

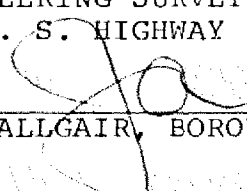
REPORT UPON
WATER DISTRIBUTION FACILITIES

FOR THE
BOROUGH OF SOUTH RIVER

NOVEMBER 1978

PREPARED BY:

ENGINEERING SURVEYING PLANNING ASSOCIATES
258 U. S. HIGHWAY 9, HOWELL, N. J. 07731



JOHN ALLGAIR, BOROUGH ENGINEER

FILE SR-041-B (V1559)

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January 8, 1979

PLEASE REFER
TO OUR FILE NO. SR-041-B
(V1559)

Mayor and Borough Council
Borough of South River
61 Main Street
South River, New Jersey 08882

Gentlemen:

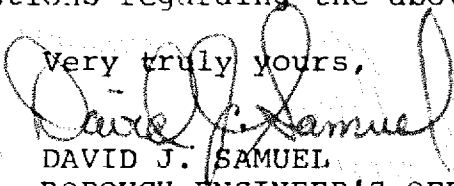
RE: LETTER OF TRANSMITTAL
REPORT UPON WATER DISTRIBUTION FACILITIES

In accordance with our Engineering Agreement we have completed the above captioned report and are transmitting 15 copies of the same for your review.

The report describes your existing water system, advises you of the condition of the system, and recommends necessary improvements. These recommended improvements are listed in a manner that could be utilized as a Long Range Improvement Schedule or Master Plan which we recommend be implemented over a period of years in order to minimize economic impact on the Borough.

We trust that this report is satisfactory and provides the Borough with a suitable plan for improving the Borough of South River's Water Facilities. If you have any questions regarding the above matters please do not hesitate to call.

Very truly yours,


DAVID J. SAMUEL
BOROUGH ENGINEER'S OFFICE

DJS:ec
enc.

cc..Mayor Mannino
Councilmen Berman, Genecki, Reba, Sullivan, Swiderski, Woronowicz
Boro Clerk Reichenbach, Borough Atty Rafano
Utility Engineer Noto, Comptroller Milano

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A C K N O W L E D G E M E N T

We thank and would like to acknowledge the assistance of Mr. Thomas Noto, Utility Engineer and members of his staff, Mr. Anthony Massaro and Mr. Chris Christiano. Their assistance and knowledge of the existing facilities has provided this Firm with information and data that was necessary for the comprehensive analysis of the Borough's Water System.

R E P O R T

I. INTRODUCTION

The purpose of this report is to provide the Mayor and Council of the Borough of South River with a detailed investigation of the Water Distribution System and related appurtenances, and to make recommendations concerning the improvements of the System where necessary.

In addition, this report has included the recommendations in a Master Plan type format which enables the Borough to implement the recommended improvements over a period of years in order to minimize economic effects on the Borough.

The Distribution System was tested through the use of pressure and flow tests and was further analyzed by comparing sample cores taken during 1978 with anticipated values projected by computer analysis. The core samples indicate that many existing lines have become encrusted with iron tubercles and require cleaning.

Generally, the Borough's Water System requires internal reinforcement where a congestion of existing old 4 inch diameter lines are relied on to provide both water service and fire protection, and also where longer dead end lines are expected to provide the same service, the looping of water mains are recommended. In addition, the Water System requires increased storage capacity specifically in the North End of the Borough.

This report appears timely in that the recent fire at the Ferry Street Tobacco factory and furniture store has demonstrated the need for improved water distribution facilities.

A section of this report specifically discusses fire flows and associated requirements and includes recommendations that should enable the Fire Department and Utility Department to maximize the amount of water available for fire fighting.

We anticipate that upon completion of recommended staged improvements the Borough of South River's Water System will have the ability to provide significantly more water for fire fighting purposes, provide reliable pressure more consistently, enhance the development of the North End Industrial Area (thereby enhancing the influx of necessary ratables), and will generally improve system flow characteristics throughout the Borough.

II. BACKGROUND AND DEVELOPMENT OF THE EXISTING WATER SYSTEM

The Borough of South River is located in Middlesex County, bounded by East Brunswick Township on the North, West, and South and the South River on the East. Elevations range from 155 feet more or less above sea level to 5 feet more or less at the River's bank.

In 1960, the population of the Borough of South River was 13,397 persons according to the Federal Census. The 1970 count was 15,248. It is estimated that the present population of the Borough exceeds 16,200 persons.

The South River Water Utility produces and distributes water to its consumers throughout the Borough. Domestic consumption accounts for approximately 95 percent of the total water production while the remaining 5 percent is utilized for commercial, industrial and public purposes.

The Water System of South River began its development like other towns in the area at the turn of the century. At that time South River was a growing manufacturing town with an expanding residential population and lacked a municipal water system.

Besides the need for safe, clean water for the populace the Borough lacked adequate fire protection. With increasing development in the downtown commercial and industrial areas, the Borough's risk of a devastating fire also increased yearly.

With this in mind the Borough government in the early 1900's decided on a significant investment, to supply and distribute water to most of the industrial, residential and commercial areas downtown.

The original water works was designed around 1909 by a civil engineer from New York, named W. W. Young. The first part of the present distribution system was completed by 1910. This consisted of approximately 8 miles of various size cast iron pipes.

The main lines in this system were the 10" main along the Raritan River Railroad and Whitehead Avenue which then ran up Main Street. Eight inch lines were installed in Charles Street and Jackson Street as well as along Thomas Street and most of Prospect Street.

A six inch line was used to service the Brick Manufacturing Companies along William Street.

Residential areas around lower Main Street and the William Street - Prospect Street area were serviced by a grid-iron of 4" and 6" Pipes.

The original source of water was from a spring. The site around this spring (about 10 Ac.) was purchased by the Borough from Charles & Sanford Culver around 1910. This same site presently serves as the Borough's well field and Utility Department garages and is located just off Whitehead Avenue in the Southeastern corner of the Municipality.

The spring water previously mentioned, originated as rain water which infiltrated the gravel hills on the West side of River Road. This water later emerged through the sand outcrop at a location near the existing power plant. The water in

the sand was collected 10' to 15' below ground by underdrains which flowed by gravity into a central cistern and later was distributed. The initial sections of the collection system were completed by 1911. Additional drains (infiltration galleries) were added around 1916.

By the early 1920's the system had expanded to over 13 miles of pipe and included a 235,000 gallon standpipe located at Exton & Main Street. The quantity of water obtained from the shallow infiltration galleries was no longer enough for the growing Borough's increased usage.

A fire insurance inspector reported in 1922 that "during wet seasons the supply is adequate and during the dry seasons inadequate"; it was often, "necessary to use raw water from the South River by pumping...to one of the manholes of the collection system".

Pumping river water may have been acceptable for emergencies such as fire, but it was undesirable for residential use. Obviously more water was needed and in 1922 and 1926 the Borough constructed its first deep wells to the Farrington Sands. This aquifer has supplied the bulk of the water consumed in the Borough ever since.

By 1930 the distribution system was extended along the Old Bridge Turnpike and more side streets downtown. Throughout the 1930's and forties, the Borough's residential areas continued to expand in areas away from the central water-work grid constructed in 1910.

To maintain adequate service to the higher areas of town, the major distribution system was reinforced in 1952. This included another transmission main (12") along Whitehead Avenue and then up Hillside Avenue. This line was linked by a 14" transmission main to the original 10" water line in Main Street to the North. Further South on Appleby Avenue, a new elevated tank was constructed and connected to the Hillside Avenue water main by a 12" line.

Residential development East of the Old Bridge Turnpike and Northwest of Main Street continued in the 1950's and sixties.

To meet the increasing demand and to compensate for the age of the original water lines, the distribution system was upgraded again during the 1970's. The most recent additions to the water system include a 2 million gallon reservoir, the new pumping station, and the new 20" transmission main along Whitehead Avenue. In 1977 Well No. 3 was replaced by Well No. 5 and in 1978 system reinforcement was completed in the areas of Kamm Avenue and Old Bridge Turnpike and along the Old Bridge Turnpike between Main Street and Cleveland Avenue.

III. EXISTING WATER FACILITIES

A. SUPPLY FACILITIES

The supply facilities of the Borough have a present capacity of approximately 3.1 MGD as a result of the recent completion of Well No. 5.

The water supply for the Borough primarily consists of water withdrawn from wells into the Farrington Sand Member of the Raritan Formation. The capacities of each well is as follows:

WELL NO. 1	- Abandoned
WELL NO. 2	- 1.3 MGD
WELL NO. 3	- Abandoned
WELL NO. 4	- 0.6 MGD
WELL NO. 5	- 1.15 MGD

TOTAL WELL CAPACITY - 3.1 MGD

In addition relatively small amounts of water are obtained from the shallow infiltration gallery into a ground water table sand member which is planned to be abandoned sometime in the future. The reason for the planned abandonment of the infiltration gallery is primarily due to the suggestion by the New Jersey Department of Environmental Protection, Bureau of Potable Water, that the infiltration gallery is susceptible to surface pollution, and also since the source may be considered not reliable from a water production standpoint.

The design of Standby Well has recently been completed and applications for this proposed Well No. 6 are being prepared. The Standby Well if approved shall have a capacity of 1.15 MGD and shall be utilized only when Well No. 2 or Well No. 5 are out of service.

B. TREATMENT FACILITIES

The water presently produced receives no formal treatment but rather the addition of a polyphosphate to sequester the iron in the water and the addition of chlorine for disinfection purposes.

A water treatment facility is presently being designed to remove excess iron from the well water, to provide for pH and hardness adjustments, and to provide chlorine for disinfection of the treated water.

C. STORAGE FACILITIES

The Borough's storage facilities consist of a 500,000 gallon elevated tank located on Appleby Avenue and 2,000,000 gallon pump storage reservoir located at the Whitehead Avenue Plant. The storage requirements for the Borough basically consist of a 24 hour supply based on average daily consumption.

D. DISTRIBUTION FACILITIES

1) GENERAL

The distribution system consists of water mains ranging in size from 4" diameter to the new 20" diameter transmission line. A number of these water lines date back as far as 1929 and earlier. There is evidence that the older mains suffer from corrosion and encrustation which causes supply and pressure problems in some areas, especially where the small diameter lines are involved.

The piping network is extensive in that most of the Borough is covered by interconnected water mains as shown on Plate I, however, many of these mains consist of four (4") inch and six (6") inch diameter cast iron pipes which do not have sufficient capacity to provide both consumption and fire flows. The breakdown of sizes and approximate lineal footage of water lines are listed in Table I.

In addition, Plate II was also prepared which indicates the approximate age of water mains in the existing system. This can be an important tool in determining where potential system weaknesses exist and allow the Utility Engineer to ascertain reasons for repeated breaks or other problems in a specific area.

PLATE I

WATER DISTRIBUTION SYSTEM

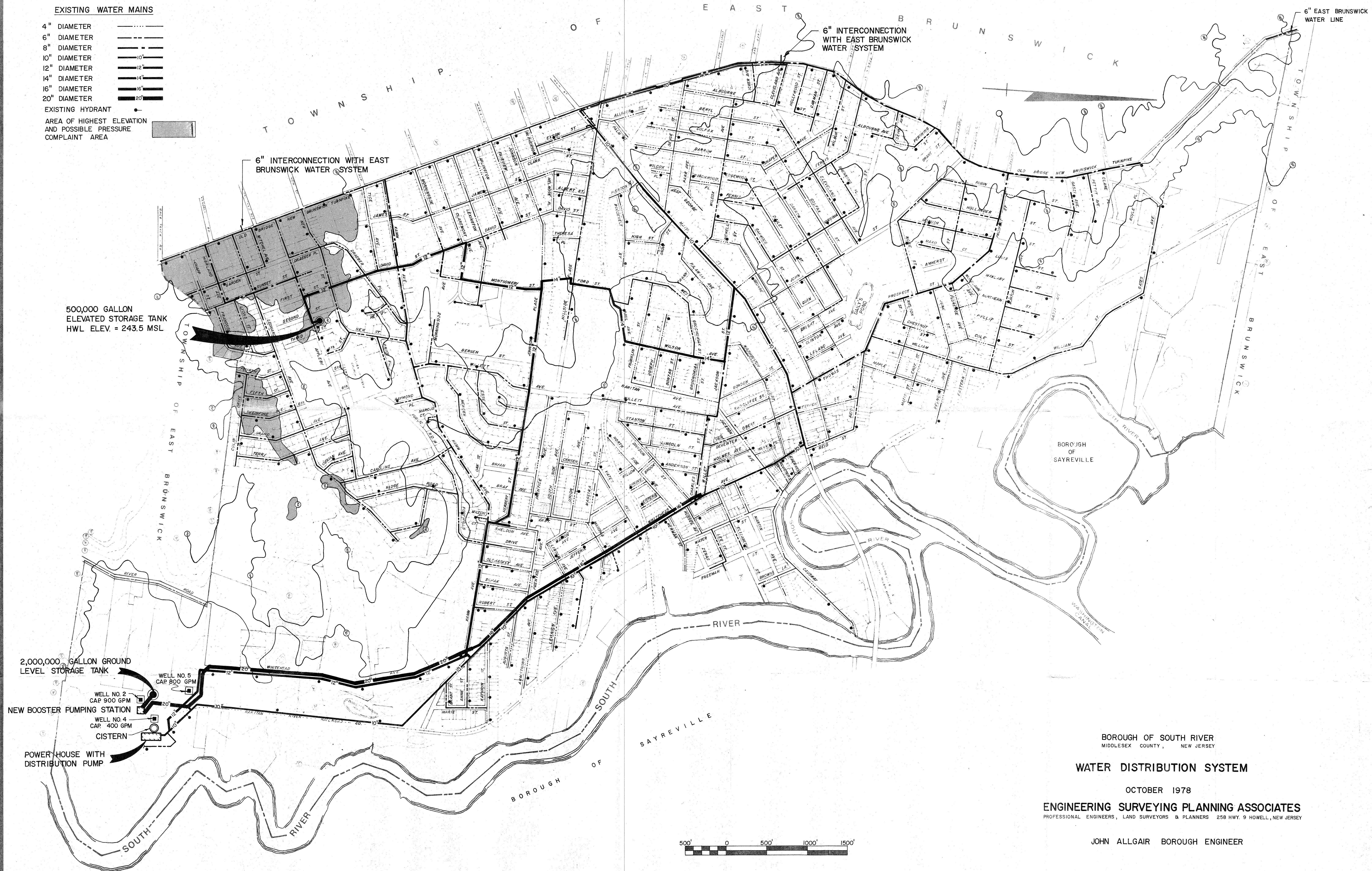
LEGEND

EXISTING WATER MAINS

4" DIAMETER	----
6" DIAMETER	----
8" DIAMETER	----
10" DIAMETER	----
12" DIAMETER	----
14" DIAMETER	----
16" DIAMETER	----
20" DIAMETER	----

EXISTING HYDRANT

AREA OF HIGHEST ELEVATION
AND POSSIBLE PRESSURE
COMPLAINT AREA



BOROUGH OF SOUTH RIVER
MIDDLESEX COUNTY, NEW JERSEY

WATER DISTRIBUTION SYSTEM

OCTOBER 1978

ENGINEERING SURVEYING PLANNING ASSOCIATES
PROFESSIONAL ENGINEERS, LAND SURVEYORS & PLANNERS 258 HWY. 9 HOWELL, NEW JERSEY

JOHN ALLGAIR BOROUGH ENGINEER

BOROUGH OF SOUTH RIVER
WATER DISTRIBUTION SYSTEM

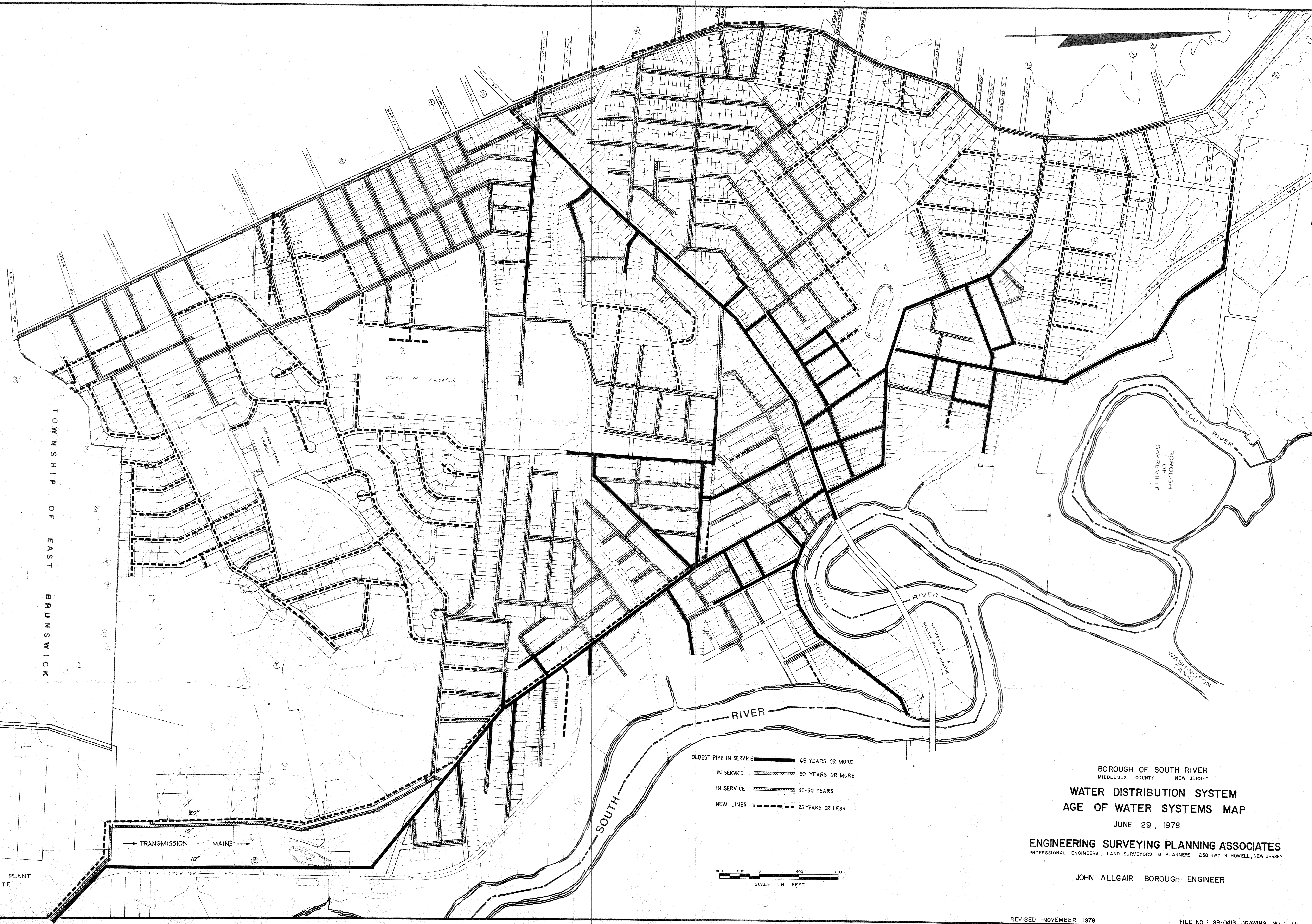
TABLE I
EXISTING WATER MAINS

1978

<u>SIZE AND TYPE</u>	<u>ESTIMATED QUANTITY</u>	<u>PERCENT OF TOTAL</u>
4" Cast Iron	84,000 l.f. <u>±</u>	35.6%
6" Cast Iron	91,500 l.f. <u>±</u>	38.7%
8" Cast Iron	20,750 l.f. <u>±</u>	8.8%
10" Cast Iron	14,650 l.f. <u>±</u>	6.2%
12" Cast Iron	14,250 l.f. <u>±</u>	6.0%
14" Cast Iron	3,000 l.f. <u>±</u>	1.3%
16" Cast Iron	3,500 l.f. <u>±</u>	1.5%
20" Cast Iron	4,500 l.f. <u>±</u>	1.9%
		100%
 TOTAL ESTIMATED LENGTH	 236,150 l.f. <u>±</u>	
TOTAL ESTIMATED LENGTH	45 miles <u>±</u>	

PLATE II

AGE OF EXISTING WATER MAINS



BOROUGH OF SOUTH RIVER
MIDDLESEX COUNTY, NEW JERSEY
**WATER DISTRIBUTION SYSTEM
AGE OF WATER SYSTEMS MAP**
JUNE 29, 1978

ENGINEERING SURVEYING PLANNING ASSOCIATES
PROFESSIONAL ENGINEERS, LAND SURVEYORS & PLANNERS 258 HWY 9 HOWELL, NEW JERSEY

JOHN ALLGAIR BOROUGH ENGINEER

- OLDEST PIPE IN SERVICE ————— 65 YEARS OR MORE
IN SERVICE ————— 50 YEARS OR MORE
IN SERVICE - - - - - 25-50 YEARS
NEW LINES 25 YEARS OR LESS

400 200 0 400 800
SCALE IN FEET

2) SYSTEM PRESSURES

The existing system gradient is about elevation 243.5 MSL which is the high water elevation in the elevated storage tank on Appleby Avenue. Since about 50 percent of the Borough is below elevation 50 (MSL) at least one half of the Borough experiences system static pressures greater than 80 psi with predominate static pressure of about 100 psi in that zone.

About 10 to 15 percent of the Borough lies between elevation 50 MSL and elevation 100 MSL. Water uses in this area experience static pressure greater than about 60 psi.

The remaining two areas in the Borough which is considered the high ground ranges from 100 MSL to 150 MSL and slightly over elevation 150 MSL.

The elevation 100 to 150 zone experiences system static pressures greater than 40 psi while the area above elevation 150 experiences pressures less than 40 psi.

Residents in this last area which comprises less than 10 percent of the Borough have complained about poor water pressure over the years.

Providing that the elevated storage tank is operated near full the entire Borough can be considered to have good system static pressure with exception to the area above elevation 150 MSL, that area can be considered satisfactory.

The aforementioned pressures represent static pressure when water is not running. To maintain good water pressure while using the water, the distribution system must be adequately linked and composed of properly-sized water mains which is the subject of this report.

IV. EXISTING AND FUTURE WATER DEMANDS

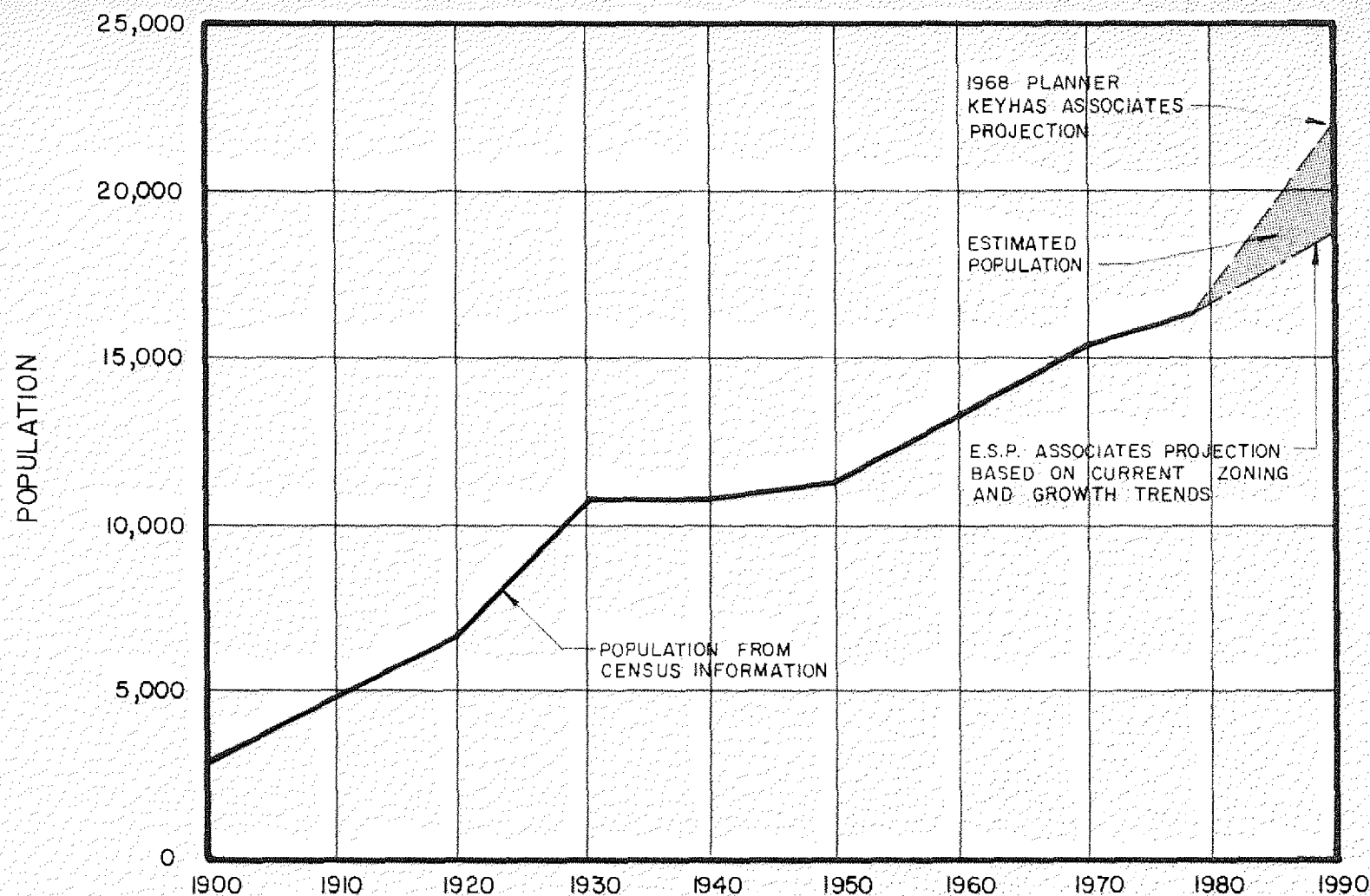
A. POPULATION

The Borough of South River's population growth is shown on Plate III entitled "Population Growth". This Plate also indicates growth projections until 1990.

It is anticipated that between the years 1990 to 2000 the Borough of South River will be approaching an ultimate population based on current zoning of 22,600 as has been projected by Borough Planners. This Firm anticipates the growth rate to be somewhat lower than projected by others until the problems of future water supply, and other associated (water, sewer and power) utility extensions in the North End are resolved.

The growth rate of the Borough may increase to the ultimate population of 22,600 by 1990 or shortly thereafter if these questions are resolved and/or zoning changes are implemented. The latter case could increase the ultimate population level depending on type of zoning implemented.

PLATE III
POPULATION GROWTH



BOROUGH OF SOUTH RIVER
MIDDLESEX COUNTY, NEW JERSEY

WATER DISTRIBUTION SYSTEM
POPULATION GROWTH
1978

ENGINEERING SURVEYING AND PLANNING ASSOCIATES
PROFESSIONAL ENGINEERS, LAND SURVEYORS & PLANNERS 258 HWY. 9 HOWELL, N.J.

B. WATER USAGE

An investigation of water records for the years 1973-1977 inclusive were utilized to determine existing demands over the last 5 years. The results of this investigation are listed in Table II entitled "Existing and Future Water Production". As can be determined by the title this Table also includes projections of water production requirements until 1990 based on current zoning and growth trends.

Based on an estimated population of 16,200 for 1977 and an average daily production of 1.52 MGD the per capita production, or assuming production equals consumption (which is not entirely true due to system losses) the per capita consumption is about 94 gallons per person per day. This figure is higher than normal range of about 60 to 80 gallons per person per day for other municipalities with size and land use characteristics similar to South River. This difference could just mean that more water is utilized on lawn watering or other functions but could mean that there is significant leakage from the system. All known leaks or unmetered flows should be minimized and eliminated if possible in order to maximize on the amount of available water and minimize the additions to the supply and treatment systems necessary to counteract system leakage.

Considering the present quality of water which is distributed to residents, i.e., water that can be considered aggressive and containing significant quantities of iron, it is anticipated that the water usage will increase to about 100 to

BOROUGH OF SOUTH RIVER
WATER DISTRIBUTION FACILITIES

TABLE II

EXISTING AND FUTURE WATER PRODUCTION

1. EXISTING WATER PRODUCTION

<u>YEAR</u>	<u>TOTAL WATER PRODUCTION</u>	<u>AVERAGE DAILY PRODUCTION</u>	<u>PEAK MONTH</u>	<u>PEAK MONTHLY PRODUCTION</u>	<u>PEAK DAILY PRODUCTION</u>
1973	514 MG	1.4 MGD	Aug.	53.2 MG	2.4 MGD
1974	512 MG	1.4 MGD	July	57.9 MG	2.5 MGD
1975	510 MG	1.4 MGD	Aug.	49.0 MG	2.1 MGD
1976	555 MG	1.5 MGD	Aug.	57.0 MG	2.9 MGD
1977	555 MG	1.52 MGD	May	56.3 MG *	3.2 MGD *

* Peak Day and Peak Monthly figures for 1977 are lower than actual demands since water ban was in effect most of Summer

2. ESTIMATED FUTURE PRODUCTION REQUIREMENTS

<u>YEAR</u>	<u>TOTAL POPULATION</u>	<u>ESTIMATED AVERAGE DAILY PRODUCTION****</u>	<u>ESTIMATED AVERAGE DAILY - PEAK MONTH PRODUCTION</u>	<u>ESTIMATED PEAK DAILY PRODUCTION</u>
1980	20,000 **	2.0 MGD	2.5 MGD	4.0 MGD
1990	22,000 **	2.2 MGD	2.8 MGD	4.4 MGD
Ultimate Development	22,600 ***	2.3 MGD to 2.6 MGD	2.9 MGD to 3.2 MGD	4.6 MGD to 5.8 MGD

Ultimate Development could result in higher production requirements if Borough changes from present patterns.

** Based on Master Plan Population Estimates

*** Based on Current Zoning and Land Use

**** Based on increase in per capita consumption resulting from better quality water and increased pressures.

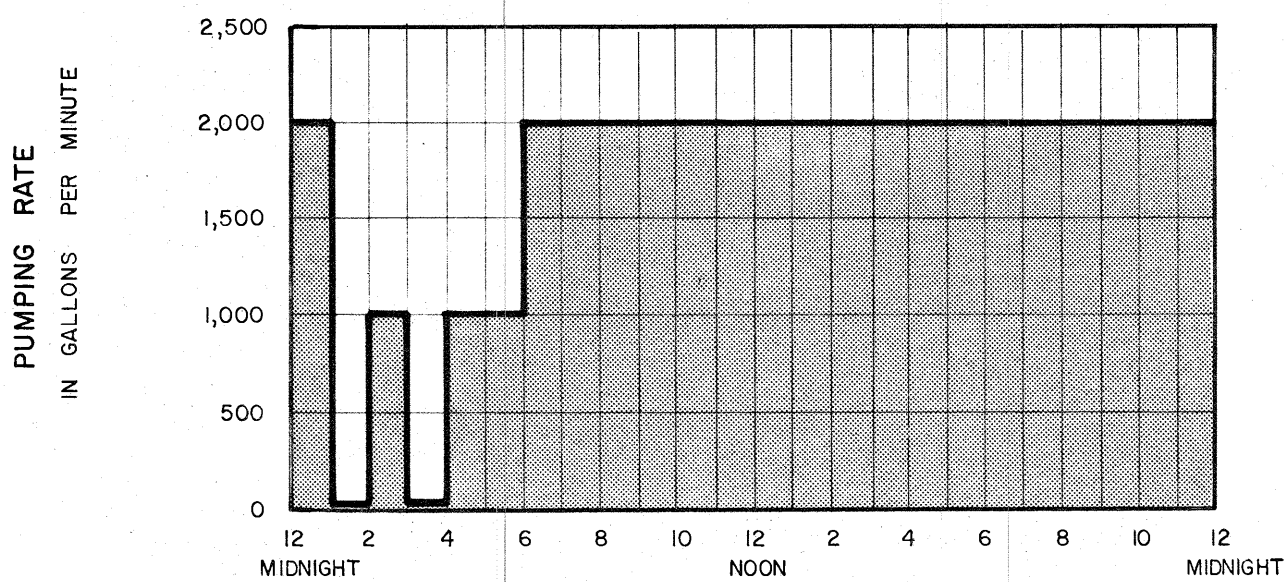
110 gallons per person per day when the proposed Water Treatment Plant is completed within the next few years. In order to minimize the effects of this increase the Borough should institute a campaign to make people aware of the cost savings to each homeowner that could result by installing water saving devices. Further provisions should be included in Borough Ordinances requiring that all new construction as well as rehabilitation projects include water saving devices.

C. DEMAND CHARACTERISTICS

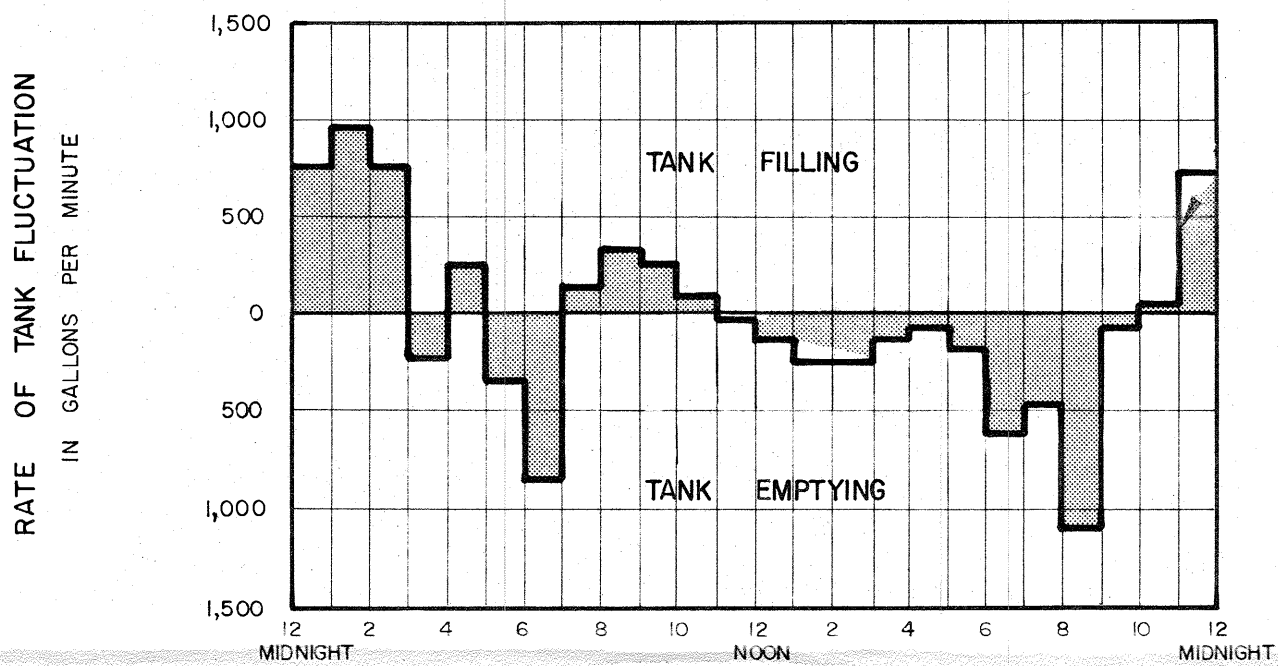
The Borough's existing demand characteristics were analyzed based on the available records of pumping time logs and storage tank levels. This information was utilized to prepare Plate IV "Peak Day Demand" which illustrates the systems demand characteristics August 30, 1973 which was the day of greatest water usage in the last 5 years. Plate V "1978 Peak Day Demand" was utilized to determine the most recent years peaking characteristics.

Table III represents the Design and Analysis Criteria of the existing system characteristics as well as projections of future demand characteristics.

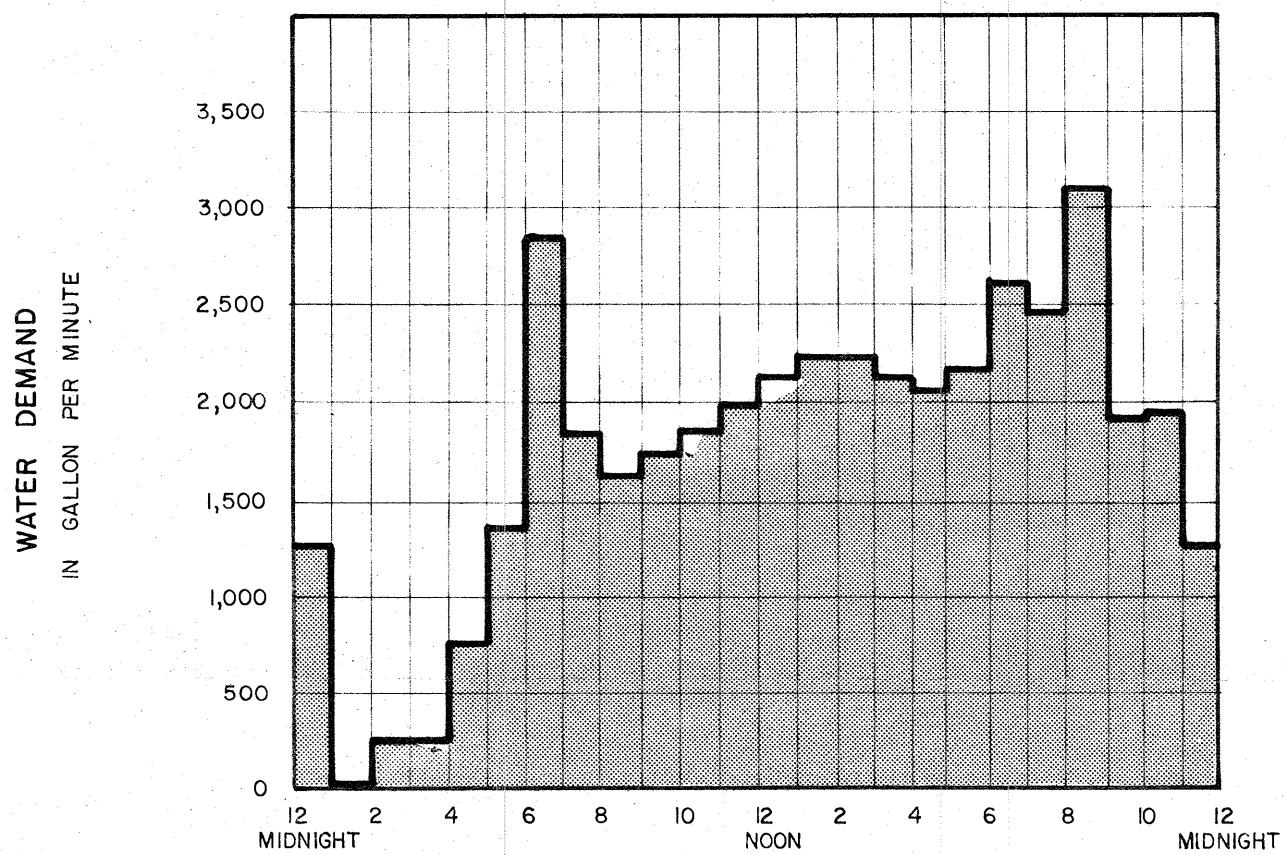
PLATE IV
PEAK DAY DEMAND



DISTRIBUTION PUMPING
AUGUST 30, 1973



ELEVATED STORAGE
AUGUST 30, 1973



PEAK DAY
WATER DEMAND
AUGUST 30, 1973

(COMPOSITE DEVELOPED FROM PUMPING &
ELEVATED STORAGE CHARACTERISTICS)

BOROUGH OF SOUTH RIVER
MIDDLESEX COUNTY, NEW JERSEY

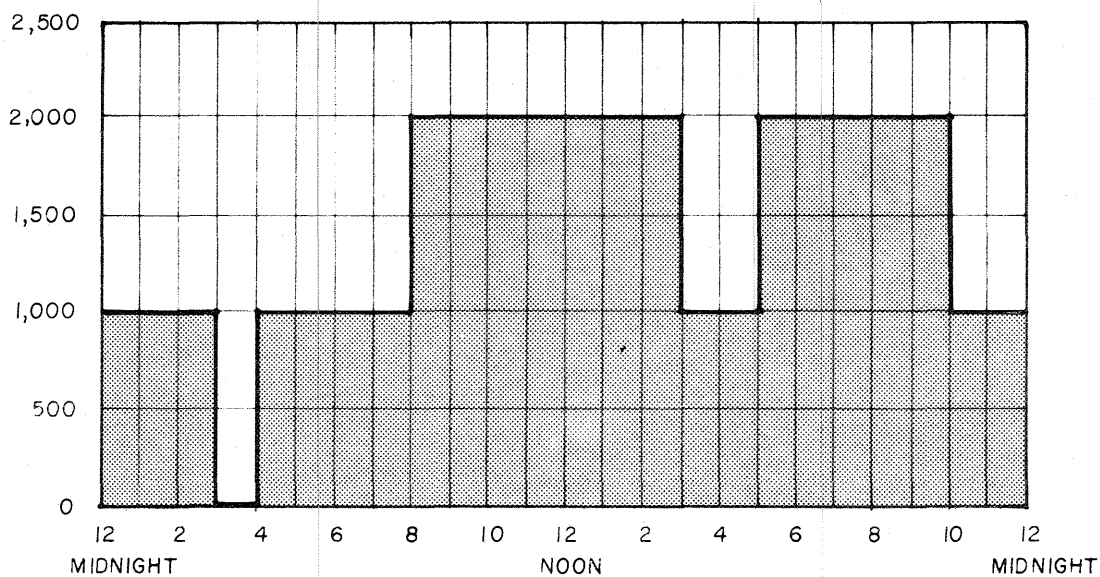
WATER DISTRIBUTION SYSTEM
PEAK DAY DEMAND

ENGINEERING SURVEYING AND PLANNING ASSOCIATES
PROFESSIONAL ENGINEERS, LAND SURVEYORS & PLANNERS 258 HWY. 9 HOWELL, N.J.

PLATE V

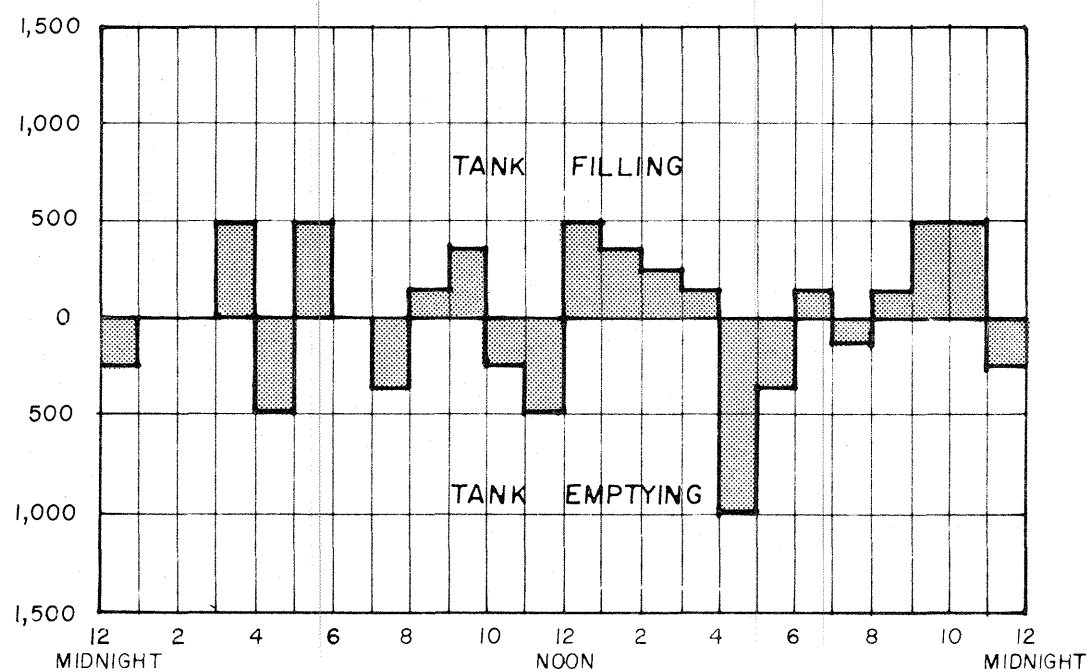
1978 PEAK DAY DEMAND

PUMPING RATE
IN GALLONS PER MINUTE



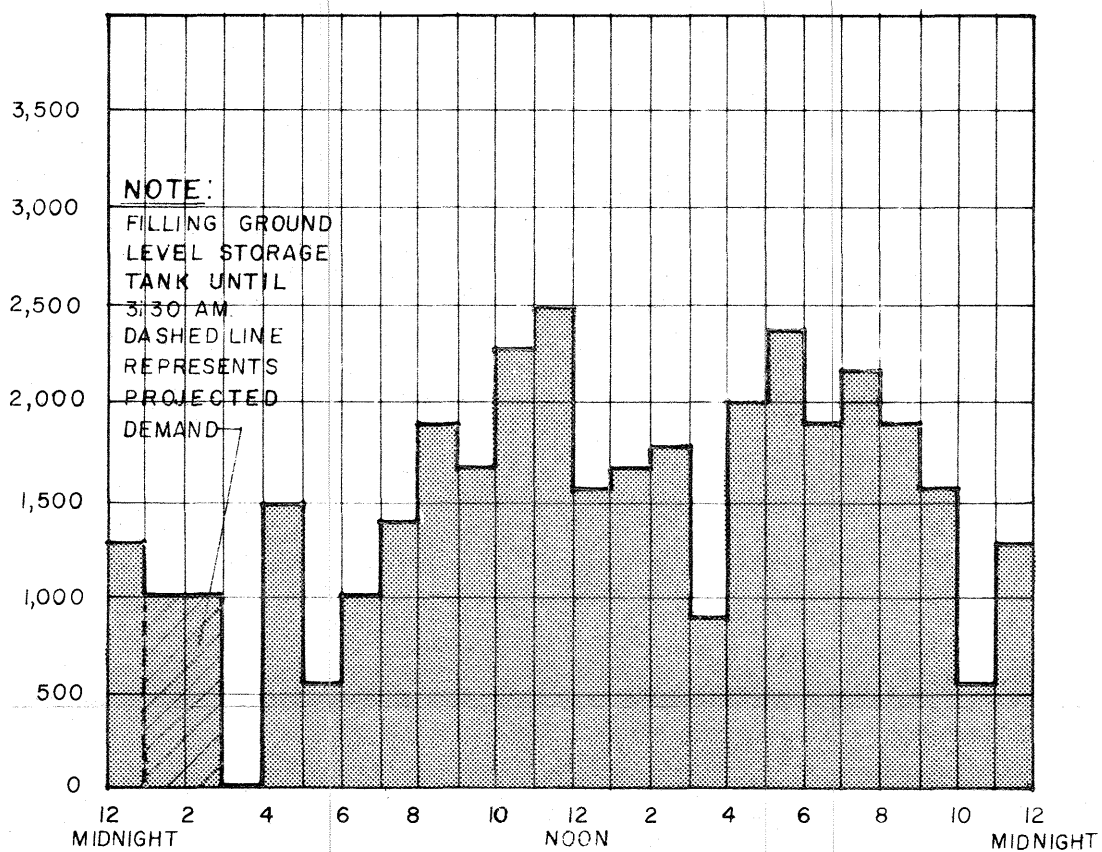
DISTRIBUTION PUMPING
JUNE 30, 1978

RATE OF TANK FLUCTUATION
IN GALLONS PER MINUTE



ELEVATED STORAGE
JUNE 30, 1978

WATER DEMAND
IN GALLONS PER MINUTE



PEAK DAY
WATER DEMAND
JUNE 30, 1978

(COMPOSITE DEVELOPED FROM PUMPING &
ELEVATED STORAGE CHARACTERISTICS)

BOROUGH OF SOUTH RIVER
MIDDLESEX COUNTY, NEW JERSEY

WATER DISTRIBUTION SYSTEM
1978 PEAK DAY DEMAND

ENGINEERING SURVEYING AND PLANNING ASSOCIATES
PROFESSIONAL ENGINEERS, LAND SURVEYORS & PLANNERS 258 HWY. 9 HOWELL, N.J.

BOROUGH OF SOUTH RIVER
WATER DISTRIBUTION SYSTEM
DESIGN AND ANALYSIS CRITERIA

TABLE III

DESIGN & ANALYSIS CRITERIA	(A) YEARLY AVERAGE DAILY FLOW		(B) PEAK MONTH AVERAGE DAILY FLOW		(C) PEAK DAILY FLOW		(D) PEAK HOURLY FLOW	
	MGD	GPM	MGD	GPM	MGD	GPM	MGD	GPM
UNITS								
Present	1.52	1050	1.87	1300	3.2	2225	4.46	3100
Near Future	2.2	1528	2.8	1944	4.4	3056	6.6	4583
Ultimate Development	2.5	1736	3.1	2153	5.5	3820	8.25	5730

V. COMPUTER MODELING OF THE DISTRIBUTION SYSTEM

We have analyzed the Borough's Distribution System using the known existing water production rates and projection of future demand. The entire system was considered using a network analysis known as the "Hardy-Cross" method.

Utilizing this method demands were projected at various locations throughout the Borough. Beginning the analysis at the water works site and then working through to the outer extremities of the Borough, the friction losses through the various branches of the network were balanced and then adjusted for the difference in elevation between the area under study and the plant. The computer provides the static pressure in the area being studied at the flow rate being considered.

The aforementioned method considers only 10" and larger mains as major components of the distribution system. However 8" and 6" lines were also analyzed in areas where they close off loops or where two or more small lines run in parallel. Certain dead end lines such as the old mains along William Street and the causeway were tested and analyzed independently.

The Hardy-Cross method utilizes the mathematical formulae for friction loss known as the Darcy-Weisbach equation where head loss (H_L) is equal to $f \frac{L}{D} \frac{V^2}{2g}$. This equation accounts for the friction in the pipe, the velocity of the water in the pipe as well as the pipe size and the length. On a large network with many different branches and flow conditions such as the

system under investigation, the Hardy-Cross method can be tedious since it involves many calculations in a series of successive approximations. Fortunately, the method is systematic and lends itself to computer modeling.

A. FRICTION FACTORS FOR COMPUTER MODEL

The friction factor (f) in the Dracy-Weisbach equation accounts for the energy lost by the moving water along the inner walls of the pipe. Generally the (f) factor tends to increase with the age of a pipe and the quality of water carried by the pipe.

The friction factor (f) used for new pipes were obtained either from the manufacturers' literature, text books, or AWWA publications.

Because the age of the pipe is critical in assigning the value of (f), the "Age of Water Systems Map" (Plate II) was prepared and included in this report, and flow tests were conducted at numerous points on the older lines.

Generally, the results of these tests indicated very high friction losses in the oldest lines of the system as anticipated. Presumably, the high iron content of the untreated water and the fact that the original pipes were unlined account for the same. The severe encrustation on a core from the 10" line on Main Street taken in the Summer of 1978 indicated that the high friction factors arrived at are characteristic of the system.

The friction factors utilized in the computer modelling of the system are listed in Table IV. This table is broken down into 3 categories; new cast iron pipe, average aged cast iron pipe (average age in the system is about 30 to 40 years old), and systems oldest pipes which are about 55 to 68 years old.

The friction factors of some of the lines tested are listed in Table V.

BOROUGH OF SOUTH RIVER
WATER DISTRIBUTION SYSTEM
PIPE CHARACTERISTICS
UTILIZED IN COMPUTER MODELLING

TABLE IV

FRICTION FACTOR (f)

SIZE	NEW CAST IRON PIPE	AVERAGE AGED CAST IRON PIPE	SYSTEMS OLDEST CAST IRON PIPES
4"	N.A.	N.A.	0.40
6"	0.0135 *	0.033	0.14
8"	0.013 *	0.029	0.085
10"	0.0125 *	0.027	0.065
12"	0.012 *	0.16 *	N.A.
14"	0.012 *	0.16 *	N.A.
16"	0.0115 *	N.A.	N.A.
20"	0.011*	N.A.	N.A.

* Represents friction factor for cement lined cast iron pipe

RESULTS OF CORE TESTING

TABLE V

SIZE & LOCATION OF MAIN	EXPERIENCED FRICTION FACTOR (f)
4" - Downtown Industrial Area	0.40 <u>±</u>
6" - William Street (North End)	0.14 <u>±</u>
8" - Prospect Street	0.085 <u>±</u>
10" - Ferry Street & Main Street	0.065 <u>±</u>
8" - Old Bridge Turnpike at Icker Ave.	0.14 <u>±</u>
8" - Main Street and Hillside Avenue	0.14 <u>±</u>

B. DEMAND FIGURES FOR COMPUTER MODEL

The demand figures utilized in the computer model have been tabulated on page 28. These figures are based on past production records and have been projected for future conditions as developed in other applicable sections of this report, allowing for continued development and an increase in the per capita consumption. Increased consumption is anticipated due to the proposed treatment facilities which will provide better quality water to consumers and also due to anticipated improvements in the distribution system.

These figures have been calculated for the four different design criteria A, B, C, & D for each of the three conditions: present, near future (1990-2000) and ultimate development based on existing zoning and have been previously shown in Table III in the demand characteristics section of this report.

The four different design criteria are: (A) the yearly average daily flow, (B) the peak month (Summer) average daily flow, (C) the peak daily flow, (D) the estimated peak hourly flow.

C. FIRE PROTECTION REQUIREMENTS

The Borough's distribution system is also used for fire protection. The amount of water required in a given area for fire protection is a function of building type, use and density.

Based on the discussion and figures contained in the Fire Protection Handbook (14th ed. 1976) the Borough's requirements fall into one of the three groups tabulated below.

<u>USE</u>	<u>MINIMUM FIRE FLOW</u>
Low density residential	500 gpm
Medium density residential & commercial	1000 gpm
High density, buildings continuous (schools, Downtown, etc.)	2500 gpm to 4000 gpm depending on density

Distribution lines were analyzed and proposed lines sized based upon the maximum daily demand (C) plus the required fire flow to the particular area under consideration. The sum of the required fire flow and the peak daily flow (C) figures for each condition as shown below were utilized as the input for the computer program:

	<u>MAJOR FIRE</u>	<u>SERIOUS FIRE</u>	<u>AVERAGE FIRE</u>
Present Condition	4,725 gpm	3,225 gpm	2,725 gpm
Near Future	5,550 gpm	4,050 gpm	3,550 gpm
Ultimate Development	6,325 gpm	4,825 gpm	4,325 gpm

For the purposes of distribution line sizing it was assumed that the quantity of water required is available. It was further assumed that the minimum requirements for fire protection shall be provided at a minimum of 20 psi residual pressure in the main, at the required flow rate for 2 hours duration.

Peak day figures are generally used because it is not normally economically feasible to design the systems distribution pumps to meet the peak hourly demand. Accordingly the difference between the peak day demand (C) and the peak hour demand (D) generally is obtained from storage facilities.

VI. FIRE FLOW TESTING

The Borough's water system was extensively tested with respect to available fire flows. The result of these tests are shown on Plate VI.

As previously discussed in the Computer Modeling Section of this report the Required Fire Flows based on the National Fire Protection Association Handbook are as listed in that section and also on Plate VI.

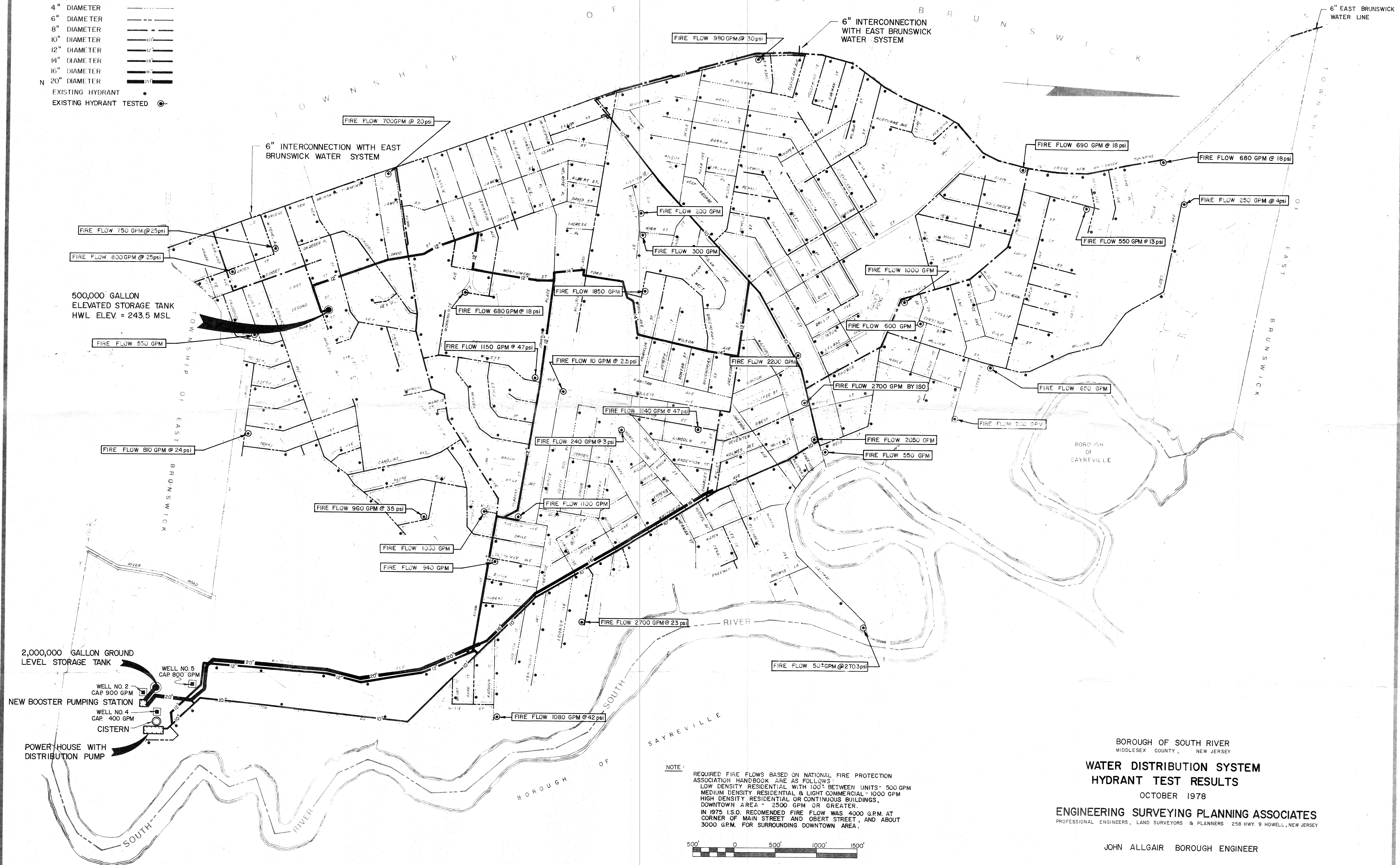
Approximately 32 hydrants were tested in various areas throughout the Borough with only 8 of the 32 hydrants meeting or exceeding the NFPA Flows. Twelve of the test results indicated extremely poor fire flows and should be major concern areas for recommended improvements and will be further discussed in this report.

PLATE VI

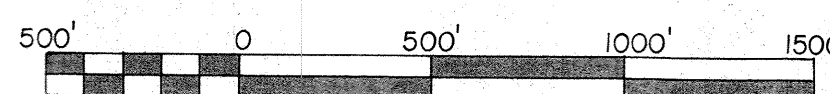
LEGEND

EXISTING WATER MAINS

4" DIAMETER	----
6" DIAMETER	----
8" DIAMETER	----
10" DIAMETER	----
12" DIAMETER	----
14" DIAMETER	----
16" DIAMETER	----
20" DIAMETER	----
EXISTING HYDRANT	•
EXISTING HYDRANT TESTED	⊙



NOTE: REQUIRED FIRE FLOWS BASED ON NATIONAL FIRE PROTECTION ASSOCIATION HANDBOOK ARE AS FOLLOWS:
 LOW DENSITY RESIDENTIAL WITH 100' BETWEEN UNITS - 500 GPM
 MEDIUM DENSITY RESIDENTIAL & LIGHT COMMERCIAL - 1000 GPM
 HIGH DENSITY RESIDENTIAL OR CONTINUOUS BUILDINGS, DOWNTOWN AREA - 2500 GPM OR GREATER.
 IN 1975 I.S.O. RECOMMENDED FIRE FLOW WAS 4000 G.P.M. AT CORNER OF MAIN STREET AND OBERT STREET, AND ABOUT 3000 G.P.M. FOR SURROUNDING DOWNTOWN AREA.



BOROUGH OF SOUTH RIVER
 MIDDLESEX COUNTY, NEW JERSEY
**WATER DISTRIBUTION SYSTEM
 HYDRANT TEST RESULTS**
 OCTOBER 1978
ENGINEERING SURVEYING PLANNING ASSOCIATES
 PROFESSIONAL ENGINEERS, LAND SURVEYORS & PLANNERS 258 HWY. 9 HOWELL, NEW JERSEY

JOHN ALLGAIR BOROUGH ENGINEER

VII. RECOMMENDED SYSTEM IMPROVEMENTS

A. SUPPLY FACILITIES

The Borough is presently making application to the State of New Jersey for the Installation of a Stand-By Well. After completion of the same the Borough's supply facilities should be adequate until about 1985 at which time or sooner if system characteristics change, an Engineering Analysis should be made to determine where future water will be obtained.

It is not anticipated, due to the salt water encroachment of the aquifer that additional increases in water diversion will be permitted or should be permitted from the Farrington Sand Member. It is anticipated that water will have to be purchased from other water purveyors or that a peaking supply be developed by constructing reservoirs on the Borough property adjacent to the Utility Department garages. The reservoirs may then be filled with water from the South River during periods of low chlorides. Depending on water quality and State approval water may then be treated directly by a surface water clarifier and then pumped through the proposed Water Treatment Plant. An alternate approach might be to utilize this River water to recharge the Old Bridge Sands and then withdraw the water by pumping through wells. This latter approach would permit the natural filtration of the water through the Old Bridge Sands.

B. ADDITIONAL STORAGE FACILITIES

The Insurance Service Office (ISO) of New Jersey has recommended in 1975 that the required fire flow for the Borough be 3000 gallons per minute (gpm) for 3 hours (540,000 gal.) The ISO have also indicated that the recommended System Storage be equal to the Peak Day System Demand plus the 540,000 gallons. By utilizing this criteria about 4 million gallons of additional water storage would be required by the year 2000. Due to the economics involved in the construction of at least two new storage tanks and pumping facilities an alternate analysis approach was utilized to determine a more feasible design.

This alternate analysis recognizes that the Borough has surface water supplies available which can be utilized for fire fighting purposes, as well as recognizes that in the event that a major fire occurred during a summer peak period a ban could be instituted during that day to limit lawn watering.

The system demand characteristics were evaluated and it was determined that about 400,000 gallons of water above Elevation 220 MSL is required to maintain system pressures throughout the day by 1990 unless additional booster pumping capacity is provided. The recommended emergency storage is the peak day water consumption which is 5.5 MGD for Ultimate Development and would be economically unfeasible. The peak day water consumption less lawn watering has been estimated at 2.5 MGD for Ultimate Development. Therefore the emergency

storage plus demand equalization storage is equal to 2.9 MG.

If the Fire Reserve storage of 540,000 gallons is included, the total storage requirement would become 3.44 MGD. Since the Borough presently has a total storage capacity of 2.5 MG an additional 0.94 MG would be required.

In a report prepared in 1970 by Alfred Crew a recommendation was made to construct a 2 million gallon ground level storage tank and pump station in the Northern section of the Borough near Prospect Street.

We have reviewed the water system characteristics herein and concur that the Borough needs additional water storage in the North End; however, we recommend that if the Borough can better utilize the water presently existing in Daily's Pond and the South River to fight fires in the Downtown area a reduction in that quantity of storage required for about the next 10 to 15 years could be achieved.

In order to reduce the previously recommended quantities of storage, Daily's Pond would have to be dredged within the next few years and an access road and hydrant intake from the River near Laffins should be constructed to insure that water is available from these sources. In addition, it is recommended that when the area between the causeway and new bridge to Sayreville is developed for a park or other use, a fire pond can be constructed with access road to Water Street and hydrant intake structure in order to help meet future fire reserve demands.

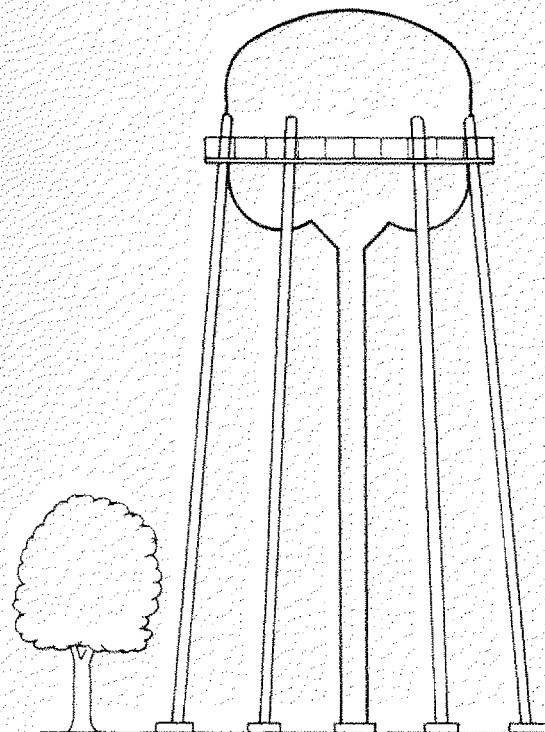
Further, as development in the North End Industrial area progresses the Borough may need additional fire reserve storage in that area which can be provided by either a pumped, ground level storage tank or by a fire pond with emergency fire pump and separate distribution system. Such a facility should be considered prior to reconstruction in that area.

Consequently we recommend that a 500,000 gallon elevated storage tank be constructed near the intersection of Old Bridge Turnpike and Prospect Street. The remaining 440,000 gallons of water could be obtained from the aforementioned surface water supplies for fire fighting purposes. The 1979 estimate of cost for the Proposed 500,000 gallon Elevated Storage Tank is listed on Plate VII for the various styles of tanks available. Since the tank will have to be a minimum of 143 feet tall it is recommended the Alternate B or Alternate C be selected due to aesthetic reasons.

Alternate sites near the intersection of Old Bridge Turnpike and Prospect Street should be considered and purchased after a soils investigation is made to determine the suitability of the site.

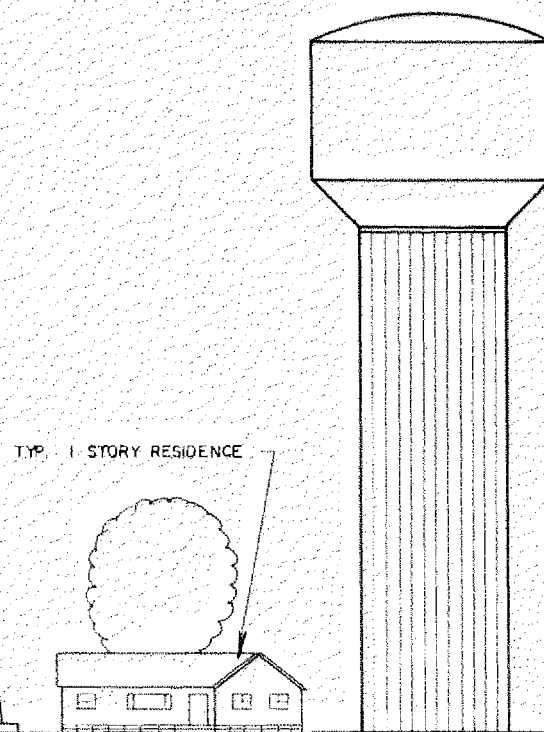
PLATE VII
ELEVATED STORAGE TANKS

ALTERNATE A



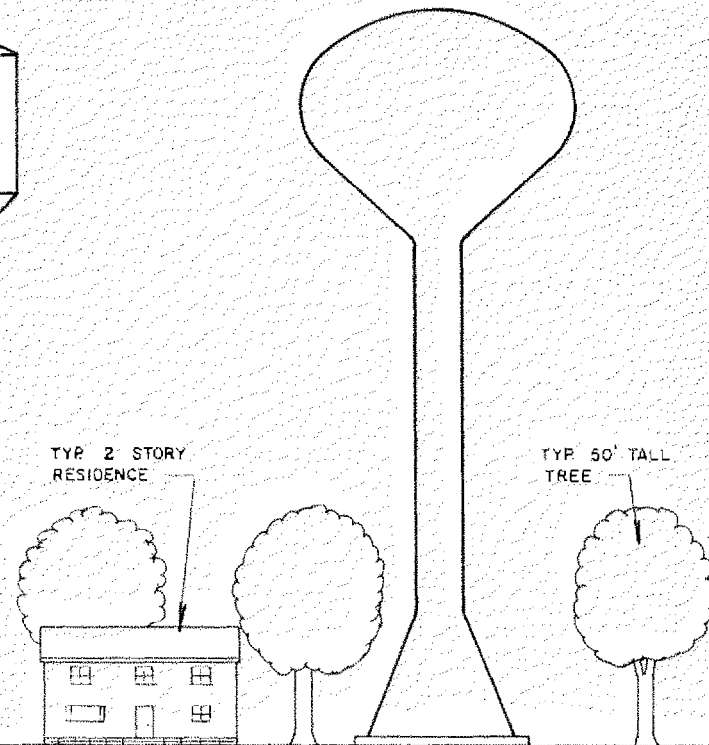
500,000 GALLON
TORO - SPHERICAL DESIGN
\$ 450,000.^①

ALTERNATE B



500,000 GALLON
HYDRO - PILLAR DESIGN
\$ 500,000.^①

ALTERNATE C



500,000 GALLON
PEDESTAL SPHEROID DESIGN
\$ 530,000.^①

NOTE :

ALTERNATE B OR C IS RECOMMENDED
FOR AESTHETIC REASONS.

BOROUGH OF SOUTH RIVER
MIDDLESEX COUNTY, NEW JERSEY

WATER DISTRIBUTION SYSTEM
ELEVATED STORAGE TANKS

ENGINEERING SURVEYING AND PLANNING ASSOCIATES
PROFESSIONAL ENGINEERS, LAND SURVEYORS & PLANNERS 258 HWY 9 HOWELL, N.J.

① ESTIMATED 1979 CONSTRUCTION COST FOR 500,000 GALLON TANK
WITH OVERFLOW 143 FEET ABOVE GROUND AND SUITABLE SOIL CONDITIONS

C. DISTRIBUTION SYSTEM REINFORCEMENT

Problems associated with corrosion and encrustation in the older water mains in the Borough as well as the inadequate looping of large diameter lines and inadequate elevated storage has resulted in the poor available fire flows reflected in the flow tests and large fluctuations in system pressure during periods of peak demands. In addition, it is anticipated that unless steps are initiated presently to mitigate the increase of corrosion and encrustation or to improve the distribution system the Borough can anticipate significant problems in the future with regard to the satisfactory distribution of water throughout the Borough.

This report is intended to serve as a Master Plan for Water System Improvements for the next 15 years or more.

1. STAGE I - IMPROVEMENTS

Plate VIII represents the Proposed Stage I Improvements. The bolder dashed lines, representing various sized lines as shown in the Legend on that Plate are recommended to be constructed over a seven year period as indicated in Table VI which also includes the estimated cost of these improvements.

The improvements recommended in the Stage I - Improvement Plan are primarily for fire protection and improved water service. Note the recommended improvements in the Willet Avenue-Prentice Avenue area, the Roosevelt Street area, the causeway areas, as well as the end of William Street area are an immediate necessity when one reviews the Hydrant Test Results shown on Plate VI.

PLATE VIII

LEGEND

EXISTING WATER MAINS

4" DIAMETER	----
6" DIAMETER	----
8" DIAMETER	----
10" DIAMETER	----
12" DIAMETER	----
14" DIAMETER	----
16" DIAMETER	----
20" DIAMETER	----
EXISTING HYDRANT	•

PROPOSED WATER MAINS

8" DIAMETER	----
10" DIAMETER	----
12" DIAMETER	----
INSERT VALVE	✕

500,000 GALLON
ELEVATED STORAGE TANK
HWL ELEV. = 243.5 MSL

6" INTERCONNECTION WITH EAST
BRUNSWICK WATER SYSTEM

6" INTERCONNECTION
WITH EAST BRUNSWICK
WATER SYSTEM

PROPOSED 500,000 GALLON
ELEVATED STORAGE TANK

(OTHER SITES ABOVE ELEV. 100 MSL CAN ALSO
BE CONSIDERED)

INSERT
VALVE

INSERT
VALVE

2,000,000 GALLON GROUND
LEVEL STORAGE TANK

WELL NO. 5
CAP 800 GPM

WELL NO. 2
CAP 900 GPM

NEW BOOSTER PUMPING STATION

WELL NO. 4
CAP 400 GPM

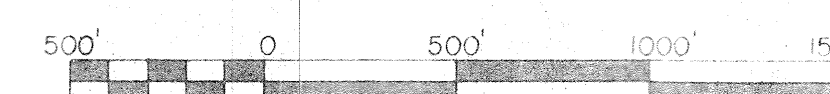
CISTERN

POWER HOUSE WITH
DISTRIBUTION PUMP

BOROUGH OF SOUTH RIVER
WATER DISTRIBUTION SYSTEM
PROPOSED STAGE I IMPROVEMENTS
OCTOBER 1978

ENGINEERING SURVEYING PLANNING ASSOCIATES

JOHN ALLGAIR BOROUGH ENGINEER



BOROUGH OF SOUTH RIVER
WATER DISTRIBUTION SYSTEM
TABLE VI
PROPOSED STAGE I IMPROVEMENTS
1979 - 1986
ESTIMATED COST⁽¹⁾

PROPOSED SCHEDULED YEAR	IMPROVEMENT	ESTIMATED CONSTRUCTION COST
	1. Prentice, Willet, Southside and Magiera Streets area	
1979-1980	A. 900' - 10" diameter D.I.P. @ \$35/ft	\$ 31,500
1984	B. 1600' - 8" diameter D.I.P. @ \$30/ft	48,000
1981	2. Old Bridge Turnpike-William Street Connection 950' - 12" diameter D.I.P. @ \$40/ft	38,000
	3. Proposed 500,000 gallon elevated storage tank	
1982 & 1983	A. Storage Tank & Site Work	500,000
1983	B. 4400' - 12" diameter D.I.P. @ \$40/ft	176,000
1980	C. Property Aquisition	To be determined
1985	4. Whitehead Avenue to Causeway Reinforcement 2100' - 8" diameter D.I.P. @ \$30/ft	63,000
1986	5. Roosevelt Street-Main Street Connection 900' - 9" diameter D.I.P. @ \$30/ft	27,000
1986	6. Insert Valves at locations shown	6,000
1986	7. Rubin Street Reinforcement 200' - 10" diameter D.I.P. @ \$35/ft	7,000
	SUBTOTAL	\$896,500 ±
	CONSTRUCTION CONTINGENCY	134,500 ±
	TOTAL ESTIMATED CONSTRUCTION COST (LESS PROPERTY AQUISITION)	\$1,031,000 ±

(1) Based on 1979 Construction Costs

Also included under Stage I Improvements are a 500,000 gallon elevated storage tank and transmission main which is a necessity to improve the water system in the North and Central portion of the Borough. The proposed tank and transmission main if constructed would also provide more elevated storage that would result in more consistant pressures in the Southwest portion of the Borough.

Further, the proposed storage tank would enhance the development of the North End Industrial area by providing necessary water storage for Industrial Development.

The other improvements included in Stage I are the installatin of insert valves for water conservation reasons and the installation of about 300 feet of 10" pipe on Rubin Street to better loop the system.

2. STAGE II IMPROVEMENTS

The water system improvements recommended under Stage II are intended to provide increased fire flows as well as improved water service to other areas throughout the Borough that are in need of the same. These Stage II improvements are shown on Plate IX.

The most important improvement recommended under this plan is the construction of a 12 inch water main from the existing 16" main in Whitehead to Main Street and from Main Street up Reid Street to the V.F.W. where the proposed main would run through easements to the William Street Industrial area.

The proposed 12" water line that runs along the proposed realignment of William Street should be installed when the road is reconstructed and has not been included in the Cost Estimate for the Stage II Improvements which are listed in Table VII.

Other improvements included under Stage II are minor system reinforcement throughout the Borough as well as the necessary cleaning of the Main Street water main.

PLATE IX
STAGE I & II IMPROVEMENTS

LEGEND

EXISTING WATER MAINS

4" DIAMETER	----
6" DIAMETER	----
8" DIAMETER	----
10" DIAMETER	----
12" DIAMETER	----
14" DIAMETER	----
16" DIAMETER	----
20" DIAMETER	----
EXISTING HYDRANT	•

PROPOSED WATER MAINS

8" DIAMETER	----
10" DIAMETER	----
12" DIAMETER	----
INSERT VALVE	+

6" INTERCONNECTION WITH EAST BRUNSWICK WATER SYSTEM

6" INTERCONNECTION WITH EAST BRUNSWICK WATER SYSTEM

PROPOSED 500,000 GALLON ELEVATED STORAGE TANK

(OTHER SITES ABOVE ELEV. 100 MSL. CAN ALSO BE CONSIDERED)

500,000 GALLON ELEVATED STORAGE TANK
HWL ELEV. = 243.5 MSL

CLEAN EXISTING 10" MAIN UNDER STAGE II IMPROVEMENTS

NOTE: PROPOSED 12" WATER LINE SHOULD BE INSTALLED IN PROPOSED LIMITS OF REALIGNED ROADWAY, AND COULD BE INSTALLED DURING DEVELOPMENT OF THIS AREA UNLESS PROBLEMS ARE EXPERIENCED IN NOT BEING ABLE TO FILL PROPOSED TANK.

2,000,000 GALLON GROUND LEVEL STORAGE TANK

NEW BOOSTER PUMPING STATION
WELL NO. 2 CAP 900 GPM
WELL NO. 4 CAP 400 GPM
CISTERN

POWER HOUSE WITH DISTRIBUTION PUMP

INSERT VALVE
STAGE I

INSERT VALVE
STAGE I

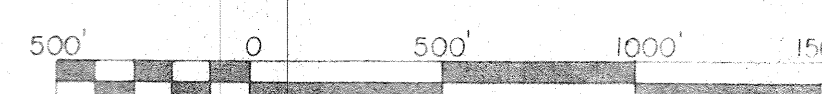
BOROUGH OF SOUTH RIVER
MIDDLESEX COUNTY NEW JERSEY

WATER DISTRIBUTION SYSTEM
PROPOSED STAGE I & II IMPROVEMENTS

OCTOBER 1978

ENGINEERING SURVEYING PLANNING ASSOCIATES
PROFESSIONAL ENGINEERS, LAND SURVEYORS & PLANNERS 250 HWY 9 HOWELL, NEW JERSEY

JOHN ALLGAIR BOROUGH ENGINEER



BOROUGH OF SOUTH RIVER
WATER DISTRIBUTION SYSTEM
TABLE VII
PROPOSED STAGE II IMPROVEMENTS
1987 - 1994
ESTIMATED COST

PROPOSED SCHEDULED YEAR	IMPROVEMENT	ESTIMATED CONSTRUCTION COST
1987-1990	1. Whitehead Avenue-William Street Transmission Main 5200' - 12" diameter D.I.P. @ \$40/ft *(Easement Acquisition not included)	\$208,000 *
1991	2. Clean existing Main Street Water Line 5200' - 8" diameter Cleaning @ \$2/ft	10,400
1992	3. Miscellaneous System Reinforcement A. Northern St - 350' - 8" @ \$30/ft B. Burton Ave - 300' - 8" @ \$35/ft C. Monush Ave (North) 350' - 8" @ \$30/ft D. Sunset St - 200' - 8" @ \$30/ft	10,500 10,500 10,500 6,000
1993-1994	4. Claremont, James & Arlington 1650' - 8" diameter D.I.P. @ \$30/ft	49,500
	SUBTOTAL	\$305,400
	CONSTRUCTION CONTINGENCIES	45,800
	TOTAL ESTIMATED CONSTRUCTION COST	\$351,200

3. STAGE III IMPROVEMENTS

The recommended improvements included under Stage III further provides the Borough with necessary system reinforcement and extensions. These Stage III facilities are shown along with Stage I and II facilities on Plate X.

Most of the improvements shown on the aforementioned Plate X and listed in Table VIII represent spot system reinforcements which are recommended to provide a better integrated water distribution system.

The most important of these improvements is the proposed 10" water line on Rubin Street from Prospect to Burton and along Old Bridge Turnpike from Burton to Claire Place. The aforementioned line provides a valuable link between the proposed storage tank and William Street line.

Further the cleaning of the 6" main on Prospect Street should be cleaned to avoid the installation of a new line in that roadway.

Note that estimates for these improvements have not been prepared since the recommended schedule calls for them to be installed more than 15 years away and estimates that far into the future are purely speculative.

Other lines have been included on Plate X in order that it provide a Master Plan of line sizes for future construction.

PLATE X

STAGE I, II & III IMPROVEMENTS

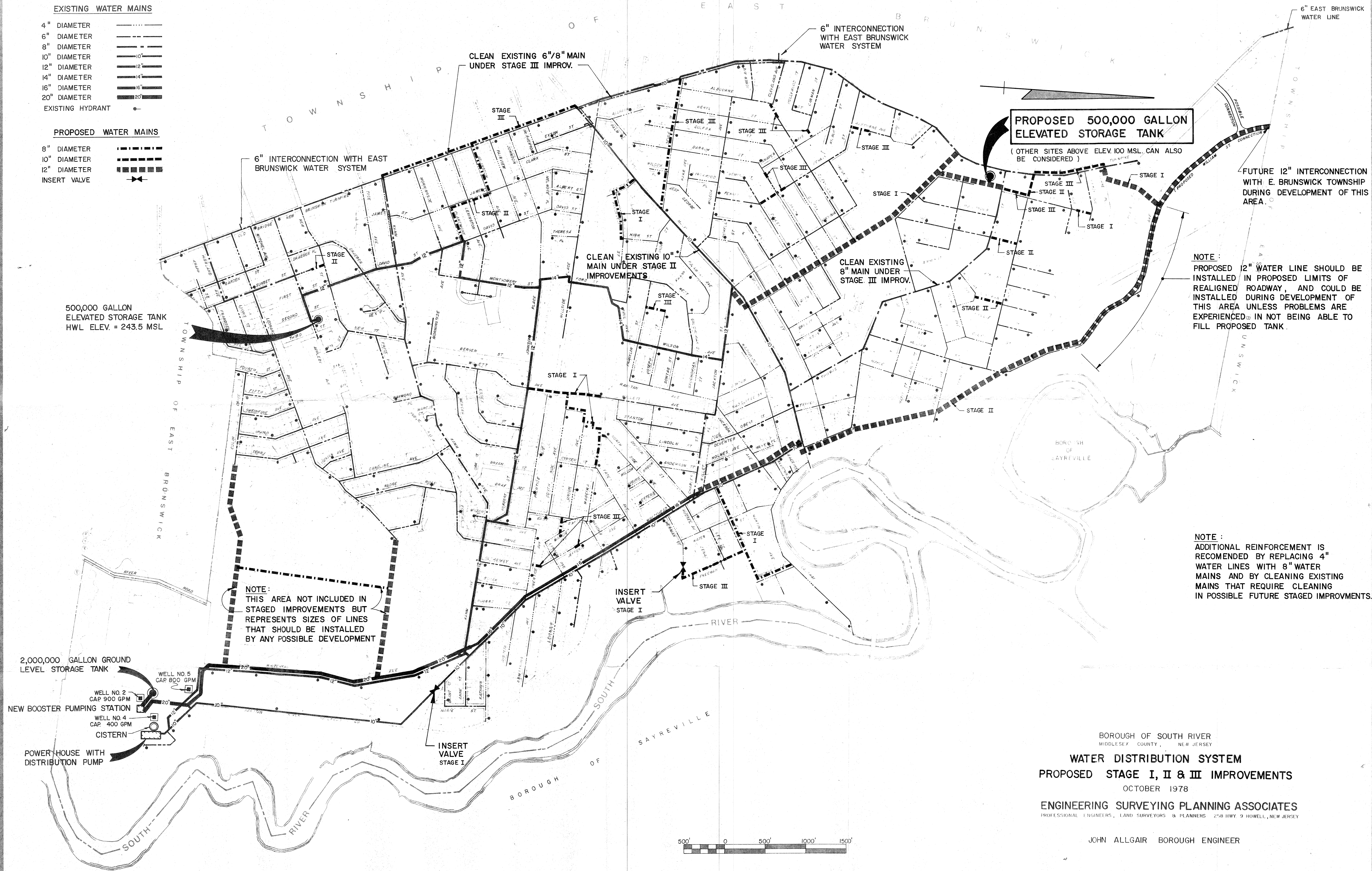
LEGEND

EXISTING WATER MAINS

4" DIAMETER	----
6" DIAMETER	----
8" DIAMETER	----
10" DIAMETER	----
12" DIAMETER	----
14" DIAMETER	----
16" DIAMETER	----
20" DIAMETER	----
EXISTING HYDRANT	•

PROPOSED WATER MAINS

8" DIAMETER	----
10" DIAMETER	----
12" DIAMETER	----
INSERT VALVE	✕



NOTE:
PROPOSED 12" WATER LINE SHOULD BE INSTALLED IN PROPOSED LIMITS OF REALIGNED ROADWAY, AND COULD BE INSTALLED DURING DEVELOPMENT OF THIS AREA UNLESS PROBLEMS ARE EXPERIENCED IN NOT BEING ABLE TO FILL PROPOSED TANK.

NOTE:
ADDITIONAL REINFORCEMENT IS RECOMMENDED BY REPLACING 4" WATER LINES WITH 8" WATER MAINS AND BY CLEANING EXISTING MAINS THAT REQUIRE CLEANING IN POSSIBLE FUTURE STAGED IMPROVEMENTS.

BOROUGH OF SOUTH RIVER
MIDDLESEX COUNTY, NEW JERSEY
WATER DISTRIBUTION SYSTEM
PROPOSED STAGE I, II & III IMPROVEMENTS
OCTOBER 1978

ENGINEERING SURVEYING PLANNING ASSOCIATES
PROFESSIONAL ENGINEERS, LAND SURVEYORS & PLANNERS 258 HWY. 9 HOWELL, NEW JERSEY

JOHN ALLGAIR BOROUGH ENGINEER

BOROUGH OF SOUTH RIVER
WATER DISTRIBUTION SYSTEM
TABLE VIII
PROPOSED STAGE III IMPROVEMENTS

1. Old Bridge Turnpike - Kamm to Main Street
2600' - 8" diameter D.I.P.
2. Old Bridge Turnpike - Burton to Claire Place
900' - 10" diameter D.I.P.
3. Rubin Street - Prospect to Burton
350' - 10" diameter D.I.P.
4. DeVoe Street
1600' - 8" diameter D.I.P.
5. Miscellaneous System Reinforcement
1650' - 8" diameter D.I.P.
6. Clean 8" Main on Prospect Street
4200' - 8" diameter cleaning
7. Clean old 6" & 8" main on Old Bridge Turnpike

NOTE: Cost Estimate have not been included on the above items since this work is projected into future more than 15 years and cost would be speculative.

VIII. SUMMARY

The Borough's Water System is badly in need of improvements. It is anticipated the corrosion and encrustation of the unlined water mains will continue and pose major distribution difficulties within the near future, some of which presently exist. The Staged Improvements recommended herein provide the Borough with a Master Plan - yearly improvement plan to correct these deficiencies.

The fire recently experienced on November 13, 1978 at the tobacco and furniture businesses on Ferry Street highlight the need for these improvements. During that fire, lack of system storage, transmission, and distribution capabilities was evident.

In addition to the Staged Improvements presented earlier in this report the Borough Utility Department should undertake a program of cleaning water lines to reduce power consumption necessary for distribution pumping and to maximize the available carrying capacity of the water lines. Such a program would save the Borough considerable monies if undertaken by the Utility Department and if successful may even offset the need for some of the Stage III improvements.

Although all the improvements recommended are necessary the most important improvements are the construction of a 500,000 gallon elevated storage tank and associated transmission main and the construction of a water main linking the 16 inch Whitehead Avenue water main with Old Bridge Turnpike through the William Street area.

Further, the development of surface water fire ponds for emergency fire fighting is imperative if future storage improvements are to be limited to an additional 500,000 gallons.

Fire Fighting Programs should be instituted in which the Fire Departments can become thoroughly knowledgeable with regard to the location of the hydrants with greatest capacity as is evident to some degree on Plate VI. The Fire Department should also immediately notify the Water Department about any fires in order that maximum utilization of the distribution pumps can be obtained in order to extinguish the fire as soon as possible. Perhaps regularly scheduled meetings should be held with the Utility Department and Fire Department and this office if necessary to institute a program which would provide benefits to the entire Borough during an emergency.

With regard to the distribution pumping capacity of Borough's Water System, both pumping stations must be maintained with the old distribution pumps as a standby for the new station unless new pumps are installed in an addition to the new pumping station.

During the mid 1980's it is imperative that the water supply facilities be studied to determine where future water supplies will be obtained. The salt water encroachment in the aquifer providing the Borough's present supply creates a precarious condition which must be continuously monitored to avoid complete loss of the water supply wells. The Borough should promote the development of a regional supply in order to provide a backup system for the existing wells or consider the purchasing of water from other water purveyors.

We have endeavored to provide a thorough and accurate analysis of the Borough Water System and we strongly recommend that a program be instituted to undertake the necessary improvements.