

ROOT CREEK

BOLIVAR, NEW YORK

LOCAL FLOOD PROTECTION PROJECT

DETAILED PROJECT REPORT

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PERTINENT DATA FOR RECOMMENDED PLAN

1. DESCRIPTION OF IMPROVEMENT

a. Location of project - Root Creek is a tributary to the Little Genesee Creek, having its mouth in Bolivar, New York. The study area extends from the mouth of Root Creek upstream for a distance of approximately 7,350 feet to the Route 17 Highway bridge.

b. Type of project - The project proposed herein would consist of an improvement of the Root Creek channel, including moderate widening, deepening and slope protection.

c. Purpose - The purpose of the project would be to alleviate flooding conditions in and about Bolivar, New York, thereby providing monetary and other tangible and intangible benefits, including the contribution to the general welfare of the people employed in and living in the Bolivar area.

d. Hydrologic data -

Drainage area	9.1 sq. mi.
Flow of maximum flood of record, June 1972	2,000 c.f.s.
Elevation of maximum flood of record at damage reference point	Elev 1606.4 m.s.l.
Design discharge (100 year)	2,000 c.f.s.
Existing stream channel slope	0.011 ft./ft.

e. Environmental Impacts - During project construction there would be a temporary increase in suspended solids and turbidity, however, the relative coarseness of the streambed material, frequent low flows in the creek and temporary erosion and sedimentation control measures would reduce, somewhat the adverse effects. Removal of bank vegetation in the project area could raise water temperatures, thereby reducing oxygen levels slightly, however, to the extent possible bank vegetation will be replaced. Flood damages in the project area would be reduced. There will be a loss of wildlife population inhabiting the reach of the stream involved, however, considering the natural character and high level of habitat diversity occurring in the basin, this loss would be negligible. A reduction in the benthic population would result from the construction work. Establishment of a new benthic community in Root Creek is anticipated to occur in the future, subsequent to the construction work, which differs in character from the present one. Construction of the proposed channel improvement would not significantly influence future population trends, existing recreation facilities and/or hunting and fishing opportunities in the area. Land use and development patterns are not expected to be significantly changed.

(cont)

f. Features of recommended local protection project -

Length 4,750 feet

Bottom widths:

Station	
16+20 to 19+00	Natural channel width
19+00 to 24+20	20 feet
24+20 to 27+37 (NYDOT Improvement)	30 feet
27+87 to 48+70	20 feet
48+70 to 63+00	Natural channel
63+00 to 66+00 (Debris Basin)	75 feet

Bottom Grades (between drop structures):

Station 16+20 to 19+00	level
" 19+00 to 24+20	0.5%
" 24+20 to 27+37 (NYDOT Improvement)	0.5%
" 27+37 to 33+60	0.5%
" 33+60 to 42+00	0.5%
" 42+00 to 45+25	0.5%
" 45+25 to 48+50	0.5%
" 48+50 to 63+00	Natural invert
" 63+00 to 66+00 (Debris Basin)	0.4%

Side Slopes:

Side slopes would vary from 1 vertical on 2 horizontal to 1 vertical on 1.75 horizontal as shown on PLATES 3 through 7.

Backfill and Disposal Area Treatment:

Seeding would be provided on disposal fills and on exposed cut side slopes. Gabion slope protection would be provided on all slopes to or greater than the design discharge elevation.

Bridge and Culvert Adjustments:

One bridge, the Davis Street bridge, would need underpinning and the wingwalls would be revamped.

Non-Federal cooperation:

The local cooperating agency's participation in the construction phase of the project would include the provision of lands, easements and rights-of-way. The participating non-Federal agency would also be required to maintain the improvement after construction.

(cont)

2. COST ESTIMATES - RECOMMENDED PLAN

a. Federal first cost:

(1) Channel improvement, including contingencies	\$429,000
(2) Engineering and design and supervision and administration	<u>130,000</u>
(3) Total Federal first cost, rounded	\$559,000

b. Non-Federal first cost

(1) Land, including contingencies	\$ 21,700
(2) Legal, engineering and supervision	<u>2,178</u>
(3) Total non-Federal first cost, rounded	\$ 24,000

3. ECONOMIC EVALUATION

a. First costs -

Federal	\$559,000
Non-Federal	<u>24,000</u>
Total Federal and non-Federal first costs	\$583,000

b. Annual charges (5-7/8% interest rate, 50-year project life) -

Federal

Interest (.05875 x \$559,000)	\$ 32,841
Amortization (.00359 x \$559,000)	<u>2,007</u>
Total	\$ 34,848

Non-Federal

Interest (.05875 x \$24,000)	\$ 1,400
Amortization (.00359 x \$24,000)	86
Maintenance	<u>5,000</u>
Total	\$ 6,486

Total Average Annual Federal and
Non-Federal Charges

\$ 41,300

(cont)

c. Annual benefits -

Primary flood control benefits \$ 48,000

d. Economic ratio - 1.2

4. LOCAL COOPERATING AGENCY

The State of New York Department of Environmental Conservation

ROOT CREEK
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SECTION I - INTRODUCTION

1. AUTHORIZATION

a. Congressional authority - A small flood control project on Root Creek in Bolivar, New York is considered under the authority of Section 205 of the Flood Control Act of 1948, as amended, which states as follows:

"The Secretary of the Army is hereby authorized to allot from any appropriation heretofore or hereafter made for flood control, not to exceed \$25,000,000 for any one fiscal year, for the construction of small projects for flood control and related purposes not specifically authorized by Congress, which come within the provisions of Section 1 of the Flood Control Act of June 22, 1936, when in the opinion of the Chief of Engineers such work is advisable: Provided, that not more than \$2,000,000 shall be allotted under this section for a project at any single locality and the amount allotted shall be sufficient to complete Federal participation in the project; Provided further, that the provisions of local cooperation specified in Section 3 of the Flood Control Act of June 22, 1936, as amended, shall apply; And provided further, that the work shall be complete in itself and not commit the United States to any additional improvement to insure its successful operation, except as may result from the normal procedure applying to projects authorized after submission of preliminary examination and survey reports."

b. Authority for detailed project report - Preparation of this detailed project report and authority to proceed with funding is contained in a teletype 312009Z and a letter to the Division Engineer, Ohio River, DAEN-CWP-C, dated 1 November 1973, subject: Root Creek, Bolivar, New York.

2. PURPOSE AND EXTENT OF STUDY

a. Purpose - The study was undertaken to consider in detail the extent of the flooding problem in Bolivar and the methods of resolution available to reduce the identified problem at the least cost to the community, the State, the Federal Government and the area.

b. Extent of study

(1) Topographic surveys - Valley cross-sections were obtained throughout the 7,300-foot reach. These sections were supplemented by aerial topographic maps provided by the State of New York Department of Transportation, photographs and plane table surveys.

(2) Hydrologic and hydraulic studies - Hydrologic studies have been developed for the project area and are included in Appendix I, Hydrology, which is attached to this report. High water marks for the July 1970 and June 1972 floods were obtained by field survey. Hydraulic studies were then performed to establish the high water profile for the July 1972 flood, which is the maximum flood of record having a recurrence interval computed at once in 100 years. The hydraulic design for the proposed improvement alternatives was then completed.

(3) Geologic investigations - Bolivar is located on the maturely dissected Appalachian Plateau just south of the terminal moraine of the southern advancing Wisconsin ice sheet, and within the small outwash valley of the Little Genesee Creek. The streambed of Root Creek (tributary to the Little Genesee Creek and flowing through Bolivar) consists of glacial outwash which is at least fifty (50) feet thick and generally composed of 60% cobbles and gravels, 30% sands, and 10% silts and clays. Most of this material consists of local flat and slabby heterogeneous gravels with scarce bedding features. The bedrock floor and walls of the valley are composed of horizontally bedded upper Devonian shales and siltstones at the very top of which are some remnants of Mississippian shales and thin sandstones. There are bedrock outcrops within the study limits. The soil composition of the slopes is similar to that in the stream bed except that the silt and clay content (at the expense of the cobble and gravel fraction) is probably 5% to 10% higher. Using this information, a slope design of 1 vertical on 1-3/4 horizontal (30 degrees) was considered adequate where 1 vertical on 2 horizontal slopes (26.5 degrees) were not possible. The reaches where these 1 on 1-3/4 cuts are proposed are on the left bank between stations 29+00 and 42+00. (See PLATES 4 and 5.)

(4) Flood damage study - The flood damage study for the Root Creek, Bolivar, New York area was made in July 1972 and was based on the June 1972 flood. Values and degree of development have been revised to the July 1974 level.

(5) Environmental impact study - A complete environmental analysis was completed and incorporated into the development of alternatives and the preparation of this report.

(6) Recreation - Although the possibilities of providing recreational activities as part of the proposed project in Bolivar were investigated, it was evident that the potential for such was very limited.

3. PRIOR INVESTIGATIONS

The Corps of Engineers has investigated water related problems on Root Creek in Bolivar, Allegany County, New York, on one previous occasion as follows:

In response to a letter directed to the President and referred for reply to the Pittsburgh District, a representative of the District visited Bolivar on 3 October 1961, to meet with local interests and to investigate possible flood related problems. The problems pertained to flood and soil erosion damage to properties adjacent to the creek. At that time, it was concluded that a project for flood control would be feasible from an engineering viewpoint; however, it was found that such a project would be infeasible from an economic standpoint since project benefits would not be commensurate with project costs.

SECTION II - GENERAL DESCRIPTION

4. LOCATION AND DESCRIPTION OF PROJECT AREA

a. Location of study area - The problem area is located in the Village of Bolivar, Allegany County, New York, about 17 road miles east of Olean, New York.

b. Description of the study area - The study area is situated within the boundaries of Bolivar, which is an incorporated village with a 1970 population of about 1,400. The village is primarily a residential community with all the usual public utilities such as water and sewage, gas and electricity. The stream, as shown on PLATE A, runs through the southern end of town in a westward direction emptying into the Little Genesee Creek. Access to the study area is provided by State Routes 17 and 275. The study has been limited to that reach of Root Creek which lies between the Route 17 Highway bridge, east of the Town of Bolivar, and the stream's mouth on the Little Genesee Creek (see PLATES 1 and 2). This is the area of concentrated damage due to flooding. Root Creek is a headwater stream which drains approximately 9 square miles of area. The Creek flows from high ground in the east, through the Village of Bolivar and then through a small marshland before it empties into the Little Genesee Creek.

c. Basin characteristics - The Root Creek basin above the Route 17 Highway bridge, is sparsely populated and consists of much forest and some farmland. The basin relief ranges from elevation 2440 m.s.l., on the southeastern perimeter of the basin to about elevation 1570 m.s.l., at the lower limit of the study area. Generally, the valley of Root Creek is narrow and the surrounding hillsides are steep producing a rapid concentration of runoff in the valley floor. Inadequate hydraulic capacity of the natural channels and several man-made obstructions tend to impede flow and cause Root Creek to overflow its banks.

d. Stream characteristics - The stream bed of Root Creek in the study reach has an average slope of about 11 feet per thousand feet. The widths of the existing channel range from 12 to 35 feet and the existing bank slopes range from nearly vertical to 1 vertical on 3 horizontal.

e. Bridges - There are four bridges crossing Root Creek in the study area. Physical features of these structures are tabulated in TABLE 1. See PLATES 1 and 2 for bridge locations.

TABLE 1
BRIDGES IN STUDY AREA

<u>Bridge</u>	<u>Stream</u>	<u>Sta.</u>	<u>Horizontal Clearance (ft)</u>	<u>Vertical Clearance(ft)</u>	<u>Existing Approx. Waterway Opening (ft²)</u>
First Street	Root Creek	22+90	16.0	3.2	51
Main Street	Root Creek	26+10	24.0	3.3	79
Davis Street	Root Creek	41+30	23.0	10.1	232
Rt. 17 Highway	Root Creek	73+75	42.5	10.1	429

5. ECONOMIC DEVELOPMENT

a. Community development - Bolivar is primarily a residential community, although there are situated within the village, a number of commercial outlets, several light industrial firms, a central school and several churches. Private dwellings are generally in a fair to good condition. At one time the area was very prosperous due to the oil industry; however, as the oil production declined, the local economy did likewise. Currently, many of the community's residents are retired and many of those who do work, travel to nearby Olean or Wellsville. Wellsville is the economic center of Allegany County and along with the Village of Alfred provides a major contribution toward the county's mean income of \$10,022 per year. The mean income in Bolivar, however, is about \$7,800 per year. In the past 30 years the population of Bolivar and the economy has not significantly changed. It is felt that these trends will continue unless new methods of oil recovery are devised which would then promote a possible significant growth in the area.

b. Industry - There are two industries that appear to act as an economic base for the community. The Expert Cutlery Company employs approximately 15 people and the Allegany Forge Company employs approximately 10 people. Producers Gathering Company and Dempsey Pipe and Supply are involved in removing, reclaiming and selling the pipe formerly used as oil well casing are the other two minor industries in Bolivar.

c. Fish and wildlife-associated recreational activities - Recreational activities such as fishing and hunting are present in the Bolivar area. Hunting is good and vigorously pursued in the Root Creek and adjacent basins. Fishing in the area is also good, but not in Root Creek. The fish population of Root Creek consists of a variety of small minnows and darters which are not in the category of a game fish. The major sport fishing in the area is confined to Little Genesee Creek where the trout population is significant due mainly to annual stocking.

6. FLOODING

a. Nature of flood problem - A flood problem exists in the area occupied by and immediately surrounding the Village of Bolivar which lies in that reach of Root Creek between the Route 17 Highway bridge and the Creek's mouth. In this residential area, houses are susceptible to flooding, especially from the flash type, due to intense rainfall and very high runoff. Flooding is the result of the existing channel's inability to contain most high flows and low bridge clearances which create backwater effects, which adds to the overbank flooding. The Root Creek watershed is typical of the many steep, small tributaries in the Allegheny River basin that are susceptible to high rates of runoff due to intense summer storms.

b. Pattern of flooding - Due to the geography of the watershed, floods are of high intensity and short duration. The more numerous floods are of the basement-damaging variety associated with overbank flows. Property losses during such periods generally include damages to garages, streets, yards, walks, driveways, gardens and patios. In addition, the stream banks are affected by erosion and in some wide areas with low banks the stream centerline shifts. Floods with a less than annual frequency begin to cause first floor damage in several areas. A stage-damage curve is inclosed as Exhibit A.

c. Flooding from Little Genesee Creek - Although the Little Genesee Creek overtops its banks near Bolivar, very little, if any flood damages are incurred. The lands that are flooded are now lying and little used.

d. Record of floods - There is no dependable record of major floods on Root Creek. However, newspaper accounts and interviews have established the following approximate record, in chronological order:

July 1942
January 1959
September 1967
July 1970
June 1972

e. Flood of June 1972, design flood - The findings of this study are based on the flood of June 1972. This flood resulted from extremely intense rainfall due to Tropical Storm Agnes. Because the stream is both swift and turbulent at high flows, it was not possible to obtain a firm determination of discharge by slope and area. However, a discharge value has been calculated, based on the available effective cross-section area and on an estimated critical velocity of 2,000 second-feet at its peak, or about 220 second-feet per square mile of drainage area. This flood has been estimated to have a frequency of recurrence interval of once in 100 years.

f. Stage-discharge-frequency relations - A stage-discharge relation was developed for Root Creek at the damage reference point at Bolivar which is

600 feet upstream of the existing Main Street Bridge. Since discharge records were not available, the curve was established from backwater computations. A stage-frequency relationship was developed for the damage reference point by means of a regional analysis of basins with characteristics similar to those of the Root Creek basin. The stage-discharge and stage-frequency curves are inclosed in APPENDIX I - HYDROLOGY, which presents more detailed information on stream flow characteristics.

SECTION III - PROBLEMS INVESTIGATED

7. FLOOD DAMAGES

Damage from the June 1972 flood on Root Creek occurred to 111 residential buildings, 10 commercial buildings and other structures and facilities totaling \$181,300 in primary damages as noted in TABLE 2. During the July 1970 flood, which is the only other event for which estimates could be obtained, 72 residential and 8 commercial buildings, in addition to other facilities suffered a total of approximately \$68,000 in primary damages as listed in TABLE 3.

TABLE 2
DAMAGES - JUNE 1972 FLOOD
(Oct 1973 Values)

Type	No.	Yards and Foundations	Basements	1st Floor	Est. Value	Est. Damage
Residential	111	30	50	31	\$ 820,000	\$ 92,400
Commercial	10	--	5	5	268,000	44,300
Industrial(Lt.)	3	--	--	3	97,000	12,400
Schools	1	--	1	--	953,000	7,200
Churches	1	--	1	--	25,000	4,300
Municipal	5	2	1	2	184,000	19,600
Utilities	2	1	--	1	1,500	1,100
TOTAL	133	33	58	42	\$2,348,500	\$ 181,300

TABLE 3
DAMAGES - JULY 1970 FLOOD
(Oct 1973 Values)

Type	No.	Yards and Foundations	Basements	1st Floor	Est. Value	Est. Damage
Residential	72	28	36	8	\$ 495,500	\$ 40,400
Commercial	8	--	5	3	170,000	13,300
Industrial (lt)	2	--	--	2	27,000	4,400
Schools	1	--	1	--	950,000	3,300
Municipal	3	2	1	--	130,000	5,900
Utilities	1	--	--	1	1,500	700
TOTAL	87	30	43	14	\$1,774,000	\$ 68,000

In both of these floods, as in all the floods on Root Creek, the stream banks were adversely affected by the high velocity. The outer stream banks were undercut causing slides, with the displaced material being deposited in the creek channel. In addition, yards, gardens, retaining walls and dikes were affected. In the study area, average annual damages caused by frequent flooding are estimated at approximately \$53,400 (July 1974 values).

8. IMPROVEMENTS BY OTHER AGENCIES

The State of New York Department of Transportation is presently entering the final design stages of a proposed Bolivar highway improvement project which is scheduled for construction in calendar year 1974. The project consists of a considerable amount of roadway rebuilding, replacement of the Main Street bridge and an improvement of a section of channel on Root Creek. The roadway rebuilding will eliminate a present flow restriction caused by an inadequate bridge clearance and the channel improvement will improve conditions to the extent that the design flow will be carried under the bridge unrestricted. The channel improvement will consist of a widening and deepening of the present channel, generally along its existing alignment, starting approximately 300 feet upstream from the existing bridge and extending 100 feet downstream (see PLATE 1). The new channel is to be lined with a six-inch layer of concrete. At the upstream end of this improvement, there will also be a four-foot concrete drop structure.

An addition to the proposed N.Y.D.O.T. channel improvement will be the removal of the First Street bridge which presents a serious hydraulic problem due to its very limited clearance. The New York Department of Transportation has recommended to the Town and Village of Bolivar that the bridge be abandoned so that it can be removed. The local officials have given their consent since the bridge is on a side street which is not a major traffic artery.

Continued coordination between the New York Department of Transportation and the Corps has yielded two plans that when completed, will be compatible with each other.

9. IMPROVEMENTS DESIRED

The U. S. Army Engineer District, Pittsburgh, has maintained contact with officials of the State of New York Department of Environmental Conservation, the County of Allegany and the Village and Town of Bolivar. The State of New York will act as the local cooperating agency should a project for flood protection in Bolivar be approved. Both the State of New York and the people of Bolivar desire flood protection by any practicable means as expressed by both with favorable comments at the 4 March 1974 Public Meeting in Bolivar.

SECTION IV - PLAN FORMULATION

10. NON-STRUCTURAL ALTERNATIVES

a. Criteria for minimum degree of non-structural protection - As an outgrowth of Presidential Order 11296, a design flood used in the Flood Plain Management Services Program and identified as the Intermediate Regional Flood (IRF) is generally recognized and accepted by Federal and non-Federal interests as being the reasonable minimum elevation of expected flooding to be used in community and regional planning activities. A hydrologic regional analysis has established that the crest elevation of this 100-year frequency flood would be equal to the June 1972 flood throughout the reach of Root Creek under study.

b. Available non-structural alternatives -

(1) Temporary evacuation after taking advantage of flood forecasting service - A most basic measure which can be taken to protect life and movable property is temporary evacuation. In order for this method to be effective, it would be necessary for local officials to completely familiarize themselves with the flood warning system operated by the Environmental Science Service Administration in Pittsburgh, Pennsylvania. A consideration of particular importance in implementing an evacuation program is the possibility of occurrence of a major storm centered directly over the study area. It is estimated that the warning time for a general storm over the basin would be about four hours; but for a summer thunderstorm, it is believed that at a maximum, only one hour's warning could be given. Therefore, although a temporary evacuation plan could avoid injury and worse, and prevent damage to certain movable property items, it would not completely eliminate the major damages caused by a significant flood. Moreover, with the extremely short warning time associated with a thunderstorm and the problem of information dissemination, it is doubtful if most movable property could be successfully displaced or all persons notified of the impending hazardous condition.

(2) Floodproofing - Floodproofing could be employed by those interests affected by flooding. This would be accomplished to the extent that all openings below the IRF elevations are sealed and made watertight, either permanently or temporarily during floods.

(3) Flood insurance - Flood insurance is a means for providing monetary recovery from flood damages. Reimbursement for such damage is generally available at subsidized rates, under the National Flood Insurance Program, for one to four family residential units and small businesses. Under this program a community must make application for this insurance and if they qualify, the residents are to obtain insurance. Bolivar does not as yet qualify and therefore cannot participate in the Federal Flood Insurance Program.

(4) Flood plain management (zoning) - Several Flood Plain management practices can be employed to avoid increasing potential flood hazards. The use of open space for recreation and conservation areas may offer the most productive land use with the least potential flood hazard. To be effective, flood plain zoning must be initiated before development occurs on the flood plain, and any development which might occur thereafter should be elevated to a level above the IRF level.

c. Discussion of non-structural alternatives as they apply to the current project -

(1) Temporary evacuation would only be an applicable and effective means of protection if the bulk of the damages sustained during a flood were to occur to objects which can be moved quickly and efficiently out of the danger zone. This method of protection is considered inadequate in this case, since much of the damage occurs to immovable structures and also, since the warning time for a serious storm occurring directly over the basin is estimated at only four hours. This method, however, would save lives and prevent some of the damage caused to movable items.

(2) Floodproofing would involve structural treatment of most of the homes, churches and commercial buildings in the flood zone. The treatment would consist of individual floodproofing of the involved buildings or the construction of separate dikes or walls to provide for their protection. Not all of the damageable structures, however, could be individually floodproofed economically because of their foundation and structural conditions. An estimate of cost for floodproofing, based on those structures for which floodproofing was determined economically feasible, was made. The estimated amount is \$592,000 which results in an average annual cost of \$36,900. The associate average annual benefits associated with the floodproofing plan is \$27,200 which when compared to the annual cost yields a B/C ratio of about 0.7. The residual damages which are estimated to still occur annually, with the floodproofing plan, are about \$23,000. This plan would also leave certain unprotectable structures, such as roads and public utilities, still vulnerable to damage. Other benefits usually provided by a flood protection works, such as the elimination of losses resulting from the interruption of commerce, production and traffic, and the danger of loss of human life, would also be foregone.

(3) Flood insurance is not a rational alternative to flood protection. Rather, flood insurance should be one of the final resorts, when it is found that no structural solution exists or that a flood protection project is infeasible. With a flood insurance program at Bolivar, all damages would, of course, still occur. Premiums would necessarily be paid by individuals who would wish to protect their damageable property. One major benefit to be derived from such a plan would be partial monetary compensation for direct damages. Flood insurance also could be a viable intermediate solution in the event a structural solution is feasible and is to be constructed in the future.

(4) Since the flood plain at Bolivar is already in an advanced stage of development, flood plain management techniques such as zoning would not provide a suitable means of damage prevention. Future development is expected to occur; however, it is considered that such development will consist mainly of improvements to existing structures and other damageable properties.

d. Conclusion - Non-structural approaches to the Bolivar flooding problem can be of significant benefit to the community. However, while some damage could be averted, substantial damage and inconvenience would still be experienced.

11. ALTERNATIVE STRUCTURAL PLANS CONSIDERED

a. General - The structural plans considered for the alleviation of flood conditions in Bolivar were (1) channel improvements; (2) a channel, dike and wall combination; and (3) a reservoir.

b. Discussion of plans -

(1) A channel improvement was considered first as a possible means of providing a degree of flood protection, recognizing the limited flood control benefits available. A channel plan providing a reasonable degree of protection while still being economically justified was developed.

(2) Although reviewed as an alternate means of providing protection, a combination plan employing a minor channel improvement, dikes and walls was eliminated as being unacceptable due to high initial construction costs, high maintenance costs and the high costs of pump stations necessary to relieve internal drainage problems. In addition, walls and dikes would prove to be more detrimental to the local environment than other available means of protection in that the social impact of having to relocate several families would be very significant.

(3) Topographically, the best site, of several investigated, for an impoundment on Root Creek is located about 1.6 miles above the stream's mouth. This site, however, would inundate an area where there are many small oil wells, some of which are still in operation, and would require 1.2 miles of costly highway relocation. Also, because of a steep stream gradient and relatively steep valley walls, a project capable of impounding the runoff necessary to significantly reduce flood damages downstream, would require a high dam at a substantial cost.

Although there are benefits, besides flood control, to be derived from a reservoir project, high construction and relocation costs and other impacts precluded such an alternative from further consideration.

(4) In summary, a channel improvement project, as illustrated in Table 4, is the only feasible structural alternative and would cause the

least overall environmental degradation. The social acceptability of a channel improvement project is greater than that of a channel, wall and dike combination, and much greater than that of a reservoir.

TABLE 4
STRUCTURAL ALTERNATIVE DATA

Type	Overall	Social	Average Annual		B/C Ratio
	Environmental Effects		Charges	Benefits	
Improvement	minimal	good	\$41,300	\$48,000	1.2
Channel, wall and dike combination	moderate	fair	59,000	48,000	less than 1.0
Reservoir (Flood control only)	high	questionable	300,000 (minimum)	53,000	Far less than 1.0

12. COMPARISON OF FLOODPROOFING TO A CHANNEL IMPROVEMENT

The following table (TABLE 5) compares the economics of a floodproofing plan to those of a channel improvement plan. It should be remembered that the floodproofing plan is based on several assumptions which were presented in Paragraph 10-C(2).

TABLE 5
COMPARISON OF A FLOODPROOFING PLAN
TO A CHANNEL IMPROVEMENT PLAN

Type of Plan	Structures Protected	Total Cost	Annual Cost	Annual Damages	Annual Benefits	Net Benefits	B/C Ratio
Floodproofing	68	\$592,000	\$36,900	\$50,400	\$27,200	-\$9,700	0.7
Channel Improvement	133	\$583,000	\$41,300	\$50,400	\$48,000	\$6,700	1.2

Based on this economic analysis, the information in Paragraph 10-C(2) and the information presented in TABLE 7, a channel improvement plan appears to be a more viable solution to the flooding problem in Bolivar.

13. VARIOUS CHANNEL IMPROVEMENT SCHEMES

Eight channel improvement schemes were investigated to determine either the most economic plan or the most desirable plan of improvement. TABLE 6

gives the specifics of each investigated plan. Each plan incorporated the replacement of the Main Street Bridge and its associated channel work by NYDOT and an upstream debris basin.

TABLE 6
CHANNEL IMPROVEMENT SCHEMES

<u>Degree of Protection</u>	<u>Length (station to station)</u>	<u>Average Annual Charges</u>	<u>Annual Benefits</u>	<u>Net Benefits</u>
25 <u>1/</u>	16+20 to 59+00	\$29,200	\$42,000	\$12,800
25	16+20 to 48+50	24,600	42,000	17,400
50 <u>1/</u>	16+20 to 59+00	34,100	44,300	10,200
50	16+20 to 48+50	29,900	44,300	14,400
75 <u>1/</u>	16+20 to 59+00	37,800	45,100	7,300
75	16+20 to 48+50	33,500	45,100	11,600
100 <u>1/</u>	16+20 to 59+00	41,300	48,000	6,700
100	16+20 to 48+50	36,300	48,000	11,700

1/ EQ type plan as described in paragraph 14.

a. National Economic Development (NED) Plan - As shown on Plate 10, the 25 year scheme maximizes net benefits. This would be the NED plan, however, the selected plan is the 100 year EQ plan. The reasoning behind the selection of this plan is that it provides a totally acceptable form and degree of protection while still being economically feasible. It also provides protection from the maximum flood of record which has been calculated to have a 100 year frequency of recurrence. Maximization, in this instance, would not provide a satisfactory degree of protection.

Table 7, on pages 13 thru 17, inclusive, spells out the specifics of the alternative's, both structural and non-structural, effect with respect to various factors in more detail. Only the selected structural alternative was evaluated since all the channel schemes would essentially produce the same effects.

SECTION V - PLAN OF IMPROVEMENT

14. SCOPE OF PROPOSED PLAN

a. General - In consideration of the area surrounding Root Creek, the proposed plan of improvement would consist of the features described in the following subparagraphs.

TABLE 7
ASSESSMENT OF ALTERNATIVES
ROOT CREEK
BOLIVAR, NEW YORK

FACTORS	STRUCTURAL				NON-STRUCTURAL			
	RECOMMENDED PLAN (RP)	FLOODWALLS & DIKES	RESERVOIR	TEMPORARY EVACUATION	FLOOD- PROOFING	FLOOD PLAIN ZONING	FLOOD INS.	NO ACTION
<u>ECONOMIC INPUTS</u>								
a. Initial const. cost	\$559,000	\$750,000	\$4,000,000	Nominal installation cost less than RP	Tot. cost less than RP, more expensive to individual prop. owners. Est. cost - \$592,000	No initial costs	Less than RP to community premiums expensive to individual prop. owners	NONE
b. Annual charges	\$ 41,300	\$ 59,000	\$ 300,000	Nominal	\$24,400	NONE	Same as above	NONE
c. Regional impact	1.3 miles of stream bank	Same as RP except more relocations required	Greater and more varied than RP	NONE	NONE	NONE	NONE	NONE
d. Tax base impact	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
e. Property values	\$ 21,700	Slightly more than RP	Much greater than RP	NONE	NONE	NONE	NONE	NONE
f. Public facilities	Limited utility relocation	More than RP	1.2 mi. of road & extensive utility relocation	NONE	NONE	NONE	NONE	NONE
g. Public service	Minor traffic disruption during construction	Same as RP	Greater than RP	NONE	NONE	NONE	NONE	NONE
h. Business & Industrial Activity	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
i. Employment/Labor force	Temporary increase in construction jobs	Same as RP	Greater than RP	NONE	NONE	NONE	NONE	NONE
j. Displacement of farms	NONE	NONE	Greater than RP	NONE	NONE	NONE	NONE	NONE

TABLE 7 (Cont'd)

FACTORS	STRUCTURAL			NON-STRUCTURAL				
	RECOMMENDED PLAN (RP)	FLOODWALLS & DIKES	RESERVOIR	TEMPORARY EVACUATION	FLOOD- PROOFING	FLOOD PLAIN ZONING	FLOOD INS.	NO ACTION
<u>ECONOMIC OUTPUTS</u>								
a. Annual benefits	\$48,000	\$48,000	\$ 53,000	Possible minor reduction in flood damages	Flood damage reduction less than RP. \$27,200 in benefits.	None-cont'd. damage to existing development	Distribution of flood losses	NONE
b. Annual net benefits	\$ 6,700	-\$11,000	-\$250,000	Nominal	-\$9,700	NONE	NONE	NONE
c. Benefit-cost ratio	1.2	Less than 1.0	Far less than 1.0	Not determined	0.7	Not determined	Not determined	N/A
d. Property values	Substantial reduction of average annual flood damages plus possible increase in real estate activities			NONE	Less than RP	NONE	NONE	Restrained
e. Regional impacts	See "Property Values" (above) plus temporary employment opportunities			NONE	Less than RP	Less than RP	NONE	NONE
f. Public facilities	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
g. Public services	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
h. Business and Industrial Activity	Potential for increased activity would be per- manently established			NONE	NONE	NONE	NONE	Restrained
i. Employment/Labor force	The labor force would remain basically the same; however, potential for increased employment opportunity would be established			NONE	Less than RP	NONE	NONE	NONE
<u>PHYSICAL INPUTS</u>								
a. Land requirements	4 acres	More than RP	Considerably more than RP	NONE	NONE	None-use would be restricted	NONE	NONE
b. Improvements	NONE	More than RP	Considerably more than RP	NONE	Approx. 68 units in 100-yr. flood plain area	NONE	NONE	NONE

TABLE 7 (Cont'd)

FACTORS		STRUCTURAL			NON-STRUCTURAL			
	RECOMMENDED PLAN (RP)	FLOODWALLS & DIKES	RESERVOIR	TEMPORARY EVACUATION	FLOOD-PROOFING	FLOOD PLAIN ZONING	FLOOD INS.	NO ACTION
<u>PHYSICAL OUTPUTS</u>								
a.	Reduction in flood stage	2.3 feet (100-Year Flood)	Same as RP	Greater than RP	NONE	NONE	NONE	NONE
b.	Improvements protected	133 units	133 units	Greater than RP	NONE	68	NONE	NONE
<u>SOCIOLOGICAL IMPACTS</u>								
a.	Persons displaced	NONE	Several families	Slight	NONE	NONE	NONE	NONE
b.	Transportation patterns	Minor temporary disruption during const.	Same as RP	Greater than RP	NONE	NONE	NONE	NONE
c.	Acoustics	Slight	Same as RP	Less than RP because of location	NONE	Slight	NONE	NONE
d.	Community Cohesion	Possible improvement	Less improvement than RP; project more intrusive	Same as RP	NONE	NONE	NONE	NONE
e.	Community growth	Possible improvement	Same as RP	Greater than RP	NONE	NONE	Zoning may restrict growth	NONE
<u>ENVIRONMENTAL INPUTS</u>								
a.	Aesthetics	Loss of existing stream conditions. Debris basin and stream cleanup.	Similar to RP	Loss of natural stream and lands having good but not unique scenic qualities. No debris cleanup in Bolivar.	NONE	NONE	NONE	NONE
b.	Recreation	NONE	NONE	NONE	NONE	NONE	NONE	NONE
c.	Ecological	Loss of 1.3 mi. of stream bank vege. & slight alt. of aquatic eco-sys. on Root Creek and Little Genesee Creek	Same as RP plus part of adj. flood plain for dikes	Loss of free-flowing stream & aquatic eco-sys. it supports	NONE	NONE	NONE	NONE

TABLE 7 (Cont'd)

FACTORS		STRUCTURAL			NON-STRUCTURAL			
	RECOMMENDED PLAN (RP)	FLOODWALLS & DIKES	RESERVOIR	TEMPORARY EVACUATION	FLOOD- PROOFING	FLOOD PLAIN ZONING	FLOOD INS.	NO ACTION
<u>ENV. INPUTS (Cont'd)</u>								
d. Archeological	NONE (potential)	More potential than RP	More potential than RP	NONE	NONE	NONE	NONE	NONE
e. Man-made resources	NONE	More than RP	Considerably more than RP	NONE	Approx. 68 units in 100-yr. flood plain area	NONE	NONE	NONE
f. Natural resources	Use local stone aggregate	Similar to RP	Inundation of oil wells	NONE	NONE	NONE	NONE	NONE
g. Historical	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
h. Air pollution	Temp. rise during construction	Same as RP	Greater than RP	NONE	Less than RP	NONE	NONE	NONE
i. Water pollution	Slight increase in turbidity during constr.	Same as RP	Greater than RP	NONE	NONE	NONE	NONE	NONE
j. Water quality	Possible slight increase in water temps.	Same as RP	NONE	NONE	NONE	NONE	NONE	NONE
<u>ENVIRONMENTAL OUTPUTS</u>								
a. Aesthetics	Existing vegeta- tion removed by const. will be selectively re- growing trees and shrubs. Improve- ment from debris basin and stream cleanup.	Same as RP	Proj. removed from Bolivar; minimal land- scaping near dam. No im- provement from debris cleanup.	Continuation of present stream conditions				
b. Recreation	NONE	NONE	Potential recreation opportunities	NONE	NONE	NONE	NONE	NONE
c. Ecological	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
d. Health and sanitation	Post-flooding health hazards reduced	Same as RP	Same as RP	Continuation of post-flooding health hazards				

TABLE 7 (Cont'd)

FACTORS	STRUCTURAL			NON-STRUCTURAL				
	RECOMMENDED PLAN (RP)	FLOODWALLS & DIKES	RESERVOIR	TEMPORARY EVACUATION	FLOOD- PROOFING	FLOOD PLAIN ZONING	FLOOD INS.	NO ACTION
<u>ENV. OUTPUTS (Cont'd)</u>								
e. Man-made resources	NONE	NONE	NONE	Developments would remain susceptible to flooding				
f. Natural resources	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
g. Air pollution	No change	No change	No change	No change	No change	No change	No change	No change
h. Water pollution	No change	No change	No change	No change	No change	No change	No change	No change

TABLE 7A

SUMMARY COMPARISON OF ALTERNATIVE PLANS

	1	2
	Recommended Plan (100 yr. Protection)	Channel Improvement (100 yr. Protection)
A. PLAN DESCRIPTION	Approx. 3,200 feet of excavated channel with gabion protected side slopes; 1,100 feet of gabion protection on natural banks near high school; an upstream debris basin; and 5 gabion drop structures.	Approx. 3,200 ft. of excavated channel with gabion protected side slopes; an upstream debris basin; and 5 gabion drop structures. (Same as 1 without bank protection near high school.)
B. SIGNIFICANT IMPACTS		
1. Economic	An estimated \$48,000 reduction in average annual flood damages; possible increase in real estate value and activities; and an increase in temporary employment.	Estimated annual damage reduction is the same as 1. The difference is that future O & M costs will be slightly higher due to continued erosion of banks near high school. Other aspects would also be the same as 1.
2. Social	Minor temporary disruption of traffic patterns during construction; slight rise in noise levels; possible improvement in community cohesion and community growth; and a reduction of personal concerns associated with the threat of floods and flood damages.	The same as 1 except community would not be in agreement with leaving the banks near the high school unprotected.
3. Environmental	Loss of existing stream conditions; loss of 1.3 miles of existing stream bank vegetation; slight alteration of aquatic eco-system on Root Creek and Little Genesee Creek; slight increase in stream turbidity; and a possible slight increase in water temperature. Preservation of existing stream bank and vegetation near high school.	Essentially the same as 1 except stream banks near high school with its present vegetation, would not be protected from future erosion.

TABLE 7A (Cont'd)

SUMMARY OF COMPARISON OF ALTERNATIVE PLANS

C. PLAN EVALUATION

1. Contribution to Planning Objective of Flood Control

a. Adverse

5% of estimated average annual damages would still occur

Same as 1

b. Beneficial

95% reduction in estimated average annual flood damages

Same flood reduction as 1. Slightly higher future O & M costs. (See 2-B1)

2. Relationship to Four (4) National Accounts

a. National Economic Development (N.E.D.)

The benefit is the prevention of an estimated \$48,000 in average annual flood damages to Bolivar. The adverse contribution is an estimated annual economic cost of \$41,300.

The benefit is the same as 1. The adverse contribution is an estimated annual economic cost of \$36,300.

b. Environmental Quality (E.Q.)

Essentially the same as B.3.

Essentially the same as B.3.

c. Social Well Being (S.W.B.)

Essentially the same as B.2.

Essentially the same as B.2.

d. Regional Development (R.D.)

Regional development may increase slightly in the form of improvements to existing structures and also as stated in B.1.

Same as 1

TABLE 7A (Con't)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

1	2
Recommended Plan (100 yr. Protection)	Channel Improvement (100 yr. Protection)
<p>This plan is totally acceptable to the State of New York and the residents and officials of the Village of Bolivar. It provides protection from a recurrence of a 100 year frequency flood. It is complete in the overall objective of providing the best protection for Bolivar. The B/C ratio is 1.2. The economic stability of the area should increase slightly.</p> <p>The Federal Government (Corps) will be responsible for awarding a construction contract and funding the actual construction of the project. The local sponsor, in this case the State of New York, would be responsible for the acquisition of all necessary lands, easements and rights-of-way. The State would also be required to perform all, if any, utility relocations before project construction. After construction, the State would be responsible for maintaining the project to insure its proper functioning capability. The estimated annual maintenance cost is \$5,000.</p>	<p>This plan is not as acceptable as Plan 1 in that it would not prevent the continuing erosion of the left bank near the high school. It does, however, provide the same degree of protection as Plan 1. The B/C ratio is 1.3. The economic stability of the area should increase slightly.</p> <p>The responsibilities associated with this plan would be the same as 1. The amount of land to be acquired would be slightly less and the annual maintenance cost would be slightly higher, \$6,000.</p>

3. Plan Response to Associated Evaluation Criteria

D. IMPLEMENTATION RESPONSIBILITY

TABLE 7B

SYSTEM OF ACCOUNTS

1 Recommended Plan (100 yr. Protection)		2 Channel Improvement (100 yr. Protection)		Coding <u>1/</u>
<u>Location of Impacts</u> Within the immediate planning area	Within the rest of the nation	<u>Location of Impacts</u> Within the immediate planning area	Within the rest of the nation	Timing Uncertainty Exclusivity Actuality Shown in sequential coding 0-0-0-0
1. National Economic Development (NED)				
a. Beneficial Impacts				
(1) Value of increased outputs of goods and services	Estimated \$48,000 reduction in average annual flood damages	Same as 1		1-6-7-9
(2) Value of output resulting from external economies	-0-	-0-	-0-	
(3) Value of output from under-or un- employed resources (labor)*	Slight increase in temp- orary employment oppor- tunities with a resulting potential for increased permanent employment opportunity.	Minimal effect	Same as 1	Minimal effect 1-6-8-9
Total N.E.D. Benefits	\$48,000	\$48,000	\$48,000	\$48,000

TABLE 7B (Cont'd)

SYSTEM OF ACCOUNTS

1 Recommended Plan (100 yr. Protection)		2 Channel Improvement (100 yr. Protection)		Coding <u>1/</u>
<u>Location of Impacts</u> Within the immediate planning area	Within the rest of the nation	<u>Location of Impacts</u> Within the immediate planning area	Within the rest of the nation	Timing Uncertainty Exclusivity Actuality Shown in sequential coding 0-0-0-0
Estimated average annual cost of \$41,300 which includes an estimated annual main- tenance cost of \$5,000.		Estimated average annual cost of \$36,300 which includes an estimated annual main- tenance cost of \$6,000.		1-6-7-9
-0-	-0-	-0-	-0-	
\$ 6,500 <u>2/</u>	\$ 34,800	\$ 7,000 <u>2/</u>	\$ 29,300	
\$41,500	\$-34,800	\$41,000	\$-29,300	
4,300 feet	-0-	3,200 feet	-0-	1-6-8-9

TABLE 7B (Cont'd)

SYSTEM OF ACCOUNTS

1		2		Coding <u>1</u> / Timing Uncertainty Exclusivity Actuality Shown in sequential coding 0-0-0-0
Recommended Plan (100 yr. Protection)		Channel Improvement (100 yr. Protection)		
<u>Location of Impacts</u> Within the immediate planning area	Within the rest of the nation	<u>Location of Impacts</u> Within the immediate planning area	Within the rest of the nation	
95% reduction in estimated average annual flood damages		Same as 1		1-6-7-9
Significantly reduced	-0-	Reduction slightly less than 1.	-0-	1-6-7-9
Select, suitable fast growing trees and shrubs would be planted where existing vegetation would be removed due to project construction.	-0-	Same as 1 only over a shorter project reach.	-0-	1-6-7-9
Slight sediment load increase during con- struction & maintenance	-0-	Slightly less than 1.	-0-	1-6-7-9
No probable damage	-0-	Same as 1	-0-	1-5-8-9
Slightly altered	-0-	Slightly less than 1.	-0-	1-6-8-9
Possible slight increase in water temperature	-0-	Same as 1	-0-	1-5-8-9
Noise, dust and traffic during construction	-0-	Same as 1	-0-	1-6-8-9

TABLE 7B (Cont'd)

SYSTEM OF ACCOUNTS

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176

1		2		Coding 1/ Timing Uncertainty Exclusivity Actuality Shown in sequential coding 0-0-0-0
Recommended Plan (100 yr. Protection)		Channel Improvement (100 yr. Protection)		
<u>Location of Impacts</u> Within the immediate planning area		<u>Location of Impacts</u> Within the immediate planning area		
Within the rest of the nation		Within the rest of the nation		
c. E.Q. - Destroyed				
(10) Stream Bank vegetation (existing)	Removed in project -0-	Same as 1	-0-	1-6-8-9
(11) Sport fishing	Future possibility of such prevented by drop- structures -0-	Same as 1	-0-	1-6-8-9
3. Social Well-Being (S.W.B.)				
a. Beneficial Impacts				
(1) Enhancement of health and community well being*	Community atmosphere improved due to reduced threat of floods and associated damages. Also the communities cohesion should be improved. -0-	Same as 1	-0-	1-6-8-9
(2) Educational, cultural and recreational opportunities	Reduced erosion at high school. -0-	No direct change	-0-	1-6-8-9

TABLE 7B (Cont'd)

SYSTEM OF ACCOUNTS

1 Recommended Plan (100 yr. Protection)		2 Channel Improvement (100 yr. Protection)		Coding 1/ Timing Uncertainty Exclusivity Actuality Shown in sequential coding 0-0-0-0
Location of Impacts Within the immediate planning area	Within the rest of the nation	Location of Impacts Within the immediate planning area	Within the rest of the nation	
b. Adverse Impacts				
(3) Displacement of people*	-0-	-0-	-0-	
(4) Public facilities and service, edu- cational facilities	Slight traffic dis- ruption during con- struction	Same as 1	-0-	1-6-8-9
4. Regional Development (R.D.)				
a. Beneficial Impacts				
(1) Value of increased income	Not significant	Same as 1	-0-	1-6-8-9
(2) Quantity of in- creased employment	10-20 temporary all types	Same as 1	-0-	1-6-8-9
(3) Desirable popula- tion distribution	No change	Same as 1	-0-	1-6-8-9
(4) Increase stability of economic growth*	Possible improvement	Same as 1	-0-	2-5-8-9

TABLE 7B (Cont'd)

SYSTEM OF ACCOUNTS

1 Recommended Plan (100 yr. Protection)		2 Channel Improvement (100 yr. Protection)		Coding 1/ Timing Uncertainty Exclusivity Actualty Shown in sequential coding 0-0-0-0
<u>Location of Impacts</u> Within the immediate planning area	Within the rest of the nation	<u>Location of Impacts</u> Within the immediate planning area	Within the rest of the nation	
b. Adverse Impacts				
(5) Value of Income lost	No change -0-	Same as 1 -0-	-0-	
(6) Quantity of jobs lost	-0- -0-	-0- -0-	-0-	
(7) Undesirable growth	-0- -0-	-0- -0-	-0-	

Timing

1. Impact is expected to occur prior to or during implementation of the plan.
2. Impact is expected within 15 years following plan implementation.
3. Impact is expected in a longer time frame (15 or more years following implementation.)

Uncertainty

4. The uncertainty associated with the impact is 50% or more.
5. The uncertainty is between 10% and 50%
6. The uncertainty is less than 10%.

Exclusivity

7. Overlapping entry; fully monetized in NED account.
8. Overlapping entry; not fully monetized in NED account.

Actualty

9. Impact will occur with implementation.
10. Impact will occur only when specific additional actions are carried out during implementation.
11. Impact will not occur because necessary additional actions are lacking.

2/

The State of New York, Department of Environmental Conservation is the local sponsor so most of this cost will be the State's responsibility.

* Items specifically required in Section 122 (R & H and FCA 1970) and ER 1105-2-105, dated 15 December 1972.

(1) The channel invert and side slopes would be cleared and excavated from station 16+20 to 48+50. The channel would be 20 feet wide having a 0.5% grade.

(2) The side slopes, which vary from 1 vertical on 2 horizontal to 1 vertical on 1.75 horizontal, as shown on PLATES 3 through 7, would be protected with stone filled gabion mattresses from station 19+00 to 48+70. The protection would be to the design water surface elevation and to a thickness as deemed necessary due to the velocities in each area. In investigating the possibility of reducing the elevation of the side slope protection, it was found that the savings associated with protecting to only the 10-year flood elevation was minimal. The gabion would have a green poly-vinyl coating to retard corrosion, abrasion and add a pleasing appearance to the stark stone protection. The gabions when placed on the slopes will be toed into the channel bottom to a depth of about three (3) feet. In investigating this method versus a completely lined bottom, several items were considered. The first item would be the cost, however even though the cost of the completely lined bottom was greater, it would not affect the feasibility of the project. The next item was the fact that equipment that would be used for project maintenance could not operate on the gabion protected channel bottom because it could damage the gabion mesh. Thirdly, a natural channel bottom would be more in line with a recommendation from the Bureau of Sport Fisheries and Wildlife that a low-flow channel be constructed along the shaded side of the creek in order to prevent an unusual increase in water temperature. This letter is shown as EXHIBIT C. Although construction of such a channel is not possible in the type of streambed material that exists in this area, a low-flow channel will develop naturally. Also, significant increases in the water temperature of Root Creek will not occur since the proposed project will not significantly decrease the amount of shade normally provided to the creek.

(3) At various points throughout the improvement, there will be gabion drop structures as proposed; one 2-foot, two 3-foot and two 4-foot drop structures all 20 feet wide. The drop structures would have gabions on the invert and side slopes for a specific length upstream and downstream to prevent scour. The locations of the drop structures and the limits of the special protection are shown on PLATES 3 through 7 and a cross-section is shown on PLATE 8.

(4) Between stations 36+23 and 37+07 a gabion gravity wall would be constructed. The wall would rise from the channel invert to the existing ground level. The channel bottom in this area would be slightly widened to recover some of the hydraulic area lost in the construction of the wall. (See PLATES 4 and 8.)

(5) There are also four (4) areas within the project reach where small rolled earth fill dikes would be needed to contain the

design water discharge. The dikes would be no higher than four (4) feet above the existing ground level and would be 1.5 feet above the design water surface elevation. These areas are located on PLATES 2 and 3.

(6) At the upstream end of the study area in a flat area upstream of the Bolivar Central School bus garage, a debris basin would be provided. The debris basin would have a bottom width of 75 feet and a length of 300 feet. The invert slope would be 0.4% and the side slope 1 vertical on 3 horizontal. The basin would capture a major portion of transported materials and would reduce maintenance costs in the improved channel by centralizing material removal. This area, between station 63+00 to 66+00, was chosen because of easy access and available adjacent land.

(7) Temporary erosion and sediment control measures will be utilized by the contractor during construction of the project. The exact type will be spelled out in the plans and specifications prior to construction. These problems and others and the measures to take in controlling them are spelled out in The Guide Specifications of Environmental Protection, CE 1300, June 1973.

(8) The Davis Street bridge wing walls will be revamped and its existing abutments underpinned. The channel invert under the bridge will be protected with gabions to further protect the abutments from unmining caused by erosion.

(9) Disposal areas for the excavated material are shown on Plates 1 and 2. The material excavated for the debris basin will be placed on either side of the basin. The remaining two areas, on the left bank upstream of the Davis Street Bridge and the area behind the left bank just downstream of the First Street Bridge, will accomodate the remaining material.

(10) In order to reduce the possible increase in the water temperature of Root Creek, fast growing shade trees will be planted in areas where they are needed. Consideration was also given to the possibility of excavating a low-flow channel for the same purpose. However, due to the composition of the existing streambed material, such a channel would fill in with sediment in a very short period of time. A low-flow channel will, however, develop naturally. This will be due, again, to the type of material in the channel. Lining the channel invert with gabions in the form of a shallow "v" would create a permanent low-flow channel, but then the channel could not be economically maintained. To maintain the channel economically, machinery must be used; if gabions lined the invert, machinery would not be permitted on them. Therefore, it is more desirable and economical to have a natural channel invert and let a natural low-flow channel develop.

15. ENVIRONMENTAL QUALITY PLAN

In order to make the proposed project more complete, concur with the desires of local interests and prevent unnecessary erosion, that in the

past has caused many trees to fall, the left bank from station 48+70 to 58+25 and the right bank from station 56+00 to station 59+00 of the natural channel will be protected with gabions. The slopes will be cleared and the slope of 1 vertical on 1.75 horizontal will be used. The gabion slope protection will be placed to the 15-year flood elevation, this additional work will be added to the above 100-year plan and thus create the EQ plan. The results of implementing this plan would be a moderate decrease in future O & M costs. Also included in this EQ plan will be the planting of trees, both to replace those that will have to be removed during construction and enhance the natural values of the area. The excavated areas above the gabion slope protection and the disposal areas will also be seeded after the construction is completed.

16. ENVIRONMENTAL IMPACTS OF THE PROPOSED PROJECT

a. Water quality - During project construction, there would be a temporary increase in suspended solids and turbidity resulting from excavation in the stream channel. This condition would be most evident during the single construction season (April to October) necessary to construct the proposed project and would continue to a lesser degree until adequate vegetative cover is established on exposed soils. The relative coarseness of the stream bed material, frequent low flows in the creek and temporary erosion and sediment control measures would reduce, somewhat, the adverse effects of increased turbidity and suspended solids. A portion of the suspended solids generated by the project would be deposited in the Little Genesee Creek near the mouth of Root Creek, resulting in a temporary disruption to aquatic organisms and fishlife.

The stabilization of the stream banks in the project area, upon completion of the proposed modification, would reduce erosion in the project limits and benefit the community of Bolivar.

The removal of some bank vegetation in the project area could raise water temperatures, thereby reducing oxygen levels slightly. However, bank vegetation will be replaced to the extent possible. Also, the stream velocities are such that the water will be subjected to increased exposure to the sun for only a short period of time. Therefore, this reduction in dissolved oxygen is anticipated to be negligible.

b. Flooding - The proposed project would reduce flood damages in the project area with a negligible increase in downstream water levels during periods of high flow.

c. Vegetation - A number of larger trees would have to be removed for construction. Of these, several are located on the bank and would eventually, be lost anyway by further erosion. When the project is complete, those remaining will be safe from this action. In addition, fill areas will be reseeded and where consonant with the functioning of the project, bank vegetation will be replaced.

d. Wildlife - During construction of the proposed channel modification, existing wildlife populations would move away from the area as a result of habitat destruction, increased noise levels, etc. The proposed reduction in streambank vegetation will restrict the ability of the area to support the terrestrial wildlife populations presently associated with this riparian habitat. Project construction would therefore result in a loss of wildlife populations inhabiting the reach of the stream involved. Considering the natural character and high level of habitat diversity occurring in the basin, this loss would be negligible.

Effects upon the aquatic ecosystems of both Root Creek and Little Genesee Creek would be disruptive. Modification of approximately 3,000 feet of stream channel will eliminate the existing diverse benthic habitat and community in Root Creek. A reduction in the benthic population, which serves as a food source for the larger aquatic wildlife, would result in a decline in the fish population in Root Creek. Existing fish population in Root Creek can be expected to emigrate into Little Genesee Creek as their food source declines. This relocation would somewhat disrupt the established ecosystem of Little Genesee Creek through increased competition for space and nourishment. The severity of this problem would depend upon the number of fish migrating into Little Genesee Creek from Root Creek. This is not expected to present a serious problem because of the periodic low-flow conditions. Establishment of a new benthic community in Root Creek is anticipated to occur in the future, differing in character from the present one.

e. Socio-Economics

(1) Land use and development - Erosion activity has resulted in direct loss of acreage. With the proposed control this loss in this manner would be minimized. Stabilization, in addition to the cleaning up of existing debris in the channel, could make those vacant areas adjoining Root Creek desirable and more valuable home sites as there will be less subjection to inundation. A flood plain management program could be adopted by local interests to support and enhance the effectiveness of the proposed construction project so that even greater protection and aesthetic quality would be maintained. The township presently has a comprehensive plan which should preclude unwise land use. It is not anticipated that the proposed project would significantly alter the land use and development patterns because more important factors, such as the local economy, outweigh it.

(2) Natural resources - Implementation of the proposed project would involve utilization of local stone-fill material for the gabion structures. This material would be obtained from a quarry located in Portville, Cattaraugus County, approximately 15 miles from the proposed project. No other natural resources would be affected by the proposed project.

(3) Population - As in the past, the population is directly related to the oil fields. The proposed project would not significantly influence future trends. There would be no displacement or disruption of inhabitants as a result of the project.

(4) Recreation - Construction of the proposed channel modification would not affect existing recreational facilities in the area.

(5) Hunting and fishing - Hunting and fishing opportunities in the area would not be affected directly or to any great extent by the proposed project.

(6) Aesthetics - The aftermath of any flooding activity invariably includes debris, mud and other similar type aesthetic intrusions, if only on a temporary basis. With flood control, those situations would be substantially reduced. Local policing could reduce the amount of debris thrown into and resting in the creek. This would significantly improve aesthetic quality.

Bank stabilization and the reduction of flooding activity, in conjunction with landscaping, including slope-seeding, could improve visual appeal. However, replacement of a natural channel with a man-made one would generally reduce the aesthetic quality of the stream.

(7) Archeological and historical resources - Although it appears that the proposed project will have no impact on these resources, information from the New York State Parks and Recreation Division of Historic Preservation disclosed that there may be sites of archeologist value in the area. As a result, a timely inventory will be made of the possible sites so that any required salvage can be performed prior to construction of the project. It is anticipated that the site inventory will be performed for the Corps by a recognized archeologist. The actual salvage, if required, will be the responsibility of the National Park Service.

(8) Future maintenance - Future maintenance has been estimated at \$5,000 annually. This will consist of sediment removal from the debris basin and below each drop structure should it need it. Unusually large deposits in the channel will also have to be removed. Also, the control of woody vegetation growth amidst the gabion slope protection would also require control.

SECTION VI - ECONOMIC ANALYSIS

17. COST ESTIMATES

a. Federal first costs - An estimate of Federal first costs has been developed to establish the feasibility of the plan outlined above. Estimate of costs as of July 1974 are shown in the following table.

TABLE 8
FEDERAL FIRST COSTS

Item	Units	Quantity	Unit Cost	Amount	Total
Clearing	Acres	5	\$ 300.00	\$ 1,500	
Excavation (Common)	Cu.Yds.	36,500	3.25	118,600	
9" Gabion Slope Protection	Cu.Yds.	3,100	40.00	124,000	
Placed Fill Over Slope Bottoms	Cu.Yds.	5,000	1.50	7,500	
Filter Cloth (Slopes)	Sq.Yds.	10,000	2.25	22,500	
Gabion Drop Structures:					
2-Foot Drop Structure (1):					
12" Slope and Invert Protection	Cu.Yds.	90	40.00	3,600	
36" Invert and Slope Protection	Cu.Yds.	108	40.00	4,320	
Filter Cloth (Invert)	Sq.Yds.	110	2.25	248	
Gabion Block Drop	Cu.Yds.	27	40.00	1,080	
Structural Excavation	Cu.Yds.	35	6.00	210	
Concrete Grout	Sq.Yds.	120	4.00	480	
Backfill	Cu.Yds.	9	22.00	198	
3-Foot Drop Structures (2):					
12" Slope and Invert Protection	Cu.Yds.	90	40.00	3,600	
36" Invert and Slope Protection	Cu.Yds.	378	40.00	15,120	
Filter Cloth (Invert)	Sq.Yds.	300	2.25	675	
Gabion Block Drop	Cu.Yds.	65	40.00	2,600	
Structural Excavation	Cu.Yds.	75	6.00	450	

TABLE 8 (Cont'd)

Item	Units	Quantity	Unit Cost	Amount	Total
Concrete Grout	Sq.Yds.	460	4.00	1,840	
Backfill	Cu.Yds.	18	22.00	396	
4-Foot Drop Structures (2):					
12" Slope and Invert Protection	Cu.Yds.	90	40.00	3,600	
36" Invert and Slope Protection	Cu.Yds.	475	40.00	19,000	
Filter Cloth (Invert)	Sq.Yds.	350	2.25	790	
Gabion Block Drop	Cu.Yds.	80	40.00	3,200	
Structural Excavation	Cu.Yds.	90	6.00	540	
Concrete Grout	Sq.Yds.	460	4.00	1,840	
Backfill	Cu.Yds.	20	22.00	440	
Gabion Gravity Wall:					
Gabions	Cu.Yds.	104	40.00	4,160	
Structural Excavation	Cu.Yds.	185	6.00	1,110	
Crushed Stone	Cu.Yds.	30	10.50	315	
Granular Backfill	Cu.Yds.	30	10.50	315	
12" Gabion Invert Protection (Upstream End of Debris Basin)	Cu.Yds.	50	40.00	2,000	
Filter Cloth	Sq.Yds.	150	2.25	338	
Davis Street Bridge:					
Underpinning of Abutments, Wing Wall, revamping and Invert Protection	L.S.	---	---	20,000	

TABLE 8 (Cont'd)

Item	Units	Quantity	Unit Cost	Amount	Total
Rolled Earth Fill (Dikes)	Cu.Yds.	600	4.00	2,400	
Seeding	Acres	4	250.00	1,000	
Beautification	L.S.	---	---	3,000	
		Subtotal		\$372,965	
		Subtotal (rounded)			\$373,000
Contingencies @ 15%					56,000
		Subtotal (rounded)			\$429,000
Engineering and Design @ 20%					85,800
Supervision and Administration					44,200
Total, Federal First Costs (rounded)					\$559,000

b. Non-Federal first cost - An estimate of non-Federal first cost for the proposed plan of improvement is contained in the following table. Estimates of costs are based on July 1974 price levels.

TABLE 9
NON-FEDERAL FIRST COSTS

Item	Amount	Total
Rights-of-Way		
Permanent Easements	\$ 10,500	
Temporary Easements	500	
Severance	5,420	
Subtotal	\$ 16,420	
Acquisition Cost (brokerage) @ 15%	2,460	
Subtotal		\$ 18,880
Contingencies @ 15%		2,820
Total Land (rounded)		\$ 21,700
Legal, Engineering and Supervision at 10%		2,170
Total, Non-Federal First Costs (rounded)		\$ 24,000

18. ANNUAL CHARGES

a. Average annual charges - The average annual Federal and non-Federal charges based on a 50-year project life with July 1974 values are summarized in the following table.

TABLE 10
AVERAGE ANNUAL CHARGES

Item	Amount
<u>Federal at 5-7/8%</u>	
Interest (.05875 x \$559,000)	\$ 32,841
Amortization (.00359 x \$559,000)	<u>2,007</u>
Total	\$ 34,848
<u>Non-Federal at 5-7/8%</u>	
Interest (.05875 x \$24,000)	\$ 1,400
Amortization (.00359 x \$24,000)	86
Maintenance	<u>5,000</u>
Total	\$ 6,486
Total Average Annual Federal and Non-Federal Charges (rounded)	\$ 41,300

19. ESTIMATES OF BENEFITS

a. Summary of average annual primary flood control damages and benefits (July 1974 values)

Natural Flood Damages	\$ 53,400
Natural Flood Damages (After N.Y.D.O.T. improvement)	50,300
Damages after Corps' improvement	<u>2,300*</u>
Benefits	\$ 48,000

b. Other attributable benefits - In investigating the benefits of a project, there are benefits in addition to primary flood control benefits that can be attributed to a project. These additional benefits are normal future development benefits and redevelopment benefits.

*These residual damages are those which occur above the 100 year level of protection, on an annual basis.

(1) Normal future development benefits - Based on a 3-1/4% growth rate and average annual damages to the contents of residential dwellings in the amount of \$16,716, approximately \$12,600 in average annual normal future development benefits can be obtained. This estimate is based on a present worth factor of 12.08261 (3-1/4% annual growth rate for 50 years) and a partial payment factor for 50 years of 0.062340, both at a 5-7/8% interest rate.

$$\$16,716 \times 12.08261 = \$201,973 \times 0.062340 = \underline{\$12,591}$$

(2) Redevelopment benefits - Although the project area is not classified as an Economic Development Administration area, much of the surrounding area, within a 50-mile radius of Bolivar, is classified as such. Therefore, it may be assumed that a portion of the skilled, semi-skilled and unskilled labor needed in the construction of the proposed project would come from these areas. However, for the purposes of this report, the possibility of redevelopment benefits will only be recognized and not determined since their impact would be minimal.

(3) These other benefits are recognized but will not be used to justify the proposed project. Only primary flood control benefits will be used.

20. MAINTENANCE

a. Responsibility - The State of New York, the local cooperating agency, would be responsible for the continued effectiveness of the improvement by performing proper and systematic maintenance of the improved channel and associated structures.

b. Maintenance required - Local interests would be required to maintain the geometric shape and grade of the improved Root Creek channel by keeping it free of debris, sediment deposits, undesirable vegetation and other materials which would tend to decrease its efficiency. The debris basin is properly maintained with a periodic cleaning out. Periodic repair of the gabion slope protection and drop structures may also be required.

c. Annual maintenance cost - The average annual cost of maintaining the proposed improvement is estimated at \$5,000. This estimate is based on a percentage of the cost for structures in the proposed improvement plus the estimated cost of cleaning out the debris basin annually.

d. Sediment disposal - Sediment removed from the debris basin and the channel will be used as land fill in the low areas behind the left bank downstream of the end of the proposed improvement.

21. BENEFIT-COST ANALYSIS

The following table summarizes the proposed project's cost compared to its attributable benefits:

TABLE 11
BENEFIT-COST ANALYSIS
(Average Annual)

Average Annual Project Benefits		Average Annual Project Cost	B/C Ratio
A. Primary flood control only	\$48,000	\$41,300	1.2
B. Primary flood control and normal future development	\$60,600	\$41,300	1.5
C. Primary flood control and normal future development and redevelopment	slightly higher than B	\$41,300	slightly higher than B

SECTION VII LOCAL COOPERATION AND COORDINATION

22. LOCAL COOPERATION

a. Local cooperation required - Local cooperation as specified in Section 3 of the Flood Control Act of 22 June 1936, as amended, would basically apply. The State of New York, the local cooperating body, would be required prior to the commencement of construction to:

(1) Provide without cost to the United States all lands, easements, and rights-of-way including suitable borrow and spoil disposal areas as determined by the Chief of Engineers as necessary to the construction of the project, at a presently estimated cost of \$24,000.

(2) Adjust utilities as necessary without cost to the United States;

(3) Hold and save the United States free from damages due to the construction work and maintenance of the project excepting, however, damages due to the fault or negligence of the United States or its contractors.

(4) Prescribe and enforce regulations to prevent obstruction or encroachment on channels and interior ponding areas which would reduce their flood carrying capacity or hinder maintenance and operation, and control development in the project area to prevent an undue increase in the flood damage potential;

(5) Maintain the project works after completion in accordance with regulations prescribed by the Secretary of the Army;

(6) At least annually, notify interests affected that the improvement will not provide complete protection from floods greater than the design conditions; and

(7) Comply with Section 221 of P.L. 91-611.

b. A letter, dated 11 February 1975, from the New York State Department of Environmental Resources expressing the State of New York's desire to comply with the items of local cooperation is inclosed as Exhibit B.

23. COORDINATION WITH OTHER AGENCIES

The plan to provide flood protection for Bolivar, New York has been outlined and referred to various Federal and non-Federal agencies for comment. Copies of correspondence from the following agencies have been received to date and are included in this report as EXHIBITS C through I, inclusive.

Bureau of Sport Fisheries and Wildlife
United States Department of the Interior

Department of Housing and Urban Development

Soil Conservation Service
United States Department of Agriculture

United States Environmental Protection Agency

New York State Department of Environmental Conservation

National Park Service
United States Department of the Interior

New York State Office of Parks and Recreation

SECTION VIII
RESULTS OF INVESTIGATION

24. STATEMENT OF FINDINGS

I have reviewed and evaluated in light of the overall public interest, the documents concerning the proposed action, as well as the stated views of interested agencies and the concerned public, relative to the various practicable alternatives for providing flood protection in the Root Creek Basin of Allegany County and with particular regard to the Village of Bolivar. Public and interagency coordination and communication have been maintained throughout the study, with several agencies participating in the evaluation of problems and alternative solutions.

The possible consequences of constructing the proposed project, as well as each of the alternatives, have been studied for environmental, social and economic effects, both regional and national, as well as engineering feasibility. Other factors bearing on my review have included the fulfillment of public need, particularly with regard to the alleviation of flood damages.

In the evaluations of viable alternative solutions and, ultimately, the selected plan, the following were considered pertinent:

a. Environmental Considerations - Of primary concern was the evolution of a plan that would best provide the level of flood protection desired by the affected local residents and maintain or enhance the physical environmental setting of the study area. Specifically, these considerations included modification of the existing stream channel; the effects on existing plant and animal life, both aquatic and terrestrial; aesthetic quality during construction and after project completion; water quality; local air quality and noise levels during project construction; and the effect on historical and archaeological values.

The most significant adverse environmental effect that could result from project construction would involve a possible increase in the present water temperatures of Root Creek. This possible increase in water temperatures could have an effect on the brown trout population of Little Genesee Creek to which Root Creek is a tributary. However, I have concluded, based on the information currently available to me, that this effect would be minimal.

b. Social Well-being Considerations - The proposed project will cause changes in the local social environment. Reducing the threat of flooding in the project area will lessen anxiety, promote better health, improve general living conditions, promote orderly community development and help generally to improve the standard of living. Negative social effects will be confined to the period of construction and include temporary traffic congestion and increased noise, dust and exhaust emissions from the construction equipment.

c. Engineering Considerations - Alternative solutions to the flooding problem of Root Creek through the Village of Bolivar involved consideration of a range of structural and non-structural measures. Included were an upstream reservoir; flood walls; increasing the existing channel capacity by widening, deepening or a combination of both; flood plain management; flood warning systems; flood insurance; flood proofing; relocation; and no-action of any kind. The no-action alternative would not provide any degree of relief from the currently experienced flood damages and would therefore be unresponsive to the needs and desires of the local people. The non-structural alternatives, while offering a small measure of benefit, involve unacceptably high costs to the community. Such measures should be viewed as a supplement to the proposed plan for structural protection.

General design studies for the structural measures relating to the Root Creek flooding problem were accomplished with a view toward the development of a plan of protection capable of providing the greatest return per dollar invested while meeting the desires of the people directly involved. After examination of all structural alternatives, the only possibilities that offered economic feasibility related to modification of the channel to provide various degrees of protection. The choice of the level of protection was that which would contain the flood of record which has an estimated 100-year frequency.

d. Economic Considerations - Construction of the proposed project would produce changes in the economy of the Bolivar area. The frequency of overbank flooding, and thus flood damages, within the project area will be reduced, resulting in economic savings to local residents. The project would require the conversion of approximately 4 acres of land from private to public ownership, thus removing that land from local tax rolls. However, these lands are essentially confined to the channel area and any loss could be offset by increased property values because of reduced flood hazard.

I find that the action proposed is based on a thorough analysis and evaluation of various practicable alternative courses of action for achieving the stated objectives; that wherever adverse effects are found to be involved, they cannot be avoided by following reasonable alternative courses of action which would achieve the Congressionally-specified purposes; that where the proposed action has an adverse effect, this effect is either ameliorated or substantially outweighed by other considerations of national policy; that the recommended actions are consonant with national policy, statutes, and administrative directives; and that on balance the total public interest should best be served by the implementation of the recommended plan.

25. DISCUSSION

a. General - This detailed project report is concerned with the physical, hydrologic, hydraulic, environmental and economic features of Root

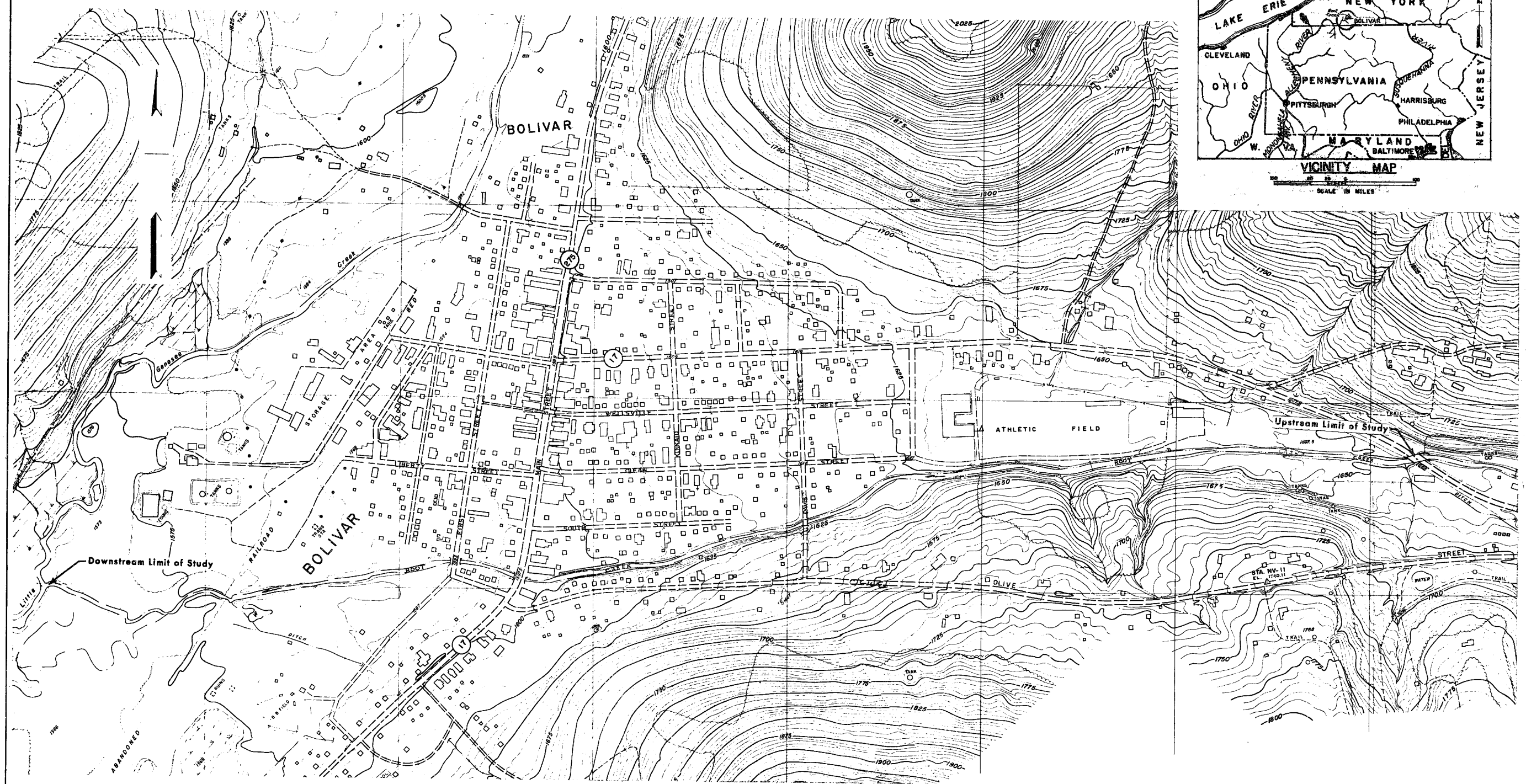
Creek in Bolivar. Considered in the report are the flood problem, the history and evaluation of flood damages, alternative methods of flood protection, the environmental setting with and without a project, cost estimates for the recommended plan and the economic justification and prospective benefits of providing flood protection.

b. Summary - Flood protection by channel improvement was found to be the only practicable solution to the problems in Bolivar. The plan herein proposed would substantially reduce primary damages from floods up to the maximum known flood. The proposed project would provide protection against the 100-year flood such as resulted from Tropical Storm "Agnes" in June of 1972. The Federal cost of the project is estimated to be \$559,000. Obligations of the local cooperating agency are evaluated at \$24,000. The development of a flood control project according to the recommended plan herein presented is feasible and economically justified. The current economic ratio is 1.2 considering primary flood control benefits only.

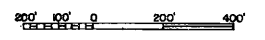
26. RECOMMENDATION

It is recommended that a channel improvement project for flood protection on Root Creek in Bolivar, New York, as developed in this report, be selected by the Chief of Engineers for implementation under the authority of Seciton 205 of the Flood Control Act of 1948, as amended, and further, that this detailed project report be approved as a basis for preparation of contract plans and specifications.

MAX R. JANAIRO, JR.
Colonel, Corps of Engineers
District Engineer



ROOT CREEK
BOLIVAR, NEW YORK
STUDY AREA AND VICINITY MAP

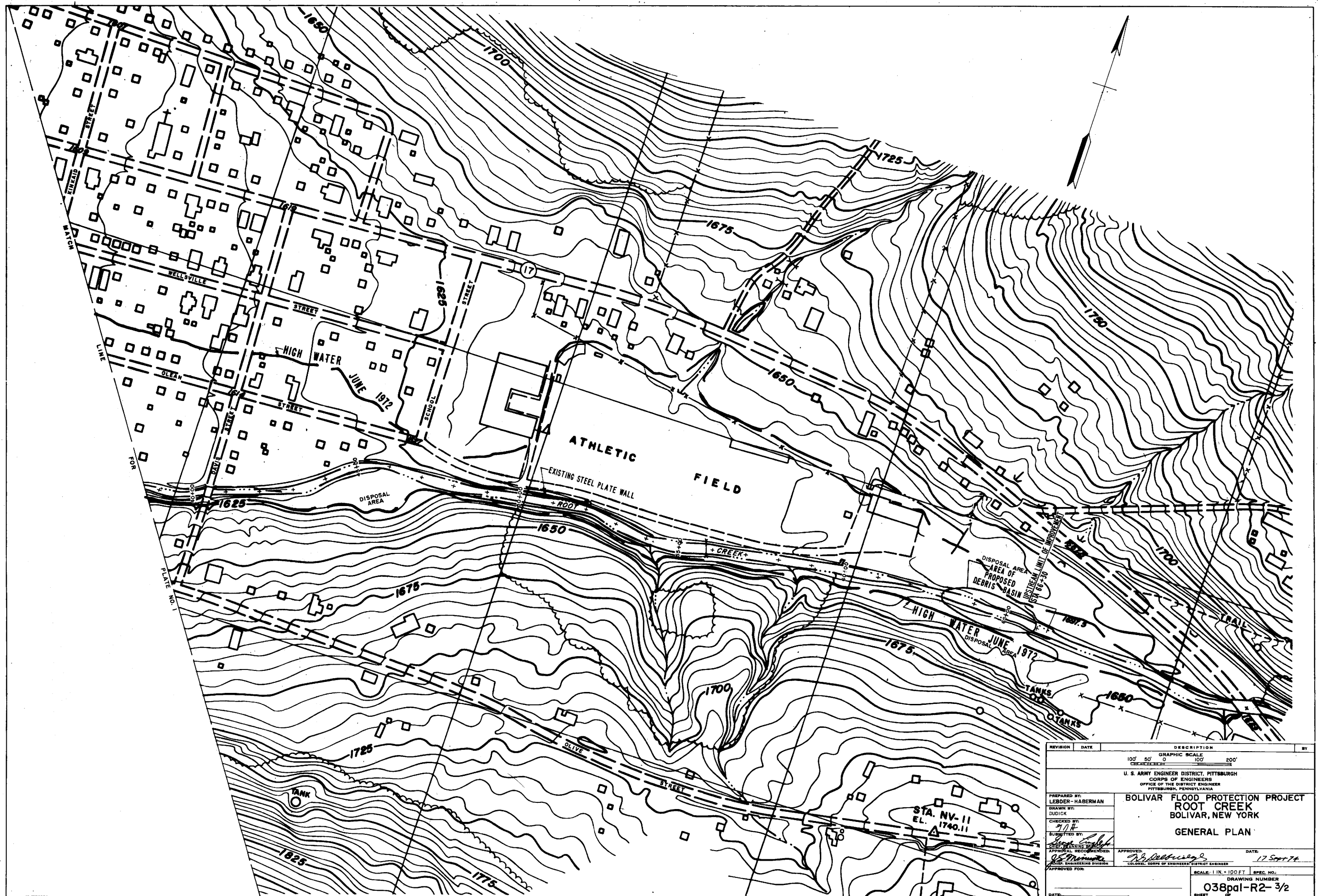


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OFFICE OF THE DISTRICT ENGINEER, PITTSBURGH, PA.

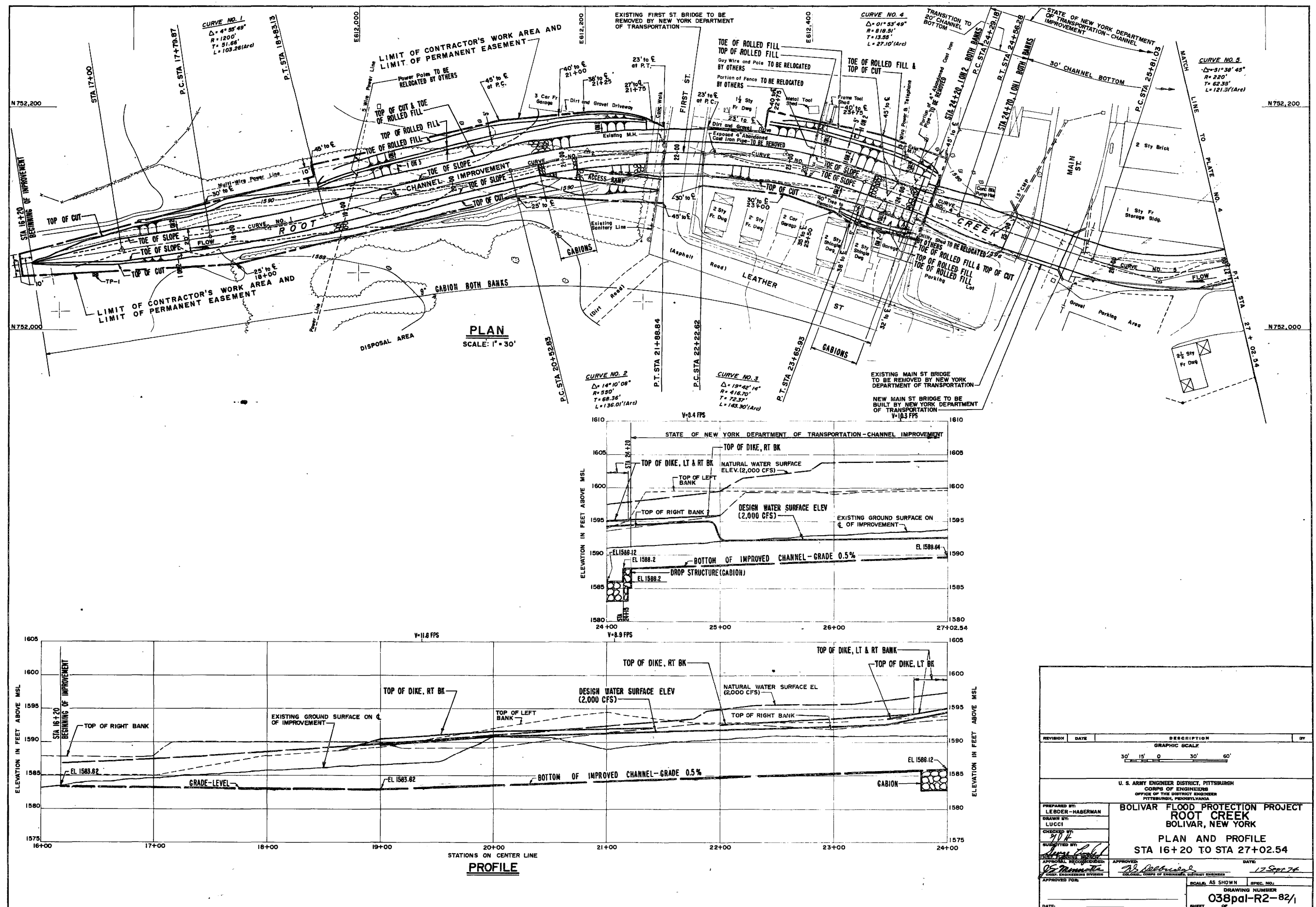
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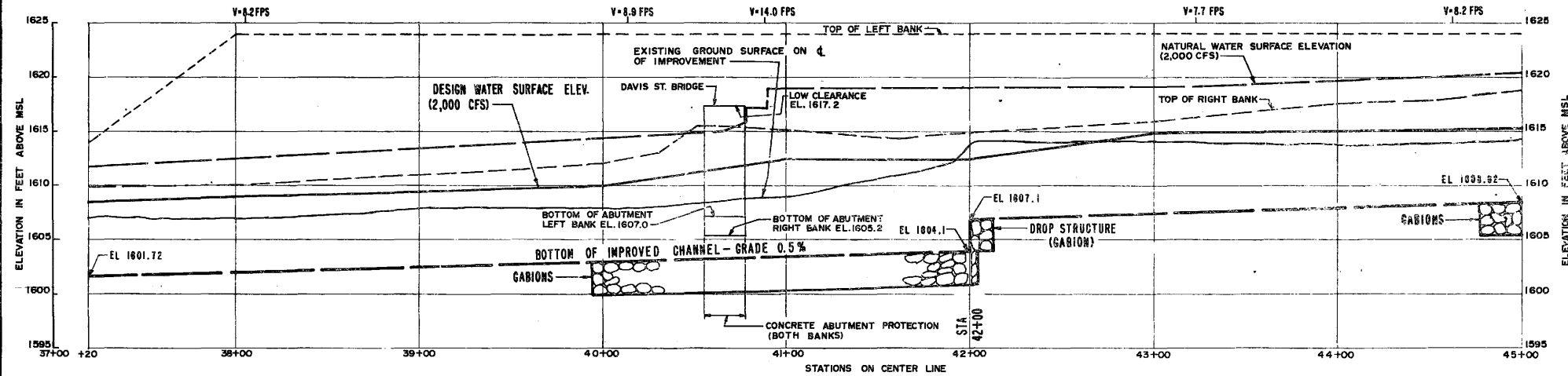
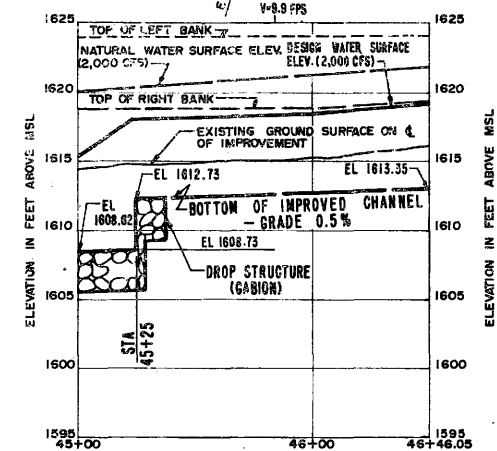
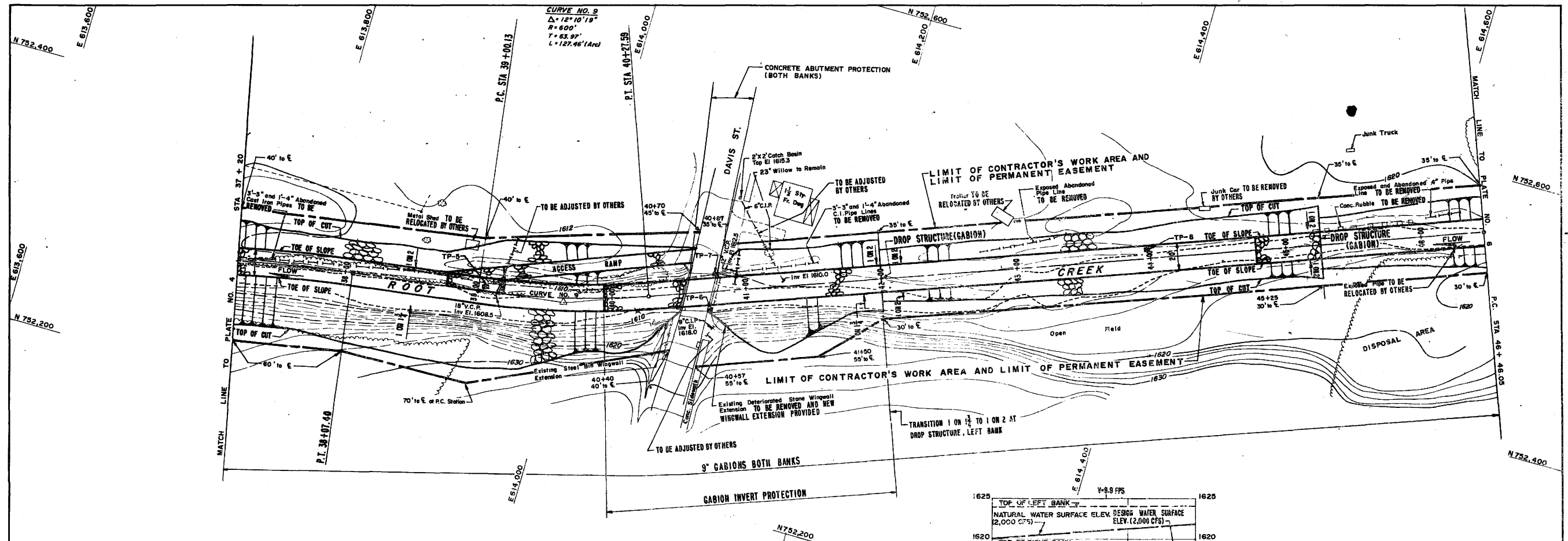
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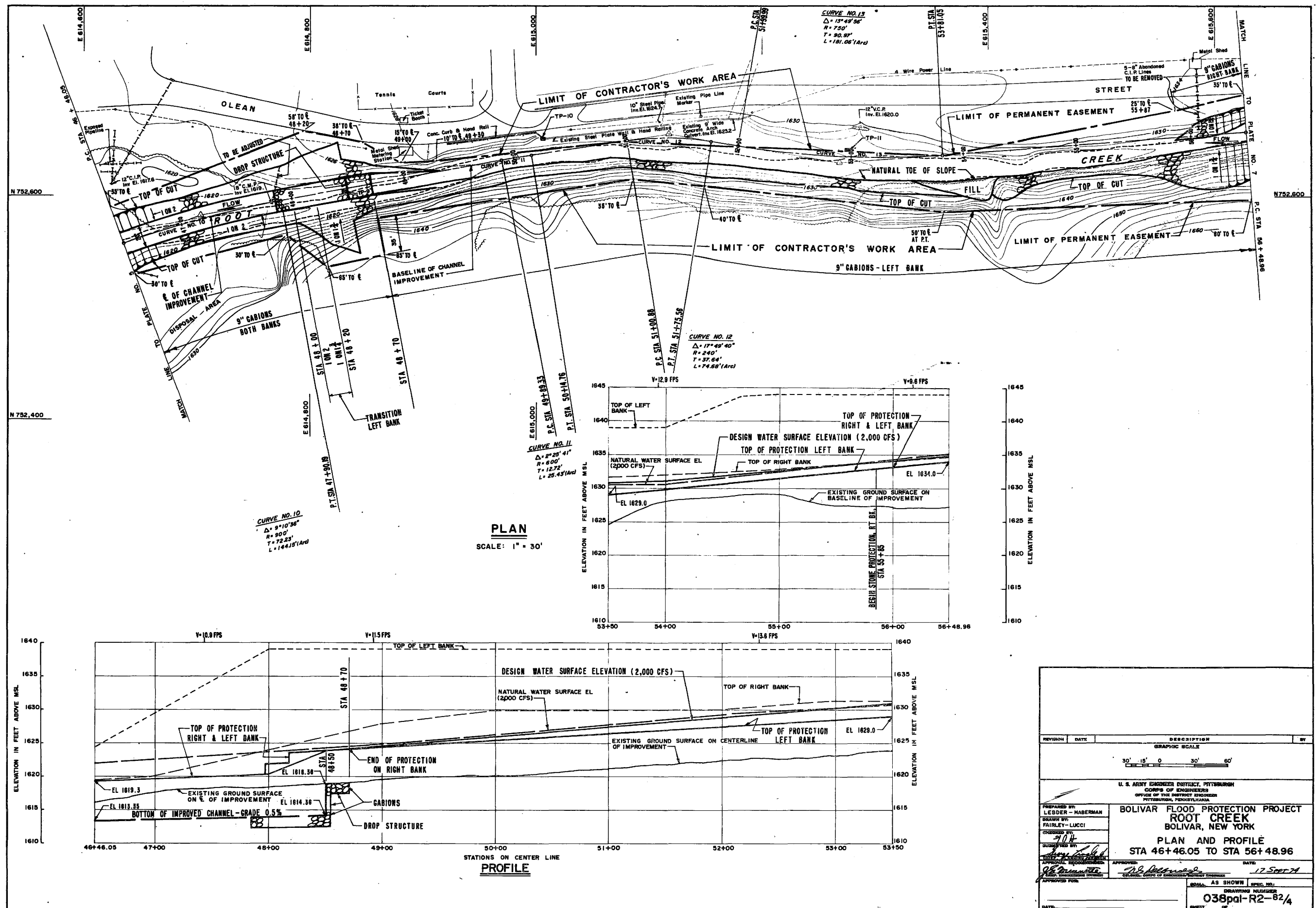


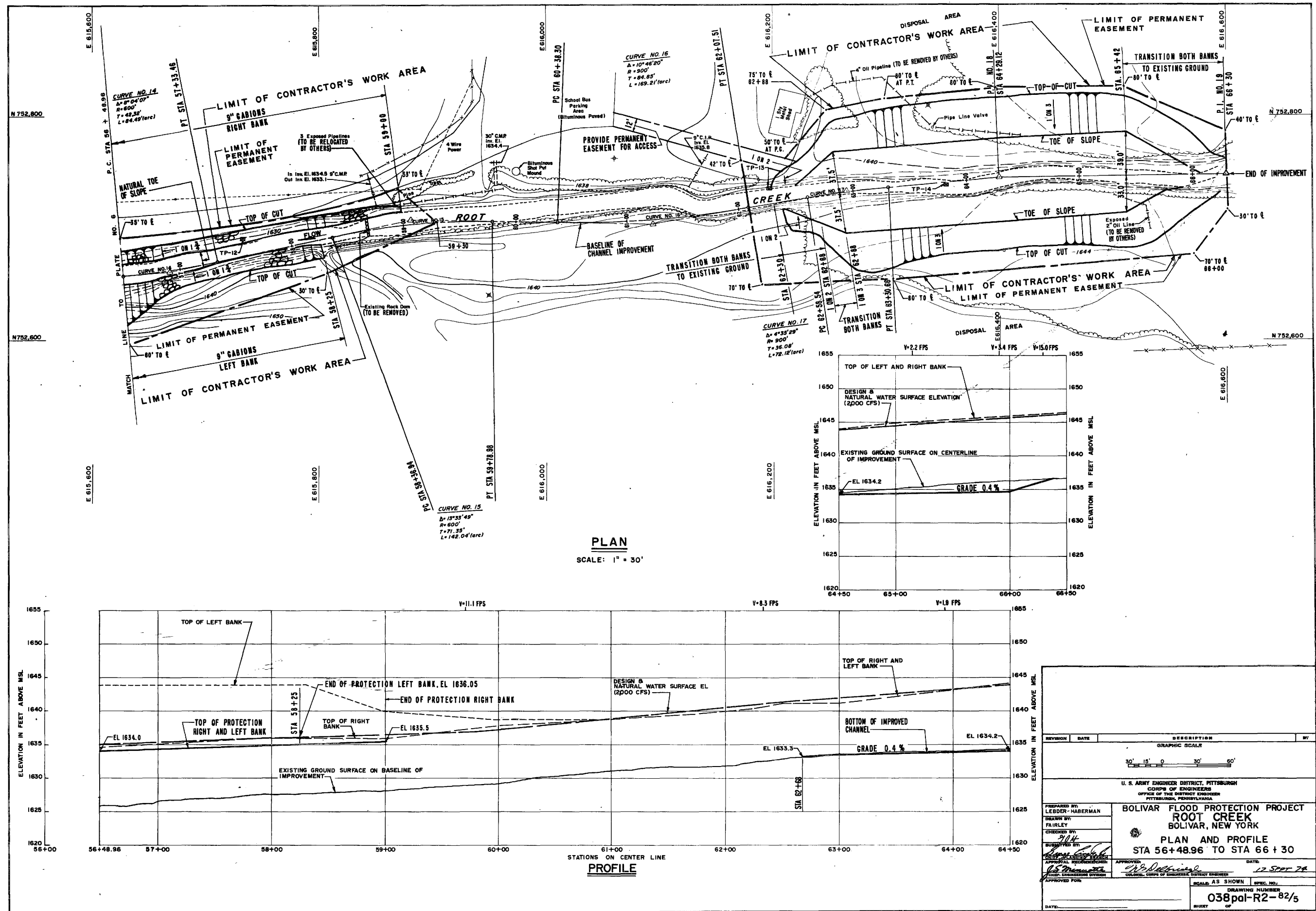
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BOLIVAR FLOOD PROTECTION PROJECT ROOT CREEK BOLIVAR, NEW YORK GENERAL PLAN			
PREPARED BY: LEBOER-HABERMAN	DATE: 17 Sept 74		
DRAWN BY: DUDICK	APPROVED: <i>[Signature]</i> COLONEL, CORPS OF ENGINEERS, DISTRICT ENGINEER		
CHECKED BY: 9/17/74	APPROVED FOR: <i>[Signature]</i> ENGINEERING DIVISION		
STATION: STA. NV-11 ELEVATION: EL. 1740.11		DRAWING NUMBER 038pd-R2- 3/2	
DATE:		SHEET	

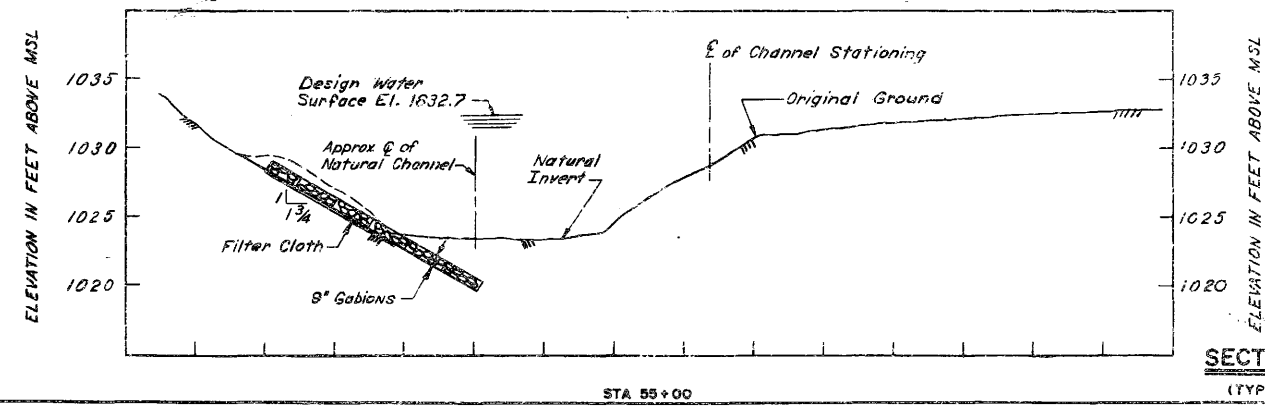
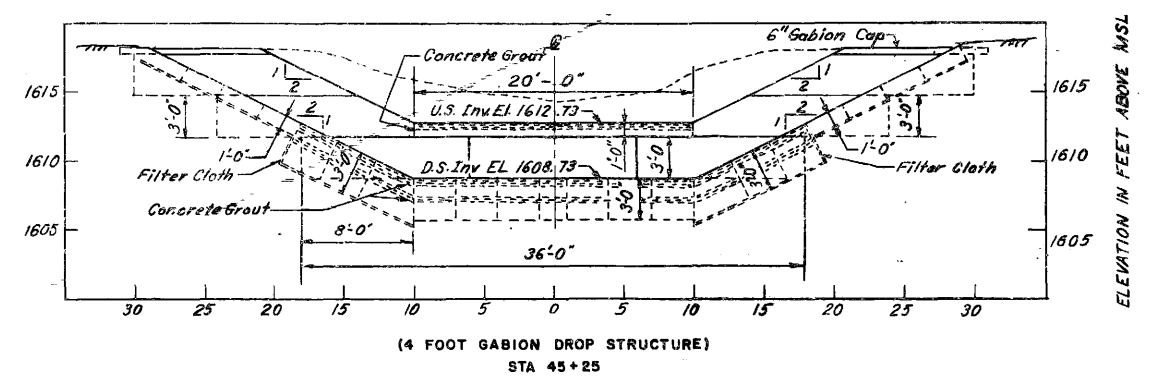
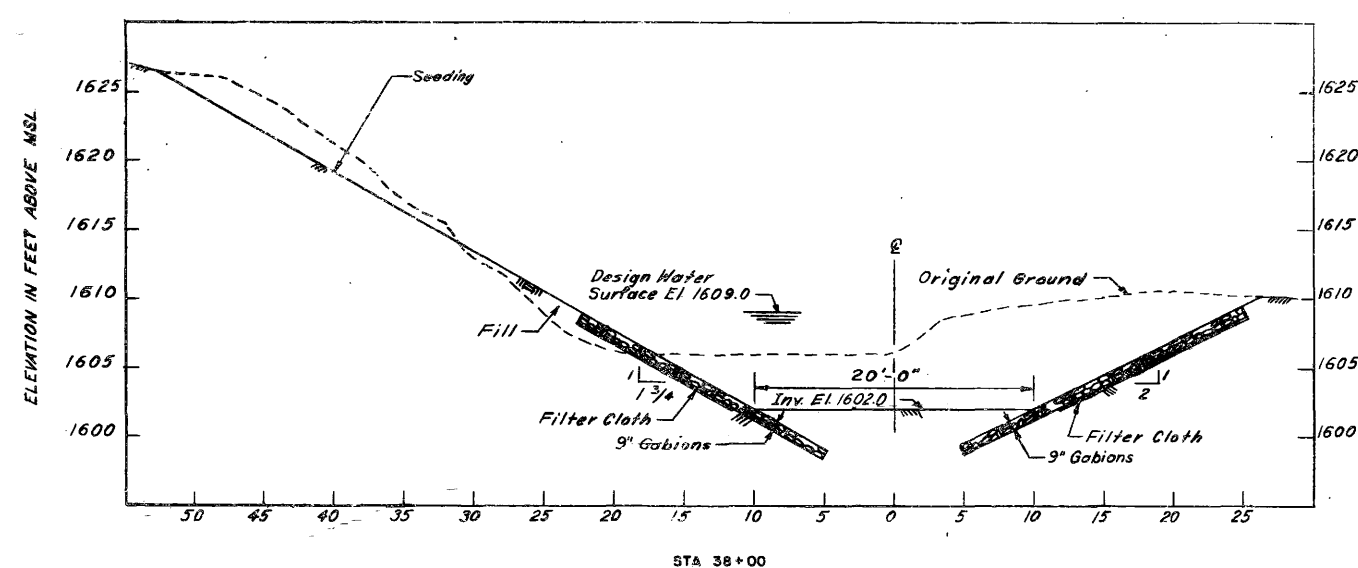
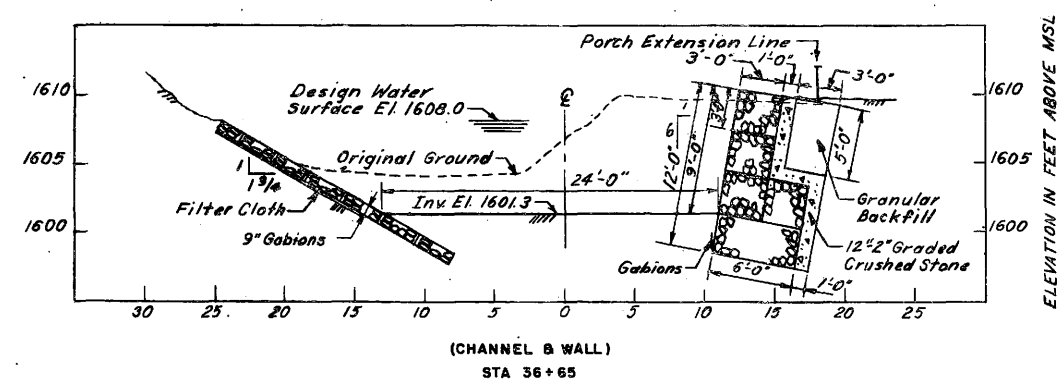
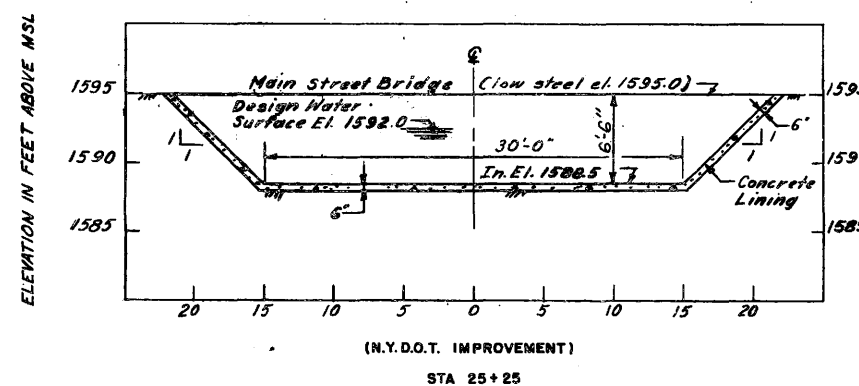
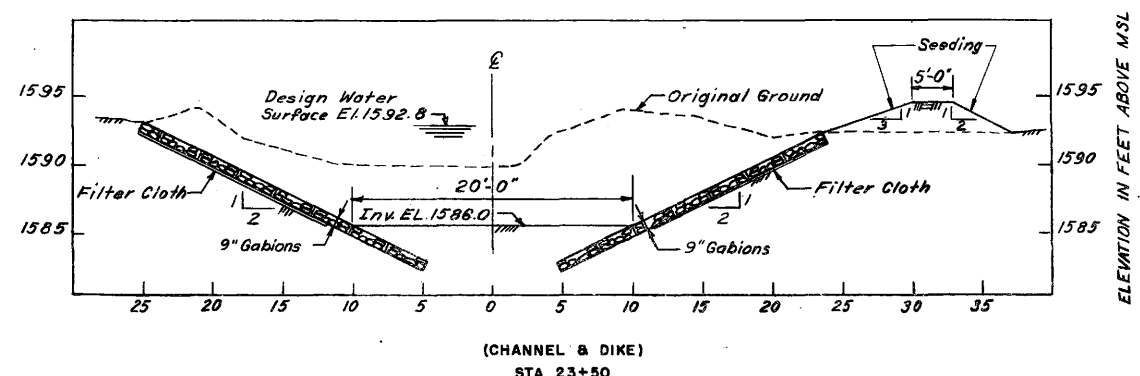
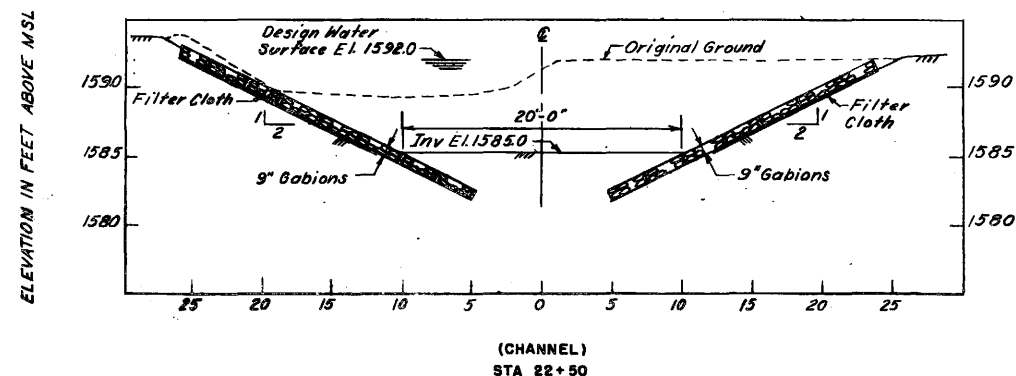




REVISION	DATE	DESCRIPTION	BY
GRAPHIC SCALE			
U. S. ARMY ENGINEER DISTRICT, PITTSBURGH CORPS OF ENGINEERS OFFICE OF THE DISTRICT ENGINEER PITTSBURGH, PENNSYLVANIA			
PREPARED BY: LESDER-HABERMAN DRAWN BY: FAIRLEY CHECKED BY: 704 SUBMITTED BY: 704		BOLIVAR FLOOD PROTECTION PROJECT ROOT CREEK BOLIVAR, NEW YORK PLAN AND PROFILE STA 37+20 TO STA 46+05	
APPROVAL RECOMMENDED: J. S. Mennette CHIEF ENGINEERING DIVISION		APPROVED: J. S. Mennette COLONEL, CORPS OF ENGINEERS, DISTRICT ENGINEER	
APPROVED FOR:		DATE: 17 Sept 74	
SCALE: AS SHOWN		SPEC. NO.	
DRAWING NUMBER 038pal-R2-82/3		SHEET OF	







REVISED	DATE	DESCRIPTION	BY
GRAPHIC SCALE			
AS SHOWN			
U. S. ARMY ENGINEER DISTRICT, PITTSBURGH CORPS OF ENGINEERS OFFICE OF THE DISTRICT ENGINEER PITTSBURGH, PENNSYLVANIA			
PREPARED BY HABERMAN	BOLIVAR FLOOD PROTECTION PROJECT ROOT CREEK BOLIVAR, NEW YORK		
DRAWN BY GRATZINGER	SECTIONS		
CHECKED BY 9/04	APPROVED 17 SEPT 74		
SUBMITTED BY 9/04	APPROVED FOR 038pal-R2-82/6		
DATE	SCALE	BY	NO.

LOCATION		DIRECTION OF HOLE FROM VERTICAL		DATE HOLE STARTED		HOLE NO.		SIZE AND TYPE OF BIT OR SAMPLER	
N752,080 E811,708		0°		14 NOV. 1973		TP-1		J.D. 310 BACKHOE	
ELEVATION	DEPTH	LL	PL	VS	BLOWS PER FOOT	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CODE OF MATERIAL	REMARKS
1585.0	0.0						BROWN SANDY GRAVEL (GP) (SAND BAR)		TOP OF HOLE
1584.5	0.5						BROWNISH GRAY ORGANIC SILTY SAND (OL) W/TRACE GRAVEL AND ROOTLETS		
1582.0	3.0						BROWNISH GRAY SANDY GRAVEL (GP) W/TRACE OF SILT		
1579.7	5.3						GRAY SANDY GRAVEL (GP) W/TRACE OF SILT		
1579.6	5.4						LIGHT BROWN SILTY SANDY GRAVEL (GM)		
1578.0	8.0						GRAY SANDY GRAVEL (GP) W/TRACE OF SILT		BOTTOM OF HOLE

LOCATION		DIRECTION OF HOLE FROM VERTICAL		DATE HOLE STARTED		HOLE NO.		SIZE AND TYPE OF BIT OR SAMPLER	
N752,088 E812,944		0°		13 NOV. 1973		TP-2		J.D. 310 BACKHOE	
ELEVATION	DEPTH	LL	PL	VS	BLOWS PER FOOT	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CODE OF MATERIAL	REMARKS
1588.7	0.0						BROWNISH GRAY SANDY GRAVEL (GP) W/TRACE OF SILT		TOP OF HOLE
1583.7	3.0						BROWNISH GRAY SILTY SANDY GRAVEL (GM)		
1588.7	10.0								BOTTOM OF HOLE

LOCATION		DIRECTION OF HOLE FROM VERTICAL		DATE HOLE STARTED		HOLE NO.		SIZE AND TYPE OF BIT OR SAMPLER	
N752,162 E813,381		0°		13 NOV. 1973		TP-3		J.D. 310 BACKHOE	
ELEVATION	DEPTH	LL	PL	VS	BLOWS PER FOOT	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CODE OF MATERIAL	REMARKS
1601.5	0.0						BROWNISH GRAY SANDY GRAVEL (GP) W/TRACE OF SILT		TOP OF HOLE
1598.5	3.0						BROWNISH GRAY SANDY GRAVEL (GP) W/TRACE OF CLAY		
1592.0	9.5								BOTTOM OF HOLE

LOCATION		DIRECTION OF HOLE FROM VERTICAL		DATE HOLE STARTED		HOLE NO.		SIZE AND TYPE OF BIT OR SAMPLER	
N752,274 E813,700		0°		14 NOV. 1973		TP-4		J.D. 310 BACKHOE	
ELEVATION	DEPTH	LL	PL	VS	BLOWS PER FOOT	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CODE OF MATERIAL	REMARKS
1604.0	0.0						BROWNISH GRAY SANDY GRAVEL (GP)		TOP OF HOLE
1601.5	2.5						LIGHT BROWN SILTY CLAYEY SANDY GRAVEL (GC)		
1600.8	3.2								BOTTOM OF HOLE

LOCATION		DIRECTION OF HOLE FROM VERTICAL		DATE HOLE STARTED		HOLE NO.		SIZE AND TYPE OF BIT OR SAMPLER	
N752,318 E813,938		0°		14 NOV. 1973		TP-5		J.D. 310 BACKHOE	
ELEVATION	DEPTH	LL	PL	VS	BLOWS PER FOOT	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CODE OF MATERIAL	REMARKS
1608.2	0.0						GRAY GRAVELLY SAND (GP)		TOP OF HOLE
1604.2	4.0						BROWN SILTY CLAYEY SANDY GRAVEL (GC)		
1598.2	10.0								BOTTOM OF HOLE

LOCATION		DIRECTION OF HOLE FROM VERTICAL		DATE HOLE STARTED		HOLE NO.		SIZE AND TYPE OF BIT OR SAMPLER	
N752,348 E814,101 AT LEFT ABUTMENT DAVIS ST. BRIDGE		0°		15 NOV. 1973		TP-6		J.D. 310 BACKHOE	
ELEVATION	DEPTH	LL	PL	VS	BLOWS PER FOOT	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CODE OF MATERIAL	REMARKS
1609.4	0.0						GRAYISH BROWN SILTY SANDY GRAVEL (GP)		TOP OF HOLE
1607.9	1.5						BROWN SILTY CLAYEY SANDY GRAVEL (GC)		
1605.4	4.0								BOTTOM OF HOLE

LOCATION		DIRECTION OF HOLE FROM VERTICAL		DATE HOLE STARTED		HOLE NO.		SIZE AND TYPE OF BIT OR SAMPLER	
N752,375 E814,000 AT RIGHT ABUTMENT DAVIS ST. BRIDGE		0°		14 NOV. 1973		TP-7		J.D. 310 BACKHOE	
ELEVATION	DEPTH	LL	PL	VS	BLOWS PER FOOT	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CODE OF MATERIAL	REMARKS
1608.4	0.0						GRAYISH BROWN SILTY SANDY GRAVEL (GM)		TOP OF HOLE
1608.4	3.0						BROWN SILTY CLAYEY SANDY GRAVEL (GC)		
1604.4	5.0								BOTTOM OF HOLE

LOCATION		DIRECTION OF HOLE FROM VERTICAL		DATE HOLE STARTED		HOLE NO.		SIZE AND TYPE OF BIT OR SAMPLER	
N752,477 E814,400		0°		15 NOV. 1973		TP-8		J.D. 310 BACKHOE	
ELEVATION	DEPTH	LL	PL	VS	BLOWS PER FOOT	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CODE OF MATERIAL	REMARKS
1615.9	0.0						TOPSOIL		TOP OF HOLE
1614.4	1.5						GRAY SILTY SANDY GRAVEL (GP)		
1613.4	2.5						GRAYISH BROWN SANDY GRAVEL (GP) W/TRACE OF SILT		
1611.9	4.0						GRAY SILTY SANDY GRAVEL (GM)		
1611.4	4.5						GRAYISH BROWN SANDY GRAVEL (GP) W/TRACE OF SILT		
1609.9	6.0						BROWNISH GRAY SANDY GRAVEL (GP) W/TRACE OF SILT		
1604.9	11.0								BOTTOM OF HOLE

LOCATION		DIRECTION OF HOLE FROM VERTICAL		DATE HOLE STARTED		HOLE NO.		SIZE AND TYPE OF BIT OR SAMPLER	
N752,803 E814,838		0°		15 NOV. 1973		TP-9		J.D. 310 BACKHOE	
ELEVATION	DEPTH	LL	PL	VS	BLOWS PER FOOT	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CODE OF MATERIAL	REMARKS
1619.9	0.0						BROWN SILTY SANDY GRAVEL (GP) W/TRACE OF CLAY		TOP OF HOLE
1608.9	10.0								BOTTOM OF HOLE

LOCATION		DIRECTION OF HOLE FROM VERTICAL		DATE HOLE STARTED		HOLE NO.		SIZE AND TYPE OF BIT OR SAMPLER	
N752,851 E815,000 AT W/S END OF RETAINING WALL		0°		16 NOV. 1973		TP-10		J.D. 310 BACKHOE	
ELEVATION	DEPTH	LL	PL	VS	BLOWS PER FOOT	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CODE OF MATERIAL	REMARKS
1621.5	0.0						BROWN SILTY SANDY GRAVEL (GM)		TOP OF HOLE
1619.8	2.5						GRAYISH BROWN SILTY SANDY GRAVEL (GM) W/TRACE OF CLAY		
1617.0	4.5								BOTTOM OF HOLE

LOCATION		DIRECTION OF HOLE FROM VERTICAL		DATE HOLE STARTED		HOLE NO.		SIZE AND TYPE OF BIT OR SAMPLER	
N752,841 E815,275		0°		15 NOV. 1973		TP-11		J.D. 310 BACKHOE	
ELEVATION	DEPTH	LL	PL	VS	BLOWS PER FOOT	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CODE OF MATERIAL	REMARKS
1624.8	0.0						BROWN SANDY GRAVEL (GM) W/TRACE OF SILT		TOP OF HOLE
1622.1	2.5						BROWN SILTY FINE SAND (SM) W/FEW GRAVELS		
1619.8	5.0						BROWN GRAVELLY SAND (SP) W/TRACE OF SILT		
1618.6	8.0						BROWN SANDY GRAVEL (GP)		
1614.1	10.5								BOTTOM OF HOLE

LOCATION		DIRECTION OF HOLE FROM VERTICAL		DATE HOLE STARTED		HOLE NO.		SIZE AND TYPE OF BIT OR SAMPLER	
N752,880 E815,733		0°		16 NOV. 1973		TP-12		J.D. 310 BACKHOE	
ELEVATION	DEPTH	LL	PL	VS	BLOWS PER FOOT	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CODE OF MATERIAL	REMARKS
1629.2	0.0						BROWN SILTY SANDY GRAVEL (GM)		TOP OF HOLE
1628.2	3.0						GRAY SANDY SILTY CLAYEY GRAVEL (GC)		
1619.2	10.0								BOTTOM OF HOLE

LOCATION		DIRECTION OF HOLE FROM VERTICAL		DATE HOLE STARTED		HOLE NO.		SIZE AND TYPE OF BIT OR SAMPLER	
N752,735 E816,187		0°		16 NOV. 1973		TP-13		J.D. 310 BACKHOE	
ELEVATION	DEPTH	LL	PL	VS	BLOWS PER FOOT	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CODE OF MATERIAL	REMARKS
1633.0	0.0						BROWN SANDY GRAVEL (GP) W/TRACE OF SILT		TOP OF HOLE
1623.0	10.0								BOTTOM OF HOLE

LOCATION		DIRECTION OF HOLE FROM VERTICAL		DATE HOLE STARTED		HOLE NO.		SIZE AND TYPE OF BIT OR SAMPLER	
N752,738 E816,932		0°		16 NOV. 1973		TP-14		J.D. 310 BACKHOE	
ELEVATION	DEPTH	LL	PL	VS	BLOWS PER FOOT	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CODE OF MATERIAL	REMARKS
1634.0	0.0						BROWN SANDY GRAVEL (GP) W/TRACE OF SILT		TOP OF HOLE
1628.0	6.0								BOTTOM OF HOLE

NOTE: Water was encountered at the top of all holes except TP-8 where it was encountered at 2.0' depth.

REVISION	DATE	DESCRIPTION	BY
GRAPHIC SCALE			
U. S. ARMY ENGINEER DISTRICT, PITTSBURGH CORPS OF ENGINEERS OFFICE OF THE DISTRICT ENGINEER PITTSBURGH, PENNSYLVANIA			
PREPARED BY: N. IRR	DRAWN BY: N. BORDEN		
CHECKED BY: J. J. JAMES	APPROVED BY: J. J. JAMES		
BOLIVAR FLOOD PROTECTION PROJECT ROOT CREEK BOLIVAR, NEW YORK FOUNDATION EXPLORATION TEST PITS HOLES TP-1 TO TP-14 INCLUSIVE		DATE: 17 Sept 74	
SCALE: AS SHOWN		SHEET NO.: 038pal-R2-10/1	

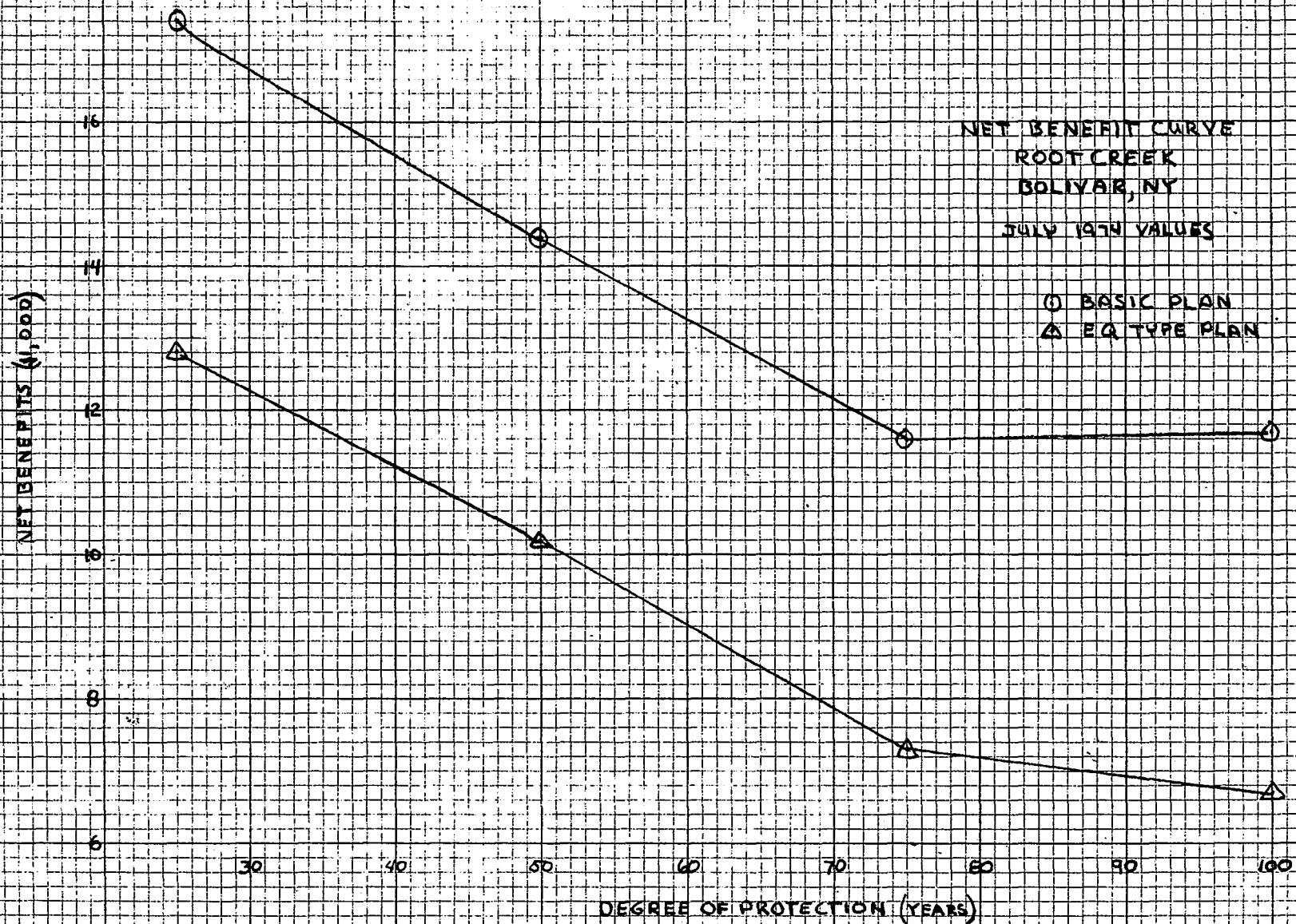
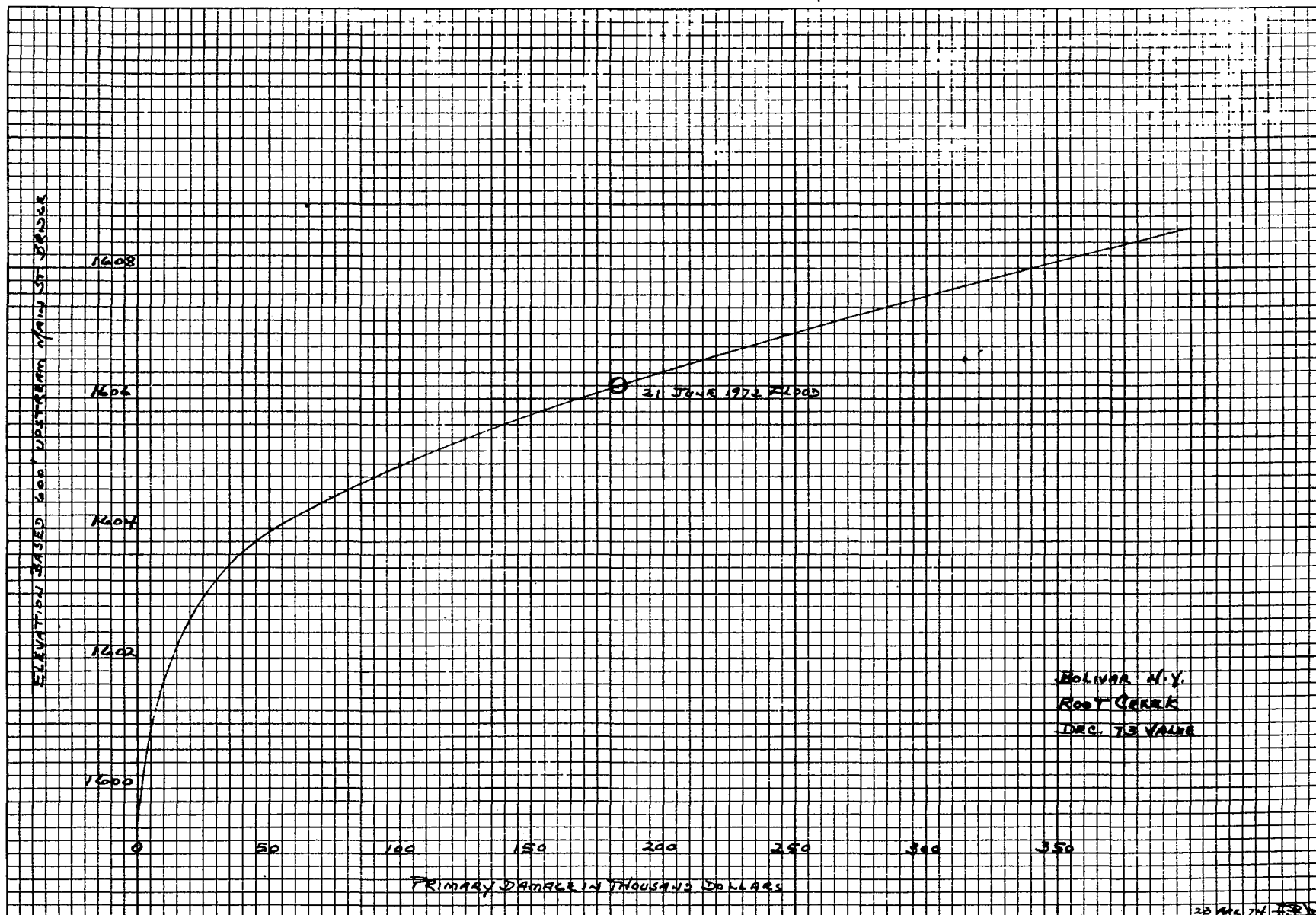


EXHIBIT A



New York State Department of Environmental Conservation

50 Wolf Road, Albany, New York ~~12201~~ 12233



OGDEN REID
~~XXXXXXXXXXXX~~
Commissioner

OFFICE OF PROGRAM DEVELOPMENT, PLANNING AND RESEARCH
PROGRAMMING AND ANALYSIS BUREAU

February 11, 1975

Colonel Max R. Janairo, Jr.
District Engineer
Department of the Army
Pittsburgh District, Corps of Engineers
Federal Building
1000 Liberty Avenue
Pittsburgh, Pennsylvania 15222

Dear Colonel Janairo:

This letter is with reference to the proposed Root Creek Flood Protection at Bolivar, New York. In our letter of January 13, 1975, we provided comments on the Draft Detailed Project Report and stated that the Department of Environmental Conservation is willing to provide the necessary assurances of local cooperation for any project that is engineeringly and environmentally sound and economically justified.

After sending that letter we received your letter of January 7, 1975, requesting a statement of willingness to comply with the terms of local cooperation for the proposed project. In telephone conversations with Messrs. DeMario and Haberman of your staff, we learned that your higher authority requires a letter of intent specifying those items of local cooperation appropriate to this project, rather than the general statement which we furnished.

It has been our practice in recent years to furnish letters of intent to participate in various projects whenever required without listing the specific items of cooperation. We feel that a general statement of intent to participate is sufficient until such time as it becomes necessary to enter into a formal agreement of local cooperation. The four other Corps of Engineers Districts with which we work have found the general letters of intent sufficient prior to execution of formal agreements.

EXHIBIT B

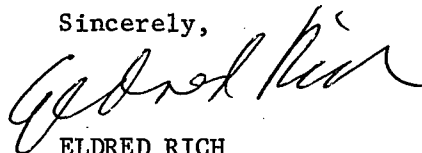
February 11, 1975

In view of the request from your higher authority that you obtain from us a more specific assurance of our intent, we reaffirm willingness to participate in a local protection project for Root Creek at Bolivar, New York, which is determined to be engineeringly and environmentally sound and meets local needs. Our participation will include the following items:

1. Provide without cost to the United States all lands, easements and rights-of-way including suitable borrow and spoil disposal areas as determined by the Chief of Engineers as necessary to the construction of the project, at a presently estimated cost of \$24,000.
2. Adjust utilities as necessary without cost to the United States.
3. Hold and save the United States free from damages due to the construction works and maintenance of the project excepting, however, damages due to the fault or negligence of the United States or its contractors.
4. Prescribe and enforce regulations to prevent obstruction or encroachment on channels and interior ponding areas which would reduce their flood carrying capacity or hinder maintenance and operation, and control development in the project area to prevent an undue increase in the flood damage potential.
5. Maintain the project works after completion in accordance with regulations prescribed by the Secretary of the Army.
6. At least annually notify interests affected that the improvement will not provide complete protection from floods greater than the design conditions.
7. Comply with Section 221 of P.L. 91-611.

In the future we prefer to furnish general letters of intent during preliminary phases of planning and design, as discussed above.

Sincerely,



ELDRED RICH
Assistant Director for
Programming & Analysis

RLK/ea

EXHIBIT B



UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
John W. McCormack Post Office and Courthouse
BOSTON, MASSACHUSETTS 02109

MAY 17 1974

District Engineer
Pittsburgh District, Corps of Engineers
New Federal Building
1000 W. Liberty Street
Pittsburgh, PA 15222

Dear Sir:

This letter is a supplement to our preliminary report dated February 27, 1974 on fish and wildlife aspects of the proposed Root Creek flood protection plan for Bolivar, Allegany County, New York. It has been prepared in view of additional information which you recently submitted to our Upper Darby, Pennsylvania office.

Since it is now clearly evident that the monetary costs involved with the construction of an upstream reservoir on Root Creek would be exceedingly high, we feel that our original recommendation calling for such construction cannot be reasonably justified.

As was also previously stated in our preliminary report, our main concern was centered upon potential adverse effects of project construction on the downstream trout fishery resource of Little Genessee Creek. Since the proposed plan of improvement for Root Creek would widen the existing channel, remove stream bank vegetation, and reduce stream flow velocities; increased water temperatures can be expected to occur, particularly during periods of hot weather and low stream flow. Such warming will increase water temperatures downstream in Little Genessee Creek to levels unsuitable for trout. Construction of a low flow channel along the shaded side of the stream bed would minimize warming of Root Creek flows during low flow periods. It will be necessary, however, to plant fast growing trees and shrubs along the excavated banks in order that stream shading be provided as rapidly as possible.

Consequently, to minimize the environmental risks associated with the warming of Root Creek, the Bureau of Sport Fisheries and Wildlife recommends that:

1. A low-flow channel be constructed along the shaded side of the excavated stream bed in Root Creek.
2. Fast growing trees and shrubs be planted along the excavated stream banks of Root Creek.

Please advise us of any action taken by your office regarding our recommendations.

Sincerely yours,

Robert A. Shultz
Regional Director

ACTING



DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
AREA OFFICE
GRANT BUILDING, 560 MAIN STREET, BUFFALO, NEW YORK 14202

March 1, 1974

AREA OFFICES
Buffalo, New York
Camden, New Jersey
New York, New York
Newark, New Jersey
San Juan, Puerto Rico

REGION II
REGIONAL OFFICE
NEW YORK, NEW YORK

IN REPLY REFER TO:
2.2PT

•Colonel N.G. Delbridge
District Engineer
Dept. of the Army
Corps of Engineers
Federal Bldg.
1000 Liberty Ave.
Pittsburgh, Pa. 15222

Dear Colonel Delbridge:

This office acknowledges receipt of your report letter dated December 11, 1973. Inadvertently the letter was sent to our Regional Office and time was lost in forwarding it to this office for a response.

We have completed our review of your plan for flood protection at Bolivar, New York. We have no objections to your proposed plan of channel improvement to provide protection from the 100 year flood at Bolivar, N.Y.

Sincerely,

Frank D. Cerabone
Frank D. Cerabone
Area Director

EXHIBIT D

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

700 East Water Street, Syracuse, New York 13210

March 13, 1974

Colonel N. G. Delbridge
District Engineer
Pittsburgh District, Corps of Engineers
Federal Building
1000 Liberty Avenue
Pittsburgh, Pennsylvania 15222

Re: Root Creek, Bolivar, N. Y.
Detailed Project Report

Dear Colonel Delbridge:

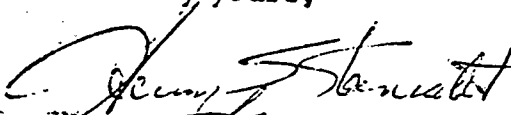
We have reviewed your memo describing the Section 205 project report currently being prepared for the flood problems connected with Root Creek in Bolivar, New York.

We note particularly your finding that a reservoir for 100-year protection, alone and in combination with channel work, is unfeasible. The other measures described would appear to be worthwhile alternatives to study in more detail.

The Soil Conservation Service does not have any project-type activities underway or planned that would affect this project.

We appreciate the opportunity to comment on this proposal.

Sincerely yours,



A. C. Addison
State Conservationist

cc: Eudell F. Bivens, Watershed Planning Leader, SCS, Syracuse
Eugene C. Hanchett, AC, SCS, Batavia, New York
Kermit Kruse, DC, SCS, Belmont, New York





UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION II

26 FEDERAL PLAZA

NEW YORK, NEW YORK 10007

Colonel N.G. Delbridge
District Engineer
Department of the Army
Pittsburgh District, Corps of Engineers
Federal Building, 1000 Liberty Avenue
Pittsburgh, Pennsylvania 15222

MAR 12 1974

Dear Colonel Delbridge:

We have received your request for comments relative to your Detailed Project Report under preparation for a flood control project on Root Creek in Bolivar, Allegheny County, New York that would consist of channel widening and deepening, debris basin and channel drop structures and bridge reconstruction in coordination with NYDOT.

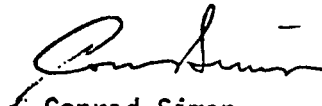
Our comments and questions are as follows:

1. Has the NYDOT obtained permits to channelize the 600 feet of the creek involved in their project and for the construction of the bridge? Why is it necessary for the NYDOT to include channelization as a part of their project?
2. A more detailed description of the proposed project should be provided, including the number and location of drop structures, the size of the debris basin, the extent of the proposed widening and deepening, any easements or property purchases required, and the movement or removal of any buildings. Is the sheet pile wall indicated on sheet Number 2 already in existence, or is it yet to be constructed?
3. How often will maintenance of the channel be required? This can have a serious effect on the biota of the river through habitat destruction. The types and condition of the biota should be noted, the value, if any, of the stream as a fishery and/or source of recreation and the water quality. Is the stream used as a water supply?
4. The aesthetic values of the area at present and as they will be affected by the proposed system are also of importance.
5. A description of the frequency, height and extent of the flooding and damages incurred relative to those of the 100 year flood should be included.

6. Will the project affect the internal drainage of the village?
7. Where would the spoil from the stream banks and bed be deposited?
8. The extent of the construction impacts and inconveniences should be pointed out.
9. How serious would be the effect, in the downstream regions, of the storm water moving more quickly downstream?
10. Besides gabions, what other methods of bank stabilization could be used? Revegetating the area with dense growth could stabilize the soil and be more aesthetically pleasing than a rock filled mattress.
11. The consequences of additional development as a result of the project should be included. An increase in development would decrease the amount of infiltration, thereby increasing runoff and so flood water heights. This would lower the effect of the project, with less water causing higher floods.

We appreciate the opportunity to comment on the proposed project and hope our reply is of value to you.

Sincerely yours,



Conrad Simon
Director

Environmental Programs Division



IN REPLY REFER TO:

United States Department of the Interior

NATIONAL PARK SERVICE
~~Mid-Atlantic Region~~

~~NORTHEAST REGION~~

143 SOUTH THIRD STREET
PHILADELPHIA, PA. 19106

(MAR)PSA

APR 2 1974

Col. N. G. Delbridge, District Engineer
Department of the Army
Pittsburgh District, Corps of Engineers
Federal Building
1000 Liberty Avenue
Pittsburgh, Pennsylvania 15222

Dear Col. Delbridge:

Thank you for your letter and information concerning the Root Creek, Bolivar, New York flood protection project. Our principal concern in this matter would be historic and archaeological resources. Since the project involves channel work within a developed area, the chances of disturbing cultural values are not too great. However, the possibility that buried prehistoric sites may be present always exists. We, therefore, recommend that the project area be inspected by a professional archeologist to establish the presence or absence of cultural resources. Should such be found, they should be considered fully in the environmental impact statement.

Should you have any questions, please do not hesitate to contact Mr. Wilfred Husted, Archeologist, of this office.

Sincerely yours,

Benjamin J. Zerbey
Acting Regional Director
Mid-Atlantic Region



'76

Let's Clean Up America For Our 200th Birthday

EXHIBIT G



NEW YORK STATE PARKS & RECREATION South Swan Street Bldg. South Mall, Albany, New York 12223 Information 518 474-0456
Alexander Aldrich, Commissioner

April 16, 1974

Department of the Army
Pittsburgh District, Corps of Engineers
Federal Building
1000 Liberty Avenue
Pittsburgh, Pennsylvania 15222

ATTENTION: ORPED-P

Re: Root Creek, Bolivar, New York;
Detailed Project Report

Gentlemen:

This office has reviewed the proposal for flood protection along Root Creek in Bolivar and a staff member has made an on-site inspection of the project area.

We have determined, as a result of the visit to the area, that no structures of historic or architectural merit will be affected. However, we are concerned with sites of archeological value in the area in question.

According to our files, several sites have been recorded in the vicinity of Root Creek, and we have been advised by a professional archeologist that it is very likely that there are more sites here than we have knowledge of at the present time.

We recommend, therefore, that prior to any construction a systematic survey be conducted by a recognized archeologist and that the presence or absence of archeological remains be fully reported.

We suggest that you contact either this office or Dr. Ellis F. McDowell, Anthropology-Sociology, SUNY College at Cortland, Cortland, New York 13045 for the names of archeologists who would be available to do such work.

Sincerely,

Lewis C. Rubenstein

Lewis C. Rubenstein
National Register Supervisor
Division for Historic Preservation

LCR:cak

cc: Dr. Robert E. Funk, State Archeologist
Ms. Ann Webster Smith, Compliance Officer, Advisory Council on
Historic Preservation

EXHIBIT H

New York State Department of Environmental Conservation

50 Wolf Road, Albany, New York ~~XXXX~~ 12233



Ogden Reid
~~XXXXXXXXXXXXXXXXXXXX~~
Commissioner

OFFICE OF PROGRAM DEVELOPMENT, PLANNING AND RESEARCH
PROGRAMMING AND ANALYSIS BUREAU

January 13, 1975

Mr. J. S. Minotte, Chief
Engineering Division
Department of the Army
Pittsburgh District, Corps of Engineers
Federal Building
1000 Liberty Avenue
Pittsburgh, Pennsylvania 15222

Dear Mr. Minotte:

We have completed our review of the Draft Detailed Project Report for the Root Creek Flood Protection Project, located in Bolivar, Allegany County, New York and have the following comments:

Section 73 of the Water Resources Development Act of 1974 states that a minimum of 80% of the costs of a non-structural solution to flood protection are attributable to the Federal Government. Non-structural alternatives should be considered on an equal basis with structural solutions. Alternatives examined should include flood-proofing and flood plain regulation, acquisition and relocation. We feel it is inadequate to consider only the possibility of privately-financed flood-proofing.

The section on flood insurance should be rewritten to reflect the changes in the 1973 Federal Legislation and the 1974 New York State Legislation (copy enclosed). The Village of Bolivar has been notified that it must participate in the Federal Flood Insurance Program. If the Village fails to meet the requirements for participation by its Federally mandated deadline, the State will take the necessary steps to insure Village participation in the program.

Our experience in project maintenance leads us to believe that your \$3000 estimate of annual maintenance costs is too low and that \$9000 would be a more accurate estimate. We estimate that channel maintenance will cost approximately \$5000 annually, while the removal of material from the debris basin approximately \$2500. It is mandatory that the debris basin be adequately maintained to insure the design life of the gabions. The balance of the costs is attributed to the unknown maintenance requirements of the gabion structures, because of this Department's unfamiliarity in maintaining gabions.

EXHIBIT I

January 13, 1975

The most efficient and inexpensive means of brush control is the use of chemical herbicides. Unfortunately, these chemicals are very corrosive. Although the gabions are vinyl coated, it is questionable whether the vinyl coating can be maintained during placement, normal maintenance operations or from abrasion and sheer of stream load. Either a more expensive and less efficient method of brush control will be required, or the design life of the gabions will be endangered by the use of corrosive herbicides. Maintenance of gabions is labor intensive and, therefore, expensive. It may be possible to minimize some of the wear to the gabions and maintenance expense by spoiling some of the fine material on the upper half of the gabions and seeding this covering.

We appreciate having the opportunity to comment on this draft report. We hope that the final DPR will answer or incorporate these comments. As always, this Department is willing to provide the required assurances of local cooperation for any project that is engineeringly and environmentally sound and economically feasible.

Sincerely,



ELDRED RICH
Assistant Director for
Programming & Analysis

ANG/ea
Enclosure

BOLIVAR, NEW YORK
LOCAL FLOOD PROTECTION PROJECT

* ROOT CREEK

DETAILED PROJECT REPORT

APPENDIX I

HYDROLOGY

BOLIVAR, NEW YORK
LOCAL FLOOD PROTECTION PROJECT
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SECTION I - BASIN CHARACTERISTICS

1. GENERAL TOPOGRAPHY

a. Root Creek is a tributary of Little Genesee Creek, which is a tributary of Oswayo Creek, which flows into the Allegheny River. Located in western New York in Allegany County, Root Creek enters the Little Genesee Creek at Bolivar, New York.

b. The Root Creek basin lies entirely in Allegany County, New York, and has its source at the Allegheny River basin's western divide at approximate elevation 2380. From this source, it flows for approximately 6.25 miles due west to where it enters Little Genesee Creek. The Root Creek basin has a total drainage area of 9.1 square miles and is approximately five miles long and two miles wide. The Root Creek basin and project location are shown on Plate 1.

c. The average channel slope is 60 feet per mile from the mouth to stream mile three. The slope then increases in the headwater portion to 125 feet per mile. The height of banks varies from 1 to 10 feet. Valley profiles are shown on Plate 2.

d. The Root Creek basin above the project has approximately 90 percent of its area in forest and the remaining 10 percent in open and developed land. The urban development is chiefly along the main stream. State Route 17 follows the stream along the valley.

SECTION II - CLIMATOLOGY

2. CLIMATE

a. The climate of the Root Creek area is temperate with a normal seasonal variation in temperature. The area is in a region of variable air mass activity; weather changes are usually gradual, but may have frequent and rapid changes resulting from passage of fronts associated with air mass movements. The normal percent of possible sunshine during the year varies from about 35 percent during the winter to about 60 percent in the summer. Precipitation equal to or greater than 0.1 inch occurs about 167 days per year and approximately 85 days per year during the construction season, May through November. Prevailing wind direction is from the west or has a westerly component.

b. A summary of climatology is presented in Table 1. The two stations used were selected as representative of the project area because of their close proximity to it. The information is based on data published in "Climatological Data" -- New York; "Climatic Summary of the United States", Section 81, Western New York (data up to and including the year 1930); "Supplement to the Climatic Summary for New York for the years 1930 through 1952"; "Hourly Precipitation Data" - New York for 1952 through 1972.

3. TEMPERATURES

The mean monthly and annual temperatures are fairly uniform throughout the basin of its small area. The normal daily average temperature varies from a minimum of 18.6° F. in January to a maximum of 64.9° F. in July. For the period of record, the highest temperature was 101° F. and the lowest temperature was -6° F. occurring in July and January, respectively. The temperatures for this basin are above 32° F. on the average of 225 days per year (frost free period) and above 90° F. about 10 days per year. (From "Climatic Atlas of the United States" June 1968).

4. PRECIPITATION

a. Precipitation data are available from the U. S. Weather Bureau Stations at Bolivar since June 1890 and at Wellsville, shown on Plate 1, since June 1955. These stations are located at the mouth of Root Creek and 12 miles east of Bolivar, New York, respectively. The mean monthly precipitation varies from a minimum of 2.18 inches in February to a maximum of 4.39 inches in June. Table 2 lists precipitation stations and pertinent data.

b. The late spring-summer rains frequently result from storms of convective or orographic origin. These types of storms are usually localized with high intensity cells and are of short duration. Precipitation during the fall, winter and early spring seasons is usually the result of the passage of low-pressure systems over the area. Wave disturbances along a quasi-stationary front produce an occasional period of prolonged precipitation.

c. The mean annual snowfall for this basin is approximately 100 inches. Continuous snow cover usually lasts for several weeks at a time and is not uncommon to last for two to three months.

SECTION III - HYDROLOGY

5. STREAM GAGING STATIONS AND RECORDS

The first and only stream gaging station in the Root Creek basin was established in December 1972 when the Corps of Engineers installed a wire-weight gage at the Davis Street Bridge in Bolivar. No stage discharge

TABLE 1
CLIMATIC SUMMARY

Station	Years of Record	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
<u>Mean Monthly and Annual Precipitation (Inches)</u>														
Bolivar	82	2.67	2.26	2.78	3.15	3.65	4.14	4.16	3.50	3.36	2.88	2.82	2.69	38.06
Wellsville	18	1.98	2.09	2.45	3.17	3.05	4.64	3.15	2.65	2.56	2.38	3.02	2.10	33.24
Mean for Basin		2.32	2.18	2.61	3.16	3.35	4.39	3.65	3.07	2.96	2.63	2.92	2.39	35.65
<u>Mean Temperature (Degrees Fahrenheit)</u>														
Bolivar	28 :1896-1925	22.9	22.1	32.9	43.8	54.5	62.5	66.7	65.1	58.6	48.7	37.1	25.9	45.1
Bolivar	3 :1970-1972	18.6	20.3	27.7	40.5	53.5	60.9	64.9	63.9	60.0	48.9	36.7	31.7	43.9

TABLE 2
PRECIPITATION STATIONS

Station	County, N.Y.	Approx. Elevation	Records Available From	To	Gage Type	Gage Operating Agency
Bolivar	Allegany	1580	Jun 1890	Date	:Recording	:U.S. Weather Ser.
Wellsville	Allegany	1510	Jun 1955	Date	:Recording : and Non- :Recording	:U.S. Weather Ser.

relation has been computed because of the brief period of record at the Davis Street gaging station but a discharge curve has been developed by backwater computation for a Damage Reference point 600 feet unstream of the Main Street Bridge. Stage discharge curves for natural and improved conditions are shown on Plate 3.

6. FLOOD OF RECORD

a. General - There have been no significant rises on Root Creek since the establishment of the present gage in December 1972. The only flood history available for this basin is based on high water marks, newspaper accounts and information obtained from residents of the area. A list of floods is shown in Table 3.

b. Storm and Flood of 23 June 1972 - "Agnes", the first hurricane of the 1972 season, formed as a tropical depression off the Yucatan Peninsula in the Gulf of Mexico at about 6 p.m. on 15 June 1972. At about noon of 19 June she made her landfall near Panama City, Florida. At noon on 22 June, "Agnes" was just off the New Jersey coast moving westward into northern Pennsylvania. Then after a slow loop in western and central Pennsylvania, a weakening "Agnes" moved north through New York State and was absorbed by the storm center over Pennsylvania. Total rainfall for the Root Creek basin for the period 20 June to 23 June was 12.09 inches with most of this rain occurring during the early part of 21 June.

TABLE 3

HIGHEST KNOWN FLOODS

<u>Flood</u>	<u>Elevation at Main Street Bridge (ft. above m.s.l.)</u>
June 1972	1600.5
Feb 1959	1599.7
July 1970	1599.6
Sept. 1967	1599.6

7. FLOOD FREQUENCY

Since runoff records for Root Creek are non-existent, a regional analysis using basins with similar characteristics to Root Creek was used to develop a flood frequency at Bolivar. The flow frequency developed is shown on Plate 4. A flood stage frequency for the natural and improved conditions was developed by applying the flow frequency to the stage discharge relation. These curves are shown on Plate 5.

8. UNIT HYDROGRAPH

a. A synthetic three-hour unit hydrograph was developed for Bolivar with runoff distribution proportioned by basin area, shape, main channel length and slope to other basins having similar characteristics. The three-hour unit hydrograph for Root Creek is shown on Plate 6.

b. The unit hydrograph for Root Creek at Bolivar was used to reproduce the June 1972 storm hydrograph. The rainfall values recorded at Bolivar and Wellsville were averaged and assumed to be representative of the Root Creek basin. Infiltration rates, as determined by computations of the June 1972 storm over the upper Allegheny River basin, were used for the storm over Root Creek. The rainfall excess was applied to the unit hydrograph and the peak flow of 2200 c.f.s. agreed with the flow determined by backwater computations. The reproduced storm hydrograph is shown on Plate 7.

9. STANDARD PROJECT FLOOD

a. The standard project flood is defined as one which would be exceeded in magnitude only on rare occasions. It establishes a standard for design of structures that would provide a higher degree of flood protection without regard to economic or other practical limitations. The magnitude of the SPF is approximately 40 to 50 percent of the maximum probable flood.

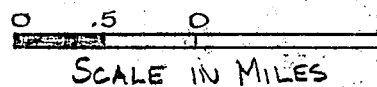
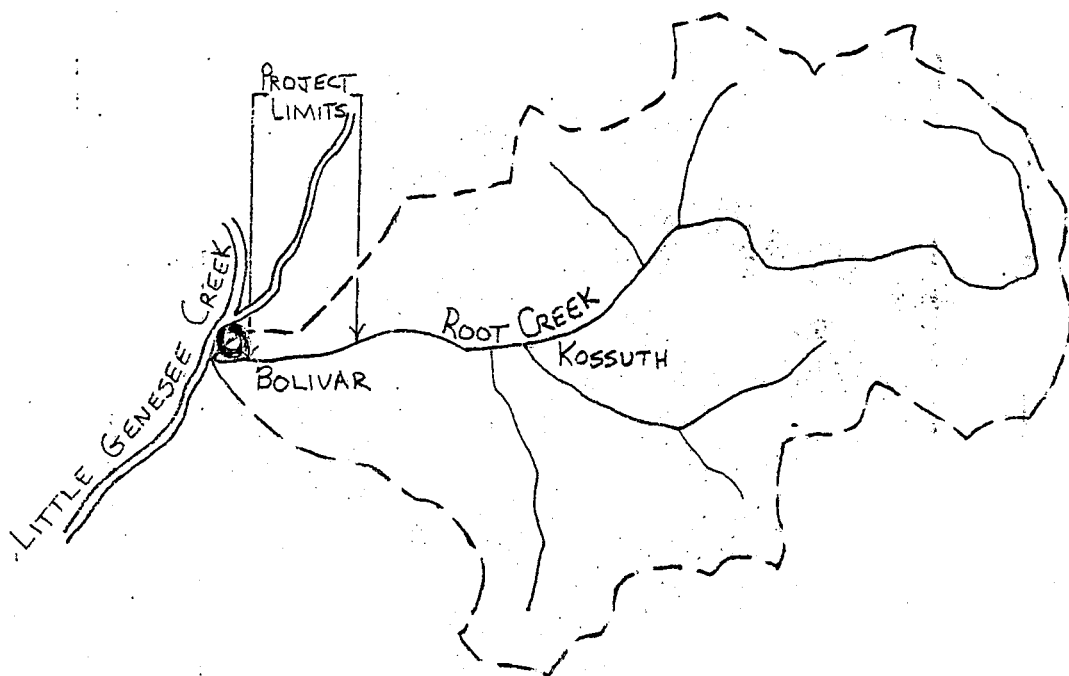
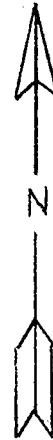
b. The standard project flood for Root Creek, at Bolivar, has been adopted as the flood which would be caused by a storm with rainfall as set forth in Civil Engineering Bulletin No. 52-8, Office of Chief of Engineers, dated 26 March 1952, subject: "Standard Project Flood Determinations". On the basis of this rainfall, the standard project storm would have a maximum six-hour intensity rainfall of 11.18 inches and 17.03 inches in 24 hours. The total 4-day rainfall was computed to be 20.55 inches. Infiltration computed for storms in the upper Allegheny River basin, for the season in which the standard project flood would normally occur, has assumed to be applicable. The total assumed losses for the standard project flood were 2.33 inches with total runoff of 18.22 inches of which 16.58 inches would occur within 24 hours. The peak of the natural inflow hydrograph is 7,600 c.f.s. The standard project flood hydrograph is shown on Plate 8.

10. DESIGN DISCHARGE

The June 1972 computed flood discharge of 2,000 c.f.s. was used as the design discharge for the Root Creek project. This flood flow was derived from rainfall and unit hydrograph analysis. A check was made by using a backwater profile and actual high water marks.

11. NORMAL STREAM FLOW CHARACTERISTICS

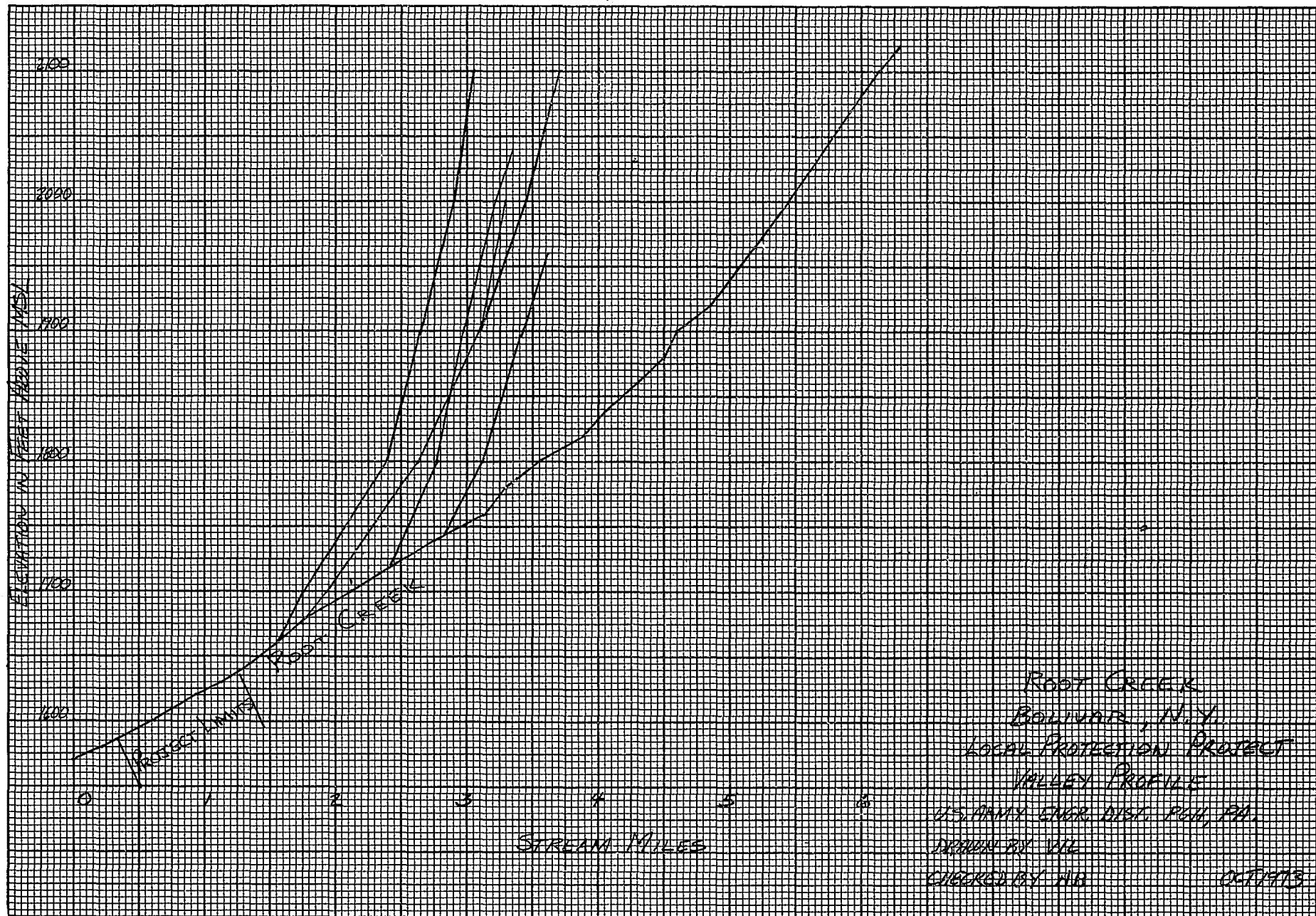
Root Creek is a perennial stream that often experiences low flow that exists through most of the summer. This low flow condition consists of 1"-3" of slow-moving water with several small, and often isolated shallow ponds that after a few days become stagnant.



LEGEND

○ - PRECIPITATION STATION

ROOT CREEK
BOLIVAR N.Y.
LOCAL FLOOD PROTECTION
LOCATION MAP
US ARMY ENGINEER DIST. P&H, PA.
DRAWN BY WL
CHECKED BY AR OCT 1973



CURVE
A
B
C

CONDITIONS

NATURAL

NATURAL MODIFIED BY STATE IMPROVEMENT

NATURAL MODIFIED BY STATE AND CORPS IMPROVEMENT



ROOT CREEK

POLOWAY, N.Y.

ELEVATION VS. DISCHARGE

AT STA. 600' C/S OF MAIN ST. BR.

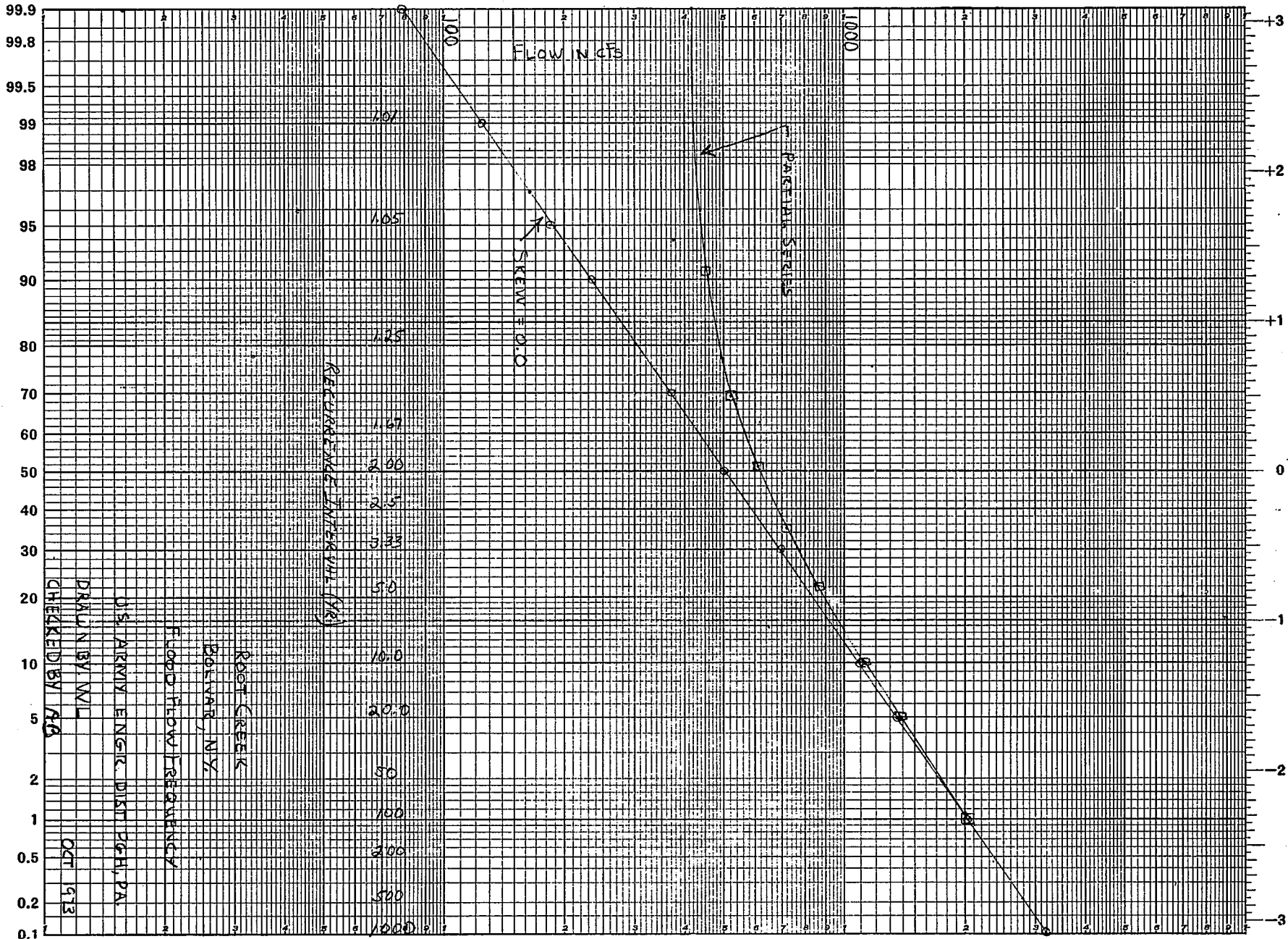
U.S. ARMY ENGR. DIST. PENN., PA.

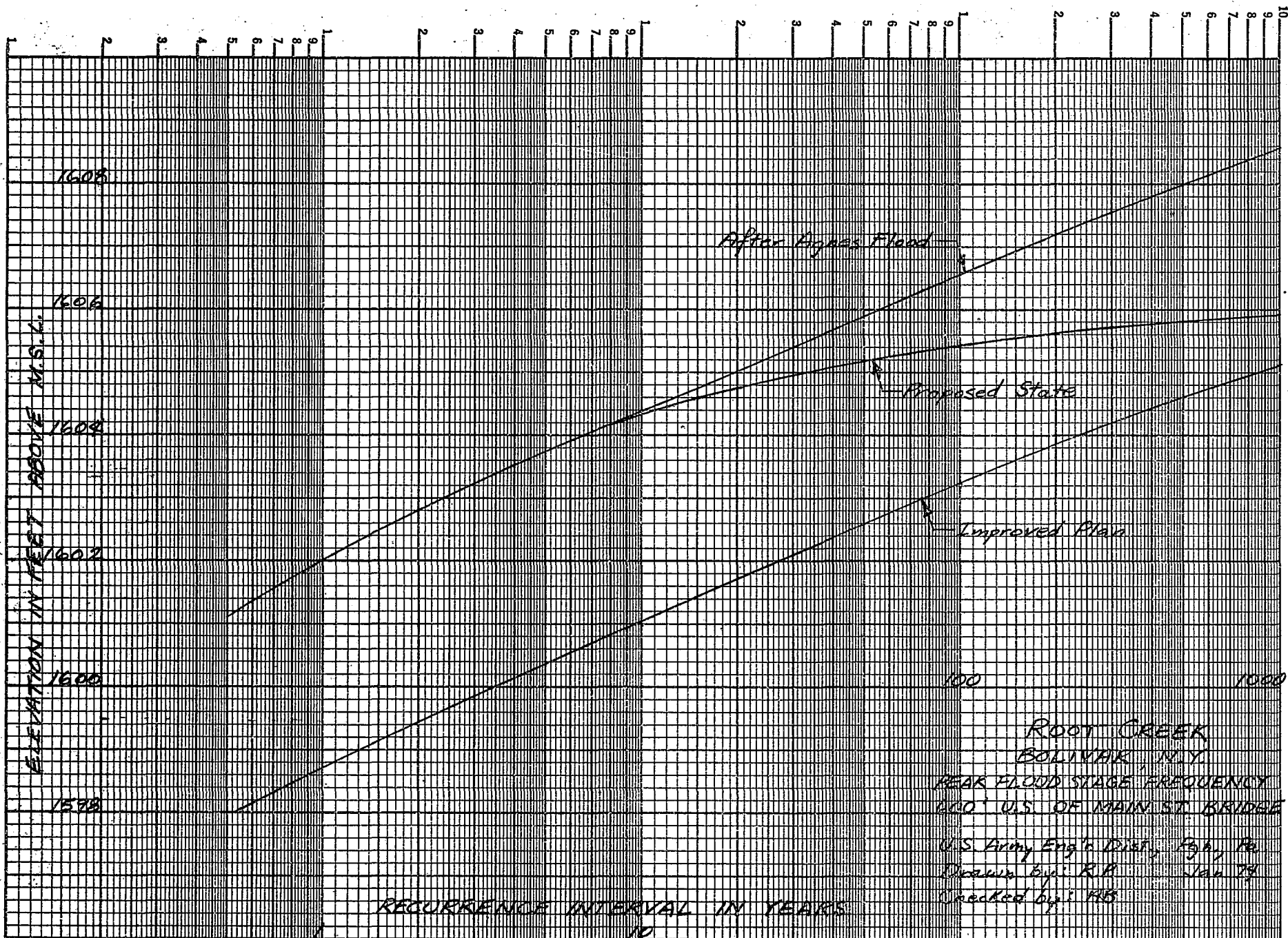
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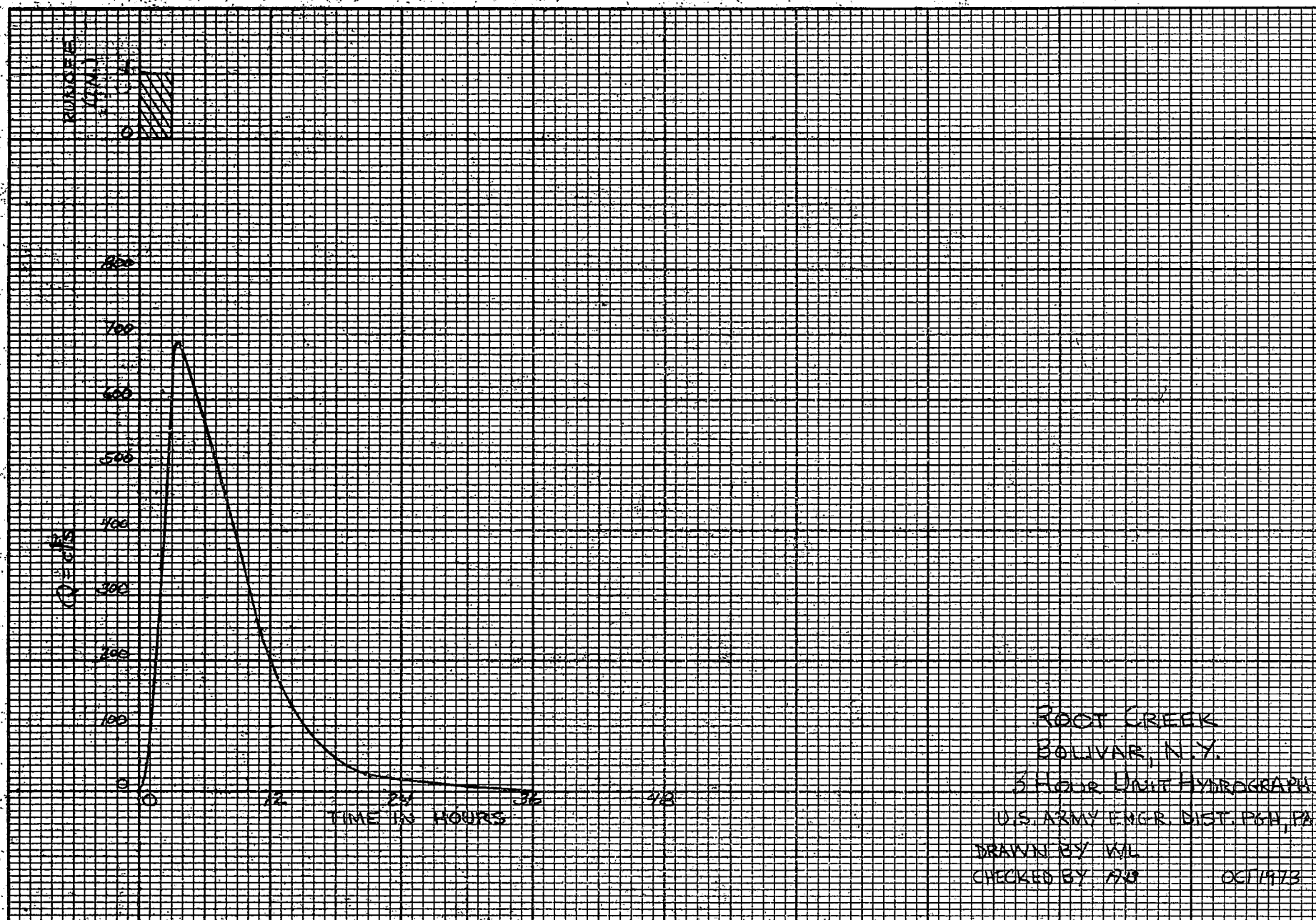
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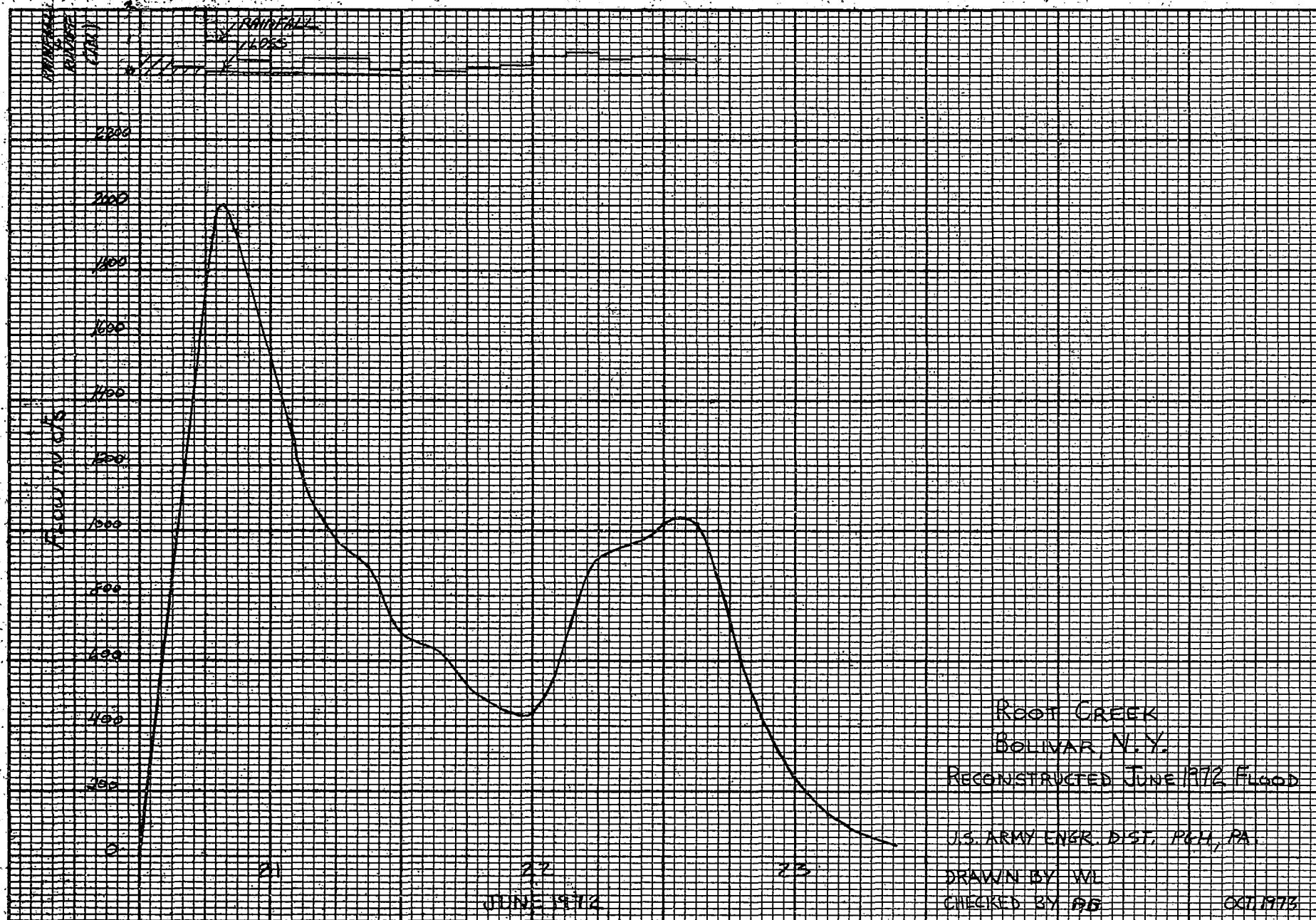
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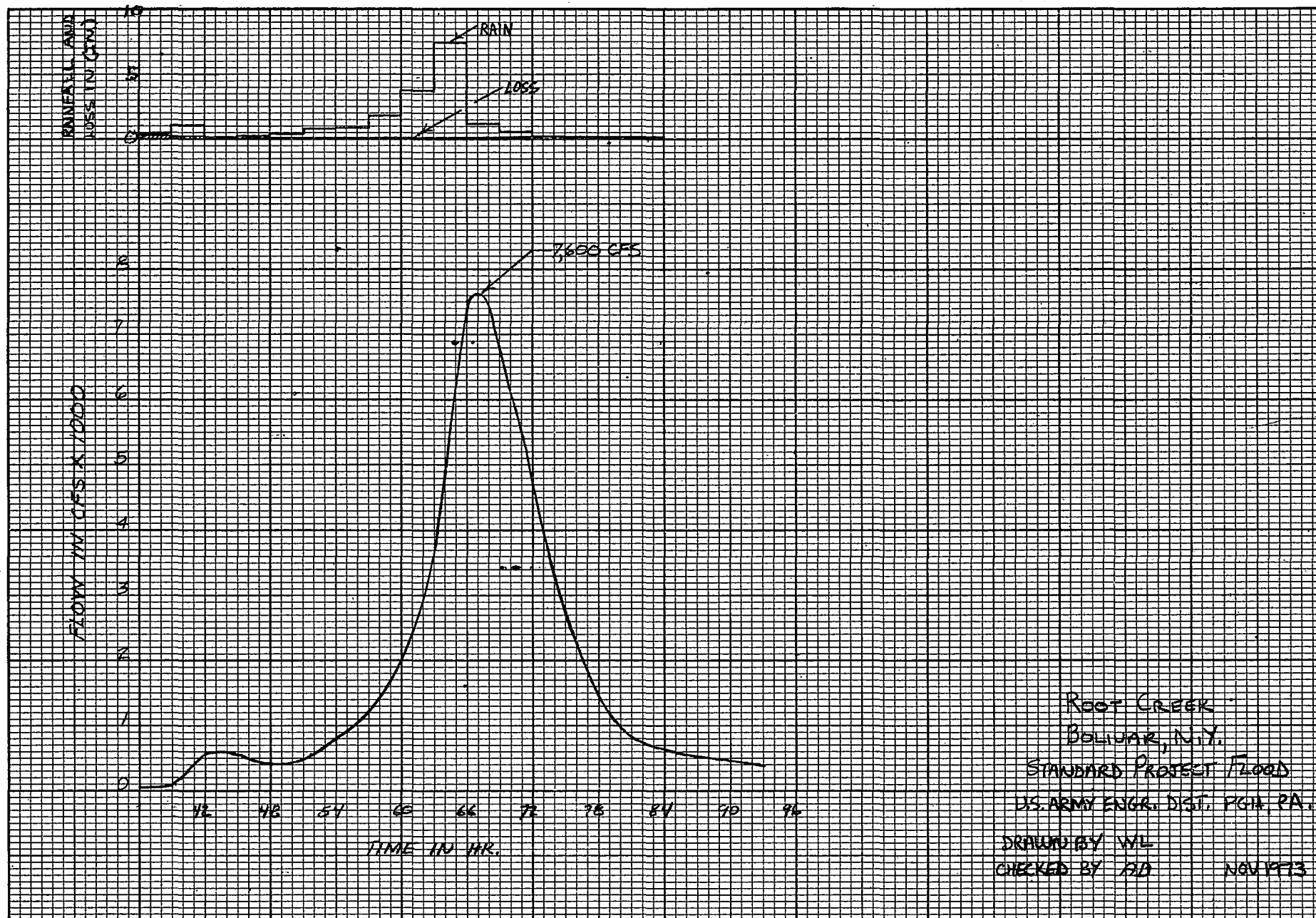
PLATE 4 APPENDIX I











BOLIVAR, NEW YORK

LOCAL FLOOD PROTECTION PROJECT

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APPENDIX II

HYDRAULICS

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HYDRAULICS

1. DESIGN DISCHARGE

The June 1972 computed discharge of 2,000 c.f.s. was adopted as the design flow. This flood flow was derived from rainfall and unit hydrograph analysis as explained in Appendix I, "Hydrology".

2. PROPOSED IMPROVEMENT

a. The channel would be excavated from station 16+20 to 48+50. The channel bottom width would be 20 feet wide with side slopes varying between 1 on 2 and 1 on 1.75 with an invert grade of one-half of one percent. Gabions would provide the necessary slope protection as shown on Plates 3-7 of the main report. A detailed discussion of the gabions together with other features of the project are covered in the main report under Section V, "Plan of Improvement".

b. The channel improvement would include a reach between station 24+20 and 28+57 which is to be constructed by the New York Department of Transportation in conjunction with the replacement of the Main Street Bridge. This would consist of a 30 ft. wide concrete-lined trapezoidal channel and a 4 ft. high drop structure.

c. Five gabion drop structures would be provided as shown below in paragraph 5, Table 1, to control the effective gradient and thereby reduce velocities and channel erosion without otherwise excessive excavation requirements.

d. Upstream from the project, a debris basin 75 ft. wide by 30 ft. long would be provided to trap a major portion of debris and bed load which otherwise would increase channel maintenance downstream.

3. MODEL TESTS

Model tests were not considered necessary for the design of this project.

4. HYDRAULIC PROFILE COMPUTATIONS

a. Water surface profiles for the design flow of 2000 c.f.s. and for a 1.3 year flow of 500 c.f.s. in the proposed channel improvement are shown on Plate 1 of this appendix. The natural profile for the design flow is

labeled, "Flood of June 1972 in August 1972 Channel". This was necessitated because of the significant bulldozing which took place shortly after the June 1972 flood to remove considerable deposition from the channel. Consequently, the natural profile represents existing conditions. Improved channel computations begin at critical depth at station 19+00 where higher flows break out of the channel at the end of the small rolled fill dike.

b. Hydraulic Elements - Hydraulic elements were obtained from soundings in the creek and topography along the banks, as shown on Plates 3-7 of the main report.

c. Profile Computations - Water-surface profiles before and after proposed improvement were obtained using Corps of Engineers computer programs developed for subcritical and supercritical flows.

(1) Flood of June 1972 - As mentioned above, the natural flood was translated to post-June 1972 channel conditions. Data on post-June 1972 roughnesses was derived from verification of the July 1970 flood (1200 c.f.s.) in the pre-June 1972 channel together with a field inspection of the post-June 1972 channel. The average channel roughness was judged to be 0.036 after the significant bulldozing and some realignment as compared to an average of 0.043 previously.

(2) Improved Scheme - An average "n" value of 0.033 was assumed for the proposed channel except where concrete is proposed by the State of New York. This would allow for alignment changes, channel bed roughening where unprotected, and for light vegetation to establish itself in the gabions on the slopes. The critical slope for this condition is 1.1% which is double the proposed channel slope of 0.5%. The adoption of 0.5% bottom gradient is intended to save on excavation and to provide depths greater than 1.1 times critical depth for flow stability.

(3) Losses - Friction losses were governed by the roughnesses previously given. Eddy losses were assumed to be 0.10 and 0.30 times the differences in velocity heads for contracting and expanding reaches, respectively, whenever encountered. Bend losses are not significant enough to be separated from friction losses and are included in the roughness coefficient.

5. GENERAL PROJECT DATA

a. The beginning and end of project improvement were established by economic and hydraulic considerations to provide maximum practical protection. Proposed reduction in flood heights are shown throughout the project on Plate 1 of this appendix. At the damage reference point, 600 ft. upstream from Main Street, the reduction would be about 3.4 ft. at design flow.

b. Two improvement schemes, labeled "200" and "250", are shown on Plate 1 of this appendix. The schemes are identical except for the profile between stations 24+15 and 33+00 which results from providing a 30 ft. wide crest at the drop at station 27+37 as proposed by the State of New York versus a 20 ft. wide crest. Hydraulically, scheme 200 is preferable over scheme 250 because the 30 foot crest (scheme 250) causes critical depth to form at the end of the return transition to the 20 foot channel, 50 feet upstream. This would initiate supercritical flow upstream from and across the drop whereas scheme 200 (20 foot crest at drop) holds control at the drop and at once builds a backwater curve upstream. Nevertheless, scheme 250, based on the State proposal should function satisfactorily since the channel downstream will be concrete lined.

c. Hydraulic jumps for the design flow (2000 cfs) and the 1.3 year flow (500 cfs) are tabulated on Plate 1 of this appendix. All jumps are weak or undular and have no special requirements other than proper length of pool. The lengths would be 4 times the conjugate depths for undular and 4.4 times for weak jumps. Special protection would be provided based on the low-turbulence charts of Hydraulic Design Criteria, HDC 712-1.

d. Velocities for the improved project would average about 8.7 ft./sec. for the design flow except where influenced by the drop structures where they would be higher. The comparative value for the 1.3 year flow would be 5.8 ft./sec.

e. As shown on Plate 1 of this appendix, the flow line for the improved design flow reverts to approximately natural conditions immediately because of the grade-restoring drop structure. Computations upstream from the project indicate that flow is essentially at critical depth except where the debris basin would be located. The velocities in the debris basin would average 2 ft./sec. for the design flow and 1.2 ft./sec. for 500 cfs, a 1.3 year flow. The basin should function effectively with these low velocities.

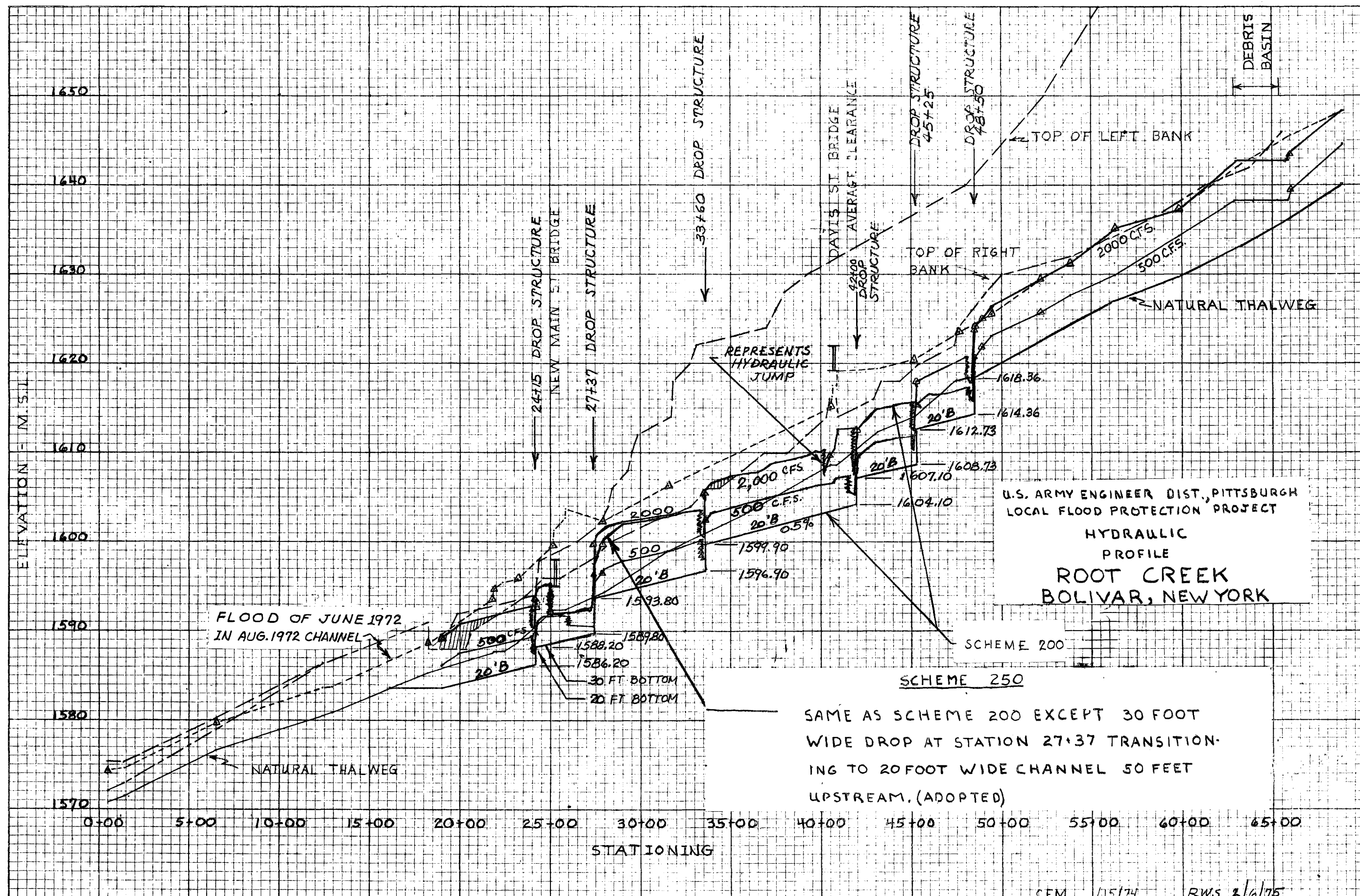
TABLE 1

DROP STRUCTURES

<u>Station</u>	<u>Flow</u>	<u>Drop Height (feet)</u>	<u>V_1</u>	<u>F</u>	<u>Basin Action</u>
24+15	500	2	11.06	1.41	Undular
	2000		17	1.5	Undular
27+37 (State of New York)	500	4	9.40	1.28	Undular
	2000		17.54	1.65	Undular-Weak
33+60	500	3	9.53	1.33	Undular
	2000		17	1.5	Undular
42+00	500	3	8.4	1.1	Undular
	2000		20.75	1.9	Weak
45+25	500	4	12.2	1.62	Undular-Weak
	2000		17.4	1.5	Undular
48+50	500	4	9.6	1.15	Undular
	2000		16.7	1.4	Undular

6. OTHER SCHEMES INVESTIGATED

Other improvements which were investigated consisted of varying the bottom grade of the channel and/or siting drop structures at other locations to find the best scheme. More details on these schemes are provided in the main report.



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LOCAL FLOOD PROTECTION PROJECT
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FOUNDATION INVESTIGATION

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1. EXPLORATION

There were 14 test pits excavated in November 1973 within the limits of the proposed improvement as shown located on Plates Nos. 3 through 7. The pits depths ranged between 4.5 feet and 11 feet, and were dug to determine the character of materials within the Root Creek channel. Jar samples were taken within each pit at pertinent intervals and sent back to the Pittsburgh District laboratory for visual classifications. Two bag samples representative of the channel material were also sent to the laboratory for visual classification and sieve analysis. Logs of the test pits are shown on Plate 9.

2. SOIL CLASSIFICATION

The channel materials, in general, are composed of 60% gravels, 30% sands, and 10% silts and clays, and classify as silty sandy gravel and clayey sandy gravel.

3. GEOLOGY

Bolivar is located on the maturely dissected Appalachian Plateau just south of the terminal moraine of the southern advancing Wisconsin ice sheet and within the small outwash valley of the Little Genesee Creek. The streambed of Root Creek (tributary to the Little Genesee Creek and flowing through Bolivar) consists of glacial outwash which is at least fifty (50) feet thick and generally composed of local flat and slabby heterogeneous gravels with scarce bedding features. The bedrock floor and walls of the valley are composed of horizontally bedded upper Devonian shales and siltstones at the very top of which are some remnants of Mississippian shales and thin sandstones. There are no bedrock outcrops within the project limits.

4. SLOPE STABILITY

a. The criteria for choosing safe design slopes for this project are principally founded on relating the natural bank geometry and soil composition to the desired bank geometry, and deducing as to whether stability has been improved, unchanged, or compromised. This approach was necessarily applied on the left bank in the three reaches between approximate Stations 29+00 and 42+00, 47+00 and 53+00, and 55+00 and 59+00, where the natural slopes are the highest (15 feet to 30 feet) and the steepest (30 degrees to 55 degrees). The soil composition within these reaches is uniform and about the same composition as that found in the creek bed, except

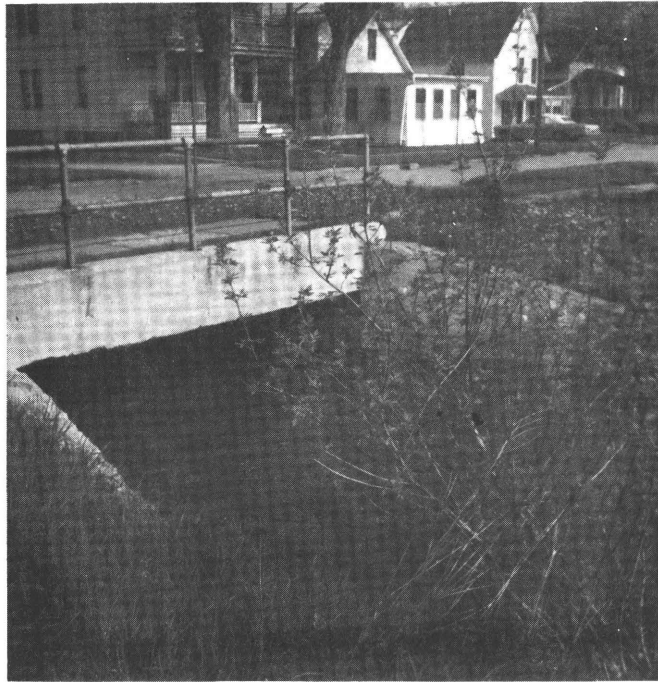
that the silt and clay content (at the expense of the cobble and gravel fraction) is probably 5% to 10% higher. Utilizing this information, a slope design cut of 1 vertical on 1-3/4 horizontal (30 degrees) was chosen as a safe economical cut within these three reaches on the left bank. In most areas this design improves slope stability and in no area does it compromise slope stability. Further, except as noted below, there are no structures or other improvements near the top of the slope.

b. Particular attention, however, had to be paid to the reach on the left bank between Stations 31+75 and 33+50 where several structures stand close to the top edge of the natural embankment. Here, also, is found the most marginally stable section (Station 32+66 on the left bank) involving a two story frame dwelling surcharge on top of a 20 foot high embankment with a 50 degree to 55 degree natural slope. In order to determine whether the proposed channel improvement would jeopardize this particular reach, a relative stability analysis was performed on the critical section (32+66).

c. A critical circular arc failure surface was first found through this section without including the proposed channel improvement. Iterative calculations were then performed to determine the angle of internal friction needed (excluding the cohesive strength parameter) for a factor of safety of one. Phi was found to be 34 degrees. Employing this angle of internal friction, another critical circular arc failure surface was found for the section that included the proposed channel improvement. The soil mass and surcharge above this failure surface was safe by a factor of 1.65. This supports an intuitive conclusion that the proposed left bank channel cut within this area has been designed for enough away from the toe of the natural embankment so as not to aggravate the stability of that bank any further.

d. To reduce the possibility of the undisturbed natural embankment sliding into the new channel on its own and thus further jeopardizing the structures above (between Stations 31+75 and 33+50 on the left bank), a wedge of soil excavated from the new channel will be placed at a slope of 2 horizontal to 1 vertical against the natural embankment at its toe, wherever possible, to act as a counter weight and toe support. This support further increases the calculated stability (for arcs intersecting the new channel) of this slope section to 1.8.

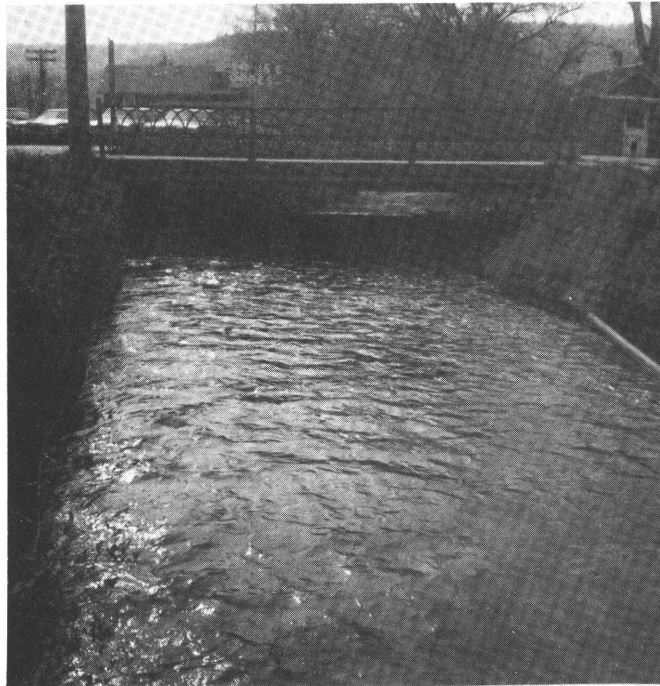
PHOTOGRAPHS



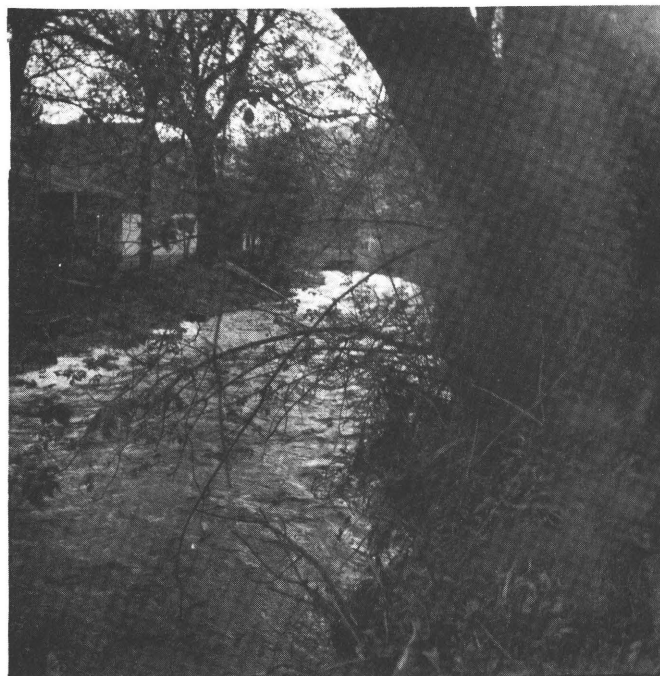
Station 22+00, First Street Bridge which is
to be removed by NYDOT



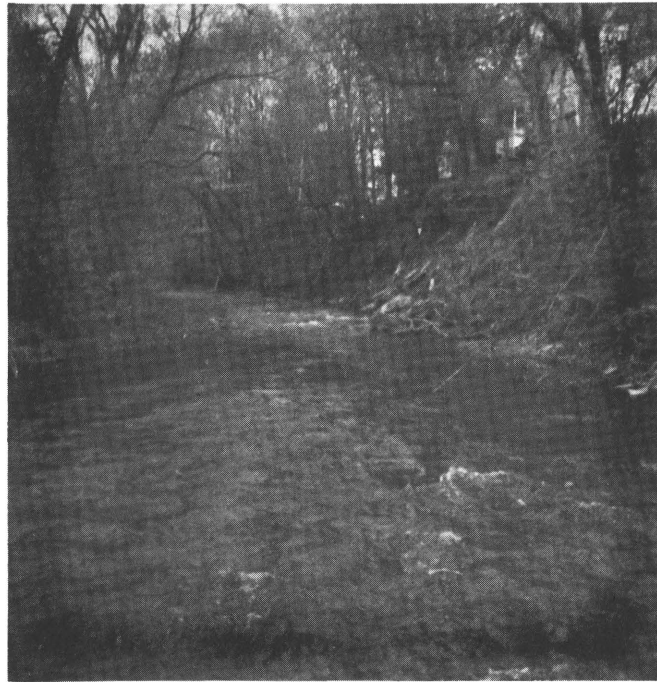
Station 21+00 to 19+00 - looking downstream



.Station 28+00 to 24+00 - looking downstream
and the Main Street Bridge which is to be
replaced by NYDOT



Station 24+00 to 22+00 - looking downstream



Station 32+00 to 34+00 - looking upstream



Station 32+00 to 28+00 - looking downstream



Station 45+00 to 42+00 - looking downstream



Station 42+00 to 38+00 - looking downstream
and Davis Street Bridge



Station 54+00 to 48+50 - looking downstream



Station 45+00 to 48+70 - looking upstream



Station 64+50 to 62+50 - looking downstream
(Area of proposed debris basin)



Station 58+00 to 55+00 - looking downstream