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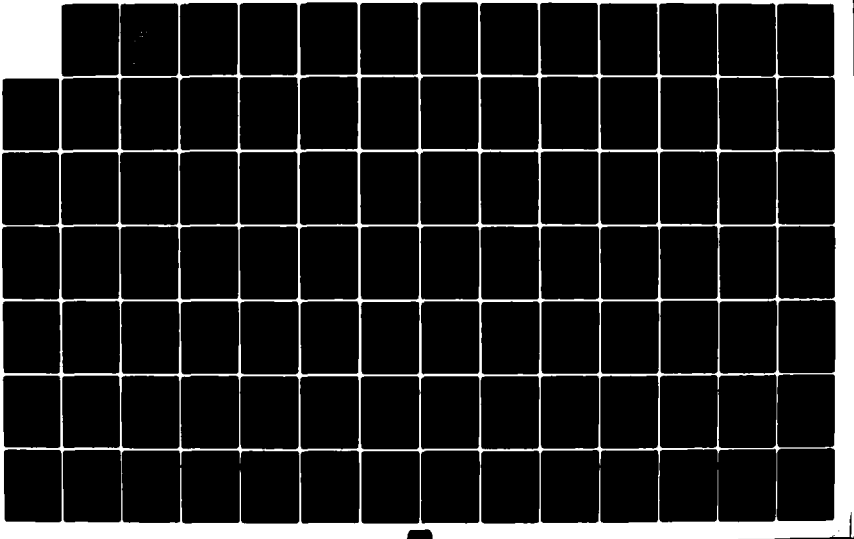

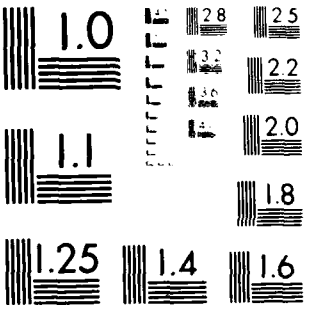

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Buffalo Metropolitan Area, N.Y.
Water Resources Management

AD-A133 783

Interim Report On Feasibility Of Flood Management

Tonawanda Creek Watershed

(Final Feasibility Report And Final Environmental Impact Statement)

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US Army Corps of Engineers
Buffalo District

July 1983

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This final feasibility report on the Tonawanda Creek Watershed is an interim reply to the study authorization which requested determination of the feasibility of providing flood protection in the Buffalo Metropolitan Area, N.Y. The study area is located in Western New York State and includes an area of 511 square miles. The existing flooding problem causes nearly $3.0 million in average annual damages to existing urban and agricultural development.

A wide range of alternative plans were investigated as solutions to the

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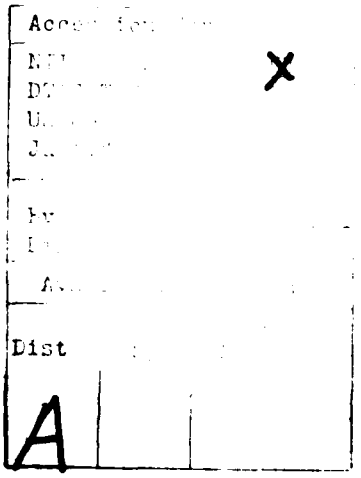
flooding problem including non-structural and structural. The plans were evaluated for engineering, economic, and environmental feasibility.

The Batavia Reservoir Compound-Modified Plan was selected as the Reccommended Plan. This plan is described as the shallow (normally dry) detention reservoir upstream of Batavia that act as flood alternators and provides 1-10 year flood protection in the lower reservoir, 500-year flood protection in the lower portion of the Erie Plain floodland (including the city of Batavia) and 1-10 year protection in the Huron Plain floodland downstream. This plan reduces the existing average annual flood damages by approximately 74 percent.

The total first cost is $2.9 million at October 1982 price levels with a benefit-cost ratio of 1.19 to 1.0. This plan is designated the NED plan.



EXECUTIVE SUMMARY

This final feasibility report on the Tonawanda Creek Watershed is an interim reply to the study authorization which requested determination of the feasibility of providing flood protection in the Buffalo Metropolitan Area, NY. This report was prepared using the Principles and Standards, and other applicable laws and regulations.

The study area is located in Western New York and includes 511 of 648 square miles in the Watershed. Two downstream tributaries, Bull and Ellicott Creeks, are not included in the study area because they are being investigated separately, and are not affected by flooding in the upstream portion of the Watershed. The existing flooding problem causes nearly $3,000,000 in average annual damages to existing urban and agricultural development, and can potentially cause increasing future damage as the area faces increasing pressure for residential development. In addition, farmers and dairymen are unable to make full and productive use of the unusually fertile soils within the flood plain due to frequent flooding.

Prior studies and improvements in the study area have investigated and implemented localized solutions to problems, but have not addressed the regional flood management problem. The primary planning objective was to reduce urban and agricultural flood damage, and a secondary objective was to reduce the flood potential in the areas of highly productive soils. Additional planning criteria included the need to: determine the Federal interest; insure proposals meet with current guidelines, laws, and regulations; and insure that the solution has local support.

A wide range of alternative plans were investigated as solutions to the flooding problem including nonstructural and structural measures. The structural plans included local flood protection, and reservoir and multireservoir plans. These plans were formulated using appropriate planning criteria, and input from public and agency coordination. The plans were evaluated for engineering, economic, and environmental feasibility, and were compared to select the plan which best meets all tests.

The Batavia Reservoir Compound-Modified Plan was selected as the Recommended Plan. This plan is described as two shallow (normally dry) detention reservoirs upstream of Batavia that act as flood attenuators and provides 1-10 year flood protection in the area of the lower reservoir, 500-year flood protection in the lower portion of the Erie Plain floodland (including the city of Bataiva, and roughly 1-10 year protection in the Huron Plain floodland downstream. This plan reduces the existing average annual flood damages by approximately 74 percent. The total first cost of this plan is $29,000,000. The economic effeciency of the Recommended Plan, based on an economic life of 100 years and an interest rate 7-7/8 percent, is 1.19 and meets the criteria to be designated as the NED Plan. The average annual cost of the plan, including costs for operation, maintenance, and repair is $2,878,000. The average annual net benefit of the plan is $541,100.

Construction of the Recommended Plan makes a significant contribution to the human environment by reducing flood damages while having a minimal impact upon the natural environment. Mitigation of those lands impacted by construction of the two dams is recommended by improved management of existing wetlands in the watershed.

The designated EQ Plan (or Least Environmentally Damaging (LED) Plan) is the Nonstructural Plan which combines five nonstructural management measures, and has a negligible impact on the environment. The LED Plan is not economically feasibile and includes a large number of relocations which makes it socially unacceptable.

Flood plain development expected to occur after construction of the project consists of residential units and related structures that would be built under without-project conditions. Three major reasons these future units would be located in the north eastern portion of the Buffalo Metropolitan Area adjacent to Tonawanda Creek are: the location of employment opportunities and the associated demand for replacement housing; a well developed infrastructure to support that development is already in place including sanitary sewerage facilities; and the level of protection afforded by the Recommended Plan in the downstream reaches is low and should not alter the perception of the flood hazard to such an extent that induced or project-sensitive development would occur.

The selection of the Recommended Plan fully considered the findings of earlier reports, the planning objectves and criteria, the means of eliminating or mitigating possible adverse social, regional development, and environmental impacts associated with the Plan; and includes the views and endorsement of the local interests.

In view of the investigations described in this report, the implementation of the Batavia Reservoir Compound-Modified Plan is recommended to provide flood damage protection in the Tonawanda Creek Watershed, subject to cost-sharing and financing arrangements satisfactory to the President and the Congress.

TONAWANDA CREEK WATERSHED, NY
FINAL FEASIBILITY REPORT
AND
FINAL ENVIRONMENTAL IMPACT STATEMENT

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SECTION 1 - BACKGROUND

STUDY AUTHORITY

Authorization for study of the feasibility of flood management in the Tonawanda Creek Watershed, New York, derives from a resolution of the Committee on Public Works, Senate, United States Congress, adopted 15 June 1950, which reads as follows:

> "Resolved by the Committee on Public Works of the United States Senate, that the Board of Engineers for Rivers and Harbors, created under Section 3 of the Rivers and Harbors Act, approved June 13, 1902, be, and is hereby, requested to review the report on Tonawanda Creek, New York, published as Senate Document Numbered 46, Eightieth Congress, First Session, with a view to determining the feasibility of providing flood protection along Mud Creek in Niagara and Orleans Counties, New York."

This authorization was expanded by resolutions of the Committee on Public Works, House of Representatives, United States Congress, adopted 16 August 1950 and 23 July 1956, which requested a review of reports. On 5 March 1973, the Chief of Engineers, Corps of Engineers, authorized study of water resources management in the Buffalo Metropolitan Area, New York, and directed that the Study Area include the Buffalo Urban Area (SMSA) and its tributary watersheds. Since the Tonawanda Creek Watershed is part of the Buffalo Metropolitan Area, the study of flood management needs in the Tonawanda Creek Watershed is part of the Buffalo Metropolitan Area Study.

LOCATION OF STUDY AREA

The Tonawanda Creek Watershed, an area of about 648 square miles, is located in western New York and includes substantial portions of Erie, Genesee, Niagara, and Wyoming Counties and a small section of Orleans County. The Watershed comprises many tributary watersheds, including those of Ellicott Creek and Bull Creek which join the mainstream, Tonawanda Creek, near its mouth on the Niagara River. Because flood management needs in the Bull Creek and Ellicott Creek watersheds are normally independent of those in the remainder of Tonawanda Creek Watershed, studies of those needs have been accomplished separately. That part of the Tonawanda Creek Watershed considered in this study is shown in Plate 1. This area of about 511 square miles represents the watershed less the subwatersheds of Bull and Ellicott Creeks (shaded portion).

TYPE OF STUDY

This report presents the results of a final feasibility study undertaken by the Buffalo District, Corps of Engineers, in interim response to the study authorization for the purpose of reporting to Congress for their action on the need for and desirability of undertaking a plan to solve the flood damage reduction needs of the study area. The report will also present a full and fair discussion of the economic and environmental impacts of the recommended plan and considered alternatives.

This report is a rewritten version of the earlier Final Feasibility Report, dated November 1981. The content of this revised report is identical to that of the earlier Feasibility Report, except that the report has been condensed into a more concise format. This format change and technical safety requirement for the project design was incorporated upon receipt of guidance from higher Corps authority. Minor modifications to the plan and report were added to address public concerns raised during the recent public coordination period (August-December 1982).

PROBLEMS AND OPPORTUNITIES

a. General. The water and related land resource problems and opportunities in the Tonawanda Creek Watershed fall into two general categories: damage to existing and potential urban development in the suburban Buffalo area and in the low lying areas near Batavia; and the inability of farmers and dairy men in the Basin to make full and productive use of the unusually fertile soils found in the Tonawanda Creek flood plain.

b. Urban. The Buffalo Metropolitan Area has, in recent years, seen a stabilization of overall population growth. This stabilization is caused by a number of factors, the most significant of which is the closing of heavy industrial plants in the area which, in turn, has caused some emmigration and curtailed almost all immigration into the area. Other light industries in the area have not experienced these dramatic swings and, therefore, are stabilized or showing moderate growth. The net result of these factors is that as the fortunes of those people living in the central city improve, there is a demand for a steady, continuing market of new, mostly replacement, housing. The growth pattern, generally speaking, is for the new development to be towards the south and northeast portions of the metropolitan area. Most of the existing residential development in the northeast portion of the Buffalo Metropolitan area, which is threatened by Tonawanda Creek flooding, is in the communities of Clarence, Amherst, Pendleton, and Wheatfield. These are also the communities receiving much of the pressure for new residential housing.

Indicative of this pressure for new development is the construction of a new campus for the State University of New York at Buffalo and the new Audubon community, both in the town of Amherst. While not directly subject to Tonawanda Creek flooding or contributing to the flood damage potential along the creek, these developments are causing significant pressure for residential and commercial development in the Tonawanda Creek area. The State of New York estimates that the new campus, alone, will create 50,000 jobs in and around the campus development.

A second new large-scale residential development, Ransom Oaks, in the town of Amherst is being constructed and lies in the flood plain of Tonawanda Creek. Ransom Oaks is expected to provide approximately 1,000 apartment, townhouse, and single-family dwellings before 1990.

Other than Buffalo and its suburbs, there are two cities of larger than 10,000 population which are at least partly in the Tonawanda Creek Watershed,

namely Batavia and Lockport. Populations of these long-established communities have changed little in recent years, and growth in their suburbs has been moderate. Again the primary impacts for new suburban growth have been replacement housing for central city residents achieving a higher standard of living. The main transportation arteries, which attract the new residential developments, roughly parallels Tonawanda Creek, thus encouraging additional development in the flood plain.

c. Agriculture. Agricultural activity within the watershed contributes substantially to both the local and regional economy. Within the boundaries of the watershed, farming is the primary industry. Dairy farming is the largest single producer of agricultural revenue in every county in the watershed. In Erie and Niagara Counties the secondary agricultural emphasis is for truck farming of vegetables for both cannery processing and direct sale to retail outlets and open air markets. On the other hand, the secondary agricultural emphasis in Genesee and Wyoming Counties is on production of field crops, almost all of which goes to support the dairy operations.

The agricultural activity in the basin could realize significant increases in productivity with little, if any, increase in costs with a reduction of flooding frequency on the highly productive soils. Generally speaking the soils within the 5-year flood plain of Tonawanda Creek have a production capability significantly higher than adjacent upland soils. Depending on crop and location the production increases range from 15 to 60 percent higher for the same level of management. These more fertile soils are not extensively used at present for the most productive crops because the threat of frequent flooding makes this use uneconomical.

PRIOR STUDIES, REPORTS, AND IMPROVEMENTS

Several prior studies and reports have been conducted in the Tonawanda Creek Watershed by the Corps of Engineers and others. Numerous improvements have also been made at selected sites by the Corps of Engineers and others. The types of studies and reports and a description of the improvements are briefly discussed in the following paragraphs with more detail available in the technical appendicies.

Corps of Engineers studies and reports date back to 1887 when navigation improvements to Tonawanda Harbor were investigated. Since then the majority of studies have addressed the flood and flood-management problems within the watershed. Structural measures such as channel improvements and upstream reservoirs have been investigated. A series of Flood Plain Management Reports discuss the results of investigations of nonstructural management measures.

Studies and reports by others include: a New York State Department of Environmental Conservation (NYSDEC) reconnaissance study on the water resources of the state in 1966; a study by the Erie-Niagara Basin Regional Water Resources Planning Board investigated the water resources management needs of the basin; and an Erie and Niagara Counties Regional Planning Board Report investigating the storm drainage needs of the two counties.

Improvements provided in the Tonawanda Creek Watershed by the Corps include: construction of navigation improvements to Tonawanda Creek and Harbor; several localized channel improvements, including a local flood protection project in Batavia; localized clearing and snagging in one large tributary; and the removal of a debris jam in the town of Alexander.

Improvements by others date back to work performed by the State of New York on the Erie Barge Canal in 1825. The State has also cleared and improved many of the small tributaries to Tonawanda Creek, made structural changes to the Barge Canal; and straightened a portion of the creek downstream of the city of Batavia. The city of Batavia has constructed a levee on the creek within the city limits. The town of Amherst has cleared and snagged two tributaries; Black and Ransom Creeks. Erie County has constructed a diversion channel in Ellicott Creek Park diverting water from Ellicott to Tonawanda Creek in the town of Tonawanda. The village of Attica has built floodwalls along the creek within its borders, and were rebuilt after being damaged by the June 1972 Tropical Storm Agnes. More detail on all improvements is in the appendicies.

SECTION 2 - PLANNING OBJECTIVES AND CRITERIA

PLANNING OBJECTIVES

The objectives of the study were developed from the Congressional resolutions authorizing the study. They specifically mentioned the need for flood protection in the watersheds tributary to the Buffalo Metropolitan Area. This need is developed in greater detail in the Problems and Opportunities Section of this report where the problems of agricultural and urban flood damages along Tonawanda Creek are discussed. This leads to the primary objective of the study which is to:

- Reduce urban and agricultural flood damages in the study area.

The high productivity of the soils found along the Tonawanda Creek streambed and in the highly floodprone areas near the stream are also discussed in the Problems and Opportunities Section. The possibility of increased production from these soils if the frequency of flooding is reduced leads to secondary objective of this study which is to:

- Reduce the flood potential on highly productive soils in the study area for the purpose of increasing agricultural production.

It is important that for this study of the Tonawanda Creek Watershed that the extreme lower reaches of Tonawanda Creek (i.e. below the confluence of large tributaries such as Bull and Ellicott Creeks) are not included in this study or its objectives because flood flows in these reaches are not significantly affected by upstream portions of Tonawanda Creek.

PLANNING CRITERIA

a. General. There are three basic criteria which must be met for the Corps of Engineers to participate in the implementation of a water resources development project. These are:

(1) - That there is a Federal interest in the solution to the problem or realization of an opportunity;

(2) - That the proposed plan meets the requirements stated in current executive (administration) guidelines; and

(3) - That there is general support for the proposed plan by Non-Federal interests and that these interests express an intent to provide the local requirements for implementation.

For the need to decrease economic losses due to flooding in the Tonawanda Creek Basin, is described above, the Federal Interest was established by the Flood Control Act of 1936 on the condition that "the benefits to whomsoever they may accrue are in excess of the estimated costs, and if the lives and social security of people are otherwise adversely affected." This has been interpreted to mean that the net national benefits must exceed the cost and

that any regional benefit which may occur, at the expense of another region of the country, is not measured against the project costs.

The executive guidelines under which this study was conducted are the Principles and Standards of the Water Resources Council. These criteria will be discussed in greater detail later in the report.

The coordination appendix and later discussion of the responsibilities of the local project sponsor will address the last of the three general planning criteria.

b. National Economic Development (NED) Criteria. In accordance with the Congressional resolutions authorizing this study and other applicable Corps rules and regulations, i.e. the Principles and Standards, the following criteria were developed for comparing effectiveness of alternative plans:

- Reduce existing and future urban and agricultural damages within the Tonawanda Creek Watershed, along Tonawanda Creek and its tributaries from stream mile 9.8 to 65.3.

In accordance with the Congressional resolutions authorizing this study, alternative plans were developed to provide, as fully as practicable, for all flood management needs in the study area. These alternative plans will include the required nonstructural plan and highlight the structural plan which maximizes national economic benefits as required in the Principles and Standards.

- Increase employment of unemployed or underemployed resources in the study area.

The resource in this case is labor which is locally underused. The public to be affected is the available construction labor pool.

- Increase use of farmlands within the study area.

The low lying farmlands along Tonawanda Creek have high production potential which could be brought back into production with a minimum of effort. The farmers using and renting these low lying lands would be positively affected by allowing them to increase production and their profits.

- Reduce future floodproofing costs within applicable areas of the study area.

The public affected by this criterion would be potential property buyers of homes falling within the limits of the 100-year flood plain as defined in applicable Flood Plain Information Reports.

- The interest rate to be used in formulating and evaluating alternative plans will be 7-7/8 percent (Fiscal Year 1983) in accordance with the formula prescribed by the Water Resources Council.

- Each separable unit or purpose of all alternative plans must provide benefits at least equal to its cost in accordance with Corps of Engineers and Water Resources Council policy.

- Evaluate all structural flood damage reduction alternative plans on a 100-year economic life.

- Develop a nonstructural base plan using applicable Corps criteria.

c. Environmental Quality (EQ) Criteria. The criteria for maintaining and enhancing the environment are contained in: Public Law 91-190, National Environmental Policy Act (NEPA) of 1969; Public Law 91-611, Flood Control Act of 1970; and Principles and Standards. In addition to the criteria mentioned in these statutes, alternative plans should meet the additional criteria which follow.

- Preserve wetlands in the project area in conformance with Executive Order 11990.

The wetlands resource of this area provide nesting opportunities for waterfowl and other birds and animals.

- Reduce flood-related erosion along the creekbed and channel slopes.

This criterion is especially important because of the degradation of the human and natural environment caused by erosion. The flood-related erosion of creekbed and channel slopes disrupts the land and water resource, as well as, the flora and fauna in those and adjacent areas.

- Maintain water quality in Tonawanda Creek and its tributaries within the study area.

- The water quality resource in the study area supports fishing and serves as water supply for the city of Batavia.

- Preserve or salvage significant (as determined by National Register of Historic Places criteria) historic and prehistoric cultural resources sites affected by potential project construction impacts in accordance with the authorities contained in the National Historic Preservation Act of 1966; the Reservoir Salvage Act of 1960, as amended by Public Law 93-291; and Executive Order 11593.

d. Regional Development (RD) Criteria. The criteria for regional development follow the rules in the Principles and Standards. Other specific criteria are discussed below.

- Increase employment within the region.

As stated under the NED criteria the study area has a high unemployment rate. Use of this manpower resource for project construction would produce benefits within and adjacent to the study area.

- Increase the output of goods in the region.

The agricultural farmland resources has a positive effect on output by allowing farmers to use lands with higher productivity potential.

- Increase in per capita income.

By increasing the output of the study area, a net increase in per capita income can be achieved for both farmers and workers in the study area.

e. Social Well-Being (SWB) Criteria. The criteria in this paragraph are designed to protect and enhance the well-being of people.

- Protect human well-being with a safe level of flood protection.

All publics within the flood plain are interested in a well designed and safe project which reduces the risk to human life associated with flooding.

- Reduce hazards to human health.

Many publics are affected by the potential for disease and health hazards from periodic flooding. A project that reduces the flood threat will also reduce the potential health hazards.

- Limit flooding in unprotected areas to without project conditions.

The solution to the flooding problem in one area should not be the cause of increased flooding for another area upstream or downstream of the project.

- Minimize relocation of properties in the project area.

All efforts should be made to minimize adverse impacts to people associated with relocation of their homes and families.

- Minimize impacts in local community from the constructed project (property tax base, school bus routes, traffic continuity, etc.).

SECTION 3 - FORMULATION AND EVALUATION OF ALTERNATIVES

PLAN FORMULATION APPROACH

The "planning process" is an investigation which is designed to effectively and efficiently solve a particular water and land-related resource problem in an identified area given a set of objectives and constraints.

Plan formulation is the process whereby all reasonable alternative plans are identified, developed, evaluated, and compared. Impractical and unfeasible alternative plans were eliminated through the planning process, and those plans remaining became more refined through additional development and subsequent iterations. After all iterations have been performed, a recommendation as to the "best" solution is made. That recommendation is the basis for authorization of a project in the case of a positive report. In this section, the plan formulation approach will be presented to show: where alternative plans were proposed; how they were developed; what steps were taken in screening and evaluating them; and how they were compared to one another.

In general, alternative plans identified as potential solutions come from: earlier studies; plans identified by the publics; experience with similar water and land-related resource problems; and those required by law or regulation.

The development of alternative plans attempts to define the plan and its relative contributions to solving the problem. At this point, an initial screening of plans is made to determine whether or not they could potentially solve the problem. If they have potential, they are carried forward in the process; if not, they are noted and dropped from subsequent evaluation.

The evaluation of plan effects consists of assessment and appraisal. Assessment is the process of measuring or estimating the effects of an alternative plan, and it uses the difference between the without plan and with plan conditions for each of the catagories of effects. Appraisal is the process of assigning social values to the technical information gathered as part of the assessment process. This appraisal includes setting up a system of accounts to determine the relative contribution of each plan to the national economic development, environmental quality, regional development, and social well-being accounts.

The comparison of plans focuses on the differences among the alternative plans as determined during the evaluation phase. The differences are organized on the basis of effects defined by the system of accounts. During the comparison, the Corps is required to designate an NED Plan and an EQ (or an LED (Least Environmentally Damaging)) Plan. The NED Plan is the plan which reasonably maximizes the net economic benefits; while the EQ (or LED) Plan is the plan which most enhances or does the least damage to the environment. The comparison phase will often require some type of trade-off analysis where one plan is not shown to be significantly superior to another.

Table 1 - Characteristics of Measures Considered in the Preliminary Feasibility Study

Item	Flood Warning and Emergency Action	Flood-proofing	Flood Insurance	Floodplain Management	Permanent Evacuation	Sierks Reservoir	Linden Reservoir	Alexander Reservoir	Batavia Reservoir Compound	Batavia Reservoir	Batavia Project Modification	Alabama Reservoir Compound	Clarence-Amherst Diversion Measure
ENVIRONMENTAL QUALITY													
Woody Scrubland Gained or Lost (+ acres)	None	None	None	None	None	Consider. Loss	Consider. loss	-4	-22	-28	Negligible	-105	Some loss
Wetlands Gained or Lost (± acres)	None	None	None	None	None	None	None	-6	- 8	- 6	None	None	None
Natural Channel Bottom Gained or Lost (+ acres)	None	None	None	None	None	- 3	-3.5	Some loss	Some gain	Some gain	Some loss	None	Some loss
Improved Channel Bottom Gained or Lost (± acres)	None	None	None	None	None	None	None	Some gain	Some gain	Negligible	Some gain	None	Some loss
Unvegetated Land Areas Gained or Lost (± acres)	None	None	None	None	None	-20	-5	None	Some gain	Negligible	None	None	None
Revegetated Area Gained or Lost (± acres)	None	None	None	None	None	+10	+10	Some gain	Some gain	Some gain	Some gain	Possible +1540	Some gain
Cultivated Land Gained or Lost (+ acres)	None	None	None	None	None	Some loss	Some loss	Some gain	Consider. gain	Some gain	None	Some gain	Some loss
Pool Environment Gained or Lost (± acres)	None	None	None	None	None	+810	+920	None	None	None	None	+1480	None
Effect on Stream Quality	None	None	None	None	None	Positive	Positive	Positive	Positive	Positive	Negative	Positive	Negative
Effect on Air Quality	None	None	None	None	None	None	None	None	None	None	None	None	None
Effect on Local Wildlife Breeding Habitat	None	None	None	None	None	Negative	Negative	Negligible	Positive	Negligible	Negative	(3)	(1)
Rare, Endangered, or Unique Species Affected	None	None	None	None	None	None	None	None	None	None	Unknown	Blue heron	(1)
Scenic, Recreation, or Wilderness Area Affected	None	None	None	None	None	s.,r.gain;w loss	s.,r.gain;w loss	None	None	None	Unknown	r.gain;s,w loss	None
Historical and/or Archeological Sites Affected	None	None	None	None	None	Unknown	Unknown	None	To be determined	1	Unknown	None	(1)
Effect on Stream Erosion	None	None	None	None	None	Positive	Positive	Positive	Positive	Positive	Negative	Positive	Negative
Mineral Resources Affected	None	None	None	None	None	Maybe salt or natural gas	Maybe salt	None	None	Gravel	None	None	(3)
Effect on Area Water Table	None	None	None	None	None	Positive	Positive	Negligible	None	Negligible	Negligible	Positive	Negligible
SOCIAL WELL-BEING													
Flood Protection													
Residences Protected	None	(1)	None	None	Some	All downstream	All downstream	All downstream	All downstream	All downstream	Some locally	All downstream	Some locally
Businesses Protected	None	(1)	None	None	Some	All downstream	All downstream	All downstream	All downstream	All downstream	Some locally	All downstream	Some locally
Farmlands Protected (acres)	None	(1)	None	None	Some	All downstream	All downstream	All downstream	All downstream	All downstream	None	All downstream	Some locally
Total Flood Damage Reduction (percent)	None	(1)	None	None	Positive	Roughly 38	Roughly 10	29	51	62	14	42	(1)
Effect on Downstream Flooding	None	None	None	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Negative	Positive	Negative
Relocations Required (residences)	None	None	None	None	Neg impact	26	23	8	82	40		9	(1)
Bridge Modifications or Removal	None	None	None	None	None	1	1	None	None	None	None	1	(1)
Roads Severed	None	None	None	None	None	4	2	1	None	1	None	None	(1)
Socially Important Sites Affected (churches, etc)	None	None	None	None	Some	1	1	None	None	None	None	None	(1)
Effect on Public Health and Safety	Minor	None	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
Effect on Available Water Supply	None	None	None	Positive	None	Positive	Positive	None	Positive	Some	Negligible	Positive	None
Effect on Recreation Activities	None	None	None	Positive	Positive	Positive	Positive	Negligible	Positive	Negligible	Negligible	Positive	Positive
REGIONAL DEVELOPMENT													
Loss in Area Tax Base	None	Negative	None	Some	Some	Considerable	Considerable	Some	Negligible	Considerable	Some	Some	Some
Effect on Community Development Patterns	None	Negative	Positive	Negative	Negative	Negative	Negative	Negative	None	Negative	Positive	None	Negligible
Effect on Recreation Developments	None	None	None	Positive	Positive	Positive	Positive	None	Positive	Negative	Negative	Positive	Positive
Effect on Regional Economic Growth	None	Negative	Positive	Negative	Negative	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive

(1) Not determined.
(2) Value is likely low.
(3) Cannot be determined.

After consideration of the various alternative plans and their effects, public input, and appropriate iterations, a plan is selected and recommended.

PRELIMINARY ANALYSIS AND SCREENING OF ALTERNATIVE PLANS

There are a series of preliminary screenings of alternative plans that take place in the initial stages of the planning process. These screenings help to reduce the number of plans which must be carried all the way through the process, thereby making resources available to investigate the most promising plans in greater detail. There are three major types of alternative plans that have been investigated for the Tonawanda Creek Watershed. These three types are: nonstructural measures; structural-local protection measures; and structural-regional protection measures. Table 1 gives a comprehensive examination of all measures considered during the Preliminary Feasibility Study. Locations of the structural plans considered in the study are shown on Plate 3.

Several plans were dropped from further consideration because of their failure to adequately comply with the planning objectives and criteria. The Sierks and Linden Reservoirs were dropped because they individually did not provide an appreciable level of protection. The Alabama Reservoir was dropped because it provided no protection to the city of Batavia, and had significant environmental impacts. The Clarence-Amherst Diversion did little to solve the regional flooding problem and had some negative environmental impacts, and was, therefore, dropped from further consideration. The plans which were carried through for further analysis are: the Nonstructural Base Plan; the Batavia Project Modification Plan; the Alexander Reservoir Plan; the Batavia Reservoir Plan; and the Batavia Reservoir Compound Plan. Note that although some of the local protection projects had benefit-cost ratios above 1.0, their flood management capability was highly localized and did not sufficiently reduce average annual flood damages in the watershed in order to be considered as the only solution to the flooding problem.

ALTERNATIVE PLANS TO BE EVALUATED

This paragraph will introduce and explain the initial screening of those plans which were carried forward for Final Feasibility analysis. This discussion includes three plans which were not mentioned in the previous pargraph. In the beginning of this study, three possible reservoir combination plans had not been investigated: the Sierks Reservoir-Linden Reservoir Plan; the Batavia Reservoir-Alabama Reservoir Compound Plan; and the Seirks Reservoir-Alabama Reservoir Plan. These three plans along with a modified Batavia Reservoir Compound Plan, designated the Batavia Reservoir Compound Plan (Modified), were added to the initial screening performed in the Final Feasibility study. The "Modified" Plan was the direct result of public concerns and input.

At the beginning of the Final Feasibility studies, it was determined that there was a need to review the nine plans, and perform an initial screening to narrow the focus of the study to those plans with the most potential merit. Table 2 presents the screening criteria and results of this analysis.

Table 2 - Screening of Plans During Initial Final Feasibility Studies

Criteria	Batavia Project Modification	Alexander Reservoir	Batavia Reservoir	Batavia Reservoir Compound	Sierks Reservoir-Linden Reservoir	Batavia Reservoir-Alabama Reservoir Compound	Sierks Reservoir-Alabama Reservoir
1. Degree of Protection Provided (Erie/Huron Plains)	25-year in parts of Batavia downstream to Bushville (no regional protection).	20-Year/ Incidental.	SPF/50-Year	SPF/50-Year	100-Year/ 1 to 25-Year	SPF/SPF	100-Year/ 200-Year
2. Average Annual Flood Damage Reduction (2)	$199,200	$412,700	$754,200	$882,300	$683,000	$1,295,000	$1,223,800
3. Residual Average Annual Flood Damage (Relative)(2)	$1,223,800	$1,010,300	$668,800	$540,700	$740,000	$128,000	$199,200
4. Benefit-Cost Ratio (100-Year Economic Life at 6-1/8 Percent Interest Rate and 1976 Price Levels)	2.53	1.27	0.99	1.46	0.58	1.19	1.03
5. First Cost (1976 Price Levels)	$1,710,600	$109,505,700	$29,295,200	$20,054,700	$46,969,500	$44,567,700	$50,378,700
6. Average Annual Net Benefit	$199,500	$189,100	-	$616,000	-	$529,200	$90,400
7. Operational Dependability	Good	Excellent	Poor	Excellent	Excellent	Good	Good
8. Flood Damage Effect (Upstream or Downstream)	Significant	Minimal	Minimal	Negligible	Minimal	Considerable	Considerable
9. Environmental Effects (General)	Many relocations including one historic landmark.	Minimal	Detrimental change to land use and local environment. Large acquisition.	Minimal	Minimal	Extensive damage to wetland management area.	Extensive damage to wetland management area.
10. Public Acceptability of the Plan	Benefactors endorse; F&W opposed.	Benefactors endorse.	Affected parties do not endorse.	The plan most people endorsed.	Locals strongly oppose addition of recreation to make multi-purpose.	Affected parties do not endorse.	Unknown; however, opposition expected due to environmental effects.
Reason(s) for Elimination of Plan from Further Consideration (1)	1, 2, 3, 7, 8, 9, and 10	1, 2, 3, and 5	4, 6, 7, 9, and 10	See writeup on this plan.	4, 5, 6, and 10	5, 8, 9, and 10	5, 6, 9, and 10

(1) Reasons are taken from the evaluation and comparison of each plans' set of criteria above.
(2) December 1975 Development Conditions and price level total average annual damages $1,423,000.

Note that seven of the plans were eliminated from further consideration for reasons cited in Table 2. The Nonstructural Base Plan was carried forward in addition to the Batavia Reservoir Compound Plan (Modified).

The elimination of the Batavia Reservoir Compound Plan requires additional explanation. This plan was presented to the public upon release of the Final Feasibility Report in 1976, and was the plan which had the consensus of public support. This plan was later modified and continued into the additional studies which resulted in this Final Feasibility Report. The reasons for modifying the original plan were: the design of the plan proved to be engineeringly unfeasible because of stability problems, because it was found that there was potential for a serious subsurface problem in the vicinity of the lower dam. The modifications made to the original plan were: the location of the lower dam (a new, shorter embankment with the same dam and pool elevation was selected) was moved upstream (compare Plates 4 and 5); the western emergency spillway was removed; and the upper and lower dam embankments were designed for overtopping by floods equaling or exceeding the 100-year flood at the upper dam and 500-year flood of the lower dam. Although the original Batavia Reservoir Compound Plan and its modified version were not compared on an equivalent cost basis, the modified plan is believed to be proportionately cheaper due to the reduction in embankment length for the lower dam. The modified plan is also a more stable design, because unknowns which had not been resolved at the time the Batavia Reservoir Compound Plan was developed have since been resolved. The Batavia Reservoir Compound Plan (Modified) will be discussed in more detail in the remainder of this section and the next.

ALTERNATIVE 1 (NO ACTION)

a. Description. The No Action Alternative would not solve any of the planning objectives. The primary planning objective of reducing present and future urban and agricultural damages would not be attained, and significant average annual damages would continue and increase over time. Environmental degradation of the creekbed areas would continue unchecked with frequent landslides in downstream areas, and consequent erosion/deposition problems. The primary Social Well-Being criteria of improving health and human safety would not be achieved. The No Action Plan should, therefore, only be selected in the event that no plans for flood management were feasible, or if no feasible plan were socially acceptable.

b. Comparative Evaluation of Key Criteria.

(1) NED Criteria - In the without project condition, the average existing annual flood damages of nearly $3,000,000 would continue. In addition, because of the projected increase of residential use of downstream areas, the potential exists for flood damages to increase significantly in the future. The primary planning objective, to reduce urban and agricultural flood damages in the study area, would not be realized. Other criteria which could not be enhanced in a without project situation are: increased employment of unemployed or underemployed labor resources in the study area;

increased use of farmlands; and reducing the future floodproofing costs in the study area.

(2) EQ (or LED) Criteria - If no action is taken, the present degradation of the environmental, as well as the aesthetic qualities of the natural channel, is expected to continue and potentially increase over time due to urbanization. Erosion/deposition, flood-related landslides, and degradation of water quality are expected to occur in a similar manner. It is unlikely that the No Action Plan would result in any significant impacts to the preservation of wetland areas, or to the preservation of historic or cultural sites within the study area.

A Least Environmentally Damaging (LED) Plan may or may not be identified depending on the nature of the recommended plan and the completeness of the mitigation for it. An LED Plan would be recommended in the event that all plans produced net negative environmental impacts when compared to the without plan condition.

(3) RD Criteria - The without project condition is projected to have a no-net-impact or a negative impact for the following criteria: employment in the region; output of goods in the region; and per capita income. Some industry may be forced to relocate or shut down because of the frequent flooding problem, and the presently unusable valuable flood plain farmland will remain in that condition. This may decrease employment opportunities and per capita income, and result in a reduction of the output of both industrial and agricultural goods.

(4) SWB Criteria - In the without plan condition, the present hazardous condition would continue with regard to human health and safety. The present flooding conditions would continue with natural effects on upstream and downstream areas. For example, debris jams have occured in the past which can cause an increase in upstream water elevations, as well as increase the risk to downstream areas if the debris jam should suddenly break up.

ALTERNATIVE 2 (NED/RECOMMENDED PLAN)

a. Description. The NED/Recommended Plan is the Batavia Reservoir Compound Plan (Modified) (BRC-M Plan) with the reservoir dams designed to Probable Maximum Flood (PMF) design standards (see Plate 5). This plan provides a high degree of flood damage reduction, maximizes net benefits, and provides a high degree of safety from project failure. The benefit-cost ratio for the plan is 1.19 with average annual net benefits of $541,100. The first cost of this plan would be $29,000,000, with $2,458,000 in interest and amortization, and $420,000 in operation and maintenance costs for a total of $2,878,000 in average annual costs. The total present and future average annual benefits of the recommended plan derived from reduction in agricultural and urban flood damages is $3,419,100. The system of accounts is shown in Table 3.

Table 3 - Accounts for Alternative Plans 1/

Account		No Action: Floodlands	No Action: Rest of Nation	Non-Structural Base Plan: Floodlands	Non-Structural Base Plan: Rest of Nation	Sierks Reservoir - Linden Reservoir: Floodlands	Sierks Reservoir - Linden Reservoir: Rest of Nation	Sierks Reservoir - Alabama Reservoir Compound: Floodlands	Sierks Reservoir - Alabama Reservoir Compound: Rest of Nation	Alexander Reservoir: Floodlands	Alexander Reservoir: Rest of Nation
NATIONAL ECONOMIC DEVELOPMENT											
Average Annual Benefit											
Flood Damage Reduction		None	None	$775,800	None	$1,038,900	None	$1,866,900	None	$623,800	None
Use Intensification		None	None	None	None	18,600	None	367,700	None	12,400	None
Development Cost Savings		None	None	None	None	200,800	None	524,200	None	136,000	None
Construction Employment		None	None	$176,800	None	474,900	None	524,900	None	111,900	None
Total		None	None	$952,600	None	1,733,200	None	$3,283,700	NOne	$884,100	None
Average Annual Costs											
Interest and Amortization		None	None	N.D.	N.D.	Minor	$ 2,883,900	Minor	$ 3,093,300	N.D.	N.D.
Operation, Maintenance & Repair		None	None	$115,000	None	None	100,000	Minor	100,000	N.D.	N.D.
Total		None	None	N.D.	N.D.	Minor	2,983,900	Minor	$ 3,193,300	N.D.	N.D.
Average Annual Net Benefit		None	None	None	None	None	None	$ 90,400	None	$189,100	None
ENVIRONMENTAL QUALITY											
Land											
Soils Utility	(2,3,4,6,8,9)	Impaired	N.A.	N.A.	N.A.	Enhanced	Enhanced	Enhanced	Enhanced	Enhanced	N.A.
Physiography	(1,9)	N.C.	N.C.	Slight.chg	N.C.	N.C.	Mod. chgd.	Mod. chgd.	Mod. chgd.	Slight.chgd	N.C.
*Air Quality	(1,9)	N.C.	N.C.	Decreased	N.C.	N.C.	Decreased	Decreased	Decreased	Decreased	N.C.
*Water Resources											
Groundwater											
Water Table	(2,3,5,11)	N.C.	N.C.	N.C.	N.C.	N.C.	Raised	Raised	Raised	N.C.	N.C.
Quality	(2,3,6,11)	N.C.	N.C.	N.C.	N.C.	N.C.	Increased	N.C.	Increased	N.C.	N.C.
Surface Water											
Stored											
Acreage	(2,3,6,8,11)	N.C.	N.C.	N.C.	N.C.	N.C.	1,730 gained	1,500 gained	1,200 gained	N.C.	N.C.
Volume	(2,3,6,11)	N.C.	N.C.	N.C.	N.C.	N.C.	Increased	Increased	Increased	N.C.	N.C.
Quality	(2,3,6,11)	N.C.	N.C.	N.C.	N.C.	Increased	Increased	Increased	Increased	N.C.	N.C.
Streams											
Supply	(2,3,5,11)	N.C.	N.C.	N.C.	N.C.	Increased	N.C.	Increased	N.C.	N.C.	N.C.
Quality	(2,3,5,11)	N.C.	N.C.	N.C.	N.C.	Increased	N.C.	Increased	N.C.	Slight.inc.	N.C.
*Ecosystems											
Floral Resources											
Natural											
Woodland Acreage	(1,6,8,9)	N.C.	N.C.	N.C.	N.C.	N.C.	500 destroyed	N.C.	600 destroyed	Slight.dec.	N.C.
Wetland Acreage	(1,6,8,9)	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	3,000 encumbered	N.C.	Slight.dec.	N.C.
Cultivated											
Grassland Acreage	(1,6,8,9)	N.C.	N.C.	Slight.dec	N.C.	N.C.	2,000 destroyed	N.C.	1,000 destroyed	Slight.inc.	N.C.
Cropland Acreage	(1,6,8,9)	N.C.	N.C.	N.C.	N.C.	N.C.	800 destroyed	N.C.	400 destroyed	N.C.	N.C.
Faunal Resources											
Fish	(2,3,4,5,9)	Impaired	N.A.	Impaired	N.A.	Enhanced	Enhanced	Enhanced	N.A.	Enhanced	N.A.
Other Aquatic Wildlife	(1,2,3,5,9)	Impaired	N.A.	Impaired	N.A.	Enhanced	Enhanced	Enhanced	N.A.	Enhanced	N.A.
Terrestrial Wildlife	(1,2,3,5,9)	Impaired	N.A.	Impaired	N.A.	Impaired	Impaired	Impaired	N.A.	Enhanced	N.A.
SOCIAL WELL-BEING											
Cultural Resources											
Archaeology	(2,3,4,9)	Impaired	N.A.	Impaired	N.A.	Enhanced	N.A.	Enhanced	N.A.	Enhanced	N.A.
Educational Opportunity	(2,3,4,11)	Impaired	N.A.	Impaired	N.A.	Impaired	N.A.	Impaired	N.A.	N.A.	N.A.
Recreational Opportunity	(2,3,5,10)	Impaired	N.A.	Impaired	N.A.	Enhanced	Enhanced	Enhanced	Enhanced	Enhanced	N.A.
*Aesthetics	(1,2,3,5,9)	Impaired	N.A.	Impaired	N.A.	Enhanced	Enhanced	Enhanced	Enhanced	Enhanced	N.A.
Health and Welfare											
*Families Protected	(1,6,8,9)	None	None	[illegible]	None	Roughly 3,115	None	Roughly 4,851	None	Roughly 2005	None
*Community Cohesion	(1,5,9)	N.A.	N.A.	Impaired	N.A.	Enhanced	Enhanced	Enhanced	Enhanced	Enhanced	N.A.
*Community Growth	(1,5,11)	N.A.	N.A.	Impaired	Enhanced	Enhanced	Enhanced	Enhanced	N.A.	Enhanced	N.A.
*Noise	(1,5,9)	N.C.	N.C.	Increased	N.C.	N.C.	Increased	Increased	N.C.	Increased	N.C.
REGIONAL DEVELOPMENT											
Social Effects											
Population Growth	(2,3,4,9)	N.A.	N.A.	Impaired	N.A.	Enhanced	Impaired	Enhanced	N.A.	N.A.	N.A.
Population Distribution	(2,3,4,9)	N.A.	N.A.	Impaired	Enhanced	Enhanced	Enhanced	Enhanced	N.A.	Slight.imp.	N.A.
*Effects on Man-Made Resources											
Housing	(1,6,7,9)	N.C.	N.C.	[illegible] relocated	N.C.	N.C.	49 relocated	9 relocated	26 relocated	8 relocated	N.C.
*Public Buildings	(1,6,7,9)	N.C.	N.C.	Included above	N.C.	N.C.	1 relocated	1 relocated	N.C.	N.C.	N.C.
Recreation Facilities	(1,2,3,5,9)	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	1 encumbered	N.C.	N.C.	N.C.
Roads	(1,6,7,9)	N.C.	N.C.	N.C.	N.C.	N.C.	4 severed	N.C.	4 severed	1 severed	N.C.
*Farms	(1,6,7,9)	N.C.	N.C.	N.C.	N.C.	N.C.	11 relocated	N.C.	7 relocated	N.C.	N.C.
*Non-farm Businesses	(1,6,7,9)	N.C.	N.C.	Included above	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.
Economic Effects											
*Property Value	(2,3,5,9)	Decreased	N.C.	Decreased	N.C.	N.C.	Increased	Increased	N.C.	Increased	N.C.
*Property Tax	(2,3,5,9)	N.C.	N.C.	Increased	N.C.	N.C.	Increased	N.C.	Increased	Slight.inc.	N.C.
*Employment	[illegible]	N.A.	N.A.	Enhanced	N.A.	Enhanced	N.A.	Enhanced	N.A.	Slight.enh.	N.A.
Income	[illegible]	N.A.	N.A.	Enhanced	N.A.	Enhanced	N.A.	Enhanced	N.A.	Slight.enh.	N.A.
*Public Services	(2,3,4,11)	N.A.	N.A.	N.A.	N.A.	N.A.	Impaired	N.A.	N.A.	N.A.	N.A.
*Regional Growth	(2,3,4,8,11)	N.A.	N.A.	Impaired	Enhanced	Mod. enhanced	Enhanced	Greatly enhanced	N.A.	Slight.enh.	N.A.

Account	Batavia Reservoir Compound: Floodlands	Batavia Reservoir Compound: Rest of Nation	Batavia Reservoir: Floodlands	Batavia Reservoir: Rest of Nation	Batavia Reservoir - Alabama Reservoir Compound: Floodlands	Batavia Reservoir - Alabama Reservoir Compound: Rest of Nation	Batavia Project Modification: Floodlands	Batavia Project Modification: Rest of Nation	Batavia Reservoir Compound (Modified) 2/: Floodlands	Batavia Reservoir Compound (Modified) 2/: Rest of Nation
NATIONAL ECONOMIC DEVELOPMENT										
Average Annual Benefit										
Flood Damage Reduction	$1,343,000	None	$1,132,000	None	$2,087,100	None	$313,600	None	$2,021,800	None
Use Intensification	216,500	None	204,100	None	376,000	None	None	None	1,397,300	None
Development Cost Savings	200,800	None	272,700	None	524,200	None	None	None	None	None
Construction Employment	187,700	None	217,900	None	378,400	None	$ 15,900	None	None	None
Total	$1,948,000	None	$1,826,700	None	$3,365,700	None	$329,500	None	$3,419,100	None
Average Annual Costs										
Interest and Amortization	Minor	$ 1,233,000	Minor	$ 1,798,700	Minor	$ 2,736,500	$ 21,300	$84,700	Minor	$2,458,000
Operation, Maintenance & Repair	Minor	100,000	Minor	50,000	Minor	100,000	$ 25,000	None	Minor	420,000
Total	Minor	$ 1,332,000	Minor	$ 1,848,700	Minor	$ 2,836,500	$ 45,300	$84,700	Minor	$2,878,000
Average Annual Net Benefit	$ 616,000	None	None	None	$ 529,200	None	$199,500	None	$ 541,100	None
ENVIRONMENTAL QUALITY										
Land										
Soils Utility	Enhanced	N.A.	Enhanced	N.A.	Enhanced	N.A.	N.A.	N.A.	Enhanced	N.A.
Physiography	Mod. chgd.	N.C.	Mod. chgd.	N.C.	Consid. chgd	N.C.	N.C.	N.C.	Mod. chgd.	N.C.
*Air Quality	Decreased	N.C.	Decreased	N.C.	Decreased	N.C.	Decreased	N.C.	Decreased	N.C.
*Water Resources										
Groundwater										
Water Table	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.
Quality	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.
Surface Water										
Stored										
Acreage	N.C.	N.C.	N.C.	N.C.	1,500 gained	N.C.	N.C.	N.C.	N.C.	N.C.
Volume	N.C.	N.C.	N.C.	N.C.	Increased	N.C.	N.C.	N.C.	N.C.	N.C.
Quality	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.
Streams										
Supply	N.C.	N.C.	N.C.	N.C.	Increased	N.C.	N.C.	N.C.	N.C.	N.C.
Quality	Increased	N.C.	Increased	N.C.	Increased	N.C.	N.C.	N.C.	Increased	N.C.
*Ecosystems										
Floral Resources										
Natural										
Woodland Acreage	Slight. dec.	N.C.	Slight. dec.	N.C.	Slight. dec.	N.C.	N.C.	N.C.	Slight. dec.	N.C.
Wetland Acreage	Slight. dec.	N.C.	Slight. dec.	N.C.	Slight. dec.	N.C.	N.C.	N.C.	Slight. dec.	N.C.
Cultivated										
Grassland Acreage	Slight. inc.	N.C.	Slight. inc.	N.C.	Slight. dec.	N.C.	N.C.	N.C.	Slight. inc.	N.C.
Cropland Acreage	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.
Faunal Resources										
Fish	Enhanced	N.A.	Enhanced	N.A.	Enhanced	N.A.	Slight. imp	N.A.	Enhanced	N.A.
Other Aquatic Wildlife	Enhanced	N.A.	Enhanced	N.A.	Impaired	N.A.	Slight. imp	N.A.	Enhanced	N.A.
Terrestrial Wildlife	Enhanced	N.A.	Enhanced	N.A.	Impaired	N.A.	N.A.	N.A.	Enhanced	N.A.
SOCIAL WELL-BEING										
Cultural Resources										
Archaeology	Enhanced	N.A.	Enhanced	N.A.	Enhanced	N.A.	Enhanced	N.A.	Enhanced	N.A.
Educational Opportunity	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Recreational Opportunity	Enhanced	N.A.	Enhanced	N.A.	Enhanced	N.A.	Enhanced	N.A.	Enhanced	N.A.
*Aesthetics	Enhanced	N.A.	Impaired	N.A.	Impaired	N.A.	Enhanced	N.A.	Enhanced	N.A.
Health and Welfare										
*Families Protected	Roughly 3,085	None	Roughly 3,085	None	Roughly 4,853	None	Roughly 1,965	None	Roughly 3,[illegible]85	None
*Community Cohesion	Enhanced	N.A.	Enhanced	N.A.	Enhanced	N.A.	Enhanced	Enhanced	Enhanced	N.A.
*Community Growth	Enhanced	N.A.	Enhanced	N.A.	Enhanced	N.A.	Enhanced	Enhanced	Enhanced	N.A.
*Noise	Increased	N.C.	Increased	N.C.	Increased	N.C.	Increased	Increased	Increased	N.C.
REGIONAL DEVELOPMENT										
Social Effects										
Population Growth	Enhanced	N.A.	Enhanced	N.A.	Enhanced	N.A.	N.A.	N.A.	Enhanced	N.A.
Population Distribution	Slight. imp.	N.A.	Impaired	N.A.	Impaired	N.A.	N.A.	N.A.	Slight. imp.	N.A.
*Effects on Man-Made Resources										
Housing	40 relocated	N.C.	82 relocated	N.C.	91 relocated	N.C.	N.C.	N.C.	22 relocated	N.C.
*Public Buildings	N.C.	N.C.	1 relocated	N.C.	1 relocated	N.C.	N.C.	N.C.	N.C.	N.C.
Recreation Facilities	N.C.	N.C.	N.C.	N.C.	1 encumbered	N.C.	N.C.	N.C.	N.C.	N.C.
Roads	1 severed	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	[illegible] severed	
*Farms	3 relocated	N.C.	7 relocated	N.C.	7 relocated	N.C.	N.C.	N.C.	N.A.	N.C.
*Non-farm Businesses	3 relocated	N.C.	5 relocated	N.C.	5 relocated	N.C.	N.C.	N.C.	N.A.	N.C.
Economic Effects										
*Property Value	Increased	N.C.	Increased	N.C.	Increased	N.C.	Increased	N.C.	Increased	N.C.
*Property Tax	N.C.	N.C.	Increased	N.C.	Increased	N.C.	N.C.	N.C.	N.C.	N.C.
*Employment	Mod. enh.	N.A.	Enhanced	N.A.	Enhanced	N.A.	N.A.	N.A.	Mod. enh.	N.A.
Income	Mod. enh.	N.A.	Enhanced	N.A.	Enhanced	N.A.	N.A.	N.A.	Mod. enh.	N.A.
*Public Services	N.A.	N.A.	Enhanced	N.A.	Enhanced	N.A.	N.A.	N.A.	N.A.	N.A.
*Regional Growth	Mod. enh.	N.A.	Enhanced	N.A.	Greatly enh.	N.A.	N.A.	N.A.	Mod. enh.	N.A.

*Section 122 of Public Law 91-611 requires assessment of impacts of alternative plans on this item.
(1) Impact expected [illegible] completely implemented.
(2) Impact expected within 15 years after plan is implemented.
(3) Impact expected [illegible] years after plan is implemented.
(4) Certainty of impact is greater than [illegible] percent.
(5) Certainty of impact is between [illegible] per cent.
(6) Certainty of impact is greater than [illegible] per cent.
(7) [illegible]
(8) Impact partly is monetized in N.E.D. account.
(9) Impact caused by plan.
(10) Impact caused by extra plan action currently considered.
(11) Impact caused by extra plan not currently considered.
N.A. - Not affected
N.C. - No change
N.D. - Not determined

1/ The Batavia Reservoir Compound (Modified) - costs and benefits were [illegible] per cent interest rate, all other plans were computed at 1976 price levels [illegible] per cent interest rate.
2/ The Batavia Reservoir Compound (Modified) Plan has [illegible] detailed tests [illegible] find. [illegible] other plans would increase, given the same criteria [illegible]

b. Comparative Evaluation of Key Criteria.

(1) NED Criteria - The BRC-M Plan is the plan which reasonably maximizes the National Economic Development benefits when compared to other considered alternatives. This plan maximizes NED benefits and has a benefit-cost ratio of 1.19, based on reductions in present and future urban and agricutltural flood damages. This plan, therefore, meets the primary planning objective of reducing urban and agricultural flood damages in the study area.

The plan, as designed, provides 1 to 10-year protection in the area between the upper and lower dams in the Erie Plain floodlands, 500-year protection to the city of Batavia, and 1 to 10-year protection in the Huron Plain floodland. This plan will, therefore, enhance use of farmlands by reducing the annual flood threat, providing a high level of protection to the city of Batavia, and reducing residential damages in the lower watershed.

During project scoping, numerous constraints limited potential project designs in terms of the level of protection offered. It was determined during plan formulation that two reservoirs in series would afford significant protection to Batavia, the agricultural community, and to a lesser extent urban downstream areas. Flood control works in the lower watershed previously considered were not feasible because of significant environmental impacts at state and national wildlife protection areas, significant induced damages along Tonawanda Creek due to the required levees, lack of benefits to the upstream city of Batavia, and impacts to the Tonawanda Indian Reservation. These factors focused attention on a civil works project upstream of Batavia.

The area upstream of Batavia offer prime and unique farmlands which were a major concern while identifying the problems and needs in plan formulation. It was a major concern of the community, state, and Corps to minimize any adverse impacts on these farmlands. Consideration of a single flood retention structure immediately above Batavia was dismissed during early study stages because it did not meet study objectives, and it would remove significant amounts of prime agricultural lands from production. However, a tandem reservoir scheme would significantly reduce high frequency flooding in portions of the Lower Reservoir during the growing season by storing water in the Upper Reservoir area.

In general, net benefits are affected by changing either the size of the facilities or further refining the operation policy. During plan formulation, the operation policy was held constant while the facility sizes were varied and evaluated. Physical and social constraints were the primary factors resulting in the selection of the final configuration for the Upper and Lower Reservoirs of the Batavia Reservoir Compound modified. Among these considerations were topography, road network, and upstream communities.

The spillway crest elevation of the Upper Reservoir at 922.5 feet NGVD (National Geodetic Vertical Datum, 1929) was based upon the maximum practical water surface elevation with freeboard requirements in order that the pool

would not seriously affect the community of Alexander. This resulted in the selected size since a decrease in crest elevation would not result in a significant reduction in length, but would adversely affect the available storage which is only 1.2 inches at 922.5 feet NGVD. Based on this, it was inferred that the incremental cost of the selected plan is significantly less than incremental benefits.

The spillway crest elevation of 900.0 feet NGVD for the Lower Reservoir was similarily developed. At higher crest elevations, the length of the training dikes would significantly increase until the Lower Reservoir assumed the shape of a "three-sided box". Additionally, with a high embankment, the riprap would have to be increased and safety may become an issue. Increasing the crest height would not substantially increase the downstream benefits but would geometrically increase the cost of the project. Thus we inferred that a higher crest elevation was not incrementally justified. To obtain additional benefits downstream, it would be necessary to have other project features in the downstream area. Lowering the spillway crest would reduce the protection without a significant decrease in dam length. Hence the spillway crest was set at elevation 900.0 feet NGVD in order to maximize (within the given topographic information of ten feet contours) the available storage with minimum dam length. The Lower Reservoir has a storage capacity of 1.7 inches at the spillway crest elevation of 900.0 feet NGVD.

(2) EQ Criteria - The BRC-M Plan will have some environmental impacts. The actual locations of the earthen embankments will destroy the wetland and terrestrial habitat beneath them. There will be minor effects in the dry reservoir areas due to clearing and snagging of the existing channel and some possible sedimentation. A mitigation plan has been developed to mitigate for all these losses. Recreational resources would be enhanced because the creek would be cleared of snag and debris jams for a 13-mile stretch. This will enhance canoeing opportunities that are currently poor due to the numerous portages required around snag areas. This plan would reduce the potential for flood-related erosion and landslides downstream, thereby enhancing the land and water resource.

(3) RD Criteria - This plan has the potential to meet all three RD criteria. Employment is enhanced because industries will continue operation and new industries may be attracted to the area. The output of goods is increased in relation to the industrial growth and agricultural intensification of valuable flood plain farmland. The growth in per capita income can be foreseen from these other two criteria.

(4) SWB Criteria - The NED Plan will provide a suitable level of protection to ensure human safety. The plan will provide 500-year protection in the city of Batavia and downstream on the remainder of the Erie Plain, and 1 to 10-year protection on the Huron Plain floodlands. This degree of protection will enhance human health by reducing frequent floods which promote disease and health hazards. This project will limit flooding to the pre-project condition everywhere but in the two reservoir pools where the floodwaters will be retained for a longer period of time than would occur naturally. Twenty-two residential properties in the upper and lower reservoirs will have to be acquired for this plan. Portions of the roadway along Creek Road and Old Creek Road will be raised to provide access to residences located on high ground adjacent to the flood pool.

ALTERNATIVE 3 (NS/LED PLAN)

a. Description. The Nonstructural Base Plan (N-SB Plan) is actually a combination of five nonstructural measures. These measures are flood warning and emergency action, floodproofing, flood insurance, flood plain management, and permanent evacuation. The plan has a first cost of $21,180,000 at 1976 price levels with average annual costs of $1,415,400 and annual benefits of $952,600. This plan has a benefit-cost ratio of 0.67, and reduces tangible average annual damages by 35 percent. It would provide 100-year degree protection for 4,647 individual and commercial sites, but it provides no protection for farmlands. Residual average annual damage would be very high.

This plan has also been selected as the Least Environmentally Damaging (LED) Plan. An LED Plan may be selected in lieu of a true EQ Plan in the case where a positive net contribution to the EQ account cannot be confirmed for any of the plans considered in detail. Of the detailed plans considered, only the N-SB Plan has no net effect on the environment and is, therefore, designated the LED Plan. All the other plans have impacts associated with their construction.

b. Comparative Evaluation of Key Criteria.

(1) NED Criteria - The N-SB Plan does produce a small amount of benefits by providing 100-year degree protection for residences and commercial sites in the flood plain. The total reduction, however, is small by comparison to other measures, and no net benefits are realized. This plan would not have any positive effect on use of farmlands or in reducing future floodproofing costs. It may contribute in some minor way to employment of unemployed resources because of: the work required to implement such a plan; and the protection of businesses which may expand in the future.

(2) EQ Criteria - The N-SB Plan has no net effect on wetlands and the environment when compared to the without project condition. It reduces damages, but does not change the landscape. For this reason, and the fact that all strucural plans have negative impacts on the environment, it has met the test of the LED Plan.

(3) RD Criteria - The N-SB Plan may have the potential for a very small improvement in RD criteria, assuming industries presently located in the flood plain would expand because the flood threat is reduced because of floodproofing or relocation. This effect is judged to be minimal when compared to other alternative plans. This plan provides no protection to affected agricultural lands.

(4) SWB Criteria - The N-SB Plan would help protect human well-being with a safe level of protection in areas within the 100-year flood plain. There would be a partial reduction in hazards to human health in that basements and homes would not be flooded, and sewers would have check-valves to keep them from backing up. The health hazard associated with the flooding of septic tanks and fields would still exist. Flood damage effects caused by this plan would not be measurable. Relocation of properties (flood plain evacuation) would be considered on the case-by-case basis of economic feasibility.

The effect this plan has on social well-being is significant because of the number of relocations required by permanent evacuation of the flood plain.

SECTION 4 - THE RECOMMENDED PLAN

RECOMMENDED PLAN SETTING

The proposed dam sites are located in the towns of Batavia and Alexander, Genesee County, NY (see Plate 5). This area is located within the Erie-Ontario Plain. The two dams are about 15 feet (upper dam) and 10 feet (lower dam) high, above the relatively flat to gently rolling topography adjacent to them. Because of the flat topography, the dam embankments are very long relative to their height, and, approximately 1 mile long.

BASIC HYDROLOGY OF THE TONAWANDA CREEK WATERSHED

The Tonawanda Creek Watershed encompasses and area of 648 square miles, wholly in Western New York State. Plate 1 shows the location of the study area within the State and the numerous tributary drainage areas within the Tonawanda Creek Watershed. Tonawanda Creek flows from its source in the Cattaraugus Hills in Wyoming County, through deep valleys with steep slopes, northward for approximately 22 miles to Attica. From there the creek passes through flat bottom land, with limited channel capacity, to Batavia. Turning westward at Batavia, the creek winds its course through more level terrain. The channel is often insufficient; the creek flows sluggishly and often floods extensively during periods of high flow. Ledge-Murder Creek is the principal tributary emptying into Tonawanda Creek between Batavia and Rapids, NY. Below river-mile 11.2, Tonawanda Creek forms a portion of the New York State Barge Canal and continues to the Niagara River. This reach, as part of the Barge Canal system, has an improved channel with flood discharges usually flowing well within the channel. A large portion of the lower watershed drains within this reach. Mud Creek enters immediately upstream of the Barge Canal confluence. Ransom-Black-Gott Creek enters just below this confluence. Ellicott and Bull Creeks join the mainstream near Tonawanda's confluence with the Niagara River. Flood management needs for Ellicott and Bull Creeks are independent of those in the remainder of the watershed, and studies of those needs have been accomplished separately, resulting in a study area of 511 square miles.

There have been 12 climatological stations located in or adjacent to the Tonawanda Creek Watershed. Of these 12, only eight are still in operation, including the Weather Bureau First-Order station at the Buffalo International Airport. The average annual precipitation for the 12 stations (through 1966) is 36.92 inches. Monthly averages vary from a minimum of 2.53 inches in February to a maximum of 3.33 inches in May. The average annual snowfall for the 12 stations (through 1966) is 82.3 inches.

According to records, most of the floods in the Tonawanda Creek Watershed have been caused by melting snow with moderate amounts of rainfall rather than rainfall alone. The magnitude of a snowmelt flood is highly dependent upon the amount of snowpack, and the magnitude and temporal variation of temperature. During the March 1960 flood, only 0.2 inch of rain fell over the basin. With temperatures reaching 66°F, the 5.2 inches of water-equivalent snow melted rapidly resulting in the flood of record. During the March 1978

flood, however, with maximum daily temperatures reaching only 45°F, the 2.4 inches of water equivalent of snow melted slowly with minimal flooding. The orientation of the watershed with respect to the usual direction of travel of frontal systems in this area also influences the effect of rainfall on runoff. Tonawanda Creek below Batavia flows generally westward, and frontal system direction is typically from west to east. An examination of streamflow records for the Tonawanda Creek at Alabama gage for the period 1922 through 1977 revealed 84 flows above the bankfull stage of 12 feet. Of these, 75 occurred during December through April, with nine occurring during the remainder of the year.

The 1960 flood of record was calculated to have a 30-year recurrence interval for the Erie Plain floodlands, and a 10-year recurrence interval for the Huron Plain floodlands. The estimated damages for this flood using 1975 level of development and prices was $5,640,000, and does not include agricultural damages. Additional information on the hydrology and hydraulics of the watershed can be found in Appendix A.

DISCHARGE FREQUENCY ANALYSIS

Peak discharge-frequency and discharge-duration-frequency analyses were used in the design of the flood attenuation structures in the recommended plan. Table 4 gives hydrologic data on some of the peak discharges on Tonawanda Creek at Batavia along with the recurrence interval on both the Erie and Huron Plain floodlands. Plate 6 presents the peak discharge-frequency curves for the area downstream of Batavia.

HYDRAULIC CHANNEL CAPACITY OF TONAWANDA CREEK AND ITS TRIBUTARIES

It is imparative that the channel capacity of flood control reservoirs is adequately investigated and considered in sufficient detail to allow the establishment of sound project formulation and evaluation criteria. For Tonawanda Creek and its tributaries, channel capacities were determined from stream gage records and field observations. The sum total of data collected helped to develop a range of channel capacities for all reaches to be established with the lower values used during the reservoir operation studies in order to not overstate the benefits attributable to the operation of the considered reservoirs. The adequacy of the field data precluded the need for an expensive backwater analysis.

Table 5 lists the channel capacities for the various tributary reaches within the Tonawanda Creek Watershed. The locations of these reaches can be found on Plates Ala-Ald in Appendix A. The channel capacities downstream from the upper and lower dams in the recommended plan are 2,000 cfs and 6,000 cfs, respectively.

Table 4 - Hydrologic Data for Major Floods by Tonawanda Creek at Batavia and Alabama

Year	Peak Discharge at Batavia, cfs: Date	RI-Years	Q-cfs	Peak Discharge at Alabama: Date	Q-cfs	RI-Years	Rainfall Inches	Runoff Inches	Snow on Ground, Inches	Temp °F: Max.	Min.
1902	6 July	5.3	5,350 (1)	(2)	(2)	(2)	4.2	(2)	0	(2)	(2)
1916	28 March	24	7,050 (1)	(2)	(2)	(2)	0.4	(2)	(2)	58	40
1942	17 March	9	6,000 (1)	(2)	6,860 (1)	6.3	1.5	(2)	(2)	59	33
1956	7 March	13.9	6,480	8 March	6,850	6.3	2.5	1.9	1-2	46	22
1957	23 January	9.4	6,090	24 January	6,180	3.9	1.8	2.1	12-18	55	12
1959	22 January	4.8	5,230	23 January	9,000 (6)	31.3	1.5	1.7	12-18	52	12
1960	31 March	29	7,200	31 March	7,980	13.3	0.2	3.3	23 (3)	61	33
1977	25 September	4.2	5,120	26 September	5,020	2.2	7.7	5.5	0	69	56
1978	22 March	1.9	3,800	23 March	3,680	1.3	0.6	3.6	15 (4)	45	31
1979	5 March	6.3	5,570	6 March	4,200	1.5	0.3	3.0	11-18(5)	52	35

(1) Corps of Engineers estimate based on highwater marks and backwater computations.
(2) Unknown.
(3) Average value from snow survey made by Corps of Engineers. Water content of snow was 5.2 inches.
(4) USGS New York Cooperative Snow Survey. March 13-15, 1978.
(5) Based upon NWS records and USGS New York Cooperative Snow Survey taken 5-7 February 1978 and 5-7 March 1978.
(6) This discharge was determined by the USGS from an ice-affected stage.

Table 5 - Tonawanda Creek Channel Capacities

Reach	Approximate Location	Channel Capacity (cfs)
T-1 through T-3	Amherst-Pendleton	10,000-12,000
T-4 through T-7	Clarence-Lockport	4,000-6,000
T-8 through T-10	Newstead-Royalton	3,500-4,500
M-1 through M-6	Mud Creek	200-400
RB-1 through RB-4	Ransom Creek-Black Creek	200-400
T-11 and T-12	Downstream of Batavia	3,200-4,200
B-1 through B-5	Batavia	6,000
T-13	Reservoir Areas	2,000
A-1 through A-3	Alexander-Attica	3,000-5,000

GEOTECHNICAL CONSIDERATIONS

a. General.

The Tonawanda Creek valley between Batavia and Alexander, NY, is largely filled with stratified gravel, sand, and silt. Poorly drained, low-lying areas are typically filled with organic silty alluvium. Some of these organic deposits are more than 3 feet thick (U. S. Soil Conservation Service, 1969) and probably developed in depressions left in glacial outwash.

The topography of the valley north of Alexander is low except for several knobby ridges that were deposited by glacial ice and are composed of stratified, well-sorted sand and gravel. The ridges have as much as 100 feet of relief and are used as borrow areas for sand and gravel. Many low areas adjacent to the ridges are also composed of sand and gravel. These deposits are glacial outwash, inwash to glacial Great Lakes, and alluvium. The lower dam site is located on outwash and beach deposits.

Ground water is relatively close to the surface and is generally encountered within 5 feet of the surface. Water levels are mostly controlled by the stage of Tonawanda Creek. Most soils are very permeable.

The banks of Tonawanda Creek in the project vicinity are low, relatively stable, and composed of fine sand. Their stability is probably due to the low velocities in the stream.

There were two important considerations in siting the dams. The man-made consideration was locating a suitable distance from the two abandoned railroad embankments which cross the reservoir sites in the same general

west-east direction. These embankments were determined to be unsuitable for use as dams because their design, stability, and history were unknown. They may, however, be investigated as a source of borrow material for future projects. The other condition which affected the siting of the lower dam was the proximity of the Clarendon-Linden Fault system to the project site. The seismic knowledge and evaluation is presented in the next paragraph.

b. Seismicity.

Northwestern New York is located in an area classified as a Seismic Risk Zone 3. This is defined as an area where major damage could occur due to seismic activity. The greatest recorded earthquake occurring at Attica, NY, in 1929, had an intensity of VIII on the Modified Mercalli Scale. According to published reports, 251 house chimneys were thrown down and walls were cracked. In a small cemetery east of town, practically every monument went down. Westward of Attica Reservoir, a number of wells went dry; and in the reservoir there was a sudden increase of about 1,000,000 gallons per day without any rain; this flow continued for some days. In Batavia, several house chimneys fell and a small lake overflowed a highway.

The major structural geologic feature in the area is the Clarendon-Linden Fault system. This system forms a 3 to 9-mile wide zone, running in a north-south alignment in the vicinity of the project site. Due to the proximity of this fault system, additional soil testing for liquification potential and design stability of embankments will be performed in future advanced design studies. Future hydraulic analyses will include a dam failure analysis to determine areas flooded and severity of flooding in the event of dam failure.

c. Soils Exploration and Design.

A subsurface exploration program for the Batavia Reservoir Compound Plan (Modified) was performed in May 1979. It consisted of eight soil borings in the proposed alignments of the upper and lower embankments and the training dikes for the lower reservoir. The primary purposes of this program were to determine the character of the foundation materials and the liquification potential of the soils by measurement of their relative density. Soils testing was limited to identification of soils and their moisture content for use in the preliminary design of the structures. Underseepage analyses showed that a positive seepage cut-off is not required.

The upper and lower embankment designs are essentially the same design except for differences in riprap size. The foundation conditions for the stability of the embankments was good. The design cross sections of these low earthen dams for the recommended plan are shown on Plate 7. These embankments have 1 vertical on 3 horizontal side slopes, an impervious core (which may be modified to use on site materials after further analysis), pervious fill, filter zones, and riprap to protect the spillway. Future studies will investigate the stability and economics of other types of spillway protection.

The availability of construction materials was considered. All the necessary materials are available within 30 miles of the project site. The disposal of

spoil materials from stripping, clearing and grubbing, and excavation will be in landfills or buried on-site.

DESIGN CRITERIA

a. General. Some treatment of design elements for the recommended plan have been mentioned in previous paragraphs of this section. They have dealt with the foundation, embankment design, underseepage, and seismic considerations for the two earthen embankments. The paragraphs which follow, present design criteria dealing with dam safety and spillway design, hydrology considerations, and other features of the recommended plan.

b. Dam Safety. A conservative approach was taken in selecting the spillway design flood for the recommended plan. Due to physical and social constraints, the dams for this plan were limited in height and capacity. For this reason, the role these dams could play in flood control was limited to being flood attenuating structures. This means they will hold back water for controlled releases for frequent floods of the 1 to 10-year frequency variety for the lower portion of the watershed. The outlet structures are designed for this high frequency type of operation. In the event of a major flood, these outlet structures do not have sufficient capacity; the dams will be overtopped (100-year event for the upper dam and 500-year event for the lower dam). The spillway runs nearly the entire length of the two dams, except for the nonoverflow sections abuting existing ground. The Probable Maximum Flood (PMF) Design was selected for the Spillway Design Flood (SDF). This conservative approach was selected to provide the maximum degree of dam safety and protect human well-being downstream from the dams. The PMF Design was developed using the following assumptions and criteria:

(1) Both the Lehigh Valley and Conrail Railroad embankments just downstream from the lower dam would be nonexistent during the PMF for riprap design. However, the railroads embankments were assumed to remain in setting the height of the non-overflow sections. This condition results in a higher pool elevation for the PMF in the lower reservoir due to the shift in control from the lower dam to the 5-foot higher Conrail embankment, and hence an accompanying increase in abutment crest elevation.

(2) Weir flow coefficients ranging from 1.1 to 3.0 were used for spillway rating curve development.

(3) The Probable Maximum Flood was used for the Spillway Design Flood.

(4) Gated outlet works were located to abutment areas.

(5) The lengths of abutments were increased to minimize potential crossflow problems along the downstream face of each spillway.

(6) Riprap for spillways was resized using Rend Lake model study based upon assumptions (1) through (3). The full range of discharges was considered throughout the PMF.

(7) Toe protection was modified to minimize potential for scour.

Table 6 - Design Features of the Recommended Plan

Description	Upper Reservoir	Lower Reservoir
Spillway Design Flood (cfs)		
Inflow	81,200	104,400
Outflow	81,100	104,000 (1)
Controlled	2,000	6,000
Maximum through Culvert	10,700	6,000
Overflow	70,400	96,000
Elevations (USC&GS Datum) and Storages		
Maximum Pool		
Headwater Elevation (feet)	925.7	905.9 (1)
Tailwater Elevation (feet)	919.0	900.9 (2)
Storage (inches)	1.8	3.8
Flood Control		
Headwater Elevation (feet)	922.5	900.0
Tailwater Elevation (feet)	910.9	893.9
Storage (inches)	1.2	1.7
Channel Bottom Elevation Near Dam (feet)	900.0	880.0
Outflow Section		
Riprap size (inches) - Upstream	18.0	18.0
- Downstream	36.0	18.0
Crest Elevation (feet)	922.5	900.0
Length (feet)	4,500	4,000
SDF Unit Discharge (cfs/feet)	18.0	26.0
Nonover Flow Section		
Dam Abutment		
Elevation (feet)	930.0	910.0
Length (feet) - Left	1,675	160
- Right	1,260	1,770
Training Dikes		
Elevation (feet)	None	910.0
Length (feet) - Dike "a"	None	1,650
- Dike "b"	None	200
- Dike "c"	None	840
- Dike "d"	None	3,670
Culverts and Sluice Gates		
Invert Elevation (Inlet and Outlet at Same) (feet)	900.0	880.0
Height and Width (feet)	11 X 11	11 X 11
Number (3)	5	4
Location	Nonoverflow Section/left abutment	Nonoverflow/ right abutment
Stilling Basin (4)	Yes	Yes
Contributing Drainage Area (square miles)	102	171
Channel Capacity Downstream from Dam (cfs)	2,000	6,000

(1) LVRR and Conrail embankments remain.
(2) LVRR and Conrail embankments out.
(3) Includes one spare gate.
(4) Concrete Basin with end sill and baffle blocks.

(8) O&M costs were increased for hydromet system and personnel costs for project operation.

Plates 7a and 7b present the PMF Design cross sections for the two dams. The gated cutlet works in the lower dam are in the right abutment for the PMF Design. For specific dimensions of abutments, training dikes, and riprap, refer to Table 6.

c. Hydrology Considerations. The Batavia Reservoir Compound (Modified) is located in the upper portion of the Tonawanda Creek Watershed. The drainage areas upstream of the upper and lower dams are 102 and 171 square miles, respectively. The elevation of the upper dam spillway is 922.5, and the elevation of the lower dam spillway is 900.0. The upper dam stands a maximum of 15 feet above the surrounding flood plain, while the lower dam stands a maximum of 10 feet above its surrounding flood plain. The elevations of the upper and lower spillways provide for 6,750 acre feet (1.2 inches of runoff) and 15,500 acre feet (1.7 inches of runoff) of storage, respectively. Any additional runoff will overtop the spillways on the dam structures. During a PMF, the water depth on the spillways will be 3.2 and 5.9 feet (0.9 feet if the railroad embankments are out below the lower dam) for the upper and lower dams, respectively. These higher elevations will increase the storage in the reservoir pools to 1.8 and 3.8 inches, respectively. Because the recommended plan acts as a flood attenuator (like large scale, low-level weirs), the reservoirs will limit flows downstream of the lower dam to actual channel capacity for flood events less than or equal to a 500-year frequency. Flows above this frequency (including the SPF and PMF conditions) will overtop the dams and flow downstream at the same discharge that would occur without the project. In the Huron Plain floodlands downstream of Batavia and Bushville (see Plate 8), flood protection will be at a much lower level due to additional inflows, decreased channel capacities, and the slow moving, meandering nature of the creek in these areas. The depth of flooding will be reduced about 1.5 feet in this area for large floods, and many of the frequent flood events (1 to 10-year) will be accommodated within channel banks.

PLAN DESCRIPTION AND FEATURES

a. General. The Batavia Reservoir Compound (Modified), shown on Plate 5, would consist of two shallow detention reservoirs (normally dry) arranged in series. The plan would require construction of two earth dams, each with its own principal outlet works and emergency spillway, and the lower dam with four training dikes. Snags and debris jams in the channel of Tonawanda Creek within the lower reservoir area would be removed to insure natural channel capacity of approximately 2,000 cubic feet per second, and in the upper reservoir to restore natural channel conditions. The two reservoirs would include a tract of roughly 4,865 acres within the floodland between the village of Alexander and the city of Batavia. More detailed information on the recommended plan is located in Appendix D.

b. Upper Reservoir.

(1) Upper Reservoir Embankment and Emergency Spillway. The upper embankment would be located approximately 200 feet downstream of the Conrail Railroad embankment, formerly the Erie-Lackawanna embankment. The embankment would stretch 7,435 feet across the Tonawanda Creek valley, north of the village of Alexander. The location selected for the embankment has two advantages: the area to be occupied by the embankment is presently cleared of substantial vegetation and its nearness to the existing railroad embankment allows this embankment to blend in with the surrounding area, providing minimum disruption of transportation facilities and land use. The location for the upper reservoir embankment is shown on Plate 5.

The embankment would be designed to function as an emergency spillway with a top elevation of 922.5 in order to satisfy hydraulic requirements for the reservoir. Approximately 3.2 feet of water would flow over the embankment during a Probable Maximum Flood assuming a maximum pool elevation of 925.7.

A typical cross section for the upper embankment is shown on Plate 7a. The section was conservatively developed with 1 vertical on 3 horizontal sideslopes. A conservative development process was followed because of the lack of geotechnical information pertaining to the site. The design of the cross section will be modified when more is known of the existing conditions. A 10-foot top width was utilized for most of the upper embankment in an effort to develop the most cost effective recommendation.

A principal outlet works, consisting of several gated conduits, would be constructed through the upper embankment. The outlet works are discussed in detail in paragraph (2).

A 16-foot wide access roadway would be provided along a portion of the top of the upper embankment. A 20-foot top width would be necessary to accommodate the access road. The access roadway is discused in more detail under paragraph (3)(a).

(2) Principal Outlet Works.

(a) Control Structure - The principal outlet works for the upper reservoir would consist of a control structure, stilling basin, and outlet channel located at or near the intersection of the upper embankment and Tonawanda Creek (see Plate 9).

The control structure would be a five-conduit, reinforced concrete box culvert with adjacent inlet flume. The culvert would have capacity to pass flows of approximately 2,000 cubic feet per second under natural flow conditions and up to approximately 10,700 cubic feet per second under the 100-year flood condition when the upper pool reaches El. 922.5. Each conduit would be 11 feet wide by 11 feet high and equipped with an electrically operable fixed wheel control gate. Each gate would be operated from controls

mounted on the electric gate lift and/or from controls located in the equipment building at the west abutment. A steel sheet pile cutoff wall would be provided under the control structure to reduce groundwater seepage.

(b) Stilling Basin - The stilling basin would be a reinforced concrete structure 61 feet wide and 62 feet long. The basin would be designed to reduce the energy of water discharged from the control structure to within tolerable limits. Baffle blocks and raised end sill would be utilized for this purpose. A profile through the stilling basin is shown on Plate 9.

(c) Outlet Channel - The meandering Tonawanda Creek channel immediately downstream from the upper embankment would be abandoned. A new outlet channel, starting at the stilling basin, would be excavated normal to the embankment in order to provide a gradual transition to natural channel conditions. The outlet channel bottom, flaring from a width of 71 feet at the stilling basin to 91 feet, would be protected with 24-inch riprap placed on a 12-incn bedding layer for a distance of approximately 100 feet. Thence, the channel would be narrowed to 50 feet to form a pilot channel for low flows. The 50-foot wide pilot channel with 1 vertical on 2.5 horizontal sideslopes would extend downstream an additional 1,100 feet to a junction with the existing creek channel. The abandoned creek channel would be used as a spoil area for waste material from clearing and stripping operations associated with the construction of the upper embankment and from clearing and snagging operations along the existing creek channel within the upper and lower reservoirs.

(3) Appurtenances.

(a) Access Roadway - A 16-foot wide access road would be provided across the top of the upper embankment. The roadway would run from State Route 98 to Tonawanda Creek, a distance of approximately 1,800 feet. The roadway would have light-duty bituminous pavement. Guardrails would be installed on both sides of the roadway along the emergency spillway, a distance of approximately 1,500 feet. The access road would provide for operation and maintenance of the principal outlet works.

(b) Miscellaneous Facilities - Electrical service to the principal outlet works would be provided by existing transmission lines along State Route 98 and underground cables laid in conduit along the top of the upper embankment. A 15-foot by 20-foot equipment building of simple design would be located along the access road at the west abutment. A standby electrical generator, capable of operating the principal outlet works, would be located in the equipment building. Appropriate heating, lighting, and communications equipment would be provided.

(c) Clearing and Snagging - The existing Tonawanda Creek channel between Railroad Avenue and the upper embankment would be cleared of snags and debris jams. Dead trees along the channel banks and overhanging, partially uprooted trees would also be removed. This work is expected to restore the creek to a natural channel capacity of approximately 2,000 cubic feet per second near the upper dam, thereby reducing the frequency of minor

flooding. The debris removed form the creek channel would be buried in the abandoned sections of the creek channel downstream from the upper embankment.

(d) Debris Collection - A log boom will be installed upstream of the principal outlet works of the upper dam. The log boom will prevent debris from entering the outlet works that could cause problems in operation of the sluice gates. A debris collector consisting of timber piles will be placed at intervals across the floodway immediately downstream of the upper dam. The Corps of Engineers will be responsible for periodically removing major debris from the channel and adjacent farm fields. Debris removal will be scheduled so as not to disrupt farm operations.

(4) Relocations. The Conrail Railroad and roadways within the boundaries of the upper reservoir would be maintained in their present condition with the following exception: through-traffic on Old Creek Road would terminate at the upper embankment. Minor washouts, requiring post flood maintenance, could be anticipated along the railroad right-of-way and Old Creek Road. The local region near the upper reservoir has sufficient alternate roadways so that only minimal inconvenience to local residents would occur. Existing power and telephone lines within the reservoir would remain in place and are not expected to experience any adverse effects due to the anticipated short duration of flooding. Real estate requirements and the relocation of buildings within the upper reservoir are discussed later in this section.

Downstream from the upper reservoir, a section of Peaviner Road and the existing bridge over Tonawanda Creek would require relocation due to the realignment of the creek channel in the vicinity of the principal outlet works. Approximately 2,000 feet of roadway would be realigned and reconstructed with a light-duty bituminous pavement. A 24-foot wide road with 10-foot shoulders would be provided. A 60-foot span highway bridge would be provided over the new outlet channel from the principal outlet works. The bridge would have reinforced concrete abutments and wingwalls and a precast concrete deck with a bituminous wearing surface.

c. Lower Reservoir.

(1) Lower Reservoir Embankment and Emergency Spillway. The lower embankment would be located between 500 feet and 3,100 feet south of the abandoned Conrail Railroad embankment, formerly the Lehigh Valley embankment. The embankment would stretch 5,930 feet across the Tonawanda Creek valley to within a short distance from the intersection of Route 98 and the abandoned railroad embankment. This represents a major change from the location previously proposed for the Batavia Reservoir Compound. The revised location, selected for the lower embankment, was chosen because of its minimal length and improved foundation conditions. The location for the lower reservoir embankment is shown on Plate 5.

The embankment would be designed to function as an emergency spillway with a top elevation of 900.0 feet from Creek Road westward for approximately 4,000 feet. The emergency spillway is required to satisfy hydraulic requirements for the reservoir. The spillway would be overtopped during a 500-year flood event or greater. Approximately 5.9 feet of water would flow over the

embankment during a Probable Maximum Flood assuming a maximum pool elevation of 905.9. From Creek Road to the east abutment, and for a short distance at the west abutment, the embankment would be designed as a non-overflow section with a top elevation of 910.0 and grassed slopes.

A typical cross section for the emergency spillway of the lower embankment are shown on Plate 7b. The cross section is similar to the upper embankment except for riprap design.

A principal outlet works, consisting of several gated conduits, would be constructed through the emergency spillway section of the lower embankment. The outlet works are discussed in detail under paragraph (2).

A 16-foot wide access roadway would be provided along a portion of the top of the emergency spillway section of the lower embankment. The top width would be increased to 20 feet to accommodate the access road. The access roadway is discussed in more detail under paragraph (3)(b).

(2) Principal Outlet Works.

(a) Control Structure - The principal outlet works for the lower reservoir would consist of a control structure, stilling basin, outlet channel, and inlet channel located approximately 900 feet east of the intersection of the lower embankment and Tonawanda Creek.

The control structure would be a four-conduit reinforced concrete box culvert with adjacent inlet flume. The culvert would have capacity to pass up to approximately 6,000 cubic feet per second under the 500-year flood condition when the lower pool reaches El. 900.0. This corresponds to the maximum allowable channel discharge (6,000 cfs) through the city of Batavia. Design of the control structure is similar to the upper reservoir.

(b) Stilling Basin and Outlet Channel - The stilling basin would be a reinforced concrete structure 48.5 feet wide and 62 feet long. The basin would be designed to reduce the energy of water discharged from the control structure to within tolerable limits. Baffle blocks and a raised end sill would be utilized for this purpose. A new outlet channel, starting at the spilling basin, would be excavated normal to the lower embankment. The 70-foot wide channel with 1 vertical on 2 horizontal sideslopes would extend downstream for approximately 100 feet to a junction with the existing creek channel. The outlet channel bottom, flaring from a width of 48.5 feet at the stilling basin to 70 feet, would be protected with 24-inch riprap placed on a 12-inch bedding layer for its total length. A profile through the stilling basin and outlet channel is shown on Plate 9.

(c) Inlet Channel - The meandering Tonawanda Creek channel immediately upstream from the lower embankment and west of the principal outlet works would be abandoned. A new inlet channel, starting at the inlet flume, would be excavated normal to the embankment in order to provide a gradual transition to natural channel conditions. The 70-foot wide channel with 1 vertical on 2 horizontal sideslopes would extend upstream for approximately 500 feet to a junction with the existing creek channel. The abandoned creek

channel would be utilized as a spoil area for waste material from clearing and stripping operations associated with the construction of the lower embankment and from clearing and snagging operations along the existing creek channel within the upper and lower reservoirs.

(3) Appurtenances.

(a) Training Dike - Several training dikes would be located along the east and west sides of the Tonawanda Creek valley. Along the east side, a dike would stretch 1,650 feet across a natural saddle located approximately 1,000 feet south of East Road. Along the west side, three dikes would be located approximately 500 feet east of Route 98 in the reach between Cookson Road and the former Lehigh Valley Railroad embankment. These dikes would stretch 3,670 feet, 840 feet, and 200 feet across low areas in order to prevent possible overtopping of Route 98. The locations for the training dikes are shown on Plate 5.

Each dike would be designed as a non-overflow section with a top elevation of 910.0 and grassed slopes. The maximum height of these dikes varies from 10.0 to 13.5 feet.

Natural drainage from small areas adjacent to the lower reservoir would be cut off by the training dikes. A gated culvert would be constructed through each dike to provide the required interior drainage. During periods of flooding, the culverts would function in reverse to prevent a flood pool from inundating the area adjacent to the reservoir. The culverts would be positioned in the dikes at natural low points. The culverts would consist of 24-inch to 36-inch diameter reinforced concrete pipe, reinforced concrete headwalls and wingwalls, and automatic flap gates mounted on the resorvoir side of each dike.

(b) Access Roadway - A 16-foot wide access road would be provided across the top of the lower reservoir embankment. The roadway would run from Creek Road to Tonawanda Creek, a distance of approximately 820 feet. The roadway would have light-duty bituminous pavement. Guardrails would be installed on both sides of the roadway along the emergency spillway. The access road would provide for operation and maintenance of the principal outlet works.

(c) Miscellaneous Facilities - Electrical service to the principal outlet works would be provided by existing transmission lines along State Route 98 and underground cables laid in conduit along the top of the lower embankment. A 15-foot by 20-foot equipment building of simple design would be located near Route 98. A standby electrical generator, capable of operating the principal outlet works, would be located in the equipment building. Appropriate heating, lighting, and communications equipment would be provided.

(d) Clearing and Snagging - The existing Tonawanda Creek channel within the lower reservoir would be cleared of snags and debris jams. Dead trees along the channel banks and overhanging, partially uprooted trees would also be removed. This work is expected to restore the creek to a natural

channel capacity of approximately 2,000 cubic feet per second near the upper dam, thereby reducing the frequency of minor flooding. The debris removed from the creek channel would be buried in the abandoned sections of the creek channel downstream from the upper embankment and upstream from the lower embankment.

(e) Bridge Removal - The abandoned Conrail Railroad Bridge, formerly the Lehigh Valley Bridge, over Tonawanda Creek would be removed in order to improve hydraulic conditions downstream of the lower reservoir. The bridge superstructure and abutments would be demolished. In addition, the creek banks adjacent to the abutments would be excavated to stable 1 vertical on 2 horizontal sideslopes.

(4) Relocations - Roadways within the boundaries of the lower reservoir would be maintained in their present condition. Minor washouts, requiring post-flood maintenance, could be anticipated along several of the light-duty roadways within the reservoir. The local region near the lower reservoir is considered to have sufficient alternate roadways so that only minimal inconveniences to local residents would occur. No major east-west highways cross the lower reservoir. Existing power and telephone lines within the reservoir would remain in place and are not expected to experience any adverse effects due to the anticipated short-duration flooding. However, sections of these lines may require relocation after more detailed analysis and consultation with the affected utilities during advanced engineering and design. Real estate requirements and the relocation of residences situated within the lower reservoir are discussed later in this section.

A section of Creek Road in the vicinity of its intersection with the lower embankment would require relocation due to embankment construction. Approximately 500 feet of roadway would be realigned vertically in order to cross over the lower embankment. A 24-foot wide road with 10-foot shoulders and guardrails on both sides would be provided. The roadway would have light-duty bituminous pavement.

d. Environmental Features. There are no specific environmental features identified for the recommended plan. Several archeological sites were identified during the feasibility study, and additional archeological surveys during future study will determine the need for mitigation or recovery during project constuction.

e. Mitigation. A wildlife mitigation plan has been included as part of the recommended project to offset the wildlife impacts associated with the loss of 75 acres of wetland habitat.

The plan involves improvements to the Oak Orchard Game Management Area that would increase the habitat value and wildlife productivity of the area. The Oak Orchard Game Management Area is currently owned and operated by the New York State Department of Environmental Conservation (NYSDEC). The area is about 2,500 acres in size, and is located about 10 miles to the northwest of Batavia, NY. The improvement plan is described in detail in Appendix H, Part 2. It generally consists of raising levees around Goose Pond to roughly double the water storage capacity of the pond. Water from Goose Pond is used

to nourish downstream wildlife (waterfowl) marshes in the game management area. The additional water in the pond will reduce winter fish kill problems and attenuate summer botulism outbreaks in ducks that use the waterfowl marshes.

The estimated construction cost of the mitigation plan is $76,000. Annual maintenance costs would be minimal, about $1,500 a year. The Federal Government would fund the construction of the plan. NYSDEC would own and administer the improvements and fund annual operations and maintenance costs.

f. Recreation Facilities. No specific recreational facilities were added to the recommended plan. The primary reason for this is the functional use of all project lands. The two embankments are functional as spillways and as dams. The flooded lands in the reservoir areas will not be purchased outright. A flooding easement will be purchased so that the land can remain in productive use when flood waters are not present.

The Genesee County Department of Planning has plans to develop a Batavia-Alexander Recreational Trail along the north-south abandoned Erie-Lackawanna Railroad right-of-way. The trail will be open for cross-country skiing, hiking, and bicycling. The proposed trail plans will not be disrupted by the recommended Corps project. The U. S. Department of Interior Bureau of Recreation, in a letter dated 25 June 1976, supported a recreational trail and canoe route to provide access for the public.

g. Real Estate.

(1) Land Acquisition. Land to be used for the upper reservoir would include about 1,223 acres of farmland, wetland, and woodland. Sixty-five acres of this land would be purchased, and flowage easements would be obtained for 1,158 acres. No buildings are located within this tract; however, a maximum of nine residences, one farm, and one business situated in the upper reservoir area might be included within the headwater fringe of floodpools caused by maximum probable flooding. These buildings include town equipment sheds and residences. The residences would be purchased and removed. These buildings comprise all buildings in the vicinity of the upper reservoir susceptible to frequent flood damage.

Land to be used for the lower reservoir would include roughly 2,519 acres of principally farmland, wetland, and woodland. Forty-five acres of land would be purchased in fee title, while flowage easements would be obtained on 2,474 acres in the lower reservoir. Lower reservoir land would be protected by the upper reservoir from flooding of up to a 10-year flood event near the upper dam. Additional flowage easements would be obtained for 1,616 acres in the spillway area downstream of the lower dam.

(2) Acquisition of Buildings. The Final Feasibility Report identified 46 houses, six farms (buildings only), and one commercial building (Alexander Highway Department garages), to be purchased and removed in the upper and lower reservoir areas. This was estimated as a worse case condition. Preliminary investigations have revealed that raising portions of Creek Road and Old Creek Road (3-4 feet) would allow many of the homes to remain by

providing access during a full pool. These homes are presently on high ground above the flood pool but lack access during flood conditions. If the roads are raised, approximately 22 homes would be purchased, and the land will revert back to agricultural use. The buildings on six farms, and the town of Alexander Highway Department garages would not be acquired. This reduction in the number of homes to be purchased resulted in a savings to the first cost of the project, once the cost for the road improvements is added to the first cost. This modification to the real estate acquisition will be investigated in greater detail during the advanced design phase, when detailed topographic maps with full pool outlines are provided and detailed real estate appraisals are completed.

RECOMMENDED PLAN COSTS

The project costs for the recommended plan have been developed and are summarized in Table 7. These costs are based on October 1982 price levels, and 7-7/8 percent interest over a 100-year project life. The total cost of the recommended plan is $29,000,000, operation and maintenance costs are $420,000, and this equates to an average annual cost of $2,878,000. The detailed cost estimate is contained in Appendix D.

A high level of conservatism was adhered to in developing the design configurations and cost estimates for each design. The use of riprap for spillway slope protection is considered to be a very expensive alternative. Other alternatives could include gabions and precast units. It is expected that these and other alternatives will be investigated during advanced design studies with the aid of hydraulic model studies to be performed by the Waterways Experiment Station.

Table 7 - Summary of Estimated Costs for Batavia Reservoir Compound (Modified)

Item	Cost
	$
First Cost	
Real Estate	4,400,000
Construction	24,600,000
Total	29,000,000
Investment Cost	
Real Estate	4,400,000
Construction	24,600,000
Total	29,000,000
Interest During Construction	2,200,000
Total	31,200,000
Average Annual Cost	
Interest	2,457,000
Amortization	1,000
Operation & Maintenance	420,00
Total	2,878,000

Price Level - October 1982, 7-7/8 percent interest over a 100-year project life.

IMPLEMENTATION

The recommended plan for flood management in the Tonawanda Creek Watershed would be implemented over a period of several years. The established procedure requires that this report be reviewed by higher Corps authorities and other concerned Federal, State, and local agencies and then submitted to the Secretary of the Army and Congress. Congress would have to authorize the project and appropriate funds for it before the advanced engineering and design (AE&D) study could begin.

The AE&D study would be conducted in two phases. During the first phase, public interest in the recommended plan would be re-established, and the first phase of a General Design Memorandum (a brief, letter-type Phase I GDM) would be prepared. This report would be reviewed by higher Corps authorities, and if the reviewers still concur in it, then details of the plan would be finalized and reported in the Phase II GDM. Plans and specifications would then be prepared and the construction work would be contracted out and necessary lands purchased. Construction would take approximately 2 years, after which operation of the recommended plan would begin.

Time required for the entire process, is difficult to predict. However, if the plan were authorized and funded without interruptions, construction of the Batavia Reservoir Compound (Modified) could be completed within 4 to 5 years afterward.

OPERATION OF THE RECOMMENDED PLAN

As mentioned earlier in the report, most runoff contributing to flooding within the Tonawanda Creek watershed is shed by the Cattaraugus Hills, upstream from the Erie Plain floodland. Runoff from these hills would flow into the Batavia Reservoir Compound. Flows of Tonawanda Creek would enter the upper reservoir first. Flows of Little Tonawanda Creek would enter the lower reservoir.

Normally, both reservoirs would be dry. Usual flows of both creeks would pass through the reservoirs within their channels. This plan provides for the removal of snags and debris jams in the channel of Tonawanda Creek between the upper and lower limits of the compound. At the present time, these obstructions severely limit the capacity of the natural channel so that even small flows are apt to overtop the banks and cause floods. Removal of these snags and jams would permit smaller flows, which now flood, to pass within channel. The effect of this would be that lands within the compound, even those within the upper reservoir, would be flooded less during small floods which presently cause minimal overbank flooding. Small floods normally occurring during late spring and summer, are caused by rainfall only, and are controlled using a special operation policy discussed in paragraphs A2.35 through A2.38 in the Hydraulics and Hydrology Appendices. Flooding would be lessened in the Lower Reservoir area and, to a minor extent, areas downstream of Batavia because of storage in the Upper Reservoir.

The upper dam would have electrically operated gates that would comprise the principal outlet works. When the floodpool reaches the crest of the emergency spillway (El. 922.5), flow through the gates when fully opened would have a maximum discharge capacity of 10,700 cfs. Whatever excess inflow could not pass through the fully opened gates would then pass over the emergency spillway. Floods with a 100-year recurrence interval would cause the floodpool to reach El. 922.5 with the gates fully opened, and above this elevation the emergency spillway would reach a maximum depth of 3.2 feet. The Tonawanda Creek channel downstream of the dam would have a channel capacity of 2,000 cfs after it has been snagged and cleared of debris. For floods less than 100-year recurrence interval but greater than a 10-year, the gates would be operated to control discharges to 2,000 cfs as long as possible until the upper reservoir is filled. At that time, the gates would be operated to maintain inflow equal to outflows. For floods less than a 10-year recurrence interval, the gates would be operated to minimize downstream flooding.

The lower dam would also have electrically operated gates that would comprise the principal outlet works. When the floodpool reaches the crest of the emergency spillway (El. 900.0) flow through the gates when fully opened would have a maximum discharge capacity of 6,000 cfs. Whatever excess inflow could not pass through the fully opened gates would then pass over the emergency spillway. Flood with a 500-year recurrence interval would cause the floodpool to reach El. 900.0 with the gates fully opened, and above this elevation, the emergency spillway would be overtopped. During a Probable Maximum Flood, outflow over the emergency spillway would reach a maximum depth of about 5.9 feet (assuming the Lehigh Valley Railroad and Conrail embankments remain). During normal summer rainfall events, the gates would remain fully opened. During snowmelt and for floods less than a 10-year recurrence interval, the gates will be operated to minimize damage in the lower watershed.

Land within the upper reservoir would be flooded for a slightly longer duration than it is now, and would be flooded deeper than normal. The upper reservoir area would be flooded for approximately 10 to 12 days for floods up to a 500-year frequency. However, it should be noted that under existing conditions (without the project in place) the same area would also be flooded for approximately the same duration but at a lower elevation. The reservoir

would take only 1-1/2 to 3 days more to drain, than under existing conditions (reference Appendix A).

Land within the lower reservoir would also be flooded less often than now during floods less than a 2-year recurrence interval and for a slightly longer duration for larger floods. The reservoir would drain within 11 days after all floods of up to 500-year frequency. It should be noted that, in general, the lower reservoir would take only 1-1/2 to 3 days more to drain than under existing conditions. However, for small floods that occur primarily in early spring, 2-5 year recurrence interval, the lower reservoir will be filled at a greater depth and approximately 7 days longer.

Effects of the recommended plan on 100-year degree flooding throughout the major floodlands of the study area are shown in Plate 8. Further discussion on the operation of the reservoirs may be found in Appendix A.

OPERATION, MAINTENANCE, AND REPAIR

a. Required Work. Measurements of precipitation and snow-cover, and determinations of soil moisture and its state, would have to be made periodically at selected sites in the Cattaraugus Hills, in order to establish the likelihood and probable degree of possible flooding. This information would be used as the basis for operating the Batavia Reservoir Compound (Modified).

During flooding, the principal spillway gates of at least the upper reservoir would have to be regulated. During major flooding, the spillway gates of both reservoirs would have to be regulated.

All structural components of the Batavia Reservoir Compound (Modified) would have to be maintained as constructed. Necessary work will include: periodic mowing of grassed portions of the lower and training dikes; removal of undesirable vegetation and debris from the various structures; removal of obstructions from the Tonawanda Creek channel within the project limits; and periodic cleaning, lubrication, and painting of metal components of the outlet works.

After major flooding, certain structural repairs, such as the replacement of riprap on the emergency spillway of both dams, might be necessary.

b. Required Organization. Corps of Engineers employees would be used to operate and maintain the Batavia Reservoir Compound (Modified) and to gather the information necessary for its operation. The services of permanent Corps employees, consultants, and contractors would be used as needed to accomplish repair for damaged or deteriorated structures.

c. Operation, Maintenance, and Repair (OM&R). The Batavia Reservoir Compound (Modified) would provide significant regional flood protection by reducing existing tangible average annual flood damages by roughly 74 percent, 20 percent in the Erie Plain that includes the city of Batavia, NY, and 54 percent in the Huron Plain; therefore, in accordance with the Flood Control Act of 1970, it would be operated, maintained, and repaired by the Corps.

The average annual cost for OM&R of the compound would be about $420,000. This estimate is based on OM&R costs for similar Corps of Engineer projects.

d. Data Needs. Continuing additional hydrologic data are necessary to refine and complement the operation procedures for the compound. Stream gages have been reestablished on Little Tonawanda Creek in the hamlet of Linden and on Tonawanda Creek in the village of Rapids. A new stream gage has been established on Murder Creek below Akron. There is a need for the establishment of a stream gage on Mud Creek and the upgrading of all gages to a telemarked status. Approximately four telemarked climatological stations are needed to obtain the necessary data on precipitation, snow pack, and water content, temperature, and radiation. Reservoir stage gages will be needed for both the upper and lower reservoirs.

ECONOMICS OF THE RECOMMENDED PLAN

The benefits which would occur with the recommended plan fall into the two main categories of reducing urban flood damages in residential commercial and industrial portions of the study area and a reduction of agricultural flood damages along the streambank. This allows an increased use of the highly productive Hamlin, Eel, and Genesee silt loams found within the 3-year frequency flood plain.

a. Urban Benefits.

(1) General. The watershed has been divided into 31 damage reaches. Each reach has a dollar value of existing damages that may occur for any year and any specific flood event, that equates to the average annual damage for the reach. Construction of the proposed project will reduce the depth of flooding to provide a specific level of protection. The damages that may still occur above this level of protection are defined as residual damages. Subtracting the residual damages from the total existing damages gives the existing damages prevented by the project of the flood damage reduction benefits.

Construction will result in a total reduction of $640,000 in the tax base of affected communities, towns of Alexander and Batavia. This evaluation most probably overestimates the affect on the tax base of the two communities as it includes: (1) the purchase in fee simple of 110 acres due to construction of the two dams; and (2) the purchase in fee simple of 22 properties. Since most of the latter are expected to relocate in the town in which they presently reside, many if not most will not be loss from the community's tax (assessment) base. The actual loss to the communities' tax base should be considerably less than the above mentioned $640,000.

(2) Existing Condition. This category of urban benefits is directly related to prevention of flood damages in the urban sector, presented in the form of average annual dollars.

Based on damage surveys, contained in Appendix B, flood damages to residential, commercial, industrial, and public property have been determined by estimating the structures lowest physical opening by which water can enter

the building as it relates to depths of water from floods of various magnitudes. The magnitudes of floods range from a less than 1-year flood to a Probable Maximum Flood. Diagrams were derived that indicate the relationship of damage (dollars) to stage (depth of water). The curve's relating stage (depth of water) to frequency (flood occurrence interval) were combined with the stage damage curves to derive the damage-frequency curves. Using mathematical methods to derive the area under the damage-frequency curve, the annual damages were determined ($2,745,300, June 1981 prices). Since this project will not eliminate all floods (i.e., at a maximum, the project provides a 500-year level of protection in the city of Batavia), there will still be some flood damages that could occur (i.e., above the 500-year level of protection) that are termed residual inundation damages ($549,700, June 1981 prices). See Appendix B of this report for more detailed information.

(3) Future Condition. Two categories of urban benefits can be claimed for this project under Future Conditions.

The first category is termed "residential affluence." It refers to the anticipated growth of damages to contents of residential structures on the flood plain at the project's base year (1985). Essentially, residential affluence indicates that as the real income of residents rise through time, the value of the contents of their residences will also rise. Thus, a flood of given magnitude in a given project year will produce greater damages with the passage of time. On Tonawanda Creek, residential affluence produces an estimated $185,000 (October 1982 prices) of average annual benefits.

The second future urban benefit category is $10,900 (October 1982 prices) of average annual benefits resulting from the elimination of the need to floodproof commercial, industrial, and public structures projected to be constructed on the flood plain without the existence of the project (under without plan conditions of development). Since the project will eliminate the need to floodproof these structures, the costs avoided are a benefit which accrues to the project.

(4) Total Urban Benefits. Total urban benefits (October 1982 prices) are the sum of existing and future urban benefits. They are summarized in the following:

Existing Condition	1,825,900
Inundation Damage Reduction	1,825,900
Future Condition	195,900
Residential Affluence	185,000
Floodproofing Costs Avoided	10,900
Total Urban Benefits	2,021,800

b. Agricultural Benefits

(1) General. Agricultural benefits are also divided into two conditions, existing and future. The existing agricultural benefits are derived from the reduction of impaired agricultural productivity and the reduction of other agricultural damages. The existing damages are tabulated for each reach. Then, since the project will not provide complete protection, some damages will still occur above the level of protection. These are termed residual damages. The existing condition benefits, which may be termed inundation damages reduction benefits, are the difference between inundation damages and residual damages.

Future agricultural benefits can also be termed intensification benefits. The intensification benefits are derived from the fact that reduced flooding after project construction will result in a shift of most (67 percent) of the idle agricultural land (land removed from agricultural use since 1968) to agricultural production, shifting most pasture and buckwheat land from low value use to high value use (i.e., from pasture to corn), and increasing farm management practices (fertilizer, herbicides, etc.). The rationale for this benefit derivation is presented in paragraph (5).

(2) Existing Condition. There is only one benefit category for existing agricultural conditions; this is the benefit resulting from elimination of the impaired productivity of agricultural land. For example, corn silage yields increase from 11.9 tons per acre to 17.3 tons per acre. On the Tonawanda Creek flood plain, the impaired productivity primarily results from the very frequent (virtually annual) small floods which occur early in spring, this preventing farmers from planting their crops at dates which would maximum yields. This flood-induced delay in planting causes yields to be less than they should be and, thus, reduces the farmer's gross revenue and net profits. The reduced profit, which is an economic loss, plus physical damages to farm structures, fenses, roads, etc., produces total existing (without-plan) damages. These damages may be considered to be agricultural inundation damages.

In order to measure the existing condition agricultural benefit, it is necessary to combine data on land use by crop, crop yields, and normalized crop prices for crops grown on the flood plain with farm operation schedules and budgets. Total agricultural land on the flood plain amounts to 18,995 acres; this includes 2,790 acres of idle agricultural land.

All of this information was gathered from a variety of sources. Locally, these sources included flood plain farmers, Conservation District personnel (Genesee, Erie, and Niagara Counties), Soil Conservation Service personnel (U. S. Department of Agriculture), and personnel from local offices of New York State's Cooperative Extension Service. At the State level, it includes information from agricultural authorities at Cornell and Ohio State Universities, from the New York State Office of the Soil Conservation Service, and published data from Cornell University.

All of the above information and data were processed in accordance with accepted procedures to produce an estimate of existing average annual agricultural inundation damages. Just as there were remaining (residual) urban inundation damages, there also were residual agricultural inundation damages; the latter were subtracted from the former to produce an estimate of existing average annual agricultural inundation benefits. These amounted to $429,400 in October 1982 prices.

(3) Future Conditions. Future agricultural benefits are intensification benefits. The project will significantly reduce the frequency and magnitude of the flood hazard on the flood plain in the critical early spring period. The previously mentioned agricultural authorities agreed that farmers will respond to the reduced flood hazard in three ways which form the basis for development of agricultural intensification benefits. First, by shifting 1,933 acres of idle agricultural land (land which had been removed from agricultural production since 1968) back into agricultural production. Second, by shifting 1,821 acres of agricultural land from low value use to a higher value use; as for example, shifting land from pasture to corn for silage. Third, by increasing applications of inputs such as fertilizers, herbicides, and installing more drainage tiles, thus increasing yields and profits. For example, with intensified management, corn silage yields will rise from 17.3 tons per acre to 21.3 tons per acre. These changes were projected to occur over a 10-year period from 1985, the project base year, to 1995. The increase in profits from agricultural intensification, minus a projected increase in agricultural residual damages with intensified agricultural land use and practices, discounted over the 10-year transition period, produces $967,900 in average annual agricultural intensification benefits (October 1982 prices). It should be noted that the total amount of agricultural land on the flood plain remains unchanged at 18,995 acres. The distribution between crop and idle agricultural land has changed as has the percent distribution by crop. Idle agricultural land has decreased by 1,933 acres while corn for silage, for example, has increased by 1,940 acres.

(4) Total Agricultural Benefits.

	$
Existing Condition	429,400
Inundation Damage Reduction	429,400
Future Condition	967,900
Agricultural Intensification	967,900
Total Agricultural Benefits	1,397,300

(5) Agricultural Intensification.

(a) General - The three ways of measuring future agricultural intensification benefits are mentioned under paragraph (3) "Future Conditions." The paragraphs which follow derive the rationale for developing these benefits. They discuss the need, the marketing patterns for the products, and a

comparison of the productivity of soil types found along the creek alighment to those in upland areas.

(b) Need - Agricultural activity within the watershed contributes substantially to both the local and regional activity. Within the boundaries of the watershed, farming is the primary industry. Dairy farming is the largest single producer of agricultural revenue in every county in the watershed. In Erie and Niagara Counties, the secondary agricultural emphasis is for truck farming of vegetables for both cannery processing and direct sale to retail outlets and open air markets. On the other hand, the secondary agricultural emphasis in Genesee and Wyoming Counties is on production of field crops, almost all of which go to support the dairy operations.

(c) Marketing Patterns - The truck farming and contract farming activities are extensive, not only in the Tonawanda Creek Watershed, but in the Western New York region as well. Numerous vegetable processing plants purchase crops from regional farmers for national distribution of canned and frozen foodstuffs. Truck farming for local markets also takes place in the Tonawanda Creek Watershed with local farmers producing fresh fruits and vegetables for retail outlets and open air markets in Buffalo, Niagara Falls, Rochester, and smaller regional communities.

A similar marketing pattern is found in the dairy and milk processing industries. The region produces far more milk than can be consumed fresh within a realistic transporting radius. The remaining milk, which is the bulk of the production, supplies a cheese industry which, similar to the truck farming mentioned above, serves a national market.

With the large market area served by both the primary and secondary agricultural activity in the basin, virtually 100 percent of the agricultural production in the basin can be considered a basic crop.

(d) Soil Types - Although there are over 100 different soil types identified throughout the Tonawanda Creek Watershed, there are only seven of significance for agricultural production within and immediately adjacent to the Tonwanda Creek flood plain. These are the Eel silt loam, Genesee silt loam, and Rhinebeck silt loam, typically found in Genesee and Wyoming Counties; and Collamer silt loam with greater than 2 percent slope, Collamer silt loam with less than 2 percent slope, Raynham silt loam and Hamlin silt loam, typically found in Erie and Niagara Counties. Almost without exception, the Hamlin, Eel, and Genesee soils are found adjacent to the streambank and are considered representative of the 3-year flood plain. The Rhinebeck, Collamer and Raynham formations are then immediately adjacent and just outside the 3-year flood plain. The correlation between the 3-year flood plain and soil types is stronger for the Eel-Genesee-Rhinebeck grouping than for the Hamlin-Raynham-Collamer soils.

Records of crop production and soil characteristics gathered by the Soil Conservation Service and documented in the soil survey publications, show increases in productivity for the lower-lying soils of 10 to 60 percent over the adjacent types depending on soils and crops being compared. Generally, the grain crops in Genesee and Wyoming Counties show a 35 to 60 percent

increase (90 percent for wheat) and the vegetable crops averaging 25 to 30 percent increases in Niagara and Erie Counties.

Noting that the more productive soils are adjacent to the stream and generally within the 3-year flood plain, there is an opportunity to take further advantage of this increased production potential by reducing the frequency-duration of flooding on the more productive soils. Returning to the previous example of wheat and tomato cropping, let us make the very realistic assumption that the Hamlin soil field is subject to flooding twice as often as the Raynham field. Tomatoes, being a very flood-intolerant crop, would suffer damages twice as often if planted in the Hamlin field than in the Raynham field. Wheat, being a more flood-tolerant crop would not suffer the drastic consequences of being flooded and would be a more reliable crop to plant in the floodprone Hamlin field.

While not as direct, this type of intensification opportunity is available to the dairy industry. Dairy farmers in the Tonawanda Creek Watershed rely heavily on feed grains grown locally, which does not supply all the needs of the area and significant quantities are imported into the region from Ohio and Pennsylvania. With reduced flood potential on the highly productive soils in the area, not only would the grain farmers benefit from significantly increased crop production but the dairy industry would benefit either from lower costs of feed grains and forage or opportunity for increased production while maintaining a steady level of imported feed grains.

c. Total Benefits. Total benefits (October 1982 prices) are the sum of urban and agricultural benefits. Total benefits are summarized in the following Table 8.

Table 8 - Summary of Total Benefits and Costs, Batavia Reservoir Compound (Modified) (October 1982 Price Level), 7-7/8 Percent Interest Rate

Item	Cost
	$
Existing Condition	
Agriculture	429,400
Urban	1,825,900
Area Redevelopment	-
Subtotal, Existing Benefits	2,255,300
Total Average Annual Costs	2,878,000
Net Benefits	- 623,300
Existing Benefit/Cost Ratio	.78
Future Conditions	
Agriculture	967,900
Urban	195,900
Subtotal, Future Condition	1,163,800
Total Benefits	3,419,100
Total Average Annual Costs	2,878,000
Net Benefits	541,100
Benefit/Cost Ratio	1.19

COST-SHARING REQUIREMENTS

The recommended plan, Batavia Reservoir Compound (Modified), is presented in this report as a regional plan. The existing average annual flood damages are extensive throughout the downstream reaches. With the project in place, flood damages throughout the downstream reaches would be significantly reduced. Overall, the plan would reduce existing tangible average annual flood damages in the total watershed by roughly 74 percent, 20 percent in the Erie Plain that includes the city of Batavia, and 54 percent in the Huron Plain (downstream of Batavia). The city of Batavia receives a large degree of protection (500 years), but the amount of urban average annual damages is only a moderate portion of the total average annual damages for the watershed. Note that 85 percent of the average annual damages in the Erie Plain and 71 percent of the average annual damages in the Huron Plain are prevented. In an Issue Resolution Conference held 24 March 1982, the Office, Chief of Engineers, agreed that the project provided regional protection and, according to current guidance, should be a 100 percent Federal cost. The recommended plan is subject to cost-sharing and financing arrangements with the responsible non-Federal agencies sponsoring the project which are satisfactory to the President and Congress.

SECTION 5 - COORDINATION

GENERAL

The coordination of this study has involved a continuous and comprehensive process in an effort to effectively plan a viable and acceptable solution to the flood management problem in the Tonawanda Creek Watershed. This coordination has taken the form of formal public meetings, workshops, and public information meetings. A minimum of 20 Corps-sponsored meetings were held between November 1975 and December 1982 to: develop alternative plans; formulate the plans; and provide information and a forum for questions. In addition to coordination with the public; Federal, State, and local agencies have been closely coordinated with on a continuous basis. The paragraphs which follow demonstrate the extent and results of this coordination.

A major public coordination effort has taken place since submission of the Final Report to the Division office in November 1981. Many issues were raised at that level and the report was modified and recoordinated relative to the changes made. The same procedure was repeated when the report was elevated for review by the Board of Engineers for Rivers and Harbors in July 1982, and the Corps participated as a technical advisor for two meetings sponsored by the State. As mentioned earlier in the report, this is a rewritten report which includes all the updated information, both technical improvements, and additional coordination are included in this report.

PUBLIC COORDINATION

The Division Engineer's Notice was distributed to the public on 31 July 1982. At the request of the public, the public review period had been extended through 31 December 1982. During this time period, August 1982 through December 1982, Buffalo District conducted three public information meetings in Batavia, NY, at the request of the Genesee County Legislature. Buffalo District staff also provided technical assistance at New York State Department of Environmental Conservation (NYSDEC) meetings held on 1 and 2 March 1983.

A special interest group, Tonawanda Dam Study Committee, was formed shortly after distribution of the Division Engineer's Notice. This committee had taken a position of opposing the recommended project.

Because of the many questions and misinformation circulated in Genesee County, Buffalo District prepared a Public Information Report, dated 1 December 1982. The intent of this report was to address questions raised by the public at meetings, in letters, and in newspaper articles.

As a result of the vocal opposition by Tonawanda Dam Study Committee and the deadlocked position of the Tonawanda Creek Watershed Committee (appointed by the Genesee County Legislature), the Genesee County Legislature reversed their position and passed a resolution opposing the recommended project while

supporting the need for flood control. This resolution, dated 8 December 1982, stated several concerns:

a. It (project) has not proven cost effective.

b. The benefits to Genesee County are negligible.

c. The loss of the tax base in the respective taxing districts will be substantial.

All of these concerns were addressed in the Corps Public Information Report, dated 1 December 1982.

Erie County submitted a letter dated 10 January 1983 in support of the proposed flood damage reduction project. Niagara County submitted a resolution dated 1 February 1983 in support of the project.

The city of Batavia (in Genesee County) passed a resolution dated 13 December 1982, supporting the proposed project. The town of Batavia also submitted a letter of support.

Eight towns in Genesee County provided letters opposing the Corps of Engineers project. They are the towns of Alexander, Bethany, Stafford, Oakfield, LeRoy, Alabama, Pembroke, and Darien. However, it should be noted that only the towns of Batavia, Alexander, and Bethany are in the flood plain.

Within the downstream reaches in Erie and Niagara Counties, there are six towns in the flood plain; towns of Amherst, Clarence, Newstead, Pendleton, Lockport, and Royalton. The Supervisors of each of these towns have expressed support of the project by telephone contact with Buffalo District staff. Letters of support have been received from the towns of Amherst, Clarence, Pendleton, Lockport, and Newstead.

COORDINATION WITH KEY AGENCIES

a. General. The key agencies involved in coordination of this report are: the New York State Department of Environmental Conservation (NYSDEC); the U. S. Fish and Wildlife Service (USF&WS); and the New York State Department of Agriculture and Markets (NYSDAM). NYSDEC and USF&WS have been involved in a great deal of coordination relative to project construction impacts and the level of mitigation required to offset them. NYSDAM has been involved in review of project impacts in the reservoir areas and downstream. These agencies have requested to be directly involved in the post-authorization phases of this project to minimize impacts to the environment and agriculture.

b. Local Sponsor - New York State Department of Environmental Conservation. The local cooperator for all flood control projects in New York State is the NYSDEC. In a letter dated 27 December 1982, Buffalo District requested that NYSDEC provide a new letter of support for the recommended project. The NYSDEC was requested to reevaluate their position

regarding the regional project by weighing the opposition and support of the counties and towns in the watershed. NYSDEC, in a letter dated 20 April 1983, supported the proposed Tonawanda Creek flood damage reduction project, Batavia Reservoir Compound (Modified). The letter stated "that while some of the objections to the project are valid, particularly in the upper portions of the watershed, the benefits to be received from the project far outweigh the negative impacts and the greatest good to the region would be served by construction of the project."

The Corps of Engineers worked closely with the NYSDEC and the USF&WS in the preparation of the EIS, and development of a mitigation plan for the recommended plan. Considerable coordination took place over the extent and locale of mitigation lands.

c. U. S. Fish and Wildlife Service. The USF&WS has been involved with this study since its inception. They have worked closely with the Corps of Engineers in determining the types and extent of studies required, and have provided planning aid letters and a Fish and Wildlife Coordination Report. This last report provided the basis for the EIS. They have also reviewed and commented on the Draft and Final EIS. Along with the NYSDEC, they have worked closely with the Corps of Engineers in assessing the impacts of the alternative and recommended plan, and will continue to aid in developing an acceptable mitigation plan. Refer to Appendix G for more information.

d. New York State Department of Agriculture and Markets. The Corps of Engineers has also coordinated with the New York State Department of Agriculture and Markets to respond to their comments. Buffalo will coordinate further with this agency and other agricultural agencies during the advanced design stage to incorporate recommendations to minimize agricultural impacts from construction or operation of the recommended plan.

COORDINATION OF THE DRAFT REPORT

The Tonawanda Creek Final Feasibility Report was first distributed to the public in 1976. Between that time and the Division Engineer's Notice in July 1982, many additional studies and improvements were made to the report. Most of this work involved addressing questions about geotechnical conditions in the project area, the hydrologic and hydraulic aspects of the recommended plan's design, and the economics and environmental impacts of the recommended plan.

SECTION 6 - CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

All practical alternatives have been investigated in addressing the flood management problems in the Tonawanda Creek Watershed. No action, nonstructural plans, channel improvement plans, reservoir plans, multireservoir plans, and combination plans were considered in their response to the planning objectives.

The adverse environmental impacts of the recommended plan are mitigated by establishment of additional wetland area and improved management of existing wetlands.

The plan being recommended is consistent with national policy, statutes, and administrative directives.

The Batavia Reservoir Compound Plan (Modified) is engineeringly, economically, and environmentally sound and best serves the public interest.

RECOMMENDATIONS

I recommend construction authorization of the Tonawanda Creek Watershed flood damage reduction project, subject to cost-sharing and financing arrangements with the responsible non-Federal agencies sponsoring the project which are satisfactory to the President and the Congress.

Robert R. Hardiman

ROBERT R. HARDIMAN
Colonel, Corps of Engineers
Commanding

NCDPD-PF (29 Jun 83) 1st Ind
SUBJECT: Buffalo Metropolitan Area Study - Interim Report on Feasibility of Flood Management in Tonawanda Creek Watershed 15 JUL 1983

DA, North Central Division, Corps of Engineers, 536 South Clark Street, Chicago, Illinois 60605

TO: Resident Member, Board of Engineers for Rivers and Harbors, Kingman Building, Fort Belvoir, Virginia 22060

I concur in the analysis and recommendations of the District Commander. The recommended plan is subject to cost-sharing and financing arrangements (with the responsible non-Federal agencies sponsoring the project) which are satisfactory to the President and Congress.

CHARLES L. SHREVES
Colonel, Corps of Engineers
Acting Commander

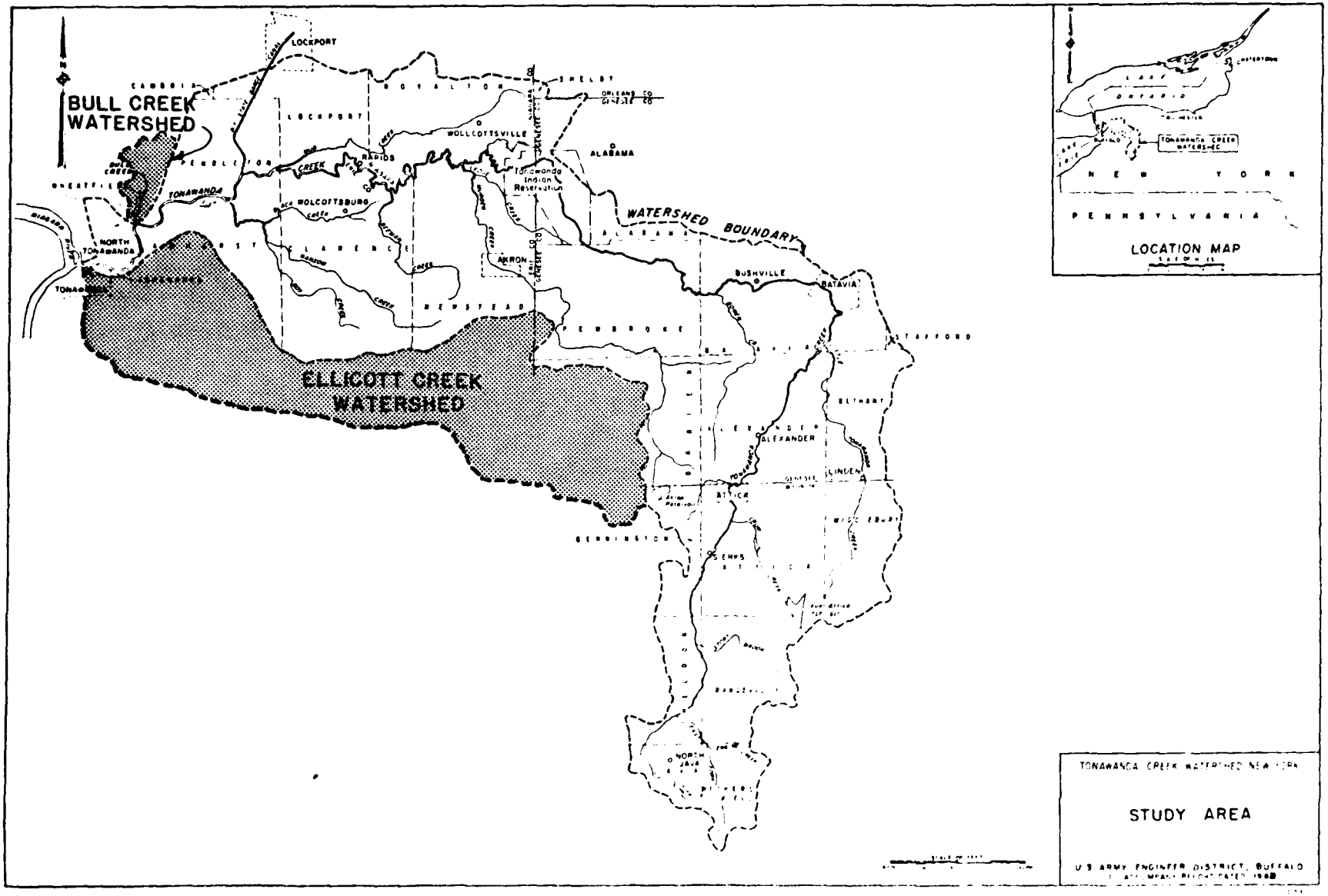

BULL CREEK WATERSHED
ELLICOTT CREEK WATERSHED
WATERSHED BOUNDARY
LOCKPORT
WOLCOTTSVILLE
ALABAMA
Tonawanda Indian Reservation
AKRON
BUSHVILLE
BATAVIA
NORTH TONAWANDA
TONAWANDA
WOLCOTTSBURG
STAFFORD
ALEXANDER
LINDEN
BERGEN
LOCATION MAP
LAKE ONTARIO
NEW YORK
PENNSYLVANIA
TONAWANDA CREEK WATERSHED NEW YORK
STUDY AREA
U S ARMY ENGINEER DISTRICT, BUFFALO

PLATE 1

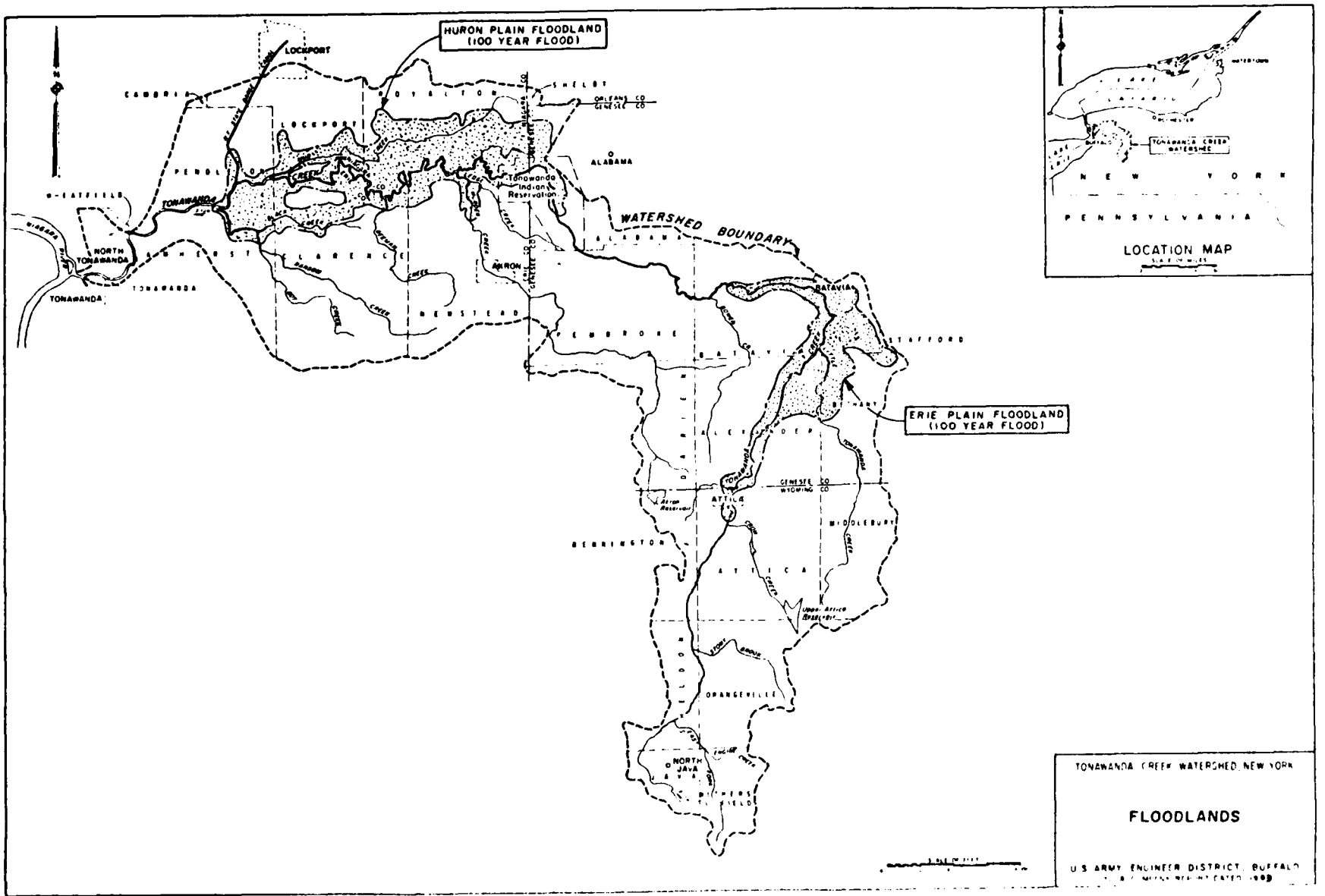

HURON PLAIN FLOODLAND
(100 YEAR FLOOD)
ERIE PLAIN FLOODLAND
(100 YEAR FLOOD)
WATERSHED BOUNDARY
LOCKPORT
NORTH TONAWANDA
TONAWANDA
BATAVIA
ATTICA
ALABAMA
Tonawanda Indian Reservation
LOCATION MAP
NEW YORK
PENNSYLVANIA
TONAWANDA CREEK WATERSHED, NEW YORK
FLOODLANDS
U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE 2

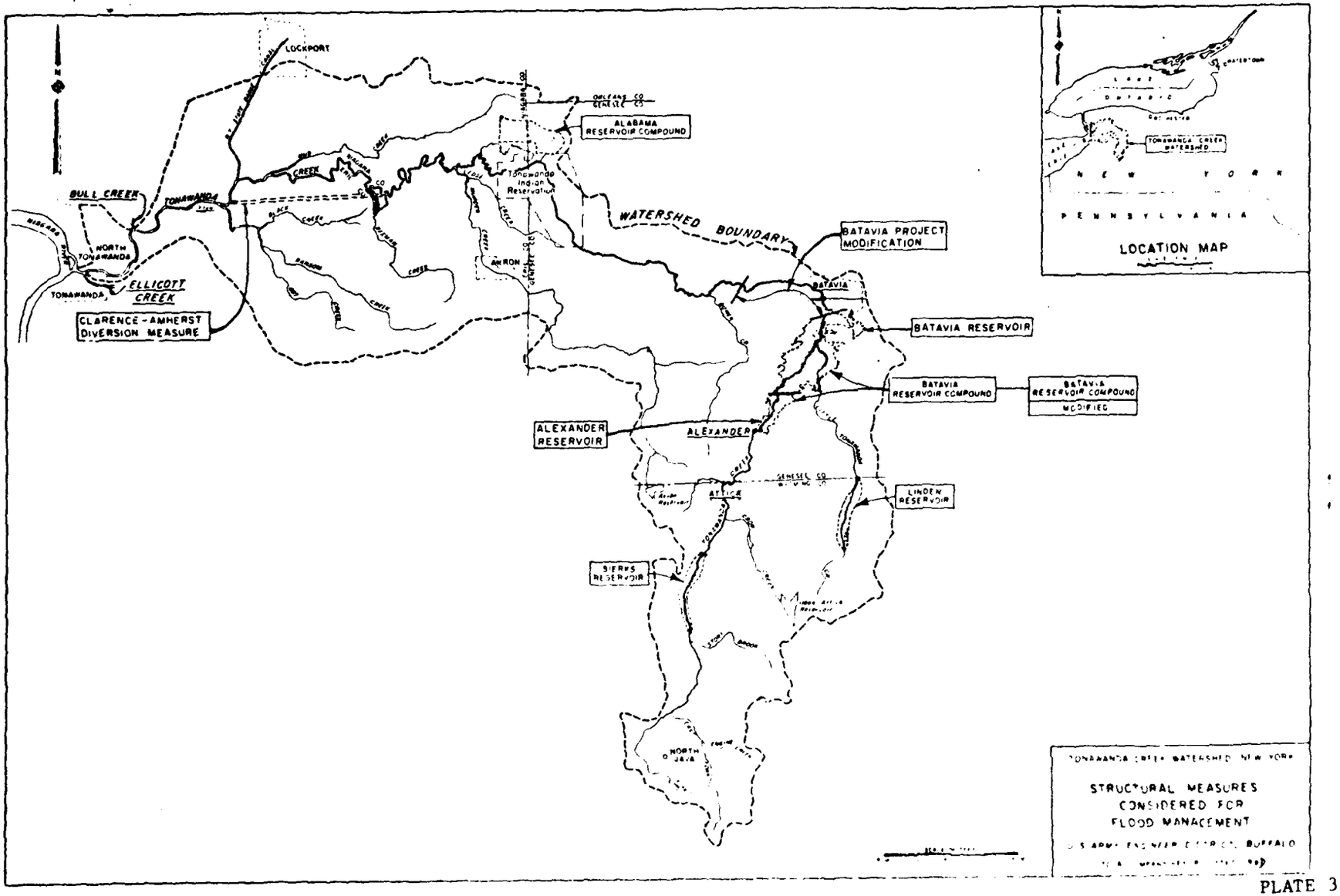

LOCKPORT
ALABAMA RESERVOIR COMPOUND
BULL CREEK
TONAWANDA
Tonawanda Indian Reservation
WATERSHED BOUNDARY
BATAVIA PROJECT MODIFICATION
NORTH TONAWANDA
ELLICOTT CREEK
TONAWANDA
CLARENCE - AMHERST DIVERSION MEASURE
AKRON
BATAVIA
BATAVIA RESERVOIR
BATAVIA RESERVOIR COMPOUND
BATAVIA RESERVOIR COMPOUND MODIFIED
ALEXANDER RESERVOIR
ALEXANDER
GENESEE CO
ATTICA
LINDEN RESERVOIR
SIERPS RESERVOIR
NORTH JAVA
LOCATION MAP
N E W Y O R K
P E N N S Y L V A N I A
STRUCTURAL MEASURES CONSIDERED FOR FLOOD MANAGEMENT

PLATE 3

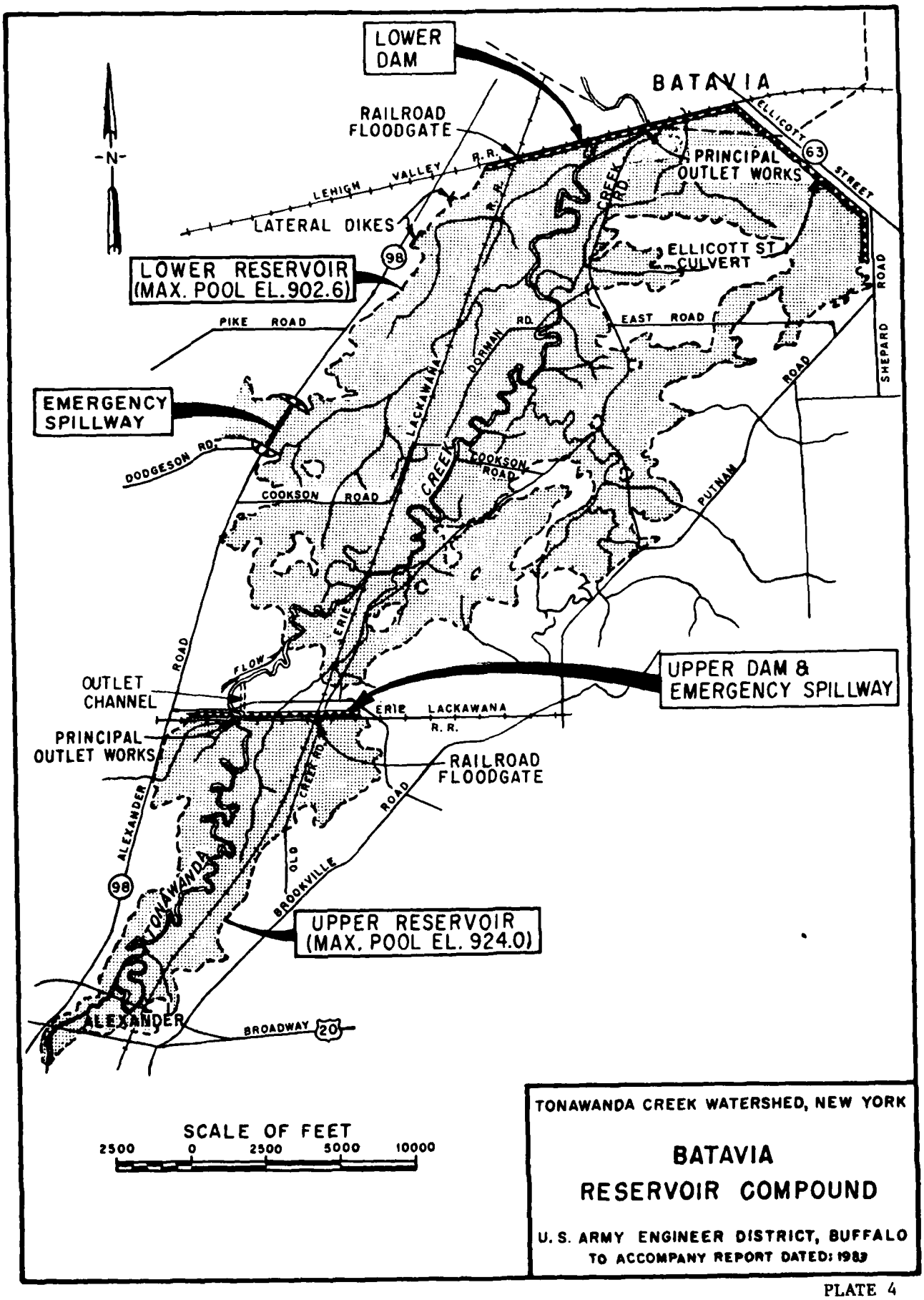

LOWER DAM
BATAVIA
RAILROAD FLOODGATE
-N-
LEHIGH VALLEY R.R.
LATERAL DIKES
PRINCIPAL OUTLET WORKS
ELLICOTT STREET
63
ELLICOTT ST CULVERT
LOWER RESERVOIR (MAX. POOL EL. 902.6)
98
PIKE ROAD
EAST ROAD
SHEPARD ROAD
DORMAN RD.
LACKAWANA CREEK
EMERGENCY SPILLWAY
DODGESON RD.
COOKSON ROAD
PUTNAM ROAD
ERIE
FLOW
OUTLET CHANNEL
UPPER DAM & EMERGENCY SPILLWAY
ERIE LACKAWANA R.R.
PRINCIPAL OUTLET WORKS
RAILROAD FLOODGATE
ALEXANDER ROAD
OLD CREEK RD.
BROOKVILLE ROAD
TONAWANDA
UPPER RESERVOIR (MAX. POOL EL. 924.0)
ALEXANDER
BROADWAY
20
SCALE OF FEET
2500 0 2500 5000 10000
TONAWANDA CREEK WATERSHED, NEW YORK
BATAVIA
RESERVOIR COMPOUND
U. S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY REPORT DATED: 1983

PLATE 4

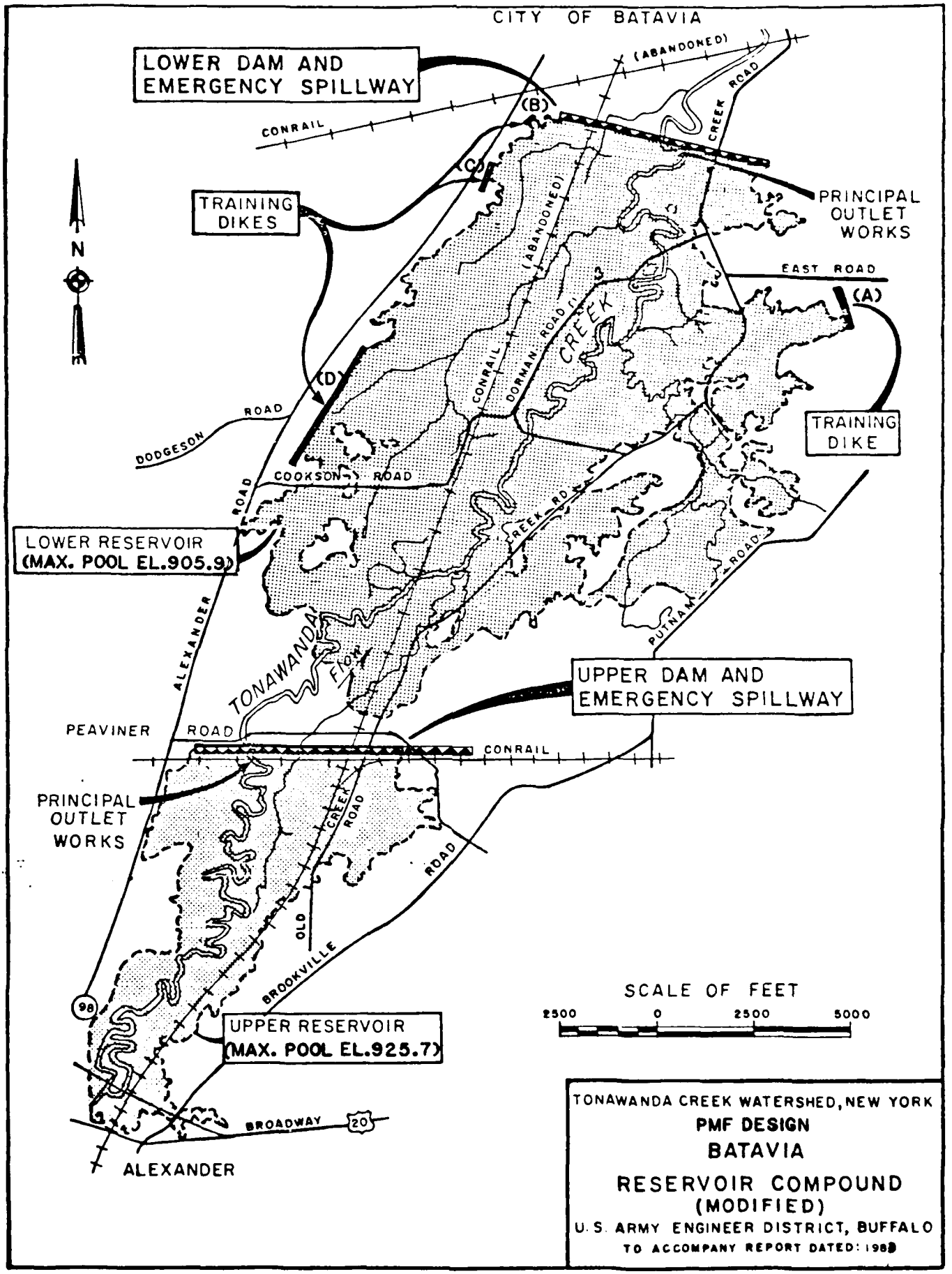

CITY OF BATAVIA
LOWER DAM AND EMERGENCY SPILLWAY
(ABANDONED)
CONRAIL
(B)
CREEK ROAD
(C)
TRAINING DIKES
PRINCIPAL OUTLET WORKS
N
EAST ROAD
(A)
(D)
CONRAIL
DORMAN ROAD
(ABANDONED)
CREEK
TRAINING DIKE
DODGESON ROAD
COOKSON ROAD
ROAD
LOWER RESERVOIR (MAX. POOL EL.905.9)
CREEK RD
PUTNAM ROAD
ALEXANDER
TONAWANDA
UPPER DAM AND EMERGENCY SPILLWAY
PEAVINER ROAD
CONRAIL
PRINCIPAL OUTLET WORKS
CREEK ROAD
ROAD
OLD
BROOKVILLE
98
UPPER RESERVOIR (MAX. POOL EL.925.7)
SCALE OF FEET
2500 0 2500 5000
BROADWAY
20
ALEXANDER
TONAWANDA CREEK WATERSHED, NEW YORK
PMF DESIGN
BATAVIA
RESERVOIR COMPOUND
(MODIFIED)
U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY REPORT DATED: 1988

PLATE 5

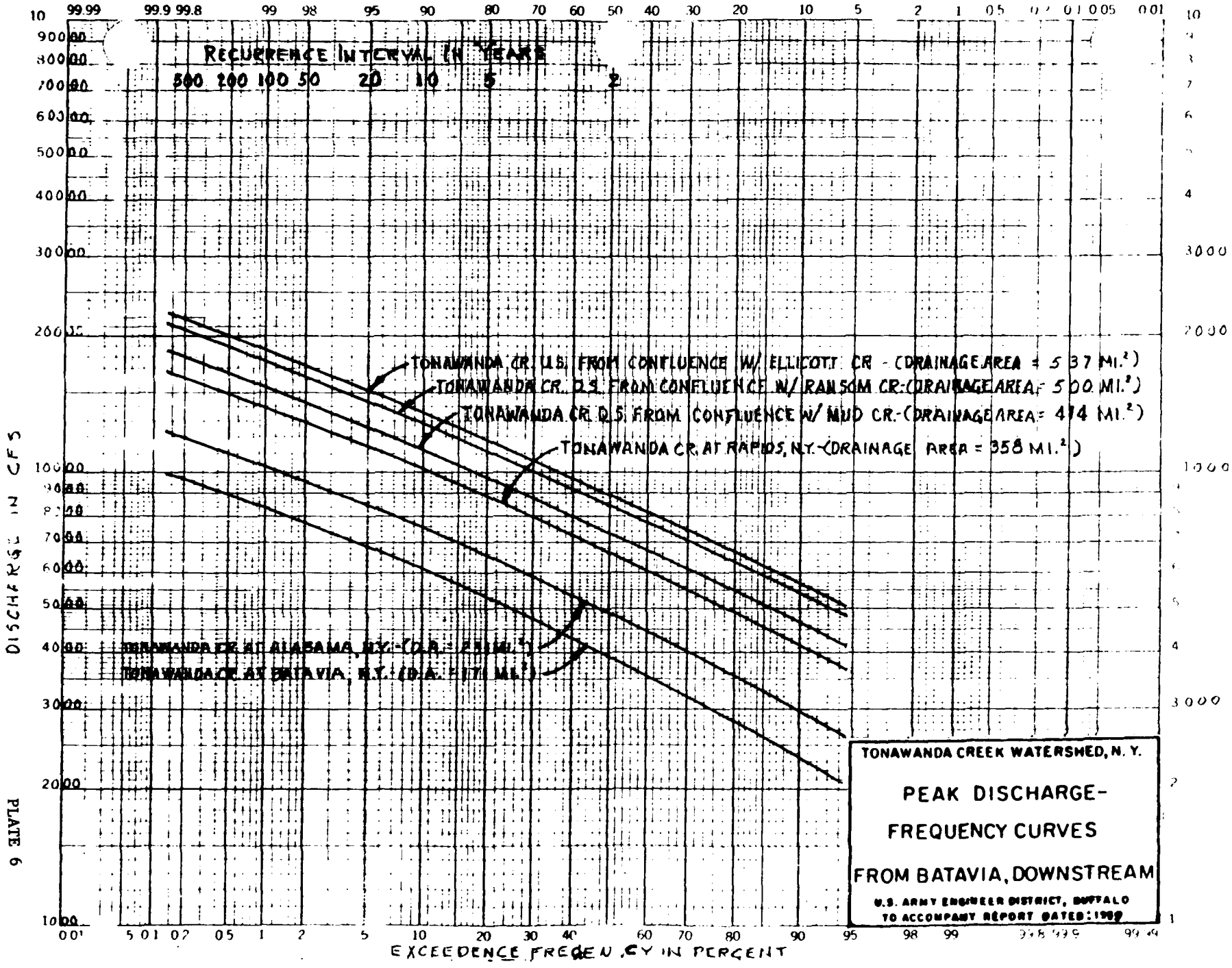
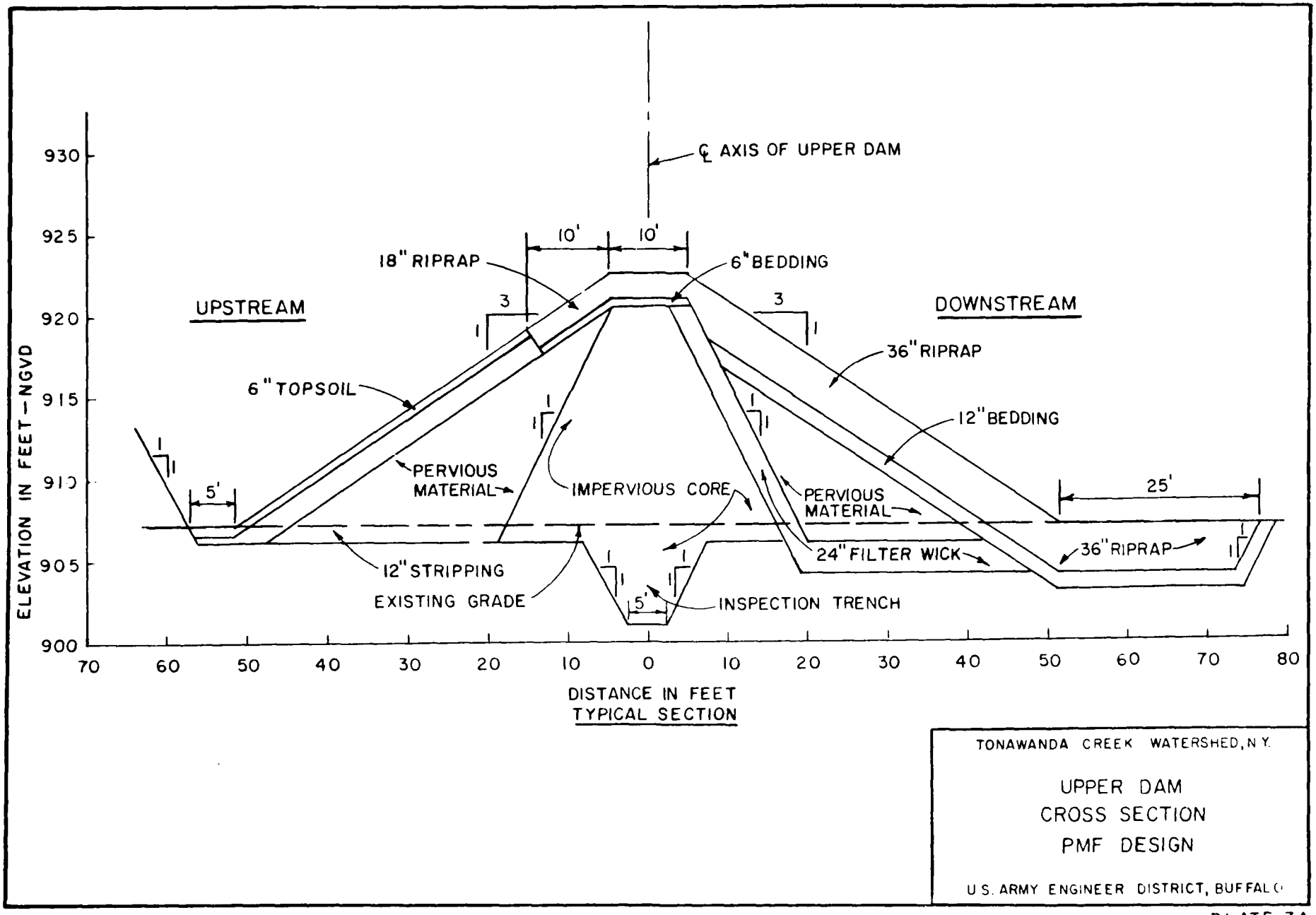

RECURRENCE INTERVAL IN YEARS
500 200 100 50 20 10 5 2
TONAWANDA CR. U.S. FROM CONFLUENCE W/ ELLICOTT CR - (DRAINAGE AREA = 537 MI.²)
TONAWANDA CR. D.S. FROM CONFLUENCE W/ RANSOM CR.-(DRAINAGE AREA = 500 MI.²)
TONAWANDA CR. D.S. FROM CONFLUENCE W/ MUD CR.-(DRAINAGE AREA = 474 MI.²)
TONAWANDA CR. AT RAPIDS, N.Y.-(DRAINAGE AREA = 358 MI.²)
TONAWANDA CR. AT ALABAMA, N.Y.-(D.A. = 221 MI.²)
TONAWANDA CR. AT BATAVIA, N.Y.-(D.A. = 171 MI.²)
DISCHARGE IN CFS
EXCEEDENCE FREQUENCY IN PERCENT
TONAWANDA CREEK WATERSHED, N. Y.
PEAK DISCHARGE-
FREQUENCY CURVES
FROM BATAVIA, DOWNSTREAM
U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY REPORT DATED: 1969

PLATE 6

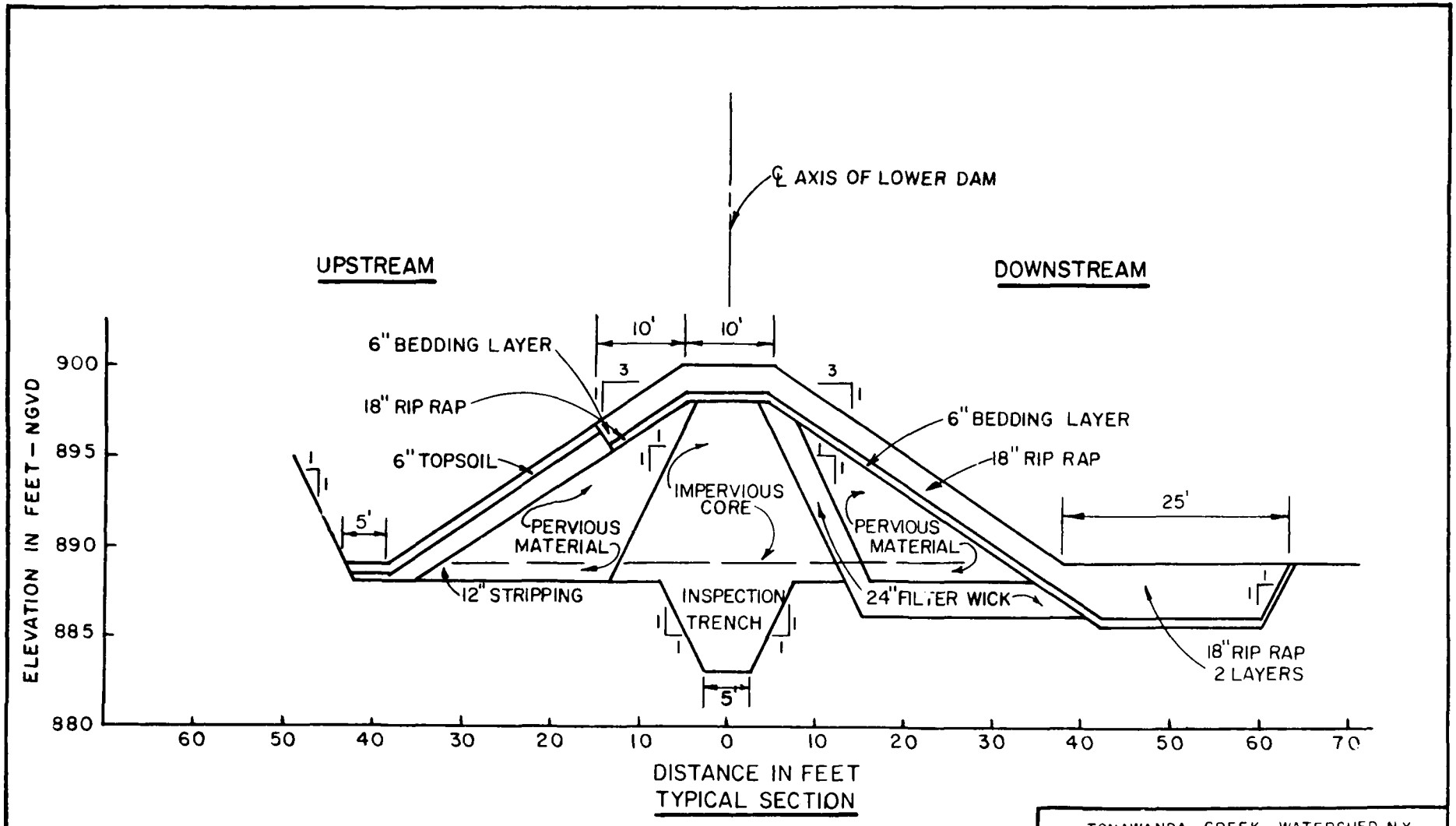


TONAWANDA CREEK WATERSHED, N.Y.

UPPER DAM
CROSS SECTION
PMF DESIGN

U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE-7A



TYPICAL SECTION

TONAWANDA CREEK WATERSHED, N.Y.

LOWER DAM
CROSS SECTION
PMF DESIGN

U.S ARMY ENGINEER DISTRICT, BUFFALO

PLATE-7B

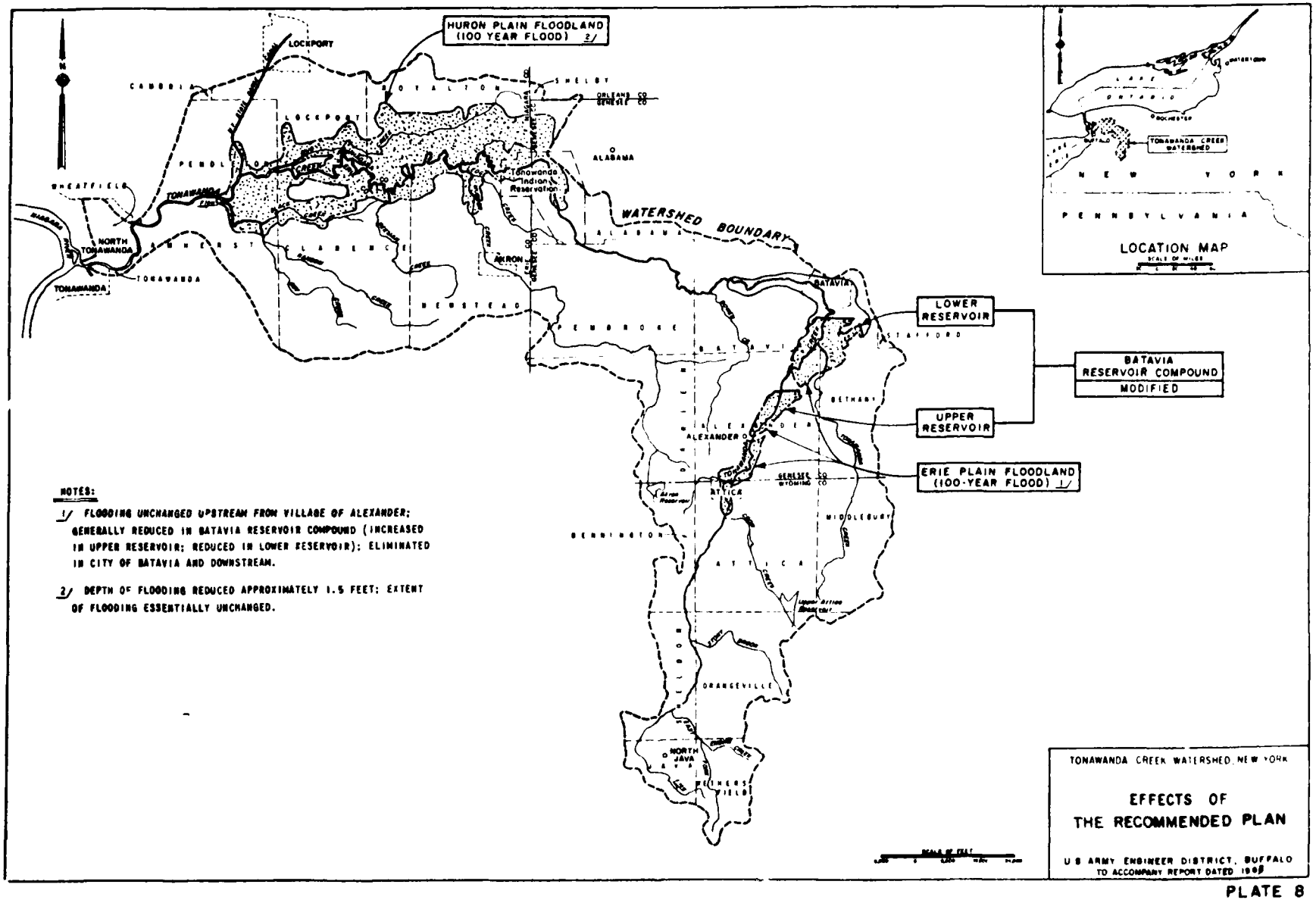
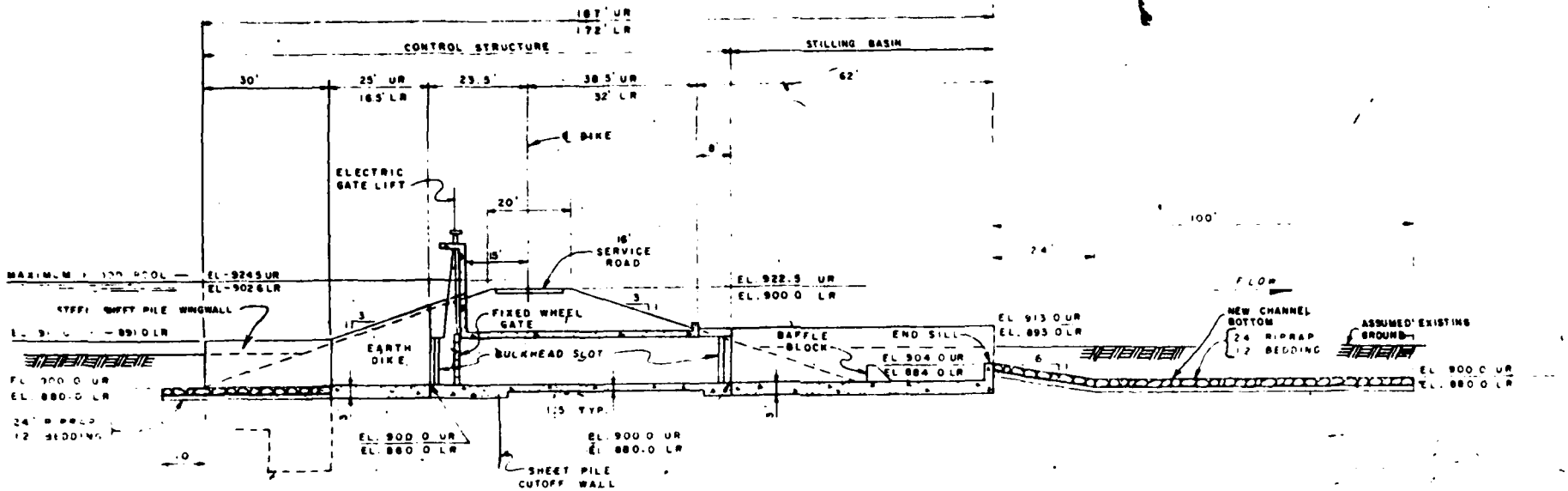

HURON PLAIN FLOODLAND
(100 YEAR FLOOD) 2/
WATERSHED BOUNDARY
LOWER RESERVOIR
BATAVIA RESERVOIR COMPOUND
MODIFIED
UPPER RESERVOIR
ERIE PLAIN FLOODLAND
(100-YEAR FLOOD) 1/
LOCATION MAP
TONAWANDA CREEK WATERSHED
NOTES:
1/ FLOODING UNCHANGED UPSTREAM FROM VILLAGE OF ALEXANDER; GENERALLY REDUCED IN BATAVIA RESERVOIR COMPOUND (INCREASED IN UPPER RESERVOIR; REDUCED IN LOWER RESERVOIR); ELIMINATED IN CITY OF BATAVIA AND DOWNSTREAM.
2/ DEPTH OF FLOODING REDUCED APPROXIMATELY 1.5 FEET; EXTENT OF FLOODING ESSENTIALLY UNCHANGED.
TONAWANDA CREEK WATERSHED, NEW YORK
EFFECTS OF
THE RECOMMENDED PLAN
U S ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY REPORT DATED 1969

PLATE 8



PRINCIPAL OUTLET WORKS

(CENTERLINE PROFILE OF TYPICAL CONDUIT)

NOT TO SCALE

UPPER RESERVOIR (UR): 5 - 11' X 11' GATED CONDUITS
LOWER RESERVOIR (LR): 4 - 11' X 11' GATED CONDUITS

TONAWANDA CREEK WATERSHED, NEW YORK
BATAVIA RESERVOIR COMPOUND (MODIFIED)
PRINCIPAL OUTLET WORKS
U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY REPORT DATED, 1968

PLATE 9

FINAL
ENVIRONMENTAL IMPACT STATEMENT

Proposed Plan for Regional Flood Control
Tonawanda Creek, Genesee
County, New York

The responsible lead agency is the U. S. Army Engineer District, Buffalo, NY

Abstract: The Buffalo District has investigated public concerns about the provision of flood control in the Tonawanda Creek Watershed. The watershed, about 648 square miles in size, is located in Western New York and includes substantial portions of Erie, Genesee, Niagara, and Wyoming Counties.

During preliminary planning a number of nonstructural and structural flood management measures were considered. Structural measures were of local protection and regional protection nature. Of the large number of plans considered, three were selected for detailed evaluation. Alternative 1, the No Action Plan, would provide no structural or nonstructural measures for flood protection. Alternative 3, the Nonstructural Base Plan provides for a combination of measures including flood warning and emergency action, floodproofing and flood insurance, flood plain management and permanent evacuation. Alternative 2, the Batavia Reservoir Compound (Modified) Plan provides for the construction of two normally dry, detention dams and reservoirs arranged in series along Tonawanda Creek upstream of Batavia, New York. This plan would provide a high degree of regional flood protection in the Tonawanda Creek watershed.

Alternative 2 has been chosen as the Selected Plan based upon its performance in addressing the identified public concerns and ability to meet the study's planning objectives.

SEND YOUR COMMENTS TO THE DISTRICT ENGINEER BY:

If you would like further information on this statement, please contact:

Mr. Philip E. Berkeley
U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207
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FTS Telephone: 473-2171

NOTE: Information, displays, maps, etc., discussed in the Tonawanda Creek Main Report are incorporated by reference in this FEIS.

FINAL

ENVIRONMENTAL IMPACT STATEMENT

Proposed Plan for Regional Flood Control
Tonawanda Creek, Genesee
County, New York

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SUMMARY

FINAL ENVIRONMENTAL IMPACT STATEMENT

Proposed Plan for Regional Flood Control
Tonawanda Creek, Genesee
County, New York

This chapter presents the major factors which were considered in and influenced planning-related decisions. It is presented in the following four discussions:

a. Major Conclusions and Findings. This discussion identifies the alternatives that were considered and a brief rationale for the study's NED Plan, EQ Plan and Selected Plan, and other major conclusions and findings of the District Engineer are presented.

b. Areas of Controversy. This section describes those issues that were the subject of major disagreement among public interests during the course of the study and the outcome of any resolved controversies.

c. Unresolved Issues. This section describes the unresolved major disagreements among study area interests and actions proposed or taken to resolve these disagreements.

d. Relationship to Environmental Protection Statutes and other Environmental Requirements. This section summarizes the relationship of each detailed plan to the requirements of environmental laws, executive orders, and other policies. The table, at the end of this summary, presents a summary of compliance with these requirements.

Major Conclusions and Findings

As a first task in the planning process, problems in a study area are identified by eliciting information from the public about water and related land resource management needs. The primary needs identified for the Tonawanda Creek Watershed involve reducing flood damage to existing and potential urban development areas in the suburban Buffalo, New York area. In addition, farmers in low lying upstream areas of Tonawanda Creek cannot make full and productive use of the very fertile soils found along Tonawanda Creek due to the flood threat.

As mandated by the Corps planning process, various alternative plans have been formulated to address area needs and planning objectives. These plans have been addressed and evaluated for social, economic, and environmental impacts.

During preliminary planning a number of nonstructural and structural flood management measures were developed and screened. In addition, No Action was

considered. These measures were refined, developed into alternatives, and evaluated on a preliminary basis. Three plans were considered for detailed analysis and possible recommendation. Alternative 1, No Action implies that the Federal Government would take no action to provide flood control in the Tonawanda Creek Watershed. Alternative 2, the Batavia Reservoir Compound (Modified) Plan would provide a high degree of regional flood protection in the watershed. It would involve the construction of two dams and reservoirs upstream of Batavia, New York to hold and provide regulated release of flood waters to downstream areas. This plan has been chosen as the Selected Plan. Alternative 3, the Nonstructural Base Plan includes a number of measures including flood warning and emergency action, floodproofing and flood insurance, flood plain management, and permanent evacuation. This plan would be implemented by the local communities involved.

The National Economic Development (NED) Plan addresses the planning objectives in a way which maximizes net economic returns. As a minimum, the NED Plan will produce net economic benefits; that is, annual benefits will exceed annual costs. With net annual economic benefits totaling $541,100. Alternative 2 has been designated as the NED Plan.

Recognizing that Environmental Quality (EQ) has both natural and human manifestations, an EQ Plan addresses the planning objectives in the way which emphasizes aesthetic, ecological, and cultural contributions. Beneficial EQ contributions are made by preserving, maintaining, restoring, or enhancing the significant cultural and natural environmental attributes of the study area. Determination of EQ benefits involves subjective analysis, underscoring the need for interdisciplinary planning with extensive public input to place values on the environmental contributions of plans. Designating an EQ Plan involves measuring the environmental changes related to different plans and selecting the plan which, based on public input, contributes to, or is most harmonious with environmental objectives. At a minimum, an alternative plan must make net positive contributions to the EQ account in order to be designated the EQ Plan. None of the detailed plans have proven to provide net positive contributions to the EQ account. Therefore, the Least Environmentally Damaging (LED) Plan has been determined. Alternative 3, the Nonstructural Base Plan, has been designated the LED Plan.

Areas of Controversy

In general, most study area interests agree that there is a need for flood protection in the Tonawanda Creek Watershed. However, there is considerable disagreement about how it could be provided. Upstream reservoirs, such as with the Selected Plan, tend to confine impacts to areas disproportionately to the amount of flood control benefit provided in the project area. On the other hand, downstream communities gain most of the flood reduction benefit while suffering little or no adverse impact as a result of project construction. The Genesee County legislature has passed a resolution opposing the recommended project while supporting the need for flood control. This resolution, dated 8 September 1982, stated several concerns: It (project) has not proven cost effective; the benefits to Genesee County are negligible; the loss of the tax base in the respective taxing districts will be substantial.

Erie County submitted a letter, dated 10 January 1983, in support of the proposed flood damage reduction project. Niagara County submitted a resolution, dated 1 February 1983, in support of the project. The city of Batavia (in Genesee County) passed a resolution, dated 13 December 1982, supporting the proposed project. The town of Batavia also submitted a letter of support. Eight towns in Genesee County have provided letters opposing the Corps of Engineers project. Generally speaking, towns in downstream areas of Erie and Niagara Counties support the plan.

Alternative 1, the No Action Plan, was not chosen as the Selected Plan because it does not provide for flood management in the Tonawanda Creek Watershed, and because residents within the flood plain would continue to experience property damage, personal hardship, and threat to human health and life. In addition, plans exist which could economically provide flood protection in the watershed. Alternative 3, the Nonstructural Base Plan, was not selected due to its low Benefit to Cost Ratio (B/C = 0.67) and the high level of residual damages that would exist with this plan. In addition, this plan has a high level of social impact due to the large number of relocations that would be required.

The Selected Plan is Alternative 2, the Batavia Reservoir Compound (Modified) Plan. This plan provides a high degree of flood damage reduction, maximizes net benefits, and provides a high degree of safety from project failure. This plan best meets the primary planning objectives of reducing urban and agricultural flood damages in the study area. The plan is acceptable to the State of New York. Recently, the Genesee County Legislature voiced opposition to the plan, although they still feel there is a need for flood control in the watershed. In general, downstream towns and counties are in favor of the plan while upstream areas, where the project will be constructed, are opposed.

In accordance with Executive Order 11990, Protection of Wetlands, a determination has been made that no practicable alternative to undertaking the proposed action within a wetland exists. Efforts have been made to minimize the loss and degradation of the beneficial values of wetlands lost. A fish and wildlife mitigation plan has been developed and recommended as part of the Selected Plan to offset wetland impacts of the plan. The general objective of Executive Order 11988, Flood Plain Management, is to avoid, to the maximum extent possible, long and short-term adverse impacts associated with the occupation and modification of the base flood plain whenever there is a practicable alternative to such an action. The Corps has concluded that there is no practicable alternative to the proposed action, which would occur within the 100-year flood plain of Tonawanda Creek and within existing wetlands, and that the recommended action is in conformance with both Executive Orders.

An evaluation in compliance with Section 404 of the Clean Water Act has not been completed. Additional information will be developed to comply with Section 404 during further engineering and design studies and prior to the actual discharge of dredged or fill material. A preliminary Section 404 Evaluation and Public Notice would be prepared and circulated during the general design phase of the study, if the proposed project is authorized for construction.

Unresolved Issues

The need for mitigation of fish and wildlife resources and habitats lost as a result of the Selected Plan has been a significant concern during the course of the study. The U. S. Fish and Wildlife Service has recommended that 665 acres of wetland habitat be acquired and managed for fish and wildlife purposes as part of the Selected Plan. The New York State Department of Environmental Conservation also feels that additional habitats should be purchased and managed for fish and wildlife purposes as part of the Selected Plan. The Corps of Engineers, as a result of the analysis contained in Appendix H, Part 2, has recommended that a mitigation plan of habitat improvement at the Oak Orchard Game Management Area that does not involve land purchase be authorized as part of the Selected Plan. The scope and degree of fish and wildlife mitigation desired by the applicable agencies has not been resolved as of the writing of this FEIS.

The exact amount of land acquisition, flooding easements, and relocations required for the construction of the project are a significant issue to the affected property owners. Determinations of the required real estate acquisitions and easements are based upon existing topographic mapping (10-foot contours) and the best detail that can be obtained from such maps. During Advanced Engineering and Design, detailed topographic, maps with full reservoir pool outlines will be prepared. This mapping will give a clear picture of what properties will be needed for the project.

Relationship to Environmental Protection Statutes and Requirements

The detailed plans have been considered in relation to a number of Federal laws and policies as well as State laws, which have a bearing on the issues involved. The table, which immediately follows, presents a summary of environmental review and consultation requirements applicable to Corps Civil Works actions.

Relationship of Plans to Environmental Protection Statutes and Other Environmental Requirements (Selected Plan is Alternative 2)

	Alternatives		
	1	2	3
FEDERAL STATUTES			
Archeological and Historic Preservation Act, as amended 16 USC 469 *et seq.*	FULL	FULL	FULL
Clean Air Act, as amended, 42 USC 7401, *et seq.*	FULL	FULL	FULL
Clean Water Act, as amended (Federal Water Pollution Control Act) 33 USC 1251 *et seq.*	N/A	FULL	N/A
Coastal Zone Management Act, as amended, 16 USC 1451 *et seq.*	N/A	N/A	N/A
Endangered Species Act, as amended, 16 USC 1531 *et seq.*	FULL	FULL	FULL
Estuary Protection Act, 16 USC 1221 *et seq.*	N/A	N/A	N/A
Federal Water Project Recreation Act, as amended, 16 USC 460-1(12) *et seq.*	FULL	FULL	FULL
Fish and Wildlife Coordination Act, as amended, 16 USC 661 *et seq.*	FULL	FULL	FULL
Land and Water Conservation Fund Act, as amended, 16 USC 4601-11 *et seq.*	FULL	FULL	FULL
Marine Protection, Research and Sanctuaries Act, 22 USC 1401 *et seq.*	N/A	N/A	N/A
National Historic Preservation Act, as amended, 16 USC 470 a *et seq.*	FULL	FULL	FULL

Relationship of Plans to Environmental Protection Statutes and Other Environmental Requirements (Selected Plan is Alternative 2) (Cont'd)

	Alternatives		
	1	2	3
National Environmental Policy Act, as amended, 42 USC 4321 *et seq.*	FULL	FULL	FULL
Rivers and Harbors Act, 33 USC 401 *et seq.*	FULL	FULL	FULL
Watershed Protection and Flood Prevention Act, 16 USC 1001 *et seq.*	FULL	FULL	FULL
Wild and Scenic Rivers Act, as amended, 16 USC 1271 *et seq.*	FULL	FULL	FULL
EXECUTIVE ORDERS, MEMORANDUM, ETC.			
Flood Plain Management (EO 11988)	FULL	FULL	FULL
Protection of Wetlands (EO 11990)	FULL	FULL	FULL
Environmental Effects Abroad of Major Federal Actions (EO 12114)	N/A	N/A	N/A
Analysis of Impacts on Prime and Unique Farmlands (CEQ Memorandum 30 Aug 1976)	FULL	FULL	FULL

NOTES: The compliance categories used in this table were assigned based on the following definitions:

1. Full Compliance - All requirements of the Statute, EO, or other policy and related regulations for the current stage of planning have been met.

2. Partial Compliance - Some requirements of the statute, EO, or other policy and related regulations for the current stage of planning remain to be met.

3. Noncompliance - None of the requirements of the statute, EO, or other policy and related regulations have been met.

4. Not Applicable - N/A - Statute, EO, or other policy not applicable.

1. NEED FOR AND OBJECTIVES OF ACTION

1.01 This chapter explains how and why the Corps of Engineers became involved in the study and what public concerns and consequent planning objectives were identified as the basis for plan formulation. It is presented in the following three discussions:

a. Study Authority. This discussion identifies the study's authorizing document and summarizes the Congressional intent for undertaking the study.

b. Public Concerns. This section describes the public concerns and related resource management needs (problems and opportunities) which were identified in the study.

c. Planning Objectives. This discussion states the planning objectives which were derived from the aforementioned resource management needs and employed in plan formulation.

Study Authority.

1.02 Authorization to study the feasibility of flood management in the Tonawanda Creek Watershed, New York, derives from a resolution of the Committee on Public Works, Senate, United States Congress, sponsored by Senator Irving M. Ives, and adopted 15 June 1950, which reads:

> "Resolved by the Committee on Public Works of the United States Senate, that the Board of Engineers for Rivers and Harbors, created under Section 3 of the Rivers and Harbors Act, approved June 13, 1902, be, and is hereby, requested to review the report on Tonawanda Creek, NY, published as Senate Document Numbered 46, Eightieth Congress, First Session, with a view to determining the feasibility of providing flood protection along Mud Creek in Niagara and Orleans Counties, NY."

1.03 This authorization was expanded by resolutions of the Committee on Public Works, House of Representatives, United States Congress, adopted 16 August 1950 and 23 July 1956. Finally, on 5 March 1973, the Chief of Engineers, Corps of Engineers, authorized study of water resources management in the Buffalo Metropolitan Area, New York, and directed that the Study Area include the Buffalo Urban Area (SMSA) and its tributary watershed, including the Tonawanda Creek Watershed. The Chief designated this study area the Buffalo Metropolitan Area, New York 44012. Since the Tonawanda Creek Watershed is part of the Buffalo Metropolitan Area, the study of flood management needs in the Tonawanda Creek Watershed has been made as an interim report to the Buffalo Metropolitan Area Study.

Public Concerns

1.04 Flooding Problem. Major flooding has occurred in the Tonawanda Creek Watershed in March 1902, March 1916, March 1942, March 1956, January 1957, March 1960, September 1977, March 1978, and March 1979. The largest flood of record occurring in 1960, caused an estimated $5,640,000 in flood damages using 1975 level of development and prices. This flood caused damage to 450 residences, 48 commercial units, 250 agricultural units and an undetermined number of roads and public facilities. In general, major flooding occurs in the spring and has been caused by snowmelt augmented by rainfall.

1.05 Human Health And Safety. The health and safety of the floodprone areas of the watershed are an important consideration in determining the need for flood management. Flooding could temporarily deprive persons of necessary supplies, services, and facilities, as well as cause psychological hardship. Floodwaters could also spread disease by causing back-up of sewers and inundation of septic tanks and leach beds. The largest concentrations of persons needing flood protection are in the city of Batavia and in new developments in the towns of Clarence and Amherst. The safety of persons residing below a dam that might be constructed is also a major public concern.

1.06 Nonindustrial Properties. Nonindustrial properties susceptible to flood damage include residential, public recreation, and transportation properties. Although residential properties exist throughout the floodlands, most are situated within the cities of Batavia and North Tonawanda or within new developments in the towns of Clarence, Amherst, Pendleton, and Wheatfield. Three public recreation properties susceptible to flooding are Kibbe Park in the city of Batavia, Ellicott Creek Park in the town of Tonawanda, and the Tonawanda Game Management Area in Genesee Niagara Counties. Transportation properties susceptible to erosion and other flood damage include several small airstrips in the watershed, railroad lines and many State, county, and local roads throughout the floodprone areas.

1.07 Farmland. Farmland occupies large tracts of the floodlands. This farmland is subject to several kinds of flood damage. Floodwater erodes fertile topsoil from farmlands, greatly diminishing their crop production capabilities. Large areas of extremely fertile soils on the flood plain have been left idle or abandoned due to the flood threat.

1.08 Industry. Primary industries which could be encumbered by flooding include farming, lumbering, and mining; however, only farming is now, and would be encumbered appreciably. Standing floodwater also causes considerable damage to affected farmlands. Many of these properties are nearly flat; consequently, floodwater stays on them for as long as several weeks. Occupying floodwater not only precludes use of these lands, but also promotes saturation of their soils, so that long after floodwater has run off, the lands are too wet to support farm use. Early spring flooding often delays planting until well into the growing season, so that many of the characteristically fertile lands, generally capable of supporting at least two crops per year, are used for generally no more than one.

1.09 Existing and Potential Development. Land uses within floodlands of the watershed have changed very little in the past 30 years. Recently, however, tracts within the Buffalo Metropolitan Area in the towns of Wheatfield, Pendleton, Amherst, and Clarence, formerly forested or used for farming, have been developed for residential and industrial use. The greatest potential future users of the Tonawanda Creek flood plain are farmers who plant a variety of grains and forage crops for consumption by the watershed's dairy opertions. However, no net demand for agricultural land is expected since the general trend of decreasing farming units of larger size is anticipated to continue in the foreseeable future.

1.10 Erosion Problem. In late winter and early spring, creek channels often carry high flows for prolonged periods and their banks become saturated. Then, the floodwaters subside much more rapidly than the saturated banks can drain, so the banks fail, sliding into the channels to obstruct and divert their flows. In addition to eroding soils, floodwaters tend to flush plants and other debris into stream channels where they snag and accumulate, impeding flow and causing further erosion by diverting water. Debris blockages are commonplace throughout reaches of the Tonawanda Creek channel downstream of Attica.

1.11 Fish and Wildlife and Related Habitat. Natural vegetation is subject to damage by the floodwater itself and by flood-carried debris. Bushes and trees growing near the banks of creeks are often toppled when flood-eroded banks collapse. Flooding within the watershed could directly destroy wildlife inhabiting the floodlands, and could also damage or destroy established animal habitats and food supplies. Waterfowl and other birds could also be disrupted or destroyed by flooding, particularly if it occurs during the nesting season.

1.12 The U. S. Fish and Wildlife Service (USF&WS) and New York State Department of Environmental Conservation (NYSDEC) have concerns about the fish and wildlife impacts of the various plans considered and about providing adequate resource mitigation for unavoidable impacts.

Planning Objectives.

1.13 Development of the various alternative plans for flood control in the Tonawanda Creek Watershed considered the national objectives for planning water resource projects as set forth in the U. S. Water Resource Council's "Principles and Standards for Planning Water and Related Land Resources." These two national objectives are:

a. National Economic Development (NED). National Economic Development is achieved by increasing the value of the nation's output of goods and services and improving economic efficiency. For the Tonawanda Creek Watershed Study, the primary tangible benefit associated with the NED account is the reduction of urban and agricultural flood damages in the study area. According to Principles and Standards, the NED Plan is the alternative which maximizes net benefits.

b. Environmental Quality (EQ). Environmental Quality is achieved by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems.

1.14 Two other criteria for planning water resource projects, as set forth in the Principles and Standards, are Regional Development (RD) and Social Well Being (SWB).

a. Regional Development - Contributions to the RD account are determined by establishing a proposal's effects on a region's income, employment, population, economic base, environment, and social development.

b. Social Well Being - Contributions to the SWB account are determined by establishing a proposal's effects on real income, security of life, health and safety, education, cultural and recreational opportunities, emergency preparedness, and other factors.

1.15 Specific planning objectives were formulated to meet the national, State, and local water and related land management needs, opportunities and problems specific to the study that relate to NED, EQ, RD, and SWB. The Buffalo District has established the following planning objectives to guide the formulation of a plan of flood protection for the Tonawanda Creek Watershed:

a. Reduce existing and future urban and agricultural flood damages within the Tonawanda Creek Watershed, along Tonawanda Creek and its tributaries from stream mile 9.8 to 65.3.

b. Reduce the flood potential on highly productive soils in the study area for the purpose of increasing agricultural production.

c. Increase employment of unemployed or underemployed resources in the study area.

d. Increase use of farmlands within the study area.

e. Reduce future floodproofing costs within applicable areas of the study area.

f. Preserve wetlands in the project area in conformance with Executive Order 11990.

g. Reduce flood-related erosion along the creekbed and channel slopes.

h. Maintain water quality in Tonawanda Creek and its tributaries within the study area.

i. Preserve or salvage significant (as determined by National Register of Historic Places criteria) historic and prehistoric cultural resources sites affected by potential project construction impacts in accordance with the authorities contained in the National Historic Preservation Act of 1966;

the Reservoir Salvage Act of 1960, as amended by Public Law 93-291; and Executive Order 11593.

j. Increase employment within the region.

k. Increase the output of goods in the region.

l. Increase in per capita income.

m. Protect human well-being with a safe level of flood protection.

n. Reduce hazards to human health.

o. Limit flooding in unprotected areas to without project conditions.

p. Minimize relocation of properties in the project area.

q. Minimize impacts in the local community from the constructed project (property tax base, school bus routes, traffic continuity, etc.).

1.16 A more detailed discussion of the above mentioned planning objectives can be found in Section 2 of the Main Report.

2. ALTERNATIVES

2.01 Introduction. A number of flood management measures, both nonstructural and structural, were considered for possible implementation during the course of the Tonawanda Creek Study. In general, nonstructural measures protect against flood damage at specific sites, but do not manage the flooding itself. Structural measures protect against flooding by changing the nature of flooding. The following paragraphs will briefly describe the preliminary nonstructural and structural measures considered in the study.

Nonstructural Measures Considered.

2.02 Nonstructural measures for use in flood management serve two general functions: to protect against flood-related losses at individual sites, and to reduce the overall need for flood protection. Flood warning and emergency action, floodproofing and flood insurance partially protect at localized sites of possible flood damage. Floodplain management and permanent evacuation reduce the need for flood protection by regulating the uses of the floodplain, but provide no protection for existing development that cannot be relocated.

2.03 Flood Warning and Emergency Action. Flood warning implies that actions can be taken to warn people about possible flooding so they can take action to remove themselves from affected areas or so that they can employ emergency measures such as sandbagging to protect themselves. These measures could be implemented in the lower Tonawanda Creek watershed if a formal flood warning system were developed.

2.04 Floodproofing. Floodproofing measures, both temporary and permanent, provide onsite protection of individual properties against flood-related damages. Temporary measures include closure devices and barricades. Permanent measures include watertight substructures, building anchors, pedestal foundations, and individual dikes, levees, and floodwalls. Many of the older houses and farm buildings within the watershed have been located on knolls or rises. Normally, the structures remain dry, although they are sometimes isolated for periods of time. Newer residential structures, however, even in rural areas, have not always been placed on higher ground and are more susceptible to damage. Floodproofing, therefore, may be most applicable for the newer residential areas in the watershed.

2.05 Flood Insurance. Flood insurance provides some financial protection to victims of flood-related property losses, but does not prevent such losses. The 1968 National Flood Insurance Act, and subsequent amendments, established the National Flood Insurance Program to promote regulation of uses of lands susceptible to special flood hazards, to curb risks of future flood damage, and to afford Federally insured flood insurance at low premium rates. All communities within the Tonawanda Creek Watershed are eligible for flood insurance. Various areas within some communities, including the villages of Attica and Alexander and the city of Batavia, have been identified as special flood hazard areas. These communities may purchase flood insurance to be eligible for any new or additional Federal, or Federally-related, financial assistance for any building within community limits.

2.06 Flood Plain Management. Flood plain management measures regulate land use to prevent or reduce future flood-damageable development in flood plains. By means of zoning laws, building codes, and subdivision regulations, a flood plain management program would prevent highly damageable uses of floodlands, while permitting less susceptible uses such as farming and recreation. Presently, large tracts of the floodlands of Tonawanda Creek Watershed are free of highly damageable developments, and could be kept so by effective flood plain management. However, small tracts of these floodlands, particularly in the towns of Batavia, Clarence, and Amherst, are already occupied by highly damageable developments. Perpetuation of such undesirable development could be prevented by regulations permitting local governments to acquire such flood-susceptible property for flood-compatible purposes, or to require that new developments be floodproofed.

2.07 Permanent Evacuation. This measure would require the removal of some or all flood damageable structures from the floodplain. This would reduce the need for other flood damage management measures. Implementation of permanent evacuation would involve considerable social disruption for current residents of the Tonawanda Creek flood plain area.

Structural Measures Considered.

2.08 Introduction. A number of structural measures were developed during the preliminary planning of the Tonawanda Creek study. These measures fall into two basic categories: those which provide local flood protection and those which provide regional flood management. Local flood protection measures, such as modified channels, diversion channels, levees, and floodwalls, conduct floodwater through or away from flood-damageable areas, and protect properties only in their immediate vicinities. Regional flood protection measures, such as detention reservoirs and storage reservoirs, store floodwater upstream from damageable areas and release it at nondamaging rates. Regional measures protect, to some degree, all properties within the watershed downstream from them.

2.09 A number of possible structural measures, as described in the following paragraphs were considered during the study. The locations of these potential measures are illustrated on Plate 3 of the Main Report.

Local Protection Measures.

2.10 Batavia Project Modification. In 1956 the Corps of Engineers completed construction of a local flood control project in the city of Batavia, New York. This local protection project could be modified to construct levees and bank protection, as well as, downstream channel enlargement to the village of Bushville to increase the level of flood protection in the city of Batavia.

2.11 Clarence-Amherst Diversion Measure. This measure would involve the construction of a diversion channel, dike, and levees in the downstream towns of Clarence and Amherst, New York. The reconstructed channel would extend from Tonawanda Creek near its junction with Beeman Creek for about seven miles to near its junction with Ransom Creek. Flood flows of Tonawanda and Black Creeks would be routed into the New York State Barge Canal.

Regional Protection Measures.

2.12 During preliminary planning for flood control on Tonawanda Creek, a number of regional protection measures in the form of reservoirs were considered. These reservoir measures are briefly described in the following paragraphs.

2.13 Sierks Reservoir. This measure involves the construction of a storage reservoir on Tonawanda Creek in the Cattaraugus Hills, near the hamlet of Sierks, New York. It could serve five purposes: flood management, fishery enhancement, recreation, water quality management, and irrigation. The measure would involve an earth dam and a permanent pool normally having a maximum depth of 87 feet and surface area of 1,050 acres. The dam would be located approximately three miles upstream from the village of Attica, New York. The Sierks Reservoir would intercept runoff from 61.3 square miles of the Cattaraugus Hills, which are a major source of runoff presently contributing to flooding in the watershed. This area represents approximately 35.6 percent of the watershed above the city of Batavia and 9.5 percent of the whole watershed.

2.14 Linden Reservoir. This measure involves the construction of a storage reservoir on Little Tonawanda Creek in the Cattaraugus Hills, near the hamlet of Linden, New York. The measure involves a dam constructed of earth fill and a pool normally having a maximum depth of 63 feet and surface area of 1,015 acres. The dam would be located approximately 0.2 mile upstream from the hamlet of Linden, New York. The Linden Reservoir would intercept runoff from a tract of the Cattaraugus Hills 21.4 square miles in area. This area represents approximately 12.4 percent of the watershed above the city of Batavia and approximately 3.3 percent of the whole watershed.

2.15 Alexander Reservoir. This measure involves the construction of a detention reservoir (normally dry) on Tonawanda Creek, near the village of Alexander, New York. The reservoir would have a dam adjacent to, and, downstream from an abandoned embankment of the Erie-Lackawanna Railroad, extending across the flood plain between the hamlets of North Alexander and East Alexander. The Alexander Reservoir would intercept runoff from a tract of the Cattaraugus Hills 102 square miles in area. This area represents approximately 59.3 percent of the watershed above the city of Batavia and approximately 20.0 percent of the whole watershed.

2.16 Batavia Reservoir Compound. The Batavia Reservoir Compound involves the construction of two shallow detention reservoirs (normally dry) arranged in series. The reservoirs would have dams adjacent to two railroad embankments. Together, they would include a tract of roughly 4,840 acres within the floodland between the village of Alexander, New York, and the city of Batavia, New York. Land to be used for the upper reservoir would include roughly 940 acres of farmland, wetland, and woodland. Land to be used for the lower reservoir would include roughly 3,900 acres of farmland, wetland, and woodland. The Batavia Reservoir Compound would intercept all runoff from that part of the Tonawanda Creek Watershed upstream from the city of Batavia - a tract of 172 square miles representing approximately 33.7 percent of the whole watershed. The Batavia Reservoir Compound is illustrated on Plate 4 of the Main Report.

2.17 Batavia Reservoir. This measure involves the construction of a detention reservoir (normally dry) on Tonawanda Creek immediately upstream from the city of Batavia, New York. The reservoir would have a dam adjacent to, and upstream from, an embankment of the Lehigh Valley Railroad. Land to be used for the reservoir would include roughly 6,460 acres of farmland, wetland, and woodland. The Batavia Reservoir would intercept runoff from the same part of the Tonawanda Creek Watershed as the Batavia Reservoir Compound.

2.18 Alabama Reservoir Compound. This measure involves the construction of a complex of reservoirs including both storage and detention reservoirs near the hamlet of Alabama, New York, in the Oak Orchard Creek Watershed. It would include eight reservoirs (two storage reservoirs and six detention reservoirs) and a diversion measure to convey floodwater from nearby Tonawanda Creek to the storage reservoirs. The reservoir compound would occupy about 3,000 acres within the northern part of the 5,500-acre Tonawanda Game Management Area. The dikes providing the reservoirs would include 27,000 feet of existing embankments along Feeder Road, Meadville Road, and Wagoner Road (modified as necessary) and 45,600 feet of new earth fill embankments. The dikes would stand about 17 feet above the adjacent flood plain. The Alabama Reservoir Compound would intercept most excess runoff from that part of the Tonawanda Creek Watershed above its inlet structure - a tract of 230 square miles comprising approximately 45 percent of the whole watershed.

Formulation of Plans.

2.19 The various measures previously discussed were evaluated in themselves and in some instances in combination during the Preliminary Feasibility Stage of Study and during early stages of preparation of the Final Feasibility Report. This screening involved nine plans as listed below.

a. Batavia Project Modification - See Paragragh 2.10.

b. Alexander Reservoir - See Paragraph 2.15.

c. Batavia Reservoir - See Paragraph 2.17.

d. Batavia Reservoir Compound - See Paragraph 2.16.

e. Sierks Reservoir - Linden Reservoir - This plan is a combination of both reservoir measures - See Paragraphs 2.13 and 2.14.

f. Batavia Reservoir Compound - Alabama Reservoir Compound - This plan is a combination of both reservoir compound measures - See Paragraphs 2.16 and 2.18.

g. Sierks Reservoir - Alabama Reservoir Compound - This plan is a combination of the two reservoir measures - See Paragraphs 2.13 and 2.18.

h. Nonstructural Base Plan - Discussed as a detailed plan in forthcoming paragraphs.

i. Batavia Reservoir Compound (Modified) - Discussed as a detailed plan in forthcoming sections.

Elimination of Plans.

2.20 During the initial screening process, seven of the nine plans listed above were eliminated from further consideration for the reasons discussed below.

a. Batavia Project Modification Plan - This plan was eliminated as it did not significantly reduce flood damages in the watershed, and because of its extensive environmental impacts to the city of Batavia, New York.

b. Alexander Reservoir Plan - This plan was eliminated early in the evaluation process as its residual average annual flood damages would be high and due to its low average annual net benefits when compared to other plans.

c. Batavia Reservoir Plan - This plan was eliminated during the screening process as it has no net benefits (B/C = 0.99) and due to its extensive social impacts (82 residences to be relocated and 6,460 acres of land to be purchased).

d. Batavia Reservoir Compound Plan - This plan, as originally envisioned, was eliminated from further consideration due to subsurface problems in the vicinity of the lower dam caused by a combination of subsurface soil conditions and the proximity to the Clarendon-Linden Fault System. A modification to this plan was made and is discussed as a detailed plan in forthcoming sections of the FEIS.

e. Sierks Reservoir - Linden Reservoir Plan - This plan was eliminated due to its economic infeasibility (B/C = 0.58).

f. Batavia Reservoir - Alabama Reservoir Compound - This plan was eliminated as it would require using large areas of existing wildlife (waterfowl) marshes to provide flood storage pools (Alabama Compound). It was also generally unacceptable to the public and New York State.

g. Sierks Reservoir - Alabama Reservoir Compound - This plan was eliminated due to its low net benefits when compared to other plans and its extreme environmental impact associated with the Alabama Reservoir Compound.

Plans Considered in Detail.

2.21 Alternative 1 (No-Action). No Action means the Corps of Engineers would do nothing to alleviate flooding in the Tonawanda Creek Watershed. If nothing was done to reduce the flooding problems in the watershed, there would be no expenditure of Federal money for flood management in this area. Inundation of the flood plain would continue to occur, and residents would still experience property damage and personal hardship. Continued flooding would jeopardize the health and safety of floodplain residents. Floodwaters would deposit debris on properties and temporarily cut off transportation routes for movement of emergency vehicles. Lack of adequate flood protection would continue to create a feeling of community insecurity among flood plain residents. Since the threat of significant flooding would continue to be a possibility, sale of homes in the flood plain may be more difficult. In

addition, maintenance to correct flood damages would require expenditures of time and money by landowners and public service agencies, to help restore any damaged property, roadways, drainage ditches, culverts, and utilities. Temporary impacts such as relocation of affected families, disruption of transportation routes, utilities, employment, commercial and farming activities would continue. This alternative plan was not selected because it does not provide for flood management in the Tonawanda Creek Watershed, and because residents within the flood plain would continue to experience property damage, personal hardship and threat to human health and life. In addition, plans exist that could economically provide flood protection within the watershed.

2.22 Alternative 3 - Nonstructural Base Plan. The Nonstructural Base Plan provides for a combination of measures that includes flood warning and emergency action, floodproofing and flood insurance, flood plain management, and permanent evacuation. The total number of units affected in some way by a flood of 100-year magnitude, in the Tonawanda Creek Watershed would be about 4,921. Of these units, approximately 140 would be relocated and 4,507 units would be floodproofed. Remaining units would not require structural alteration due to the structural characteristics of these units (i.e. houses on knolls). Flood warning procedures would be developed to provide flood plain residents with hydrologic information regarding expected timing and severity of flooding. Flood insurance and flood plain regulations would be established in accordance with the National Flood Insurance Program. This alternative plan would be implemented by local communities. Each community would need to establish plans for: (a) flood warning and emergency action to alert local people, (b) coordination and assurance that all homes in flood prone areas are adequately floodproofed to at least the 100-year flood level or 3 feet above the first floor, (c) development of flood plain regulations to limit the amount and type of development in the floodprone areas, in order to qualify under the National Flood Insurance Program, (d) and establishment of a plan to permanently evacuate residents from the flood hazard areas.

2.23 The Nonstructural Base Plan was not selected due to its low B/C Ratio (0.67) and the high level of residual damages that would exist with this plan. It also has high social impact due to the large number of relocations that would be required. This plan has been designated the Least Environmentally Damaging (LED) Plan as it has lesser environmental impacts than the other plans of development.

2.24 Alternative 2 - Batavia Reservoir Compound (Modified). Alternative 2 is the Batavia Reservoir Compound (Modified) Plan with the reservoir dams designed to Probable Maximum Flood (PMF) Standards. Under the PMF design, the plan provides a high degree of flood damage reduction and also a high degree of safety from project failure. The proposed dam sites for the compound are located in the towns of Batavia and Alexander, Genesee County, New York. Due to low topography in the project locale, the earthern dam embankments are relatively low (15-feet upper dam, 10-feet lower dam) when compared to their length.

2.25 As illustrated on Plate 5 of the Main Report, Batavia Reservoir Compound is divided into two distinct parts. The upper dam stretches about 7,435 feet across the Tonawanda Creek Valley. The embankment is designed to function as a spillway with a top elevation of 922.5 feet. The principal outlet works for the upper reservoir consists of a control structure, stilling basin, and an outlet channel. The lower dam is located upstream from the abandoned Conrail Railroad embankment near the city of Batavia. The lower dam extends for about 5,930 feet across the Tonawanda Creek Valley. Principal outlet works are similar to those for the upper reservoir dam. The embankment is designed to function as a spillway, with a top elevation of 900.0 feet.

2.26 Several training dikes would be located along both the east and west sides of the Tonawanda Creek Valley at locations ilustrated on Plate 5 of the Main Report. The purpose of the dikes is to prevent floodwaters held in the Batavia Reservoir Compound from passing through natural drainageways inundating areas adjacent to the reservoir. A gated culvert will be constructed through each dike to provide the necessary interior drainage. Along the east side of the lower reservoir, a dike would run for 1,650 feet across a natural saddle in the Tonawanda Creek Valley. Along the west side of the lower reservoir, three dikes would be located about 500 feet east of Route 98 in the area between Cookson Road and the former Lehigh Valley Railroad embankment. These dikes would run for about 3,670 feet, 840 feet, and 200 feet across low areas to prevent possible overtopping of Route 98.

2.27 The existing Tonawanda Creek Channel within the limits of the reservoir compound would be cleared of snags and debris jams. Dead trees along the channel banks and overhanging, partially uprooted trees would also be removed. This work is expected to restore the creek to a natural channel capacity of approximately 2,000 cubic feet per second in the upper and lower reservoir reaches of the creek, thereby reducing the frequency of minor flooding. The debris removed from the creek channel would be buried in the abandoned sections of the creek channel.

2.28 Under normal flow conditions, both reservoir floodpools would be essentially dry. The normal flows of both Tonawanda Creek and Little Tonawanda Creek would pass through the reservoir areas within their channels. The upper dam is designed to contain a floodpool for the 100-year frequency flood and the floodpool would reach elevation 922.5 with the gates open, before overtopping the spillway. For floods of less than 100-year occurrence and greater than 10-year occurrence, the gates would be operated to control discharges from the upper reservoir at 2,000 cfs, until the reservoir is filled. After this, the gates would be operated to maintain inflow equal to outflow from the reservoir. For floods of less than 10-year frequency, the gates would be operated to minimize downstream flooding.

2.29 The lower reservoir will be operated in a similar manner to the upper reservoir. Floods with a 500-year recurrence interval would fill the floodpool to 900 feet with the gates fully open, before overtopping the spillway. During normal summer rainfall events, the gates would remain fully open. During snowmelt and floods less than a 10-year recurrence interval, the gates will be operated to minimize damage in the lower watershed.

2.30 Due to the large size of the project, a considerable number of relocations, flowage easements, and purchases of property will be needed for construction and operation of the Batavia Reservoir Compound (Modified). The land to be used for the upper reservoir totals about 1,208 acres of farmland, wetland, and woodlands. Of this total, 65 acres would be purchased for construction of the embankment and outlet works. Flowage easements would be obtained for 1,158 acres. Flowage easements would allow continued farming within this area but construction of any new structures would not be allowed. Purchase and removal would be required for eight buildings and residences. The land to be used for the lower reservoir totals about 2,474 acres of farmland, wetland, and woodland. This land would be protected by the upper reservoir from flooding of up to 10-year frequency near the upper dam, and about 2-year frequency near the lower dam. Flowage easements would be obtained for about 2,474 acres, allowing continued farming within the area but no new building construction. Purchase and removal would be needed for 14 residences. Forty-five acres of land would be purchased for construction of the embankment and outlet works. Additional flowage easements would be purchased on 1,616 acres immediately downstream of the lower dam, for a 500-year event or greater spillway.

2.31 Included as part of the recommended project is a mitigation plan to offset the predicted impacts to wildlife resources. The mitigation plan calls for dike improvements to the New York State Department of Environmental Conservation's (NYSDEC) Oak Orchard Wildlife Management Area which is located about 10 miles northwest of Batavia in the town of Oakfield, NY. The improvements are designed to improve the wildlife (primarially waterfowl) productivity of the area to offset the losses of wetland habitat and wildlife resources that are predicted to occur with the Batavia Reservoir Compound. A complete discussion of the mitigation analysis and this mitigation plan can be found in Appendix H, Part 2.

2.32 The abandoned Conrail Railroad Bridge, formerly the Lehigh Valley Bridge, over Tonawanda Creek would be removed in order to improve hydraulic conditions downstream of the lower reservoir. A section of Creek Road in the vicinity of its intersection with the lower embankment would require relocation due to embankment construction. Other roads within the confines of the floodpools will be elevated where necessary to provide access to residences in the areas during floodpool use.

2.33 In accordance with current Corps of Engineers policy on regional flood management projects, specific items of local cooperation are not required since the project cost and maintenance is completely a Federal responsibility. The Batavia Reservoir Compound Plan (Modified) has the greatest net benefits of any of the detailed plans and, therefore, it has been designated the National Economic Development (NED) Plan. It has also been designated as the Selected Plan as it does more to meet the planning objectives of this study than any of the other detailed plans.

Comparative Impacts of Alternatives.

2.34 Table EIS 2.1 describes, in comparative form, the base environmental conditions and the impacts of the detailed plans on the significant resources in the study area. More detailed discussion of the environmental effects of the detailed plans can be found in Section 4 of this FEIS.

Table EIS-2.1 - Comparative Impacts of Alternatives
(Alternative 2 is the Recommended Plan)

Base Condition and Alternatives	Wetlands	Displacement of People	Threatened and Endangered Species	Agriculture	Prime and Unique Farmland	Idle Farmlands	Cultural Resources	Plan Economics
Base Condition	Available: 9,000 acres within 100-year flood plain.	N/A	Within the range of Federal endangered species (Bald Eagle, Peregrine Falcon, Osprey, Bog Turtle).	Available: 18,955 acres in SPF flood plain. Frequent flooding of flood plain lands.	Available: Most of the acreage within the watershed is prime farmland. 18,955 acres of agricultural lands in the flood plain.	Available: 2,890 acres of idle farmlands on floodplain.	Number of sites in flood plain is unknown. Possible disruption by floodwater scouring action.	N/A
Alternative 1: No-Action	No significant impact.	No significant impact.	No significant impact.	No major changes from current trends and practices are expected.	No significant impact. Continuation of flood problems.	No significant change.	Possible disruption by floodwater scouring action.	N/A
Alternative 2: Batavia Reservoir Compound (Modified) PFM Design	Impact:-75 acres (32 acres forested wetland, 33 acres shrub swamp, 10 acres emergent marsh).	22 homes relocated.	No significant impact.	Flood control provided to agricultural acreage within the lower floodpool. 3,754 acres shifted to cash crop production.	Flood control provided to agricultural acreage within the lower floodpool. Downstream areas allowed to be more intensively farmed.	1,933 acres of idle farmland brought into production.	23 sites subject to potential impact by construction and/or flooding.	Total Cost: $29,000,000 Net Benefits: $541,100 B/C Ratio: 1.19
Alternative 3: Nonstructural Base Plan	No significant impact	Approximately 140 homes relocated.	No significant impact.	No major changes from current trends and practices are expected	No significant impact. Continuation of flood problems.	No significant change.	Possible disruption by floodwater scouring action.	Total Cost: $21,180,000 Net Benefits: $-462,800 B/C Ratio: 0.67

3. AFFECTED ENVIRONMENT

3.01 This chapter describes the study area's existing and without conditions in the following discussions:

a. Environmental Conditions. This discussion describes the major characteristics of the study area's natural and human resources to provide a general understanding of physical, ecological, social, cultural, and economic conditions.

b. Significant Resources. This section describes each significant resource included in the Comparative Impacts of Alternatives table (p. EIS-22), including its location, quantity, and quality. In further identifying and characterizing resources, consideration is also given to the following criteria for resource significance:

(1) Resources identified in the laws, regulations, guidelines, or other institutional standards of national, regional, and local public agencies. Resources identified in the guidelines of certain private groups were also considered.

(2) Resources meeting certain study-specific technical criteria for measuring characteristics that may be critical to resource existence. Technical criteria include, but are not limited to, measurement of resource scarcity, fragility, resiliency, reproducibility, and tolerance.

(3) Resources specifically identified as a concern by public interests.

(4) Resources which, if affected by a plan, would violate an institutional standard, meet a study-specified technical criterion, or become the subject of public concern.

Environmental Conditions

3.02 The Tonawanda Creek Watershed, an area of about 648 square miles, is located in Western New York and includes substantial portions of Erie, Genesee, Niagara, and Wyoming Counties and a small portion of Orleans County. The watershed is composed of many tributary watersheds including those of Ellicott Creek and Bull Creek which join Tonawanda Creek, near its mouth at the Niagara River. Tonawanda Creek flows through two physiographic provinces; upstream the watershed is located in the Cattaraugus Hills a part of the Appalachian Upland while downstream the larger part of the watershed is located in the flatter Erie-Ontario lowland. Through most of its lowland length Tonawanda Creek is a sluggish widely meandering warm water stream. The Batavia Reservoir Compound (Modified) would be located between the city of Batavia and town of Alexander in Genesee County, NY. Tonawanda Creek throughout this reach is a slow moving, low gradient meandering stream.

3.03 Vegetation in this area consists of cultivated plants used in dairy farming, and numerous hardwood stands. Interspersed over the area are haylands and pastures. Fields are often used for corn crops and bottom land areas tend to be grown to hardwoods, shrublands and interconnected hedgerows

of trees, shrubs, and weeds. Along Tonawanda Creek itself trees most often encountered are Eastern Cottonwood, Box Elder, and Black Willow. Numerous wetlands are scattered through the area.

3.04 Fish in Tonawanda Creek, particularly in lowland areas, tend to be of the warm water variety. Northern pike, smallmouth bass, and largemouth bass are the most common game species. Common forage species include common shiner, bluntnose minnow, and various suckers. Fishing does not appear to be a major recreational pursuit along the area of Tonawanda Creek near the Batavia Reservoir Compound (Modified). Mammals of the area are typical of the northeast and include white-tailed deer, raccoon, and cottontail rabbit. Over 384 species of birds have been recorded in the Niagara Frontier region. Nearby Federal and State Refuges attract significant numbers of waterfowl, particularly Canada Goose, during spring and fall migrations.

3.05 In 1970, about 112,800 persons resided in the Tonawanda Creek Watershed area. The largest cities within the watershed are Batavia (1980 population of 16,703); Lockport (24,844); Tonawanda (18,693) and North Tonawanda (35,760). Population growth has been rather stable in the upstream rural areas of the watershed. In the western (downstream) parts of the watershed near the Buffalo Metropolitan Area, suburban areas have undergone rapid population growth.

3.06 In rural areas of the watershed, farming, lumbering, and mining are the primary industries. Construction and manufacturing are the largest industries in the western areas of the watershed close to the Buffalo Metropolitan Area.

Significant Resources

3.07 Wetlands. Many acres of wetlands, primarily wooded wetlands and shrub swamps, exist within the Tonawanda Creek Watershed. Within the confines of the 100-year flood plain from the mouth of Tonawanda Creek upstream to the area of the upper reservoir for the Batavia Reservoir Compound (Modified) over 9,000 acres of wetlands are known to exist. The remainder of this discussion will focus upon wetlands within the confines of the Batavia Reservoir Compound (Modified).[1/]

3.08 Primary wetlands within the Batavia Reservoir Compound (Modified) are forested wetlands, emergent marshes, and shrub swamps. Wet meadows and small areas associated with railroad rights-of-way also frequently support wetland vegetation. Table EIS-3.1 below presents a compilation of total wetland acreage within the Batavia Reservoir Compound (Modified).

1/ More detailed information on wetlands in this area can be found in the U.S. Fish and Wildlife Service Coordination Act Report dated 23 October 1980 (Appendix H, Part 3).

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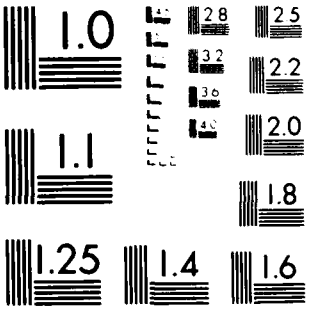

Table EIS-3.1 - Wetland Types and Acreage Within the Batavia Reservoir Compound (Modified)[1/]

Wetland Type	Upper Pool (acres)	Lower Pool (acres)	Total (acres)
Emergent Marsh	108	89	197
Shrub Swamp	125	319	444
Forested Wetland	196	908	1,104
Totals	429	1,316	1,745

3.09 Forested wetlands vary from permanently flooded to seasonally dry. The wettest areas are dominated by green ash, silver maple, red maple, and willow. Other species associated with wet areas include silky dogwood, buttonbush, slippery elm, honeysuckle, water parsnip, water plantain, cardinal flower, and fringed loosestrife. Drier sites are dominated by American beech, shagbark hickory, bitternut hickory, red oak, white oak, and sugar maple. Other species in dry sites include silver maple, green ash, choke cherry, ironwood, witch-hazel, buckthorn, hawthorne, wild grape, wild rose, woodbine, Christmas fern, blue cohosh, enchanter's nightshade, beggarticks, and May-apple. Forested wetlands have a diverse fauna associated with them and are an important component of the terrestrial ecosystem, providing many nesting sites for birds, denning sites for snakes and mammals, and cover for terrestrial amphibians.

3.10 Emergent marshlands typically have a mixture of open water and several species of cattail. Other plants found in association with cattail marshes were willow, purple loosestrife, yellow iris, white iris, water parsnip, water hemlock, nightshade, sensitive fern, and various horsetails, sedges, and grasses. These areas usually have some standing water throughout the year and have much intrinsic value to wildlife. Some species, including many frogs, toads, salamanders, and birds, require these areas for their seasonal breeding activities and for the development and the raising of young. Other species, such as barn swallows, tree swallows, and kingfishers, use these areas solely for feeding, whereas fish, green frogs, bullfrogs, water snakes, aquatic turtles, and some birds are year-round residents. Migrating waterfowl, herons, and shorebirds use these areas extensively in spring and fall.

1/ According to the USF&WS Coordination Act Report.

3.11 Shrub swamps are comprised of woody species such as red-osier dogwood, silky dogwood, arrow-wood, buckthorn, slippery elm, hawthorne, willow, eastern cottonwood, and white and green ash. Herbaceous species present include purple loosestrife, yellow iris, bindweed, Joe-Pye-weed, and various grasses, sedges, and legumes. Wildlife use is extensive and many resident and non-resident species have been observed in these areas. Most shrub species provide an important winter food resource for resident birds and mammals, and for migrant birds in spring and fall.

3.12 Wet meadows are the most homogeneous of existing cover types and are dominated by introduced species of yellow and white iris. Other plants found in association with the iris were skunk cabbage, purple loosestrife, and various sedges and grasses. Few vertebrates were found in association with this cover type and those that do occur are usually associated with open water pools, or are only seasonally present. Gray treefrogs, leopard frogs, bullfrogs, kingbirds, bobolinks, red-winged blackbirds, barn swallows, spotted sandpipers, mallard ducks, and muskrats have been found in association with this cover type in late spring and summer, and migrating shorebirds and waterfowl have been observed to make extensive use of these areas in spring and fall.

3.13 Railroad rights-of-way possess a diverse floral association that includes forests, shrublands, and old-field herbaceous situations. Species most intimately associated with these rights-of-way include hawthorne, slippery elm, staghorn sumac, willow, box-elder, common elderberry, arrow-wood, buckthorn, red-osier dogwood, woodbine, and wild grape. Herbaceous species found were numerous and include teasel, milkweed, Queen Anne's lace, poison-ivy, cow parsnip, touch-me-not, sorrel, curled dock, and various grass species. The faunal component was equally diverse, while the diversity of both the flora and fauna seemed richest on the unmanaged and abandoned rights-of-way.

3.14 Threatened and Endangered Species. A number of plant and animal species, whose existence is considered to be in peril, have present or prior natural ranges which encompass the Tonawanda Creek Watershed area. These species are protected by the Federal Government under the Endangered Species Act of 1973, as amended and by New York State under the Environmental Conservation Law. Only four endangered species have much possibility of occurring in the vicinity of the proposed Batavia Reservoir Compound (Modified) area. These four are the: (1) Bald eagle (Haliaeetus leucocephalus); (2) Peregrine falcon (Falco peregrinus); (3) Osprey (Pandion haliaetus); and (4) Bog turtle (Clemmys muhlenbergi). No recent observations of any of these four species as breeding individual have been made in the project area. Any of the three species of birds are likely to be seen at various times in the area due to their wide ranging migratory and transient movements. However, no habitat, that could be considered critical to their survival has been identified within the confines of the Batavia Reservoir Compound (Modified).

3.15 Agriculture. Large amounts of land within the Tonawanda Creek Watershed are used for agriculture. About 450 square miles of 648 total square miles of land in the watershed are classified as agricultural. Much of this land has been abandoned in recent years for various reasons, however, current agricultural activity, primarily dairying, cultivation of cash crops and field crops (corn, wheat, oats, etc.), is still one of the major industries of the watershed, particularly in Genesee and Wyoming Counties. Some of the best agricultural lands exist within the flood plain of Tonawanda Creek, however, frequent flooding and lack of adequate drainage prevents more intensive cultivation in these areas. Flooding for lengthy periods, often running several weeks, saturates the land, delays spring planting and the use of pasture, and in some cases restricts production to a single crop where two crops might be possible. About 18,955 acres of land on the Tonawanda Creek SPF flood plain were devoted to agriculture in 1978. Of this, about 77 percent (14,640 acres) were devoted to crops. About 3,810 acres of land are agricultural within the confines of the Batavia Reservoir Compound.

3.16 Idle Agricultural Lands. Based upon the economic evaluation used in this Final Feasibility Report, idle agricultural lands within the Tonawanda Creek Flood Plain are areas that had been cultivated at the time of a 1968 land use survey but were not cultivated in 1978. In upland areas of the Tonawanda Creek Watershed, large acres of similarly idled land and farmlands abandoned for upwards of 40 years also exist. Generally, upland agricultural lands have less productive soils and have reverted through natural succesion to heavy brush or woodlands. Idle agricultural lands in the flood plain have been cultivated more recently, i.e. since 1968, for low value crops such as hay, oats, buckwheat. Flood plain areas have highly productive soils but they suffer considerable flood damage. Most of the idle acreage on the flood plain has been plowed within the last 5 to 6 years and could be returned to agricultural production quickly and easily. The total acreage classified as agricultural within the Tonawanda Creek Watershed amounts to about 286,000 acres. Within the SPF flood plain, 18,955 acres are classified as agricultural of which 2,890 acres are idle.

3.17 In terms of wildlife habitat values, brushy or heavily wooded upland areas provide good habitat for numerous wildlife species. For instance, deer can use these areas for food sources and cover as well as over wintering areas. Idle agricultural areas in the flood plain provide less valuable habitat as they are generally grassy open fields that may support large numbers of rodents and rabbits. Occasional plowing for various agricultural reasons further disrupts habitat value. Considerable discussion of the relative habitat value of flood plain idle agricultural areas is contained in Appendix H, Part 2.

3.18 Prime and Unique Farmland. Throughout the entire Tonawanda Creek Watershed and particularly in Genesee County, large agricultural tracts classified as prime farmland by the U.S. Soil Conservation Service (SCS) exist. Unique farmland is found in smaller tracts. Based primarily on soil characteristics, prime farmland is defined as land best suited for producing food, feed, forage, fiber, and oilseed crops. Unique farmland is land other than prime farmland that is used for producing specific high value crops such as

grapes, fruits, or vegetables. Based upon maps produced by SCS, it appears that almost all the lands, with the exception of wetland areas, within the Batavia Reservoir Compound and along downstream areas of Tonawanda Creek are prime farmlands.

3.19 Cultural Resources. Numerous prehistoric and historic cultural resources sites exist within the Tonawanda Creek Watershed. The Buffalo District contracted with the Public Archaeology Facility at SUNY-Binghampton to conduct a Phase I cultural resources survey of the Batavia Reservoir Compound (Modified). As a result of this survey, 23 new archaeological sites were recorded. Sixteen of these sites were prehistoric and six sites consisted of historic foundations. Appendix H, Part 4 gives further information on cultural resources in the project area as well as correspondence letters with cultural resource agencies.

4. ENVIRONMENTAL EFFECTS

4.01 This chapter describes the effects of each detailed plan on the previously described significant resources. It contains a detailed analysis of the environmental consequences of each alternative, including the Selected Plan, and provides backup analysis for the Comparative Impacts of Alternatives Table (p. EIS-22).

4.02 Section 102 of the Rivers and Harbors Act of 1970 (PL 91-611) requires that impacts to certain resources be identified and evaluated. The effects of the detailed plans on the Section 122 resources are also discussed here.

ALTERNATIVE 1 - NO ACTION

Social Effects.

4.03 Displacement of People. Under this alternative, no residences would be permanently relocated. However, some people would continue to be temporarily displaced from their homes due to flooding and the resultant threat to their safety and well-being, as well as property damage.

4.04 Community Cohesion. Under this alternative, flooding problems in the watershed would not be reduced. Floodwaters and water deposited debris would temporarily cut off transportation routes possibly stranding or separating portions of the community or individual families from needed public facilities and services, such as emergency vehicles or hospitals. Daily life routines would be temporarily interrupted, such as the ability to get to work, thus impacting on the functioning of the community. Lack of adequate flood protection would continue to create a feeling of community insecurity among flood plain residents.

4.05 Housing. No homes would be permanently relocated under this alternative. Homes would continue to be inundated during times of flood, possibly experiencing property damage. Since the threat of significant flooding would continue to be a possibility, sale of homes in the flood plain may be more difficult.

4.06 Desirable Community Growth. No significant impact.

4.07 Health and Safety. Continued flooding would jeopardize the health and safety of flood plain residents. There is a possibility sewage treatment systems could fail, or the potable water supply would not be adequate, increasing the risk of disease. Also, access to emergency vehicles and services, such as hospitals could be temporarily cut off. Residents could become stranded in their homes, creating possible problems with heat, food, and personal health.

4.08 Transportation. Under this alternative, no action would be taken to alleviate flood conditions. Floodwaters would continue to temporarily cut off transportation routes for movement of traffic, including emergency vehicles. This could, in effect, cut off portions of the community, isolating them from needed services.

4.09 Noise. No significant impact.

4.10 Aesthetics. Under this alternative, floodwaters would continue to deposit debris, silt and gravel on properties, which would not be aesthetically pleasing.

4.11 Cultural Resources. Any archaeological sites located along the banks of Tonawanda Creek could be disrupted by floodwater scouring action caused by creek flows of increased velocity, thereby precluding salvage or protection of any such cultural resources in the future.

Economic Effects

4.12 Tax Revenues and Property Values. The No Action Plan would have only a minor effect on existing property values. Some homes that are severely damaged by flooding would not be rebuilt by their owners, resulting in losses of property value and secondarily tax revenues to the affected communuties.

4.13 Desirable Regional Growth, Public Facilities and Services. If nothing was done to reduce the flooding problems in the watershed, inundation of the flood plain would continue to occur, and residents would still experience property damage and personal hardship. Floodwaters would deposit debris on properties and temporarily cut off transportation routes for movement of emergency vehicles. Since the threat of significant flooding would continue to be a possibility, sale of homes in the flood plain may be more difficult. In addition, maintenance to correct flood damages would require expenditures of time and money by landowners and public service agencies, to help restore any damaged property, roadways, drainage ditches, culverts, and utilities. Temporary impacts such as relocation of affected families, disruption of transportation routes, utilities, employment, commercial and farming activities would continue.

4.14 Agriculture. No major changes from current trends and practices are expected.

4.15 Employment/Labor Force. No significant impacts.

4.16 Business and Industrial Activity. No significant impacts.

4.17 Plan Economics. The No Action Plan implies no cost to the Federal Government to provide flood control on the Tonawanda Creek Watershed. This plan has no net benefits and no benefit to cost ratio.

Environmental Effects

4.18 Air Quality. No significant impact.

4.19 Water Quality. High floodwater velocities would continue to result in high stream turbidity levels.

4.20 Wetlands. No significant impact.

4.21 Threatened and Endangered Species. No significant impact.

4.22 Habitat. Fish and wildlife habitat would continue to be susceptible to flood damages. Environmental degradation of the streambed areas would continue unchecked with frequent slumping, and consequent erosion/deposition problems.

4.23 Vegetation. High floodwater velocities would continue to destroy and dislodge streambank vegetation. Overbank flooding would continue to deposit silt and gravel on the flood plain and inhibit or destroy natural vegetation.

4.24 Erosion. Natural erosive forces would result in the continued loss of streambank areas and prime and unique farmland soils.

ALTERNATIVE 2 - BATAVIA RESERVOIR COMPOUND (MODIFIED)

Social Effects.

4.25 Displacement of People. The primary social effect associated with this plan would be the required relocation of 22 homes within the boundaries of the upper and lower floodpools.

4.26 Community Cohesion. Community cohesion will be enhanced by this alternative, in that the degree and incidence of flood events will be reduced. People will no longer be isolated due to flooded roads and residents will have a greater sense of security about living in the flood plain area. A negative impact of this plan is the fact that 22 residences will have to be relocated. Movement could be either to nearby areas just outside the Batavia compound project zone, or to more distant areas that would necessitate readjustment to new neighborhood conditions and to new transportation routes to work.

4.27 Housing. There will be a negative impact on housing, under this alternative, in that 22 residences will have to be relocated. A positive impact is that protected homes, in the watershed, may be easier to sell, and their market values increased because they are no longer subject to flooding. New housing developments may also be built due to the flood protection provided by the project.

4.28 Desirable Community Growth. No significant impact.

4.29 Health and Safety. The safe construction and operation of the dams and reservoirs is a concern to many, particularly those in the City of Batavia located immediately downstream of the lower dam. The dams and lateral training dikes are constructed not to fail. The dams consist of a clay, impermeable core, a permeable outer layer, and will be covered with erosion protection stone. In addition, the reservoirs are normally dry holding water on the average only several days per year. The dams have been designed to withstand the probable maximum flood (PMF design) and due to their low height

and the hydraulic capacity of Tonawanda Creek through Batavia, no catastrophic flooding would occur in Batavia even if they failed. Considerably more detail on the dam design is contained in Appendix D.

4.30 This plan will provide a suitable level of protection to ensure human safety. The plan will provide 500 year protection in the City of Batavia and downstream on the remainder of the Erie Plain, and 1-10 year protection on the Huron Plain floodlands. This degree of protection will enhance human health by reducing frequent floods which promote disease and health hazards. Construction activities and use of heavy equipment would create a temporary potential safety hazard to those who may be present at the worksite. However, general safety requirements as outlined in various Corps of Engineer safety manuals, would be used as guidelines to implement necessary safety procedures.

4.31 Transportation. No primary north-south or east-west roads will be disrupted by this project. For the most part, transportation would be enhanced under this alternative, since most secondary roads would no longer experience flooding. A short section of Peaviner Road (a County road), including a bridge on the road, would be relocated (realigned) at Federal cost. Also, a short section of Creek Road will be realigned. In some cases, homes exist near the margins of the maximum floodpool and are located physically above the level of the maximum flood but have access roads that would be covered with water during flooding. Where possible, these roads will be elevated to allow continued access to the homes during floodpool usage.

4.32 Construction activities could temporarily disrupt vehicular traffic flows and patterns in the proposed compound vicinity. Such disruptions would be localized and of low-magnitude due to the distance of the construction areas from major urban zones. Short-term detours might be required to avoid potential interference and safety hazards that would result from the presence of automotive traffic in close proximity to construction equipment. Possible interruption of local travel routes during construction might temporarily affect some business activity at commercial facilities in Batavia and Alexander.

4.33 Noise. Use of heavy equipment for clearing debris jams and snags, excavation, filling, grading, and hauling of materials would cause temporary noise, in the general vicinity of the project site. This would include work activities on access roads and rights-of-way.

4.34 Aesthetics. Disturbance of the environment by construction activity in the project locale would cause temporary unsightliness in the existing rural setting. Use of heavy equipment for clearing debris jams and snags, excavation, filling, grading, and hauling of materials would cause temporary mud and dust in the general vicinity of the project site. Lands cleared during construction would alter the existing rural setting. The spillway, dams, and dikes constructed on grubbed and cleared lands would be reseeded with an appropriate seed mixture, to help mitigate impact on the rural aesthetic appearance. The construction of the two dams and associated reservoir flooding will significantly change the aesthetics of the project location. The dams are rather low (maximum of 10 to 15 feet) and long. They will appear much as railroad embankments currently do, that pass through the area except when in close proximity to the dams and outlet works.

4.35 A beneficial aesthetic impact that could be expected after construction, is the anticipated reduction in deposition of debris, silt and gravel downstream of the upper dam.

4.36 Cultural Resources. Twenty-three archaeological sites were recorded as present within the limits of the maximum floodpools of the Batavia Reservoir Compound (Modified). All of the 23 sites are subject to potential impact by the project, either by direct impact of construction of the dams and lateral training dikes, or indirectly by flooding when the floodpools are in use. Therefore, during Advanced Engineering and Design phases of the Tonawanda Creek Study, intensive investigations will be conducted. If the project were implemented, flood damage protection would be provided to known and unknown cultural resources in downstream floodlands of the Tonawanda Creek Watershed. However, it is also possible that the flood protection provided to downstream floodlands could be followed by some increased development, which in turn may have an impact on any unknown cultural resources.

Economic Effects

4.37 Tax Revenues and Property Values. November 1982 estimates place the loss of tax assessable property at about $640,000 ($496,000 in Alexander and $140,800 in Batavia) as a result of project land acquisition. The initial annual tax loss is estimated to be about $10,700. It is expected that land values will increase as a result of the flood control and increased agricultural production provided by the project. Many owners of purchased homes are expected to relocate back in the same towns. These actions should more than off-set the predicted tax loss.

4.38 Desirable Regional Growth, Public Facilities and Services. The nature of future residential, commercial, industrial, transportation, or other developments and expansions will be regulated by local land use plans and zoning laws, investment opportunities, population changes, and other factors. The Batavia Reservoir Compound (Modified) Alternative would reduce the expenditures of time and money by landowners and public service agencies, needed to correct flood damages, as described in Paragraph 4.13, No Action Alternative.

4.39 Agriculture. A major benefit of the Batavia Reservoir Compound (Modified) is that by providing flood control to agricultural acreage within the lower floodpool and in downstream areas, farmers will be allowed to more intensively farm the high quality soils located in the Tonawanda Creek flood plain. It is predicted that 3,754 acres of agricultural land that is idle or used primarily for pasture and the production of buckwheat will be shifted to the production of corn cash crops and other more valuable farm products. Additional expenditures by farmers for drainage, fertilizer, seeds, etc., will result in greater yields of produce per acre and higher profits per acre for the farmer.

4.40 Implementation of the project will require the removal of 22 homes (mostly farmsteads) within the compound, however, farmers will still be allowed to use their lands for farming in the area. Clearing and snagging of

Tonawanda Creek throughout the reservoir compound will actually reduce average annual agricultural damages in the lower reservoir. Farmers will be inconvenienced to some degree there, however, as they will not be allowed to live in close proximity to their farmlands.

4.41 Employment/Labor Force. Employment would be benefited due to construction of the project due to the need for construction personnel during project implementation. The exact nature of any long-term effects of such a short-term economic stimuli are difficult to predict. However, in view of the current slump in the construction trades, construction related employment and spending could enhance long-term business activity, and increase tax revenues derived from such sources. After project construction, two persons would be required on a full-time basis to operate the project. In addition, maintenance of the project in the future would create some additional employment opportunities.

4.42 Business and Industrial Activity. Provision of flood control with the Batavia Reservoir Compound (Modified) would enhance the value of existing business and industrial activity in the Tonawanda Creek flood plain. As previously discussed, farm production would be intensified. Assuming that most construction materials for the project would be purchased locally, local and regional business activity would be enhanced by project construction. Construction workers and equipment will be needed for the project although it is not known if they would work for a locally based company.

4.43 Land Purchase and Flowage Easements. Construction of the Batavia Reservoir Compound (Modified) will require the purchase of 110 acres of land to construct the dams and outlet works. This land will become the property of the Federal Government. In addition, 22 homes will be purchased that are in the confines of the upper and lower reservoir floodpools. Permanent flowage easements will be purchased on about 1,158 acres in the upper reservoir; 2,474 acres in the lower reservoir; and 1,616 acres in the spillway. Flowage easements allow the Corps to use the land for occasional water storage or flowage across the land. The owner of the land would retain his ownership, but development would be restricted. No occupied houses would remain and other buidings could remain only if solidly built and at the owners risk. Farming and other practices that do not intefere with flowage easements would be allowed on the land.

4.44 Project Economics. The Batavia Reservoir Compound (Modified) has a total first cost of $29,000,000. It has average annual costs of $2,878,000 which includes $420,000 for operations and maintenance. The project has average annual benefits of $3,419,100 and net benefits of $541,100. The project's benefit to cost ratio is 1.19.

Environmental Effects

4.45 Air Quality. The operation of heavy construction equipment would result in a temporary degradation of local air quality. Corps of Engineers specification CW 01430, dated June 1978 "Civil Works Construction Guide Specifications for Environmental Protection" requires that all emitted water, atmospheric and noise pollutants are to be in compliance with Federal, State,

and local standards. The Contractor would be required to abide by the general requirements outlined in the aforementioned specification, and therefore, no significant impact on air quality is anticipated.

4.46 Water Quality. Snagging and clearing operations, and the construction of dry dams, lateral dikes, and outlet works would result in an increase in turbidity levels in the creek in the immediate vicinity of and downstream from project construction and maintenance activities. The Contractor would be required to mitigate soil loss into the creek by seeding and mulching disturbed banks as soon as possible. After project completion, some improvement in water quality can be expected due to a reduction in peak flows. However, despite the settling out of suspended particulates in the reservoirs, some of the material would be resuspended by waters leaving the reservoirs.

4.47 Wetlands. Based upon a Corps of Engineers Analysis (Appendix H, Part 2) it is predicted that about 75 acres of wetland habitat will be lost as a result of construction of the Batavia Reservoir Compound (Modified). This alternative will have no significant impact on wetlands located downstream of the Batavia Reservoir Compound (Modified). These wetlands are created and fed primarily by poor drainage in the area, as well as from tributaries and streams located downstream of the compound, and not by overbank flooding of Tonawanda Creek. Therefore, these wetlands are in no danger of having their water source cut off by the retention of floodwaters in the Batavia Reservoir Compound (Modified).

4.48 Threatened and Endangered Species. As indicated in Paragraph 3.14, no threatened or endangered species are subject to impact from the proposed project.

4.49 Habitat. Construction of the Batavia Reservoir Compound (Modified) would result in the loss of about 75 acres of wetland habitat and an additional 83 acres of cropland and pasture habitat. Detention of water in the compound during floods of roughly Probable Maximum Flood magnitude, would result in a slightly broader area of wildlife habitat being temporarily inundated than under existing conditions. This flooding could destroy or render temporarily unusable nesting and cover habitat. Riparian habitat would be reduced by snagging and clearing operations. The removal of snags, debris, and associated sediment deposits would reduce both the availability and the diversity of aquatic habitats for macro-invertebrates, fish, frogs, and turtles. Increased stream turbidity during construction would temporarily reduce sunlight penetration, thereby affecting plant photosynthesis, food chains, and cause some fish to temporarily avoid the project area.

Currently idle agricultural areas (see paragraphs 3.16 and 3.17) within the lower reservoir and in downstream areas on the flood plain would be converted to active agriculture with the project. It is predicted that if the project is constructed, 1,933 acres of the 2,890 (66.9 percent) currently idled acres would be converted back to active crop production. Upland idle areas are not idled due to flooding. Therefore, the project would not have an effect on these areas. The conclusions of the mitigation analysis (Appendix H, Part 2)

are that the loss of 75 acres of wetland habitat is significant and should be offset by an appropriate mitigation plan as discussed there. In addition, the analysis concludes that short term flooding in the reservoir compounds would not have a significant effect on wildlife and their habitats. No significant effects on wildlife are expected as a result of the shift of 1,933 acres of idle agricultural flood plain lands to active production.

4.50 Vegetation. Some unavoidable soil compaction from the use of construction equipment could be expected; such compaction could inhibit or delay the establishment of vegetation. Lands cleared during construction by grubbing and clearing would eliminate existing woody and herbaceous vegetation along selected stream sections. Streambank activities necessary for snag removal would disturb riparian vegetation that both stabilizes the creek banks and provides wildlife cover. The streambanks, spillway, dams, and dikes would be reseeded with an appropriate seed mixture to help mitigate this impact and to help provide shaded stream sections for fish and herbaceous vegatation for wildlife.

4.51 Erosion. Damaging floodwater veolicites that scour and erode prime and unique farmland soils, destory and dislodge vegetation, and deposit silt, sedimment, and debris over the land would be reduced in the flood plain.

ALTERNATIVE 3 - NON-STRUCTURAL BASE PLAN

Social Effects.

4.52 Displacement of People. Under this alternative, approximately 140 homes would be required to be relocated.

4.53 Community Cohesion. Under this alternative, disruption from flooding in the watershed would continue. Roads would still flood, possibly stranding persons or cutting off one portion of the community from another, as well as from emergency vehicle and services access. Daily life routines would be interrupted including the ability to get to and from work. Permanent evacuation in the highly developed residential areas would have a considerable negative impact on community cohesion. This measure is unacceptable to many residents having strong historical ties to their homes and community.

4.54 Housing. Under this alternative, approximately 140 homes will have to be relocated, and about 4,508 units would be floodproofed. Appearances of structures would be affected to some degree by floodproofing. This may have some effect on resale value. New housing developments would have to be constructed in accordance with flood plain regulations.

4.55 Desirable Community Growth. No significant impact.

4.56 Health and Safety. A flood warning system requires installation of early warning equipment to monitor stream flow. Local funds would be used to install, maintain, and operate such equipment. This plan is not very reliable, because there is the possibility that the warning system could break down, thereby precluding prompt dissemination of flood warning information to area residents. Also, funding to operate the system may not always be available to local interests. People have to be available to carry out

emergency actions. Property loss would still occur when people are away from their homes, or do not have the means to carry out the emergency actions within the limited time provided by warnings. This plan provides varying degrees of protection to floodlands of the watershed. There would be about 24 to 36 hours to implement early warnings and emergency actions to protect life and property effectively in the City of Batavia. Adequate facilities for feeding, housing, and health care of flood victims would have to be made available. An emergency plan would have to be developed, practiced and implemented when required.

4.57 The benefit of floodproofing depends upon the abilities and inclinations of people to place floodproofing closures in time. Such closures could be temporary or permanent. Effectiveness of floodproofing depends largely on such factors as depths and durations of flooding around floodproofed structures and on velocities and debris loads of flood flows. Flooding of significant depth and duration could affect the social well-being of residents on floodproofed properties by stranding persons in flooded areas, thereby possibly creating significant problems with regard to food, heat, and personal health. It is possible for a greater flood to occur than the degree of floodproofing protection, thereby creating risk of serious danger to persons stranded in their homes. Flooded roads make access difficult for fire and emergency equipment and public utility services. It is possible for floodwaters of significant depth and duration to cause the walls of floodproofed structures to fail. High velocity currents could erode or overload floodproofed structures; accordingly, in some substructures, this measure might induce flood-related losses greater than those without floodproofing protection. In addition, floodproofing measures are not dependable protection against fast-flowing, debris-laden floodwater. Although floodproofing is more economically applied to new construction, it is also applicable to existing structures.

4.58 The time available for placing temporary floodproofing structures is dependent upon the flood warning time. In the upstream areas of the watershed, such as in Alexander and Attica, the warning time is normally too short to implement a flood warning system. In the areas downstream of Batavia, particularly in the Wolcottsville and Rapids area, there is adequate time to install temporary protective measures. Also, people would have to be available at the time to take temporary floodproofing actions. If floodproofing were implemented, flooding outside the protected area would still occur.

4.59 By having flood insurance, property owners would feel some degree of financial security. However, flood damages to existing structures and properties would still occur. With continued flooding, backflow of sanitary sewers into residential areas during flood periods could be a safety hazard to public health. Only those individuals that purchased flood insurance would be benefited after the flood event.

4.60 Development and implementation of flood plain regulations would control the extent and types of future development in the flood plain. This would reduce the threat to public health and safety in time of flooding and

offer protection from personal loss or injury that may result from flooding. However, continued flooding could create problems to public health in the community. This plan would provide 100-year degree protection for residences and commercial sites in the flood plain.

4.61 Transportation. Floodwaters would continue to temporarily cut off transportation routes for movement of traffic, including emergency vehicles. This could, in effect cut off portions of the community, isolating them from needed services.

4.62 Noise. No significant impact.

4.63 Aesthetics. Under this alternative, floodwaters would continue to deposit silt, debris, and gravel on properties, which would not be aesthetically pleasing. The appearances of properties and structures would be affected to some degree by floodproofing.

4.64 Cultural Resources. Any archaeological sites located along the banks of Tonawanda Creek could be disrupted by floodwater scouring actions, caused by creek flows of increased velocity, thereby precluding salvage or protection of any such cultural resources in the future.

Economic Effects

4.65 Tax Revenues and Property Values. Implementation of the Nonstructural Base Plan would require floodproofing of about 4,500 homes and permanent removal of about 140 homes. Tax revenues would be lost from the 140 residences removed. Floodproofing measures such as sandbagging and structural renovation of older homes are not usually aesthetically appealing and do not significantly increase the value of a home. Many residences would still suffer damages from flooding which might lead to decreases in their value.

4.66 Desirable Regional Growth, Public Facilities and Services. A number of residences would be removed and no new development would be allowed within the limits of the 100-year flood. There would be considerable demand for public services and aid to provide post-flood cleanup and any necessary emergency services during flooding. Flooding could cause some interruption of public services such as power, ambulance, police, and fire protection. Only those individuals that purchased flood insurance would be benefited after the flood event. However, this would not eliminate the clean-up required after the flood, nor the time and effort to replace damaged property.

4.67 Agriculture. No major changes from current trends and practices are expected.

4.68 Employment/Labor Force. No significant impact.

4.69 Business and Industrial Activity. No significant impact.

4.70 Plan Economics. The Nonstructural Base Plan would have a total first cost of $21,180,000 based upon 1976 price levels. It has negative net benefits of -$462,800 and has a benefit to cost ratio of 0.67.

Environmental Effects

4.71 Air Quality. No significant impact.

4.72 Water Quality. High floodwater velocities would continue to result in high stream turbidity levels.

4.73 Wetlands. No significant impact.

4.74 Threatened and Endangered Species. No significant impact.

4.75 Habitat. Fish and wildlife habitat would continue to be susceptible to flood damages. Environmental degradation of the streambed areas would continue unchecked with frequent slumping, and consequent erosion/deposition problems. Permanent evacuation and the implementation of flood plain regulations could help prevent the encroachment of more intensive land uses on wildlife habitat and natural sites.

4.76 Vegetation. High floodwater velocities would continue to destroy and dislodge streambank vegetation. Overbank flooding would continue to deposit silt and gravel on the flood plain and inhibit or destroy natural vegetation.

4.77 Erosion. Natural erosive forces would result in the continued loss of streambank areas and prime and unique farmland soils.

5. LIST OF PREPARERS

5.01 The following people were primarily responsible for preparing this Environmental Impact Statement:

Name	Discipline/Expertise	Experience	Role in Preparing EIS
Mary Jo A. Braun	Political Science/ Social Science	4 years, EIS studies, Buffalo District, 1/2 year Permit Processing, Buffalo, District	Socioeconomic Impacts
William E. Butler	Geography, Physical Science	1 year, cartographic aid, Bureau of Land Management, 3 years EIS studies, Buffalo District	Socioeconomic, Biological Resources Impacts
Philip E. Berkeley	Biology	8 years, EIS studies, Buffalo District	EIS Coordinator, Biological Impacts, Fish and Wildlife Mitigation

6. PUBLIC INVOLVEMENT

6.01 This section describes public involvement in the study and how public views guided and were incorporated into the study's decision-making process. It is presented in the following five discussions:

a. Public Involvement Program. This discussion describes the means used to involve the public in the study and the major results of such involvement, including scoping activities.

b. Agency Coordination. This section describes required coordination with other agencies and groups.

c. Statement Recipients. This section lists agencies, groups, and individuals to whom copies of the EIS were sent.

d. Public Views and Responses. This section describes public views that have had a major influence on the study and how such views were incorporated into the study's decision making process.

e. Required Coordination Remaining. This section describes remaining required coordination.

Public Involvement Program

6.02 A minimum of 20 Corps-sponsored or attended meetings were held between November 1975 and December 1982 to develop alternative plans; formulate the plans; and provide information and a forum for questions. A public meeting was held on 20 November 1975, at the Batavia High School Auditorium in Batavia, NY, to present preliminary alternative plans for flood management in the Tonawanda Creek Watershed. Public workshops were also held on 24 February 1976 (Alexander Fire Hall) and on 25 February 1976 (Town Hall in the city of Batavia), to obtain local views on the Batavia Reservoir Compound alternative. A similar workshop was also held for local governmental officials on 12 March 1976, at the County Legislative Chamber, County Building, at Main and Court Street in Batavia, NY. A fourth workshop meeting was held in Pendleton to discuss alternative flood management plans with officials in the lower Tonawanda Creek area. Numerous meetings have been held with representatives of Genesee County and State and Federal agencies during the final planning of the Batavia Reservoir Compound from 1979 until the present.

6.03 Two public meetings were held during November 1979 to present the modified plan for the Batavia Reservoir Compound to concerned individuals and groups. The meeting of 8 November 1979 was held in the city of Batavia, NY, and jointly coordinated by the Corps and the city of Batavia and Genesee County. The meeting of 16 November 1979 was held in Clarence, NY, and jointly coordinated by the Corps and the Erie-Niagara Counties Regional Planning Board. The meetings were informal and no transcripts of the meeting were made.

6.04 The Division Engineer's Notice was distributed to the public on 31 July 1982. During the time period, August 1982 through December 1982, Buffalo District conducted three public information meetings in Batavia, NY, at the request of the Genesee County Legislature and provided technical support at two NYSDEC public information meetings.

Agency Coordination

6.05 Fish and Wildlife Coordination - The Buffalo District and the Cortland Field Office of the U.S. Fish and Wildlife Service jointly conducted fish and wildlife field studies of the Batavia Reservoir Compound area. Much of the data generated was used to conduct a Habitat Evaluation Procedures (HEP) analysis of the impacted habitats. The majority of the field work was conducted during the spring and summer of 1979. The Fish and Wildlife Service used the data gathered for preparation of an official Fish and Wildlife Coordination Act Report. The Buffalo District used the data to prepare this FEIS under the National Environmental Policy Act (NEPA). The Final U.S. Fish and Wildlife Service Report, dated 23 October 1980, contained a number of recommendations for the Batavia Reservoir Compound (Modified). Due to problems with the original HEP analysis (see Appendix H, Part 2), the Fish and Wildlife Service provided a supplement dated 23 February 1983 to the original Coordination Act Report. This supplement revised some of the assumptions used in the HEP analysis, provided some new tables for the analysis, and modified some of the original Fish and Wildlife recommendations.

6.06 The U.S. Fish and Wildlife Service Coordination Act Report contained 13 separate recommendations. [1/] The supplement revised Recommendation 11 and eliminated Recommendation 1. [2/] These recommendations will be repeated in brief here and the Corps of Engineers responses to the recommendations will be discussed.

a. Recommendation 1 - The Fish and Wildlife Service had requested that a system of managed/natural flood control be given full consideration as a project alternative. Based upon Corps judgment, and current knowledge of the basin, such a plan would be neither economically justified nor acceptable to property owners. Such a plan could not provide regional flood control such as provided by the Batavia Reservoir Compound (Modified). Provision of regional flood control in the Tonawanda Creek Basin is the primary objective of this study. The Corps will consider developing and evaluating such a plan during post-authorization planning. The 23 February 1983 supplement eliminated this recommendation.

b. Recommendation 2 - The Fish and Wildlife Service recommends post-construction studies of the project's impacts on fish and wildlife and resources. The Corps will consider conducting such studies, through the Corp's Research and Development Program, if the project is constructed.

1/ A copy of this USF&WS Report is reproduced in Appendix H, Part 3.
2/ A copy of the USF&WS Supplement is reproduced in Appendix H, Part 3.

c. Recommendation 3 - The Fish and Wildlife Service recommends that a plan be developed to minimize project-induced erosion siltation, and water pollution in Tonawanda Creek by the joint efforts of several agencies. The Corps normally develops such plans during Advanced Engineering and Design of a project. Such plans are developed to minimize siltation, erosion, and water pollution. The appropriate Federal and State agencies will be kept fully advised of the Corp's plans on the matters discussed in this recommendation.

d. Recommendation 4 - The Fish and Wildlife Service has recommended that the dam's outlet works be modified to permit upstream-downstream fish passage during nonflood periods. The Corps will modify the outlet works where appropriate and necessary to permit fish passage. The actual details of such modification will be determined during the design of the project and will be coordinated with the Fish and Wildlife Service and other concerned agencies.

e. Recommendation 5 - The Fish and Wildlife Service has recommended that instream construction activities be limited to certain low flow periods. The Corps will comply with this recommendation.

f. Recommendation 6 - The Fish and Wildlife Service recommends that a joint plan be developed for removal of snags from Tonawanda Creek. The actual determination of how snags will be removed from Tonawanda Creek will not be determined until Plans and Specifications are prepared for the project. The Corps will minimize the effects of snag removal to the maximum extent possible. The Corps will also coordinate efforts on the preparation of plans for snag removal and clearing operations for the project with the Fish and Wildlife Service and other appropriate agencies during the Advanced Engineering and Design of the project.

g. Recommendation 7 - The Fish and Wildlife Service has recommended that the proposed disposal sites be maintained as conservation pools. The Corps cannot currently accept this recommendation as no alternative feasible disposal sites are known. However, the Corps will investigate alternative disposal sites during post-authorization studies when more data are available on the type and total volume of spoil that will be generated by project construction.

h. Recommendation 8 - The Fish and Wildlife Service recommends that disturbed areas be replanted and monitoring of revegetated areas be jointly conducted and funded at project cost. The Corps accepts this recommendation as presented. The revegetation, maintenance, and monitoring plan will be developed during Advanced Engineering and Design studies. The costs of revegetation can be included in initial construction costs and the costs of maintenance and monitoring can be included in the O&M cost for the project.

i. Recommendation 9 - The Fish and Wildlife Service recommends that flood waters be retained in the reservoirs for the shortest possible periods of time and that plans for operation of the reservoirs be jointly developed by the Corps, Fish and Wildlife Service, and NYSDEC, and that any other agency that might take over operation of the reservoirs adhere to such plans. The gates of the two dams of the compound will be operated to retain water for the shortest period of time consistent with the primary purpose of

providing regional flood control and downstream flood management. The project is completely a Federal project, and as such, will be operated by the Corps and not turned over to another agency. The Corps will consider any suggestions by the Fish and Wildlife Service and NYSDEC regarding operation of the dams as long as they don't seriously compromise the primary flood control purposes of the project.

j. Recommendation 10 - The Fish and Wildlife Service has recommended that certain wetland complexes within the lower floodpool be protected with lateral dikes and flapgates. The Corps has determined that such protective structures could not be built economically nor would they provide the type of protection required.

k. Recommendation 11 - The U.S. Fish and Wildlife Service originally recommended that about 665 acres of wildlife habitat areas (wetlands) be obtained to compensate for projected project-induced habitat losses and that such purposes be authorized as part of the project. The projected losses are based upon the Habitat Evaluation Procedures (HEP) analysis discussed in Fish and Wildlife Coordination Act Report. This recommendation was subsequently revised in the 23 February 1983 supplement to the Fish and Wildlife Coordination Act Report. Based upon revisions made to the HEP analysis, the conclusion reached by the Fish and Wildlife Service is that no mitigation is required for the construction and predicted mud flat formation impacts of the project. However, the Fish and Wildlife Service does recommend that a HEP analysis be conducted on the 1,933 acres of idle agricultural lands that are predicted to return to active agricultural usage if the project is implemented. They further recommend, that the total amount of acreage (665 acres) of mitigation lands recommended in the original Coordination Act Report be used as an estimate of the mitigation acreage required until such time that a HEP analysis can be performed on the idle agricultural lands in question. The Corps of Engineers independent mitigation analysis (Apppendix H, Part 2) has concluded that mitigation for these idle agricultural land conversions is not warranted. The Corps has also recommended a mitigation plan to offset the predicted loss of 75 acres of wetland habitats. The plan involves certain improvements to the NYSDEC's Oak Orchard Wildlife Management Area. The cost of implementing this plan and subsequent operations, maintenance and monitoring costs can be paid by the Corps of Engineers through appropriate contracts with the NYSDEC. This plan is being recommended for authorization by Congress as a part of the Batavia Reservoir Compound (Modified) Plan.

l. Recommendation 12 - The Fish and Wildlife Service has recommended that certain improvements for public access to the reservoir areas be incorporated as part of the project. During post-authorization studies, the Corps will further develop plans for providing public access to the reservoir areas. The contingency cost in the project estimates is sufficient to provide such access improvements as the Fish and Wildlife Service has recommended.

m. Recommendation 13 - The Fish and Wildlife Service has recommended that all mitigation activities be jointly performed by the Corps, Fish and Wildlife Service, and the NYSDEC. This recommendation is accepted in principal. The Corps can fund such activities of other agencies at project cost.

6.07 New York State Department of Environmental Conservation Recommendations on Mitigation - In a letter dated 10 March 1983 1/ the New York State Department of Environmental Conservation (NYSDEC), Avon, NY, Regional Office provided some suggestions for fish and wildlife mitigation based upon the Corps described loss of 45 acres of wetlands through project construction and 20 acres of forested wetland by clearing and snagging of Tonawanda Creek. In general, NYSDEC prefers on-site mitigation. Three possible mitigation plans were suggested. The first would involve acquisition and development improvements to a 100-acre wetland site located to the west of the lower reservoir floodpool. The second on-site plan would involve restoration of wet meadow areas within the reservoir floodpools by ditching and island construction. At this time, the Corps does not believe that on-site mitigation that would require Federal land purchase or the placement of restrictive conservation easements on private lands is a viable option primarily due to the public objections raised by residents of the town of Alexander, NY, and Genesee County about land purchases associated with the project.

6.08 The third NYSDEC mitigation suggestion is an off-site plan that would involve the acquisition of about 30 acres of agricultural land adjacent to the Oak Orchard Wildlife Management Area and reconstruction of dikes within the management area to increase storage capacities in the impoundment. The Oak Orchard Wildlife Management Area is located about 8 miles northwest of Batavia, NY, on Oak Orchard Creek in the town of Oakfield, NY. The plan has been modified and developed in more detail and is presented in the mitigation analysis (Appendix H, Part 2). The Corps of Engineers has coordinated this modified mitigation plan with the NYSDEC and the USF&WS.

6.09 New York State Department of Agriculture and Markets - The New York State Department of Agriculture and Markets has stated its concern for the agricultural interests in the area, and the impacts the project may have on farmers. The Corps agrees to minimize impacts on farmers, caused by construction and operation of the recommended plan, to the maximum possible extent.

6.10 Cultural Resources Coordination - In response to the lack of data about cultural resources in the Batavia Reservoir Compound project area, the Buffalo District contracted with the Anthropology Department of the State University of New York at Binghamton. The purpose of this contract was to perform a reconnaissance level cultural resources investigation of the project area. The field and literature search efforts were conducted during the summer and early fall of 1979. A report has been submitted to the Buffalo District and has been reviewed by the District, the State Historic Preservation Officer (SHPO), the State Archaeologist, and the Heritage Conservation and Recreation Service. Appendix H, Part 4 of this FEIS gives more details on the cultural resources investigations and coordination.

1/ See Appendix H, Part 3.

Statement Recipients

6.11 The Draft Environmental Impact Statement (DEIS) presenting the Batavia Reservoir compound as the Selected Plan was distributed to a large number of agencies, individuals, and groups for review and comment on 4 May 1976. At the same time, the DEIS was filed with the Council on Environmental Quality and a Notice of Availability was recorded in Federal Register on 14 May 1976 commencing the official 45-day review period. A complete list of all statement recipients receiving the DEIS is included in paragraph H1.1 of Appendix H, Part 1.

Public Views and Responses

6.12 Public input, in the form of statements presented through public meetings, technical workshops, and written correspondence, have influenced this study and have been incorporated into the study's decision-making process.

6.13 DEIS Comments Received - A number of comment letters were received during the 45-day review period for the DEIS. Table EIS-6.1 lists the sources of all comment letters, their locations in Appendix H, Part 1 and notes any substantial issues raised in the comment letters. The letters have been separated into specific comments and numbered along the left hand margins of the letter. Corps responses to each comment can be found by referring to the corresponding number to the right of each letter of comment.

The following discussion will briefly outline the major issues raised as a result of DEIS review and describe what actions were taken by the Corps and other agencies to resolve the significant issues raised in the DEIS comment letters.

6.14 The U.S. Department of Transportation, Federal Highway Administration stated that the proposed construction of the upper reservoir may produce changes in flooding frequency of State Route 98 and U.S. 20. Based on available information, the present design of the reservoir should decrease the frequency of flooding on these two routes. However, should the Corps determine during further study that the present design would increase flooding frequency, appropriate design or road modifications would be made to provide the same as the existing protection.

6.15 The U.S. Department of Health, Education, and Welfare (HEW) suggested that efforts be undertaken to initiate local/regional planning to regulate any project-induced floodplain development. Currently, all communities having lands which would be protected from the 100-year flood by the Batavia Reservoir Compound have plans for the use of these lands. These communities would probably not change these plans until the design and construction of the Batavia Reservoir Compound is certain, at a point in time several years in the future.

6.16 U.S. Department of the Interior, Fish and Wildlife Service (USF&WS) requested that the Buffalo District conduct additional biological field studies in order to more accurately assess project impacts. These additional studies were conducted in 1979. In addition, USF&WS requested that further information particularly regarding project area wetlands, and a more detailed assessment of habitat impacts be presented in the FEIS. Where appropriate, the FEIS was revised to address these comments. Finally, USF&WS recommended the preservation of stream bank vegetation within the project area. Although the extent of debris and snag removal is not specifically known at this time, every effort would be made to protect shaded stream sections. Where bank disruption is unavoidable, consideration would be given to revegetating disturbed areas with herbaceous and woody species to help mitigate some of the plant loss.

6.17 U.S. Department of Agriculture, Forest Service, (USFS) stated that the Batavia Reservoir Compound plan is the most environmentally sound. USFS suggested that, if possible, trees and shrubs be planted at dike and spillway construction areas. Although these plantings would provide some benefits to wildlife and local aesthetics, they could endanger the structural stability of the dikes and interfere with the hydraulic design of the spillways. for these reasons, USFS's recommendations were not incorporated into the Selected Plan.

6.18 U.S. Department of Agriculture, Soil Conservation Service (SCS) stated that intensity of agricultural use in the upper reservoir area would be decreased significantly. The Corps concurs with SCS's comment since flooding in the upper reservoir area would be more frequent, thereby, resulting in reduced agricultural activity.

6.19 U.S. Department of the Interior, National Park Service commented that the DEIS lacked sufficient detail in order to fully assess impacts to cultural resources. Since the preparation of the DEIS, a new cultural resources report has been prepared and revisions made in this FEIS.

6.20 U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA) - Environmental Research Laboratories noted that construction activities would result in a short-term degradation in water quality, however, the long-term effect of the project would be some improvement due to a reduction in peak flows. The Corps concurs with NOAA's comment and would require the Contractor to seed and mulch the disturbed banks as soon as possible.

6.21 New York State Department of Environmental Conservation (NYSDEC) stated that they must approve of the disposal site for any solid wastes generated by the project. The Corps would comply with this requirement. NYSDEC commented that the detention of floodwaters would cause siltation within the reservoir areas resulting in the filling of wetlands, drainage ditches and small streams, and may also result in an odor problem. The Corps concurs that some siltation would occur as it does under existing flood conditions. Within the lower reservoir area, however, siltation would be reduced. Odors may occur after flooding, but this would be a temporary condition and should not vary significantly from the base condition. NYSDEC recommended that measures be

taken during construction to minimize soil erosion and water pollution. The Corps concurs and would require the Contractor to adhere to various environmental protection measures. NYSDEC expressed concern that less frequent flooding in the lower reservoir area may threaten the existence of wetland areas. Wetlands in the project area are fed by small, local tributaries and do not depend on the floodwaters of Tonawanda Creek for recharge. NYSDEC recommended the mitigation of adverse impacts to wetlands. The Corps concurs and is recommending a fish and wildlife mitigation plan as part of the project. Finally, NYSDEC suggested that the Corps incorporate nonstructural measures in the lower Tonawanda Creek Basin. The Corps has provided floodplain information reports to the towns of Tonawanda, Amherst, and Clarence and would work with these communities upon request to implement nonstructural measure. Nonstructural measures could be considered during the General Design Memorandum I study.

6.22 U. S. Environmental Protection Agency (USEPA) requested that the FEIS describe the measures that would be taken to control erosion and improve drainage after project implementation. However, because part of the proposed project is to improve Tonawanda Creek's capacity, flooding of farmlands would occur less frequently with the project. Because the frequency of flooding would be less, the frequency of channel bank erosion and adjacent farmland saturation should be lessened. USEPA asked that the FEIS indicate if the farmers plan to cultivate their lands after project implementation, and if so, would their losses be compensated if a disasterous flood were to occur during the growing season. Project implementation would not preclude the continued cultivation of farmland but farmers would do so with the knowledge that a flood could occur. In effect, the farmers would be compensated for their losses by the purchase of flowage easements on their lands. USEPA stated the Batavia Reservoir Compound plan would be the Least Environmentally Damaging plan and classified the DEIS LO-2 (lacks objections to the proposed action provided the above mentioned additional information is included in the FEIS).

6.23 Great Lakes Basin Commission; U.S. Department of the Interior, Bureau of Indian Affairs; U.S. Department of the Interior, Bureau of Mines; U.S. Department of the Interior, Bureau of Outdoor Recreation; Town of Pendleton; and the Sierra Club all responded to the DEIS but offered no substantial comments.

Required Coordination Remaining.

6.24 In accordance with the National Environmental Policy Act, this FEIS is being circulated for review. Letters of comment received during the official review period will be answered. Section 404(r) of the Clean Water Act of 1977 requires that, if possible, the evaluation of the discharge of dredged or fill materials into waters of the United States be included in an Environmental Impact Statement submitted to Congress pursuant to the National Environmental Policy Act of 1969 prior to the authorization of that project for construction or an appropriation of funds for construction of the project. The Buffalo District would conduct a Section 404(b)(1) evaluation during Phase I, AE&D studies.

Comment From	Date of Letter	Location of Letter	Substantial Issues Raised
Great Lakes Basin Commission	5/13/76	H1-3	No
U.S. Department of Transportation; Federal Highway Administration	5/27/76	H1-4	Highway Flooding
U.S. Department of Interior; Bureau of Indian Affairs	6/4/76	H1-5	No
U.S. Department of Interior; Bureau of Mines	6/4/76	H1-6	No
Sierra Club	6/7/76	H1-7	No
U.S. Department of Health, Education, and Welfare	6/8/76	H1-8	Induced Floodplain Development
Town of Pendleton, Supervisor	6/17/76	H1-9	No
U.S. Department of Interior; Fish and Wildlife Service	6/17/76	H1-10 - H1-13	Relocations, Effects on Fish, Wildlife and Habitats
U.S. Department of Agriculture; Forest Service	6/18/76	H1-14	Tree Planting
U.S. Department of Agriculture; Soil Conservation Service	6/22/76	H1-15 - H1-16	Farmland Use in Reservoir Floodpool
U.S. Department of Interior; National Park Service	6/22/76	H1-17 - H1-20	Cultural Resources
U.S. Department of Commerce	6/22/76	H1-21 - H1-23	Siltation and Water Quality
New York State Department of Environmental Conservation	6/24/76	H1-24 - H1-26	Reservoir Siltation Non-structural Measures
U.S. Department of Interior; Bureau of Outdoor Recreation	6/25/76	H1-27 - H1-28	No
U.S. Environmental Protection Agency	6/25/76	H1-29 - H1-30	Erosion and Drainage

INDEX, REFERENCES, AND APPENDICES
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Subject	Study Documentation: Environmental Impact Statement (pages)	Main Report (pages)	Report Appendices
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Agency Coordination	EIS-42-45	48-49	G, H
Agriculture	EIS-27, 30, 33, 38	3, 10, 13-14, 15, 16, 18	B, H
Alternatives	EIS-14-22	9-19	-
Areas of Controversy	EIS-3-4	-	-
Comparative Impacts of Alternatives	EIS-21-22	15	-
Cover Sheet	EIS-1	-	-
Cultural Resources	EIS-28, 30, 33, 38	10, 14, 15	H
Elimination of Plans	EIS-18	11	-
Environmental Conditions	EIS-23-24	-	B
Environmental Effects	EIS-29-39	-	-
Formulation of Plans	EIS-17	9, 11	-
Idle Agricultural Lands	EIS-27, 35	10, 13-14, 15 16, 18	B, H
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Local Protection Measures	EIS-15	10, 11, 12	-
Major Conclusions and Findings	EIS-2-3	50	-
Need for and Objectives of the Action	EIS-9-13	2-4, 5-8	A, B
Nonstructural Measures Considered	EIS-14-15	10, 11	F

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Plan Economics	EIS-22, 30, 34, 39	11, 13, 14, 15, 16, 17, 35, 39-45	B, C, D
Planning Objectives	EIS-11-13	5-8	-
Plans Considered in Detail	EIS-18-21	11-19	-
Prime and Unique Farmland	EIS-27-28	-	-
Public Concerns	EIS-10-11	2-3	G, H
Public Involvement	EIS-41-49	47-49	G, H
Public Involvement Program	EIS-41-42	47-48	-
Public Views and Responses	EIS-46-48, 49	47-48	G, H
Regional Protection Measures	EIS-16-17	10, 11, 12	-
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Required Coordination Remaining	EIS-48	-	-
Significant Resources	EIS-24-28	-	B, H
Statement Recipients	EIS-46	-	H
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Summary	EIS-2-8	i	-

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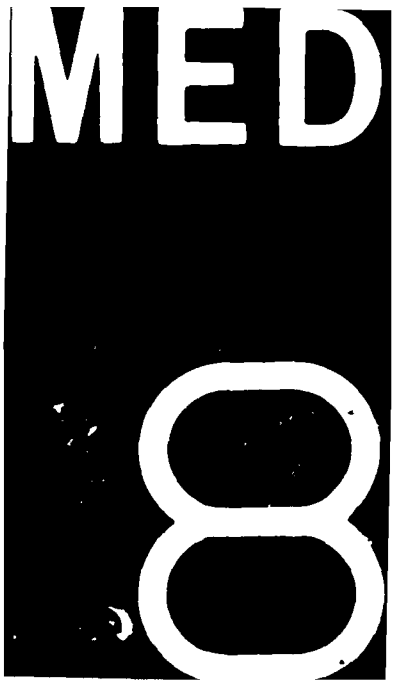
Unresolved Issues	EIS-5	-	-
Wetlands	EIS-24-26, 31, 35, 39	10, 14, 15, 17, 18, 33-34	H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