

WATER RESOURCES DEVELOPMENT PROJECT  
NORTH NASHUA RIVER

OPERATION AND MAINTENANCE  
MANUAL  
FOR  
LOCAL PROTECTION PROJECT

FITCHBURG, MASSACHUSETTS

DEPARTMENT OF THE ARMY  
NEW ENGLAND DIVISION, CORPS OF ENGINEERS  
WALTHAM, MASSACHUSETTS

OPERATION AND MAINTENANCE MANUAL  
FOR  
LOCAL PROTECTION WORKS  
NORTH NASHUA RIVER  
FITCHBURG, MASSACHUSETTS

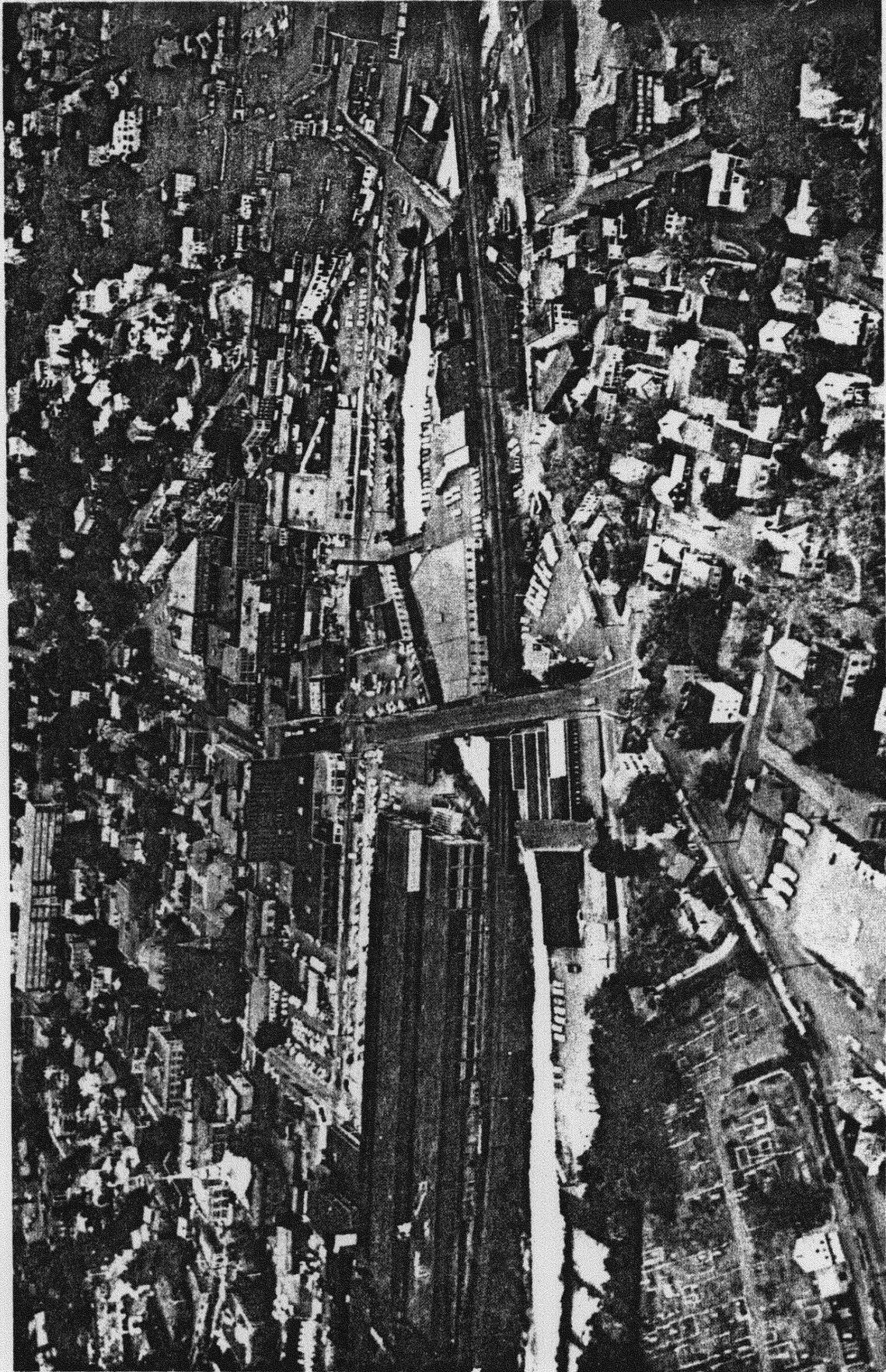
FOREWARD

The successful functioning of the Local Protection Works is not assured solely by construction of a system of floodwalls, slope protection, bottom grading, and other appurtenant structures. The system, to perform the functions for which it was designed, must be carefully maintained during periods of normal river stages and properly operated during flood periods.

The need for proper maintenance cannot be too highly stressed in view of the fact that large damages may be incurred through operating failure of a critical element in flood time, caused by deterioration or damage that would have been eliminated by proper maintenance.

Necessary maintenance and proper operation require that responsible local persons have a thorough understanding of the functions of the various units of the system and the recommended methods of maintaining the system. It is the purpose of this manual to provide complete information so that all parties may fully understand their responsibilities in maintaining and operating the flood protection system in accordance with the regulations prescribed by the Secretary of the Army as amplified by this manual.

The general flood control Regulations for Maintenance and Operation of Flood Control Works quoted herein were approved by the Acting Secretary of War on 9 August 1944. Upon establishment of the Department of Defense, the improvement of rivers and harbors and other waterways for flood control and other purposes, formerly under the jurisdiction of the Secretary of War, became the responsibility of the Secretary of the Army. Reference therein to the Secretary of War and War Department shall be construed to mean respectively, the Secretary of the Army and the Department of the Army. Where reference is made to the District Engineer in the Regulations included in this manual, it shall be construed to mean the Division Engineer, New England Division, Corps of Engineers.



NORTH NASHUA RIVER FLOWING THROUGH FITCHBURG'S DOWNTOWN BUSINESS SECTION.  
PUTNAM STREET IS IN CENTER.

OPERATION AND MAINTENANCE MANUAL  
CHANNEL REHABILITATION PROJECT  
FITCHBURG, MASSACHUSETTS

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## SECTION I. INTRODUCTION

1-01. Authorization - A comprehensive plan for development of water resources of the North Nashua River Basin, a principal tributary of the Merrimack River, was authorized by the 1966 Flood Control Act substantially in accordance with Senate Document 113, 89th Congress. The plan provides for a coordinated system of reservoirs and local protection projects for flood protection, water supply, recreation and allied purposes.

Restoration of the North Nashua River Local Protection Project was specifically authorized under Title II, Section 203 of the 1966 Flood Control Act in accordance with the recommendations of the Chief of Engineers in Senate Document Numbered 113, 89th Congress.

1-02. Location - The Channel Rehabilitation Project is located on the North Nashua River within the limits of the city of Fitchburg, Massachusetts. The project consists of twenty-three (23) miscellaneous work items which commence at river station 347+00 and extend to river station 580+00+. The project work sites are within the developed and built-up area of the city and are in most instances in confined areas. Stations are noted on the drawings included in Appendix E.

1-03. Dates of Construction - The original protective works at Fitchburg was constructed in 1937. The project extends along 4.4 miles of the North Nashua River from Cowees Mill Dam (since removed) upstream of Oak Hill Road, and continuing downstream to the Fitchburg-Leominster Airport on Falulah Road just above the Leominster town line. At several places earth banks were protected with concrete crib walls. At other locations the riverbed and toes of the banks were protected against scour by emplacement of grouted riprap. The work included channel enlargement, relocation of the outlet of Punch Brook, and removal of several abandoned dams.

In 1955, under the disaster relief authority of Public Law 875, 81st Congress, as amended, the Corps of Engineers restored the channel in some areas to its preflood condition, but no permanent improvements could be made under this authority. Gravel deposits and debris were removed from the streambed and washed out river bank slopes were filled, but no repairs were made to deteriorated concrete cribbing at nine individually identified work areas.

Construction of the channel Rehabilitation Project commenced in July 1979 and was completed in May 1981. The project consisted of restoring the existing protective works to its original 1937 capacity. The project was constructed by Shah Construction Company of Wakefield, Massachusetts.

### 1-04. Description of Project.

a. General. The completed rehabilitation project consists of miscellaneous items of work at approximately 23 locations within the five mile reach of the river.

b. Erosion Protection. New slope protection has been provided where the existing slopes were unstable and erosion had taken place. Broken boulders, excess stone, and granite deposits were removed from the riverbed to provide for restored channel capacity. New riprap was placed where the existing stone protection had been damaged.

c. Walls. Walls which had been damaged or destroyed were restored to their original condition or replaced by an alternate form of protection. Debris caused by the deteriorating walls was removed.

d. Bridge Pier Removal. Two midstream bridge piers upstream from the Fifth Street Bridge were removed. The bridge abutment on the north riverbank was retained and the upper two courses of granite block were grouted for safety.

e. Dam Removal. The Syphon Dam, located between the Falulah Road Bridge and the Bemis Road Bridge which had been partially washed out was totally removed. Rock slope protection was placed on both adjacent riverbank areas downstream of the Syphon Dam location.

1-05. Protection Provided. The rehabilitation project essentially restores the existing flood protective works to its original 1937 condition and again assures a channel capacity of 9,000 cubic feet per second for stream flow.

1-06. Location Map. Location maps showing all areas of rehabilitation are included in Appendix E.

## SECTION II. LOCAL COOPERATION REQUIREMENTS

2-01. Flood Control Acts. The authorizing legislation for the Fitchburg Local Protection Project was the Flood Control Act of 1966, Public Law 89-789.

"a) Provide, without cost to the United States, all lands, easements, and rights-of-way necessary for the construction of the projects; provide necessary relocations and alterations to highways, roads, and highway bridges; relocate all utilities; and construct interior drainage ditches.

"b) Hold and save the United States free from damages due to the construction, operation, and maintenance of the project except damages due to the fault of the United States or its Contractors.

"c) Maintain and operate the project after completion in accordance with regulations prescribed by the Secretary of the Army.

"d) Prevent encroachments on the improved channels.

"e. Comply with requirements of non-Federal cooperation specified in Sections 210 and 305 of the Public Law 91-646, approved 2 January 1971, entitled the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970."

2-02. A copy of local assurances is given in Appendix C of this manual.

### SECTION III. - GENERAL REGULATIONS

3-01. Purpose of this Manual. The purpose of this Manual is to present detailed information to be used as a guide in complying with "Flood Control Regulations - Maintenance and Operation of Flood Control Works" as approved by the Acting Secretary of War on 9 August 1944, and published in Appendix A of this Manual.

The regulations, intended to cover all local protection projects constructed by the Department of the Army throughout the United States, are general in nature and obviously cannot give detailed instructions for the maintenance and operation of a specific project. The details set forth in this Manual for maintenance and operation of the Fitchburg project are intended to supplement the Regulations to insure maximum protection against floods for which the project was designed. Failure to maintain and operate the project as required by the Regulations and as detailed herein can result in loss of life, severe property losses, and irreparable loss of confidence in the flood protection system by citizens who have invested their funds on the basis of the protection afforded by the flood control works.

Included in the authorization of the project are conditions specified by the Secretary of the Army to be met by local interests. One of these conditions is the Operation and Maintenance of the project after its completion. Under Assurances dated 25 April 1979 furnished to the Government by the Commonwealth of Massachusetts and by the city of Fitchburg to the Commonwealth, the city of Fitchburg has agreed to meet these conditions and in particular, to operate and maintain the project after its completion. Copies of the above assurances are included in Appendix C of this Manual.

3-02. General Rules and Regulations. Paragraph 208.10 (a) of the regulations prescribed by the Secretary of War gives general rules for the maintenance and operation of structures and facilities constructed by the United States for local flood protection. Applicable portions are quoted below to avoid the necessity for cross reference and are further defined by remarks under each quotation.

"(1) The structures and facilities constructed by the United States for local flood protection shall be continuously maintained in such a manner and operated at such times and for periods as may be necessary to obtain the maximum benefits."

These requirements cannot be overstressed, and city authorities must make adequate provisions for funds, personnel, equipment, and materials to allow for the proper maintenance and operation of the flood protective works.

"(2) The State, political subdivision thereof, or other responsible local agency, which furnished assurance that it will maintain and operate flood control works in accordance with regulations prescribed by the Secretary of War, as required by law, shall appoint a permanent committee consisting of or headed by an official hereinafter called the 'Superintendent', who shall be responsible for the development and maintenance of, and directly in charge of, an organization responsible for the efficient operation and maintenance of all of the structures and facilities during flood periods and for continuous inspection and maintenance of the project works during the periods of low water, all without cost to the United States."

The committee shall be composed of competent members, preferably experienced in engineering and construction work of a nature similar to the flood protection works. The committee must be given broad authority to carry out its responsibilities. The name, address, and office and home telephone numbers of the Superintendent, and any changes thereof, shall be promptly furnished the Division Engineer, U. S. Army Corps of Engineers, New England Division, Waltham, Massachusetts 02254, Attn: Project Operations Branch.

"(3) A reserve supply of materials needed during a flood emergency shall be kept on hand at all times."

"(4) No encroachment or trespass which will adversely affect the efficient operation or maintenance of the project works shall be permitted upon the rights-of-way for the protective facilities."

The disposal of rubbish, erection of fences, or barriers, the painting or erection of signs, the attachment of clotheslines to flood-walls, or any form of trespassing on the project shall be prohibited.

"(5) No improvement shall be passed over, under, or through the walls, dikes, improved channels or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior determination by the District Engineer of the War Department or his authorized representative that such improvement, excavation, construction or alteration will not adversely affect the functioning of the protective facilities. Such improvements or alterations as may be found to be desirable and permissible under the above determination shall be constructed in accordance with standard engineering practice. Advice regarding the effect of proposed improvements or alterations on the functioning of the project and information concerning methods of construction acceptable under standard engineering practice shall be obtained from the District Engineer or, if otherwise obtained, shall be submitted for his approval. Drawings or prints showing such improvements or alterations as finally constructed shall be furnished the District Engineer after completion of the work."

Any contemplated improvements or alterations as outlined above must be submitted to the Corps of Engineers, Waltham, Massachusetts, and the approval of the Division Engineer obtained prior to the city authorizing the work. All requests for approval shall be in writing and complete drawings in duplicate, one set of which shall be in reproducible form, must be submitted along with a full description of the work intended. The city will be held responsible for obtaining prior approval from the Corps of Engineers for any improvements or alterations proposed by itself, private parties or any public parties. The city shall furnish the Division Engineer as-built drawings, in duplicate, of the completed work.

"(6) It shall be the duty of the Superintendent to submit a semi-annual report to the District Engineer covering inspection, maintenance and operation of the protective works."

See paragraph 3-05 for instruction on submitting reports.

"(7) The District Engineer or his authorized representatives shall have access at all times to all portions of the protective works."

The Division Engineer or his representatives will make periodic inspections of the protective works to determine if the project is being properly maintained and operated by the city. "Follow-up" inspections, when necessary, will be made to determine if deficiencies observed during the inspection have been corrected. A report with the results of each inspection will be furnished to the city for appropriate action.

"(8) Maintenance measures or repairs which the District Engineer deems necessary shall be promptly taken or made."

The city should maintain the facilities and keep them in good repair and not wait for the Division Engineer to call such matters to its attention. Upon request, the Division Office will advise the city how to make any major repairs to the facilities. This is expressly applicable to the maintenance and repair of concrete work throughout the project.

"(9) Appropriate measures shall be taken by local authorities to insure that the activities of all local organizations operating public or private facilities connected with the protective works are coordinated with those of the Superintendent's organization during flood periods."

The city should formulate plans and negotiate agreements with local organizations and companies, who are operating facilities connected with the protective works, to insure that their activities will be properly coordinated with the Superintendent's organization during flood periods.

"(10) The War Department will furnish local interests with an Operation and Maintenance Manual for each completed project or separate useful part thereof, to assist them in carrying out their obligations under these regulations."

The flood control committee should familiarize itself with the contents of this manual. The city authorities are encouraged to call on the Division Office of the Corps of Engineers for any additional advice or instructions required by them in carrying out the city's obligations for maintaining and operating the flood protection facilities.

### 3-03. Maintenance

a. The word "maintenance" as used in this manual applies to the upkeep, repair and care of the work constructed by the United States and turned over to the city. If the work is neglected there will be deterioration and possible failure in flood time when there is dire need of dependable protection.

b. Satisfactory and dependable operation depends on constant maintenance. The organization that performs maintenance must be familiar with various parts of the system and be in a position to use them effectively in time of stress.

c. Maintenance includes regular inspection of the entire system. The purpose of an inspection is to detect any deterioration or faulty operation that indicates a need for repair or replacement. This does not mean a casual automobile trip to places easily accessible but actually walking over every part of the system.

### 3-04. Operation

a. Operation in this manual refers to the actual use of the various features of the protection works during flood periods. It is intended that the procedure outlined herein will be sufficient to insure protection from floods to the design stage.

b. When abnormal river flows and stages are expected, it is important that the Superintendent make immediate decisions and take prompt action and that he have the authority to carry out his decisions.

c. To insure correct operation, it is essential that at least one person (preferably two people) be familiar with all phases of the flood protection works, and know what supplies and transport are on hand and what manpower and tools can be mobilized for the patrolling and repair work.

d. Representatives of the Division Engineer, Corps of Engineers stand ready to assist the city in the operation of the project. Advice relative to surveillance during storm periods may be obtained at any time from the Reservoir Control Center of the Corps of Engineers (telephone 617-894-2400, extension 627 or 617-894-2414 during non duty hours). However, sole responsibility for the operation of the project rests with the city.

### 3-05. Reports

a. Inspection and Reports. The regulations prescribed by the Secretary of the Army call for semi-annual reports to be submitted by the Superintendent to the Division Engineer, covering inspection and maintenance. Inspection of the flood protective facilities shall be made immediately prior to flood seasons, immediately following floods, and otherwise at intervals not exceeding 90 days as required by the regulations.

b. To assist the Superintendent in making his inspection and reports, a sample check list (NED Form 513) is included in Appendix D. The Superintendent shall have additional copies printed for use in submitting his reports. Items on Form 513 not applicable to Fitchburg are noted N/A thereon.

c. The semi-annual reports should be submitted on NED Form 513 in triplicate each February and August to the Division Engineer, Attn: Project Operations Branch, Operations Division, U. S. Army Corps of Engineers, New England Division, 424 Trapelo Road, Waltham, Massachusetts 02254. The report will be submitted in letter form with copies of the inspection forms covering the inspections made during the period of the report. The reports shall cover the following points:

(1) A description of the maintenance work performed in the preceding six months.

(2) The number and classification of men working on maintenance, regularly and intermittently.

(3) Description of any work performed by contract on the repair or improvement of the project.

(4) Description of use or operation of the system during the period being reported.

(5) Suggestions relative to public cooperation and comments concerning public sentiment on the protection obtained are considered pertinent and desirable data for inclusion in the project report, but such data are not required.

d. The report form "Designation of Superintendent" shall be submitted annually with the February inspection report. A sample copy is included in Appendix D.

#### SECTION IV MAINTENANCE OF IMPROVEMENTS

4-01. Description - The channel rehabilitation consists of 23 areas of construction along a 4.4 mile reach of the North Nashua River, designed to restore the channel to its original 1937 condition.

4-02. Maintenance - Paragraph 208.10(g)(1) of the prescribed regulations sets forth rules for the maintenance of channels and floodways. These rules are quoted below, followed by brief comments on the particular applicability of these rules to the project.

Channels and Floodways - (1) Maintenance - Periodic inspection of improved channels and floodways shall be made by the Superintendent to be certain that:

"(i) the channel or floodway is clear of debris, weeds, and wild growth;"

All debris and growth which tend to restrict the channel shall be removed promptly. All stone protection shall be kept free of all vegetation growth.

"(ii) The channel or floodway is not being restricted by the depositing of waste materials, building of unauthorized structures or other encroachments;"

Dumping of waste materials or any types of encroachment on the channel shall be prohibited and prompt steps shall be taken to remove or have removed any such encroachments.

"(iii) The capacity of the channel or floodway is not being reduced by the formation of shoals;"

Shoal areas should be removed but care should be exercised that stone protection is not displaced and that the slopes of the channel and existing banks are not undercut. Existence of shoal areas will be apparent from inspections during time of low flow.

"(iv) Banks are not being damaged by rain or wave wash, and that no sloughing of banks has occurred;"

Banks damaged by rain or wave wash or sloughing shall be repaired promptly, using bankrun gravel and rock similar to that used in their original construction.

"(v) Riprap sections and . . . . dikes and walls are in good condition."

Stone protection must be maintained in good condition to resist erosion. Any loss of rock due to slides, erosion or vandalism must be promptly replaced. Periodic checks should be made of the stone protection for possible movement or loss of stone, and prompt corrective action taken.

"(vi) Approach and egress channels adjacent to the improved channel or floodway are sufficiently clear of obstructions and debris to permit proper functioning of the project works."

"Such inspections shall be made prior to the beginning of the flood season and otherwise at intervals not to exceed 90 days. Immediate steps will be taken to remedy any adverse conditions disclosed by such inspections. Measures will be taken by the Superintendent to promote the growth of grass on bank slopes and . . . . dikes. The Superintendent shall provide for periodic repair and cleaning of debris . . . . as may be necessary."

4-03. Operation - Paragraph 208.10(g)(2) of the prescribed regulations gives rules for operation of channels and floodways. These rules which are quoted below are self explanatory and require no amplification with regard to the project.

(2) Operations. "Both banks of the channel shall be patrolled during periods of high water, and measures shall be taken to protect those reaches being attacked by the current or wave wash. Appropriate measures shall be taken to prevent the formation of jams of ice or debris. Large objects which become lodged against the bank shall be removed. The improved channel or floodway shall be thoroughly inspected immediately following each major high water period. As soon as practicable thereafter, all snags and other debris shall be removed and all banks, riprap, walls, drainage outlets, or other flood control structures repaired."

SECTION V. DRAWINGS

5-01. General. A complete set of "As-Built" tracings was turned over to the city of Fitchburg at the completion of the project construction.

5-02. O&M Manual Drawings and Photos. Pertinent drawings and photographs which help to clarify this O&M Manual are included in Appendix E.

APPENDIX "A"

REGULATIONS PRESCRIBED BY THE SECRETARY OF THE ARMY

## TITLE 33—NAVIGATION AND NAVIGABLE WATERS

### Chapter II—Corps of Engineers, War Department

#### PART 208—FLOOD CONTROL REGULATIONS MAINTENANCE AND OPERATION OF FLOOD CONTROL WORKS

Pursuant to the provisions of section 3 of the Act of Congress approved June 22, 1936, as amended and supplemented (49 Stat. 1571; 50 Stat. 877; and 55 Stat. 638; 33 U. S. C. 701c; 701c-1), the following regulations are hereby prescribed to govern the maintenance and operation of flood control works:

§ 208.10 *Local flood protection works; maintenance and operation of structures and facilities*—(a) *General*. (1) The structures and facilities constructed by the United States for local flood protection shall be continuously maintained in such a manner and operated at such times and for such periods as may be necessary to obtain the maximum benefits.

(2) The State, political subdivision thereof, or other responsible local agency, which furnished assurance that it will maintain and operate flood control works in accordance with regulations prescribed by the Secretary of War, as required by law, shall appoint a permanent committee consisting of or headed by an official hereinafter called the "Superintendent," who shall be responsible for the development and maintenance of, and directly in charge of, an organization responsible for the efficient operation and maintenance of all of the structures and facilities during flood periods and for continuous inspection and maintenance of the project works during periods of low water, all without cost to the United States.

(3) A reserve supply of materials needed during a flood emergency shall be kept on hand at all times.

(4) No encroachment or trespass which will adversely affect the efficient operation or maintenance of the project works shall be permitted upon the right-of-way for the protective facilities.

(5) No improvement shall be passed over, under, or through the walls, levees, improved channels or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior determination by the District Engineer of the War Department or his authorized representative that such improvement, excavation, construction, or alteration will not adversely affect the functioning of the protective facilities. Such improvements or alterations as may be found to be desirable and permissible under the above determination shall be constructed in accordance with standard engineering practice. Advice regarding the effect of proposed improvements or alterations on the functioning of the project and information concerning methods of construction acceptable under standard engineering practice shall be obtained from the District Engineer or, if otherwise obtained, shall be submitted for his approval. Drawings or prints showing such improvements or alterations as finally constructed shall be furnished the District Engineer after completion of the work.

(6) It shall be the duty of the superintendent to submit a semiannual report to the District Engineer covering inspection, maintenance, and operation of the protective works.

(7) The District Engineer or his authorized representatives shall have access at all times to all portions of the protective works.

(8) Maintenance measures or repairs which the District Engineer deems necessary shall be promptly taken or made.

(9) Appropriate measures shall be taken by local authorities to insure that the activities of all local organizations operating public or private facilities connected with the protective works are coordinated with those of the Superintendent's organization during flood periods.

(10) The War Department will furnish local interests with an Operation and Maintenance Manual for each completed project, or separate useful part thereof, to assist them in carrying out their obligations under these regulations.

(b) *Levees*—(1) *Maintenance*. The Superintendent shall provide at all times such maintenance as may be required to insure serviceability of the structures in time of flood. Measures shall be taken to promote the growth of sod, exterminate burrowing animals, and to provide for routine mowing of the grass and weeds, removal of wild growth and drift deposits, and repair of damage caused by erosion or other forces. Where practicable, measures shall be taken to retard bank erosion by planting of willows or other suitable growth on areas riverward of the levees. Periodic inspections shall be made by the Superintendent to insure that the above maintenance measures are being effectively carried out and, further, to be certain that:

(i) No unusual settlement, sloughing, or material loss of grade or levee cross section has taken place;

(ii) No caving has occurred on either the land side or the river side of the levee which might affect the stability of the levee section;

(iii) No seepage, saturated areas, or sand boils are occurring;

(iv) Toe drainage systems and pressure relief wells are in good working condition, and that such facilities are not becoming clogged;

(v) Drains through the levees and gates on said drains are in good working condition;

(vi) No revetment work or riprap has been displaced, washed out, or removed;

(vii) No action is being taken, such as burning grass and weeds during inappropriate seasons, which will retard or destroy the growth of sod;

(viii) Access roads to and on the levee are being properly maintained;

(ix) Cattle guards and gates are in good condition;

(x) Crown of levee is shaped so as to drain readily, and roadway thereon, if any, is well shaped and maintained;

(xi) There is no unauthorized grazing or vehicular traffic on the levees;

(xii) Encroachments are not being made on the levee right-of-way which might endanger the structure or hinder its proper and efficient functioning during times of emergency.

Such inspections shall be made immediately prior to the beginning of the flood season; immediately following each major high water period, and otherwise at intervals not exceeding 90 days, and such intermediate times as may be necessary to insure the best possible care of

the levee. Immediate steps will be taken to correct dangerous conditions disclosed by such inspections. Regular maintenance repair measures shall be accomplished during the appropriate season as scheduled by the Superintendent.

(2) *Operation*. During flood periods the levee shall be patrolled continuously to locate possible sand boils or unusual wetness of the landward slope and to be certain that:

(i) There are no indications of slides or sloughs developing;

(ii) Wave wash or scouring action is not occurring;

(iii) No low reaches of levee exist which may be overtopped;

(iv) No other conditions exist which might endanger the structure.

Appropriate advance measures will be taken to insure the availability of adequate labor and materials to meet all contingencies. Immediate steps will be taken to control any condition which endangers the levee and to repair the damaged section.

(c) *Flood walls*—(1) *Maintenance*. Periodic inspections shall be made by the Superintendent to be certain that:

(i) No seepage, saturated areas, or sand boils are occurring;

(ii) No undue settlement has occurred which affects the stability of the wall or its water tightness;

(iii) No trees exist, the roots of which might extend under the wall and offer accelerated seepage paths;

(iv) The concrete has not undergone cracking, chipping, or breaking to an extent which might affect the stability of the wall or its water tightness;

(v) There are no encroachments upon the right-of-way which might endanger the structure or hinder its functioning in time of flood;

(vi) Care is being exercised to prevent accumulation of trash and debris adjacent to walls, and to insure that no fires are being built near them;

(vii) No bank caving conditions exist riverward of the wall which might endanger its stability;

(viii) Toe drainage systems and pressure relief wells are in good working condition, and that such facilities are not becoming clogged.

Such inspections shall be made immediately prior to the beginning of the flood season, immediately following each major high water period, and otherwise at intervals not exceeding 90 days. Measures to eliminate encroachments and effect repairs found necessary by such inspections shall be undertaken immediately. All repairs shall be accomplished by methods acceptable in standard engineering practice.

(2) *Operation*. Continuous patrol of the wall shall be maintained during flood periods to locate possible leakage at monolith joints or seepage underneath the wall. Floating plant or boats will not be allowed to lie against or tie up to the wall. Should it become necessary during a flood emergency to pass anchor cables over the wall, adequate measures shall be taken to protect the concrete and construction joints. Immediate steps shall be taken to correct any condition which endangers the stability of the wall.

(d) *Drainage structures*—(1) *Maintenance*. Adequate measures shall be taken to insure that inlet and outlet channels are kept open and that trash, drift, or debris is not allowed to accumulate near drainage structures. Flap gates and manually operated gates and valves on

drainage structures shall be examined, oiled, and trial operated at least once every 90 days. Where drainage structures are provided with stop log or other emergency closures, the condition of the equipment and its housing shall be inspected regularly and a trial installation of the emergency closure shall be made at least once each year. Periodic inspections shall be made by the Superintendent to be certain that:

(i) Pipes, gates, operating mechanism, riprap, and headwalls are in good condition;

(ii) Inlet and outlet channels are open;

(iii) Care is being exercised to prevent the accumulation of trash and debris near the structures and that no fires are being built near bituminous coated pipes;

(iv) Erosion is not occurring adjacent to the structure which might endanger its water tightness or stability.

Immediate steps will be taken to repair damage, replace missing or broken parts, or remedy adverse conditions disclosed by such inspections.

(2) *Operation.* Whenever high water conditions impend, all gates will be inspected a short time before water reaches the invert of the pipe and any object which might prevent closure of the gate shall be removed. Automatic gates shall be closely observed until it has been ascertained that they are securely closed. Manually operated gates and valves shall be closed as necessary to prevent inflow of flood water. All drainage structures in levees shall be inspected frequently during floods to ascertain whether seepage is taking place along the lines of their contact with the embankment. Immediate steps shall be taken to correct any adverse condition.

(e) *Closure structures—(1) Maintenance.* Closure structures for traffic openings shall be inspected by the superintendent every 90 days to be certain that:

(i) No parts are missing;

(ii) Metal parts are adequately covered with paint;

(iii) All movable parts are in satisfactory working order.

(iv) Proper closure can be made promptly when necessary;

(v) Sufficient materials are on hand for the erection of sand bag closures and that the location of such materials will be readily accessible in times of emergency.

Tools and parts shall not be removed for other use. Trial erections of one or more closure structures shall be made once each year, alternating the structures chosen so that each gate will be erected at least once in each 3-year period. Trial erection of all closure structures shall be made whenever a change is made in key operating personnel. Where railroad operation makes trial erection of a closure structure infeasible, rigorous inspection and drill of operating personnel may be substituted therefor. Trial erection of sand bag closures is not required. Closure materials will be carefully checked prior to and following flood periods, and damaged or missing parts shall be repaired or replaced immediately.

(2) *Operation.* Erection of each movable closure shall be started in sufficient time to permit completion before flood waters reach the top of the structure sill. Information regarding the proper method of erecting each individual closure structure, together with an estimate of the time required by an experienced crew to complete its erection will be given

in the Operation and Maintenance Manual which will be furnished local interests upon completion of the project. Closure structures will be inspected frequently during flood periods to ascertain that no undue leakage is occurring and that drains provided to care for ordinary leakage are functioning properly. Boats or floating plant shall not be allowed to tie up to closure structures or to discharge passengers or cargo over them.

(f) *Pumping plants—(1) Maintenance.* Pumping plants shall be inspected by the Superintendent at intervals not to exceed 30 days during flood seasons and 90 days during off-flood seasons to insure that all equipment is in order for instant use. At regular intervals, proper measures shall be taken to provide for cleaning plant, buildings, and equipment, repainting as necessary, and lubricating all machinery. Adequate supplies of lubricants for all types of machines, fuel for gasoline or diesel powered equipment, and flash lights or lanterns for emergency lighting shall be kept on hand at all times. Telephone service shall be maintained at pumping plants. All equipment, including switch gear, transformers, motors, pumps, valves, and gates shall be trial operated and checked at least once every 90 days. Megger tests of all insulation shall be made whenever wiring has been subjected to undue dampness and otherwise at intervals not to exceed one year. A record shall be kept showing the results of such tests. Wiring disclosed to be in an unsatisfactory condition by such tests shall be brought to a satisfactory condition or shall be promptly replaced. Diesel and gasoline engines shall be started at such intervals and allowed to run for such length of time as may be necessary to insure their serviceability in times of emergency. Only skilled electricians and mechanics shall be employed on tests and repairs. Operating personnel for the plant shall be present during tests. Any equipment removed from the station for repair or replacement shall be returned or replaced as soon as practicable and shall be trial operated after reinstallation. Repairs requiring removal of equipment from the plant shall be made during off-flood seasons insofar as practicable.

(2) *Operation.* Competent operators shall be on duty at pumping plants whenever it appears that necessity for pump operation is imminent. The operator shall thoroughly inspect, trial operate, and place in readiness all plant equipment. The operator shall be familiar with the equipment manufacturers' instructions and drawings and with the "Operating Instructions" for each station. The equipment shall be operated in accordance with the above-mentioned "Operating Instructions" and care shall be exercised that proper lubrication is being supplied all equipment, and that no overheating, undue vibration or noise is occurring. Immediately upon final recession of flood waters, the pumping station shall be thoroughly cleaned, pump house sumps flushed, and equipment thoroughly inspected, oiled and greased. A record or log of pumping plant operation shall be kept for each station, a copy of which shall be furnished the District Engineer following each flood.

(g) *Channels and floodways—(1) Maintenance.* Periodic inspections of improved channels and floodways shall be made by the Superintendent to be certain that:

(i) The channel or floodway is clear of debris, weeds, and wild growth;

(ii) The channel or floodway is not being restricted by the depositing of waste materials, building of unauthorized structures or other encroachments;

(iii) The capacity of the channel or floodway is not being reduced by the formation of shoals;

(iv) Banks are not being damaged by rain or wave wash, and that no sloughing of banks has occurred;

(v) Riprap sections and deflection dikes and walls are in good condition;

(vi) Approach and egress channels adjacent to the improved channel or floodway are sufficiently clear of obstructions and debris to permit proper functioning of the project works.

Such inspections shall be made prior to the beginning of the flood season and otherwise at intervals not to exceed 90 days. Immediate steps will be taken to remedy any adverse conditions disclosed by such inspections. Measures will be taken by the Superintendent to promote the growth of grass on bank slopes and earth deflection dikes. The Superintendent shall provide for periodic repair and cleaning of debris basins, check dams, and related structures as may be necessary.

(2) *Operation.* Both banks of the channel shall be patrolled during periods of high water, and measures shall be taken to protect those reaches being attacked by the current or by wave wash. Appropriate measures shall be taken to prevent the formation of jams of ice or debris. Large objects which become lodged against the bank shall be removed. The improved channel or floodway shall be thoroughly inspected immediately following each major high water period. As soon as practicable thereafter, all snags and other debris shall be removed and all damage to banks, riprap, deflection dikes and walls, drainage outlets, or other flood control structures repaired.

(h) *Miscellaneous facilities—(1) Maintenance.* Miscellaneous structures and facilities constructed as a part of the protective works and other structures and facilities which function as a part of, or affect the efficient functioning of the protective works, shall be periodically inspected by the Superintendent and appropriate maintenance measures taken. Damaged or unserviceable parts shall be repaired or replaced without delay. Areas used for ponding in connection with pumping plants or for temporary storage of interior run-off during flood periods shall not be allowed to become filled with silt, debris, or dumped material. The Superintendent shall take proper steps to prevent restriction of bridge openings and, where practicable, shall provide for temporary raising during floods of bridges which restrict channel capacities during high flows.

(2) *Operation.* Miscellaneous facilities shall be operated to prevent or reduce flooding during periods of high water. Those facilities constructed as a part of the protective works shall not be used for purposes other than flood protection without approval of the District Engineer unless designed therefor. (49 Stat. 1571, 50 Stat. 877; and 55 Stat. 638; 33 U.S.C. 701c; 701c-1) (Regs. 9 August 1944, CE SPEWFF)

[SEAL]

J. A. ULIO,  
Major General,  
The Adjutant General.

**APPENDIX B**

**STANDARD OPERATING PROCEDURES  
DURING STORM PERIODS  
FITCHBURG, MASSACHUSETTS**

APPENDIX B

STANDARD OPERATING PROCEDURES  
DURING STORM PERIODS  
FITCHBURG, MASSACHUSETTS

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## APPENDIX B

### STANDARD OPERATION PROCEDURE DURING FLOOD PERIODS

#### PURPOSE AND SCOPE

##### 1. General

This appendix prescribes details for the operation of the flood control features of the Fitchburg Local Protection Project. Climatology and hydrologic data are included for background information.

#### RESPONSIBILITIES

##### 2. City of Fitchburg

The city is responsible for the operation, maintenance and protection of the entire flood protection works. Instructions for the operation are presented in this appendix. Areas of responsibility include:

a. Complete operation of the project during flood periods in the North Nashua River.

b. Training sufficient personnel to insure efficient and effective maintenance and operating procedures.

c. Maintaining an adequate communication system to obtain weather and flood forecasts.

##### 3. National Weather Service

The National Weather Service (NWS) has no direct role in the operation of the project; however, it has the responsibility of issuing weather and flood forecasts to the general public. Flood forecasts for the eastern Massachusetts area are issued by the NWS office at Boston, Massachusetts.

##### 4. Corps of Engineers

The Reservoir Control Center (RCC) of the Corps of Engineers continually monitors rainfall and runoff conditions in much of New England. This climatologic and hydrologic information is available upon request. RCC will review operational procedures following major floods to determine whether the prescribed regulation instructions need revisions.

## CLIMATOLOGY

5. General. The North Nashua River basin has a variable climate and frequently experiences periods of heavy precipitation produced by local thunderstorms and larger weather systems of tropical and extra-tropical origin. The basin lies in the path of the prevailing "westerlies" which traverse the country in an easterly or northeasterly direction and produce frequent weather changes. Temperature extremes within the basin range from summer-time highs of about 100° Fahrenheit to sub-zero temperatures in the minus teens occurring for short periods in the winter.

6. Precipitation. The average annual precipitation over the North Nashua River Basin is approximately 43 inches, uniformly distributed throughout the year. The maximum and minimum annual precipitation at Fitchburg are 60.23 and 27.45 inches, respectively. Table B-1 lists the mean, maximum and minimum monthly and annual precipitation at Fitchburg for 111 years of record, through 1975.

7. Snow Fall. The annual snowfall in the basin averages about 62 inches at Fitchburg, located at about elevation 400 feet msl. Table B-2 gives the mean monthly and annual snowfall at Fitchburg for 90 years of record, through 1975.

TABLE B-1

MONTHLY PRECIPITATION AT  
FITCHBURG, MASSACHUSETTS  
(In Inches)

<u>Monthly</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>
January	3.44	7.78	0.84
February	3.28	8.33	0.34
March	3.67	12.15	Trace
April	3.42	9.91	0.57
May	3.57	8.25	0.57
June	3.66	11.56	0.09
July	3.67	12.68	0.46
August	3.66	10.72	0.17
September	3.64	14.04	0.19
October	3.43	13.01	Trace
November	3.84	7.79	0.38
December	3.51	9.33	0.58
Annual	42.77	60.23	27.45

TABLE B-2

SNOWFALL DATA AT  
FITCHBURG, MASSACHUSETTS  
(Depth in Inches)

<u>Month</u>	<u>Mean</u>
January	15.6
February	17.6
March	11.3
April	2.5
May	Trace
June	-
July	-
August	-
September	-
October	Trace
November	3.5
December	11.7
Annual	62.2

8. Snow Cover. Snow surveys have been taken in or adjacent to the North Nashua River watershed since 1950. These surveys indicate that the water content of the snow normally reaches a maximum about the first of March. The recorded mean, maximum and minimum average basin water content of the snow for the nearby Millers River basin for 27 years of record through 1976 is given in Table B-3.

TABLE B-3

WATER EQUIVALENT IN SNOW COVER  
MILLERS RIVER WATERSHED

1950 - 1976  
(inches)

<u>Month</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>
1 February	2.1	4.2	0.3
15 February	2.7	5.6	0.0
1 March	3.1	7.6	0.0
15 March	3.2	7.7	0.0
1 April	2.0	8.2	0.0
15 April	0.3	4.9	0.0

9. Storms. The North Nashua River Basin experiences storms of four general types, namely:

(1) Extra-tropical continental storms which move across the basin under the influence of the prevailing "westerlies".

(2) Extra-tropical maritime storms which originate and move northward along the eastern coast of the United States.

(3) Storms of tropical origin, some of which attain hurricane magnitude.

(4) Thunderstorms produced by local convective activity or by more general frontal action.

The most severe storms in southern and central New England have been of tropical origin which occur during the late summer and early autumn.

10. Runoff - The U.S. Geological Survey (USGS) has maintained a continuous record of streamflow on the North Nashua River in Leominster since 1935. The drainage area of the river at the site of this gage is 107 square miles and the long-term average flow is 193 cfs, equivalent to an annual runoff from the watershed of 24.7 inches. This represents 58 percent of the annual precipitation. The following tabulation indicates the maximum and minimum values of runoff.

TABLE B-4

ANNUAL RUNOFF  
NORTH NASHUA RIVER NEAR LEOMINSTER

Drainage area = 107 square miles  
(cubic feet per second)

<u>Month</u>	<u>Average</u>		<u>Maximum</u>		<u>Minimum</u>	
	(cfs)	(inches)	(cfs)	(inches)	(cfs)	(inches)
January	205.5	2.23	465	5.05	50.9	0.55
February	215.7	2.12	534	5.24	88.8	0.87
March	372.8	4.05	1289	14.00	140.0	1.52
April	422.5	4.44	868	9.13	154.0	1.62
May	242.7	2.64	450	4.89	85.4	0.93
June	155.5	1.63	393	4.13	64.3	0.68
July	91.1	0.99	392	4.26	42.9	0.47
August	75.1	0.82	286	3.11	38.1	0.41
September	90.6	0.95	595	6.26	38.9	0.41
October	95.8	1.04	606	6.58	39.4	0.43
November	155.6	1.64	485	5.10	44.4	0.62
December	190.8	2.07	429	4.66	58.6	0.64
Annual	192.8	24.66	307	39.27	81.2	10.39

RECENT FLOOD HISTORY

11. General. Floods in the North Nashua River occur during any season of the year as a result of either intense rainfall over the watershed or from rainfall in conjunction with melting snow. However, the largest floods have developed from intense rainfall associated with tropical storms. Since flow records have been maintained, the North Nashua River has experienced three notable high flows. These occurred in March 1936, September 1938 and October 1955. All three high flows were generally produced by about 4 to 6 inches of rainfall in about a 24-hour period.

The following paragraphs are a discussion of recent significant flood producing storms experienced along the North Nashua River. Peak discharges for these floods are also included for reference below.

TABLE B-5

PEAK FLOWS, NORTH NASHUA RIVER

<u>Location</u>	<u>Fitchburg</u>		<u>Leominster</u>		
Drainage Area, sq. miles	63.7		107		
<u>Date</u>	<u>Peak Discharges</u>				<u>Runoff</u>
	(cfs)	(csm)	(cfs)	(csm)	(inches)
18 Mar 1936	9,400	149	16,300	152	4.0
21 Sep 1938	8,900	141	10,300	96	4.7
15 Oct 1955	7,800	124	8,870	83	5.0

a. March 1936 Flood. The greatest recorded flow on the North Nashua River at the Leominster gage was 16,300 cfs and occurred as a result of two consecutive storms during March 1936. Intermittent periods of moderate to heavy rainfall during the month, combined with considerable snowmelt, produced two distinct high flows. The first rise, occurring on the 12th, was largely the result of runoff from melting snow with some contribution from moderate rainfall which averaged about 3 inches over the basin during the period 9-13 March. A second storm period, between the 16th and 19th, produced the record flow on the North Nashua River. This peak resulted from intense rainfall, which averaged about 5.5 inches, with only minor contribution from snowmelt.

b. September 1938 Flood. Another high flow producing event occurred as a result of rainfall associated with the September 1938 hurricane that passed up the Connecticut River valley. The North Nashua basin narrowly missed the brunt of this storm with rainfall amounts of 14 inches occurring a short distance to the west. Rainfall averaged about 7 inches in 18-21 September in the North Nashua basin, with about 4 inches falling in a 24-hour period on the 20th. The resulting peak flow at the Leominster gage was 10,300 cfs and computed peak flow over Arden Mill dam in Fitchburg was about 8,900 cfs.

c. October 1955 Flood. The North Nashua watershed escaped the widespread torrential hurricane rainfall of August 1955, but did experience high flow producing rainfall in October 1955. The October storm resulted from the interaction of a west to east frontal weather system with a coastal low pressure system moving northward. Rainfall in the watershed amounted to about 5 inches in 24 hours on the 15th, based on rainfall records at Sterling, Massachusetts. Total storm rainfall was in the order of 7 inches.

The peak flow of the river at Leominster, as recorded at the gage, was 8,870 cfs. The peak flow at Fitchburg, based on high water data, was estimated to be about 7,800 cfs.

12. Peak Discharge Frequencies. A peak discharge frequency curve was developed for the North Nashua River at Fitchburg by relating the computed frequency statistics of the flow records for the North Nashua River at Leominster through comparison of common flood events at the two locations. The frequency curve at Leominster was developed by statistical analysis of the annual peak flows using a Log Pearson Type III distribution. The developed frequency curves are shown on Plate B-3.

13. Design Flood. The channel rehabilitation project basically restores the integrity of the channel to its original design capacity of about 9,000 cfs which is nearly equivalent to the discharge of the March 1936 flood of record.

#### OPERATION

14. General. The Fitchburg Channel Rehabilitation Project requires no direct operation.

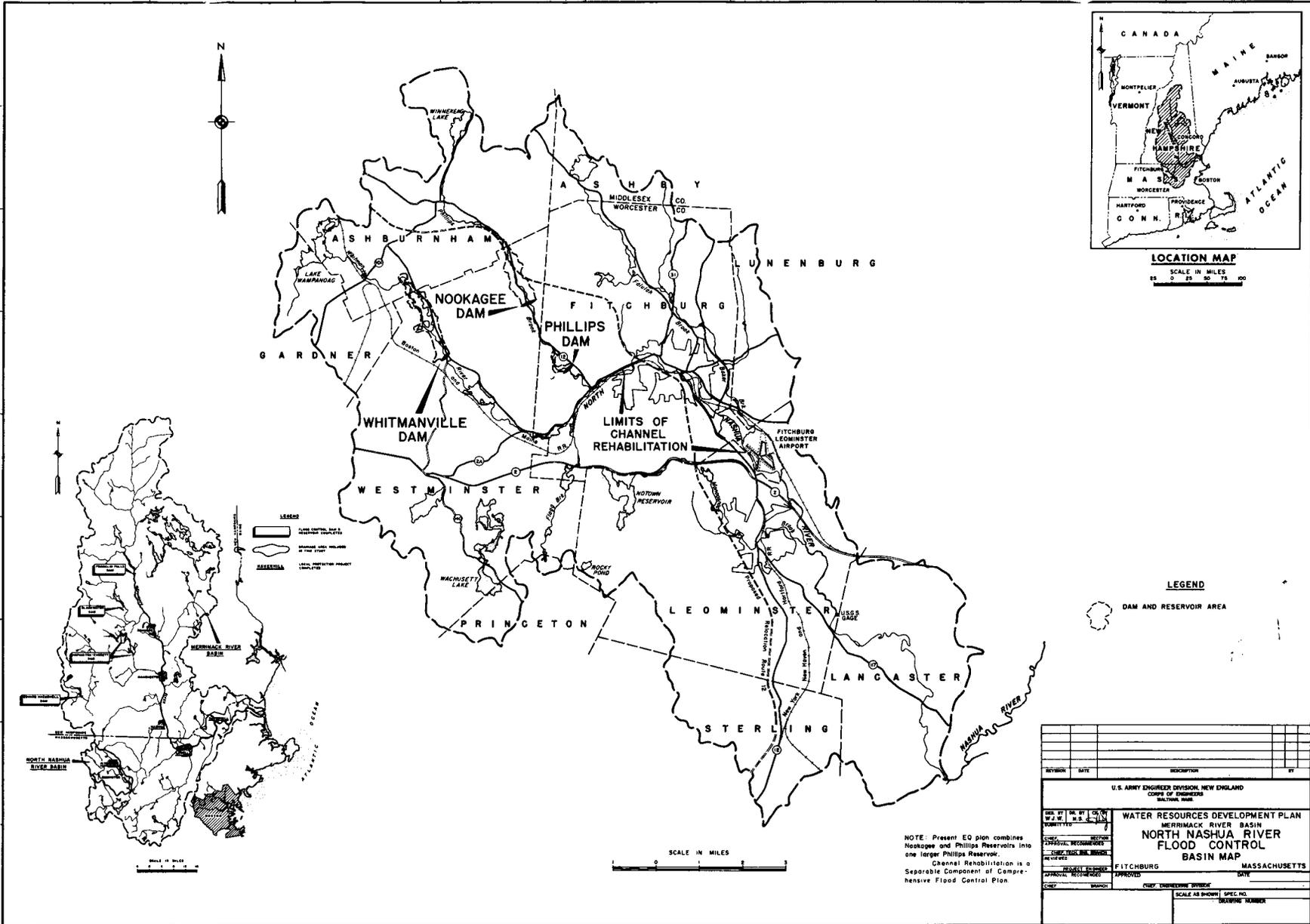
#### OPERATIONAL CONSIDERATIONS

15. General. The Fitchburg Channel Rehabilitation Project provides flood protection from the North Nashua River flooding within the limits of this design, and its effectiveness is contingent upon proper maintenance and operations. Factors which must be considered in anticipating the operation of this project are:

a. The channel must be kept clear of flow obstructions in order that it may carry full design capacity.

b. All culverts and bridges should be clear of flow obstructions which might collect behind them hence restricting flow.

16. Emergency Measures. The superintendent shall take immediate action to correct any condition which endangers the stability of the walls. All such measures taken will be reported to the Division Engineer immediately after the flood period.



**LOCATION MAP**  
 SCALE IN MILES  
 0 25 50 75 100

**LEGEND**

DAM AND RESERVOIR AREA

REVISION	DATE	DESCRIPTION	BY
U. S. ARMY ENGINEER DIVISION, NEW ENGLAND CORPS OF ENGINEERS MILITARY DISTRICT			
COMMITTED CHECKED DESIGNED DRAWN REVISIONS	<b>WATER RESOURCES DEVELOPMENT PLAN</b> NERRIMACK RIVER BASIN <b>NORTH NASHUA RIVER</b> <b>FLOOD CONTROL</b> <b>Basin Map</b>		MASSACHUSETTS DATE
PROJECT ENGINEER APPROVAL RECOMMENDED CHECK	FITCHBURG	APPROVED CHIEF ENGINEERING DISTRICT	SCALE AS SHOWN DRAWING NUMBER

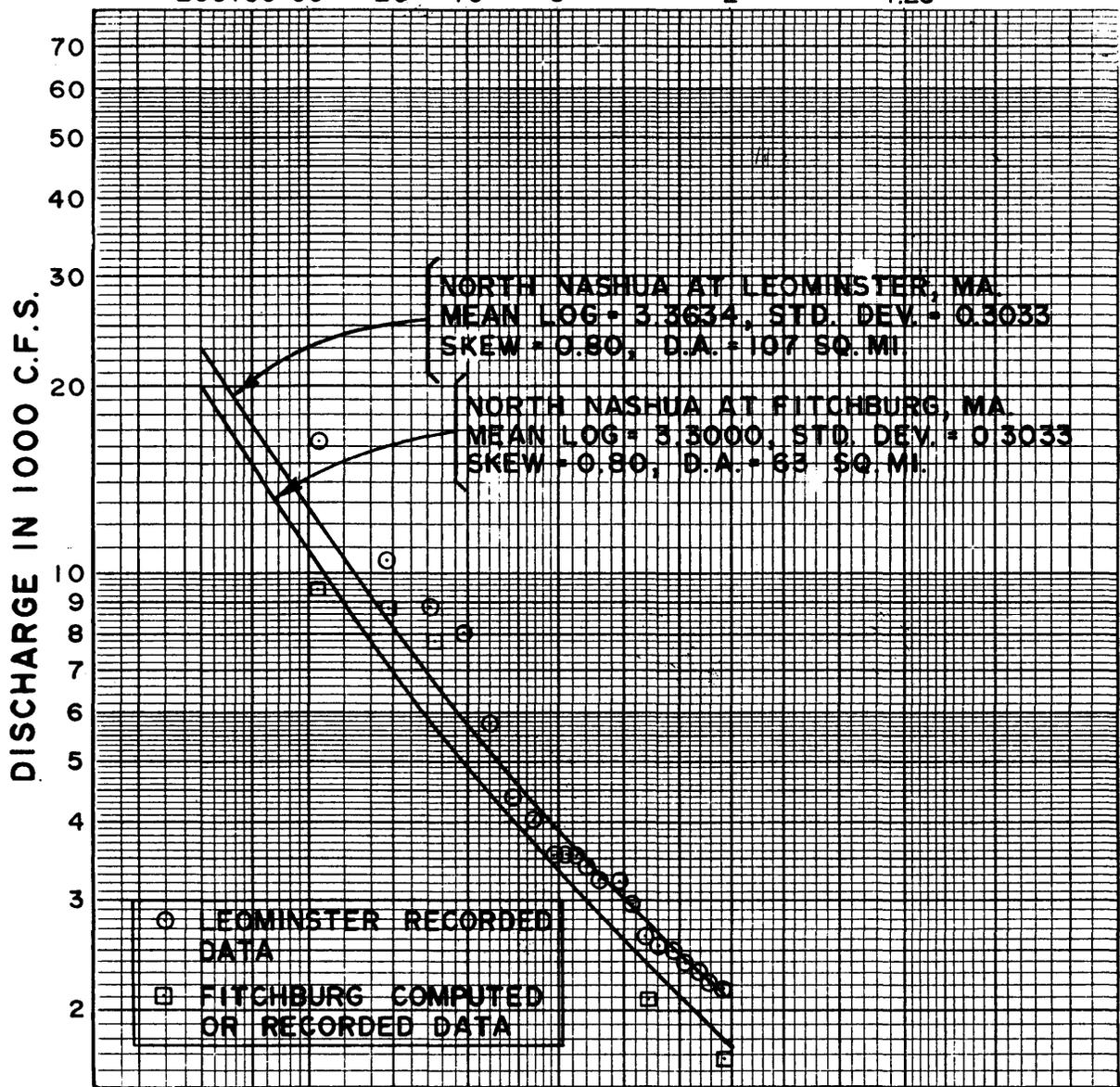
NOTE: Present ED plan combines Nookagee and Phillips Reservoirs into one larger Phillips Reservoir. Channel Rehabilitation is a Separable Component of Comprehensive Flood Control Plan.

Plate B-1



# AVERAGE RECURRENCE INTERVAL IN YEARS

200 100 50 20 10 5 2 1.25



PERCENT CHANCE OF OCCURRENCE IN ANY ONE YEAR

WATER RESOURCES DEVELOPMENT PLAN  
 MERRIMACK RIVER BASIN  
 NORTH NASHUA RIVER WATERSHED  
 PEAK DISCHARGE FREQUENCY CURVES  
 NEW ENGLAND DIVISION, WALTHAM, MASS.

APPENDIX C

ASSURANCES OF LOCAL COOPERATION

AGREEMENT BETWEEN  
THE UNITED STATES OF AMERICA  
AND  
THE COMMONWEALTH OF MASSACHUSETTS  
FOR LOCAL COOPERATION AT  
NORTH NASHUA RIVER CHANNEL IMPROVEMENT PROJECT  
FITCHBURG, MASSACHUSETTS

THIS AGREEMENT entered into this 25<sup>th</sup> day of April, 1979  
by and between the UNITED STATES OF AMERICA (hereinafter called the  
"Government"), represented by the Contracting Officer executing the agree-  
ment, and the COMMONWEALTH OF MASSACHUSETTS (hereinafter called the  
"Commonwealth"), acting by and through the DEPARTMENT OF ENVIRONMENTAL  
QUALITY ENGINEERING, with the consent of the Governor, WITNESSETH THAT:

WHEREAS, construction of the Channel Improvement Project on the North  
Nashua River; Fitchburg, Massachusetts (hereinafter called the "Project")  
was authorized by the Flood Control Act of 1966, approved 7 November 1966,  
Public Law 89-789, 89th Congress, 2nd Session, substantially in accordance  
Senate Document No. 113, 89th Congress; and

WHEREAS, the Commonwealth hereby represents that it has the authority  
and capability to furnish the non-Federal cooperation required by the  
Federal legislation authorizing the Project and by other applicable law.

NOW, THEREFORE, the parties agree as follows:

1. The Commonwealth agrees that, if the Government shall commence construction of the North Nashua River Channel Improvement Project, Fitchburg, Massachusetts, substantially in accordance with Federal legislation authorizing such Project, Public Law 89-789, Title II, Section 203, the Commonwealth shall, in consideration of the Government commencing construction of such Project, fulfill the requirement of non-Federal cooperation in such legislation, to wit:

a. Provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction of the projects; provide necessary relocations and alterations to highways, roads, and highway bridges; relocate all utilities; and construct necessary interior drainage ditches.

b. Hold and save the United States free from damages due to the construction, operation, and maintenance of the project except damages due to the fault of the United States or its contractors.

c. Maintain and operate the project after completion in accordance with regulations prescribed by the Secretary of the Army.

d. Prevent encroachments on improved channels.

e. Comply with requirements of non-Federal cooperation specified in Sections 210 and 305 of Public Law 91-646, approved 2 January 1971, entitled the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970".

2. The Commonwealth hereby gives the Government a right to enter upon, at reasonable times and in a reasonable manner, lands which the Commonwealth owns or controls, for access to the Project for the purpose of inspection and for the purpose of completing, operating, repairing and maintaining the Project, if such inspection shows that the Commonwealth for any reason is failing to complete, repair and maintain the Project in accordance with the assurances hereunder and has persisted in such failure after a reasonable notice in writing by the Government delivered to Commonwealth officials. No completion, operation, repair and maintenance by the Government in such event shall operate to relieve the Commonwealth of responsibility to meet its obligations as set forth in paragraph 1 of this Agreement, or to preclude the Government from pursuing any other remedy at law or equity.

3. This Agreement is subject to the approval of the Secretary of the Army.

IN WITNESS WHEREOF, the parties hereto have executed this contract as of the day and year first above written.

THE UNITED STATES OF AMERICA

BY *John P. Chandler*  
JOHN P. CHANDLER  
Colonel, Corps of Engineers  
Division Engineer  
Contracting Officer

For The Secretary of the Army

Date 1 May 1979

THE COMMONWEALTH OF MASSACHUSETTS  
DEPARTMENT OF ENVIRONMENTAL  
QUALITY ENGINEERING

BY *Thomas F. Cortese*  
For ANTHONY D. CORTESE, Sc. D.  
Commissioner

Date 2-14-79

APPROVED: \_\_\_\_\_  
  
\_\_\_\_\_  
~~For the Secretary of the Army~~

APPROVED:  
*Edward J. King*  
Governor

I have reviewed the foregoing Agreement and have considered the effect of Section 221 of the Flood Control Act of 1970, Public Law 91-611, and I am satisfied that the Commonwealth can fully comply with the provisions of said Agreement.

4/27/79 *Francis K. Bellotti*  
FRANCIS K. BELLOTTI  
Attorney General

CERTIFICATION

I, *Michael J. Connolly* , certify that I am Secretary of the Commonwealth, that *Thomas F. McLaughlin* who signed this Agreement on behalf of the Commonwealth, was then <sup>Acting</sup> Commissioner of Environmental Quality Engineering; that said Agreement was duly signed for and on behalf of the Commonwealth, and that said Agreement is within the scope of his powers; and that Francis X. Bellotti was Attorney General of the Commonwealth at the time of his certification of this Agreement.

I further certify that *Edward J. King* was Governor of this Commonwealth at the time of his approval of this Agreement.

*Michael Joseph Connolly*

---

Secretary of the Commonwealth

(Commonwealth Seal)



AGREEMENT BETWEEN  
THE COMMONWEALTH OF MASSACHUSETTS  
AND  
THE CITY OF FITCHBURG  
FOR LOCAL COOPERATION AT  
NORTH NASHUA RIVER CHANNEL IMPROVEMENT PROJECT  
FITCHBURG, MASSACHUSETTS

THIS AGREEMENT entered into this 25th day of April  
1970 by and between THE COMMONWEALTH OF MASSACHUSETTS (hereinafter  
called the "State"), acting by and through the Department of  
Environmental Quality Engineering, and THE CITY OF FITCHBURG  
(hereinafter called the "City"), acting by and through the Mayor,  
with the consent of the City Council,

WITNESSETH THAT:

WHEREAS, construction of the Channel Improvement Project on  
the North Nashua River, Fitchburg, Massachusetts (hereinafter  
called the "Project") was authorized by the Flood Control Act of  
1960, approved 7 November 1966, Public Law 89-720, 89th Congress,  
2nd Session, substantially in accordance with Senate Document  
No. 113, 89th Congress; and

WHEREAS, the State is entering into a similar agreement for  
local cooperation at the Project with the United States of  
America (hereinafter called the "Government") and

WHEREAS, the City hereby represents that it has the  
authority and capability to furnish the non-federal cooperation  
required by the Federal legislation authorizing the Project and  
by other applicable law.

NOW, THEREFORE, the parties agree as follows:

1. The City agrees that, if the Government shall commence construction of the North Nashua River Channel Improvement Project, Fitchburg, Massachusetts, substantially in accordance with Federal legislation authorizing such Project, Public Law 89-789, Title II, Section 203, the City shall, in consideration of the State's entering into said similar agreement for local cooperation with the Government, which is incorporated herein by reference and made a part hereof, fulfill the requirements of non-Federal cooperation in such legislation, to wit:

a. Provide without cost to the State all lands, easements, and rights-of-way necessary for the construction of the projects; provide necessary relocations and alterations to highways, roads, and highway bridges; relocate all utilities; and construct necessary interior drainage ditches.

b. Hold and save the State free from damages due to the construction, operation, and maintenance of the project except damages due to the fault of the State or its contractors.

c. Maintain and operate the project after completion in accordance with regulations prescribed by the Secretary of the Army.

d. Prevent encroachments on improved channels.

e. Comply with requirements of non-Federal cooperation specified in Sections 210 and 305 of Public Law 91-646, approved 2 January 1971, entitled the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970".

2. The City hereby gives the State a right to enter upon,

at reasonable times and in a reasonable manner, lands which the City owns or controls, for access to the Project for the purpose of inspection and for the purpose of completing, operating, repairing and maintaining the Project, if such inspection shows that the City for any reason is failing to complete, repair and maintain the Project in accordance with the assurances hereunder and has persisted in such failure after a reasonable notice in writing by the State delivered to City officials. No completion, operation, repair and maintenance by the State in such event shall operate to relieve the City of responsibility to meet its obligations as set forth in paragraph 1 of this Agreement, or to preclude the State from pursuing any other remedy at law or equity.

3. This Agreement is subject to the approval of the Department of the Attorney General.

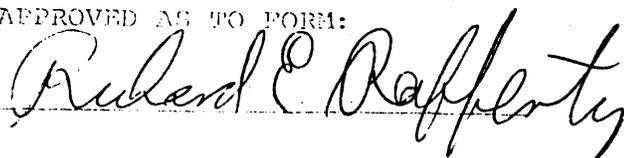
IN WITNESS WHEREOF, the parties hereto have executed this agreement as of the day and year first above written.

CITY OF FITCHBURG

  
\_\_\_\_\_  
Mayor

  
\_\_\_\_\_  
Commissioner, Department of  
Environmental Quality Engineering

APPROVED AS TO FORM:

  
\_\_\_\_\_  
Richard C. Rafferty

CERTIFICATION

I, *Marion M. Smith*, certify that I am City Clerk, that *David M. Gilman* who signed this Agreement on behalf of the City, was then Mayor of the City of Fitchburg; that said Agreement was duly signed for and on behalf of the City, and that said Agreement is within the scope of his powers.

*Marion M. Smith*

---

City Clerk

(City Seal)

APPENDIX D  
INSPECTION REPORT FORM

# LOCAL FLOOD PROTECTION PROJECT INSPECTION REPORT

**Project:**

**Maintaining Agency:**

**Type Inspection:** \_\_\_\_\_ Semi-Annual Staff \_\_\_\_\_ 90 Day Interim

**River Basin:**

**Date of Inspection**

Feature	Sat	Unsat	Deficiencies
<b>PUMPING STATIONS - STRUCTURES</b>			<b>N/A</b>
INTERIOR			
EXTERIOR			
<b>PUMPS - MOTORS - ENGINES</b>			<b>N/A</b>
TRIAL OPERATED			
GENERAL CONDITION			
POWER SOURCE			
INSULATION TESTS			
METAL INTAKES/OUTLETS			
GATE VALVES			
<b>GATES - DRAINAGE STRUCTURES</b>			<b>N/A</b>
TRIAL OPERATED			
GENERAL CONDITION			
LUBRICATION			
<b>DIKES - DAMS</b>			
GENERAL CONDITION			
SLOPES/EROSION			
SAND BOILS/CAVING			
TRESPASSING			
SLOPE PROTECTION			
DRAINS			
<b>STOP-LOGS - LOG BOOM</b>			<b>N/A</b>
CONDITION OF LOGS			
AVAILABILITY OF LOGS			
HIGHWAY SLOTS			
STORAGE FACILITIES			
<b>CHANNELS - OUTLET WORKS CHANNEL</b>			
BANKS			
OBSTRUCTION CONTROL			



DESIGNATION OF SUPERINTENDENT

Name of Project: \_\_\_\_\_

Location: \_\_\_\_\_

MAINTAINING MUNICIPAL AGENCY:

Agency: \_\_\_\_\_

Address: \_\_\_\_\_ Tel. No. \_\_\_\_\_

"SUPERINTENDENT" - as required by Section 208.10 (a) (2), Chap II, Title 33 USC

Name & Title: \_\_\_\_\_

Employed by: \_\_\_\_\_

Business Address: \_\_\_\_\_

Business Tel. No.: \_\_\_\_\_

Nights, Sundays, Address: \_\_\_\_\_

Nights, Sundays, Tel. No.: \_\_\_\_\_

Remarks:

Signed: \_\_\_\_\_

Title: \_\_\_\_\_

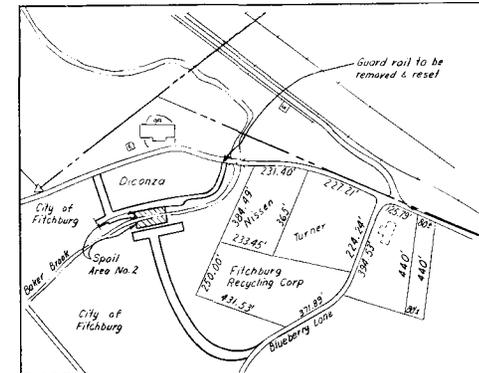
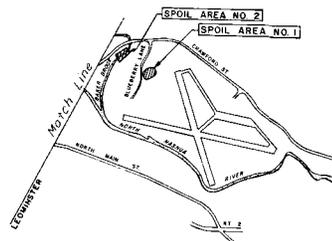
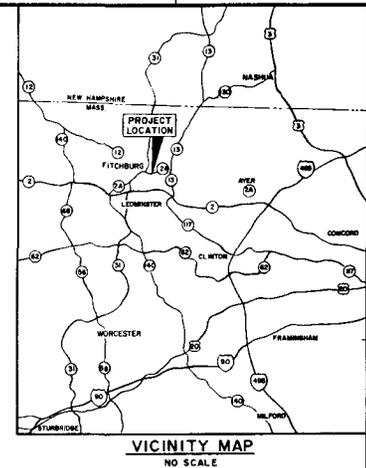
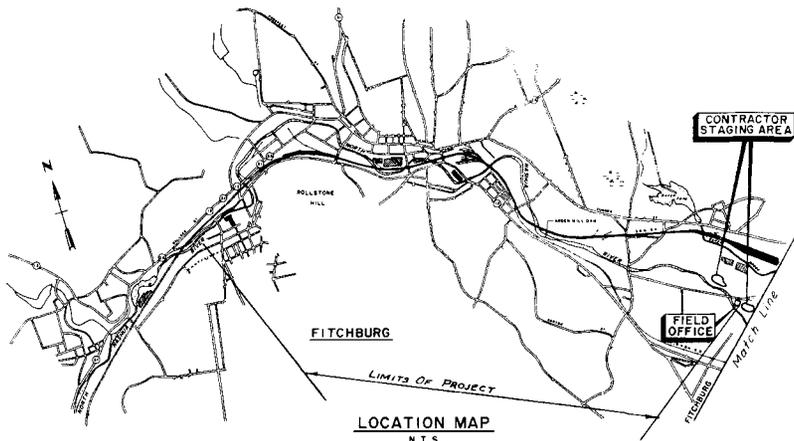
Date: \_\_\_\_\_

NOTE: To be submitted and updated as necessary by the responsible agency which will maintain and operate the works in accordance with regulations prescribed by the Secretary of the Army as required by law (Title 33, Chap. 208, Sec II, USC).

APPENDIX E

PERTINENT DRAWINGS AND PHOTOGRAPHS

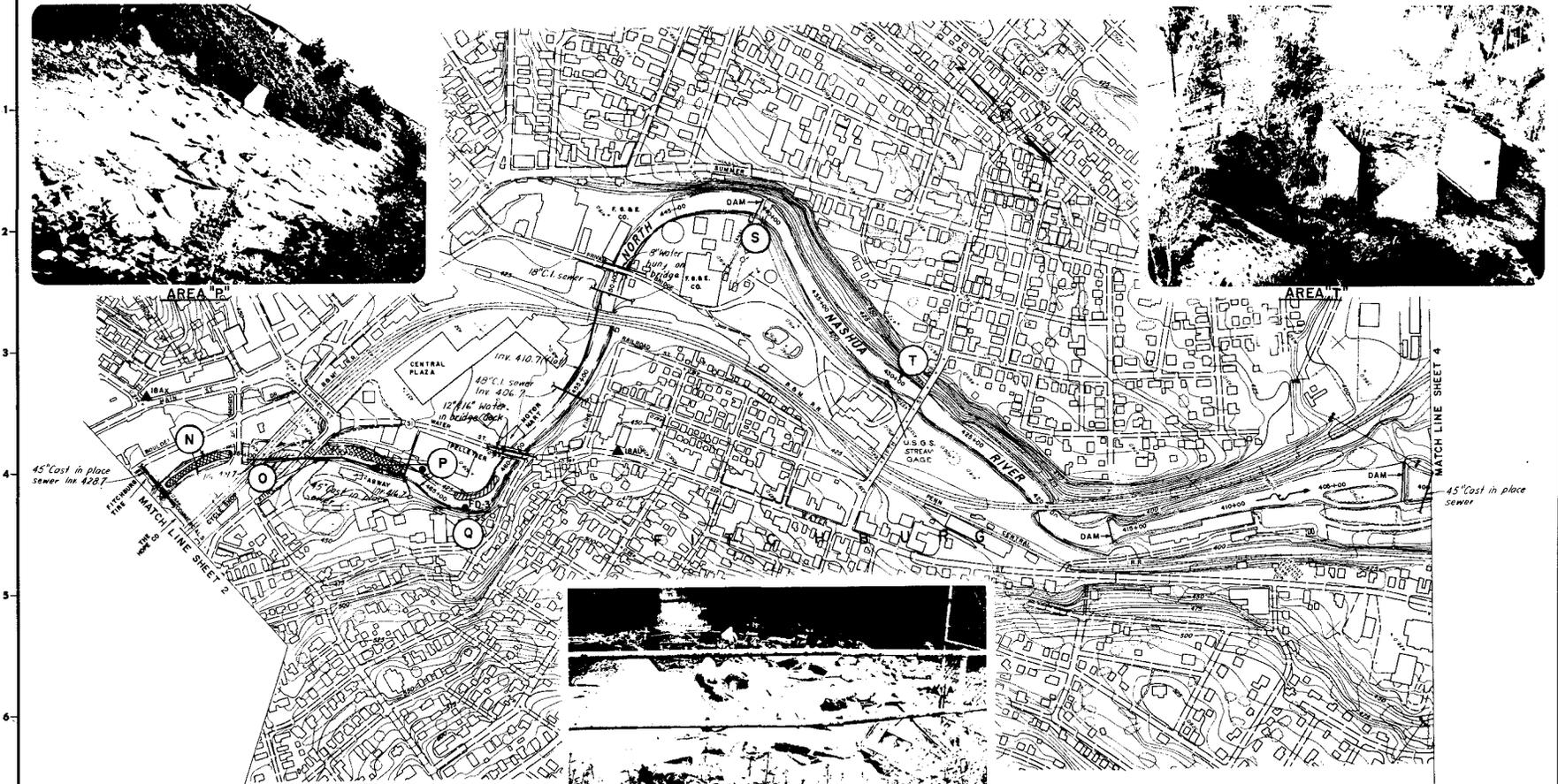
INDEX TO DRAWINGS		
DWG. NO.	SH. NO.	TITLE
MER-34	1	INDEX TO DRAWINGS
MER-34	2	GENERAL PLAN NO. 1
MER-34	3	GENERAL PLAN NO. 2
MER-34	4	GENERAL PLAN NO. 3
MER-34	5	AREA A PLAN AND SECTIONS
MER-34	6	AREAS B AND J PLANS, SECTIONS AND ELEVATION
MER-34	7	AREA F PLAN, SECTION AND ELEVATION
MER-34	8	AREA F WALLS-STRUCTURAL DETAILS
MER-34	9	AREA L PLAN AND SECTION
MER-34	10	AREA M PLAN AND SECTION
MER-34	11	AREA O PLAN, SECTIONS AND ELEVATIONS
MER-34	12	AREA N PLAN, SECTIONS AND ELEVATIONS
MER-34	13	AREAS P AND Q PLANS, SECTIONS AND ELEVATIONS
MER-34	14	AREA V PLAN AND PROFILE
MER-34	15	AREA V SECTIONS
MER-34	16	PLANTING PLAN NO. 1
MER-34	17	PLANTING PLAN NO. 2 AND DETAILS
MER-34	18	TREE REMOVAL PLAN NO. 1
MER-34	19	TREE REMOVAL PLAN NO. 2
MER-34	20	TREE REMOVAL PLAN NO. 3
MER-34	21	HYDROGRAPH
MER-34	22	MISC. PLANS AND SECTIONS-AREAS (C)(D)(H)(I)(S)(U)
DRAWINGS INCLUDED WITH SPECIFICATIONS		
DWG. NO.	SH. NO.	TITLE
STD-36	-	SAFETY SIGN
STD-22A	-	CONSTRUCTION PROJECT SIGN
NED 1009A	-	TREES AND SHRUBS
40-02-03	-	WATERSTOPS - TYPES U & Y



**As Built Drawing**  
Contract No. DACW 33-79-C-0074

DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION CORPS OF ENGINEERS WALTHAM, MASS.			
DESIGNED BY DRAWN BY CHECKED BY DATE	PROJECT NO. DRAWING NO. SHEET NO.	WATER RESOURCES DEVELOPMENT PROJECT FITCHBURG, MASSACHUSETTS NORTH NASHUA RIVER CHANNEL REHABILITATION INDEX TO DRAWINGS	APPROVED BY DATE FEB. 1979
SCALE SPEC. NO. DACW 33-79-C-0074 DRAWING PROJECT		MER-34 SHEET 1	

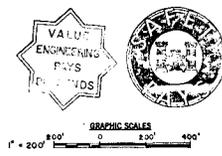




**KEY**

- Ⓐ Cap concrete wall on west bank so that its top elevations will be the same as the top elevations along east bank wall. Provide channel bottom grading. (See sheet No. 13)
- Ⓑ Remove about 250 feet of concrete cribbing at crib sites No. 5 and No. 6, and replace with concrete walls. Remove shoaling. (See sheet No. 11)
- Ⓒ On the east bank, restore approximately 110 feet of wall; remove temporary sand dike and material along base of wall in stream bed. Remove boulders 300' downstream from Laurel St. Bridge. Sandblast wall 129' long, 13' high and in place fence. Remove rubbish from south bank. Remove shoaling. Channel bottom grading. (See sheet No. 13)
- Ⓓ At crib site No. 7, face cribbing with a 1.5 foot thick concrete veneer for a length of 250 feet. (See sheet No. 13)
- Ⓔ Deleted.
- Ⓕ Reset pieces of broken stone boulders downstream of power service dam. (see sheet 22)

- Ⓗ Remove two mid-stream piers to concrete foundation (prior removed foot bridge) immediately upstream of the Fifth Street Bridge. Abutment in east bank to be retained but upper two courses of granite block to be pointed. There are existing high tension lines, an 8' chain link fence and an elevated pipeline on the west bank.

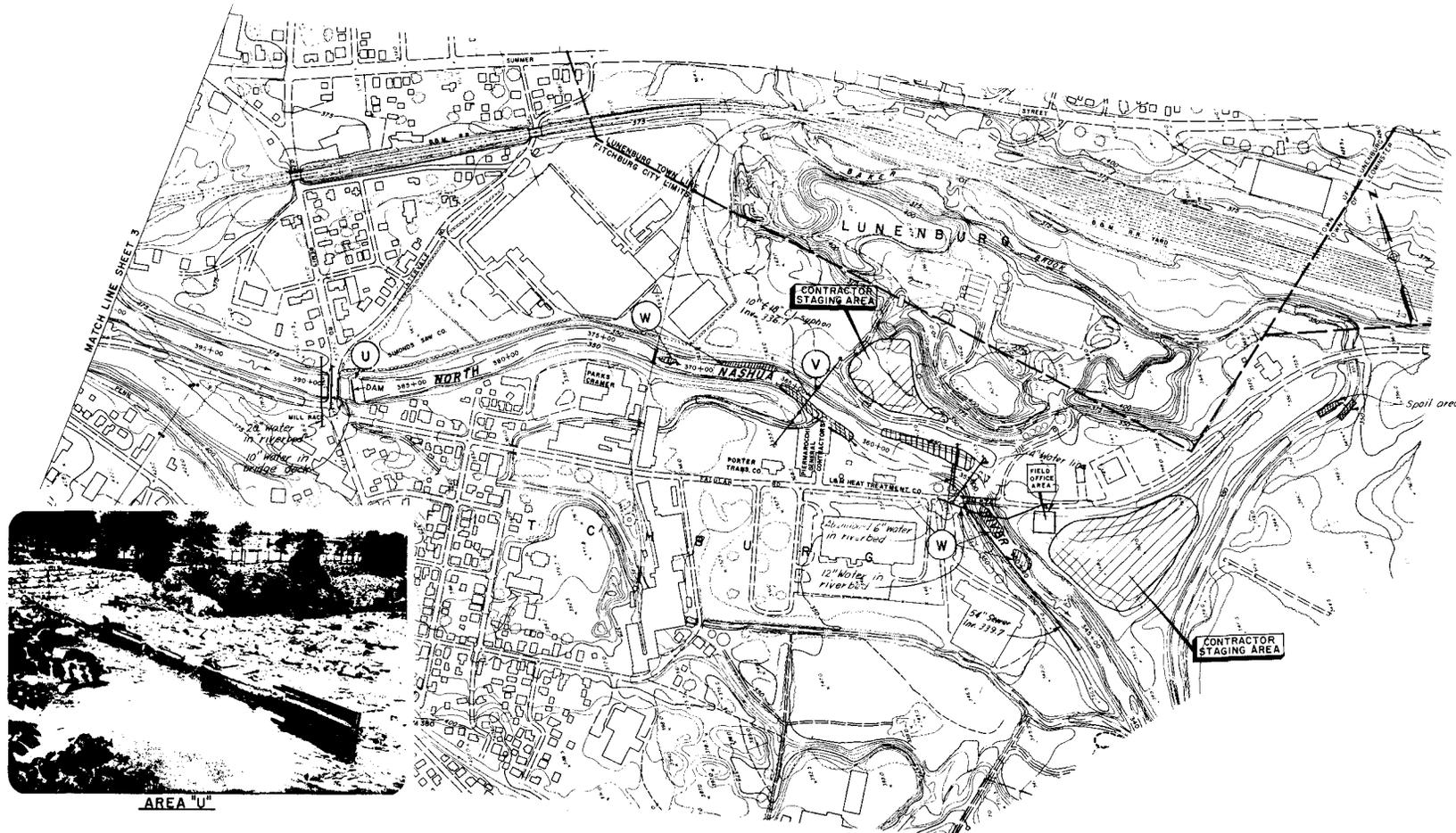


**As Built Drawing**  
Contract No. DACW 33-75-C-0074

REVISION	DATE	Final field corrections	BY

DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION CORPS OF ENGINEERS WALTHAM, MASS.	
COL BY: [Signature] LTJG: [Signature] CAPT: [Signature] MAJOR: [Signature] ENGINEER: [Signature]	WATER RESOURCES DEVELOPMENT PROJECT FITCHBURG, MASSACHUSETTS <b>NORTH NASHUA RIVER                  CHANNEL REHABILITATION                  GENERAL PLAN NO. 2</b> NORTH NASHUA RIVER MASSACHUSETTS APPROVED: [Signature] DATE: FEB. 1979 SPEC. NO. DACW33-75-R-0001 DRAWING NUMBER: MER-34



AREA "U"

**KEY:**

- (U) Reset large broken stones in stream immediately downstream from Benois Road Dam. Plug two gate openings in mill race intake with concrete. (See Sheet 22)
- (V) Restore banks and river bottom by raveling and placing stone protection on both river bank areas. Take out the remains of the existing Japhan Dam and protect the corner of the existing building. Also improve the outlet of the existing canal into the river. Construct up and downstream rock sills to prevent river bottom erosion. (See sheet Nos. 14 & 15)
- (W) Remove shoaling.



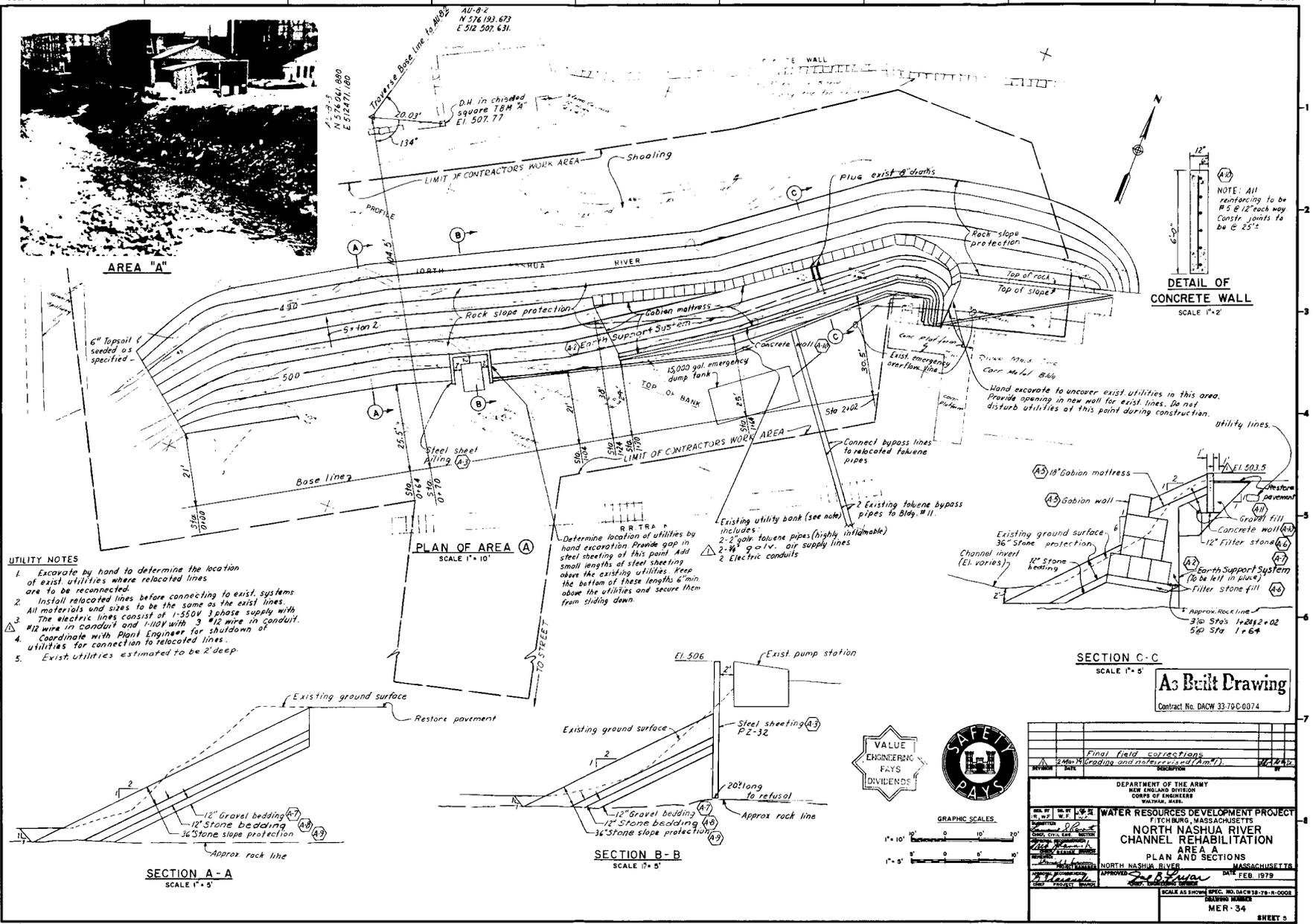
**As Built Drawing**

Cont. 1 No. 646-N 35 79-C-0074

Final field corrections		
DATE	BY	REVISION
1/24/79	W. J. [Signature]	1
DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION CORPS OF ENGINEERS WALTHAM, MASS.		
WATER RESOURCES DEVELOPMENT PROJECT FITCHBURG, MASSACHUSETTS		
NORTH NASHUA RIVER CHANNEL REHABILITATION GENERAL PLAN NO. 3		
NORTH NASHUA RIVER MASSACHUSETTS		DATE: FEB 1979
PROJECT NO. DACW33-79-D-0002		DRAWING NUMBER
MER-34		SHEET 4



AREA "A"



UTILITY NOTES

1. Excavate by hand to determine the location of exist utilities where relocated lines are to be reconnected.
2. Install relocated lines before connecting to exist systems. All materials and sizes to be the same as the exist lines.
3. The electric lines consist of 1-550V 3phase supply with #12 wire in conduit and 1-110V with 3 #12 wire in conduit.
4. Coordinate with Plant Engineer for shutdown of utilities for connection to relocated lines.
5. Exist utilities estimated to be 2' deep.

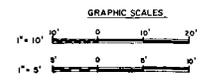
PLAN OF AREA A  
SCALE 1" = 10'

SECTION A-A  
SCALE 1" = 5'

SECTION B-B  
SCALE 1" = 5'

SECTION C-C  
SCALE 1" = 5'

As Built Drawing  
Contract No. DACW 33-76C-0074



DATE	DESCRIPTION	BY	CHKD.
	Final field corrections		
	2nd field grading and notes (A.M.F.)		

DEPARTMENT OF THE ARMY  
NEW ENGLAND DIVISION  
CORPS OF ENGINEERS  
WALTHAM, MASS.

WATER RESOURCES DEVELOPMENT PROJECT  
FITZBURGH, MASSACHUSETTS  
NORTH NASHUA RIVER  
CHANNEL REHABILITATION  
AREA A  
PLAN AND SECTIONS  
NORTH NASHUA RIVER, MASSACHUSETTS

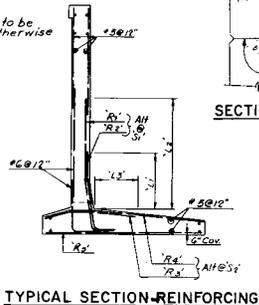
APPROVED: *[Signature]* DATE: FEB 1979  
CHECKED: *[Signature]*

SCALE AS SHOWN SPEC. NO. DAC 13-79-1-0005  
DRAWING NUMBER  
MER-34  
SHEET 5

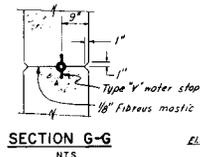




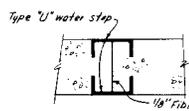
NOTE  
All cover to be 4" unless otherwise noted.



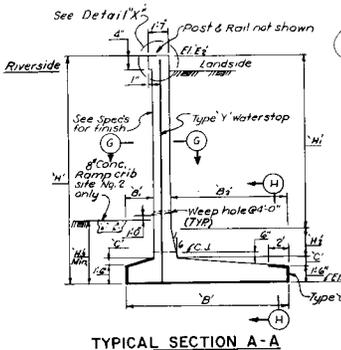
TYPICAL SECTION-REINFORCING



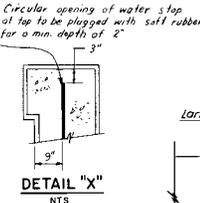
SECTION G-G  
NTS



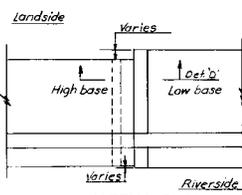
SECTION H-H  
NTS



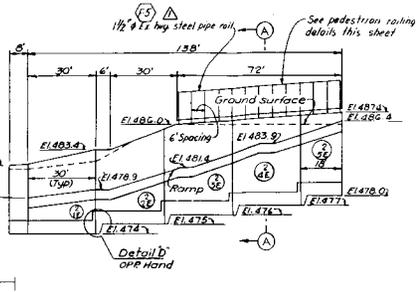
TYPICAL SECTION A-A



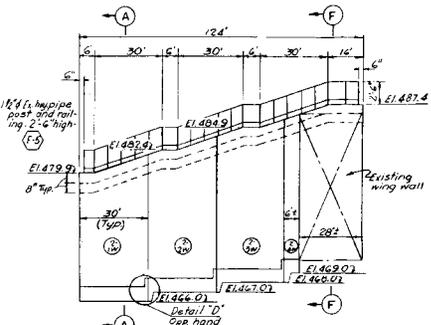
DETAIL "X"  
NTS



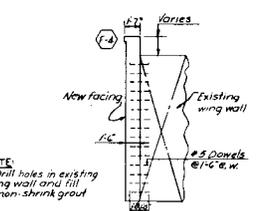
PARTIAL PLAN  
BASE TRANSITION  
SCALE 3/16"=1'-0"



ELEVATION - CRIB SITE NO. 2  
EAST WALL  
SCALE VERT. 1"=5'

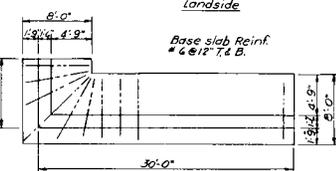


ELEVATION - CRIB SITE NO. 2 - WEST WALL  
SCALE VERT. 1"=5'

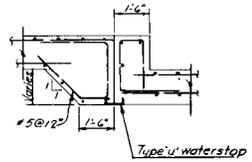


SECTION F-F AT EXISTING WALL  
SCALE 1"=5'-0"

BAR SIZE	MIN. LAP LENGTH FOR BAR SPLICES	TOP BARS	OTHER BARS
3	1'-0"	1'-0"	
4	1'-2"	1'-2"	
5	1'-6"	1'-6"	
6	2'-0"	1'-10"	
7	2'-0"	2'-1"	
8	3'-7"	2'-4"	
9	4'-7"	3'-3"	
10	5'-9"	4'-1"	
11	7'-1"	5'-0"	



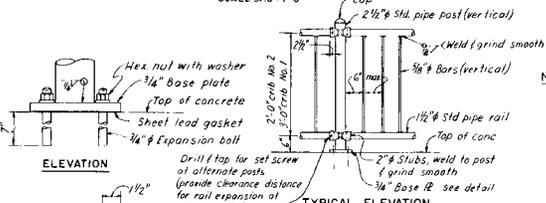
PLAN-MONOLITH-2-1E  
SCALE 3/16"=1'-0"



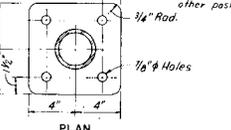
DETAIL "D"  
SCALE 1/2"=1'-0"

NOTES:  
1. See sheet 7 for crib site No. 1 elevation.  
2. Cover range of crib site No. 2 to have 6" #4 @ 12" spaced with fabric w/4" cover top and bottom.

ITEM	CRIB SITE NO. 1					CRIB SITE NO. 2 - WEST					CRIB SITE NO. 2 - EAST				
	MONO 1-1	MONO 1-2	MONO 1-3	MONO 1-4	MONO 1-5	MONO 2-1W	MONO 2-2W	MONO 2-3W	MONO 2-4W	MONO 2-1E	MONO 2-2E	MONO 2-3E	MONO 2-4E	MONO 2-5E	
AREA	18'-0"	19'-0"	20'-0"	20'-0"	17'-0"	18'-11"	16'-11"	17'-11"	17'-5"	9'-5"	10'-6"	10'-6"	10'-0"	9'-0"	
PERIMETER	15'-0"	15'-0"	15'-0"	17'-0"	17'-0"	16'-11"	16'-11"	16'-11"	16'-11"	7'-7"	8'-8"	8'-8"	8'-9"	8'-0"	
VOLUME	17'-3 1/2"	2'-17 1/2"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	
WEIGHT	2'-3"	2'-4"	2'-6"	2'-6"	2'-3"	2'-3"	2'-3"	2'-3"	2'-3"	2'-9"	2'-9"	2'-9"	2'-9"	2'-9"	
REINFORCING	#4	#4	#4	#4	#4	#4	#4	#4	#4	#4	#4	#4	#4	#4	
CONCRETE	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	
STEEL	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	
FORMWORK	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	1.5872	
ELEV.	288.0	288.0	288.0	288.0	288.0	288.0	288.0	288.0	288.0	288.0	288.0	288.0	288.0	288.0	

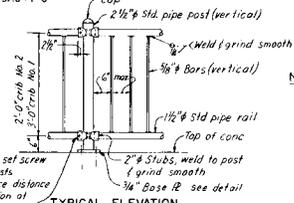


ELEVATION



PLAN

BASE PLATE DETAILS  
SCALE 3/16"=1'-0"



TYPICAL ELEVATION  
SCALE 3/16"=1'-0"

PEDESTRIAN RAILING DETAILS  
SCALE 3/16"=1'-0"



GRAPHIC SCALES



NOTE:  
Provide 4" weep holes 1'-0" above riverside grade, spaced at 4'-0", for all non cantilever and gravity concrete walls of Area F, Area O, and Area P.

As Built Drawing  
Contract No. DACW 33-79-C-0074

Final field corrections

DEPARTMENT OF THE ARMY  
NEW ENGLAND DIVISION  
CORPS OF ENGINEERS  
WALTON MASS

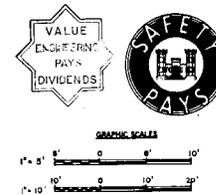
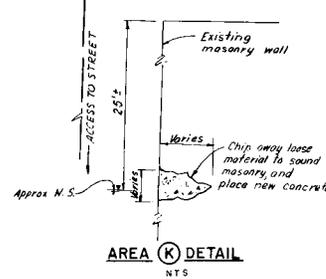
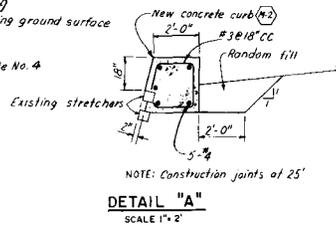
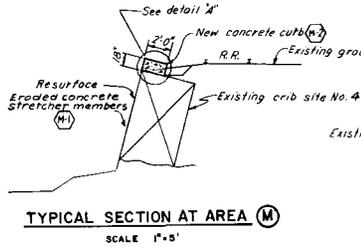
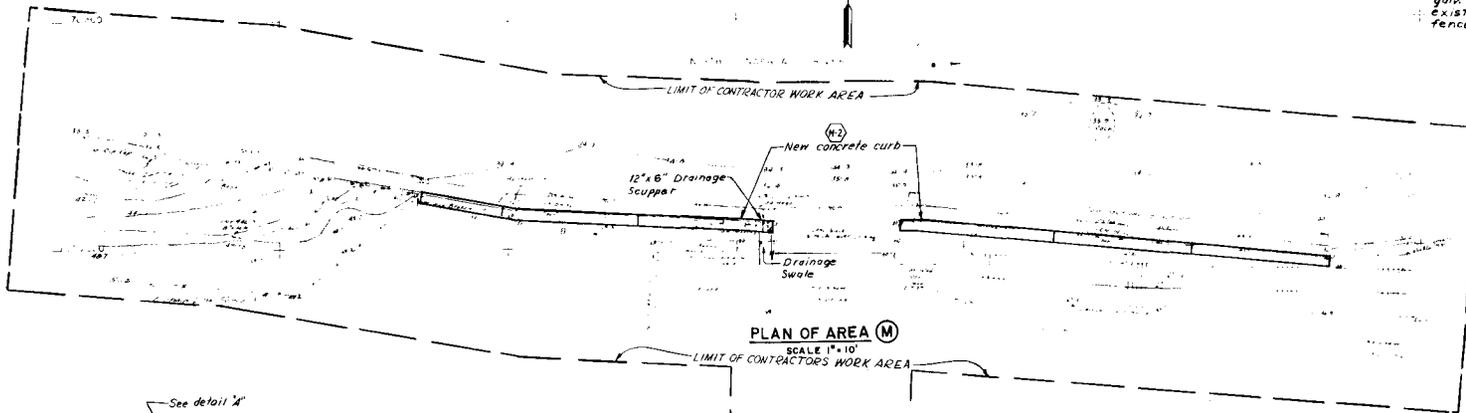
WATER RESOURCES DEVELOPMENT PROJECT  
FITCHBURG, MASSACHUSETTS  
NORTH NASHUA RIVER  
CHANNEL REHABILITATION  
AREA F WALLS  
STRUCTURAL DETAILS  
NORTH NASHUA RIVER  
MASSACHUSETTS

APPROVED: *Joe B. Ryan* DATE: FEB. 1979  
PROJECT: CHANNEL REHABILITATION

SCALE: SPEC NO. DACW 33-79-C-0002  
DRAWING NUMBER: MER-34  
SHEET 8

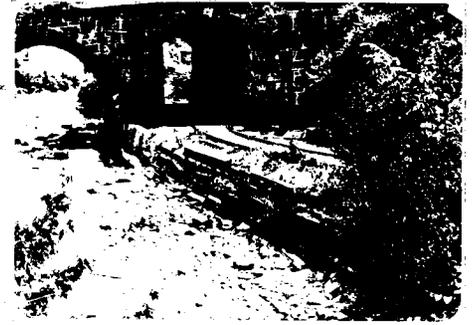
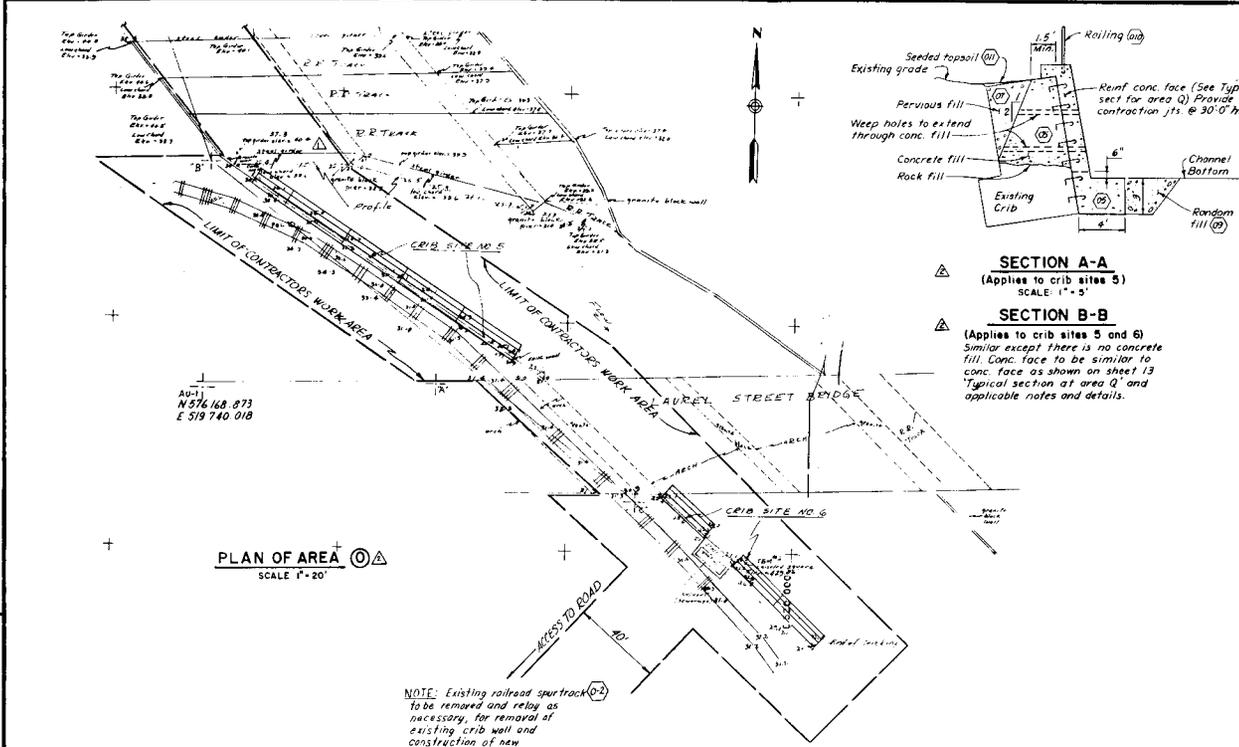


NOTE:  
 Install 4' high vinyl coated chain link fence along top of new conc. wall with galv. chain and snap hook over existing conc. ramp. Anchorage of fence posts to be similar to area "P".

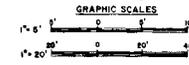
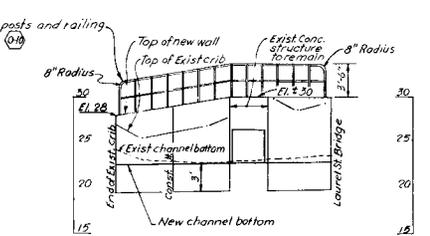
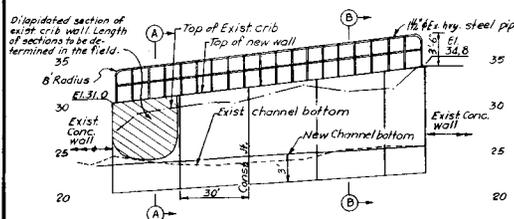


**As Built Drawing**  
 Contract No. DACW 33 79 C-0074

REVISION	DATE	DESCRIPTION
		Final field correction
DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION CORPS OF ENGINEERS WALTHAM, MASS.		
WATER RESOURCES DEVELOPMENT PROJECT FITCHBURG, MASSACHUSETTS <b>NORTH NASHUA RIVER CHANNEL REHABILITATION</b> AREA M PLAN AND SECTION NORTH NASHUA RIVER MASSACHUSETTS		
DATE	APPROVED	BY
FEB. 1979	<i>[Signature]</i>	<i>[Signature]</i>
SCALE AS SHOWN SPEC. NO. DACW33-79-R-0002 REVISION NUMBER		
MER-34		SHEET 10

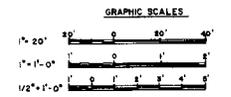
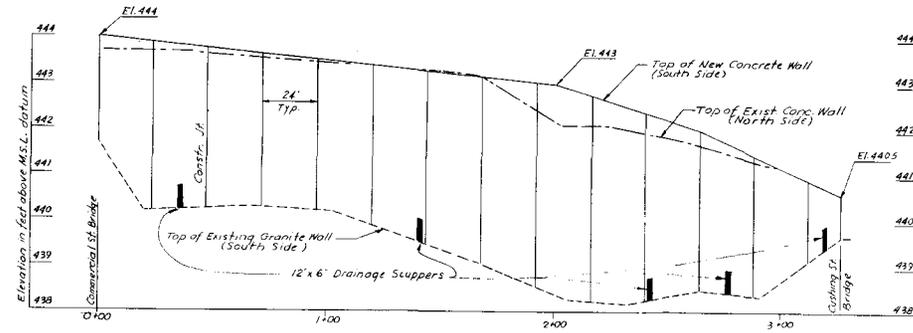
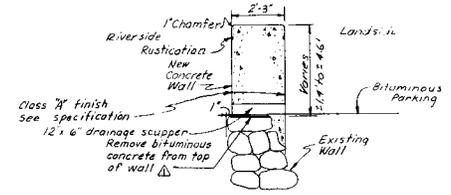
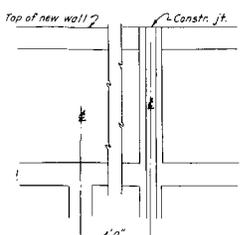
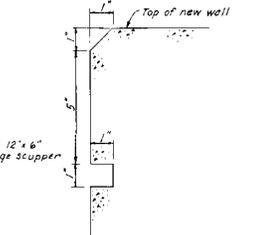
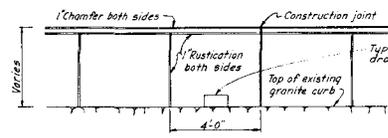
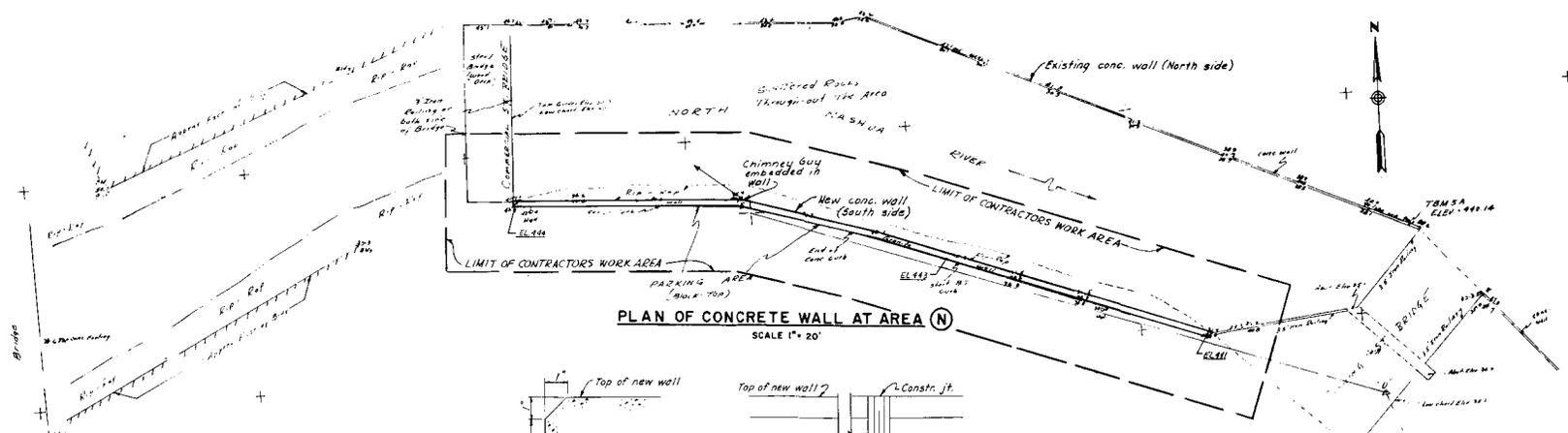


- NOTES:
1. Provide cofferdam on riverside of wall.
  2. Do not use piles driven below the channel bottom for cofferdam.
  3. Remove portion of dilapidated crib, where section A-A applies, to existing rock fill.
  4. Pour fill conc. where rock fill is missing (section A-A only) with weep holes and dowels embedded, as indicated.



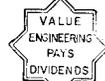
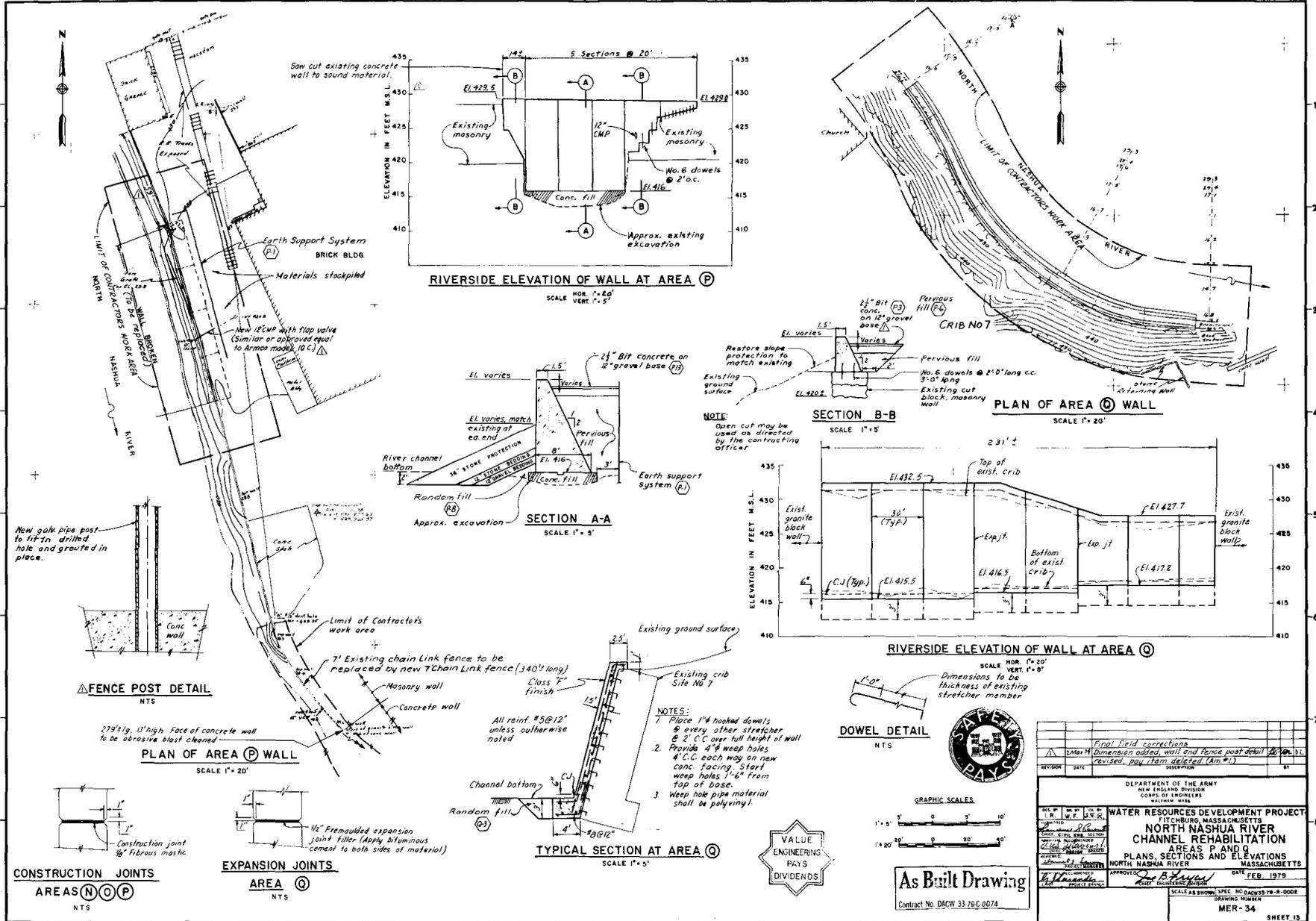
**As Built Drawing**  
Contract No. DACW 3370 C-8074

DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION CORPS OF ENGINEERS FITCHBURG, MASSACHUSETTS	
WATER RESOURCES DEVELOPMENT PROJECT NORTH NASHUA RIVER CHANNEL REHABILITATION AREA Q PLAN SECTIONS AND ELEVATIONS MASSACHUSETTS	
DATE: FEB. 1979	DRAWN BY: J. B. HAYES
SCALE AS SHOWN SPEC. NO. DACW 33-79-8-0008	BRIDGE NUMBER: MER-34
SHEET 11	



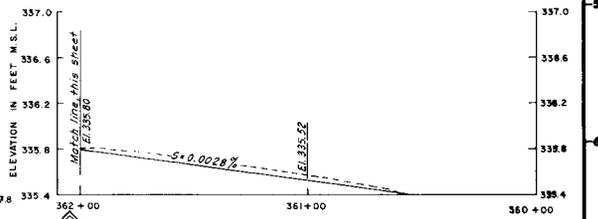
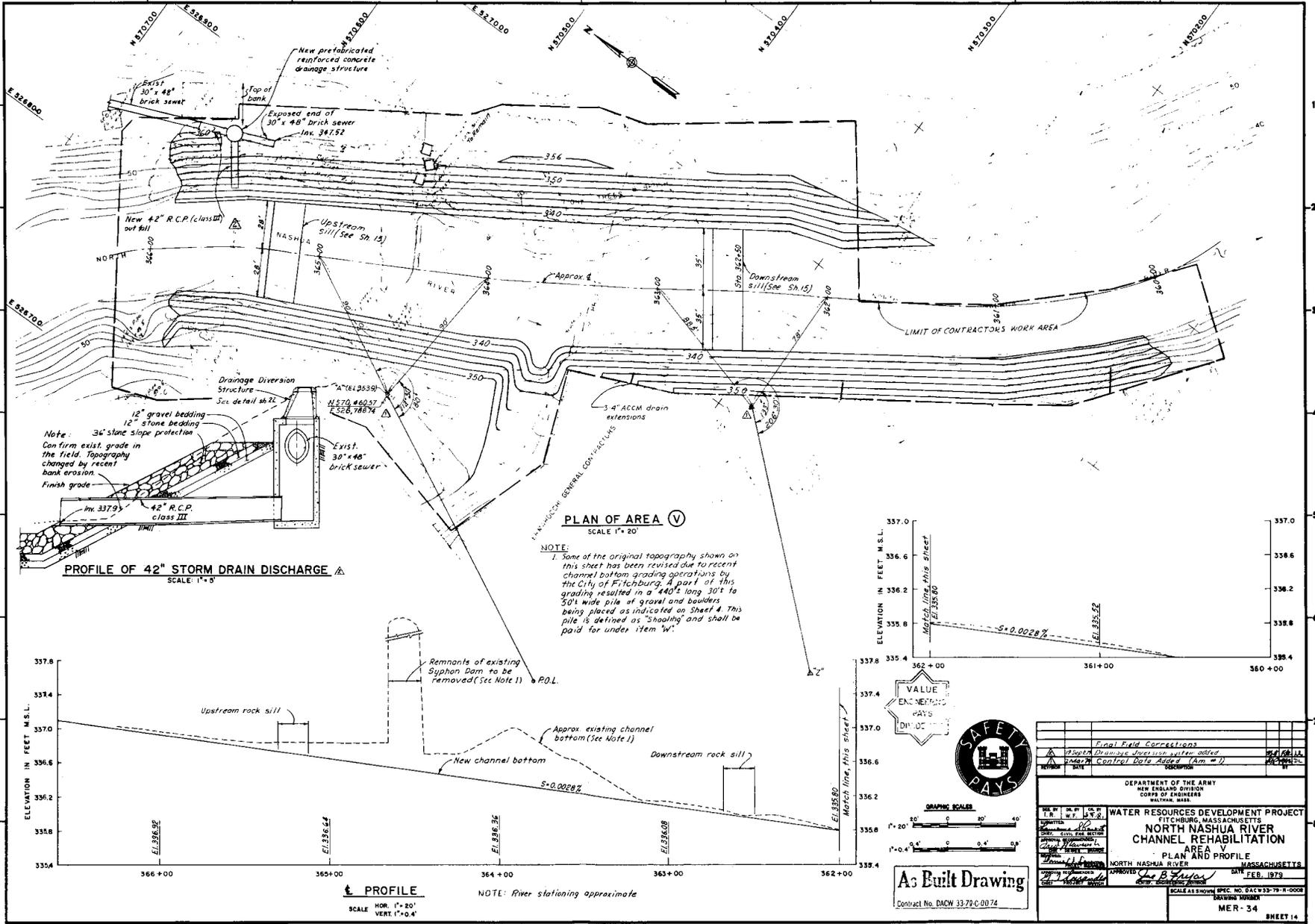
As Built Drawing  
Contract No. DACW 33 79 C 0074

Final field corrections		
REVISION	DATE	DESCRIPTION
1	5/2/79	Note added (Am. #1)
DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION CORPS OF ENGINEERS WATERFAIR, MASS.		
WATER RESOURCES DEVELOPMENT PROJECT FITCHBURG, MASSACHUSETTS NORTH NASHUA RIVER CHANNEL REHABILITATION AREA N PLAN SECTIONS AND ELEVATIONS NORTH NASHUA RIVER		
DATE FEB. 1979	APPROVED: <i>She B. Evans</i> CONF. ASSISTANT ENGINEER	
SCALE AS SHOWN SPEC. NO. DACW 33-79-R-0002		DRAWING NUMBER
MER-34		SHEET 12



As Built Drawing  
Contract No. DACW 33 76-C-0074

DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION CORPS OF ENGINEERS WASHINGTON, D.C.			
WATER RESOURCES DEVELOPMENT PROJECT FITCHBURG, MASSACHUSETTS <b>NORTH NASHUA RIVER</b> <b>AREAS P AND Q</b> PLANS, SECTIONS AND ELEVATIONS NORTH NASHUA RIVER MASSACHUSETTS			
PREPARED BY DRAWN BY CHECKED BY DATE	REVISION DATE DESCRIPTION BY	APPROVED BY DATE	SCALE AS SHOWN SPEC. NO. DACW 33-76-R-0008 DRAWING NUMBER <b>MER-34</b> SHEET 13



**VALUE ENGINEERING PAY'S DIVISION**

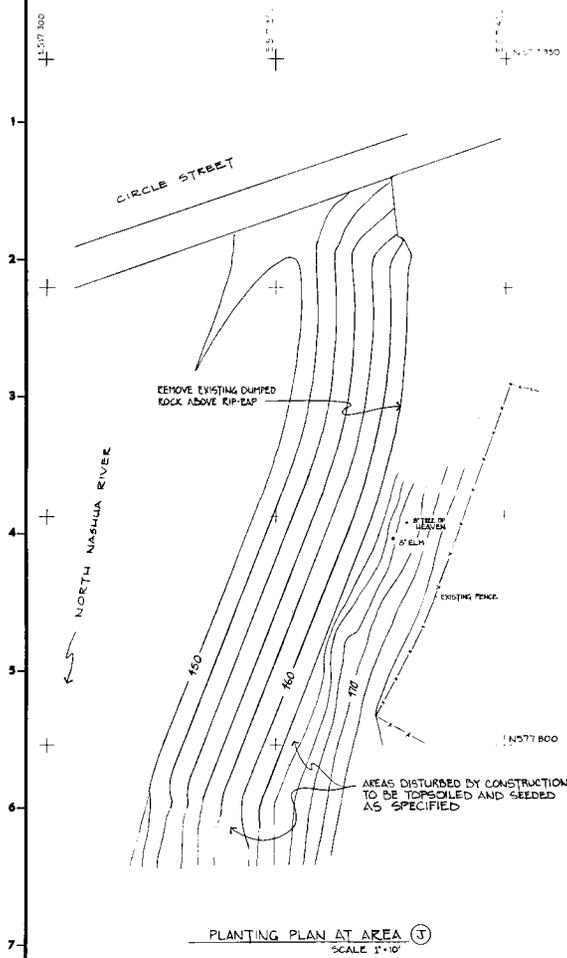
**SAFETY PAYS**

**GRAPHIC SCALES**  
1" = 20'  
1" = 0.4'

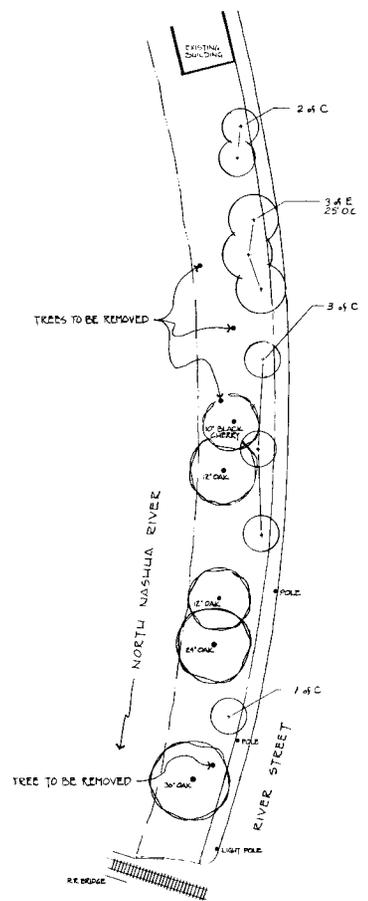
**As Built Drawing**  
Contract No. DACW 3379-C-0074

Final Field Corrections			
Suppl. Drainage Division letter added	1/24/79	LL	
Control Data Added (Am #1)	1/24/79	LL	
REVISION	DATE	BY	CHKD.
DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION CORPS OF ENGINEERS WATER RESOURCES DEVELOPMENT PROJECT FITCHBURG, MASSACHUSETTS <b>NORTH NASHUA RIVER CHANNEL REHABILITATION AREA V PLAN AND PROFILE</b> NORTH NASHUA RIVER MASSACHUSETTS APPROVED: <i>[Signature]</i> DATE: FEB. 1979 DRAWING NUMBER: MER-34 SCALE AS SHOWN SPEC. NO. 67C V33-79-R-0002 SHEET 14			





PLANTING PLAN AT AREA J  
SCALE 1"=10'

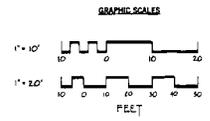


PLANTING PLAN AT STA 567+00 AREA C  
APPROX SCALE 1"=20'

**PLANTING LIST**

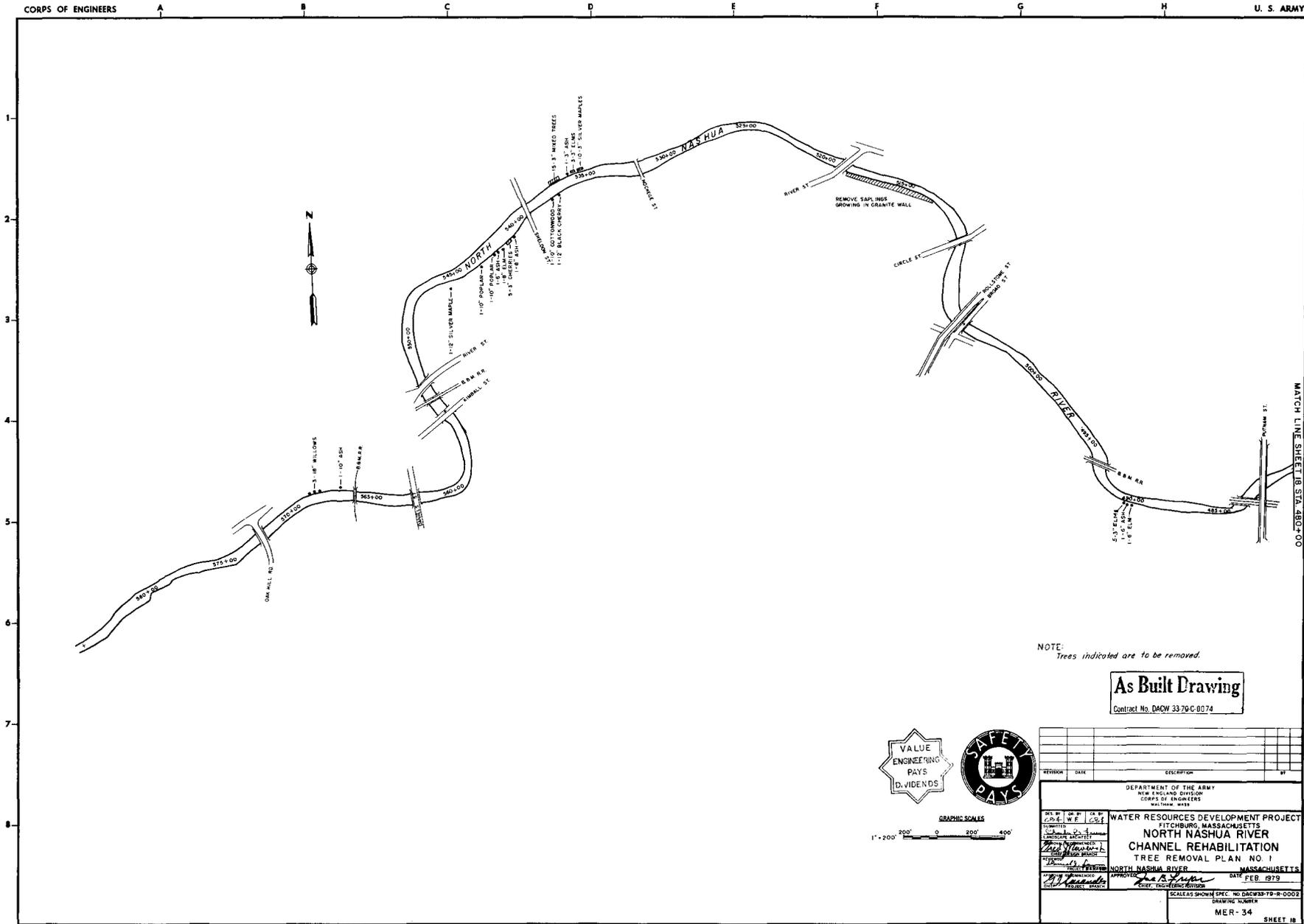
KEY	BOTANICAL NAME	COMMON NAME	QUANT	SIZE	SPACING	REMARKS
A	CORNUS KOUSA	KOUSA DOGWOOD	1	7'8"	-	SPECIMEN PLANTS
B	FORSYTHIA SUSPensa	WEeping FORSYTHIA	143	3'4"	3' O.C.	
C	MALUS ZUMI GALOCARPA	ZUMI CRAB	16	9'10"	14' O.C.	2 1/2'-3' CAL. - WIDE BRANCHING
D	PINUS NIGRA	ALSTRIAN PINE	4	4'5"	-	
E	GLEDITSIA TRIACANTHOS	-	11	-	-	
F	INERNSIA "SHADEMASTER"	"SHADEMASTER" HONEYLOCUST	2	8'14"	-	
G	PARTIENOCISSUS TRICUSPIDATA	BOSTON IVY	25	-	-	3-YEAR, POTTED
H	VIBURNUM AMERICANUM	AMERICAN CRANBERRY BUSH	23	3'4"	5' O.C.	
I	V. OPULUS NANAUM	SWAMP CRANBERRY BUSH	56	12'15"	2' O.C.	

**As Built Drawing**  
Contract No. DACW 33-78-C-0074



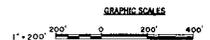
Final Field Connections		REVISION	DATE	QUANTITY OF PLANT KEY 'S' INCREASED FROM 10 TO 11	BY
DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION CORPS OF ENGINEERS WALTHAM, MASS.					
WATER RESOURCES DEVELOPMENT PROJECT FITCHBURG, MASSACHUSETTS <b>NORTH NASHUA RIVER CHANNEL REHABILITATION PLANTING PLAN NO. 1</b>					
PROJECT TITLE: NORTH NASHUA RIVER				APPROVED: <i>[Signature]</i> DATE: FEB 1979	
SCALE				SPEC. NO. DACW33-78-R-0002	
DRAWING NUMBER				MER-34	
SHEET 16					





NOTE:  
Trees indicated are to be removed.

**As Built Drawing**  
Contract No. DAOW 33-79-C-0074



REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY  
NEW ENGLAND DISTRICT  
CORPS OF ENGINEERS  
WALTHAM, MASS.

DESIGNED BY: *[Signature]* CHECKED BY: *[Signature]* DATE: FEB. 1979

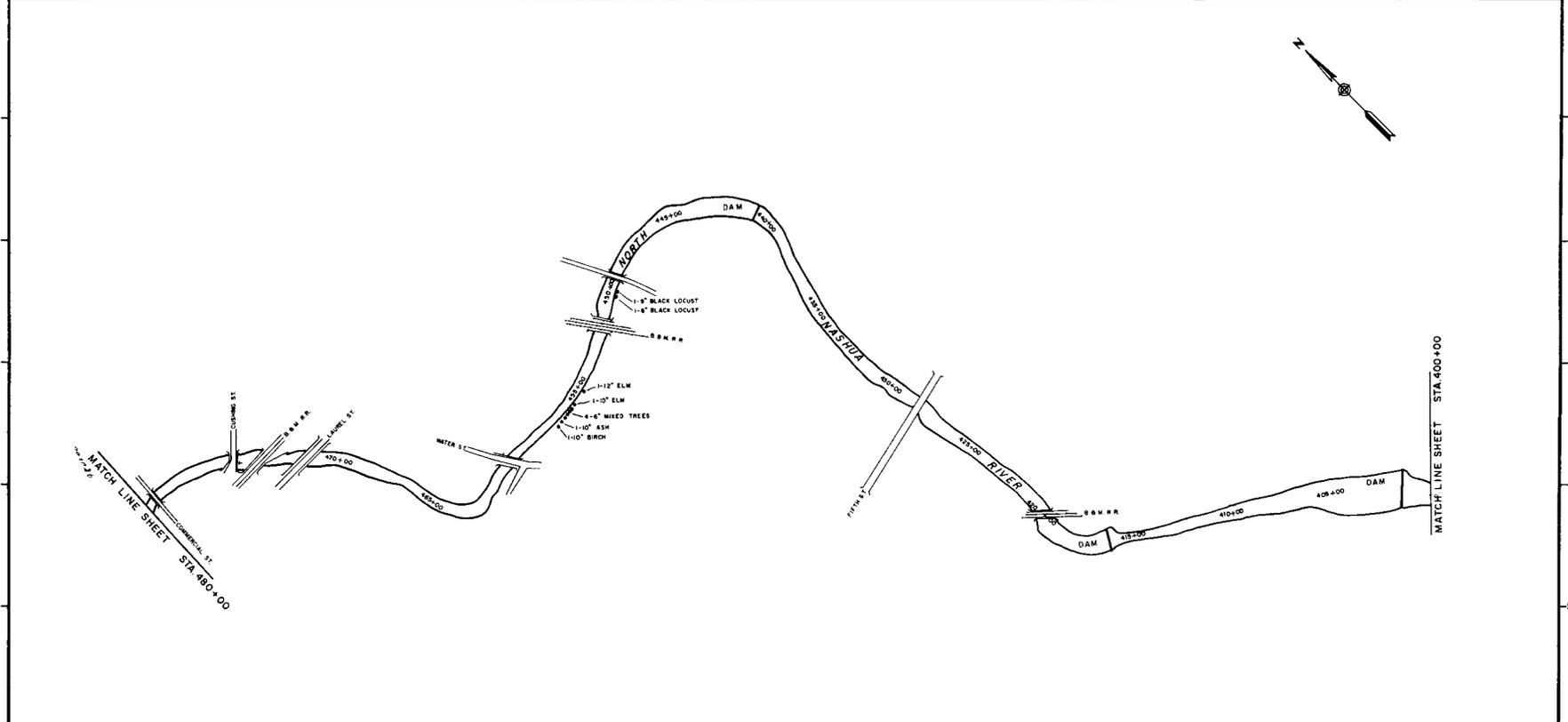
PROJECT: WATER RESOURCES DEVELOPMENT PROJECT  
FITCHBURG, MASSACHUSETTS  
NORTH NASHUA RIVER  
CHANNEL REHABILITATION  
TREE REMOVAL PLAN NO. 1

APPROVED: *[Signature]* DATE: FEB. 1979

SCALE: AS SHOWN SPEC. NO. DACW33-TD-R-0002  
DRAWING NUMBER: MER-34  
SHEET 18

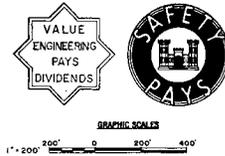
1  
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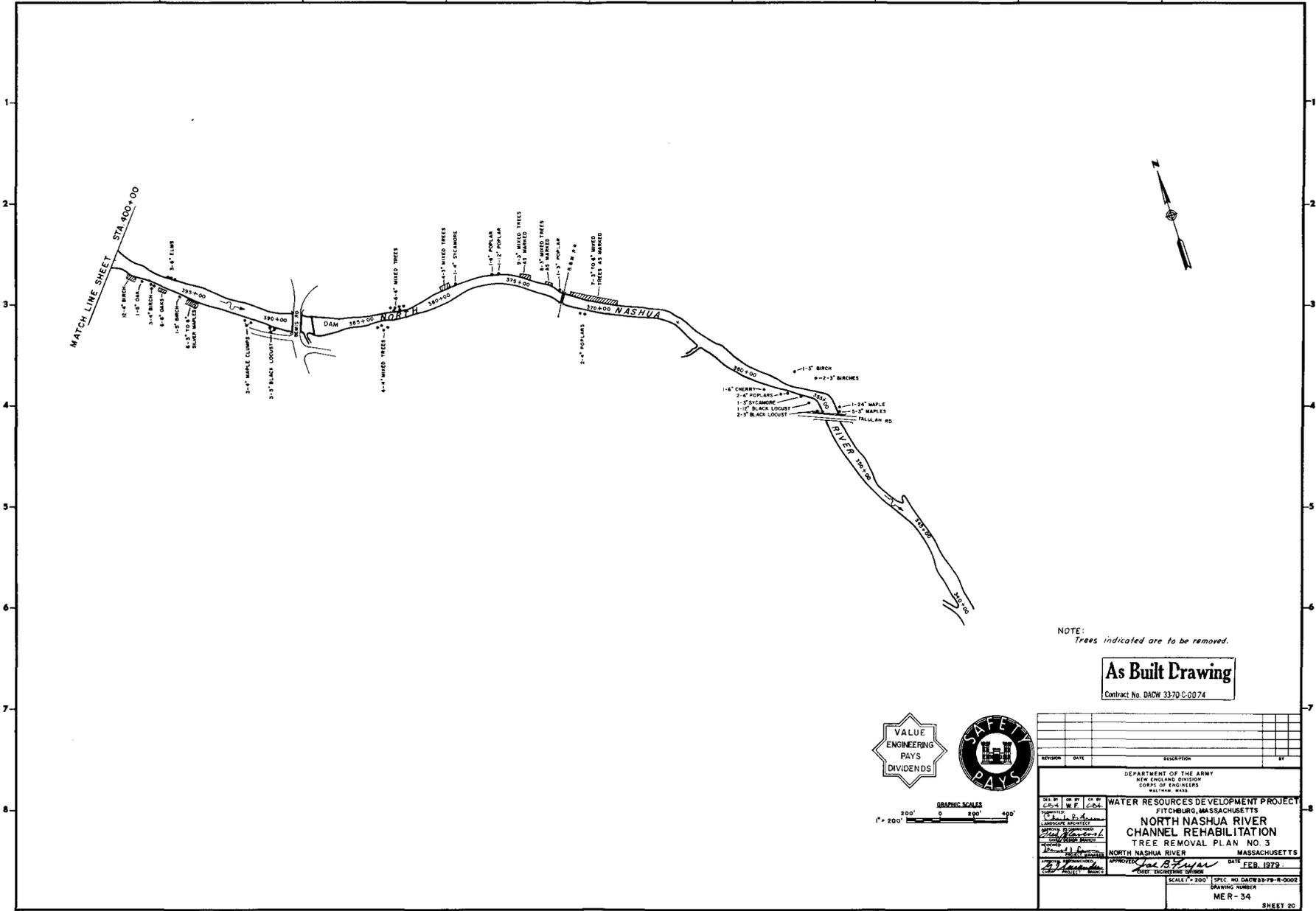


NOTE:  
Trees indicated are to be removed.

**As Built Drawing**  
Contract No. DACW 3379 C 0074

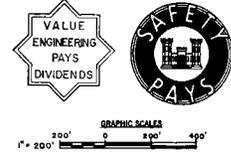


REVISION	DATE	DESCRIPTION	BY
DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION CORPS OF ENGINEERS FITCHBURG, MASS.			
WATER RESOURCES DEVELOPMENT PROJECT FITCHBURG, MASSACHUSETTS <b>NORTH NASHUA RIVER</b> <b>CHANNEL REHABILITATION</b> TREE REMOVAL PLAN NO. 2			
NORTH NASHUA RIVER		MASSACHUSETTS	
APPROVED:	<i>[Signature]</i>	DATE:	FEB. 1979
SCALE AS SHOWN SPEC. NO. DACW 33-79-R-0005			
DRAWING NUMBER			MER-34
			SHEET 12



NOTE:  
Trees indicated are to be removed.

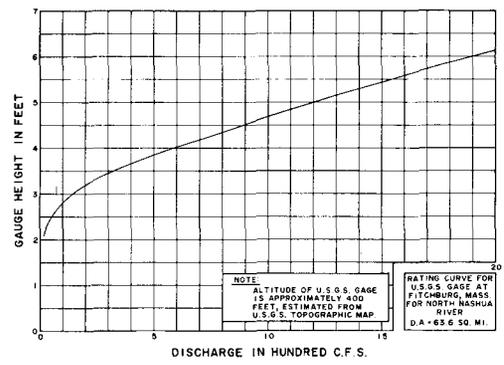
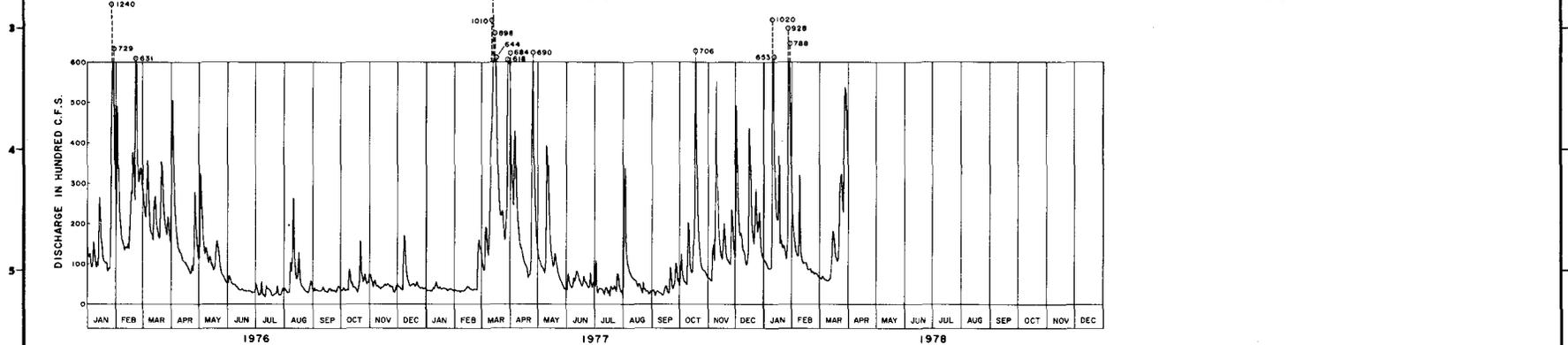
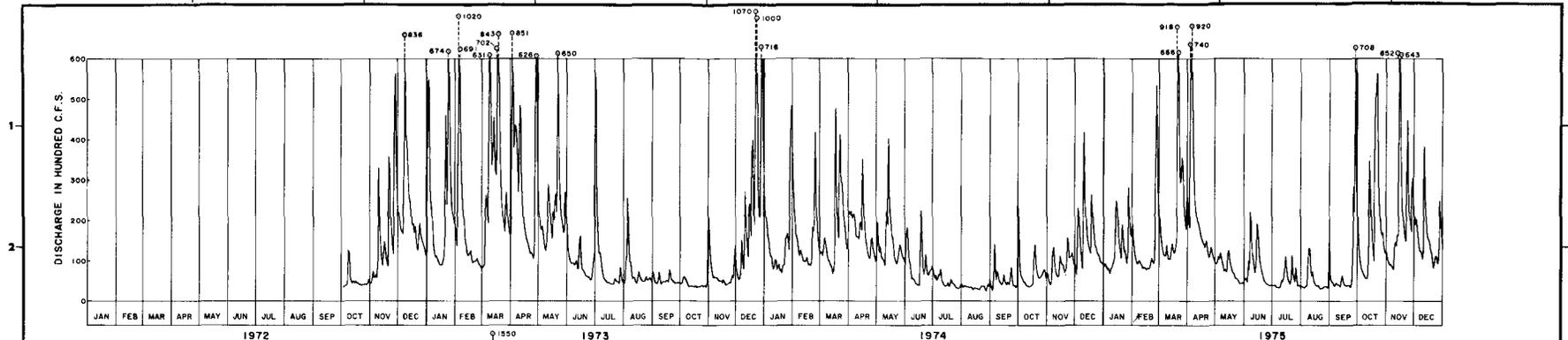
**As Built Drawing**  
Contract No. DADW 3370 C-0074



REVISION	DATE	DESCRIPTION	BY

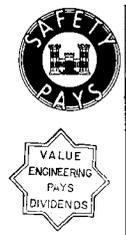
  

DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION CORPS OF ENGINEERS WALTHAM, MASS.	
DESIGNED BY <i>W. F. C. M.</i>	WATER RESOURCES DEVELOPMENT PROJECT FITCHBURG, MASSACHUSETTS <b>NORTH NASHUA RIVER          CHANNEL REHABILITATION          TREE REMOVAL PLAN NO. 3</b>
CHECKED BY <i>[Signature]</i>	NORTH NASHUA RIVER MASSACHUSETTS
APPROVED BY <i>[Signature]</i>	DATE <b>FEB. 1979</b>
SCALE: 1" = 200' DRAWING NUMBER <b>MER-34</b>	SPEC. NO. DACW 33-79-R-0002 DRAWING TORRER

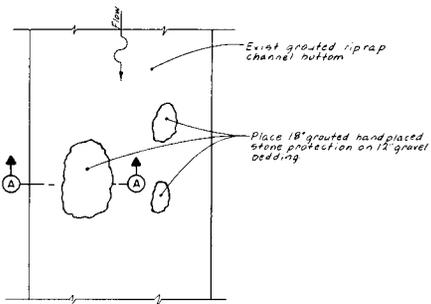


- NOTES:
1. THESE HYDROGRAPHS ARE THE DAILY AVERAGE STREAMFLOW OF THE NORTH NASHUA RIVER, AT THE U.S.G.S. GAGING STATION IN FITCHBURG, MASSACHUSETTS FROM THE TRIBUTARY DRAINAGE AREA OF 63.6 SQUARE MILES. FLOW REGULATED BY MILLS AND RESERVOIRS UPSTREAM. FLOW ALSO AFFECTED BY DIVERSIONS FOR MUNICIPAL USE.
  2. SOME INSTANTANEOUS PEAK DISCHARGES ARE SHOWN BY SYMBOL - O.
  3. THE DATA CONTAINED HEREON ARE NOT INTENDED AS REPRESENTATIONS OR WARRANTIES BUT ARE FURNISHED AS INFORMATION ONLY. IT IS EXPRESSLY UNDERSTOOD THAT THE GOVERNMENT WILL NOT BE RESPONSIBLE FOR ANY DEDUCTION, INTERPRETATION OR CONCLUSION THEREFROM MADE BY ANY BIDDER OR CONTRACTOR.

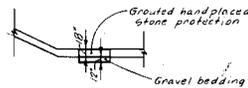
**As Built Drawing**  
Contract No. DACW 33 79 C 0074



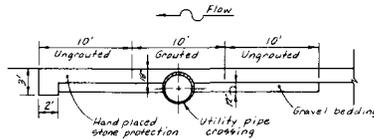
REVISION	DATE	DESCRIPTION	BY
DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION CORPS OF ENGINEERS WALTHAM, MASS.			
WATER RESOURCES DEVELOPMENT PROJECT FITCHBURG, MASSACHUSETTS <b>NORTH NASHUA RIVER CHANNEL REHABILITATION</b> HYDROGRAPH			
DESIGNED BY CHECKED BY DRAWN BY PROJECT ENGINEER	DATE DATE DATE DATE	APPROVED BY DATE DATE DATE	DATE DATE DATE DATE
NORTH NASHUA RIVER		MASSACHUSETTS	
SCALE		SPEC. NO. DACW 33 79 R 0002	
DRAWING NUMBER MER-34		SHEET 21	



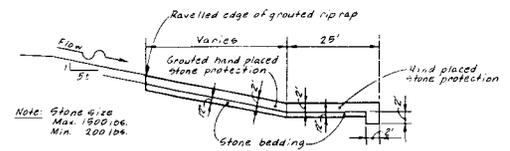
PLAN OF AREA E  
N.T.S.



SECTION A-A  
N.T.S.

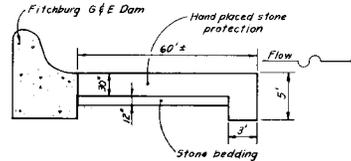


TYPICAL SECTION AT AREA I  
N.T.S.

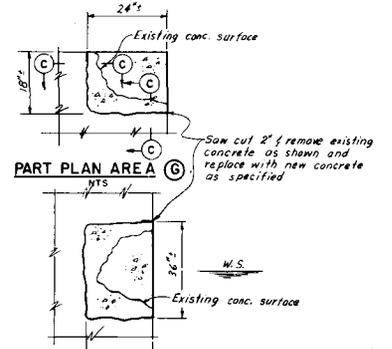


TYPICAL SECTION AT AREA J  
N.T.S.

- NOTES:
1. All area 'U' fill washout behind 2 openings at millrace entrance 10' length x 5' wide x 6' depth.
  2. The 2 openings are 3' x 4' and shall be plugged with concrete.

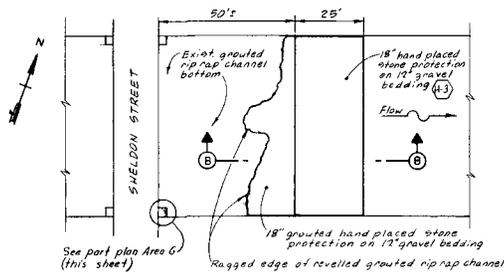


TYPICAL SECTION AT AREA S  
N.T.S.

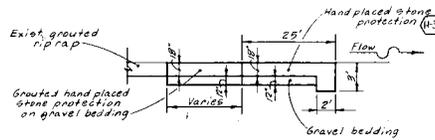


PART PLAN AREA G  
N.T.S.

SECTION C-C  
N.T.S.

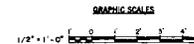


PLAN OF AREA G - AREA H SIMILAR  
N.T.S.



SECTION B-B  
N.T.S.

As Built Drawing  
Contract No. DACW 33-78-C-0074



REVISION	DATE	DESCRIPTION	BY
		Final field corrections insert drainage diversion structure added	

DEPARTMENT OF THE ARMY  
NEW ENGLAND DIVISION  
CORPS OF ENGINEERS  
WATER RESOURCES DEVELOPMENT PROJECT  
FITCHBURG, MASSACHUSETTS  
**NORTH NASHUA RIVER  
CHANNEL REHABILITATION**  
MISC PLANS & SECTIONS - AREAS G, H, I, J, S  
NORTH NASHUA RIVER MASSACHUSETTS  
APPROVED: [Signature] DATE: FEB 1979  
SCALE AS SHOWN SPEC. NO. DACW 33-78-R-0002  
DRAWING NUMBER  
MER-34 SHEET 22