporative losses. *(Photo at top by Jeff Featherstone)*

Learning From Others

The Commission continued its efforts in 1993 to promote water conservation by example.

This time it picked the brains of agricultural experts in an effort to publicize ways to cut down on water use in crop irrigation.

As part of the annual meeting of the Vegetable Growers Association of New Jersey, Inc. held in Atlantic City in January, the Commission held a session titled, "Irrigation Water Conservation and Management."

The session focused on:

- water conserving irrigation equipment and maintenance techniques;
- cost savings through drip irrigation;
- irrigation efficiency through system evaluation and maintenance;
- desired application quantities; and
- sources of funding to cost share the installation of soil and water conservation practices on agricultural lands.

Speakers included Gary Clark, extension specialist in agricultural engineering at the University of Florida's Gulf Coast Research and Education Center; Craig Storlie, extension specialist in agricultural engineering, Rutgers University Research and Development Center; and Samuel R. Race, executive secretary, State Soil Conservation Committee, New Jersey Department of Agriculture.

Gerald Hansler, the DRBC's executive director, spoke about the Commission's mission and its role in water conservation.

Such technology transfer sessions enable representatives of business and industry to trade information on how they save water through conservation programs at their own facilities. The Commission has sponsored previous sessions with representatives of the pulp and paper, chemical and pharmaceutical, and commercial landscaping sectors. It also co-sponsored a conference on water pricing rate structures which promote conservation.

Free copies of the proceedings of the "Irrigation Water Conservation and Management" session are available from the Commission.

Taking on City Hall

In 1992, the City of Cape May was asked to pay the city's Water and Sewer Utility for the water it used in its public buildings.

In an effort to conserve and reduce the bill, City Council decided to retrofit all public buildings with low flow plumbing fixtures at a cost of about $20,000.

This involved City Hall, the Lifeguard Headquarters, Convention Hall, the City Welcome Center, the City Library, the Civic Center, the Fire House, the Historic House, the Chamber of Commerce Bus Depot, the Public Works Facility, and seven public restrooms. Installed as replacements were 57 toilets (1.6 gallons per flush), 15 urinals (.5 gallons per flush) and 45 metered faucets.

In the first two quarters of 1992, before the retrofitting began, these facilities used 1,654,000 gallons of water. In the first two quarters of 1993, after the retrofitting, the facilities used only 999,000 gallons of water.

This amounts to a savings of 655,000 gallons or a 39.6% decrease in water use.

For the entire year of 1992 the city used 4,610,000 gallons of water in its public buildings at a cost of $37,156. In 1993, only 2,687,000 gallons were consumed, costing $21,657.

In all, 1,923,000 gallons were saved netting a 41.7% decrease in water use and financial rewards of $15,499.

That's close to the $20,000 the city spent in the first place on the low flow plumbing fixtures.

By the time you read this the fixtures should be paid for and the savings will continue to flow in.

Easy on the Water

Mr. and Mrs. Julius Hober own the Coachman's Inn and Rusty Nail Lounge in Cape May, N.J.

Some years ago they realized that their sewer and water bills were eating into their profits.

So, in 1988 they installed low flow shower heads and faucet restrictors in the inn. A year later they replaced an old dishwasher in the restaurant. Then in 1992 they replaced every toilet in the inn and restaurant with low flow 1.6 gallon per flush models.

David A. Carrick, superintendent of the city's Water and Sewer Utility, estimates the Hobers reduced their water and sewer bills by $10,000 from 1987 to 1992.

Perhaps that explains why some of the regulars at the Rusty Nail are now in the habit of ordering their drinks "with just a little splash of water, please."

Water Quality: Controlling Toxic Pollutants

The Delaware Estuary Toxics Management Program completed one of its major goals in 1993: development of procedures to establish wasteload allocations and effluent limitations for toxic pollutants contained in wastewater discharged directly to the estuary.

The effluent limitations and wasteload allocations would be included in discharge permits for both industrial and municipal facilities along the tidal portion of the river.

The procedures are designed to address the acute and chronic toxicity to aquatic life and the potential for effects on humans through ingestion of water and resident fish and shellfish.

Acute toxicity refers to short-term effects on the survival of free-swimming, drifting and benthic aquatic organisms. Chronic toxicity includes longer-term effects on the survival, growth and reproduction of aquatic organisms. The combined effects of toxic chemicals on aquatic life also are addressed through the use of toxicity tests.

With respect to human health, the procedures address controls to minimize the promotion and induction of carcinogenicity, and to prevent the occurrence of non-carcinogenic or systemic effects by specific chemicals.

The concept of Total Maximum Daily Loads (TMDLs), the maximum daily loading of a pollutant from all sources which still assures that water quality criteria are not exceeded, was used in developing the implementation procedures. The federal Clean Water Act requires states to identify those waters for which existing controls are not stringent enough to meet water quality standards, and develop TMDLs for those waters on a priority basis.

Several of the implementation procedures rely on mathematical models of the estuary to predict the instream concentration of a toxic pollutant under various hydrological conditions (such as river flow and tidal stage) and loadings in wastewater sources. One is a tidal version of the Cornell Mixing Zone (CORMIX) models which will be used to evaluate and appropriately size the area where wastewater effluent initially mixes with the river. These areas will be minimized to assure the protection of critical aquatic habitat, prevent lethal conditions near the discharges, and allow for a zone of passage for drifting aquatic organisms such as plankton, and free-swimming organisms like the white perch and American shad.

A far-field, one-dimensional model of the estuary from Trenton, N.J. to Artificial Island at the head of Delaware Bay will be used to control chronic toxicity to aquatic life and potential impacts on human health due

The 46-foot "Delaware" motors out to the Delaware Estuary to conduct sediment sampling for toxics. The boat, owned by the Delaware Department of Natural Resources and Environmental Control, has been used for water quality monitoring work on the river and bay since 1969 under a joint venture with the Commission. *(Photo by Tom Fikslin)*

to extended exposure to toxic pollutants. This model will be used to predict the transport and fate of two groups of pollutants which have the greatest potential to impact aquatic life and human health. Several metals and volatile organic chemicals are targeted for the development of wasteload allocations using this model.

A report on a study of the occurrence and distribution of toxic metals and organic chemicals also was completed in 1993.Titled, "Sediment Contaminants of the Delaware River Estuary," it is available at no charge from the Commission.

Toxic pollutants in the sediment are a special concern because of their impact on organisms which are in contact with the river bed such as shellfish and bottom-feeding fish. Additionally, pollutants may be reintroduced into the water as a result of re-suspension of the sediments by tidal or freshwater inflows.

Sediment samples were collected at twelve sites between Trenton and Artificial Island and analyzed for metals, chlorinated pesticides such as DDT, PCBs, and polynuclear aromatic hydrocarbons (PAHs). The highest concentration of most pollutants occurred in the vicinity of Philadelphia. The levels of lead, cadmium, zinc, DDT, dieldrin and several PAHs exceeded levels which were reported by the National Oceanic and Atmospheric Administration to be lethal to aquatic organisms inhabiting the sediment.

Water quality criteria for the Delaware Estuary have already been developed as part of the program and were presented at a public briefing held in June of 1992.

The Commission plans to hold public hearings in 1994 on proposed regulations which will incorporate the water quality criteria and implementation procedures for establishing the wasteload allocations and effluent limitations. Formal adoption by the Commission would follow evaluation of the comments received at the hearings.

The Delaware Estuary Toxics Management Program, coordinated by the Commission, is an interstate cooperative effort involving the states of Delaware, New Jersey and Pennsylvania and the U.S. Environmental Protection Agency.

Ron Rulon, a sanitary engineer in the Commission's water quality implementation section, cleans sediment sampling equipment onboard the "Delaware." A device with a clamshell bucket is lowered to the river bottom where it scoops up sediment to be analyzed for toxic metals and organic chemicals. Philadelphia is in the background. *(Photo by Tom Fikslin)*

Controlling Non-Point Source Pollutants

The Commission held public hearings in June of 1993 to receive comments on proposed regulations which would establish controls for non-point source pollutants.

The proposed amendments to the Commission's existing water quality regulations are designed to further protect high water quality in basin waterways which are designated as "Special Protection Waters."

In December of 1992, the Commission adopted a regulatory package which created the Special Protection Waters classification to prevent water quality degradation in certain streams and rivers in the basin considered to have "exceptionally high scenic, recreational, ecological or water supply values . . ."

The regulations were first applied to a 125-mile reach of the Delaware River from Hancock, N.Y. downstream to the Delaware Water Gap, including both the Upper and Middle Delaware Scenic and Recreational Rivers and an eight-mile reach between Millrift and Milford, Pa. Tributary reaches located within the boundaries of the Delaware Water Gap National Recreation Area and the Upper Delaware Scenic River corridor also were included.

These regulations, however, did not cover non-point source pollutants, found in runoff that washes into streams and rivers, especially after heavy rains. Proposed regulations to address the non-point source issue were the subject of the public hearings, held June 16 in Wilmington, Del. and June 22 in Matamoras, Pa.

The hearing record was held open for 60 days, closing on August 23, 1993. There were 93 responses to the draft regulations, including comments from local, state and federal governmental agencies, sportsmen, business and environmental organizations, and individual citizens.

A response document to address both comments made at the hearings and written statements submitted to the Commission was being finalized at year's end and was expected to be submitted to the commissioners in early 1994.

Although the regulations approved in 1992 initially affected only the Middle and Upper Delaware, they, along with the pending non-point source regulations, could be applied to other basin waterways meeting Special Protection Waters' criteria.

The Commission will consider nomination petitions from local, state and federal agencies and the public calling for the designation of Special Protection Waters in other parts of the watershed. Any proposal would involve further studies and public hearings on a case-by-case basis before Commission action could be taken.

The non-point source regulations as proposed at year's end:

- Address new non-point source pollutants on a project-by-project basis under the Commission's existing project review regulatory process and under the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) stormwater permitting regulations.

- Address new and existing non-point sources on a priority watershed basis with management plans being developed and implemented for high priority watersheds.

- Encourage the development and implementation of watershed non-point source plans on a voluntary basis in watersheds which are not considered high priority. A process to identify priority watersheds is included in the proposal.

In addition, projects would be subject to Commission review if the Commission's executive director determines they may generate increased non-point source pollution loads which could have a substantial impact on Special Protection Waters.

The proposed regulations, once adopted, also would apply to the 125-mile reach of the Delaware River from Hancock, N.Y. to the Delaware Water Gap.

The regulations adopted in December of 1992 discourage, but do not ban, direct discharges of wastewater to Special Protection waterways, stipulating that "no new or expanded wastewater discharges or expansions of existing discharges shall be permitted in waters classified as Special Protection Waters until all non-discharge/load reduction alternatives have been fully evaluated and rejected because of technical and/or financial infeasibility."

Non-discharge alternatives include natural systems like spray irrigation where treated wastewater is applied to the ground, floating aquatic plant systems, and filtering wetland systems.

The regulations also require, with possible exceptions, that:

- The minimum level of wastewater treatment for all new and expanding wastewater treatment projects discharging to Special Protection Waters, including projects approved by the Commission after September 1988, will be "Best Demonstrable Technology," including ultraviolet light disinfection or an equivalent disinfection process that results in no harm to aquatic life, does not produce toxic chemical residuals, and results in effective bacterial and viral destruction. "Best Demonstrable Technology" as defined by the regulations represents a tertiary level of treatment including reduction in nutrients and high biochemical oxygen demand (BOD) removals.

- All wastewater treatment facilities discharging to Special Protection Waters shall have available standby power facilities and facilities not staffed 24 hours every day shall have a remote alarm to continuously monitor plant operations whenever the plant is not staffed and alert a person in authority if there is a malfunction.

The regulations also tighten the review threshold for new industrial and municipal wastewater treatment plants discharging to Special Protection Waters, requiring plants designed to discharge a daily average rate of 10,000 gallons a day or more be subject to Commission review. In the rest of the basin, the Commission review threshold remains at 50,000 gallons a day or more.

In certain instances point source regulations for Special Protection Waters could be waived if it is demonstrated that the requirements are not necessary for the protection of the existing water quality due to the distance of a sewage treatment plant from those waters, the time of travel of the plant's effluent, the existence of water storage impoundments, the waste assimilation characteristics of the receiving stream, or other relevant hydrological and limnological factors.

In 1987, the Commission and the National Park Service began working on a water resources management plan to protect the high water quality within the Delaware Water Gap National Recreation Area. The plan was triggered by increasing land development, especially in the Poconos and an attendant increase in the number of wastewater treatment plants and a projected increase in non-point source pollutants. The management plan later was expanded to include the Upper Delaware Scenic River corridor.

The regulations passed in December of 1992, along with the proposed non-point source regulations, were developed with scientific and policy input from the Commission's Water Quality Advisory Committee, which includes representatives from the four basin states, the federal government, the academic and scientific communities and the public sector.

Richard Albert, DRBC supervising engineer, checks readings on a conductivity meter and a dissolved oxygen meter while doing water quality sampling work on Sawkill Creek near Milford, Pa. *(Photo by Elizabeth Johnson)*

Scenic Rivers Monitoring Program

Thirty-nine Delaware River sites and more than 50 tributary sites from Hancock, N.Y. to the Delaware Water Gap were monitored for water quality parameters during the summer of 1993 as part of the Scenic Rivers Monitoring Program conducted by the Commission and the National Park Service. Included were pH, dissolved oxygen, water and air temperature, conductivity, and bacteria.

Macroinvertebrates were sampled at 14 of the river sites.

Twenty-two of the tributaries also were monitored for flow to develop and maintain water surface elevation and flow relationships. Precipitation and flow data are used in combination with water quality data to determine variations in water quality during dry and wet weather.

Most of the water quality and flow monitoring sites are located within the Delaware Water Gap National Recreation Area and the Upper Delaware Scenic and Recreational River.

In addition, 32 river and 36 tributary sites were monitored under a special program designed to collect data necessary for calibration and vertification of a Delaware River water quality model.

The data included stream flows, total Kjeldahl nitrogen (TKN), nitrite plus nitrate, ammonia plus ammonium, total phosphorus, total

A water quality sonde, which measures temperature, conductivity, dissolved oxygen, ammonia, pH, turbidity, and copper and/or nitrates, is about to be submerged into the waters of Sawkill Creek. Holding the instrument is Warren Huff, DRBC water resources planner. Elizabeth Johnson, chief of research and resource planning at the Delaware Water Gap National Recreation Area, looks on. The sonde analyzes the water as it passes the end of electronic probes. The data is then stored in a computer. *(Photo by Richard Albert)*

ortho-phosphate, five-day biochemical oxygen demand (BOD_5), total dissolved solids (TDS), total suspended solids (TSS), and fecal coliform bacteria.

In all, more than 900 sites were sampled from May through September.

The water quality model will be used to assess potential impacts to the river from both man-induced and natural sources. Pollutant transport and assimilation from Hancock to the Gap will be simulated by the model under various pollutant-discharge and river flow conditions.

Since May of 1993, more than 300,000 U.S.G.S. flow data were analyzed for the development of a flow model for the same stretch of the river. This model is not only a vital step for the calibration of the water quality model but will facilitate the planning and implementation of remedial strategies for hazardous spills along this reach of the river.

New Monitoring Equipment Tested

The Commission and the Park Service entered into an agreement in April of 1993 to evaluate state-of-the-art water quality monitoring equipment in the Delaware Water Gap National Recreation Area.

The computerized equipment was tested for use as part of a round-the-clock surveillance mechanism for monitoring and comparing existing water quality against newly developed water quality standards.

Unlike traditional monitoring where samples are collected in the field and analyzed in a laboratory, the equipment being evaluated stores water quality data in an onboard computer. A technician visiting the sampling site then downloads the data into a portable computer making the data available for immediate examination.

The study, conducted under the Park Service's Challenge Cost-Share Program, tested the reliability, durability, and ease of use of the equipment. Electronic probes that measure water temperature, dissolved oxygen, pH, conductivity, turbidity, ammonium, nitrate and copper were tested in conjunction with monitoring equipment which measured water depth. The depth measurements were correlated to water surface elevation and water flow relationships.

Water quality data were recorded from June through November at a site on the Sawkill Creek in Milford, Pa. Water depth data were recorded from July through November at the same site. Precipitation data were obtained from a National Atmospheric Deposition Program monitoring station that is maintained by the U.S. Forest Service within the Sawkill Watershed. The precipitation data provided a continuous record of the duration of storms and rainfall totals.

Many electrical and mechanical problems were encountered forcing unanticipated delays in the program. However, the water quality data that were collected will be associated with stream flows and precipitation events to determine runoff effects on the stream's water quality.

CSO Study

Commission staff has completed data collection on the physical characteristics, historical water quality, and flow amounts for the approximately 270 combined sewer overflow (CSO) discharge points along the Delaware Estuary.

Combined sewer overflows are a nationwide problem for waterways bordered by older urban development. These sewer systems which collect sanitary sewage and industrial wastewater for delivery to wastewater treatment plants are designed to also collect stormwater runoff from streets and parking lots.

When it rains, the volume of combined sanitary sewage, industrial wastewater and stormwater runoff often is too great for the treatment plant to handle, resulting in a bypass directly into a waterway. Some discharges also occur during dry weather because gates which divert the waste to the river or stream during storm events get stuck in the open position.

Water quality for the estuary and its tributaries was monitored following a major storm event in 1993. The Delaware Department of Natural

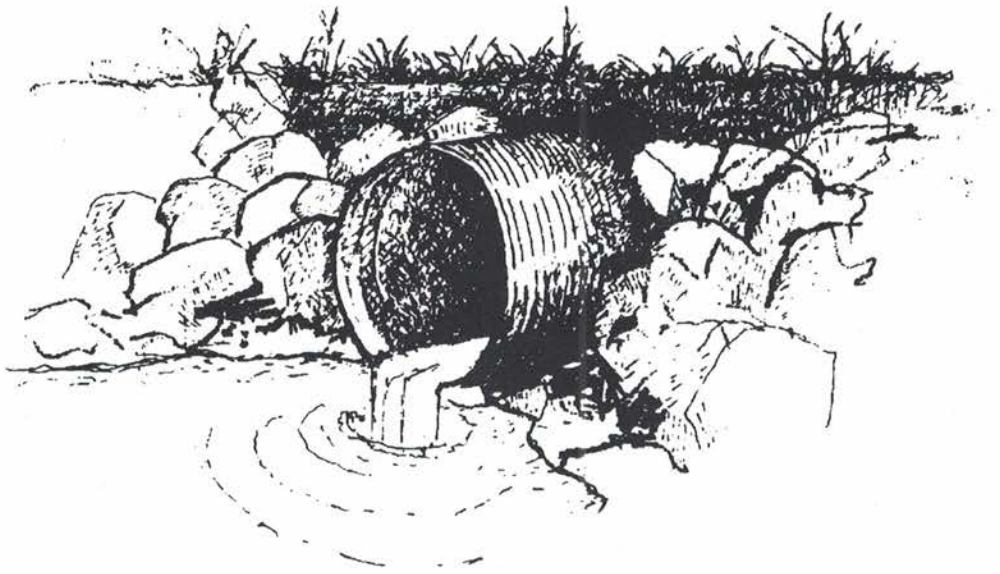
Resources and Environmental Control conducted boat run sampling of the estuary and provided analysis of the data. Sampling of the tributaries was conducted by staff of the CSO owners, including the cities of Philadelphia and Camden.

All data have been used by the New Jersey Department of Environmental Protection and Energy as input into stormwater models, which evaluate groups of CSOs. Department personnel will train CSO owners and Commission staff on the use of the stormwater models, which will allow development of cost-effective means to minimize CSO pollution.

The CSO study requires the use of a computer model to predict the impact of CSO loads. The current model used by Commission staff and others to predict water quality is the Delaware Dynamic Estuary Model (DEM).

As the wastewater treatment plants along the estuary have upgraded levels of pollutant removals, the concentrations of dissolved oxygen (DO) have improved dramatically. Recent measurements of estuary DO suggest that the DEM has under-predicted the values of DO concentrations for summer, low-flow conditions in recent years. It is unknown whether recalibration is needed to reflect current, possibly changed, sediment decay rate coefficients, whether other factors are involved and require incorporation into the DEM, or whether a different model is needed.

The U.S. Environmental Protection Agency, Region II, awarded the Commission an amendment to its CSO study grant to oversee and fund an investigation of the DEM model. After advertising for submission of qualifications, the Commission selected four consulting firms to submit proposals for the model's re-evaluation. A contract is expected to be awarded in early 1994.



Low Reservoir Levels Trigger Drought Warning

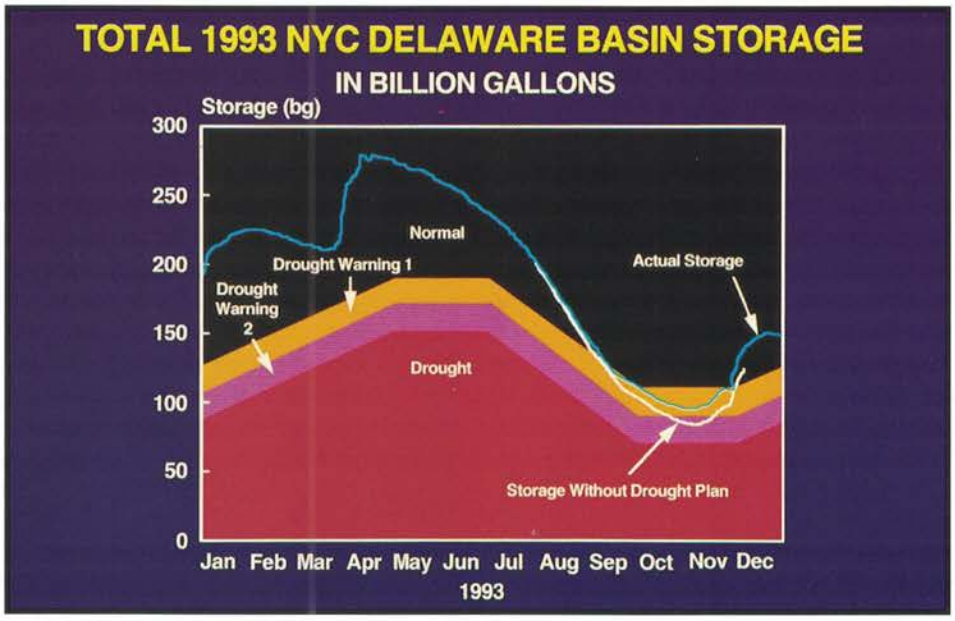
The Delaware River Basin had its share of unsettling weather in 1993: a March blizzard, April floods, then bone dry conditions up north in May and through most of the summer.

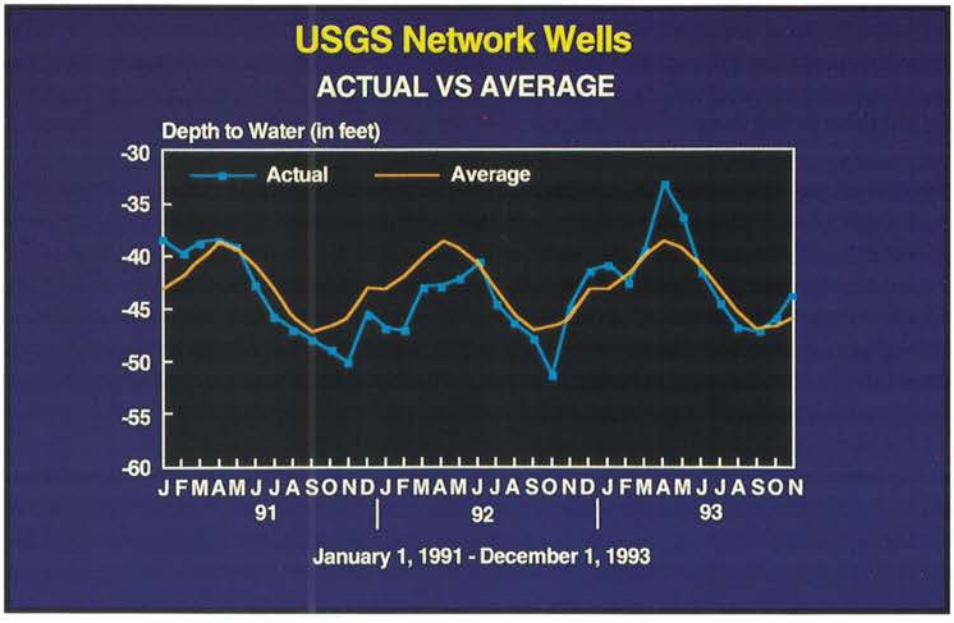
The three major water supply reservoirs in the upper basin spilled on April 11 as the result of runoff from persistent rain and melting snow. But only a little more than an inch of precipitation fell in May and on May 11 storage levels dropped below normal and continued to fall. By September 21 the basin was in drought warning, the seventh in the past 12 years.

The reservoirs, Pepacton, Neversink and Cannonsville, held only 116 billion gallons of water (43 percent of capacity) on September 21 compared to normal seasonal storage of 190 billion gallons (70 percent of capacity). The impoundments hold 271 billion gallons of useable water when full and account for roughly 75 percent of the reservoir storage in the basin.

The drought warning lasted less than three months. Above average rainfall in the upper basin in October and November and powerful back to back weekend storms in late November helped increase storage in the three impoundments. On December 6 the drought warning was lifted.

When the Commission entered the warning in September, maximum withdrawal limits on out-of-basin water diversions to both New York City and central and northern New Jersey were automatically reduced by





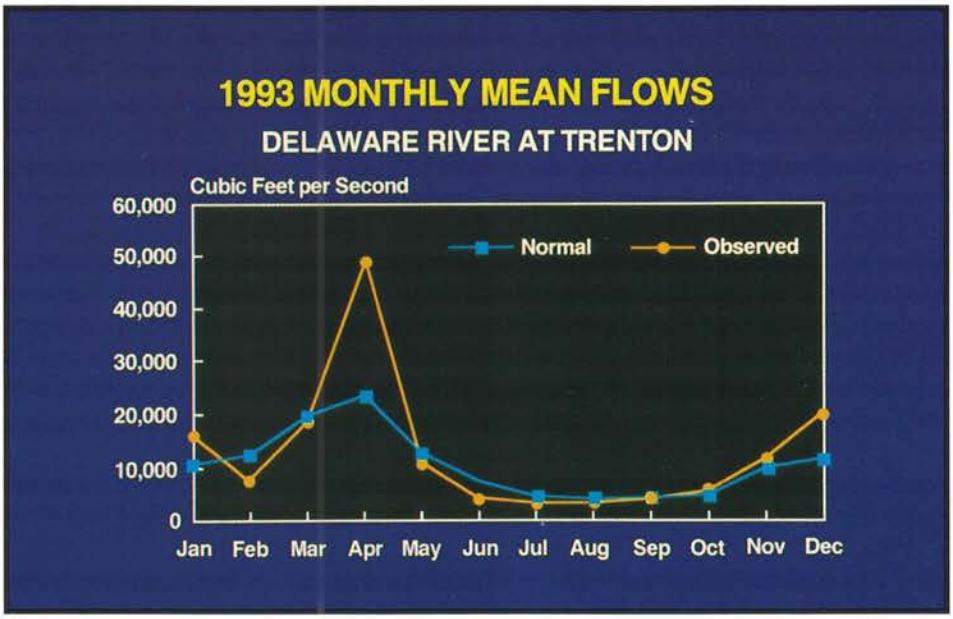
15 percent in an effort to conserve existing supplies. In all, 14 billion gallons of water were saved in reservoir storage as the result of drought management actions. Streamflow targets, which during dry periods are met by releasing water from reservoirs, also were reduced.

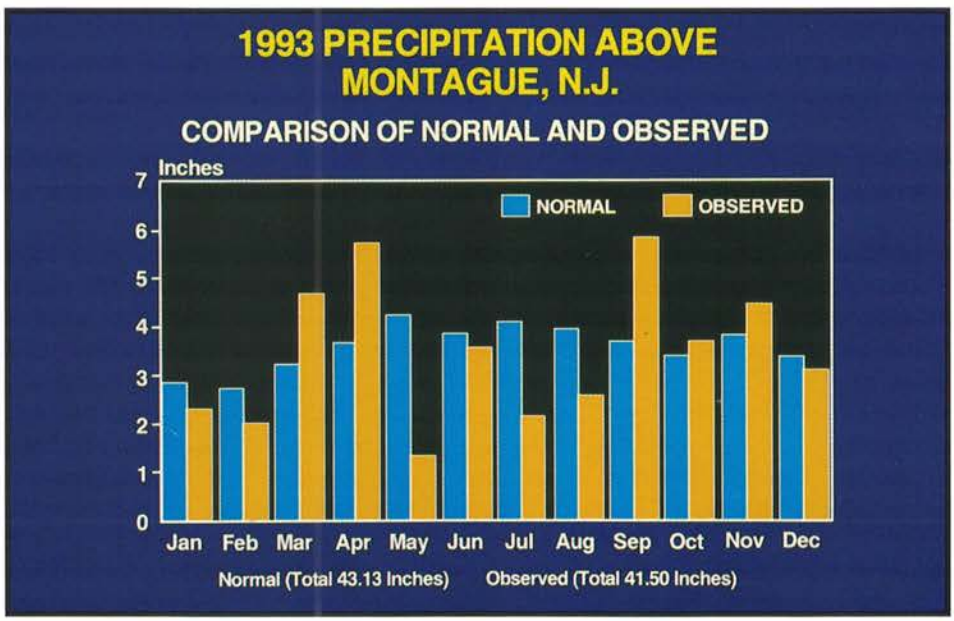
New York City, which lies outside the basin, draws roughly half its water via aqueducts from the Pepacton, Neversink and Cannonsville impoundments, located in the Catskill Mountains region of New York State.

New Jersey diverts water out-of-basin via the Delaware and Raritan Canal, which links the Delaware River just north of Trenton and the Raritan River in New Brunswick.

New York's allowable withdrawal from its three reservoirs was cut from 800 million gallons a day (mgd) to 680 mgd; New Jersey's from 100 mgd to 85 mgd. Also reduced was the minimum flow target of the Delaware River at Montague, N.J., dropping from 1,750 cubic feet per second (cfs) to 1,655 cfs.

Pursuant to a Commission resolution unanimously agreed to by the four basin states and New York City, the city must release sufficient water into the river from the three Catskill Mountain reservoirs to meet the Montague flow target. This flow augmentation combines with natural inflow and with releases from lower basin reservoirs to limit salinity intrusion in the Delaware estuary. If salty or brackish water advances too far upstream it can increase corrosion





control costs for surface water users and raise sodium levels in a large aquifer underlying southern New Jersey which is used for municipal water supply. The aquifer is recharged in part by the river.

The formula for normal reservoir diversions to New York City and the releases to the Delaware is contained in a 1954 U.S. Supreme Court decree which apportioned the waters of the Delaware for use by the city and the four basin states.

In 1961, the Delaware River Basin Compact, which created the Commission, became law. Under Article 3 of the compact, the Commission may modify the diversion and release formula to reflect hydrologic conditions not anticipated when the 40-year-old decree was issued as long as there is the unanimous consent of the five decree parties. The parties do not have to return to the court to make the changes.

Thus, through the compact, drought managers can avoid legal delays while gaining the flexibility to make modifications to the drought plan based on current hydrologic conditions throughout the basin.

Once the plan is implemented, the managers from the four basin states and New York City meet at least every 30 days to assess conditions and make mid-course adjustments if necessary.

They met the day after the latest warning was declared and added something to the plan: an emergency program which allowed the New York State Department of Environmental Conservation to make special releases to streams below the reservoirs to help protect the basin's cold water fishery.

Under the drought warning mode, the Commission called for voluntary non-essential water use reductions, encouraging residents to curtail such outdoor activities as lawn watering, non-commercial car washing, or hosing down driveways, patios or sidewalks - uses which can be highly evaporative.

Had conditions worsened a drought emergency could have been declared and mandatory water use restrictions would have most likely been imposed with a goal of reducing total consumptive water use by an average of at least 15 percent. The out-of-basin withdrawals by New York City and New Jersey also would have been further reduced, as would the Montague flow target.

In addition to releases from the three New York City reservoirs, 1.68 billion gallons of water were released over the summer from Beltzville Reservoir on the Lehigh River and Blue Marsh Reservoir on the Schuylkill River to augment flows, improve water quality and enhance fisheries.

The dry weather during the summer of 1993 prompted New York State officials to declare a drought alert on August 5 for the five boroughs of New York City and for Orange, Putnam, Westchester, Dutchess, Ulster, Sullivan and Delaware counties in the southeastern portion of the state. The officials urged public water suppliers to promote voluntary conservation and to review and update drought contingency plans. The alert was expanded to Greene, Schoharie and Otsego counties on October 7.

With reservoir levels still low, the alert was upgraded to a warning on November 10 for the city and the eleven counties with Environmental Conservation Commissioner Thomas C. Jorling noting: "While recent rainfalls have been in the normal range for this season, the water reserves have not sufficiently recovered from an exceedingly dry spring and early summer. Now, more than ever, New Yorkers should practice water conservation to ensure adequate supplies until the reservoirs are recharged next spring."

In Pennsylvania, the Department of Environmental Resources, in an August 9 news release, urged citizens to conserve water, noting that all 67 countries in the commonwealth had experienced below normal rainfall amounts over the previous three months.

The department declared a drought warning on September 22 for 17 counties either entirely or partially located within the Delaware River Basin - Berks, Bucks, Carbon, Chester, Delaware, Lackawanna, Lancaster, Lebanon, Lehigh, Luzerne, Monroe, Montgomery, Northampton, Philadelphia, Pike, Schuylkill and Wayne.

At least 12 public water suppliers in Pennsylvania located within the basin urged customers to practice either voluntary or mandatory water conservation.

The following counties in Pennsylvania fall entirely within the Delaware River Basin: Bucks, Delaware, Lehigh, Monroe, Montgomery, Northampon, Philadelphia, and Pike.

Pennsylvania counties that fall partially within the basin: Berks (99%), Carbon (99%), Chester (80%), Lackawanna, (9%), Lancaster (1%), Lebanon (5%), Luzerne (10%), Schuylkill (43%), and Wayne (96%).

The following New Jersey counties fall entirely within the basin: Cumberland, Salem and Warren.

Those partially in the basin: Atlantic (4%), Burlington (55%), Camden (50%), Cape May (33%), Gloucester (83%), Hunterdon (35%), Mercer (70%), Monmouth (25%), Morris (13%), Ocean (20%), and Sussex (67%).

There are no counties in New York State or Delaware which are completely in the basin.

New York counties partially in the basin: Broome (2%), Chenango (1%), Delaware (85%), Greene (2%), Orange (15%), Schoharie (1%), Sullivan (95%), and Ulster (15%).

Delaware counties partially in the basin: Kent (65%), New Castle (90%), and Sussex (20%).

The Delaware River at Trenton, N.J. on September 2, 1993 flowing at a lazy 2,930 cubic feet per second. The shot was taken from the Calhoun Street Bridge looking downstream. *(Photo by Chris Roberts)*

Foreign Intrigue

When foreign delegations of water resource management professionals come to the United States, they frequently request a visit to the Delaware River Basin Commission.

Two groups from the People's Republic of China, one from Bulgaria, and one from Slovakia made stops in 1993. They were eager to learn about the Commission's programs, and intrigued by the fact that five separate governmental bodies with their own sovereign powers can work together on an equal footing and accomplish so much.

The Chinese also were intrigued by Italian hoagies; the Bulgarians by Philly cheese steaks.

The U.S. Bureau of Reclamation's International Affairs Technical Services Office, Denver, Colo., acted as in-country hosts for the Chinese guests.

Zuo Shouting, left, an economist with the Henan Province Agricultural Development Project Management Office, and Su Jaming, senior engineer and deputy chief of the Henan Province Water Conservancy Bureau, atop the main dam at Merrill Creek Reservoir during a visit in November. *(Photo by Chris Roberts)*

The first group, including high level officials from China's State Planning Commission, Ministry of Water Resources, arrived in July for a two-day visit. They were looking for information which could help their country develop new water supply infrastructure, including a project to divert water 770 miles from the Yangtze River to the Hajho River Basin.

DRBC staff presentations focused on the Commission's multi-agency approach and its management on a watershed basis, underscoring the importance of public participation in the Commission's decision-making process. The Commission's water conservation initiatives also were outlined as an example of ways to reduce the need to build additional water supply projects.

The 21 Chinese visitors toured a sewage treatment plant in the Trenton suburbs as well as Merrill Creek Reservoir near Phillipsburg, N.J. A farewell picnic, featuring the hoagies "with all the works" was held on the banks of the Delaware at Washington Crossing State Park.

The second group of visitors, four engineers and an economist, all from Henan Province, arrived in November for a one day stopover, which again included staff presentations, question and answer sessions, and more hoagies. Study interests included ground water development and assessment, and operation and management of irrigation and drainage systems.

The Bulgarian visitors were interested in municipal water supply and sewerage system operations - financing, construction, and maintenance, especially the role that water conservation plays in each. The Slovakians, all high level water resource officials in different

ministries, were most interested in the Commission's institutional arrangement which coordinates a once fragmented approach to water resources management in the Delaware River Basin. Both of these countries are striving to sort out their water resources programs since the abandonment of their communistic forms of government.

Wei Changlin, above, team leader, Department of Rural Economy within China's State Planning Commission, and Liu Jihong, below, a department engineer, feast on Italian hoagies at a July farewell picnic on the banks of the Delaware River. *(Photos by Chris Roberts)*

In recent years the Commission also has hosted water resource engineers, professors, and high ranking government officials from Australia, Portugal, Sweden, Uruguay, India and Japan. And the Commission often is asked for help from government officials in this country who are working to establish institutional arrangements in an effort to solve interjurisdictional water disputes among bordering states.

Ground Water: Focusing on the Neshaminy

The Commission's Ground Water Advisory Committee recommended in late 1992 that the Commission consider funding a pilot water budget analysis within the Southeastern Pennsylvania Ground Water Protected Area. The Committee also recommended that water budget assessments be conducted on a periodic basis for critical watersheds to support the Commission's project review activities, particularly in dealing with applications for ground and surface water withdrawals.

Subsequently, the U.S. Geological Survey, in cooperation with the committee, prepared a proposal to develop a watershed assessment model for the Neshaminy Creek Basin in Bucks and Montgomery Counties in Pennsylvania. The model would be similar to that now used by the Chester County Water Resources Authority to manage water use.

By Resolution 93-4, adopted in February of 1993, the commissioners authorized a joint funding agreement with the U.S. Geological Survey for the Neshaminy study. The Commission's funding is being provided by Pennsylvania through the Ground Water Protected Area Program, which the Commission runs.

The resulting model will provide a means of comparing water use to base flow estimates for a range of hydrologic conditions in the Neshaminy Basin. The watershed has been divided into 14 sub-basins averaging 20 to 25 square miles each and defined primarily by the larger tributaries and branches to the Neshaminy. Withdrawals, discharges, allocations, depletive use, imports, exports and geology will be used to assess the water use conditions in each of the sub-basins.

Major outputs from the study will be a computer model showing the relationship between total water allocations and base flow available, and GIS data files and maps for comparing existing and proposed withdrawals with base flow estimates.

During 1993, the U.S.G.S. delineated and digitized geology and watershed boundaries for each of the 14 sub-basins and developed the data formats and file structure for the study. Work also began to determine the base flow estimates of the sub-basins using stream gauge records.

The Commission staff obtained and entered the water use and discharge data for the study. In addition to the Commission's own water use and allocation information, data were provided by numerous sources including the Pennsylvania Department of Environmental Resources, the Bucks and Montgomery County Planning Commissions, the Bucks County Health Department, and the many

water users and dischargers, both municipal and private, who responded to the staff's requests for information. This cooperation enabled the data gathering to proceed smoothly and is greatly appreciated.

During 1994, the U.S.G.S. will complete the watershed assessment model and develop the GIS data files.

Docket Renewal Period Extended

The Commission passed a resolution during 1993 to extend the renewal period of docket approvals for ground water withdrawals from five to ten years. It also imposed a ten year renewal time-frame on docket approvals for surface water withdrawals, which in the past had not been subject to mandatory periodic review.

The February 17 resolution, which became effective immediately, stipulates that docket approvals for both ground and surface water withdrawals will be a maximum of ten years. However, it provides for the approval period to be extended to a greater number of years if an applicant demonstrates to the satisfaction of the Commission the need for such an extension. This provision is intended to cover such situations as the bonding retirement period for large surface water projects like water treatment plants.

The regulation was crafted with the goal of achieving greater consistency in the review and processing of water withdrawal permits. It also recognizes that ground and surface water are interrelated and should be managed as a single system.

The Commission emphasized that it has the authority to require renewals for a period shorter than ten years if problems arise such as well interference, or overdrafting or over-allocation of a water resource. In fact, Commission staff can re-visit an approved project at any time.

In an effort to provide a level playing field among all ground water users, the Commission adopted a second resolution in August of 1993 to extend the expiration dates of existing ground water dockets and Southeastern Pennsylvania Ground Water Protected Area permits for a maximum of ten years.

Affected were dockets and permits issued prior to February 18, 1993. The extentions are for a maximum of ten years from the original date of issuance.

All applications for these extensions are subject to public notice and public hearing with their approval based on input from the four basin states, the recommendation of the Commission's executive director, and comments received at the public hearings.

The two new regulations were based on recommendations from the Commission's Ground Water Advisory Committee.

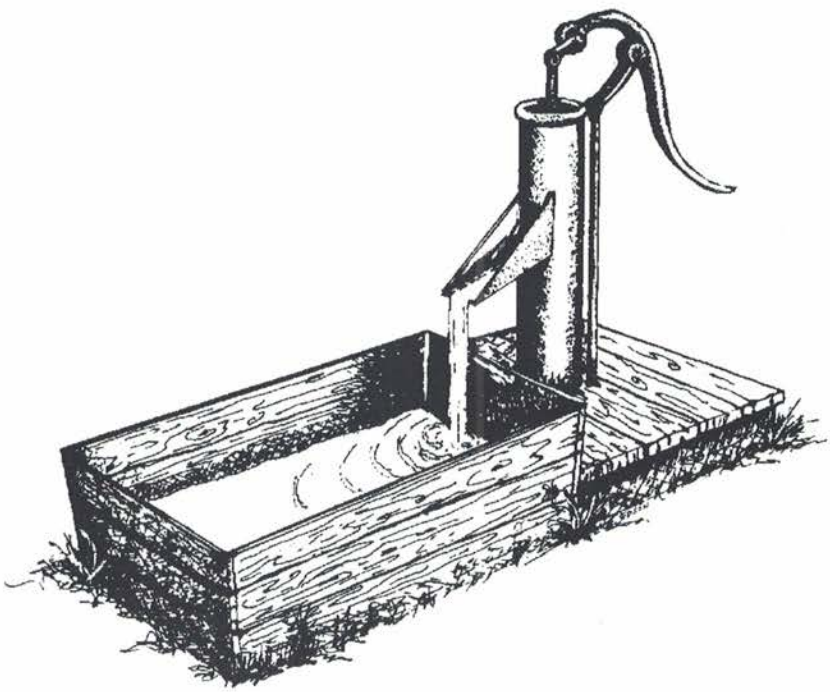
Ground Water Advisory Committee

The Commission's Ground Water Advisory Committee was created in 1982 to assist in the implementation of recommendations outlined in the Commission's Basinwide Ground Water Study. The final study report was presented to the Commission in December of that year.

Two major study recommendations, well registration and source metering of large ground water withdrawals, were adopted by the Commission in 1985 and 1986, respectively. After a period of inactivity, the committee was reconvened late in 1992 to develop additional recommendations for improved ground water management in the basin.

The committee consists of one member representing each of the signatory parties to the Commission and six public members. Since its inception, the committee has been chaired by David C. Yaeck, who recently retired from his post as executive director of the Chester County Water Resources Authority. At the request of the committee members and the Commission staff, Mr. Yaeck has agreed to continue to serve as committee chairman.

In late 1992 and 1993, the committee drafted two proposals concerning the renewal of dockets for both new and existing water withdrawals. As noted earlier, both proposals were adopted by the Commission in 1993. Also, the committee was instrumental in providing the impetus for the Commission to enter into an agreement with the U.S. Geological Survey for conducting the water management model for the Neshaminy Creek Basin in southeastern Pennsylvania. It is anticipated that the model will serve as a prototype for other areas in the basin.



Other Basin Highlights

Zeroing in on Consumptive Use

In 1992 the Commission adopted a regulation to require the review of electric generating or cogenerating facilities in the basin that are designed to consumptively use in excess of 100,000 gallons per day of water in any 30-day period.

The regulation became effective on Dec. 9, 1992, but its administration and enforcement was to be reviewed at the completion of a survey by Commission staff to identify other users with large consumptive losses that obtain their water from secondary sources.

Water that is used consumptively is permanently removed from the basin either through evaporation, evapotranspiration or through incorporation into a product via a manufacturing or bottling process. This is of concern to the Commission since large consumptive losses can significantly reduce stream flows and ground water levels, especially during droughts.

The regulation and survey were driven by plans to operate two cogeneration plants in southern New Jersey. Both plants were designed to obtain water from existing suppliers and not directly from ground or surface water sources.

The Commission historically has reviewed projects involving large ground or surface water withdrawals, but, until the new regulation was adopted in 1992, had not specifically addressed the oversight of any large consumptive users that purchased or obtained their water from secondary sources like municipal water companies or regional water supply authorities.

The survey was sent to 114 water purveyors distributing over one million gallons per day (mgd). It requested the purveyors to provide the names and addresses of customers with daily water usage of over one mgd. As of December 31, 1993, 112 of the purveyors had answered the survey.

Once Commission staff had reviewed the information, a second survey was sent to 167 customers identified as purchasing in excess of one mgd. By year's end, 83 had responded, with 30 industries indicating they exceeded the 100,000 gpd consumptive loss threshold. Of the 30, five are primarily self-supplied surface water users with Commission entitlements and three use Susquehanna River Basin water supplied by the Chester (Pa.) Water Authority.

Once the survey is completed and reviewed by the commissioners, the regulation may be reconsidered in the light of the relative impacts on non-power plant consumptive uses in addition to the consumptive use by electric generation and cogeneration plants.

Zebra Free in '93

The Delaware River Basin monitoring program for zebra mussels was expanded during the year with the help of various government agencies, industries and citizen volunteers.

No mussels were found.

Crew members aboard the U.S. Coast Guard buoy tender "Red Oak" joined the search, inspecting navigation buoys in the tidal river and bay for the pesky mollusks as part of their routine maintenance procedures.

In New Jersey, the Department of Environmental Protection and Energy set up an electronic bulletin board service to apprise water users of the statewide status of the monitoring efforts.

The mussels, which can clog water intakes and are expected to cost billions of dollars for industries, utilities and municipalities to control over the next decade, were introduced into the Great Lakes from Europe in the mid 1980s. They have since been spreading rapidly throughout the Midwest and eastern United States.

The Delaware Basin zebra mussel monitoring program was established in 1992 by the Pennsylvania Department of Environmental Resources with financial assistance from the Commission.

The USCGC "Red Oak"-- a new weapon in the zebra mussel search.
(Photo courtesy of the U.S. Coast Guard)

The Chesapeake Moves to Delaware

The Commission has donated $5,000 to help bring living science to the lower basin.

The money will help cover the cost of moving an elaborate biological model of the Chesapeake Bay from the Smithsonian Institution in Washington, D.C. to Glasgow High School in Newark, Del.

The $400,000 model, or mesocosm, measures 12 by 40 feet and will be housed in a greenhouse being built at the school. Containing 15,000 gallons of water, it represents eight major habitats in a bay and wetlands setting with some 400 species of plants and animals, including zooplankton, oysters, snails and killifish.

Salinity gradients and tidal cycles are simulated through the use of pumps, water reservoirs, a reverse osmosis apparatus, and wave buckets which are all timed to reflect seasonal cycles in the natural environment. Lamps, heaters, air conditioners, fans and sprinklers simulate meteorologic variables.

The Smithsonian, facing budget constraints, agreed to give the model to the high school, but there was a catch. The school would have to pay the estimated $50,000 to move and house it at the new location.

Once relocated, the mesocosm will be used by teachers, students and scientists from universities in the surrounding area to do research on ecosystems and on ways to better protect the environment.

Spreading the Word

Commission personnel, in an effort to stay abreast of current water-related issues, attend a number of conferences during the year, often giving presentations on Commission activities. The Commission also has a table-top display highlighting the agency's mission which it exhibits throughout the basin.

In 1993 the Commission co-sponsored three conferences relating to water resources management.

The first was the annual meeting of the Vegetable Growers' Association of New Jersey, Inc., held in January in Atlantic City. Part of the program, put together by the Commission's Water Conservation Advisory Committee, focused on irrigation methods which save water by cutting down on evaporative losses.

In June, the Commission co-hosted a Volunteer Monitoring Conference in Carlisle, Pa., contributing $1,000 to defray expenses.

The two-day event featured an array of speakers who detailed volunteer water quality monitoring programs in Pennsylvania and other states. The Commission supports such volunteer sampling efforts, recognizing that if quality assurance procedures are met the resultant data can augment existing monitoring data generated by the Commission and the basin states.

The Commission also co-sponsored a conference titled "Instream Flow

Management and the Clean Water Act" with the New Jersey, New York and Pennsylvania Sections of the American Water Resources Association. The event was held in October in Clinton, N.J.

The Commission's table-top exhibit was on display at the first two conferences, as well as these other events held in 1993:

April 22 - Earth Day celebration, New Jersey State Aquarium, Camden, N.J.

May 22 - Gloucester County Science Fair, Gloucester City, N.J.

July 25 - 3rd Annual Riverfest, Narrowsburg, N.Y.

September 5 - "Festuary," sponsored by the Delaware Estuary Program, Fort Mott, N.J.

October 3 - "Coast Day," College of Marine Studies, University of Delaware, Lewes, Del.

October 23 - Association of New Jersey Environmental Commissions (ANJEC) Fall Conference, Mt. Holly, N.J.

November 5 - Delaware River Greenway 4th Annual Forum, Washington Crossing, Pa.

The Commission Published the Following Reports in 1993:

Delaware River Basin Commission Annual Report 1992 (June)

Findings of the 1992 Scenic Rivers Water Quality Monitoring Program, Report No. 15 (March)

Sediment Contaminants of the Delaware River Estuary (March)

Status of $CBOD_{20}$ Wasteload Allocations (July)

Irrigation Water Conservation and Management (proceedings of a Technology Transfer Session conducted by the Delaware River Basin Commission (January)

Basis and Background Document, Special Protection Waters, Proposed Non-Point Source Regulations (March)

Public Hearing Response Document, Special Protection Waters Non-Point Source Regulations (October)

Commission Supervising Engineer Richard Albert accepts the Award of Recognition from the Upper Delaware Council at its 1993 Awards Banquet held in March at Hawley, Pa. Mr. Albert, who is in charge of Water Quality Planning and Analysis, was recognized for having made a substantial contribution to protecting the resources and communities of the Upper Delaware River Valley. *(Photo by Richard Tortoriello)*

Financial Summary

Statement of Revenues and Expenditures-General Fund

Year Ended June 30, 1993

REVENUES	Budget	Actual
Signatory Parties:		
State of Delaware	$282,000	$282,000
State of New Jersey	510,000	510,000
State of New York	246,700	246,700
State of Pennsylvania	625,400	625,400
United States	475,000	475,000
Water Quality Pollution Control Grant	240,000	240,000
Sale of publications and sundries	12,000	9,366
Project review fees	110,000	147,046
Reimbursement of overhead-Agency Fund	45,000	45,000
Interest	80,000	93,470
Fines and assessments	18,000	7,132
TOTAL REVENUES	$2,644,100	$2,681,114
EXPENDITURES		
Personal services	$1,562,000	$1,560,930
Special and contractual services	157,000	159,637
Other services	65,700	54,084
Supplies and materials	63,100	62,418
Space	143,000	116,912
Communications	65,800	35,507
Travel	30,000	32,765
Maintenance, replacements and acquisitions	79,000	71,562
Fringe benefits	478,500	344,907
TOTAL EXPENDITURES	$2,644,100	$2,438,722
Excess (deficiency) of revenues over expenditures	$0	$242,392
Other financing sources:		
Operating transfers in	$0	$185,207
Operating transfers out	0	(61,847)
Total other financing sources	$0	$123,360
EXCESS OF REVENUES OVER EXPENDITURES	$0	$365,752

Schedule of Changes in Special Projects Advance/(Receivable) Balance - By Project

Project	Advance Balances July 1, 1992	Cash Receipts (A)	Transfers	Expenditures (B)	Balances at June 30, 1993
Advances:					
USGS Monitors	$0	$58,850	$66,051	($110,189)	$14,712
Groundwater - PA Protected Area	66,537	229,600	(81,781)	(141,426)	72,930
Upper Delaware Ice Jam	0	461,311	12,303	(51,815)	421,799
Delaware Estuary - PA	0	127,027	0	(67,898)	59,129
Comprehensive CSO Assessment	0	102,477	(17,953)	(74,621)	9,903
Salinity - US Army Corps of Engineers	6,883	0	0	0	6,883
Subtotal Advances	$73,420	$979,265	(21,380)	($445,949)	$585,356
Accounts Receivable:					
Upper Delaware Ice Jam	($805)	$805	$0	$0	$0
Delaware Estuary - EPA	(113,695)	553,191	(21,034)	(600,109)	(181,647)
Delaware Estuary - PA	(15,518)	15,518	0	0	0
Comprehensive CSO Assessment	(17,548)	17,548	0	0	0
Toxics Management Study	(82,764)	271,762	(40,065)	(270,339)	(121,406)
Daily Flow Model and Flood Mapping	(26,375)	37,375	(7,323)	(3,677)	0
Dispersion Study	(2,800)	0	0	0	(2,800)
Ichthyoplankton Study	(32,667)	100,000	(2,000)	(65,333)	0
Estuary Salinity Model	0	0	0	(4,974)	(4,974)
Subtotal Accounts Receivable	($292,172)	$996,199	($70,422)	($944,432)	($310,827)
Totals	($218,752)	$1,975,464	($91,802)	($1,390,381)	$274,529

(A) Cash receipts were derived from:

United States Government	$810,591
Commonwealth of Pennsylvania	749,181
State of New York	231,343
State of New Jersey	125,499
Third party fees for services	58,850
Total	$1,975,464

(B) Expenditures were primarily for payroll costs and contractual services.

The records of the Commission are audited annually as required by the Compact.

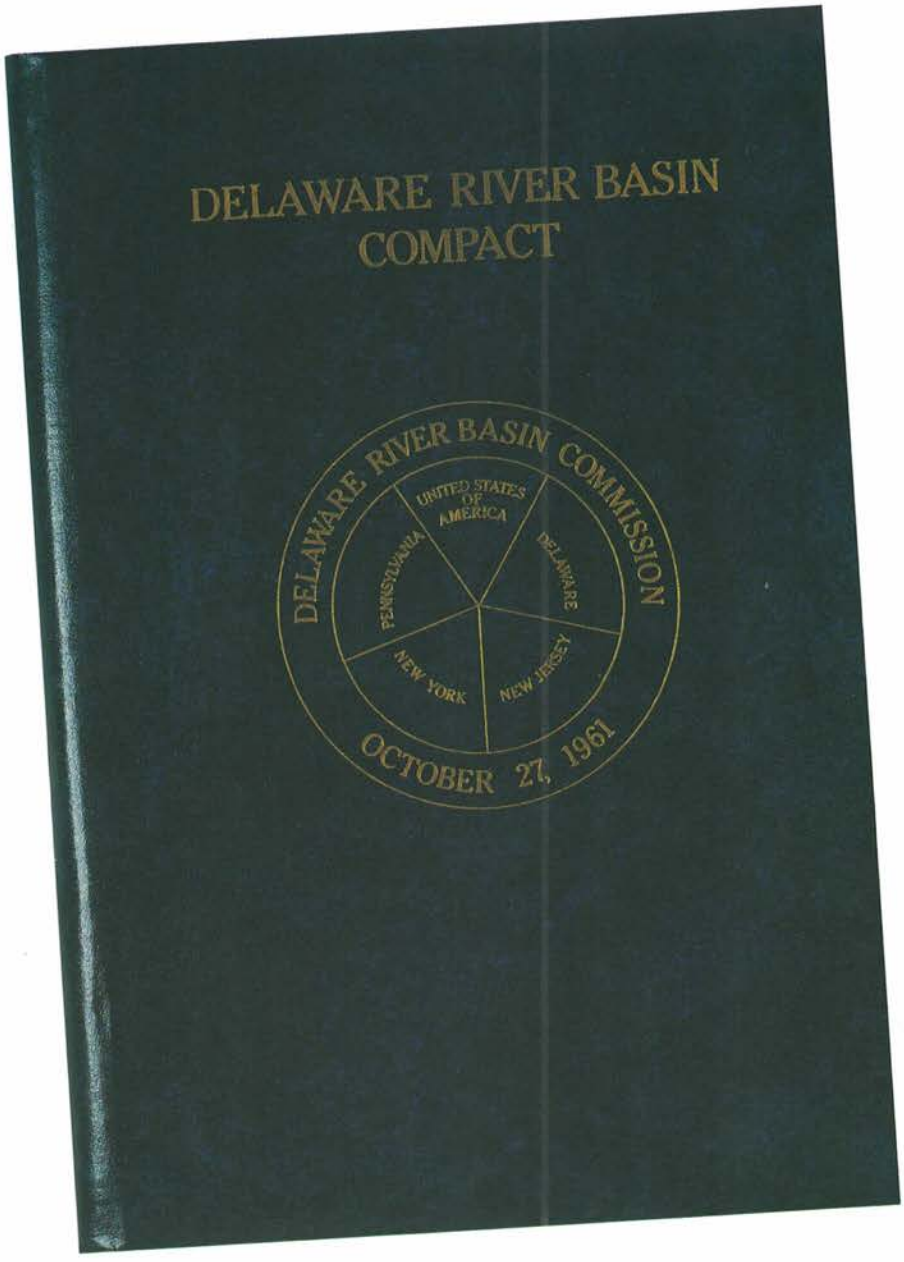
Statement of Revenues and Expenditures - Capital Projects

Year Ended June 30, 1993

REVENUES	Budget	Actual
Commonwealth of Pennsylvania	$25,000	$25,000
State of New Jersey	2,000	0
Water Charges	1,350,000	1,521,152
Western Berks - Facilities Use	20,500	20,500
Interest Income	220,000	249,933
TOTAL REVENUES	$1,617,500	$1,816,585

EXPENDITURES		
Debt Service on Projects	$862,000	$861,141
Operation and Maintenance Cost on Projects	245,000	159,613
Administrative Cost	159,100	158,437
TOTAL EXPENDITURES	$1,266,100	$1,179,191
EXCESS OF REVENUES OVER EXPENDITURES	$351,400	$637,394

Note: Debt services and operating and maintenance costs are for the Beltzville Reservoir and the Blue Marsh Reservoir Projects. Payments are made to the United States Army Corps of Engineers.


DELAWARE RIVER BASIN
COMPACT
DELAWARE RIVER BASIN COMMISSION
UNITED STATES OF AMERICA
PENNSYLVANIA
DELAWARE
NEW YORK
NEW JERSEY
OCTOBER 27, 1961

The Commission

The Delaware River Basin Commission was created on October 27, 1961 by the Delaware River Basin Compact, marking the first time in the nation's history that the federal government and a group of states had joined together as equal partners in a river basin planning, development and regulatory agency.

The Commission's formation was driven by the realization that the basin's waters and related resources are regional assets vested with local, state and national interests for which there is a joint responsibliity. At the time the Commission was created, some 43 state agencies, 14 interstate agencies and 19 federal agencies exercised a multiplicity of powers and duties within the watershed. The compact created a regional body with the force of law to oversee a unified approach to the development and control of the river system.

Commission programs include: water pollution abatement, water supply allocation, regulatory review (permitting), water conservation initiatives, regional planning, drought management, flood control and recreation.

The members of the Commission are the governors of the four basin states (Pennsylvania, Delaware, New York and New Jersey) and a federal member appointed by the President of the United States. Traditionally, the federal member has been the U.S. Secretary of the Interior. The President also appoints an alternate commissioner as do the four governors, selecting high ranking officials in the four state environmental regulatory agencies.

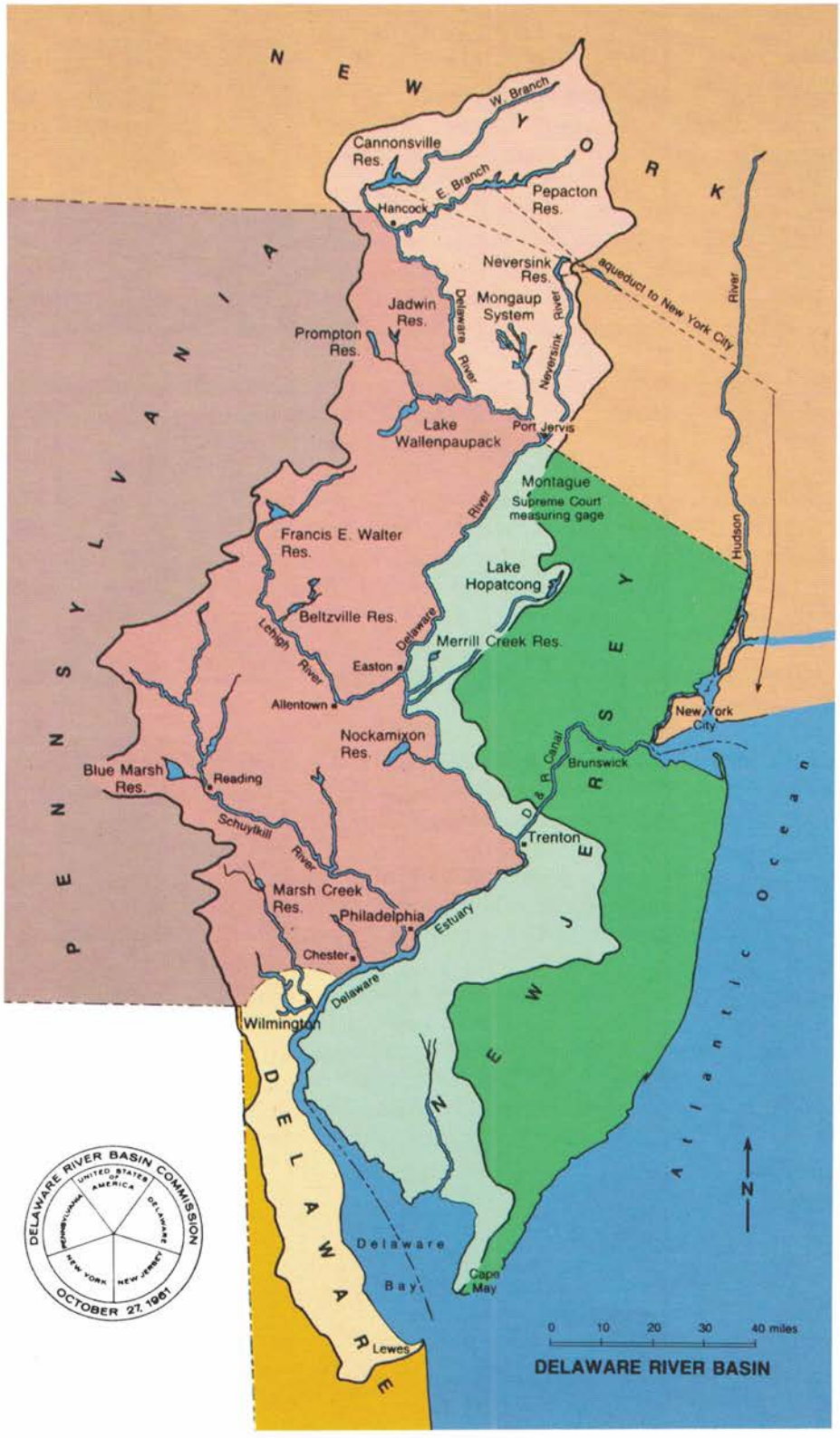
Annual elections are held each year for Commission chair and other officers, the election based on a rotation of the five signatory parties.

The Commission holds informal discussions, hearings on policy matters and projects, and business meetings once a month -- all open to the public. The Commission's various advisory committees include public as well as agency members. Their meetings also are open to the public.

Each commissioner has one vote of equal power with a majority vote needed to decide most issues. Execptions are votes on the Commission's annual budget and action on matters relating to a 1954 Supreme Court decree apportioning the waters of the Delaware River. In these two cases unanimity is required.

The Commission has a staff of 38. Its offices are located in West Trenton, N.J.

The Delaware River Basin contains 12,755 square miles, stretching 330 miles from the headwaters of the Delaware River near Hancock, N.Y. to the mouth of the Delaware Bay. Almost ten percent of the nation's population relies on the basin's waters for drinking and industrial use and the Delaware Bay is but a gas tank away for 40 percent of the people living in the United States. Yet, the basin drains only 0.4 percent of the continental U.S. land area.


NEW YORK
PENNSYLVANIA
NEW JERSEY
DELAWARE
W. Branch
Cannonsville Res.
E. Branch
Pepacton Res.
Hancock
Neversink Res.
aqueduct to New York City
Jadwin Res.
Mongaup System
Prompton Res.
Delaware River
Neversink River
Lake Wallenpaupack
Port Jervis
Montague
Supreme Court measuring gage
Hudson River
Francis E. Walter Res.
Lake Hopatcong
Beltzville Res.
Lehigh River
Delaware River
Merrill Creek Res.
Easton
Allentown
New York City
Nockamixon Res.
D & R Canal
Brunswick
Blue Marsh Res.
Reading
Schuylkill River
Trenton
Marsh Creek Res.
Philadelphia
Estuary
Chester
Delaware River
Wilmington
Atlantic Ocean
Delaware Bay
Cape May
Lewes
N
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