RECONNAISSANCE STUDY

Section 905(b) (WRDA 86) Preliminary Analysis

Upper Rockaway River, New Jersey
Flood Control and Environmental Restoration Study

1. STUDY AUTHORITY

The Upper Rockaway River, New Jersey, Flood Control and Environmental Restoration Study is being carried out under the Corps of Engineers' General Investigations (GI) Program. The study was authorized by a resolution of the Committee on Transportation and Infrastructure of the U.S. House of Representatives, dated May 7, 1997.

> *"Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That, the Secretary of the Army review the report of the Chief of Engineers on the Upper Rockaway River in Morris County, New Jersey, published as House Report Number 94-1702, and other pertinent reports, with a view to determining whether any modifications of the recommendations contained therein are advisable at the present time, in the interest of water resources development, including flood control, environmental restoration and other allied purposes."*

The New York District received $100,000 in Federal Fiscal Year 1998 funds to complete the reconnaissance phase of the study.

2. STUDY PURPOSE

The purpose of this reconnaissance study is to evaluate the potential for Federal interest in implementing solutions to frequent flooding problems, ecosystem degradation, and other related water resource problems and needs in the Upper Rockaway River Basin, New Jersey. If Federal interest is demonstrated, the study will also result in the development of a Project Study Plan (PSP) and the negotiation of a Feasibility Cost Sharing Agreement (FCSA) with a non-Federal partner for the next phase of study.

3. LOCATION OF PROJECT/CONGRESSIONAL DISTRICT

The Upper Rockaway River Basin is located in north-central New Jersey in the west-central portion of the Passaic River Basin. The headwaters originate in Jefferson Township, Morris County and flow in a southwesterly and then in an easterly direction emptying into the Boonton Reservoir. The lower Rockaway River flows from the Boonton Reservoir and then empties into the Passaic River (see Figure 1).

The Upper Rockaway River Basin study area is located in the 11th Congressional District, New Jersey (Congressman Rodney P. Frelinghuysen -R).

Rockaway River, Morris Canal, and Historic Sites

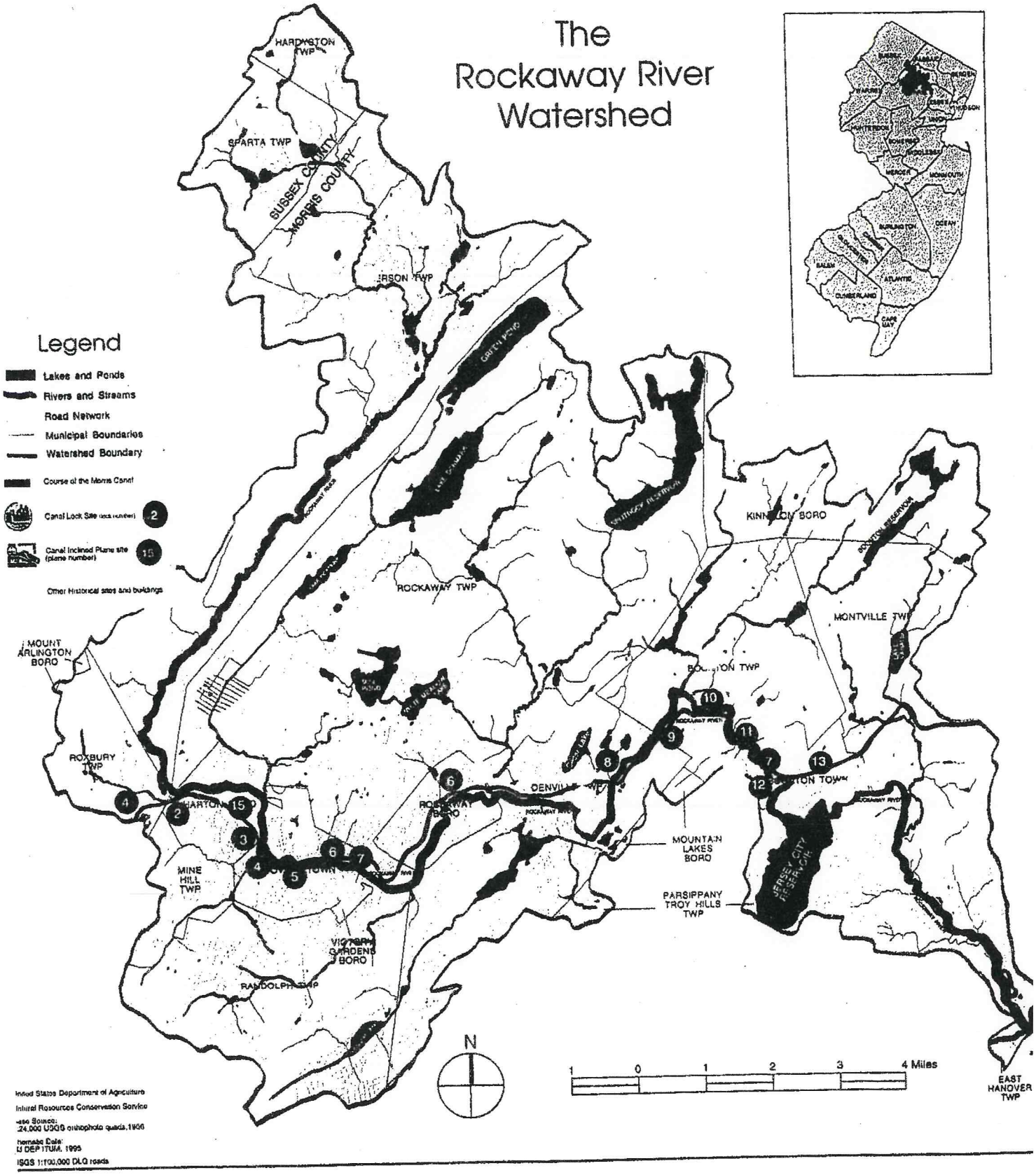


Figure 1: Study Area

4. PRIOR STUDIES AND REPORTS

4.1 Prior Studies and Reports by Corps of Engineers

The following prior reports and studies have addressed flood problems within the Upper Rockaway River Basin.

Survey Report for the Passaic River Watershed, New Jersey, October 1948

In October 1948, the New York District Engineer submitted a survey report recommending the construction of a reservoir and channel modification as a project for flood control and other purposes within the Passaic River watershed, New Jersey. Included in the District Engineer's recommendations for the main stem and tributary streams were local protection works in the Upper Rockaway River Basin. The improvements would have provided for the replacement of the existing Lake Denmark and Picatinny Lake Dams on Green Pond Brook by new structures with enlarged spillways to accommodate safely the discharge of the Probable Maximum Flood. The improvements would have provided protection to Picatinny Arsenal.

Survey Report for the Passaic River Watershed, New Jersey, June 1962

In June 1962, the New York District Engineer submitted an updated and revised draft survey report recommending favorable action on an alternative plan of improvement for the Passaic River watershed. Included among recommendations for the main stem and tributary streams were local protection works in the Upper Rockaway River Basin. Again, this involved reconstruction of the Picatinny Arsenal Dams as in the October 1948 report.

Reconnaissance Report for Tanglewood Brook in Dover Town and Rockaway Borough, New Jersey, 1970

A reconnaissance report was prepared for Tanglewood Brook in Dover Town and Rockaway Borough, New Jersey in 1970. This report documented the flood problem in that area.

Survey Report for the Passaic River Watershed, New Jersey, June 1972

The most recent survey report prepared by the Corps of Engineers was issued in June 1972 and amended by a supplemental report in April 1973. In these reports, the District Engineer recommended for authorization a plan of improvement for flood protection and allied resources development in the Passaic River Basin. Included in this recommendation were local protection plans. The plan of improvement on the Rockaway River would have provided protection through the use of levees to a concentrated residential and commercial area - located in the Township of Denville, New Jersey. The existing Lake Denmark and Picatinny Lake dams on Green Pond Brook, a tributary of the Rockaway River, would also have been replaced by new structures with enlarged spillways to accommodate safely, but with minimum freeboard, the discharge of the Probable Maximum Flood. However, the absence of non-Federal sponsorship for the comprehensive basin-wide plan precluded construction authorization by Congress, and instead, Congress authorized the Passaic River Basin Study.

Technical Report for the Longwood Valley Hydroelectric Pumped Storage Project, Upper Rockaway River, Jefferson Township, New Jersey, March 1980

In March 1980, a technical report was prepared by the Corps of Engineers and subsequently revised and updated for the proposed Longwood Valley Hydroelectric Pumped Storage Project on the Upper Rockaway River in Jefferson Township. Included in this report were several alternatives for a multipurpose project that involved water supply, flood control and hydroelectric pumped-storage. The basis of this report was a prior investigation by the Jersey Central Power and Light Company in 1966 for a multipurpose project.

Flood Control Feasibility Report, Upper Rockaway River, Morris County, New Jersey, May 1987

The Draft Report of the Phase I Study "Flood Control Feasibility; Upper Rockaway River Basin, Morris County, New Jersey" for the Upper Rockaway River Basin was completed in May 1987. The Draft Report presented an array of alternatives of which several plans were found to be economically feasible. The findings in this report are based on area field reconnaissance, field topographic surveys, hydrologic and hydraulic studies, consultation with local interests, review and evaluation of previous reports, published maps, United States census reports, consultation with local officials, and other published data. Records of the United States Geological Survey and the United States Weather Bureau were utilized for climatologic, hydrologic and hydraulic data. Flood damage, extent of flood area and other data concerning flood conditions for past floods were determined by field damage surveys, interviews with local officials, newspaper files in the area, and local and published reports. Plan formulation studies were coordinated with State and Federal agencies having expertise and interest in flood control and storm runoff, with environmentally oriented planning groups, and municipal, county and local interests.

Technical Report for the Longwood Valley Pumped-Storage Project, March 1989

In March 1989, a technical report was prepared by the Corps of Engineers. This report involved a detailed analysis of the feasibility of the proposed Longwood Valley Pumped-Storage Project.

Phase I General Design Memorandum Passaic River Basin, New Jersey and New York, Final Report on Flood Protection Feasibility Remaining Tributaries, January 1990

The Water Resources Development Act of 1976 (Public Law 94-587) authorized the Passaic River Basin Study, a Phase I Advanced Engineering and Design Study. During the initial planning stage of the Passaic River Basin Study, the water resources related problems and opportunities of tributary flood problem areas were identified and reviewed to determine the need for further study. The Upper Rockaway River Basin was identified as an area having several potential sites where interim measures would be desirable. Flood problems along the Rockaway River were identified in the communities of Boonton Town, Boonton Township, Denville Township, Rockaway Borough, Rockaway Township, Randolph Township, Victory Gardens Borough, Dover Town and Wharton Borough. Jefferson Township was also identified to be included within the planning area as a potential site for the Longwood Valley pumped storage hydropower feature of the reservoir project. In addition to the Rockaway River several tributaries were included within the planning area. They are Den Brook, Beaver Brook,

Tanglewood Brook, Mill Brook and Green Pond Brook. The extent of study on these tributaries was largely limited to the portion of the tributary affected by backwater from the Rockaway.

The 1990 General Design Memorandum indicates that there are no economically feasible structural or nonstructural flood control alternatives warranting Federal involvement for the Upper Rockaway River Basin. The early planning phase developed an array of alternatives which appeared to have the potential for economic feasibility based primarily on the potential for economically feasible hydroelectric energy, water supply and flood control as evaluated in the early to mid 1980's (see discussion of 1987 Feasibility Report above). These results were, however, based on a preliminary study at that time, and the detailed planning study involved a more intensive analysis of each alternative. Several factors contributed to all potential plans becoming infeasible. These factors include the decrease in flood damages after reanalysis of the EAD model, significant cost increases in the plans to meet the year 2040 design conditions, and the substantial costs to mitigate the environmental impacts of each plan.

4.2 Prior Studies and Reports by Others

Other studies include those prepared by the Federal Emergency Management Agency (FEMA) as part of the Federal Flood Insurance Program. These studies were carried out in most of the municipalities in the basin. In addition, Morris County has developed several watershed plans that address stormwater management, the most notable of which is described below.

Upper Rockaway River Watershed Study, January 1990

The Upper Rockaway River Watershed Study Stormwater Management Plan conducted by Morris County, New Jersey presents a detailed analysis of alternative stormwater management approaches on an integrated, regional basis. A major objective of this study was to determine if regional, area-wide detention basins could be utilized as an effective and practical means to manage stormwater in the Upper Rockaway River Watershed. This particular study provided an analysis of stormwater management (and temporary flood control) alternatives which appear to be quite effective. As a result, the engineering solutions explored in the report were evaluated to determine whether the alternatives are in the Federal interest. Additional information contained in this report is included in the Plan Formulation section of this document.

Visions & Strategies Report for The Rockaway River, April 1998

The Visions & Strategies Report was created by the Friends of the Rockaway River. The report presents specific recommendations on environmental preservation, restoration and enhancement at dozens of sites along the Upper Rockaway River.

5. PLAN FORMULATION

5.1 General Physical Setting

The Upper Rockaway River drains 116 square miles at U.S.G.S. Gaging Station 138050, 1.8 miles above the Boonton Reservoir Dam. The Upper Rockaway River Basin is characterized by

steep hills in the northwestern portion and low lying areas in the eastern portion. There are numerous small lakes. Several tributaries of importance drain into the Upper Rockaway. Russia Brook originates in Sparta Township, Sussex County and drains into the Upper Rockaway River in Jefferson Township, Morris County. Green Pond Brook originates in Green Pond, Rockaway Township and flows into the Rockaway River at the Rockaway Township/Dover/Wharton borders. Beaver Brook also originates in Rockaway Township and flows into the Upper Rockaway River at the Denville/Rockaway Borough border. Den Brook originates in Randolph Township and enters the Upper Rockaway River in Denville. Other tributaries include Mill Brook and Tanglewood Brook.

5.2 Identified Problems

5.2.1 Existing Conditions

5.2.1.1 Flood Damages

Flood damages occur along the Upper Rockaway River in Morris County, New Jersey, particularly in the areas of Denville Township, Rockaway Borough, Randolph Township and Dover Town. Flooding has also occurred to a lesser extent in other portions of the Upper Rockaway River Basin. Previous analyses determined that physical flood damages begin with floods having average recurrence intervals as short as one year. Approximately 1,000 structures in the Upper Rockaway River Basin are located within the 100-year floodplain. Flood damages consists of physical damages to residential, commercial, industrial, and public property and loss of economic activity. Several large, high value commercial and industrial complexes are located in the floodplain of the Upper Rockaway River throughout the study area. The study area contains a variety of development conditions, ranging from the dense urban character of Dover Town to several lightly developed "untouched" areas. Ecosystem restoration opportunities exist in a number of these areas.

The Upper Rockaway River Basin study area has experienced multiple, significant flood events, including the 1968, 1971, 1973, 1977, 1979, 1984, and 1996 floods. Areas severely affected by flooding along the Upper Rockaway River include the centers of Denville Township and Dover Town. A summary of past flood events and damages is provided below.

October 1996

Widespread flooding inundated homes and businesses and resulted in several major road and bridge closures in the towns of Dover, Denville, and Boonton. Denville Township in particular experienced some of its worst flooding in almost 100 years. Flood depths in areas of the township were between four and five feet.

April 1984

Flooding occurred when rain from a two day storm coincided with snowmelt runoff from the previous week's snowfall. In Denville, major streets were inundated with floodwater for the duration of one day. Homes along the Upper Rockaway River in Denville had up to two feet of

water. In Dover, floodwaters from the Rockaway River caused severe damages to pavement and drainage systems along Dover Road and Second Street. Blackwell Street in Dover was closed for 18 hours. Approximately 110 people were evacuated from their homes in Denville and Dover.

January 1979

The storm of January 1979 caused extensive damages throughout the Upper Rockaway River Basin. Damages exceeded one million dollars in Denville alone. Much of the downtown business district was flooded with water depths up to three feet. Dover Town also suffered extensive flooding. Approximately 50 businesses and 100 homes were flooded, and two auto dealerships suffered one million dollars in damages each. Floodwaters reached a depth of two feet in Dover Town's streets, and the flooding and resultant debris accumulation left streets impassable for several days. There was over three million dollars in damages in Dover and the municipality was declared a Federal disaster area. Other flooded areas included Rockaway Township, which suffered damages to homes and businesses along the river. Numerous basements were reported flooded. The Boonton well fields were also flooded, endangering municipal water supplies.

March 1977

A northeaster brought wind, rain and heavy snow to the study area. There was little, if any, snow on the ground at the onset of this event, but stream runoff was elevated due to the melting of earlier snows. This nine year event resulted in a peak at 3,970 cfs above the Boonton Reservoir. Minor localized damage occurred.

February 1973

A frontal storm brought moderate rains to the area's streams, which were elevated as a result of melting of earlier snow. The peak above Boonton Reservoir was a 12 year event at 4,100 cfs, resulting in sanitary sewer backups and traffic difficulties.

December 1973

A low pressure system brought snow and freezing rain to New Jersey on the 16th and 17th of December 1973. Several days later, another storm brought heavy rain and spring-like temperatures to the area, leading to the melting of whatever snow and ice remained on the ground. The peak flow from this event was 200 cfs higher than the February 1973 event. Localized minor damage, sanitary sewer backups and traffic difficulties were the result of this event.

September 1971

In Boonton, a pumping station and homes along the banks of the Upper Rockaway River were inundated. Most of the flooding occurred at the water supply pumping station, reaching a depth of nine feet and threatening the town's water supply. Overall, during the 1971 flood few homes in Boonton Town and Boonton Township were affected by direct flooding except for those near the banks of the Rockaway River. Residents of Denville had up to three feet of water in their homes. The central business district as well as sections of major highways were closed to traffic

when floodwaters inundated the area to a depth of three feet. Residences in Denville were severely damaged and many occupants were evacuated by boat. In Dover the Rockaway River rose six feet above normal causing flooding in some areas to a depth of three feet. The business district of Dover was completely flooded and traffic was interrupted throughout the town.

May 1968

Flooding caused minor damage to housing and transportation facilities in Boonton Town and Boonton Township. Thirty homes in the Town of Boonton were damaged due to the poor drainage and surface runoff conditions. Storm sewers backed up into low areas. Flooding inundated the cellars and basements of approximately 150 dwellings in Denville. Water was recorded reaching levels of three feet in basement areas. In addition, poor drainage caused sewers to back up in many dwellings. The flooding was severe enough to warrant evacuation of 50 residences by the Denville Police and Fire Departments. Approximately 40 dwellings suffered damages in Rockaway Township. Water was recorded at levels from one to three feet in cellars. In Dover, Tanglewood Brook, a tributary of the Rockaway River caused damages to approximately 50 dwellings.

5.2.1.2 Existing Conditions – Ecosystem Degradation

Although the Upper Rockaway River and its banks are of high quality throughout most of its length, there are sites along the river that pose serious environmental problems and threaten fish and wildlife habitat.

Berkshire Valley Sand & Stone Company Site

The Berkshire Valley Sand & Stone Company Site (510 acres) lie east of Berkshire Valley Road in Milton and west of Green Pond. There are extensive water resources on the site with the Upper Rockaway River the primary water body. Tributary streams, gravel pits, and settling ponds, in addition to both disturbed and undisturbed wetlands are common.

The property is broken into two non-contiguous parcels (70 and 440 acres). Portions of both parcels have been extensively mined for sand and gravel. Over 20 percent of the formerly mined areas are devoid of vegetation. Eroding soil, sand and gravel from the two parcels wash downstream, reducing the depth of Oak Ridge and Longwood Lakes. Heavy siltation has degraded the lakes' fisheries habitats, increased eutrophication, and diminished the recreational use of the lakes for the hundreds of year round and seasonal residents. Siltation from inactive mining operations also depletes trout habitat in the Rockaway River for miles downstream.

The western valley section comprising nearly one-half of the 440 acre parcel is highly disturbed. A high percentage of this area's sandy soil is exposed and lacks vegetation. Where vegetation has established, it is comprised of the opportunistic species phragmites and assorted weed and pioneer species. This area is characterized by deep pits filled with water, large piles of gravel, discarded mining equipment, unstable and eroding slopes, and haul roads.

The possibility of environmental contamination of the site's soil and groundwater is real. If soil and groundwater contamination is discovered, the expense of site clean-up and remediation could keep the property from being reclaimed for many years.

Washington Forge Pond

Washington Forge Pond, located on the Rockaway River, is 1,300 feet long and averages 300 feet wide. The pond is owned by the Borough of Wharton which also holds title to 35 percent of the land bordering the pond. A 9.5 acre undeveloped property lies on the west bank of the Rockaway River immediately upstream of Washington Forge Pond. The tract consists of wetlands, floodplain, and steeply sloping upland areas. A 5.9 acre privately owned property fronting the pond's east bank for 700 feet lies vacant and underutilized. Siltation from upstream lands has reduced the depth of the pond, diminishing fisheries habitat.

GPU Energy & Morris County Properties

A Public utility, GPU Energy, and Morris County own key properties along the Rockaway River between Route 80 in Jefferson and Hugh Force-Canal Park in Wharton. Extensive public works yards are found here. The GPU energy property, with nearly 900 feet of frontage on state-owned wetlands bordering the Rockaway River, is separated from the river by approximately 175 feet. The Morris County Road Department's operations facility lies within 100 feet of the river along one section of its nearly 1,400 foot river frontage. Runoff from the properties carries silt and other contaminants into the river and its wetlands at a popular trout fishing area and less than one mile upstream of Washington Forge Pond.

5.2.2 Expected Future Conditions – No Action

5.2.2.1 Flood Damages

Expected future conditions include continued flooding and associated damages throughout much of the study area. Local floodplain management ordinances ensure against future development within the 100-year floodplain. However, extensive development pressures in the upper portions of the drainage basin could alter the rainfall-runoff relationship and worsen downstream flood damages. Local efforts are underway to develop a stormwater management program to ensure that future development does not worsen flood conditions. However, the proposed stormwater management plan will not reduce flood damages below existing conditions levels.

5.2.2.2 Ecosystem Degradation

The remaining undeveloped portions of the upper drainage basin are facing extensive development pressures as population within Morris County continues to rapidly increase. Much of the natural and beneficial values within the basin ecosystem will be lost unless significant efforts are made to preserve remaining natural areas as well as to restore areas previously impacted by past mining and development activities.

5.3 Alternative Plans – Flood Control

5.3.1 1987 Feasibility Study Alternatives

The New York District conducted a detailed analysis of sixteen alternative plans for flood damage reduction in the mid 1980's. All possible management measures considered were first evaluated to determine their effectiveness to reduce flood damages and to enhance water supply and hydropower resources of the region. The measures considered are listed below. Detailed descriptions of each plan can be found in the 1987 Feasibility Report and the 1990 General Design Memorandum.

Plan No.	Plan Name	BCR (1987)	BCR (1990)	AAC (1987) ($1000)	AAC (1990) ($1000)	Percent Increase in Cost
1	Basin Wide Levees	0.96	0.50	6,687	11,217	68 %
2	100 Year Denville Levees	1.23	0.54	1,062	2,725	157 %
2a	Limited Denville Levees	1.05	1.02	137	160	17 %
3	100 Year Dover / Randolph Levees	1.30	0.90	3,567	5,043	41 %
4	100 Year Channel	1.30	0.53	4,930	12,560	155 %
5	25 Year Channel	0.85	0.34	1,772	4,388	148 %
6	Longwood Valley Multipurpose Project	1.40	0.85	41,868	36,360	-13 %
6a	Longwood Valley Dry Detention	1.70	0.54	1,456	4,413	203 %
6b	Longwood Valley Lower Pool Multipurpose	0.60	0.20	3,256	9,869	203 %
7	Green Pond (Dover) Brook Detention Reservoir	1.00	0.81	1,064	782	-27 %
8	Beaver Brook Detention Reservoir Plan	0.20	0.10	1,326	4,020	203 %
9	Dual Reservoir Plan (Plans 6a & 7)	1.70	0.73	2,520	5,141	104 %
9b	Dual Reservoir Plan (Plans 6 & 7)	1.40	0.83	42,932	37,142	-13 %
10	All Reservoir (Plans 6a, 7, & 8)	1.20	0.44	3,846	9,161	138 %
11	10 Year Nonstructural Plan	0.30	0.28	3,506	3,829	9 %
12	50 Year Nonstructural Plan	0.30	0.27	4,280	4,674	9 %
13	100 Year Nonstructural Plan	0.30	0.25	4,735	5,170	9 %

It should be noted that several of these plans appeared to be economically justified as analyzed in the 1987 Feasibility Report. However, when these analyses were revised in the 1990 General Design Memorandum, based on a more intensive analysis of each alternative, significant cost increases were encountered. The 1990 analysis resulted in significant cost increases in order to meet year 2040 expected hydrologic conditions and mitigate the environmental impacts of each plan.

5.3.2 Upper Rockaway River Watershed Plan Regional Detention Basin System

Morris County has conducted an engineering study to determine whether regional, area-wide detention basins could be utilized as an effective and practical means to manage stormwater runoff in the Upper Rockaway watershed. Six potential area-wide detention basin sites were identified. These sites are shown on Figure 2, and are listed below:

1. Rockaway River – Longwood Valley Basin;
2. Green Pond Brook – Route 15 Basin;
3. Dalrymple Pond – Center Grove Basin;

4. Mill Brook – Palmer Road Basin;
5. Beaver Brook – Meriden Lyonsville Road Basin; and
6. Stony Brook – Upstream Deer Lake Basin

The county formulated a preliminary design of basin sizes and spillway configurations for each detention area. This was followed by the development of elevation-storage relationships, and the calculation of elevation-discharge relationships for several alternative spillway configurations. Flows were routed through the detention basins using HEC-1 for expected future year 2040 land use conditions, and spillway configurations were refined to obtain the maximum storage. Points of interest numbered POI 31 through POI 42 were selected along the Rockaway River and at nodes in the HEC-1 model. Points of interest are described below and shown on Figure 2.

Point of Interest Number	HEC-1 Model Node Number	Location / Description
POI-31	1	Downstream of Subarea 240
POI-32	2	Green Pond Bk / Rockaway R. confluence
POI-33	3	Jackson Bk. / Rockaway R. confluence
POI-34	4	Mill Bk. / Rockaway R. confluence
POI-35	5	D/S of Subarea 310, CENAN POI 18
POI-36	10	Beaver Bk. / Rockaway R. confluence
POI-37	12	Den Bk. / Rockaway R. confluence
POI-38	13	D/S of Subarea 350, CENAN POI 19
POI-39	17	Stony Bk. / Rockaway R. confluence
POI-40	18	D/S of Subarea 380
POI-41	19	USGS Gauge 138050, CENAN POI 20
POI-42	21	USGS Gauge 138100, CENAN POI 21

During the spillway and storage volume optimization process, 100 year flows were analyzed at the individual subareas. Peak discharge flows were examined for various rainfall frequencies, watershed conditions and detention basin combination scenarios. The results of the hydrologic analyses for each basin is summarized in the following paragraphs.

Basin No. 1: Upper Rockaway River - Longwood Valley Basin

This basin lies within a natural geographic depression and can contain a storage volume of 1,100 acre-feet. For a large drainage subarea of 23.1 square miles, the basin will function effectively. The performance can be measured at POI-31, downstream of the basin. For the 100-year frequency, year 2040 condition, flows are reduced from 2,396 cfs without detention, to 1,944 cfs with detention. The reduction is 93% of the amount required to match existing 1986 land use condition flows of 1,910 cfs. For the 25, 10 and 5-year storms, the detention brings the peak flows below those for existing 1986 conditions.

Basin No. 2: Green Pond Brook - Route 15 Basin

This basin is located at the confluence of Green Pond Brook with the Rockaway River. Unfortunately, the total combined 100-year peak flow of 4,905 cfs entering the basin for future year 2040 land use conditions may not be accommodated by this basin. Within the physical restraints of Route 15, the Central Railroad of New Jersey and commercial developments in the area, basin volume is limited to approximately 400 acre-feet. In order to make a significant reduction in 100-year flow, a storage volume of approximately 2,000 acre-feet would be required, five times the available storage volume. When incorporated into the model, the reduction in 100-year flow was only 41 cfs. The county determined that this basin was not feasible and did not recommend the basin for further consideration.

Basin No. 3: Dalrymple Pond - Center Grove Basin

Located on the upstream end of a tributary to Mill Brook, the detention basin would increase the size of the existing Dalrymple Pond. The storage volume that can be obtained is proportional to the drainage area inflow, so the basin performs well hydrologically. For combined subareas 300A and 300B, 100-year peak outflow without detention for future year 2040 land use conditions is 696 cfs, and the detention basin routed outflow is 548 cfs. Compared to an existing 1986 land use flow of 483 cfs, this reduction represents 69% of current peak flow.

Basin No. 4: Mill Brook - Palmer Road Basin

Located downstream of Basin No. 3, this detention basin site has the required storage volume for subareas 300A and 300B. The 100-year flow for year 2040 land use conditions can be reduced from 696 cfs to 486 cfs, which is approximately the existing 1986 peak flow. Disadvantages of this basin are found in the construction and environmental aspects. The topographic location and required volume will necessitate building a levee around three quarters of the basin perimeter. Also, Mill Brook is classified by the NJDEP (Division of Fish, Game and Wildlife) as trout production waters. These factors plus the large quantity of wetlands adjacent to the site raises environmental concerns. This site is feasible based on the hydrological analysis. Further investigations are recommended based on the environmental concerns.

Basin No. 5: Beaver Brook - Meriden Lyonsville Road Basin

This basin site is located alongside Meriden Lyonsville Road on Beaver Brook, at the furthest point downstream in subarea 320. Upstream is subarea 315 and Splitrock Reservoir. The storage volume for this longitudinal basin can be maximized to provide enough stormwater attenuation to reduce the 100-year flow for year 2040 land use conditions from 1,182 cfs to 692 cfs.

Basin No. 6: Stony Brook - Upstream Deer Lake Basin

Located between Taylortown Reservoir and Deer Pond, this detention basin site is in the natural valley of Stony Brook within the Stony Brook Mountains. The storage volume can be maximized to reduce the 100-year flow for year 2040 land use conditions from 1,276 cfs to 576 cfs. This is 100% of the reduction required to match the existing 1986 flow of 574 cfs.

5.3.3 Limited Nonstructural Project

Non-structural alternatives for reducing flood damages to residential, industrial and commercial properties should be evaluated during the feasibility phase for the study area. Such alternatives would consist of voluntary floodproofing, raising-in-place, floodplain evacuation, and floodplain management measures.

Residential structures typically can be floodproofed to a height of three feet above the basement floor. If the design flood elevation exceeds three feet above the basement flood the structure would be examined to determine the economic and engineering feasibility of floodproofing the structure to higher elevations. Residential structures that cannot be floodproofed would then be evaluated for raising-in-place. If the design flood exceeds eight feet above the first floor, the structure should then be considered for permanent evacuation.

Commercial brick frame structures typically cannot be raised-in-place, but these structures can be floodproofed to a height of four feet above the first floor. If the design flood elevation exceeds four feet above the first floor, options may be limited to permanent evacuation.

5.4 Evaluation of Alternatives – Flood Control

5.4.1 1987 Feasibility Study & 1990 GDM Plans

Because the re-evaluation of the 1987 Feasibility Study Plans resulted in a negative assessment, it is not recommended that the plans be considered for further evaluation as stand-alone projects. However, the accommodation of Year 2040 flows – a major factor contributing to the assessment – were addressed by Morris County in its Upper Rockaway River Watershed Plan. As a result, it is probable that one or more the 1987 Feasibility Study and 1990 GDM alternatives would be justified if combined with the implementation of the Upper Rockaway River Watershed Plan. Discussion of the Upper Rockaway River Watershed Plan is provided below.

5.4.2 Upper Rockaway River Watershed Plan Regional Detention Basin System

The reduction and attenuation of peak flows provided by the potential detention basin sites being considered by Morris County is significant in most cases, as shown in the table below.

Point of Interest	25 Year Recurrence Frequency			50 Year Recurrence Frequency			100 Year Recurrence Frequency		
	Existing Cond	2040 Without	2040 With	Existing Cond	2040 Without	2040 With	Existing Cond	2040 Without	2040 With
31	1207	1859	1191	1506	1937	1527	1910	2396	1944
32	2395	3357	2555	2976	4030	3128	3741	4905	3908
33	2743	3816	3066	3404	4588	3671	4292	5593	4466
34	3194	4392	3518	3975	5285	4264	5000	6439	5250
35	3395	4594	3779	4200	5511	4554	5236	6708	5578
36	4944	6520	5318	6095	7806	6424	7591	9511	7872
37	5264	6866	5735	6494	8250	6940	8092	10058	8500
38	5137	6768	5658	6423	8164	6922	8050	9968	8507
39	5676	7459	6317	7115	9019	7766	8937	11018	9575
40	5687	7464	6329	7120	9024	7779	8947	11029	9598
41	5791	7587	6441	7257	9182	7924	9119	11221	9771
42	5642	7395	6341	7055	9024	7796	8934	11081	9701

After basin optimization, peak flows modeled for Year 2040 conditions at point of interest 31 were reduced to within two percent of existing conditions values for the 25, 50, and 100 year frequencies shown in the table. Percent increases for Year 2040 peak flows under with- and without-detention basin project conditions are shown below for points of interest 31 through 42.

	Percent Increase in Flow 25 Year Recurrence Frequency		Percent Increase in Flow 50 Year Recurrence Frequency		Percent Increase in Flow 100 Year Recurrence Frequency	
Point of Interest	2040 Without	2040 With	2040 Without	2040 With	2040 Without	2040 With
31	54%	-1%	29%	1%	25%	2%
32	40%	7%	35%	5%	31%	4%
33	39%	12%	35%	8%	30%	4%
34	38%	10%	33%	7%	29%	5%
35	35%	11%	31%	8%	28%	7%
36	32%	8%	28%	5%	25%	4%
37	30%	9%	27%	7%	24%	5%
38	32%	10%	27%	8%	24%	6%
39	31%	11%	27%	9%	23%	7%
40	31%	11%	27%	9%	23%	7%
41	31%	11%	27%	9%	23%	7%
42	31%	12%	28%	11%	24%	9%

The reduction in flow for existing conditions was estimated by applying the percent reduction in flow for with-project Year 2040 conditions at each point of interest and each recurrence frequency. Rating curves provided in the 1987 Feasibility Study were used to estimate the reduction in water surface elevation at each point of interest and recurrence frequency for existing and Year 2040 conditions. On average, the rating curves showed that the reduction in flow from existing conditions resulted in a 0.75 to 1.0 foot reduction in water surface elevations for each recurrence frequency presented in the Upper Rockaway River Watershed Plan.

Economic damage reaches defined in the 1987 Feasibility Study were matched as closely as possible to the twelve Points of Interest from the Upper Rockaway River Watershed Plan. Damages under improved conditions (with implementation of the watershed plan) were calculated for existing hydrology and expected future hydrology. Damages under without project conditions for both current and Year 2040 conditions were taken directly from the updated figures shown in the 1990 GDM.

Average annual equivalent damages (AAED) under without project conditions total approximately $5.9 million, while AAED under with project conditions total approximately $3.5 million, yielding average annual benefits of $2.4 million. Project first costs of the Upper Rockaway River Watershed Plan, including PED and LERRD total $16.6 million (average annual cost of $1.22 million). Annual operations and maintenance costs are expected to average $41,000 per year. Total average annual costs of the project are $1.3 million.

While this particular project does not completely eliminate damages in the base year, and becomes progressively less effective as it approaches Year 2040, it does yield a benefit to cost ratio of 1.85 and average annual net benefits of $1.1 million. At a minimum, this positive assessment provides an indication that alternatives consisting of LPPs from the 1987 Feasibility Study and the watershed plan would be economically justified. Further analysis to determine the

incremental costs and benefits of additional storage and other measures to reduce existing and future flood damages should be conducted to determine the optimal level of flood protection.

5.4.3 Limited Nonstructural Project

Basin-wide nonstructural plans previously analyzed (1990 GDM) were not economically justified. It is realized, however, that application of nonstructural measures to specific intermittent groups of structures in combination with a structural plan may be appropriate and should be investigated in the feasibility phase.

5.5 Alternative Plans – Environmental Restoration

Multiple opportunities exist for environmental restoration improvements throughout the Upper Rockaway River Basin. Wetland preservation and restoration in conjunction with land acquisition and construction of the detention basins will provide opportunities for fish and wildlife enhancement, water quality improvements and restoration of natural floodplain values. For the purposes of this reconnaissance study, one ecosystem restoration option has been formulated and is presented below for the Berkshire Valley Sand & Stone Company Site.

It is recommended that the Berkshire Valley Sand & Stone Company Site be restored by regrading the unstable slopes and re-creating natural wetland/floodplain hydrology in areas critical to water quality. A buffer of wetlands and native woodland is recommended for each side of the Upper Rockaway River and other key waterbodies on the property to aid in riparian habitat restoration and water quality protection. Yellow birch, eastern hemlock, American beech, eastern red cedar, native viburnums, silky and gray dogwood, chestnut oak, red maple, and a number of herbaceous wetland and upland grasses should be planted within these buffer areas. The buffer area could vary in width, height, and composition of species to create a natural wildlife habitat.

Revegetation of site areas most critical to water quality is recommended. Native species are most desirable since they provide quality habitat for native wildlife and ensure a self-sustaining landscape with minimal maintenance and future replacement requirements. Acquisition and restoration of the property would offer an ideal opportunity for replacing original wetlands damaged or destroyed on the site during past extraction operations and related activities.

6. FEDERAL INTEREST

The Upper Rockaway watershed qualifies for Federal flood protection interest under ER 1165-2-21 (drainage area at least 1.5 square miles, 10 year peak flows at least 800 cfs) based on hydrology of the CENAN Phase I General Design Memorandum Passaic River Basin, New Jersey and New York, 1990. In addition, flood damage reduction projects are defined as high priority outputs in the Administration's budget policy. Accordingly, the proposed flood damage reduction efforts identified during the expedited reconnaissance study are consistent with Federal law, regulation and policy. The preliminary analysis conducted during the reconnaissance phase

indicates that the monetary benefits of proposed flood damage reduction efforts will exceed project costs, and that they can be accomplished in a cost effective and efficient manner.

Ecosystem restoration projects are also defined as high priority outputs in the Administration's budget policy. Within the Civil Works program, priority is given to restoration projects which restore degraded ecosystem structures and functions, including the ecosystem's hydrology, plant and animal communities, to a less degraded condition. Accordingly, the proposed restoration efforts identified during the expedited reconnaissance study are consistent with Federal law, regulation and policy.

7. PRELIMINARY FINANCIAL ANALYSIS

The New Jersey Department of Environmental Protection (NJDEP) has indicated its willingness to serve as a local sponsor for the feasibility study. The NJDEP has indicated by letter of intent, dated 17 July 1998, that it understands the feasibility and construction cost sharing responsibilities and is willing to enter into negotiations for the feasibility phase of the investigation. A copy of the letter of intent is included as Attachment 1. The sponsor is aware that it will be responsible for all lands, easements, rights-of-way, relocations, and disposal areas for the project (LERRD). The non-Federal sponsor is also aware that it will be responsible for operating and maintaining the project at 100% non-Federal expense upon completion of construction.

8. RECOMMENDATIONS

It is recommended that this 905(b) Preliminary Analysis report be approved as a basis for developing the Project Study Plan (PSP), finalizing the Feasibility Cost Sharing Agreement (FCSA) with the non-Federal sponsor, and proceeding to the feasibility phase of the study. There are sufficient indications that an engineering solution to resolving the flood damage and ecosystem degradation problems can be formulated which will result in a project with monetary and non-monetary benefits in excess of project costs. This Section 905(b) Analysis is consistent with Army and budgetary policies and the project meets criteria for Federal participation in project implementation.

The feasibility study will employ a comprehensive watershed-based approach to developing plans for flood damage reduction throughout the Upper Rockaway River Basin, New Jersey, with an emphasis on structural solutions. The feasibility study is estimated to cost $1.24 million and is expected to be completed within 36 months of receipt of Federal and non-Federal funds.

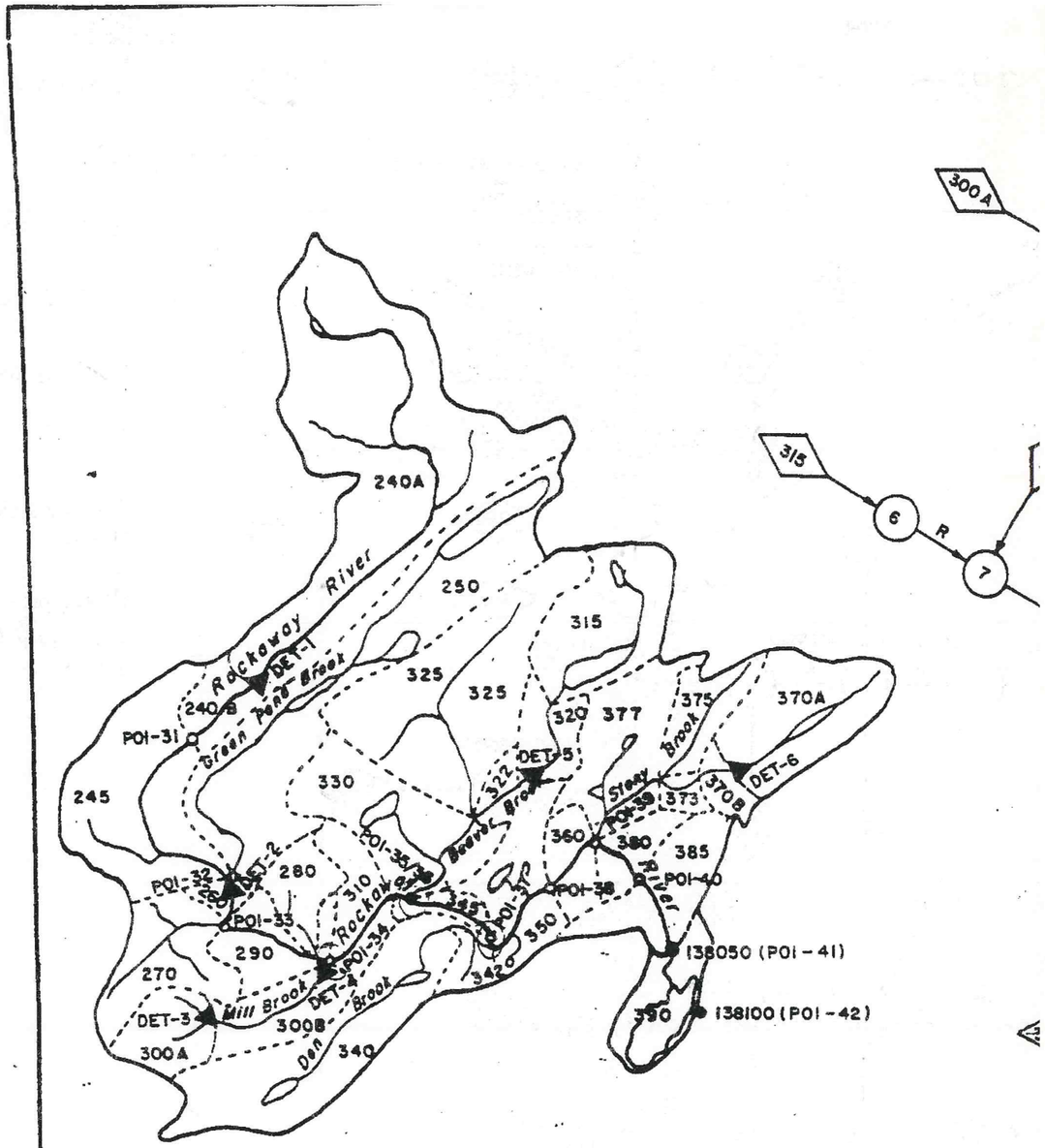
9. POTENTIAL ISSUES AFFECTING INITIATION OF FEASIBILITY PHASE

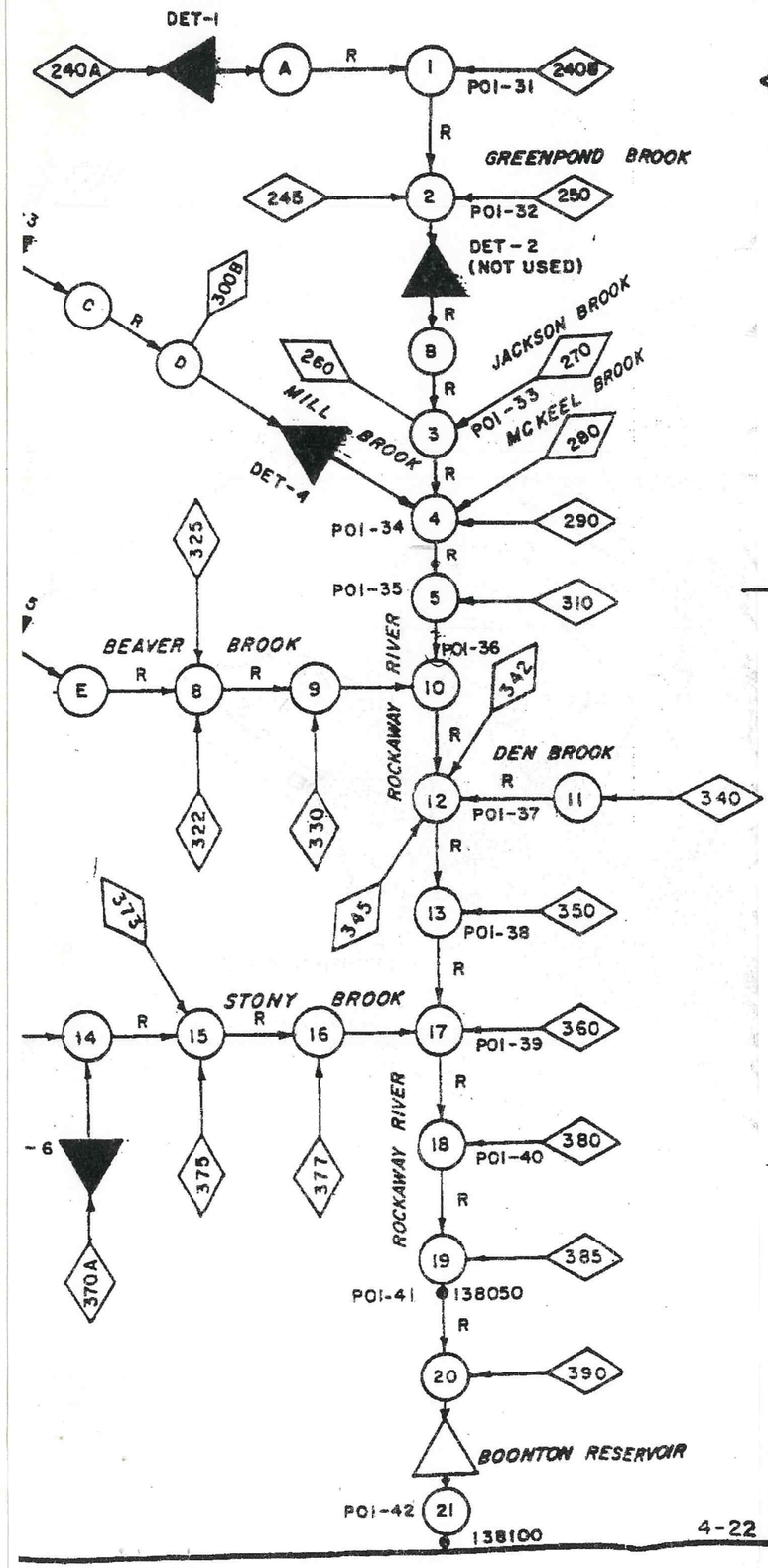
There are no known issues affecting the initiation of the feasibility phase. Preliminary discussions with the sponsor indicate no issues which would preclude signing the Feasibility Cost Sharing Agreement. The sponsor has indicated their willingness and capability to fulfill their commitments under the potential agreement.

10. PROJECT AREA MAP

Two project area maps have been included in prior sections of this document as Figures 1 and 2.

William H. Pearce
Colonel, Corps of Engineers
District Engineer





LEGEND

- Subbasin & No.
- Node
- U.S.G.S. Gage
- POI — Point of Interest
- R — Routing Reach
- Reservoir
- Proposed Detention Basin
- Inflow/ Outflow Hydrograph
- DET — Proposed Detention Basin No.

Figure 2: (Sort p 11)

Stormwater Management Plan
Morris County, New Jersey

UPPER ROCKAWAY RIVER
WATERSHED STUDY
RUNOFF MODEL
NETWORK DIAGRAM WITH
PROPOSED DETENTION BASINS