Form No. 10-300 (Rev. 10-74)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

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SEE INSTRUCTIONS IN *HOW TO COMPLETE NATIONAL REGISTER FORMS*
TYPE ALL ENTRIES -- COMPLETE APPLICABLE SECTIONS

1 NAME

HISTORIC
Lowell Locks and Canals Historic District

AND/OR COMMON
Lowell Locks and Canals Historic District

2 LOCATION

STREET & NUMBER Between the Pawtucket and Hamilton Canals, the Concord River, and the Merrimack River — NOT FOR PUBLICATION

CITY, TOWN Lowell — VICINITY OF

CONGRESSIONAL DISTRICT 5

STATE	CODE	COUNTY	CODE
Massachusetts	25	Middlesex	017

3 CLASSIFICATION

CATEGORY	OWNERSHIP	STATUS	PRESENT USE	
XX DISTRICT	— PUBLIC	X OCCUPIED	— AGRICULTURE	X MUSEUM
— BUILDING(S)	— PRIVATE	X UNOCCUPIED	X COMMERCIAL	— PARK
— STRUCTURE	X BOTH	— WORK IN PROGRESS	X EDUCATIONAL	X PRIVATE RESIDENCE
— SITE	**PUBLIC ACQUISITION**	**ACCESSIBLE**	— ENTERTAINMENT	— RELIGIOUS
— OBJECT	— IN PROCESS	X YES: RESTRICTED	— GOVERNMENT	— SCIENTIFIC
	X BEING CONSIDERED	— YES: UNRESTRICTED	X INDUSTRIAL	— TRANSPORTATION
		— NO	— MILITARY	— OTHER:

4 OWNER OF PROPERTY

NAME
Multiple (See continuation sheet.)

STREET & NUMBER

CITY, TOWN — STATE

— VICINITY OF

5 LOCATION OF LEGAL DESCRIPTION

COURTHOUSE, REGISTRY OF DEEDS, ETC. Northern Middlesex District Registry of Deeds

STREET & NUMBER
Goreham Street

CITY, TOWN — STATE
Lowell — Mass.

6 REPRESENTATION IN EXISTING SURVEYS

TITLE Historic American Engineering Record
National Register of Historic Places

DATE
1974; 1976 — X FEDERAL X STATE — COUNTY — LOCAL

576

DEPOSITORY FOR SURVEY RECORDS Library of Congress; National Register

CITY, TOWN — STATE
Washington — D.C.

7 DESCRIPTION

CONDITION		CHECK ONE	CHECK ONE
__EXCELLENT	__DETERIORATED	__UNALTERED	X__ORIGINAL SITE
X__GOOD	__RUINS	X__ALTERED	__MOVED DATE_____
__FAIR	__UNEXPOSED		

DESCRIBE THE PRESENT AND ORIGINAL (IF KNOWN) PHYSICAL APPEARANCE

The Lowell Locks and Canals Historic District encompasses approximately 125 acres; ten principal canals or feeders and their accompanying gates, locks, dams, and other associated structures; seven extant mill yards and the ruins of another, with almost all buildings of red brick construction; the Locks and Canals yard and the Lowell Machine Shop; and several company boarding houses plus a company agent's residence. Included are the first canal built in Lowell (the Pawtucket, 1796), the last (the Northern, 1848), and all those constructed in the interim. These virtually unaltered waterways, together with the surprisingly large number of relatively little-altered mills and their machinery, form what is probably the most historically significant extant aggragation of early 19th-century industrial structures and artifacts in the United States. Several of the mills still rely on the canal system for power to turn electric generators, and some are still used for the manufacture of textiles. Most, however, house a variety of service and storage firms and small industries. Principal structures not extant include Merrimack Manufacturing Company and Middlesex Woolen Mills.

For the purpose of this nomination some descriptive material has been incorporated in the accompanying historical significance section. Also, because the Historic American Engineering Record has surveyed most of the Lowell Locks and Canals Historic District and described its edifices, waterways, and machinery in detail, most of the following descriptions of principal extant structures are taken virtually verbatim either from HAER inventory cards or from The Lower Merrimack River Valley: An Inventory of Historic Engineering and Industrial Sites, a joint HAER-Merrimack Valley Textile Museum project. Other descriptive passages are based, as usual, on the research and on-site inspections of the AASLH representative.

An asterisk (*) indicates HAER or HAER-Textile Museum descriptions.

(continued)

8 SIGNIFICANCE

ENGINEERING
INDUSTRY

PERIOD	AREAS OF SIGNIFICANCE -- CHECK AND JUSTIFY BELOW				
_PREHISTORIC	_ARCHEOLOGY-PREHISTORIC	_COMMUNITY PLANNING	_LANDSCAPE ARCHITECTURE	_RELIGION
_1400-1499	_ARCHEOLOGY-HISTORIC	_CONSERVATION	_LAW	_SCIENCE
_1500-1599	_AGRICULTURE	_ECONOMICS	_LITERATURE	_SCULPTURE
_1600-1699	_ARCHITECTURE	_EDUCATION	_MILITARY	_SOCIAL/HUMANITARIAN
_1700-1799	_ART	X ENGINEERING	_MUSIC	_THEATER
X 1800-1899	_COMMERCE	_EXPLORATION/SETTLEMENT	_PHILOSOPHY	_TRANSPORTATION
X 1900-	_COMMUNICATIONS	X INDUSTRY	_POLITICS/GOVERNMENT	_OTHER (SPECIFY)
		_INVENTION		

SPECIFIC DATES 1821-1930's

BUILDER/ARCHITECT Nathan Appleton, Kirk Boott, James B. Francis

STATEMENT OF SIGNIFICANCE

Lowell, Mass., occupies an especially significant place in the Nation's history. Its "origin and growth," says geographer-historian Margaret Terrell Parker, "constitute the first instance in America of the development of a city of the primarily industrial type."[1] Futhermore, asserts historian Harry C. Dinmore "the energy supplied by its carefully controlled water-power gave birth and enduring life to the Industrial Revolution" in this country.[2]

Lowell owes its historic importance in part to the Pawtucket Falls of the Merrimack River and in part to the foresight and ingenuity of its founding fathers, chief of whom were Nathan Appleton and Patrick T. Jackson. These two industrialists and their associates began developing the falls' power in 1822. By 1826 they had completed the first portions of a complex canal system and established the city of Lowell, which they named in honor of pioneer textile manufacturer Francis Cabot Lowell. Over the next two decades they added several more canals to the system, and Lowell became the cotton textile manufacturing center of the United States. It "evolved," says American Heritage writer Alex Groner, "into the Manchester of America."[3]

The Lowell Locks and Canals Historic District encompasses approximately 125 acres; ten principal canals or feeders and their associated dams, locks, gates, and wasteways; seven extant mill yards, the ruins of another, and several ancillary structures; and four company boarding houses. The virtually

(continued)

[1]Margaret Terrell Parker, Lowell: A Study of Industrial Development (New York, 1940), 1.

[2]Harry C. Dinmore, "Proprietors of Locks and Canals: The Founding of Lowell," in Arthur L. Eno, Jr., Cotton Was King: A History of Lowell, Massachusetts (Lowell, 1976), 79.

[3]Alex Groner, The American Heritage History of American Business and Industry (New York, 1972), 101.

9 MAJOR BIBLIOGRAPHICAL REFERENCES

(See continuation sheet.)

10 GEOGRAPHICAL DATA

ACREAGE OF NOMINATED PROPERTY circa 125 acres

UTM REFERENCES

(See continuation sheet.)

	ZONE	EASTING	NORTHING		ZONE	EASTING	NORTHING
A				B			
C				D			

VERBAL BOUNDARY DESCRIPTION

(See last pages of description.)

LIST ALL STATES AND COUNTIES FOR PROPERTIES OVERLAPPING STATE OR COUNTY BOUNDARIES

STATE	CODE	COUNTY	CODE
STATE	CODE	COUNTY	CODE

11 FORM PREPARED BY

NAME / TITLE

George R. Adams, Director, Historic Landmarks Project

ORGANIZATION — DATE

American Association for State and Local History — June 1977

STREET & NUMBER — TELEPHONE

1400 Eighth Avenue South — 615/242-5583

CITY OR TOWN — STATE

Nashville, — Tennessee 37203

12 STATE HISTORIC PRESERVATION OFFICER CERTIFICATION

THE EVALUATED SIGNIFICANCE OF THIS PROPERTY WITHIN THE STATE IS:

NATIONAL ___ STATE ___ LOCAL ___

As the designated State Historic Preservation Officer for the National Historic Preservation Act of 1966 (Public Law 89-665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service.

FEDERAL REPRESENTATIVE SIGNATURE

TITLE — DATE

624

FOR NPS USE ONLY

I HEREBY CERTIFY THAT THIS PROPERTY IS INCLUDED IN THE NATIONAL REGISTER

DATE

DIRECTOR, OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION

ATTEST: DATE

KEEPER OF THE NATIONAL REGISTER

Form No. 10-300a
(Rev. 10-74)

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CONTINUATION SHEET Lowell L/C Dist ITEM NUMBER 4 PAGE one

Owners of Property

Melvin Lezburg President Proprietors of Locks and Canals on Merrimack River Boott Mills Foot of John Street Lowell, Mass. 01852	All canals, locks, dams, gatehouses, and associated structures and machinery.
Melvin Lezburg President Boott Mills Foot of John Street Lowell, Mass. 01852	Boott and Massachusetts Mills structures and one Bigelow Yard structure.
Sullivan Trust 95 Bridge Street Lowell, Mass. 01852	Massachusetts Mills structure.
Vincent P. Morton, Inc. 93 Bridge Street Lowell, Mass. 01852	Massachusetts Mills structure. Appleton Mills structure at Jackson and Revere St.
William P. & Mary K. Spanos 260 Middlesex Street Lowell, Mass. 01852 (cc to same at 133 Havilah St.)	Boott Mills Boarding House NW corner Bridge & French St.
Fitzgerald-Keefe Corporation c/o John E. Keefe 66 Ravenswood Avenue Providence, R.I. 02908	Boott Mills Boarding House SW corner Bridge & French St.
Business Manager Massachusetts Electric Corp. Lowell, Mass 01852	Massachusetts Mills structure.
Capehart Corporation Foot of John Street Lowell, Mass. 01852	Boott Mills structure.

577

(continued)

GPO 892 455

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

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Morris Sibulkin, Louis Shaftmaster, William F. Herlihy, Ed. I. McGarry Valley Associates 231 Mill Street Haverhill, Mass (Also contact: Bob Malavich Planning Director City of Lowell Lowell, Mass. 01852)	Bigelow Yard structures.
Merrimack Trading & Spinning Co. 256 Market Street Lowell, Mass. 01852	Bigelow Yard structure.
Barnet B. Stein & Martin C. Stein, Trustees c/o Grace Shoe Corporation Lowell, Mass. 01852	Bigelow Yard structure on Lower Pawtucket Canal.
Stanley Charren, Ruben Wisotzky, and James Stevens CWS Associates 200 Market Street Lowell, Mass. 01852 (cc to Pandel-Bradford, Inc. Lowell, Mass. 01852	Bigelow Yard structures on Lower Pawtucket Canal.
Lesson Corporation 2 Ashland Street Nashua, N.H.	Hamilton Yard structure.
Joan Fabrics Corporation 122 Western Avenue Lowell, Mass. 01851	Hamilton Yard structure Dutton Street Lowell Machine Shop structure.
Courier Citizen Company 165 Jackson Street Lowell, Mass. 01852	Hamilton Yard structure Tremont Yard structures.
James T. Lichoulas Appleton Trust 217 Jackson Street Lowell, Mass. 01852	Appleton Mills structures.

578

(continued)

Pellon Corporation 491 Dutton Street Lowell, Mass. 01852	Lowell Machine Shop Bldg.
Macheras Oil Company 66 Broadway Street Lowell, Mass. 01852	Locks & Canals Yard.
Frank E. Barrett Real Estate 170 Merrimack Street Lowell, Mass. 01852	Tremont Yard structure.
William J. Graham Co., Inc. 572 Suffolk Street Lowell, Mass. 01854	Suffolk Yard bldg., corner of Hall and Suffolk.
Margaret O. & Edward A. Larter Wannalancit Textile Company 562 Suffolk Street Lowell, Mass. 01854	Wannalancit Textile Co. bldgs., Suffolk Yard.
Wanskuck Company 562 Suffolk Street Lowell, Mass. 01854	Suffolk Yard structure.
Stony Brook Properties 40 Main Street Westford, Mass. 01986	Suffolk Yard structure.
Leo R. LaFortune, Inc. 6 Chandler Rd. Tewksburg, Mass. 01876	Suffolk Yard structure.
Richards Auto Supply Corner Cabot & Halls Streets Lowell, Mass. 01854 (Also contact for forwarding: Bob Malavich Planning Director City of Lowell Lowell, Mass. 01852)	Lot at NW corner of Suffolk Yard.
Steam Associates, Inc. 750 Suffolk Street Lowell, Mass. 01854	Lawrence Yard structures.

(571)

(continued)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

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George W. McQuade 5 Butt Hinge Road Chelmsford, Mass. 01824	Lawrence Yard structure on Perkins Street.
Interin Corporation, Inc. 750 Suffolk Street Lowell, Mass. 01854	Lawrence Yard structure.
Kenneth M. Scagel and Kenneth M. Scagel, Jr. Atlantic Associates 576 Lawrence Street Lowell, Mass. (Send also to: Scagel & Scagel Atlantic Associates c/o Donald Sisson 234 Nesmith Street Lowell, Mass.)	Lawrence Yard structure.
Ames Textile Corp. 720 Suffolk Street Lowell, Mass. 01854	Lawrence Yard structure.
Aiken Realty Corporation 361 Aiken Street Lowell, Mass. 01854	Lawrence Yard structures.
Woodle Realty Company 361 Aiken Street Lowell, Mass. 01854	Lawrence Yard structures.
Ms. Ruthanne Jaffe Executive Director Lowell Day Nursery 119 Hall Street Lowell, Mass. 01854	Lowell Day Nursery.
Ms. Eva Soucy 197 White Street Lowell, Mass. 01854	Suffolk Boarding House Apt.

580

(continued)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

FOR NPS USE ONLY
RECEIVED
DATE ENTERED

Normand J. and Florence Langlois 129 Cabot Street Lowell, Mass. 01854	Suffolk Boarding House Apt.
Ernest and Alda Beland 121 Cabot Street Lowell, Mass. 01854	"
Ms. Isabelle Watson 119 Cabot Street Lowell, Mass. 01854	"
Ms. Rose A. Sarrasin 113 Cabot Street Lowell, Mass. 01854	"
Ms. Lorraine I. Veator 111 Cabot Street Lowell, Mass. 01854	"
Paul J. and Lorraine L. Desmarais Maplewood Ave. Tyngsborough, Mass. 01879	"

591

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

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I. The Canals.

*Pawtucket Canal. This canal was built in 1796 as a transportation canal to avoid the Pawtucket Falls of the Merrimack River. In 1822 the builders of Lowell transformed the Pawtucket into a feeder for the Merrimack Canal, which powered the first of Lowell's large mills, the Merrimack Manufacturing Co. The Pawtucket became a two-level canal. The first level, about 30 feet above the lower Merrimack and Concord, flowed from a few hundred feet upstream of the dam to the Swamp Locks, a distance of about 5,700 feet. Locks for barges and a gatehouse were located near the intersection of the canal with Broadway, about 1,700 feet from the upper Merrimack. At the Swamp Locks were a set of locks and a wasteway. The Merrimack Canal joined the Pawtucket at this place. At the Swamp Locks the Pawtucket Canal dropped 13 feet and continued at the lower level, 17 feet above the river, for another 2,150 feet. Here, at the Lower Locks, was another set of locks and a wasteway, at which point the canal dropped into the Concord River. The width of the Pawtucket varies from 80 to 100 feet and the average depth is about 8 feet. The Pawtucket Canal today is essentially the same as that of 1825, with the exception of modification in such control areas as the locks and wasteways. It flows through Lowell from Pawtucket Dam to the Concord River.

*Merrimack Canal. This was the first power canal built by the Proprietors of Locks and Canals. It was intended to power the Merrimack Manufacturing Company with a 30-foot fall of water. Its design was crude; little attention was expended upon creating a uniform section. In some areas the section is rectangular, but in most of the Merrimack the canal has simply been gouged out of the native rock. The canal is 10 feet deep, 2,580 feet in length, and 40 to 50 feet wide. In addition to the Merrimack Manufacturing Co., the canal supplied water to the Lowell Manufacturing Co., and it provided the Eastern Canal with water, after the construction of a wasteway, rolling dam and penstock in the 1840's. Only the Merrimack Canal provides a full 30-foot fall; the other canals provide either a 13- or 17-foot fall. In order to increase the amount of water flowing in the Merrimack Canal, the Moody Street feeder, connecting the

(512)

(continued)

UNITED STATES DEPARTMENT OF THE INTERIOR
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Western Canal with the Merrimack Canal, was built in 1848. The extra water was available in 1848 because of the construction of the Northern Canal in 1847.

*Hamilton Canal. This was completed in 1826 in order to provide a 13-foot fall of water to the Hamilton and Appleton Mills. The Canal begins at the Swamp Locks and draws its water from the upper Pawtucket Canal. The water flows through the penstocks of the Hamilton and Appleton Mills and is discharged into the lower Pawtucket Canal. Excess water flows from a wasteway at the end of the Hamilton Canal to the lower Pawtucket. The Hamilton Canal is 1,936 feet in length, 10 feet deep, 35 to 100 feet wide, and is rectangular in section.

*Lowell Canal. The Lowell Canal was constructed in 1828 to provide power for the Lowell Manufacturing Co. It draws its water from the Merrimack Canal. Water from the Lowell Canal dropped 13 feet through the wheels of the Lowell Mfg. Co. and exited into the Lower Pawtucket Canal. The Lowell is 500 feet in length, 30 feet wide, and averages 10 feet in depth. It is rectangular in section. The canal was covered in 1880 by the Brussels Carpet Weaving Mill of Lowell Manufacturing Company.

*Western Canal. The Western Canal was built in 1831-32 as a two-level water power system for the Tremont and Suffolk Mills on the upper level and the Lawrence Mills on the lower level. Locks were initially constructed in the Western to enable barges to reach the textile mills but locks were filled in during the 1840's; the remnants of the locks at the Hickey Hall Dam are still visible. The Western initially drew its water from the upper Pawtucket Canal, above the Swamp Locks, and flowed in a northerly direction to the Tremont-Suffolk Mill complex. These mills, on opposite sides of the Western's upper level, drew practically all of the water through their wheelpits, a fall of 13 feet, and discharged the water into the Lawrence Canal, a spur of the lower level of the Western. Any water which did not flow through the penstock of the Tremont and Suffolk Mills flowed through the wasteway of the Western Canal and fell into the Western's lower level, where it joined the Lawrence Canal. Water from the lower level of the Western as well as

(593)

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the Lawrence Canal dropped 17 feet into the wheelpits of the Lawrence Mills, and discharged into the Merrimack River. A wasteway constructed just below the intersection of the Lawrence and lower level Western, carried excess water into the Merrimack River. The construction of the Northern Canal in 1847 radically altered the role of the Western Canal. The Northern delivered all of its water into the Western at the headgates of the Tremont and Suffolk Mills, and the mills now drew their water directly from the Northern. The lower level of the Western-Lawrence Canals remained unchanged. The upper level of the Western, however, was greatly altered. The flow of the Northern reversed the direction of the upper Western's current, and the upper Western became a feeder for the upper Pawtucket, thus providing extra water for the Merrimack, Hamilton and lower Pawtucket. The Moody Street Feeder, finished in 1848, also drew its water from the upper Western and delivered it to the Merrimack Canal. This arrangement is followed by the present operators of the Lowell Canal system. The total length of the Western Canal is 4,964 feet. Its width varies from 35 to 55 feet, and its average depth is 9 feet.

*Eastern Canal. This canal was constructed in 1835 as a single level canal to power the Prescott, Massachusetts, and Boott Mills. The Eastern began just above the wasteway and locks of the lower Pawtucket Canal, and ran for 2,037 feet, providing water with a 17-foot drop to the Massachusetts, Prescott, and Boott Mills, which discharged the water into the Concord and Merrimack Rivers. The Eastern averaged 8 feet in depth, 40 to 65 feet in width, and was rectangular in section. Additional water for the Eastern was supplied from the Merrimack Canal, which was connected by a penstock to the Eastern at the wasteway of the Eastern. Excess water from the Eastern flowed through this wasteway and into the Merrimack River.

*Northern Canal. The Northern Canal was designed by James B. Francis, Chief Engineer of the Proprietors of Locks and Canals, as a feeder to supplement the Pawtucket Canal. Built simultaneously with the dam across the Merrimack, the Northern was also intended to raise the total head available at Lowell by 3 feet, since it reduced velocity and friction losses throughout the canal system. The canal is rectangular

(594)

(continued)

in section and has only one major curve, thus allowing the water to flow in as smooth a manner as possible. It is 4,373 feet in length, averages 100 feet in width and is 15 to 21 feet in depth, depending upon the width of the canal at a given point.

*Moody Street Feeder. The Moody Street Feeder was built as part of the Northern Canal project and, like the Northern, was designed by James B. Francis. The feeder drew water from the upper Western Canal and delivered it to the Merrimack Canal, where it could be used to meet the needs of the Merrimack Manufacturing Co. The Merrimack Canal, so provided with water by the feeder, was also used to supply the Eastern Canal with water, by means of a penstock constructed in the years 1846-48. The feeder is 1,418 feet long, 30 feet in width, and 10 feet in height. It is divided into three parts by two longitudinal walls, forming the piers for three arches, which close the conduit on top. The segmented arches are made of brick. The piers and sidewalls are granite.

*Boott Penstock (near Kirk and French Streets). The Boott Penstock was built in 1846 to supply water to the Eastern Canal from the Merrimack Canal. It was enlarged in 1848 and again in 1873. In 1889 an extension to the penstock was built, designed to reduce problems of turbulence and icing in the Eastern Canal. The modification was a channel run parallel to the Eastern Canal and connected to it by 15 underwater openings through a masonry wall. An iron penstock gatehouse was added in 1906.

II. The Mill Yards and Shops.

*Hamilton Yard (Jackson Street between Hamilton and Gorham Sts). The Hamilton Manufacturing Company was the second of the large cotton corporations to begin operations in Lowell, its first mill going into production in 1826. The company was sited on the Hamilton Canal, and the water from this canal passed through its wheelpits, dropping 13 feet into the Lower Pawtucket Canal. The Hamilton manufactured shirtings, sheetings, drills, and print cloth. Like those of the Merrimack Manufacturing Company, the Hamilton's owners constructed a print works in 1828. The company, in 1839,

(continued)

produced 5 million yards of cloth annually. By 1890 the figure had risen to almost 40 million yards. The Hamilton continued operations until after World War II, when it ceased operations. The mill has been tenanted ever since. The print works have been totally removed, and only one of the original mills remains. This structure is Mill No. 4, built in 1847. The mill was originally 4 stories high, 50 feet wide, and 400 feet in length, twice the size of the original "Waltham style" mills. It had a pitch roof with dormers at 10 foot intervals, one stair tower and a water closet tower. An unusual feature in the building's construction is the use of only a single row of wooden columns, allowing a bay 25 feet deep and 10 feet wide. Most mills employed a double row of columns. In 1882 a six-story mill was completed that was adjacent to Mill No. 4 and about 90 feet of the old mill was demolished to accommodate the new structure. Sometime during the 1880's the pitch roof was removed from Mill No. 4 and two additional stories were added, with a flat roof. All of the remaining buildings in the Hamilton yard date from the very late 19th and early 20th centuries.

*Appleton Yard (Jackson Street between Revere and Hamilton Sts). The Appleton Company was established in 1828 as a manufactory of sheetings, shirtings, and drills. It drew the water for its water wheels and later its turbines from the Hamilton Canal, and its tailraces faced on the Lower Pawtucket Canal. In 1839 the company's annual production was 5,000,000 yards of cloth. In 1890 it was close to 20,000,000 yards. The company suspended operations in the 1920's, and has been tenanted ever since. Ten turbines are still in place. The two oldest are McCormack horizontal turbines (1901). The two latest turbines are horizontally mounted Hunt wheels. None of the original buildings remain. The two oldest surviving structures are a cotton storehouse dating from about 1890 and a spinning and weaving mill, entirely steam powered, which was built in 1873.

*Bigelow Yard (Market, Gorham, and Dutton Streets). The Lowell Manufacturing Company began operations in 1828 as a maker of Osnaburgs or Negro Cloth. Hand woven carpets were also made. In 1842 the Bieglow power carpet loom was introduced, and in 1848 the company switched its entire operation to carpet making. In 1914 the Company moved its

(59)

(continued)

operations to Thompsonville, Conn., as part of a conglomerate of carpet manufacturers which had been organized in 1901. The buildings were leased to the U. S. Cartridge Co. until 1920 when they were distributed among a number of small manufacturers. None of the original buildings survive and the Lowell Canal, which supplied power for the Company, has been covered over. The oldest remaining building is an 1880 weaving mill for Brussels Carpets, three stories high, 400 feet by 75 feet. The mill ran by steam power, and the boiler house built to house the boiler for the 500 HP steam engine is still standing, but is now derelict.

*Suffolk and Tremont Yards (Suffolk Street and Northern Canal). The Suffolk Manufacturing Company was organized in 1831 for the manufacture of cotton sheetings, shirtings and drills. It drew water from the Western Canal and discharged it into the Lower Western or Lawrence Canal, after a drop of 13 feet. The Suffolk was poorly managed during the Civil War years and the mill passed into the control of the Ayer brothers in 1871, together with the Tremont Mills, which faced the Suffolk Mills across the Western Canal. From this point onward the Company was known as the Suffolk and Tremont Mills. During the 1930's the mills were closed and became tenanted properties. The Suffolk remains so today, but the Tremont has been completely destroyed as part of urban renewal. Of the 1831 buildings, only the counting house remains. The remaining original buildings were replaced with larger structures during the 1860's.

*Lawrence Yard (Perkins Street). The Lawrence Manufacturing Company, named after the Boston family of financiers who invested so heavily in the industries of Lowell, was incorporated in 1831 by William Appleton and Benjamin R. Nichols, and by 1848 included 45,000 spindles, manufacturing 13.5 million yards of print cloths, shirtings and sheetings per year. In 1864 the Company added knitting frames and began to produce hosiery and knit underwear. By 1885 the mills included 105,000 spindles and 2,360 looms and knitting frames. In one week the company manufactured 425,000 yards of cloth and about 300,000 items of knitwear. Power was supplied by means of water from the Lawrence Canal and steam engines which were installed in the 1870's and '80's. Water turbines produced about 3500 HP and steam engines produced an additional 2700 HP. Six turbines remain in use, all of which are Hercules turbines dating from 1909-16. Two of the original 1832

(597)

(continued)

mills remain, although altered by the addition of a fifth story. The mill which connects these two buildings was constructed in 1855. Two other mill buildings facing upon the river were built in 1861 and 1870, but were constructed in an almost identical fashion to the 1832 mills. A bleaching house, built in 1876, remains unaltered, as does an 1876 boiler house, engine house and octagonal chimney. An 1835 cotton storehouse remains largely unaltered. The remaining buildings were erected in the years 1890-1910.

*Boott Mills (Amory Street). The Boott Mills were established in 1835 by Abbott and Nathan Lawrence and John A. Lowell and named after Kirk Boott. By 1848 the Boott produced 10.5 million yards of heavy drills, fine shirtings and print cloth per year. The mills contained 35,000 spindles. In 1884 the Boott contained 140,000 spindles and 3,875 looms. All of the six original mills, built between 1835 and 1843, are standing, although the original pitch and clerestory monitor roofs have been replaced by an additional story and flat roofs. In the 1860's several large additional buildings were added. These buildings are also still in place. The engine and boiler house were built in 1885. The steam engines produced 2400 HP. The main sorce of power was that of breast wheels, then water turbines, which were supplied with water from the Eastern Canal. Seven turbines remain in the wheel pits of the Boott, including two Swain turbines dating from 1874 and 1875, two Allis-Chalmers (1940's) and three Leffels (1920's).

*Massachusetts Mills (Bridge Street and Central Bridge). The Massachusetts Mills were the last of the large textile mills to be incorporated in Lowell. They were established in 1839 by John A. Lowell and Abbott Lawrence. In 1848 the company operated 46,000 spindles and manufactured 25 million yards of sheetings, shirtings, and drillings per year. This continued to be the company's product until the 1940's, when all operations were transferred to the company's mills in the South. The buildings today are occupied by a considerable number of tenant industries. The Massachusetts, sited at a point of land between the Concord and Merrimack Rivers, drew its water power from the Eastern Canal, and employed steam engines as well. The wheelhouse, rebuilt in 1872-88, contains six Hercules turbines dating from 1920-21, still in operation. The boiler and power houses, built in 1910, are used for other purposes. The four original mill buildings, constructed in

(598)

(continued)

1839, are in place, although altered by the addition of a fifth story and a shallow pitch roof. They are standard-sized first generation Lowell mills, 200 feet by 50 feet, with four stories and a basement. The four original buildings have been connected by additional structures erected in the 1860's and 1870's. Most interesting of the modern buildings is an 11-story, reinforced concrete storehouse dating from 1910. It was designed by Lockwood Greene Engineers. It is constructed of reinforced concrete and brick and has load bearing walls at 64-foot intervals in its 256-foot length. The basement, third, sixth, and ninth floors are concrete; the rest are of wood. The pillars are cast iron. This is a good example of a textile building constructed during the transition from brick to concrete.

*Proprietors of Locks and Canals Workshops (Western Canal near Broadway). The offices and workshops of the Proprietors of Locks and Canals were built along the Western Canal, Broadway, and Worthen Street during the 1820's and 30's. Three adjoining shops remained in 1974. Two were of wood and one was constructed of brick. All were pitch roofed. Their total length was 100 feet, and their width was 25 feet. The buildings were said to contain a large number of patterns as well as a number of tools and machines, most notably a rotary planer. The owner would not allow anyone to enter the buildings. The Proprietors of Locks and Canals moved their offices to the Boott Mills during the 1950's, and the office buildings and shops were used for storage afterward. Fire destroyed some of the buildings in 1976, but two principal ones have been stabilized.

Lowell Machine Shop (Dutton Street at Western Canal). Most of what once constituted the Lowell Machine Shop was razed in the 1930's. Those demolished structures stood, according to the Massachusetts Historical Commission, on the island created by the Pawtucket, Lowell, and Merrimack Canals. Extant, however, are a five-story red brick building (circa 1900) and a reinforced concrete plant (circa 1910 on Dutton Street at the Western Canal.

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(599)

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III. Locks, Dams, Gates, and Other Canal-Related Structures.

*Great (Francis) Gate (Pawtucket Canal north of Broadway). The Great Gate was designed in 1848 by James B. Francis, Chief Engineer of the Proprietors of Locks and Canals, and completed in 1850. The portcullis gate, of southern pine, is made up of 26 timbers, each 27 feet long and 17 inches wide. The gate has been dropped twice, in 1876 protective sheathing was attached to part of the upstream portion of the gate to protect it from floating debris. No other modifications have been made.

*Guard Locks Gatehouse (Pawtucket Canal north of Broadway). This brick gatehouse, built in 1870, replaced an 1848 wooden structure. The 1848 guard dam replaced an 1832 dam, which in its turn replaced an 1822 dam. The gatehouse encloses five sluice gates, operated by hydraulic lifting machinery. The water pressure was supplied by a 6-inch main from the Locks and Canals reservoir in Belvidere. The gatehouse and lifting machinery are essentially intact, with the exception of the three middle cylinders, which were replaced with oil hydraulic cylinders and pistons in 1965.

*Guard Locks Lockhouse (Pawtucket Canal north of Broadway). This building was erected over the upstream pair of gates in 1881, replacing the first building on this site, a functionally similar structure built in 1857. The structure shelters chain and windlass equipment which mechanically assists in opening each of the navigation guard gates. This winding equipment, also built in 1881, replaced similar machinery built prior to 1846. The light wooden frame building has a slate shingled hipped roof. The south corners of the building contain horizontal slots which permit the rotation of the gate lever beams which extend outside the structure.

*Swamp Locks and Dam (Pawtucket Canal at confluence with Merrimack Canal). The basic configuration of this complex (two navigation locks and dam at the west end of the upper lock) was achieved in 1822-23 when the Pawtucket Canal was reconstructed. However, the extant physical works are based on the rebuilding of 1839-41,

(100)

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when the dam was rebuilt in its stepped configuration and the locks narrowed from 25 feet to 12 feet. The lock walls around the three gate pockets were done in ashlar, and the remaining chamber walls were constructed of wood, all within the existing 25-foot rubble locks. The wooden sides no longer remain although they were periodically renewed. The walls of the upper chamber only were rebuilt in stone masonry to the 12-foot width in 1892. The sluice way on the south part of the dam was probably built in 1841 and the sluice way around the south end of the dam was completed in 1928. A protective light frame house over the length of the crest of the dam and the sluice gate in the dam was constructed first in 1859. Concrete was used to rebuild the north wall of the wasteway in 1942 and the apron on the face of the dam north of the 1841 sluice way in 1946.

*Lower Locks and Dam (Lower Pawtucket Canal east of Central Street). The basic configuration of this complex (two navigation locks and dam at the west end of the upper lock) was achieved in 1822-23 when the Pawtucket Canal was reconstructed. However, the extant physical works are based on the rebuilding of 1841-43, when the dam was rebuilt in its stepped configuration and the locks narrowed from 25 feet to 12 feet. The lock walls around the three gate pockets and the lower portion of the lower chamber were done in ashlar, and the remaining chamber walls were constructed of wood, all within the existing 25-foot rubble locks. The wood sides no longer remain although they were previously renewed. Due to frequent low water conditions in the Concord River at the low end of the locks, in 1905 the easterly half of the lower lock was deepened about 2.5 feet. In 1910, a 24-inch pipe was laid from a valve in the canal above the dam, beneath the upper lock, emptying into the lower lock, to drain the lower Pawtucket Canal. The sluice way on the north side of the dam, which was probably built in 1841, was reconstructed in 1887. A protective light frame house has been atop the crest of the dam and over the sluiceway since the late 19th century. Three concrete siphon spillways were built over the dam between 1946 and 1958.

(601)

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*Hickey Hall (Tremont) Locks and Dam (Western Canal at intersection of Suffolk and Hall Streets). As first constructed in 1831, this site included a dam which maintained the upper level of the Western Canal, and a flight of two navigation locks which provided access to the Lawrence Manufacturing Company's mills. In 1845, the dam was rebuilt into its present stepped configuration. As a result of changes in the system caused by the Northern Canal project, the locks were removed in 1848 and the upper chamber opening sealed to the height of the dam. This action was taken since the dam was not rebuilt to accommodate the new upper level. Instead, in order to maintain the new level, the Western Canal below its confluence with the Northern Canal was blocked by some form of dam or gates at the site of the Tremont Gate House, making navigation to the Lawrence Mills no longer possible. In 1868, the dam was cut down 2 feet in order to increase the supply of water directly into the Lawrence Canal when the Tremont and Suffolk Mills were not in full operation. A sluice way was then built in the dam next to the former lock chamber wall about 1870.

*Lawrence Dam (Lawrence Wasteway at intersection of Suffolk and Perkins Streets). This waste dam was initially constructed in 1831 when the Lawrence and Western Canals were built. It maintained the level of the Lawrence Canal. It was probably rebuilt in its present stepped configuration in the 1840's, the period when most of the other dams on the system were similarly reconstructed. The sluice way probably dates from the same period. The framehouse that was located over the sluice way was built in the latter part of the 19th century. In 1913, the cast iron flash board standards were replaced and raised one foot, as was the sluice gatehouse. The house was not extended the full length of the dam until the three siphon spillways, which required insulation, were built in 1948-49. The entire building along the crest of the dam burned in 1965.

*Tremont Gatehouse (Western Canal at Suffolk Street and French Street Extension). This gatehouse along with its gate operating equipment was built in 1855, replacing the temporary installation of 1847 that was built as part of the Northern Canal project. Its purpose was to permit the supply of water directly into the Lawrence Canal from the Northern Canal, if

(602)

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necessary. Normally, the Lawrence Canal was supplied with water through the tailraces of the Tremont and Suffolk Mills. The gatehouse contains two offset sluice gates which are each manually operated with counterweighted rack and pinion equipment. Manual operation was replaced with electric motor drive that was added to the original equipment early in the 20th century.

*Merrimack Canal Guard Gates (Canal at Swamp Locks Basin). These gates were constructed in 1847 to allow the separate draining of the Merrimack and Lowell Canals. The extant gates are a single set of swing gates of massive timber construction that are much heavier than standard navigation gates since they are required to withstand the force of the impounded water the full depth of the gate for extended periods. The operation of these gates was mechanically assisted by chain and windlass equipment, now no longer extant.

*Rolling Dam (Merrimack Canal near intersection of Kirk and French Streets). The initial construction of this dam took place in 1835 when the Merrimack Wasteway was reconstructed to facilitate wasting from the then new Eastern (Boott) Canal. It provided the intermediate level necessary to vertically align the Merrimack Canal (on the upper level of the system) and the Eastern Canal (on the lower level) so they both could discharge water through the Merrimack Wasteway. This intermediate level was later used to supply water to the Eastern Canal from the Merrimack Canal through the Boott penstock. A house sheltering either a weir or a gate was erected over the dam sometime during the latter half of the 19th century to maintain a water level of sufficient height to adequately feed the Boott penstock. A house remains over the dam, but the device used to control the water level has been removed. There is no evidence that a roller gate of the type generally associated with a "rolling dam" was ever used at this site. It is possible that this name was given to this dam because it was the only one to survive with a curved configuration to its face, although there were, at one time, several of this type in the system. The profile of the dam was slightly altered in 1934 when a concrete facing with iron strap overlay was added which slightly increased its height.

(603)

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*Boott Dam (Eastern Canal near intersection of Kirk and French Streets). This dam was originally built in 1835 to control the level of the Eastern Canal, completed at the same time. Its face was in a curved configuration and its crest was topped with flashboards. In 1878, a sluice way with portcullis gate was built into the dam to facilitate the removal of ice from the Eastern Canal. The face of the dam was probably rebuilt into its present stepped configuration and the first enclosing structure built over it at that time. In 1892, the house was rebuilt to accommodate a hydraulic lift on the sluice gate. This house and its gate machinery are extant. Subsequently, three concrete siphon spillways were added. The pair on the south side of the dam was constructed in 1948, and the one on the north side at about the same time.

*Hamilton Wasteway Gatehouse (Near intersection of Jackson and Central Streets). The Hamilton Wasteway was first built in 1850 to waste ice from the Hamilton Canal into the Lower Pawtucket Canal. The original gates and gatehouse were replaced when the wasteway was rebuilt in 1872. The gate operating equipment and the gatehouse of 1872 are extant. The two gates were originally manually controlled by counter-weighted rack and pinion machinery. The gatehouse is located at the head of the brick vaulted wasteway. Manual operation was replaced with electric motor drive that was added to the original equipment early in the 20th century.

*Hamilton Canal Guard Gates (Hamilton Canal adjacent to Jackson Street between King and Revere Streets). These gates were originally constructed in 1847 near the head of the Hamilton Canal to allow it to be drained separately. The original gates were replaced in 1853. The extant gates are a single set of swing gates of massive timber construction that are much heavier than standard navigation gates since they are required to withstand the force of the impounded water the full depth of the gate for extended periods. The operation of these gates was mechanically assisted by chain and windlass equipment which was in place at each gate by 1855, when a wooden framed house enclosed the winding equipment on the south bank. Subsequently, a house was built over the equipment on the north bank, but neither are extant, although the winding equipment is.

(604)

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*Moody Street Feeder Gatehouse (Merrimack and Dutton Streets). The Moody Street Feeder Gatehouse was completed in 1848 as part of the feeder itself. The house contains three manually operated sluice gates equipped with counterweighted rack and pinion equipment. This equipment is original except for the counterweights, which were added in 1853.

*Western Canal Guard Gates (Western Canal at intersection of Moody and Suffolk Streets). These gates were constructed in 1848 to allow the draining of selective parts of the canal system in conjunction with gate closings on other parts of the system as required. This was done by a double set of swing gates in the Western Canal between the Swamp Locks Basin and the entrance to the Moody Street Feeder. The gates, located back-to-back, open in opposite directions. Only one pair of gates was closed at a given time, depending on the portion of the system to be drained. These massive timber gates are much heavier than standard navigation gates since they were required to withstand the force of impounded water the full depth of the gate for extended periods. The gates were manually operated with chains from their ends rather than with lever beams. One of the four gates was broken off in 1960 and rests in the bottom of the canal at the entrance to the Moody Street Feeder.

*Pawtucket Dam (Merrimack River above School Street). This masonry dam was built in 1847 and 1875, replacing earlier masonry and wood dams of 1826 and 1833. The dam follows the outline of the natural ledge of the Falls. The foundation of the dam consists of granite blocks laid in a trench. The face of the dam is constructed of quarry faced granite blocks, and the interior is granite rubble set in hydraulic cement. The dam has no spillway. Its crest averages 15 feet in height above the ledge of the falls, depending on the contour of the river bottom. With its flashboards in place, the dam is capable of ponding the river for a distance of about 18 miles. The dam is 1,093.5 feet in length. The fishway was built in 1921.

(405)

*Great River Wall (Northern Canal along Merrimack River). The Great River Wall was built as a retaining wall for the upper Northern Canal in 1846-47. The wall is about 2,300 feet long, and is largely built of random coursed granite

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rubble laid in cement. About 700 feet of the wall was erected on an island formed by the excavation of the canal. As a result of the 1936 flood, about 100 feet of the lower river wall was replaced with a concrete plug.

*Northern Canal Guard Gates and Pawtucket Gatehouse (Merrimack River at School Street). This site contains the guard sluice gates, their brick gatehouse, and a navigation lock, all part of the northern canal construction project of 1846-47. The 10 sluice gates were operated by a mechanical system that consisted of a turbine located in a chamber beneath the deck of the School Street Bridge which transmitted power to the two hoisting screws on each gate. Most of the original equipment, including the Francis turbine, is intact. Alterations include a water tight enclosing wooden cover in the turbine pit in 1872 to prevent flooding of the turbine chamber in high water. Also, the line shaft was replaced in 1881, and the smaller belt pulleys replaced in 1883 by friction pulleys and clutch mechanisms which allowed independent operation of each gate. Early in the 20th century, electric motors replaced the turbine as the line shaft's prime mover. These motors were subsequently replaced by individual motors at each gate. The navigation lock has not been used since 1871 when a wooden bulkhead was built to close the lock. This bulkhead was replaced by a concrete wall in 1939.

*Northern Canal Waste Gates (Northern Canal below Moody Street Bridge). This site, which comprises the downstream end of the Great River Wall, originally included four waste gates and their manually powered operating machinery, along with a waste weir divided into multiple bays by cast iron standards. These works were completed in 1847 as part of the Great River Wall project. Major modification took place in 1872 when one of the scouring holes was converted into a wheel pit where a turbine was installed to power mechanical gate operating equipment which was added atop the original manually operated mechanisms. At the same time, a flat roofed heavy timber framed building was erected over the waste gates, and a hip-roofed, light-timber-framed building was built over the waste weir.

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*Massachusetts Wasteway Gatehouse (Eastern Canal at east side of Bridge Street). This wasteway and its gatehouse were built in 1862 to facilitate the removal of ice from the Eastern Canal. The original small wooden framed gatehouse at the entrance, which contains four bays of flashboards, is extant. In 1883, the wasteway was lengthened when the Massachusetts Yard was extended about 26 feet to the newly established river line.

IV. Mill Housing and Other Structures.

Suffolk Mills Boarding House (Cabot between Moody Street and French Street Extension). A fine example of workers' row housing, this 2 1/2-story, 18-bay-long, red brick, gable-roofed structure was erected about 1845. It contains five apartment units and has been partially restored. According to the Massachusetts Historical Commission, in the 1960's five other apartment units were removed from the north end of the building to make way for the extension of French Street. Each remaining apartment is individually owned.

Boott and Massachusetts Mills Boarding Houses (Corner of French and Bridge Streets). These red brick structures probably represent the largest remaining concentration of company housing in Lowell. Both were erected in the 1840's. The Massachusetts Mills boarding house rises three and one-half stories and is rendered in the Greek Revival style. The L-shaped, four-story Boott Mills boarding house displays an 1890's Queen Anne facade. Both buildings appear to be in sound condition.

Boott Mills Boarding House Block (Between French and Amory Streets at Kirk Street). Now the Cotton House of Boott Mills, this multistory red brick structure served formerly as a boarding house for Boott employees.

Lowell Day Nursery (119 Hall Street). This 3 1/2-story, parapet-gable-roofed structure was constructed of gray stone, laid in random ashlar, sometime prior to 1885. According to the Massachusetts Historical Commission, it served originally as the residence of the agent of the Lawrence Manufacturing Company and became the home of the mill-sponsored Lowell Day Nursery sometime after 1885, probably about 1889 when the nursery received its charter. The building displays little

(407)

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exterior alteration and still serves as a nursery facility. In the rear it is attached by an enclosed walkway to a new red brick addition.

Locks and Canals Blacksmith Shop (South bank of Merrimack River adjacent to Northern Canal Gatehouse). A small one-story frame structure, the blacksmith shop was used, according to the Massachusetts Historical Commission, in the repair of lock machinery after spring flooding. It appears to be in fair condition.

Northern Canal Gatekeeper's Cottage (On School Street adjacent to Northern Canal Gatehouse). This 1 1/2-story, Victorian style, wood frame cottage was constructed about 1850 to serve as living quarters for the gatekeeper for the Northern Canal.

Boundary Justification. The boundary of the historic district encompasses (1) the entire Lowell canal system including the several waterways and their support structures, (2) the extant structures of each principal 19th-century mill yard that used the system, and (3) several company boarding houses. Not included within the boundary are numerous attendant commercial, municipal, religious, and residential structures that appear also to merit the recognition and protection that they might receive from inclusion in a NHL district. They are excluded largely because they could not be studied adequately within the time and budgetary limits of this survey as a result of (1) new NPS inventory-preparation guidelines resulting from the Tax Reform Act of 1976 (which was passed after the survey was budgeted) and (2) the unavailability of necessary preliminary primary-source data from state and local agencies during the planning stages of this study. Some of these structures already form the Lowell City Hall National Register district, however. Furthermore, because they reflect the social and cultural aspects of Lowell as a planned industrial community, it is likely that they will be the subject of a separate NHL inventory-nomination in the next phase of the survey of commercial and industrial properties. Meanwhile, their ommission from the Locks and Canals district does not detract from its national significance.

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Boundary Description. As indicated in red on the accompanying maps [(1) U.S.G.S. 7.5' Series, Mass., Lowell Quad., 1966; (2) Locks and Canals Historic District Map, 1 inch=250 feet, Lowell Planning Department, circa 1976; and (3) Proprietors of the Locks and Canals on Merrimack River Canal System, reduced from 1 inch=300 feet, Historic American Engineering Record, 1975], a line beginning at a point on the west bank of the Pawtucket Canal at its junction with the Merrimack River and extending in a southeasterly direction approximately 6,000 feet along the right bank of said canal (and encompassing its associated structures at the upper locks) to its junction with the Hamilton Canal; thence, eastward along the south bank of the Hamilton Canal about 275 feet to a point opposite the northwest corner of the Appleton Yard structure owned by Vincent P. Morton at the northeast corner of Revere and Jackson Streets; thence, southeastward approximately 225 feet along the plane of the west side of said building to a point immediately opposite its southwest corner; thence, eastward approximately 750 feet along the plane of the south walls of said building and its associated buildings between Revere and Hamilton Streets to west curb of Hamilton Street; thence, northward about 145 feet along the west curb of Hamilton to the south curb of Jackson; thence, eastward approximately 750 along the south curb of Jackson Street to a point opposite the east side of the Hamilton wasteway near the intersection of Jackson and Central Streets; thence, northward approximately 350 feet along the east side of the Hamilton wasteway to the south bank of the Lower Pawtucket Canal; thence, eastward approximately 1,200 feet to the west bank of the Concord River; thence, northward about 140 feet along the west bank of the Concord at its junction with the Lower Pawtucket to the north bank of the Lower Pawtucket; thence, westward about 375 feet along the north bank of the Lower Pawtucket to its junction with the Eastern Canal; thence, eastward approximately 550 feet along the south bank of the Eastern Canal to a point opposite the northeast corner of the Federal Building on East Merrimack Street; thence, southward approximately 250 feet along the plane of the east side of the Federal Building to the west bank of the Concord River; thence, northeastward approximately 850 feet along the west bank of the Concord to its junction with the Merrimack River; thence, northwestward approximately 1,800 feet along the right bank of the Merrimack to the north bank of the Merrimack Canal wasteway; thence,

(604)

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southwest and then northwest approximately 700 feet along the north bank of the curving Merrimack wasteway to the south bank of the Merrimack Canal; thence, northeast about 150 feet, then northwest about 450 feet, then southwest about 300 feet along the riverside bank of the curving Merrimack Canal to its point of termination; thence, northeastward about 300 feet, then southeastward about 450 feet, then southwestward about 1,000 feet along the opposite bank of the curving Merrimack Canal to its junction with the Moody Street Feeder (and including the gatehouse at that junction); thence, northwestward approximately 1,350 feet along the northeast right-of-way of the Moody Street Feeder to the south bank of the Western Canal; thence, northeastward approximately 280 feet along the south bank of the Western Canal to the northeast curb of the French Street Extension; thence, southeastward approximately 380 feet along the northeast curb of said extension to the north curb of Tremont Street; thence, northeastward approximately 1,250 feet along the north curb of Tremont to the right bank of the Merrimack River; thence, northwestward approximately 1,600 feet along the right bank of the Merrimack to the south curb of Aiken Street; thence, southwestward approximately 600 feet along the south curb of Aiken to the northeast curb of Perkins Street; thence southeastward approximately 190 feet along the south curb of Perkins to a point on a plane parallel to and about 20 feet northwest of the northwest exterior wall of the Lowell Day Nursery at 119 Hall Street; thence, southwestward approximately 200 feet along said plane to the northeast curb of Hall Street; thence, south about 140 feet along the east curb of Hall to the northwest curb of Cabot Street; thence, eastward approximately 200 feet along the northwest curb of Cabot to the northeast curb of Perkins; thence, southeastward approximately 575 feet along the northeast curb of Perkins to the north bank of the Western Canal; thence, westward about 235 feet along the north bank of the Western Canal to the southwest curb of Hall Street; thence, northwestward approximately 525 feet along the southwest curb of Hall to the south curb of Cabot; thence, westward approximately 500 feet along the south curb of Cabot to the east bank of the Northern Canal; thence, north then west approximately 1,750 feet along the east bank of the Northern Canal to the right bank of the Merrimack River; thence, westward approximately 2,000 feet along the right bank of the river to a point opposite the west side of the

(610)

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School Street-Mammoth Road bridge; thence, due northwest approximately 350 feet to the left bank of the river; thence, southwestward approximately 500 feet along the left bank of the river to a point opposite the northernmost tip of the Pawtucket Dam; thence, due east-southeast approximately 1,000 feet to the right bank of the river (and encompassing the entire dam) at a point opposite the southern corner of the Locks and Canals Blacksmith Shop and corresponding to the Proprietors of Locks and Canals property line at that point; thence, northeastward approximately 315 feet along said property line to the west curb of School Street; thence, northward about 75 feet to the south bank of the Northern Canal; thence, eastward and southeastward approximately 3,600 feet along the curving south bank of the Northern Canal to the south curb of Cabot Street; thence, southwestward approximately 375 feet along the south curb of Cabot to the north curb of Moody Street; thence, south along the south curb of Moody about 55 feet to a point opposite the southeast corner of the Suffolk Mills Boarding House; thence, northeast approximately 375 feet along the plane of the southeast side of the boarding house to the north curb of the French Street Extension; thence, southeastward approximately 425 feet along the north curb of said extension to the north bank of the Western Canal; thence, southwestward approximately 2,600 feet and southeastward approximately 425 feet along the north bank of the Western Canal to its junction with the Pawtucket Canal; thence, westward and then northward along the east bank of the Pawtucket approximately 5,900 feet (and including its associated structures at the upper locks) to the right bank of the Merrimack River; thence, westward about 175 feet across the mouth of the canal to the point of beginning.

Excluded from the area described above are four sections defined as follows:

(1) A line beginning at the junction of the south curb of Market Street and the east bank of the Merrimack Canal and extending eastward approximately 475 feet along the eastern boundary of the Bigelow Yard complex to the north bank of the Lower Pawtucket Canal; thence, northeastward approximately 1,500 feet along the north bank of said canal to a point opposite the southeast corner of the Vincent P. Morton building in the Massachusetts Mills complex; thence, north-

611

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westward about 200 feet along the exterior plane of the southwest end wall of said building to the northwest curb of Bridge Street; thence, southwest approximately 125 feet along the northwest curb of Bridge Street to the north curb of Paige Street; thence, northwest approximately 50 feet along the north curb of Paige to a point opposite the northwest corner of the Massachusetts Mills boarding house; thence, northeast approximately 200 feet along the exterior plane of the northwest wall of said building to the north curb of French Street; thence northwest about 125 feet along said curb of French to a point opposite the southwest corner of the Boott Mills boarding house; thence, north approximately 50 feet and then southeast about 125 feet and then northeast about 200 feet along the exterior planes of the northwest end and north sides of the L-shaped boarding house to north curb of Amory Street; thence northwestward along the north curb of Amory to a point opposite the northeast corner of the old Boott Mills Boarding House Block; thence, southwest approximately 210 feet along the exterior plane of the southeast wall of said block to the northeast curb of French Street; thence, northward approximately 500 feet along the northeast curb of French to the south bank of the Merrimack Canal; thence, southwestward approximately 1,250 feet along the south bank of the Merrimack Canal to the point of beginning.

(2) A line beginning at the intersection of the south bank of the Western Canal and the south curb of Broadway and extending approximately 700 feet southward along the south curb of Broadway to the north bank of the Merrimack Canal; thence, northeastward approximately 1,175 feet along the north bank of the Merrimack Canal to its junction with the south right-of-way of the Moody Street Feeder; thence, northwestward approximately 1,250 feet along the south right-of-way of the Moody Street Feeder to the south bank of the Western Canal; thence, southwestward approximately 1,500 feet along the south bank of the Western Canal to the point of beginning.

(3) A line beginning at the junction of the south bank of the Merrimack Canal and the north bank of the Lower Pawtucket Canal and extending approximately 800 feet along the north bank of the Lower Pawtucket to a chain link fence marking the western edge of the Bigelow Yard; thence, northward approximately 620 feet along said fence to the south bank

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of the Merrimack Canal; thence, southwestward approximately 800 feet along the south bank of said canal to the point of beginning.

(4) A line beginning at the junction of the south bank of the Lower Pawtucket Canal and the north bank of the Hamilton Canal and extending approximately 625 feet along the north bank of the Hamilton to the southwest corner of the western-most mill of that portion of the Appleton Yard on the north side of said canal; thence, northward approximately 500 feet along the exterior plane of the west side of said building to the south bank of the Lower Pawtucket Canal; thence, southwestward approximately 650 feet along the south bank of the Lower Pawtucket to the point of beginning.

(613)

unaltered waterways, together with the surprisingly little altered mills and their machinery, form what is probably the most historically significant extant aggragation of early 19th-century industrial structures and artifacts in the United States.

History

Lowell, Mass., is situated on the right bank of the Merrimack River next to Pawtucket Falls. Here, before it joins the Concord River, the Merrimack bends sharply to the south and drops more than 30 feet. Because of its tremendous potential for waterpower development, this location proved one of the two chief ingredients in Lowell's becoming, according to Lowell Canal Survey historian Patrick M. Malone, "America's first great industrial city."[4] The other determinant was a group of ingenious industrialists led by Nathan Appleton and Patrick T. Jackson. Along with Francis Cabot Lowell and others, these energetic entrepreneurs built the country's first modern factory, a cotton textile operation, in Waltham in 1813. With the exception of Lowell who died in 1817, they were anxious by 1821 to establish a new factory to make finer grades of cloth, and they chose East Chelmsford, near Pawtucket Falls and the future site of Lowell, as the location for their venture. Besides Appleton and Jackson, other principals in this new enterprise, the Merrimack Manufacturing Company, included Paul Moody, Warren Dutton, and Kirk and John W. Boott.

Before these industrial developers could build in the area, they first had to secure the holdings and mill privileges of the Proprietors of the Locks and Canals on Merrimack River. Chartered in 1792, this company had constructed a 9,000-foot transportation canal around Pawtucket Falls and linked the upriver country with Newburyport on the coast. In 1803, however, the Middlesex Canal opened a direct route from the Merrimack to Boston and took most of the river traffic away from the Pawtucket, which soon lapsed into financial trouble. In the autumn of 1821 Kirk Boott, acting as chief agent and spokesman for the Appleton group, quietly bought up farm land on both sides of the river and purchased a majority of stock in the canal company. By December Boott's activities had sparked

(593)

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[4]Patrick M. Malone, Selections from the Lowell Canal Survey by the Historic American Engineering Record (Washington, 1976), 1.

a rise in land prices from $20 to $4,300 per acre, but he and his colleagues had acquired some of the choicest property and gained control of the Proprietors of the Locks and Canals. Boott, Appleton, and Jackson all won seats on the company's board of directors.

Early the next year, 1822, Appleton and his fellow promoters pushed rapidly ahead with their plans for developing the area. First, they legally incorporated the Merrimack Manufacturing Company under a State charter and enlisted new investors. Some of those who bought shares had been partners in the old Locks and Canals company, while others were associates of Appleton's in the Boston Manufacturing Company of Waltham. Once their financial arrangements were completed, the promoters turned, says Appleton biographer Frances W. Gregory, "to the mechanics of establishing a mill town in the 'wilderness,' [and] their speed and zeal caught the community by surprise."[5] Kirk Boott, a partner and former British army officer with some engineering training, acted as resident supervisor of construction. Ezra Worthen served as superintendent of a crew of about 500 laborers, and Moody and Jackson provided technical guidance.

Fully utilizing the power potential of Pawtucket Falls presented special engineering problems. Malone explains in a Historic American Engineering report:

> The ideal way to supply a number of mills with water power is to use a single canal running parallel to a river with a falls. If the canal leaves the river above the falls and reenters at some distance downstream, then the land between the canal and the river becomes an extended island on which mills can be placed in a line. By keeping the level of water in the canal close to that of the river above the falls, there will be a major difference in water level between the canal and the river at every point below the falls. Water from the canal can enter the mills on the island to drop through power-producing machinery, such as water wheels,

(591)

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[5]Frances W. Gregory, Nathan Appleton: Merchant and Entrepreneur, 1779-1861 (Charlottesville, 1975), 181.

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

and back into the lower river. In this way, the potential energy of the water due to its elevation, or "head", can power manufacturing processes in each mill.

Unfortunately for the planners of Lowell, the topography of their site and the route of the existing canal were not suitable for implementation of the ideal scheme. The land on the south side of Pawtucket Falls was rocky and rose steeply from the river's edge. The builders of the Pawtucket Canal had avoided high ground by running their channel in a wide arc around the bend in the Merrimack and ending it at the Concord River, close to the junction with the larger stream. Since Boott could not place mills on land higher than the level of the upper river, he had to plan mill sites away from the falls and new canals to reach them. The Pawtucket would have to be reconstructed to feed smaller power canals, but the resulting system would obviously be a complex one, creating far more engineering problems than a single canal. An additional difficulty was the necessity of retaining the original function of the old transportation waterway. Construction supplies, raw materials, and manufactured products would be carried in the Pawtucket Canal for years.[6]

By mid-1823 Boott had completed both the first of the Merrimack Manufacturing Company's mills and the first new canal, also named Merrimack. This waterway extended about 3,000 feet from the swamp locks basin on the lower arm of the Pawtucket Canal directly eastward to the mill site, which was on the bank of the Merrimack River but downstream of the bend. Along this course the new canal maintained the 30-foot, above-the-falls level of the river. Within another year Boott had the Pawtucket Canal operating again as a transportation artery with strengthened guard locks to hold back high water in floods, a set of sluice gates to control flow into the system, swamp locks to drop the water 13 feet into the lower section of the canal, and lower locks for a drop of 17 more feet into the

595

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[6]Malone, Selections from the Lowell Canal Survey, 3.

Concord River. From this rebuilding effort Boott turned again to expansion of the system, and by 1825 he and his follow planners had laid out routes for four more branch power canals, three to feed from the Pawtucket Canal and one from the Merrimack.

Before this work got underway, however, the Merrimack Manufacturing Company's directors, having encountered problems managing their myriad construction and manufacturing activities simultaneously, decided to form a separate company to control their surplus land (about 400 acres), the canal system, and the machine shop. In 1824 the entrepreneurs revived the old Proprietors of the Locks and Canals on the Merrimack River and transferred this property to it. The rejuvenated firm, which had the same principal owners as the Merrimack Manufacturing Company, would sell mill sites to new enterprises established in Lowell and would sell power and textile machinery to both the newcomers and the Merrimack Company. According to Gregory, this reorganization by the Lowell promoters "began the separation of business functions within the textile industry."[7]

The first new factory founded after the reorganization was the Hamilton Manufacturing Company, established by Appleton and associates in 1825. Like the Merrimack Company, which ranked among the first producers of calicoes, the Hamilton Company helped increase the diversity of textile products in the United States. "The development of calico printing," says Caroline F. Ware, historian of New England textile manufacturing, "radically altered the character and uses of plain goods, without changing the process of making the cloth."[8] Americans made no fancy goods, like checks and plaids, until after the Civil War, but the Hamilton Company did turn out bedticking, jeans, twilled goods, stripes, and Canton flannels. It was also the first company to lease water in units called "mill powers," a measure used ever since in Lowell. Led by Appleton, a committee of the Locks and Canals company formulated this means of allocating water privileges to newcomers subject

(continued) (586)

[7]Gregory, Nathan Appleton, 183.

[8]Caroline F. Ware, The Early New England Cotton Manufacture: A Study in Industrial Beginnings (Boston, 1931), 84.

to the prior rights of mills already situated in the community. One mill power represented the amount of power needed to drive the 3,584 spindles and other machinery in Appleton's second Waltham mill, about 60 net horsepower.

Between 1825 and 1836 the Locks and Canals company completed the remaining planned additions to the power system. For the Hamilton Company in 1826 Locks and Canals engineers and construction crews dug an upper level canal south of and parallel to the lower Pawtucket. In 1828 they completed the short Lowell Canal off the Merrimack to serve the Lowell Manufacturing Company; in 1831 they opened the Western Canal which extended from the Pawtucket near the swamp locks to the Merrimack River and served the Tremont, Suffolk, and Lawrence Mills; and in 1836 they finished the Eastern Canal which ran from the Pawtucket above the lower locks to the Merrimack just above its junction with the Concord. The latter canal served the Boott, and later the Massachusetts, mills.

By now, in addition to running the Locks and Canals' own machinery, the system powered 9 mill complexes, including 26 individual mills and 2 print shops. Almost 8,000 persons worked in the mills and turned out nearly 50 million yards of cloth annually. The population of Lowell, which was incorporated and named in 1826, approached 18,000, but houses. and business were situated only where they did not interfere with the routing of power canals and the production of textiles. Waterways and factories dominated the community's landscape. The scene "constitute[d]," says Parker, the first instance in America of the development of a city of the primarily industrial type."[9] And according to Ware, the corporations that ran the factories "called attention to the business advantages of the corporation accumulating a large capital, securing continuity, and making it possible to transfer shares and shift ownership." Furthermore the "enlargement of mills and increase in investment brought a geographical

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[9]Parker, Lowell, 1.

597

shift, drawing the bigger mills away from the small and easily dammed streams of Rhode Island and southern Massachusetts" and moving "the principal seat of the industry to . . . northern New England towns."[10] Lowell, says Groner, became "the Manchester of America."[11]

In 1845 the directors of the Locks and Canals company sold its machine shop and most of its land and then called in all its stock and reissued it to corporations on the canal system. The Proprietors of the Locks and Canals on Merrimack River became a service company for the textile corporations. Immediately they approved plans by Locks and Canals chief engineer James B. Francis to build a second feeder canal to bring additional water into the system. The demand for power had been rising steadily in Lowell, and now in addition to the usual shortages of the summer months, the mills were experiencing difficulties throughout the year. Between 1846 and 1848 Francis supervised construction of the Northern Canal, which ran about 4,000 feet from the head of Pawtucket Falls to the Western Canal; the Great River Wall, which held the canal above the lower rapids of Pawtucket Falls where river and canal ran parallel; the Pawtucket gatehouse, which controlled flow into the canal and operated on a waterpowered Howd inward-flow turbine; and two underground waterways, including the Boott penstock which transferred some of the Northern's flow from the Merrimack to the Eastern Canal. Later, in 1850, Francis built a tremendous wooden portcullis gate over the single lock chamber at the Pawtucket Canal's guard locks. This structure, ridiculed at first, drew wide applause in 1852 and again in 1936 when it proved instrumental in saving the town from flood waters. These and other feats of design and construction, says Malone, earned Francis and his Lowell colleagues elite positions in engineering history:

> Francis' experimental work resulted in an improved inward-flow turbine and in effective methods for measuring the flow in open channels

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[10]Ware, The Early New England Cotton Manufacture, 82, 145.

[11]Groner, American Heritage History of American Business and Industry, 101.

> and over weirs of various shapes. As the agent of Locks and Canals, he could use the canal system as a laboratory for hydraulic experiments. Here at Lowell, perhaps for the first time in America, science exerted a regular and profound influence on technology. Other talented men who worked for Locks and Canals or for the Lowell Machine Shop also made major contributions to our knowledge of hydraulic engineering. Uriah Boyden, Asa Swain, Joseph Frizell, Clemens Herschel, Hiram Mills, and Arthur Safford became major figures in the profession.[12]

Before he retired in 1885, Francis installed hydraulic rams to operate the sluice gates at the Pawtucket guard locks and a turbine to power waste gates in the Great River Wall. Over the years his successors made other improvements, such as adding electric gate controls and implementing dredging and widening programs. Despite these changes, however, the canal system still looks much as it did in Francis' time. Most of the mills that used it have survived too, and several still rely on it for power to turn electric generators.

According to Parker the peak year for Lowell's textile factories was 1918. In 1839, soon after completion of the Locks and Canals company's first major expansion program, the nine principal corporations had approximately 163,000 spindles and 5,000 looms in operation. By 1895 these same firms, along with Massachusetts Mills, were operating 900,000 spindles and 26,000 looms and producing $23 million worth of textiles annually. In 1918 yearly production soared above $73 million. The following year, however, the city's textile production began a marked decline when the Bigelow Carpet Company completed its move from Lowell to Thompsonville, Conn. Already, in 1890, the historic community had slipped to second place among New England textile centers, behind Fall River. Subsequently, during the 1920's and 1930's the Appleton Company moved to South Carolina, and some of the other Lowell mills closed their doors. These

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[12]Malone, Selections from the Lowell Canal Survey, 13.

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developments corresponded, of course, to a rapid increase in textile manufacturing in the South, where electric power proved somewhat cheaper, transportation of raw cotton required less time and expense, and laborers worked for lower wages. Today textile production in Lowell is minimal compared to the late 19th century, but most of the extant mill complexes remain in use, serving a variety of service and storage firms and small industries.

590

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621

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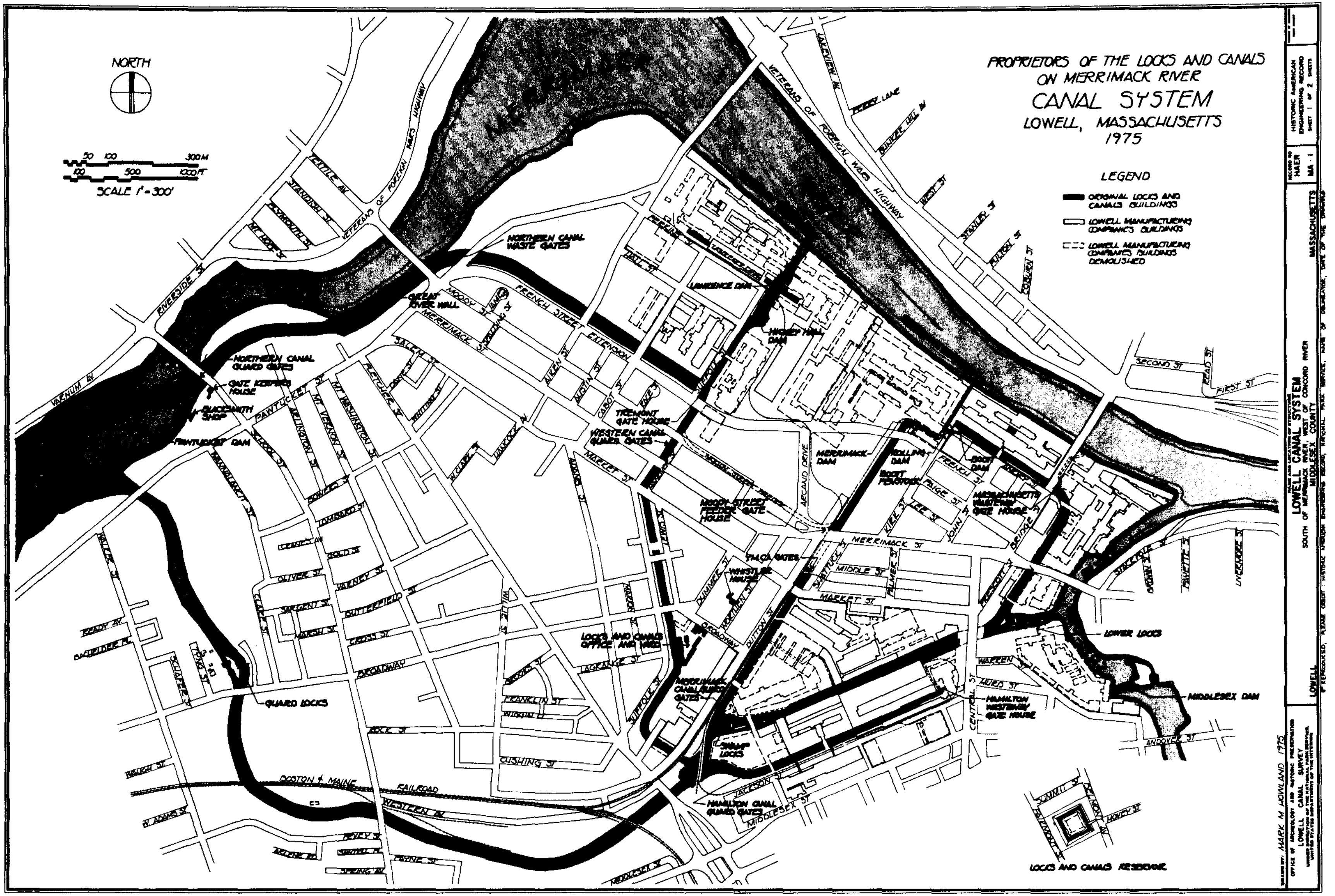
PROPRIETORS OF THE LOCKS AND CANALS ON MERRIMACK RIVER
CANAL SYSTEM
LOWELL, MASSACHUSETTS
1975
LEGEND
ORIGINAL LOCKS AND CANALS BUILDINGS
LOWELL MANUFACTURING COMPANIES BUILDINGS
LOWELL MANUFACTURING COMPANIES BUILDINGS DEMOLISHED
NORTH
SCALE 1" = 300'
NORTHERN CANAL WASTE GATES
GREAT RIVER WALL
NORTHERN CANAL GUARD GATES
GATE KEEPERS HOUSE
BLACKSMITH SHOP
PAWTUCKET DAM
LAWRENCE DAM
HICKEY HALL DAM
TREMONT GATE HOUSE
WESTERN CANAL GUARD GATES
MERRIMACK DAM
ROLLING DAM
BOOT DAM
BOOT PENSTOCK
MASSACHUSETTS WESTERN FEEDER GATE HOUSE
MOODY STREET FEEDER GATE HOUSE
TAGIA GATES
WHISTLER HOUSE
LOCKS AND CANALS OFFICE AND YARD
MERRIMACK CANAL GUARD GATES
SWAMP LOCKS
HAMILTON CANAL GUARD GATES
HAMILTON WASTEWAY GATE HOUSE
LOWER LOCKS
MIDDLESEX DAM
GUARD LOCKS
LOCKS AND CANALS RESERVOIR
VETERANS OF FOREIGN WARS HIGHWAY
MERRIMACK ST
FRENCH STREET EXTENSION
PAWTUCKET ST
MARKET ST
MIDDLE ST
BROADWAY
CENTRAL ST
WARREN ST
ANDOVER ST
MIDDLESEX ST
WESTERN AV
BOSTON & MAINE RAILROAD
VARNUM AV
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CUSHING ST
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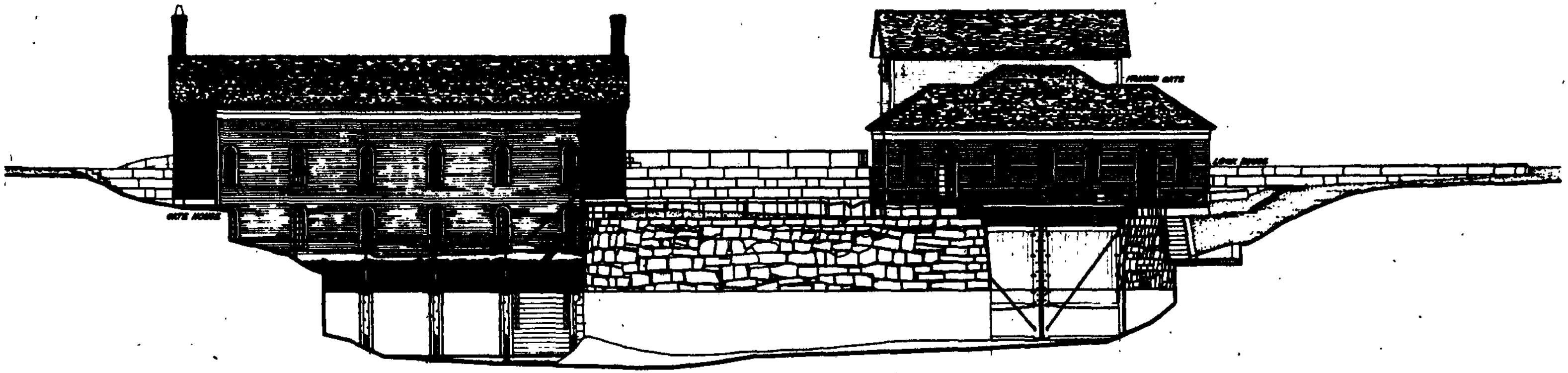

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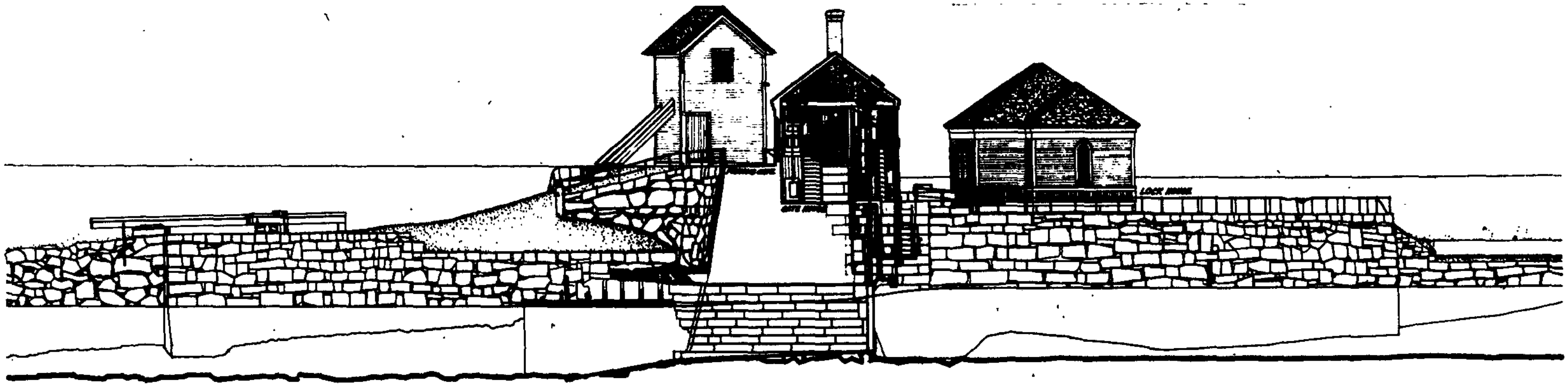


WEST

LESLIE NEWTON 1976

LOWELL CANAL SURVEY

LOWELL CANAL SYSTEM GUARD LOCKS: FRANCIS GATE (1848-50), GATEHOUSE (1870), LOCK HOUSE (1881)

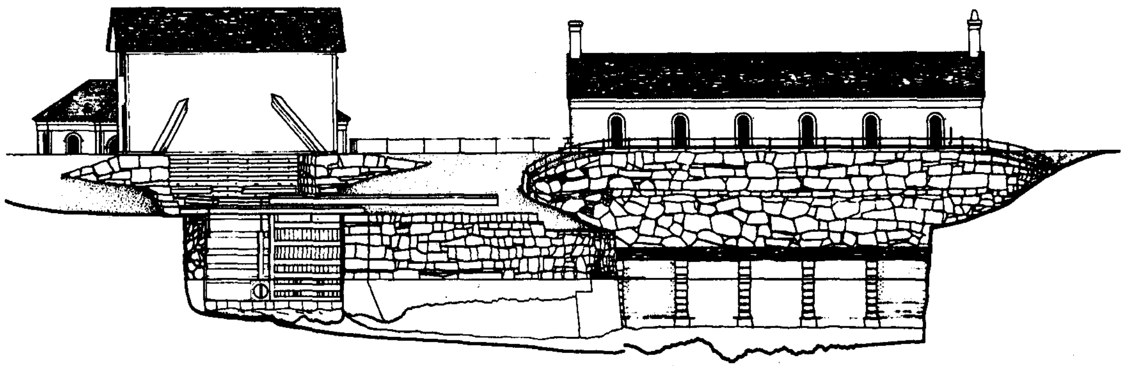
LOWELL

MIDDLESEX COUNTY

MASSACHUSETTS

HAER

HISTORIC AMERICAN ENGINEERING RECORD



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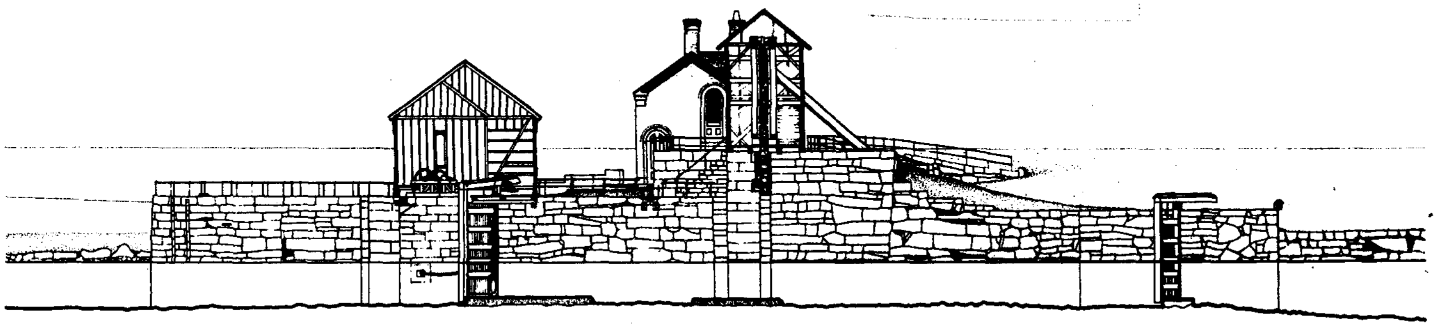

EAST

LOWELL CANAL SYSTEM GUARD LOCKS: FRANCIS GATE, GUARDHOUSE, LOCK HOUSE

LOWELL — MIDDLESEX COUNTY — MASSACHUSETTS

LOWELL CANAL SURVEY

HISTORIC AMERICAN ENGINEERING RECORD — HAER