US Army Corps
of Engineers
New York District

Reconnaissance Report

Passaic River, Vicinity of Beatties Dam, New Jersey

Flood Control Study

August 1989

19 June 2009

A message from the scanner:

It should be noted that, in the copy of the report that was scanned:

Appendix B, section 3, "Foundations and Materials" was not completed; and

Appendix D, "Environmental Resources" was not completed.

It should also be noted that in appendix D, some pages were (1) apparently out of order and/ or missing, and (2) so light that they are difficult, and on some pages almost impossible to read.

The pages of the report were scanned in the order they were given to the scanner.

Thank you.

PASSAIC RIVER, VICINITY OF BEATTIES DAM
RECONNAISSANCE REPORT

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STUDY AUTHORITY

This study is authorized by Section 607 of the Water Resources Development Act of 1986 (P.L. 99-662), subject to Section 903(a) of this act (see Figure A1). Section 607 authorizes the Secretary of the Army to undertake a project for flood control for the Passaic River in the vicinity of Beatties Dam.

STUDY AREA

The Beatties Dam study area is located in the Passaic River Basin in northeastern New Jersey (see Figure A2). Beatties Dam is located on the Passaic River in the Townships of Little Falls and Wayne, Passaic County, New Jersey (see Figure A3). This masonry dam has a 267-foot long spillway with a 152-foot arched center section, a 55-foot straight section on the right, and a 60-foot straight section on the left (see Figure A4). The potential project area is 3.2 miles in length extending along the Passaic River from Beatties Dam to Two Bridges. It includes the municipalities of Totowa, Little Falls, Wayne, North Caldwell and Fairfield. However, in order to assess potential impacts to both downstream and upstream areas, the study area extends along the Passaic River from Dundee Dam upstream to Pine Brook, a distance of 28.3 miles.

PURPOSE

The purpose of this reconnaissance study is to determine if there is a Federal interest in participating with a local sponsor in a flood control project along the Passaic River in the vicinity of Beatties Dam.

SCOPE OF STUDY

The study consisted of technical analyses of the flood problem and potential solutions along the Passaic River in the vicinity of Beatties Dam. This included hydrologic, hydraulic, and preliminary structural analyses, foundation and material considerations, assessment of environmental effects, cost estimating and economic evaluation of alternative flood control plans. The study depended in part on information from existing sources, including the data base and technical models from the overall Passaic River Basin Study; general site inspections; field topographic surveys; review and evaluation of previous

reports, published maps, United States census reports, and other published data. Records of the United States Geological Survey and the United State Weather Bureau were utilized for climatological, hydrologic and hydraulic data. Flood losses, extent of flood area and other data concerning flood conditions for past floods were determined by field damage surveys, local officials, newspaper files for the area, and other published reports. Coordination was carried out with the State of New Jersey and study area municipalities.

REPORT AND STUDY PROCESS

Planning by the Corps of Engineers for any Federal Water Resources project is accomplished in two phases: a reconnaissance phase and a feasibility phase. The reconnaissance phase is conducted at full Federal expense, while the cost of the feasibility phase is shared equally between the Federal government and a non-Federal sponsor.

Reconnaissance Phase Overview.

The reconnaissance phase begins with the issuance of appropriated reconnaissance funds, and terminates with the execution of a Feasibility Cost sharing Agreement between the Department of the Army and a non-Federal sponsor. This phase determines the degree of Federal interest in the project, with a focus on obtaining the potential non-Federal sponsor's perception of the problem and opportunities; determining whether a potential solution will likely have Federal interest, including determining the nature of project benefits, and whether a project is economically justified (that is, with a benefit to cost ratio greater than the one) and identifies a non-Federal sponsor. To accomplish this, the following activities were necessary:

- To define the problems and opportunities within the study area;
- To identify suitable alternative flood control plans; to estimate project costs, benefits and other impacts in light of current conditions;
- To determine whether planning should proceed further into the feasibility phase, based on an appraisal of Federal interest;
- To develop a cost estimate and Scope of Services for the subsequent feasibility phase;
- To assess the non-Federal sponsor's support for the potential solution; and if a non-Federal sponsor can be found, to execute a formal agreement with the non-Federal sponsor for the cost sharing of the Scope of Services in the feasibility

study phase, including identifying those items to be accomplished by the non-Federal sponsor in the form of in-kind services.

This report contains a summary of investigations, results, conclusions and recommendations of the reconnaissance phase which was initiated in March, 1988.

Feasibility Phase Overview.

The second, or feasibility, phase would undertake more detailed examination of the preferred solutions along the Passaic River in the vicinity of Beatties Dam. The feasibility study, part of the feasibility phase, begins with the issuance of initial Federal funds, following the execution of a Federal Cost Sharing Agreement, and terminates with the completion of the feasibility report and issuance of the Division Engineer's public notice. The feasibility phase determines the appropriateness of Federal participation in the construction of a project. The objectives of the feasibility phase are to evaluate the specific engineering, environmental and economic effects of an array of plans; to identify the optimum project from both a Federal and non-Federal perspective; and to recommend a project for construction, if economically feasible and supported by non-Federal sponsors. The product of the feasibility phase will be a report, including the appropriate environmental documentation, for submission to the U.S. Congress for project authorization.

PRIOR STUDIES AND REPORTS BY THE CORPS OF ENGINEERS

Planning to solve the water and related land resources problems and needs in the Passaic River Basin has been wrought with controversy and indecision. U.S. Army Corps of Engineers' involvement in Passaic River planning was first authorized in the Flood Control Acts of 1936. In the 50 years since the Corps of Engineers was first directed to plan solutions to the Passaic Basin's flood problems, public opposition prevented the implementation of any of the six plans that were recommended in reports issued in 1939, 1948, 1962, 1969, 1972 and 1973. None of these plans was implemented because they did not receive widespread public support, with opposition based on the conflicting regional concerns of municipalities and various other interests throughout the Basin.

This strong opposition centered around the use of the upstream floodplain to protect downstream damage areas; extensive structural measures, including dams, levees and floodwalls; and the vast amounts of land required for implementation. Basically, these plans lacked public acceptability; and this opposition, based on environmental, economic and social factors was mounted by various Passaic Basin

interests, including government agencies, organizations and individuals. The multiple levels of political jurisdiction within the basin have further complicated the resolution of the myriad of issues surrounding flood control planning. As a result, the people of the Passaic River continue to be plagued by economic losses, hazards to health and safety, and the threat of injury and loss of life.

In 1976 Congress authorized a new Passaic River Basin Study, a Phase 1 Advanced Engineering and Design Study. Under this authority an interim study of the Main Stem Passaic River was completed in December 1987.

A sensitivity analysis of modifying Beatties Dam was performed as part of this Phase 1 study for the Main Stem Passaic River. From that analysis it was determined that modification of the dam would require careful evaluation due to the potential impacts to downstream communities and upstream wetland areas.

The uncertainty of balancing adverse effects to downstream communities and upstream wetland areas with the beneficial flood damage reduction impacts resulted in the feasibility and extent of Beatties Dam modifications being in doubt without detailed hydrologic and hydraulic study of these impacts. What was clear from this sensitivity analysis, however, was that the relatively limited flood protection afforded by this dam modification was not responsive to the objective of the main stem study of providing comprehensive basin-wide protection. Therefore, the Phase 1 report concluded that specific modifications in the vicinity of Beatties Dam are best considered further as a potential interim action in accordance with Section 607 of P.L. 99-662.

The basin-wide plan recommended in the feasibility report for the Main Stem Passaic River includes, as the central feature, a 13.5 mile long, 39-foot-diameter main tunnel to carry floodwaters from an inlet at the upper end of the Pompton River in Wayne to its outlet, on the west bank of the Passaic River, just above its confluence with the Third River. A 1.2 mile-long, 22-foot diameter spur tunnel will convey Central Basin area floodwaters from an inlet just below Two Bridges on the Passaic River, to an underground connection with the main diversion tunnel. Some 5.9 miles of channel modifications will be required to direct the flows into the inlet, and the diversion tunnels will be augmented by some 37.3 miles of levees and floodwalls.

In addition to these structural components, a major nonstructural component of the Main Stem Passaic River recommended plan is the Preservation of Natural Storage Areas. This element will preserve 5,350 acres of natural floodplain storage in the Central Basin, including 5,200 acres of wetlands

which would otherwise be lost to development without the project and worsen the flooding problem in the future.

The State of New Jersey, through its Department of Environmental Protection, is the non-Federal sponsor for this basin-wide project known as the Main Stem Passaic River Flood Control Tunnel Plan.

The feasibility report for the Main Stem Passaic River is currently undergoing Washington level review, and on February 3, 1989, the Chief of Engineers issued a report to the Assistant Secretary of the Army (ASA). The ASA will request that the Office of Management and Budget review the project, after which it will be submitted to Congress for authorization. Preconstruction Engineering and Design activities for the recommended plan were initiated in Fiscal Year 1989 and are ongoing.

It is noted that the recommended Tunnel Plan would provide flood protection to the area now being investigated as part of this Beatties Dam Study. The relationship of a Beatties Dam project to the Main Stem Passaic River Tunnel Plan is documented later in this appendix.

The Beatties Dam study is technically and geographically linked to the Passaic River and Tributaries channel clearing project which was also authorized in Section 607 of P.L. 99-662. An Intermediate Planning Stage Report which documented the feasibility of channel clearing measures along the Passaic River and tributaries was completed by the New York District in February 1987. Channel Clearing alternatives were approved by the North Atlantic Division in March 1987 as a partial solution interim to a basin-wide flood problem.

The channel clearing alternatives would provide limited flood protection to the areas under consideration in this Beatties Dam Study. The analysis of a Beatties Dam project was not included in the Channel Clearing Study since, at the time, no funds had been appropriated for that effort. Subsequently, by letter dated November 9, 1987, the State of New Jersey, through its Department of Environmental Protection (NJDEP) requested that the Channel Clearing Study be combined with a Beatties Dam study which would also address the relationship to the Main Stem Passaic River Tunnel Plan. However, through separate action the Congress elected to add the Beatties Dam Reconnaissance Study to the Corps FY88 program as part of the Corps two-phase planning process, rather than incorporate it into the existing Passaic River Phase I investigation in which the channel clearing study had already been incorporated by prior actions. The implications of this differentiation go beyond just a separate study, since the Passaic Phase I study is currently in a totally Federally funded legislative Phase I GDM study stemming from the 1976 WRDA, while the Beatties Dam

Reconnaissance study is the first step of a potential cost-shared feasibility study stemming from the 1986 WRDA.

From a technical standpoint the results of the Beatties Dam study may affect the plan formulation and results of the Channel Clearing study since the hydraulic conditions at the vicinity of Beatties Dam will control flood stages upstream in the Channel Clearing study area. As a result, the Channel Clearing Study has been temporarily suspended pending the outcome of this Beatties Dam Reconnaissance Study. The flood control plans developed in this study will be evaluated independently of the channel clearing alternatives. If a flood control project in the vicinity of Beatties Dam is determined to be in the Federal interest then the feasibility phase of this study would be combined with the Channel Clearing Study. If a Beatties Dam project is not warranted, then the separate Channel Clearing Feasibility Study would resume.

A Phase 1 Inspection Report, as part of the National Dam Safety Program, was prepared for Beatties Dam by the Corps of Engineers in August 1981. Beatties Dam was classified as a significant hazard potential structure. It was determined to be in fair overall condition. The dam's spillway was considered to be inadequate since a flow equivalent to 30% of the Spillway Design Flood (which is one-half of the Probable Maximum Flood) would cause the dam to be overtopped.

PRIOR STUDIES AND REPORTS BY OTHERS

Several hundred reports on the development of water resources in the Passaic River Basin have been completed. These reports date back to Colonial times when the main emphasis of the studies was for irrigation of the Central Basin, and flood protection and navigation in the Lower Passaic River. The most comprehensive of these reports, published in 1931 by the New Jersey State Water Policy Commission, considered several alternative plans and made an inventory of the total flood control benefits which might be delivered within the Passaic River Basin from each plan.

More recently, a study of Beatties Dam was completed in April 1974 by Lee T. Purcell Associates for the Township of Wayne. That study concluded "that the existence of Beatties Dam plays a minor part in the circumstances that create inundation of the low-lying areas along the Passaic River within Wayne during heavy rains." The inadequate capacity of the river channel was determined to be the principal factor for the inundation of the low-lying areas.

PROBLEM IDENTIFICATION

The citizens of the potential project area have experienced recent and frequently occurring flood related economic losses to

property, hazards to health, and loss of life. The Basin's geographic location in the East Coast stormbelt, its hydrologic conditions and the extensive development in the floodplain all play a role in this susceptibility to flood damages. The 1903 flood is the Flood of Record for most of the Passaic Basin. The recurrence of the October 1903 flood would cause damages of $189.7 million along the Passaic River between Beatties Dam and Two Bridges (October 1988 price level). The Basin also experienced serious flooding in 1810, 1819, 1882, 1902, 1917, 1936, 1938, 1945, 1968, 1971, 1972, 1973, in July and September 1975, in March and April 1983, and in April 1984, when portions of the Passaic Basin were declared Federal Disaster Areas. The estimated average annual flood damages throughout the Basin total more than $86 million (October 1988 price level), of which $6.6 million occurs along the Passaic River between Beatties Dam and Two Bridges.

It is stressed that aside from these severe flood instances, the potential project area also experiences less severe flooding and related damages, but at frequencies as high as several times per year. The damages at stage associated with the 2 year flood event in the potential project area total $1.5 million while a 10 year flood would cause damages of $8.4 million.

MOST PROBABLE FUTURE CONDITIONS

Without the implementation of the flood control project along the Passaic River in the vicinity of Beatties Dam, there are four possible future scenarios. One scenario involves little change from existing conditions, another is construction of a Beatties Dam project by non-Federal interests, another includes construction of the Passaic River Main Stem Tunnel Plan and the last is construction of a Channel Clearing project.

FUTURE SCENARIO WITHOUT PROJECT

Without a Federal or non-Federal project (Beatties Dam, Tunnel, or Channel Clearing) in place, the future of the study area is expected to change very little from existing conditions and current trends as detailed in the various technical appendices to this report.

Without flood control, public health in the project area will continue to be at risk every time a flood occurs. Floodwater spilling over the Passaic's banks would be laden with disease carrying organisms from combined sewer overflows and septic systems upstream. This polluted floodwater enters living areas and basements in homes and commercial structures, and working areas and parking lots in commercial and industrial establishments.

The flood related economic losses will also continue into the future, affecting residences, commercial establishments and industries. Depending on the depth and duration of the floods, major highways and commuter railways may also become flooded

causing regional work stoppages, disruption and economic losses. The average annual equivalent damages in the potential project area are million (October 1988 price levels). The most probable outlook for the Passaic River in the vicinity of Beatties Dam without a Federal flood control project is maintenance of the existing trends into the future.

FUTURE SCENARIO WITH A NON-FEDERAL BEATTIES DAM PROJECT

Over the years there have been a number of efforts on the part of the New Jersey Legislature to implement a flood control project at Beatties Dam. As recently as September 1988, the New Jersey Assembly passed legislation that would appropriate $5 million to reconstruct the dam using floodgates along with removal of the rock ledge upstream of the dam. A non-Federal flood control project involving modification of Beatties Dam would alleviate the need for such a Federal project.

FUTURE SCENARIO WITH A FLOOD CONTROL TUNNEL PLAN

Within the Beatties Dam study area, construction of the Main Stem Passaic River Flood Control Tunnel Plan includes a tunnel inlet on the Passaic River about 500 feet upstream of the Route I-80 bridge in Wayne. In addition channel modification would be required along the Passaic River from the Route I-80 Bridge upstream for a distance of 0.8 miles. The tunnel inlet area would eliminate approximately five acres of forested wetlands which would be mitigated for on project lands elsewhere in the basin.

As discussed later in this appendix under RELATION TO MAIN STEM PLAN, the elements of the tunnel plan which would protect the Beatties Dam study area could be operational by FY 1997. The Main Stem Tunnel Plan would provide a 100 year level of protection along the Passaic River between Beatties Dam and Two Bridges and expected annual damages would be reduced by 96%. Residential, commercial and industrial structures would be protected against flooding. Firms would be less apt to leave the area if they are no longer subjected to flooding. This should, in turn, be reflected in a more stable job market both in the study area and the region. The commuter and industrial transportation systems would not be subjected to the interruptions and delays that occur now during floods.

The community cohesion, health and well-being of residents would be expected to improve with the Main Stem Passaic River Tunnel Plan in place. The diversion of floodwaters would keep iving and working in these areas, lessen emergency demands on

contamination from threatening the health of the population lthe police and fire departments during storms and floods and, in general, promote the public well-being.

FUTURE SCENARIO WITH A CHANNEL CLEARING PROJECT

Each of the alternatives investigated as part of the Channel Clearing Study would provide limited protection along the Passaic River between Beatties Dam and Two Bridges. The channel clearing alternatives would reduce expected annual damages in this area by approximately 12%. A channel clearing project could be implemented by FY 1996.

PROBLEMS AND OPPORTUNITIES

Problem and opportunity statements are expressions of public and professional concerns about the use of water and related land resources in a particular study area. These problem and opportunity statements result from analyses of existing and future conditions within the context of the physical, environmental, economic, and social characteristics of the study area. They are used to guide the formulation of alternative plans, and to evaluate the effectiveness of the plans. The problems and opportunities provided the basis for plan formulation. They primarily address the serious and frequent flood control problem and other associated needs, such as the the maintenance of fish and wildlife resources in the flood problem area.

A review of the damage history of the study area indicates that flood damages are both significant and chronic. However, as mandated by law the flood control measures are limited to the vicinity of Beatties Dam. Given the nature of the flood problem, and the geographical and physical constraints of the area the scope of improvements are expected to be limited in both the level of protection and extent of area protected.

The objectives addressing environmental needs are being directed at maintaining the existing stream resources. Another significant environmental problem and opportunity includes the preservation of historical sites.

Water quality problems are considered under the program of other Federal, State and local governmental agencies and are not treated in this study, except for the opportunities created by water resource development plans such as the prevention of further degradation of water quality through sediment control.

Since the primary measures which will be considered are limited to modification of Beatties Dam and removal of a channel constriction there is no apparent opportunity to incorporate separable recreation features into the local protection works.

Preservation of any existing opportunities is appropriate, however.

The development of new water supply sources within the subject basin is not being considered as a problem or opportunity as part of this Beatties Dam study, since the opportunity to develop additional supplies in conjunction with local protection is non-existent. However, the maintenance of existing water supply sources is a planning objective in developing flood damage reduction alternatives including modification of existing structures within the study area.

The problem and opportunity statements developed for the study area are as follows:

a. Reduction of the flood hazard and associated urban flood damages resulting from frequent, less severe events along the Passaic River from Beatties Dam to Two Bridges.

b. Minimize adverse impacts to downstream areas.

c. Maintain the fish and wildlife resources of the existing stream environment.

d. Maintain existing open space areas and recreational opportunities in the study area.

e. Maintain the historical and cultural attributes of any site discovered within potential project boundaries that has the potential to be included on the National or State Register of Historic Places.

f. Maintain existing utilization of the area for water supply.

g. Maintain potential of the area for hydroelectric purposes.

PLANNING CONSTRAINTS

The planning approach used in this study is based on guidelines as set forth in Congressional and Corps of Engineers directives that give definitive direction to the Federal participation in planning water and related land resources. Water and related land resources project plans are to be formulated to alleviate problems and take advantage of opportunities in ways that contribute to national economic development (NED) consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. This objective was established by the U.S. Water Resources Council's Economic and Environmental Principles and

Guidelines for Water and Related Land Resources Implementation Studies published on 10 March 1983. Contributions to NED are the direct net benefits, expressed in monetary units (i.e., benefits exceed costs), that accrue in the study area and the rest of the nation.

The problem and opportunity statements listed above reflect certain concerns which are not necessarily directly related to the NED objective but are so important that they impose constraints on the planning process. The primary planning constraint in this study was the potential for transferring the flood problem to communities downstream of Beatties Dam. Other considerations included the environmental quality, which accounts for the non-monetary effects of a plan on the ecological, cultural, and aesthetic attributes of significant natural and cultural resources, and social effects which account for variables such as health and safety. Under the future scenario with the Main Stem Tunnel Plan another major constraint is timing, in that benefits would only be accrued to a Beatties Dam project if it is operational prior to the tunnel plan.

Each alternative plan, as directed by the Principles and Guidelines, was formulated in consideration of four criteria including completeness, effectiveness, efficiency, and acceptability.

NO ACTION PLAN - MAINTAIN BASE CONDITION

The No Action plan represents the base or without-conditions from which all changes are measured. As described previously, the most probable future condition without a Federal or non-Federal project in place would be a continuation of the existing trends.

No additional nonstructural or structural measures would be utilized to alleviate the flood problem. Average annual equivalent flood damages in the potential project area would total $ million. The affected communities would continue to rely on emergency and temporary evacuation measures, floodplain regulations as required under Federal, State and local law and flood insurance available under Federally administered programs. All of the communities in the potential project area are currently enrolled in the National Flood Insurance Program.

PLAN FORMULATION APPROACH

The flood control alternatives developed in this study focused on modifying the existing Beatties Dam and eliminating an upstream channel constriction. This is in accordance with

the authorizing legislation in Section 607 of P.L. 99-662, entitled Passaic River Channel Clearing, which specified a flood control project in the vicinity of Beatties Dam, and the desire of local interests that gates be installed on Beatties Dam so that they can be operated during flood events to prevent backwater flooding conditions. No consideration was given to other measures, such as nonstructural measures and snagging and clearing, since these were previously considered in the Channel Clearing Feasibility Report for the Passaic River and Tributaries or as part of the Main Stem Passaic River Feasibility Report.

The primary objective was to provide flood control to the communities upstream of the dam while minimizing potential adverse effects to downstream damage areas and upstream environmental areas. Due to the complex hydrologic and hydraulic characteristics of the flood problem in the study area, much effort was expended in formulating and developing alternative plans which would minimize downstream impacts as much as possible. The incremental effects of Beatties Dam and the channel constriction on flooding was evaluated. As part of both the Channel Clearing Study and the Main Stem Passaic River Study it was determined that channel regrading by itself would result in only minimal reductions in water surface elevations. Therefore, as part of this study, no further consideration was given to this as an independent measure. To provide even limited flood protection, it was determined that replacement of either the entire existing dam, or large sections thereof, with gated structures would be required. Plan 1, below, documents the effects of total removal and replacement of the dam. This plan demonstrated that dam modification by itself would provide significant reductions in water surface elevations for only a short distance upstream (within the first quarter mile). Next it was determined that to provide additional flood reductions both dam and channel modifications are necessary. The limited extent of the channel modification is such that it results in additional flood protection while minimizing downstream impacts. More extensive channel excavation would result in eliminating the flow reversal that occurs at the confluence of the Pompton and Passaic Rivers, thereby greatly increasing flows into the Lower Valley, resulting in significant induced flood damages.

Four alternative dam and channel modification plans were formulated as part of this reconnaissance study. None is economically feasible. The plans are described in the following paragraphs while their physical features are summarized in Table A1.

PLANS OF PROTECTION

PLAN 1

The major element of Plan 1 is dam modification. The existing Beatties Dam would be removed and replaced by a series of three gated structures. There would be two 8.3 feet high, 50-feet wide bascule gates and one 8.3 feet high, 138-feet wide bascule gate. The spillway elevation would remain at 158.3 NGVD, the same as existing conditions. Plan 1 is depicted in Figure A5.

During non-flood conditions, the gates would be in the up (vertical) position in order to maintain normal water surface elevations. During flood conditions the gates would be gradually lowered to allow the flood flows to pass downstream.

As part of the dam modification, excavation of rock from the channel bottom would be required for a distance of 50 feet downstream of the dam to reduce backwater effects. Plan 1 would take 2 years to construct. It has an estimated first cost of $33,904,000 and a total investment cost of $38,552,000 which includes the cost for mitigationg adverse environmental impacts and induced damages. These mitigation features are described under ALTERNATIVE PLAN EFFECTS AND EVALUATION.

PLAN 2

Plan 2 consists of dam modification combined with channel modification upstream of the dam. The dam modification is the same as that described in Plan 1, the complete removal and replacement of the dam with gated structures (Figure A5).

The channel modification on the Passaic River involves removal of a channel constriction formed by a natural narrow rock gorge. The channel modification would extend from a point 50 feet downstream of the dam upstream for a distance of approximately 4,670 feet. The initial 1,480 feet consists of rock excavation, while the remainder involves sediment removal. The channel would be deepened a maximum of 4 feet. The reshaped channel would have a base width of 200 feet and side slopes of 2 horizontal:1 vertical. Figure A6 illustrates the channel modification element.

Plan 2, having an estimated first cost of $53,986,000 would be constructed in 2 years. The investment cost totals $61,386,000. These costs include mitigation measures for adverse environmental impacts and induced damages.

PLAN 3

Plan 3 consists of dam modification combined with channel modification. The dam modification consists of replacement of approximately 200 feet of the dam with two gated structures, each 8.3 feet high and 95 feet wide (see Figure A7). The bascule gates would be operated only during flood conditions as described in Plan 1. The channel modification is the same as that described in Plan 2 (Figure A6). The construction duration of Plan 3 would be 2 years. It has an estimated first cost of $52,585,000 and a total investment cost of $59,793,000 which includes mitigation measures.

PLAN 4

Plan 4 also consists of dam modification combined with channel modification. The dam modification includes the replacement of a portion of the dam with a gated structure, 8.3 feet high and 100 feet wide (see Figure A8). The gate operation is the same as that described in Plan 2. The channel modification is the same as in Plans 2 and 3 (see Figure A6). Plan 4 would be constructed in 1 year at a first cost of $49,656,000. The investment cost totals $55,126,000. These costs also include mitigation for adverse impacts.

ALTERNATIVE PLAN EFFECTS AND EVALUATION

Impact assessment and evaluation studies were conducted to identify, measure and compare the significant effects of the considered plans of protection. The plan effects are detailed in the appropriate report appendices and are summarized below.

Flood Protection. All the modifications investigated would reduce upstream water surface elevations, with total replacement of Beatties Dam in conjunction with channel modification (Plan 2) resulting in the greatest reductions (see Table A2). For each of the alternatives, the level of protection is greatest at the immediate vicinity of the dam, diminshing rapidly proceeding upstream. For Plan 2, the alternative which produces the maximum reduction in flood stages, the level of protection varies from a 100 year event at the dam, to a 3 year event at Two Bridges, resulting in a weighted average level of protection, based on proportion of damages in each reach, of approximately 9 years for the Beatties Dam study area. Plan 3 would be the next most effective, followed by Plan 4, and then Plan 1. Table A3 provides the level of protection by economic damage reach for each alternative.

Downstream Effects. The nature of the measures considered and the constraints of the geographic and physical situation of the study area limit the possible levels of protection provided by any of these plans to relatively low levels. In addition, an

objective of the plans developed was to minimize downstream effects. However, even for such relatively small hydrologic increases, the potential for induced flood damage is significant especially when viewed in light of the comparable benefits provided by a Beatties Dam project. Hydrologic studies have confirmed that the impacts on downstream peak discharges resulting from the implementation of the Beatties Dam alternatives would be small.

For Plan 2, the increase in peak discharges at Beatties Dam would be less than 3% for all frequencies. For the remaining alternatives, the increase in downstream peak discharges would be similar. The increase in downstream peak discharges, although small, results in measurable increases in stage. This causes induced flood damages in the Lower Valley from Beatties Dam downstream to Dundee Dam, totalling $1.3 million. The magnitude of the induced damages is significant compared to the flood control benefits provided. Without mitigation of these induced damages the proposed plans would not be implementable due to lack of public support.

Therefore, measures to mitigate these damages were considered. Preliminary mitigation consists of minor channel work (up to 1 foot excavation) throughout the affected reach in order to return the water surface elevations to their existing levels. The estimated construction cost of this 11.0 mile channel is $22 million which alone exceeds the authorized cost of a Beatties Dam project. Levee/floodwalls were eliminated from consideration as a mitigation measure because they would be more expensive than the channel work and they would have a more adverse impact on the affected communities. Modification of S.U.M and Dundee Dams as a mitigation measure was also considered but determined to be more expensive than the channel cost. Additional studies would be required in the feasibility phase in order to refine the selected mitigation measure and associated cost.

Environmental Effects. Environmental effects of the proposed alternatives consist of loss of aquatic and terrestrial habitat, including loss of wetlands in the Great Piece Meadows and adverse cultural impacts to Beatties Dam. In order to minimize the adverse environmental effects of the Beatties Dam alternatives, preliminary mitigation measures are included in each plan.

To mitigate for the adverse aquatic effects of Plans 2, 3 and 4, the modified channel would include scour holes or rolling bottom contours to provide cover for fishes.

To mitigate for adverse effects to wetlands resulting from reductions in the 1 year flood stage, each of the alternative plans includes a low weir structure to maintain wetlands in the

Great Piece Meadows. This weir, which is essentially the same as that proposed as part of the Main Stem Passaic River Tunnel Plan, would be placed across the Passaic River at the downstream terminus of the Meadows. This weir would be in the down position at all times except when it is deemed desirable to flood the 1 year floodplain to preserve wetlands for the protection of fish and wildlife resources.

Mitigation for adverse effects to wetlands downstream of the weir would consist of either upgrading wetlands on a 2:1 ratio or intensively managing the affected wetlands to reproduce their existing characteristics.

A mitigation treatment plan for the culturally significant Beatties Dam would be developed in coordination with the State Historic Preservation Officer. This could consist of documentation of the dam and hydroelectric facility. If any prehistoric sites, such as a fish weir, are discovered in the project area, they could be mitigated through documentation, partial preservation or reconstruction.

There would be no adverse impacts to water supply in the study area. Neither the Passaic Valley Water Commission's intake at Beatties Dam nor the North Jersey District Water Supply Commission's pumping plant at Two Bridges would be affected by the alternative plans.

Design Criteria. The alternatives developed in this reconnaissance study assume the existing dam and abutments are structurally stable, resulting in costs that are optimistic given the conditions described in the Dam Safety Report. In a worst case scenario, for Plans 3 and 4, the entire dam would have to be replaced and these alternatives would then revert to Plan 2, which as designed, would safely pass about 90% of the SPF. Even then, additional studies would be required to ensure the proposed dam modification meets Corps criteria regarding stability due to subsurface conditions and hydraulic design, the identification of the objective of the spillway, the selection of a proper security standard, the determination of and routing of the spillway design flood and the design of freeboard. Consideration of these factors would likely result in an increase in the construction cost.

Economic Evaluation. The economic data (i.e., costs and benefits) for the considered plans of protection are presented in Table A4. The data reflects October 1988 price levels, a 100 year project life and an 8-7/8% discount rate. None of the alternative plans is economically justified. The authorized cost of a flood control project in the vicinity of Beatties Dam is $20 million. The construction costs of the plans are such that they all exceed the authorized cost limit.

RELATIONSHIP TO MAIN STEM PASSAIC RIVER TUNNEL PLAN

An analysis was made to determine the sensitivity of Beatties Dam formulation and design decisions to the recommended basin-wide plan for the main stem Passaic River. This plan, known as the Main Stem Passaic River Tunnel Plan, was described previously under "PRIOR STUDIES AND REPORTS BY THE CORPS OF ENGINEERS."

It is recognized that the proposed Beatties Dam plans only provide protection against frequent, nuisance type flooding for a limited portion of the Passaic River Basin. However, such improvements fulfill the objective of providing a measure of relief until the implementation of a more comprehensive solution such as the tunnel plan, which would provide protection to an extensive area against floods up to the 500 year event. A sensitivity analysis was accomplished by assessing the proposed Beatties Dam alternatives with implementation of the tunnel plan.

As an interim solution, Beatties Dam project could provide protection against frequent flooding during the time period until construction of those elements of the Tunnel Plan which would protect the area under investigation in this study are completed. Benefits would be accrued only up to the estimated time of implementation of the tunnel plan; therefore, the without project condition would not change measurably, nor would the potential benefit pool available to the more permanent solution be impacted. It is noted that some elements of a Beatties Dam project may be compatible with features of the tunnel plan. For instance, fish and wildlife mitigation of adverse effects on the Great Piece Meadows would be compatible. Conversely, Beatties Dam Plans 2, 3 and 4 would require changes in the design of the tunnel plan, since they include excavation of the rock ledge which is the hydraulic control for the Passaic River tunnel inlet. Redesign of the tunnel inlet or inclusion of a flow restrictor may be necessary. This would be an added cost attributable to the Beatties Dam alternatives.

Based upon the design and construction schedule approved as part of the Main Stem Passaic River Feasibility Study, it would take 9 years after initiation of preconstruction engineering and design activities to complete the elements of the tunnel plan that would protect the Beatties Dam area. With the PED effort for the Main Stem project initiated in October FY88, these elements could be in operation in FY 1997 (Figure A9).

Based upon a planning, design and construction schedule for a Beatties Dam project, it would take an average of 8 years after completion of the reconnaissance phase for such a plan to be operational. With the reconnaissance phase scheduled to be completed late in FY89, the earliest reasonable time that the

Beatties Dam project could become operational is also estimated to occur in FY 1997 (Figure A10). Under this scenario, there would be no benefits associated with a Beatties Dam project.

Given the uncertainty of timely budget appropriations and Congressional authorization, the above schedules are subject to change. However, given that the Beatties Dam alternatives are not economically feasible based upon a 100 year project life, utilizing a shorter timeframe to reflect the operation of a Beatties Dam project as an interim solution until the tunnel plan is functional would only result in these alternatives being even less economically feasible.

Table A5 presents a sensitivity analysis of the economic feasibility of the Beatties Dam alternatives to the implementation of the Main Stem Passaic River Tunnel Plan. This was accomplished by determining the justification of the propsed Beatties Dam plans using both a 100 year project life (without implementation of the tunnel plan) and a 10 year project life (optimistic evaluation with implementation of the tunnel plan). In this analysis, it is recognized that the expected annual benefits based on a 10-year project life are equal to those based on a 100 year life. It is noted, however, that while the determination of the certainty of benefits is consistent with the evaluation framework prescribed for flood damage reduction studies, it does not reflect a theoretical framework based on the application of statistically rigorous probability distributions. The probabilistic likelihood of flood events occurring in any given year and the uncertainty of capturing expected annual benefits over a 10 year period versus a 100 year project life is recognized. Although not quantified, the added cost to Plans 2, 3 and 4 to account for changes in the Tunnel Plan would also detract from their economic feasibility. The results of this analysis indicate that the proposed plans are not justified when evaluated optimistically, using either a 100 year or 10 year project life. A Beatties Dam project is, therefore, not warranted as either an interim project or as a long-term solution.

COORDINATION AND PERTINENT CORRESPONDENCE

Upon review of the Channel Clearing Feasibility Report of the Passaic River and Tributaries in November 1987, the State of New Jersey requested that further investigations be combined with a study of modifying Beatties Dam (see Attachment 1).

By letter dated 3 May 1988 (Attachment 2), the Corps informed the State of New Jersey that funds to initiate the Beatties Dam study had been received and transmitted a summary of the revised non-Federal cost-sharing responsibilities. The State of New Jersey was requested to act as the non-Federal sponsor for this project. In response (Attachment 3), the

Commissioner of the New Jersey Department of Environmental Protection indicated that his agency would coordinate with the Corps during the conduct of the reconnaissance study but a decision on non-Federal sponsorship would be deferred until after they reviewed the completed reconnaissance report. As part of the reconnaissance study, NJDEP requested that evaluations be made of induced downstream flooding; environmental effects; and the relation to the Main Stem Passaic River Tunnel Plan, including the feasibility of a Beatties Dam project as interim flood protection until the tunnel plan is operational. As the potential non-Federal sponsor, periodic meetings were held with NJDEP representatives to discuss study progress.

A multiple letter was sent in January 1989 (Attachment 4) to municipalities, counties, State legislators and Congressman in the study area informing them of the study and to request their perception of the problems and opportunities as well as any issues that would affect the acceptability of a solution.

Two municipalities responded to this request - Totowa and Lincoln Park. The Borough of Totowa expressed their objection to a Beatties Dam project based on concerns regarding induced downstream flood damages (Attachment 5). The Borough of Lincoln Park is interested in a Beatties Dam project, particularly if removal of the upstream channel constriction would result in flood protection for their municipality (Attachment 6).

By letter dated February 3, 1989 (Attachment 7), Assemblyman Gerald Zecker, representing Passaic and Essex Counties, indicated that a Beatties Dam project would be a way to provide interim flood protection until a long-term solution is constructed. However, he also noted several factors which could lead to opposition to a Beatties Dam project.

Coordination was also carried out with the U.S. Fish and Wildlife Service, the New Jersey State Historic Preservation Officer and the Passaic Valley Water Commission to assess plan effects.

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

The examination of a flood control project on the Passaic River, in the vicinity of Beatties Dam, New Jersey was conducted in a reconnaissance phase, the first step in the planning process. The main purposes of the reconnaissance phase were to define the magnitude of the problems in the study area, to determine if there is an economically feasible solution, to determine if there are Federal and non-Federal interests in developing a solution, and to prepare a work plan and cost estimate for the proposed feasibility phase if such interest exists.

The finding of the reconnaissance study indicate the following:

o The potential project area has a long history of significant flooding. The area is also subject to more frequent, less severe flooding. Expected annual damages are estimated at $6.6 million.

o To provide meaningful though localized flood protection the replacement of the entire dam, or large sections, with gated structures in conjunction with upstream channel modification would be required.

o Costly mitigation measures are required as part of each alternative in order to protect against significant induced flood damages to downstream communities.

o The alternative plans would cause significant adverse environmental impacts, resulting in the need for costly mitigation measures.

o There are no economically feasible flood control solutions for the Passaic River involving the modification of Beatties Dam even when evaluated under the most optimistic conditions.

On the basis of these findings, Federal interest in a flood control project on the Passaic River in the vicinity of Beatties Dam is not warranted. It is, therefore, recommended that further detailed study in the form of a feasibility report should not be undertaken.

R. M. DANIELSON
Colonel, Corps of Engineers
District Engineer

TABLE A1
SUMMARY OF PHYSICAL FEATURES OF PLANS

DAM MODIFICATION (Gated Structures)

	Gate Type	Number of Gates	Width (feet)	Height (feet)	CHANNEL MODIFICATION Rock (Length in feet)	CHANNEL MODIFICATION Sediment (Length in feet)
PLAN 1	Bascule	2	50	8.3	50	
	Bascule	1	138	8.3		
PLAN 2	Bascule	2	50	8.3	1480	3190
	Bascule	1	138	8.3		
PLAN 3	Bascule	2	95	8.3	1480	3190
PLAN 4	Bascule	1	100	8.3	1480	3190

TABLE A2

HYDRAULIC EFFECTS OF ALTERNATIVE PLANS

ELEVATION REDUCTION (FT.) UPSTREAM OF BEATTIES DAM

FLOOD EVENT	STA 1568+65 Beatties Dam	STA 1573+10	STA 1599+00	STA1660+70	1700+90	1740+60 Two Bridges
Distance Upstream of Beatties Dam(ft)	445		3,035	9,205	13,225	17,195
Plan 1 - Replace Entire Beatties Dam/Existing Channel						
1 year	7.4	2.7	1.7	0.9	0.8	0.7
10	6.9	2.4	1.4	0.7	0.8	0.6
50	6.2	2.4	1.4	0.8	0.8	0.4
100	5.9	2.4	1.4	0.8	0.7	0.4
500	4.8	2.7	1.5	0.7	0.6	0.4
Plan 2 - Replace Entire Beatties Dam/Modify Channel						
1	7.4	6.5	4.9	2.7	1.5	0.9
10	6.9	6.1	4.5	2.2	1.5	0.9
50	6.1	5.6	4.2	2.2	1.4	1.0
100	5.7	5.3	4.1	2.2	1.4	0.5
500	4.1	4.0	3.2	1.5	1.1	0.7
Plan 3 - Replace 200 feet of Beatties Dam/Modify Channel						
1 year	6.8	6.2	4.9	2.7	1.5	0.9
10	5.8	5.4	4.2	2.2	1.5	0.9
50	5.0	4.7	3.8	2.1	1.4	1.0
100	4.7	4.5	3.7	2.1	1.4	0.5
500	3.7	3.4	3.0	1.4	1.1	0.6
Plan 4 - Replace 100 feet of Beatties Dam/Modify Channel						
1 year	4.3	4.0	3.9	2.5	1.5	0.9
10	3.0	2.7	2.9	1.8	1.2	0.8
50	2.3	2.0	2.4	1.6	1.1	0.4
100	2.1	1.7	2.2	1.6	1.1	0.4
500	1.4	0.8	1.6	0.9	0.7	0.4

Table A3
Levels of Protection

Reach	Plan 1	Plan 2	Plan 3	Plan 4
020011	25 yr	100 yr	100 yr	25 yr
020012	4 yr	28 yr	25 yr	11 yr
020013	4 yr	28 yr	25 yr	9 yr
020015	–	3 yr	3 yr	1 yr
020017	3 yr	15 yr	13 yr	9 yr
020021	1.5 yr	3 yr	3 yr	3 yr
020022	2 yr	6 yr	6 yr	6 yr
020024	5 yr	6 yr	5 yr	5 yr
020029	1 yr	1.4 yr	1 yr	1 yr
020031	4 yr	6 yr	6 yr	5 yr
020032	1 yr	3 yr	1 yr	1 yr
Weighted Average for Study Area	2.7 yr	9.3 yr	8.4 yr	5.3 yr

TABLE A4

ECONOMIC SUMMARY OF PLANS
(October 1988 Price Level, $1,000's, 8-7/8% Interest Rate, 100 Year Project Life)

	PLAN 1	PLAN 2	PLAN 3	PLAN 4
FIRST COSTS				
Federal	25,428	40,489	39,439	37,242
Non-Federal	8,476	13,497	13,146	12,414
Total	33,904	53,986	52,585	49,656
INVESTMENT COSTS				
First Cost	33,904	53,986	52,585	49,656
Interest During Construction	4,648	7,400	7,208	5,470
Total	38,552	61,386	59,793	55,126
ANNUAL COSTS				
Interest and Amortization	3,010	5,042	4,668	4,408
Interest During Construction	413	657	640	486
Operation and Maintenance	65	85	84	81
Total	3,488	5,534	5,392	4,975
ANNUAL BENEFITS	2,640	4,150	4,120	3,550
NET BENEFITS	-848	-1,384	-1,272	-1,425
BENEFIT/COST RATIO	0.76	0.75	0.76	0.71

TABLE A5
SENSITIVITY ANALYSIS OF PROJECT LIFE

	TOTAL ANNUAL BENEFITS ($1,000's)	TOTAL ANNUAL COSTS ($1,000's)	EXCESS ANNUAL BENEFITS ($1,000's)	BENEFIT COST RATIO
100 YEAR PROJECT LIFE				
PLAN 1	2,640	3,488	- 848	0.8
PLAN 2	4,150	5,534	-1,384	0.7
PLAN 3	4,120	5,392	-1,272	0.8
PLAN 4	3,550	4,975	-1,425	0.7
10 YEAR PROJECT LIFE				
PLAN 1	2,300	6,039	-3,739	0.4
PLAN 2	3,629	9,598	-5,969	0.4
PLAN 3	3,600	9,350	-5,750	0.4
PLAN 4	3,100	8,624	-5,524	0.4

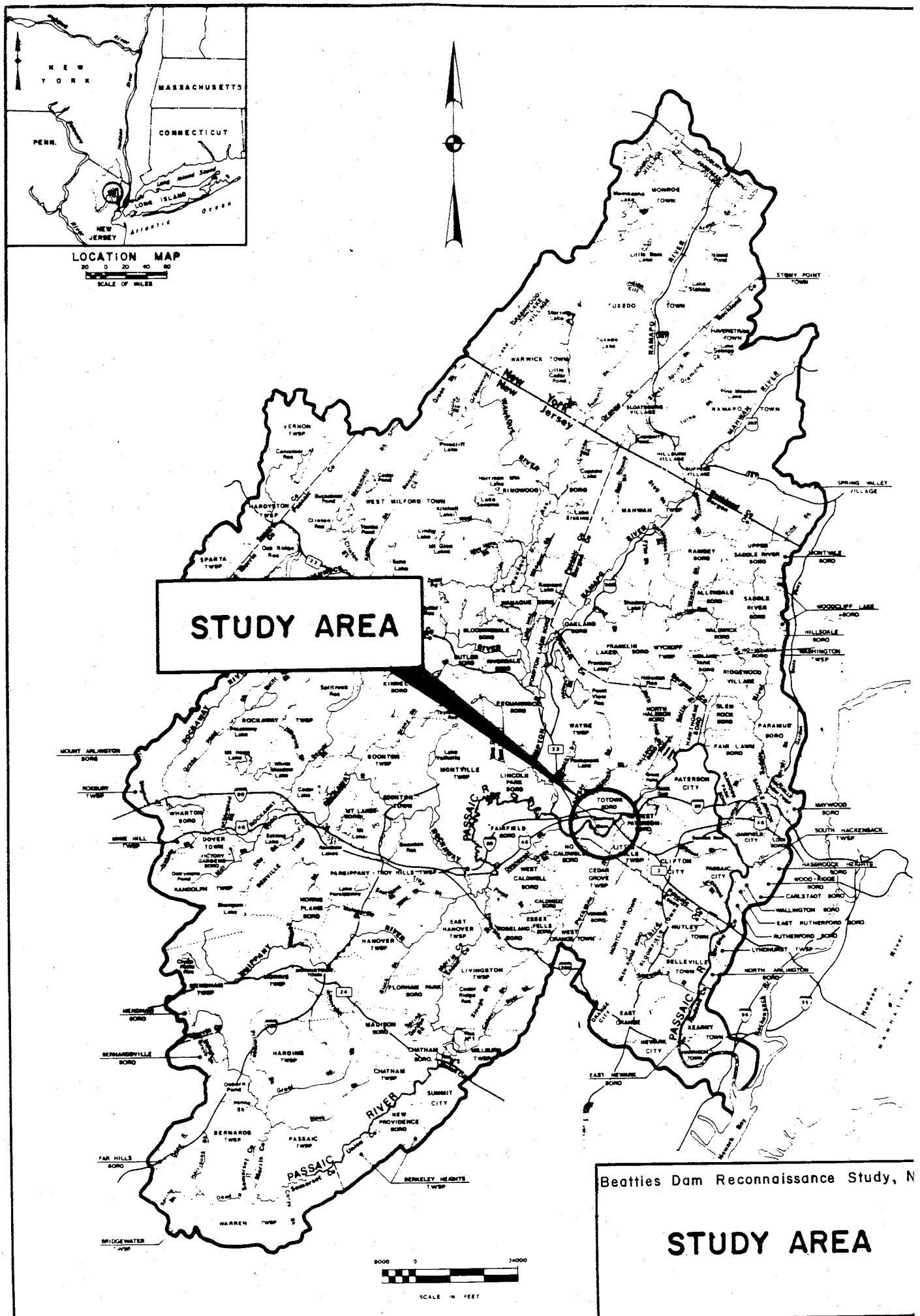
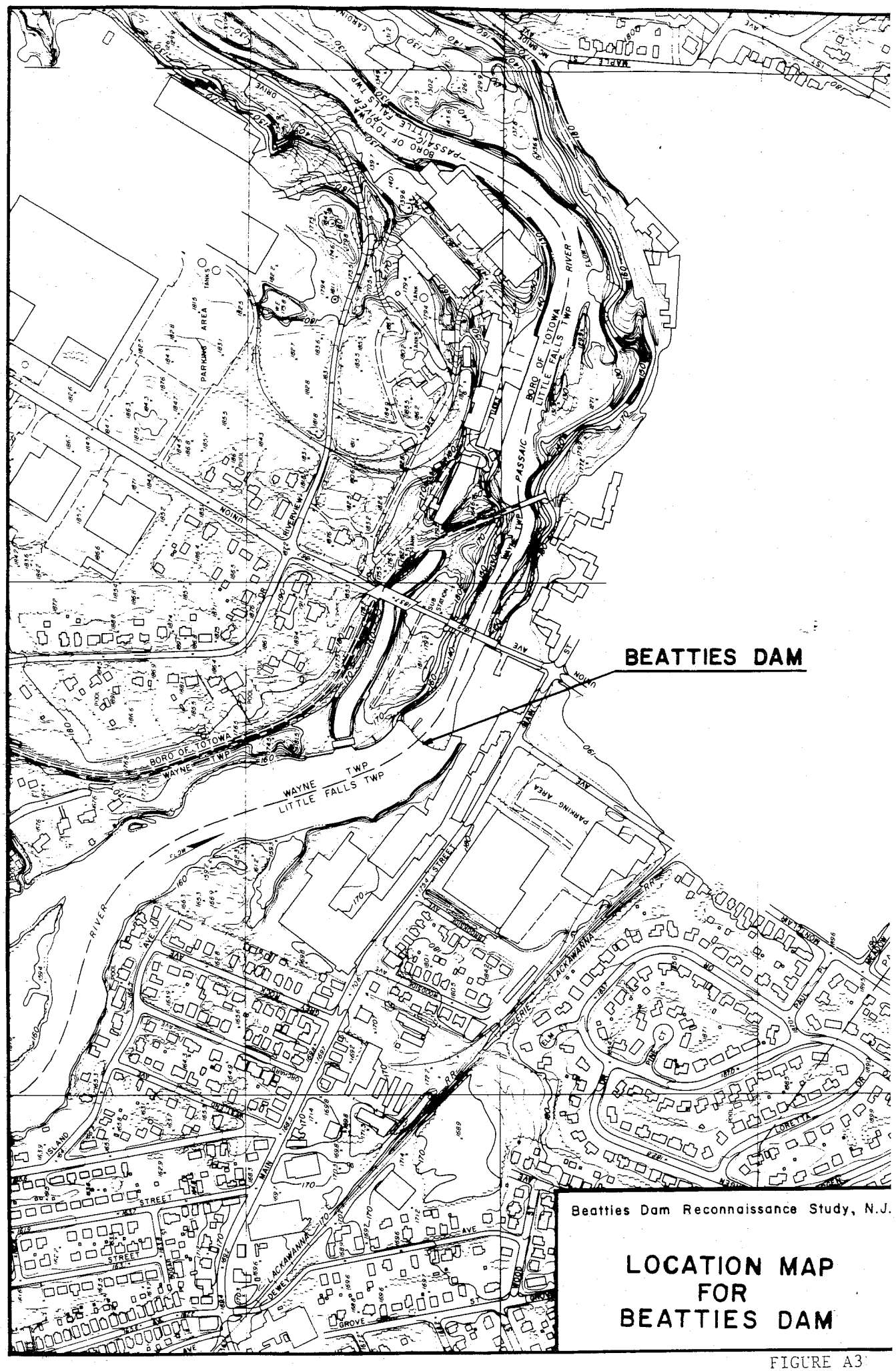

NEW YORK
MASSACHUSETTS
CONNECTICUT
PENN.
NEW JERSEY
LONG ISLAND
ATLANTIC OCEAN
LOCATION MAP
SCALE OF MILES
STUDY AREA
SCALE IN FEET
Beatties Dam Reconnaissance Study, N
STUDY AREA

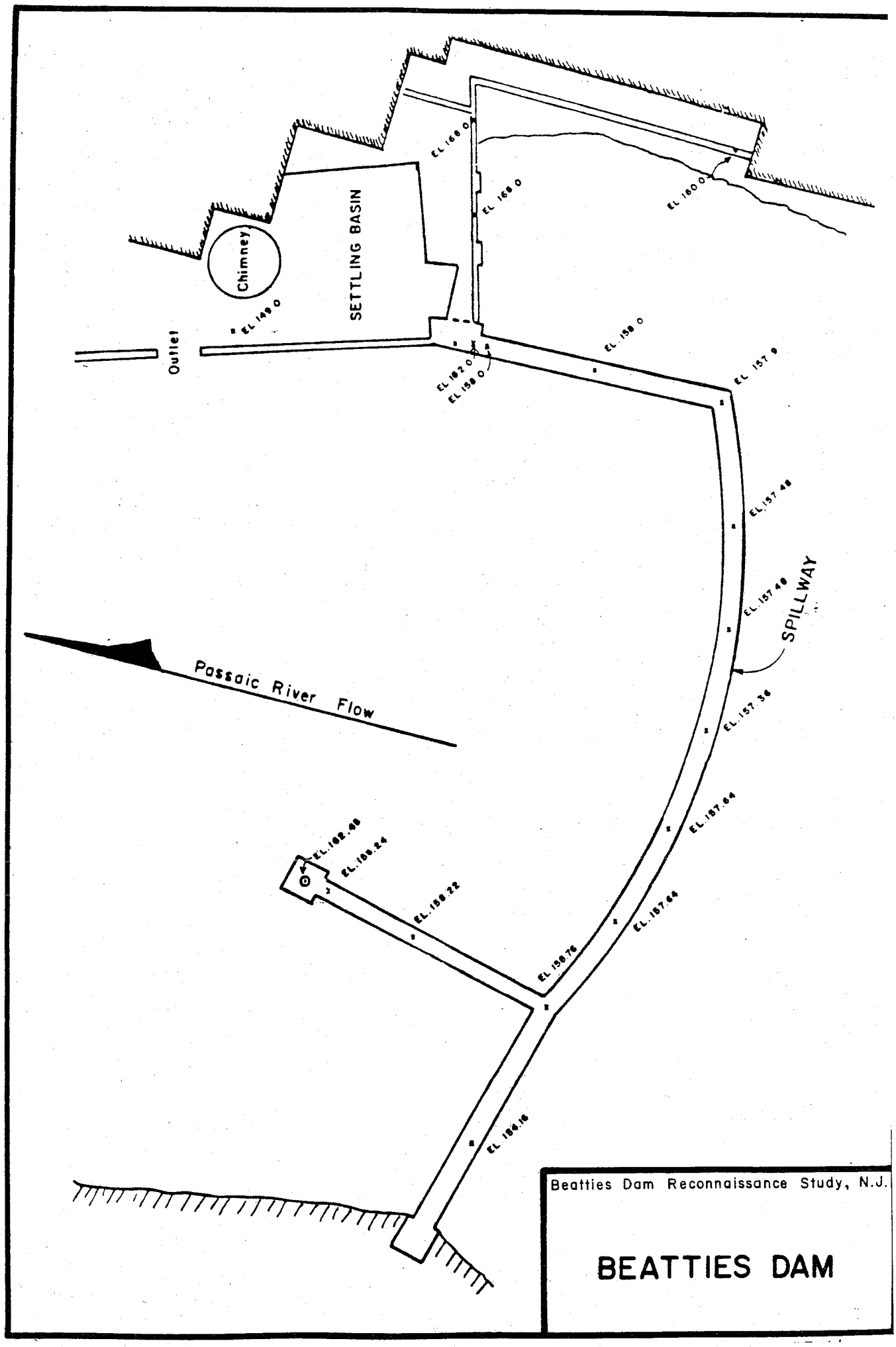
FIGURE A



Beatties Dam Reconnaissance Study, N.J.

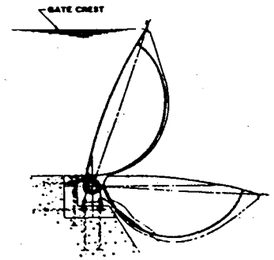
LOCATION MAP FOR BEATTIES DAM

FIGURE A3

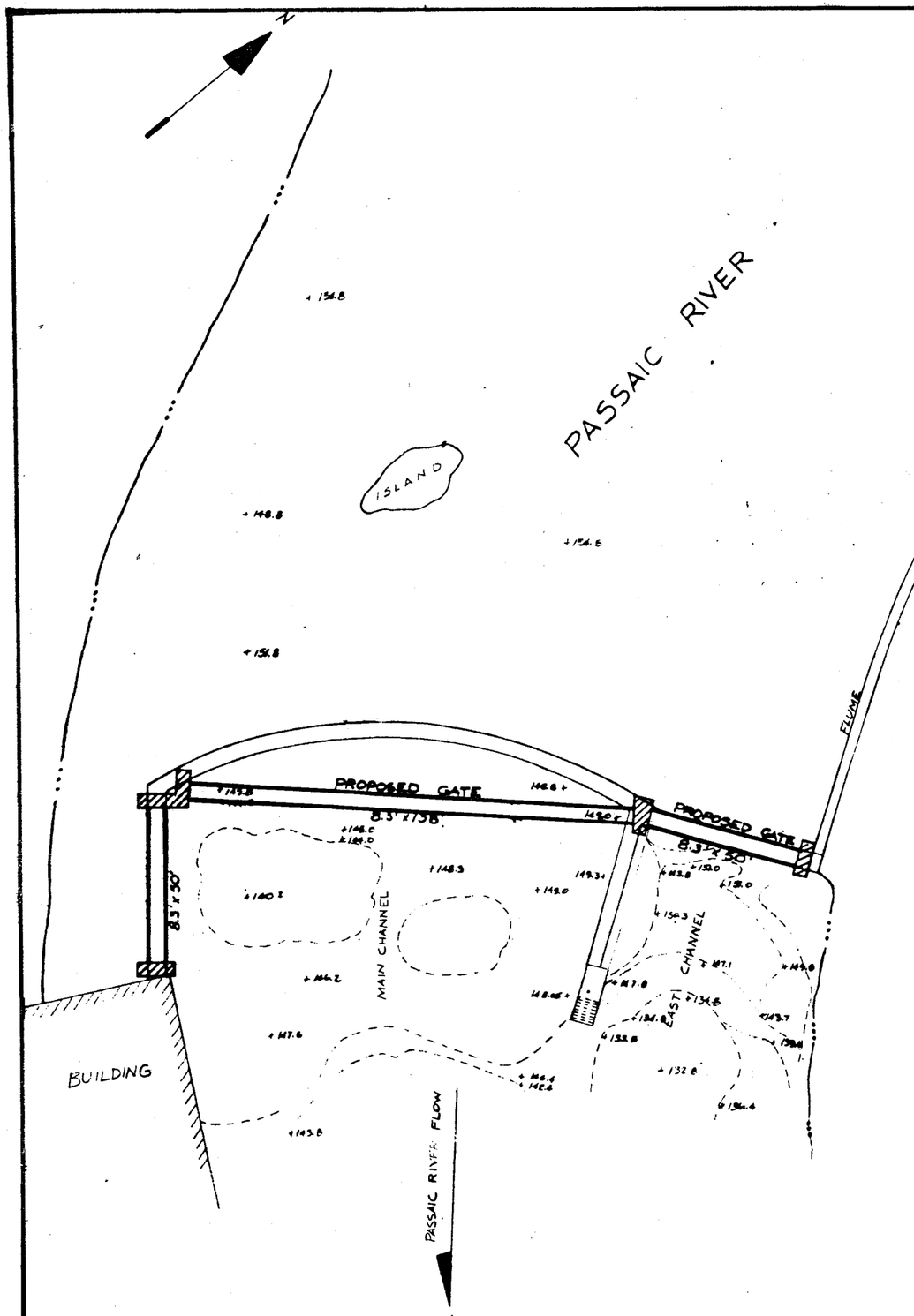


Beatties Dam Reconnaissance Study, N.J.

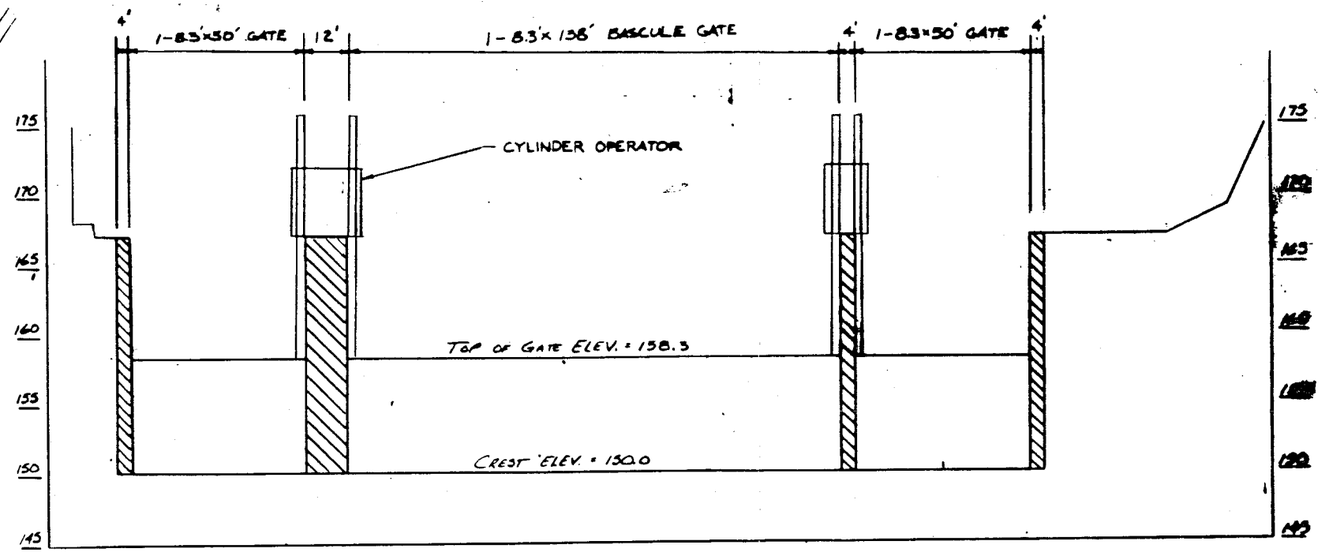
BEATTIES DAM



BASCULE GATE
N.T.S.



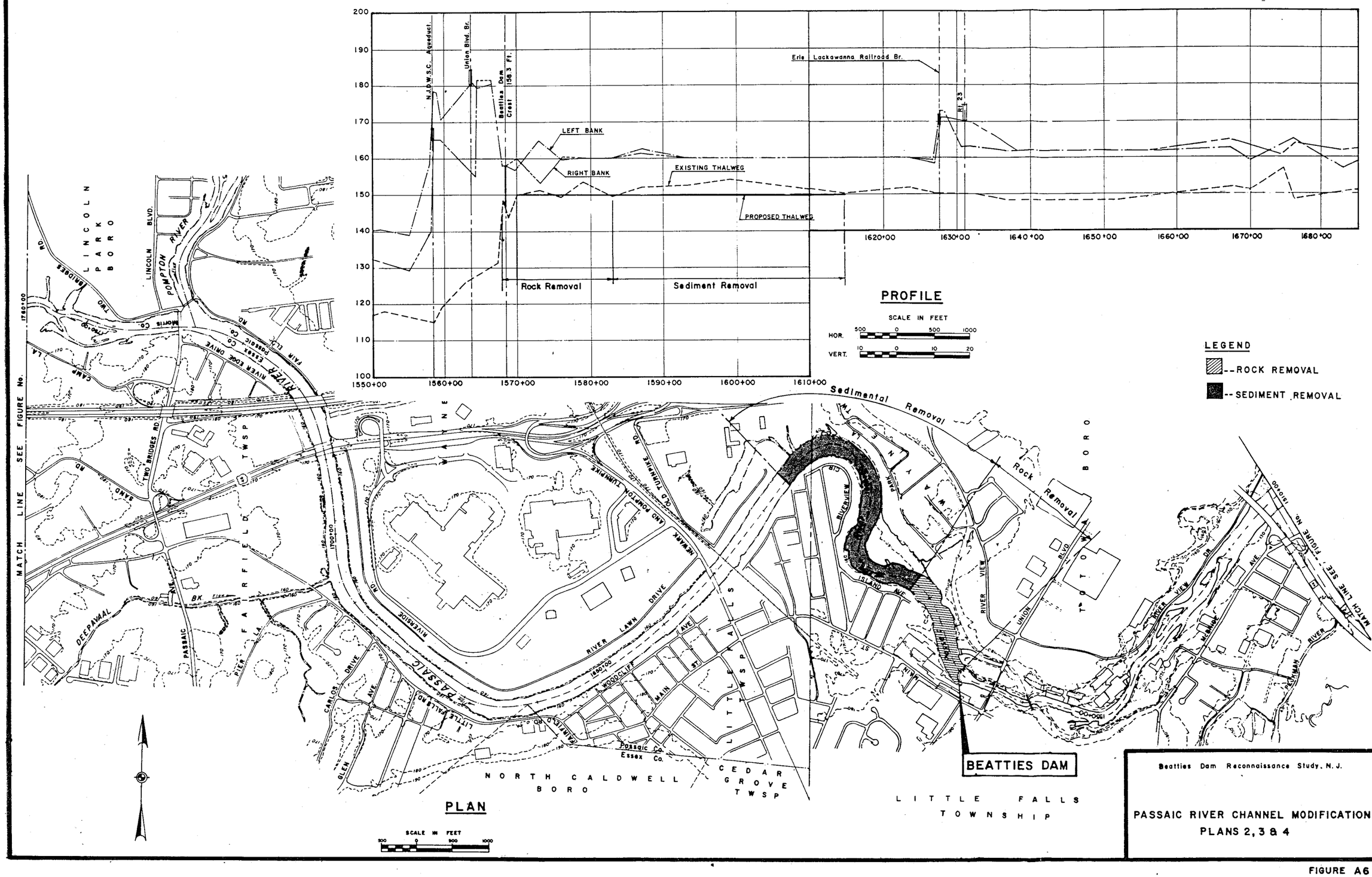
PLAN
SCALE: 1"=20'



SECTION
SCALE: 1"=20' HORI
1"=5' VERT

Beatties Dam Reconnaissance Study, N.J.

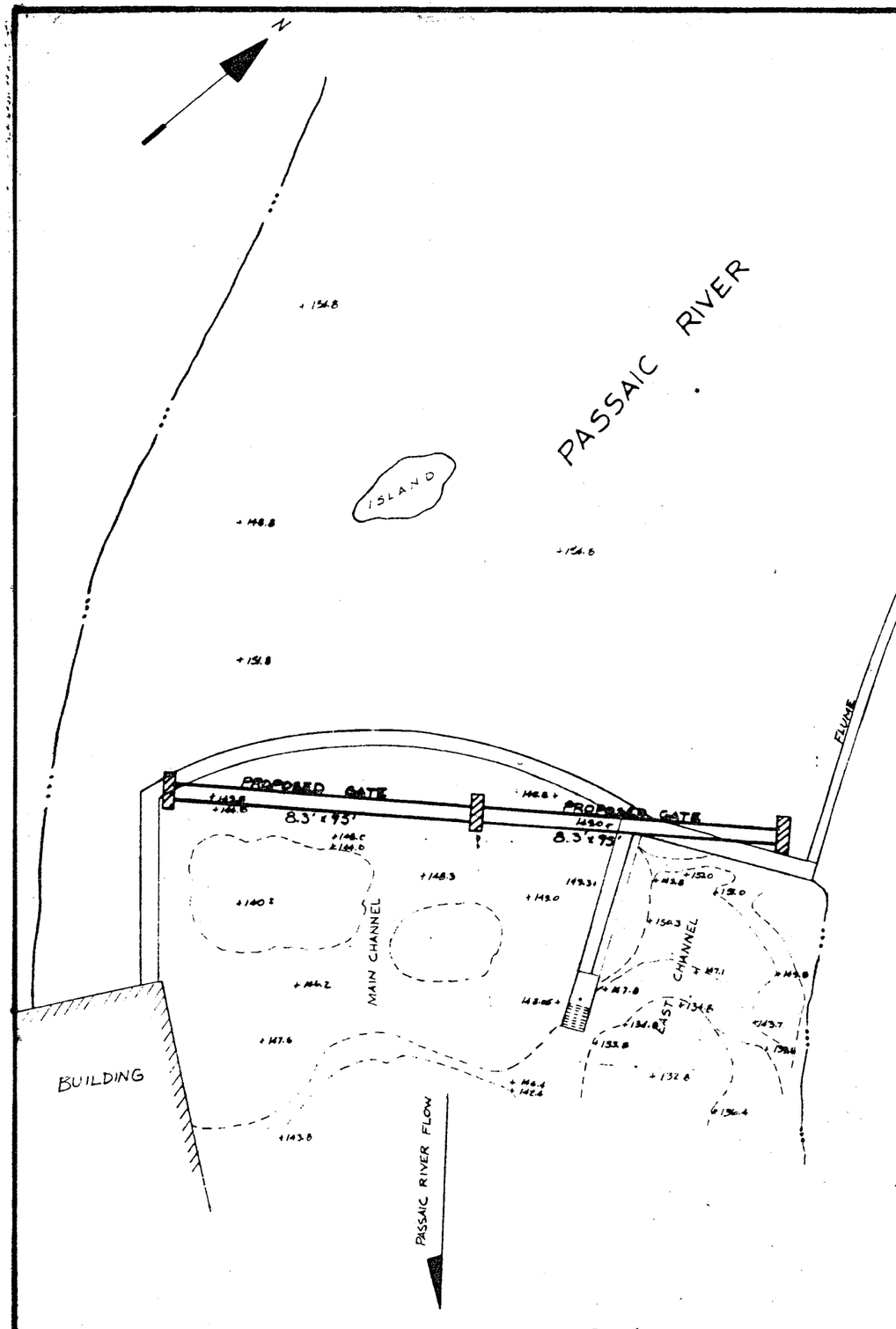
PLANS 1&2



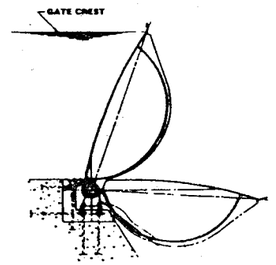
Beatties Dam Reconnaissance Study, N. J.

PASSAIC RIVER CHANNEL MODIFICATION
PLANS 2, 3 & 4

FIGURE A6



PLAN
SCALE: 1" = 20'



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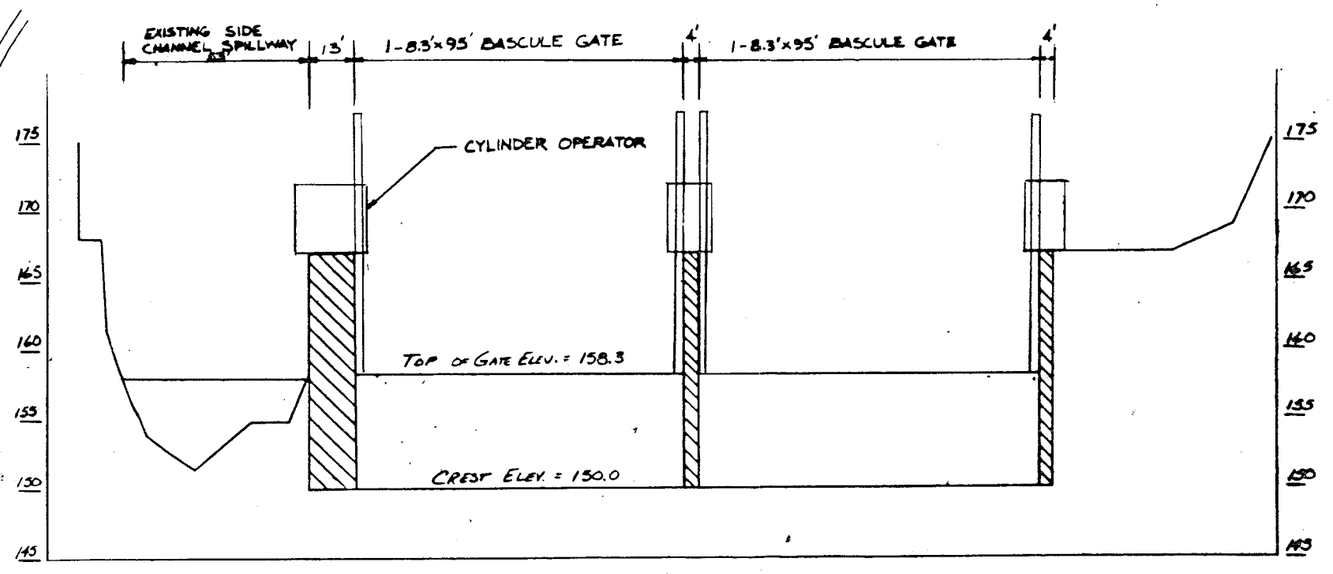
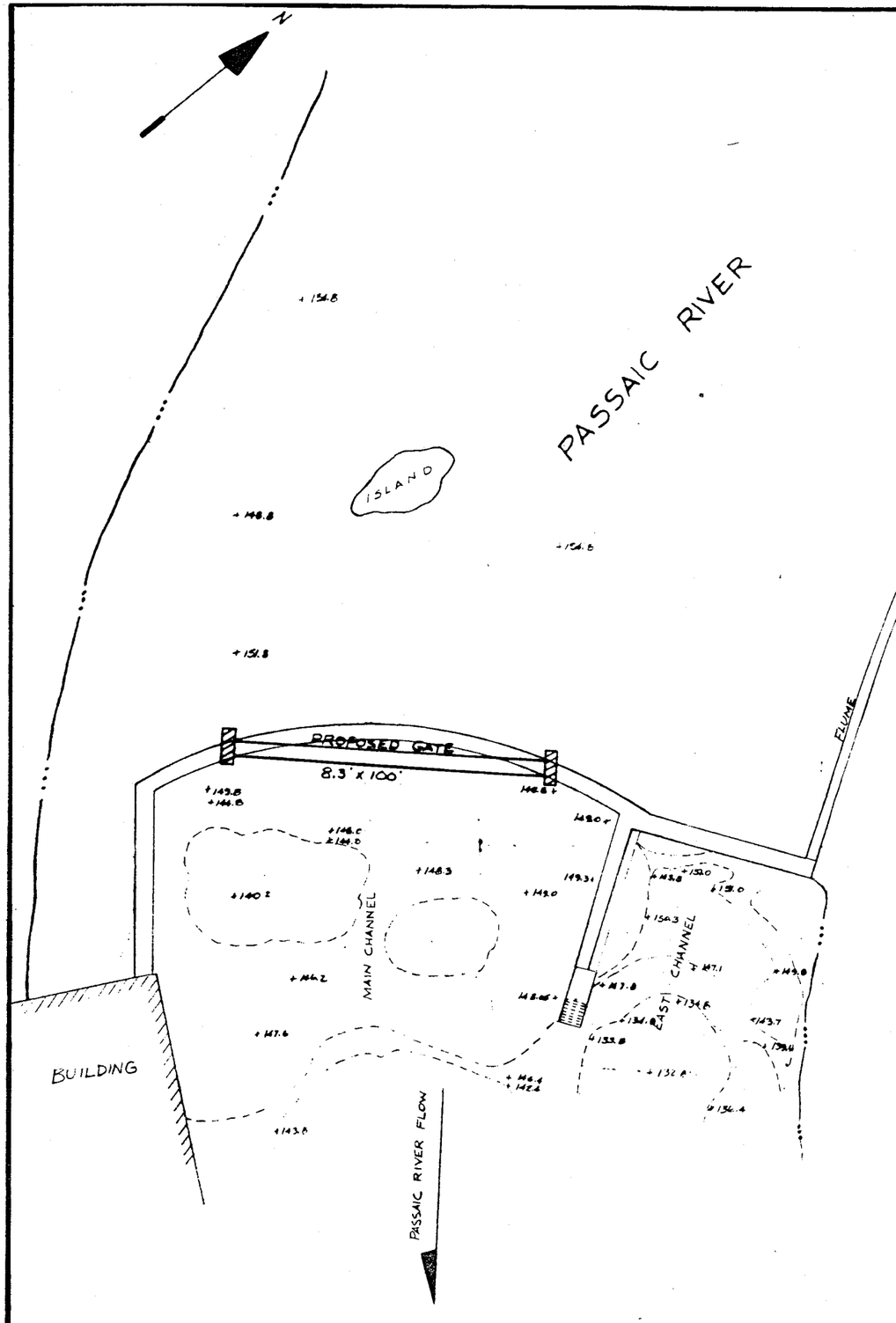


SECTION
SCALE: 1" = 20' HORI
1" = 5' VERT

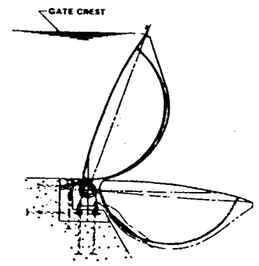
Beatties Dam Reconnaissance Study, N.J.

PLAN 3

FIGURE A7



PLAN
SCALE: 1"=20'



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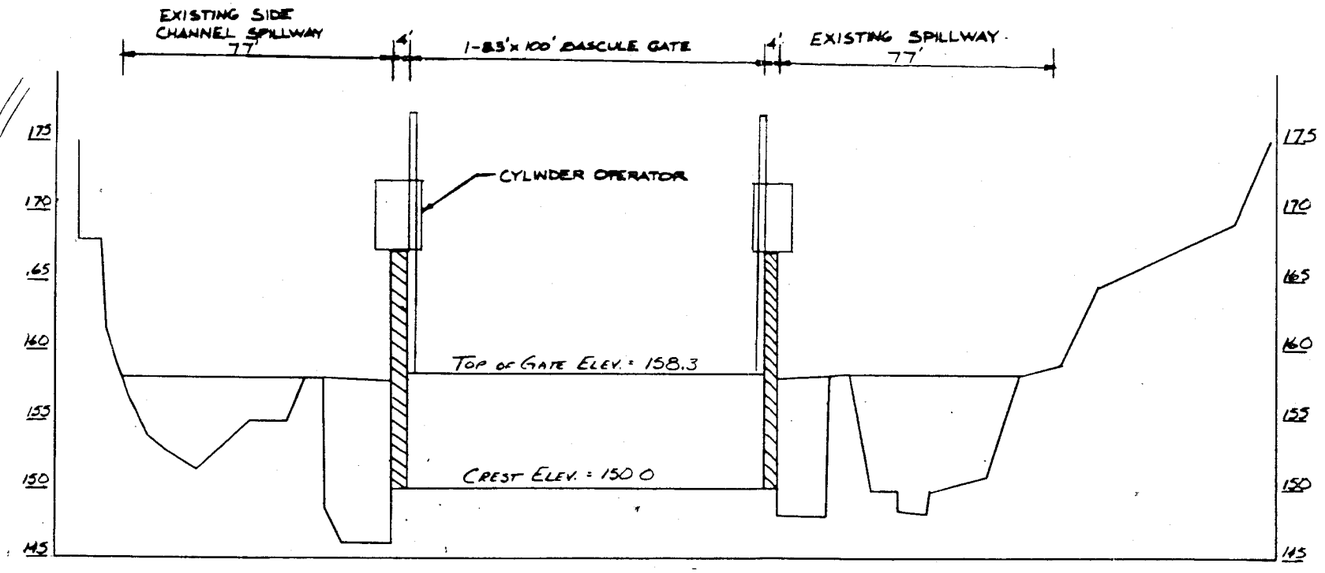


SECTION
SCALE: 1"=20' HORI
1"=5' VERT

Beatties Dam Reconnaissance Study, N.J.

PLAN 4

FIGURE A8

FIGURE A9
MAIN STEM PASSAIC RIVER
DESIGN AND CONSTRUCTION SCHEDULE

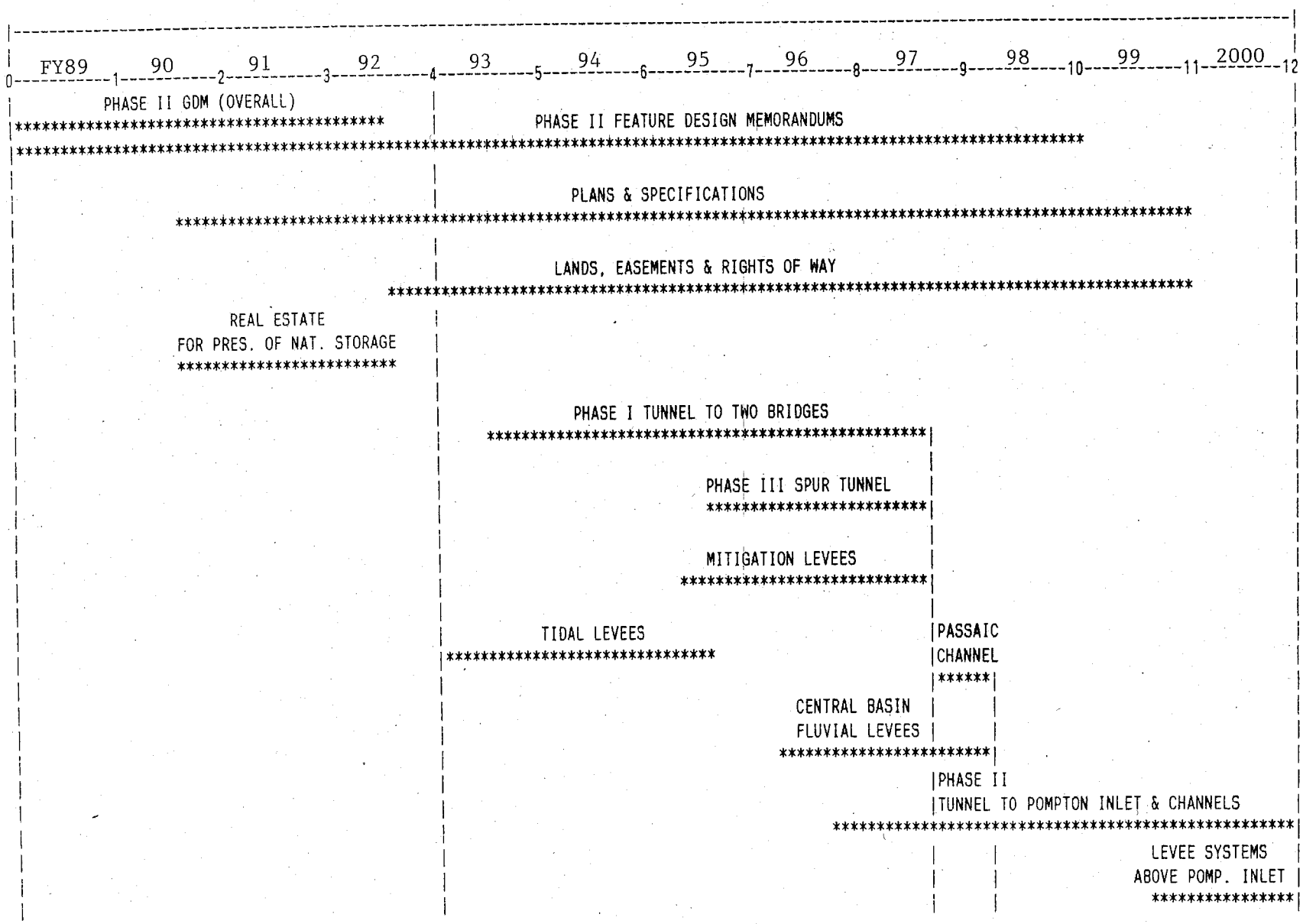
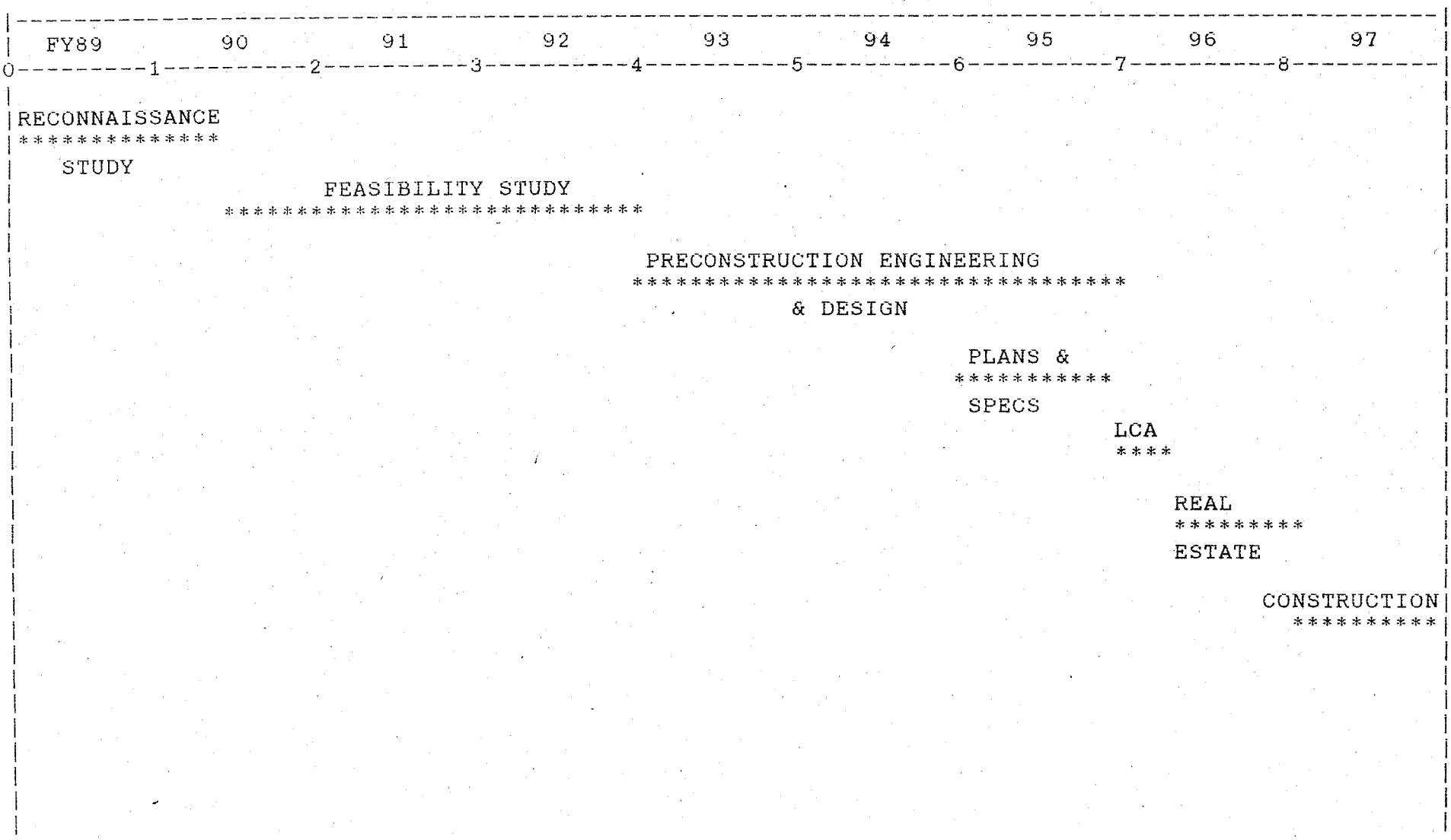


FIGURE A10
BEATTIES DAM
PLANNING, DESIGN AND CONSTRUCTION SCHEDULE



DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

31 AUG 1981

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Beatties Mill Dam in Passaic County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Beatties Mill Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate because a flow equivalent to 30 percent of the Spillway Design Flood - SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood.) However, more detailed hydraulic and hydrologic studies are not recommended due to the limited site condition and the intended purpose of the dam. To ensure the adequacy of the structure, the following actions as a minimum, are recommended:

a. Within one year from the date of approval of this report the owner should engage a qualified professional consultant to perform the following:

(1) Design and oversee repair procedures for the replacement of the large masonry blocks which have been dislodged from the north side of the training wall which is at the left center of the dam.

(2) Evaluate the potential for undermining of the foundation support at the downstream end of the masonry spillway training wall at the left center of the dam caused by the loss of several large bedrock blocks, and design and oversee corrective measures as needed.

(3) Investigate measures to assure the stability of the dam under severe overtopping conditions.

b. Within one year from the date of approval of this report the owner should repair the eroded construction joints.

c. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam, within one year from the date of approval of this report.

d. An emergency action plan and warning system should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Minish of the Eleventh District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

ROGER L. BALDWIN
Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

BEATTIES MILL DAM (NJ00824)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 23 April 1981 by Anderson-Nichols and Co. Inc., under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Beatties Mill Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate because a flow equivalent to 30 percent of the Spillway Design Flood - SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood.) However, more detailed hydraulic and hydrologic studies are not recommended due to the limited site condition and the intended purpose of the dam. To ensure the adequacy of the structure, the following actions as a minimum, are recommended:

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(3) Investigate measures to assure the stability of the dam under severe overtopping conditions.

b. Within one year from the date of approval of this report the owner should repair the eroded construction joints.

c. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam, within one year from the date of approval of this report.

d. An emergency action plan and warning system should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

APPROVED: Roger L. Baldwin

ROGER L. BALDWIN
Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

DATE: 31 Aug 81

ATTACHMENT B2-1 (cont.)

PASSAIC RIVER, VICINITY OF BEATTIE'S DAM
RECONNAISSANCE REPORT
APPENDIX B - ENGINEERING
SECTION 1 - HYDROLOGY

PASSAIC RIVER, VICINITY OF BEATTIE'S DAM
RECONNAISSANCE REPORT
APPENDIX B - ENGINEERING
SECTION 1 - HYDROLOGY

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RECONNAISSANCE REPORT
APPENDIX B - ENGINEERING
SECTION 1 - HYDROLOGY

DATA SOURCE

Much of the hydrologic input pertinent to development of the considered plans of improvement for the Passaic River in the vicinity of Beattie's Dam was obtained from the Phase I General Design Memorandum entitled "Flood Protection Feasibility - Main Stem Passaic River Supporting Documentation, Part I, Hydrology," dated December 1987. This memorandum is a published document which has been widely disseminated and should be available to anyone desiring a greater understanding of the nature of flooding upstream of Beattie's Dam.

The Phase I General Design Memorandum involved consideration of both present and future (1990 and 2040) states of upland watershed development, present and future volumes of floodplain storage in the Central Basin area, water resources developments by others (e.g., Monksville Reservoir), and various flood protection works, all of which could be expected to have impacts on the extent, duration, frequency and severity of flooding as well as on the environment in general. The memorandum reflects coordination with interested parties both in and outside of the Corps of Engineers.

WATERSHED DESCRIPTION

The Passaic River empties into Newark Bay, N.J. It's watershed area of 935 square miles lies in northeastern New Jersey and southeastern New York. The roughly elliptical basin is bounded on the north and west by the Appalachian Highlands of New York and New Jersey, on the south by the First Watchung Mountains, and on the east by the Piedmont Plain. The watershed is divided into three distinct topographic and hydrologic regions, designated as the Highland Area, the Central Basin and the Lower Valley (Figure 1).

TOPOGRAPHIC AND HYDROLOGIC FEATURES IMPACTING ON BEATTIE'S DAM

Beattie's Dam essentially defines the break point between the Central Basin and the Lower Valley. It intercepts the runoff from 762 of the 935 square miles in the Passaic River Basin. It is located about 3 miles downstream of the Great Piece Meadows, a large, natural flood detention area which is one of the great influences on the shapes of flood hydrographs at Beattie's dam.

The Central Basin, containing 262 square miles, is a flat, oval-shaped depression about 10 miles wide and 30 miles long, lying between the foot of the easterly slope of the Highland Area and the crescent-shaped Watchung Mountains to the south and

east. Low-lying and marshy lands bordering the various streams form a floodplain that originally extended over 19,000 acres above Little Falls and included the Great Piece Meadows, Hatfield Swamp, Troy Meadows, Black Meadows, and Bog and Vly Meadows.

The Passaic River passes through this floodplain from the southwest and meanders generally to the north and east until it passes out of the area through the gorge at Little Falls. The five major tributaries from the Highland Area discharge into the bottom lands near Fairfield Township and at Two Bridges. The basin elevation averages 300 feet m.s.l., varying from about 500 feet m.s.l. at the rims of the basin to 160 feet m.s.l. at the northeasterly end of the basin. The average stream slope varies from 19.5 feet per mile in the headwaters above Chatham to 1.4 feet per mile through the floodplain downstream of Chatham (Table 1 and Figures 1 and 2).

As indicated by the topographic features, these three regions of the Passaic River basin have different flood-producing characteristics. The basins of the Highland Area are the greatest flood producers in the Central Basin although they contain a large number of natural and artificial lakes and reservoirs. These impoundments, which tend to dampen the flood peaks to some extent, are used principally for water supply and recreational purposes. The northerly upland tributaries, namely the Ramapo, Wanaque, and Pequannock Rivers, join to form the Pompton River, the greatest producer of extreme floods in the Central Basin. Although the flood peaks are reduced and retarded somewhat due to the lake and reservoir storage on the tributaries and the valley storage between Pompton Lakes and the Passaic River at Two Bridges, the Pompton River peak reaches Two Bridges from 40 to 50 hours earlier than the Passaic River peak during basin-wide floods. The southerly upland tributaries, namely the Whippany and Rockaway Rivers, are as precipitous as the northerly tributaries, but they join the Passaic River at widely separated times which results in desynchronization of their peaks. Also, they are greatly affected by the large valley storage in their lower reaches lying wholly or partly in the Central Basin, and they therefore contribute less to flood peaks in the Central Basin.

Flooding upstream of Two Bridges is caused by the restricted river section and control above Little Falls which throttles the flow into the Lower Valley. This effect, combined with the extremely mild channel gradients upstream of Beattie's Dam ranging from 1 to 2 feet per mile on the Pompton and much of the Passaic River, causes a partial, temporary diversion of Pompton River flood flows upstream into the Great Piece Meadows, part of the Central Basin floodplain. Thus, the combined flow from the total watershed above Two Bridges raises the water level in the meadows until it becomes equal to or greater than that at Two Bridges. As a result, during periods of flood, the floodplain

in the Central Basin acts as a natural detention reservoir which significantly retards flood peaks and reduces flood intensities in the Lower Valley below Little Falls. Pertinent watershed data for the Passaic River and its principal tributaries are given in Table 1.

CLIMATE

The climate of the Passaic River Basin is characteristic of the entire Middle Atlantic Seaboard. Marked changes of weather are frequent, particularly during the spring and fall. The winters are moderate with moderate snowfall and the summers are moderate with hot, sultry, mid-summer weather and frequent thunderstorms. The rainfall is moderate and well distributed throughout the year. The relative humidity is high. The average annual temperature varies from 49oF. at Charlotteburg to 54oF. at Paterson, with extremes from 26oF. below zero (Canoe Brook) to 106oF. above zero (Paterson). The growing season averages 171 days and the mean annual relative humidity varies from 67 percent to 73 percent. Prevailing winds are from the northwest with an annual average velocity of 9.7 miles per hour. Rainy days average about 121 per year. Climatological data are shown on Figures 3, 4, and 5. Temperature, sunshine and frost data are given in Table 2. Data for wind, humidity, evaporation and rainy days are given in Table 3.

PRECIPITATION STATIONS

The Passaic River Basin is presently served by a network of official U.S. Weather Bureau gaging stations which provide necessary input for the mathematical modeling of historic flood events in the vicinity of Beattie's Dam. The location, period of record and type of station are shown on Figure 6, which also includes data on pertinent discontinued stations.

ANNUAL AND MONTHLY PRECIPITATION

The overall average annual precipitation for the Passaic watershed is approximately 47 inches as derived from a compilation of past records at 29 U.S. Weather Bureau stations in and adjoining the basin (Table 4). The observed extreme annual values were 85.99 inches at Paterson (1882) and 25.26 inches at Morristown (1930). The monthly extremes were 25.98 inches in September 1882 at Paterson and 0.02 inches at Plainfield and Jersey City in June 1949. The distribution of precipitation throughout the year is fairly uniform with higher amounts occurring during the summer months (Table 4). Figure 4 shows the variation of precipitation over the basin.

SNOWFALL

The average snowfall of about 34 inches for the Passaic River Basin is equivalent to about four inches of rain. The

average snow season is longest in the Highland Area where it extends from the middle of October through the middle of April. The variation of snowfall over the basin is shown on Figure 5. The average snowfall for the different areas and at individual stations is given in Table 5. The depths of snow given are for freshly fallen snow with an approximate content of one inch of water to 10 inches of snow.

STORM TYPES

Storms affecting the Passaic River Basin are characterized as tropical and extra-tropical events. The tropical storm arises, not surprisingly, in the tropics: a hurricane is the most severe, but not the most common, occurrence of this type. The extra-tropical storm arises from the interaction of warm and cold fronts; thunderstorm activity is the frequent result of such interaction, but storms of much greater areal extent also arise therefrom, for example, the northeaster, so named for the strong northeast winds which accompany it. The season for tropical storms runs from about June to about November, that for northeasters from about November to about April. Thunderstorms are most frequent in the summer months and, due to rapid convective circulations, are generally limited in extent although they may be embedded as cells in larger weather systems. Thunderstorms frequently cause local flooding on flashy streams.

PAST STORMS

A review of great storms which have occurred in the northeastern states (Table 6) reveals that the Passaic River basin, located in the center of the North Atlantic storm belt, has frequently been impacted by such events.

RUNOFF RECORDS

Data for some of the major pertinent floods were obtained at Little Falls, located a short distance downstream of Beattie's Dam. Data for others were obtained at the S.U.M. (Society of Useful Manufactures) Dam located somewhat further downstream. Records for both recording sites are considered by the United States Geological survey to be interchangeable to a high degree, the drainage area difference being quite small and incremental storage effects minimal. Hence, whichever gaging station captured a particular basin-wide event, the recorded hydrograph and peak would probably constitute a very good estimate of what happened at Beattie's Dam.

ANNUAL RUNOFF

The average runoff from the Passaic River watershed is affected to a considerable extent by diversions for water supply from the Rockaway, Pequannock, Wanaque and Ramapo Rivers, Canoe

Brook, and the Passaic River itself. Average runoff past Beattie's Dam is about 1.55 cfs per square mile exclusive of average water supply diversions amounting to about 0.35 cfs per square mile, which brings the total corrected runoff to 1.90 cfs per square mile. This runoff is equivalent to 25.7 inches per year or 53 percent of basin precipitation. Seasonal variation in runoff occurs with over 50 percent of the annual amount taking place in the months December through April.

FLOOD RUNOFF

The flood runoff from this watershed is affected by its topographic and hydraulic features. The great natural storage that occurs during flood periods over the flat swamps and meadows above Little Falls has a great effect on the runoff of watershed, especially into the Lower Valley. Because of the variable flood runoff characteristics, each hydrologic division of the watershed requires a different treatment for the analysis of flood runoff such as the unit hydrograph method in the Highland Area and the Lower Valley, and a combination of the unit hydrograph and flood routing methods in the Central Basin.

FLOODS OF RECORD

Significant Passaic Basin floods are on record as having occurred in calendar years 1811, 1865, 1882, 1896, 1902, 1903, 1936, 1945, 1968, 1977, and 1984. Little is known of the earlier events beyond the fact that the first two were, respectively, the second and fourth largest at Little Falls (Beatties's Dam), discounting any changes in ranking that might arise from adjustments for watershed development. Of the more recent events, it can be said that some were of basin-wide consequence while others were of interest only in specific subareas. Descriptions of some significant floods at Beattie's Dam are given in the following paragraphs.

Hydrographs of three of the historical events are included in this document (Figures 10, 11 and 12). The latter plots shows two versions of the pertinent event. The first is based upon a gaging station record. The second is a reconstitution based upon mathematical modeling using Computer Program HEC1 (see below). Apparent from a review of these drawings will be the long duration of runoff at near-peak rates of flow, which is indicative of a large amount of flood detention storage in the Passaic Basin (see also Table 10, which deals with estimates of hypothetical floods).

Flood of October 1903. This flood was the maximum of record in the Passaic River watershed. The beginning of the sudden flood rise was almost simultaneous on all tributaries of the Passaic River at about 6:00 P.M. on Thursday, 8 October. The Pompton River reached a maximum at 4:30 P.M. on Friday, 9 October, and continued at a high rate of discharge until noon of

Saturday, 10 October. The peak on the Passaic River reached a maximum at about 12:00 P.M. at Two Bridges, 4:00 P.M. at Little Falls and 9:00 P.M. at Dundee Dam on Saturday, 10 October. The peak discharge on the Passaic River at Little Falls was about 31,700 c.f.s. See Figure 10.

Flood of March 1936. This was the worst winter flood occurring between March 1902 and April 1984. The peak discharge recorded at the S.U.M. Dam was 19,700 c.f.s. on 13 March. The peak flow on the Pompton River occurred about 24 hours before the peak on the Passaic River. The total runoff volume was 5.99 inches, equivalent to about 67 percent of the total rainfall and accumulated snow cover (water equivalent).

Flood of July 1945. This was a major flood downstream of Two Bridges, with flash flooding occurring on all Lower Valley small streams tributary to the Passaic River. Because this storm was located primarily over the Lower Valley, it's hydrograph is specifically not interchangeable between the Little Falls and S.U.M. gage sites. The peak on the main stem was due to the simultaneous high flows from the short tributaries, as indicated by the shape of the flood hydrograph at the S.U.M. Dam (see Figure 11, which shows a "spike" of runoff that is simply not found on hydrographs of floods that have undergone ponding in Great Piece Meadows). The first peak of 19,500 c.f.s. was caused primarily by the flow from the small tributaries below Two Bridges while the second peak of 11,600 c.f.s. occurred more than 24 hours later and can be attributed to the flow from the Great Piece Meadows area above Two Bridges. The retardation and reduction of flood peak effected by this natural reservoir was clearly shown during this flood. The peak flow on the Pompton River at Pompton Plains, which has a drainage area equal to about one-half that just below Two Bridges, was estimated at 9,690 c.f.s. and the peak time was estimated at one hour after the first peak in the Lower Valley of the Passaic River at S.U.M. Dam, and 18 hours before the second peak of 11,600 c.f.s. attributed to the Great Piece Meadows area. The runoff volume was 5.0 inches, equivalent to 59 percent of the average rainfall over the basin. Beatties Dam is known to have been damaged by this event, but no record of the associated peak stage at that structure has been found, according to a dam safety inspection report (see" Standard Project Flood" below).

Flood of May 1968. The flood of May 1968 caused widespread damage over the Passaic River Basin. Flooding occurred on the main stream and all major and most minor tributaries from the headwaters to the City of Passaic, about 12 miles upstream of the mouth of the Passaic River in Newark Bay. Flooding was most severe on the Pompton, Ramapo, Wanaque and Pequannock Rivers, equalling or exceeding the March 1936 flood. Peak flow at Little Falls was 13,500 cfs on 31 May 1968. The peak flow on the Pompton River at Pompton Plains occurred on 30 May 1968 and was estimated at 13,100 cfs.

Flood of April 1984. The flood of April 1984 resulted, in part, from high antecedent flows due to precipitation in late March. At a number of gaging stations in the northern and western subareas of the Passaic Basin with 40 or more years of record, the peaks were the highest or second highest recorded. Estimated average return periods of the peaks ranged from 25 years at Little Falls to 50 years at Pompton Plains. See Figure 12.

DESIGN WATERSHED DEVELOPMENT CONDITION

The plans considered in this document were designed to provide protection against flood discharges reflecting the anticipated state of watershed development in 1990. These discharges are some of those designated "Q4" in Table 38 of the document entitled "Flood Protection Feasibility, Main Stem Passaic River" dated December 1987. They are included in Table 10 of this current document under the column headed "One Hour," to which footnotes (A), (B) and (C) apply. Refer to the 1987 document for a discussion of the development of the "Q4" discharges.

FUTURE WATERSHED DEVELOPMENT CONDITION

The analysis period for watershed development for the Phase I report upon which much of this document is based extends through 2040. Changes in such development over the intervening years will lead to increasing discharges at a given frequency or, putting it another way, to more and more frequent occurrences of selected discharges. This will be readily apparent from a review of Figure 8 and of the flows designated "Q5" in Table 38 cited above.

BEATTIE'S DAM PEAK DISCHARGE-FREQUENCY RELATION

Beattie's Dam is located 0.6 miles upstream of the Passaic River gaging station at Little Falls. The difference in drainage areas for the two locations is minimal, as is the intervening flood storage. Therefore, the discharge frequency relation at Little Falls, where the period of record is 88 years, was assumed to apply at Beattie's Dam. See Figures 7 and 8.

HYPOTHETICAL FLOODS KEYED TO SPECIFIC FREQUENCIES

Determination of project impacts generally requires the development of a series of flood hydrographs with peaks associated with a range of frequencies. Eight hydrographs were used in this analysis with peaks ranging from 5784 c.f.s. to 44868 c.f.s. (existing conditions), and these had associated frequencies of one to 500 years. These events are hypothetical in that their hydrographs do not necessarily mimic any historic ones but are representative of many.

NON-SPECIFIC-FREQUENCY HYPOTHETICAL FLOODS

Aside from the specific frequency floods discussed above, there are two other hypothetical events of more theoretical nature which have to be considered in the plan formulation process. The first of these is the Standard Project Flood, which is of interest regardless of the nature of the improvements being considered. The second is the Probable Maximum Flood, which must be evaluated whenever a dam is being considered.

Standard Project Flood. The Standard Project Flood is that event likely to follow the occurrence over a given watershed of the Standard Project Storm. This storm, which is understood to mean any period or sequence of rainfall events that may contribute to a critical flood event, was found to result in a discharge of 44,766 c.f.s. (existing conditions) at Beattie's Dam giving due consideration to antecedent conditions.

The Standard Project Flood slightly exceeds one-half of the Probable Maximum Flood (following paragraph) and thus approximates the "Spillway Design Flood" used in the analysis of Beattie's Dam under Phase 1 of the National Dam Safety Program (see "Beatties Mill Dam, NJ 00821" dated August 1981). The latter flood is reportedly "in accordance with the range of test floods given in the evaluation guidelines for dams classified as significant hazard and intermediate size (Page 9, Section 5, op cit). Thus, the Standard Project Flood is considered to be a good reference event for evaluating spillway capacity (see Hydraulics Appendix).

Probable Maximum Flood. The probable maximum flood is that event likely to follow the occurrence over a given watershed of the Probable Maximum Precipitation. The latter is defined by the American Meteorological Society as "the theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage area ...." For the Passaic River at Beattie's Dam, the associated peak discharge is estimated to be 88,000 c.f.s., approximately twice that of the Standard Project Flood.

SCOPE OF CONSIDERED PLANS

The considered plans of improvement would provide flood protection of a local nature to the area upstream of Beattie's Dam under relatively common flood events. They are not intended to be of basin wide import since they are confined to a relatively short reach of the Passaic River and would not provide any alternative path for flood runoff.

COMPUTER PROGRAMS HEC1 AND DWOPER

Computer program HEC1 was the principal analytical tool for evaluating the impact of the considered plans of improvement on flood discharges. The reason for this was the relative ease with which the HEC1 model structure can be changed to reflect the implementation of a plan of improvement. The plans considered in connection with this current study (see below) all involve changes which would alter the storage outflow relations of the basin upstream of Beattie's Dam. Storage routing is one of several options available to the user of HEC1. The storage-outflow data required (Modified-Puls methodology) was readily available as output from runs of HEC2 input files into which were coded the parameters of the proposed improvements.

The storage-outflow relations which would be affected by the considered plans of improvement include that for the Great Piece Meadows on the Passaic River upstream of Two Bridges. The relation in this reach is more complex because an unsteady flow condition results in the natural diversion of Pompton River flow upstream along the Passaic River given substantial runoff from the Pompton. Due to the occurrence of this flow reversal, the Central Basin modeling procedure was more involved and required the use of the diversion and lagging options of HEC1 in addition to the stream system procedure. Since HEC1 cannot model unsteady flow behavior directly, an aid was utilized in the modeling of complex flood wave routing in the Central basin. An unsteady flow program, "DWOPER," was used to gain insight into how flood waves move within the Central Basin and to provide a basis for determining lagging and diversion variables, thereby improving the HEC1 representation of flood wave movement.

The "DWOPER" model was prepared by HEC (Hydrologic Engineering Center, Corps of Engineers, Davis, California) and documented in its Special Projects Memo No. 81 and in a revised Memo No. 82-1 "Unsteady Flow Analysis For the Passaic Central Basin." "DWOPER" was not used as the final model analyzing the Passaic Central Basin because (1), it cannot interface directly with the family of HEC Programs used in this investigation; 2), modifying it to analyze alternative plans is extremely difficult, requiring detailed modeling changes; 3), it cannot be readily modified to evaluate future land use changes; 4) utilizing it for all necessary analyses would be too costly; and 5) a final product based on one modeling technique (HEC1) for the entire basin was highly desirable.

Therefore, diversion and lagging functions were used to simulate the dynamics of flood routing reflected in the "DWOPER" trial runs for the Central Basin. Diversion was accomplished with the option in the HEC1 program which permits the amounts of flow to be diverted to be specified.

A sample "DWOPER" hydrograph illustrating flow reversal on the Passaic River upstream of the Pompton River confluence is show on Figure 9.

HEC1 MODEL TIME STEP

The HEC1 model time step used in this study (and in the Phase I study upon which it is based) was one hour. This is the smallest that could be used to develop the full hydrographs (base-flow to base-flow) of floods at Beattie's Dam given the duration of historic events and the HEC1 limit on time steps (300). It was found to be more than adequate, however, in terms of defining the shapes of the hydrographs around their peaks since discharges there vary little over six- and 24-hour periods (Table 10) due to the characteristics of the Passaic River basin.

ALTERNATIVE PLANS

The alternatives considered in this document focused on Beattie's Dam and its approach channel in accordance with specific authorization for a flood control study in the vicinity of this dam and with the desire of local interests for the installation of moveable gates in that structure. The relatively limited cost and scope of these improvements is not inconsistent with a project of potentially limited life in view of the demand and justification for implementation of flood protection measures of wider import (see Phase I General Design Memorandum). Of the four alternatives considered, the first involved dam modification only, while the remaining three consisted of both dam and channel modification. Plan 1, that without channel work, involves a replacement dam consisting essentially of 3 gates. Plan 2 builds on Plan 1, adding to it modification of the approach channel. Plan 3 differs from Plan 2 in that less of the dam width would be replaced with gates, and two gates rather than three would be provided. Plan 4 is the least ambitious of all the dam modifications with a single gate to be provided in conjunction with channel modification.

EXISTING FLOOD WARNING SYSTEM

There is an operational flood warning system in the Passaic River basin put into operation by the Corps of Engineers in 1988. It was installed independently of any of the plans under consideration in this document but will provide an increment of safety in the operation of the gates envisioned by each of the plans, all of which require human intervention. It was proven effective by the Spring 1989 flood, an event of wide import which had return periods of 3-8 years depending upon location within the Passaic basin.

GATE POSITIONS FOR HYDROLOGIC MODELING

It should be noted that the gates proposed for the rebuild of Beattie's Dam could be held at any position between normal and fully down and that each gate could be operated independently. Associated with each set of gate positionings is a separate and distinct storage-outflow relation. Should the gates be operated with a view to holding a constant upstream pool level until such time as all are fully down, an incoming hydrograph would be impacted by a family of storage-outflow relations. This would preclude a sudden impoundment release upon warning of an impending flood. This scenario cannot readily be modelled with HEC1, which can make use of only one storage-outflow relation per routing reach per run. Since the gates would be fully down at some time during the passage of most floods of any consequence, especially around their peaks, this was the condition used for the routing of floods with a view to determining changes in peak discharge and timing. Maximum upstream benefit would be generated by fully lowered gates.

DEAD STORAGE BELOW BEATTIE'S DAM CREST

Beattie's Dam impounds approximately 1040 acre-feet of dead storage on the Passaic River between stations 1568+65 and 2403+80. This is the volume of water below the fixed crest of the existing dam. With the proposed gates fully deployed (lowered) in anticipation of the passage of a flood wave there would be no comparable dead storage. A comparison of existing and improved conditions storage-outflow relations is valid, therefore, only if the existing-conditions relations are free of dead storage. For this current study all storage-outflow relations were based on HEC2 runs. HEC2 normally uses the full depth of water at each cross-section in its computations since this is germane to a determination of conveyance, and it is the associated cross-sectional area which enters into the usual volume determinations associated with HEC2 output. However, an option of HEC2 provides for volume determinations based upon the specification of a predetermined stage at each cross-section, and this option was used in the calculation of the dead storage below the crest of Beattie's Dam (158.2 feet N.G.V.D.). Table 7 presents the volumes (storages) of interest.

HYDROLOGIC INVESTIGATIONS

Under the considered plans of improvement, the water surface profile at and upstream of Beattie's Dam associated with any given discharge would be lower than under existing conditions. Associated with the lowered profile would be changes in the wetted cross-sections of the river channel and associated with these changes would be changes in the volume of water under the

profile. Should the relationship between volume under a profile and the discharge associated with that profile change, the shape of a specific-frequency flood hydrograph would change upon implementation of the plan.

Any decrease in storage immediately upstream of Beattie's Dam could be expected to have an adverse impact on flood discharges downstream of the dam. Consequently, it was necessary to determine the nature and extent of the changes in storage. Improved conditions storages were taken from HEC2 runs which reflected the features of Plan 2. These storages were used in new HEC1 models, the output from which was compared to that from existing conditions runs.

Table 7 shows the storage-outflow relations associated with the implementation of Plan 2 and compares them to existing conditions relations. Some of the changes may appear relatively large if looked at in terms of percent change. However, they are small in the context of the total amount of storage which shapes the hydrographs at Beattie's Dam, as the results discussed below will indicate.

RESULTS OF INVESTIGATIONS

The impact of implementing Plan 2 is presented numerically in Table 8. Improved versus existing discharges, the latter enclosed in parentheses as destinguishing marks, are given for a range of frequences for six main-stream locations starting with Beattie's Dam and ending with the Saddle River confluence (discharges at confluences include tributary runoff). Associated changes in stage are given in the Hydraulics Appendix.

Figure 13 shows the variation of runoff with time of the design flood for Beattie's Dam under existing conditions. It does not show the variation associated with improved conditions even though there is an increase in peak flow because the scale of the drawing is too small for the relatively small change from existing to improved conditions to be apparent. Table 9 shows this small increase and also those associated with other frequencies. It also shows the timing of the increased peaks to change by no more than two hours within the limits of accuracy of HEC1 modeling. Table 10 makes clear the degree to which runoff rates around hydrograph peaks remain nearly constant over significant time periods and define broad hydrographs.

Plan 2 was intuitively the one likely to have the greatest impact of those which provide for a modified approach channel (Plans 2, 3 and 4). This was so because it provides for the greatest length of crest capable of being dropped upon the onset

of flooding. This length was 238 feet versus 190 feet for Plan 3 and 100 feet for Plan 4 (all gates for all spillways are the same height, 8.3 feet). Plan 1, while otherwise similar to Plan 2, would lack the modified approach channel and thus have less of an impact than Plan 2.

TABLE 7

STORAGE-OUTFLOW RELATIONS
PERTINENT TO
BEATTIE'S DAM ANALYSIS

REACH OUTFLOW (CFS)	UPSTREAM OF TWO BRIDGES — EXISTING GROSS (AC-FT)	UPSTREAM OF TWO BRIDGES — EXISTING NET (B) (AC-FT)	UPSTREAM OF TWO BRIDGES — IMPR (AC-FT)	TWO BRIDGES TO BEATTIE'S DAM — EXISTING GROSS (AC-FT)	TWO BRIDGES TO BEATTIE'S DAM — EXISTING NET (C) (AC-FT)	TWO BRIDGES TO BEATTIE'S DAM — IMPR (AC-FT)
44826	-	-	-	-	(9113)	9828
37500	-	-	-	7729	7319	(5094)
27636	-	-	-	-	(4903)	3163
23212	-	-	-	-	(3819)	2416
22700	-	-	-	4104	3694	(2346)
18529	-	-	-	-	(2901)	1779
16875	-	(74692)	70124	-	-	-
16500	73380	72750	(68318)	-	-	-
13637	-	-	-	-	(1971)	1232
13100	-	-	-	2279	1869	(1185)
12383	-	(51430)	48494	-	-	-
10629	-	(42347)	37338	-	-	-
10606	-	-	-	-	(1513)	966
9500	37130	36500	(32418)	-	-	-
9121	-	(34483)	30767	-	-	-
8025	-	-	-	-	(1145)	792
7144	-	(23960)	21360	-	-	-
6400	20630	20000	(18168)	-	-	-
5773	-	-	-	-	(824)	654
5500	16687	16057	(14306)	-	-	-
5496	-	(16045)	14289	-	-	-
3606	-	(10528)	8840	-	-	-
2594	-	(7573)	6483	-	-	-
0	0	0	0	0	0	0

(A) STORAGES IN PARENTHESES ARE THOSE COMPUTED BY HEC1 USING STRAIGHT-LINE INTERPOLATION OR EXTRAPOLATION.
(B) EXCLUDES 630 AC-FT OF DEAD STORAGE.
(C) EXCLUDES 410 AC-FT OF DEAD STORAGE.

TABLE 8
(A)
EXISTING AND IMPROVED DISCHARGES
PASSAIC RIVER
POMPTON RIVER TO SADDLE RIVER

	L O C A T I O N						
FLOOD FREQ (YRS)	BELOW POMPTON RIVER (CFS)	AT LITTLE FALLS (B) (CFS)	BELOW PECKMAN RIVER (CFS)	AT S.U.M. DAM (CFS)	BELOW DIAMOND BROOK (CFS)	AT DUNDEE DAM (CFS)	BELOW SADDLE RIVER (CFS)
ONE	5577 (5489)	5880 (5784)	5887 (5792)	5902 (5805)	5913 (5816)	5908 (5812)	5974 (5876)
TWO	7992 (7773)	8270 (8037)	8273 (8039)	8283 (8050)	8291 (8061)	8293 (8063)	8354 (8128)
FIVE	10505 (10253)	10888 (10615)	10900 (10619)	10933 (10637)	10965 (10652)	10978 (10670)	11127 (10757)
TEN	13356 (13148)	13927 (13653)	13944 (13669)	13990 (13705)	14035 (13740)	14057 (13762)	14278 (13941)
25	18139 (17919)	18831 (18555)	18859 (18579)	18907 (18623)	18952 (18659)	18966 (18665)	19267 (18940)
50	22882 (22589)	23638 (23278)	23674 (23308)	23731 (23370)	23788 (23424)	23794 (23425)	24243 (23856)
100	27416 (27049)	28256 (27760)	28301 (27805)	28375 (27874)	28452 (27948)	28455 (27955)	29061 (28524)
500	44545 (43980)	45594 (44868)	45692 (44953)	45835 (45108)	45985 (45244)	46006 (45262)	47185 (46403)
(C)	44392 (43745)	45503 (44766)	45552 (44806)	45614 (44870)	45672 (44923)	45638 (44909)	46419 (45610)

(A) EXISTING-CONDITIONS FLOWS ARE IN PARENTHESES AND CORRESPOND TO "Q4" IN TABLE 38, PHASE I G.D.M.
(B) ALSO AT BEATTIE'S DAM. CORRESPONDS TO COLUMN 2, TABLE 10.
(C) STANDARD PROJECT FLOOD. FREQUENCY UNASSIGNED.

TABLE 9

CHANGES IN FLOOD PEAKS
AND TIMING ASSOCIATED WITH
THE IMPLEMENTATION OF PLAN 2 (A)

LITTLE FALLS GAGING STATION

FREQ (YRS)	COND	HOURS BEFORE OR AFTER EXISTING-CONDITIONS PEAK (B) -3 (CFS)	-2 (CFS)	-1 (CFS)	0 (CFS)	+1 (CFS)	+2 (CFS)
ONE	EXIST		5748	5773	5783	5781	5766
	IMPR		5852	5873	5880	5874	5855
TWO	EXIST		8003	8024	8037	8022	7974
	IMPR		8244	8264	8270	8234	8155
FIVE	EXIST		10592	10610	10618	10613	10598
	IMPR	10865	10881	10888	10883	10863	
TEN	EXIST		13605	13637	13653	13650	13632
	IMPR	13916	13927	13918	13894		
25	EXIST		18470	18529	18555	18549	18513
	IMPR	18750	18805	18831	18830	18803	
50	EXIST		23211	23265	23278	23258	23200
	IMPR	23512	23597	23638	23636	23595	
100	EXIST	27601	27709	27759	27759	27717	27636
	IMPR	28183	28248	28256	28220	28146	

(A) FLOOD PEAKS (HIGHEST ORDINATES OF HEC1 OUTPUT) ARE UNDERLINED.
(B) RELATIVE TIMING. ABSOLUTE TIMES OF OCCURRENCE OF EXISTING-CONDITIONS PEAKS VARY BY AS MUCH AS 14 HOURS DUE TO RAINFALL DISTRIBUTION PATTERNS AND INITIAL AND CONSTANT LOSSES USED AND TO THE VARIATION OF FLOOD ATTENUATION IN GREAT PIECE MEADOWS WITH FLOOD MAGNITUDE.

TABLE 10

HYDROGRAPH ORDINATES AROUND PEAKS (A)

EXISTING AND IMPROVED CONDITIONS

LITTLE FALLS GAGING STATION

FLOOD FREQ (YRS)	AVERAGE ORDINATES ONE HOUR (B) (CFS)	SIX HOURS (CFS)	24 HOURS (CFS)
ONE	5880 (5784)(C)	5859 (5762)	5627 (5530)
TWO	8270 (8037)(C)	8234 (8005)	7998 (7793)
FIVE	10888 (10615)(C)	10870 (10601)	10817 (10547)
TEN	13927 (13653)(C)	13905 (13627)	13619 (13357)
25	18831 (18555)(C)	18790 (18505)	18185 (17852)
50	23638 (23278)(C)	23574 (23220)	22771 (22393)
100	28256 (27760)(C)	28183 (27690)	27208 (26723)
500	45594 (44868)(C)	45454 (44732)	43517 (42923)
(D)	45503 (44766)(C)	45359 (44644)	43587 (43007)

(A) EXISTING-CONDITIONS FLOWS ARE IN PARENTHESES.
(B) HEC1 REPORTS THIS AS THE INSTANTANEOUS PEAK.
(C) CORRESPONDS TO "Q4" IN TABLE 38, PHASE I G.D.M.
(D) STANDARD PROJECT FLOOD. FREQUENCY UNDEFINED.

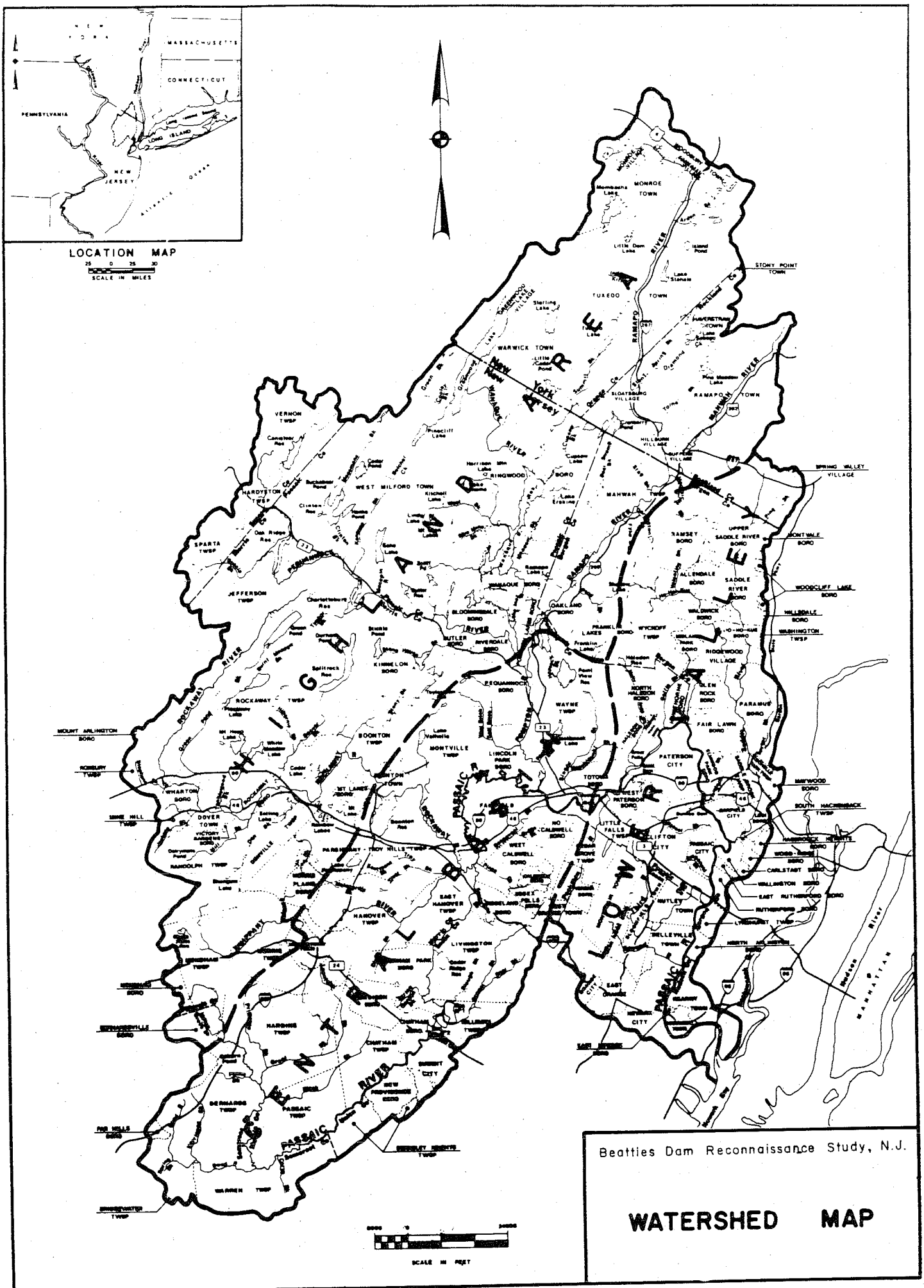

LOCATION MAP
SCALE IN MILES
Beatties Dam Reconnaissance Study, N.J.
WATERSHED MAP
SCALE IN FEET

FIGURE 1

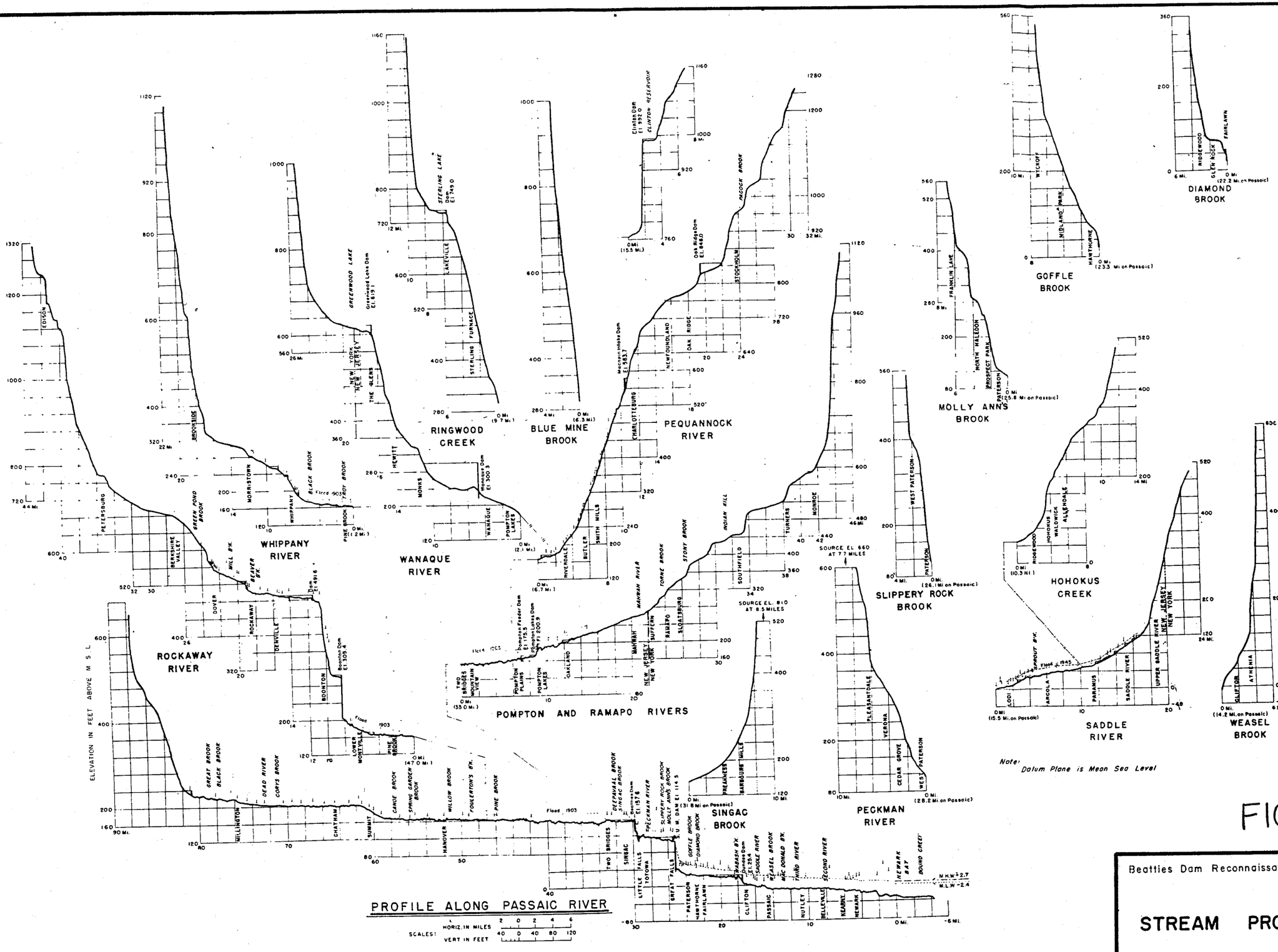


FIG. 2

Beatties Dam Reconnaissance Study, N.J.

STREAM PROFILES

FIGURE 2

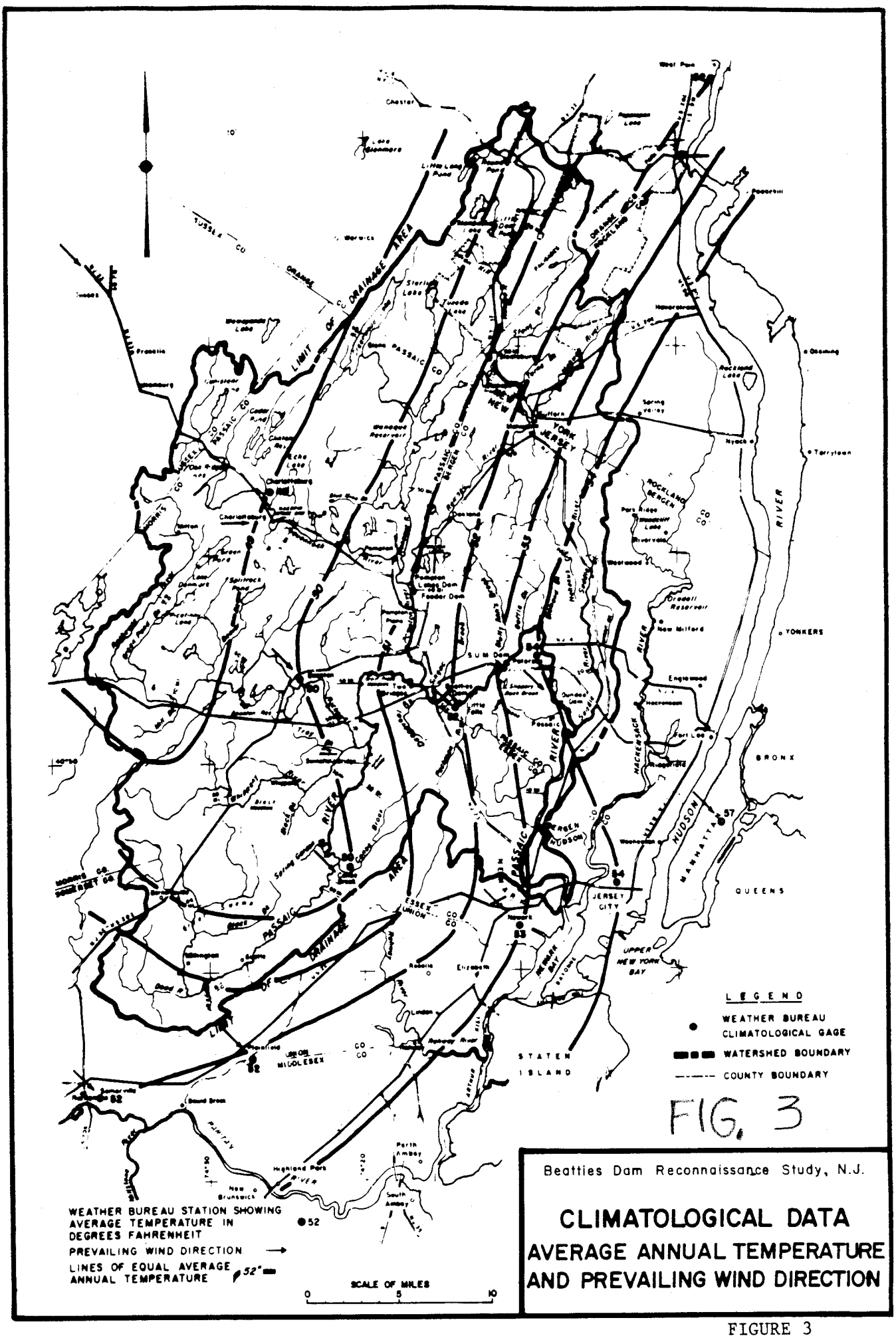


FIG. 3

Beatties Dam Reconnaissance Study, N.J.

CLIMATOLOGICAL DATA
AVERAGE ANNUAL TEMPERATURE AND PREVAILING WIND DIRECTION

FIGURE 3

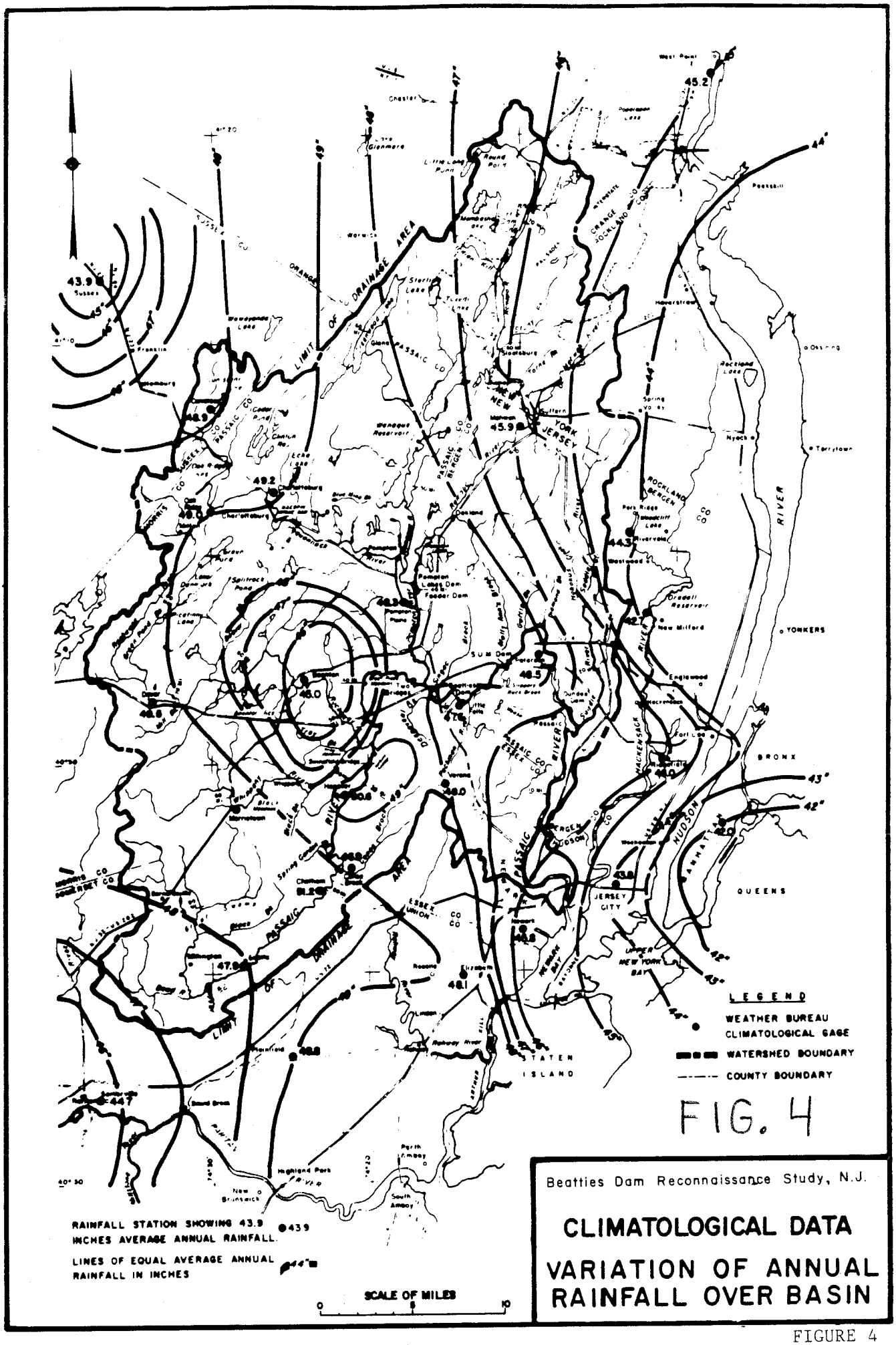


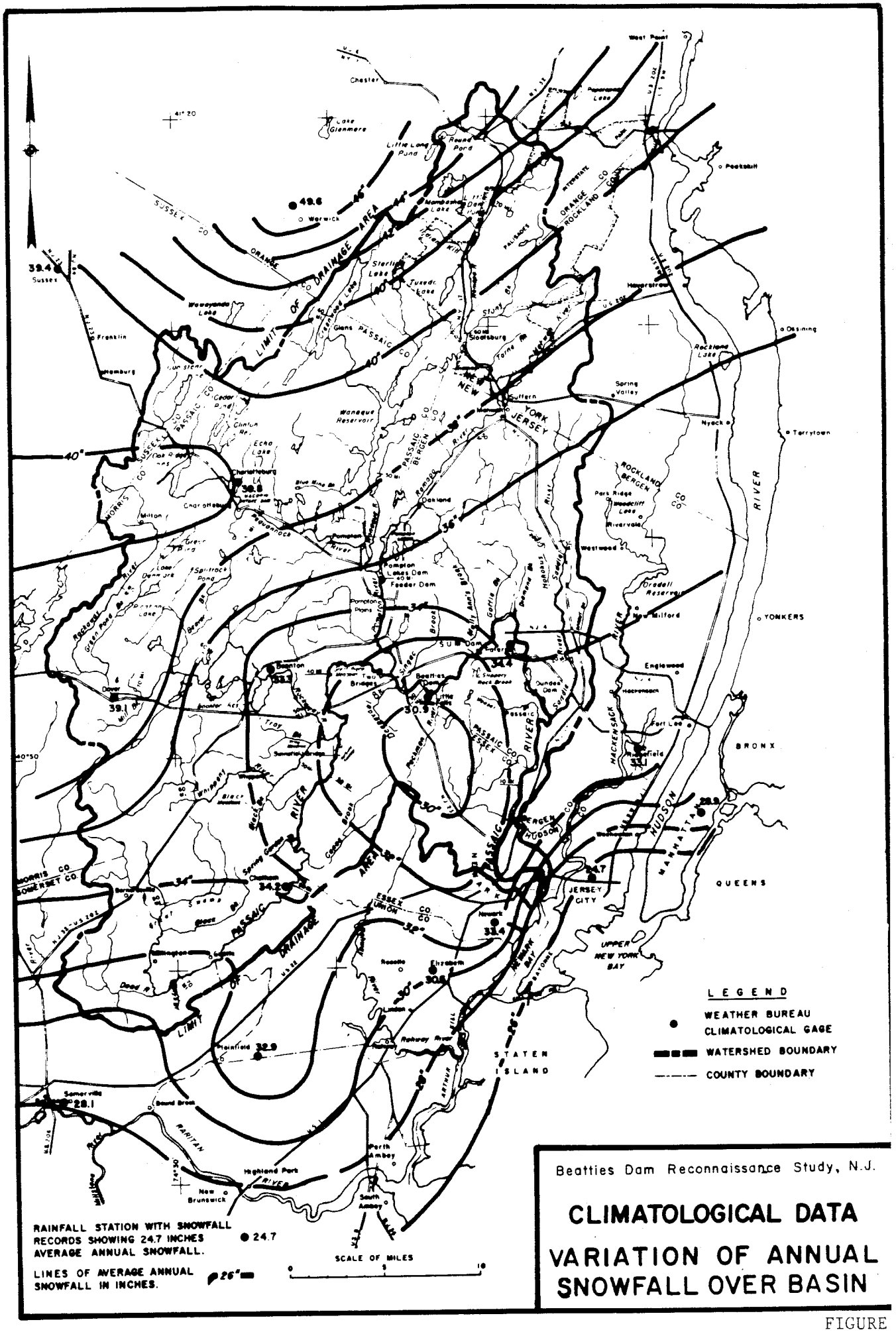
FIG. 4

Beatties Dam Reconnaissance Study, N.J.

CLIMATOLOGICAL DATA

VARIATION OF ANNUAL RAINFALL OVER BASIN

FIGURE 4

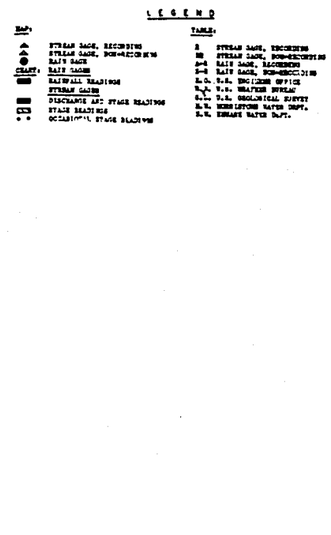

LEGEND
WEATHER BUREAU CLIMATOLOGICAL GAGE
WATERSHED BOUNDARY
COUNTY BOUNDARY
RAINFALL STATION WITH SNOWFALL RECORDS SHOWING 24.7 INCHES AVERAGE ANNUAL SNOWFALL.
24.7
LINES OF AVERAGE ANNUAL SNOWFALL IN INCHES.
26"
SCALE OF MILES
0
5
10
LIMIT OF DRAINAGE AREA
PASSAIC RIVER
HUDSON RIVER
RARITAN RIVER
NEWARK BAY
UPPER NEW YORK BAY
STATEN ISLAND
JERSEY CITY
QUEENS
BRONX
YONKERS
Beatties Dam Reconnaissance Study, N.J.
CLIMATOLOGICAL DATA
VARIATION OF ANNUAL SNOWFALL OVER BASIN

FIGURE

	№	STREAM	LOCATION	GAGE EL. FT. MSL	TYPE GAGE	AGENCY
RAIN GAGES	1	Passaic	Newark	11		
	2	Canal	Jersey City	12		
	3	Rockaway	Ridgefield	80		
	4	DO	New Milford	112		
	5		Woodcliff Valley, NY	183		
	6		Spring Valley, NY	464		
	7	Passaic	Paterson	100		
	8		Little Falls	156		
	9		Cedar Grove	408		
	10		Rutherford	11		
	11		Kingston Plains	192		
	12		Hohokus	151		
	13		Palisade Park, NY	1052		
	14		Southfield, NY	245		
	15		Raymond Dam (Tennessee)	202		
	16		Ringwood	295		
	17		Greenwood Lake	466		
	18		Pompton Dam	255		
	19		Charlottenburg	786		
	20		Newfoundland	786		
	21		Ocean Park	1062		
	22		Oak Ridge Reservoir	670		
	23		Canistar Reservoir	1062		
	24		Milton	255		
	25		Morris Plains	255		
	26		Boonton	255		
	27		Green Valley	255		
	28		Rockaway	255		
	29		Split Rock Pond	255		
	30		Dover	255		
	31		Bowling Green Mtn	255		
	32		Hanover	255		
	33		Morristown Mun. Bldg	255		
	34		Morristown Ast	255		
	35		Meadland	255		
	36		Verona	255		
	37		Orange	255		
	38		Cheney Brook	255		
	39		Chatham	255		
	40		Gillette	255		
	41		Millington	255		
	42		Saffern, NY	255		
	43		Midland Park	255		
	44		Allendale	255		
	45		Bernardsville	255		
	46		Upper Falls	255		
	47		West Wharton	255		
	48	New Jersey	Vernon	255		
	49	Delaware	Boonton	255		
	50	Raritan	Somerville	255		
	51		Watchung	255		
	52	Raritan	Plainfield	255		
	53		Westfield	255		
	54	Rahway	Springfield	255		
	55	Cedar	Elizabeth	255		
	56		Elizabethport	255		
	57		New York, NY	255		
	58	Hudson	West Point, NY	255		
	59		Warwick, NY	255		
	60		Bear Mountain, NY	124		
				DRAINAGE SQ.MI.		
STREAM GAGES	1	Passaic R.	Erie RR Br. - Newark	605.9		
	2	Second R.	Belleville	11.6		
	3	Passaic R.	Avondale Bridge	803.6		
	4	DO	Gregory Avenue Bridge	884.1		
	5	Wessel Br.	Clifton	2.45		
	6	Saddle Br.	Lodi	54.6		
	6A	Hohokus Br.	Hohokus	16.4		
	7	DO	Ridgewood	71.6		
	8	Passaic R.	Ackerman Ave Br.	818.7		
	9	DO	Dundee Dam	809.9		
	10	DO	Crooks Ave Br.	809.8		
	11	DO	Market Ave Br.	804.3		
	12	DO	Moffat Br - E. 19 St	798.6		
	13	DO	Straight St Br.	798.1		
	14	DO	Paterson (S.U.N. Dam)	795.0		
	15	DO	Lincoln Br.	376.1		
	16	DO	Lackawanna Ave Br.	762.0		
	17	DO	Little Falls	762.0		
	18	DO	Little Falls (Beatties Dam)	762.0		
	19	DO	Stegac Route 23	762.8		
	20	Pompton R.	Two Bridges	378.1		
	21	DO	DL & W RR - Lincoln Park	373.1		
	22	DO	Route 23 Hwy Br.	364.4		
	23	DO	Pequannock	364.0		
	24	DO	Lower Pompton Tail	363.8		
	25	DO	Upper Pompton - Head	363.8		
	26	DO	Upper Pompton - Tail	363.8		
	27	DO	Pompton Plains	364.0		
	28	Pequannock R.	Macopin Intake	63.7		
	29	Macopin R.	Echo Lake Res.	4.36		
	30	Clinton Br.	Clinton Res.	16.5		
	31	Pequannock R.	Oak Ridge Res.	27.3		
	32	Packer Br.	Canistear Res.	8.4		
	33	Monogue R.	Raymond Dam	90.4		
	34	DO	Raymond Dam	90.4		
	35	Pine Mine Br.	Monogue	1.71		
	36	West Br.	Monogue	11.8		
	37	Canoe Br.	Monogue	4.38		
	38	Monogue R.	Ramsey	40.4		
	39	DO	Spotting	57.1		
	40	DO	Greenwood Lake	77.1		
	41	Ringwood Cr.	Monogue	19.1		
	42	Ramapo R.	Pompton Lakes	166.0		
	43	DO	Oakland	148.1		
	44	DO	Mahwah	118.0		
	45	Passaic R.	Two Bridges	367.7		
	46	DO	Harwood Br.	364.0		
	47	DO	Pine Brook Br.	284.4		
	48	Rockaway R.	Boonton Dam (Below)	115.0		
	49	DO	Boonton Dam (Above)	114.0		
	50	Beaver Br.	Split Rock Pond	4.6		
	51	Whippany R.	Whippany Dam	12.6		
	52	DO	Morristown	29.4		
	53	Passaic R.	Chatham	224.4		
	54	DO	Stanley	100.0		
	55	DO	Millington	106.3		
	56	Rahwah R.	Suffern	16.4		
				12		

PERIOD OF RECORD

1820 1840 1860 1880 1900 1910 1920 1930 1940 1950 1960 1970 1980



Beatties Dam Reconnaissance Study, N.J.

RAIN AND STREAM GAGES

FIGURE 6

FIG. 6

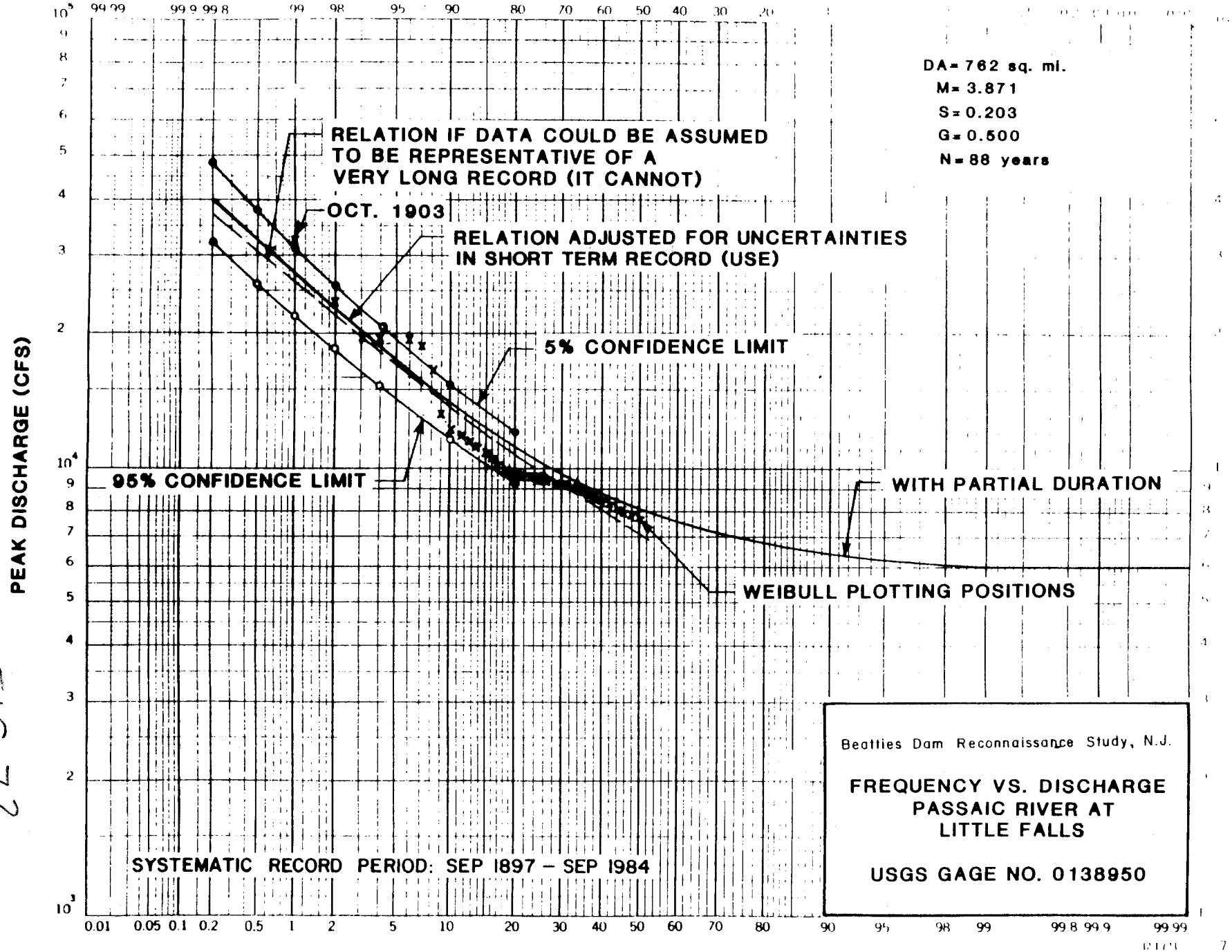

99.99
99.9 99.8
99
98
95
90
80
70
60
50
40
30
20
DA= 762 sq. mi.
M= 3.871
S= 0.203
G= 0.500
N= 88 years
RELATION IF DATA COULD BE ASSUMED TO BE REPRESENTATIVE OF A VERY LONG RECORD (IT CANNOT)
OCT. 1903
RELATION ADJUSTED FOR UNCERTAINTIES IN SHORT TERM RECORD (USE)
5% CONFIDENCE LIMIT
95% CONFIDENCE LIMIT
WITH PARTIAL DURATION
WEIBULL PLOTTING POSITIONS
PEAK DISCHARGE (CFS)
SYSTEMATIC RECORD PERIOD: SEP 1897 – SEP 1984
0.01
0.05
0.1
0.2
0.5
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.8
99.9
99.99
Beatties Dam Reconnaissance Study, N.J.
FREQUENCY VS. DISCHARGE
PASSAIC RIVER AT
LITTLE FALLS
USGS GAGE NO. 0138950

FIG. 7?

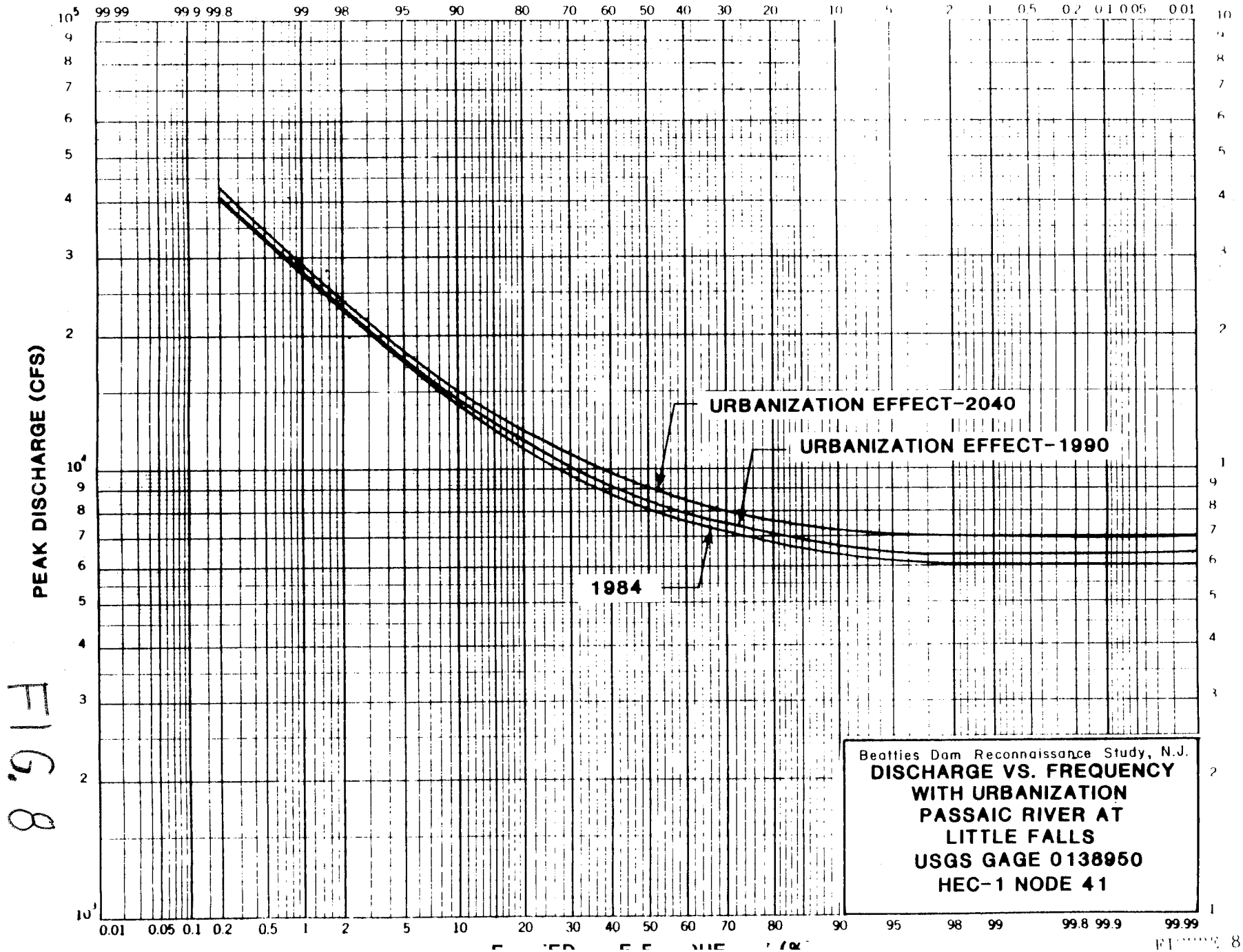
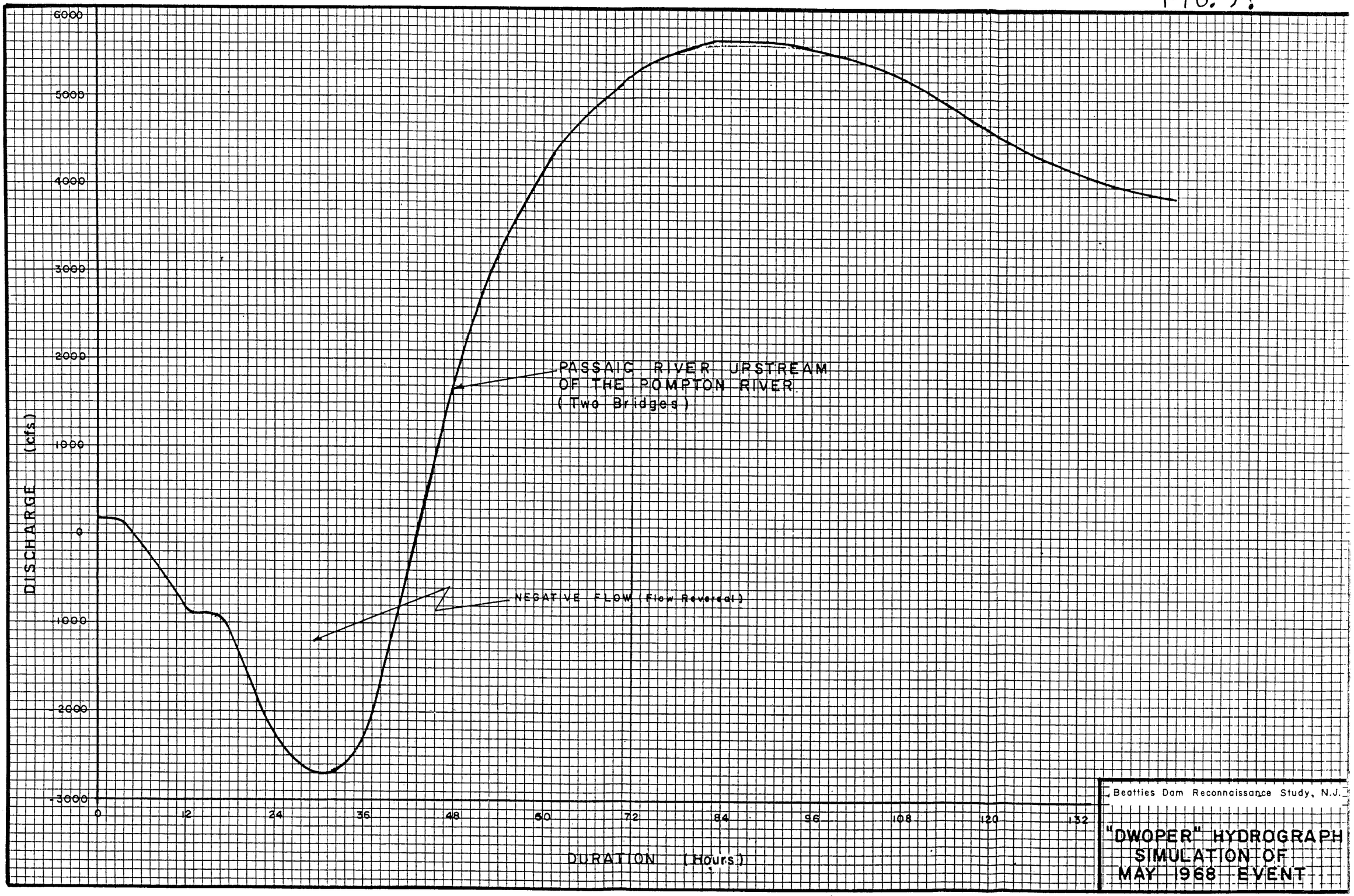

PEAK DISCHARGE (CFS)
URBANIZATION EFFECT-2040
URBANIZATION EFFECT-1990
1984
Beatties Dam Reconnaissance Study, N.J.
DISCHARGE VS. FREQUENCY
WITH URBANIZATION
PASSAIC RIVER AT
LITTLE FALLS
USGS GAGE 0138950
HEC-1 NODE 41

FIG 8

FIG. 9?


6000
5000
4000
3000
2000
1000
0
-1000
-2000
-3000
DISCHARGE (kfs.)
0
12
24
36
48
60
72
84
96
108
120
132
DURATION (Hours)
PASSAIC RIVER UPSTREAM OF THE POMPTON RIVER (Two Bridges)
NEGATIVE FLOW (Flow Reversal)
Beatties Dam Reconnaissance Study, N.J.
"DWOPER" HYDROGRAPH SIMULATION OF MAY 1968 EVENT

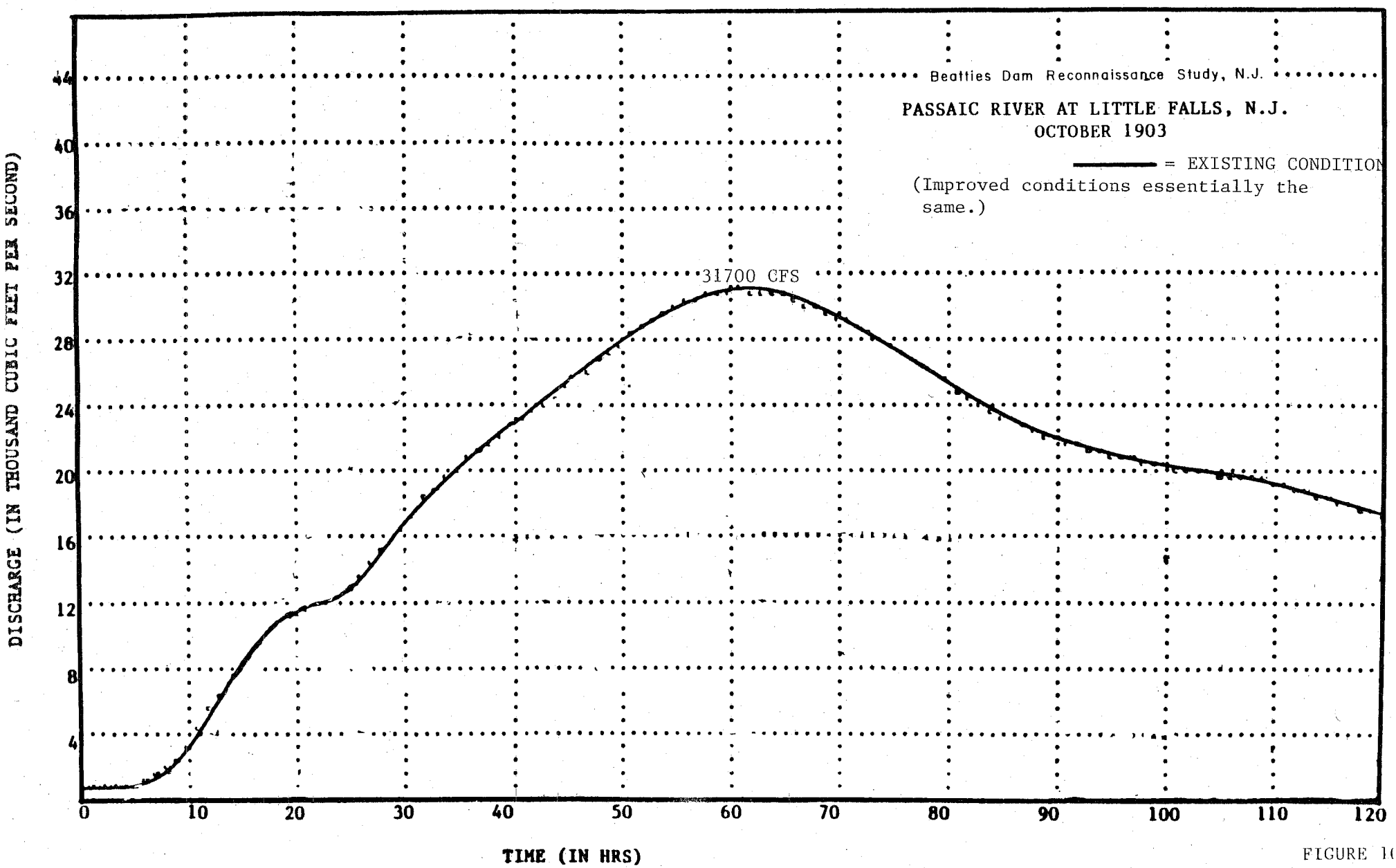
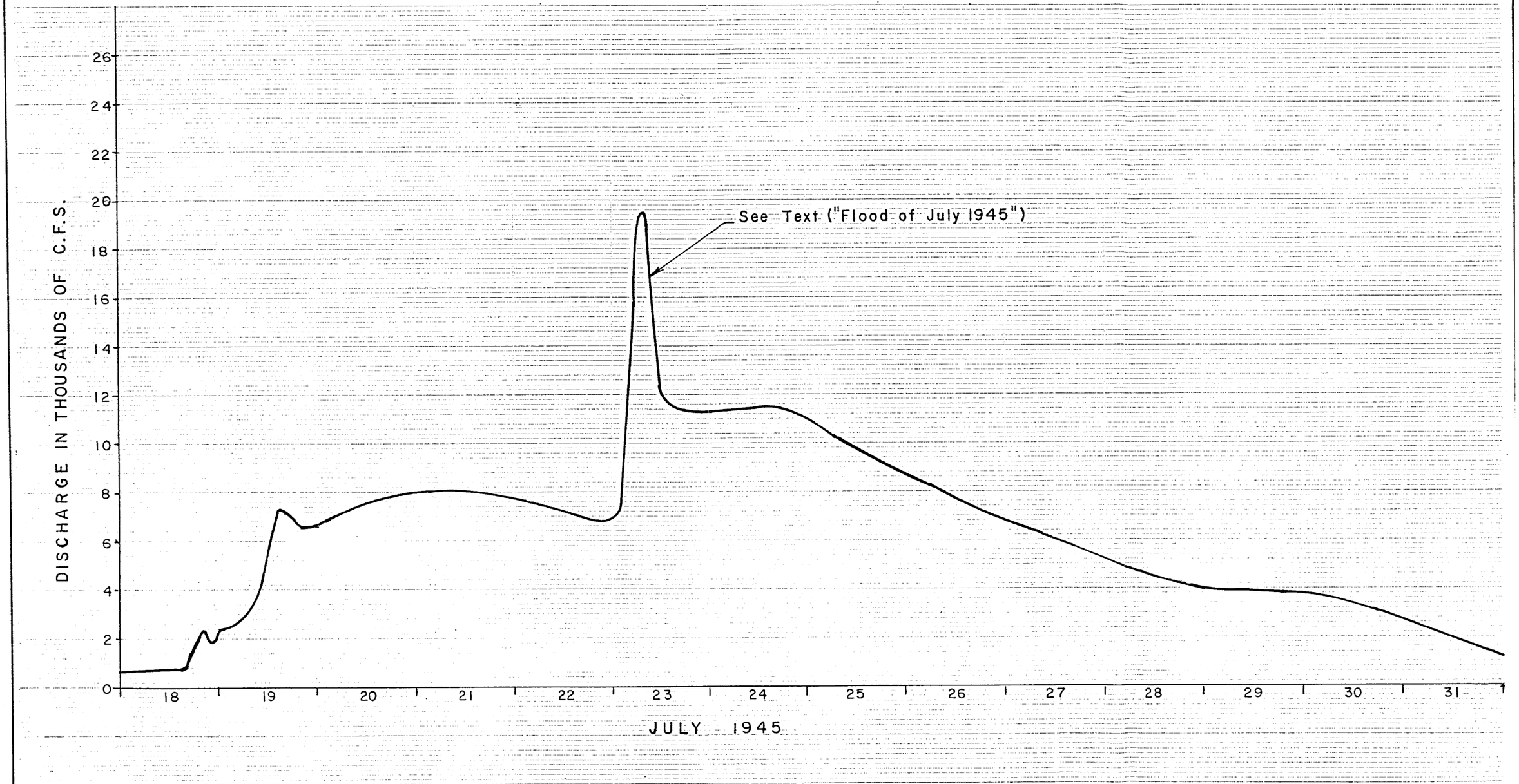

Beatties Dam Reconnaissance Study, N.J.
PASSAIC RIVER AT LITTLE FALLS, N.J.
OCTOBER 1903
= EXISTING CONDITION
(Improved conditions essentially the same.)
31700 CFS
DISCHARGE (IN THOUSAND CUBIC FEET PER SECOND)
TIME (IN HRS)
0
10
20
30
40
50
60
70
80
90
100
110
120
4
8
12
16
20
24
28
32
36
40
44

FIGURE 10



Beatties Dam Reconnaissance Study, N.J.

FLOOD OF JULY 1945
PASSAIC RIVER AT
S.U.M. DAM (Former
U.S.G.S. GAGING Station)

FIGURE

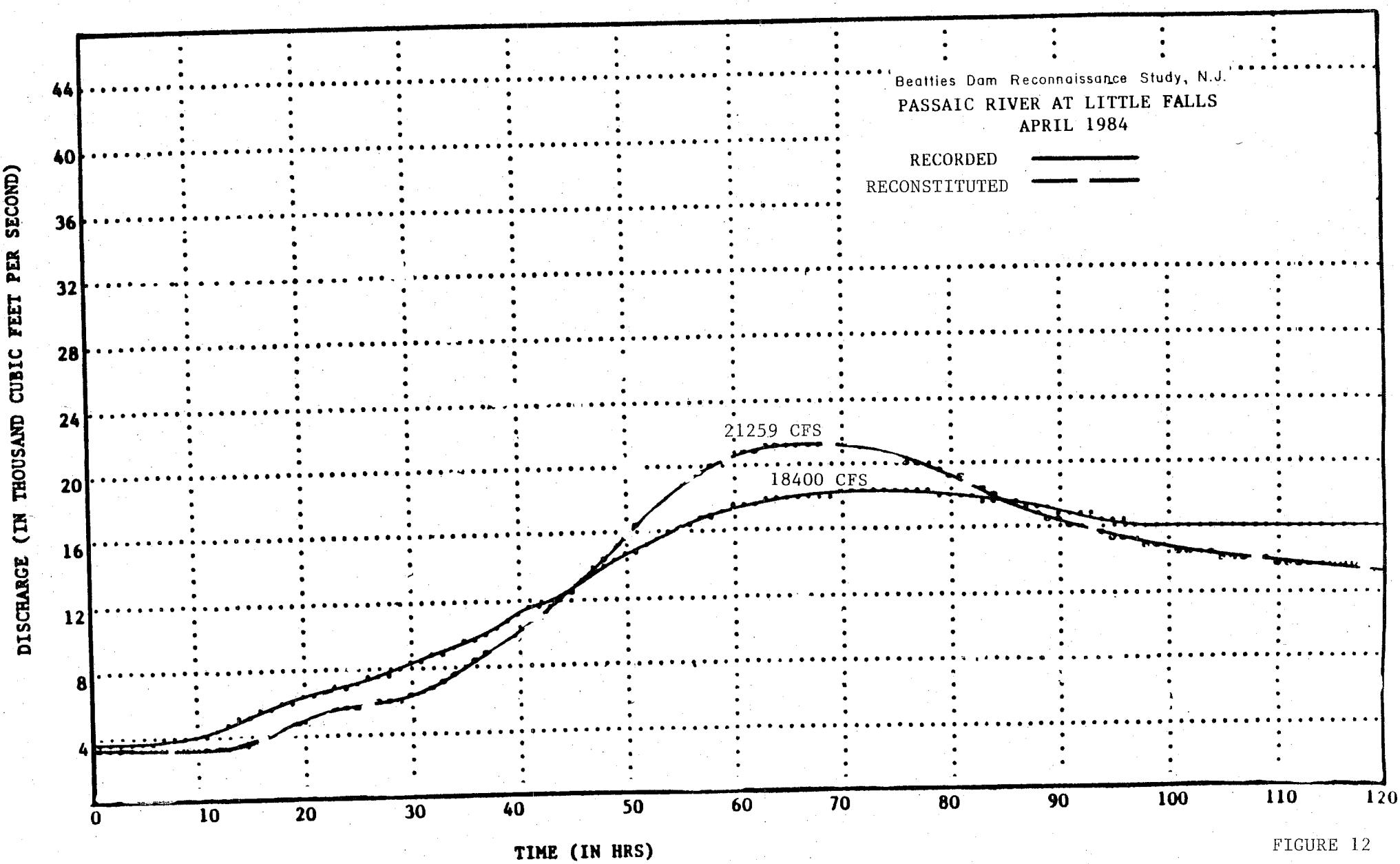

Beatties Dam Reconnaissance Study, N.J.
PASSAIC RIVER AT LITTLE FALLS
APRIL 1984
RECORDED
RECONSTITUTED
21259 CFS
18400 CFS
DISCHARGE (IN THOUSAND CUBIC FEET PER SECOND)
TIME (IN HRS)
4
8
12
16
20
24
28
32
36
40
44
0
10
20
30
40
50
60
70
80
90
100
110
120

FIGURE 12

PASSAIC RIVER, VICINITY OF BEATTIES DAM

RECONNAISSANCE REPORT

APPENDIX B - ENGINEERING

SECTION 2 - HYDRAULICS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES - continued

I. GENERAL (INTRODUCTION)

A. LOCATION

Beatties Dam is located on the Passaic River in the Townships of Little Falls and Wayne, Passaic County, New Jersey. Beatties Dam is situated at the border of the Central Basin and Lower Valley areas of the Passaic River Basin. (The Central Basin and Lower Valley are two of the three topographic regions within the Passaic River Basin. The Lower Valley extends from the mouth of the Passaic River at Newark Bay upstream to Beatties Dam. The Central Bay extends from Beatties Dam to the headwaters). Although the potential project area extends from Beatties Dam upstream for 3.2 miles to Two Bridges, in order to assess the potential impacts to both downstream communities and upstream wetland areas, the hydraulic study area extends along the Passaic River from Dundee Dam in the Lower Valley to Pine Brook in the Central Basin, a distance of 28.3 miles.

B. SCOPE OF STUDY

This section of the report summarizes the existing and improved conditions reconnaissance-level hydraulic studies for the Passaic River in the vicinity of Beatties Dam, including the relationship to the Main Stem Passaic River Tunnel Plan, a Corps of Engineer's recommended plan which would provide flood protection to the Beatties Dam study area.

C. CHANNEL AND DAM DESCRIPTION

Channel - The river channels in the Central Basin area have mild slopes and extremely large amounts of natural storage volume that tend to dampen the flood peaks from the Highland area of the Passaic River Basin. The flooding in the Central Basin is due to the combination of the mild gradients and insufficient channel capacities of the Passaic and Pompton Rivers. Locally, between Beatties Dam and Two Bridges the flooding problem is worsened by the backwater effect caused by the natural channel constriction occurring in this reach.

Dam - Beatties Dam is a concrete dam with a structural and hydraulic height of 19.3 feet. The dam's crest is a 267 foot long broad-crested overflow spillway in three sections - an arched 152 foot center section (concave downstream), a 55 foot side flow spillway typing into a condominium building which serves as the right abutment, and 60 foot left wingwall typing into the left abutment. The dam's crest width is about 5 feet, the upstream face is 2H:1V for four feet then nearly vertical, and the slope of the downstream face is 1H:1-1/2V.

The Beatties Dam is constructed on a natural rock outcrop that forms a large falls on the Passaic River. The dam was originally constructed to provide water and power to Beatties' factory complex adjacent to the river. The dam currently does not provide any hydro-power and its only function is to maintain the pool elevation upstream of the dam. The Passaic Valley Water Commission has a water intake on the river that is dependent on this pool elevation. The dam has a minor impact on flood elevations along the Passaic River upstream to Two Bridges.

D. PREVIOUS REPORTS

A flood protection feasibility report for the Main Stem Passaic River was completed by the Corps of Engineers in December 1987. Much of the existing conditions hydraulic data utilized for this Beatties Dam study was based on this previous report. Other prior reports pertaining to the Beatties Dam study area are discussed in the Plan Formulation Appendix.

II. HYDRAULIC BASIS OF DESIGN

A. RETRIEVAL AND DEBUGGING OF EXISTING CONDITIONS

The existing conditions HEC-2 models for the Passaic River were developed as part of the overall Passaic River Basin Phase I Study. The HEC-2 runs cover a reach length of about 28 miles extending from Dundee Dam on the Passaic River upstream to the Pine Brook and Passaic River confluence. According to the procedures and guidelines recommended in the "HEC-2 Water Surface Profiles Users Manual," September, 1982, all the existing conditions HEC-2 input data were thoroughly debugged and checked in preparation for the reconnaissance analysis of Beatties Dam modifications.

B. PREVIOUSLY USED CALIBRATION AND HYDRAULIC LOSSES

In order to compute and predict the flood stages of storm events having hypothetical frequencies, the reproduction of the existing condition river hydraulics were calibrated with the selected historical storms by matching published or field surveyed floodmarks. The computation of the hypothetical hydraulic flowlines were based on the incorporation of the discharges generated from the HEC-1 hydrologic model into the existing conditions hydraulic model. The calibration of the existing conditions hydraulic models utilized in this Reconnaissance Report was accomplished as part of the overall Passaic River Basin Phase I Study. The calibrated hydraulic model satisfactorily matched the historical floodmarks along the Passaic River in the study reach. The reproduction of the hydraulic model in the Central Basin, for the Passaic River from Beatties Dam to Pine Brook was accomplished with the aid of a DWOPER Model which is discussed in supporting documentation Part II, Flood

Protection Feasibility Report, Main Stem Passaic River, December, 1987. Table 1 presents a comparison of published and field surveyed floodmarks and HEC-2 computed elevations for the floods actually used in the calibration. The roughness coefficients (n values) used in the calibration of the Passaic River existing conditions HEC-2 hydraulic models, from Dundee Dam to Pine Brook, ranged from 0.025 to 0.035 for channel sections for different degrees of vegetation. Similarly for overbank sections, values ranging from 0.06 to 0.15 were used to account for varying conditions. A contraction value of 0.3 and expansion value of 0.5 were used. Bridge loss coefficients were computed using entrance and exit losses plus a friction loss. The magnitudes of all these coefficients were based on working experience and/or recommended values in the HEC-2 User's Manual and Chow's "Open Channel Hydraulics." The roughness coefficients used for calibration of the existing conditions hydraulic model are shown in Table 2.

C. STARTING WATER SURFACE ELEVATIONS

Approximately 80 feet downstream of Beatties Dam (station 1568+16), there is a large drop in elevation. This section is a hydraulic control section, i.e., critical depth occurs at this location. Therefore, the critical depth at this section was used as the starting water surface elevation for all the profiles.

D. FLOWLINE COMPUTATIONS

The flowline computations were based on starting at the control section downstream of Beatties Dam and determining the changes in the hydraulic gradient by the application of the Laws of Continuity and Conservation of Energy as described in EM 1110-2-1409, "Backwater Curves in River Channel." Flowline computations were accomplished with the used of the HEC-2 "Water Surface Profiles" computer program.

The flowlines were developed for the 1-YR, 2-YR, 5-YR, 10-YR, 25-YR, 50-YR, 100-YR, and the Standard Project Flood (SPF). The hydraulic profiles depicting several of the flood events for the existing conditions are given in Figures 1 and 2.

III. HYDRAULIC DESIGN OF IMPROVEMENTS

A. DESCRIPTION OF ALTERNATIVES

Four alternative flood control plans were evaluated as part of this reconnaissance study. They are briefly described below, with more detail and plan layouts provided in the Plan Formulation Appendix.

Plan 1 - Entire dam replacement utilizing gated structures.

TABLE 1 - FLOODMARK CALIBRATION

PASSAIC RIVER

LOCATION	DATE	AGENCY	RECORDED ELEVATION (FT.)	CALIBRATED ELEVATION (FT.)
5TH AVENUE BRIDGE	MAY, 1968	PASSAIC COUNTY	35.0	35.19
WEST BROADWAY	MAY, 1968	PASSAIC COUNTY	45.3	45.04
LACKAWANNA IN WEST PATERSON	MAY, 1968	PASSAIC COUNTY	127.9	128.19
LITTLE FALLS GAGE	MAY, 1968	U.S.G.S.	130.73	130.55
I-80 IN WAYNE	MAY, 1968	PASSAIC COUNTY	168.5	168.15
TWO BRIDGES ROAD	MAY, 1968	PASSAIC COUNTY	168.8	169.79
HORSENECK ROAD	MAY, 1968	PASSAIC COUNTY	170.1	169.49
PINE BROOK GAGE	MAY, 1968	U.S.G.S.	170.4	170.36

TABLE 2 - ROUGHNESS COEFFICIENTS

PASSAIC RIVER

FROM	TO	LEFT OVER BANK	RIGHT OVER BANK	CHANNEL
DUNDEE DAM	ROUTE 46	0.06	0.06	.025
ROUTE 46	ROUTE 80	0.06	0.06	.03
ROUTE 80	MARLOT AVENUE BRIDGE	0.10	0.10	.03
MARLOT AVENUE BRIDGE	5TH AVENUE BRIDGE	0.06	0.06	.025
5TH AVENUE BRIDGE	WAGRAW BRIDGE	0.08	0.08	.025
WAGRAW BRIDGE	PATERSON FALLS	0.08	0.08	.035
PATERSON FALLS	LACKAWANNA AVENUE BRIDGE	0.08	0.08	.035
LACKAWANNA AVENUE BRIDGE	BEATTIES DAM	0.10	0.10	.035
BEATTIES DAM	ROUTE 23	0.10	0.10	.03
ROUTE 23	TWO BRIDGES	0.10	0.08	.03
TWO BRIDGES	PINE BROOK	0.15	0.15	.035

Plan 2 - Entire dam replacement utilizing gated structures, in conjunction with channel modification extending from Beatties Dam upstream for approximately 0.9 miles.

Plan 3 - Replacement of 200 feet of dam utilizing gated structures, in conjunction with channel modification extending from Beatties Dam upstream for approximately 0.9 miles.

Plan 4 - Replacement of 100 feet of dam utilizing gated structures, in conjunction with channel modification extending from Beatties Dam upstream for approximately 0.9 miles.

B. SELECTION OF GATE

The gates at Beatties Dam would either partially or entirely replace the existing concrete spillway. All replacements would require the removal of approximately eight (8) feet of vertical height of the dam. During normal flow the pool elevation upstream of Beatties Dam would be maintained and during flood conditions, the gates would open to lower upstream elevations. The two types of gates investigated as possible alternatives for the modification of the Beatties Dam were tainter gates and bascule gates. After discussions with other Corps Districts, manufacturers and operators of the gates, the use of bascule gates for application at Beatties Dam was recommended. The reasons are as follows:

1. Due to the gate heights and weir lengths available in this design, the bascule gates are more economical than tainter gates for the defined project conditions.

2. Because bascule gates drop during flood conditions, they are not as prone to debris jam and silt build-up during operation as are the tainter gates.

3. The bascule gates offer a clear unobstructed flow over the gates for all storms as opposed to tainter gates which must be raised and could obstruct flow with the gates themselves or the required access bridges and control structures for storms larger than the design event.

4. The bascule gates offer a greater individual gate length which reduces the number of piers and access bridges required. Tainter gates are usually designed to have lengths that do not exceed 2 x their height.

5. The bascule gates, which are designed to allow flow over the crest of the gates, better duplicate existing flow conditions whereas tainter gates are designed to only allow flow below the gates.

C. IMPROVED CONDITIONS PROFILES

The existing conditions HEC-2 models were modified to reflect the dam and channel modifications for the alternative flood control plans. The plans were analyzed using discharges projected for the year 1990. The computation of flowlines for improved conditions was similar to that described for existing conditions. Improved conditions profiles are presented in Figures 3 to 14. Rating curves comparing the four alternative plans to 1990 existing conditions at selected locations are provided in Figures 16 to 23.

D. DAM AND GATE HEAD COMPUTATIONS

To obtain more accurate results, the water surface elevations at Beatties Dam were computed by hand calculations and then input to the HEC-2 model to initiate the computations. The weir flow coefficient used for the existing spillway and proposed bascule gates are 3.2 and 3.1, respectively. The discharge coefficient of 3.1 was based on the manufacturer's recommendation.

E. TAILWATER EFFECTS

As part of the modifications to Beatties Dam, a 5 foot drop immediately downstream of the dam is proposed. This excavation in conjunction with the large drop in elevation which presently exists approximately 80 feet downstream of dam results in downstream tailwater effects which are minor for all floods less than the 500-year and SPF flood events. The downstream tailwater effects were accounted for in Plan 2. Table 3 shows the effects of tailwater elevations on Plan 2. Table 4 gives a comparison of existing 1990 conditions to Plan 2 with tailwater effects. Rating curves of Plan 2 with tailwater effects are presented in Figures 20 to 23.

F. NATIONAL DAM SAFETY INSPECTION

Beatties Dam was inspected under the National Dam Inspection Act, Public Law 92-367 and the results published in the Phase 1 Inspection Report, Beatties Mill Dam, #NJ100821, August 1981, Philadelphia District, US Army Corps of Engineers. The dam is listed as a significant hazard potential structure, and is judged to be in fair overall condition. The dam's spillway is considered inadequate with a capacity to pass flow equal to 30 percent of the Spillway Design Flood (SDF equals one half the Probable Maximum Flood which is approximately equal to the Standard Project Flood). The study recommended no further detailed hydraulic or hydrologic studies due to the limited site condition. A copy of an executive summary is included as Attachment A. The design spillway for Plan 2, the most extreme of the four alternatives, will safely pass about 90 percent of the SPF in the

TABLE 3 - TAILWATER EFFECTS ON PLAN 2

(STATION 1568+65 - BEATTIES DAM)

FREQUENCY	ELEVATION W/O T.W. EFFECT	ELEVATION W/T.W. EFFECT	DIFFERENCE
1	153.94	153.94	0
2	154.91	154.91	0
5	155.91	155.91	0
10	156.99	157.01	0.02
25	158.57	158.63	0.06
50	159.97	160.07	0.10
100	161.18	161.40	0.22
500	165.37	166.05	0.68
SPF	165.38	166.04	0.66

TABLE 4 - COMPARISON OF FLOOD STAGES

(EXISTING 1990 CONDITIONS VS. PLAN 2)

LOCATION	1-YR		10-YR		50-YR		100-YR		500-YR		BANK FULL STAGE
	EXIST.	PLAN 2	EXIST.	PLAN 2	EXIST.	PLAN 2	EXIST.	PLAN 2	EXIST.	PLAN 2	
JUST UPSTREAM OF BEATTIES DAM STA. 156865	161.34	153.94	163.88	157.01	166.17	160.07	167.11	161.40	170.18	166.05	160.0
AT ROUTE 23 BRIDGE STA. 162097	162.55	159.08	166.00	162.86	169.06	165.96	170.45	167.18	174.09	172.09	162.0
AT CONFLUENCE WITH DEEPAVAAL BROOK STA. 169390	163.25	161.78	167.25	165.87	170.60	169.32	171.90	170.56	175.49	174.49	162.0
AT ROUTE 80 BRIDGES STA. 172000	163.91	162.59	168.17	166.89	171.87	170.47	172.86	172.13	176.58	175.71	162.0
AT TWO BRIDGES STA. 174060	164.32	163.41	168.72	167.81	172.41	171.36	173.45	172.92	177.16	176.48	162.0

fully opened position. If warranted, during the feasibility study, the proposed dam modifications would be designed in accordance with criteria for new project construction outlined in EM 1110-2-1101 and EC 1110-2-27. These criteria are related to stability due to subsurface conditions and hydraulic design, and the identification of the objective of the spillway for selecting of a proper security standard, the determination of and routing of the spillway design flood, and the design of freeboard.

G. CHANNEL PROTECTION

The design criteria for the rip-rap protection of earth channel bank and bottom erosion are based upon "Rip-Rap Guidelines" as developed from the Draft EM 1110-2-1601. The rip-rap was designed for a 100-year discharge and a channel side slope of 1 vertical on 2 horizontal. Information such as water depth and average velocity were obtained from the HEC-2 computer runs of the Passaic River. The toe velocities were determined based on centerline radius and water surface width. Once the toe velocity and water depth were known, the D30 stone size was found using the applicable chart. Rip-rap thickness was then selected based on a minimum D30 size and a unit weight of 165 pounds per cubic feet. A minimum rip-rap layer thickness of 12 inches is used in accordance with EM 1110-2-1601. Table 5 is a list of the 100 year channel velocities for existing and improved conditions for Plan 2. Tables 6 and 7 specify the rip-rap requirements for Plan 2. The rip-rap requirements for Plans 3 and 4 would be similar.

H. LEVEL OF PROTECTION

The levels of protection provided by the alternative plans vary throughout the study area. Protection is greatest in the vicinity of Beatties Dam, diminishing rapidly proceeding upstream. Plan 2 provides a weighted average level of protection for the Beatties Dam study area, based on proportion of damages in each reach, of approximately 9 years. Plan 3 provides an estimated 8 year level of protection while Plan 4 provides an average 5 year level of protection. The average level of protection provided by Plan 1 is less than a 3 year event. Additional information is provided in the Plan Formulation Appendix.

TABLE 5 - 100 YEAR CHANNEL VELOCITIES

STATION	VELOCITY (fps) EXISTING CONDITIONS	VELOCITY (fps) PLAN 2 IMPROVED CONDITIONS
1568+65	6.47	8.31
1569+82	7.77	10.70
1573+10	6.97	9.56
1576+00	5.35	7.65
1579+00	8.04	8.93
1582+80	4.18	5.92
1587+10	2.82	3.41
1593+30	4.66	5.06
1599+00	6.51	7.61
1606+90	5.74	6.04
1614+70	4.58	6.99

TABLE 6 - RIP-RAP REQUIREMENTS FOR PLAN 2

STATION FROM	STATION TO	RIP-RAP THICKNESS
1568+65	1572+00	12"
1572+00	1584+00	27"
1594+00	1610+00	12"

TABLE 7 - RIP-RAP SPECIFICATIONS FOR PLAN 2

LAYER THICKNESS	D100 (LBS.) MAX.	D100 (LBS.) MIN.	D50 (LBS.) MAX.	D50 (LBS.) MIN.	D15 (LBS.) MAX.	D15 (LBS.) MIN.
12"	86	35	26	17	13	5
27"	984	394	292	197	146	62

IV. IMPACT ANALYSIS

A. DOWNSTREAM IMPACTS

The proposed Beatties Dam modifications would reduce the dam's crest elevation from 158' MSL to 150' MSL. Based upon the HEC-1 hydrologic analysis there would be a small increase in the downstream discharges for the 1-YR, 2-YR, 5-YR, 10-YR, 25-YR, 50-YR, 100-YR, 500-YR and SPF flood events. Based upon a review of rating curves (see Figure 15), the water surface elevations along the Passaic River from Beatties Dam downstream to Dundee Dam would increase up to 0.2 feet for the 1-YR, 2-YR, 5-YR, 10-YR, 25-YR, 50-YR, and 100-YR flood events; the 500-YR and SPF stages would be essentially unchanged.

Therefore, the proposed Beatties Dam modifications would result in a small but measurable increase in flood stages in communities downstream of the dam. The corresponding increase in flood damage is provided in the Economics Appendix.

B. IMPACTS ON THE MAIN STEM PASSAIC RIVER TUNNEL PLAN

The rock outcrop at Beatties Dam acts as a natural control for the Passaic River flows entering the Lower Passaic Valley through the gorge in Little Falls. Beatties Dam, built on the rock outcrop, has a minor impact on the flood flow elevations of the river from the dam upstream to Two Bridges.

Flooding in the Central Basin is primarily due to the backwater effect caused by the natural channel constriction and rock outcrop occurring along the Passaic River between Two Bridges and Beatties Dam in combination with the mild gradients and insufficient channel capacities of the Passaic and Pompton Rivers.

The proposed Beatties Dam modifications would reduce the dam's crest elevation from 158' MSL to 150' MSL when open during a flood event. The lower crest would result in lower flood stages. During non-flood conditions, the pool elevation of the river would be maintained above elevation 158' with gates in the closed vertical position. Under the Main Stem Passaic River Tunnel Plan, the modification of Beatties Dam would add to the reduction in flood stages in the stream reach upstream to Two Bridges. With the existing dam, only approximately 6,000 cfs can be conveyed downstream before flood levels rise above bank stages in the Central Basin. From Table II-15, supporting documentation Part II, Phase 1 GDM, during the 100-year flood event 9232 cfs would bypass the Passaic River Tunnel inlet. This bypass flow is greater than bank full capacity. With modification of Beatties Dam,

the bank full capacity will be much greater than 9232 cfs when the gates are open. These gates can be used to allow more water downstream in a flood if the tunnel capacity is exceeded. However, during a flood event, the gates at Beatties Dam cannot be opened until tunnel flow capacity is exceeded. To open the gates any sooner would reduce the effectiveness of the tunnel and increase flood flows downstream. Therefore, with the implementation of the tunnel plan the gates would serve no apparent purpose other than to be opened for the 75 to 100 year flood event or less frequent floods when tunnel flow capacity is exceeded.

The design of the tunnel plan's Passaic River inlet at Two Bridges is based on the presence of the rock outcrop near Beatties Dam. Modification of this condition may require changes in the proposed inlet design and corresponding additional costs. This, in turn, requires that Beatties Dam be absolutely risk free in its operation because of potential adverse impacts on both the Central Basin and Lower Valley flood problems should the tunnel be unable to operate as designed. Modifications to Beatties Dam may be necessary both in control systems and structural features to assure the integrity of the tunnel project, resulting in additional costs. These added costs to the tunnel plan would be attributable to the Beatties Dam alternatives. This effect has not been evaluated in this reconnaissance study but would be undertaken in the feasibility stage if additional studies of Beatties Dam alternatives are warranted.

V. SUMMARY

The Beatties Dam was constructed on a natural rock outcrop that formed a falls on the Passaic River. The dam has a minor impact on flood elevations along the Passaic River upstream to Two Bridges. The flooding in the Central Basin is primarily due to the combination of mild gradient and insufficient channel capacities of the Passaic and Pompton Rivers. Locally, between Beatties Dam and Two Bridges, this flooding problem is worsened by the backwater effect caused by the natural channel constriction occurring in this reach.

In order to provide interim flood relief to municipalities upstream of the dam while maintaining normal wetland water levels in and around the Townships of Lincoln Park, Montville, and Fairfield, four flood control alternatives involving modification of Beatties Dam were studied. The two types of gates investigated for the modification of Beatties Dam were tainter gates and bascule gates. Based upon the economic, hydraulic and operational points of view, the use of bascule gates for the application of Beatties Dam was recommended. The proposed Beatties Dam modifications would reduce the dam's crest elevation from 158' MSL to 150' MSL. The lower crest would result in lower flood stages.

Under the Main Stem Passaic River Tunnel Plan, the modifiation of Beatties Dam would provide some additional flood protection upstream to Two Bridges during less frequent flood events. In addition, the gates can be used to allow more water downstream in a flood if the tunnel capacity is exceeded.

The Beatties Dam modification plans would result in a small but measurable increase in flood stages in communities downstream of the dam.

REFERENCES

1. U.S. Army Corps of Engineers, HEC, HEC-2 Water Surface Profiles Users Manual, September 1982.

2. U.S. Army Corps of Engineers, EM 1110-2-1601, Hydraulic Design of Flood Control Channels, July 1970.

3. U.S. Army Corps of Engineers, ETL 1110-2-120, Additional Guidance for Riprap Channel Protection, May 1971.

4. U.S. Army Corps of Engineers, Riprap Guidelines as developed in draft revised Chapter 14 for EM 1110-2-1601.

5. U.S. Army Corps of Engineers, EM 1110-2-1409, Backwater Curves in River Channels, December 1959.

6. U.S. Army Corps of Engineers, Phase 1, GDM, Flood Protection Feasibility, Main Stem Passaic River, December 1987.

7. U.S. Department of Transportation, Hydraulic Engineering Circular No. 11, Use of Riprap for Bank Protection, April 1970.

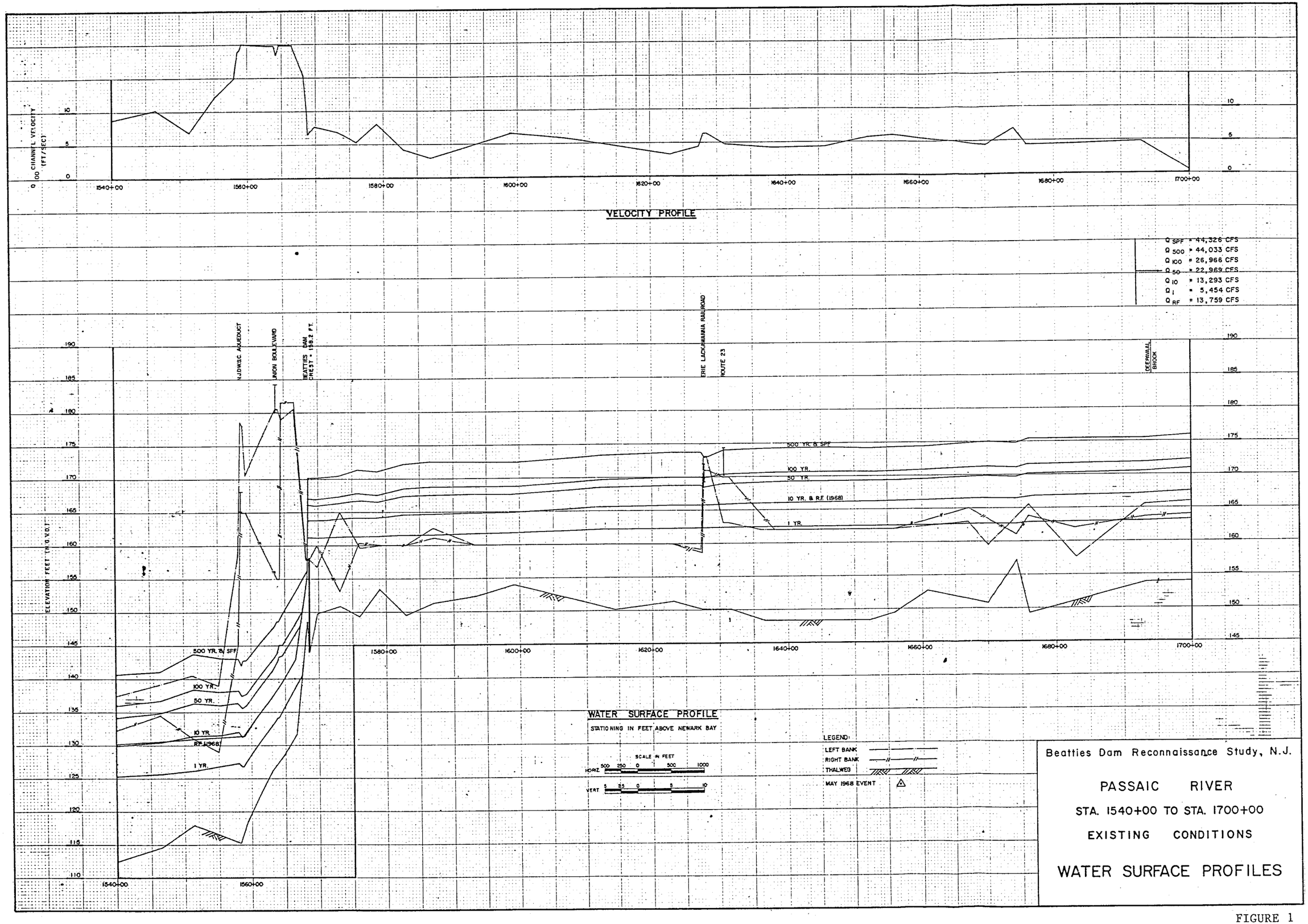
8. U.S. Army Corps of Engineers, Beatties Mill Dam Phase 1 Inspection Report, August 1981.

9. U.S. Department of Interior, Bureau of Reclamation, Design of Small Dams, 1977.

10. McGraw-Hill, Handbook of Applied Hydraulics, 1980.

11. U.S. Army Corps of Engineers, EM 1110-2-1603, Hydraulic Design of Spillways, 1987.

12. U.S. Army Corps of Engineers, EM 1110-2-1602, Hydraulic Design of Reservoir Outlet Works, October 1980.



Beatties Dam Reconnaissance Study, N.J.

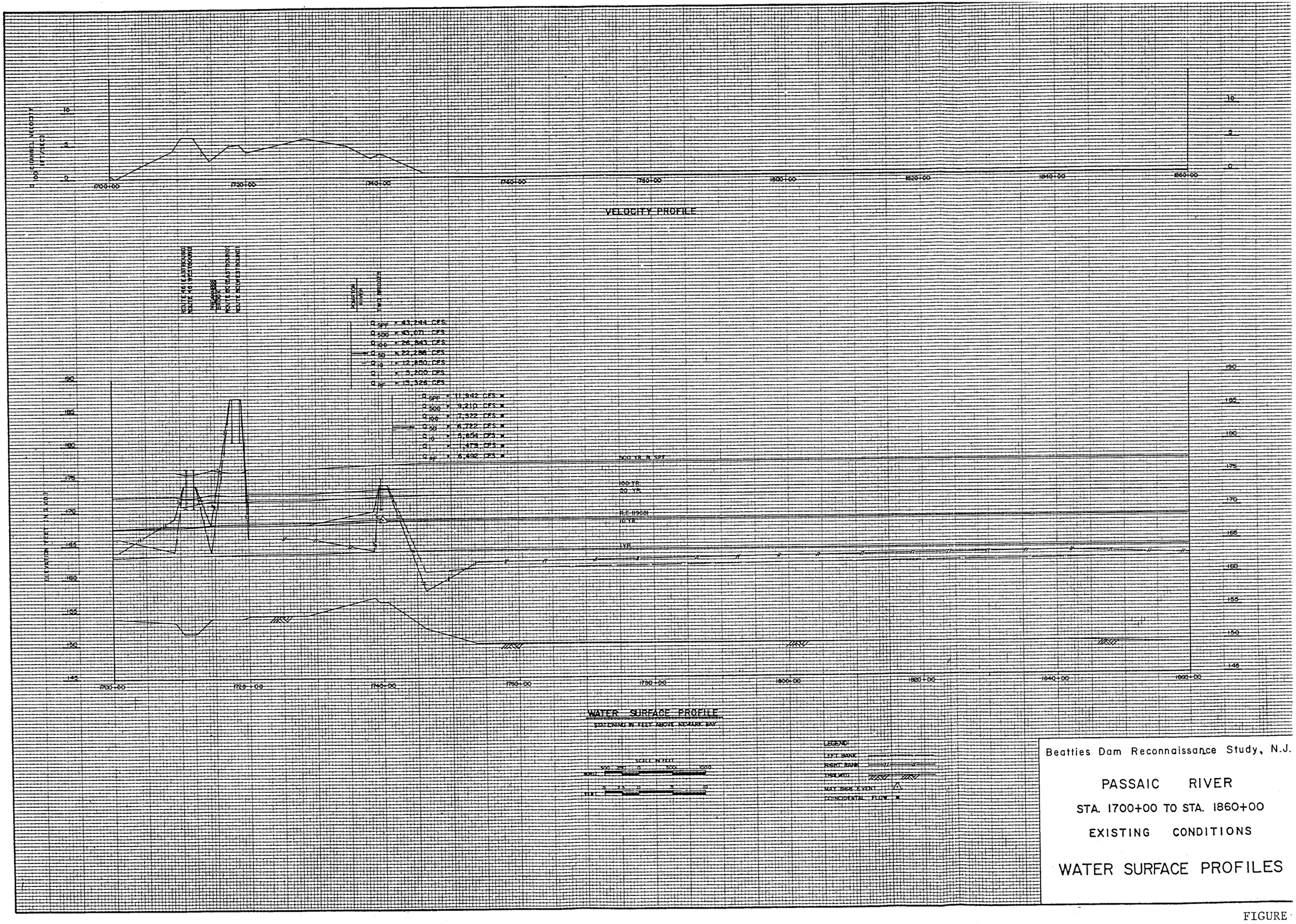
PASSAIC RIVER

STA. 1540+00 TO STA. 1700+00

EXISTING CONDITIONS

WATER SURFACE PROFILES

FIGURE 1



Beatties Dam Reconnaissance Study, N.J.

PASSAIC RIVER

STA. 1700+00 TO STA. 1860+00

EXISTING CONDITIONS

WATER SURFACE PROFILES

FIGURE

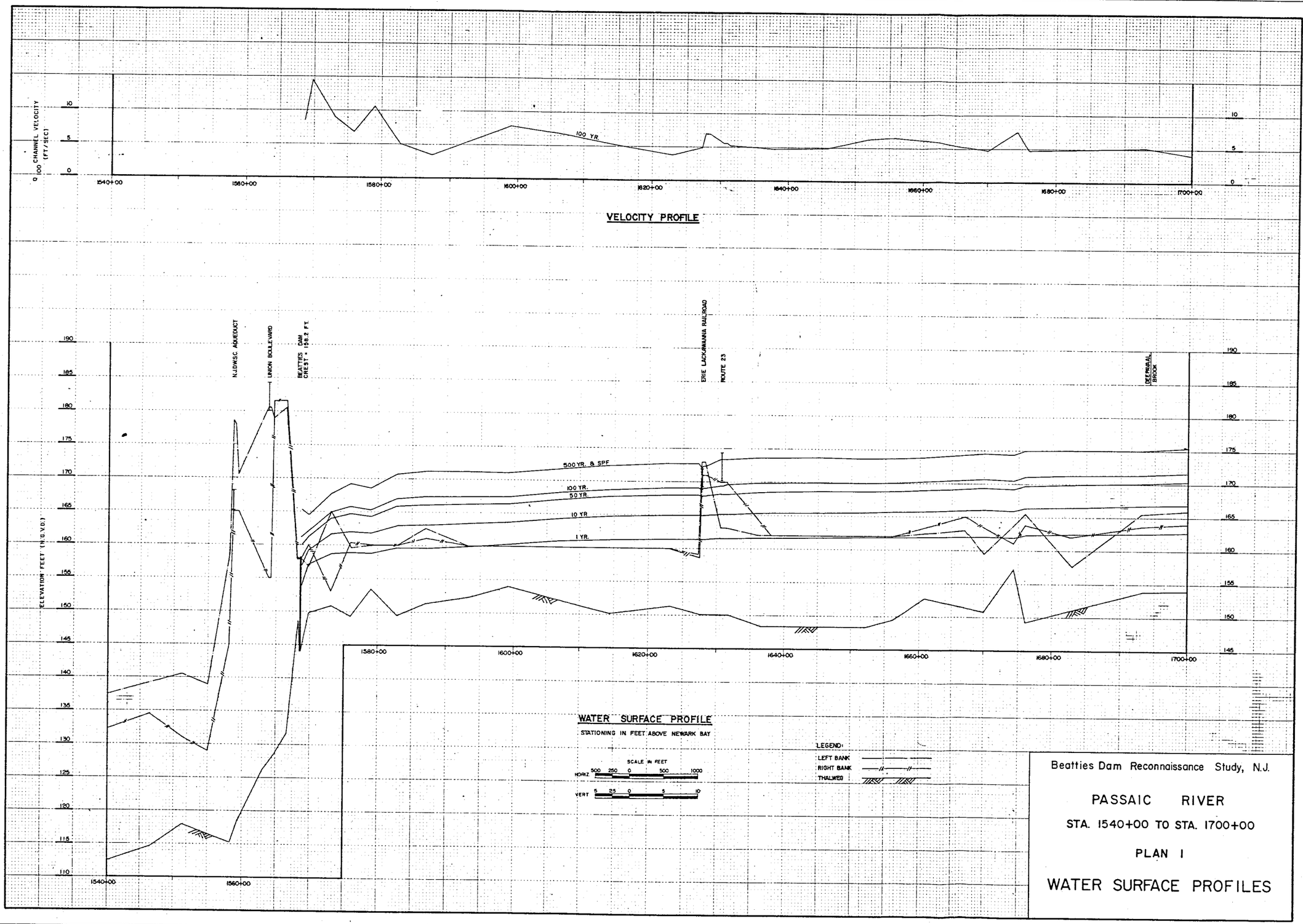
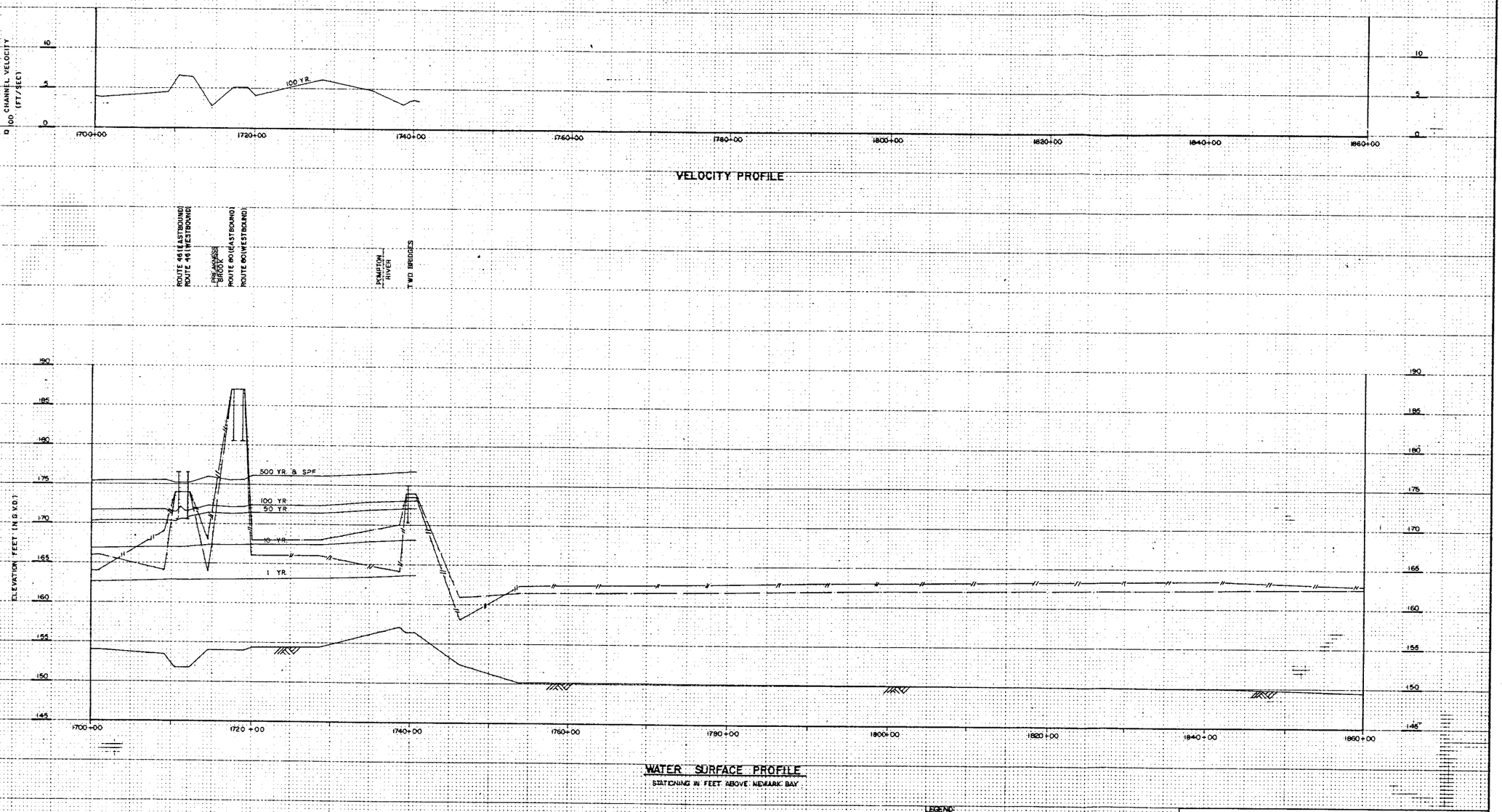

Q (100 CHANNEL VELOCITY (FT/SEC)
10
5
0
100 YR
1540+00
1560+00
1580+00
1600+00
1620+00
1640+00
1660+00
1680+00
1700+00
VELOCITY PROFILE
N.J.D.W.S.C. AQUEDUCT
UNION BOULEVARD
BEATTIES DAM CREST = 165.2 FT.
ERIE LACKAWANNA RAILROAD
ROUTE 23
DEEPAVAUL BROOK
ELEVATION FEET (N.G.V.D.)
190
185
180
175
170
165
160
155
150
145
140
135
130
125
120
115
110
500 YR. & SPF
100 YR.
50 YR.
10 YR.
1 YR.
WATER SURFACE PROFILE
STATIONING IN FEET ABOVE NEWARK BAY
SCALE IN FEET
HORIZ 500 250 0 500 1000
VERT 5 25 0 5 10
LEGEND:
LEFT BANK
RIGHT BANK
THALWEG
Beatties Dam Reconnaissance Study, N.J.
PASSAIC RIVER
STA. 1540+00 TO STA. 1700+00
PLAN I
WATER SURFACE PROFILES

FIGURE 3



Beatties Dam Reconnaissance Study, N.J.

PASSAIC RIVER

STA. 1700+00 TO STA. 1860+00

PLAN I

WATER SURFACE PROFILES

FIGURE 4

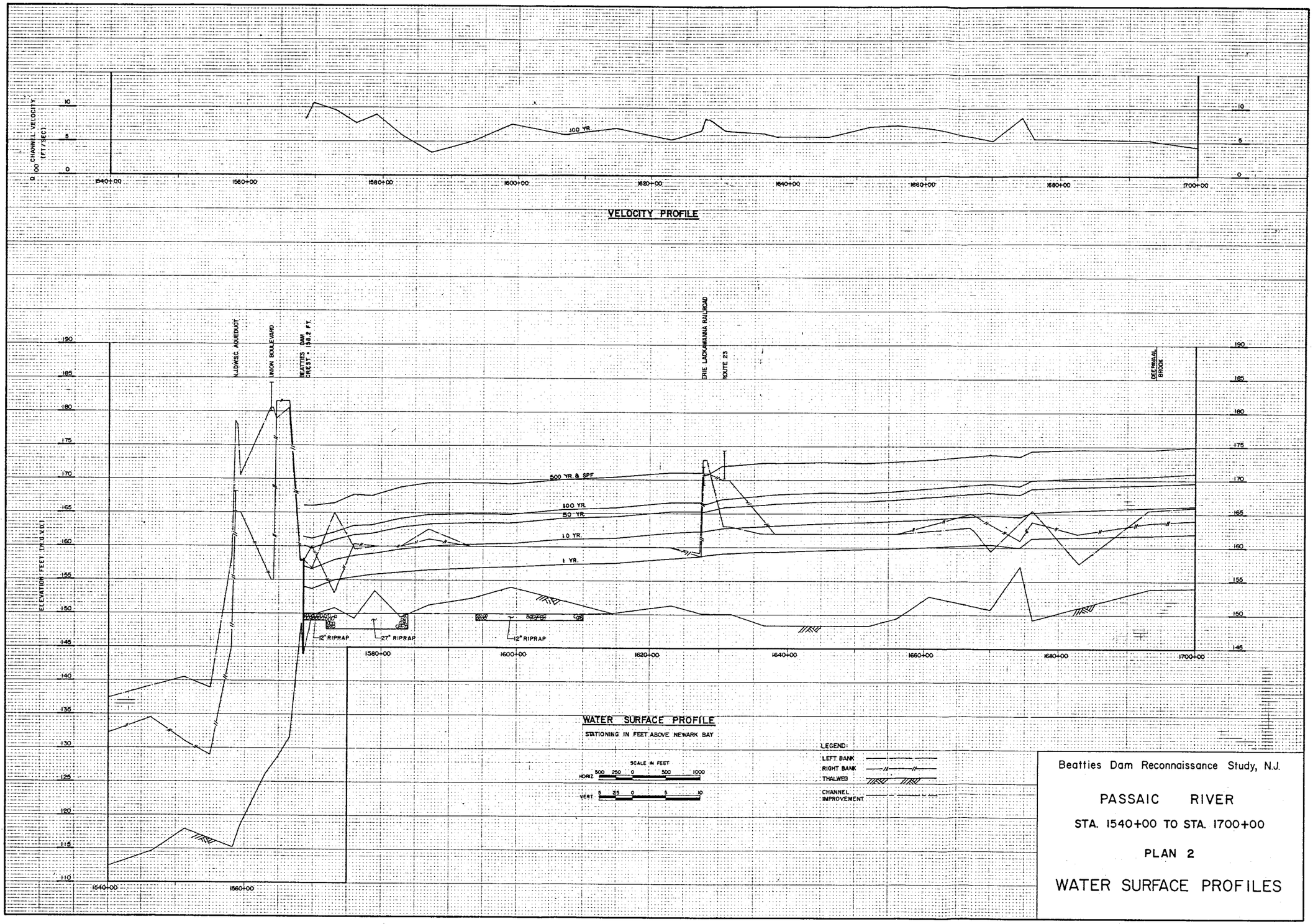
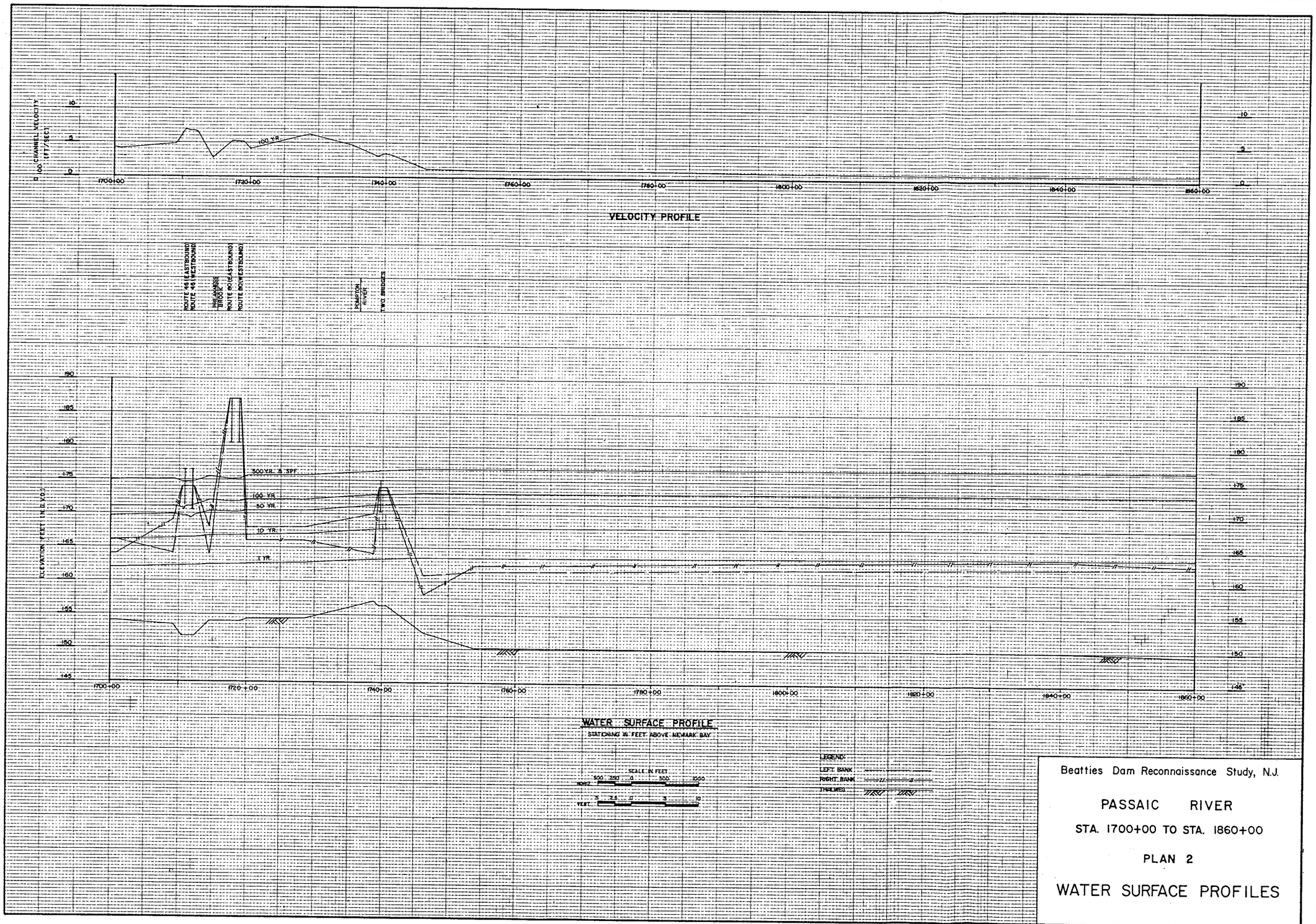

VELOCITY PROFILE
CHANNEL VELOCITY (FT/SEC)
10
5
0
100 YR.
1540+00
1560+00
1580+00
1600+00
1620+00
1640+00
1660+00
1680+00
1700+00
N.J.D.W.S.C. AQUEDUCT
UNION BOULEVARD
BEATTIES DAM CREST, 185.2 FT.
ERIE LACKAWANNA RAILROAD
ROUTE 23
DEEPAVAAL BROOK
ELEVATION FEET (N.G.V.D.)
190
185
180
175
170
165
160
155
150
145
140
135
130
125
120
115
110
500 YR. & SPF
100 YR.
50 YR.
10 YR.
1 YR.
12" RIPRAP
27" RIPRAP
12" RIPRAP
WATER SURFACE PROFILE
STATIONING IN FEET ABOVE NEWARK BAY
SCALE IN FEET
HORIZ 500 250 0 500 1000
VERT 5 25 0 5 10
LEGEND:
LEFT BANK
RIGHT BANK
THALWEG
CHANNEL IMPROVEMENT
Beatties Dam Reconnaissance Study, N.J.
PASSAIC RIVER
STA. 1540+00 TO STA. 1700+00
PLAN 2
WATER SURFACE PROFILES

FIGURE 5



Beatties Dam Reconnaissance Study, N.J.

PASSAIC RIVER

STA. 1700+00 TO STA. 1860+00

PLAN 2

WATER SURFACE PROFILES

FIGURE 6

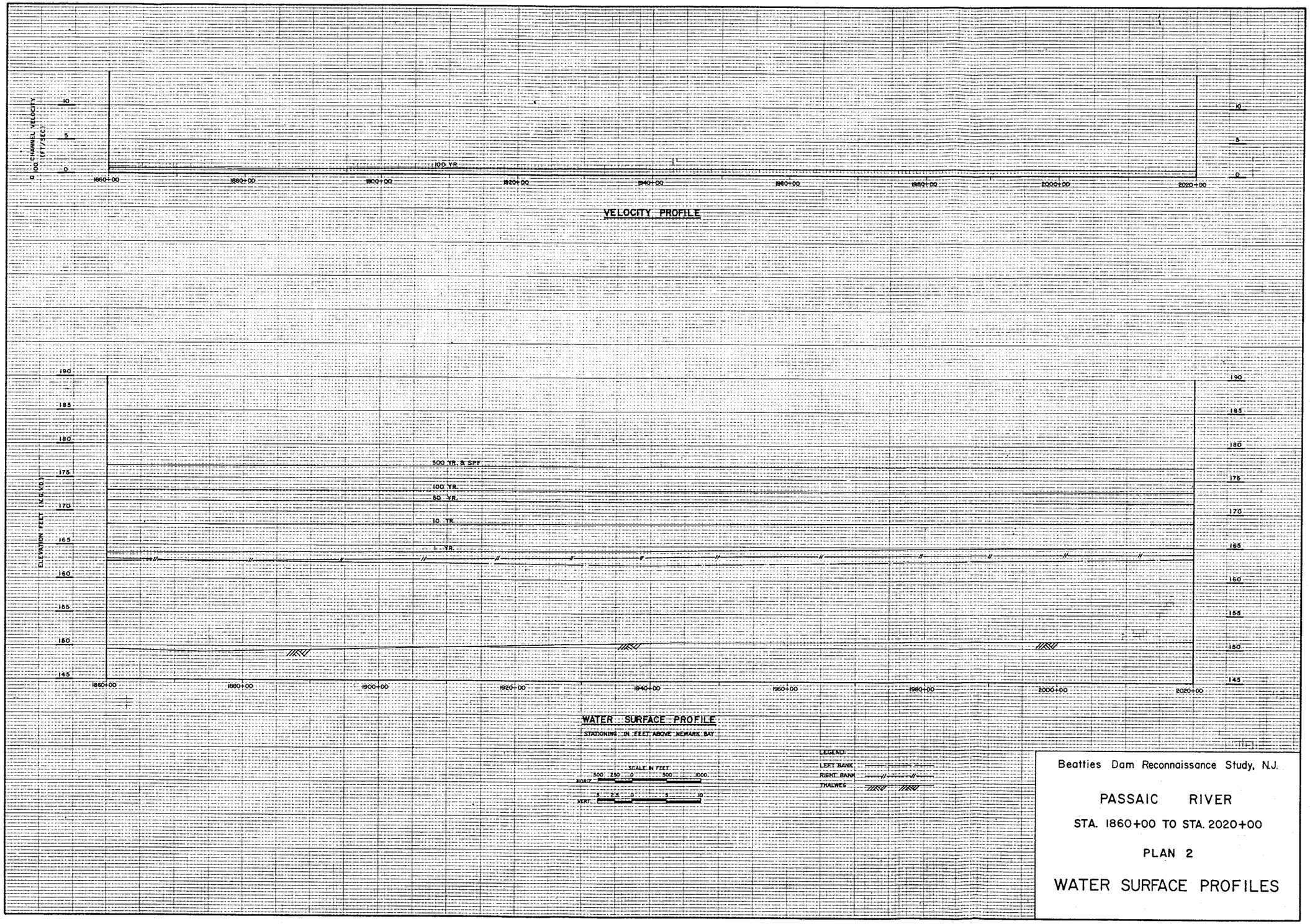

CHANNEL VELOCITY (FT/SEC)
10
5
0
1860+00
1880+00
1900+00
100 YR
1920+00
1940+00
1960+00
1980+00
2000+00
2020+00
VELOCITY PROFILE
ELEVATION FEET (N.G.V.D.)
190
185
180
175
170
165
160
155
150
145
500 YR. & SPF
100 YR.
50 YR.
10 YR.
1 YR.
WATER SURFACE PROFILE
STATIONING IN FEET ABOVE NEWARK BAY
SCALE IN FEET
HORIZ. 500 250 0 500 1000
VERT. 5 2.5 0 5 10
LEGEND
LEFT BANK
RIGHT BANK
THALWEG
Beatties Dam Reconnaissance Study, N.J.
PASSAIC RIVER
STA. 1860+00 TO STA. 2020+00
PLAN 2
WATER SURFACE PROFILES

FIGURE 7

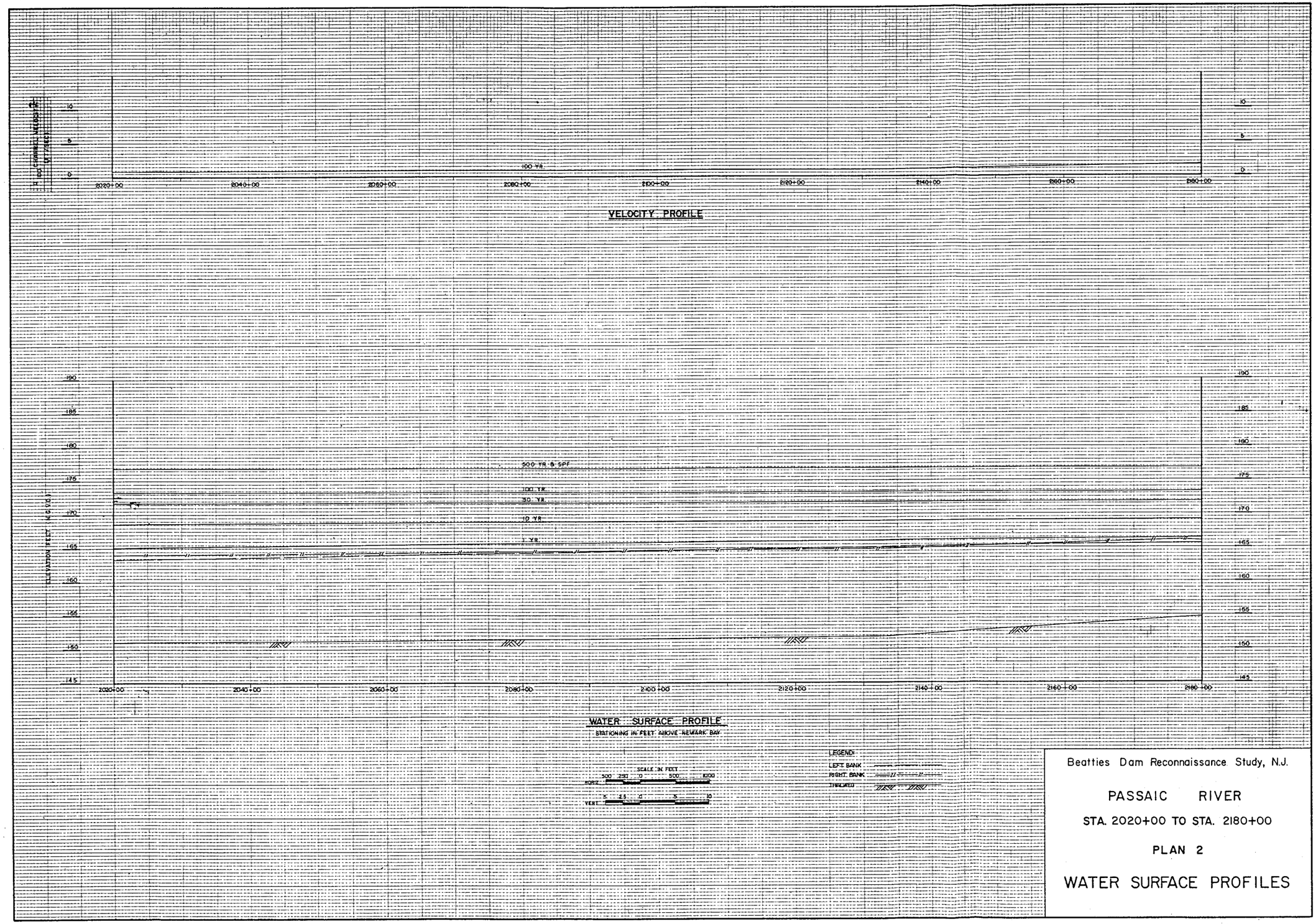

VELOCITY PROFILE
FT. PER CHANNEL VELOCITY
10
5
0
100 YR
2020+00
2040+00
2060+00
2080+00
2100+00
2120+00
2140+00
2160+00
2180+00
ELEVATION FEET (N.G.V.D.)
190
185
180
175
170
165
160
155
150
145
500 YR & SPF
100 YR
50 YR
10 YR
2 YR
WATER SURFACE PROFILE
STATIONING IN FEET ABOVE NEWARK BAY
SCALE IN FEET
500 250 0 500 1000
HORIZ.
VERT. 5 2.5 0 5 10
LEGEND:
LEFT BANK
RIGHT BANK
THALWEG
Beatties Dam Reconnaissance Study, N.J.
PASSAIC RIVER
STA. 2020+00 TO STA. 2180+00
PLAN 2
WATER SURFACE PROFILES

FIGURE 8

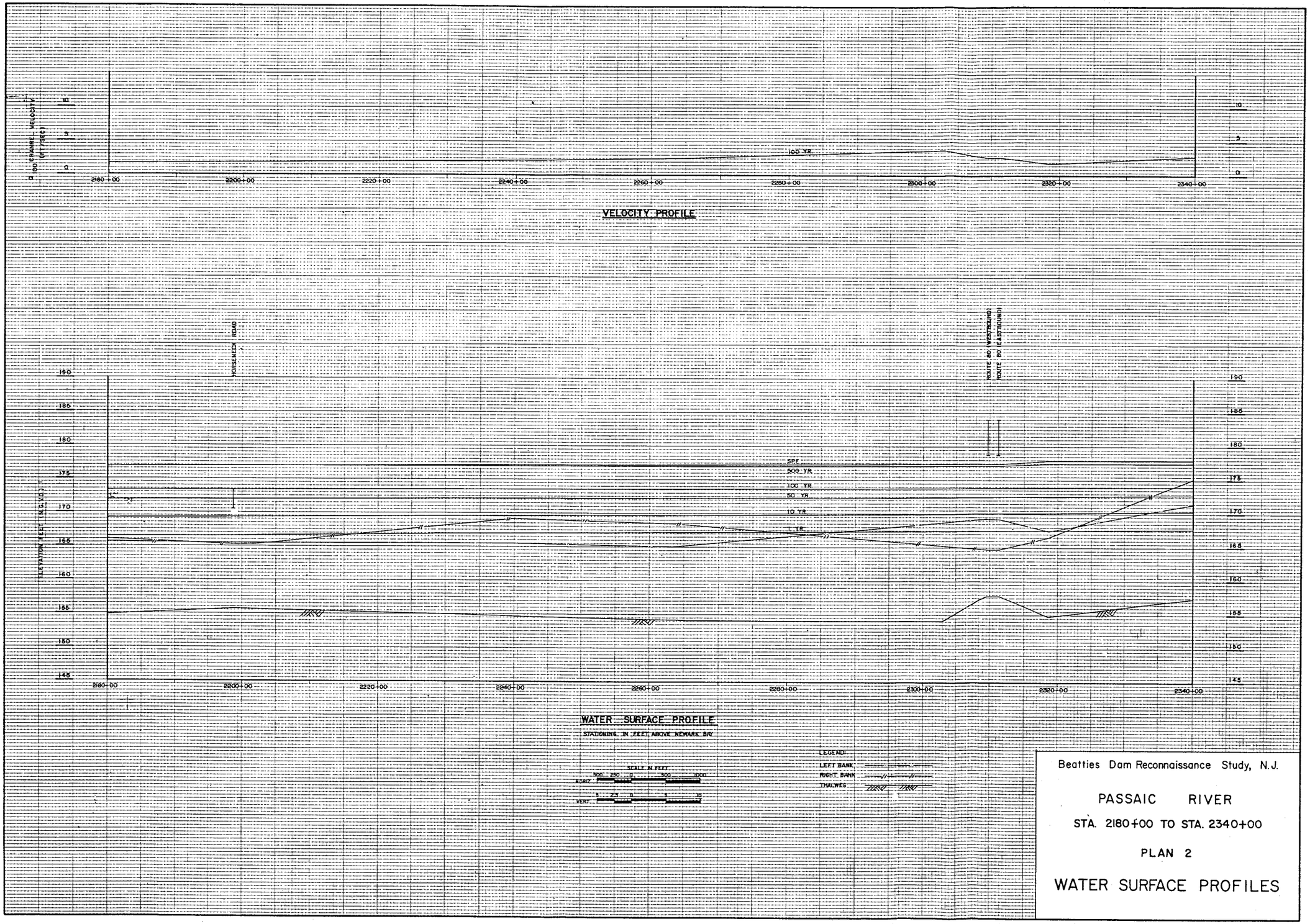

VELOCITY PROFILE
Q (100 CHANNEL VELOCITY (FT/SEC))
10
5
0
100 YR
2180+00
2200+00
2220+00
2240+00
2260+00
2280+00
2300+00
2320+00
2340+00
HORSENECK ROAD
ROUTE 80 (WESTBOUND)
ROUTE 80 (EASTBOUND)
ELEVATION (FEET, NGVD)
190
185
180
175
170
165
160
155
150
145
SPF
500 YR
100 YR
50 YR
10 YR
2 YR
WATER SURFACE PROFILE
STATIONING IN FEET ABOVE NEWARK BAY
SCALE IN FEET
HORIZ.
VERT.
LEGEND
LEFT BANK
RIGHT BANK
THALWEG
Beatties Dam Reconnaissance Study, N.J.
PASSAIC RIVER
STA. 2180+00 TO STA. 2340+00
PLAN 2
WATER SURFACE PROFILES

FIGURE 9

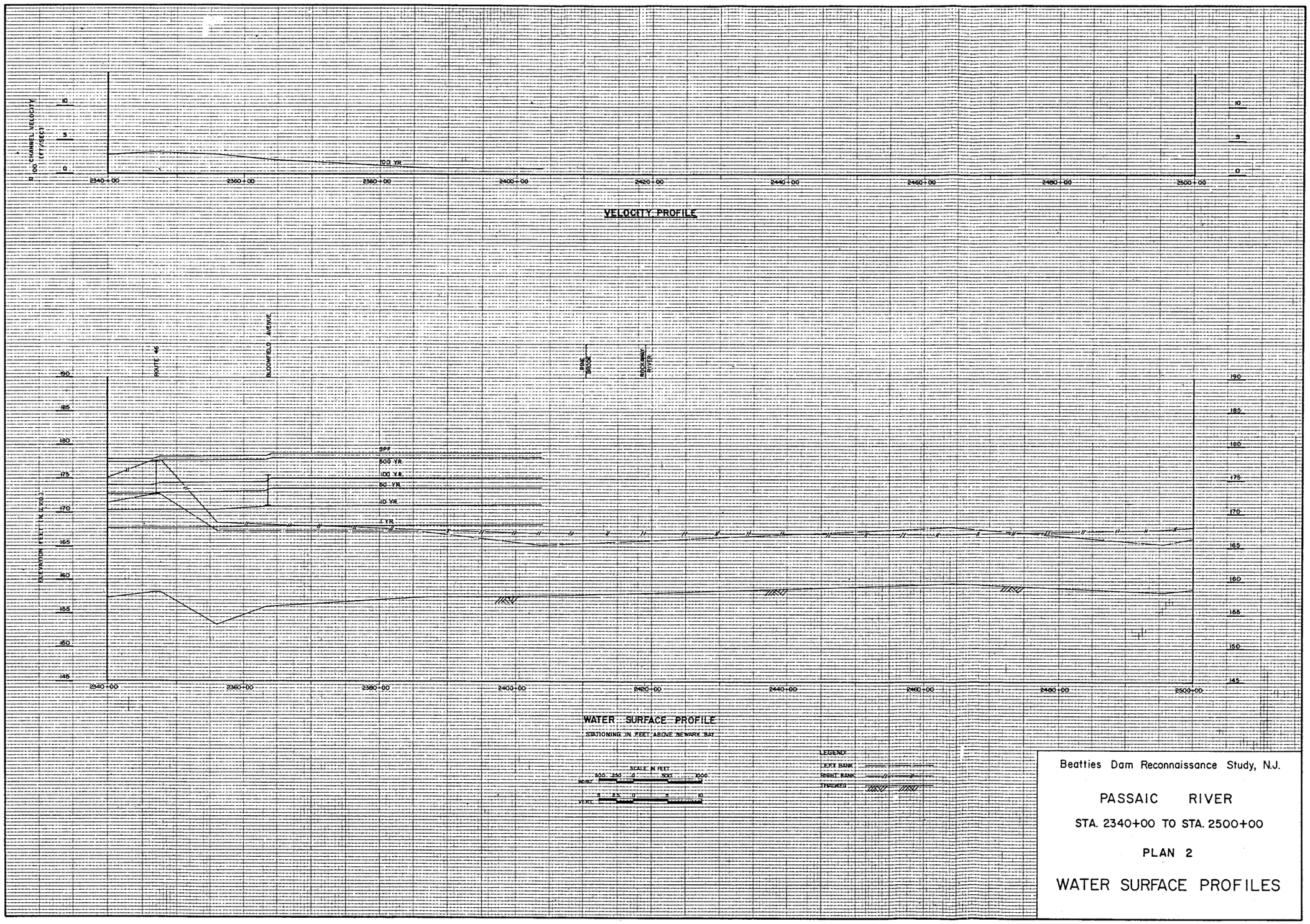
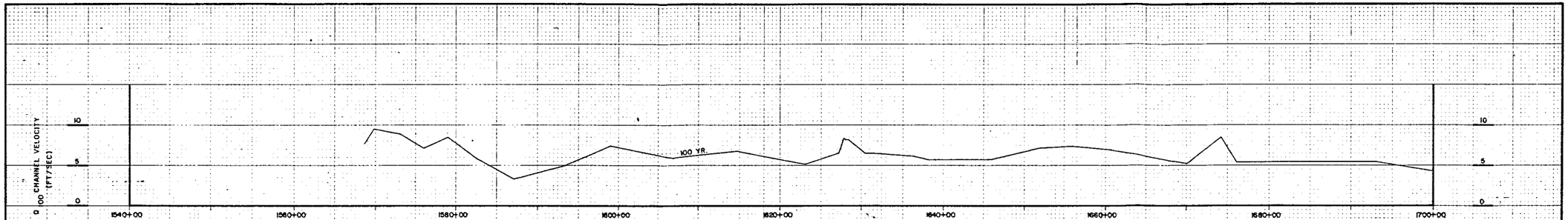
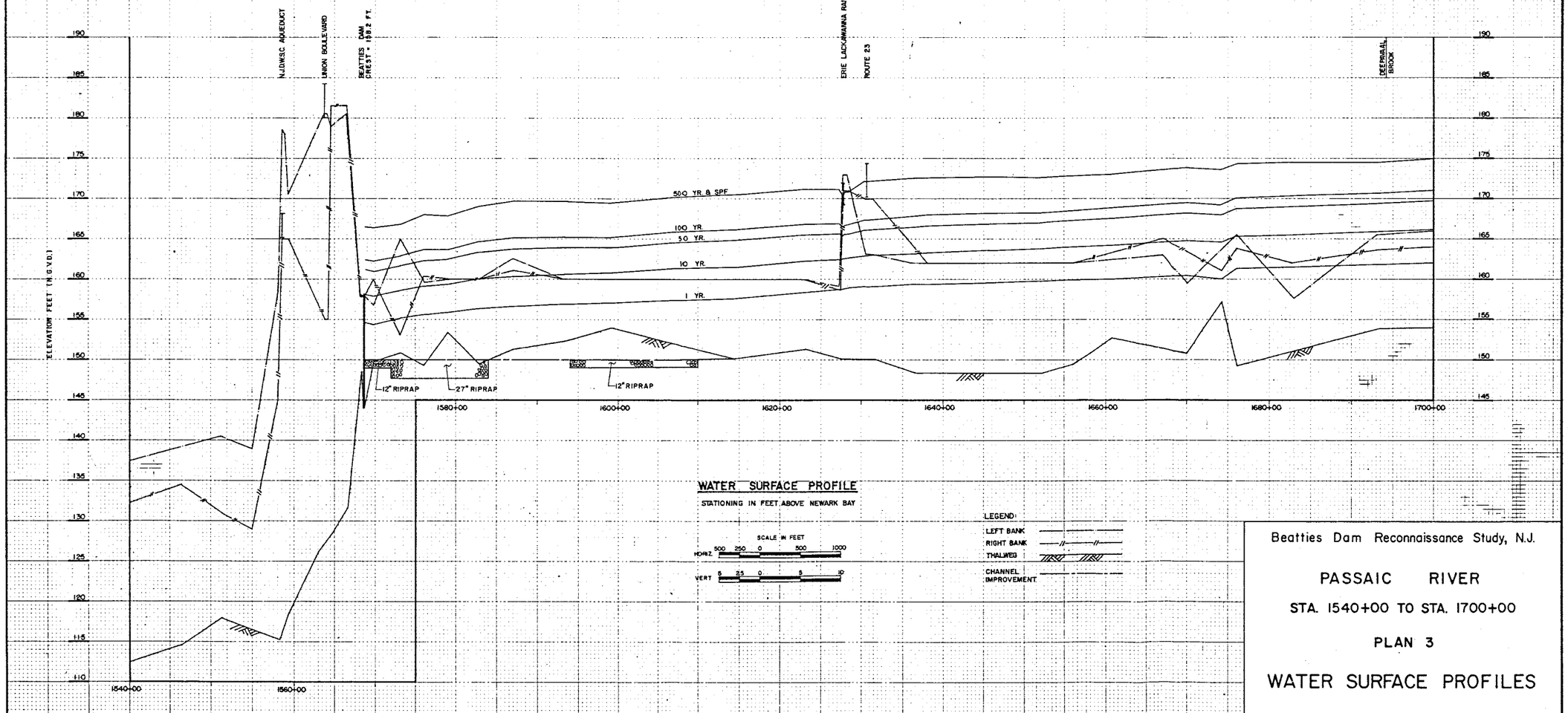

CHANNEL VELOCITY (FT/SEC)
15
5
0
100 YR.
2340+00
2360+00
2380+00
2400+00
2420+00
2440+00
2460+00
2480+00
2500+00
10
5
0
VELOCITY PROFILE
ROUTE 46
BLOOMFIELD AVENUE
PINE BROOK
ROCKAWAY RIVER
ELEVATION (FEET IN N.G.V.D.)
190
185
180
175
170
165
160
155
150
145
SPF
500 YR.
100 YR.
50 YR.
10 YR.
1 YR.
WATER SURFACE PROFILE
STATIONING IN FEET ABOVE NEWARK BAY
SCALE IN FEET
HORIZ. 500 250 0 500 1000
VERT. 5 2.5 0 5 10
LEGEND
LEFT BANK
RIGHT BANK
THALWEG
Beatties Dam Reconnaissance Study, N.J.
PASSAIC RIVER
STA. 2340+00 TO STA. 2500+00
PLAN 2
WATER SURFACE PROFILES

FIGURE 10



VELOCITY PROFILE



WATER SURFACE PROFILE

STATIONING IN FEET ABOVE NEWARK BAY

SCALE IN FEET

HORIZ. 500 250 0 500 1000

VERT 5 25 0 5 10

LEGEND:

LEFT BANK

RIGHT BANK

THALWEG

CHANNEL IMPROVEMENT

Beatties Dam Reconnaissance Study, N.J.

PASSAIC RIVER

STA. 1540+00 TO STA. 1700+00

PLAN 3

WATER SURFACE PROFILES

FIGURE 11

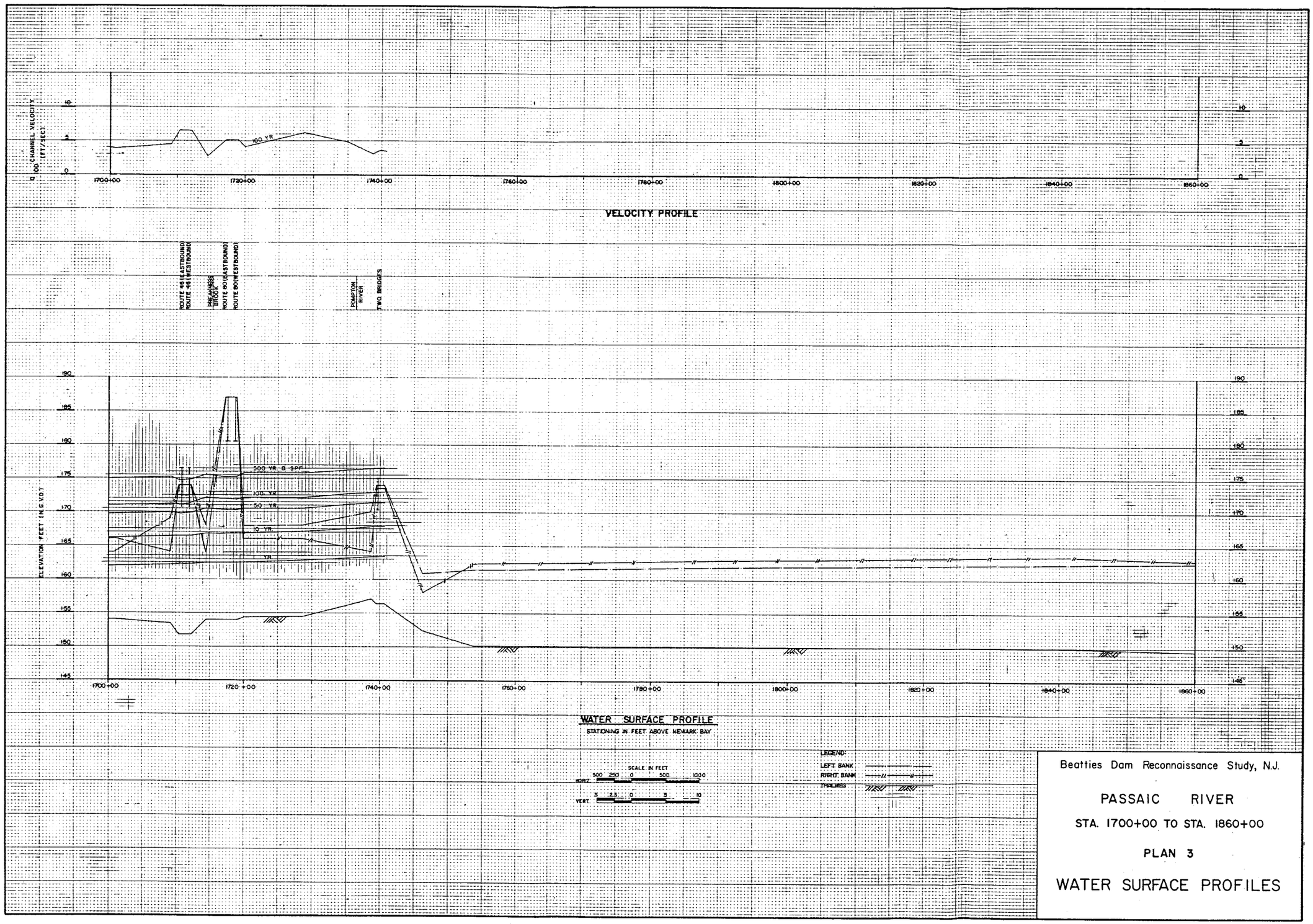

CHANNEL VELOCITY (FT/SEC)
10
5
0
100 YR
1700+00
1720+00
1740+00
1760+00
1780+00
1800+00
1820+00
1840+00
1860+00
VELOCITY PROFILE
ROUTE 46 (EASTBOUND)
ROUTE 46 (WESTBOUND)
HACKENSACK BROOK
ROUTE 80 (EASTBOUND)
ROUTE 80 (WESTBOUND)
PASSAIC RIVER
TWO BRIDGES
ELEVATION - FEET (N.G.V.D.)
190
185
180
175
170
165
160
155
150
145
500 YR. & SPF
100 YR
50 YR
10 YR
5 YR
WATER SURFACE PROFILE
STATIONING IN FEET ABOVE NEWARK BAY
SCALE IN FEET
HORIZ. 500 250 0 500 1000
VERT. 5 2.5 0 5 10
LEGEND:
LEFT BANK
RIGHT BANK
THALWEG
Beatties Dam Reconnaissance Study, N.J.
PASSAIC RIVER
STA. 1700+00 TO STA. 1860+00
PLAN 3
WATER SURFACE PROFILES

FIGURE 12

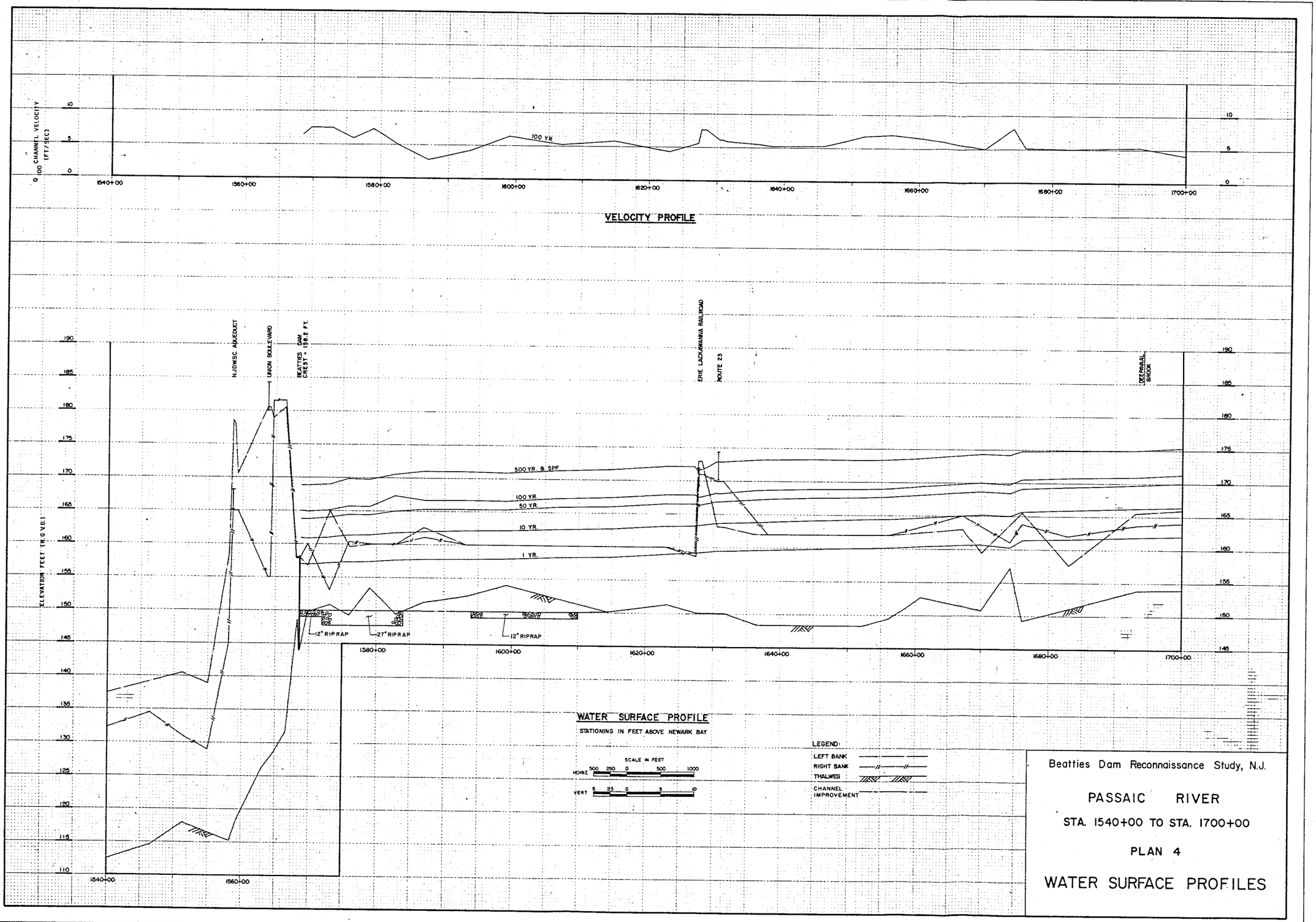
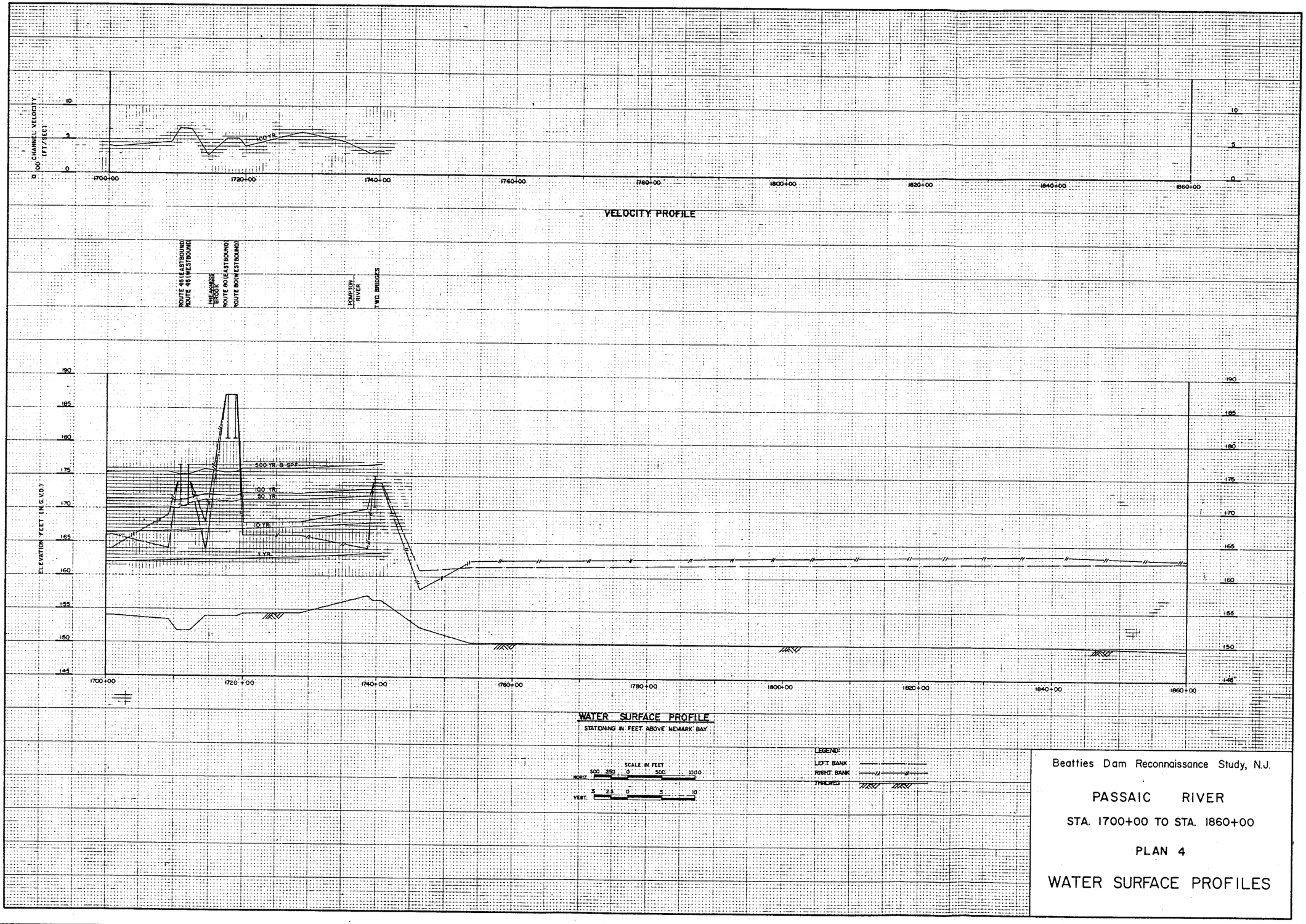

Q 100 CHANNEL VELOCITY (FT/SEC)
10
5
0
100 YR
1540+00
1560+00
1580+00
1600+00
1620+00
1640+00
1660+00
1680+00
1700+00
VELOCITY PROFILE
ELEVATION FEET (N.G.V.D.)
190
185
180
175
170
165
160
155
150
145
140
135
130
125
120
115
110
N.J.D.W.S.C. AQUEDUCT
UNION BOULEVARD
BEATTIES DAM CREST = 158.2 FT.
ERIE LACKAWANNA RAILROAD
ROUTE 23
DEPEGRAL BROOK
500 YR. & SPF
100 YR.
50 YR.
10 YR.
1 YR.
12" RIPRAP
27" RIPRAP
12" RIPRAP
1540+00
1560+00
1580+00
1600+00
1620+00
1640+00
1660+00
1680+00
1700+00
WATER SURFACE PROFILE
STATIONING IN FEET ABOVE NEWARK BAY
SCALE IN FEET
HORIZ 500 250 0 500 1000
VERT 5 25 0 5 10
LEGEND:
LEFT BANK
RIGHT BANK
THALWEG
CHANNEL IMPROVEMENT
Beatties Dam Reconnaissance Study, N.J.
PASSAIC RIVER
STA. 1540+00 TO STA. 1700+00
PLAN 4
WATER SURFACE PROFILES

FIGURE 13



Beatties Dam Reconnaissance Study, N.J.

PASSAIC RIVER

STA. 1700+00 TO STA. 1860+00

PLAN 4

WATER SURFACE PROFILES

FIGURE 14

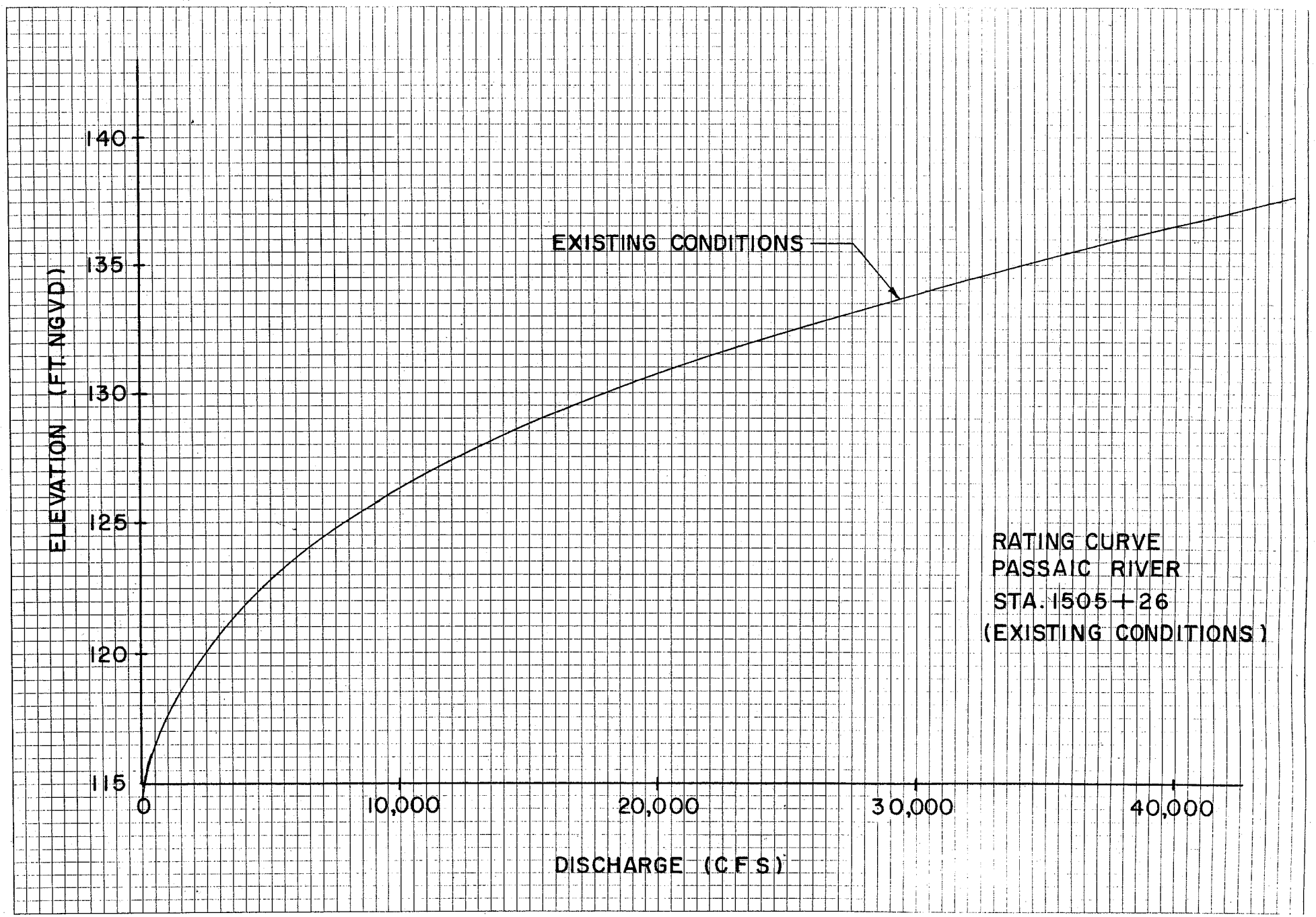


FIGURE 15

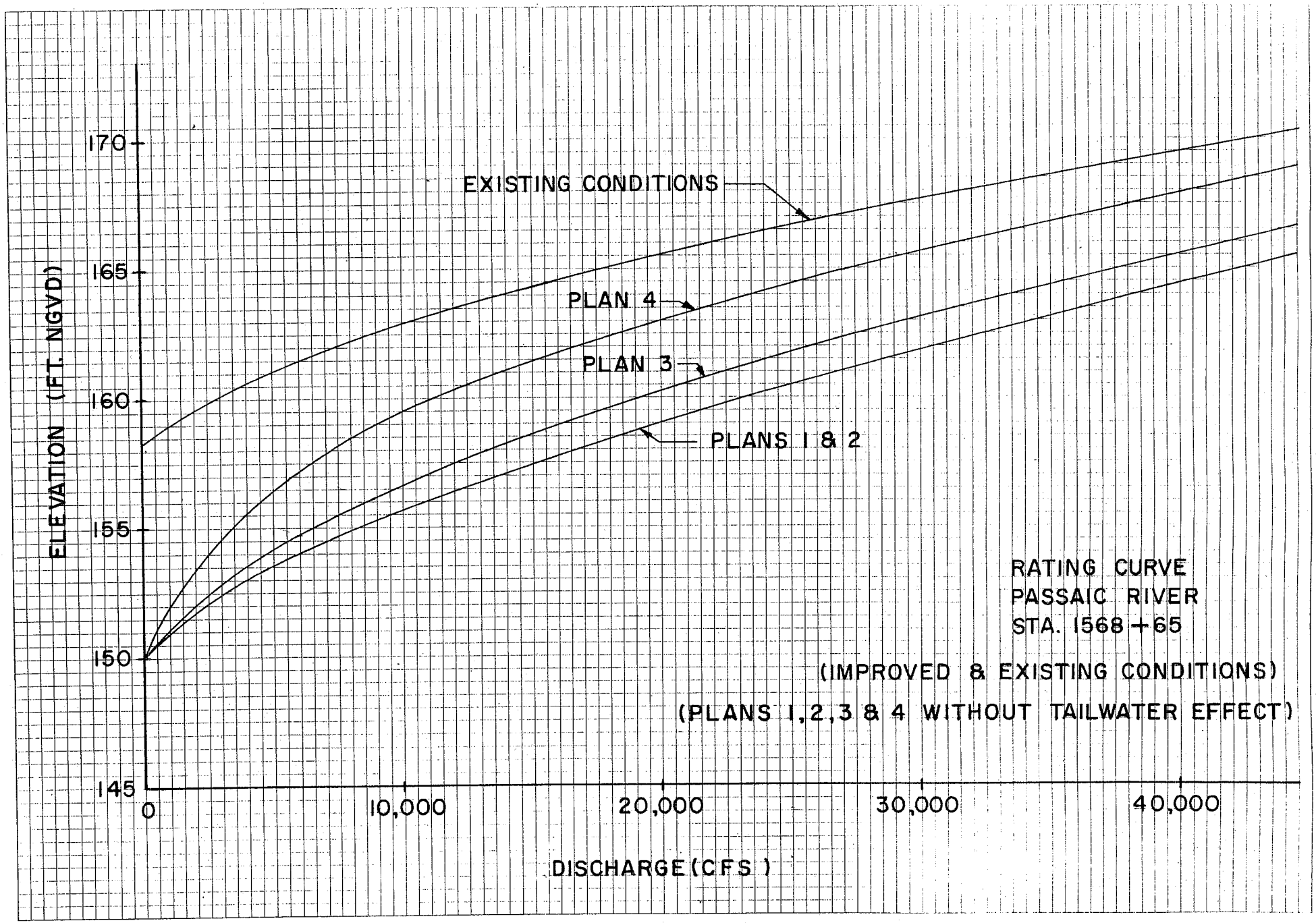


FIGURE 16

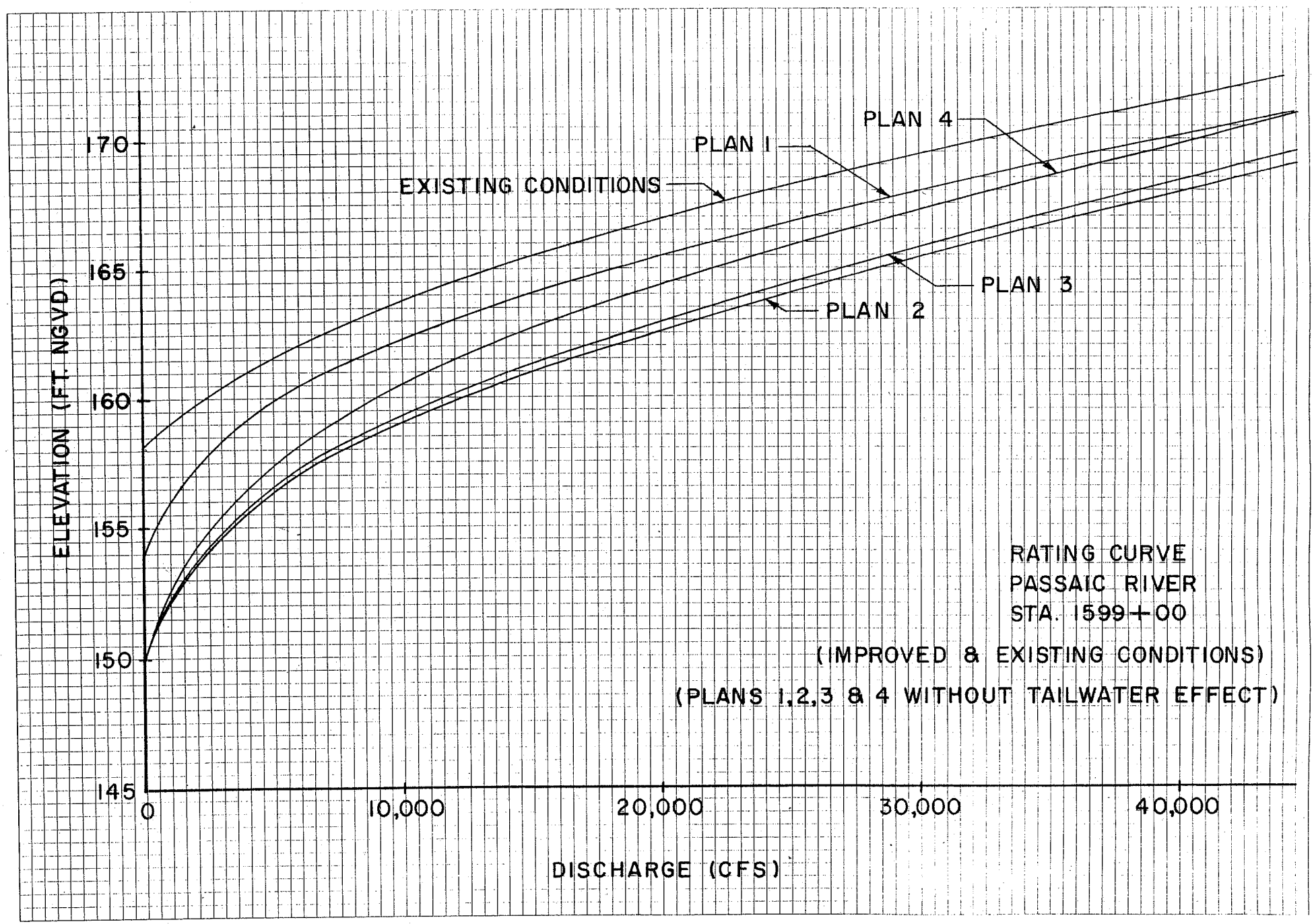


FIGURE 17

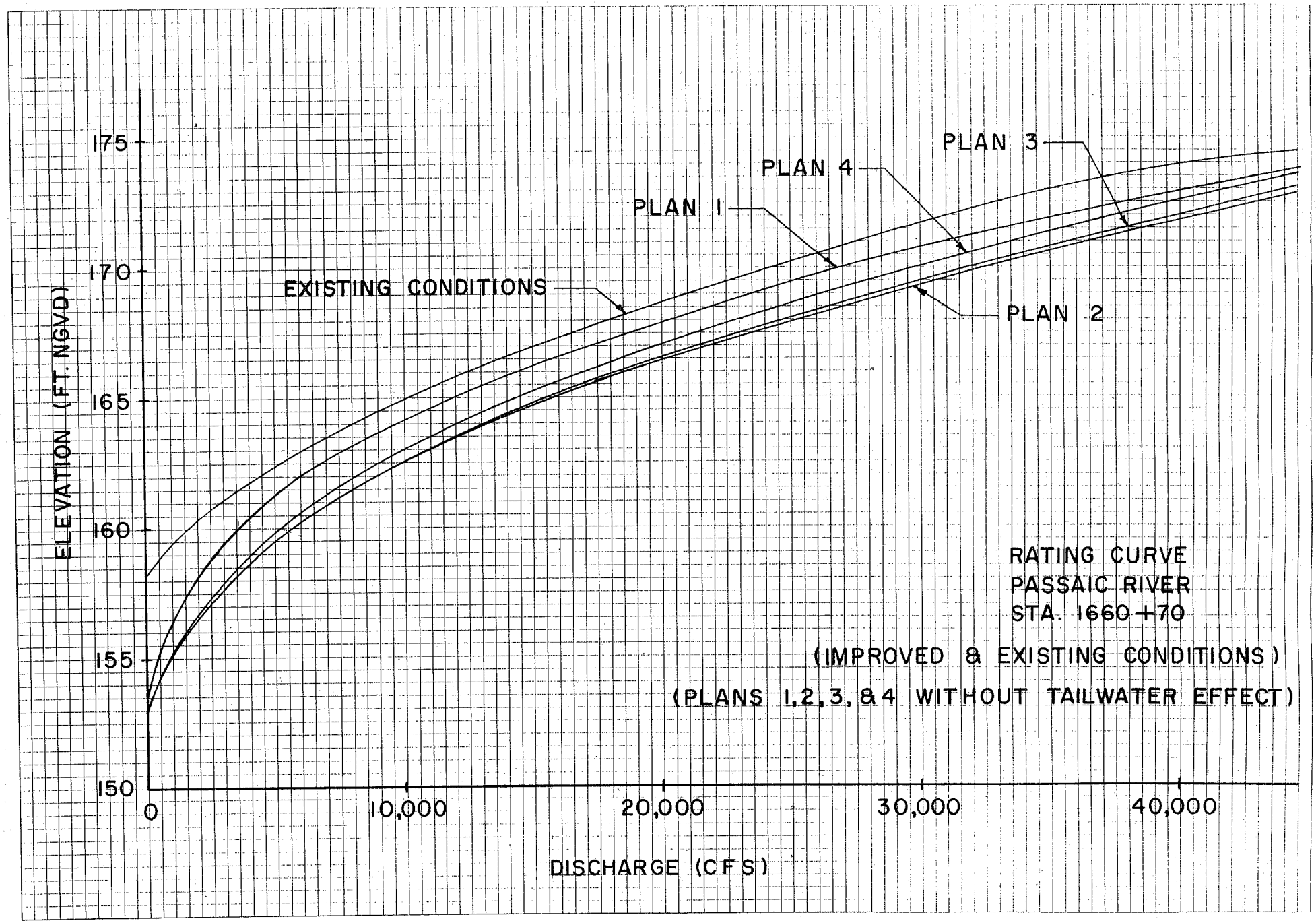


FIGURE 18

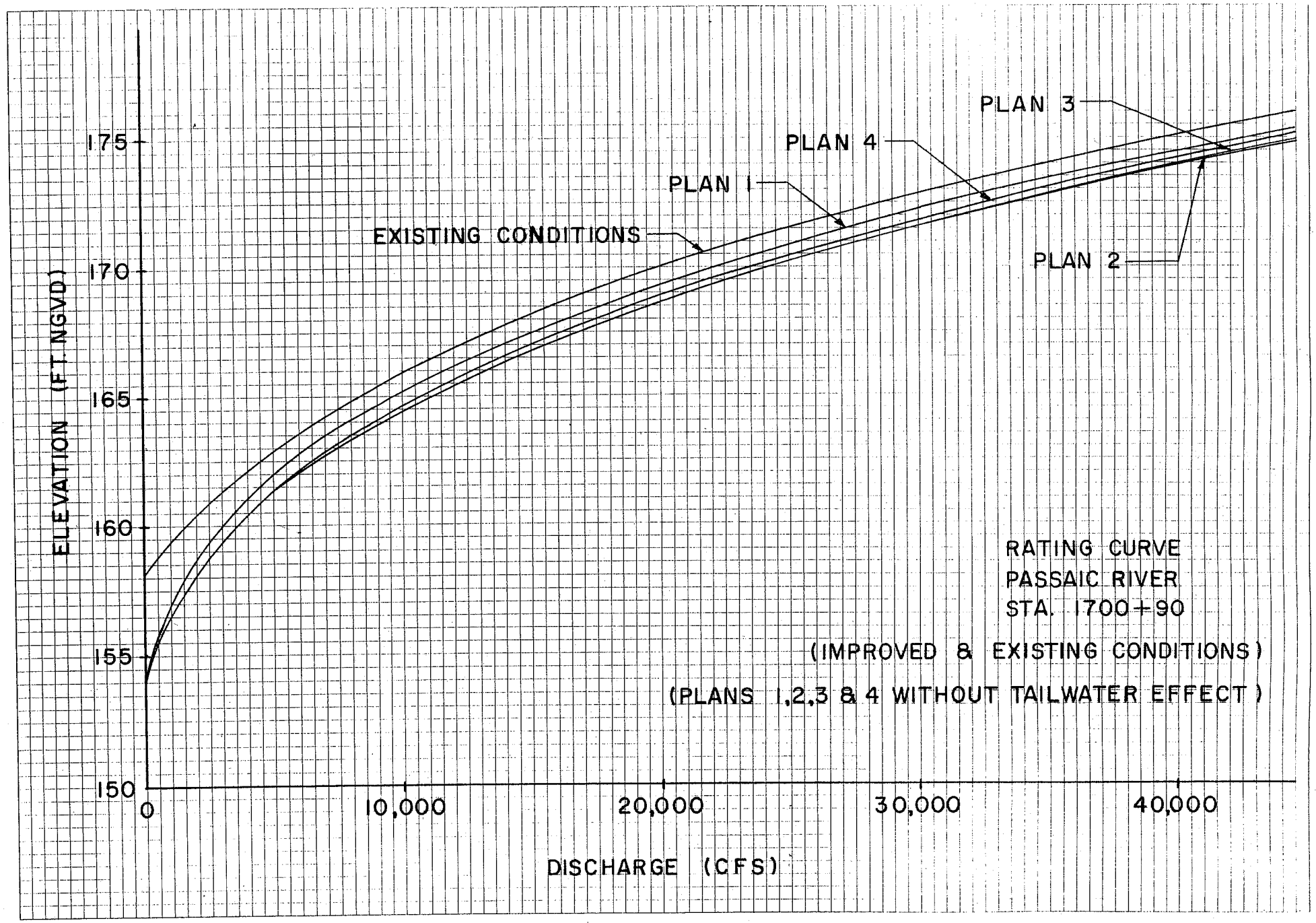


FIGURE 19

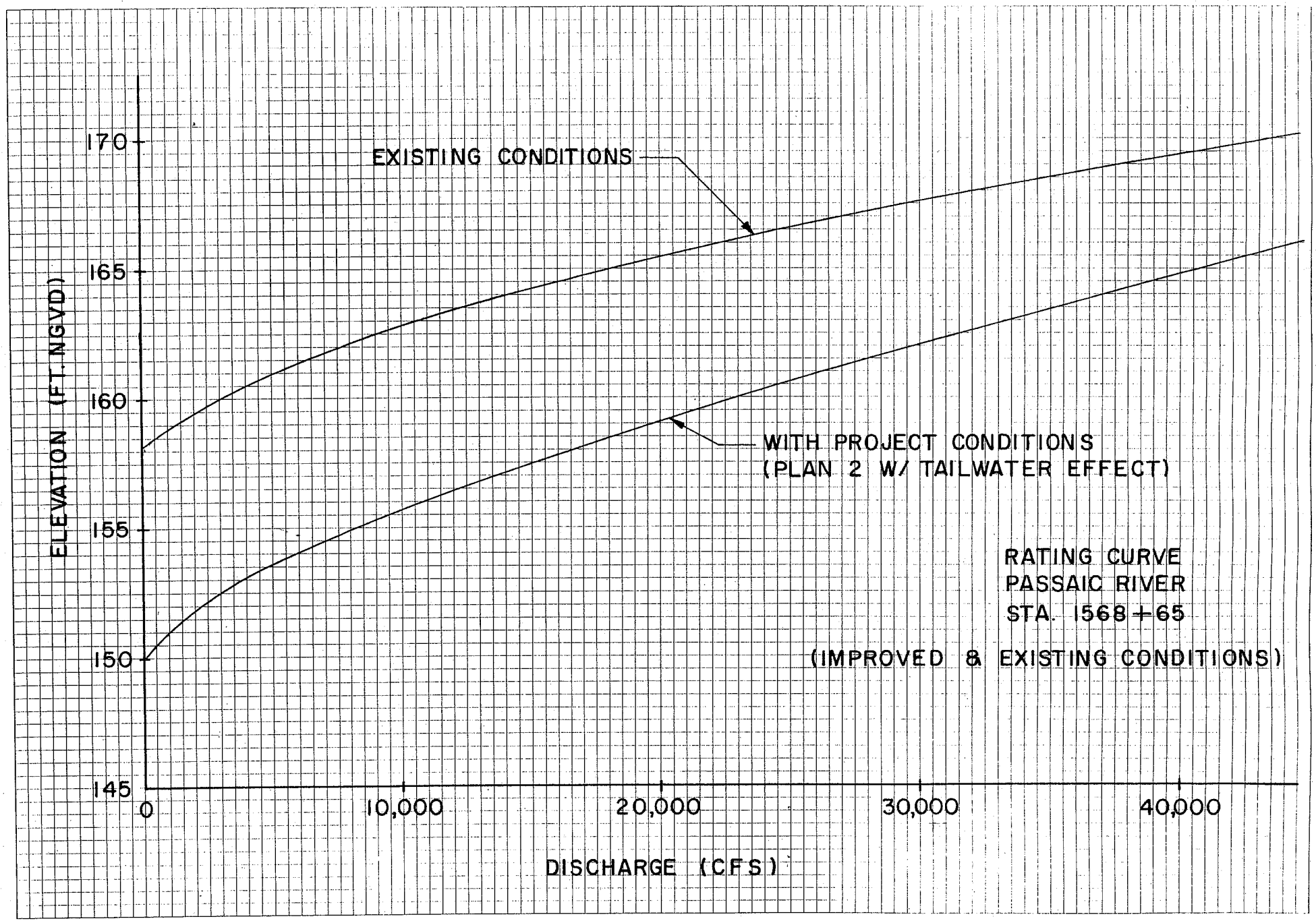


FIGURE 20

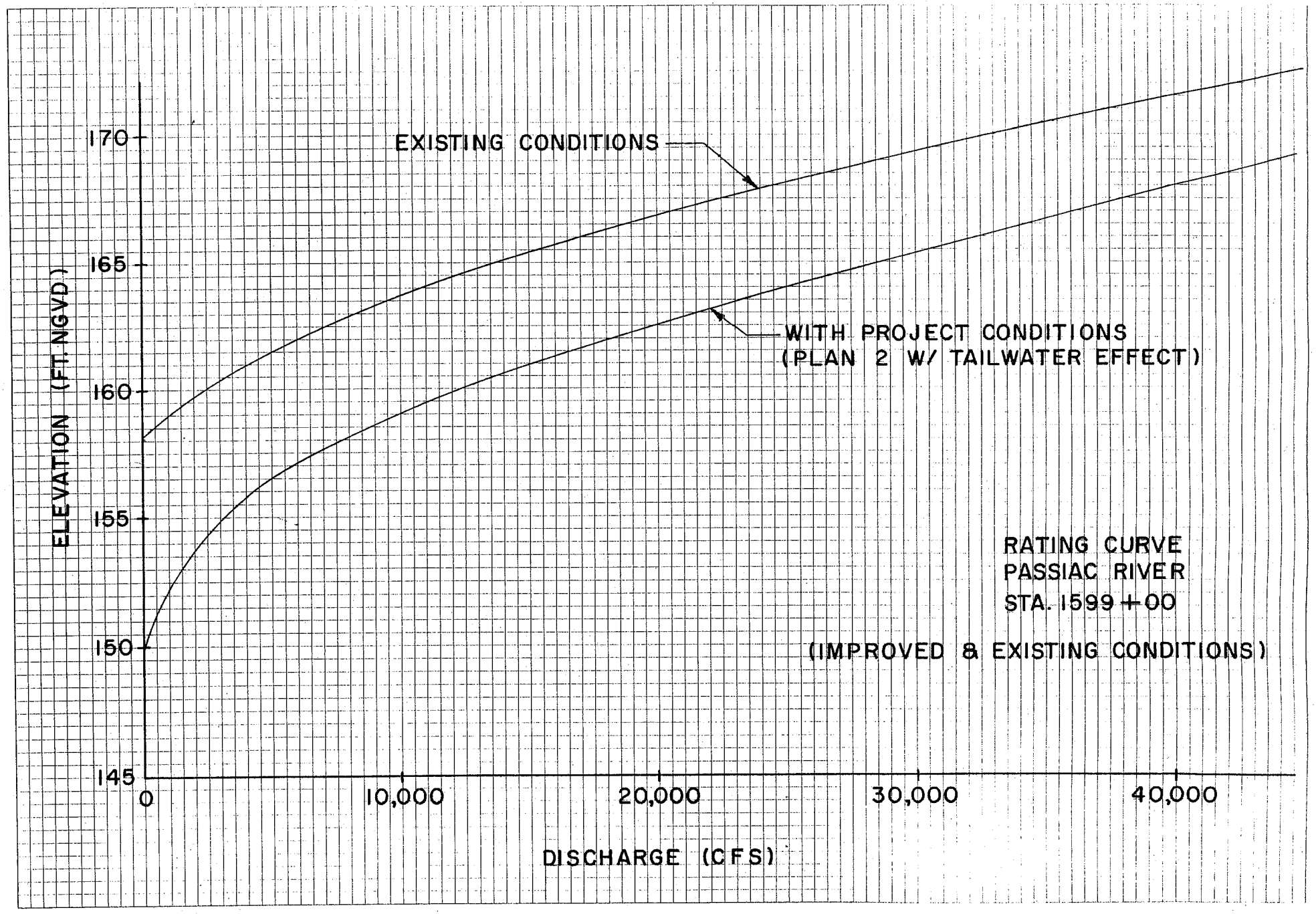
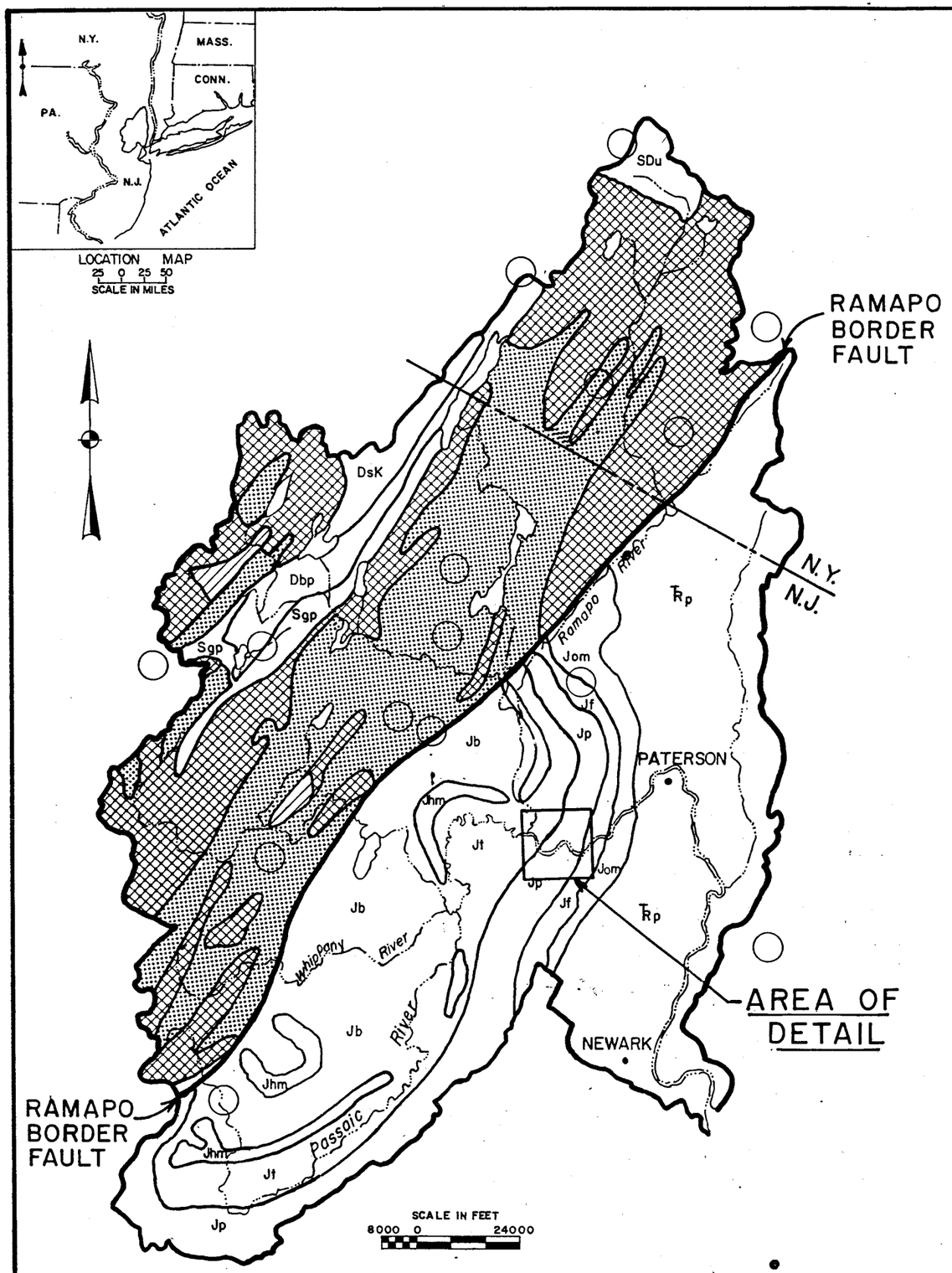


FIGURE 21

PASSAIC RIVER, VICINITY OF BEATTIES DAM
RECONNAISANCE REPORT

APPENDIX B – ENGINEERING
SECTION 3 FOUNDATIONS AND MATERIALS

(NOT COMPLETED)



LEGEND

SEDIMENTARY ROCKS

JURASSIC

- Jb, Jt, Jf — Boonton sandstone and shale; Towaco sandstone and shale; Feltville sandstone and shale

TRIASSIC

- T_{Rp} — Passaic sandstone and shale

DEVONIAN

- DsK — Skunnemunk conglomerate
- Dbp — Bellvale sandstone and Pequanac shale

DEVONIAN AND SILURIAN

- SDu — Undifferentiated conglomerate, sandstone, shale and limestone

SILURIAN

- Sgp — Green Pond conglomerate, Decker limestone, Longwood shale

CRYSTALLINE ROCKS

JURASSIC

- Jhm — Hook Mt. basalt
- Jp — Preakness Mt. basalt
- Jom — Orange Mt. basalt

PRE-CAMBRIAN

- Losee gneiss
- Byram gneiss
- Pochuck gneiss

○ Earthquake Epicenter (Ratcliffe, N.M. 1980)

Note: Data partially compiled from State Geologic Maps. "The Area of Detail" Includes the Beatties Dam Reconnaissance Study Area.

Beatties Dam Reconnaissance Study, N.J.

GEOLOGIC FORMATIONS OF THE PASSAIC BASIN

FIGURE B5

PASSAIC RIVER, VICINITY OF BEATTIES DAM
RECONNAISSANCE REPORT

APPENDIX B - ENGINEERING
SECTION 4 - BEATTIES DAM

PASSAIC RIVER, VICINITY OF BEATTIES DAM
RECONNAISSANCE REPORT

APPENDIX B - ENGINEERING
SECTION 4 - BEATTIES DAM

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PASSAIC RIVER, VICINITY OF BEATTIES DAM
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APPENDIX B - ENGINEERING
SECTION 4 - BEATTIES DAM

DAM LOCATION AND DESCRIPTION

Beatties Dam is located on the Passaic River in the Townships of Wayne and Little Falls, New Jersey. The present dam was built in 1896 and reconstructed after being damaged by a flood in 1945. It is a concrete run-of-the-river dam with 267 feet of its 287 foot crest serving as a broad-crested overflow spillway. The spillway is composed of three sections - an arched 152-foot center section (concave upstream), a 55-foot right wingwall tying into a former factory building currently being renovated for condominiums, and a 60-foot left wingwall tying into the left abutment. There is a 3-foot wide, 1-foot deep notch in the right wingwall for low flows. The dam creates a diversion pool for a water supply intake owned by the Passaic Valley Water Commission (PVWC).

The portion of the dam located in Wayne, up to the centerline of the Passaic River, is owned by the PVWC. The remainder of the dam in Little Falls is owned by the Affirmative Development Corporation. However, PVWC has been maintaining the entire dam since acquiring its portion from the Beatties Carpet Company.

PHASE 1 INSPECTION REPORT - NATIONAL DAM SAFETY PROGRAM

Beatties Dam was inspected and a report completed in August 1981 under the National Dam Inspection Act, Public Law 92-367 prepared by the United States Army Corps of Engineers, Philadelphia District. The purpose of the inspection was to evaluate the structural and hydraulic condition of Beatties Dam and appurtenant structures, and to determine if the dam constitutes a hazard to human life or property. According to the definition contained in the guidelines under which the dam was inspected, the dam is in the intermediate size category. The dam is also defined to be in the significant hazard category.

The assessment of the dam was based primarily on the results of a visual inspection since there was limited engineering data available. The inspection revealed several large masonry blocks are missing from the upstream end of a stone masonry training wall at the left center of the dam. This has caused vertical and horizontal displacement of other stones in the training wall, and could lead to seepage and undermining of the spillway. In addition, some erosion and undermining of the rock foundation at the downstream end of the training wall has occurred.

None of the visual observations were indicative of structurally unstable conditions. However, because no data were available concerning the engineering properties of the foundation materials for the dam, it was not possible to make an evaluation of the stability of the structure or the factor of safety.

The dam's spillway is considered to be inadequate because a flow equivalent to 30% of the Spillway Design Flood would cause the dam to be overtopped. (The Spillway Design Flood is equal to one-half of the Probable Maximum Flood.)

The Dam Safety Report recommended that the owner of the dam arrange for the following measures to be carried out:

(1) Design and oversee repair procedures for the replacement of the large masonry blocks which have been dislodged from the north side of the training wall which is at the left center of the dam.

(2) Evaluate the potential for undermining of the foundation support at the downstream end of the masonry spillway training wall at the left center of the dam caused by the loss of several large bedrock blocks, and design and oversee corrective measures as needed.

(3) Investigate measures to assure the stability of the dam under severe overtopping conditions.

(4) Repair the eroded construction joints.

(5) Develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

DAM MODIFICATIONS

As part of this reconnaissance study for flood control alternatives along the Passaic River, in the vicinity of Beatties Dam, four alternative plans have been developed which include channel improvements and modifications to the existing dam. The Corps of Engineer's Mobile District conducted a structural design analysis to develop the structures for the dam modifications to the extent that reasonable cost estimates could be made for construction of the project.

DESCRIPTION OF PLANS

Plan 1: This alternate consists of complete removal and replacement of the existing dam with only minimal channel excavation in the vicinity of the dam. The existing fixed crest spillway would be replaced with a gated spillway consisting of two 8.3-foot high by 50-foot wide bascule gates and one 8.3-foot high by 138-foot wide bascule gate. In the closed (vertical) position, the top of the bascule gates would be at elevation 158.3 NGVD which is the same as the crest of the existing dam. During non-flood conditions, the gates would be in the closed position in order to maintain normal water surface elevations, and during flood conditions the gates would be lowered to pass the flood flows. Plan 1 is shown on Plate No. 1.

Plan 2: Plan 2 consists of the dam replacement as described for Plan 1 with additional channel modification for a distance of 4,620 feet upstream of the dam. The channel would be deepened a maximum of 4 feet and reshaped to have a base width of 200 feet and side slopes of 2 horizontal to 1 vertical. Plan 2 is shown on Plate No. 1.

Plan 3: Plan 3 consists of the channel modification described in Plan 2 along with the replacement of approximately 200 feet of the existing dam with a gated spillway consisting of two 8.3-foot high by 95-foot wide bascule gates. The top of gate elevation and operation is the same as described in Plan 1. Plan 3 is shown on Plate No. 1.

Plan 4: Plan 4 consists of the channel modification described in Plan 2 with replacement of a portion of the existing dam with a gated spillway consisting of one 8.3-foot high by 100-foot wide bascule gate. The top of gate elevation and operation is the same as described in Plan 1. Plan 4 is shown on Plate No. 2.

HYDRAULIC DESIGN CONSIDERATIONS

General: Hydraulic computations were based on hydrographic and topographic survey data of the area in the vicinity of Beatties Dam. In addition, the following flood-frequency discharges and associated Beatties Dam tailwater elevations were utilized.

RIVER STAGE (FT. NGVD)	FLOOD FREQUENCY	DISCHARGE (CFS)
154.20	1-YR	5773
155.19	2-YR	8025
156.19	5-YR	10615
157.22	10-YR	13637
158.72	25-YR	18529

159.99	50-YR	23212
161.08	100-YR	27636
164.83	500-YR	44826
164.82	SPF	44765

River Stages During Construction: River stages during construction of all alternatives were determined by using the weir equation, $Q=CLH^{3/2}$, with corrections for submergence of the weir. Weir lengths were determined form the cofferdam designs. The 5-YR discharge of 10,615 cfs was selected as the design discharge. This discharge was based on an assumed construction period of one year for each stage for each alternative. The existing spillway crest elevation of 158.3 was used for Construction Stage 1 computations. A spillway crest elevation of 150.0 was used for Construction Stage 2 cofferdam computations. Some excavation upstream of the dam would be required to allow water to reach the dam at elevation 150.0 for Plan 1 and may be required for other alternatives.

Cofferdam cell elevations were set assuming between 1.0 and 1.5 ft. of freeboard above the 5-YR flood elevation. For the most downstream cells, the elevations were set at 158.0. The most upstream cells were set based on the computed head from the weir equation. Water surface elevations would not be reduced at the water supply diversion channel for any alternative considered. Cell elevations for the various alternatives are shown in the following table.

PLANS 1 AND 2

STAGE 1		STAGE 2	
CELLS	ELEVATION	CELLS	ELEVATION
1-3	167.0	12-18	168.5
4	168.5	COMMON CELL 4	168.5
5-6	167.0	19-20	168.5
7	158.0	COMMON CELL 8	163.0
8	163.0	7	158.0
9-11	158.0	21-25	158.0

PLAN 3

STAGE 1		STAGE 2	
CELLS	ELEVATION	CELLS	ELEVATION
1-9	169.0	16-20	162.5
10	164.0	COMMON CELL 6	169.0
11-15	158.0	21-22	162.5
		COMMON CELL 10	164.0
		23-25	158.0

PLAN 4

STAGE 1		STAGE 2	
CELLS	ELEVATION	CELLS	ELEVATION
1-8	170.5	- -	- -
9	164.0		
10-12	158.0		
13	164.0		
14-15	170.5		

MECHANICAL CONSIDERATIONS

General: The bascule gates evaluated in this report are assumed to be operated by hydraulic cylinders located on top of the adjacent piers. The hydraulic power unit is to be located in a building on the left side of the river. It is recommended that two (2) operators be used on all gates. This will decrease torsional stress in the gate as well as distribute water/gate loads more evenly to the piers. The gates should be equipped with positive, mechanical type latches on either side to hold the gate in the closed (vertical) position. The gates should also be fitted with both bottom and side seals to minimize leakage. The operation of the gates will be either fully automatic, or manual, as selected by the user.

STRUCTURAL DESIGN

General: Information provided in the Foundations and Materials Appendix and the on-site inspection of Beatties Dam was used in the preliminary structural design for the gated spillway structures. It was assumed that the rock upon which the structures would be founded would have adequate bearing capacity and sliding resistance so that the structures could be sized for overturning. A one-foot design strip of the spillway monoliths and a monolithic design of the pier monoliths were investigated for the following conditions:

Conditions	Description
Normal Condition	Headwater at El. 158.3, Tailwater at El. 146.5, Gates in closed (vertical) position.
Flood Condition	Headwater at El. 165.0, Tailwater at El. 146.5, Gates fully open.
Maintenance Condition	Headwater at El. 158.3, Tailwater at El. 146.5; Stoplogs in place 2 feet downstream from upstream edge of monolith. Area between stoplogs and gate dewatered.

These conditions were considered adequate to give reasonable concrete quantities for the cost estimates. Typical calculations of the stability analyses are shown in Attachment A. Results of the design analysis are shown on Plate No. 3. It was assumed for this study that the existing dam structures were stable and would not require remedial work when the new structures were built. Final determination of this would be made from a condition survey and structural analysis of the existing dam to be conducted during a subsequent study. In a worst-case scenario, the entire existing dam would require replacement resulting in Plans 3 and 4 not being technically feasible and reverting to Plan 2.

CONSTRUCTION SEQUENCE AND COFFERDAM PLAN

General: Construction dewatering for all four alternates would be accomplished by the use of steel sheetpile coffercells and pumps. Phased construction would be required for Plans 1, 2, and 3 to allow river flows to be passed around the construction areas. Cofferdam height was based on providing 1 to 1-1/2 feet of freeboard above a five-year frequency flood. Construction of Plan 4 and stage two of Plans 1, 2 and 3 would be without land access. Access would be by barge with a staging area on the left bank.

Plans 1 and 2: The construction of Plans 1 and 2 would be accomplished in two stages. During the first stage the 50-foot wide gate on the left side of the river would be constructed within a cofferdam as shown on Plate No. 1. The upstream arm of the cofferdam would provide protection to elevation 167.0 and the downstream arm to elevation 158.0. Provisions would be made on the spillway pier monolith to accommodate tie-ins with the second stage cofferdam. After completion of the left side gate, the first stage cofferdam would be removed, associated channel work would be completed, and the second stage cofferdam constructed as shown on the plans. The remaining two spillway gates would then be constructed inside the second stage cofferdam. Construction access would be from the left bank for both stages of construction, as there is limited room and a

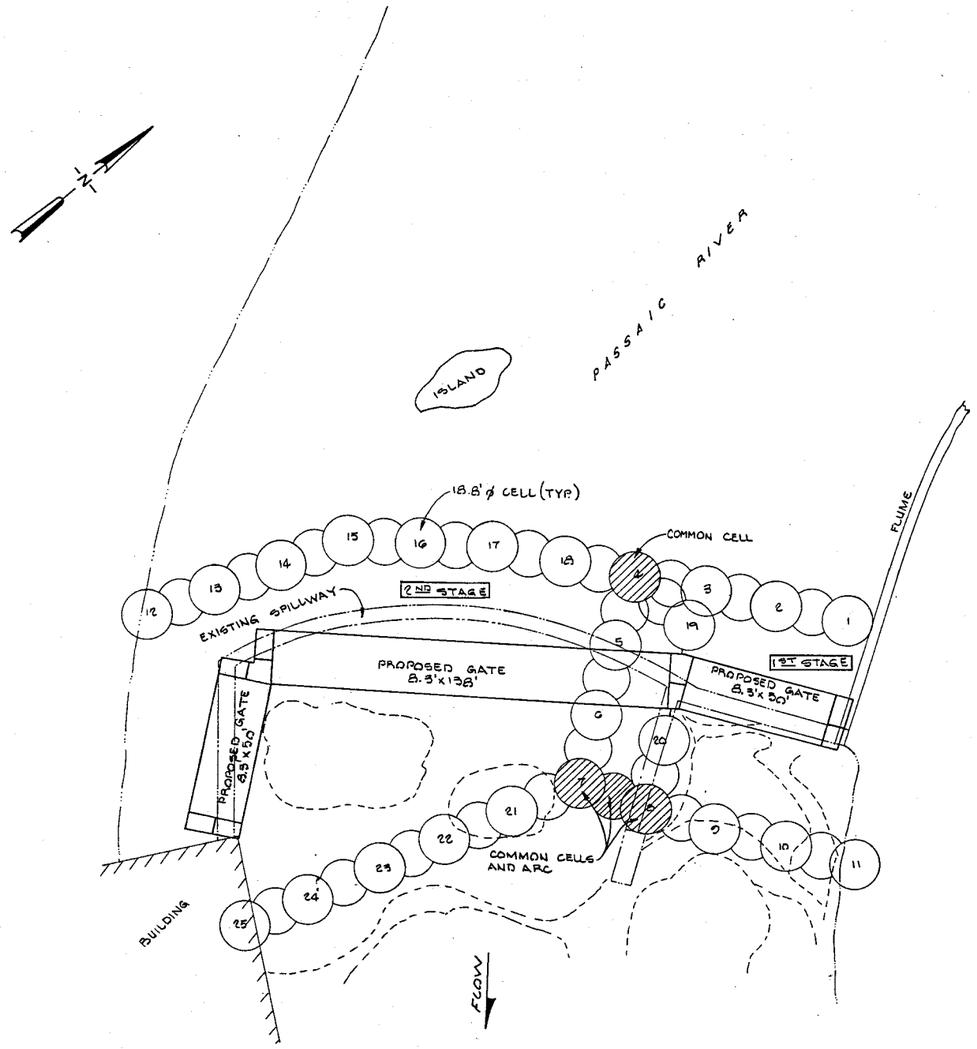
residential complex on the right bank. Total time for construction of Plans 1 or 2 was estimated to be two years.

Plan 3: Plan 3 would also be constructed in two stages. During the first stage the left side 95-foot wide gate would be constructed within a cofferdam as shown on Plate No. 1. The first stage cofferdam would provide protection on the upstream arm to elevation 169.0 and to elevation 158.0 on the downstream arm. As in the first two alternates, provisions would be made on the spillway pier monolith to tie-in the second stage cofferdam. The second stage cofferdam would provide protection to elevation 162.5 on the upstream arm and to elevation 158.0 on the downstream arm. Construction access and time would be the same as for Plans 1 and 2.

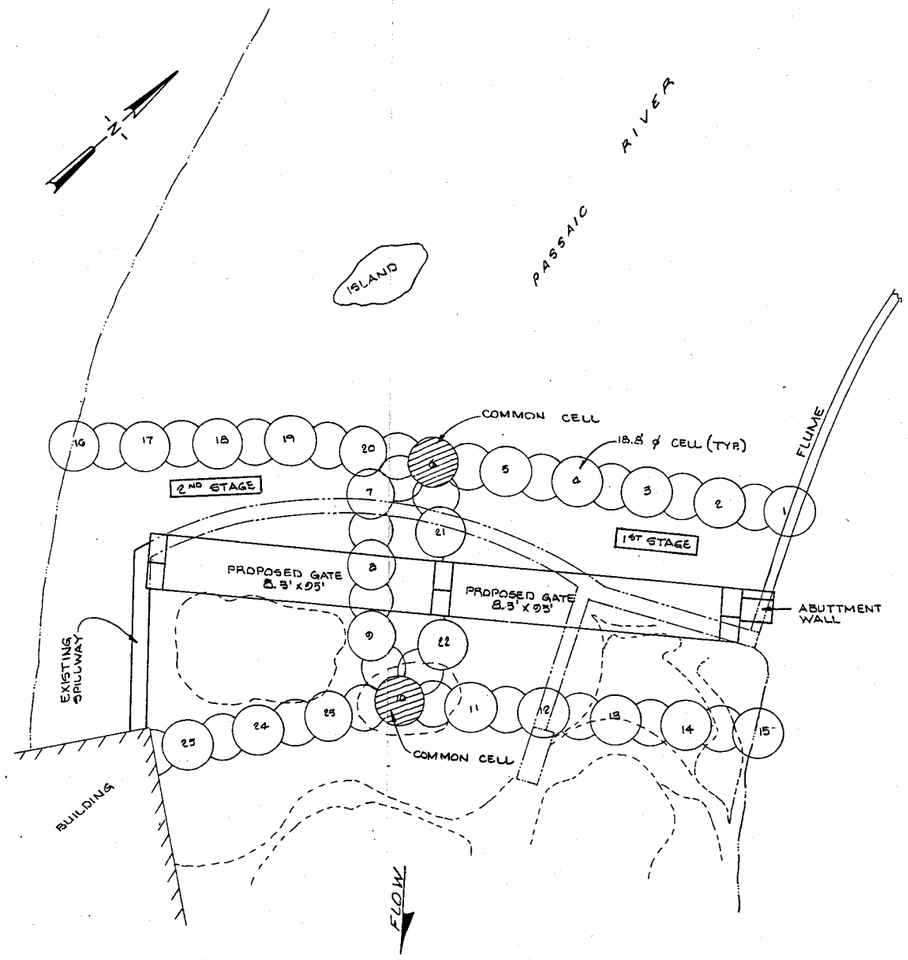
Plan 4: The construction of Plan 4 would be accomplished in one stage as shown on Plate No. 2. A single cofferdam would provide protection to elevation 170.5 on the upstream arm and elevation 158.0 downstream. Access to the construction site would be from the left bank and construction time was estimated to be one year.

U. S. ARMY

REVISIONS					
REVISION SYMBOL	NO. SYMB.	AMD. C.O.R.	DESCRIPTION	DATE	APPROVED



PLAN - ALTERNATES NO. 1 & 2
SCALE: 1"=20'



PLAN - ALTERNATE NO. 3
SCALE: 1"=20'

NOTE: SEE REPORT FOR TOP ELEVATION OF COFFERCELLS.

SCALE: 1"=20'
20' 0 20' 40 FT.

DESIGNED BY: M.T.	U.S. ARMY ENGINEER DISTRICT, MOBILE CORPS OF ENGINEERS MOBILE, ALA.
DRAWN BY: C.C.	BEATTIES DAM, PASSAIC RIVER, N.J.
CHECKED BY: M.T.	BEATTIES DAM MODIFICATION
SUPERVISED BY: L.C.	ALTERNATES NO.1, 2 & 3
BR. REF. NO.	SPEC. NO. / FILE NO.
SCALE: AS SHOWN	DATE: / SHEET / DRAWING NO.

PLATE NO. 1

REVISIONS					
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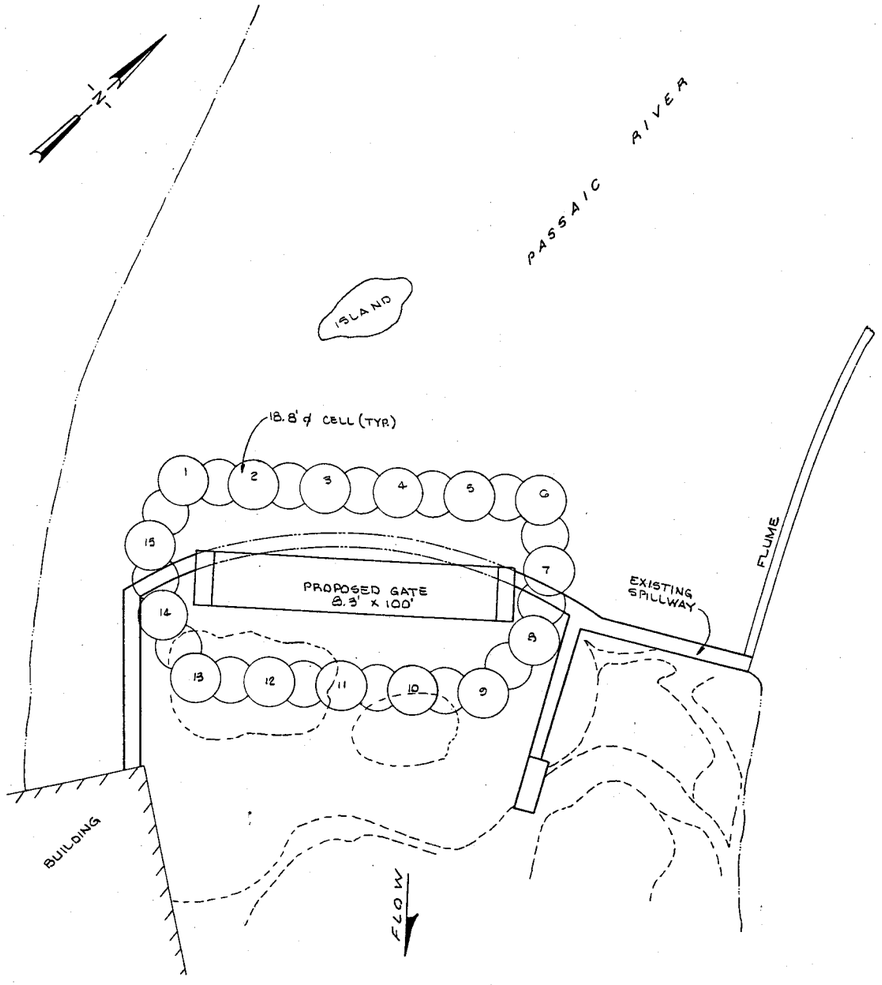

PLAN - ALTERNATE NO. 4
SCALE: 1" = 20'

NOTE: SEE REPORT FOR TOP ELEVATION OF COFFERCELLS.

SCALE: 1" = 20'
20' 0 20 40 FT.

DESIGNED BY: M.T.	U.S. ARMY ENGINEER DISTRICT, MOBILE CORPS OF ENGINEERS MOBILE, ALA.
DRAWN BY: C.C.	BEATTIES DAM, PASSAIC RIVER, N.J.
CHECKED BY: M.T.	BEATTIES DAM MODIFICATION
SUPERVISED BY: L.C.	ALTERNATE NO. 4
SH. REF. NO.	SPEC. NO. / SIZE / FILE NO. / DRAWING NO. / SCALE: As Shown / DATE: / SHEET

REVISIONS

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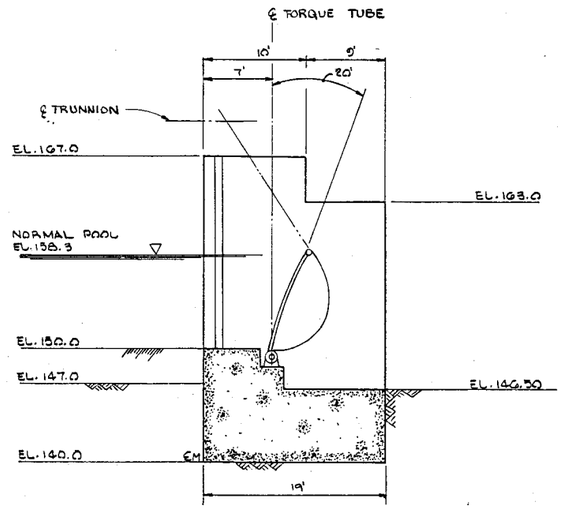
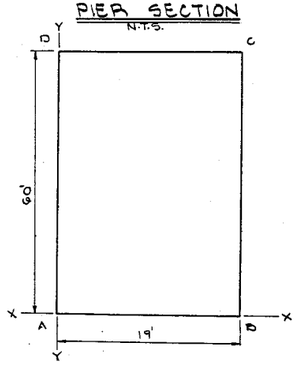
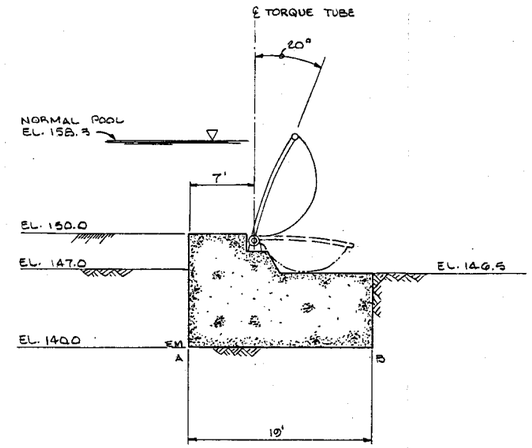


PIER SECTION
N.T.S.



PLAN OF BASE
N.T.S.

CONDITION	EV KIPS	EH KIPS	EM FT. KIPS	EMY FT. KIPS	FOUNDATION PRESSURE TONS / FT² A	B	C	D	$S_{s.f}$
NORMAL CONDITION	1040	563	13,857	51,800	.13	.79	.79	.13	4.51
FLOOD CONDITION	1210	727	14,576	36,300	.11	.96	.11	.96	3.71
NORMAL WITH MAINTENANCE	962	563	11,716	86,527	.11	.89	.73	0	4.46



SPILLWAY SECTION
N.T.S.

CONDITION	EV KIPS	EH KIPS	EM FT. KIPS	EM/EV	FOUNDATION PRESSURE TONS/ FT² A	B	$S_{s.f}$
NORMAL CONDITION	12.9	9.4	160	12.40'	0.03	.66	4.24
FLOOD CONDITION	16.5	11.4	197	11.94'	0.10	.78	3.71
NORMAL WITH MAINTENANCE	10.5	9.4	146	13.90'	0	.66	3.84

DESIGNED BY: M.T.	U.S. ARMY ENGINEER DISTRICT, MOBILE CORPS OF ENGINEERS MOBILE, ALA.
DRAWN BY: C.C.	BEATTIES DAM, PASSAIC RIVER, N.J.
CHECKED BY: M.T.	BEATTIES DAM MODIFICATION
SUPERVISED BY: L.C.	DESIGN RESULTS
SUBS. REF. NO.	SPEC. NO. / FILE NO. / DRAWING NO.
	SCALE: As Shown / DATE: / SHEET

Passaic River, Vicinity of Beatties Dam

Reconnaissance Report

Appendix B-Engineering

Section 5-Cost Estimates

PASSAIC RIVER, VICINITY OF BEATTIES DAM

RECONNAISSANCE REPORT

APPENDIX B-ENGINEERING: SECTION 5 - COST ESTIMATES

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ATTACHMENT

I. FORMULATION OF PROJECT FIRST COSTS

INTRODUCTION

This appendix documents the development of cost estimates for this Reconnaissance Study. Methods for deriving costs of various plan components are discussed. All costs in this study were estimated at October 1988 price levels.

FIRST COSTS

First costs include the charges arising from the construction of the project, including costs of contingencies, engineering, design, supervision and administration. The project first costs for the alternative plans of protection are presented in Table B5-1 to B5-4.

The cost estimates were prepared in accordance with the guidance as shown in EM 1110-2-13-1 "Cost Estimates - Planning and Design Stages," Draft EC 1110-2-263 "Civil Works Construction Cost Estimating", Draft ER 1110-2-1460 "Construction Costs and Cost Estimating", EP 1105-2-45 "Economic Considerations," and Draft EC 1110-2-538 "Civil Works Project Cost Estimating - Code of Accounts."

UNIT COSTS

Unit costs for material and equipment are developed and based upon: current costs from projects of a similar nature, and by contacting manufacturers, dealers, distributors, and contractors in the area of the project.

LUMP SUM ITEMS

Certain items of cost, such as maintenance of traffic, are listed in the estimates as lump sum items because of the number of items and multiplicity of activities utilized to accomplish each of these work features.

LAND REQUIREMENTS AND ACQUISITION COSTS

In order to construct the considered plans of improvement, local interests would be required to provide certain lands and easements. The estimated value of lands needed for the dam and channel modifications were based on a 16 September 1986 report titled "Appraisal of Passaic River Dual Inlet Tunnel Plan - Volumes I & II" and updated to October 1988 price level. The methodology for this approach was initiated by CENAN-PL-P and approved by the Real Estate Division of NAN (See Attachment B5-1). Permanent easements (upland) and temporary easements are included in each estimate. These estimates include costs for items such as contingencies, planning and surveys, appraisals and administration.

CONTINGENCIES

The estimate of cost for each major subdivision or features of the project includes an item for "contingencies." The item for "contingencies" is an allowance against some adverse or unanticipated condition not susceptible to exact evaluation from the data at hand but which must be expressed or represented in the cost estimate. Ordinarily, it represents possible latent difficulties in foundation conditions; deficiencies in surveys, borings or other basic data; or uncertainties beyond the control of the estimator.

It is an allowance to cover possible added cost that may arise because of not having specific information as to the exact extent and scope of relocations which may finally be required. It is not an allowance for omissions of work items which during all stages of project development are known to be required, but for work items for which fairly accurate quantities have not yet been determined by specific design.

The normal contingency allowance, as provided for in EM 1110-2-1301 Appendix C, dated 31 July 1980, (as amended by change 1 dated 15 April 1982), for use in estimates of cost of construction and relocation features of civil works projects is a percentage of the estimated direct construction cost. A contingency factor of 25 percent was used for alternatives in this study given the general nature of the reconnaissance level report.

ENGINEERING AND DESIGN

The engineering and design cost includes all engineering, design, surveys, plans, specifications and related work required for the construction of the project. These costs were taken as 15 percent of the direct construction cost, including contingency. This cost was obtained and based on previous experience, relative complexity of the design and an analysis of cost record of projects of a similar nature. This conforms with the guidance and format as set forth in EC 1110-2-538 and EC 1110-2-263.

INSPECTION, SUPERVISION, ADMINISTRATION AND OVERHEAD

The cost of supervision and administration is included in the estimate to provide for anticipated items such as the salaries of the resident engineer, his staff of engineers, surveymen, inspectors, draftsmen, clerical, and custodial personnel; construction and fixed charges for transportation and for other field equipment; field supplies; construction management, general construction supervision; project office administration, distributive cost of area office and general overhead charged to the project. Accordingly, an estimated amount of 10 percent of the direct construction cost, including contingency, was added to the estimate to account for the cost of supervision and administration.

INTEREST DURING CONSTRUCTION

This is the cost of construction money invested in a project before the beginning of the period of economic analysis and before the accumulation of benefits by the project. Interest during construction (IDC) costs are added to the project cost to determine investment costs. Average annual costs are determined based on investment costs which include IDC.

Planning Guidance Notebook (EP 1105-2-45, paragraph 2-6, page 2-2) states that costs incurred during the construction period should be increased by adding compound interest at the applicable project discount rate from the date the expenditures are made to the beginning of the period of analysis. For purposes of this study, construction expenditures are assumed to occur in equal annual increments.

The construction durations of the alternative plans are estimated to range from one to two years. This would include land acquisition, channel excavation, dam construction, and implementation of environmental measures.

II. ANNUAL CHARGES

PROJECT LIFE

It is estimated that the major features of the plan of improvement will have a useful life expectancy of at least 100 years, provided a consistent program of maintenance is adhered to by the operating agency.

INTEREST AND AMORTIZATION

The interest rate used in converting investment costs to an equivalent annual cost is the rate set by the Water Resources Council for the evaluation of Federal Government Water Resources Projects. This rate is set at 8-7/8 percent for FY89.

Amortization is the financial or economic process of recovering an investment in a project. The amortization period is the period of time assumed or selected for economic recovery of the net investment in a project by the process of amortization. The definition of amortization can more readily be explained by stating that it is the equivalent annual amount which, with compound interest, will accumulate to provide one dollar at the end of the amortization period.

When combined, interest and amortization become the capital recovery factor which, when applied to project costs, will result in the annual cost of the project investment. The interest and amortization factor, based on a 100 year project life and 8-7/8 percent interest rate, is 0.088768.

MAINTENANCE AND OPERATION

The operation and maintenance (O&M) costs are estimated to represent the anticipated average annual economic costs necessary to maintain the project at full operating efficiency throughout the project life. After completion of the project, operation and maintenance of project facilities would be performed by the local cooperating agency in accordance with government regulations.

The basis for developing the O&M costs was consideration of the procedures needed to maintain the project over its 100 year life.

Operation of the bascule gates in Beatties Dam and the Great Piece Meadows Weir would be by automatic control and would not require full time personnel. Periodic test operation and preventative maintenance generally consisting of replacing seals, lubricating equipment and painting miscellaneous metal parts would be accomplished. Dewatering for major repairs should occur about every ten years. Storage facilities for the dewatering stoplogs will be a continuous operation and maintenance expense.

The annual maintenance that would have to be performed on the channel would include but not be limited to: inspection, maintenance, repair and replacement of riprap; clearing of debris from the channel and bridges; sediment removal as needed, shoal removal, brush and tree control, trash pickup; cutting of grass along the channel banks. The wetlands would be self-perpetuating once established. Therefore, there are no O&M costs associated with this mitigation features.

III. COST SHARING RESPONSIBILITIES

The requirements for the Federal and non-Federal sharing of responsibilities in the construction, operation and maintenance of Federal water resources projects are set forth in the water Resources Development Act of 1986 (PL 99-662). For a flood control project in the vicinity of Beatties Dam, the authorizing legislation mandates 75% Federal/25% non-Federal sharing of the project cost. Operation and maintenance costs are a non-Federal responsibility. Table B5-5 presents a summary of the alternative project costs.

TABLE 1

BEATTIES DAM, PASSAIC RIVER, NEW JERSEY

PROJECT COST ESTIMATE - Alternate No. 1

Price Level - October 1988

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
01.-.-.-	LANDS & DAMAGES						
01.A.-.-	Project Lands:						
	(Wayne Township)						
01.A.-.-	Temporary Easement Rights	5.35	AC	$7,000	$37,450	$9,400	$46,850
01.A.-.-	Perm.Easem't Rights(Upland)	0.1	AC	70,000	7,000	1,800	8,800
01.A.-.-	Perm.Easement Rights(River)	0.25	AC	10,000	2,500	600	3,100
	(Little Falls Township)						
01.A.-.-	Temporary Easement Rights	0.35	AC	7,000	2,450	600	3,050
01.A.-.-	Perm.Easem't Rights(Upland)	0.1	AC	70,000	7,000	1,800	8,800
01.A.-.-	Perm.Easement Rights(River)	0.25	AC	10,000	2,500	600	3,100
01.A.-.-	Planning & Surveys (3%)	1	JOB	LS	1,800	400	2,200
01.A.-.-	Appraisal & Admin.(2%)	1	JOB	LS	1,200	300	1,500
	Subtotal				$61,900		
01.A.Z.-	Contingencies 25.0%					$15,500	
01.A.-.-	Project Lands Total:						$77,400
04.2.-.-	SPILLWAY						
04.2.A.A	Mobilization, Demobilization and Preparatory Work:	1	JOB	LS	$250,000	$62,500	$312,500
04.2.B.-	Care and Diversion of Water:						
04.2.B.B	Stl.Sht.Piling (Drive/Pull)	430	TON	$1,600.00	688,000	172,000	860,000
04.2.B.B	Cell Fill (Place & Remove)	5,605	CY	20.00	112,100	28,000	140,100
04.2.B.B	Dewatering	1	JOB	LS	300,000	75,000	375,000
04.2.D.-	Earthwork for Structures:						
04.2.D.B	Remove Exist.Spillway Conc.	890	CY	90.00	80,100	20,000	100,100
04.2.D.B	Excavation, Common	1,320	CY	20.00	26,400	6,600	33,000
04.2.D.B	Excavation, Rock	1,970	CY	80.00	157,600	39,400	197,000
04.2.E.-	Foundation Work:						
04.2.E.B	Foundation Preparation	565	SY	10.00	5,650	1,400	7,050
04.2.F.-	Seepage Control:						
04.2.F.B	Mob & Demob Grout Spread	1	JOB	LS	10,000	2,500	12,500
04.2.F.B	Drilling Grout Holes	750	LF	15.00	11,250	2,800	14,050
04.2.F.B	Grouting Holes (2-stage)	25	EA	300.00	7,500	1,900	9,400
04.2.R.-	Associated General Items:						
04.2.R.B	Maint.& Protect.of Traffic	1	JOB	LS	75,000	18,800	93,800
04.2.R.B	Topsoil & Seeding	5.9	AC	10,000.00	59,000	14,800	73,800

TABLE 1

BEATTIES DAM, PASSAIC RIVER, NEW JERSEY

PROJECT COST ESTIMATE - Alternate No. 1

Price Level - October 1988

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
04.2.-.-	SPILLWAY (Continued)						
04.2.2.-	Concrete Overflow Section:						
04.2.2.C	Concrete, in place	1,880	CY	500.00	940,000	235,000	1,175,000
04.2.2.C	Reinforcing Steel	94,000	Lbs	1.00	94,000	23,500	117,500
04.2.5.-	Gates, Stoplogs and Equipment:						
04.2.5.E	Stoplogs	51	TON	4,000.00	204,000	51,000	255,000
04.2.5.E	Gates,Incl.Oper.Machinery	1	JOB	LS	2,769,000	692,300	3,461,300
04.2.5.A	Control House	1	JOB	LS	100,000	25,000	125,000
	Subtotal, Construction Costs:				$5,889,600		
04.2.Z.-	Contingencies 25.0%					$1,472,500	
04.2.-.-	Spillway Total:						$7,362,100
06.3.-.-	WILDLIFE FACILITIES AND SANCTUARIES						
06.3.3.-	Wetlands:						
06.3.3.A	Land Acquisition	240	AC	$2,800.00	$672,000	$168,000	$840,000
06.3.3.B	Cleanup & Site Preparation	240	AC	5,000.00	1,200,000	300,000	1,500,000
06.3.3.B	Planting	240	AC	4,100.00	984,000	246,000	1,230,000
06.3.3.B	Maint.& Protect of Traffic	1	JOB	LS	20,700	5,200	25,900
06.3.3.B	Levees	770	LF	61.00	47,000	11,700	58,700
06.3.3.B	Weir Structure, Complete	1	JOB	LS	695,600	173,900	869,500
	Subtotal, Construction Costs:				$3,619,300		
06.3.Z.-	Contingencies 25.0%					$904,800	
06.3.-.-	Wildlife Facilities & Sanctuaries Total:						$4,524,100
09.-.-.-	CHANNELS AND CANALS						
09.0.2.-	Channels:						
09.0.2.B	Excavation, Rock	1,400	CY	70.00	98,000	24,500	122,500
09.0.R.-	Associated General Items:						
09.0.R.B	Maint.& Protect.of Traffic	1	JOB	LS	125,000	31,300	156,300
	Subtotal, Construction Costs:				$223,000		
09.0.Z.-	Contingencies 25.0%					$55,800	
09.-.-.-	Channels and Canals Total:						$278,800

TABLE 1

BEATTIES DAM, PASSAIC RIVER, NEW JERSEY

PROJECT COST ESTIMATE - Alternate No. 1

Price Level - October 1988

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
18.-.-.-	CULTURAL RESOURCE PRESERVATION						
18.0.1.-	Identification, Data Analysis and Reports:						
18.0.1.A	Document entire complex IAW HAER/HABS Guidelines	1	JOB	LS	$47,600	$11,900	$59,500
18.0.1.A	Document & Reconstruct Weir	1	JOB	LS	17,900	4,500	22,400
18.0.1.A	Data Recovery & Partial Preservation	1	JOB	LS	59,600	14,900	74,500
	Subtotal, Construction Costs:				$125,100		
18.0.Z.-	Contingencies 25.0%					$31,300	
18.-.-.-	Cultural Resource Preservation Total:						$156,400
	TOTAL CONSTRUCTION COST				$9,857,000	$2,464,400	$12,321,400
01.-.-.-	LANDS AND DAMAGES				61,900	$15,500	77,400
30.-.-.-	ENGINEERING & DESIGN			15.0%	1,478,600	369,700	1,848,200
31.-.-.-	SUPERVISION & ADMINISTRATION			10.0%	985,700	246,400	1,232,100
	TOTAL PROJECT COST - Alternate No. 1				$12,383,200	$3,096,000	$15,479,100
	Interest During Construction						2,121,600
	TOTAL PROJECT COST, INCLUDING INTEREST						17,600,700

TABLE 1

ALTERNATE NO.]

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
LOWER VALLEY MITIGATION CHANNEL							
01.-.-.-	Lands & Damages						
01.A.-.-.	Project Lands:						
01.A.-.-.	Temporary Easement Rights	53.6	AC	6,000	1,608,000	402,000	2,010,000
01.A.-.-.	Perm. Easem't Rights (Upland)	26.8	AC	60,000	321,600	80,400	402,000
01.A.-.-.	Perm. Easem't Rights (River)	293.5	AC	10,000	2,935,000	733,800	3,668,800
01.A.-.-.	Planning & Surveys (3%)				145,900	36,500	182,400
01.A.-.-.	Appraisal & Admin. (2%)				57,300	14,300	71,600
	Subtotal				5,067,800		
01.A.7.-	Contingencies 25%					1,267,000	
01.A.-.-	Project Lands Total:						6,334,800
09.-.-.-	CHANNELS AND CANALS						
09.0.2.-	Channels:						
09.0.2.B	Excavation, Common	337,400	CY	15.00	5,061,000	1,687,000	6,748,000
	Excavation, Common (Toxic)	17,800	CY	75.00	1,335,000	333,800	1,668,800
09.0.R.-	Associated General Items:						
09.0.R.B	Maint. & Protect of Traffic	1	Job	LS	200,000	50,000	250,000
09.0.R.B.	Topsoil & Seeding	80.4	AC	10,000.00	804,000	201,000	1,005,000
	Subtotal, Construction Costs:				7,400,000		
09.0.7.-	Contingencies 25.0%					2,271,800	
09.-.-.-	Channels and Canals Total:						9,671,800
09.-.-.-	TOTAL CONSTRUCTION COST				7,400,000	2,271,800	9,671,800
01.-.-.-	LANDS & DAMAGES				5,067,800	1,267,000	6,334,800
30.-.-.-	ENGINEERING & DESIGN			15%	1,110,000	340,800	1,450,800
31.-.-.-	SUPERVISION & ADMINISTRATION			10%	740,000	227,200	967,200
	TOTAL PROJECT COST				14,317,800	4,106,800	18,424,600
	Interest During Construction						2,526,000
	TOTAL PROJECT COST, INCLUDING INTEREST						20,950,600

TABLE 1

Alternate No. 1

SUMMARY OF COMPREHENSIVE COST, INCLUDING MITIGATION

TOTAL PROJECT COST	33,903,600
INTEREST DURING CONSTRUCTION	4,647,600
TOTAL PROJECT COST, INCLUDING INTEREST	38,551,200

TABLE 2

BEATTIES DAM, PASSAIC RIVER, NEW JERSEY

PROJECT COST ESTIMATE - Alternate No. 2

Price Level - October 1988

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTA PROJEC COS
01.-.-.-	LANDS & DAMAGES						
01.A.-.-	Project Lands: (Wayne Township)						
01.A.-.-	Temporary Easement Rights	12.2	AC	$7,000	$85,400	$21,400	$106,80
01.A.-.-	Perm.Easem't Rights(Upland)	1.6	AC	70,000	112,000	28,000	140,00
01.A.-.-	Perm.Easement Rights(River)	14	AC	10,000	140,000	35,000	175,00
	(Little Falls Township)						
01.A.-.-	Temporary Easement Rights	2.5	AC	7,000	17,500	4,400	21,90
01.A.-.-	Perm.Easem't Rights(Upland)	1.6	AC	70,000	112,000	28,000	140,00
01.A.-.-	Perm.Easement Rights(River)	13.8	AC	10,000	138,000	34,500	172,50
01.A.-.-	Planning & Surveys (3%)	1	JOB	LS	18,100	4,500	22,60
01.A.-.-	Appraisal & Admin.(2%)	1	JOB	LS	12,100	3,000	15,10
	Subtotal				$635,100		
01.A.Z.-	Contingencies 25.0%					$158,800	
01.A.-.-	Project Lands Total:						$793,90
04.2.-.-	SPILLWAY						
04.2.A.A	Mobilization, Demobilization and Preparatory Work:	1	JOB	LS	$250,000	$62,500	$312,50
04.2.B.-	Care and Diversion of Water:						
04.2.B.B	Stl.Sht.Piling (Drive/Pull)	430	TON	$1,600.00	688,000	172,000	860,00
04.2.B.B	Cell Fill (Place & Remove)	5,605	CY	20.00	112,100	28,000	140,10
04.2.B.B	Dewatering	1	JOB	LS	300,000	75,000	375,00
04.2.D.-	Earthwork for Structures:						
04.2.D.B	Remove Exist.Spillway Conc.	890	CY	90.00	80,100	20,000	100,10
04.2.D.B	Excavation, Common	1,320	CY	20.00	26,400	6,600	33,00
04.2.D.B	Excavation, Rock	1,970	CY	80.00	157,600	39,400	197,00
04.2.E.-	Foundation Work:						
04.2.E.B	Foundation Preparation	565	SY	10.00	5,650	1,400	7,05
04.2.F.-	Seepage Control:						
04.2.F.B	Mob & Demob Grout Spread	1	JOB	LS	10,000	2,500	12,50
04.2.F.B	Drilling Grout Holes	750	LF	15.00	11,250	2,800	14,05
04.2.F.B	Grouting Holes (2-stage)	25	EA	300.00	7,500	1,900	9,40
04.2.R.-	Associated General Items:						
04.2.R.B	Maint.& Protect.of Traffic	1	JOB	LS	75,000	18,800	93,80
04.2.R.B	Topsoil & Seeding	5.9	AC	10,000.00	59,000	14,800	73,80

TABLE 2

BEATTIES DAM, PASSAIC RIVER, NEW JERSEY

PROJECT COST ESTIMATE - Alternate No. 2

Price Level - October 1988

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
04.2.-.-	SPILLWAY (Continued)						
04.2.2.-	Concrete Overflow Section:						
04.2.2.C	Concrete, in place	1,880	CY	500.00	940,000	235,000	1,175,000
04.2.2.C	Reinforcing Steel	94,000	Lbs	1.00	94,000	23,500	117,500
04.2.5.-	Gates, Stoplogs and Equipment:						
04.2.5.E	Stoplogs	51	TON	4,000.00	204,000	51,000	255,000
04.2.5.E	Gates,Incl.Oper.Machinery	1	JOB	LS	2,769,000	692,300	3,461,300
04.2.5.A	Control House	1	JOB	LS	100,000	25,000	125,000
	Subtotal, Construction Costs:				$5,889,600		
04.2.Z.-	Contingencies 25.0%					$1,472,500	
04.2.-.-	Spillway Total:						$7,362,100
06.3.-.-	WILDLIFE FACILITIES AND SANCTUARIES						
06.3.3.-	Wetlands:						
06.3.3.A	Land Acquisition	240	AC	$2,800.00	$672,000	$168,000	$840,000
06.3.3.B	Cleanup & Site Preparation	240	AC	5,000.00	1,200,000	300,000	1,500,000
06.3.3.B	Planting	240	AC	4,100.00	984,000	246,000	1,230,000
06.3.3.B	Maint.& Protect of Traffic	1	JOB	LS	20,700	5,200	25,900
06.3.3.B	Levees	770	LF	61.00	47,000	11,700	58,700
06.3.3.B	Weir Structure, Complete	1	JOB	LS	695,600	173,900	869,500
	Subtotal, Construction Costs:				$3,619,300		
06.3.Z.-	Contingencies 25.0%					$904,800	
06.3.-.-	Wildlife Facilities & Sanctuaries Total:						$4,524,100
09.-.-.-	CHANNELS AND CANALS						
09.0.2.-	Channels:						
09.0.2.B	Excavation, Common	189,200	CY	15.00	2,838,000	946,000	3,784,000
09.0.2.B	Excavation, Rock	66,300	CY	70.00	4,641,000	1,160,300	5,801,300
09.0.2.B	Riprap	38,800	CY	45.00	1,746,000	436,500	2,182,500
09.0.2.B	Filter Cloth	73,000	SY	3.00	219,000	54,800	273,800
09.0.2.B	Bedding Material	12,000	CY	38.00	456,000	114,000	570,000
09.0.R.-	Associated General Items:						
09.0.R.B	Maint.& Protect.of Traffic	1	JOB	LS	125,000	31,300	156,300
09.0.R.B	Topsoil & Seeding	12	AC	10,000.00	120,000	30,000	150,000
	Subtotal, Construction Costs:				$10,145,000		

09.0.Z.- Contingencies	25.0%	$2,772,900	
09.-.-.- Channels and Canals Total:			$12,917,90

TABLE 2

BEATTIES DAM, PASSAIC RIVER, NEW JERSEY

PROJECT COST ESTIMATE - Alternate No. 2

Price Level - October 1988

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTA PROJEC COS
18.-.-.-	CULTURAL RESOURCE PRESERVATION						
18.0.1.-	Identification, Data Analysis and Reports:						
18.0.1.A	Document entire complex IAW HAER/HABS Guidelines	1	JOB	LS	$47,600	$11,900	$59,50
18.0.1.A	Document & Reconstruct Weir	1	JOB	LS	17,900	4,500	22,40
18.0.1.A	Data Recovery & Partial Preservation	1	JOB	LS	59,600	14,900	74,50
	Subtotal, Construction Costs:				$125,100		
18.0.Z.-	Contingencies	25.0%				$31,300	
18.-.-.-	Cultural Resource Preservation Total:						$156,40
	TOTAL CONSTRUCTION COST				$19,779,000	$5,181,500	$24,960,50
01.-.-.-	LANDS AND DAMAGES				635,100	$158,800	793,90
30.-.-.-	ENGINEERING & DESIGN			15.0%	2,966,900	777,200	3,744,10
31.-.-.-	SUPERVISION & ADMINISTRATION			10.0%	1,977,900	518,200	2,496,10
	TOTAL PROJECT COST - Alternate No. 2				$25,358,900	6,635,700	$31,994,60
	Interest During Construction						4,385,30
	TOTAL PROJECT COST, INCLUDING INTEREST						36,379,90

TABLE 2

ALTERNATE NO. 2

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
LOWER VALLEY MITIGATION CHANNEL							
01.-.-.-.	Lands & Damages						
01.A.-.-.	Project Lands:						
01.A.-.-.	Temporary Easement Rights	53.6	AC	6,000	1,608,000	402,000	2,010,000
01.A.-.-.	Perm. Easem't Rights (Upland)	26.8	AC	60,000	321,600	80,400	402,000
01.A.-.-.	Perm. Easem't Rights (River)	293.5	AC	10,000	2,935,000	733,800	3,668,800
01.A.-.-.	Planning & Surveys (3%)				145,900	36,500	182,400
01.A.-.-.	Appraisal & Admin. (2%)				57,300	14,300	71,600
	Subtotal				5,067,800		
01.A.Z.-	Contingencies 25%					1,267,000	
01.A.-.-	Project Lands Total:						6,334,800
09.-.-.-	CHANNELS AND CANALS						
09.0.2.-	Channels:						
09.0.2.8	Excavation, Common	449,900	CY	15.00	6,748,500	2,249,500	8,998,000
	Excavation, Common (Toxic)	23,700	CY	75.00	1,777,500	444,400	2,221,900
09.0.R.-	Associated General Items:						
09.0.R.8	Maint. & Protect of Traffic	1	Job	LS	240,000	60,000	300,000
09.0.R.8.	Topsoil & Seeding	80.4	AC	10,000.00	804,000	201,000	1,005,000
	Subtotal, Construction Costs:				9,570,000		
09.0.Z.-	Contingencies 25.0%					2,954,900	
09.-.-.-	Channels and Canals Total:						12,524,900
09.-.-.-	TOTAL CONSTRUCTION COST				9,570,000	2,954,900	12,524,900
01.-.-.-	LANDS & DAMAGES				5,067,800	1,267,000	6,334,800
30.-.-.-	ENGINEERING & DESIGN			15%	1,435,500	443,200	1,878,700
31.-.-.-	SUPERVISION & ADMINISTRATION			10%	957,000	295,500	1,252,500
	TOTAL PROJECT COST				17,030,300	4,960,600	21,990,900
	Interest During Construction						3,015,000
	TOTAL PROJECT COST, INCLUDING INTEREST						25,005,900

TABLE 2

Alternate No. 2

SUMMARY OF COMPREHENSIVE COST, INCLUDING MITIGATION

TOTAL PROJECT COST	53,985,500
INTEREST DURING CONSTRUCTION	7,400,300
TOTAL PROJECT COST, INCLUDING INTEREST	61,385,800

TABLE 3

BEATTIES DAM, PASSAIC RIVER, NEW JERSEY

PROJECT COST ESTIMATE - Alternate No. 3

Price Level - October 1988

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
01.-.-.-	LANDS & DAMAGES						
01.A.-.-	Project Lands: (Wayne Township)						
01.A.-.-	Temporary Easement Rights	12.2	AC	$7,000	$85,400	$21,400	$106,80(
01.A.-.-	Perm.Easem't Rights(Upland)	1.6	AC	70,000	112,000	28,000	140,00(
01.A.-.-	Perm.Easement Rights(River)	14	AC	10,000	140,000	35,000	175,00(
	(Little Falls Township)						
01.A.-.-	Temporary Easement Rights	2.5	AC	7,000	17,500	4,400	21,90(
01.A.-.-	Perm.Easem't Rights(Upland)	1.6	AC	70,000	112,000	28,000	140,00(
01.A.-.-	Perm.Easement Rights(River)	13.8	AC	10,000	138,000	34,500	172,50(
01.A.-.-	Planning & Surveys (3%)	1	JOB	LS	18,100	4,500	22,60(
01.A.-.-	Appraisal & Admin.(2%)	1	JOB	LS	12,100	3,000	15,10(
	Subtotal				$635,100		
01.A.Z.-	Contingencies 25.0%					$158,800	
01.A.-.-	Project Lands Total:						$793,90(
04.2.-.-	SPILLWAY						
04.2.A.A	Mobilization, Demobilization and Preparatory Work:	1	JOB	LS	$250,000	$62,500	$312,50(
04.2.B.-	Care and Diversion of Water:						
04.2.B.B	Stl.Sht.Piling (Drive/Pull)	415	TON	$1,600.00	664,000	166,000	830,00(
04.2.B.B	Cell Fill (Place & Remove)	5,130	CY	20.00	102,600	25,700	128,30(
04.2.B.Q	Dewatering	1	JOB	LS	300,000	75,000	375,00(
04.2.D.-	Earthwork for Structures:						
04.2.D.B	Remove Exist.Spillway Conc.	675	CY	90.00	60,750	15,200	75,95(
04.2.D.B	Excavation, Common	1,320	CY	20.00	26,400	6,600	33,00(
04.2.D.B	Excavation, Rock	1,412	CY	80.00	113,000	28,200	141,20(
04.2.E.-	Foundation Work:						
04.2.E.B	Foundation Preparation	465	SY	10.00	4,650	1,200	5,85(
04.2.F.-	Seepage Control:						
04.2.F.B	Mob & Demob Grout Spread	1	JOB	LS	10,000	2,500	12,50
04.2.F.B	Drilling Grout Holes	600	LF	15.00	9,000	2,300	11,30
04.2.F.B	Grouting Holes (2-stage)	20	EA	300.00	6,000	1,500	7,50
04.2.R.-	Associated General Items:						
04.2.R.B	Maint.& Protect.of Traffic	1	JOB	LS	75,000	18,800	93,80
04.2.R.B	Topsoil & Seeding	5.9	AC	10,000.00	59,000	14,800	73,80

TABLE 3

BEATTIES DAM, PASSAIC RIVER, NEW JERSEY

PROJECT COST ESTIMATE - Alternate No. 3

Price Level - October 1988

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
04.2.-.-	SPILLWAY (Continued)						
04.2.2.-	Concrete Overflow Section:						
04.2.2.C	Concrete, in place	1,535	CY	500.00	767,500	191,900	959,4
04.2.2.C	Reinforcing Steel	77,000	Lbs	1.00	77,000	19,300	96,3
04.2.5.-	Gates, Stoplogs and Equipment:						
04.2.5.E	Stoplogs	35	TON	4,000.00	140,000	35,000	175,0
04.2.5.E	Gates,Incl.Oper.Machinery	1	JOB	LS	2,228,000	557,000	2,785,0
04.2.5.A	Control House	1	JOB	LS	100,000	25,000	125,0
	Subtotal, Construction Costs:				$4,992,900		
04.2.Z.-	Contingencies 25.0%					$1,248,500	
04.2.-.-	Spillway Total:						$6,241,4
06.3.-.-	WILDLIFE FACILITIES AND SANCTUARIES						
06.3.3.-	Wetlands:						
06.3.3.A	Land Acquisition	240	AC	$2,800.00	$672,000	$168,000	$840,0
06.3.3.B	Cleanup & Site Preparation	240	AC	5,000.00	1,200,000	300,000	1,500,0
06.3.3.B	Planting	240	AC	4,100.00	984,000	246,000	1,230,0
06.3.3.B	Maint.& Protect of Traffic	1	JOB	LS	20,700	5,200	25,9
06.3.3.B	Levees	770	LF	61.00	47,000	11,700	58,7
06.3.3.B	Weir Structure, Complete	1	JOB	LS	695,600	173,900	869,5
	Subtotal, Construction Costs:				$3,619,300		
06.3.Z.-	Contingencies 25.0%					$904,800	
06.3.-.-	Wildlife Facilities & Sanctuaries Total:						$4,524,1
09.-.-.-	CHANNELS AND CANALS						
09.0.2.-	Channels:						
09.0.2.B	Excavation, Common	189,200	CY	15.00	2,838,000	946,000	3,784,0
09.0.2.B	Excavation, Rock	66,300	CY	70.00	4,641,000	1,160,300	5,801,3
09.0.2.B	Riprap	38,000	CY	45.00	1,746,000	436,500	2,182,5
09.0.2.B	Filter Cloth	73,000	SY	3.00	219,000	54,800	273,8
09.0.2.B	Bedding Material	12,000	CY	38.00	456,000	114,000	570,0
09.0.R.-	Associated General Items:						
09.0.R.B	Maint.& Protect.of Traffic	1	JOB	LS	125,000	31,300	156,3
09.0.R.B	Topsoil & Seeding	12	AC	10,000.00	120,000	30,000	150,0
	Subtotal, Construction Costs:				$10,145,000		

09.0.Z.- Contingencies	25.0%	$ 2,772,000	
09.-.-.- Channels and Canals Total:			$12,917,90

TABLE 3

BEATTIES DAM, PASSAIC RIVER, NEW JERSEY

PROJECT COST ESTIMATE - Alternate No. 3

Price Level - October 1988

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
18.-.-.-	CULTURAL RESOURCE PRESERVATION						
18.0.1.-	Identification, Data Analysis and Reports:						
18.0.1.A	Document entire complex IAW HAER/HABS Guidelines	1	JOB	LS	$47,600	$11,900	$59,500
18.0.1.A	Document & Reconstruct Weir	1	JOB	LS	17,900	4,500	22,400
18.0.1.A	Data Recovery & Partial Preservation	1	JOB	LS	59,600	14,900	74,500
	Subtotal, Construction Costs:				$125,100		
18.0.Z.-	Contingencies	25.0%				$31,300	
18.-.-.-	Cultural Resource Preservation Total:						$156,400
	TOTAL CONSTRUCTION COST				$18,882,300	$4,957,500	$23,839,000
01.-.-.-	LANDS AND DAMAGES				635,100	$158,800	793,900
30.-.-.-	ENGINEERING & DESIGN			15.0%	2,832,300	743,600	3,575,900
31.-.-.-	SUPERVISION & ADMINISTRATION			10.0%	1,888,200	495,800	2,384,000
	TOTAL PROJECT COST - Alternate No. 3				$24,237,900	$6,355,700	$30,593,600
	Interest During Construction						4,193,300
	TOTAL PROJECT COST, INCLUDING INTEREST						34,786,900

TABLE 3

ALTERNATE NO. 3

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
LOWER VALLEY MITIGATION CHANNEL							
01.-.-.-	Lands & Damages						
01.A.-.-.	Project Lands:						
01.A.-.-.	Temporary Easement Rights	53.6	AC	6,000	1,608,000	402,000	2,010,000
01.A.-.-.	Perm. Easem't Rights (Upland)	26.8	AC	60,000	321,600	80,400	402,000
01.A.-.-.	Perm. Easem't Rights (River)	293.5	AC	10,000	2,935,000	733,800	3,668,800
01.A.-.-.	Planning & Surveys (3%)				145,900	36,500	182,400
01.A.-.-.	Appraisal & Admin. (2%)				57,300	14,300	71,600
	Subtotal				5,067,800		
01.A.Z.-	Contingencies 25%					1,267,000	
01.A.-.-	Project Lands Total:						6,334,800
09.-.-.-	CHANNELS AND CANALS						
09.0.2.-	Channels:						
09.0.2.8	Excavation, Common	449,900	CY	15.00	6,748,500	2,249,500	8,998,000
	Excavation, Common (Toxic)	23,700	CY	75.00	1,777,500	444,400	2,221,900
09.0.R.-	Associated General Items:						
09.0.R.8	Maint. & Protect of Traffic	1	Job	LS	240,000	60,000	300,000
09.0.R.8.	Topsoil & Seeding	80.4	AC	10,000.00	804,000	201,000	1,005,000
	Subtotal, Construction Costs:				9,570,000		
09.0.Z.-	Contingencies 25.0%					2,954,900	
09.-.-.-	Channels and Canals Total:						12,524,900
09.-.-.-	TOTAL CONSTRUCTION COST				9,570,000	2,954,900	12,524,900
01.-.-.-	LANDS & DAMAGES				5,067,800	1,267,000	6,334,800
30.-.-.-	ENGINEERING & DESIGN			15%	1,435,500	443,200	1,878,700
31.-.-.-	SUPERVISION & ADMINISTRATION			10%	957,000	295,500	1,252,500
	TOTAL PROJECT COST				17,030,300	4,960,600	21,990,900
	Interest During Construction						3,015,000
	TOTAL PROJECT COST, INCLUDING INTEREST						25,005,900

TABLE 3

Alternate No. 3

SUMMARY OF COMPREHENSIVE COST, INCLUDING MITIGATION

TOTAL PROJECT COST	52,584,500
INTEREST DURING CONSTRUCTION	7,208,300
TOTAL PROJECT COST, INCLUDING INTEREST	59,792,800

TABLE 4

BEATTIES DAM, PASSAIC RIVER, NEW JERSEY

PROJECT COST ESTIMATE - Alternate No. 4

Price Level - October 1988

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTA PROJEC COS
01.-.-.-	LANDS & DAMAGES						
01.A.-.-	Project Lands: (Wayne Township)						
01.A.-.-	Temporary Easement Rights	12.2	AC	$7,000	$85,400	$21,400	$106,80
01.A.-.-	Perm.Easem't Rights(Upland)	1.6	AC	70,000	112,000	28,000	140,00
01.A.-.-	Perm.Easement Rights(River)	14	AC	10,000	140,000	35,000	175,00
	(Little Falls Township)						
01.A.-.-	Temporary Easement Rights	2.5	AC	7,000	17,500	4,400	21,90
01.A.-.-	Perm.Easem't Rights(Upland)	1.6	AC	70,000	112,000	28,000	140,00
01.A.-.-	Perm.Easement Rights(River)	13.8	AC	10,000	138,000	34,500	172,50
01.A.-.-	Planning & Surveys (3%)	1	JOB	LS	18,100	0	
01.A.-.-	Appraisal & Admin.(2%)	1	JOB	LS	12,100	0	
	Subtotal				$635,100		
01.A.Z.-	Contingencies 25.0%					$151,300	
01.A.-.-	Project Lands Total:						$793,90
04.2.-.-	SPILLWAY						
04.2.A.A	Mobilization, Demobilization and Preparatory Work:	1	JOB	LS	$250,000	$62,500	$312,50
04.2.B.-	Care and Diversion of Water:						
04.2.B.B	Stl.Sht.Piling (Drive/Pull)	330	TON	$1,600.00	528,000	132,000	660,00
04.2.B.B	Cell Fill (Place & Remove)	4,180	CY	20.00	83,600	20,900	104,50
04.2.B.Q	Dewatering	1	JOB	LS	200,000	50,000	250,00
04.2.D.-	Earthwork for Structures:						
04.2.D.B	Remove Exist.Spillway Conc.	435	CY	90.00	39,200	9,800	49,00
04.2.D.B	Excavation, Common	270	CY	20.00	5,400	1,400	6,80
04.2.D.B	Excavation, Rock	710	CY	80.00	56,800	14,200	71,00
04.2.E.-	Foundation Work:						
04.2.E.B	Foundation Preparation	235	SY	10.00	2,350	600	2,95
04.2.F.-	Seepage Control:						
04.2.F.B	Mob & Demob Grout Spread	1	JOB	LS	10,000	2,500	12,50
04.2.F.B	Drilling Grout Holes	330	LF	15.00	4,950	1,200	6,15
04.2.F.B	Grouting Holes (2-stage)	12	EA	300.00	3,600	900	4,50
04.2.R.-	Associated General Items:						
04.2.R.B	Maint.& Protect.of Traffic	1	JOB	LS	75,000	18,800	93,80
04.2.R.B	Topsoil & Seeding	5.9	AC	10,000.00	59,000	14,800	73.80

TABLE 4

BEATTIES DAM, PASSAIC RIVER, NEW JERSEY

PROJECT COST ESTIMATE - Alternate No. 4

Price Level - October 1988

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
04.2.-.-	SPILLWAY (Continued)						
04.2.2.-	Concrete Overflow Section:						
04.2.2.C	Concrete, in place	820	CY	500.00	410,000	102,500	512,500
04.2.2.C	Reinforcing Steel	41,000	Lbs	1.00	41,000	10,300	51,300
04.2.5.-	Gates, Stoplogs and Equipment:						
04.2.5.E	Stoplogs	37	TON	4,000.00	148,000	37,000	185,000
04.2.5.E	Gates,Incl.Oper.Machinery	1	JOB	LS	1,152,000	288,000	1,440,000
04.2.5.A	Control House	1	JOB	LS	50,000	12,500	62,500
	Subtotal, Construction Costs:				$3,118,900		
04.2.Z.-	Contingencies 25.0%					$779,900	
04.2.-.-	Spillway Total:						$3,898,800
06.3.-.-	WILDLIFE FACILITIES AND SANCTUARIES						
06.3.3.-	Wetlands:						
06.3.3.A	Land Acquisition	240	AC	$2,800.00	$672,000	$168,000	$840,000
06.3.3.B	Cleanup & Site Preparation	240	AC	5,000.00	1,200,000	300,000	1,500,000
06.3.3.B	Planting	240	AC	4,100.00	984,000	246,000	1,230,000
06.3.3.B	Maint.& Protect of Traffic	1	JOB	LS	20,700	5,200	25,900
06.3.3.B	Levees	770	LF	61.00	47,000	11,700	58,700
06.3.3.B	Weir Structure, Complete	1	JOB	LS	695,600	173,900	869,500
	Subtotal, Construction Costs:				$3,619,300		
06.3.Z.-	Contingencies 25.0%					$904,800	
06.3.-.-	Wildlife Facilities & Sanctuaries Total:						$4,524,100
09.-.-.-	CHANNELS AND CANALS						
09.0.2.-	Channels:						
09.0.2.B	Excavation, Common	189,200	CY	15.00	2,838,000	946,000	3,784,000
09.0.2.B	Excavation, Rock	66,300	CY	70.00	4,641,000	1,160,300	5,801,300
09.0.2.B	Riprap	38,800	CY	45.00	1,746,000	436,500	2,182,500
09.0.2.B	Filter Cloth	73,000	SY	3.00	219,000	54,800	273,800
09.0.2.B	Bedding Material	12,000	CY	38.00	456,000	114,000	570,000
09.0.R.-	Associated General Items:						
09.0.R.B	Maint.& Protect.of Traffic	1	JOB	LS	125,000	31,300	156,300
09.0.R.B	Topsoil & Seeding	12	AC	10,000.00	120,000	30,000	150,000
	Subtotal, Construction Costs:				$10,145,000		

09.0.Z.- Contingencies	25.0%	$ 2,772,900	
09.-.-.- Channels and Canals Total:			$12,917,90

TABLE 4

BEATTIES DAM, PASSAIC RIVER, NEW JERSEY

PROJECT COST ESTIMATE - Alternate No. 4

Price Level - October 1988

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
18.-.-.-	CULTURAL RESOURCE PRESERVATION						
18.0.1.-	Identification, Data Analysis and Reports:						
18.0.1.A	Document entire complex IAW HAER/HABS Guidelines	1	JOB	LS	$47,600	$11,900	$59,50
18.0.1.A	Document & Reconstruct Weir	1	JOB	LS	17,900	4,500	22,40
18.0.1.A	Data Recovery & Partial Preservation	1	JOB	LS	59,600	14,900	74,50
	Subtotal, Construction Costs:				$125,100		
18.0.Z.-	Contingencies 25.0%					$31,300	
18.-.-.-	Cultural Resource Preservation Total:						$156,40
	TOTAL CONSTRUCTION COST				$17,008,300	$4,488,900	$21,497,2
01.-.-.-	LANDS AND DAMAGES				635,100	158,800	793,9
30.-.-.-	ENGINEERING & DESIGN			15.0%	$ 2,551,200	673,300	3,224,5
31.-.-.-	SUPERVISION & ADMINISTRATION			10.0%	1,700,800	448,900	2,149,7
	TOTAL PROJECT COST - Alternate No. 4				$21,895,400	$ 5,769,900	$27,665,3
	Interest During Construction						2,455,3
	TOTAL PROJECT COST, INCLUDING INTEREST						30,120,6

TABLE 4

ALTERNATE NO. 4

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
LOWER VALLEY MITIGATION CHANNEL							
01.-.-.-	Lands & Damages						
01.A.-.-.	Project Lands:						
01.A.-.-.	Temporary Easement Rights	53.6	AC	6,000	1,608,000	402,000	2,010,000
01.A.-.-.	Perm. Easem't Rights (Upland)	26.8	AC	60,000	321,600	80,400	402,000
01.A.-.-.	Perm. Easem't Rights (River)	293.5	AC	10,000	2,935,000	733,800	3,668,800
01.A.-.-.	Planning & Surveys (3%)				145,900	36,500	182,400
01.A.-.-.	Appraisal & Admin. (2%)				57,300	14,300	71,600
	Subtotal				5,067,800		
01.A.Z.-	Contingencies 25%					1,267,000	
01.A.-.-	Project Lands Total:						6,334,800
09.-.-.-	CHANNELS AND CANALS						
09.0.2.-	Channels:						
09.0.2.B	Excavation, Common	449,900	CY	15.00	6,748,500	2,249,500	8,998,000
	Excavation, Common (Toxic)	23,700	CY	75.00	1,777,500	444,400	2,221,900
09.0.R.-	Associated General Items:						
09.0.R.B	Maint. & Protect of Traffic	1	Job	LS	240,000	60,000	300,000
09.0.R.B.	Topsoil & Seeding	80.4	AC	10,000.00	804,000	201,000	1,005,000
	Subtotal, Construction Costs:				9,570,000		
09.0.Z.-	Contingencies 25.0%					2,954,900	
09.-.-.-	Channels and Canals Total:						12,524,900
09.-.-.-	TOTAL CONSTRUCTION COST				9,570,000	2,954,900	12,524,900
01.-.-.-	LANDS & DAMAGES				5,067,800	1,267,000	6,334,800
30.-.-.-	ENGINEERING & DESIGN			15%	1,435,500	443,200	1,878,700
31.-.-.-	SUPERVISION & ADMINISTRATION			10%	957,000	295,500	1,252,500
	TOTAL PROJECT COST				17,030,300	4,960,600	21,990,900
	Interest During Construction						3,015,000
	TOTAL PROJECT COST, INCLUDING INTEREST						25,005,900

TABLE 4

Alternate No. 4

SUMMARY OF COMPREHENSIVE COST, INCLUDING MITIGATION

TOTAL PROJECT COST	49,656,200
INTEREST DURING CONSTRUCTION	5,470,300
TOTAL PROJECT COST, INCLUDING INTEREST	55,126,500

CENAN-PL-P

MEMORANDUM FOR THE RECORD:

SUBJECT: Update factor to be applied to an existing gross fair market value appraisal report, dated September, 1986.

1. Discussions were held in late December of 1988 between Mr. Vincent Wahn, Chief CENAN-RE-E, and Mr. Henry Kiefer, CENAN-PL-P, concerning the utilization of land values from an existing gross value estimate appraisal report for use in two reconnaissance type level reports. These two reports were "Beatties Dam" and "Passaic River's East Bank Stabilization". The existing report of evaluation was done by the firm of Arthur D. Little Valuation, Inc. in September of 1986 and made a gross fair market value of land which runs adjacent to the Passaic River and its various branches. The subject land under analysis was located in five counties and twenty four municipalities.

2. The Beatties Dam project is located in Passaic Co. in the towns of Wayne and Little Falls. The East Bank Stabilization project is located in the counties of Bergen and Hudson in the towns of Garfield, North Arlington, Kearny, Lyndhurst, Rutherford, Wallington, East Rutherford, East Newark and Harrison. All of these counties and towns, with the exception of Garfield and East Newark, were included in the Arthur D. Little report.

3. It was suggested by Mr. Kiefer and agreed to by Mr. Wahn that the unit land values estimated in the Arthur D. Little report be used as a basis for determining land value project costs for Beatties Dam and East Bank. Due to the fact that the Arthur D. Little report was made in 1986 and the two current reports will use October 1988 as their price level, Mr. Wahn made the determination that the land price level increase should be approximately 7.5%, which is considered reasonable.

4. In order to account for the towns of Garfield and East Newark, which were not a part of the Arthur D. Little study, the land values of Wallington and Kearny, also included in the aforementioned gross value estimate which are adjacent to Garfield and East Newark, were used.

Henry F. Kiefer
CENAN-PL-P

12/29/88
Date

Vincent Wahn
C., CENAN-RE-E

12/29/88
Date

ATTACHMENT B5-1

PASSAIC RIVER, VICINITY OF BEATTIES DAM
RECONNAISANCE REPORT

APPENDIX ~~E~~ C – ECONOMICS

corrected on 19 June 2009

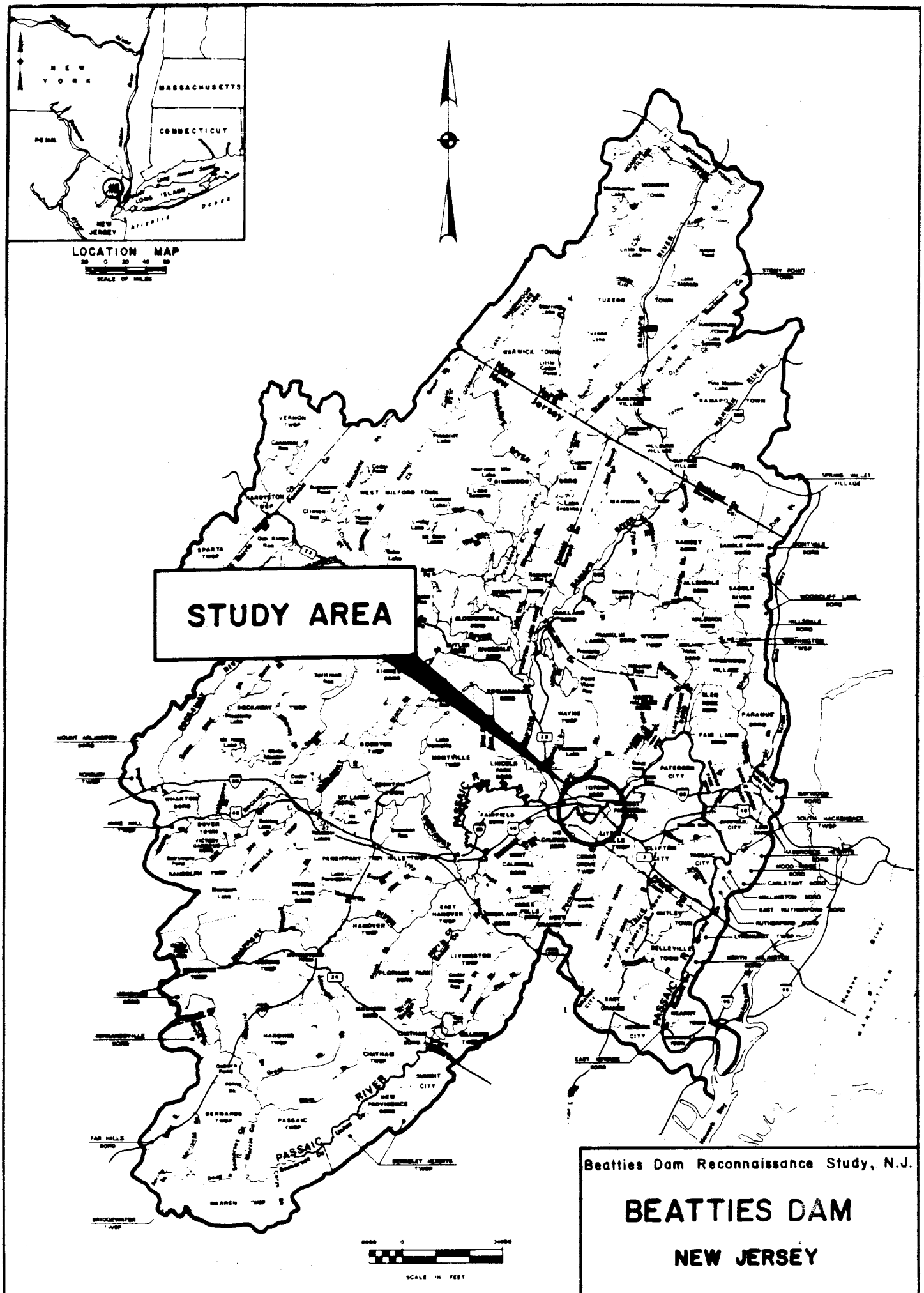
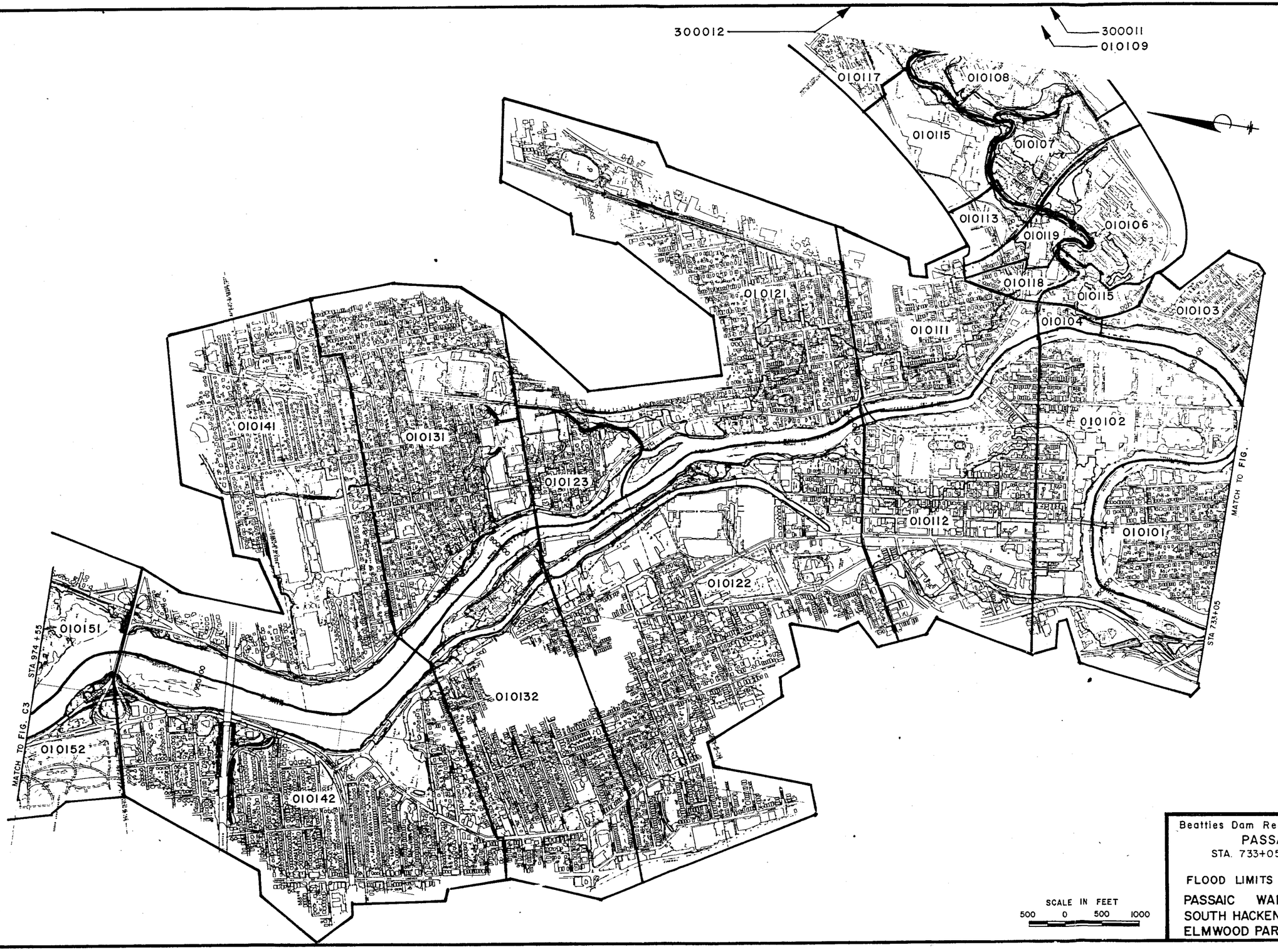

LOCATION MAP
STUDY AREA
Beatties Dam Reconnaissance Study, N.J.
BEATTIES DAM
NEW JERSEY

FIGURE C1



Beatties Dam Reconnaissance Study, N.J.
PASSAIC RIVER
STA. 733+05 TO STA. 974+55

FLOOD LIMITS & DAMAGE REACHES

PASSAIC WALLINGTON GARFIELD
SOUTH HACKENSACK LODI CLIFTON
ELMWOOD PARK PATERSON

FIGURE C2

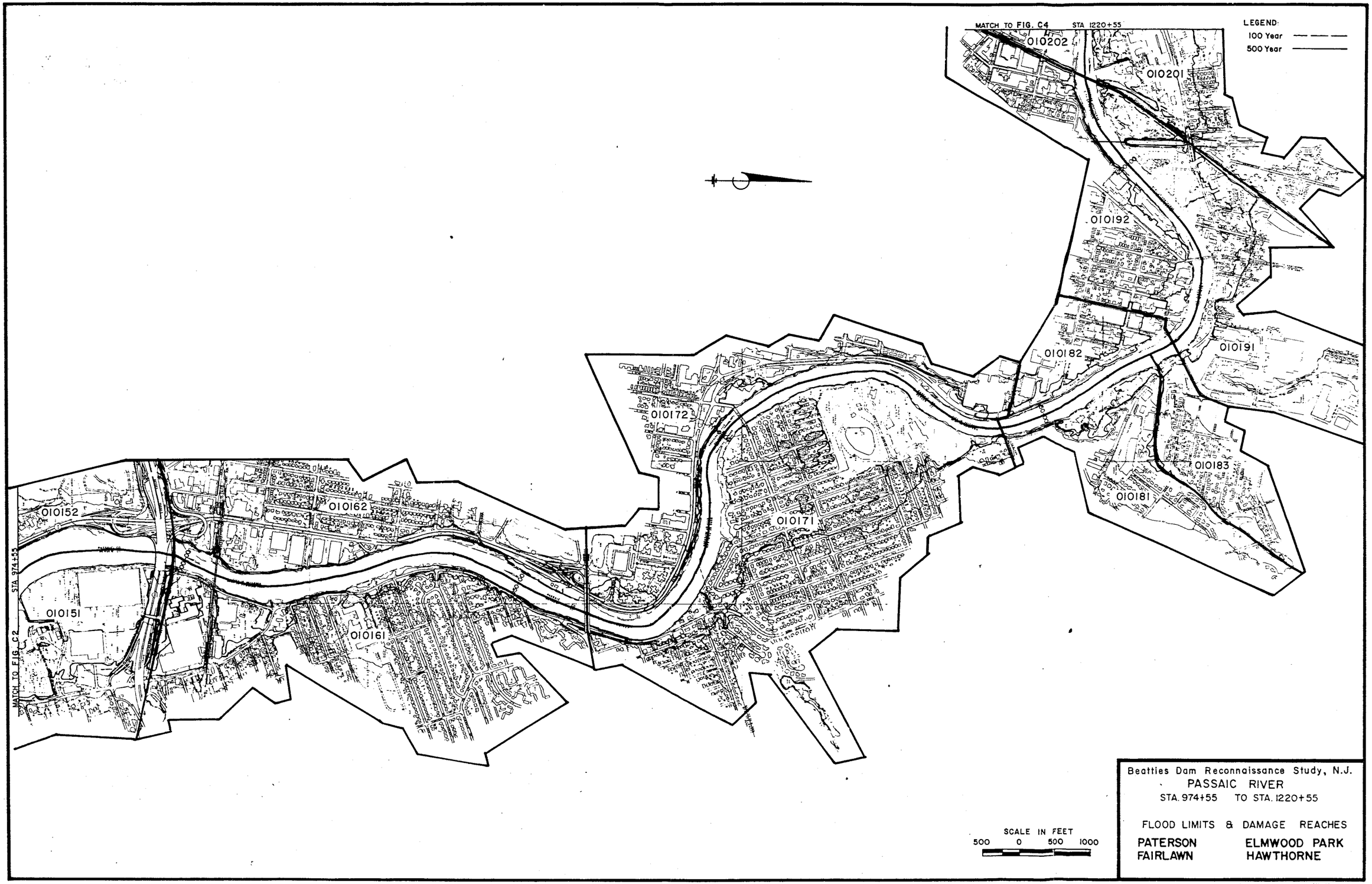
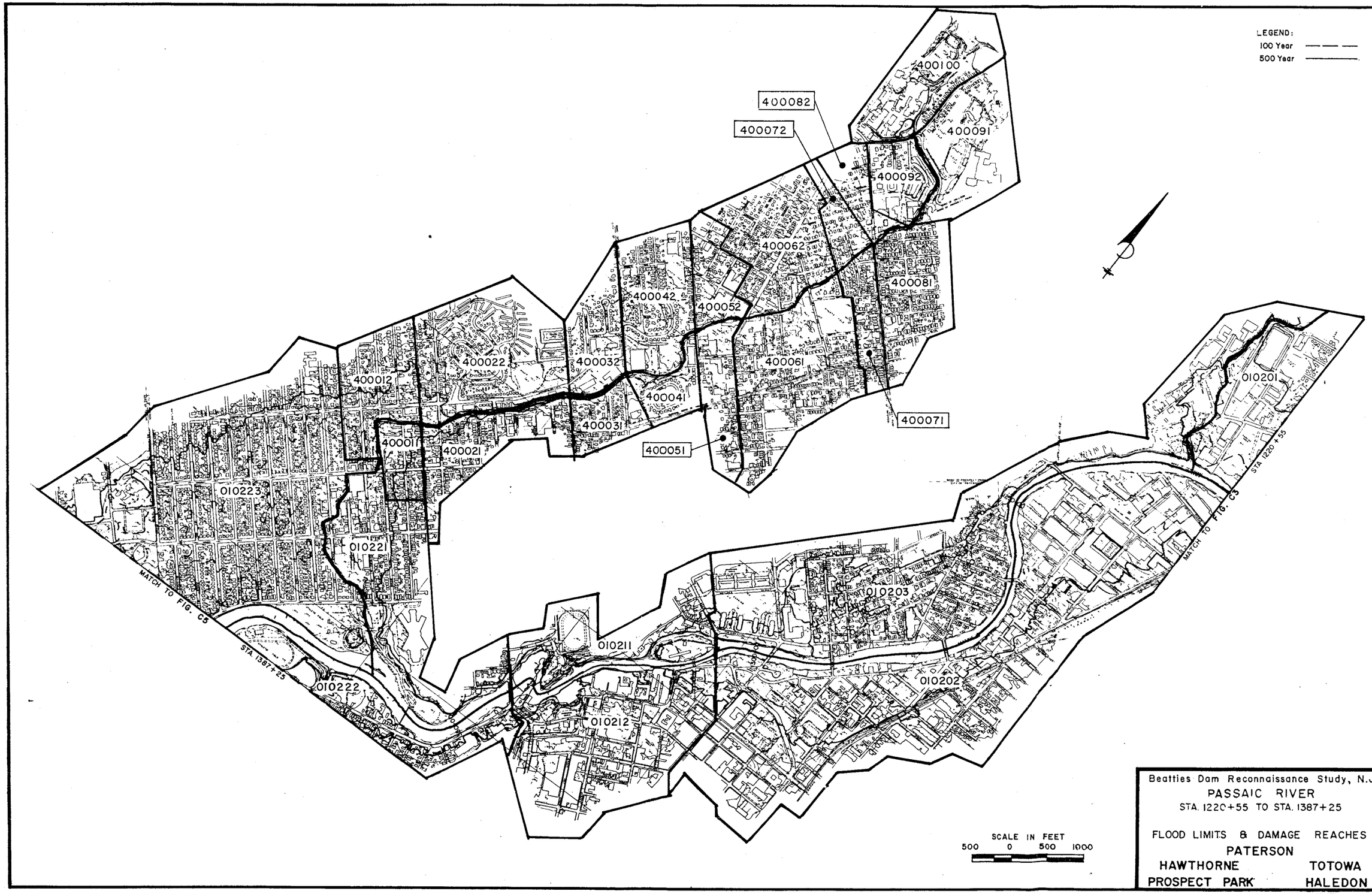

MATCH TO FIG. C4
STA 1220+55
LEGEND:
100 Year
500 Year
010202
010201
010192
010191
010182
010172
010183
010181
010171
010162
010152
010151
010161
MATCH TO FIG. C2
STA 974+55
SCALE IN FEET
500 0 500 1000
Beatties Dam Reconnaissance Study, N.J.
PASSAIC RIVER
STA. 974+55 TO STA. 1220+55
FLOOD LIMITS & DAMAGE REACHES
PATERSON
FAIRLAWN
ELMWOOD PARK
HAWTHORNE

FIGURE C3



Beatties Dam Reconnaissance Study, N.J.
PASSAIC RIVER
STA. 1220+55 TO STA. 1387+25

FLOOD LIMITS & DAMAGE REACHES
PATERSON
HAWTHORNE TOTOWA
PROSPECT PARK HALEDON

FIGURE C4

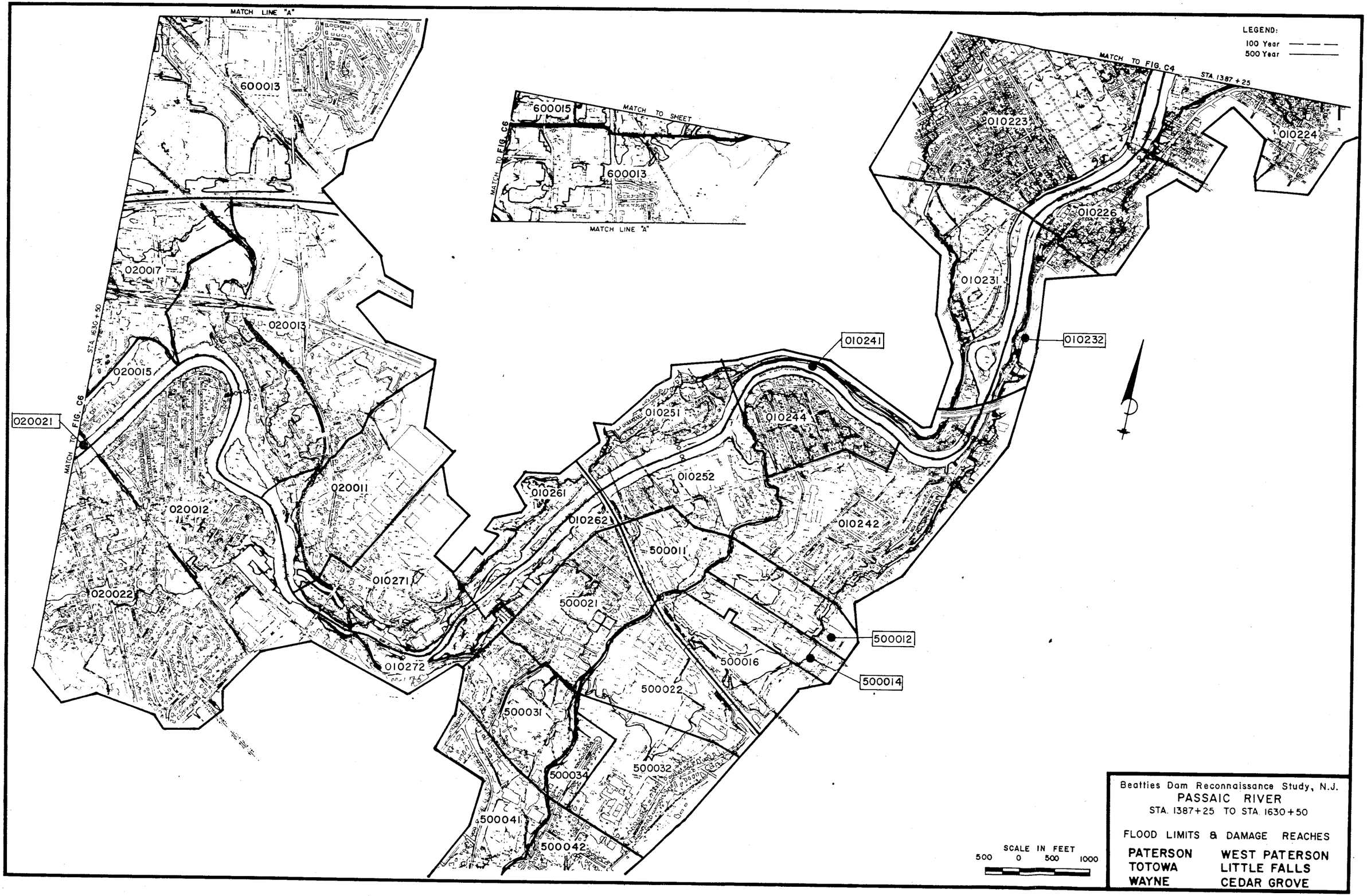
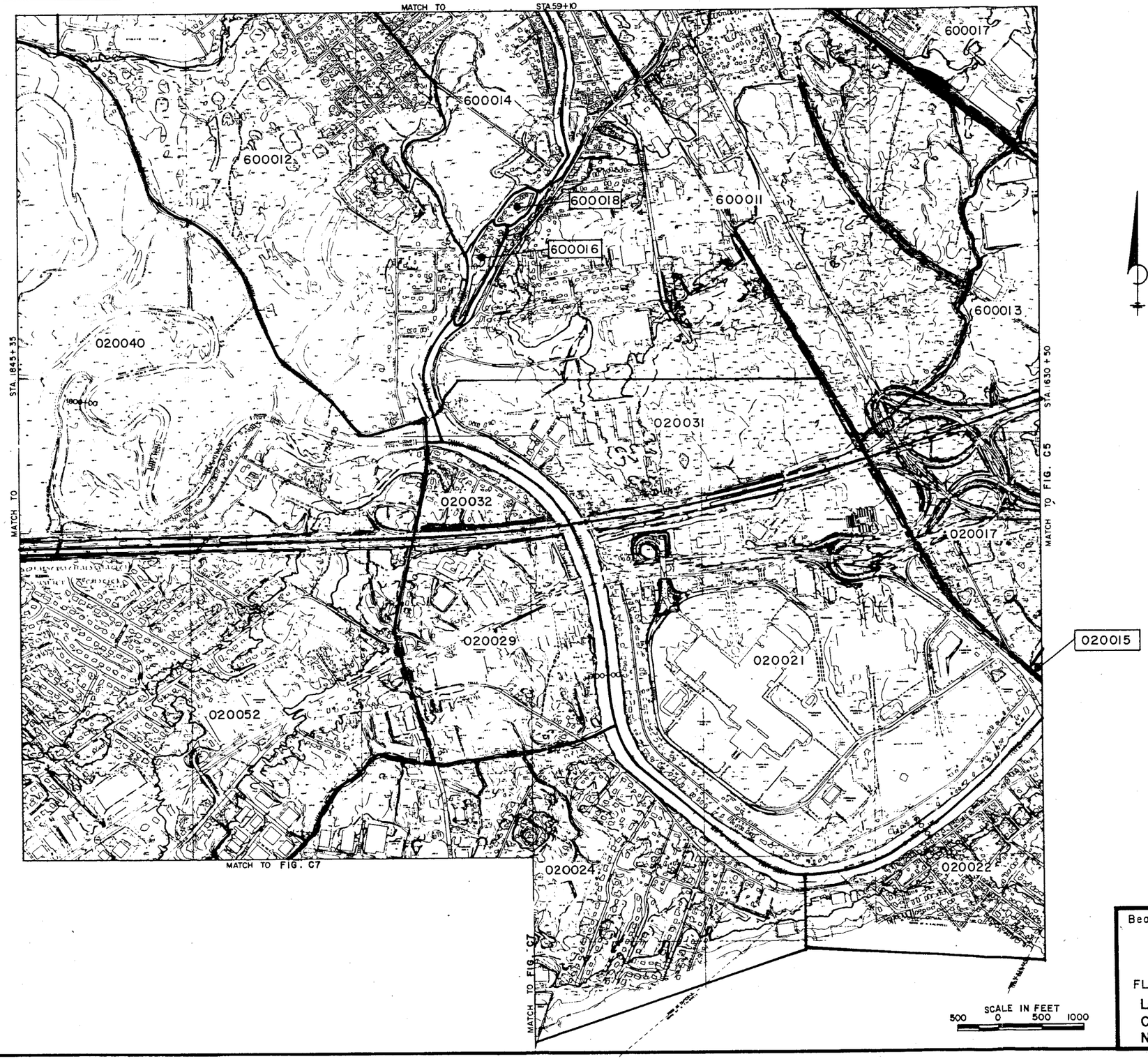

MATCH LINE "A"
600013
020017
020013
020015
020021
MATCH TO FIG. C6
STA. 630+50
020011
020012
020022
010271
010272
600015
MATCH TO SHEET
MATCH TO FIG. C6
600013
MATCH LINE "A"
LEGEND:
100 Year
500 Year
MATCH TO FIG. C4
STA. 1387+25
010223
010224
010226
010231
010232
010241
010251
010244
010252
010261
010262
010242
500011
500021
500012
500016
500014
500022
500031
500032
500034
500041
500042
SCALE IN FEET
500 0 500 1000
Beatties Dam Reconnaissance Study, N.J.
PASSAIC RIVER
STA. 1387+25 TO STA. 1630+50
FLOOD LIMITS & DAMAGE REACHES
PATERSON
TOTOWA
WAYNE
WEST PATERSON
LITTLE FALLS
CEDAR GROVE

FIGURE C5



LEGEND

100 Year ——— ——— ———

500 Year ———————

Beatties Dam Reconnaissance Study, N.J.

PASSAIC RIVER

STA 1630+50 TO STA. 1845+35

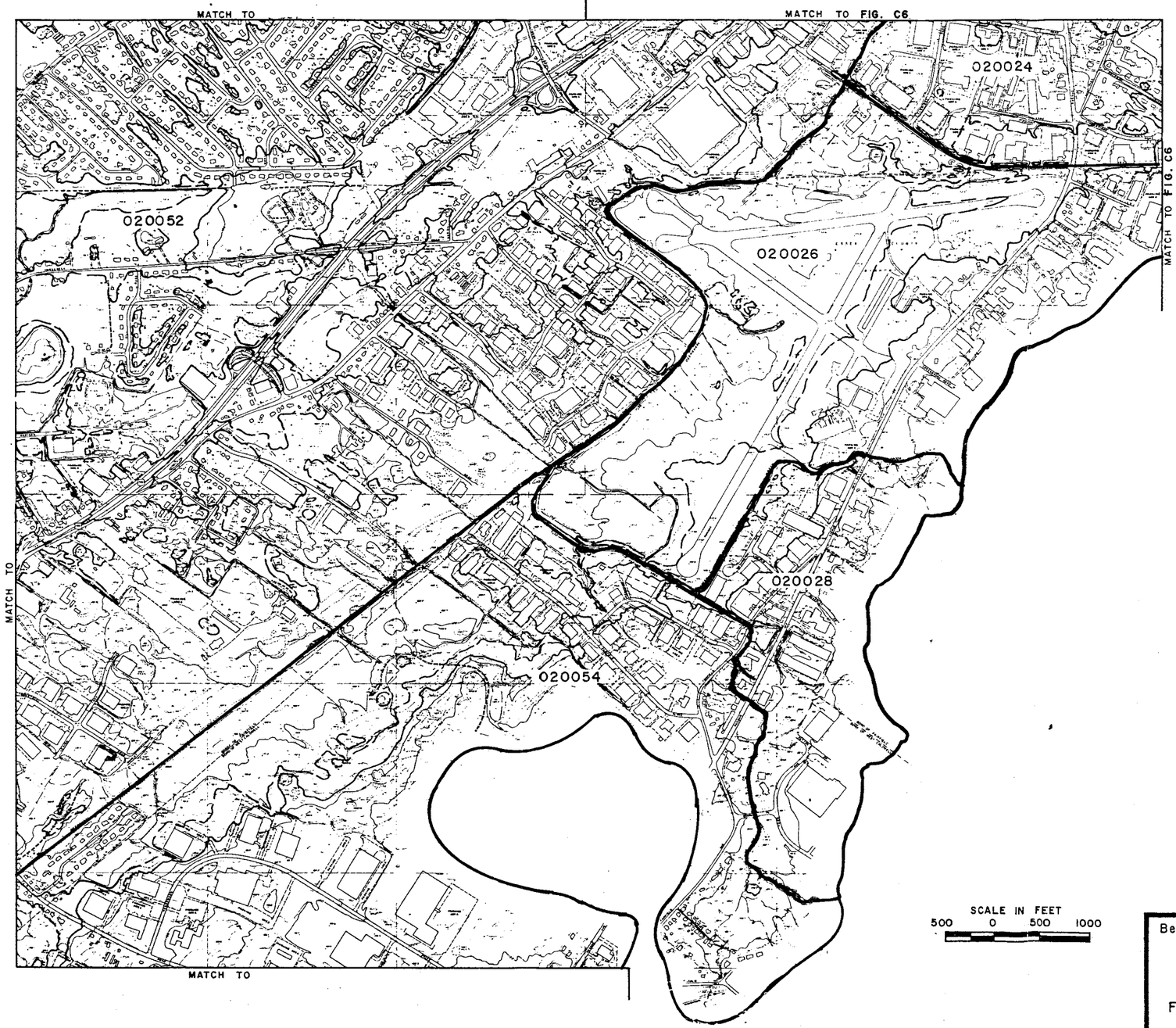
POMPTON RIVER

FLOOD LIMITS & DAMAGE REACHES

LITTLE FALLS	LINCOLN PARK
CEDAR GROVE	FAIRFIELD
NORTH CALDWELL	WAYNE

FIGURE C6

LEGEND:
100 Year — — —
500 Year ———



Beatties Dam Reconnaissance Study, N.J.

PASSAIC RIVER

FLOOD LIMITS & DAMAGE REACHES

FAIRFIELD WEST CALDWELL

FIGURE C7

PASSAIC RIVER, VICINITY OF BEATTIES DAM
RECONNAISANCE REPORT

APPENDIX ~~B~~ D – ENVIRONMENTAL RESOURCES (NOT COMPLETED)

Corrected on 19 June 2009

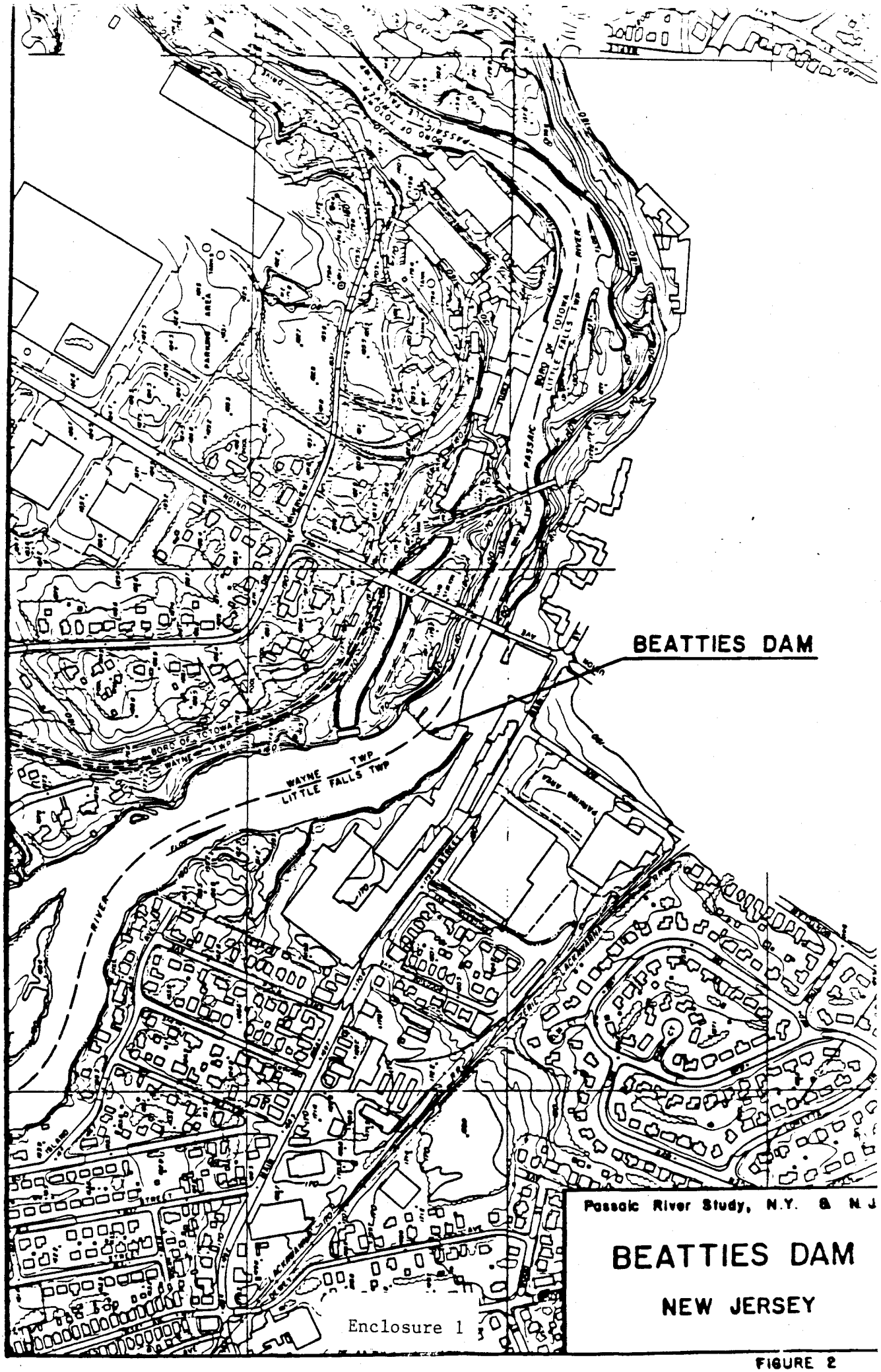

BEATTIES DAM
WAYNE TWP
LITTLE FALLS TWP
BORO OF TOTOWA
PASSAIC RIVER
Passaic River Study, N.Y. & N.J.
BEATTIES DAM
NEW JERSEY
Enclosure 1

FIGURE 2

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION

ONJH-D84-17

DIVISION OF PARKS AND FORESTRY
OFFICE OF THE DIRECTOR

PLEASE ADDRESS REPLY TO
CN 404
TRENTON, N.J. 08625

April 4, 1984

Mr. Philip M. Hoover, P.E.
Project Manager
Sguergics, Inc.
Annapolis City Marina, Suite 409
Annapolis, MD 21403

Re: Little Falls Hydroelectric Facility
Passaic County

Dear Mr. Hoover:

The Office of New Jersey Heritage reviews federally funded, licensed or approved actions for their potential to effect significant Cultural Resources. This letter serves as formal consultation comments as per 36 CFR Part 800: the Protection of Historic and Cultural Properties.

Based on the information submitted and that on file, it is my opinion, as Deputy State Historic Preservation Officer, that the Little Falls Hydroelectric Facility is eligible for listing on the National Register of Historic Places as defined in 36 CFR 60.6.

Since the project does not include any repair or alteration of this existing facility, there is no effect to the National Register eligible property. No further review is requested.

If you have any questions, please feel free to contact Mr. John McCarthy of my staff at the Office of New Jersey Heritage (609) 292-2028.

Sincerely,

R.W. Myers

Russell W. Myers, Deputy
State Historic Preservation
Officer

RWM:JPMP;ijd

c: file

Enclosure 2

Before the

FEDERAL ENERGY REGULATORY COMMISSION

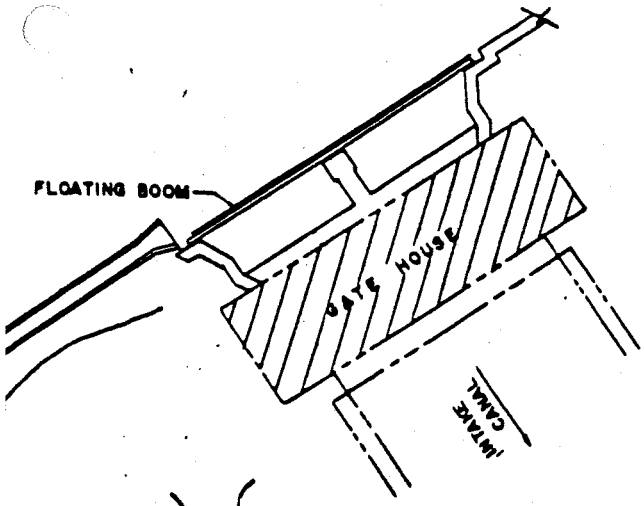
Application for License

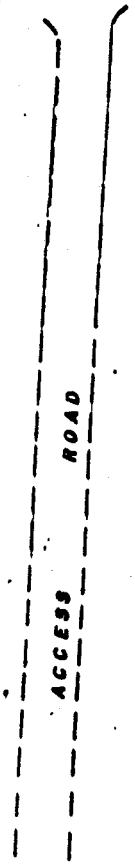
for Water Power Project

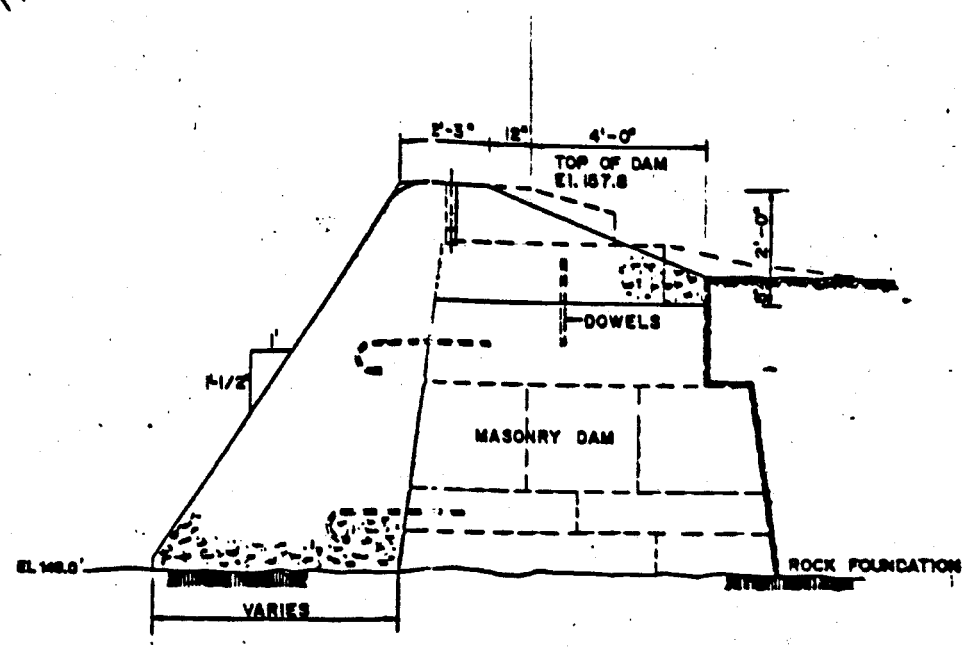
LITTLE FALLS HYDRO POWER PROJECT

PASSAIC VALLEY WATER COMMISSION

SYNERGICS, INC.







SECTION A-A
TYPICAL DAM SECTION

0 2 4
SCALE IN FEET

PASSAIC VALLEY WATER COMMISSION

DAM PLAN AND SECTION

EXHIBIT F — SHEET 2 OF 4

THIS DRAWING IS A PART OF THE APPLICATION FOR LICENSE MADE BY THE UNDERSIGNED THIS 9th DAY OF May 1985

[signature]

are recorded daily by the USGS river flow gage No. 013895000 located just downstream from the PVWC pumping plant/powerhouse. The average flow on the river at Little Falls for the period of record (1898 to present) is 1156 cfs. A flow duration curve which has been adjusted for existing and proposed diversions is included as figure 1.

(viii) The project consists of the following existing features.

(a) Dam-- Beatties Mill Dam is a concrete dam with an average height of 8-8.5 feet and a maximum height of 11.5 feet. The dam is 287 feet long, with 267 feet acting as a broad-crested overflow spillway. The overflow spillway crest is at elevation 157.8 feet mean sea level. The spillway is in three sections; an arched 152-foot center section (concave upstream), a 55-foot right wingwall tying into a factory building which serves as the right abutment, and a 60-foot left wingwall tying into the left abutment. There is a 3-foot wide 1-foot deep notch in the right wingwall for the purpose of suppling low flows to the steep gradient section of the stream downstream of the dam. The dam crest width is about 5 feet, the upstream face is 2H:1V (4 feet) and then nearly vertical, and the downstream face slopes 1H:1-1/2V.

The dam was originally constructed in 1896 and reconstructed after being damaged by flooding in 1945. The dam was inspected under the authorization of the Dam Inspection Act Public Law 42-367 in 1981 and was found to be in fair overall condition. The dam spillway was found to be inadequate because it would be overtopped with a flood equivalent to 30 percent of the spillway design flood SDF, (the Corps consider the SDF to be 1/2 the Probable Maximum Flood).

However, more detailed hydrologic and hydraulic studies were not recommended due to the low height of the dam and the limited surrounding site conditions. The recommendations as presented in the 1981 report are currently being analyzed for implementation. A copy of a letter summarizing the results of the inspection from the Corps of Engineers is included as Appendix B.

The pond created by Beatties Mill Dam, which is owned by the applicant, serves to create a diversion pool for the intake canal leading to the water treatment plant and the hydroelectric facilities.

(b) Gate house-- The canal intake gate house is on the left bank of the diversion pool. The gate house is stone and mortar with a dimensions of 85' x 26', containing six slide gates estimated to be 6' x 6'. A boom and diversion weir are located at the gatehouse to divert floating debris from the intake canal.

(c) Canal-- The canal is 1300 feet long. The canal has the dual purpose of serving the water supply treatment plant and the hydropower plant. The canal is of variable section, with the width ranging from 60 to 90 feet and the depth from 8 to 10 feet. The canal walls are vertical and in many places lined with placed stone. At the downstream end of the canal is a free overfall spillway for returning unused water to the river. Water levels in the canal are controlled by the hydropower operation and stoplogs located in the overflow spillway.

(d) Intake-- The intake to the project includes a trash rack with manually operated mechanical rack cleaning rake. The existing rack

is old and has several large holes. The intake provides the transition for flow into two penstocks feeding the turbines. A new trash rack and cleaning system is currently being designed.

(e) Penstocks-- Two existing penstocks feed the powerhouse. One is 12' in diameter with two existing 6' right angle valved taps which feed the Kaplan turbine, Unit No. 4. and the fixed blade Unit No. 3. This penstock, which is currently stubbed will also provide the generating flow to the fifth unit proposed for the vacant turbine bay. The other penstock is in sections of 12' and 10'. It has two right angle valved taps of 6' diameter which provide flow to the other two fixed blade units. Penstock lengths are as follows:

	Diameter	Length
Penstock One:	12'	250'
Taps (2)	6'	67'
New tap fifth unit	7'	85'
Penstock Two:	12'	100'
	10'	46'
Taps (2)	6'	53'

(f) Powerhouse--The housing for the hydropower project is the High Service Pumping Station owned and operated by the applicant. The powerplant is designed to provide power to the pumping station. The dimensions of the Station are 252' x 67'. The pumping plant/powerhouse is constructed of concrete and stone block. The existing powerhouse was constructed with a fifth turbine bay, specifically designed for future expansion. Minimal new construction will be required for installation of the new unit. Some tailrace excavation below the powerhouse may be required depending on the size and type of equipment which is selected. If

this excavation is required, the tailrace bay can be dewatered by bulkheading the opening on the riverside powerhouse wall.

(g) No new transmission lines will be required for the proposed project.

(ix) The project's original features were constructed in the 1890's. Modifications, improvements, and major maintenance work has been done at numerous times since then. The current equipment has been in operation since its placement in 1932. Due to the long construction history of the project, a specific cost for the existing hydropower operation is, at the present, impractical to determine. The costs for adding the fifth unit to the existing project is approximately $800,000.

2. The primary purpose of the dam, canal and other facilities at Little Falls is to provide water supply to the people of the cities of Clifton, Paterson, and Passaic together with 15 other communities in New Jersey. The hydroelectric power project is the secondary purpose of this valuable water resource. The existing and proposed power facilities which are part of this application provide power to the Commission to reduce the high pumping energy costs. This project is integral to the PVWC system and provides a public benefit to some 700,000 users of the system. All of the power generated is scheduled for use at the pumping station with no power sales anticipated.

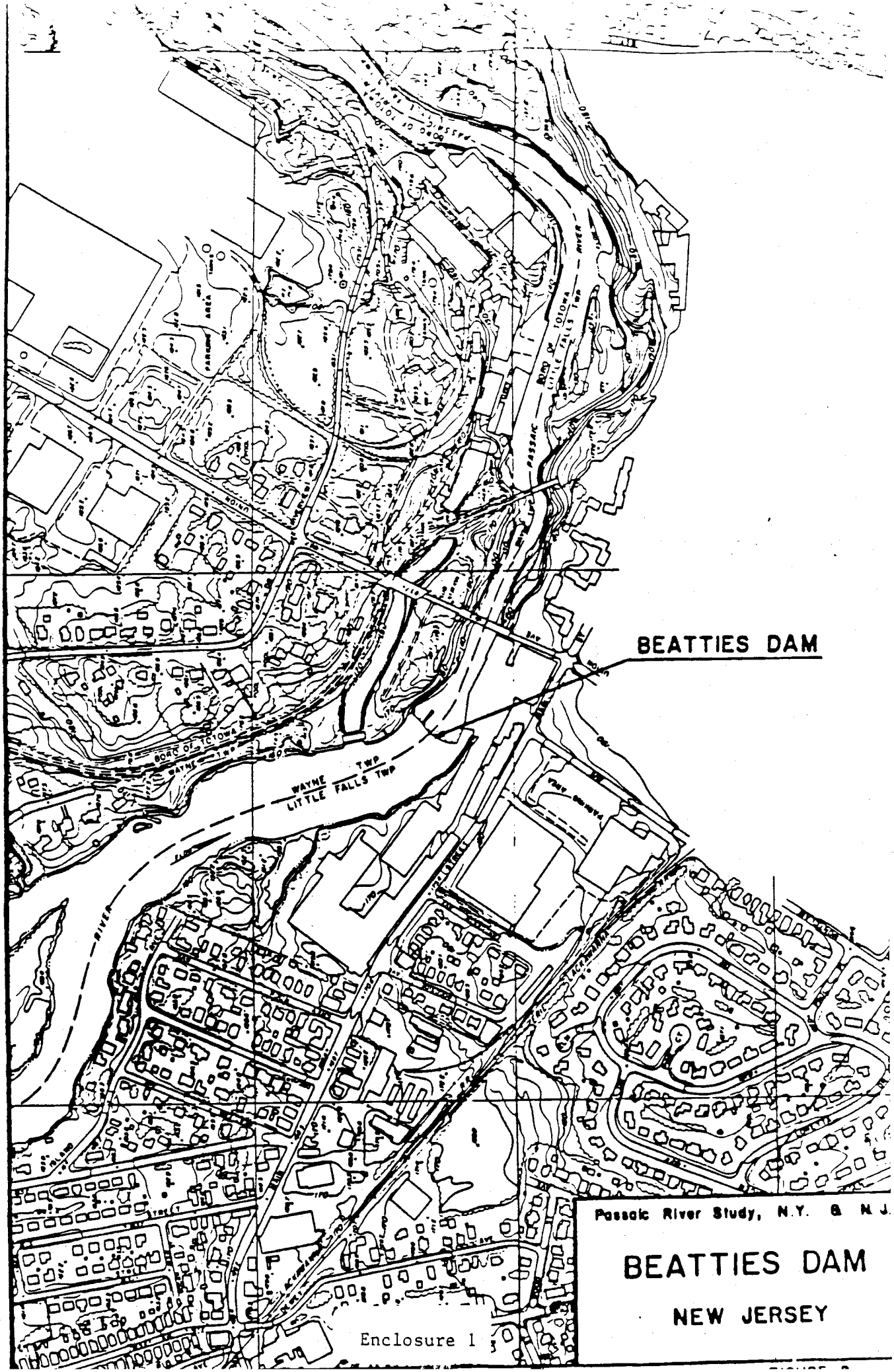
influenced the industrial development of the area. The land in the immediate area are comprised of different uses including, residential, commercial and industrial.

(vii) Historical and Archaeological

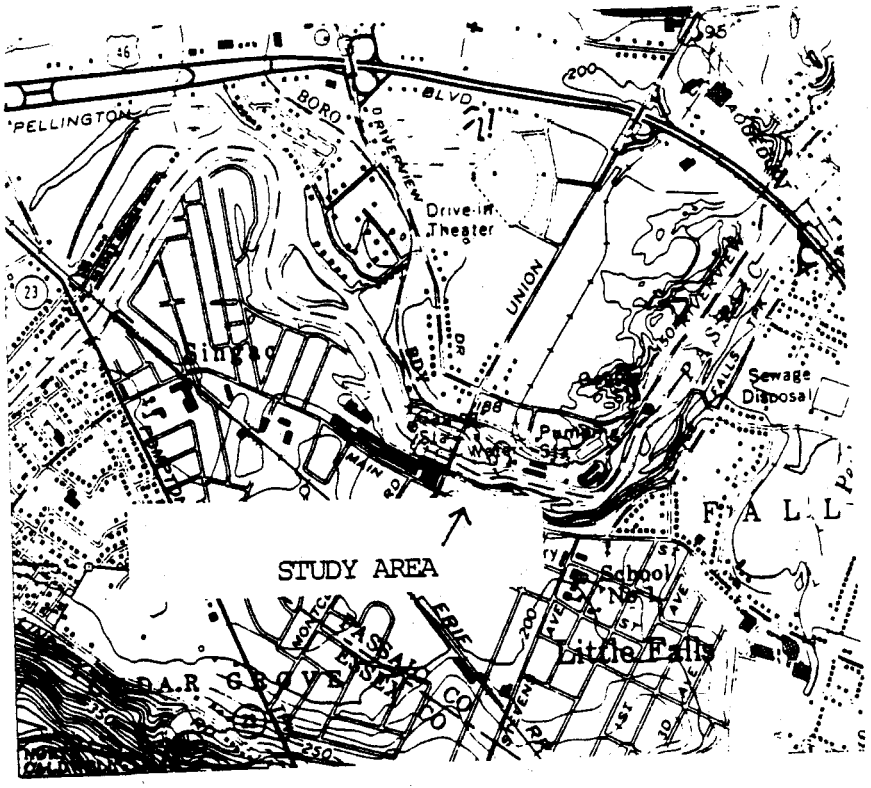
The Passaic Valley Water Commission came into being in 1927 under Chapter 195 of the New Jersey laws of 1923, which provided that two or more municipalities may join together in the purchase and operation of a water-works system. As a result of this law the cities of Paterson, Passaic and Clifton acquired in 1930 through condemnation the privately owned Passaic Consolidated Water Company. The properties secured consisted of the distribution system, the filtration plant, the pumping station, and the right to divert water from the Passaic River.

Beatties Mill Dam was constructed before the other facilities. The cornerstone of the canal gatehouse indicated that the dam was originally constructed in 1896. Some of the features of the original plant are still in use, although several additions and modifications have been carried out throughout the years.

None of the facilities on the project grounds are on the National Register of Historic Place. The Deputy State Historic Preservation Officer has offered by letter dated April 4, 1984, the opinion that the Little Falls Hydroelectric Facility is eligible for listing on the National Register of Historic Places. It was further stated that since the project does not include any alteration of the facility there is no adverse effect to the eligible property. No further review was requested.


BEATTIES DAM
WAYNE TWP
LITTLE FALLS TWP
PASSAIC RIVER
Passaic River Study, N.Y. & N.J.
BEATTIES DAM
NEW JERSEY

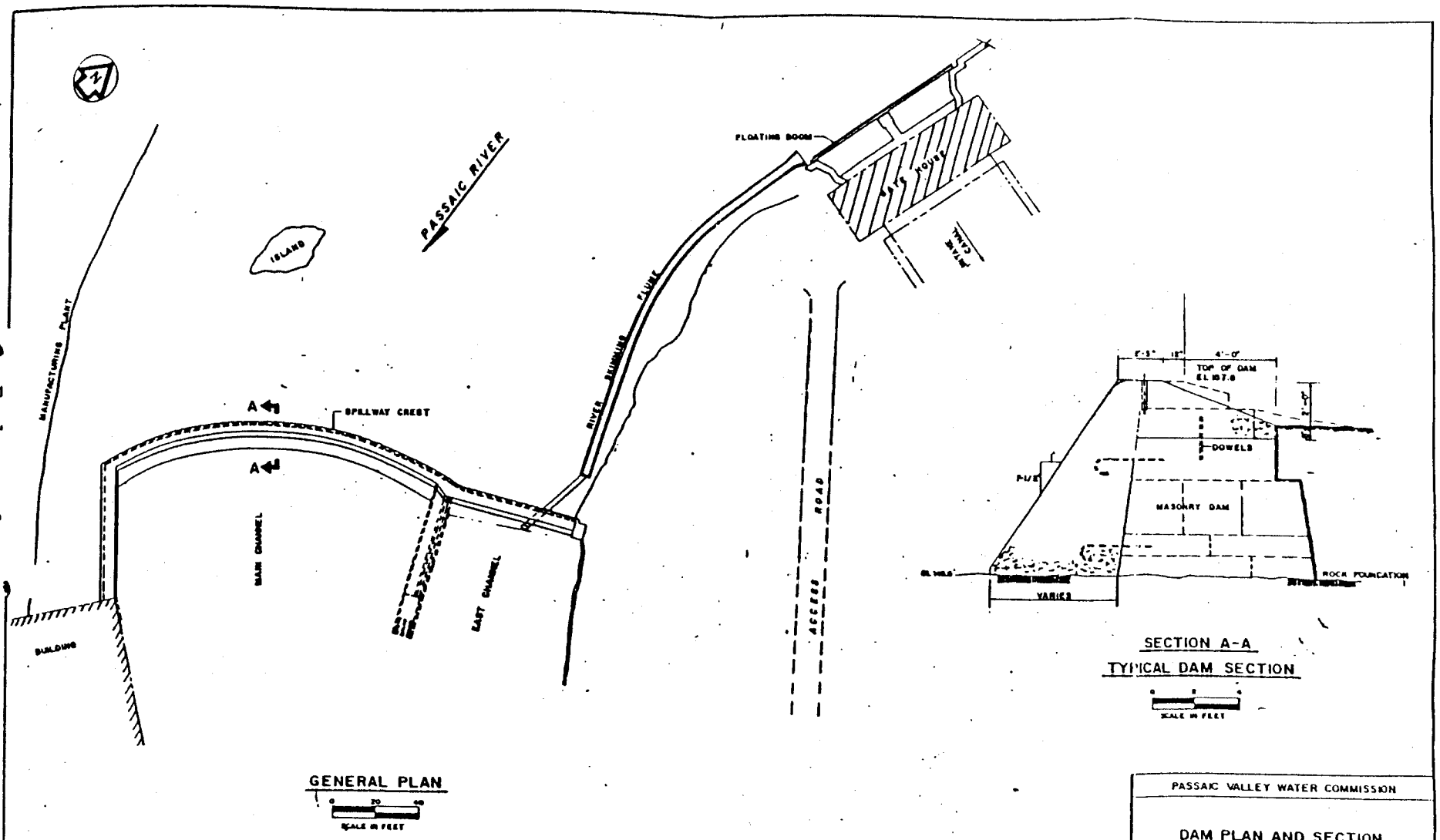
Enclosure 1



from: USGS, Paterson, NJ quadrangle

Enclosure 2

Enclosure 3

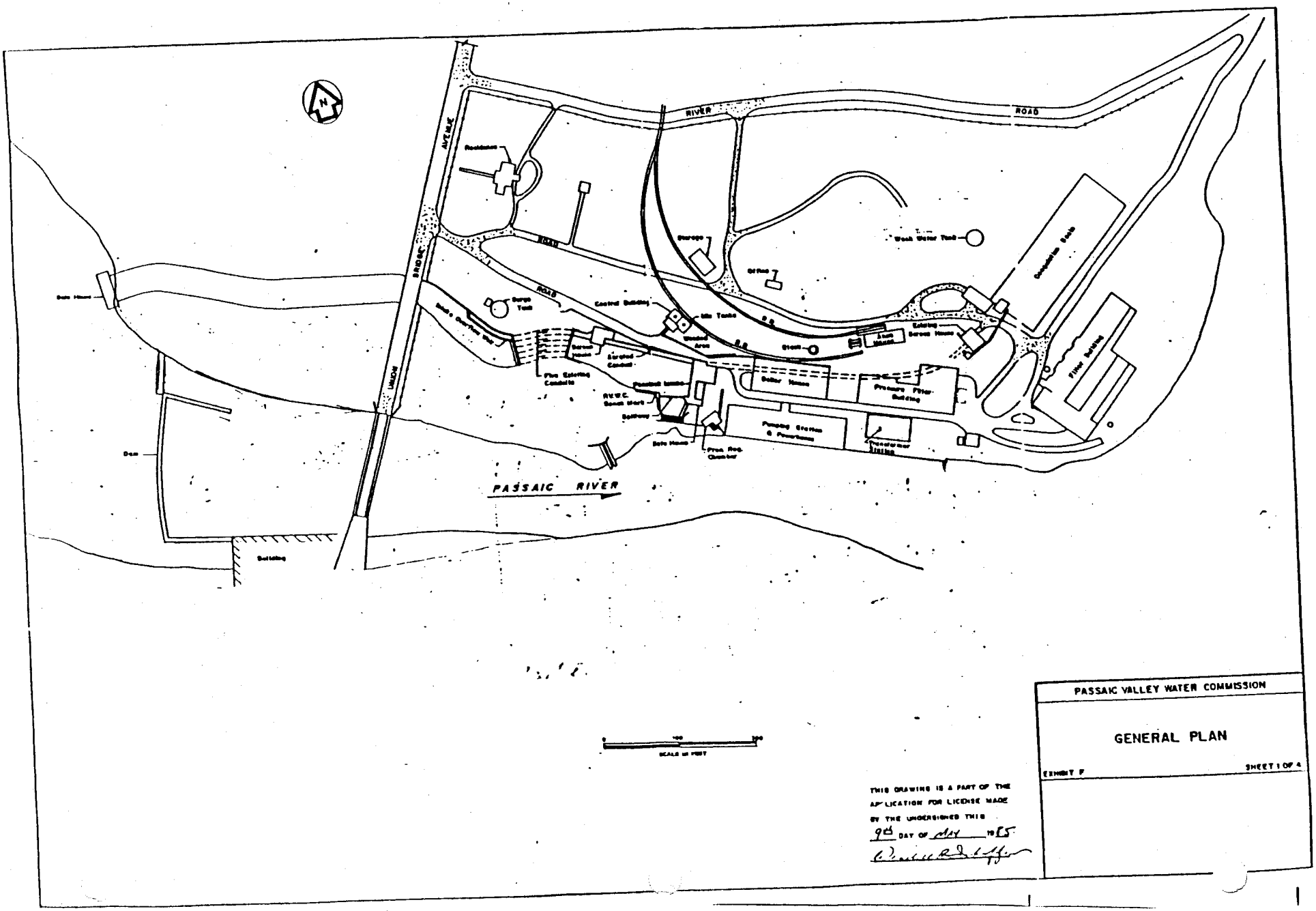


THIS DRAWING IS A PART OF THE APPLICATION FOR LICENSE MADE BY THE UNDERSIGNED THIS 9th DAY OF May 1925

PASSAIC VALLEY WATER COMMISSION

DAM PLAN AND SECTION

EXHIBIT F SHEET 8 OF 4



PASSAIC VALLEY WATER COMMISSION

GENERAL PLAN

EXHIBIT F SHEET 1 OF 4

THIS DRAWING IS A PART OF THE APPLICATION FOR LICENSE MADE BY THE UNDERSIGNED THIS 9th DAY OF May 1955

Enclosure 4

PASSAIC RIVER, VICINITY OF BEATTIES DAM
FLOOD CONTROL PLANS

PLAN DESCRIPTIONS

Plan 1

Plan 1 consists solely of dam modification. The existing Beatties Dam would be removed and replaced by a series of 3 gated structures. There would be two 8.3 feet high, 50-feet wide bascule gates and one 8.3 feet high, 138-feet wide bascule gate. The spillway elevation would remain at 158.3 NGVD, the same as existing conditions.

During non-flood conditions, the gates would be in the up (vertical) position in order to maintain normal water surface elevations. During flood conditions the gates would be lowered to allow the flood flows to pass downstream.

Plan 2

Plan 2 consists of dam modification combined with channel modification upstream of the dam. The dam modification is the same as that described in Plan 1, the complete removal and replacement of the dam with gated structures.

The channel modification on the Passaic River involves removal of a channel constriction formed by a natural narrow rock gorge. The channel modification would extend upstream from the dam for a distance of approximately 4,620 feet. The initial 1,430 feet consists of rock excavation, while the remainder involves sediment removal. The channel would be deepened a maximum of 4 feet. The reshaped channel would have a base width of 200 feet and side slopes of 2 horizontal: 1 vertical.

Plan 3

Plan 3 consists of dam modification combined with channel modification. The dam modification consists of replacement of approximately 200 feet of the dam with two gated structures, each 8.3 feet high and 95 feet wide. The bascule gates would be operated only during flood conditions as described in Plan 1.

The channel modification is the same as that described in Plan 2.

Plan 4

Plan 4 also consists of dam modification combined with channel modification. The dam modification includes the replacement of a portion of the dam with a gated structure, 8.3 feet high and 100 feet wide. The gate operation is the same as that described in Plan 1. The channel modification is the same as that described in Plan 2.

EFFECTS ON WATER SURFACE ELEVATIONS

Of the four alternative plans, Plan 2 would produce the greatest reduction in water surface elevations compared to without project conditions, followed closely by Plan 3, then Plan 4. Plan 1 would have the least effect on water surface elevations. The effects of the four plans are compared in Table 2 for the reach near Beatties Dam (STA 1373+10) and Two Bridges (STA 1[illegible]). The maximum reductions in water surface elevations occur near Beatties Dam gradually converging to existing conditions, proceeding upstream. For example, for Plan 2, the 1 year flood would be reduced by 0.7 feet near Beatties Dam but only by 0.4 feet at Two Bridges.

Since Plan 2 would have the greatest impact upstream of Two Bridges, the effects of this plan on water surface elevations in the Great Piece Meadows are tabulated in Table 3 for the more frequent floods. In this reach the maximum reduction in water surface elevations would occur at the downstream end of the meadows. At this location, the 1 year and 2 year flood stages would be reduced by 0.4 feet. The 5 year and 10 year flood stages would be reduced by 0.3 feet with Plan 2. The reductions in water surface elevations for the 25, 50, 100 and 500 year floods would be even less.

Although the alternative plans would reduce the duration of the floods, the changes are expected to be relatively minor as evidenced by the small changes in water surface elevations.

TABLE 1

SUMMARY OF PHYSICAL FEATURES
OF PLANS

	Dam Modification	Channel Modification (Length)
Plan 1	Replace entire dam	-
Plan 2	Replace entire dam	4,620 ft.*
Plan 3	Replace 200 ft of dam	4,620 ft.*
Plan 4	Replace 100 ft of dam	4,620 ft.*

* Includes 1,430 linear feet of rock removal.

TABLE 2

COMPARATIVE EFFECTS OF ALTERNATIVE PLANS
ON WATER SURFACE ELEVATIONS

Station	Frequency	Without Project Elevation	Plan 1 Elev (ft)	Plan 1 Reduction (ft)	Plan 2 Elev (ft)	Plan 2 Reduction (ft)	Plan 3 Elev (ft)	Plan 3 Reduction (ft)	Plan 4 Elev (ft)	Plan 4 Reduction (ft)
1573+10	1 year	161.4	158.7	2.7	155.7	5.7	155.9	5.5	158.4	3.0
(445 ft.	2	162.3	159.7	2.6	157.0	5.3	157.3	5.0	159.9	2.4
upstream of	5	163.1	160.7	2.4	158.3	4.8	158.6	4.5	161.1	2.0
Beatties Dam)	10	164.1	161.6	2.5	159.6	4.5	160.0	4.1	162.3	1.8
1740+60	1	164.3	163.9	0.4	163.7	0.6	163.7	0.6	163.8	0.5
(Two Bridges)	2	165.8	165.4	0.4	165.2	0.6	165.2	0.6	165.4	0.4
	5	167.3	166.9	0.4	166.7	0.6	166.7	0.6	166.9	0.4
	10	168.7	168.4	0.3	168.2	0.5	168.2	0.5	168.4	0.3

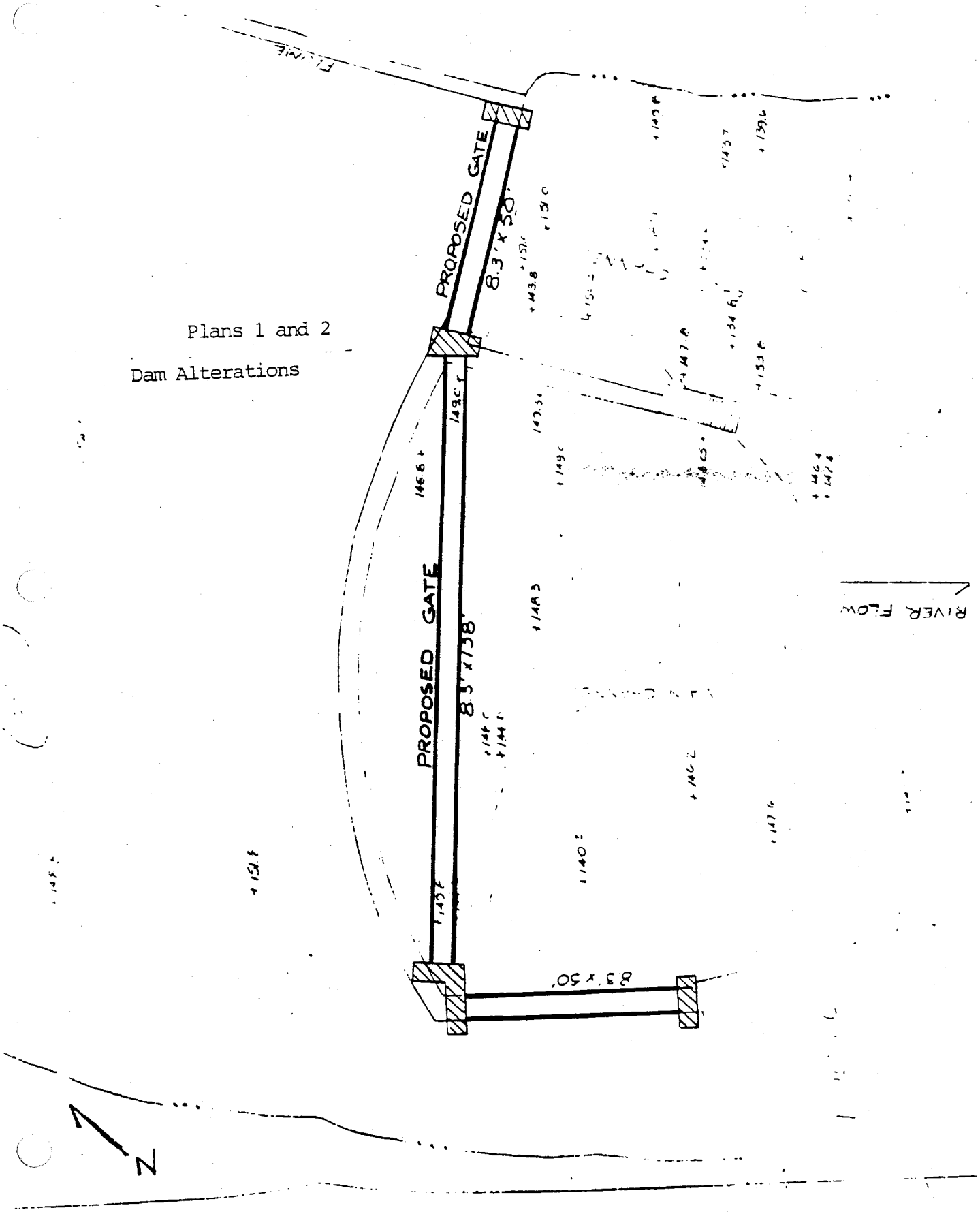
TABLE 3

EFFECTS OF PLAN 2 ON WATER SURFACE ELEVATIONS UPSTREAM OF TWO BRIDGES

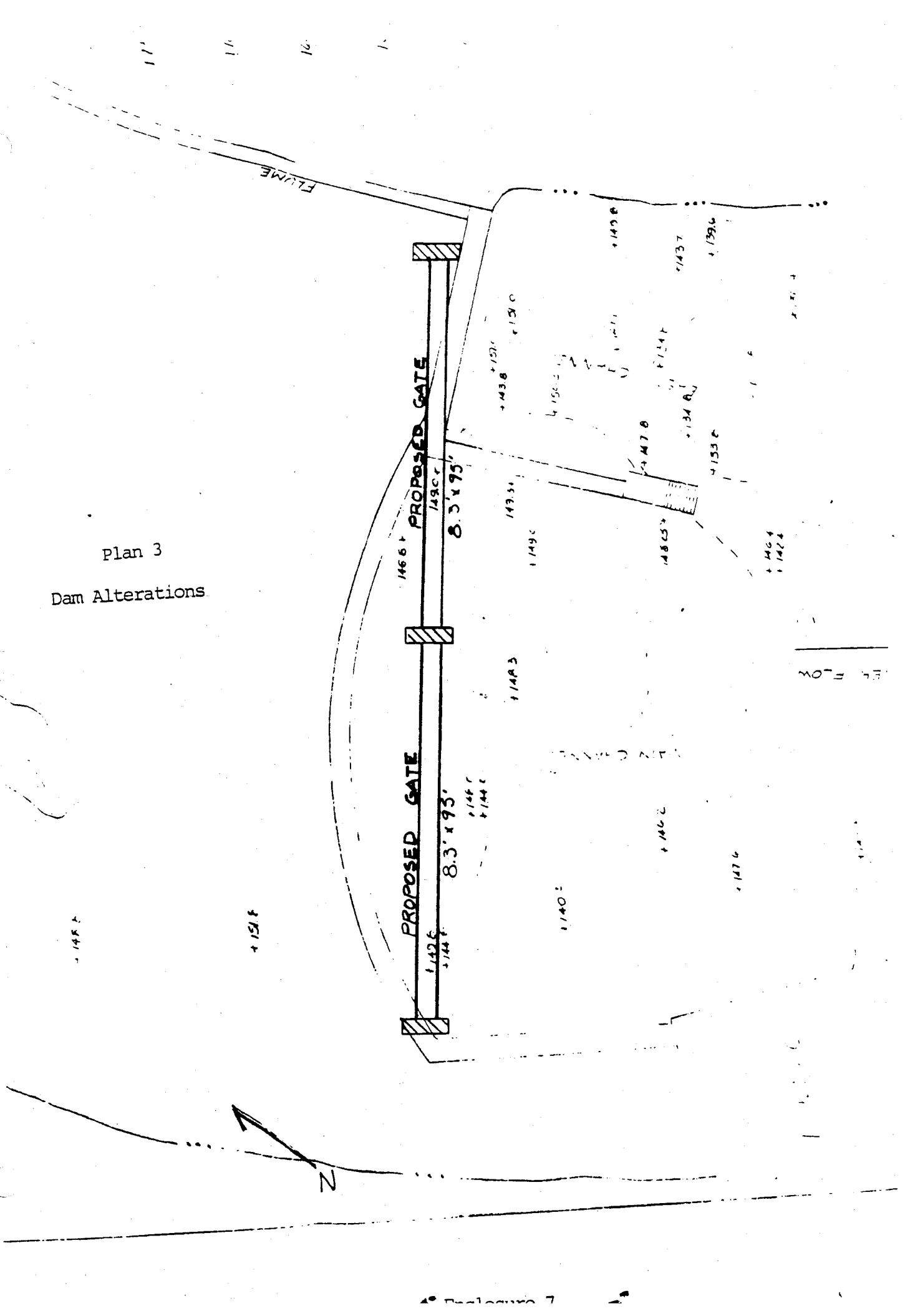
Station	Frequency	1990 Without Project Conditions	Plan 2	Reduction (ft)
1746+30	1 year	164.4	164.0	0.4
(0.1 miles above	2	165.9	165.5	0.4
Two Bridges)	5	167.3	167.0	0.3
	10	168.8	168.5	0.3
1753+90	1	164.4	164.0	0.4
(0.3 miles above	2	165.9	165.5	0.4
Two Bridges)	5	167.4	167.1	0.3
	10	168.8	168.6	0.2
1841+70	1	164.5	164.1	0.4
(1 mile above	2	166.0	165.6	0.4
Two Bridges)	5	167.5	167.2	0.3
	10	168.9	168.7	0.2
1874+20	1	164.5	164.1	0.4
(1.5 miles	2	166.0	165.7	0.3
below Tom's	5	167.5	167.2	0.3
Point)	10	168.9	168.7	0.2
1940+00	1	164.8	164.5	0.3
(1 mile below)	2	166.1	165.8	0.3
Tom's Point)	5	167.7	167.4	0.3
	10	169.0	168.8	0.2
2133+70	1	166.3	166.2	0.1
(1.5 miles above	2	167.1	167.0	0.1
Tom's Point)	5	168.3	168.1	0.2
	10	169.5	169.2	0.3
2177+50	1	166.5	166.4	0.1
(0.4 miles below	2	167.3	167.2	0.1
Horseneck Road)	5	168.5	168.3	0.2
	10	169.6	169.3	0.3
2198+60	1	166.6	166.6	0.0
(Horseneck Road)	2	167.5	167.4	0.1
	5	168.6	168.4	0.2
	10	169.7	169.4	0.3
2240+00	1	167.0	167.0	0.0
(0.5 miles above	2	168.1	168.1	0.0
Horseneck Road)	5	168.9	168.8	0.1
	10	169.9	169.7	0.2

Plans 1 and 2

Dam Alterations



Enclosure 6

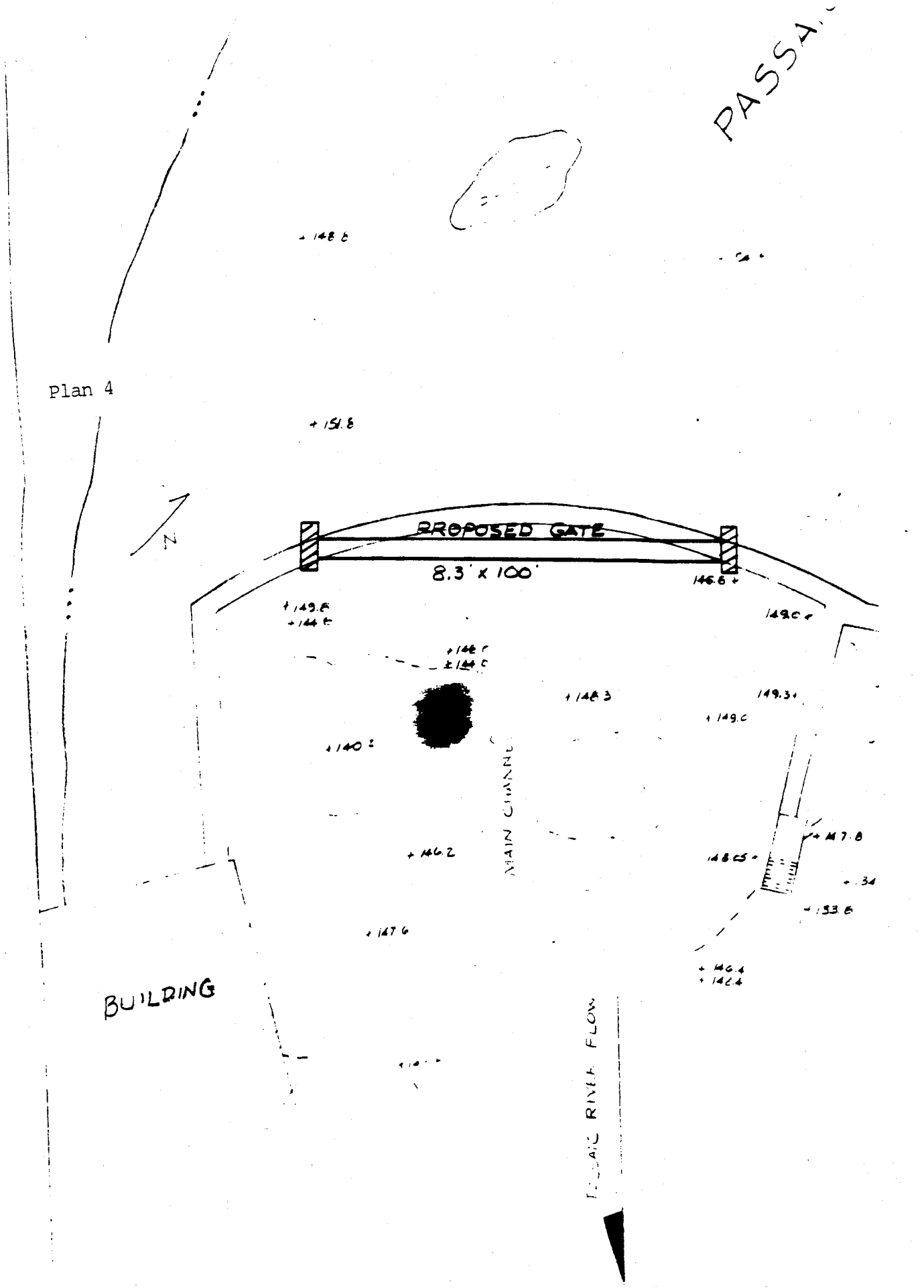


Plan 3

Dam Alterations

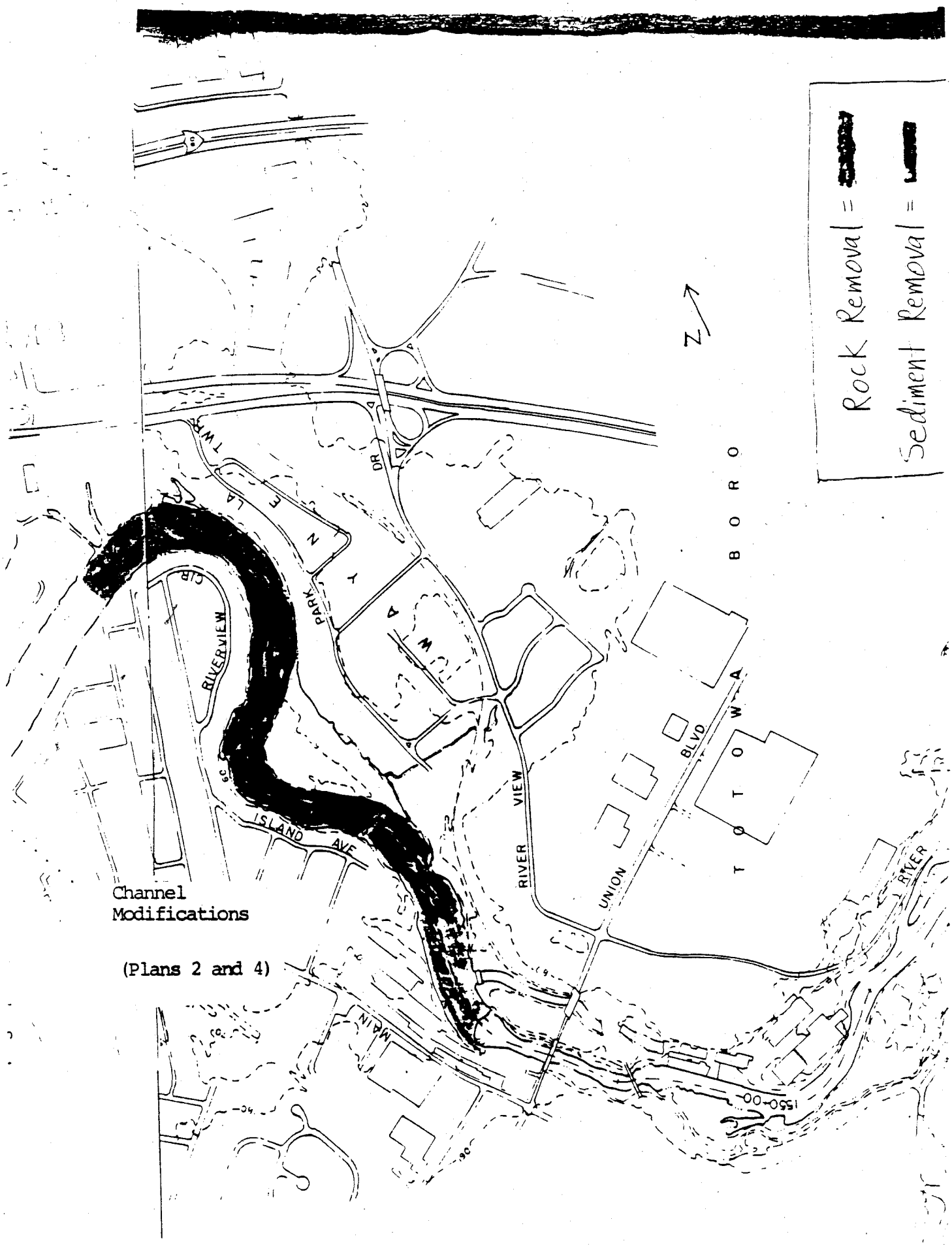
Enclosure 7

Plan 4



PLAN

SCALE 1" = 40'



Channel Modifications

(Plans 2 and 4)

Enclosure 9