MYSTIC RIVER BRIDGE
(Bridge No. 362)
U.S. Route 1, spanning Mystic River
Croton
New London County
Connecticut

HAER No. CT-174

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

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

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(Bridge No. 362) HAER No. CT-174

Location:
U.S. Route 1, spanning Mystic River
Groton
New London County, Connecticut

USGS Mystic Quadrangle
UTM Coordinates: 19.251590.4582160

Date of Construction: 1922

Engineers: Waddell & Son, Thomas E. Brown & Son
Fabricator: American Bridge Company
Contractor: J. E. Fitzgerald Company

Present Owner:
State of Connecticut
Department of Transportation
2800 Berlin Turnpike
Newington, Connecticut 06131-7546

Present Use: Vehicular bridge

Significance: The Mystic River Bridge is significant as an example of the Brown Balance Beam Bascule, an innovative design that raised movable-bridge technology to a new level of refinement in the early 20th century. The bridge also has historical significance because it completed the State Highway Department's improvement program for coastal Route 1, Connecticut's most important "Trunk Line" highway.

Project Information: This documentation was undertaken in accordance with a Memorandum of Agreement between the Federal Highway Administration and the Connecticut State Historic Preservation Office. The bridge is scheduled for major rehabilitation.

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Description

The Mystic River Bridge crosses the Mystic River between the towns of Groton and Stonington, Connecticut. The bridge is located within a small commercial and residential village, known as Mystic, that extends back from the river on both sides. Small commercial blocks, stores, and restaurants form the immediate surroundings of the bridge, and usually there are numerous power and sail craft moored at the wharves that line the riverbanks. The east side of the river south of the bridge is now a public park. The Mystic River, a tributary to Long Island Sound, has about 4 feet of tide at this point.

The bridge is a steel single-leaf bascule built in 1922. It follows the Brown Balance Beam design, named for its inventor, Thomas E. Brown. The plate-girder bascule, 85 feet in length, is raised with the assistance of two 230-ton concrete counterweights attached to the ends of overhead trusses, known as balance beams, which pivot on a tower structure at the west end of the bascule. Linkage arms run from the east ends of the balance beams to the tops of the bascule girders. Inclusive of three deck-girder approach spans and the short span for the tower structure, the bridge measures 223 feet long overall. The bridge has an overall width of 48 feet, including a two-lane 33-feet-wide roadway and two 5-feet-wide concrete sidewalks carried outside the girders on angle outriggers. The bridge provides a channel 75 feet wide between the wooden fenders protecting the piers; it crosses close to the water, at a level approximately 4 feet above mean high tide.

The bascule span's two main girders are 7 1/2 feet deep and 80 feet long, with stiffeners at intervals of 3 feet. Between them run a series of plate-girder cross beams, 3 feet deep, that carry the floor structure at a level about midway up the main girders. Diagonal sway bracing extends from the cross-beams up through the roadway to the inside face of the girders. The present deck, an open steel grate, was installed in 1936. Prior to that, the bridge had a deck of thick wooden blocks. The bascule pivots on large trunnions at the west end.

Piers and abutments are of reinforced concrete construction; because of the extensive wooden fenders erected as protection, none are readily visible.

There are two principal mechanical systems in the bridge: the drive mechanism, which transmits the force produced by electric motors through the drive linkage to the bascule; and the counterweight mechanism, which balances the weight of the bridge through a separate linkage. Each side of the bridge, that is, each of the two principal girders, is raised by its own drive and counterweight linkage and has its own motor housing and pit for the gears beneath the roadway at the west end. The bridge is raised directly by an operating arm connected between the top of the girder and the circumference of a large cast-iron segmental spoked wheel. A rack gear on the underside of the wheel, described in contemporary accounts as a "bull wheel," is driven by a pinion gear, which in turn is powered by a series of reduction gears located in the pit, including a worm gear set that provides a 20:1 reduction. The motors for the bridge were originally in the pit as well, but following the hurricanes of 1955 they were relocated to shed-roofed clapboarded motor housings located above the sidewalk adjacent to the counterweight tower structure. The motors drive the reduction gearing in the pits by means of heavy chains running in a conduit. Although the motors themselves and the chain arrangement are modern, the rest of the drive mechanism, including a hydraulically operated brake on the reduction gearing, appears to be original. There is an emergency manual drive, accessed through an opening in the center of the roadway between the towers, that operates a shaft connecting the two drive pinions.

The two reinforced-concrete counterweights, enclosed in steel-plate covering added in 1937, are rigidly attached (in fact, poured in place around) the west ends of the 60-feet-long balance beams, the other ends of which are attached to long eye-bars forming connecting arms to the middle of the bascule girders. The arms have short links, pivoted at both ends, near their point of attachment to the tops of the bascule girders. The balance beams are connected by light transverse bracing.

The towers that carry the balance beams are triangular in profile and are built of large box-girder uprights with angle-iron bracing. The towers, 34 feet in height, are connected by transverse portal struts with diagonal sway bracing, resulting in an overhead clearance of 13 feet 2 inches for the roadway.

The operation of the bridge is controlled from a clapboarded, two-story hip-roofed operator house located on the south side of the south tower, cantilevered out over the river on steel beams. The current operator house is a replacement for the original, which was of similar appearance though only a single story in height and located at the roadway level. Existing records do not record precisely when the operator house was rebuilt at its present height, though it was sometime between 1936 and 1955. The current Cutler-Hammer operating console dates from the 1950s, with the exception of an original Westinghouse hydraulic brake controller.

There are two identical commemorative bronze plaques mounted on the bull-wheel enclosures; they give the name and date of the bridge and list the names of the highway-department officials, the Groton and Stonington selectmen, and the two contractors, J. E. Fitzgerald and the American Bridge Company. Smaller plaques identify the number and date of Thomas E. Brown's patent for this type of bascule.

Other than the changes already cited, the bridge has undergone few alterations that affect its historic appearance: originally, the bridge carried streetcars on a set of tracks in the center of the roadway; catenary towers at the end of the bascule and the east approach provided support for the overhead wire. Also, the present sidewalk railings and street lights are of relatively modern construction.

Historical Background

The histories of this crossing and Mystic Village are inextricably intertwined. The immediate area was not a particular focus of settlement or other activity until the first bridge was erected in 1819. Undertaken by a private company with a charter granted by the State Legislature, the bridge provided a convenient coastal route between New London and Groton on the west side and Stonington and Rhode Island points to the east. The bridge was a wooden structure with a lift span to accommodate waterborne traffic. The Mystic River was an important waterway because of the numerous shipyards lining its banks, most of which were north of Mystic village. Merchant vessels, fishing boats, and whalers were produced in great numbers in Mystic beginning as early as 1670 and continuing to the early part of the 20th century. The shipbuilding and refitting businesses gave rise to a number of secondary enterprises, such as forges, chandleries, and other suppliers. The Mystic River in the early 19th century also had a number of mercantile wharves and was used by residents engaged in whaling, all of which tended to bring a certain prosperity to the vicinity.

The bridge across the river provided a focus for much of the commercial activity associated with shipbuilding and shipping. Along with ship supplies, artisan shops, and general provisions stores, Mystic accommodated inns and taverns catering to travelers. Throughout the 19th century, the village was a modestly prosperous small commercial center. Although the shipyards are now gone, the river remains an important resource used by large numbers of recreational sailing vessels, steam and sail tourist excursions, and activities associated with Mystic Seaport Museum, located a short distance upriver from the bridge.

The original wooden bridge was rebuilt twice in wood, each time with a draw span. The two towns took joint ownership of the bridge beginning in 1854. In 1866 it was rebuilt in iron as a symmetrical swing span pivoting on a center pier. That bridge was a Truesdell cast and wrought-iron truss with cables running from the ends to a central tower structure; although a questionable design from the perspective of scientific engineering, the bridge served for nearly 40 years, at which time the needs of the Groton and Stonington Street Railway made it obsolescent. The towns replaced it with a larger, more conventional steel through-truss swing-bridge in 1904.

That bridge also might have sufficed for many years were it not for the fact that Connecticut's coastal route was quickly becoming overburdened by rising automobile and truck traffic. Route 1 was the most important of the state's "Trunk Lines," a system created in 1907 whereby the State Highway Department assumed responsibility for the re-construction and maintenance of fourteen major roads. The Trunk Line legislation recognized the desirability of creating a system of interconnected improved roads to serve the entire state. Enacted at a time when the Connecticut General Assembly was disproportionately dominated by rural interests, the Trunk Line system was regarded as vital to increasing the Connecticut farmer's access to markets. In 1915, the legislature added the construction of Trunk Line bridges to the responsibilities of the State Highway Department.

Planning began immediately for a series of improvements to the coastal route, straightening it, widening it, and installing a number of movable bridges across local waterways. The new bridges were wider than their predecessors and had the load capacity to accommodate the heavy truck, automobile, and streetcar traffic that shared the road along Route 1. The bridge in Mystic was the final link in that first program of improvements.

Technological Significance

The Mystic River Bridge is a good example of the ongoing refinement of the bascule bridge by early 20th-century engineers, two of the most eminent of whom, J. A. L. Waddell and Thomas E. Brown, collaborated in its design. The choice of a bascule to replace the swing bridge at the Mystic River crossing reflected several advantages of the type. Bascules provided a single wide channel rather than the two channels created by a swing bridge's center pier, an distinct advantage in the case of a relatively narrow waterway such as that at Mystic. The danger of obstruction posed by the pier was also a heightened concern because of the experience of World War I, during which it became apparent that many of the country's shipbuilding and other industrial resources depended upon relatively narrow channels leading off the coastal waterways of the Northeast. Bascules also offered the possibility of being partly raised to allow smaller craft to pass (though currently the bridge is always put through a full cycle) and generally faster operating times than swing spans. Finally, bascules preserved the possibility of widening the roadway by simply constructing an additional parallel bridge, an option not possible with swing bridges. Although relatively few bascules were ever widened in this way, the need for future widening was specifically considered at the time of the Mystic Bridge's design (Hovey 1926, I, 128).

In developing the Mystic project, the State Highway Department rejected a vertical-lift bridge because of the extreme height clearance needed by river navigation (135 feet) relative to the channel width, and the closeness of buildings on both sides of the river made a swing bridge of the desired width impractical. The choice that remained was among several variants of the bascule.

American bascules had undergone a period of great technological innovation in the 1890s and early years of the 20th century. First in Chicago, where rails, roads, and river channels intersected in an especially busy and intricate matrix, and then throughout industrial America, steel bascules were built to provide stronger, more reliable, and faster-operating bridges across navigable waterways. Particularly with spans under 100 feet, the challenge involved both structural and mechanical engineering innovation in order to optimize load-bearing capacity, operating speed, and resistance to wind, all the while minimizing the cost of construction and maintenance.

A number of unique approaches were developed, among them several designed by Thomas E. Brown. This particular Brown design was believed to have several distinct advantages. Because of the extra link in the connecting arms, the overhead beams and counterweights rotate only 69 degrees for 90 degrees of bridge movement. Since they do not have to move between the towers, the counterweights can be kept in the same vertical plane as the main girders and operating linkages, minimizing transverse forces. Also, the bridge does not require toe locks: the weight of the girders and the inertia of the mechanism provide sufficient downward force at the end of the leaf. The bull-wheel arrangement makes it impossible to overdrive the bridge when lowering it, thus simplifying motor control. Finally, the articulated linkage arm and the leverage of the bull wheel act as a stop at the top of the cycle, braking the bridge and keeping it from moving against the tower. According to its proponents, these considerations allowed the Brown design greater economy of material compared to competing designs such as the Strauss bascules.

The Mystic River Bridge received considerable attention in the technical literature of the period. In addition to a lengthy description by the son of the inventor in Transactions of the American Society of Civil Engineers, the bridge was discussed by J. A. L. Waddell (the consulting engineer for the overall Mystic River Bridge project) in his influential Economics of Bridgework (1921, p. 291), in which he praised the Brown patent as "the most economic bascule with overhead counterweight yet evolved."[1] The Mystic River Bridge was also

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[1] Waddell appears to have had an appreciation of Brown's mechanical innovation: he chose a somewhat different Brown-designed bascule in another project he undertook for the Connecticut Highway Department, the 1921 Washington Bridge carrying Route 1 over the Housatonic River between Milford and

described in detail and illustrated in Otis Hovey's textbook, Movable Bridges (1926, I, 131-33).

John Alexander Low Waddell (1854-1938) was a prolific engineer, credited with designing over a thousand bridges in his lifetime. A Canadian by birth, his education included an engineering degree from Rensellaer Polytechnical Institute and a master's degree from McGill University. After more than a decade of practical experience working for the Canadian Pacific Railway, the Canadian government, and the Phoenix Bridge Company, Waddell ventured out on his own as a consulting engineer in 1887 in Kansas City, Missouri; he later relocated to New York City. Waddell designed numerous important bridges, many of which ranked among the largest for their day: a bridge in East Omaha with two 520-feet swing spans (1893); the South Halsted Street Bridge in Chicago (1895), which had a vertical lift of 155 feet; and the Marine Parkway Bridge, a 540-feet-long lift bridge over New York's Rockaway Inlet. Waddell also traveled widely as a consultant and educator in Russia, Japan, and China.

Waddell's influence went beyond the example of his own work. He was also a tireless writer of textbooks and reference works on bridge engineering, whereby he contributed to the education of generations of other engineers. His major books include The Designing of Ordinary Highway Bridges (1884), De Pontibus (1898), Bridge Engineering (1916), and Economics of Bridgework (1923). At the time of his death, he was working on the Trylon and Perisphere for the 1939 New York World's Fair.

Thomas Ellis Brown (1854-1922) was in his day better known as a mechanical engineer than as a designer of bridges, though his improvements on the bascule won him widespread recognition. He attended the Columbia School of Mines, but did not graduate because of health problems. From 1875 until 1884, he was employed as a surveyor and engineer on a number of railroad and elevated-railroad projects in New York City, as well as working a short time with the eminent bridge engineer Alfred Boller on a drawbridge over the Harlem River.

In 1884, Brown became chief engineer for the Otis Elevator Company, where he played a large role in the development of hydraulic and electric mechanisms for elevators. Among his

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Stratford, Connecticut.

notable projects were the inclined elevators installed in the Eiffel Tower in Paris in 1888 and 1889 and the elevators for the Woolworth Building in New York City (1914).

In 1891, Brown was named Consulting Engineer at Otis, a position that allowed him to take on outside work as well as continue doing special projects for the elevator company. Brown designed several funiculars in this country and abroad, as well as a number of elevators for European tunnels, including elevators for the London Underground built in 1905 and 1906. As early as 1896 he had turned his attention to the problems of movable bridges, winning a $5,000 prize for an innovative design for a Brooklyn, N.Y. bascule. Other movable bridges designed by Brown were erected in 1908 and 1914. In 1918 he patented the balance-beam design used in the Mystic River Bridge (Patent No. 1,270,925; <u>U.S. Patent Office Official Gazette</u>, July 2, 1918, p. 50).

The steel for the Mystic River Bridge was fabricated and erected by the American Bridge Company. American Bridge was formed in 1900 by the same interests that controlled the United States Steel Corporation and was an attempt to monopolize the nation's bridge-building industry. Within a few years of its founding, American Bridge had acquired 28 other bridge-building companies and could claim over half the structural-steel fabricating capacity of the country. The American Bridge Company represented both a horizontal near-monopoly in fabricating and further vertical integration for the already closely controlled steel industry. American Bridge was organized as a wholly owned subsidiary of U.S. Steel, and from 1904 on, had its headquarters in Pittsburgh, Pennsylvania. In its early years the company relied upon affiliated firms to erect its bridges, but by the 1920s it was undertaking construction contracts under its own name.

Although never in complete control of the bridge market, the American Bridge Company supplied a substantial portion of the steel bridges purchased by state and local highway officials in the early 20th century, and there can be no doubt that the company was the single most important fabricator of the period.

The general contractor for the project and the builder of the bridge's footings, piers, and abutments was a local firm, the J. E. Fitzgerald Company of New London. The company was founded by stonemason Patrick Fitzgerald (died ca.1905) as a masonry contracting firm. His son Jeremiah E. Fitzgerald took over the business and expanded it into railroad and marine construction. An advertizement appearing in a local directory described their principal focus as follows:

> Railway and General Contractors. Estimates given on Every description of Stone, Masonry, Piers, Abutments of Stone and Reinforced Concrete, Rock and Earth Excavations, Grading, etc.

Jeremiah Fitzgerald also operated two other firms, the J. E. Fitzgerald Realty Company and the Northeast Construction Company.

BIBLIOGRAPHY

Brown, Thomas E., Jr., and William G. Grove. "A Bascule Bridge of New Type and Its Construction." Engineering News-Record, 91 (September 6, 1923): 374-77.

Brown, Thomas E. Obituary, New York Times, August 16, 1923.

________. Memoir by Otis E. Hovey. Transactions of the American Society of Civil Engineers, 87 (1924): 1315-17.

Burgess, Charles F., ed. Historic Groton, Comprising Historic and Descriptive Sketches. Moosup, Conn.: C. F. Burgess, 1909.

Clouette, Bruce, and Matthew Roth. Connecticut Historic Bridge Inventory. Connecticut Department of Transportation, 1990.

________. Connecticut's Historic Highway Bridges. Hartford: Connecticut Department of Transportation, 1992.

Connecticut Department of Transportation. Bridge Inspection files, Bridge Drawings files. Newington, Connecticut.

Connecticut Highway Commissioner. Annual Report, 1922-1923.

Connecticut State Highway Department. Forty Years of Highway Development in Connecticut, 1895-1935. Connecticut Tercentenary Commission Publication No. 46. New Haven: Yale University Press, 1935.

Cutler, Carl C. Mystic: The Story of a Small New England Seaport. Mystic: Marine Historical Association, 1945.

Hovey, Otis E. Movable Bridges. 2 vols. New York: John Wiley & Sons, 1926.

New London and Groton Directory, 1890-1922.

Roth, Matthew W. Connecticut: An Inventory of Historic Engineering and Industrial Sites. Washington: Society of Industrial Archeology, 1981.

Stark, Charles R. Groton, Connecticut, 1705-1905. Stonington, Conn.: Palmer Press, 1922.

Talbot, R. A. American Bridge Division: History and Organization. Pittsburgh: United States Steel Corporation, 1975.

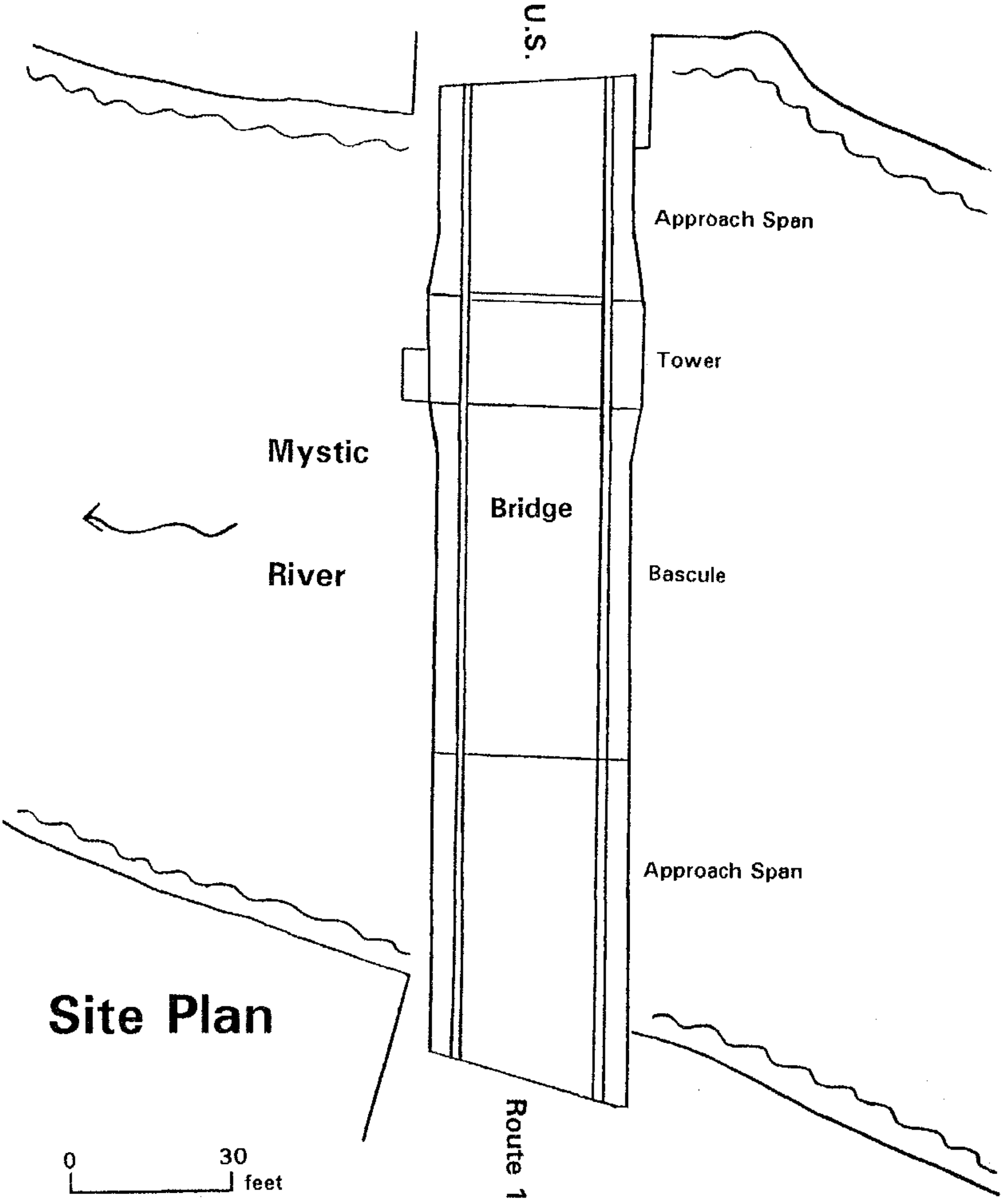
Waddell, J. A. L. Bridge Engineering. New York: John Wiley & Sons, 1916.

________. Economics of Bridgework. New York: John Wiley & Sons, 1921.

________. Obituary, New York Times, March 3, 1938.

"Waddell, John Alexander Low." National Cyclopedia of American Biography, 25: 35-36.

Wheeler, Richard A. History of the Town of Stonington. New London, Conn.: Day Publishing Company, 1900.


U.S.
Approach Span
Tower
Mystic
Bridge
River
Bascule
Approach Span
Route 1
0
30
feet

Site Plan

ADDENDUM TO:
MYSTIC RIVER BRIDGE
(Bridge No. 362)
Spanning Mystic River at U.S. Route 1
Groton
New London County
Connecticut

HAER CT-174
HAER CONN,6-GROT,2-

FIELD RECORDS

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
U.S. Department of the Interior
1849 C Street NW
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