



FIG. 1—Washington Crossing State Park; showing boundary in solid line and historic Continental Lane in broken line. A—Toward behind which boats for Washington's Army were loaded in Penna. B—Washington Grove, the bank where the troops landed. C—Historic McKonkey Ferry House. D—State Forest Nursery. E—Sullivan's Grove. F—Green's Grove.

REPORTS OF THE
DEPARTMENT OF CONSERVATION AND DEVELOPMENT
STATE OF NEW JERSEY

M
REPORT

FOR THE FOUR YEARS ENDING
JUNE 30, 1927

**DEPARTMENT OF
CONSERVATION AND DEVELOPMENT**

Administering

GEOLOGY, SOILS, WATER RESOURCES, FORESTRY,
FOREST FIRE SERVICE, STATE MUSEUM,
TESTING LABORATORY, STATE
PARKS, MORRIS CANAL



TRENTON, N. J.
PUBLISHED BY THE STATE

1928

Letter of Transmittal

To His Excellency, A. Harry Moore, Governor.

Sir—For your information and for transmittal to the Legislature, as required by law, I submit the report of the Department of Conservation and Development for the four-year period ending June 30, 1927. Reports by the Director, the State Geologist, State Forester, State Firewarden, and State Hydraulic Engineer are included.

Yours respectfully,

HENRY B. KÜMMEL,

Director.

State Office Building,
January 31, 1928.

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The Department of Conservation and Development

State Office Building, Trenton, N. J.

BOARD MEMBERS

Howard F. McConnell, <i>President</i>	Montclair
Albert W. Drake	Plainfield
William E. Florance	New Brunswick
John L. Kuser	Bordentown
Bloomfield H. Minch	Bridgeton
Henry L. Moeller	Hoboken
Walter E. Robb	Burlington
Owen Winston	Mendham Township (P. O. Gladstone)

DIVISION AND BUREAU CHIEFS

Henry B. Kümmel	<i>State Geologist and Director</i>
Charles P. Wilber	<i>State Forester</i>
Howard T. Critchlow	<i>Chief Hydraulic Engineer</i>
Mayville W. Twitchell	<i>Asst. State Geologist</i> ¹
Robert B. Gage	<i>Chemical Engineer</i>
Willis M. Baker	<i>Associate Forester</i>
Leonidas Coyle	<i>State Fire Warden</i>
John N. Brooks	<i>Hydraulic Engineer</i>
J. Gilbert Borton	<i>Land Agent</i>
Loren P. Plummer	<i>Topographic Engineer</i>
Mrs. Kathryn Greywacz	<i>Curator of State Museum</i>
J. E. Tittensor	<i>Administrative Assistant</i>

¹Died April 3, 1927. Succeeded July 1, 1928, by Meredith E. Johnson.

Report of the Director of Conservation and Development

July 1, 1923—June 30, 1927

HENRY B. KÜMMEL, DIRECTOR

This administrative report covers in a summary way the more important of the department activities for the four years ending June 30, 1927.

SCOPE OF THE DEPARTMENT

The Department of Conservation and Development represents the interest of the people of New Jersey in geology, forestry, potable waters and undeveloped resources. It publishes topographic and geologic maps, studies the natural resources, administers the State forests, prevents forest fires, has charge of several State parks, investigates the flow of streams, the occurrence of underground water and yield of wells, supervises the construction of dams, and equitable distribution of the potable water supplies. It conducts a State Testing Laboratory and the State Museum. Its work is in part research and in part administrative. The great diversity of its field and the extent of its activities necessitates the employment of a large scientific and technical force in addition to its clerical employees.

In addition to its regular work, it has during the past four years had charge of the dismantlement and sale of the Morris Canal. This work has been done in the name of the Morris Canal and Banking Company, of which the eight members of the Board of Conservation and Development constitute the Board of Directors.

ORGANIZATION

The department is divided into three divisions; a Division of Geology and Topography; a Division of Forestry and Parks;

a Division of Waters, with a geologist, a forester and a hydraulic engineer in charge of each. The Board appoints one of these chiefs Director of the Department for a four-year term.

PERSONNEL

During the period covered by this report, Henry B. Kümmel, State Geologist, has been Director; Charles P. Wilber, State Forester and chief of the Division of Forestry and Parks, and Howard T. Critchlow, chief Hydraulic Engineer, Chief of the Division of Waters. Willis M. Baker, Associate Forester, has been in immediate charge of the technical work of the State Forests; Leonidas Coyle, State Firewarden has had charge of the forest-fire service. R. B. Gage, chemical engineer, has directed the Testing Laboratory and Mrs. Kathryn Greywacz, the State Museum. Oliver Hartwell, of the U. S. Geological Survey, has been detailed to New Jersey as resident engineer, in charge of stream gaging, which is done under cooperative agreement between that organization and this department.

BUREAU OF INFORMATION

The Bureau of Information, formerly called Land Registry, has been in charge, first of Taylor O. Cook, until February, 1926, and later, J. E. Tittensor. During the period covered by the report the character of the work has gradually changed as experience led the way.

While every assistance is still given to persons wishing to locate in New Jersey, this is now done chiefly by bringing them in touch with County Agricultural Agents and with reputable farm real-estate agencies, rather than by trying to maintain a registry of vacant farms in the department. More stress has been laid on exhibits of the work of the department and of the State's resources at State and County fairs and similar gatherings.

Effort has also been made to bring the results of the work of the department to the public through the press by the preparation of brief and accurate summaries. In this the department has received a good measure of cooperation from the newspapers.

REPORT OF THE DIRECTOR

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OFFICES

The offices of the department in the State Office Building, which were occupied in October, 1922, and at the time seemed adequate, have become so crowded that it has been necessary to find additional space in other buildings. This condition will be remedied with the completion of the new State building in which the Department is to be.

GROWTH

The increase in personnel and appropriations may be taken as one measure of the growth of the department's work. During the four years, the personnel has increased from 75 to 139, and the appropriations from \$126,506 to \$221,086. This does not include the expenditure on account of the Morris Canal or the personnel of that organization.

PUBLICATIONS

The results of certain investigations of the department have been published in special bulletins, leaflets and circulars, as follows:

Geologic Series:

- Bulletin 25—Soil Survey of the Chatsworth Area.
- Bulletin 26—The Mineral Industry of New Jersey for 1923.
- Bulletin 27—The Mineral Industry of New Jersey for 1924.
- Bulletin 28—Soil Survey of the Trenton Area.
- Bulletin 29—The Mineral Industry of New Jersey for 1925.
- Industrial Opportunities in New Jersey—second edition.
- Vacationists Handbook of New Jersey.
- Information for applicants for Construction, Alteration or Repair of Dams.
- A list of forestry publications is given on page 40.
- New additions of maps have been issued as stated on page 16.

For further details regarding the work of the department, the reader is referred to the reports of the administrative officers which follow.

Report of the State Geologist

HENRY B. KÜMMEL

The division of Geology and Topography includes the topographic and geologic work, publication of maps, the collection of statistics of mineral production, the state museum and the testing laboratory.

The sudden death on April 3, 1927, of Dr. M. W. Twitchell, for twelve years Assistant State Geologist, was a great shock to all who knew him, and a loss to the department. He had just finished a lecture before the Newark Mineralogical Society and was walking with friends to a hotel, when he was seized with a sudden attack of heart disease and died in a few minutes. His place has not yet been filled.

TOPOGRAPHIC MAPS

This work is in charge of Loren P. Plummer, who has prepared the following paragraphs:

"Constant revision and the addition of new culture is essential to the full usefulness of the topographic atlas of the State. These maps are invaluable for water-supply investigations, the study of geology, dams, roads, drainage projects, forestry and the work of the Forest-Fire Service. In addition, many public agencies, numerous organizations and individuals continually find them a great aid in various fields where an accurate knowledge of the State's geography or topography is essential.

"During the period covered by this report, a number of the atlas sheets have been resurveyed and the changes and additions incorporated on new editions for publication. Nine maps (No. 21, embracing part of Sussex and Warren Counties; No. 23, part of Bergen and Passaic; No. 26, all of Hudson and part of Bergen, Passaic, Essex, Union and Middlesex; No. 27, part of Hunterdon, Mercer and Burlington; No. 29, part of Middle-

sex, Monmouth and Ocean; No. 30, part of Gloucester and Salem; No. 31, part of Burlington, Camden, Gloucester, Atlantic and Salem; No. 33, part of Ocean; and No. 34, part of Cumberland and Salem Counties), on the scale of one mile to the inch have been completed and republished. Sheet No. 26, in the area opposite New York City and extending from Paterson to Amboy has been revised for boundary lines only, but the other maps were gone over in the field more or less in detail. Sheet N. 23 in the northeast part of the State, and No. 31, in South Jersey, embracing the territory bounded by Camden, Mount Holly, Hammonton and Elmer, entailed an unusual amount of work both in the field and office owing to the long interval since the last revision and the numerous changes in these sections adjacent to the metropolitan areas. Field work was also done on atlas sheets No. 25 (part of Morris, Somerset, Union and Middlesex) and Nos. 36 and 37 (part of Atlantic and Cape May Counties), and the office work put well under way. No. 25 will be finished and ready for the engraver by October, 1927.

"One map of the whole State (No. 39) on a scale of four miles to the inch, known as the 'County and Municipality Map' showing the various political divisions was revised and republished during the period.

"The Newark, Morristown, Boonton and Jersey City sheets, known as the 'Large Scale Series Topographic Maps' have been resurveyed and the necessary office work completed. The first three have been sent to the engraver and the Newark and Morristown sheets have been published. The Boonton sheet will be ready for distribution by October, 1927, and the Jersey City sheet before the close of the year. These maps are all furnished to the public at the cost of printing and mailing.

"The mile-to-the-inch sheets covering the whole State and the 2000-feet-to-the-inch maps covering only certain portions have, until of late years, quite satisfied the public demand. However, the question has arisen as to the advisability of extending the area covered by our present fifteen large scale maps west of New York City to include the remainder of Bergen and Passaic Counties and part of Morris County and lying immediately north of the Hackensack, Paterson, Boonton and Dover

sheets. Inquiries are constantly being made concerning the availability of the larger scale in this area, and it would seem that the continued development and growing importance of this section, so nearly a part of the metropolitan area, would warrant the publication of five or six maps here. It is felt that they would serve a rapidly growing demand if funds could be provided to make them ready. With the base data in this area already in the hands of the State, the expense would be comparatively small.

"All of the inch-to-the-mile topographic maps are 27 by 35 inches in size and embrace a territory of about 700 square miles, except along the State borders. The large-scale maps each cover a territory about 90 square miles in extent. Seventeen sheets of the former cover the State and twenty-four of the latter are published. Both sets show all natural features, the elevation of all parts above the level of the sea and the works of man.

"Although the map work has taken the greater portion of the time of the Topographic Engineer, yet at intervals he has been engaged on miscellaneous mapping and engineering work for the department and other agencies. Among them, the coloring of large maps showing water sheds of the State; the proposed Long Hill System of water supply for the State Water Policy Commission, the Water Engineer and others. Various surveys were made and engineering work done in connection with the development of Washington Crossing Park and the preparation and coloring of large maps of the park for the State House and the McKonkey Ferry House and checking, revising and repainting the large relief map of the State for the museum. A survey and map was made for the Bureau of State Police in connection with a suit; testimony given in court pertaining to various matters and a number of miscellaneous maps made for other divisions of the department.

"Attention is called to the worn condition of the engraved stones. Most of these have been in use since the maps were first published by the State in 1887 and it is advisable to have new plates made as early as possible if the usual standard of our maps is to be maintained."

STATE MUSEUM¹

"Museum Rooms.—In the latter part of the summer of 1922, the New Jersey State Museum was moved from the third floor of the State House to the basement of the State Office Building on West Hanover Street. Installation of exhibits in the museum's new quarters was greatly delayed by the necessity of procuring new steel equipment in place of some of the wooden exhibition cases that were damaged in dismantling and moving. The unpacking, repairing, and installing of exhibits took place during the summer and fall of 1923, and the museum was opened to the public again on February 11, 1924. Since that time additions have been made to its permanent collections and many special exhibits have been held, which are described in brief detail below.

"During the time the museum's exhibit activities were at a standstill, great strides were made in the development of its lending collections department, so that at the present time the museum is making from 7,000 to 8,000 shipments of educational exhibits throughout the State each year. The lending work is also taken up in more detail in one of the paragraphs that follow.

"According to the plans of the State House Commission, fitting quarters will be assigned to the museum in the new State Office Building that is being built adjacent to the State House on West State Street. It is hoped that it will then be possible for the museum to exhibit many of its collections that have been in storage for some years past, and to adopt a more expansive and useful program.

"Permanent exhibits and accessions.—The present quarters have not permitted the display of all the museum's material. Sample displays showing some of the fish, birds, mammals, reptiles, minerals, rocks and archæology of the State, and also 'process' exhibits of some of its leading industries have been made. Replacements and additions of specimens were made so far as funds were available; and during the spring of 1925, the mammals and birds which had been stored in the State House basement for nearly ten years were gone over thoroughly by an expert

¹ Paragraphs regarding the museum are by Mrs. Kathryn B. Greywacz, Curator.

taxidermist. After selecting the specimens that were in sufficiently good condition to work with, they were cleaned, repaired and fumigated; then accessioned and stored in sealed cases to await exhibition sometime in the future. In order to establish more complete records, work was begun on reaccessioning the museum's entire collections. This has been almost finished.

"The museum's collection of Indian relics was so meager for a State rich in Indian lore, that special efforts have been made to increase this exhibit. The following relics have been added by purchase and gifts: **Two large stone mortars**, one found near Trenton and the other near Paterson; a collection of New Jersey wampum; and a group of choice relics found in Mercer, Burlington, and Bergen Counties.

"In December, 1925, Governor Silzer presented to the State Museum, for preservation, the letter and American flag dropped near Mt. Holly by the crew of the 'Shenandoah' on its fateful trip.

"*Special Exhibitions.*—In order to keep interest aroused in the museum, special exhibitions are held from time to time. Brief descriptions of the most important of such exhibits held during the past four years are here given.

"Silk Industry in New Jersey (February 11 to March 8, 1924). This exhibit was held in conjunction with the opening of the museum. It included silk culture; process exhibits of throwing, weaving, dyeing, printing and finishing of silks; and the history of silk, portrayed by dolls in historic costumes. One hundred and two classes of school children made a special study of it. This is the museum's record for class statistics during any one exhibit, the former record being sixty-one classes attending the Wild Flower exhibit in 1917.

"The American Indian (April 28—May 15, 1924). This exhibit included Indian relics found in New Jersey, Pennsylvania and New York; specimens of Indian beadwork, pottery, silver, basketry and weaving; and a model of an Indian village.

"China and the Chinese (January 12—February 12, 1925). Articles illustrating modern life in China were shown, as well as its ancient and modern arts. A Chinese pagoda was constructed in the museum and it was furnished to represent differ-

ent rooms in a Chinese home. The collections were loaned by The Newark Museum Association, the Pennsylvania Museum of Art and private individuals. Seventy-eight classes visited the museum during this exhibit.

"The Development of Transportation (May 18—June 6, 1925). Models made by fifth and sixth grade pupils of the manual training department of the Trenton Public Schools, made up this exhibit, covering the development of transportation on land, water and in air.

"New Jersey's First Inventions (November 1—December 10, 1925). Originals, replicas and models of New Jersey's outstanding first inventions were shown. Loans were made by the United States National Museum, Stevens Institute of Technology, the Pennsylvania Railroad, Thomas Edison, Hudson Maxim and others. Forty-six classes made a study of this exhibit.

"Colonial Exhibit (December 20, 1926—February 14, 1927). A colonial kitchen was constructed in the museum, with a fireplace, equipped with fire and cooking utensils used in those days. Examples of early American pewter, brasses, silver, pottery, glass, furniture, clothing, books and manuscripts were also shown. This exhibit was held in conjunction with the special celebrations for the 150th anniversary of the Battle of Trenton.

"Leather: Its Making and its Uses (March 21—April 15, 1927). This exhibit was assembled and loaned by the Newark Museum Association. It illustrated the history of leather, its tanning, currying and finishing. A display of real and imitation leathers was particularly interesting.

"Radioactivity Exhibit (May and June 1927). The story of the discovery of radium and its uses was told. Methods of separating radium from ores, and specimens of radio active minerals and radiographic prints were also included. The exhibit was assembled by Capt. T. I. Miller, President of the Newark Mineralogist Society.

"*Lending Collections.*—The museum's lending collections include educational lantern slides, motion-picture films, charts, stereographs, natural-history cases, and mounted pictures, which

it circulates to schools and other organizations throughout the State. In the past four years the number of loans has more than doubled, and according to attendance records on the use of the material loaned, over three and a half million people were in the audiences which viewed or used this museum material during the year 1926-1927. The development of this work is shown in the tables below.

<i>Number of</i>	<i>Year</i>				
	'22-'23	'23-'24	'24-'25	'25-'26	'26-'27
Slide orders	1,648	1,732	1,803	2,206	2,796
Film orders	988	1,289	2,550	3,844	3,407
Chart, picture and case orders..	882	922	1,357	1,277	1,734
Total number of orders	3,518	3,943	5,710	7,327	7,937
<i>Number of</i>					
Slides circulated	68,808	69,529	72,960	97,546	129,642
Films circulated	1,947	2,153	3,221	4,465	4,218
Charts circulated	2,066	2,119	1,652	1,424	1,619
Mounted pictures circulated	7,270	9,252	16,007	16,636	18,387
Stereographs circulated	10,103	7,636	6,422	5,863	14,028
Natural history cases and special exhibits	158	180	216	187	209

"Nature Clubs.—In the spring of 1924, Nature Clubs were organized at the museum and have been carried on successfully since that time. The schools of the city were invited to send representatives to meetings held at four o'clock in the museum two days each week until the closing of schools. Nature lessons and stories on flowers and birds were given by students of the State Normal School, who received credit in their courses of study for the work done. A series of field trips were taken on Saturday mornings and these proved so popular that it was necessary to restrict the number of pupils. Clubs for the study of other nature subjects will be organized soon.

"Attendance.—The number of visitors to the museum is quite gratifying when it is realized that it is not of easy access. The location of the new quarters should cause a substantial increase in the number of its visitors. The yearly attendance at the museum for the past four years is given below. The decrease shown is due to the fact that less time could be given to the planning of special exhibits as the work of the lending department increased.

REPORT OF STATE GEOLOGIST

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	<i>No. of Visitors</i>	<i>No. of Classes</i>
February, 1924—July 1, 1924	8,804	127
(Museum opened February 11, 1924)		
Year 1924-1925	17,481	146
Year 1925-1926	14,792	156
Year 1926-1927	14,248	104

SOIL SURVEY

"The classification and mapping of the soils of the State which had been carried on for a number of years in cooperation with the U. S. Bureau of Soils at Washington were substantially completed July 1, 1925, and on that date Mr. L. L. Lee who had been in charge of that work in behalf of the State for several years was transferred to the State Agricultural Experiment Station. With the completion of the field surveys, this department could very well terminate its connection with the work. Methods of utilizing these investigations, and making them of concrete value to the agricultural interests of the State belong to the Experiment Station rather than to this department.

"Reports and maps of the Sussex, Freehold, Camden, Belvidere, Millville, Bernardsville, Chatsworth and Trenton areas have been published, in cooperation with the U. S. Bureau of Soils. Reports on the Salem, and Bergen areas have not yet been issued."

MINERAL PRODUCTION

Statistics of the mineral industry of New Jersey have been collected annually in cooperation with the U. S. Geological Survey and later with the U. S. Bureau of Mines and Bureau of Census. This work was in charge of Dr. M. W. Twitchell until his sudden death in April, 1927.

The statistics cover the calendar year and not the fiscal year of the State. Bulletins giving the production for the years 1923, 1924 and 1925 have been published. The report for 1926 has been retarded by Dr. Twitchell's death.

The total value of the mineral production was as follows:

1923	1924	1925	1926
\$82,310,148	\$81,558,477	\$85,259,450	\$90,008,915

The clay industry including raw clay, brick, tile and pottery makes about 55 per cent of the total, stone 4 per cent, and sand and gravel 4 per cent.

Zinc ore, the State's most important metal is produced entirely by one company and, therefore, the values cannot be disclosed. About 600,000 short tons of zinc ore are mined annually, although the output varies somewhat from year to year. This is equivalent to about 160,000,000 to 170,000,000 pounds of recoverable zinc, although the bulk of the New Jersey ore is not manufactured into this metal.

The State produces none of the precious metals, no copper or lead, no coal, oil or gas; nevertheless, computed on the basis of value per square mile of area, it stands first or second among all the States.

POTASH IN THE GREENSAND MARLS

In the greensand marl deposits of South Jersey, the State possesses its greatest undeveloped mineral resource. These deposits extend from Atlantic Highlands in Monmouth County to the Delaware Bay in Salem County. Over wide areas they occur at the surface or so thinly covered that they can be readily dug with a steam shovel.

They contain 6 to 7 per cent of potash and form the largest accessible reserve supply of that substance in the country. Unfortunately for their commercial exploitation, the potash is present in a stable chemical compound, insoluble and not readily available as a fertilizer. Some method must be devised by which the potash can be extracted from this compound at a low cost. This necessitates that some profitable use for the residue be found. The cost at which foreign potash salts in soluble form can be laid down in this country determines of course the amount which can be spent in digging and treating the New Jersey greensands.

Certain potash investigations are now being carried on at the station of the U. S. Bureau of Mines at New Brunswick. These

relate to potash deposits of Texas and adjacent states, and the problems of the New Jersey deposits can not be undertaken. Tentative arrangements have, however, been made by which this department can secure the cooperation of the experts there assembled, if funds for the State work can be provided. The department is asking for \$5,000.00 per year for five years for this work. The development of a commercial process will mean a great increase in the value of the State's mineral resources, and it is believed that the chances of success are sufficient to warrant this very moderate expenditure.

Report of the State Forester

July 1, 1923, to June 30, 1927

CHARLES P. WILBER

FOREST FIRES

The Forest Fire situation and the work of the Forest Fire Service is completely covered by the report of the State Firewarden and is, therefore, not dealt with in the report of the State Forester.

PERSONNEL

Forest Service.—In the four years covered by this report, July 1, 1923, to June 30, 1927, the forestry personnel of the department has increased from 11 to 17. This increase has been in the number of technical forestry assistants, in men employed as rangers on the State Forests, and in assistance needed for land purchase work. In addition, there are what amount to permanent crews of laborers employed by the day on the State Forests, for considerable parts of each year, totalling approximately 15 men, and a nursery crew sometimes numbering from 10 to 20 for special seasonal needs.

Fire Service.—In the Forest Fire Service, there has been a very much larger expansion, which is dealt with in detail in the report of the State Firewarden in this same publication. See page 42.

Park Service.—On the State Parks the personnel is practically all new, the organization of work on the areas having been begun since 1923. On the three parks the permanent employees at present include four men employed in supervisory capacity and five others as helpers in subordinate positions. From 2 to 6 additional laborers are used for special seasonal work from time to time.

WATER RESOURCES



FIG. 2—A potential lake site easy and not costly to develop.

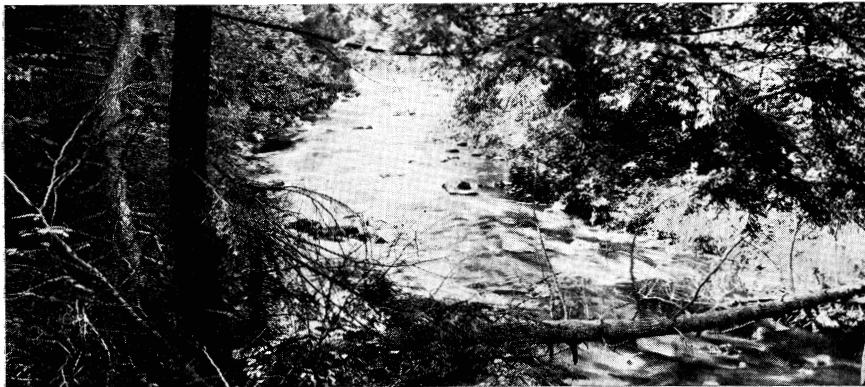


FIG. 3—Ideal streams abound for fishing, camping and water supply.



FIG. 4—Stony Lake, developed by the Montclair Council of Girl Scouts for its summer camp, Stokes Forest.

A great wealth of undeveloped and unused water possibilities await development on the State Forests.

REPORT OF STATE FORESTER

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Needs.—The State Forest personnel demands a very considerable increase in order to take care in adequate fashion of areas at present under State ownership and to provide for additional acquisitions now being rapidly made.

LEGISLATION

The following acts dealing with forestry matters have been passed by the legislature from 1924-1927 inclusive;

Chapter 15 P. L. 1924—A law providing for the appointment of County Shade Tree Commissions, drawn along the same lines as the previous Municipal Shade Tree Commission Law.

Chapter 106 P. L. 1924—A law permitting acquisition by the department of delinquent tax sale land from the municipalities for State Forest use.

Chapter 18, P. L. 1924—An amendment fixing penalties for violations of the regulations of the department governing the use and administration of the State Forests.

Chapter 168, P. L. 1926—An amendment, increasing the tax lieu paid by the State to the municipalities for State Forest land from 2 cents to 10 cents an acre.

Chapter 187, P. L. 1926—A law prohibiting the injuring or destroying of trees and other vegetable wild life on any private property.

Chapter 326, P. L. 1926—A law providing for acquisition by the department of a seashore park, when funds are made available.

Joint Resolution 7, 1926—Endorsing and recommending the proposition of rapid expansion in the area of State Forests.

Chapter 107, P. L. 1927—An amendment permitting the department to take land for State Forest purposes under certain conditions even though a fee simple title is not available.

Chapter 205, P. L. 1927—A law directing the department to make a State Park survey of the State, when funds are made available.

STATE FORESTS

General Policy.—The general policy under which the State Forests are being acquired and handled seeks to locate an adequate area of forest land thruout the State, under State ownership; 1, to provide for the redemption and development of the wild-land and backward sections of the State where progress depends

intimately, if not entirely, upon the solution of the forest problem; 2, to grow locally under State control, with its guaranteed permanency of management, at least a part of the future timber supply necessary to meet a growing timber shortage; 3, to determine on and to demonstrate to private woodland owners the practicability and the best methods of growing, protecting and harvesting timber crops at a profit; 4, to make adequate and permanent provision for public out-of-door recreation, including fish and game needs; 5, to provide under permanent public ownership for the continuous maintenance of forest cover on the watersheds of potable streams in the State. (See page opp. 26.)

Acquisition.—The announced policy of the department calls for the acquisition of not less than 200,000 acres of wild land to be held as State Forests. In conformity with this, appropriations have been made for building up the State Forest area as follows:

Fiscal year 1925, 15,000; 1926, 30,000; 1927, 30,000; 1928, 100,000.

Because of the small size of the appropriations during the first three of these years, which this report covers, it has been possible only to make additions to existing State Forest areas. Purchases have been made as follows:

<i>Forest</i>	<i>Area July 1, 1923</i>	<i>Area June 30, 1927</i>	<i>Gain in Acres</i>
Stokes	7,231	9,274	2,043
Lebanon	4,809	6,742	1,933
Penn	2,764	2,764	0
Bass River	1,534	2,044	510
Jackson	43	43	0
Mt. Laurel	21	21	0
	<hr/> 16,402	<hr/> 20,888	<hr/> 4,486

There have been alienations from the State Forests to the amount of 713 acres during the same period; in one or two instances to permit private developments such as cranberry properties, etc., already adjacent to the forest to expand, and 500 acres transferred to the New Lisbon State Colony for Feeble-Minded Males for its use, at the request of the Department of Institutions and Agencies. The total amount purchased 1923-1927 is, there-

STATE FORESTS—BUILDINGS



FIG. 5—Coursen Ranger Station, Stokes Forest.

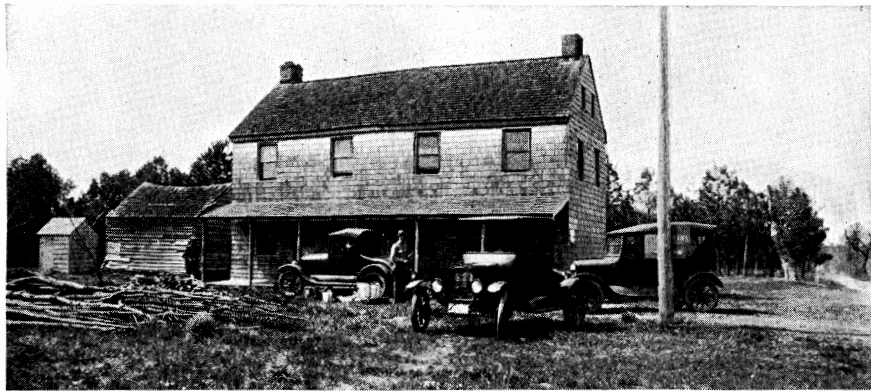


FIG. 6—French Farm Ranger Station, Bass River Forest.



FIG. 7—Supervisor's Headquarters, Stokes Forest.

The State Forest Officers live with their work.

fore, 5,199 acres. The overhead cost involved in acquisition under the small appropriations has been higher than was desirable because of the necessity of dealing with small lots rather than purchasing larger holdings. In addition, the average land values thruout the State are steadily rising, emphasizing the economy in making State Forest purchases just as promptly as can be done.

Buildings and Equipment.—On the Stokes Forest, upon newly acquired areas, a supervisor's headquarters, and two ranger's headquarters have been established and put in usable condition, together with two garages and outbuildings. These additions have also permitted the moving of headquarters which were decidedly inaccessible to the public, to a location on the main public road which released the former headquarters for use as an additional ranger station. On the Lebanon Forest a permanent ranger's headquarters has been leased from the State Colony for Feeble-Minded Males and put into condition for use. On the Bass River Forest an old residence has been renovated and repaired, to take care of a permanent ranger and helper. Telephone service has been provided to each of the headquarters and ranger's quarters. (See opposite page.)

A team of mules and an automobile truck have been put into use on the Stokes Forest and a considerable amount of equipment such as wagons, plows, shovels, spray tanks, and other tools have been furnished for the Stokes, Lebanon and Bass River Forests.

Timber Cutting.—All of the cutting done on the State Forests has been either improvement cutting in the standing timber, or salvage cutting to use fire killed or injured timber. During the fiscal years 1924-1927, about 800 acres of timberland have been gone over by improvement cuttings taking out scrubby, mature, fire-damaged, diseased or otherwise inferior timber. Of this, 230 acres have been thinned leaving a thrifty stand on the ground. The balance has been practically clear cut and more than half of this cut area has already been planted up with seedlings, the rest being handled by leaving seed trees to bring in the new forest. (See opp. page 31.)

The income from the State Forests during the last four years has been as follows:

	<i>Fiscal year</i>				
	1924	1925	1926	1927	Total
Balance on hand	\$752.14	.....	.....	.....	\$752.14
Stokes Forest	181.69	\$540.41	\$801.65	\$1,092.77	2,616.52
Lebanon Forest	284.00	187.00	461.00	1,260.35	2,192.35
Bass River Forest	515.19	596.20	1,070.61	412.87	2,594.87
Penn Forest	2,900.00	10.00	10.00	.....	2,920.00
Jackson Forest	233.08	323.25	15.50	8.00	579.83
	<u>\$4,866.10</u>	<u>\$1,656.86</u>	<u>\$2,358.56</u>	<u>\$2,773.99</u>	<u>\$11,655.71</u>

The income is increasing from year to year steadily, the receipts from these properties being derived largely from the sale of timber in thinnings and salvage cuttings. No real inroad has been made upon the thrifty merchantable stands where there are such. During 1924 the Penn Forest was severely burned and a salvage sale of all merchantable material remaining after the fire brought the receipts during that year to considerably above normal. In addition to the sale of timber a small, but continuous, revenue comes in from leases and other minor uses, largely in connection with the recreational facilities available on the State Forests. The income under the law is set aside as a special fund for the forest development of the properties and has been used as follows: Stokes, \$3,454.66; Lebanon, \$1,073.27; Bass River, \$3,074.20; Penn, \$5,430.00; Jackson, \$258.58; Mt. Laurel, none; General (used on all Forests), \$505.74; total, \$8,420.75, leaving a balance on June 30, 1927, of \$3,234.96.

Protection.—The Stokes Forest has had less than 10 acres burned over by fire during the four years. The South Jersey Forests have been severely injured. The Penn Forest in 1924, suffered from a fire which burned 1,000 acres and swept over the entire merchantable timber stand on the property. The Bass River Forest has had about 600 acres burned over, the burning being confined mostly to previously fire damaged and scrub growth and to open areas that would eventually have had to be cleared and planted any way. On the Lebanon Forest 2,000 acres, which also had previously been damaged by fire, have been burned over. On the Jackson one small fire burned approxi-

TIMBER SALES AND IMPROVEMENT



FIG. 8—Ties from Stokes Forest sale on the way to the railroad.



FIG. 9—Improvement thinning in short leaf pine on Bass River Forest.



FIG. 10—Portable track for swamp logging and cedar thinning on Lebanon Forest.

Timber and other forest products are sold from the State Forests, producing income and improving the woodlands in the same operation.

mately an acre, doing almost no damage and on the Mt. Laurel Forest there has been no fire. Most of the fire loss occurred during the calendar years 1923-1924, before the Forest Fire Service had been expanded and developed to its present organization and efficiency. A considerable portion of the loss could have been averted by a more effective personnel, the number of employees which it has been possible to keep on the properties having been too small to provide adequate protection. During the last four years, real progress has been made in fire-proofing considerable areas by splitting them up with safety belts. There is a large amount of this work still to be done. It has been proposed that an attempt be made to meet this need promptly by employing prison labor, but funds asked for this purpose from the 1927 Legislature were not made available.

Planting.—A total of approximately 490 acres have been planted on the State Forests and Parks. Of this nearly 400 acres have been planted since 1923 with more than 300,000 seedlings. The species used have been principally red pine, shortleaf pine, Norway spruce, loblolly pine, European larch, white pine and Scotch pine, given in the order of the amount used. Nearly 275 acres of the total has been land which had been clear cut previously to provide the planting area, the balance has been old fields.

Recreation.—Although the State Forests from the first have been used to some extent by sportsmen and outdoor lovers of all sorts, the major development of their recreational use has come within the last four years. Under the Department's policy of administration, all of the State Forest areas are open to fishermen and gunners, subject only to the restrictions of the Fish and Game Laws and to reasonable regulations with regard to the use of fire. In addition, trails and old roads have been made available for hikers and a considerable amount of road improvement has been done on the State Forests to make the areas available by automobile, and the areas have been posted to aid visitors in getting about the properties and finding special features. Camping on the properties is allowed under a free use permit for transient occupation and permanent camps are located under a system of leases to permit the use of such areas as are

available by those who want to provide for more permanent occupation. The properties have been zoned, setting aside areas which are available for transient use; areas in which permanent occupancy will be permitted and areas where no such recreational use will be allowed. Under this system six permanent camp sites, including a large group camp for the Girl Scouts, have been established on the Stokes Forest and two on the Lebanon Forest. There have been developed 15 transient camp sites and four attractive picnic sites on the Stokes Forest and one picnic site on the Bass River Forest. Funds for a much more general development of the properties for recreational use are badly needed to supplement a small appropriation of \$5,000 made by the 1927 Legislature to meet this need. The program of the department calls for much larger expenditures, principally for opening up the areas by roads and trails, partly for the developing of streams and recreational features and partly for co-operation with the Fish and Game Commission in keeping the streams and woodlands stocked with fish and game. The availability of the areas for public recreation is limited almost entirely by the amount which can be spent in such development.

Laboratory Use.—The State Forests are growing more valuable, in addition to their other uses, as the location for research work of all classes. Although a considerable amount of study is being conducted on private lands, the greater part of this work is and ought to be maintained on the publicly owned areas where protection can be more certainly guaranteed and continuity of management can be assured.

RESEARCH

A large number of general forest problems and a still larger number of special or local problems intimately affecting the choice of forest practice in the State remain to be answered. In order that the department may be in a position to apply and to recommend the best practice in all cases, a large volume of research work has been begun. Most of this is undertaken on the State Forests where the area is under permanent control. However, a considerable amount of experimental work has been established on private land, when local conditions suitable to the par-

ticular problem could not be secured on public land. These investigations embrace the questions of forest planting (species, age seed vs. seedlings and similar questions), forest management (species to be favored, method of cutting for improvement, for increased volume, for reproduction, etc.), forest protection (fire prevention and control, insect and disease problems), forest utilization (logging practice, manufacture, special markets, transportation, etc.) In planning and carrying on this work the department has co-operated with a special committee on forest information, of the Allegheny Section of the Society of American Foresters, in making a complete analysis of the forestry studies and investigations now under way in this State and adjoining states. Also, co-operation has been extended to the U. S. Forest Service in a movement, recently successful, for the establishing of a Federal Forest Experiment Station to serve the area in which New Jersey is included.

There are being carried on approximately 36 major investigations covering all the branches of information indicated above, forestation, protection, management, mensuration, utilization, economics, dendrology and ecology. Practically all of this work has been begun since 1923.

Nearly 1,000 acres of forest plantations, of which approximately half are on private land, have been established and have been closely observed. More than 50 separate cutting operations have been made and kept under observation for studies of growth, reproduction, etc., covering several hundred acres of land in all, mostly on the State Forests. Major problems under consideration in these studies are: (1) Reforestation on South Jersey sands with special study of the changing of sprout oak stands to pine forest. (2) Reforestation of old fields in North Jersey. (3) Natural production in hardwood forest in North Jersey and in the pine forests of South Jersey. (4) Artificial fire line safety strips in South Jersey. (5) Profitable thinning in the South Jersey white cedar swamps. (6) Increasing the growth and studying the response to thinning in thrifty young stands of hardwoods, pine and cedar. (7) Study and methods of nursery practice. (8) Special studies in fire protection.

FOREST PLANTING

Beginning in the spring of 1923, the department undertook a new service in the furnishing of forest planting stock for reforestation work in New Jersey. By an arrangement with the commercial nurserymen, large quantities of the most desirable species were reserved for the use of the department and orders against these reservations were taken from land owners in the State. The price at which the trees have been furnished has been the price quoted to the department by the nurserymen and has been well below the normal price quoted by the nurserymen for retail business. Under this arrangement, in but four years, the use of planting stock for reforestation in New Jersey has grown, as indicated in the figures which follow, from a small beginning to a total of more than a million trees annually.

	1924	1925	1926	1927
Reservation asked	400,000	900,000	1,375,000	1,500,000
Reservation secured	400,000	900,000	1,375,000	925,000
Distributed	488,500	693,000	1,015,250	1,173,600
Number of buyers	93	82	214	284

In 1926 the supply available from the commercial nurserymen was short 50,000 of one largely used species. In 1927, for the same reason, the Department was unable to fill orders for more than 100,000 seedlings which would have been used, if available.

Because of difficulty in securing sufficient trees of the species best for use and because of growing evidence that an assured supply of the right species of guaranteed quality and in the right quantity could not be assured from the commercial nurserymen eventually, and because certain species needed for wholesale or for experimental use are not furnished by the commercial companies at all, a State Forest Nursery was established at Washington Crossing Park in the spring of 1926. The planting this first year was limited to less than 200,000 trees because of lack of funds. State appropriations for this purpose, supplemented by Federal financial co-operation under the Clarke-

RECREATIONAL USE



FIG. 11—Fishing and hunting are rapidly improving and are encouraged.



FIG. 12—A leased camp site on which the holder can provide a summer bungalow.



FIG. 13—A free camp site on which the transient may enjoy an outing.

The State Forests are rapidly becoming the wild land playgrounds for Jersey men.

McNary Act, made it possible to establish two million trees by the 1927 planting, which will assure New Jersey users an adequate supply of planting stock beginning with the spring of 1929, when the first large quantity of seedlings will be available from the nursery for distribution. These seedlings will be furnished to New Jersey land owners at the cost of production, handling and shipping.

The type of land owners who are using this planting material is indicated by the following figures, for the distribution in the spring of 1927: State Forests, 50,000; water companies and municipalities, 230,000; industries and corporations, 38,000; farmers and private owners, 855,600; total, 1,173,600—comprising a total of 284 orders.

The species principally used have been red pine, Scotch pine, Norway spruce and Douglas fir. In addition to these species, white pine, which is under quarantine for import into the State because of fungus disease thruout a large part of its range, shortleaf pine, loblolly pine and European larch, will be produced from the State Nursery in quantities sufficient to meet requirements for them. A few other species are being grown experimentally and will be used first on State Forests to test their availability and to determine whether they have any advantage over other species before they are produced in quantity for public use.

CO-OPERATION WITH PRIVATE OWNERS

The Department has continued to maintain a service and help to private owners in dealing with their problems of reforestation, woodland improvement, harvesting and marketing. The services of the professional foresters of the Department are available so far as the number of men and funds available make it possible, to all those in the State who are interested in improving, establishing or using woodland property and products. The services rendered in this connection are indicated by the following figures for the period 1924-1927:

<i>Owners</i>	<i>Reforestation Work</i>	<i>Woodland Improvement</i>
State Institutions	9	5
Counties and Municipalities	6	3
Industrial Organizations:		
Water Companies	12	7
Mining "	1	1
Powder "	2	2
Textile "	2	1
Foundry "	2	
Electric "	1	
Schools and Colleges	10	3
Y. M. C. A's and Boy Scouts	11	8
Other Organizations and Clubs	15	8
Individuals:		
Farmers	500	150
Large Estates	21	9
Total	592	197

In a number of instances public agencies in the above list have been given systematic help annually, and others have been helped on more than one occasion. Under the Department's guidance in this way a large acreage of woodland has been improved by the right kind of cutting, the products taken out having in all instances paid at least the cost of the work and in many instances a considerable profit to the owner, beside leaving him with better property. No accurate compilation of the acreage covered in this way has been attempted and no figures for the amount of land which has been reforested under the advice of the Department in this way has been made.

A number of outstanding examples in forestry have been established during the last four years among which the work being done by the Vineland Training School, as a State agency, by the East Orange Water Department, the Jersey City Water Department, and the Perth Amboy Water Department, as municipal agencies and by the Ingersoll Rand Company and the Millville Manufacturing Company in the commercial field are especially noteworthy.

In order to provide for the establishing of forestry work under the Agricultural Extension Service in the State, one of the Department's foresters was detailed for approximately half of the year

1926 to serve as extension forester under this agricultural agency. Under this stimulus and thru funds provided by the Federal Government for this work thruout the county, a permanent transfer of the agent was made the following year, beginning a very helpful addition to the promotion of forestry among the farmland owners of the State thru the Agricultural Extension Service. This extension specialist in Forestry, working thru the county agricultural agents, has by agreement with the Department undertaken to take over the furnishing of advice and assistance to farmers in practicing forestry on their lands, leaving the Department's function in this field the dealing with other classes of land owners. This arrangement, of course, largely amplifies the effectiveness and the scope of help that can be given to all classes of owners in the State.

STATE PARKS

Swartswood.—Swartswood Park has been improved by the addition of a number of conveniences such as fireplaces, comfort stations, tables, benches, etc., for the use of the public at Emman's Grove, the only sizable area of land which is a part of the park property. Also, this grove has been thoroughly gone over to take out dead, dying and otherwise undesirable trees, putting the remaining growth in first class condition. Funds available for use at this park have been very limited so that the improvement of any of the other approaches to the lake, which forms the main body of the park, has not been possible.

Hacklebarney.—By deed of gift, accepted by the 1924 Legislature, Mr. A. E. Borie, of Hacklebarney, transferred to the State an area of 32 acres to be maintained by the State as a public park and picnic ground under the administration of this Department. Thru the generosity of Mr. Borie, a handsome entrance has been provided for the park. In addition to this, considerable improvement in opening and posting trails, in thinning out the forest growth, in planting open land and in providing public conveniences has been put into the park. Funds for any major improvements on this area have not been available.

Washington Crossing Park.—Washington Crossing Park has been increased in area by the purchase of four small parcels which

were interior exceptions, and a larger property which controlled a large portion of the river front, making the total area of the park at the present time 237½ acres. Under appropriations for the development of the park, approximately 15 acres of the front part of the area has been largely improved under a comprehensive landscape plan, and the river and canal frontages have been put into condition for public use and enjoyment. In addition to this, the historic McKonkey Ferry House has been renovated and fitted up as an attractive and authentic shrine and museum. A large stone house on the property has been completely renovated and repaired to serve as headquarters for the park employees; comfort stations, picnic facilities and public water supplies have been installed, and a large amount of work in improvement and opening up other parts of the park has been done so that more than half of it is now available for public recreation.

Approximately 100 acres of open fields have been planted with forest seedlings of a variety of species to provide in the future a piece of woodland which, as it grows, will be an invaluable adjunct to the park, as well as a source of income to the State. Under lease, the Department has secured control of the canal towpath so that its development can be made co-incident with that of the adjoining park lands. As one of the features of the Park, the State Forest Nursery has been established on the area, approximately 10 acres being set aside for its ultimate use. A number of gifts have already been made as memorials by patriotic organizations, including a very handsome old-fashioned garden installed by the Daughters of the Revolution; a flag pole by the Sons of the Revolution; an old-fashioned pump by the Sons of the American Revolution; and a handsome marker by the Daughters of the American Revolution. Thru the co-operation of the Federal War Department and the State National Guard, seven old cannon have been placed in the park.

The formal opening and dedication of the Park was held on June 4, 1927, although bad weather curtailed the program and prevented participation by a large number of the members of the American Legion, and other bodies which had generously volunteered to take part in the occasion. (See Frontispiece)

SHADE TREES

A service of advice and assistance to public bodies in charge of shade-tree work and to tree owners is maintained with a forester especially assigned to this work. Lack of funds and personnel make it necessary to give a considerable portion of this help to private tree owners by mail only. Personal attention in the field is given to municipal, county and institutional problems. From 1924 to 1927 approximately 200 different persons, institutions and shade tree commissions have been given field advice and assistance on shade-tree matters.

Shade-tree work and interest in the State has been materially stimulated by the passage of the County Shade-Tree Act in 1924, modelled on the admirable N. J. Municipal Shade Tree Laws. Since the last report eight municipal shade tree commissions have ceased to function, and 22 new commissions have been appointed as follows—1924: Greenwich, Pitman, Spring Lake, Ventnor City—1925: Barrington, Burlington, Lambertville, Millburn Township, Newfield, Washington—1926: Avon-by-the-Sea, Barnegat, Brooklawn, Cranford, Woodstown, Dumont, Kenilworth, National Park, Red Bank, Ringwood—1927: Cape May, Landis Township. The total number of such commissions now is 100. Since the passage of the County Commission Act, five counties have appointed commissions as follows: 1925, Mercer, Warren; 1926, Morris, Sussex and Union, and shade tree work is actively going forward along the county highways under the guidance and stimulus of these commissions.

The State Highway Commission is doing a considerable amount of replacement work along State Highways where new construction has made it necessary to take out old shade. This Commission, with the assistance of one of the Department's forester's, has also established three experimental plantings along State Highways in Warren, Somerset and Monmouth Counties, as the possible beginning of a more general planting of this sort along all of the State Highways.

In 1925, the Department initiated a movement for closer co-operation among the shade-tree commissions in the State and was successful in securing the organization of the "N. J. Federa-

tion of Shade-Tree Commissions," which seeks to establish a more intimate contact between the local shade-tree interests and to work out general problems common to the entire State. At its beginning, 37 commissions and three private individuals affiliated themselves in this organization. The organization has been holding two well attended meetings annually, one of which each year has been a field meeting.

The observance of Arbor Day has been encouraged each year by special publications, special notices, or other special activity on the part of the Department, in co-operation with the Shade Tree Commissions, Schools, American Legion, and other public and civic bodies.

MISCELLANEOUS ACTIVITIES

Lectures.—A large proportion of the service clubs of the State have been covered by addresses on forestry and a great number and variety of other organizations have been furnished with speakers on forestry, shade trees, State-Forest activities, etc. Three series of lectures on forestry have been given to students in Rutgers University.

Exhibits.—Forestry, forest-fire, and shade-tree exhibits of various sorts have been installed in connection with the State Fair, with numerous county fairs, and at a considerable number of meetings of special bodies such as the State Department of Agriculture, Women's Clubs, Parent-Teacher Associations, etc.

Conferences.—Representatives of the Department have attended and taken an active part in a large number of technical and administrative conferences and the Allegheny Section of the Society of American Foresters has been entertained at a field meeting in the State, covering the greater part of the major forest problems and the principal forest regions in the State.

Publications.—The following publications have been prepared and distributed during the period covered by this report:

"Forestry News"—At first a monthly, now a quarterly news publication of the Forestry Division.

Bulletin—"Forestry for Profit"—88 pages, revised and reprinted.

Booklet—"Why Forestry in New Jersey"—20 pages, 2 editions.

Booklet—"How to Plant Forest Tree Seedlings"—6 pages.

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Booklet—"The Why-Where-What of Forest Planting"—15 pages.
Booklet—"A Shade Tree Guide"—20 pages, revised and reprinted.
Booklet—"Arbor Day Handbook"—16 pages.
Leaflet—"County Shade Trees"—4 pages.
Leaflet—"Municipal Shade Trees"—4 pages.
Leaflet—"Land Acquisition"—5 special, 4 pages each.
Leaflet—"State Forests Circular"—15 pages.
Leaflet—"Forestry Laws"—Revised and reprinted, 13 pages.
Leaflet—"Shade Tree Laws"—Revised and reprinted, 12 pages.
Leaflet—"N. J. in American Forest Week"—6 pages.

In addition a considerable number of articles have been prepared and published in current periodicals and a large volume of press material has been published.

Report of the State Firewarden

LEONIDAS COYLE

Changes.—During the years 1910 to 1923 the Forest Fire Service consisted of a State Firewarden and three Division Firewardens, ten lookout watchers and three hundred and fifty local firewardens. In 1922 the Legislature by a joint resolution recognized the need for the extension of the Service and recommended the expenditure of \$24,000 for the completion of the lookout tower system and the expenditure of \$36,000 for the employment of extra wardens and watchers. This money was not available in that year but the following year, 1923, the appropriation bill made the sum of \$35,000 available for this purpose in July. Reorganization was started and was well under way by November of the same year.

Organization.—Study of the forest fire problem showed that efficiency demanded that the forest area be divided into tactical areas rather than the township areas as has heretofore been established and that the handling of the fires in these areas or sections should be the fixed and definite responsibility of a chief with the necessary authority and ability. Accordingly the whole forest area of the State was divided into 29 sections of about 85,000 acres each and the new position of Section Warden was created to have charge of these sections. The divisions remained the same—Division A, from the north boundary of the State to the Raritan River; Division B, from the Raritan River to the Mullica River, and Division C, from the Mullica River to Cape May. Seven sections were set aside in Division A; eleven in B, and eleven in C. This gives each section from 10 to 15 local wardens and under each of the local wardens, are crews of from 10 to 15 men, who make themselves available for this duty, and are instructed and trained as far as practicable. The force now consists of the State Firewarden in charge and two division firewardens at Trenton Headquarters and in the field

ORGANIZATION OF THE NEW JERSEY FOREST FIRE SERVICE

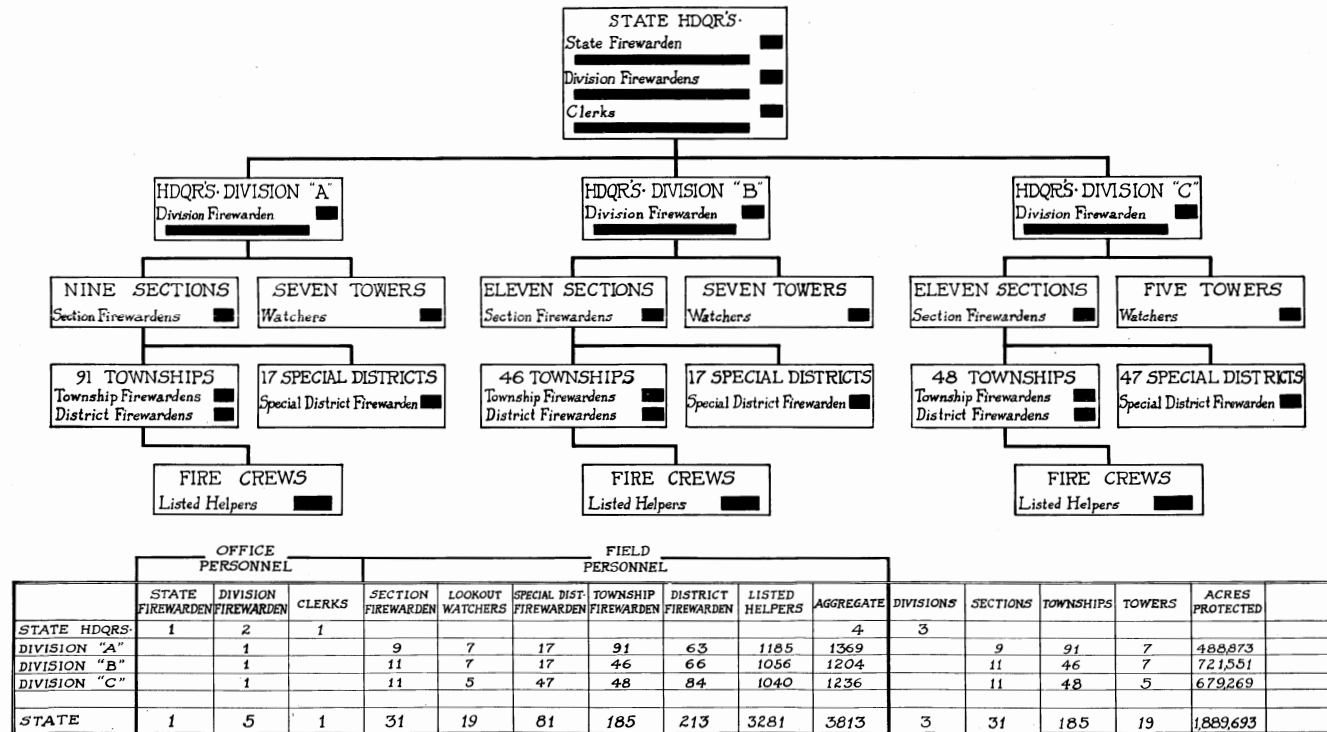


FIG. 14—Organization of the Forest Fire Service.

three division firewardens, 18 lookout watchers, 30 section firewardens, 398 local firewardens and about 3,500 men in the fire crews (see chart opp. page 42).

Construction.—During the last four years eight lookout towers have been constructed, one each at Belle Plain, Mizpah, Cedar Bridge, Farmingdale, Budds Lake, Retreat, Batsto, Catfish Pond. About 25 miles of telephone line has been constructed to connect these towers with trunk lines and about 20 more miles of private lines have been constructed in co-operation.

Equipment.—Each section warden has been equipped with tools and apparatus for about 30 men and arrangements have been made for privately owned automobiles for transportation of the entire force of firefighters and arrangements made for the necessary air patrol and reconnaissance.

Methods.—Division and section firewardens are put on a competitive basis—comparative figures of area burned, cost, get-away time and efficiency are always before them. Yearly the statistics and methods of each section are carefully analysed and studied, corrections made and the service strengthened for the next year. From a special report the operations at every fire that burns 100 acres or more is analysed and criticized. During the fire season a daily forecast of fire conditions is made, warning sent out to each division warden, section warden and lookout watcher. Reports of all fires and operations are sent to Trenton headquarters every night.

Public Relationship.—Section firewardens are required to organize and educate the people living in their sections so that the public may realize the danger and importance of forest fires and will not only exercise care but will give warning when a fire is discovered. They give talks at schools and other meetings and see that the necessary signs and posters are put up. They report all violations of the forest-fire law and fix the responsibility for the carelessness which starts the fires. Arrangements have been made with the telephone companies so that a central will connect any person calling with the nearest firewarden. Report of fires and warning as to fire weather is given to the public through the press and radio daily during the fire season from State headquarters. Special articles on forest fires are

prepared for publication from time to time. A film giving the story of a forest fire and the work of the wardens has been prepared for distribution.

Statistics.—Since the reorganization 4,442 fires have been extinguished, \$17,871 in fines collected and 2,370 violations of the law established. The average size of the fire in the 10 years 1913 to 1923 was 101 acres, in the four years 1924 to 1926 it was 53 acres. Ninety-five percent of the fires do not reach this average size, and the other five percent are large fires responsible for about eighty percent of the acres burned. Comparison of property protected, cost of protection, loss through fire with 10 year average—1913 to 1923, with the 4 year average—1924 to 1926—and with the large cities in New Jersey is as follows:

COST AND LOSS PER \$100 OF VALUE

	<i>Property</i>	<i>Cost</i>	<i>Loss</i>	<i>Cost-Loss</i>
Forest Fire Service 10 yr. average	\$100	\$0.11	\$3.25	\$3.37
Forest Fire Service 4 yr. average	100	.21	2.28	2.49
City Fire Depts., 4 yr. average	100	.49	.40	.89

Recommendations.—While these figures are only approximate it is fair to conclude that the cost-plus-loss item must be reduced to about 89 cents before adequate protection for reasonable insurance is reached.

In order to reach this figure the following recommendations are made: 1st, to decrease the number of fires and to provide lines on which large fires may be stopped, a law should be passed requiring the brushing out of the forest along railroads and roadsides; 2d, a small increase should be made in personnel to build up the weaker sections and to supervise clearing operations; 3d, entire State control instead of partial township control should be established in the interest of economy and efficiency; 4th, aero equipment should be provided as the only means of prompt control of large fires.

Report of the Division of Waters

1924-1927

H. T. CRITCHLOW, CHIEF

INTRODUCTION

During the four-year period covered in this report there has been continued expansion in the activities on water-supply matters, necessitating the creation of a separate Division of Waters on July 1, 1924. The technical force has increased from 4 to 7, clerical from 2 to 3, local observers from 21 to 46, 10 of whom are employed on ground water investigations started during the period.

The drought of the summer of 1923 showed that many of the public water supplies throughout the State had inadequate capacity in their sources of supply to meet the demands of a critical period. This caused increased activity in the development of new sources of supply, resulting in the filing of 124 applications for diversion during the four years, or an average of 31 per year, as compared with 26 applications during the preceding two years, or 13 per year. The Board approved 116 applications authorizing the diversion of 163.7 million gallons daily, 70.1 million gallons daily from surface and 93.6 million gallons daily from ground waters. The importance of ground water as a source of public supply is shown in these figures, particularly since 108 of the 116 approvals given were for underground diversion.

The Department has been studying the ground water through its Division of Geology for many years, particularly from the geological standpoint. The necessity for information as to the safe yield of the different ground water horizons resulted in a special investigation of these resources during the past four years. This study was made in co-operation with the United States Geological Survey and has resulted in the collection of valu-

able data on the occurrence and movement of ground waters in certain areas of the State. Mr. David G. Thompson, Geologist, of the United States Geological Survey, was in charge of this investigation.

The work on the inspection of dams has increased, due largely to the construction of lakes in connection with real estate and recreational developments. During the four-year period plans for 70 dams have been approved, as compared with plans for seven during the preceding two years. This work has been in charge of Mr. John N. Brooks, Hydraulic Engineer, since October 1, 1924. Mr. John L. Weber acted as Hydraulic Engineer from September 15, 1923, to September 30, 1924.

The stream gaging work has been continued in co-operation with the United States Geological Survey, Mr. O. W. Hartwell, District Engineer.

The supervisory work on water supply development and the construction of dams as required by law must be carried on as necessity requires. The investigational work on our water resources must be continued uninterruptedly to receive the greatest benefit and make available records that will cover critical periods. The demands for accurate information on these subjects are ever increasing on account of the work which the Division must do under the law, and also due to the need for information by engineers and officials in charge of the development of our water resources.

WATER SUPPLY

Permits for the Diversion of Water.—Acting under the provisions of Chapter 252, Laws of 1907, and Chapter 304, Laws of 1910, which relate to the diversion of water for potable and public use, the Board of Conservation and Development has considered applications for permits to divert water, and under the provisions of Chapter 152, Laws of 1917 (Article XXXII, Sections 1 and 15), has considered contracts for the supply of water between municipalities.

These activities of the Board are summarized in the following table:

REPORT OF DIVISION OF WATERS

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Year Ended June 30

	1924	1925	1926	1927
Applications for right to divert:				
Approved	9	28	32	27
Withdrawn	0	0	1	2
Disapproved	0	0	3	2
Applications for approval of Contract:				
Approved	3	6	3	8
Applications for Transfer of Rights:				
Approved	1	0	2	2
Total number of Decisions..	13	34	41	41
Quantity of Water Approved for Diversion—Million Gallons Daily:				
Surface	50.000	2.000	10.050	8.060
Underground	12.580	19.024	29.145	32.858
Total	62.580	21.024	39.195	40.918

The name of each applicant, the date of action by the Board, the quantity of water to be diverted and its source, whether surface or underground are shown in the following table:

YEAR ENDED JUNE 30, 1924

Application Number	Name of Applicant	Date of Approval	Quantity Approved for Diversion Million Gallons Daily	
			Surface	Underground
150	Stone Harbor, Borough of	July 12, 1923		0.720
151	Park Ridge, Borough of	Nov. 8, 1923		0.200
152	Evans, Charles N., Development			
153	ment Co.	Nov. 8, 1923		0.025
154	Salem, City of	¹ Nov. 8, 1923		(Cancelled)
155	North Jersey District Water Supply Commission	² Jan. 16, 1924	50.000	
155½	Garfield, City of	Jan. 16, 1924		(Contract)
156	Camden, City of	Jan. 16, 1924		10.000
155	Hoboken, City of	Feb. 14, 1924		(Contract)
158	Berlin, Township of	Feb. 14, 1924		1.000
159	Egbert Water Co.	³ Feb. 14, 1924		0.360
160	Ocean Gate Water Co.	Mar. 13, 1924		(Transfer of rights)
161	Wallington, Borough of	April 7, 1924		0.275
162	Riverdale, Borough of	April 7, 1924		(Contract)

¹ Approval withdrawn October 9, 1924.² In addition to 50. m. g. d. granted December 16, 1926.³ Rights transferred to New Jersey Water Co. April 14, 1926. Cancelled July 2, 1926.

CONSERVATION AND DEVELOPMENT

YEAR ENDED JUNE 30, 1925

Application Number	Name of Applicant	Date of Approval	Quantity Approved for Diversion Million Gallons Daily	
			Surface	Underground
165	Atlantic County Water Company,	July 10, 1924	2.000	(Cancelled)
164	Ramsey, Borough of	July 10, 1924		1.120
166	Stockton Water Co.	July 10, 1924		1.500
167	Essex Fells, Borough of	Sept. 11, 1924		0.700
169	Cliffwood Beach Co., Inc.	Sept. 11, 1924		0.075
170	Lodi, Borough of	Sept. 11, 1924		2.000
171	National Park, Borough of	Sept. 11, 1924		0.400
172	Ridgewood, Village of	Sept. 11, 1924		2.500
173	Ocean City Water Co.	Sept. 11, 1924		2.000
163	Salem, City of	Oct. 9, 1924		
174	Avon-by-the-Sea	Oct. 9, 1924		1.152
175	Lawrenceville Water Co.	Oct. 9, 1924		0.050
176	Garfield, City of	Oct. 9, 1924		0.280
177	Lavallette, Borough of	Oct. 9, 1924		0.200
179	Brigantine Water Co.	Nov. 13, 1924		0.250
180	Rockaway, Borough of	Nov. 13, 1924		0.432
178	Keansburg, Borough of	Dec. 11, 1924		1.000
181	Crane, Arthur D., Co.	Dec. 11, 1924		0.040
183	Merchantville Water Co.	Jan. 8, 1925		1.500
184	Brighton Mills	Jan. 8, 1925		0.100
157	Montclair, Town of	Mar. 12, 1925		(Contract)
182	Bloomfield, Town of	Mar. 12, 1925		(Contract)
186	Kearny, Town of	Mar. 12, 1925		(Contract)
185	Gindin, Samuel	Mar. 12, 1925		0.300
187	Homelands Development Co.	Mar. 12, 1925		(Cancelled)
188	Collingswood, Borough of	Mar. 12, 1925		1.000
190	Passaic Consolidated Water Co. ..	April 6, 1925		(Cancelled)
192	Egg Harbor, City of	May 6, 1925		0.200
193	Vineland, Borough of	May 6, 1925		1.500
194	Margate City, City of	May 6, 1925		0.720
191	Nutley, Town of	June 11, 1925		(Contract)
195	Wildwood, City of	June 11, 1925		1.000
196	Home Colony, Inc.	June 11, 1925		0.005
197	East Orange, City of	June 11, 1925		(Contract)

YEAR ENDED JUNE 30, 1926.

Application Number	Name of Applicant	Date of Approval	Quantity Approved for Diversion Million Gallons Daily	
			Surface	Underground
189	Mountain Lakes, Borough of	Sept. 10, 1925	5.000	(Disapproved)
198	Red Bank, Borough of	Sept. 10, 1925		1.000
199	Pitman, Borough of	Sept. 10, 1925		0.100
200	Commonwealth Water Co.	Sept. 10, 1925		2.500
205	Commonwealth Water Co.	Sept. 10, 1925		0.450
201	Moorestown, Township of	Sept. 10, 1925		1.800
203	Monmouth County Water Co.	Sept. 10, 1925		1.728
207	New Jersey Water Co.	Sept. 10, 1925		0.750
208	Point Pleasant Beach, Borough of,	Oct. 8, 1925		2.500
209	Lakehurst, Borough of	Oct. 8, 1925		0.060
202	Garfield, City of	Oct. 19, 1925		3.000
210	Mount Holly Water Co.	Nov. 12, 1925		1.000
211	Tintern Manor Water Co.	Nov. 12, 1925		
206	Atlantic City, City of	Nov. 12, 1925		1.500
212	Haddonfield, Borough of	Nov. 12, 1925		0.500
204	Commonwealth Water Co.	Nov. 12, 1925		1.500
213	Medford Water Co.	Dec. 3, 1925		0.150
214	Roebling's, John A., Sons Co.	Dec. 3, 1925		1.000
215	Commonwealth Water Co.	Jan. 7, 1926		0.375
217	Dover, Town of	Jan. 7, 1926		1.500
216	Morristown, Town of	Mar. 10, 1926		(Withdrawn)
218	McGalliard, William V.	Mar. 10, 1926		0.025
219	Gloucester, City of	Mar. 10, 1926		1.500
220	Mountain Lakes, Borough of	Mar. 10, 1926		0.500

¹Rights transferred to New Jersey Water Co., October 8, 1925.

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YEAR ENDED JUNE 30, 1926 (Continued).

Application Number	Name of Applicant	Date of Approval	Quantity Approved for Diversion Million Gallons Daily	
			Surface	Underground
221	Sea Isle City, City of	Mar. 10, 1926		0.850
222	Sterling Farm Agency, Inc.	Mar. 10, 1926		0.050
223	Asbury Park, City of	April 14, 1926		2.000
224	East Paterson	April 14, 1926		(Contract)
225	New Brunswick, City of	April 14, 1926	5.000	
226	Passaic Consolidated Water Co. ..	¹ April 14, 1926	0.050	
227	Cedar Grove, Township of	April 14, 1926		(Contract)
228	Union Beach, Borough of	May 12, 1926		0.720
229	Ashland Terrace Water Co.	May 12, 1926		0.200
230	Runnemede Water Co.	² May 12, 1926		0.087
231	Riverton and Palmyra Water Co.,	May 12, 1926		1.500
232	Ship Bottom-Beach Arlington Borough of	June 9, 1926		0.300
233	Highland Park, Borough of	June 9, 1926		(Contract)

YEAR ENDED JUNE 30, 1927

Application Number	Name of Applicant	Date of Approval	Quantity Approved for Diversion Million Gallons Daily	
			Surface	Underground
234	New Jersey Water Co.	July 2, 1926		0.720
235	Avon-by-the Sea, Borough of	July 2, 1926		1.000
236	Glassboro, Borough of	Aug. 4, 1926		0.500
237	South Belmar, Borough of	Aug. 4, 1926		(Contract)
239	Hackensack Water Co.	Aug. 4, 1926		(Cancelled)
238	Margate, City of	Sept. 8, 1926		0.600
240	Mountain Lakes, Borough of	Sept. 8, 1926		(Withdrawn)
241	Tuckerton Water Co.	Sept. 8, 1926		0.150
243	Florham Park, Borough of	Oct. 13, 1926		0.250
245	Perth Amboy, City of	Oct. 13, 1926		2.000
246	Saddle River Township	Oct. 13, 1926		(Contract)
247	Brooklawn, Borough of	Oct. 13, 1926		0.200
242	Morristown, Town of	Nov. 10, 1926	3.000	
244	Parsippany Water Co.	Nov. 10, 1926		0.036
248	Mountain Lakes, Borough of	Nov. 10, 1926		0.300
249	Denville, Township of	Nov. 10, 1926		0.500
250	Commonwealth Water Co.	Dec. 8, 1926	5.000	
251	Clifton, City of	Dec. 8, 1926		(Contract)
252	Atlantic County Water Co.	Dec. 8, 1926		0.575
253	Camden, City of	Jan. 12, 1927		1.700
256	Point Pleasant Beach	Feb. 9, 1927		(Contract)
258	Ventnor, City of	Feb. 9, 1927		0.750
259	Greenbrook and North Caldwell Water Co.	Feb. 9, 1927		(Contract)
254	Mt. Ephraim, Borough of	Mar. 9, 1927		(Withdrawn)
260	Paulsboro, Borough of	Mar. 9, 1927		0.864
261	Union Beach, Borough of	Mar. 9, 1927		(Contract)
263	Atlantic City, City of	April 20, 1927		20.000
264	Spring Lake, Borough of	April 20, 1927		1.500
265	Hamburg, Borough of	April 20, 1927		0.200
266	Colonial Manor Water Co.	April 20, 1927		0.288
267	Elmer Water Co.	May 11, 1927		0.250
268	Ringwood Company	May 11, 1927		0.075
269	Bloomsbury Water Co.	May 11, 1927	0.060	
272	Kearny, City of	May 11, 1927		(Contract)
273	Mt. Ephraim, Borough of	May 11, 1927		(Contract)
255	New Jersey Water Co.	June 8, 1927		(Disapproved)
257	Runnemede, Borough of	June 8, 1927		(Disapproved)
270	Jamesburg Water Co.	June 8, 1927		0.150
271	Netcong, Borough of	June 8, 1927		0.250

¹For Little Falls Water Co. Right transferred to Mountain Water Service Co., October 13, 1926.

²Right transferred to New Jersey Water Co., November 10, 1926.

Excess Diversion Charges.—Under the provisions of Chapter 252, Laws of 1907, and Chapter 304, Laws of 1910, all municipal corporations, corporations or persons diverting water, either from surface, sub-surface, well or percolating sources, or from any combination of such sources for public water supply purposes, are required to keep accurate records by meter or other approved methods of the amount of water used and to report the same quarterly to the Board, as successor to the State Water Supply Commission. The Act of 1907 imposes certain charges for the excess diversion of water from surface sources.

For these years the Board fixed a rate of \$1 per million gallons, the minimum rate provided by law. Certification was made to the State Comptroller of the amounts due the State as per the table below. Each amount has been paid in full.

EXCESS DIVERSION OF SURFACE WATERS

<i>Calendar Year</i>	<i>Total Free Allowance in Million Gallons</i>	<i>Total Diversion in Million Gallons</i>	<i>Excess Diversion in Million Gallons and Charge in Dollars</i>
1923	57,165.417	85,215.861	28,050.46
1924	57,767.985	85,807.985	28,040.02
1925	57,718.496	89,833.296	32,114.83
1926	57,429.260	93,130.200	35,700.94

Consumption.—The tables below show the gross and per capita consumption of water for 1923, 1924, 1925 and 1926.

CALENDAR YEAR 1923

<i>SOURCE OF SUPPLY</i>	<i>Number of Systems</i>	<i>Population Supplied</i>	<i>Consumption (Gallons Daily)</i>	
			<i>Total</i>	<i>Per Person</i>
Surface	49	1,983,735	228,217,000	115
Underground	146	734,772	75,051,000	102
Combination	14	354,831	39,697,000	112
Totals	209	3,073,338	342,965,000	112

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CALENDAR YEAR 1924

SOURCE OF SUPPLY	Number of Systems	Population Supplied	Consumption (Gallons Daily)	
			Total	Per Person
Surface	44	1,994,843	226,045,000	113
Underground	144	761,500	76,565,000	101
Combination	15	373,699	40,285,000	108
Totals	203	3,130,042	342,895,000	110

CALENDAR YEAR 1925

SOURCE OF SUPPLY	Number of Systems	Population Supplied	Consumption (Gallons Daily)	
			Total	Per Person
Surface	43	2,029,947	236,775,000	117
Underground	149	810,958	82,612,000	102
Combination	16	418,312	42,692,000	102
Totals	208	3,259,217	362,079,000	111

CALENDAR YEAR 1926

SOURCE OF SUPPLY	Number of Systems	Population Supplied	Consumption (Gallons Daily)	
			Total	Per Person
Surface	43	2,028,226	240,260,000	118
Underground	153	874,632	83,966,000	96
Combination	15	433,912	48,330,000	111
Totals	211	3,336,770	372,556,000	112

Measurement of Water Consumption.—The work of measuring the consumption of water with a portable meter was continued during 1923 to 1927 on a number of systems which have no means of measuring the water used. The results of these tests were used as a basis for determining the quantity of water diverted from the sources of supply. Measurements were made as follows:

CONSERVATION AND DEVELOPMENT

Boonton Water Department—May 19 to June 3, 1924.
June 7 to 21, 1926.
Bound Brook Water Company—June 6 to July 28, 1924.
Branchville Water Department—September 29 to October 11, 1922.
Buckhorn Springs Water Company (Belvidere)
September 18 to 26, 1924.
August 15 to 22, 1926.
Butler Water Company—June 24 to 30, 1926.
Hackettstown Water Department—September 10 to 17, 1924.
May 18 to 25, 1926.
Newton Water Department—September 15 to 23, 1922.
May 28 to June 3, 1926.
Sussex Water Department—July 30 to August 12, 1926.
Washington Water Company—August 7 to September 2, 1924.
May 10 to 17, 1926.

INSPECTION OF DAMS

During the four-year period covered by this report, the Board has approved the plans for a total of 70 dams. Their engineers have made 184 inspections of these structures during construction. The majority of the dams have been built to form lakes in connection with real estate developments. In the examination of existing dams the engineers have made 258 inspections. In a few instances our attention has been directed to structures where the drainage area is less than one square mile, but no action has been taken even where unsafe structures existed, because the present law exempts all such dams from the supervision of the Board. This raises the question as to whether it is in the interest of public safety to amend the law to bring such structures under the jurisdiction of the Board upon complaint of interested parties whose property might be endangered.¹

The work of the Department in relation to dams is summarized in the following table:

¹The Legislature of 1928 amended the law (Sec. 1, Chap. 243, P. L. 1912), reducing the drainage area limitation to one-half square mile.

REPORT OF DIVISION OF WATERS

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Item	Year ending June 30			
	1924	1925	1926	1927
Number of proposed new dams, plans for which were reviewed and acted upon by the Board	17	14	16	23
Number of inspections of above dams while under construction	56	46	38	44
Number of inspections of dams, plans for which had been reviewed in earlier years ..	11	25	18	44
Number of existing dams inspected for stability and safety	103	90	40	25
Total number of dams inspected	120	104	56	48
Total number of inspections made ..	170	161	96	113

The data obtained by these inspections are preserved in the Department files. On June 30, 1927, the facts regarding 468 dams were on file.

STREAM GAGING

Aid from the United States Geological Survey.—In consequence of the appropriation made from the water-supply fund by the Legislature of 1921 for water-supply investigations, a co-operative agreement was made with the U. S. Geological Survey for re-establishing and maintaining the stream-gaging work which had been abandoned in 1914 on account of lack of funds. Under this agreement, that bureau detailed Mr. O. W. Hartwell, District Engineer, to take charge of this work on July 1, 1921, under the general supervision of this Department. Mr. Otto Lauterhahn, Assistant Engineer, was also assigned to work in New Jersey, and has met the requirements of the State Civil Service Commission. On January 1, 1924, a junior engineer was added to the stream gaging force. This position was held by Mr. H. C. Barksdale from January 1, 1924 to December 31, 1926; by Mr. R. B. Letcher from February 4, to May 19, 1927, and by Mr. W. R. Voght from June 15, 1927, to date. The Federal Bureau has provided funds for this work from which are paid one-half the salary to the district engineer and the junior engineer, together with certain other expenses, also special equipment for stream gaging.

Work in progress.—At the close of the fiscal year 1926-27, there were thirty-six stream gaging stations, of which twenty-eight were equipped with automatic recording gages. Progress made during the period covered by this report was as follows:

<i>Year</i>	<i>During year</i>		<i>Stations at end of year</i>	
	<i>Stations Establish- ed</i>	<i>Stations Discon- tinued</i>	<i>With water stage recorders</i>	<i>Total</i>
1922-23			14	32
1923-24	4	0	21	36
1924-25	0	1	22	35
1925-26	1	0	28	36
1926-27	2*	1	29*	37*

*Includes station on Batsto River, established September 20, 1927.

It has been found necessary to install the automatic instruments in order to overcome trouble from daily fluctuations in the streams caused by artificial regulation of the flow by mill operators, etc., and to eliminate difficulty in getting competent gage readers at some of the remotely located stations. Furthermore, the automatic record is not open to the question of human error which might be raised by parties inclined to discredit our records. The interest in this work throughout the State is reflected in the fact that one-third of the gaging stations have been constructed largely at the expense of co-operating parties, the Department maintaining and operating most of them. The following table gives a complete list of stations being operated, type of gage and name of co-operating party.

LIST OF GAGING STATIONS

Station	Location	Gage	Cooperating Party
Hackensack River	New Milford	Automatic	Hackensack Water Co.
Passaic River	Millington	Automatic	
Passaic River	Paterson	Automatic	
Rockaway River	Boonton	Automatic	Jersey City Water Department.
Whippany River	Morristown	Staff	Department of Public Works, Town of Morristown.
Ramapo River	Mahwah	Automatic	
Ramapo River	Pompton Lakes	Automatic	Boro. of Pompton Lakes and Jersey Central Power & Light Co.
Wanaque River	Greenwood Lake	Automatic	No. Jersey District Water Supply Commission.
Wanaque River	Wanaque	Automatic	No. Jersey District Water Supply Commission.
Pequannock River	Macopin	Automatic	Newark Water Department.
Saddle River	Lodi	Automatic	
Elizabeth River	Elizabeth	Automatic	
Rahway River	Rahway	Staff	
Robinsons Branch, Rahway River	Goodmans	Staff**	
South Branch, Raritan River	High Bridge	Automatic	Taylor-Wharton Iron & Steel Company.
South Branch, Raritan River	Stanton	Automatic	
Raritan River	Manville	Automatic	
North Branch, Raritan River	Far Hills	Automatic	Somerset Lake and Game Club.
North Branch, Raritan River	Milltown	Staff	
Black River	Pottersville	Automatic	
Millstone River	Blackwells Mill's	Staff	
Green Brook	Bound Brook	Staff	
Lawrence Brook	Farrington Dam	Automatic	City of New Brunswick.
Lawrence Brook	Patricks Corner	Automatic***	
Swimming River	Red Bank	Automatic	Tintern Manor Water Company.
Batsto River	Batsto	Automatic	
Absecon Creek	Absecon	Automatic	Atlantic City Water Department.
Great Egg Harbor River	Folsom	Automatic	
Delaware River	Belvidere	Staff	
Delaware River	Riegelsville	Automatic	
Delaware River	Trenton	Chain	U. S. Weather Bureau.
Flat Brook	Flatbrookville	Automatic	
Paulins Kill	Blairstown	Automatic	
Pequest River	Pequest	Automatic	
Beaver Brook	Belvidere	Automatic	
Musconetcong River	Hackettstown	Automatic	
Musconetcong River	Bloomsbury	Automatic	Warren Manufacturing Company.
Assunpink Creek	Trenton	Automatic	
North Branch, Rancocas Creek	Pemberton	Automatic	

*The flow of the Passaic River at Paterson has been determined by compilation of records furnished by the Society for Establishing Useful Manufactures, Newark Water Department, Jersey City Water Department, East Orange Water Department, and Commonwealth Water Company.

**Discontinued December 31, 1925.

***Discontinued December 31, 1926.

Nature of work.—Stream gaging work consists primarily in keeping a continuous record of the actual flow of the streams. Only a portion of the rainfall and snowfall finds its way into the surface stream. The relation between the precipitation and surface run-off in the streams varies so widely with different conditions of topography, character of soil and underlying strata, forest cover, vegetation, temperature, wind movement, distribution of rainfall, etc., that direct measurement of the run-off is the only satisfactory way of determining its amount.

Records of the flow of New Jersey streams are necessary in determining the amount of water that they may be depended upon to yield for water supply or other purposes. Stream flow varies so much from day to day, from month to month, and from year to year, that a single measurement or a single season's record cannot give the true measure of a stream.

Continuous records.—It is important that these records extend over a period of years. Records of 10 years are of considerable value, but in such a short period the maximum and minimum conditions of the flow may not occur. These extremes, as well as reliable averages, are needed before accurate studies of our water resources can be made.

Available data.—The stream-gaging information collected by the United States Geological Survey is published in the Water Supply Papers by run-off years, ending September 30. These papers give the following information for each gaging station: Description of station, list of discharge measurements, tables of daily and monthly discharge. There is necessarily some delay in getting this information into print. Therefore, the Survey and this Department are prepared to furnish data on file in their offices in blueprint form upon request from interested parties. In requesting this information, give name of stream, location, and character of information desired.

Records of stream flow in New Jersey may also be found in the following publications:

Geological Survey of New Jersey, Volume III, 1894;

Annual Reports of the State Water Supply Commission of New Jersey for 1908 and 1913;

Water Supply Papers of the United States Geological Survey, as per following table:

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<i>Year</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>
1903	97	1915	401
1904	125	1916	431
1905	166	1917	451
1906	202	1918	471
1907-8	241	1919-20	501
1909	261	1921	521
1910	281	1922	541
1911	301	1923	561
1912	321	1924	581
1913	351	1925	601
1914	381	1926	621

Descriptions of Stations.—On page 62 et seq. of the Annual Report of the Department for 1922-3, will be found descriptions of gaging stations which were in operation at the time of preparation of that report. The following stations have since been equipped with automatic recording gages:

<i>Station</i>	<i>Recorder Installed</i>
Passaic River near Millington	July 3, 1925
Wanaque River at Greenwood Lake	April 1, 1926
So. Branch Raritan River at Stanton	August 17, 1925
No. Branch Raritan River at Far Hills	June 18, 1925
Flat Brook near Flatbrookville	January 6, 1926
Pequest River at Pequest	June 22, 1926

Descriptions of the following stations have not been previously published:

LAWRENCE BROOK AT FARRINGTON DAM

Location.—At Farrington Dam, one-half mile southeast of Milltown, Middlesex County, $1\frac{5}{8}$ miles downstream from mouth of Beaver Dam Brook, and $3\frac{3}{4}$ miles upstream from mouth of Lawrence Brook.

Drainage Area.—34 square miles (measured on State topographic maps).

Records Available.—May 7, 1927, to date. At Patricks Corner, $2\frac{1}{2}$ miles upstream, June 21, 1922, to December 21, 1926.

Equipment.—Water-stage recorder in shelter on left abutment of dam. Discharge measurements made by wading below dam.

Control.—Concrete dam with spillway 300 feet long which contains notch 9.95 feet long and half foot deep.

Cooperation.—Shelter for water-stage recorder built and recorder inspected by employees of the City of New Brunswick, Mr. Asher Atkinson, City Engineer.

BATSTO RIVER AT BATSTO

Location.—Near pond at county highway bridge, Batsto, Burlington County and three-fourths mile upstream from mouth of Batsto River.

Drainage Area.—71 square miles (measured on State topographic maps).

Records Available.—September 20, 1927, to date.

Equipment.—Water-stage recorder on right bank, 300 feet downstream from pond. A vertical staff gage in pond is read once daily.

Discharge measurements are made by wading near gage.

Channel and Control.—Channel, sand. Control, a 6x6-inch wooden sill, 42 feet long, 50 feet below gage, set in concrete foundation.

Diversion and Regulation.—Occasionally a water wheel diverts a small amount of water from the pond around gaging station to operate a pump and feed mill. The operation of gates in dam and saw mill above gage slightly affect distribution of flow.

GREAT EGG HARBOR RIVER AT FOLSOM

Location.—At county Highway bridge, 1 mile south of Folsom, Atlantic County, and 2¼ miles upstream from mouth of Penny Pot Stream.

Drainage Area.—56 square miles (measured on State topographic maps).

Records Available.—September 8, 1925, to date.

Equipment.—Water-stage recorder on right bank, 15 feet upstream from bridge.

Discharge measurements made by wading near gage or from bridge.

Channel and Control.—Channel, sand; banks overflow at high stages. Control, sand bar under bridge; shifting.

GROUND WATER SUPPLIES

Importance.—By ground water is meant the water present in the sands, gravels and rocks beneath the surface of the ground. This water is made available for potable and industrial use by means of wells.

Many communities are practically dependent on ground water for their public water supply because their location makes the expense of developing surface supplies prohibitive. This is particularly true of the seashore resorts situated on the string of islands reaching from Point Pleasant to Cape May.

From 1917 to 1924, ground water comprised 27 per cent of the total amount of water furnished from public supplies. Thirty (30) per cent of the total population supplied received ground water.

REPORT OF DIVISION OF WATERS

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The amount of water diversion which has been approved by the Board of Conservation and Development during the past four years is as follows:

	<i>Year ending June 30</i>			
	1924	1925	1926	1927
	<i>Millions of Gallons Daily</i>			
Surface	50.0	2.0	10.1	8.1
Underground	12.6	19.0	29.1	32.9
Total	62.6	21.0	39.2	41.0

The grant of 50 million gallons daily of surface water in 1924 was to the Wanaque development of the North Jersey District Water Supply Commission. If this single large grant is omitted it is seen that in the past four years the new diversions of underground water have been nearly five times as great as of surface water.

The largest developers of ground water and their 1926 consumption are as follows:

Camden Water Dept.	16.92	million	gallons	daily
Elizabethtown Water Co., Cons.	8.46	"	"	"
Plainfield-Union Water Co.	7.88	"	"	"
Perth Amboy Water Dept.	7.75	"	"	"
Atlantic City Water Dept.	6.66	"	"	"
Commonwealth Water Co.	6.34	"	"	"

In addition to the ground water developed for public supplies, a large amount is developed by private owners such as hotels, laundries, creameries and manufacturing plants. A partial survey covering only a few cities showed the development for private uses of 35 million gallons in 1924.

Investigations.—During the past 50 years the New Jersey State Geological Survey, now administered by the Department of Conservation and Development, has collected information concerning wells throughout the State. This information covers the distribution of the water-bearing sands, gravels and rocks, the depth at which they lie, the quantity of water yielded by wells and the quality of the water.

A comprehensive report assembling and analyzing these data, has been prepared by the late Doctor M. W. Twitchell, former Assistant State Geologist. Although this report has not been published, the information contained in it has been freely supplied to well drillers and others who have sought it.

Doctor Twitchell's report brought out the fact that in portions of the State there has been a marked lowering of the water level and a decrease in the yield of many wells. These facts suggested the desirability of further study to determine, if possible, the ultimate capacity of the various water-bearing beds. This Department in 1923 therefore arranged with the United States Geological Survey for a co-operative investigation of the ground water resources of the State.

Co-operation.—Mr. David G. Thompson, of the United States Geological Survey, was assigned to take charge of this investigation. With headquarters in the office of the Department of Conservation and Development from July 1, 1923, until July 1, 1927. He was assisted by a junior engineer of the Federal Survey*, by the Department's personnel, and had the benefit of counsel with other members of the Survey.

Since the time and funds available made it impossible to investigate the ground-water situation throughout the entire State, certain typical localities were selected for intensive studies, in the expectation that, from the data obtained, certain general conclusions could be drawn.

The most detailed work has been done in Atlantic City and vicinity. Observations have also been made in the well fields of the Camden Water Department, the Perth Amboy Water Department, the Princeton Water Company, the Asbury Park Water Department, the Belmar Water Department, the Water Department of Avon-by-the-Sea, the Commonwealth Water Company and the Garfield Water Department.

In connection with the study of water available for recharging the water-bearing beds, experiment stations for measuring the evaporation from both water surfaces and from land areas

*Henry C. Barksdale, Junior Engineer, January, 1924, to September, 1924, and December, 1926, to date.

Ernest W. Downs, Junior Engineer, October, 1924, to November, 1926.

were established at the Atlantic City Water Works and the Perth Amboy Water Works.

Studies at Atlantic City.—Although the investigation is incomplete and is still being carried on, certain results have been obtained which are here summarized as follows:

In the Atlantic City region an average of about 8 million gallons a day is pumped from wells about 800 feet deep, tapping the sands of the Kirkwood formation and located from a few hundred to a few thousand feet from the ocean. Since the first wells were drilled about 30 years ago, as the pumpage has increased the water level has dropped gradually. Whereas the first wells flowed and the water rose in pipes to an elevation of about 20 feet above sea level, at the end of June, 1927, in Atlantic City, the static elevation in observation wells was about 65 feet below sea level, indicating a total drop of about 85 feet. Daily observations of the static elevation show that as pumpage increases in summer the water level drops gradually and as it decreases after the close of the resort season the water level rises. From this fact and from a consideration of the principles of hydraulics it is concluded that there will be a further lowering of the water level as the average daily pumpage increases from year to year. Enough data have not yet been obtained to enable a prediction as to how great the future lowering of the water level may be, but there is some indication that with the increase in pumpage expected in the next 25 years the water level in the wells may be lowered at least to between 100 and 200 feet below sea level.

The elevation of the water in the 800-foot sand bed at Atlantic City has been below sea level for many years. In other localities where wells are similarly located so near to the ocean, heavy pumping has caused salt water to be drawn in. The possible danger of salt-water contamination in the Atlantic City region therefore becomes an important problem. Some wells have actually yielded salt water, but in every such case it has been proven that the salt has entered from upper horizons through defects in the well casing. The water from properly constructed wells in Atlantic City contains only 6 to 15 parts per million of chloride, which shows that as yet salt water has not been

drawn in from beneath the ocean. However, the mere fact that contamination has not occurred is no assurance that it may not occur in the future. Certain conditions indicate that salt-water contamination is entirely possible, although it may not happen within the near future. Careful attention is being given to this problem.

Investigations of ground-water supplies on the mainland in the Atlantic City region suggest that a large supply can be obtained from wells 100 to 200 feet deep, drawing on the sands of the Cohansey formation. Although data are lacking as to certain critical conditions, there is some indication that the capacity of the water-bearing formations lying at a depth of less than 200 feet is somewhat better than the 800-foot formation, which is used along the beaches. However, in considering the development of water from these shallow horizons due precaution must be taken against salt-water contamination.

Studies at Camden.—In Camden and vicinity a total of about 30 million gallons a day is pumped from wells, mostly from water-bearing beds known as the Raritan formation. Even with this heavy pumpage there appears to have been no important lowering of the static water level, and it is evident that with a proper distribution of wells to prevent interference with existing supplies a large additional supply can be developed. The Raritan in this locality is probably the best water-bearing formation in the entire State. The well system of the Camden Water Department constitutes one of the largest developments of ground water for public supply in the United States. With the increase in population of the Camden region following the completion of the Delaware River bridge, the consumption of ground water will doubtless increase considerably and it is important to determine more fully the probable safe yield of the formations in the region.

Studies at Asbury Park.—In the vicinity of Asbury Park there are three water-bearing horizons, namely, in descending order, the Mount Laurel-Wenonah, the Englishtown, and the Raritan. At Asbury Park they lie at depths of about 400, 500, and 900 feet, respectively. Although the pumpage from the Mount Laurel-Wenonah formation is not great, there has been an

inordinate lowering of the water level in the formation and it is evident that its water-bearing capacity is not great. The English-town formation is a better yielder than the Mount Laurel-Wenonah but the elevation of its water has already been lowered considerably and if a great draft is imposed on it the decline of the water level may be relatively even greater than that in the deep formation used at Atlantic City. The Raritan formation apparently has not been seriously affected by fairly heavy pumping and it offers the best opportunity for the future development of a large quantity of water in the Asbury Park region. However, the use of it is attended by two disadvantages: First, the great depth to which wells must be drilled, and second, the necessity of aerating and filtering the water to remove an excessive quantity of iron.

Studies at Princeton.—Although the Princeton supply is relatively small, the problems presented there are typical of those met in some parts of the State underlain by hard rock. The water-bearing rocks form a comparatively small underground reservoir that is filled up in wet seasons and is drained rapidly in the months of heavy draft. As a result there is a great range in the fluctuation of the water level, being about 125 feet in the first six months of 1925. The safe yield of the well field appears to have been reached and there is no great opportunity to increase materially the ground-water supply, except at a distance of several miles from the city.

Studies at Runyon.—In the Runyon region, extensive studies have not been made except for the collection of evaporation and stream-flow data. Certain puzzling conditions have been found, and pending the solution of these, definite conclusions have not been reached. However, it appears that although the Perth Amboy well field draws upon the same horizon as that which yields so much water at Camden, at the former place its water-bearing capacity is not as great as at the latter.

Metropolitan District.—Such work as has been done in the Metropolitan District shows that there are serious problems that should be given further study. In several industrial sections the water level has been lowered many feet below its original elevation. In two localities contamination of the ground water

has recently been reported under conditions that suggest that this may become a serious problem in other parts of the region where there is heavy pumping, resulting from its built-up character and the more or less open texture of the rocks.

Summary.—Many of the towns and cities of New Jersey depend solely on water supplies from wells. With the growth of these communities the pumpage is constantly increasing, and their future growth and industrial development necessarily requires further enlargement of their water supplies. The ground waters are, however, not unlimited in quantity, and along the coast there is danger that excessive pumping will ultimately draw in salt water and jeopardize the very existence of the communities affected. It is, therefore, wise public policy that these scientific studies of the valuable resource represented by the ground waters of the State be continued so that it can be prudently and economically developed.

It is well recognized by hydraulic engineers that in studies of surface water supplies systematic observations must be made covering a period of years in order to obtain records that will serve as a sound basis for development and that the value of these records increases with the length of time the observations are continued. Systematic records covering a number of years are even more necessary in quantitative studies of ground water, because the physical characteristics of the rocks and other conditions which control the ground water are complicated and the occurrence and movements of the ground water are likewise complicated. Although much valuable information has been obtained in the four years of ground-water investigation covered by the foregoing statement, the observations and study must be continued for a period of years, if results are to be obtained which will serve as a reliable basis for full development and utilization of the ground water supplies of the State.

Jurisdiction.—The law by which the Board of Conservation and Development is empowered to control the development of ground waters presents an unfortunate anomaly. Any municipality, corporation or person desiring to develop ground water for sale must obtain the consent of the Board to its proposed development. However, if the water is not to be sold, but is

to be used on the owner's premises as in an hotel or manufacturing plant, the Board has no jurisdiction. This situation practically defeats the purpose of the law; for example, in the Atlantic City region, while the Board can control the increased taking of water from the 800-foot sand by the Atlantic City Water Department it has no power to regulate the draft from this formation by the hotels and other private users. This is obviously unfair to the municipalities and prevents the Board from conserving these valuable underground waters in the interest of the public.

The Morris Canal

BY HENRY B. KÜMMEL

ACQUISITION BY THE STATE

Legislation of 1922.—After more than a quarter of a century of agitation, legislative debate and investigation by various commissions, the Legislature passed and the Governor approved on March 11, 1922, an act authorizing the acquisition of the Morris Canal. William H. Spear, of Jersey City; Frank H. Sommer, of Newark, and Louis A. Focht, of Trenton, were named commissioners to negotiate and agree upon terms of settlement with the Canal Company and the Lehigh Valley Railroad, its lessee. Upon the resignation of William Spear, Edward Young, of Jersey City, was appointed in his place, and the commission, organized with the election of Frank H. Sommer as President. The above act provided that the canal, if acquired, should pass to the custody of the Board of Conservation and Development, pending further action by the Legislature.

The Sommer agreement.—On November 29, 1922, these commissioners concluded an agreement with the canal company and the railroad by which the canal became the property of the State. In brief the agreement provided that the canal together with all its feeders, reservoirs, lands and structures, between the outskirts of Phillipsburg and the Hackensack River, together with all water rights wherever situated, as well as all outstanding canal stock owned by the railroad, and all bonds of the canal company and all personal property, passed to the State. The Lehigh Valley retained the canal terminals in Phillipsburg and the canal strip from the Hackensack River to Washington Street in Jersey City. The terminal properties in Jersey City were divided. The State became the sole owner of the Little Basin and the railroad company of the Big Basin. The rail-

road company agreed also to purchase and deliver to the State all outstanding stock of the canal company, then in the hands of the minority stockholders, and the State agreed to lend its powers of condemnation, if the stock could not be purchased at a fair price in open market.

In addition, the railroad company agreed to pay the State \$875,000 in five annual installments, with interest at five percent on deferred payments. The first payment was made December 15, 1922. Four additional payments with interest were made on each fifteenth of December for the years 1923, 1924, 1925 and 1926, and the obligation has been satisfied. The total payments with interest amounted to \$962,500.

The agreement provided also that the railroad would maintain the canal in the usual manner until March 1, 1923, but that all rentals and other income from the canal from January 1, 1923, should accrue to the State. These amounted to \$14,957.28, which sum was paid the State on March 1.

Transfer of stock and bonds.—On December 29, 1922, in accordance with the agreement, the Lehigh Valley delivered to the Board of Conservation and Development 21,320 shares of canal stock, \$41,480.00 of preferred stock scrip and \$500,000 of mortgage bonds, the entire issue. The capital stock issued and not delivered amounted to 680 shares. Subsequently 254 shares additional were turned over, leaving 426 outstanding. By the terms of the Sommer agreement, the Lehigh Valley Railroad is obligated to pay the guaranteed dividends on this stock until it is acquired and delivered to the State. Condemnation proceedings have been initiated and an award made. An appeal is now pending before the Court of Errors and Appeals.¹

Transfer of canal property.—On March 1, 1923, the physical property was transferred to the custody of the Board of Conservation and Development. The Board took over also the entire canal personnel, with the exception of Mr. Wm. I. Powers, Superintendent, who chose to remain with the Lehigh Valley Railroad. Mr. B. B. Metz, Chief Clerk, was appointed Superintendent. With the canal property, the railroad company, also,

¹The Court has sustained the award of the Commission and all stock except shares have now (Oct. 1, 1928), been delivered to the State.

turned over all title papers, leases, agreements, maps, etc., relating to it.

After a quarter of a century of effort the railroad was relieved of the necessity of maintaining an economic failure and the State was in possession of a right of way across the State, some parts of which were of great value for future highway use, and of water rights which were absolutely essential to the future development of needed water supplies.

Legislation of 1923.—The act of 1922, authorizing the acquisition of the canal, vested in the Board of Conservation and Development, the control and management of all the property to be acquired, subject to further action by the Legislature. On February 28, 1923, the Legislature passed and the Governor approved an act (Chap. 11, P. L. 1923) vesting title to the property, (except the stock, bonds and scrip), in the Morris Canal and Banking Company. A second act (Chap. 110, P. L. 1923) passed and approved March 19, vested title to the capital stock in the Board of Conservation and Development and declared the members of the board eligible to serve as directors of the canal company. A third act (Chap. 111, P. L. 1923) reduced the number of directors to eight, the same as the Board of Conservation and Development, and limited their powers. The Legislature adjourned without making provision for dismantling the canal or disposing of the property.

Reorganization of the canal company.—The first ensuing annual meeting of the stockholders of the canal company was held at its principal office in Jersey City on Monday, April 2, 1923, pursuant to its by-laws and legal notice. The holders of 21,451 shares were present in person or by proxy. By resolution duly carried the existing by-laws were repealed and new by-laws conforming to the changed conditions were adopted. The several laws enacted by the legislature and affecting the affairs of the company were accepted. The old board of directors having been legislated out of office, the stockholders elected the several members of the Board of Conservation and Development as a new board. Immediately after the stockholders' meeting the new board met and elected the following officers:

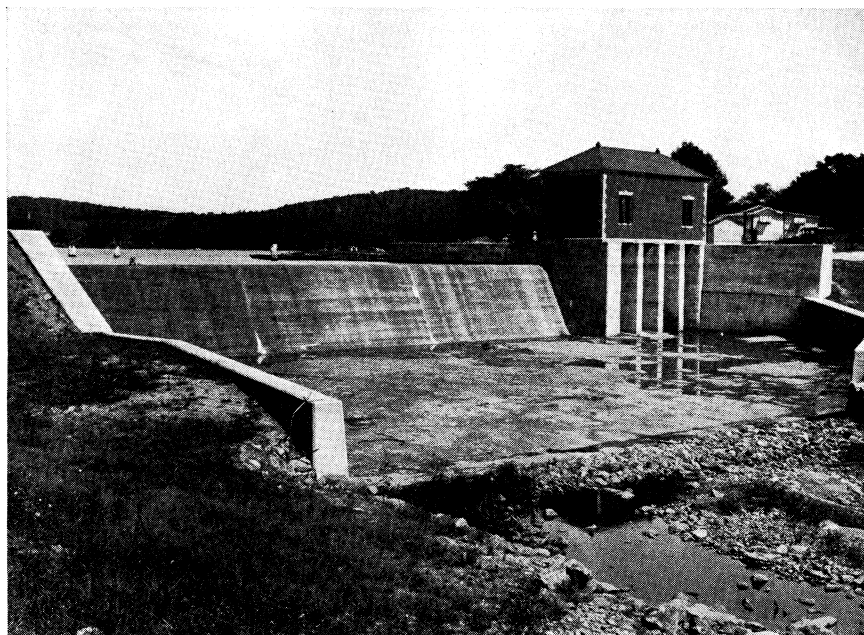


FIG. 15—Dam and Gate House, Lake Hopatcong.



FIG. 16—Dam and spillway, Stanhope Reservoir, Netcong.

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President, John L. Kuser; Vice President, Wm. E. Florance; General Manager, Henry B. Kümmel; Assistant General Manager, Charles P. Wilber; Secretary and Treasurer, Sara Cooley. The principle office was ordered moved to Trenton.

THE FUTURE OF THE CANAL

Early investigations.—The State had acquired the canal, but the Legislature had adjourned without taking any definite action regarding its future. During the quarter century preceding its acquisition, at least three commissions had made detailed investigations of its affairs, and all had united in recommending that it be abandoned as a canal. Its usefulness for water transportation had passed, and by no legerdemain could it be restored. The new directors, however, in the absence of legislative sanction to abandon navigation had no alternative but to maintain it as a canal, even though there was no traffic over it and no tolls had been received for years.

The Silzer committee.—In April, 1923, Governor Silzer requested a number of prominent citizens to recommend plans for the future use of this property. The following members were named by him: Albert E. Drake, Chairman; Edward D. Duffield, Samuel P. Leeds, William Osgood Morgan and C. C. Vermeule; Percival Chrystie and Owen Winston represented the Board of Conservation and Development, and Hudson Maxim, H. M. Riddle, David Young, James Wilson, Frank Sommer and Edward L. Young were chosen as representatives of the municipalities. Henry B. Kümmel, at the request of the Governor, acted as Secretary, and Sara Cooley, Assistant Secretary.

The Committee inspected the canal and held hearings in each county to receive suggestions. It was found that to maintain it necessitated the constant repair of about 150 wooden bridges, 22 planes, many locks, several large dams and aqueducts. Its banks must be constantly patrolled and its waters regulated, particularly in time of storms. The working force varied from about 90 to 125 men, and for several years immediately before the State took it over, the Lehigh Valley Railroad had spent about \$180,000 annually, exclusive of taxes. Even with maintenance charges cut to the lowest figure, consistent with safety, and

everything possible postponed in anticipation of future abandonment, merely holding the property was costing the State an average of \$7,500 per month.

Recommendations of the committee.—In December the Committee submitted its report recommending that it be no longer continued as a canal; that the State retain for public use all right of storing and diverting waters; that it retain all its rights in the various lakes, ponds and reservoirs of the canal; that the other property be offered for sale to the municipalities in which it lay, and after a reasonable period unsold portions be sold to the highest responsible bidder; that permanent roadways be constructed across the canal in place of the company's bridges, the dams and sluice ways at the reservoirs be repaired or rebuilt where necessary, the planes dismantled, locks filled and permanent drainage cuts made to restore the waters to their ancient watercourses; and that this work should be done under the direction of the Board of Conservation and Development, acting as directors of the Morris Canal and Banking Company.

Legislation of 1924.—Bills to carry out these recommendations were prepared by the Committee and at its request were introduced in the Senate. As a result of this action the Legislature of 1924 passed the following measures: An act authorizing the abandonment of navigation, dismantlement of the canal and sale of portions of property (Chap. 229, P. L. 1924); an act to enable municipalities to acquire portions of the canal property (Chap. 78, P. L. 1924); an act relating to the money received for the canal (Chap. 79, P. L. 1924). These acts made the recommendations of the Committee effective. A fourth act (Chap. 71, P. L. 1924) increased the powers of the board of directors by giving it authority to grant to any municipality the right to construct and maintain a sewer along the right of way of the canal for the purpose of protecting the purity of the potable waters of the State.

Grant to Jersey City.—Under this authority the board granted to Jersey City the right to construct and maintain a trunk sewer along the canal from Rockaway to a point in Boonton. As compensation for this privilege the city undertook the entire expense of dismantling the canal within these limits, according to

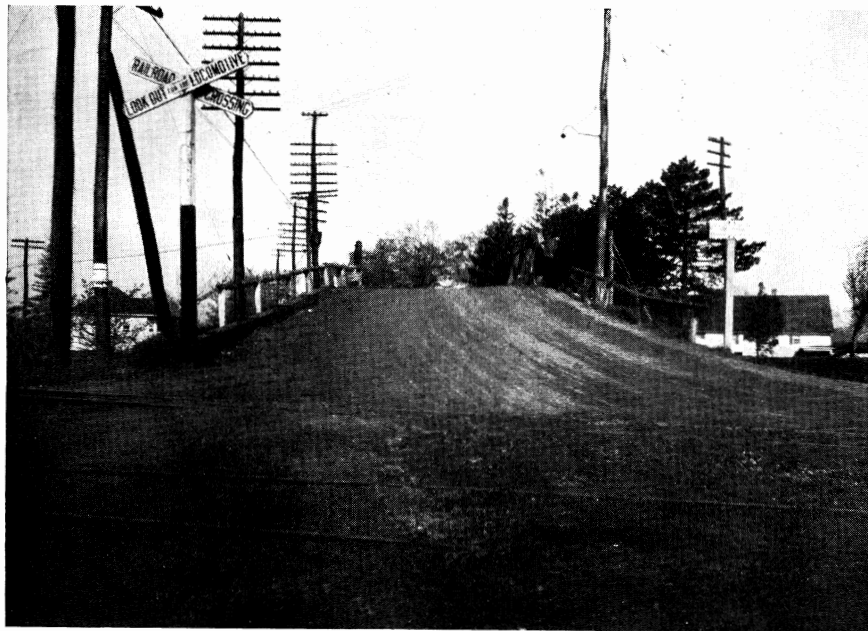


FIG. 17—Railroad and canal bridge on State Highway at Kenil.



FIG. 18—Same after removal of bridge and filling of canal.

THE MORRIS CANAL

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the plans and specifications of the company's engineer. The value of this work to the canal company according to its engineer's estimates was \$48,977. Inasmuch as contractor's bids have averaged 76 percent of the estimates, the actual cash value to the canal company of this transaction was probably about \$37,300.

DISMANTLEMENT OF PROPERTY

Work to be done.—The work necessary to be done by the canal company in dismantling the canal can be tabulated as follows:

Bridges to be removed and canal filled and roadways constructed at these points	149
Aqueducts to be removed	9
Drainage cuts to be safe and protected	153
Planes to be dismantled	22
Locks to be dismantled	27
Dams to be rebuilt or repaired	9
Bridges to be rebuilt	2

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At several places local authorities requested that work for which they were responsible be included in the canal company's contract, they to pay the proportionate rate. The inclusion of this work increased to 404, the separate pieces of construction work for which detailed plans and specifications had to be prepared.

Engineering corps.—It was immediately apparent that it would be necessary to organize an engineering corps under the direction of an experienced chief, and in April, 1924, Mr. C. C. Vermeule, of East Orange, was appointed Consulting and Directing Engineer. Offices were established and a staff of engineers and surveyors under the direction of John McBride, resident engineer, was put in the field.

Up to July 1, 1927, 291 standard sheets of drawings, 56 sheets of details, and 9 property surveys have been made. This of course has necessitated a large amount of field surveying, in addition to which the engineering corps has supervised all construction

work, furnished the contractor with all levels and measurements and made monthly estimates of the amount done on each contract.

Construction work accomplished to July 1, 1927.—Exclusive of the agreement with Jersey City above referred to, twenty contracts had been entered into previous to July 1, 1927. With the exception of two small ones relating to the removal of single bridges, the first of these was signed in September, 1924, and was for rebuilding the dam at Lake Hopatcong. The existing dam was in poor repair and the gate chambers and outlet lock were leaking seriously. The masonry walls and floor of the lock had been built on log grillage which was much decayed, so that the walls had commenced to sag inward. Careful study of existing conditions and test borings made it evident that an entirely new structure was advisable. Accordingly the plans provided for a reinforced concrete dam, immediately in front (down stream) of the old one, with spillway and discharge gates ample for any flood. In order to furnish the minimum dry-season flow for Musconetcong River a fountain was constructed to discharge 12 cubic feet per second. The dam was completed and the water turned into the fountain early in July, 1925. The fountain plays continuously day and night, summer and winter, and during certain months its discharge is supplemented by a flow over the spillway or through the gates. It adds much to the attractiveness of the landscape and in hot weather is a great boon to bathers.

The canal company is by law charged with the duty of so regulating the discharge from the lake as to preserve the rights of the riparian owners along the Musconetcong and on the lake itself. The Board has adopted a tentative program as to drafts upon the lake, which so far has seemed to work pretty well. The summers of 1926 and 1927 were, on the whole, rather wet, so that the level of the lake has been well maintained, and at the same time there has been a good discharge down the Musconetcong. The real test of the Board's plan will come when there is a dry season. In that event, probably neither the people on the lake, nor the power owners along the river will be wholly satisfied, but if the Board can equitably divide the waters it will be satisfied.



FIG. 19—Old canal bridge, Belvidere Avenue, Washington.



FIG. 20—Belvidere Avenue after removal of canal bridge.



FIG. 21—Highway diverted to canal bed, and a railroad grade crossing abolished.

In addition to the Lake Hopatcong dam, the canal company has built a handsome new dam at Lake Musconetcong (Stanhope Reservoir). Construction work is in progress on a new dam at Saxton Falls, and plans have been prepared for a new structure at Greenwood Lake. More or less extensive repairs to smaller dams have been made or are underway at Phillipsburg, Stanhope, Cranberry Reservoir, and Bear Pond. Plans are being prepared for a new dam at the head of the Pompton Feeder.¹

The table below presents in brief form facts about the various contracts made to July 1, 1927. The bridges across the canal are numbered consecutively from Phillipsburg eastward, and the numbers affixed to each contract show the bridges included therein. In addition to the bridges, each contract covered the drainage cuts, locks, planes and miscellaneous work within the section. Those which did not include important dams, covered from 5 to 10 miles or more of canal. The fact that the work was so widely spread out, necessitated frequent moving of machinery and resulted in higher costs. Nevertheless, the table shows that the contracts were let at extremely advantageous figures, in many cases much below the engineer's estimates. Except for contracts covering individual bridges, bids were made at unit prices on estimated quantities. For all but the first two or three, the contractor specified the percent of the engineer's estimate for which he would do the work. Payment for work actually done was made on the basis of his bid. In a few instances some extra work was ordered, notably the removal of stumps at Lake Musconetcong, which is wholly the property of the State.

A few of the contracts contained items for which the counties were responsible. By arrangement with the county this work was included in the contract and the canal company was afterwards reimbursed, as shown in the table. In other instances work included in the contract was assumed by the county, or municipality, and was omitted by the contractor, payment to him being reduced accordingly. In still other cases the amount of work actually done did not tally exactly with the engineer's

¹ Since the above was written the dams at Saxton Falls, Greenwood Lake, Stanhope, Cranberry Reservoir and Bear Pond have been completed and work has been commenced on the dam at Pompton Feeder, Oct. 1, 1928.

estimate of quantities, on which the contractor's bid was based. The above facts explain why the amounts actually paid the contractor differ from his bid.

LIST OF CONTRACTS

Section	Contractor	Engineer's Estimate	Contractor's Bid	Amount Paid	Per Cent. Completed
Bridge 64—Kenvil	Culp Construction Co.	\$900.00	\$900.00	\$900.00	100
Bridge 95—Montville	Hyde-McFarlin Construction Co. ...	1,000.00	1,000.00	1,000.00	100
Lake Hopatcong Dam, Section 60	Gotham Construction Co.	114,984.00	97,560.00	105,305.14	100
Pompton-Little Falls, Section 103-115	Franklin Contracting Co.	74,501.00	61,997.00	69,683.12	100
Bridge 65—Kenvil	Culp Construction Co.	2,500.00	2,500.00	2,500.00	100
Bridge 27—Washington	James Construction Co.	8,272.00	8,272.00	8,156.50	100
Bridge 14—New Village	State Highway Department	23,739.00	23,739.00	23,505.25	100
49—Hackettstown					
74—Rockaway					
Surfacing Bridge 65—Kenvil.....					
Bridge 134—Brookdale	Essex County	4,000.00	4,000.00	4,000.00	100
Boonton-Mountain View, Section 86-102 ..	Culp Construction Co.	131,093.00	81,826.40 ¹	67,000.52	100
Paterson-Belleville, Section 86-102	Franklin Contracting Co.	124,092.00	100,672.93 ²	83,033.92 ³	100
Lake Musconetcong, Section 56-57	John W. Heller Co.	127,644.00	105,133.94	115,262.33	100
Little Falls-Paterson, Section 116-127	Dyer-Kane Co.	125,068.00	91,174.57 ⁴	92,051.28 ⁵	100
Bridge 63—Ledgewood	Culp Construction Co.	8,910.00	7,038.90	6,885.64 ⁶	100
71—Dickerson's					
Port Morris-Boonton, Section 58-85	Culp Construction Co.	106,528.00	82,557.12	81,520.77	100
Bridge 34—Port Murray	Township of Mansfield	4,453.00	4,453.00	.....	...
Section 21-51					
Washington, Mansfield & Independence Twp.	Hyde-McFarlin Construction Co. ...	135,379.00	99,501.56	57,793.26	75
Bridge 6—Port Warren	County of Warren	8,827.25	8,827.25	.....	...
Phillipsburg to Franklin, Section 2-20	F. H. Clement & Co.	144,891.00	99,050.34 ⁷	43,381.71	51
Saxton Falls Dam, Section 52-53	F. H. Clement & Co.	99,869.00	70,906.99	18,283.56	30
Totals		\$1,246,650.25	\$951,111.00	\$780,263.00	

¹Included work amounting to \$6,715.62, assumed by Morris County and deducted from contract.

²Included work amounting to \$8,876.42, assumed by City of Clifton, and \$6,972.12, assumed by Town of Belleville, and deducted from the contract.

³Included work amounting to \$8,138.85, paid by Passaic County to Morris Canal and Banking Company.

⁴Included work amounting to \$3,771.70, assumed by Town of Little Falls, and \$8,029.32, by Borough of West Paterson, and afterwards deducted from contract.

⁵Included work amounting to \$29,074.49, paid for by Passaic County, to Morris Canal and Banking Company.

⁶Included work amounting to \$1,795.00, for which the Morris County Traction Company paid the Morris Canal and Banking Company.

⁷Includes \$8,827.25 for Bridge 6, at Port Warren, afterwards deducted from contract.

THE MORRIS CANAL

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Since July 1, 1927, the following contracts have been let, and work has been commenced:

CONTRACTS LET AFTER JULY 1, 1927.

<i>Section</i>	<i>Contractor</i>	<i>Engineer's Estimate</i>	<i>Contractor's Bid</i>
Sec. 54-55			
Cranberry Lake, Waterloo, ..	John W. Heller Co.,	\$85,819.00	\$66,581.36
Bear Pond			
Greenwood Lake Dam,	Richards & Gaston, Inc.,	72,704.00	57,327.10

Work to be done.—In addition to completing the above contracts, two additional jobs are still to be undertaken. The dam across the Pompton River at the head of the Pompton Feeder, erected about 1835, must be rebuilt. It forms a long pool in the river and raises the water, so that it could be taken into the old feeder. The canal company acquired title to the land flowed and to an additional strip along the bank, which it used for a tow-path. This strip is now quite valuable as access to the river can be gained only across it. To permit the dam to go to ruin, would not only destroy the value of the State's property, but would greatly depreciate the value of the adjacent lands on some of which valuable summer residences have been erected. A beautiful body of still water extending for nearly two miles would be replaced by a shallow, narrow stream bordered by marshy ill-smelling mud flats. The canal company feels justified, therefore, in maintaining this dam, and plans are being prepared for its rebuilding.

The other job is the bridge across this ponded portion of the Pompton Feeder, known as the Colfax bridge, originally built by the canal company. It cannot be replaced by a fill and roadway, as in the case of a bridge across the canal, because it crosses a natural water course.¹

It is expected that all work in connection with dismantling the canal will be completed by the first of January, 1929.²

¹ Both of these jobs are now (Oct. 1928) underway and in part completed.

² Necessary delays in awarding the last two contracts make it impossible to complete the work as soon as anticipated.

SALE OF THE CANAL

Character of title.—The property acquired for the canal was obtained in a variety of ways. Some was purchased outright and was held by deeds in fee. Some was held by deeds containing reversionary clauses of various wording; some by agreements promising to make absolute conveyance provided the canal was located across the grantor's land; some by similar agreements promising to make conveyance for restricted use only. Other portions were taken by condemnation in the manner set forth in the charter, and for still other parts, the company's only title rests upon undisputed occupancy and possession for nearly one hundred years.

The title map of the canal lists 571 separate tracts along that portion of the canal and its feeders acquired by the State, exclusive of its flowage rights in Lake Hopatcong, Cranberry Lake, and Bear Pond. The additional tracts in these will bring the total numbers well above 650.

Not a few of these tracts were affected by leases, agreements, easements, etc., a few perpetual, but most of them subject to cancellation on thirty, sixty, or ninety day's notice. After the Legislature had authorized the drainage of the canal, it was not possible to draw the water from some sections until some of these agreements relating to use of water had been formally cancelled.

A short section of the canal above the Boonton plane was affected by a continuing right to the use of water for power purposes. The same was true of a section at Stanhope, immediately below the outlet of Lake Musconetcong. It was therefore not possible to drain these portions of the canal, and in its dismantlement provision had to be made for maintaining the flow. Fortunately this could be done without great expense and these sections were finally sold subject to the flowage rights.

Many of the leases and agreements were a source of revenue, which although they did not at all equal the cost of maintenance of the property, contributed toward that end.

Property to be sold.—The law directed that all the canal property except the lakes, reservoirs and water rights, and the lands at the lakes necessary to their maintenance and control, should

be sold, to municipalities if they desired to purchase, to others if not. This property consisted of (a) the canal right of way, a strip of land extending from the Hackensack River to the outskirts of Phillipsburg, a distance of 100 miles, including the Lake Hopatcong and Pompton feeders; (b) additional lands, some adjacent to and others separate from the right of way; (c) the terminal property of about 20 acres on Hudson River in Jersey City, known as the Little Basin.

The right of way, 100 miles in length, varies in width from 30 feet in some parts of Newark to over 100 feet where the limiting embankments are high and have broad bases. Except for the Pompton Feeder, the deeds covering the right of way convey "the land occupied by the canal and its appurtenances" or use words of similar portent. The condemnation papers give only the compass bearing of the canal line, the length of each course and the total acreage acquired from each owner. Along the Pompton Feeder, constructed at a later date, some of the deeds locate the center line and convey a specified distance on each side, so that the limits of the canal property can be definitely fixed. Elsewhere the canal company claims to hold under its deeds, etc., the land occupied by the canal bed, the banks, embankments and towpaths.

Value.—The canal property was appraised for the Morris Canal Investigation Commission of 1912 by Louis Focht, Engineer of the State Board of Taxes and Assessment. His valuation of the portion acquired by the State, exclusive of the reservoirs, the Little Basin, and the land at Lake Hopatcong, was \$2,066,774 of which \$1,631,093 was in Newark. The Little Basin, owned in fee, was appraised at \$1,189,000 to \$1,211,425. This appraisal was based on the value of adjacent property and vicinity sales. No discount was made for deficiencies of title, or existing easements or limitations. It was stated, however, that if the canal were abandoned and right of way sold piecemeal, much of it would have no value and other portions only partial value.

The law under which the property was to be sold directed that the canal company, in case the purchaser be a municipality, in fixing the price should take into consideration not only the



FIG. 22—Drainage cut, Pompton Feeder into Pompton River.



FIG. 23—Spillway and waste channel, Lopatcong Creek, Phillipsburg.

actual value of what it had to sell, but also "the conditions of the canal in the municipality and the effect thereof upon said municipality and the adjoining property and also the nature of the use to which said property is to be devoted and the estimated cost of adapting the property to such new use." Manifestly no uniform rule could be formulated as to how this requirement should be applied. Every case had to be considered by itself. The character of the title the canal company could convey, the effect on the title of any easements and restrictions, and the discount for the public use to be made, all were elements on which there could be a great diversity of opinion. The value of the canal strip as so much land was only one element of the problem.

In its sales of the canal strip to others than municipalities, it was necessary to deal almost exclusively with the owner of the adjacent land since there was no other purchaser. This was due, first, to the character of the company's title, the adjacent landowner usually being the holder of whatever reversionary rights might exist, and second, to the fact that except where the canal was crossed by a public road access to it could be had only over the lands of adjacent owners. In general, therefore, there was no competition for the property and high prices could not be obtained.

Sales to municipalities.—The following municipalities have either acquired the canal property within their limits or have contracted to purchase it. Newark, Belleville, Bloomfield, Clifton, Paterson (in part), West Paterson, Little Falls, Lincoln Park (in part), Montville (in part), Boonton, Rockaway (in part), Dover, Wharton (in part). Negotiations are pending with Jersey City and Phillipsburg.

The North Jersey District Water Supply Commission purchased the greater part of the Pompton Feeder and a portion of the main canal in Wayne Township for use in locating its pipe line from the new Wanaque Reservoir.

Sales to individuals.—Sales to others than municipalities could be made only after public advertisement and to the highest bidder. Advertisement was made by publication in several newspapers circulating in the municipality where the property lay, and by notices posted along the canal.

Rarely has there been any competitive bidding. A few bids for parts of the tract advertised were usually received within the date set, but in no case did these cover all the property offered for sale. For most of that sold to individuals, it was necessary to hunt up a bidder, and as already stated, in most instances by force of circumstances the property could be sold only to the adjacent owner.

Litigation over reversion rights has so far been avoided. The holders of these rights have recognized that it was less expensive to pay a moderate sum for a deed conveying the State's title, than to make the necessary searches to establish their own claims. To July 1, 1927, one hundred and twenty-three transfers had been made to others than municipalities, and there are considerable sections as yet unsold.

Receipts from sale of property.—For canal lands already sold there has been received (October 1, 1927) in cash, the sum of \$557,031.85 and \$8,871.00 is due on delivery of deeds. Cash sales to municipalities amounted to \$518,291.45, to individuals and corporations \$47,611.40. In addition, several municipalities have relieved the canal company of some of the dismantlement work in return for property deeded them. The value of this work to the canal company, which otherwise must have been done by it, was estimated by its engineer to be \$227,421.34 and is in addition to the cash receipts. Contractors have allowed \$3,050 in reduction of their bids for scrap in the planes, and \$1,998.63 has been received in cash.

The total sales, therefore, have amounted to \$798,374.82. This amount does not include the value of the Little Basin in Jersey City, nor of unsold portions of the canal. The total receipts from the sale of the property will ultimately be about \$1,740,000.

FINANCIAL STATEMENT

The following statement shows the receipts and disbursements from the time the State received the property to June 30, 1927.

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CASH AND STOCK ACCOUNT

Total receipts March 1, 1923, to June 30, 1927—4 years, 4 months.

	<i>Cash</i>
Received from the Lehigh Valley R. R., principal and interest	\$962,500.00
Rents, etc.	242,663.19
Sales of property	507,644.59
Payments on contracts	39,008.34
Total cash receipts	\$1,751,816.12
Transferred from stock in excess of additions to	9,969.21
Total of all receipts	\$1,761,785.33

Total disbursements for maintenance and abandonment—
March 1, 1923, to June 30, 1927.

	<i>Cash and stock</i>	<i>Aver. per year</i>
Administration	\$33,825.30	\$7,800
Superintendence	56,808.72	13,100
Engineering	160,894.38	39,000
General and legal expenses	51,379.17	11,850
Paid on contracts	749,246.46	172,600
Dismantlement by company men	2,551.58	
Maintenance of bridges, banks, etc.	238,730.95	45,250
Stock charged off as of no value ..	4,206.22	
	\$1,297,642.78	
Balance on hand	464,142.55	
	\$1,761,785.33	

The following statement shows the estimated receipts and expenditures (assets and liabilities) from July 1, 1927, to December 31, 1928, at which time it is believed the dismantlement work will be completed and all property sold. Final figures cannot, of course, be given until all contracts have been completed.

Estimated Receipts

1. Funds in State Treas. acct.	\$464,142.55
2. Estimated rentals for 18 mo.	30,000.00
3. Accts. receivable	68,166.00
4. Unsold property—estimated	942,000.00
	\$1,504,308.55

Estimated Expenditures

Est. administration, engineering and maintenance for 18 mos.	\$153,000.00
Existing contracts	188,655.85
10% reserve on contracts	26,945.89
Needed for additional contracts (estimated)	320,000.00
Surplus ¹	815,706.81
	<hr/>
	\$1,504,308.55

¹ Unavoidable delay in completing the work, which was unforeseen when the above was written, and which probably cannot be done before July 1, 1929, has increased the expenses. Receipts from the sale of the property will fall somewhat short of the values given in the above figures. Hence the estimated surplus in this table is somewhat too large—Oct. 1, 1928.

