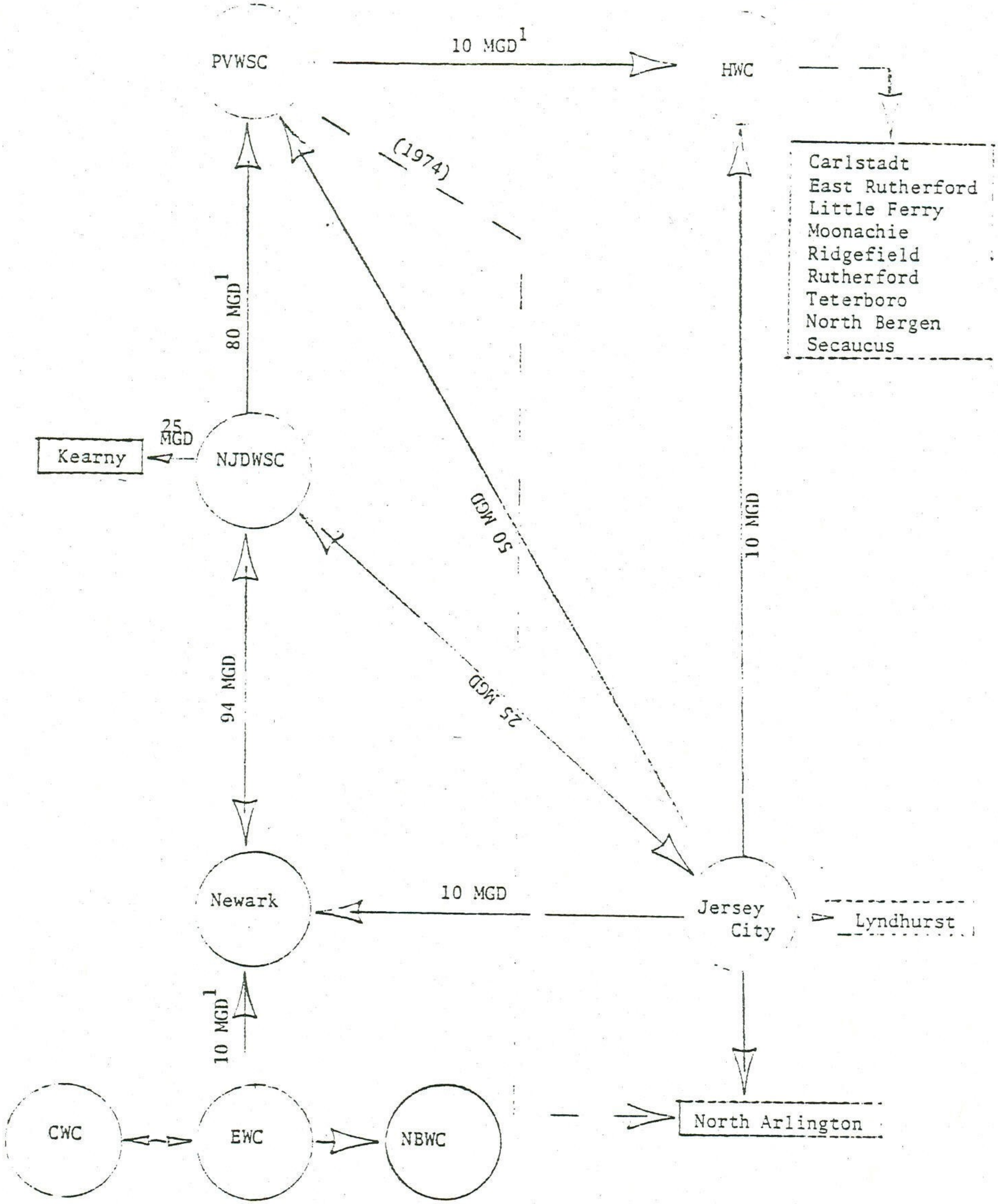
FIGURE 4


PVWSC
10 MGD1
HWC
(1974)
Carlstadt
East Rutherford
Little Ferry
Moonachie
Ridgefield
Rutherford
Teterboro
North Bergen
Secaucus
80 MGD1
25 MGD
Kearny
NJDWSC
50 MGD
10 MGD
25 MGD
94 MGD
Newark
10 MGD
Jersey City
Lyndhurst
10 MGD1
CWC
EWC
NBWC
North Arlington

CHAPTER 4 -- DRAINAGE

Existing Drainage Network

Uplands Kearny is built upon a ridge which runs north south and reaches an elevation of approximately 100 feet. It slopes gradually on the west side toward the Passaic River, and on the east toward the edge of the Hackensack Meadows. The Kearny Meadowlands area is virtually flat with a ground surface elevation of about +5 feet. Runoff to the Hackensack Meadowlands from uplands Kearny must make its way across those meadows to its final discharge point into the Hackensack River, either via tidegate or pump station (see Figure 5).

Historically, repeated attempts have been made, these going back to the construction of the Belleville Pike by Peter Schuyler in 1763, to keep the lowland area free of standing water. (Until the rain stops, this will never be entirely possible.) The cedar forests which once covered much of this area, now gone save for their stumps, were a prodigious source of mosquitos. Since the forest's disappearance -- in the wake of fires, tidal flooding and plank road building -- ditches have been cut, through which surface waters would drain rapidly as the tide receded. Where possible, tide gates were erected at the peripheries to prevent the inflow of water on high tides.

As development took place, and in order to reduce the amount of fill required, pump stations were constructed in conjunction with ditches and tide gates to keep the inland water levels to a munimum. Two such pump stations continue in existence today, and where roads or raillines cross the meadows, culverts were installed so as to facilitate this movement of water to the rivers.

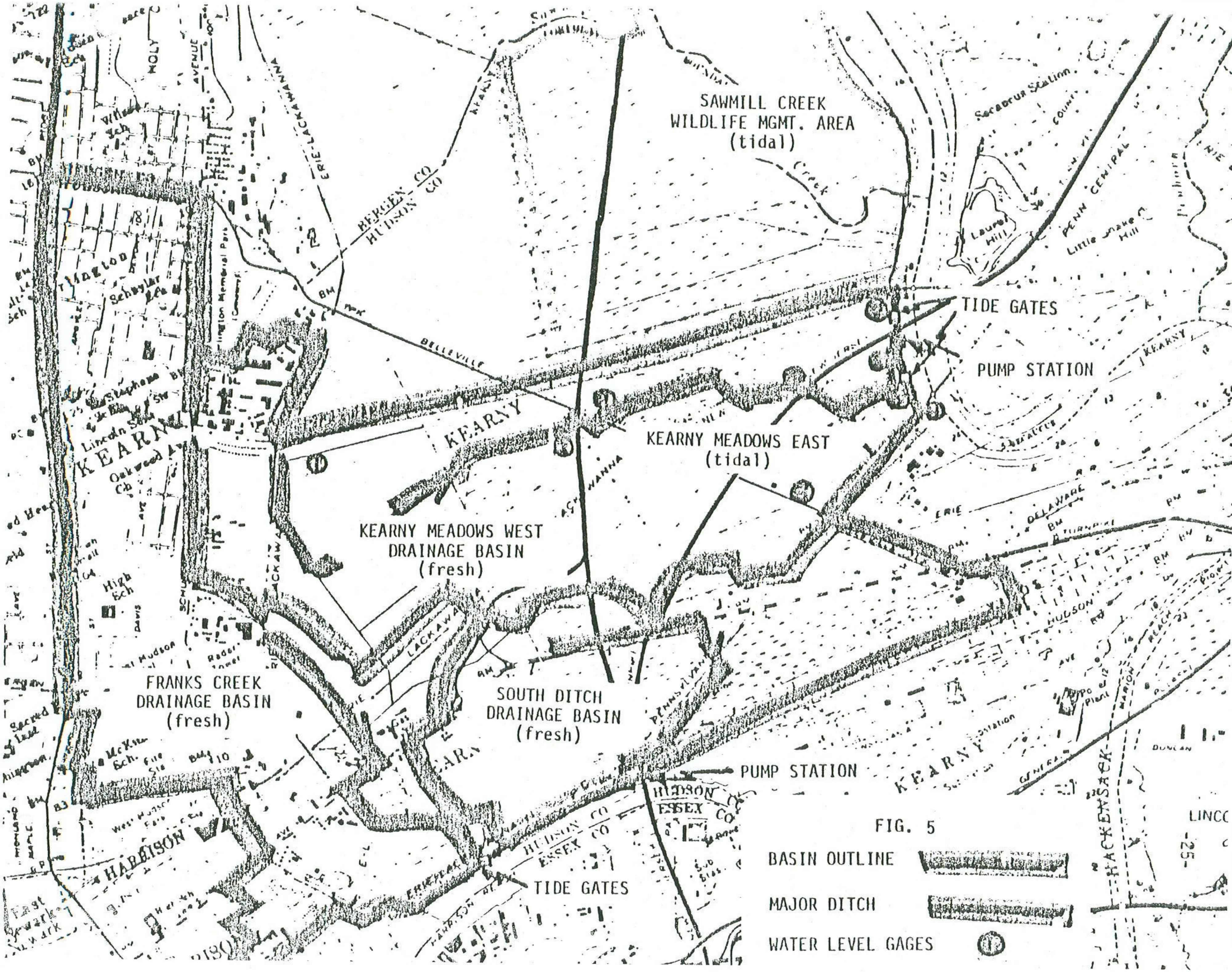
When the Hudson County Mosquito Commission was disbanded, some of the responsibility for maintaining the system passed to the Hudson County Department of Roads.

Existing drainage patterns are shown in Figure 5 .

Existing Flooding

The existing drainage system has numerous problems. Drainage ditches and culverts have been blocked or silted in; tide gates and pump stations have lost varying degrees of effectiveness. In addition, many of the culverts installed years ago are not large enough to handle today's expanded flows.

As summarized above, flooding in the Kearny area can result from two water sources: excessive high tides or heavy rainfall. These can occur in combination. The most severe flooding problems today occur in the uplands area in periods of heavy rains. These are usually localized problems and may be of short duration. A few areas are flooded within the developed meadowlands portion of Kearny as a result of heavy rains. This occurs when


SAWMILL CREEK
WILDLIFE MGMT. AREA
(tidal)
TIDE GATES
PUMP STATION
KEARNY MEADOWS EAST
(tidal)
KEARNY MEADOWS WEST
DRAINAGE BASIN
(fresh)
SOUTH DITCH
DRAINAGE BASIN
(fresh)
FRANKS CREEK
DRAINAGE BASIN
(fresh)
PUMP STATION
TIDE GATES
BERGEN CO
HUDSON CO
ERIE-LACKAWANNA
PENN CENTRAL
KEARNY
HARRISON
HACKENSACK
BASIN OUTLINE
MAJOR DITCH
WATER LEVEL GAGES
FIG. 5

the water level in the adjacent meadows is higher than normal (after periods of heavy rainfall), preventing the escape of surface water. Abnormally high tides and tides "held" in the estuary by strong south winds exacerbate this situation by restricting for longer periods, the outward flow of water to the river.

Commission Staff have developed a preliminary understanding of the entire drainage network through a series of water height and flow studies, conducted in June, July, and August, 1976. The first such study consisted of placing gauges at various points throughout the system and periodically measuring water surface elevations. That data is presented in Figure 6 . The study confirms the inadequate condition of the existing drainage system. Tidal effects, measured in salinity gradients can be seen in portions of the area which were once securely diked from tidal influence. Water heights recede slowly after a storm, indicating a constricted flow network and demonstrating the value of the 405 acre Kearny fresh meadows as a retention basin.

It is also clear that flooding problems are not worse than they are because of the fact that little development has taken place in the meadowlands area; thus the water retention basin's area has remained large and the absence of pavement results in slower, and thus more manageable, water flow rates.

Because the existing marsh surface areas have remained extensive, even large volumes of water entering the basin raise the height of the water only a small amount -- measurable in inches. After the storm passes, the detained water is slowly released through the constricted drainage system to the river. Figure 7 records these field observations.

This past summer, hydrological studies were performed in an attempt to trace the flowing waters. Water level indicators (see Figure 7) were places in nine locations throughout the Kearny Study Area. Periodic readings on water levels, west of the New Jersey Turpike's western spur, indicated moderate water fluctuations and predictable water level increases or decreases in areas east of the New Jersey Turnpike's western spur. These moderate fluctuations in the west were attributable to seasonal rainfall and evapotranspiration losses. Predictable levels on the east side tie directly into tidal fluctuations. Subsequent analysis revealed two old, broken tide gates in the eastern sector which allow tidal intrusion It becomes apparent, from previous aerial photographs, that the tide gates and adjacent pump station were once capable of handling the fresh water runoff diverted towards the Kearny Study Area, but since 1972, the area became more tidally inundated as the old gates became less operative.

The effects of Hurricane Belle (August, 1976) on the western section of the Study Area showed that 2.15 inches of rain fell during the storm and that the water level rose, in response, to 1.4 feet. Precipitation data measured prior to the storm showed that for the four-month period beginning in April and ending in July, the recorded rainfall amounted to 12.07 inches: comparing this with the 40 year mean for that time period -- 14.17 inches -- leaving a mean lag of 2.10 inches. Thus the effect of the hurricane deluge

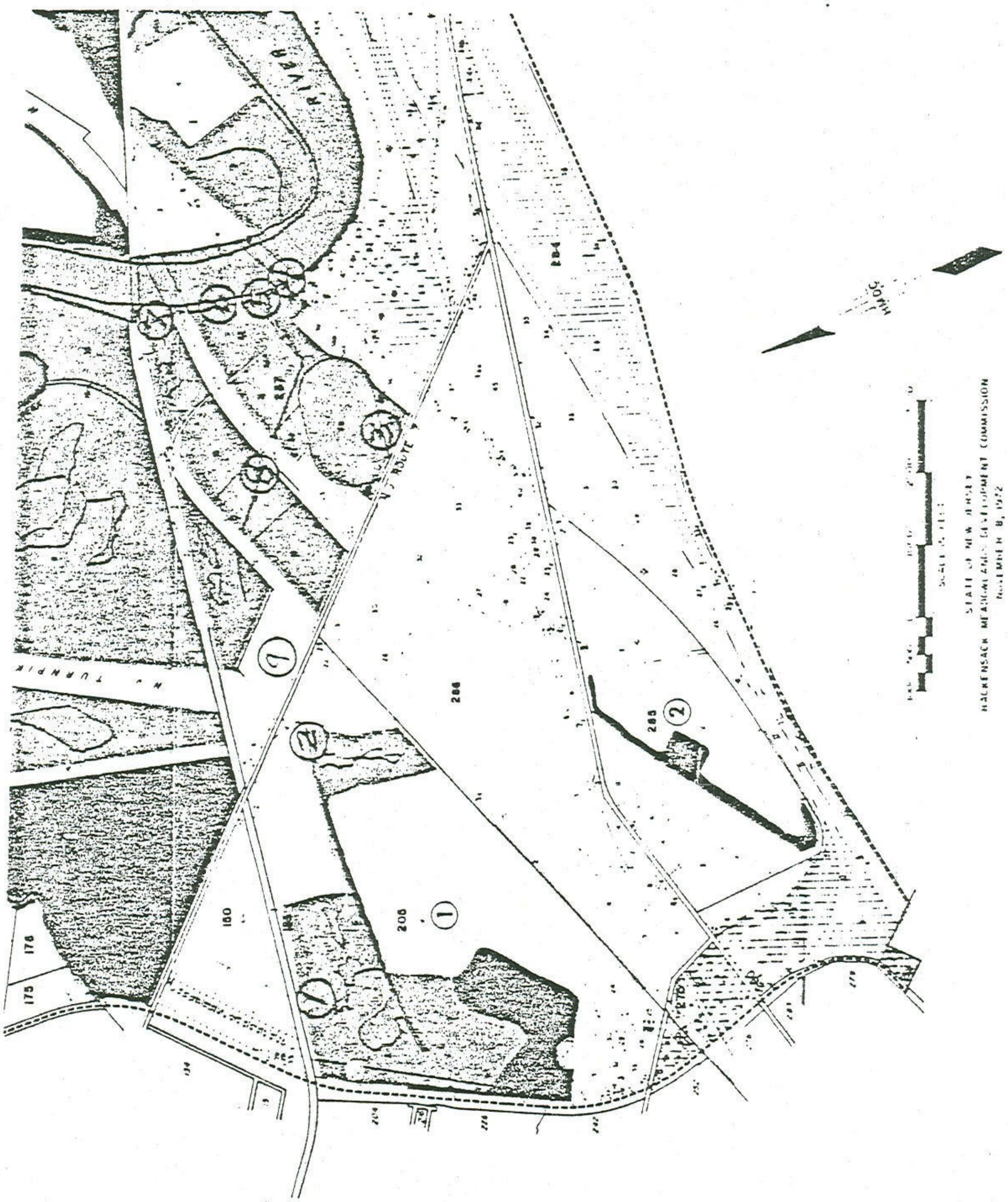
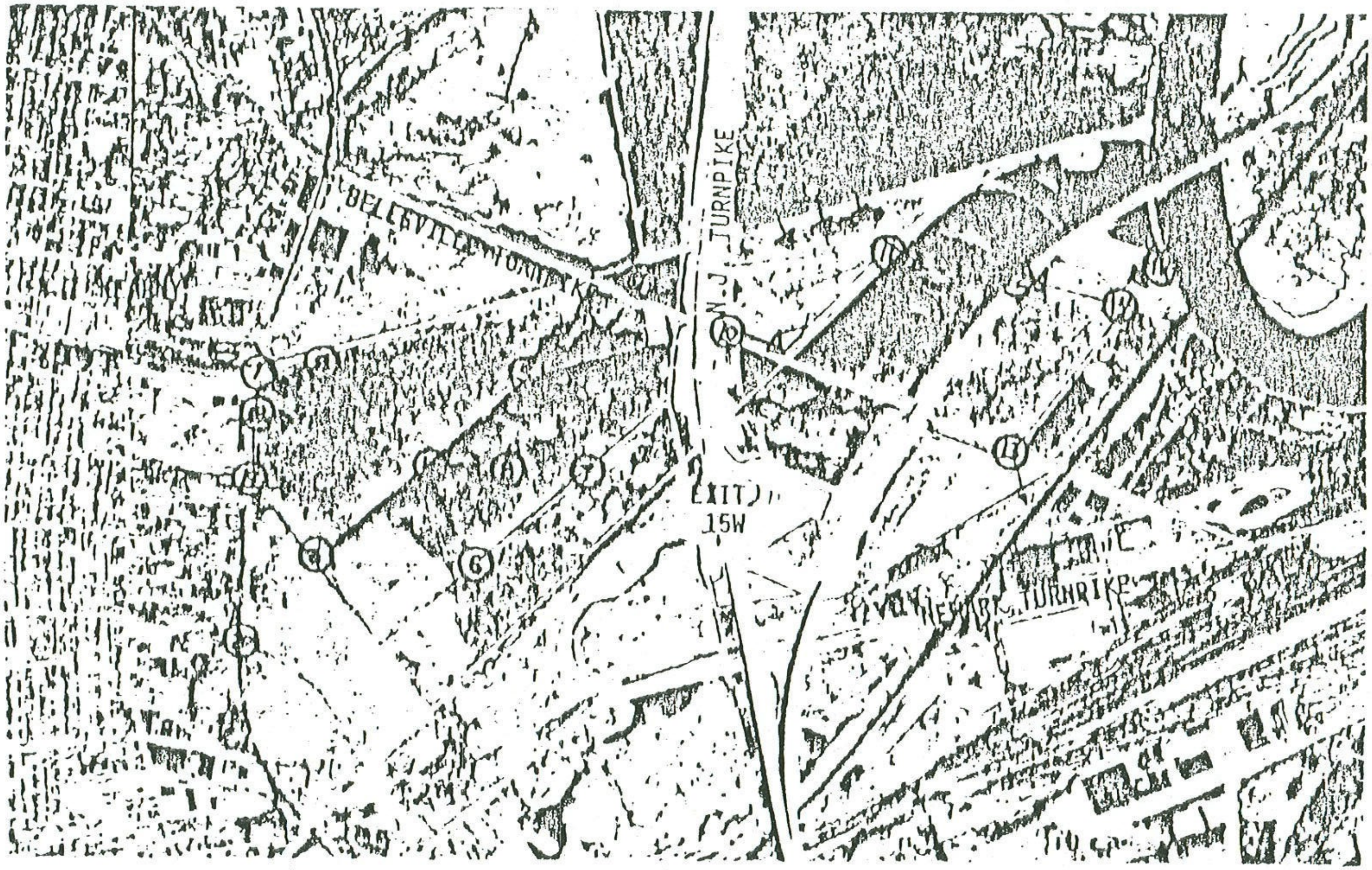

RIVER
STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION

Figure 6

Figure 7



STATION-1	.5 MG/DAY	STATION-13	No Flow
-10	.8 MG/DAY	-14	.15 MG/TIDE Cycle
-11	2.5 MG/TIDE cycle	-15	3.2 MG/TIDE Cycle
-12	.2 MG/TIDE Cycle	-16	.7 MG/TIDE Cycle

Pump STATION
RATED @ 9.36 MGD
MEASURED @ 2.48 MGD

raised the total rainfall to its mean range. At monitoring point #2, (See Figure 7) between April and August 9, 1976, the water level dropped by 1.8 feet. During that time period, the rainfall totalled 12.33 inches. The drop of water level elevation is directly attributable to two sources: evapotranspiration and the flow of water towards the river in seeking its natural exit flow pattern.

Water movement in the Kearny Study Area (see Figure 7) reveals, via velocity and field surveys, the following patterns:

1. Site 1 -- .5 million gallons per day of industrial and domestic wastes and fresh water runoff;

2. Site 18 -- A stormwater bypass permits periodic discharges into the marsh during heavy rainfall;

3. Site 19 -- A combination of industrial and stormwater flows enter via underground culvert;

4. Sites 2 & 9 -- Open water areas or ditches where no visible water movement was observed;

5. Site 17 -- Temporary potable water enters from a leaky Jersey City Aqueduct;

6. Site 10 -- Average flow, leaving the western section of the Kearny Study Area, was measured at 8 MGD, flowing always in an easterly direction -- or towards the river;

7. Site 11 -- Tidal intrusion under the stone and earthen dike along the Boonton branch of CONRAIL and outgoing tidal waters at site 11 amounted to a net inflow at that location of 2.5 MG/tidal cycle;

8. Site 12 & 14 -- Amounted to .2 and .15 MG/tidal cycle respectively;

9. Site 13 -- No flow was recorded;

10. Site 15 & 16 -- Figure 1, below, indicates tidal inflow at 3.2 MG and .7 respectively, per tidal cycle, at these two locations;

11. Fresh water pump station is rated at 9.36 MGD capacity; however, it was measured in the field at 2.48 MGD.

In sum, tidal waters enter at sites 15 and 16 via the broken tide gates, under the earthen dikes along the river, and under the Boonton railroad tracks to the north. The pump stations adjacent to these two site locations cannot maintain adequate water drawdown due to the large tidal intrusion. The penetrating waters thus cause fluctations in water levels in the eastern section and allow for little drawdown of fresh waters, during rainfall, in the western area.

Future Development

As future development takes place, two important drainage factors would give rise to increased flooding without improvements to and expansion of the existing system. These factors, described above, are:

(1) An increased quantity of runoff due to increased impervious areas (roof tops and driveways), and

(2) An increased water surface elevation caused by this runoff due to the decreased area of natural marsh detention basins.

Flooding Analysis by Mathematical Modeling

In June, 1975, the Department of the Army, New York District Corps of Engineers, released a report entitled "Hackensack Meadowlands Mathematical Study", prepared under contract by the New York firm of Tippetts, Abbett, McCarter, & Stratton. The purpose of the study was to develop "a mathematical model of the Hackensack Meadowlands, formulated to perform hydraulic routing of floods and tides through the complex network of channels and marshes in the system." HMDC Staff engineers and environmental specialists worked closely with the consultants in delineating the estuary's physical and hydrologic characteristics.

The Complete program developed by that study pattern utilizes a network of "links" and "nodes" to describe the major geographic and hydrographic characteristics of the project area. Storage volume of channels and flooded areas are ascribed to the "links".

The boundary conditions of the model are inflow hydrographs (water flow from rainfall) for each of the streams tributary to the Hackensack Meadowlands, and for tidal height at Newark Bay. Those boundary conditions, varying for different events, are summarzied below:

INFLOW FROM ORADELL		MAX. TIDE HEIGHT AT NEWARK BAY	
Nominal	500cfs	Mean High	2.95
1 year flood	1600cfs	1 year tide	5.1
10 year flood	2900cfs	10 year tide	6.6
(Hurricane Donna = 2390)		100 year tide	8.6 (Max. tide of record, Hurric[illegible] Donna 8.3)
125 year flood	9240cfs	Standard Project Tide	17.0
Standard Project Flood	14800cfs		

Tidal surge is that component of maximum tidal height caused by wind and by the barometric pressure effects of a storm. Such a surge may or may not coincide with mean high tide. For example, the measured surge of record in the Hackensack Estuary occurred in 1950, but did not produce the tide of record because it occurred during low tide and was of short duration. Had the 1950 surge occurred at mean high tide, it has been calculated by the Corps of Engineers, that it would have produced a tide of 12.0 feet.

Because of the particular topography and geography of the area, the Kearny Meadows area, today, is much more susceptible to damage from tidal fluctuation than from fluvial flooding (floodings caused by heavy upstream rainfall). Thus, for example, in our proposed and open space map designations for SU-3, we give high priority to preserving the tidal wetland lying adjacent to the Hackensack River. We suggest further that a new ring road, further inland, double as a protective tidal dike within which tide gates can be constructed to release fresh water runoff into that wetland buffer.

Water surface elevations have been calculated for the HackensackRiver in the area of Kearny for combinations of tidal and fluvial flooding events as follows:

Max. Tide of given frequency	Max. Flood of given frequency	Resulting Water Surface Elev. (ft amsl) 1972	1984
1 year	SPF*	5.0	5.2
10 year	1 year	5.6	5.7
100 year	1 year	7.0	7.2
SPT*	1 year	13.0	13.2

* Standard Project event - A mathmatically simulated occurrance representing the worst possible combination of Tide-causing and Flood-causins events respectively.

Stormwater Management

In the Hackensack Meadowlands District, threee techniques, in thier various combinations, have been employed to minimize the damage and inconvenience which may result from the stormwater buildup from heavy rainfalls. They are:

(1) Constructing building on fill, with elevated finished floors;

(2) The common ditch, dike and pump system;

(3) Use of stormwater retention basins.

1. F̲i̲l̲l̲. In order to minimize construction costs, early development, within the Carlstadt Meadowlands, for example, minimized the quantity of fill placed prior to construction. Finished floor elevations of +4 or +5 feet are not uncommon there, with parking lots often filled to only +2 or +3 feet During heavy rains or extreme high tides, these buildings and their occupants and visitors have suffered the consequences. As additional lot by lot development and filling have taken place in subsequent years, flooding of these sites, in come cases, has worsened.

In order to guarantee the protection of property, the HMDC adopted, in its Zoning Regulations, a requirement that all new Hackensack Meadowlands District construction have a minimum floor elevation of +10 feet above mean sea level (amsl). This figure was derived from consultations with the U. S. Army Corps of Engineers.

2. The ditch, dike and pump technique was often employed in the early development of the Meadowlands to permit construction at lower floor elevations. Dikes were placed along the boundaries of the area in question to hold out the incoming tide, with the top of the dike usaully placed at +6 to +8 feet amsl. In order to remove rainfall from the now isolated areas, pumps were installed to drain water from the diked area and to discharge it to the river. Ditches delivered rainfall runoff to the pumps. Such pumps and ditches are normally designed to pass the peak flow from a given storm. The HMDC Subdivision Regulations require utilizing the 25 - year design storm.

3. Stormwater Retention. Peak flows from 25 - year storms, depending on the particular circumstances of the area, may require construction of very large pump stations. Peak flows and the costs of associated pump stations may be reduced through the use of storm water retention basins. As development has expanded in the Kearny Meadowlands and as the dike and pump systems have deteriorated, the ponding (water retention) capacity of the meadows areas has become more and more important in controlling both tidal and stormwater flooding.

Preliminary Drainage Conclusions

Because of the extensive cost of fill material and of flood protections structures, we think it possible that the existing wetlands strip bordering the Hackensack River could serve as a water retention and flood protection buffer zone; and that the new, proposed ring road could be constructed as a protective dike inside of which construction could be undertaken at lower finished floor elevations.

Determining the feasibility of such a system will require an analysis of the existing dike's elevations and conditions, and estimating the cost of preparing it in conjunction with the cost of constructing the new ring road at the required elevation. The Army Corps of Engineers model will have to be run before this required elevation can be explicitly determined.

It also appears clear that control of water elevations behind this dike will require drainage improvements throughout the system. Major drainage ditches will have to be dredged and improved and many existing culverts will probably have to be replaced with larger ones.

The capacity of the pump station on the Hackensack River will undoubtedly also have to be increased. The required capacity of these drainage elements (ditches, culverts, pumps) can be kept to a minimum by retaining key sections of existing marsh as detention basins. Special Use Area I, the Kearny Fresh Meadows, now serves this purpose. As described here for the proposed SU-3, the preservation of valuable wetland areas - - one of the Commission's environmental resonsibilities - - is accomplished through required open space percentages within clustered developments. And as noted, these preservation areas also serve as valuable flood control devices.

With completion of a more detailed development plan for the Kearny study area, these drainage improvements can begin to quantified. Specifically, a drainage study, encompassing the following, would be required:

(1) A detailed survey of existing conditions including topography, size and condition of drainage ditches and culverts;

(2) An estimate of future rainfall runoff from each basin based on projected development;

(3) Calculation of the required capacity of the various drainage elements, and estimate cost for these improvements;

(4) A treatment of the ecological considerations which ensure the proper maintenance of wildlife habitat associated with particular water surface elevations and salinities.

CHAPTER 5 -- WATER QUALITY

The previous Chapters showed how the physical characteristics, natural and manmade, affect how and where the basin's waters mix, flow, scour, percolate and pond.

Water quality in the Kearny Meadow's, it follows, is closely related to these, the basin's patterns of drainage. The sources of water, fresh and tidal, encounter, in their travel overland, a series of wastewater flows. Some are industrial; others are constituted of storm water runoff, of sanitary sewage, and of landfill leachates. In many instances, various combinations of these flows merge, with the consequent water chemistry a homogenizing and diluting of the mix.

Two water sampling programs were conducted in June-July-August, 1976, these designed to measure the effects described above. Dissolved Oxygen, Temperature, BiochemicalOxygen Demand, Fecal Coliforms, Total Oxygen Demand, Total Organic Carbon, and Nitrogen Oxides were sampled by a combined HMDC/New Jersey Institute of Technology 9-person team. This type of monitoring "blitz" is necessary in order to frame an understanding of the water quality interrelationships among the many parts of this complex system.

The laboratory analysis was then performed, over the subsequent 24 hour periods, by Dr. Richard Trattner's Hackensack Meadowlands Water Quality Study Group, using, for TOD, TOC and NOX, equipment purchased for Dr. Trattner's Water Quality Lab from a series of grants made by the Victoria Foundation to expand our knowledge of how New Jersey's coastal ecosystems work. (Other aspects of this work, on which this study was patterned, are recorded in "Water Quality in a Recovering Ecosystem: 1970-1976," a report of the Hackensack Meadowlands Development Commission.)

The results, aggregated in Figure 8 , "Water Quality Monitoring Results," are briefly summarizable as follows.

Dissolved Oxygen levels, these a central index of the possibilities for aquatic life and, simultaneously, an indication of water quality stress points, present a differentiated pattern.

Figure 9 , its water quality stations numbered according to the canoe route ("Turn left at the big muskrat house") rather than some more easily understood scheme, traces the flow of water (roughly) eastward from its upland runoff point to its Hackensack River destinations. Stations 1, 17, 18, 19 are inflow points: 1, steady (see Figure 9); 18 and 19 intermittent (during storms when regulators are triggered); and 17 as leakage, southerly, from an aqueduct.

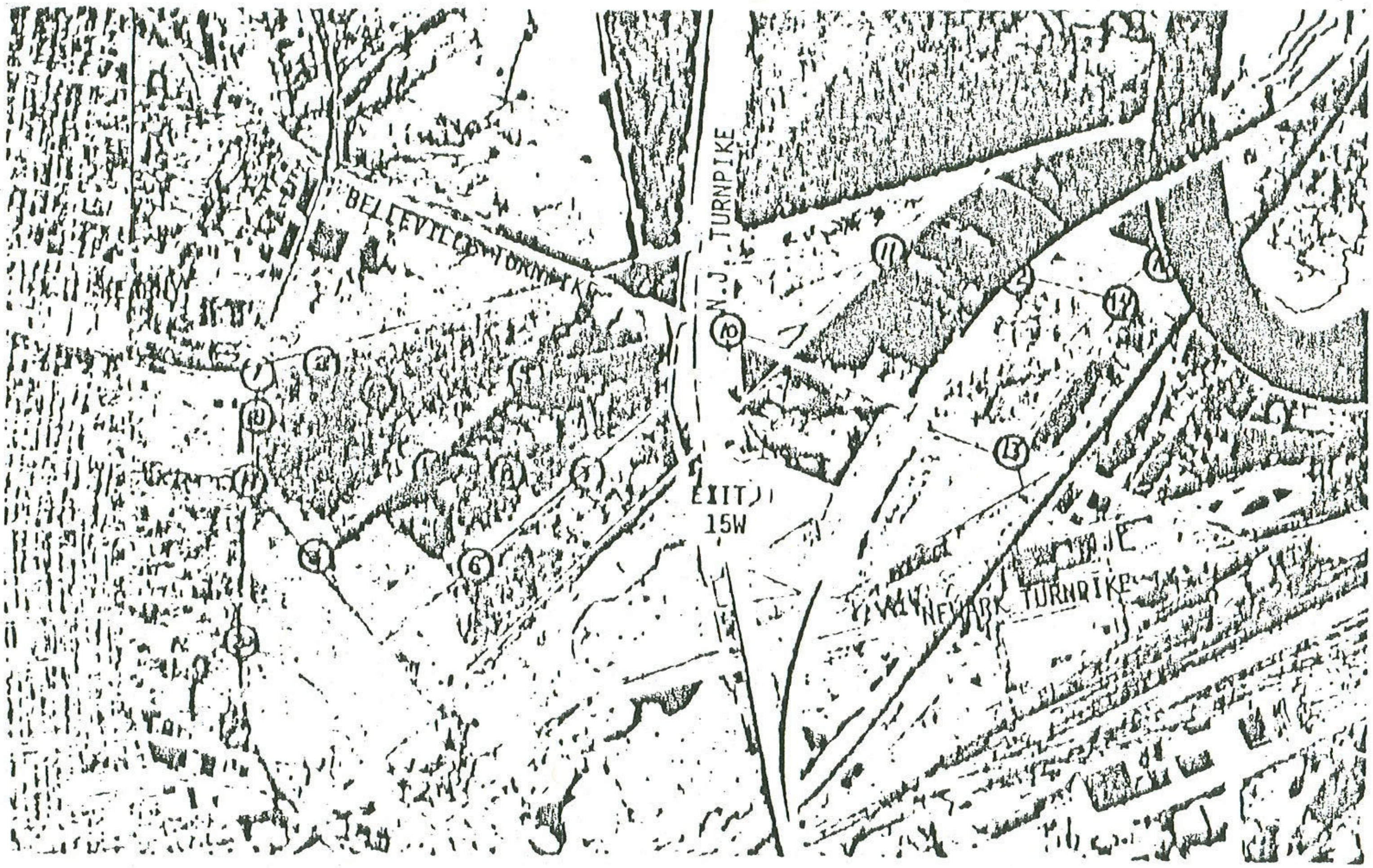


Figure 9 WATER QUALITY MONITORING STATIONS

Station 1, a steady flow point, and revealing an oxygen level of 0.4ppm, provides water to the ecosystem, but highly stressed water. A color source (most likely a paint or dye make-up plant) contributes an endless variety of hues, but a constant supply of trouble. Water pollution abatement action is needed in this upland basin. Only the large, additional quantities of dilution water from the balance of the basin, coupled with the oxygen-producing plankton in the ecosystem, prevent this point source from crippling aquatic life.

Stations 3, 3A and 6 can be construed as reflecting, after dilution, the effect on oxygen levels of any landfill leachates oozing into the large, fresh water meadows. Dissolved Oxygen levels at these two stations varied, with readings of 2.2, 2.5; 0.2, 4.0; 1.0 and 6.0. The average of these 6 readings is 2.65 -- not sufficient, yet, to support large fish populations. But, as Bill Dovel, a Hudson River biologist is fond of saying, fish, mobile organisms, "do not breathe average dissolved oxygen." They seek out and breathe oxygen where it is sufficient(and, of course, where nutrients are concentrated), and avoid low oxygen areas where it is not.

Stations 2, 4, 5, 7, 8, and 9 -- these accessible only by canoe (and re-discoverable only by Don Smith), can be read as indicators of the aquatic health of the interior of this large (405 acre) fresh water marsh. Oxygen levels vary, but a distinct pattern of improving water quality can be read from east to west. Our conclusion is that the marsh, an oxygen producing system, serves to improve on the water quality delivered to it, to the effect that oxygen produced here is both beneficial to the estuary, beyond and supportive here of the forms of life recorded in Chapter 6 . In fact, we have observed this type of pattern on dozens of occasions over a 6-year period at other stations throughout the Hackensack Estuary. We do not assert, however, that these two, summer sampling occasions permit us to make definitive statements about the permanence of cross-seasonal, or diurnal aspects of such a pattern. More work is needed, and time-consuming work it is.

Station 10, the westerly boundary of the fresh water system, is, we feel, a key indicator of that entire system's collective water quality effects at any given moment. For example, the mean DO for all the stations west of number 10 was 3.1ppm; while the two station 10 readings were, respectively, 2.3 and 3.6ppm (the average, 3.2).

Between Stations 10 and 11, the convergence of the two water flows -- fresh from the west, tidal from the east -- occurs. The Salinity at Station 10, for example, read 1.2 and 0.8ppt on the two occasions. Moving eastward, the tide's salinity gradient increases, with Stations 15 and 16, actual tidal entrance points, representing typical river conditions for this part of the estuary -- a range between 7.8 and 11.7ppt. Station 13, adjacent to a landfill, cannot be read within this pattern. Its salinities reflect, we feel, the chlorides (salts) which flow as typical leachates from landfills.

Returning to DO levels, Stations 11, 12 and 14 can be read as indicators of the aquatic health of the interior of this tidal wetland ecosystem. They lie along a continuous (near) north-south man-made ditch, which, over the years, has become a major drainage route and whose banks have high biological value in the ecosystem. It is such interfaces between mud, water and rooted plants, for example, where the most intense convergences occur among the estuary's life forms. Chapter 6 , following, describes these convergences as "energy-transfer" points, where natural predation occurs and thus where the food web's links are consummated, again and again. Thus, for example, we recommend (Chapter 13 , Summary) that the natural drainage system be retained as extensively as possible within the clustered developmental patterns recommended.

Biochemical Oxygen Demand and Total Organic Carbon, both constituents of water chemistry which indicate the presence of (various) organic materials in the system, can be read to sense the effects of nearby point-sources of pollution in combination with the oxygen demanded by the natural cycles of life and death in the marsh. A system free of B.O.D.'s would also be devoid of any life forms, as well. It is just because a marsh imposes stresses on itself that we are particularly concerned about artifically induced sources. Figure 8 shows the particularly high B.O.D. stress points -- Stations 1, 18, 19 and 20, these corresponding to low Dissolved Oxygen areas. T.O.C. levels, measuring the presence of carbon-bearing constituents, are more evenly distributed throughout the system, with the exception of the peak readings (77.4 and 33.5) recorded adjacent to a landfill. Conclusions are difficult from this limited sampling regimen, but it can be hypothesized that the landfill's T.O.C. contributions are diluted as they move into and through the system.

Total Oxygen Demand, in some ways a summary of T.O.C. and B.O.D. combined, is a laboratory-derived reading. All the organic and inorganic materials which could impose a demand on oxygen in the water are combusted in the lab. Thus the lab test speeds up considerably what, in nature, is a slower process. T.O.D.'s then, are a good comparative indicator of point source problems, and, as well, serve as comparative year-to-year indicators of total pollutants entering a system. Note, for example, the peak T.O.D., 393ppm, recorded adjacent to Station 13, a landfill.

Fecal Coliforms, an indicator of sewage, show peaks of 32,000 colonies per 100ml 30,000, 10,000, 6,300, 2,600, and 1,900 at Stations 18, 3, 12, 3A, 20, and 15, respectively. Most are explainable -- at unsewered inflow points or at landfills. Two sites, however -- 12 and 15 (in the tide marsh and at a Hackensack River tide gate) mystify us. Fecal coliforms do not survive for long in tidal waters.

In summary, we conclude that, on water quality terms, the Kearny Meadows has its share of disaster points. These must be corrected. We also conclude, as we have elsewhere in the Estuary on numerous such study occasions, that the aquatic ecosystem is remarkably resilient and productive, due in part to the massive volumes of water "processed" and oxygenated by these marshes.

In that the development of SU-3 will result, inevitably, in the loss of some of these wetlands, it will be necessary to equip the various development plans with water quality strategies designed for these two ecosystems -- fresh and tidal. It is clear, however, that the sewering of the basin, via the Hudson County Regional Plan, will bring with it considerable water quality gains. In addition, water pollution abatement efforts, particularly in the vicinity of Stations 1, 18, and 20, are necessary.

Chapter 6 : -- Wetland Ecosystems

Chapters 4 and 5 (Drainage and Water Quality) established the topograpnic, the hydrologic and the water chemistry pa_terns discovered in the 1,279 acre study area (see p. 24 ff.)

Two wetland bio-zones have formed in response to these patterns: the 405 acre Kearny Fresh Water Meadows, lying east of Gunnal Oval and west of the New Jersey Turnpike's Western Spur; and the tide-flowed marshes lying between that Turnpike Spur and the Hackensack River.

The Fresh Water Marsh has been interlaced with a series of mosquito ditches over the last 40+ years so that its waters, following the land's topography, could more rapidly drain eastward to the tide-gates and pumps at the Hackensack River. At one time, a portion of these drainage flows was drawn off by Frank's Creek. But the vast network of roads, rails, acquducts, power lines, and natural gas transmission lines flung across these meadows over the years has changed the patterns. New culvert construction and maintenace have tried to keep pace with that ever-expanding network.

The biological result of all this altering of the natural landscape has been to create, where once lay a tide marsh (and stretches of cedar forest whose vestigial stumps make canoeing adventurous today), a magnificent fresh water wetland ecosystem of rare natural beauty boarded by an old overgrown landfill which burns on occassion.

During the last 5 years, particularly this area has undergone some dramatic ecological changes due to a combination of additional fresh water flow diverted here from the uplands, and to the disrepair and lowered efficiency of the tide gates and pump stations at the Hackensack River. As pointed out in chapter , the silting in of culverts along the way contributes to the periodic sluggishness of the drainage system. The ponding effects in the fresh water marsh have spread, as well, to the more westerly tide marshes, somewhat to the dismay of muskrat trappers who have seen some former trapping areas flooded out. These conditions have resulted in the ponding of some 450 acres of fresh water reed/duckweed marsh and some 300 acres of reed brackish marsh.

The standing water, which varies in depth over the land from 1' to 3', has caused the drowning of some areas where the Common Reed Grass (Phragmites communis) was growing prodigiously at low elevations. The dying off of the reed grass in these areas has resulted in ponds, varying in size from a fraction of an acre to approximately 20 acres, and a fresh water Phragmites marsh has formed where formerly lay a fresh water Phragmites meadow.

Growing in close association with the reed grass over much of the fresh water area and responding to the flooding is the smallest rooted plant in the world, Duck Weed (Lemna minor). This tiny aquatic floats on the surface of the water with its roots suspended below, absorbing nutrients from the water. During the peak growing season, this plant grows in such profuse mats that it is often called algae by the untrained observer.

Found in association with the duck week in great numbers are two snails Tadpole snail and Pond snail. These invertebrates provide a source of protein for many species of aquatic birds utilizing this marsh.

To look at the basic structure of the marsh, we must look at the water entering the marsh, from the uplands, which comes in the form of industrial run-off, and storm water. During periods of heavy rainfall, the storm water system from the uplands adds sanitary waste, since the waste-water storm collection system is of an old combined structure type.

This water quality, which is discussed in Chapter 5 , forms the basis for the fresh water marsh system. This water flows through the mosquito ditches and across some of the ponds as well. The plants begin nature's natural treatment of the water by using some of the nutrients from the sewage as fertilizer. That portion of the water, which moves from west to east and undergoes the natural treatment process, passes through some of the ponds as crystal clear effluent containing little, if any, of the visible pollutants it entered with. It is here in these clear ponds that one can peer into the water and see some of the basic life functions in process. Although the human eye cannot detect the presence of normal amounts of phytoplankton (those single-celled plants which are suspended in the water, photosynthesizing, multiplying, and giving off oxygen), we can, with careful observation, detect some forms of zooplankton such as copepods and daphnia, both tiny aquatic invertebrates which feed directly on the phytoplankton. These small animals are then preyed upon by young fish and by aquatic birds as well. Thus we can see the food chain put into motion.

This motion, called energy flow, can be traced further as it flows eastward towards the Hackensack River. Shortly after the water flows through a culvert under the Belleville Turnpike (Route 7), it begins to mix with salt water (Water Quality Station II) which enters this section of marsh through a washed out tide gate along the river, and through seepage under the Erie Greenwood Lake Branch track bed. This mixing of fresh and salt water forms a water chemistry area termed brackish water. Under this condition, certain forms of life which exist in the fresh marsh, such as frogs and the pond snails, cannot be found. Here, instead, we can see grass shrimp and blue claw crabs in the water--both marine species.

Certain species of fish and many species of birds utilize both areas. Along with this exchange of energy flow, the water from the fresh system is bringing with it nutrients and detritus (Decomposing plants and animals), some of which are metabolized by organisms in this brackish zone, and some of which are passed along, mixed with energy produced in this zone, and then exported to the Hackensack River.

After the waters from this marsh enter the river, this energy flow process continues to be utilized and fuels other life forms. An example is the young striped bass found in the Hackensack River feeding primarily on shrimp and yound killie fish which are also produced in the estuary and are exported to the river. These bass, in turn, are either consumed by larger fish or they grow larger and become important to people as a source of protein. This energy flow process is also visible in blue claw crabs feeding on the detritus and invertebrates and being exported, now larger, to the river. They are, in turn, caught by the thousands in traps cast into the river by local residents, and consumed.

Since the brackish system has only existed at its present size for the past 2 years, it is far from having attained ecological stability. The combined effects of changing water depths and salinity intrusions have caused, for example, the dying off of low-lying reed grass, with the result the same as in fresh marsh ponds of various sizes. The small aquatic plant, duck weed, not a salt water plant, cannot be found in the brackish system. Some marine algaes have become established, but much further research and inventory work are needed in their identification by genus and species.

We have communicated with Dr. J.M. Shay, Professor and Director of the University of Manitoba's University Field Station on the huge fresh water Delta Phragmites marsh to discover their experience in monitoring the response of Phragmites communis to flooding. Dr. Shay reports that Phragmites communis:

> "generally thrives best where water is shallow (15-30 cm in depth), indeed it can be very productive in sites that are wet in the spring and early summer and become dry as the season advances.
>
> In the Delta Marsh water depths of 75 cm to 1 m for a period of three years or more killed Phragmites. It does not spread in water deeper than 50 cm but can survive short periods of inundation and a lowering of the water table. Under the latter conditions, it may persist for years as long as the roots are in contact with the ground water table.
>
> Haslam reports that it can survive in Britain when flooded up to half its height. At Delta it seems to avoid water depths greater than 50 cm. The majority of extensive stands are not covered with standing water in early June."

(Letter of November 5, 1976 to Mr. Donald J. Smith, Staff Naturalist, HMDC)

Generally, our own preliminary field observations of flooding depth (Chapter 4) and of Phragmites communis growth pattern changes show results analogous to those on the Delta Marsh. The Kearny system is far from stable, however, so these observations can only be tentatively asserted, and followed by more detailed work.

In summary, the two aquatic bio-zones are tremendously productive. Although we have not researched the various forms of life beneath the water, we can and do see the many and diverse forms of life living above which depend upon the marsh, below, for their existence.

Whether one is an avid bird watcher or just a casual observer, the sighting of a 5 foot tall great blue heron or the small, secretive least bittern, both wading birds which prey upon fish, may provide a pleasant experience. The biological importance of the sighting is that the system is functioning from plant production to fish production to bird consumption.

Our preliminary inventory follows. It has been expanded to incorporate the field work of 2 Ramapo College students, Ken Miller and Brad Koller, interns at the Hackensack Meadowlands Development Commission over the summer of 1976.

Avian Inventory

Sighted in Fresh Water Marsh (West of Turnpike

- Canada Goose (Branta canadensis)
- Black Duck (Anas rubripes)
- Blue-winged Teal (Anas discors)
- Greater Scaup Duck (Aythya marila nearctica)
- Mallard (Anas platyrhynchos platyrhynchos)
- Marsh Hawk (Circus eyaneushudsonius)
- Sparrow Hawk (Falco sparverius)
- Florida gallinule (Gallinula chloropus cachinnans)
- Coot (Fulica americana)
- Black-crowned night heron (Nycticorax Hycticorax hoactli)
- Solitary Sandpiper (Tringa Solitaria Solitaria)
- Lesser Yllowlegs (Totanus Flauipes)
- Killdeer (Charadrius vociferus vociferus)
- Great Black-Backed Gull (Larus marinus)
- Herring Gull (Larus Argentatus)
- Red-winged Black bird (Agelaius Phoeniceus)

Sighted in Brackish Area East of Turnpike

- Canvas Back (Aythya valisineria)
- Sora rail (Porzana Carolina)
- Mallard
- Coot
- American Egret (Casmerodius allous egretta)
- Black-crowned Night Heron
- American Bittern (Botaurus Lentiginosus)
- Wilson's Snipe (Capella gallinago delicata)
- Solitary Sandpiper
- Lesser Yellowlegs
- Killdeer
- Herring Gull
- Black-Capped Chickadee (Parus atricapillus)
- Red-winged Blackbird
- Swamp Sparrow (Melospiza georgiana)

Mammals; Amphibians Sighted:

Muskrat
Vole
Cottontail Rabbit
Norway Rat
American Toads

Microscopic Life

Algae:
- Oscillatoria
- Cyciotella
- Navicula
- Botryococcus
- Oedogonium
- Stigeocionium

Protazoans:
- Coleps
- Synura
- Volvox

Dratoms:
- Thalassionema-nitzchioides

Crustaceans:
- Cyclops
- Canthocamtos

Desmids:
- Closterium

Rotifers:
- Chromogaster
- Trichocerca
- Keratella

CHAPTER 7 -- WASTEWATER TREATMENT

EXISTING SEWAGE SYSTEM

For the purpose of discussing the existing sewage system, Kearny can be divided into three sections: the upland area, the Kearny Point area, and the Meadowlands area. See Figure 10

All of the upland area is served by sanitary or combined sewers, with a ridge line running through upland Kearny from north to south, dividing the sewer system approximately in half. Sewage flows on the eastern half generally proceed from the northwest to the southeast. On reaching the southern end of Kearny, sewage flows west by interceptor through Harrison, under the Passaic River, and thence to the Passaic Valley Sewerage Commission (PVSC) Treatment Plant in Newark, whose dishcarge is to upper New York Bay.

The PVSC Treatment facility is a primary treatment plant with a present design capacity of 250 mgd; whose 1975 average flow was 260 mgd. The first phase of expansion to 720 mgd is currently under way, with completion of Phase I estimated for 1978 , to provide 83 to 85% removal of biochemical oxygen demand (BOD) and of suspended solids.

Because of the prevalence of combined sewers, a series of regulators functions through the system. The overflows from these regulators ultimately reach Frank's Creek. No regulator overflow discharges to the Kearny fresh water marsh area, however.

The Kearny Point industrial area is served by the Kearny municipal plant. This plant was constructed in 1955 and was designed to provide primary treatment for 4 million gallons per day of (predominantly) industrial waste. The 1974 average flow was 2.6 mgd, although combined sewers bring considerably larger flows to the plant during wet weather conditions. The plant has experienced a number of problems and currently provides limited treatment capabilities.

No municipal sanitary sewer system exists in the Meadowlands area of Kearny. In two cases, sanitary wastes are treated by individual package treatment plants, while a few other buildings have holding tanks for sanitary waste, leaving the remainder of the older buildings to rely on septic systems or raw discharges to local ditches.

No detailed industrial waste survey has yet been carried out but since none of the industry is served by the municipal sewer system, it is probably safe to assume that industrial wastes emanate from a number of buildings in this area.

In addition to industrial process wastes being directly discharged to the meadowlands area, industrial surface runoff is of equal concern. A number of industries, including rendering plants and drum cleaning operations, are utilizing outdoor storage. These areas of outdoor storage accumulate a great deal of liquid waste, and these wastes enter the surface waters during periods of rainfall.

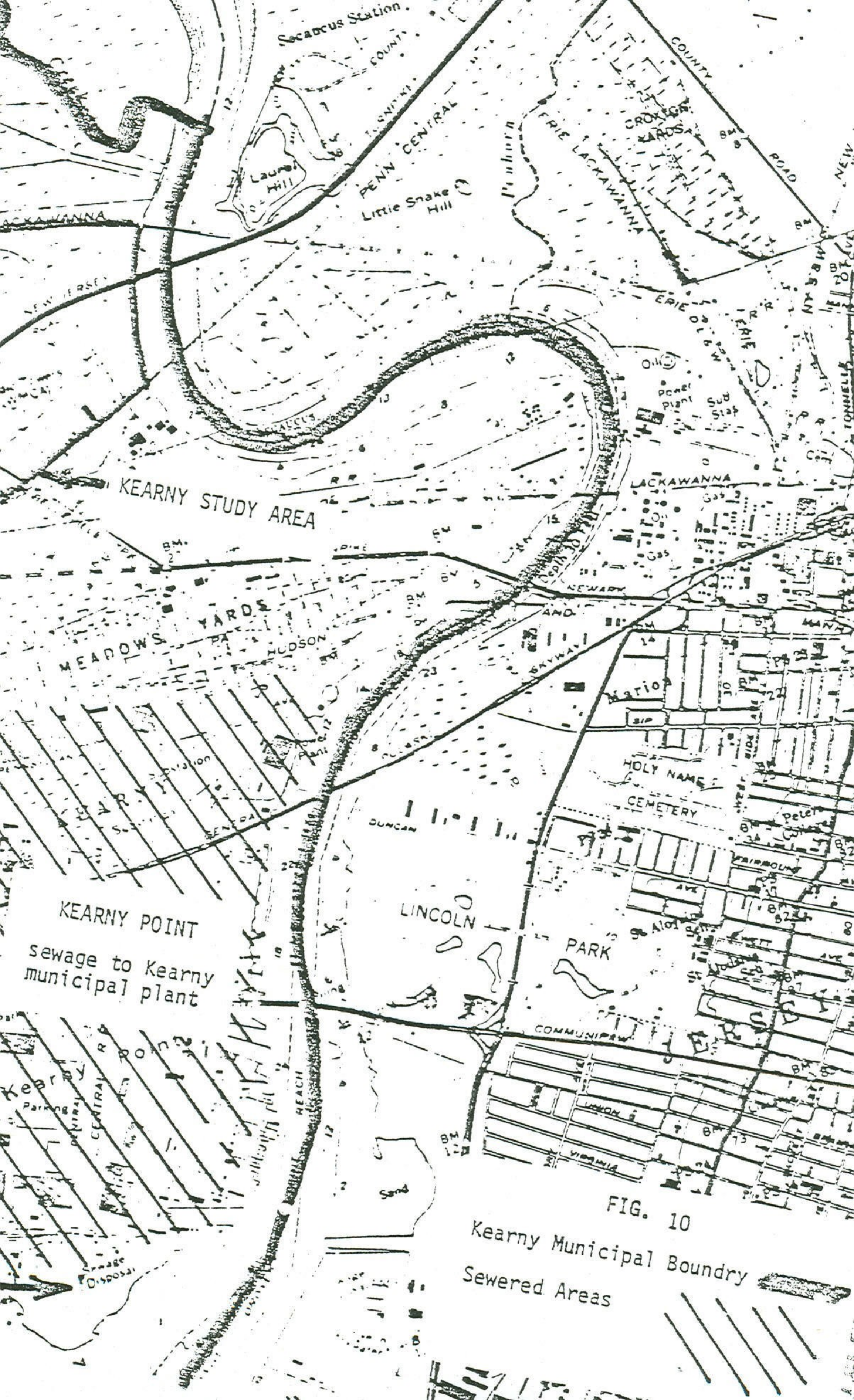
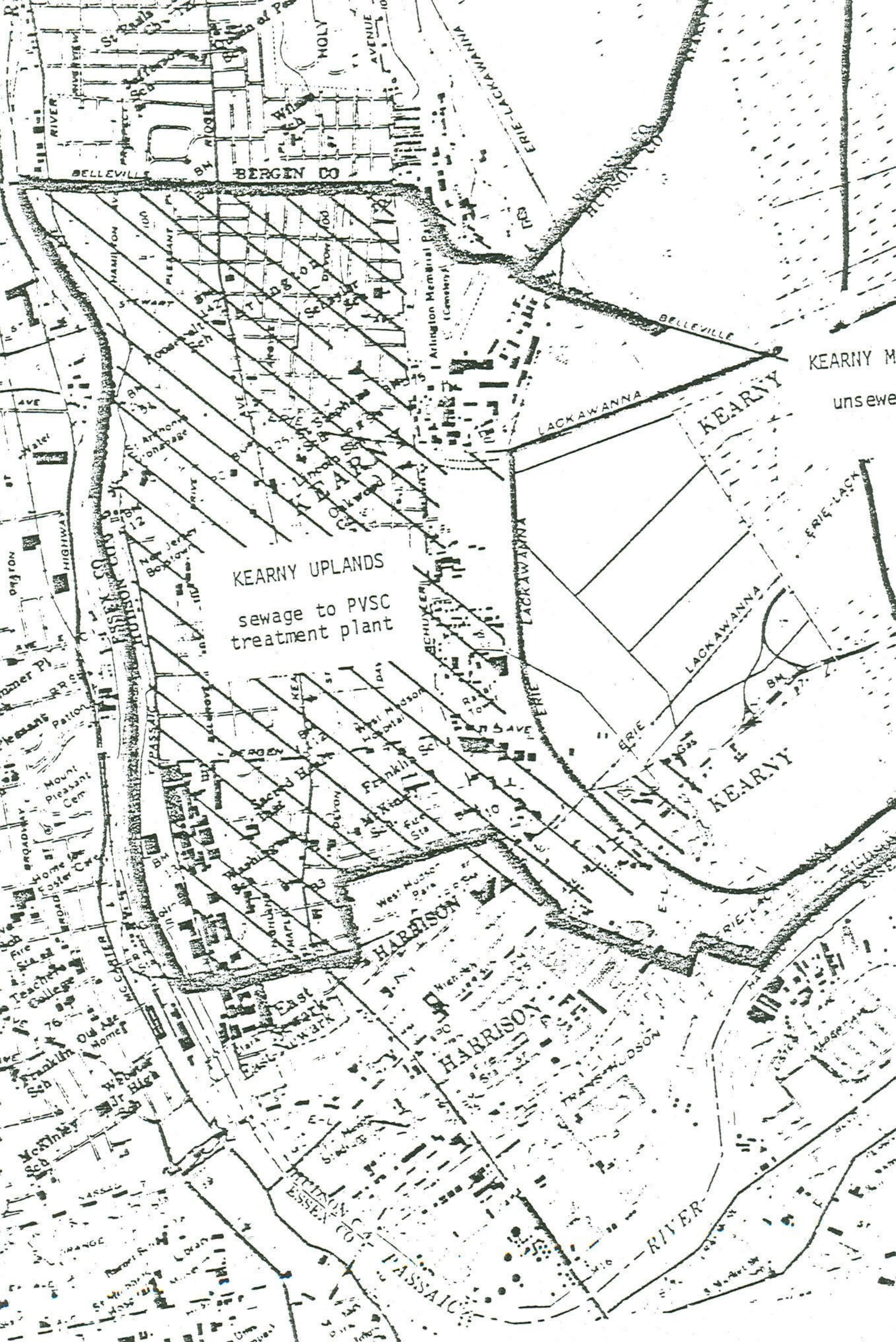


FIG. 10

Kearny Municipal Boundry

Sewered Areas



KEARNY UPLANDS
sewage to PVSC
treatment plant
KEARNY M
unsewe
KEARNY
HARRISON
BERGEN CO
ESSEX CO
HUDSON CO
BELLEVILLE
LACKAWANNA
ERIE-LACKAWANNA
ERIE
Arlington Memorial Park (Cemetery)
Mount Pleasant Cem
West Hudson Park
East Newark
PASSAIC
RIVER

The differentiated effects of th·:e combined sewer overflows, raw discharges, improperly treated flows, industrial waste discharges, and surface runoff, as discussed above, combineu with the landfill leachate and stormwater flows discussed elsewhere, can be read in the water quality data described at Ch ter 5 .

Land Use and Sewage Flow Projections

The quantity of sewage currently being generated in Kearny can be roughly estimated from water consumption figures. Based on data from the North Jersey District Water Supply Commission, approximately 10 million gallons per day of water is deliverd to the Kearny area. Of this total, approximately 6 mgd of sewage goes to PVSC plant from the uplands portion of Kearny. Meter readings at the Kearny Point plant indicate that this facility receives approximately 3 mgd from the tributary industrial area. Somewhat less than 1 mgd than remains, by substraction, as sewage generated within the Kearny Meadows area.

Population growth along the uplands ridge is limited by the lack of available land for development. Population growth has stabilized to such a point that less than 1,000 new residents can be expected to be added to today's "ridge" population of approximately 37,600. These new residents, plus scattered fill-in commercial growth, should not add more than .2 mgd to the sewage flow from the uplands area.

Projecting sewage flow from the Kearny Point industrial area is much more difficult due to the extreme range of flows generated by different industries. However, little vacant land remains in this area, and future flows will probably not exceed a total of 4 mgd.

The majority of the land within the Kearny Meadows area is vacant. Future sewage flows can be calculated from the land use mix described in the Zoning Ordinance and from the SU-3 zone proposed here. Those calculations are as follows:

Research Park & Research Distribution Park	.05-.1 MGD
Heavy & Light Industrial	.5-1.9 MGD
Special Use I	.5-2.0 MGD
Transp· ·tation Center II	.06- 2MGD
Highwa, Commercial	.6-.9 MGD
Special Use III	.2-.6 MGD

The flow factors used in this chart are adapted from "WATER SUPPLY IN THE HACKENSACK MEADOWLANDS: A CASE STUDY IN REGIONAL RESOURCE PLANNING," 1972, a report of the HMDC.

Water Quality Goals and Standards

The Federal Water Pollution Control Act (FWPCA) Amendments of 1972 (Public Law 92-500) set as a national goal the elimination of the discharge of pollutants into navigable waters by 1985. Where attainable, an interim goal, to be achieved by July 1, 1983, is water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water.

In order to carry out the objectives of this Act, effluent limitations for publicly owned treatment works are to be achieved as follows:

(1) By July 1, 1977, for treatment works then in existence or where construction was approved before July 30, 1974 -- secondary treatment;

(2) By July 1, 1983, compliance with the effluent limitations provided by the use of the best practicable waste treatment technology.

As part of the State's responsibility under this Act, the New Jersey Department of Environmental Protection (NJDEP) has established a state continuing planning process and has set water quality goals and standards for all major rivers and tributaries in the state. This is a two part process: first, goals for the use of the water body are set, such as for contact recreation, fish propagation, etc.; and second, water quality standards are adopted for the given stream, such as 5 ppm oxygen, which standards, when attained, will permit the uses described as step 1. Figure 11 shows these use and water quality classifications in the Hackensack and Passaic Rivers.

The water quality goals of the HMDC may be considered somewhat higher in the sense that the Commission views the entire length of the Hackensack River as a single unit whose waters are to be made "suitable for secondary recreation; the maintenance of fish populations, the migration of anadromous fish; the maintenance of wildlife; and any other reasonable uses." In fact, it is the Hackensack River around which the entire Master Plan for the District is fashioned. This Plan calls for an extensive, 6 square mile "waterpark," with the Hackensack River at its center and which is comprised of parks, wetland conservation areas, and marinas. Concomitantly, all upland development, whether residential, commerical, industrial, or recreational, has been zoned and assigned environmental controls such that compatibility with the waterpark is both stimulated and assured.

The HMDC, within those Zoning Regulations, has established environmental performance standards in the following areas: noise, vibration, airborne emissions, fire and explosion hazards, glare, radioactive materials, and water quality.

Regarding sewage treatment planning, these environmental performance standards include water quality discharge standards:

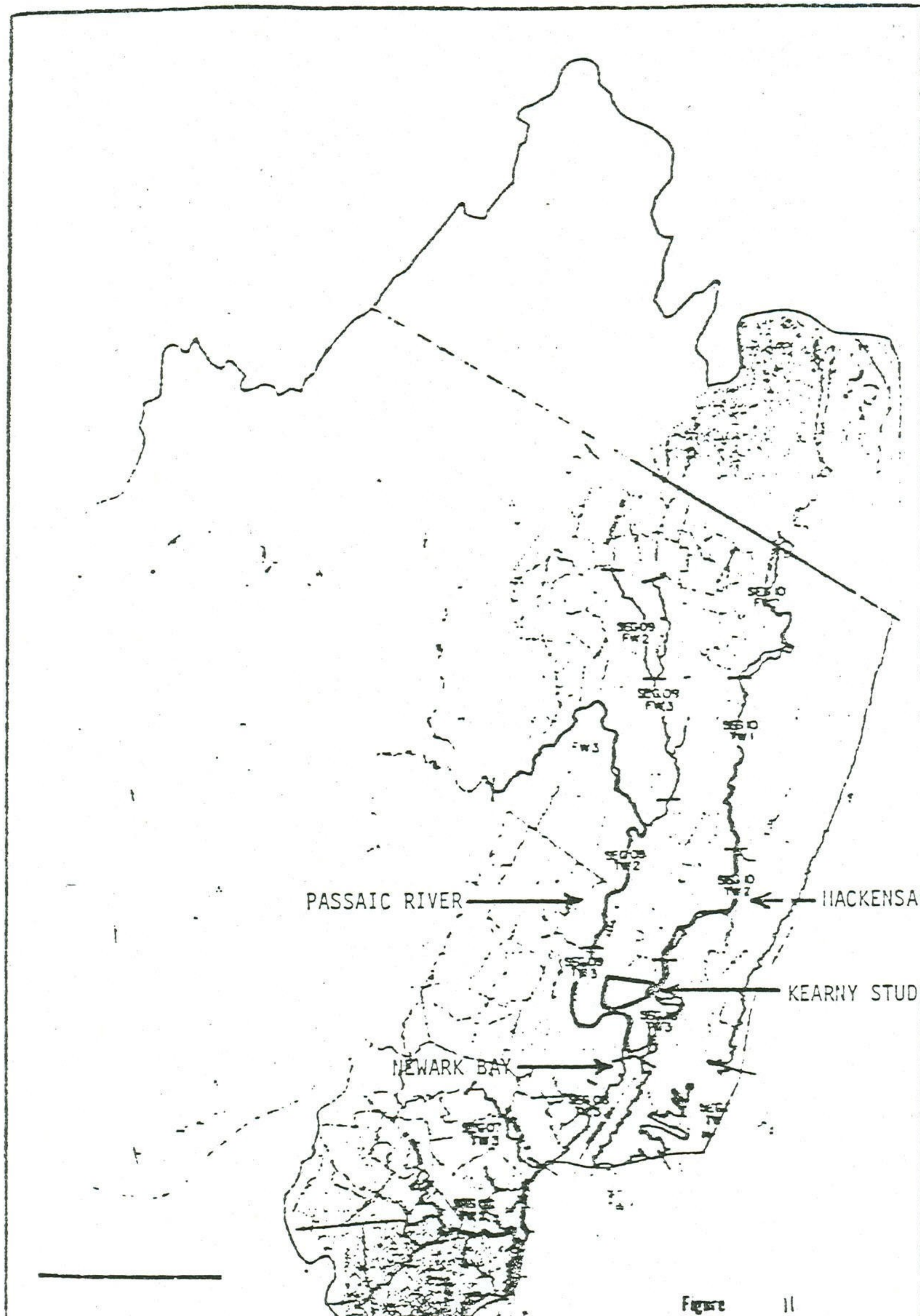


Figure 11

URBAN AREA STREAM CLASSIFICATIONS

Water Quality Management Basin Plan
Northeast New Jersey Urban Area

August, 1975

FIGURE 11A

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

WATER QUALITY GOALS (USE CLASSIFICATION)

FRESH WATERS

FW-1 Existing water quality will be upgraded or maintained in its natural state and shall not be subject to any man-made wastewater discharges. The waters are preserved for posterity to preserve the natural aquatic environment and its associated biota.

FW-2 Existing water conditions will be upgraded (or maintained) for public potable water supply; for recreation; for propagation, migration and harvest of aquatic life.

FW-3 Existing water conditions will be upgraded (or maintained) for recreation; for the propagation, migration and harvest of aquatic life.

TIDAL WATERS

TW-1 Existing water conditions will be upgraded (or maintained) for contact recreation; for boating; for the propagation, migration and harvest of aquatic life.

TW-2 Existing water conditions will be upgraded (or maintained) for limited recreation; for the survival and migration of aquatic life.

TW-3 Existing water conditions will be upgraded (or maintained) for navigation; for pleasure craft; for fish survival.

WATER QUALITY STANDARDS

USE CLASSIFICATION	TEMPERATURE °F MAX.	MAX. DEV. 1/	DISSOLVED OXYGEN MG/1 DAILY AVE.	ABS MIN.	FECAL COLIFORM MPN/100 ML	pH
FW-2	86	5	5	4	200	6.5 - 8.5
FW-3	86	5	5	4	200	6.5 - 8.5
TW-1	85	4 nter 1.5 summer	5	4	200	6.5 - 8.5
TW-2	85	4 winter 1.5 summer	4	4	770	6.5 - 8.5
TW-3	85	4 winter 1.5 summer	3	3	1500	6.5 - 9.5

1/ Deviation from ambient stream temperatures.

(a) For direct discharge, via a temporary package treatment plant, to the Hackensack River or a tributary thereto;

(b) For discharge to a sewage treatment plant;

(c) For discharge from a sewage treatment plant to the Hackensack River or a tributary thereto.

These discharge criteria, or effluent limitations, (for (a) and (c)) are as follows (selected parameters):

- temperature of discharge shall not exceed 85° Fahrenheit;
- 5 day BOD not to exceed 25 milligrams per liter during any period of discharge;
- suspended solids shall not exceed 40 milligrams per liter by weight;
- colorform organisms shall not exceed 5000 colonies per 100 ml, based on most probable number (MPN);
- fecal coliform organisms shall not exceed 1500 colonies per 100 ml;
- pH shall not be less than 6.5 nor greater than 8.5.

The NJDEP is also responding to a section of the FWPCA Amendments of 1972 which mandates that each state shall identify those waters within its boundaries for which the effluent limitations previously established are not stringent enough to implement the water quality standard applicable to such waters. This identification process takes place through the development of a Basin Plan which is part of the State's continuing planning process.

The most important step in the basin planning process is the classification of stream segments into water quality or into effluent limited segments.

Water quality limited segments are defined as water bodies that will not meet the water quality standards even if best practicable waste treatment technology (currently defined as secondary treatment) is used to abate pollution.

In such water quality limited segments, an analysis is performed to determine the amount of waste the water body can tolerate and still meet the water quality goals and standards. This level of tolerable waste is divided or allocated into allowable discharges to the given stream segment, which discharge limit predicts the level of treatment required at each such point, with the level often higher than secondary treatment.

In effluent limited water segments, on the other hand, the water quality standards can be met by employing best practicable (secondary) waste treatment technology. Thus, in these segments, it is not necessary to allocate waste loads as above.

A draft basin plan has been completed for the Hackensack and Passaic River areas and is discussed in further detail below.

Wastewater Management Plan

Water Quality Management Basin - - Northeast New Jersey Urban Area

In August of 1975, the NJDEP published a draft Section 303(e) Water Quality Management Basin Plan for the northeast New Jersey urban area; which includes the Hackensack River Basin and the tidal portions of the Passaic River Basin.

The purpose of this draft basin plan is to coordinate and direct the state's Water Quality decisions on a river basin scale. It identifies and then sets forth measures to correct the basin's short range water quality problems. The steps in formulating that basin plan have included:

(1) Delineating the study area;

(2) Assembling information on existing water quality and pollution sources, and existing and projected development;

(3) Assessing existing water quality problems and classify stream segments as water quality limited or effluent limited;

(4) In water quality limited segments, making waste load allocations and establishing compliance schedules;

(5) In effluent limited segments, establishing compliance schedules; and

(6) Assessing municipal facilities needs.

The most important results, for purposes of this Kearny Study, are the segment designations and their resulting waste load allocations. For this, southern portion of the River, the segment is designated as water quality limited, the more stringent classification; and the waste load allocations are calculated on the basis of a choice between a Hackensack River outfall or a Hudson River outfall or Hudson County's regionally collected wastes. Kearny's sewage will flow to such a regional facility.

For the Hackensack River, if the Bergen County Sewer Authority Treatment plant's discharge were to be switched to the Hudson River, only level II treatment would be required of other plants discharging to the Hackensack. The draft basin plan also indicates that with the Bergen County Sewer Authority continuing to discharge to the Hackensack River, all other plants will require level IV treatment. (These levels of treatment are defined in Appendix)

Assuming tnat all Hackensack River d.;charges met their effluent limitations, discharges directly to Newark Bay (one of which includes the existing Kearny Industrial Plant) would require only level I treatment.

Northeast New Jersey Water Quality Management Study

Concurrent with the development of the short range basin plan above, a longer range water quality management planning effort is under way. This is known as the Northeast New Jersey Water Quality Management Study (referred to as the Northeast Study) and is funded under Section 3(c) of the 1970 Amendments to the Federal Water Pollution Control Act. Formulation of the short range, 5-year basin plan, discussed above, is part of its technical analysis, and will be incorporated into the long range, 20-year plans being developed for the Northeast Study.

Hudson County Sewer Authority

The Hudson County Sewer Authority was formed in 1970 to serve the regional sewage collection and treatment needs for Hudson County, including the Kearny Meadows and the Kearny Point area.

The Hudson County Sewer Authority is ranked number 1 on the State's sewage project priority funding list and is eligible for over $200 million of federal construction grant funds under Section 201 of the FWPCA.

Grants are divided into three steps:

Step 1 - facilities planning

Step 2 - design

Step 3 - construction

In contrast with the state-wide character of basin planning, facilities planning (under Section 201 of the FWPCA) is limited to smaller geographical areas under such jurisdictions as the Hudson County Sewer Authority. The HCSA (201) facilities planning region has been subdivided into three smaller areas. At the time of this writing, separate consultants are now being selected for each area. It [illegible] anticipated that a contract for development [illegible] a facilities plan [illegible]or the area including Kearny will be signed s[illegible]ortly. The results of this study and its specific recommendations should be available within one year of signing.

HMDC Water Quality Research

The HMDC has completed a series of water quality research efforts, these related to tide flows, volumes and velocities in the estuary; to oxygen budgets over given 12-hour periods (recording the volumes of oxygen produced, consumed by given wetland units); and a series of nitrogen and phosporus budgets (how many kilograms of these nutrients are delivered to various wetland basins; are consumed within these basins as nutrients; are exported from these basins).

Shou.d there be a developmental response to the Special Use Zoning proposed here before the Hudson County regional interceptor and treatment facilities come on line, a study would have to be prepared which, patterned on the above studies, assessed the proposed impact from its treated sewage and prescribed the levels of treatment which would be provided at a temporary sewage treatment plant until the regional facilities became available. Such a temporary plant would have to be compatible with the regional plan, and connect into it when constructed.

CHAPTER 8 -- SOILS, BEDROCK PROFILE, FOUNDATIONS

At present, there is not sufficient data from past soil borings -- development in the Kearny Meadows has been scattered and sparse save for along Harrison Avenue -- to make specific findings about building conditions within the study area.

There is sufficient general data, however, to permit a broad characterization of

(a) bedrock depths. They are, in contrast, say, to the Hartz tract, more remote from the surface (Figure 13), and therefore pose higher foundation costs for tall, piled buildings (10 stories or more); and

(b) soil characteristics. The soils are less stiff (more sand and silt, less clay; with all three components more mixed than varved) under the Kearny Meadows than in, for example, the Bellemead tract, with this condition requiring somewhat lighter buildings on controlled fill or buildings constructed on friction piles.

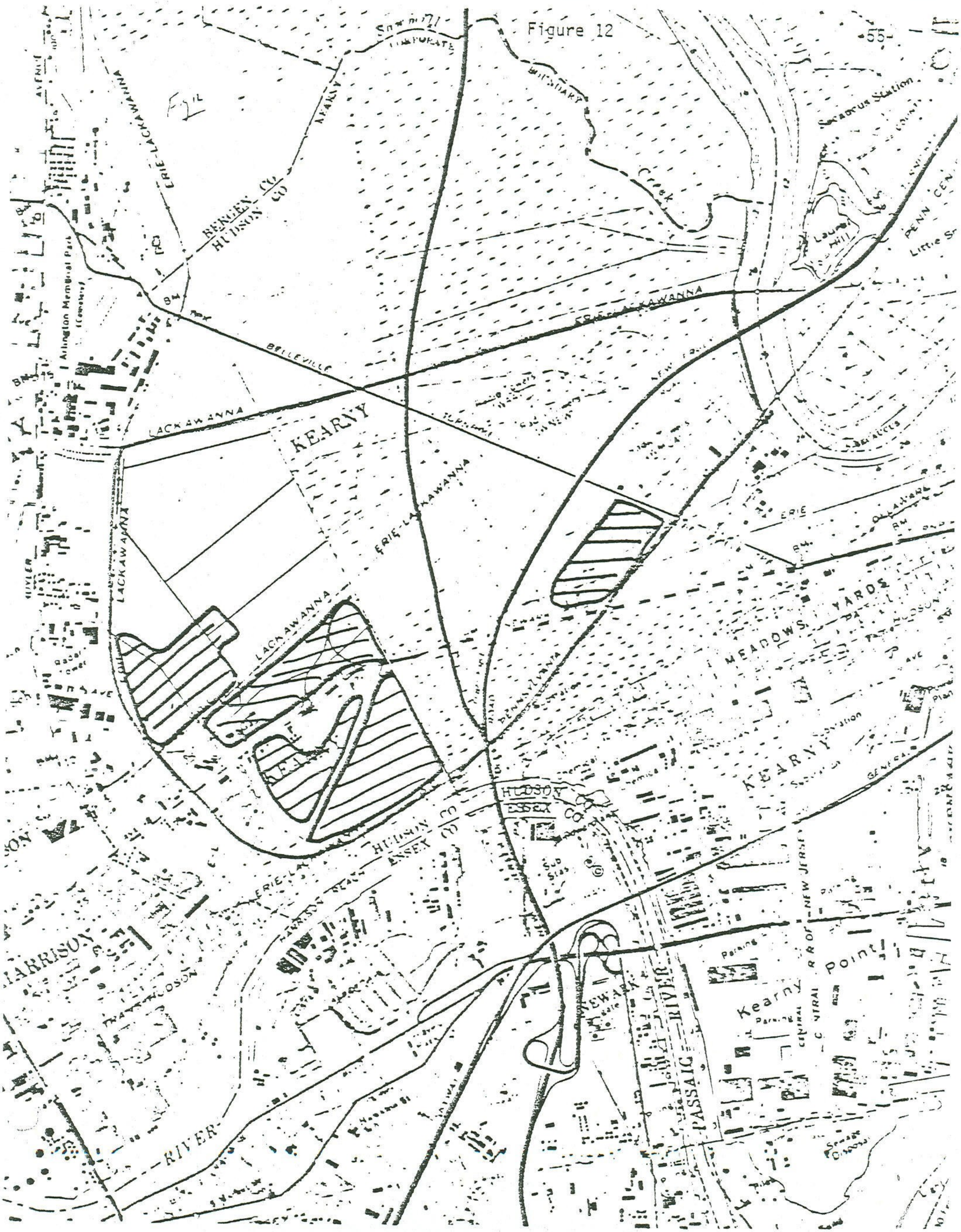
Thirdly, there are 5 landfills of varying solid waste depths; these mapped on Figure 12. Needless to say, construction possibilities in these areas are extremely limited, with the degree of engineering and environmental difficulty tied directly to depth, condition, and age of solid waste fill.

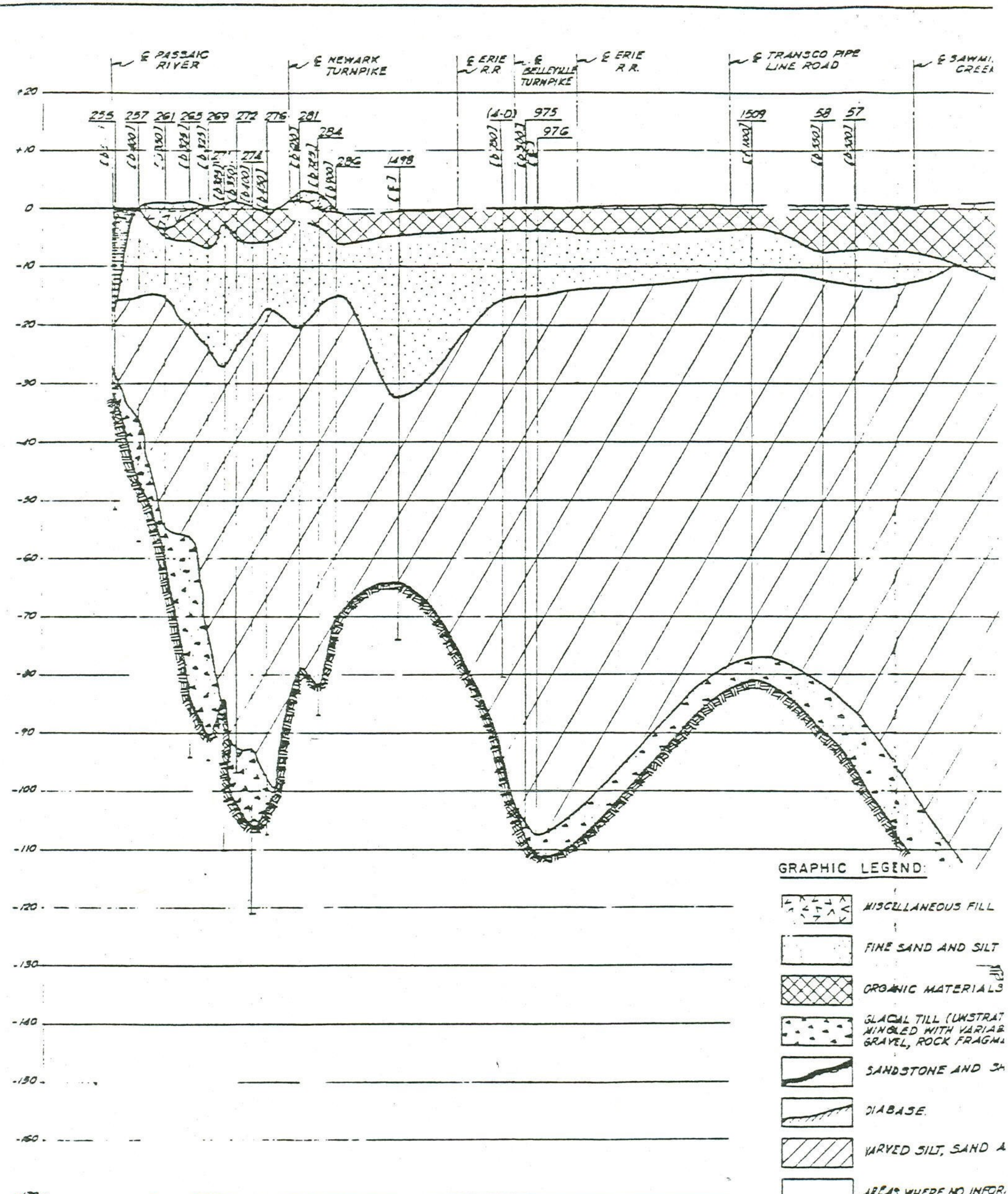
The boring logs which we examined -- those of the New Jersey Turnpike, of the Port Authority of New York and New Jersey, of the Janna Corporation, and those catalogued in the Ward Report -- are incorporated as Figures 13 through 15 , at pages 56 through 58. Bedrock, near the surface at the western boundary of the study area (Gunnal Oval), plunges steeply to a depth of greater than 126 feet; then gradually slopes upward from west to east until, at the New Jersey Turnpike (east) Hackensack River crossing, its depth is 72 feet below the surface. There may be local ripples in this pattern, of course, these in areas not depicted by the boring logs available. There appears to be a pattern of gradual rise in the bedrock profile from south to north, although this pattern is neither pronounced nor precipitous.

It is difficult to assess and characterize soil stiffness (and thus building support capability) from the only data available in the logs -- blows on the spoon, and field soil descriptive terms such as "medium stiffness."

It would be appropriate to say, however, that the two most likely forms of foundations required by these broadly characterized bedrock and soil patterns are the "controlled fill" and "friction pile" types.

The appropriate foundation preparation method in a controlled fill procedure is to muck out the organic peaty materials which the fresh and tidal marshes have formed over the years, and the soft clay or silt layers lying slightly below. These materials are then replaced with controlled layers of backfill and, if needed, a level of surcharge. A waiting period, usually a year, is required for stabilization to occur. Then, the developer


KEARNY
LACKAWANNA
ERIE-LACKAWANNA
BELLEVILLE
TURNPIKE
BERGEN CO
HUDSON CO
HUDSON CO
ESSEX CO
Arlington Memorial Park (Cemetery)
Secaucus Station
Laurel Hill
PENN CENTRAL
Little Snake
Creek
BOUNDARY
CORPORATE
ERIE
MEADOWS YARDS
PENNSYLVANIA
HARRISON
PASSAIC RIVER
NEWARK
Kearny Point
CENTRAL R R OF NEW JERSEY
Parking
Sub Sta
RIVER
HARRISON



PREPARED BY JOSEPH S WARD, INC.
DATE JULY 2, 1962 (C6205-10)

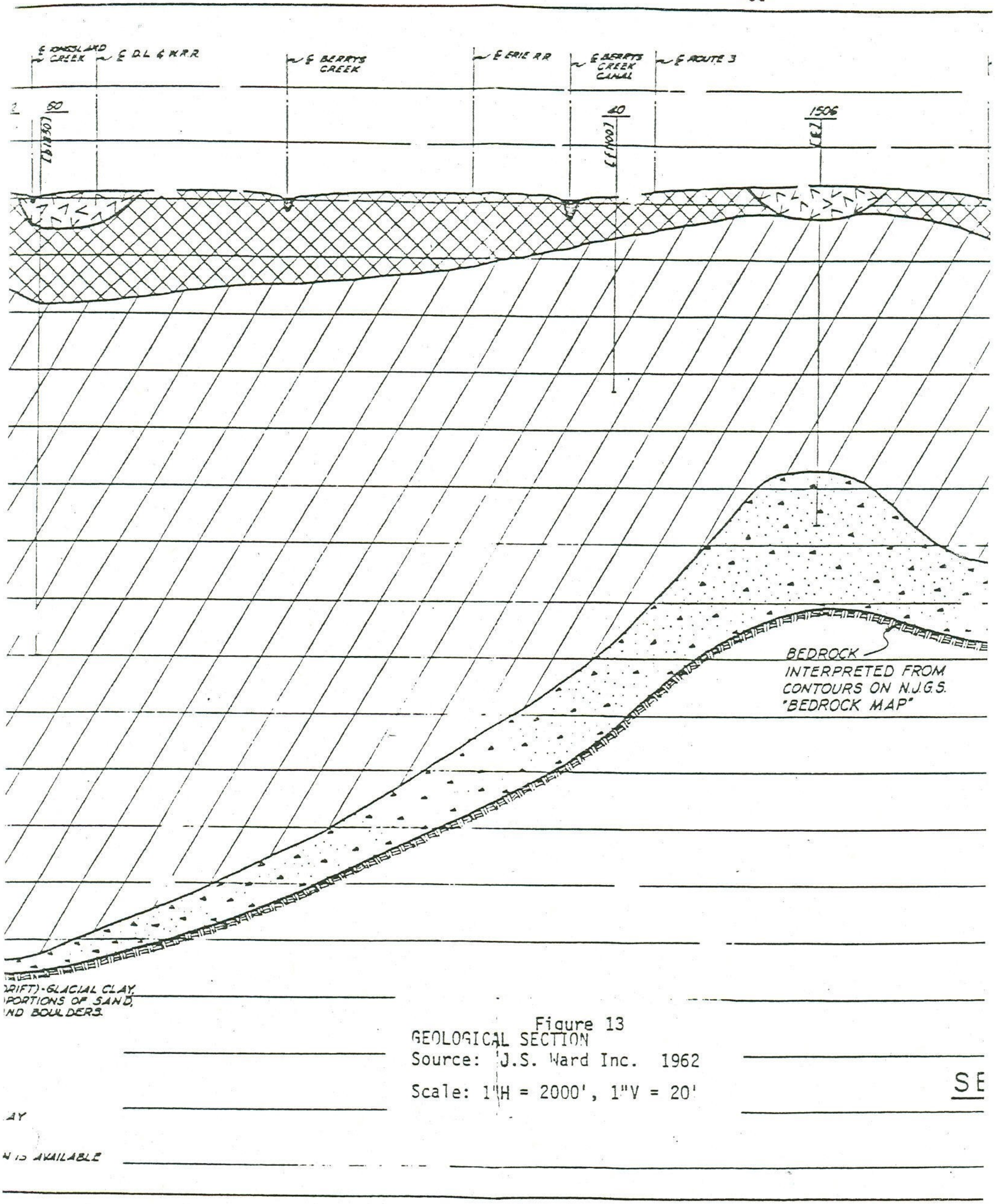


Figure 13
GEOLOGICAL SECTION
Source: J.S. Ward Inc. 1962

Scale: 1"H = 2000', 1"V = 20'

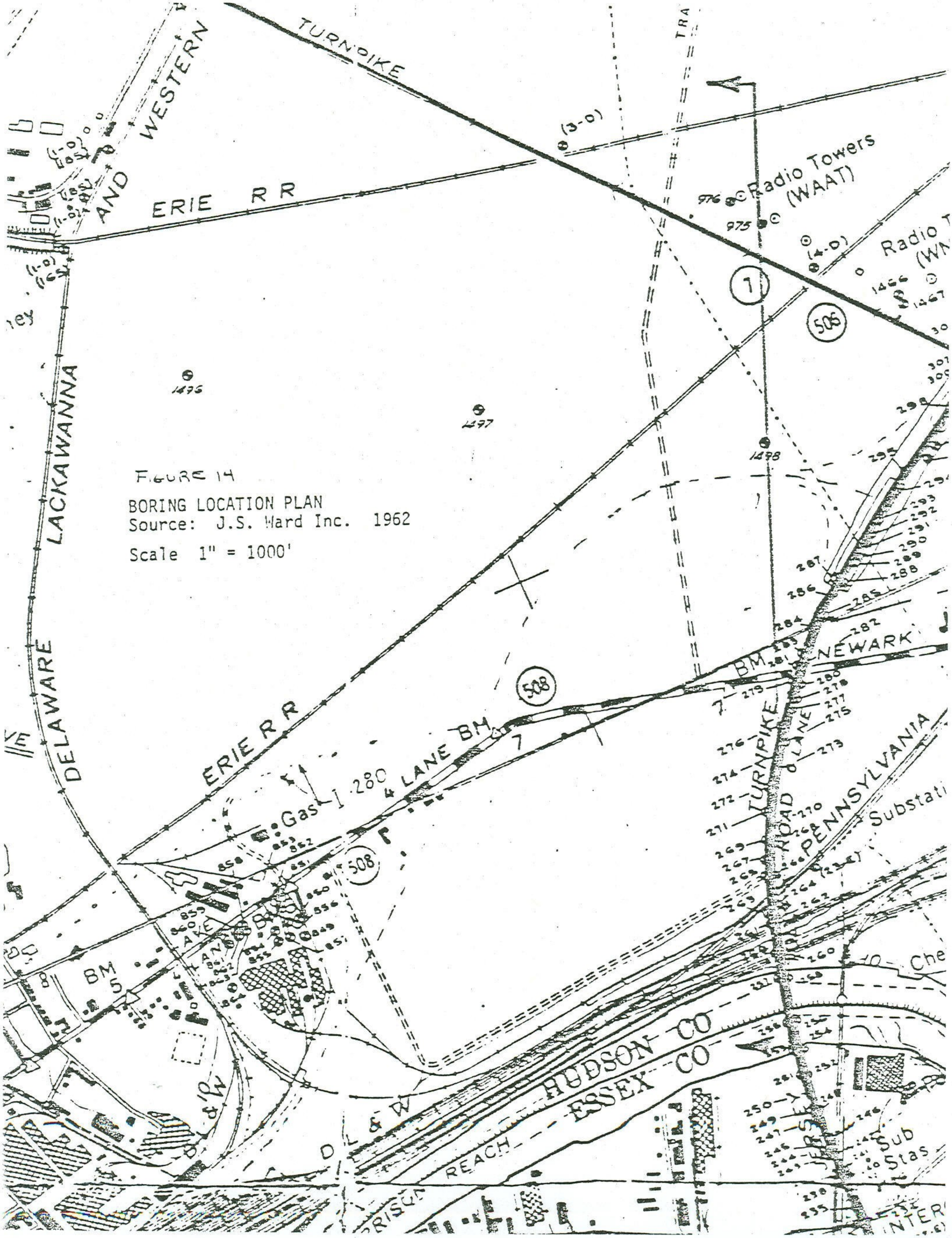
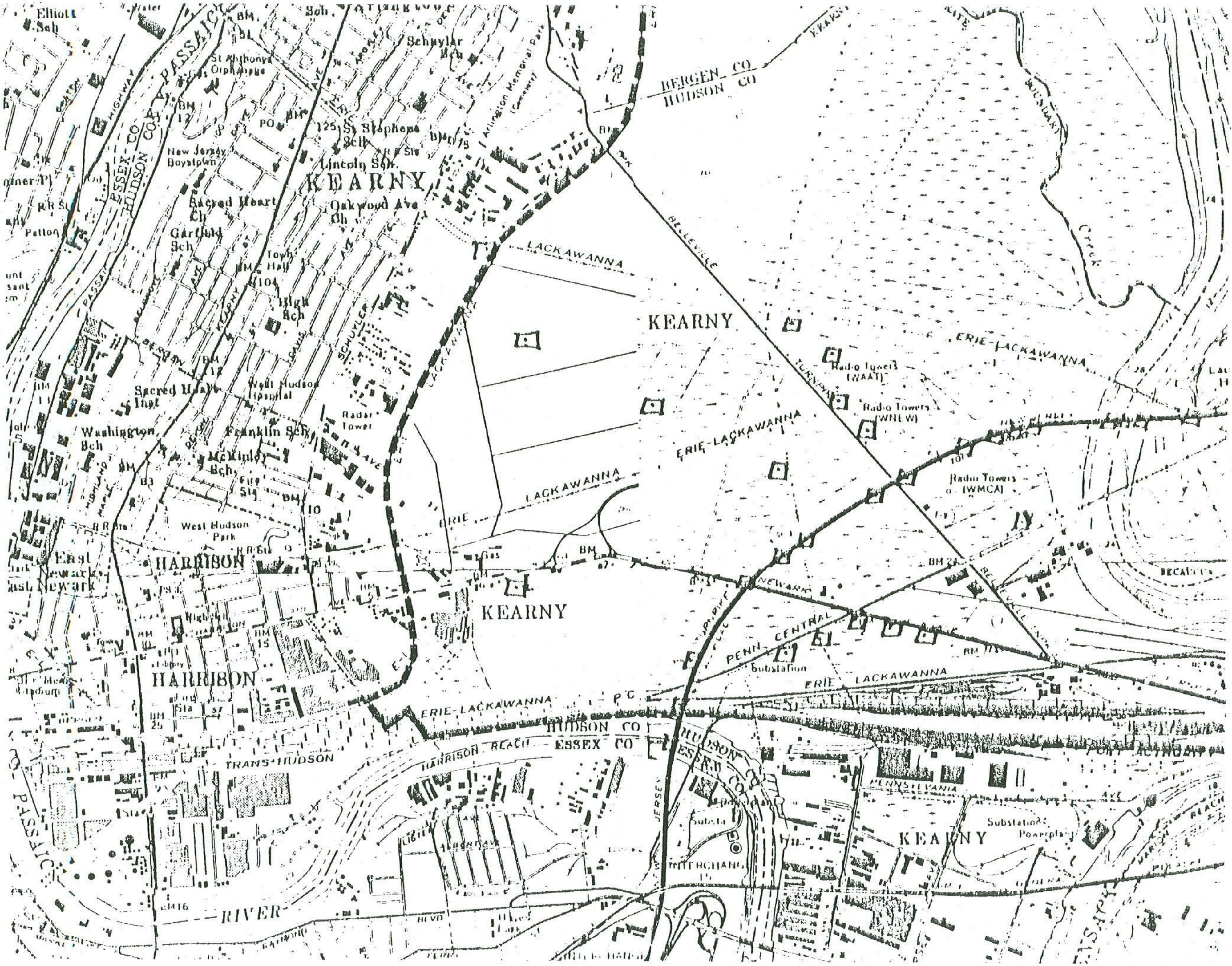


FIGURE 14

BORING LOCATION PLAN
Source: J.S. Ward Inc. 1962

Scale 1" = 1000'



KEARNY
KEARNY
KEARNY
KEARNY
HARRISON
HARRISON
East Newark
BERGEN CO
HUDSON CO
ESSEX CO
HUDSON CO
PASSAIC
RIVER
HARRISON REACH
TRANS-HUDSON
ERIE-LACKAWANNA
LACKAWANNA
PENN CENTRAL
PENNSYLVANIA
BELLEVILLE
TURNPIKE
NEWARK
Creek
Schuyler Sch
St Anthonys Orphanage
St Stephens Sch
Lincoln Sch
New Jersey Boystown
Sacred Heart Ch
Oakwood Ave Ch
Garfield Sch
Town Hall
High Sch
Arlington Memorial Park (Cemetery)
West Hudson Hospital
Sacred Heart Inst
Radar Tower
Washington Sch
Franklin Sch
McKinley Sch
Fire Sta
West Hudson Park
Patton
Elliott Sch
Radio Towers (WAAT)
Radio Towers (WNEW)
Radio Towers (WMCA)
Substation
Substation Powerplant
Library

proceeds in a normal construction pattern; that is, to pour standard concrete footings on the controlled fill pad, with the building walls and roof resting on these footings. The floor slab rests directly on grade.

The appropriate foundation preparation method in a friction pile procedure is to muck out the organic materials and replace it with fill. A waiting period for stabilization is not required as the developer immediately can drive timber or other piles to the appropriate depth and then pour pile caps and grade beams. Wall loads and roof loads are carried by the friction piles. A floor slab may rest directly on grade, or its loads may also be transferred to the piles.

We estimate with these two techniques, one and two story warehouses can be easily constructed and three to five story office buildings can be supported on either piles or controlled fill. There are, of course, other foundation methods adaptable to this region which can support taller buildings.

CHAPTER 9 -- FISCAL IMPACT ASSESSMENT: TWO LAND USE SCENARIOS

A. Municipal Services

Of the many services provided by the Town of Kearny each year, only a few would require expansion under the development plan recommended by this Report for the eastern portion of the study area. Three of those -- police, fire, and roads -- would be funded solely by the Town.

Currently, Kearny has 136 policemen at average salaries of $17,051 per year. The total police appropriation for 1976 is $2,536,475. Based on these figures and on the 392-acre proposed development of SU-3, we project an expansion of seven additional policemen at an approximate cost of $119,360 annually to the Town. In addition, approximately $11,745 per year in other expenses would be required. Total increase for the Town in the realm of police protection, then, would amount to $131,100.

The Kearny Fire Department, at present, operates with a total budget of $2,132,652 -- $2,042,027 in salaries and $90,625 in other expenditures. Expanded fire protection to accomodate SU-3 development would ultimately require eight additional firemen. This translates to a budget increase of about $136,410 in salary appropriation and $4,890 in other expenditures -- for a total annual increase of $141,300.

In the 1976 budget, $327,250 has been allocated for road repair, street cleaning, and snow removal. Based, once again, on the 392-acre development size, a projection can be made of approximately $15,700 (for street cleaning), $1,350 (for snow removal), and $550 (for road repair) in additional annual costs, for a total of $16,400.

Expansion of services -- police and fire protection, and road maintenance -- would thus require an addition of approximately $288,800 per year in the Town budget. It is likely that these figures will alter, along with the costs of service on which they are based; however, our projections here are made solely for the purposes of fiscal impact, and we are basing income projections on 1976 valuation as well -- thus it is the relationship, rather than the exact numbers, that is important. While it is true that service costs may rise, it is also inevitable that valuation of development in this area (with the completion of Route 280, for example) will also rise.

B. Building Costs

Three general categories combine to make up the total construction cost for any structure -- site preparation, site work, and building construction. Influence of these categories on the total cost will vary in accordance with such factors as soil characteristics and type of building.

Included in site preparation costs are wet excavation, building fill and parking and landscape fill. These are likely to wield a major influence on development in Kearny, since the wetland nature of the property and bedrock depth will require more extensive treatment than property with stiffer soil characteristics.