WATER STREET BRIDGE
(NH DOT Bridge No. 181/100)
Water Street (US Route 3) spanning the
Boston and Maine Railroad tracks
Concord
Merrimack County
New Hampshire

HAER No. NH-29

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NH
7-CON,
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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Northeast Region
Philadelphia Support Office
U.S. Custom House
200 Chestnut Street
Philadelphia, P.A. 19106

HAER
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Location:	Water Street (US Route 3) spanning the Boston and Maine Railroad tracks Concord, Merrimack County, New Hampshire USGS Concord Quadrangle UTM Coordinates: 19.294800.4785300
Date of Construction:	1936
Engineer:	New Hampshire Highway Department
Contractor:	Central Construction Company, Lawrence, Massachusetts
Fabricator:	Boston Bridge Works, Boston, Massachusetts
Present Owner:	City of Concord
Present Use:	Vehicular and pedestrian bridge

Significance: The Water Street Bridge, New Hampshire Department of Transportation (NHDOT) Bridge No. 181/100, is one of thirty-five historic through girder bridges extant in the state of New Hampshire. It ranked fifth under the NHDOT bridge rating system, receiving a total of twenty-one points, exceeding the sixteen points required for National Register Eligibility. The Water Street Bridge is technologically significant because of its variable section girders and cantilevered exterior pedestrian walkways, as well as for the length of its span. The existing bridge was designed by the New Hampshire Highway Department in 1936 and completed the following year. It was fabricated by Boston Bridge Works, prolific builders of railroad related steel structures. This was the third bridge at this crossing over the railroad tracks, the first probably dating from the railroad's construction in the mid-19th century. The present bridge was built as automobile traffic increased on US Route 3, which was the central north-south trunk line through the state. As a bridge on a US route it is considered to be of state historical significance. Of additional importance is its relationship to the railroad, which was the primary factor in Concord's economy through much of its history.

Project Information: This documentation was undertaken pursuant to a Memorandum of Agreement (MOA) between Federal Highway Administration (FHWA) and the State Historic Preservation Officer (SHPO) in 1995-1996 as a mitigative measure prior to the replacement of the bridge. Prepared by Lynne Emerson Monroe, Kari Ann Federer and Teresa J. Kirker Hill, Preservation Company, 5 Hobbs Road, Kensington, New Hampshire, for the New Hampshire Department of Transportation, Concord, New Hampshire.

1. Geographical Context

The Water Street Bridge (also known as the Gas House Bridge, NHDOT Bridge No. 181/100) carries US Route 3/Water Street over the Boston and Maine Railroad tracks at the southeastern edge of the urban core of the City of Concord.

Downtown Concord is located along North and South Main Streets, which parallel the western bank of the Merrimack River just above the flood plain. On the intervale, between the downtown and river are the railroad tracks and Interstate 93. These four parallel north-south transportation routes of different periods, distinctly define the eastern edge of the city center. The section of Concord on the east side of the river has always been sparsely settled, but has experienced increasing commercial development in the late 20th century.

The Water Street bridge is located just southeast of the junction with South Main Street, which forms the lower end of Concord's central business district. South of the intersection, South Main Street continues as Route 3A, along the west side of the railroad tracks. Originally the Londonderry Turnpike, this has always been an important north-south road along the west side of the Merrimack. It now connects with the F.E. Everett Turnpike leading to Manchester and points south. On the west side of South Main is the dense grid of residential streets that forms Concord's South End.

Water Street is part of an equally important route in and out of the south end of the city, leading southeast from South Main Street. Below the Water Street Bridge, Water Street becomes Manchester Street, which continues southeast to an interchange of I-93 and then over the Merrimack River and southeast toward Manchester. Together with North and South Main Streets, Water and Manchester Streets form US Route 3, known as the Daniel Webster Highway, which developed in the early 20th century as the central north-south trunk line through the state.

Water Street on both sides of the railroad overpass contains a mix of residential and commercial properties of varying ages. Along the railroad tracks, immediately above and below the bridge are historic industrial sites, including the Concord Gas Holder and railroad structures related to the operation of the nearby railyards. A small switch house is located immediately off the south end of the bridge's southeast abutment. North of the bridge, the tracks fan out into the former rail yard. South of the intersection of Water Street and Manchester Street is Hall Street, which runs north-south between the railroad tracks and I-93, with dense residential and commercial development along it.

2. Bridge Description

The Water Street Bridge, built in 1936-37, is a single span, through plate girder bridge, with variable sections. The railroad tracks are aligned on a north-south axis, and the roadway over them northwest-southeast (23 degrees north, 20′ west), creating a bridge skew of 56 degrees 11′ right ahead. The overall length of the bridge is 126′-4 3/4″. Span length between bearings varies slightly, 121′-10 3/8″ on the southwest girder and 121′-11 3/8″ on the northeast girder. The riveted structural steel superstructure consists of girders with floor beams. The two girders are thirty-four feet apart on center. The roadway is thirty feet wide from curb to curb. The reinforced concrete bridge deck with asphalt wearing surface dates from 1981. Sidewalks, 6'-3" wide, are cantilevered on either side of the bridge for an overall width, rail to rail, of 46'-6". The abutments are stone, capped with concrete. The bridge historically crossed five railroad tracks; currently there are two tracks in place. The minimum clearance from the tops of the rails to the underside of the southwest girder ranges from 18'-1/2" at the southeast abutment to 21'-6" at the northwest abutment; the northwest girder is slightly higher.

The built-up approaches create the grade separated crossing. The roadway on the south approach has a 8.86% slope, while the slope of the north approach is 0.5%. The embankments slope down steeply on either side of the roadway, held in place by reinforced concrete retaining walls that extend from the ends of the wing walls of the abutments parallel to the roadway. Because of the skew, the faces of the abutments are not at right angles to center line of the bridge, but rather parallel to the railroad track. The alignment predates the existing bridge and was not changed when it was built because of the close proximity of buildings and structures on all sides (Powelson 1996). At the acute corners of the bridge, the wing walls extend in line with the faces of the abutments, parallel to the railroad tracks. The wing walls turn at right angles around the embankment at the obtuse corners

The depth of the girders ranges from 3'-6" to 6', curving from the rounded ends to the highest point in the center. Each girder is created by a series of twelve panels, each 10'-2" long, 9/16" thick and of varying heights, spliced and riveted together to form the web plates. Pairs of horizontal 8" X 8" X 1" angles with 18" X 5/8" cover plates are riveted around the outer edges of the girders to create flanges, and vertical angles on the ends of the girders transmit the load to the supports. The plates are spliced where they overlap and reinforced with vertical stiffeners consisting of riveted angles and plates; intermediate stiffeners are located in the middle of each plate. Bracing is provided by triangular gusset plates on the inner sides of the girders between the upper flanges and the deck. Wrought iron blast plates are shop welded to the bottom flanges of the main floor beams and the girders above the center line of the railroad tracks, to protect the steel from the corrosive gases from the steam engines (Powelson 1996). The ends of the girders bear on cast steel shoes, bolted to the bridge seat. The expansion bearings at the northwest end of the bridge consist of nests of rollers, while the southeast end of the bridge is on a fixed shoe; all have 4" pins.

The floor system consists of sixteen parallel steel I-beams, which vary in length with the skew. The longer floor beams in the clear span are equal in length, resting on the lower flanges of the girders at 10'-2" intervals. The shorter floor beams under the ends of the bridge rest on the bridge seat, spaced about 12' on center, bearing on 3'-6" square concrete pedestals. The pedestals range in height from 3" to 4" on the northwest abutment, and from 7 3/8" to 9 1/2" on the southeast abutment.

The 1936 specifications required that all steel above the roadway and sidewalk slabs be painted with one coat of red lead and oil paint in the shop, and given two field coats of green paint. The lower portions of the bridge received a bituminous coating on all exposed surfaces.

The breast and wing walls of the abutments, dating from an earlier structure, are dressed ashlar masonry, consisting of rectangular granite blocks laid in regular courses. When the current bridge was built, reinforced concrete was added in the plane of the preexisting structure, on top of the bridge seat and wing walls, and extending the breast wall of the southeast abutment. The bridge seat was raised by 3′-4 1/2″ on the northwest abutment, for an overall height from grade to bridge seat of 6′-6″. On the southeast abutment, the bridge seat was raised only slightly, resulting in an overall height 6′, with part of the older stone structure removed from the south end of the abutment to create a recessed bridge seat.

The bridge deck replaced in 1981 is reinforced concrete, 8 1/2″ thick at the curbs and 9 1/2″ at the crown, with a barrier membrane, and 2″ thick asphalt wearing surface. Along both edges of the roadway are 2′ wide concrete curbs poured monolithic with the slab. The deck is attached to the tops of the floor beams by anchor straps and welded tees, and to the girder webs with seat angles. The end dams consist of T bars welded end to end, and the expansion joints are covered with 3/4″ floor plates. The road rails are created by the upper portions of the girders, and vary in height above the roadway.

Cantilevered sidewalks extend along both sides of the bridge, projecting 6′-3″ beyond the outer edges of the girders. Each sidewalk is supported by triangular angle brackets projecting from the lower portions of the girders, creating extensions of the floor beams. The sidewalks have 2″ thick concrete filled steel grid floors coated with boiled linseed oil. These were installed in 1981 to replace the original armored concrete sidewalks. The 3′-6″ high sidewalk railings consists of two parallel, horizontal 3″ pipes and vertical 7/8″ rods. The pipes are welded to H rail posts above each bracket. A gas main runs under the southwest sidewalk, and utility poles are bolted along both outer edges of the bridge. Six foot wide sidewalks extend along the approaches. These consist of concrete slabs now paved over, with 6″ high granite curbs, and railings along outer edges. The concrete retaining walls of the approaches consist of twenty-three, 10′-2″ wide piers, varying in height from 11′ to 9′.

3. Historical Background

Historic maps show that the road that is now US Route 3, including Water Street and Manchester Street, was in place early in Concord's history. This road was an important route of access to the crossing, near the site of the present Manchester Street Bridge over the Merrimack River. This was originally served by a ferry and after 1795, a bridge. The most important route between Concord and points south was the Londonderry Turnpike, which followed South Main Street. Water Street split north of the present Water Street Bridge, and crossed the river, to other early roads continuing southeast toward Pembroke and on to Haverhill and Newburyport, both in Massachusetts, or northeast to the First New Hampshire Turnpike (US Route 4) to Portsmouth (Leavitt 1803; Carrigain 1816). Residential development was spread out along Water Street, as evidenced by the French-Thompson House, a significant brick Federal style residence, adjacent to the southwest end of the bridge. Activity in this southeastern part of the city was related to the nearby river, particularly to the river boat transportation system that operated from a wharf near the Manchester Street Bridge.

The coming of the railroad in 1842 enhanced Concord's position as a transportation hub, and resulted in increasing development and activity in this section of the city. The Concord Railroad was organized in 1835 to build a railroad from Lowell to Concord; the tracks from

Nashua to Concord were completed in 1842. Other railroads to points north, including the Boston, Concord and Montreal Railroad, were established by 1850. Concord became the regional railroad center. The original railroad shops and freight yard were located south of Bridge Street, north of Water Street, and the railyard extended along the eastern edge of downtown Concord, covering some fifty acres (Hengen and Samson 1994:4). In 1897 the railroad shops shifted to the South End following a fire at the previous site (Lyford 1903:890). The yard contained repair shops, round houses, and related buildings, along the west side of the tracks adjacent to Hall Street (Sanborn 1923). The height of railroading in Concord occurred between 1898 and 1925 when it was the division headquarters and one of the most important car repair facilities in the state, employing 1,300 people, the city's largest employer (Hengen and Samson 1994:ix). The switch house adjacent to the Water Street Bridge controlled the switches and signals leading in and out of the railroad yards. An average of twenty-five passenger cars and an equal number of freight cars passed through the city daily, while in the summer months there could be over a hundred passenger trains in a day (Winship 1965; Lyford 1903:890). Through traffic passed under the Water Street Bridge, as did trains heading in and out of the railroad yards or onto sidings of the adjacent industries (Frye 1996).

The construction date of the first overpass over the railroad tracks at Water Street has not been identified, but it was probably at the time of the railroad's construction or shortly thereafter due to the quantity of traffic that would have travelled on this route to the bridge and points beyond. Maps in Concord city directories from 1844 and 1850 show the road over the railroad tracks in this location, while at other crossings the tracks were over the roads, suggesting that a bridge at Water Street was in place and was the first of its type in the city (Watson 1844; Watson 1850). Discussion of this particular crossing was not found in Concord annual reports, but in 1850, the City did vote that the railroads must build bridges or bars at several other crossings (Concord Annual Report 1850). The construction of overpasses was soon required by law, expenses were shared in various proportions by the town and the railroad proprietors, and following the reconstruction of the crossing, the abutments and superstructure of the bridge were maintained by the railroad, while the wearing surface was the responsibility of the state or city (State of New Hampshire 1938; Powelson 1996).

Industrial activity developed along with the railroad and in close proximity to it. Concord's strong industrial base was compiled of many small factories. One of the most significant companies was the Abbott and Downing carriage factory, which had been established in 1827, north of the Water Street crossing along the west side of the railroad tracks. The Concord Gas Light Company was incorporated in 1850 and established a gas works on land acquired from the railroad, on the west side of the tracks adjacent to the Water Street Bridge. The existing gas holder was constructed in 1888 and the steel gas holder in 1921. Gas was produced from coal and oil brought to the site by the railroad and the large coal house was located along the railroad tracks below the Water Street crossing (Openo 1979; Sanborn 1879). Holt Brothers Carriage Company, which supplied wheels and woodwork for Abbot and Downing was established in 1872 on land bought from the railroad (Openo 1979). Their shops were located south of the Water Street crossing, between the gas company and the railroad yards on the west side of the tracks; Holt Brothers lumber yards were immediately along the tracks (Sanborn 1879).

The growth of industry created a demand for housing in this area and large tracts of land west of South Main Street were subdivided and developed in the mid to late 19th century, creating a grid of streets with closely spaced house lots (Openo 1979). Hall and Water Streets became somewhat more densely settled, and the Water Street crossing provided access from the outlying end of the city. There was still no development on the east side of the Merrimack, but Water Street and Manchester Street were important for through traffic between Concord and points south.

The 1879 Sanborn insurance map shows a wooden covered bridge with a corrugated iron roof (Sanborn 1879). This bridge was replaced prior to 1923 when an iron bridge is shown (Sanborn 1923). The bridge previous to the existing one, apparently the successor to the iron bridge, was a steel truss bridge with a plank floor, apparently built by the New Hampshire Division of the Boston and Maine Railroad. It had a span of 113.8 feet clear, with a height of 18 feet at pins. The roadway was 16 feet 9 inches between wheel guards, and 17 feet 11 inches between rails, having no sidewalk. The substructure was of squared stone masonry, which was reused within the existing abutments (NHDOT bridge card; Powelson 1996).

Between 1902 and 1933, the tracks of the Concord and Manchester Electric Railway passed over the Water street crossing. The tracks followed Hall Street south and crossed the Merrimack on a bridge with a "gauntlet track" shared with the railroad. Another line ran south on South Main Street to the car barns, in the vicinity of the lower railroad yard (Frye 1996; Sanborn 1923).

With the advent of automobile and truck transportation, better road surfaces and bridges were required to bear heavier loads and more frequent traffic. Better roads became a prerequisite for bettering the state's economy and encouraging the tourism that was vital to it. In 1903, the New Hampshire legislature passed laws that created the post of State Highway Engineer, called for statewide survey of highways, and designated certain roads as state highways. The State Aid Law of 1905 authorized the construction and maintenance of highways with state funds. In 1909, a system of three trunk line state highways was established, to run from the Massachusetts border, up the valleys of the Piscataqua, Merrimack, and Connecticut Rivers, and converge in the White Mountains (Garvin and Garvin 1988:188-189). The trunk line routes generally followed existing roads, and maintenance remained the responsibility of the cities and towns with assistance from State Aid funds. The Merrimack Valley Road, now US Route 3, was the north-south road through the center of the state (Bureau of Public Roads 1927). In 1921, 1925 and 1931, sections of the Merrimack Valley Road became a state highway known as the Daniel Webster Highway, running from the Massachusetts line through Nashua, Manchester, Concord, Franklin, Laconia, Plymouth, Woodstock and north to the Canadian border.

A nationwide system of primary roads, eligible to receive federal funds, was established with the Federal Aid Highway Act of 1921. In New Hampshire, these roads followed the trunk lines, and totalled 989 miles. In 1925 a federal highway numbering system was created, and the Daniel Webster Highway became US Route 3. In that year, the 16.2 mile stretch of Route 3 between Manchester and Concord saw an average of 3,906 vehicles daily (Bureau of Public Roads 1927). Sections of road within urban compact areas of cities of more than 2,500 inhabitants, which in Concord included South Main Street, but not Water Street at this time, were originally ineligible for federal funds (Anonymous n.d.; State of New Hampshire 1938). At this time, Concord's urban compact area included South Main Street, but not Water Street and points south. However, in 1933, the National Industrial Recovery Act allowed for federal aid to be spent on federal highways even in the urban compact zones (New Hampshire State Highway Department 1934). The Concord Board of Public Works applied for National Industrial Recovery Act funds to rebuild South Main Street, and in December of 1933, applied for a loan and grant of $45,000 to construct a new Gas House Bridge and approaches (City of Concord Annual Report 1933). Plans for a new Gas House Bridge at the Water Street railroad crossing had been drawn by the New Hampshire Highway Department in the spring of 1933. These differed only slightly from the bridge as built, with less variation in the depth of the girders and a greater number of floor beams. However, in 1934 Concord cancelled its applications for federal assistance, and the bridge was not built (City of Concord Annual Report 1934-1935; Concord City Engineer's Office, bridge plans).

The bridge at the Water Street crossing became the responsibility of the State when it assumed full control of construction and maintenance of all trunk lines (except those in urban compact areas), including bridges thereon in 1933. In the case of railroad bridges, the state was only responsible for the deck and road surface, while the railroad company was responsible for the substructure (Laws of 1933, Chapter 28).

The subject of a new bridge was resumed 1936, following the appropriation of $822,484 to New Hampshire for railroad grade separation and protection under the Works Program of the Emergency Relief Appropriation Act of 1935. Little of this money had been expended by the end of 1935, but all was appropriated for projects approved by the U.S. Bureau of Public Roads. Over the next several years eighteen grade separation projects were carried out in the state, greatly increasing the safety of highway travel. The State apportioned $101,024.34 to a Concord Works Program Grade Crossings account (City of Concord Annual Report 1935-1936; New Hampshire State Highway Department 1936, 1937). New plans for the Gas House Bridge were drawn by the New Hampshire Highway Department in 1936.

According to the NHDOT bridge card, the estimated cost for the bridge and approach structures was as follows:

Earth Excav.	1680 c.y.	.75	1260.00
Gr. Curb Inlets	3	15.00	45.00
Reinf. St.	155,877 #	.05	7793.85
Conc Cl. "A"	350 c.y.	22.00	7700.00
" " "B"	804 "	20.00	16,080.00
" " "C"	47 "	15.00	705.00
Brick Masonry	0.8 M	40.00	32.00
Gr Curb (7 X 18)	26 LF	1.50	39.00
" (4 X 12)	677 LF	1.25	846.25
3 1/2" Conc. Sidewalk	25 S.Y.	2.00	50.00
Str. Steel	263,700 #	0.057	15,030.90
Br. Rail "E" (App)	701 LF	5.00	3505.00
" (Br)	244 "	5.00	1220.00
PreMix As Br. Floor	47 T	10.00	470.00
Paint Waterproofing	415 SY	0.50	207.50
Blast Pls. (W.L.)	8150 #	0.07	570.50
Str. Excav.	35 CY	2.00	70.00
Remove Super (2)	lump sum		1000.00

Substr.	165 CY	2.00	330.00
Bit. Coating for SS.	2000 SF	1.30	2400.00
[error - above sub total should be 2600.00]			
Relocation of P.U. Poles	lump sum		5998.93
Armered Conc. Sink Floor	1652 SF	0.90	1486.80
C. B. (??) Gratings	3 ea	15.00	45.00
Maint. Gas Service	lump sum		out
Temporary Bridge (Foot bridge)			1600.00
			$68,330.73
[error, sub total should be $68,485.73]			
		10%	6833.07
			$75,163.80

A total of $63.482.25 was expended on the project in 1936, and $31,859.92 the following year (New Hampshire State Highway Department 1937, 1938). The bridge was fabricated by Boston Bridge Works. The contractor was Central Construction Company of Lawrence, Massachusetts (NHDOT bridge card). The new bridge opened in 1937. The bridge was maintained by the State and the Railroad. In 1940 the approaches were paved with bituminous macadam pavement. In 1950, emergency repairs were made to the sidewalk, costing $73.14 for labor and $51.10 for unspecified materials, for a total of $124.24. In 1954, repairs were made to false portal at a cost of $7,162 (NHDOT bridge card)

As automobile and truck traffic increased, a system of interstate highways was established in 1956, and Interstate-93 was constructed replacing Routes 3 and 3A as the primary north-south highways through the center of the state. Exit 13 of I-93 is located just southeast of the Water Street Bridge, between it and the Manchester Street Bridge.

The highways replaced the railroad in importance for transportation in the region. A daily passenger train was in operation as late as 1965 (Winship 1965). Presently the tracks remain active, but on a much reduced scale (Powelson 1996). The railroad line is owned by Guilford Industries of North Billerica, Massachusetts, and leased to New England Southern, which has its headquarters in the old switch house adjacent to the Water Street Bridge (Frye 1996). Commercial and industrial activity continues in the vicinity of the railroad tracks. On the east side, adjacent to the bridge are the tanks and warehouses of Gulf Oil which purchased land from the railroad in 1922. The gas company continues to operate from its historic site, though gas is no longer produced there (Openo 1979; Sanborn 1979)

The Water Street Bridge is presently located within the urban compact area and is therefore owned and maintained by the City of Concord. The bridge was redecked in 1981. The total cost was estimated at $168,425.04. Federal Aid provided some funding. The contract was administered by the N.H. Department of Public Works and Highways, and the new deck designed by its Bridge Design Division. Work was done by Shoals Construction of Eliot, Maine. Vehicular traffic was diverted, but a temporary foot bridge was in place during the project. The old deck was removed and a new concrete bridge deck installed, paved with a one inch base course and one inch wearing course. The sidewalks were replaced with new filled steel grid sidewalks. At the same time, stiffeners were patched and the sidewalk bracing reinforced (NHDOT bridge cards and plans).

Presently the Water Street Bridge is in poor condition and does not meet current standards in the width of the roadway or clearance over the railroad tracks (Powelson 1996). The through plate girders have areas of heavy section loss at their ends, and collision damage to their topsides. The floor beams have tears in the webs and areas of heavy section loss at the ends. The sidewalk support channels are heavily rusted with holed areas. The concrete deck is spalled at the haunches, with light leaking. The undersides of the sidewalks are rusted and holed. The paint is in poor condition, with heavy rusting and section loss to the metal. There are light cracks in the abutments, backwalls and bridge seats, and heavy spalls with rebar exposed and rusted. There are large cracks in the concrete wing walls, and the southeast wing has settled. The approach pavement is cracked and settled, and the granite curbs are loose and settled. The approach sidewalk slabs are holed and spalled with rebar exposed, and in some areas they have little or no bearing on the pier walls. Recent repairs by the City of Concord have included patching thin and holed areas in the floor beams, and the installation of temporary bracing under the sidewalks. The bridge and sidewalks are expected to remain in service until 1998 (Concord City Engineer's Office, bridge inspection reports).

4. Technological Significance

The modern girder bridge evolved out of simple 17th and 18th century bridges with parallel solid wooden beams (girders), with decking resting on top, used to extend across small spans. Later girders were made out of iron, steel and reinforced concrete as those technologies developed. By the early 20th century, the girder system was commonly used for railroad bridges, which needed solid, stable crossings capable of withstanding fast-moving, heavy traffic. Plate girder bridges were simple to manufacture, and faster to erect. However, the initial restriction on their use was the extensive amount of material required, especially compared to truss designs of similar size (Jackson 1988:38). For spans of over seventy feet, a riveted truss bridge would use less metal than a girder bridge. At the same time, it was difficult to transport long girders from the bridge works to the site (Johnson et. al. 1904:3). Use of the two girder system increased when fabrication costs for truss type bridges rose, while the costs for materials and shipping became less expensive; thus the deck plate girder bridge "evolved out of practicality and cost, rather than as a unique engineering design" (Historic Bridge Inventory Committee 1992).

Because rolled steel I beams large enough for these bridges could not be manufactured until after 1930, built-up girders were formed by riveting together large steel plates and other metal shapes into an I beam, hence the term plate girders (Jackson 1988:38). The girder is manufactured from a pair of angles for the top and bottom flanges riveted together with a rectangular plate, which serves as the web member. The longer the span, the heavier the angles and the thicker and deeper the plate. The flanges are reinforced by one or more cover plates along the top and bottom of the resulting beam, and stiffeners or angles riveted vertically along the plate add rigidity to the web (Cooper 1987:105). Plate girders were generally used for spans of between thirty and a hundred feet, though some were up to 126' long (Ketchum 1920:111, 158)

Girder bridges can be either deck girders, with the roadway resting on top of the girders, or through girders, with the road located between the girders, as in the case of the Water

Street Bridge. The roadway is carried on a floor system supported near the bottom of the girders; this type was used when additional headroom was required under the bridge (Johnson et. al. 1904:182).

The first known example of a roadway through plate girder bridge in New Hampshire was the Tappan Street bridge in Farmington. Other early examples include a three span bridge between Walpole, New Hampshire and Westminster, Vermont, built in 1910, and a single span bridge in Walpole built in 1919 (Anonymous n.d.). Through plate girder bridges increased in popularity during the early 20th century. A peak in their construction came in 1928 when at least nine were built in the northern part of the state, following the 1927 flood. Other new bridges that year included five high pratt trusses, four high parkers, six high warrens and nine concrete arches. NHDOT records indicate that twenty-four through plate girder bridges, most single span, were built between 1929 and 1941. They were frequently used in west central New Hampshire over the Warner, Smith and Baker Rivers, although their use was by no means restricted to this area. The reason they were used more often in some areas than others may relate to the availability of rail service for transportation of the girders to the area (Anonymous n.d.).

The Water Street Bridge is one of thirty-five historic through girder bridges extant in the state of New Hampshire. The State's Historic Bridge Inventory Committee ranked it fifth in the thematic review of the type conducted in 1988, with twenty-one points out of a possible thirty-eight (the highest value received by any of the bridges was twenty-four points). Its structural system and engineering were considered unusual or novel because of its variable section girders and the cantilevered exterior pedestrian walkways. It had the longest span of any roadway bridge of this type; the typical span was less than a hundred feet. The Water Street Bridge was considered to have noteworthy proportions and details, affecting its environmental quality. It was deemed to be in original condition, while there had been some minor site alterations (Historic Bridge Inventory Committee 1988).

The Water Street Bridge was built by a "prolific builder of conventional types." It was one of many bridges designed by the New Hampshire Highway Department during the period. Its fabricator, Boston Bridge Works, was founded by D.H. Andrews in 1876. The firm ranked second in New England to Berlin Iron Bridge Co. in structural fabrication capacity. However, the two firms did not often compete directly because Boston Bridge built mostly for railroads, while Berlin built highway bridges. Boston Bridge Company served a national market, with many western railroads among its customers. Movable bridges were a specialty, and other products were turntables and roof trusses. An advertisement referred to the company as "designers and builders of railroad bridges and heavy wrought iron structural work of ever description. Superior wrought iron turntables a specialty" (Darnell 1984:23). The bridge works were located at Cambridgeport. Boston Bridge was one of the few companies that had not been absorbed by the massive American Bridge Company (Historic Resources Consultants 1985).

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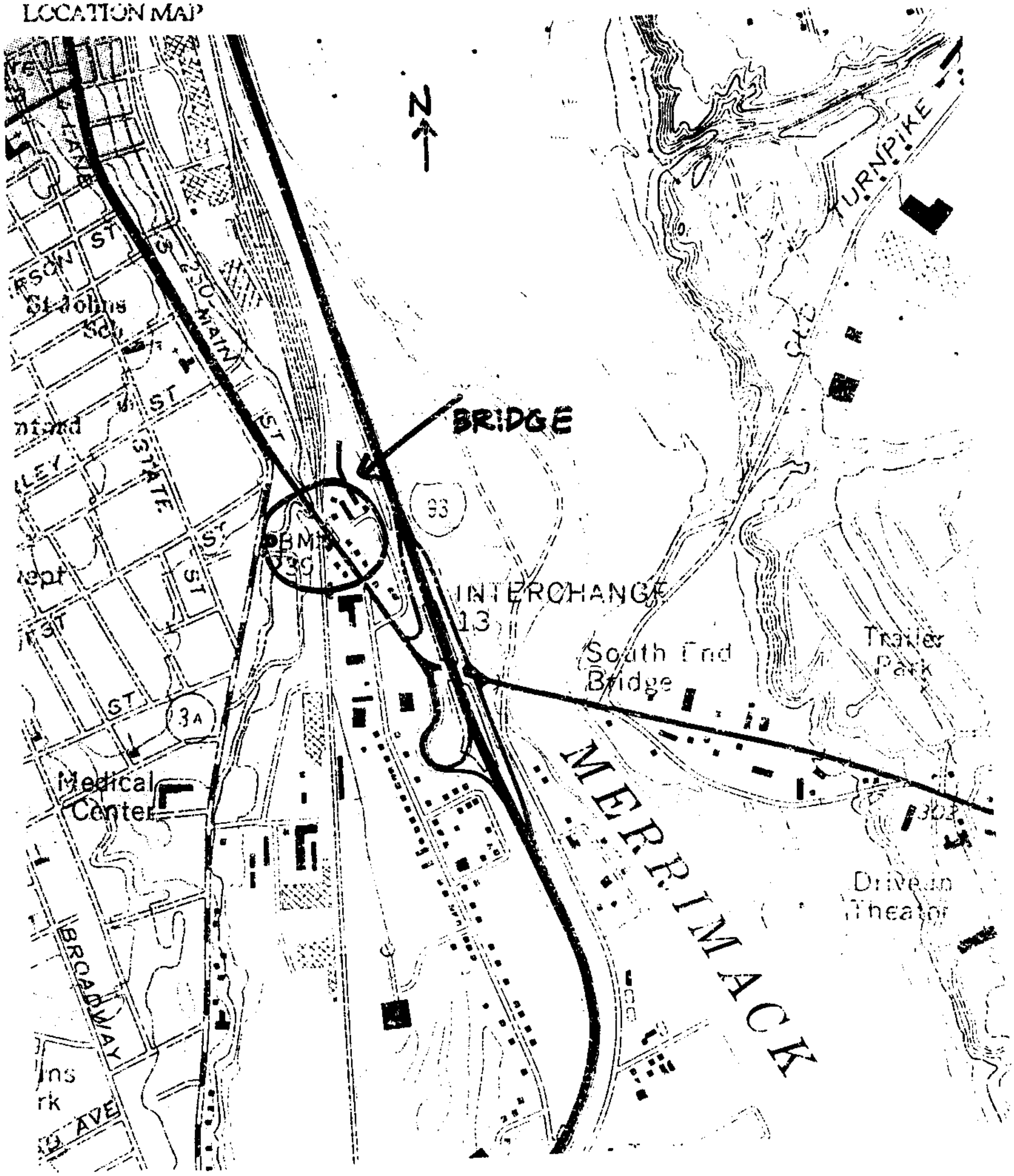
LOCATION MAP



GRAPHIC DOCUMENTATION

SITE MAP