**INDIVIDUAL INVENTORY FORM**

**NHDHR INVENTORY # EXE0084**

**Name, Location, Ownership**

1. Historic name: String Bridge
2. District or area: Waterfront Commercial Historic District
3. Street & number: String Bridge St. over Squamscott River
4. City or town: Exeter
5. County: Rockingham
6. Current owner: Exeter

**Function or Use**

7. Current use(s): Municipal highway bridge, Exeter 102/074-East & 103/074-West
8. Historic use(s): Town bridge at same location

Private bridge at same location

**Architectural Information**

9. Style: single span Concrete Rigid Frame (CRF) - two identical single span bridges
10. Architect/builder: John H. Wells, NH Highway Dept./ Hutchinson Building Co., Concord, NH
11. Source: NHDOT Records
12. Construction date: 1935
13. Source: NHDOT Records
14. Alterations, with dates: Deck rehab & membrane installed; sidewalk rehab & granite curbing installed, 1990s
15. Moved? no ☒ yes ☐ date:

**Exterior Features**

16. Foundation: Concrete abutments
17. Cladding: n/a
18. Roof material: n/a
19. Chimney material: n/a
20. Type of roof: n/a
21. Chimney location: n/a
22. Number of stories: n/a
23. Entry location: n/a
24. Windows: n/a

Replacement? no ☐ yes ☐ date:

**Site Features**

25. Setting: Village center
26. Outbuildings: n/a
27. Landscape features: River

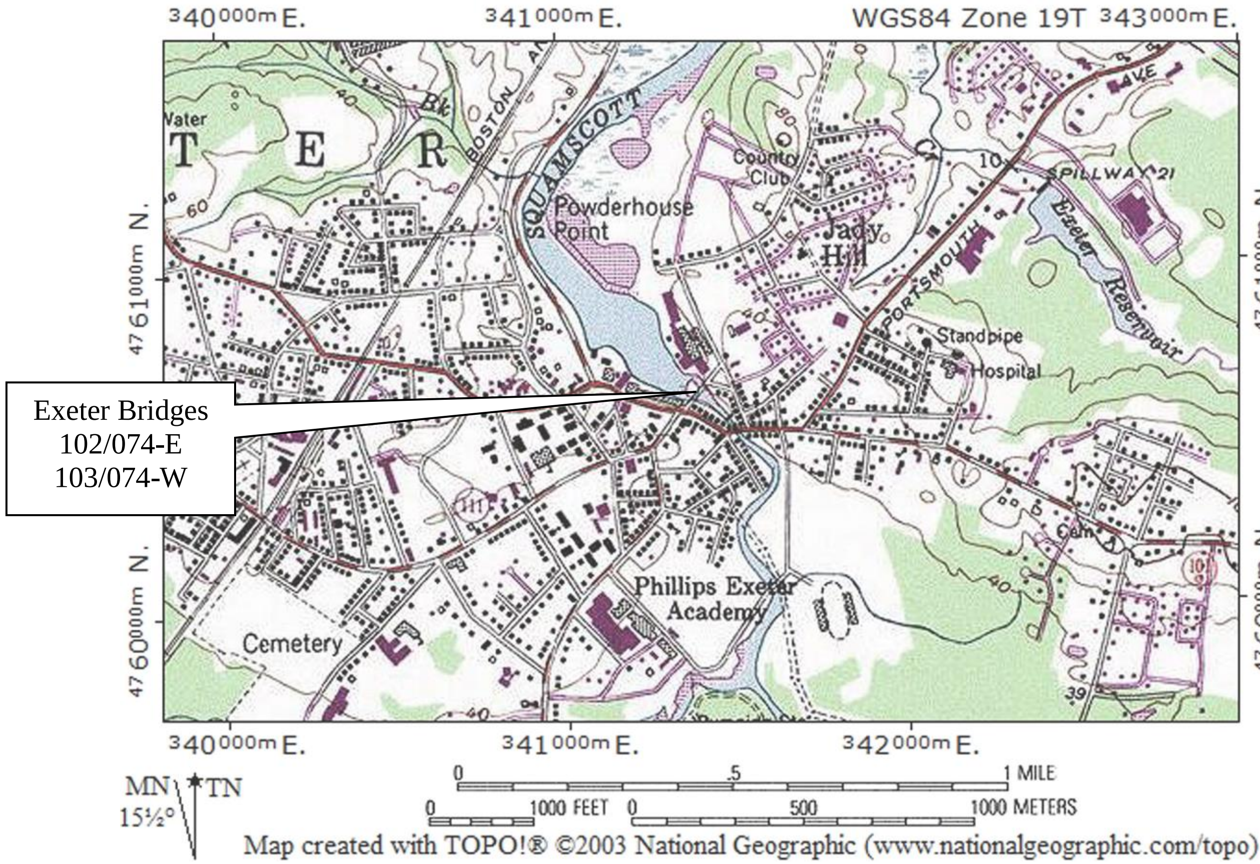
35. Photo # 1 Direction N
36. Date 08 January 2015
37. Reference (file name or frame #): EXE0084_001

28. Acreage: less than 1 ac.
29. Tax map/parcel #: n/a
30. Map reference: UTM 19.341394.4760638
31. USGS quad and scale: Exeter NH 7.5 minute 1973

**Form prepared by**

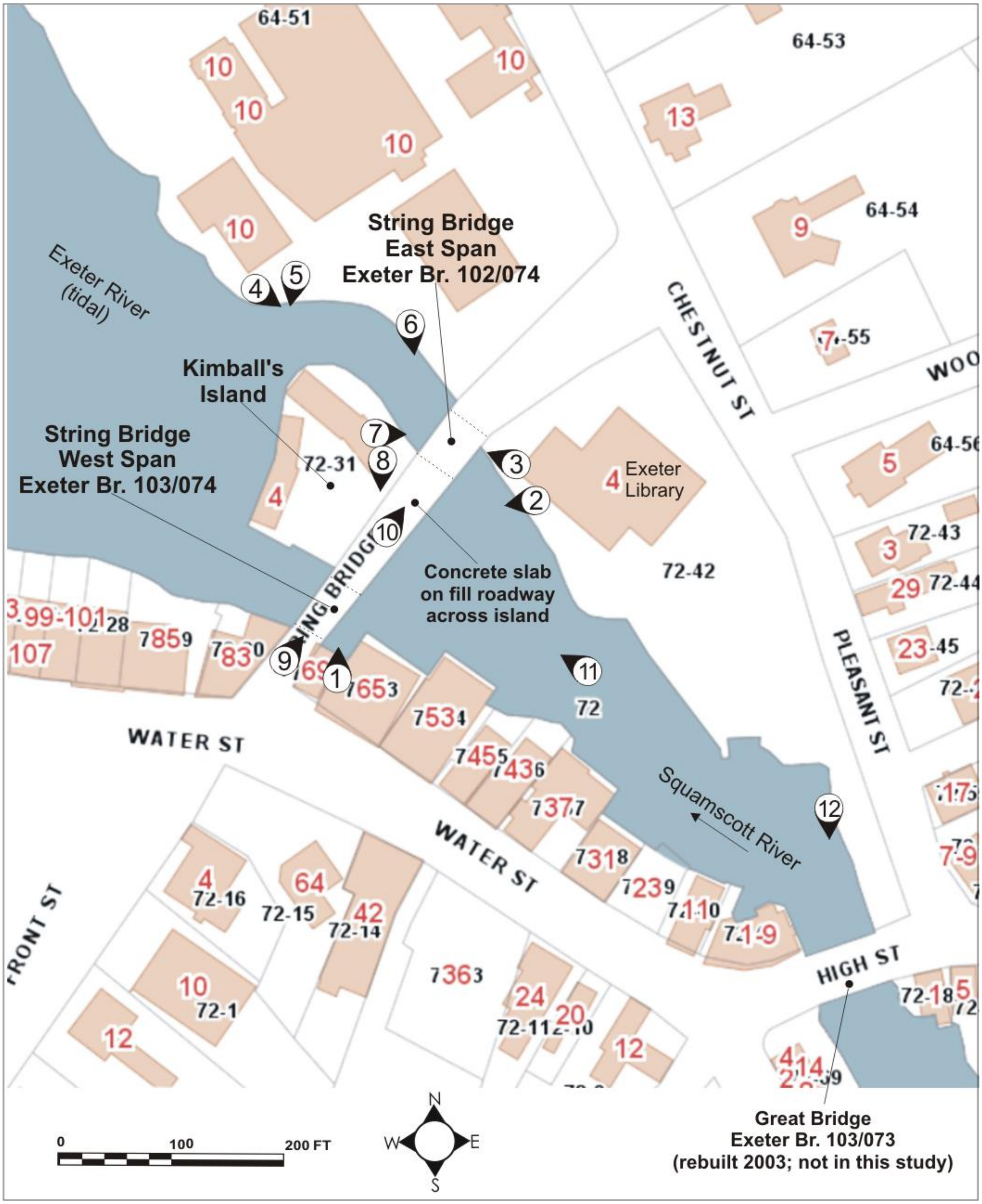
32. Name: Richard M. Casella
33. Organization: Historic Documentation Company, Inc.
34. Date of Survey: Field: 01/08/2015 Report: 03/02/2015

**39. LOCATION MAP**: USGS Quad: Exeter, NH 1973




see next page

**40A. SITE SKETCH & KEY TO PHOTOS ON TAX PARCEL PROPERTY MAP**
**(Source: http://www. http://mapsonline.net/exeternh/)**



**41. Historical Background and Role in the Town or City's Development**:

Historically two bridges have spanned the Squamscott River in downtown Exeter Village since the late 17th century: String Bridge, carrying String Bridge Street from the corner of Water and Front streets on the west side across Kimball's Island to Chestnut Street on the east side, and Great Bridge, carrying High Street (NH 108) from the corner of Water and Clifford streets over the river to Chestnut Street (see item 40.A, Site Sketch, above; Figures 1-4, below). These two bridge crossings date to the earliest settlement of Exeter Village in the 17th century. The first mention of a bridge in town records dates to 1644 when a bridge over the Lamprey River was ordered but this bridge was apparently never built. Historian Charles Bell states that "In all probability the first bridge erected in the town was that across the fresh river [Squamscott], just above the falls, where the 'great bridge' now is.[1] The exact date of its construction is apparently not known; the County Court ordered repairs to the bridge in 1675 and by 1693 it was referred to as "the great bridge," indicating, according to Bell, "that there was then at least one other bridge of less dimensions…[being] without much doubt, the predecessor of the present 'string bridge'."[2] The "predecessor" bridge was evidently a private bridge erected by Humphrey Wilson to reach his grist mill on the small island (now known as Kimball's Island) at the lower falls of the Squamscott. Wilson was granted land and rights to establish a mill on the east side of the island in 1639 – a year after the founding of the Town – taking power from the east channel. It was over the east channel that Wilson is known to have erected a simple beam span bridge consisting of one or two logs – stringers – on which pedestrians carried their grists to the mill. The exact date of this bridge and the erection of the mill has apparently not been established; local histories refer to it dating to the early 1640s. Bell, in referring to the Great Bridge as the first bridge erected, perhaps means the first bridge erected by the town with public monies.

> At a later date, Captain John Gilman became owner of another grist-mill on the western side of the island He naturally desired it to be connected with the western shore by a bridge of his own; his mill and the Wilson mill being rival establishments. At a town meeting on the first Monday of April, 1709, the town gave him all their right to the stream and the island where his mill was, "with privilege for a bridge to go on the island." This led to the completion of the second bridge across the river. It consisted for a century of nothing more than one or two timbers laid across each of the channels of the river, with hand rails at the side, so that a man could safely pass with a bag of meal on his shoulder. It obtained the name "string bridge" from the manner of its original construction, and still retains it, though for many years past it has been rebuilt in a substantial shape, with space for carriages to pass each other upon it, and a sidewalk.[3]

Historian Barbara Rimkunas notes that the String Bridge appears on the towns earliest map of 1802 (see Figure 1) and that in 1817 the townspeople raised money by pledges for the reconstruction of the bridge with new stringers and planking of width and strength to carry a single horse and carriage.[4]

In July 1888 the String Bridge was inspected and found in an unsafe condition. Over the next several months both spans and portions of the stone abutments and retaining walls were reconstructed. At that time the west span was a three span wood stringer bridge supported by two pile bents in the river (see Figure 9) and the east span was a low Warren wood truss (see Figures 9 and 10). Both east and west bridges were reconstructed as low wood trusses of an undetermined type and boxed with planking.

The String Bridge boxed trusses remained in service until the construction of the present concrete bridges in 1935. In April 1935 the New Hampshire Highway Department began drafting plans for the two concrete rigid frame replacement spans and improvements to the roadway across Kimball's Island connecting them. John H. Wells was responsible for the design of the rigid frame spans; Alfred M. Whittemore was responsible for the other concrete design including railings, retaining walls, stone wall caps and the roadway slabs across the island. A total of 7 sheets of drawings were prepared for the bridge (NHDOT File No. T-16).

In late June 1935 the construction contract was awarded to Hutchinson Building Company of Concord, NH for submitting the low bid of $17,830.00 (see newspaper clipping "The New String Bridges" below). Work on the bridge began July 1, 1935 and was substantially completed and and opened for travel on October 14, 1935.[5] The cost of the

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1 Charles Bell. *History of the Town of Exeter, New Hampshire.* Exeter: The Quarter-Millennial Year, 1888, p. 124.
2 Bell, 1888, p. 124.
3 Bell, 1888, p. 125.
4 Barbara Rimkunas. *Exeter, Historically Speaking.* Charleston, SC: History Press, 2008.
5 *The Exeter News-Letter*, October 11, 1935, p. 5.

project ultimately totaled $20,623.30, which included $19,278.48 paid to Hutchinson, $413.61 paid to the State of New Hampshire for the Highway Department's engineering services, and $755.00 to R. A. Morton[6] for engineering services (see clip "String Bridge Appropriation.." from Town Report below). The two bridges have remained in service until the present time without any substantial alterations.

**The New String Bridges**

The selectmen have awarded the contract for building the new String Bridges to the Hutchinson Building Company of Concord. The figures are $17,830, the lowest of eight bidders. Other bids were $19,252; $20,833; $22,753; $22,008; $22,318; $22,624; $19,724.

Labor for the work is to be furnished by the town of Exeter, and all materials, where possible, are to be purchased from Exeter merchants, and the contractor's bond is likewise to be furnished by an Exeter agent.

(*The Exeter Newsletter,* June 28, 1935).

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**String Bridge**
**Appropriation, $20,000.00 Bond Issue**

| | |
|---|---|
| Hutchinson Building Co. | $19,278.48 |
| R. A. Morton, engineering services | 755.00 |
| Exeter & Hamtpon Electric Co., cable | 6.90 |
| Treasurer State of New Hampshire engineering services | 413.61 |
| A. E. Foss, filling snow dump | 134.00 |
| G. W. & C. A. Lane, snow dump | 2.78 |
| Court Street Garage, snow dump | 1.00 |
| W. A. Young, snow dump | .70 |
| Hilliard & Kimball, material | 30.83 |
| | $20,623.30 |
| Appropriation | $20,000.00 |
| Credit from sale of wood | 14.00 |
| From emergency fund | 609.30 |
| | $20,623.30 |

(*Annual Report of the Town of Exeter,* 1936, p. 44).

**42. Applicable NHDHR Historic Contexts**: 84. Automobile highways and culture, 1900-present.

**43. Architectural Description and Comparative Evaluation**:

Exeter String Bridge, in its entirety, consists of two structurally identical single-span concrete rigid frame bridges and a section on roadway on a solid fill island between them. The three structural components carry String Bridge Street across the Squamscott River in downtown Exeter village. The bridge spans the river at the "Lower Falls" where the river divides and flows around the east and west sides of tiny Kimball's Island, the site of the first grist mill in Exeter. String Bridge West Span (Exeter 103/074) connects the village commercial center near the corner of Water and Front streets to the island; String Bridge East Span connects the island to Chestnut Street which parallels the river on the mostly residential east side of the river. The roadway across Kimball's Island that joins the two bridges is approximately 130' long; it was reconstructed and improved along with the construction the two bridges in 1935 and in bridge terms, functions essentially as a massive masonry/solid-fill pier linking the two 50' long spans. Improvements that were made to the island roadway, all of reinforced concrete, include the road slabs, caps on the existing stone retaining walls and the same sidewalk and open balustrade railings as on the bridge spans; these features are integral with the flanking spans and create a visually unified structure when viewed from the upstream side.

The two bridge spans are identical, designed and built from the same plans. By the mid-1930s the design of single-span concrete rigid frame bridges mostly followed standardized plans in 5' and 10' increments for the most commonly used spans between 40 and 80 feet. Elements of the 50.0' span design used for String Bridge are shown in Figures 13, 14 and 15. Each span has a clear span of 50.0' between the abutments, an overall length of 57.0' and an overall width to the outside of the railings of 29'-8". The reinforced concrete deck varies in depth longitudinally from 3.5' at the abutments to 1'-6" at mid-span. This variance in depth follows a radius of 157'-3", giving the deck in profile a very low-rise segmental arch shape, a characteristic feature of the bridge type. Transversely, the deck is

[6] *Annual Report of the Town of Exeter*, 1936, p. 44. No information on R. A. Morton or the engineering services that he provided the Town was obtained, however it is likely that he undertook the construction inspection.

uniform in thickness, which is typical of CRF (Concrete Rigid Frame) spans less than about 60 to 70 feet, as opposed to spans over 70 feet that may be of T-beam deck design (ribbed) to lower cost by material savings. It should be noted that in the CRF bridge type, the abutments are cast integral with the deck and are generally called legs. The legs perform a special structural role by bearing a portion of the deck loads (see additional discussion below). The legs of the String Bridge spans taper from a thickness of 3.5' at the top, or deck level, to 2'-3" at the base where they are socketed into the channel ledge. The presence of the ledge undoubtedly played a role in the selection of the CRF bridge type because the ability to positively anchor the legs against any movement is a structural requirement of CRF design. The overall height of the bridge frame varies from approximately 14' to 18' due to differences in the elevation of the ledge and the drop in roadway grade from the west abutment to the east of roughly 2 feet. A raised sidewalk, 5' wide, runs the entire length of bridge on the upstream side, protected with standard NHHD "B" type concrete railings, 40" high and pierced with narrow rectangular flat arched openings 6" wide spaced 12" on center. The railings are anchored into solid concrete posts over the abutments and at two points along the length of each span and at four points along the longer island section. All concrete work is flat finished without decorative detailing. The downstream side of both spans are equipped with the same railings; the downstream side of the island roadway is mostly an open driveway into the parking area serving the two buildings on Kimball's Island. Kimball's Island is an irregularly shaped manmade island with an area of 0.35 acres, consisting of fill contained within stone masonry retaining walls roughly 7 to 15 feet in height. The upstream side of Kimball's Island consists of a mortared stone retaining wall of split granite blocks roughly coursed. The wall is capped with a low concrete wall that carries the bridge railing and retains the roadway fill and slabs, mentioned above. The other walls containing the island vary in construction, consisting of random rubble, split and cut stone, mortared and dry-laid. Portions of the wall on the east side of the island have collapsed, due in part to the growth of trees in the wall joints.

*Bridge Technology Discussion*

A rigid frame can be defined as a structure with moment-resisting joints. The simplest form of concrete rigid frame bridge consists of a horizontal slab deck span supported by legs (piers or abutments) at each end to which the deck is rigidly connected (String Bridge being an example). The connection, sometimes called the "knee," is made with bent reinforcing rods and cast integral with the leg and deck. As the bridge deck (acting like a beam) deflects downward under load, the legs resist the loads through torsional strains transmitted through the solid connection. Rigid frame bridges are continuous structures that have been called a hybrid of the arch and girder bridge because some of the vertical moments on the deck become horizontal thrusts in the legs that must be restrained by the abutments or leg foundations. The solid connection between the abutments, or legs, and the deck, creates a continuous structure with economic advantages. The design can be much lighter and stronger, with a thinner deck and abutments, than a simple span of equivalent length. The most obvious practical benefits is a cost savings in concrete; they are also generally simpler to build than other types of concrete bridges and can be adapted to erection utilizing the cantilever method. The opening under the bridge is nearly rectangular, offering greater area for stream or traffic flow as compared to a concrete arch bridge for example.[7] The Concrete Rigid Frame bridge was generally used for short spans such as highway overpasses and usually consists of one span with legs that also form the abutments. When rigid frames are used in a series for multiple spans they are usually rigidly connected to each other to make the deck girder act as a continuous beam and separately categorized as a Concrete Continuous Rigid Frame bridge.

The first concrete rigid frame bridge in the U.S. was designed in 1922 by Arthur G. Hayden, engineer with the Bronx Parkway Commission. From 1922 to 1925, eight Hayden-designed CRF bridges were built by the commission over the Bronx Parkway. In 1925, the Bronx Parkway Commission was reorganized as the Westchester County (N.Y.) Park Commission, which under Hayden's direction, continued the use of the rigid frame bridge in conjunction with its massive Hutchinson Parkway and Cross County Parkway construction projects. Over the next five years, Westchester County built seventy-one Hayden-designed rigid frame bridges.[8] In 1926, Hayden authored the paper *Rigid Frames in Concrete Bridge Construction*, in which he described the strength, economy and architectural merits of the design. He presented two methods of structural analysis and drawings of the arrangement of steel reinforcement utilized in several different forms of rigid frame bridges. Hayden's analytical methods and designs were embraced by the engineering community and widely applied. With the development of the Cross moment-distribution method of analysis in 1930, rigid-frame design was greatly simplified. By 1932 over 200 rigid frame

[7] Portland Cement Association 1934, p. 5.
[8] Engineering News-Record 1933:531-533.

concrete bridges had been built in the U.S. and Hayden was recognized by his peers as the father of the bridge type and its leading expert.[9] The majority of technical papers on the subject appeared during the Depression years and led many American engineers to believe that the rigid frame bridge was a new design of their own creation. In a letter to the editor of *Civil Engineering*, A. A. Brielmaier, a civil engineer from Cleveland, set the record straight by listing dozens of the bridges which were built in Europe during a ten year period beginning in 1904.[10]

The popularity of concrete bridges, particularly the rigid frame type, soared during the depression due to tight money and government sponsored bridge building programs. The federal government stepped up the funding of grade elimination projects in connection with railroad crossings and the construction of parkways and superhighways. Economical, long lasting, and capable of being built with local labor, the concrete bridge put federal highway dollars targeted for economic relief directly into the hands of laborers who needed it most.[11] Application of the rigid frame concrete bridge surged again in the U.S. in the late 1930s due in part to the publications of standards and design guides such as *Analysis of Rigid Frame Concrete Bridges* by the Portland Cement Association.[12] The bridge type was used in huge numbers nationwide for the hundreds of limited access divided parkways and superhighways built after WWII. The inherent design is simple and has changed only slightly with technological improvements in concrete and reinforcement technology. Many state highway departments developed standard designs for rigid frames of incremental lengths, to which designers have added unique architectural treatments such as stone-faced abutments and distinctive railing or lighting details to provide a "trademark" style for a given highway project. The development of precast and post-tensioned concrete girders and deck sections which offer greater quality control and faster and cheaper erection than cast-in-place bridges have pushed the rigid frame into disuse today.

*Comparative Discussion*

The DOT Bridge Summary database lists 441 CRF bridges, of which roughly 140 date to 1950 or earlier. This number is deceiving because the vast majority of these structures are short-span structures that are essentially large box culverts without bottoms that are structurally classified as a "rigid frame" in the National Bridge Inventory because of their rigid deck-leg joint. These minor box-frame structures are unrelated to the type of CRF bridge developed by Hayden and represented by String Bridge. This large number of structures classified as CRF bridges does not suggest that the NHHD was one of the leading designers of rigid-frame bridges in the United States.

The design used for the String Bridge is the simplest structural design of the CRF bridge type and the absence of stylistic or decorative detailing makes it the most frugal expression of the type. The low arch profile of the bottom of the deck is not a decorative detail but rather a feature of the structural type that effects design efficiency thru economy of materials. The profile simply reflects the minimum deck thickness required at each point to carry the design loads. Decorative features were sometimes added to CRF bridges in the form of decorative railings, facing with veneer stone, or concrete formwork details.

In NH, several CRF bridges were identified with stone facing (see Table 1 below). This practice apparently reflects the historic-revival aesthetic movement prevalent during the heyday of the bridge type in the 1930s. Note in Table 1 that three of the bridges with stone facing are state bridges located in or near village settings; this may have been due to the availability of federal funds to assist in the cost. The other stone faced bridge, Union Street bridge in Peterborough, indicates that some municipalities also undertook the added expense. Exeter was a relatively affluent town with a strong sense of its history at the time and with stone walls ringing the site of the String Bridge the lack of stone facing is perhaps unexpected. But being the height of the Depression the choice of the simplest and most cost-efficient design would have been prudent or perhaps some justified the design as embodying the emerging modernist aesthetic. Regardless, the design was ultimately just a practical response to the restrictions imposed by site and did not require any particularly creative or innovative engineering solutions.

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[9] Baretta 1932:558; Engineering News-Record 1933:531; Portland Cement Association 1934:5.
[10] Brielmaier 1932:653.
[11] Engineering News-Record 1933:531.
[12] Portland Cement Association 1936.

***TABLE 1: Examples of Concrete Rigid Frame (CRF) Bridges (non-ribbed) in New Hampshire with similar characteristics to Exeter String Bridge.***

| *NH Bridge #* | *Carrying / Over* | *Date* | *Spans* | *Notes* |
|---|---|---|---|---|
| **Exeter 102/074, 103/074** | **String Bridge St. / Squamscott R.** | **1935** | **1 @ 50.0'** | **SUBJECT BRIDGE. plain concrete; open balustrade concrete railings** |
| Canaan 165/070 | US4 / Indian R. | 1930 | 1 @ 40.0' | plain concrete; original solid conc. railings replaced with aluminum guardrail |
| Jackson 152/058 | NH16A / Wildcat Br. | 1931 | 1 @ 70.0' | stone faced; solid conc. railings stone faced |
| Bennington 096/087 | NH31 / Contoocook R. | 1934 | 1 @ 80.0' | stone faced; solid conc. railings stone faced |
| Hopkinton 102/143 | NH103 / Contoocook R. | 1935 | 2 @ 58.5' | stone faced; solid conc. railings stone faced |
| Peterborough[13] 057/108 | Union St. / Nubanusit Br. | 1937 | 1 @ 65.0' | stone faced; solid conc. railings stone faced |
| Marlborough 092/072 | Troy Rd. / Shaker Br. | 1939 | 1 @ 45.0' | plain concrete; wood guardrail replaced with steel guardrail |

The bridges in Table 1 above are typical and unexceptional examples of the common CRF bridges of the Hayden-design type that came into widespread use during the 1930s. The solid deck type (non-ribbed) seldom exceeded 80 or 90 feet simply because the economics did not justify it; other bridge types were more cost effective. The intent of the CRF design was to serve as a template for simple economical quickly-erected short-span bridges of standardized design. Concrete railings, solid or open, were the logical choice because the bridge was concrete. Simple open railings like those on the String Bridge, consisting of plain rectangular openings (as opposed to those with pre-cast "turned" balusters) were a standard NHHD design detail, typically specified to reduce dead load on the span but perhaps also viewed as possessing a higher aesthetic quality than solid railings. The application of stone facing was an aesthetic decision, typically specified to appease those who objected to plain concrete as being ugly or cheap in appearance.

**44. National or State Register Criteria Statement of Significance**:

Criterion A: Exeter String Bridge (102/074-E & 103/074-W) is located within the boundaries of the National Register (NR) listed Exeter Waterfront Commercial Historic District (District) but is not listed as a contributing resource. String Bridge is only mentioned in the Nomination Form as the means to reach Kimball's Island and two contributing buildings located there. The bridge is not mentioned in the discussion of the District's significance to commerce or transportation; the latter of which focused on the Town's use of the Exeter River for inland and maritime shipping. Although not argued in the District nomination form, it is logical that the String Bridge did not contribute to the District's significance to transportation within the maritime context. The bridge was however, important to the development of the District under the context of commerce, since it was a component of the first established grist mill and subsequent mills located on Kimball's Island. It was very likely the first bridge crossing in the town, albeit a private one, and also one of the earliest bridges in the state. Although the wood stringer spans for which the bridge was named were replaced in the 19th century, and the wood truss spans that followed were replaced in 1935 with the present concrete spans, the surviving stone retaining walls integral with the present String Bridge provide a physical and visible link to the original historic crossing and its many incarnations. It is possible that portions of the existing stonework date to the earliest constructions of the bridge. Therefore, it is this writer's opinion

[13] Union Street Bridge was determined eligible for the National Register by the NHDHR in 2012 (Inventory # PET0035) under Criterion A "for its association with the state-wide pattern of improved alignment of major state and federal routes in the 1930s, including NH Route 101, with the use of federal and state aid;" and under Criterion C, "as a well-preserved example of a conventional bridge type, a concrete rigid frame bridge, with notable aesthetic features including stone-facing and sidewalk and noteworthy engineering elements including its length and placement on an existing crossing alignment." This author does not concur with DHR's finding because the importance of the historical associations and physical characteristics attributed to the bridge are speculative and do not rise to the level of importance necessary for National Register listing.

that the String Bridge is importantly associated with events significant to the commercial and transportation history of the District since its inception in the 1640s, and that the surviving stone masonry retains sufficient integrity to convey that association. The bridge is therefore eligible for the NR under Criterion A as a contributing resource within the Exeter Waterfront Commercial Historic District.

Criterion C: Making the argument for NR eligibility under Criterion C can be problematic when dealing with a reconstruction and retrofit structure such as String Bridge. There are two physical components of the bridge to evaluate in terms of significance and integrity: the stone retaining walls of the structure that date to the 19th century with parts perhaps dating to the 18th or even 17th centuries, and the two concrete rigid frame spans built in 1935.

The stone walls have evidently undergone numerous repairs and reconstructions including rebuilding with mortared joints, pointing and the addition of concrete caps and reinforcements in conjunction with the construction of the present String Bridge. As noted in the Criteria A discussion above, the stone masonry as a whole, meaning the collective retaining walls along the shore and island directly related to the bridge crossing, retains sufficient integrity for one to visually associate it with the historic bridge crossing. The walls do not however possess exceptional masonry workmanship nor the integrity necessary to meet NR Criteria C.

The two CRF spans are unexceptional in terms of design, materials and construction. They lack unique or important features or characteristics that would distinguish them from the other equally ordinary surviving examples of the bridge type in New Hampshire. Use of the CRF bridge type in this particular site and application appears to have been a practical choice to provide the largest waterway opening for the least cost.

Plans indicate the bridge was designed principally by NHHD engineer John H. Wells. Wells graduated in 1930 from Worcester Polytechnic Institute and began his career as an engineer with the NHHD shortly thereafter. His initials appear on bridge plans as early as 1935, and he was still with the department in 1957. In 1959 Wells was working with the engineering company of Jackson & Moreland in Boston, and by 1970 he had attained the title of chief structural engineer with that firm.[14] String Bridge was evidently one of the first projects undertaken by Wells for the NHHD. Among the many bridges Wells designed for New Hampshire were several important long-span bridges, including the Chesterfield-Brattleboro (1937) and Orford-Fairlee (1938) arches over the Connecticut River, for which awards were given by the AISC, and the Woodstock tied arch built in 1939. String Bridge followed what were essentially standardized plans and is not representative of the more complex design work Wells later undertook for the NHHD. String Bridge therefore does not possess exceptional characteristics that would make it eligible for the National Register under Criteria C.

**45. Period of Significance**: 1935

**46. Statement of Integrity**: The property retains integrity of location, setting, association, feeling, design, materials and workmanship. Repairs and alterations to the preexisting stone retaining walls that made integral to the present String Bridge have diminished the integrity of those elements.

**47. Boundary Discussion:** The boundary of the property is defined by the physical limits of the bridge and its abutments.

**48. Bibliography and/or References:** Also see footnote & caption citations.

Brielmaier, A. A. "Early Rigid Frame Bridges." *Civil Engineering*, October, 1932, p. 653.

Chase, J. *Map of Rockingham County New Hampshire*. Philadelphia: Smith & Coffin, 1857.

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*Engineering News-Record.* "Ten Years of Achievement with Rigid Frame Bridges." April 27, 1933, pp. 531-533.

[14] James L. Garvin, Draft Manuscript on New Hampshire Bridge History, and Personal Communications.

Exeter Historical Society. Photograph collection and archives.

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Hurd, D. H. *Town and County Atlas of the State of New Hampshire.* Philadelphia: D. H. Hurd & Co. 1892.

Moore (A.W.) Co. *Exeter*, *New Hampshire*. Boston: A.W. Moore, Co, 1896. [Bird's eye view map].

NHDOT Bridge Card, Inspection Files and Plan Files. Filed at NHDOT, Bridge Design, Concord.

Portland Cement Association. *Analysis of Rigid Frame Concrete Bridges*, Chicago: Portland Cement Association, 1936.

Tardiff, Olive. *The Exeter-Squamscott: River of Many Uses*. Portsmouth, N.H.: Published for the Rockingham Land Trust and Exeter River Local Advisory Committee bv P.E. Randall, 2004.

Wellge, H. *Exeter, N.H., County Seat of Rockingham County, 1884*. Brockton, Mass: Norris & Wellge, 1884. [Bird's eye view map]

Wiggin, Morton H. *A History of Barrington, NH 1966.* Copyright Joan Wiggin.

**Surveyor's Evaluation:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| NR listed: | individual | _____ | NR eligible: | | NR Criteria: | A | __X__ |
| | within district | _____ | individual | ____ | | B | _____ |
| | | | within district | __X__ | | C | _____ |
| Integrity: | yes | __X__ | not eligible | ____ | | D | _____ |
| | no | __ __ | more info needed | ____ | | E | _____ |

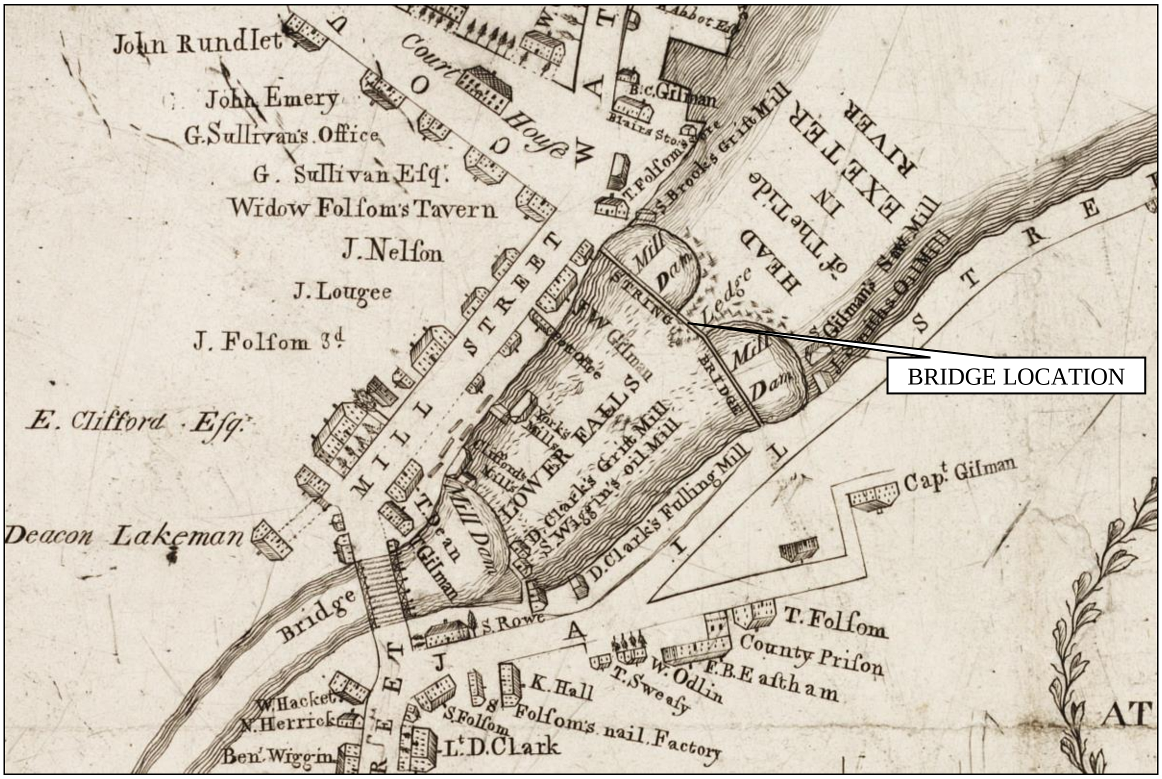



**FIGURE 1:** 1802 Map of Exeter, showing "String Bridge" (Phinehas Merrill 1802).

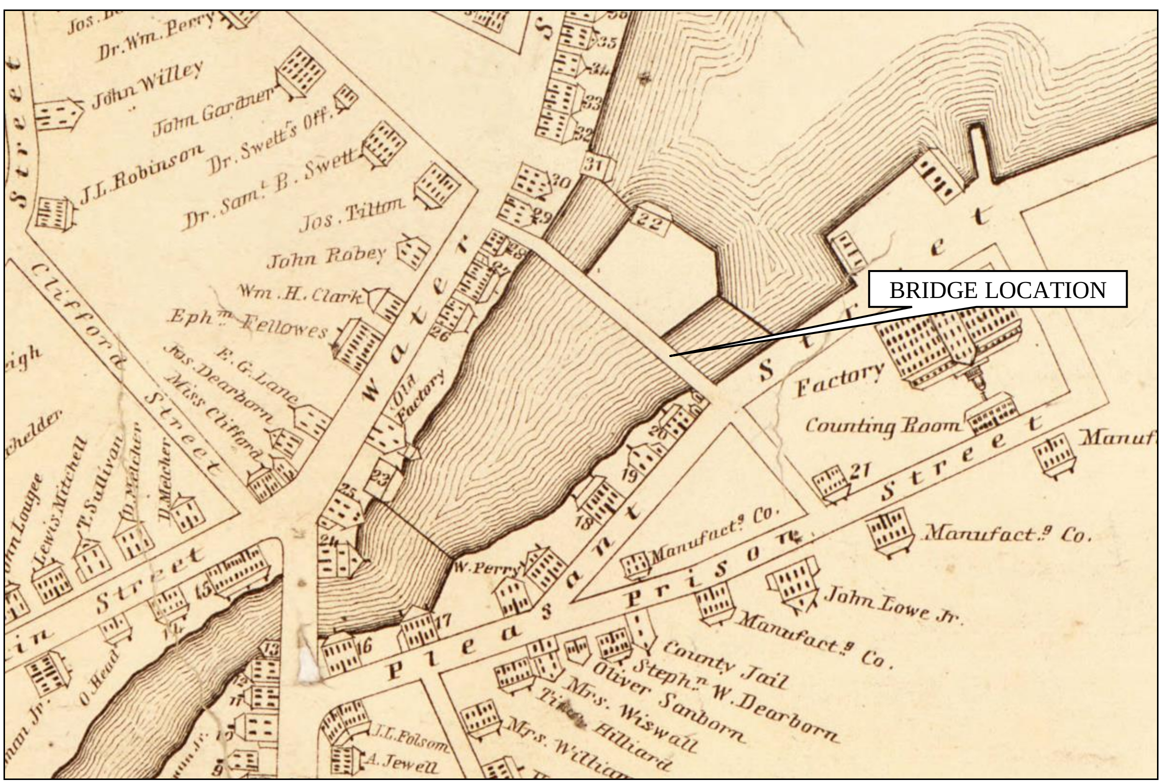



**FIGURE 2:** 1845 Map, showing enlargement of Kimball's Island (Joseph Dow 1845).

**FIGURE 3:** 1874 Map, showing conditions at that time. Note grist mill still apparently in operation on Kimball's Island (Sanford & Everts 1874).

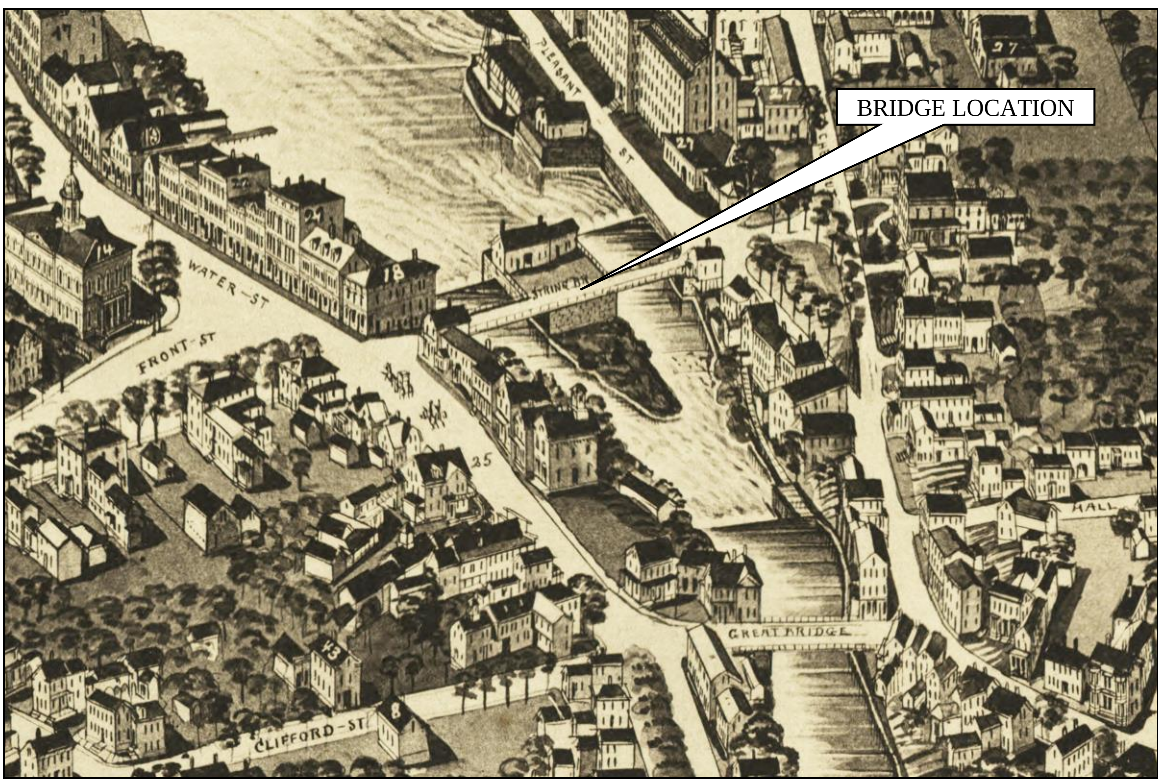


**FIGURE 4:** 1884 Birdseye View Map (Wellge 1884).

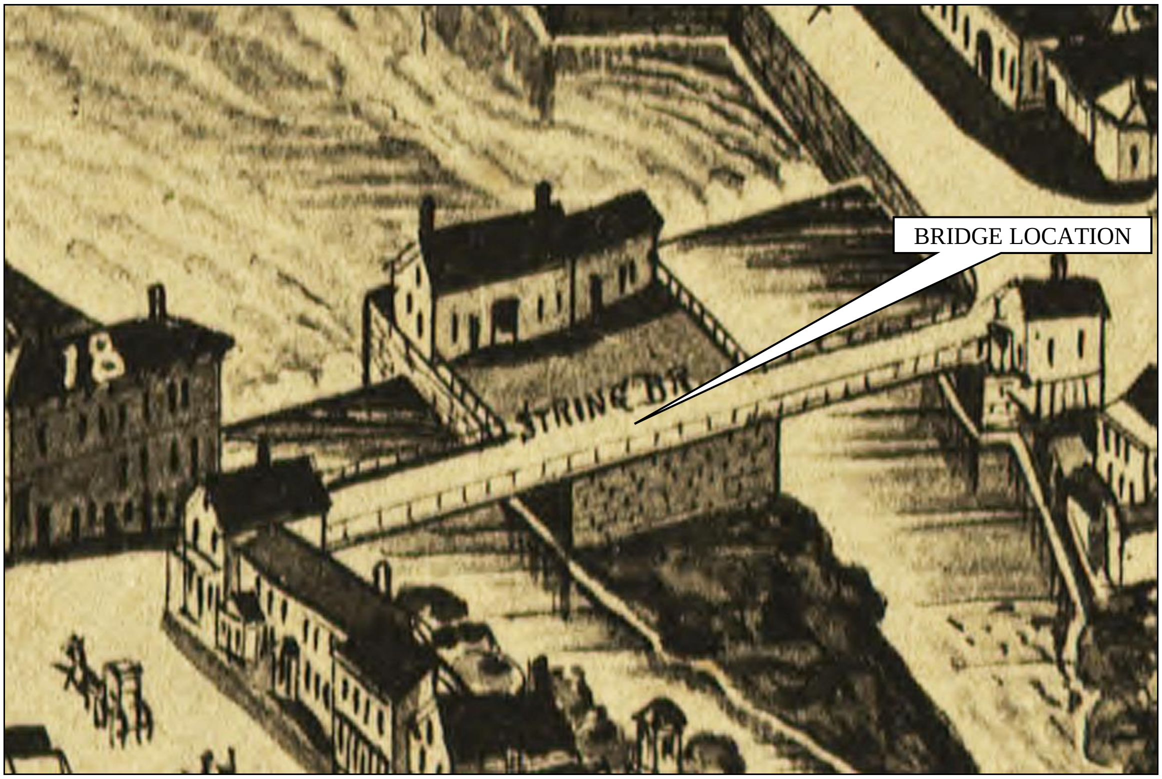



**FIGURE 5:** 1884 Birdseye View Map, enlarged to show String Bridge (Wellge 1884).

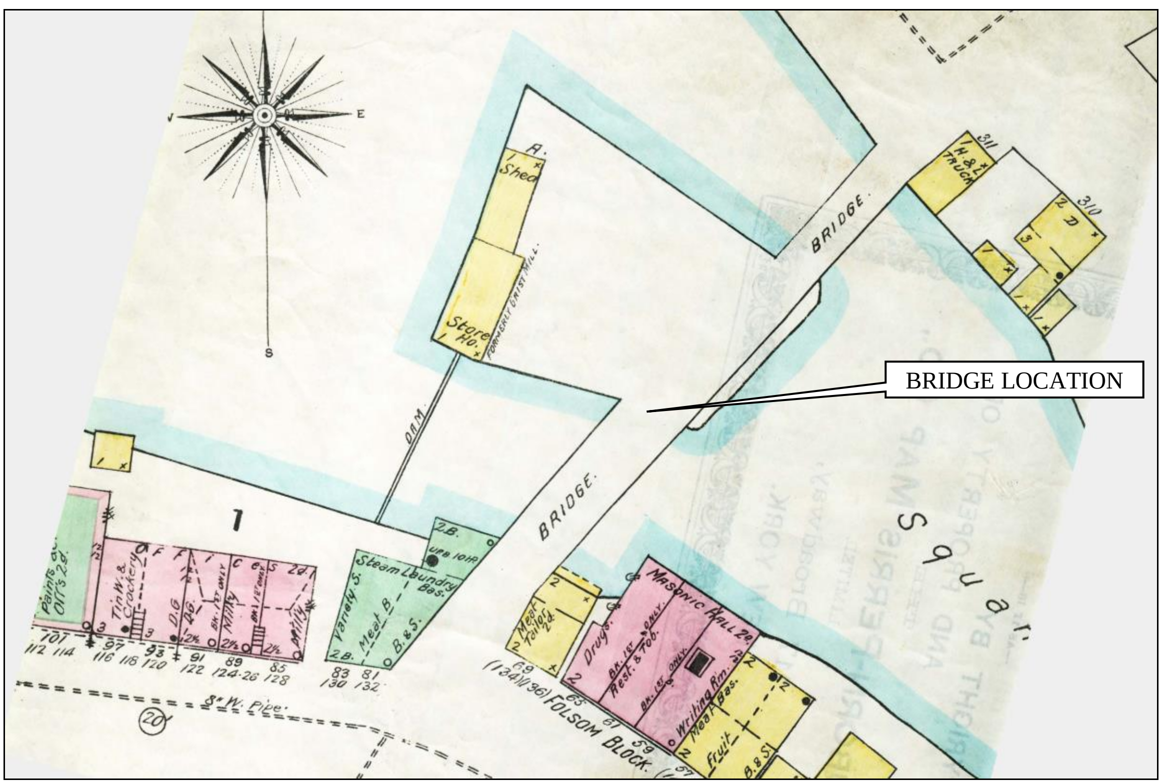



**FIGURE 6:** 1898 Sanborn Insurance Map.

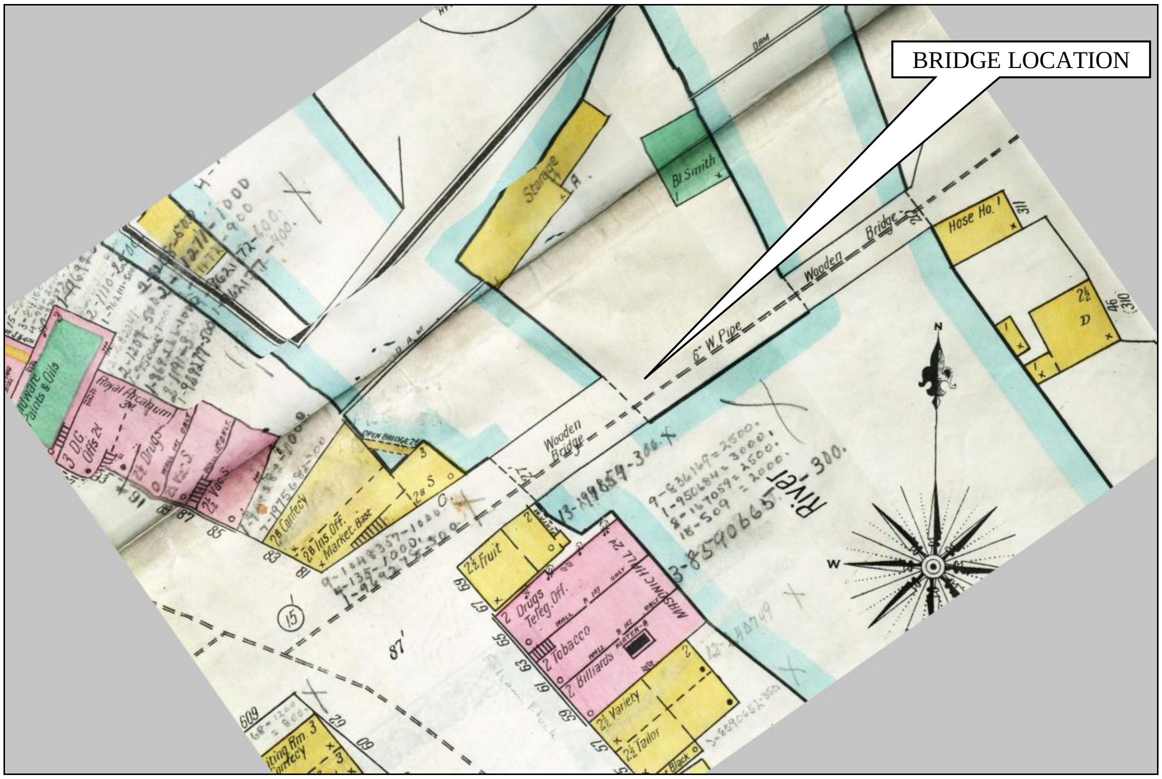



**FIGURE 7:** 1904 Sanborn Insurance Map. Note water main extended across bridge; photograph shows pipe was carried independently on steel truss (see Figure 12).

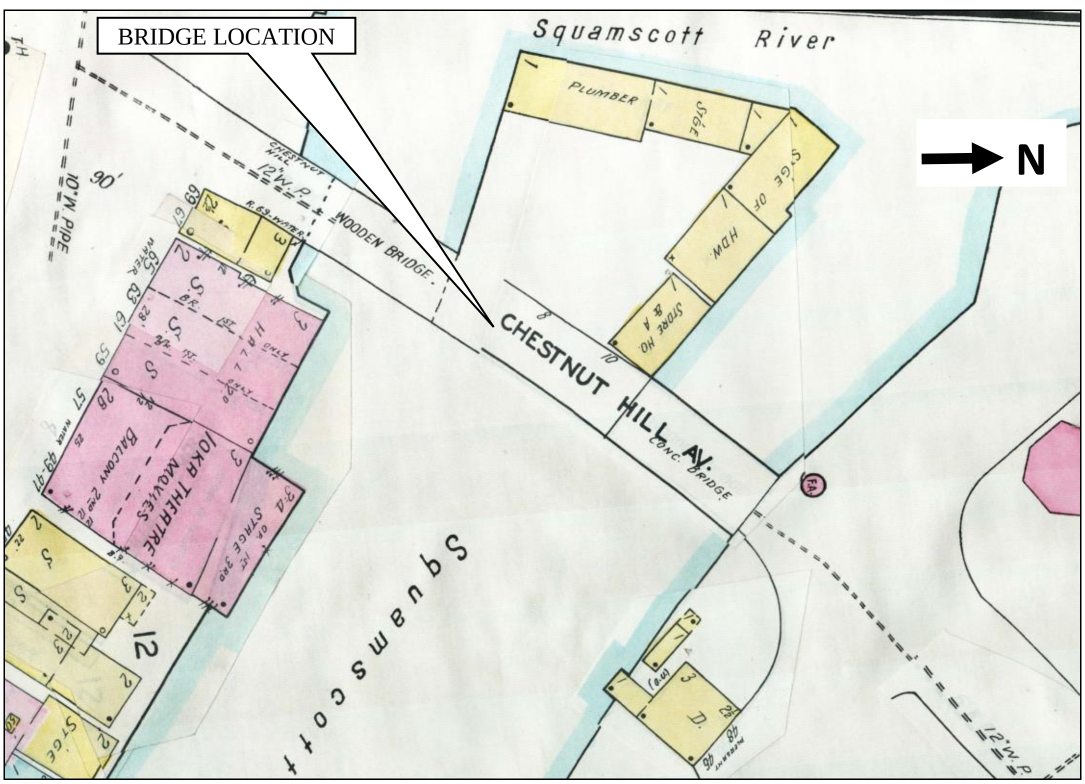



**FIGURE 8:** 1943 Sanborn Insurance Map (1924, corrected). Note west span mislabeled "wooden bridge."

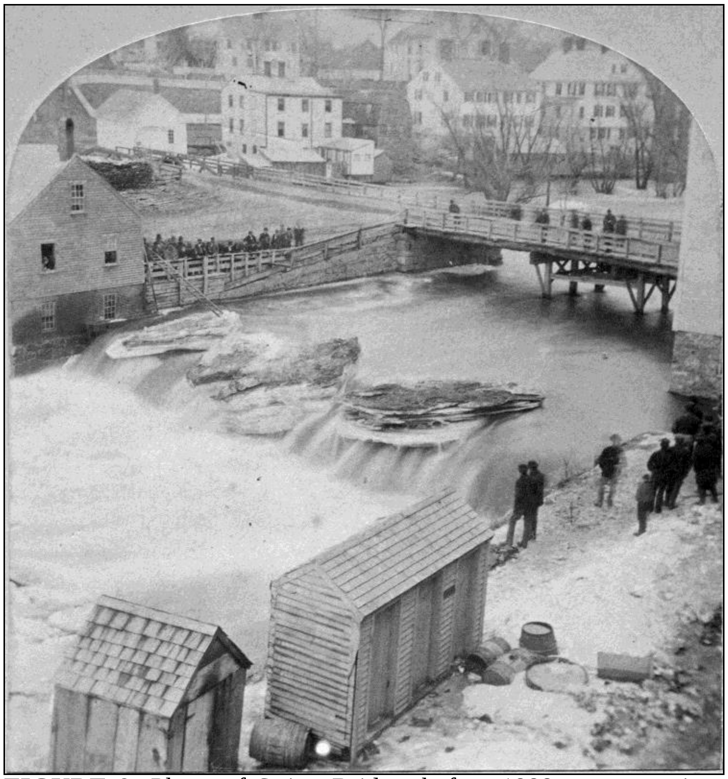


**FIGURE 9:** Photo of String Bridge, before 1888 reconstruction, downstream side and west channel. Note west span consists of stringers carried on two pile bents (actually 3-spans) and east span is a wood pony truss. Also note outhouses in foreground and crowd on Kimball's Island attempting to dislodge grounded ice cake at edge of falls with a ladder (Exeter Historical Society).

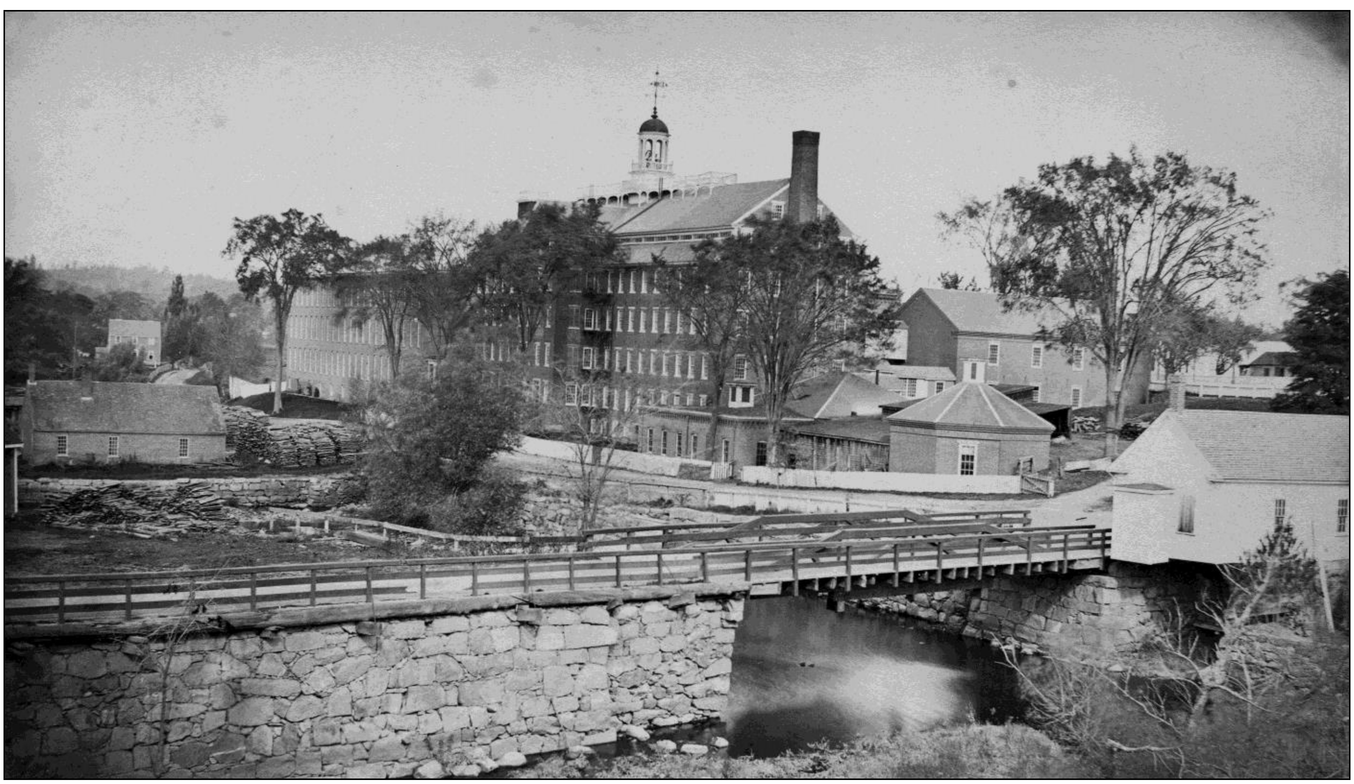


**FIGURE 10:** Photo of String Bridge, before 1888 reconstruction, upstream side and east channel. Note: east span consists of wood pony truss of the Warren type; stone retaining walls supporting island, portions of which survive today; octagonal brick Waste House of the Exeter Manufacturing Co., in background (Exeter Historical Society).

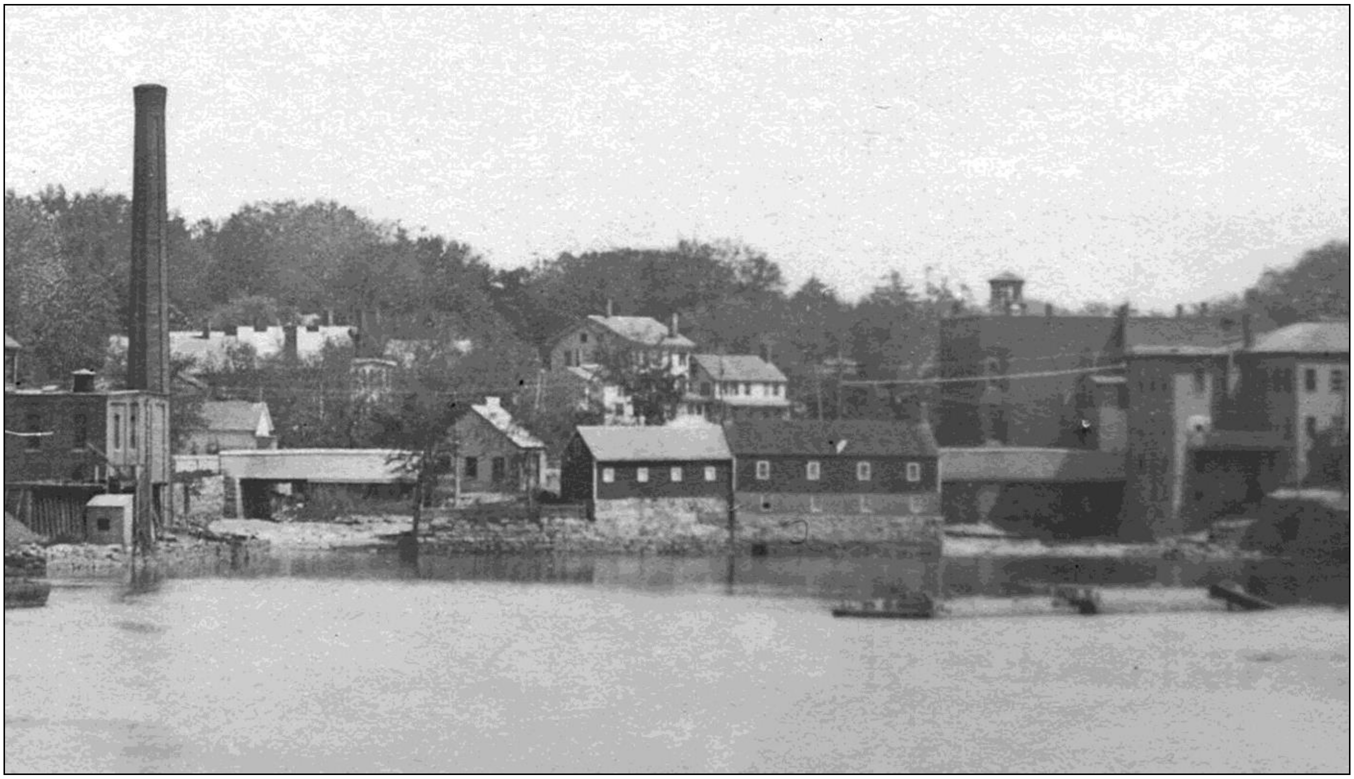


**FIGURE 11:** Photo of String Bridge, after 1888 reconstruction, downstream side. Note: both spans reconstructed as boxed wood pony truss spans; on the basis of Sanborn maps, the buildings on Kimball's Island date the photo between 1904 and 1924; see Figures 7 & 8 (Exeter Historical Society).

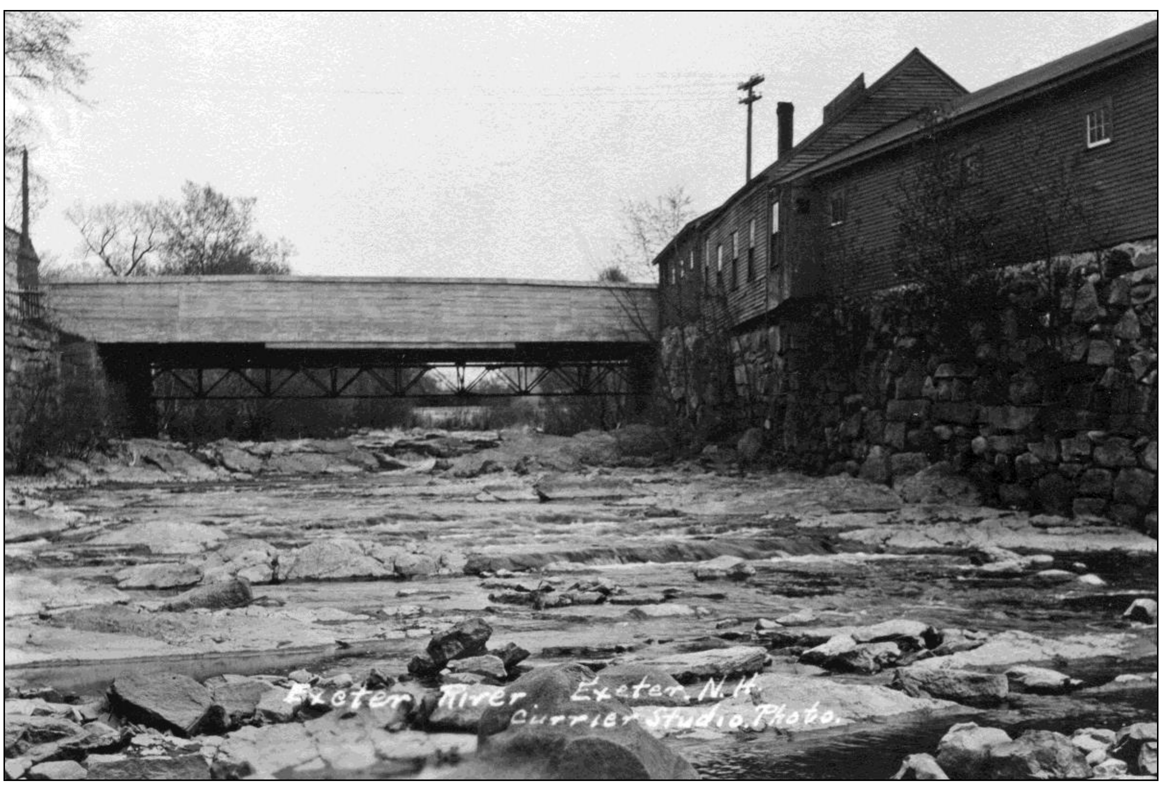



**FIGURE 12:** Photo of String Bridge, c. 1900, showing downstream side of west span, a boxed wood pony truss built 1888. Note water main carried on its own steel truss below bridge, installed between 1898 and 1904, according to Sanborn maps (Exeter Historical Society).

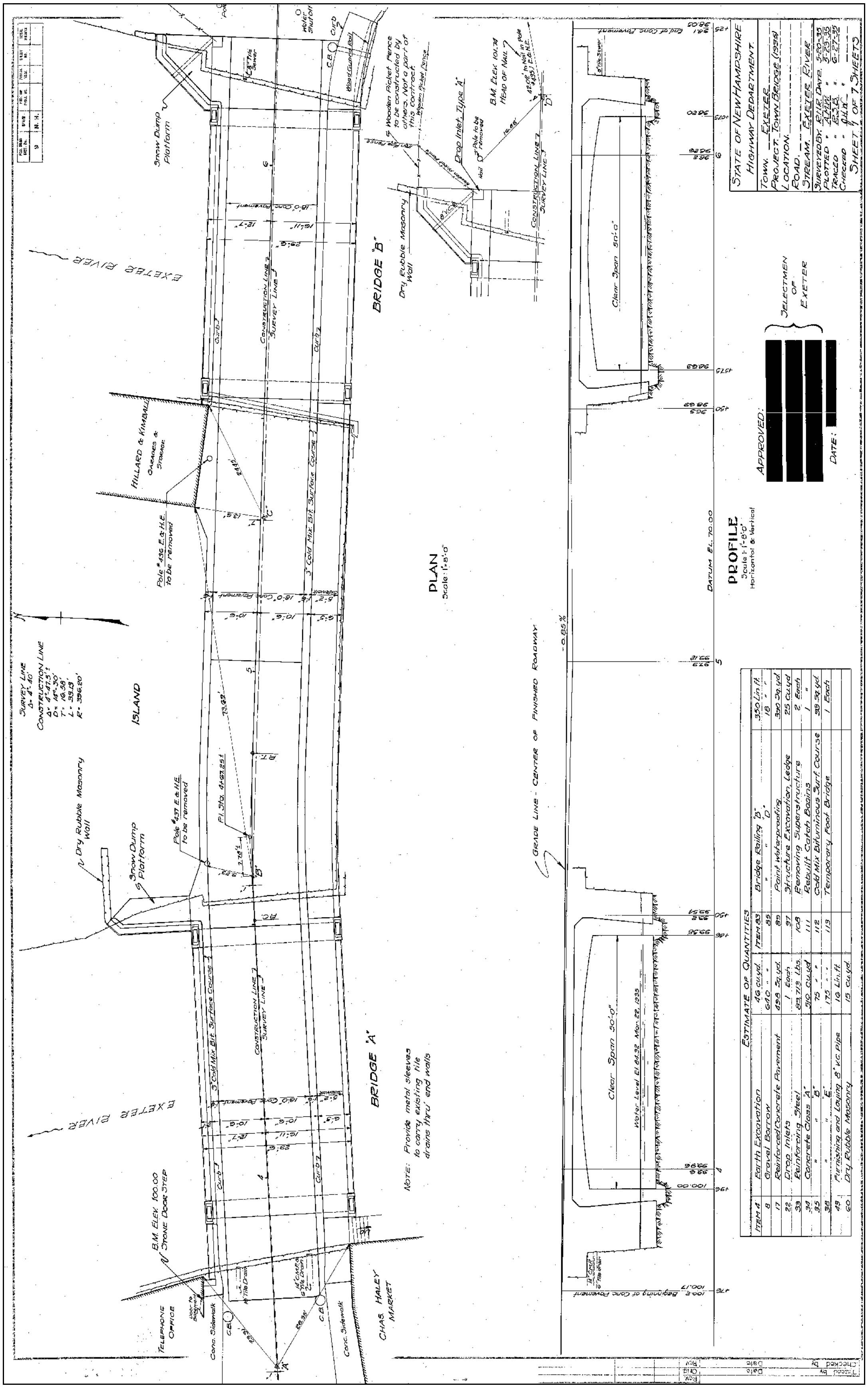



**FIGURE 13:** Original bridge plan, Sheet 1 of 7, 1935, showing plan and elevation of two structurally identical 50'-span Concrete Rigid Frame bridges separated by 130' solid fill island (NHDOT Bridge Plan File No. T-16).

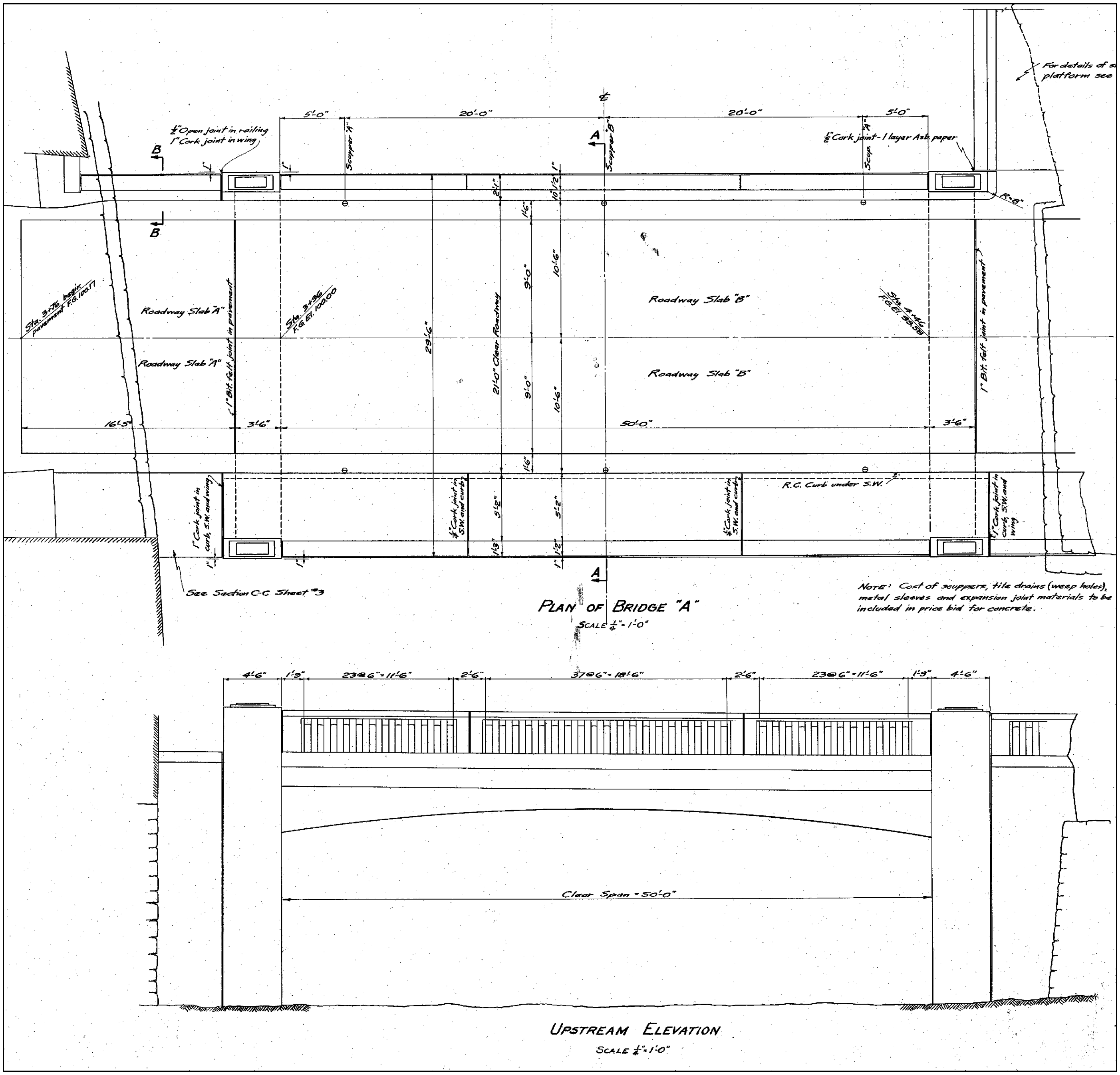



**FIGURE 14:** Original bridge plan, Sheet 2 of 7, 1935, showing plan and elevation of west span, "Bridge A" (103/074-W). Note new bridge abutments built inside existing stone abutments apparently left in place. (NHDOT Bridge Plan File No. T-16).

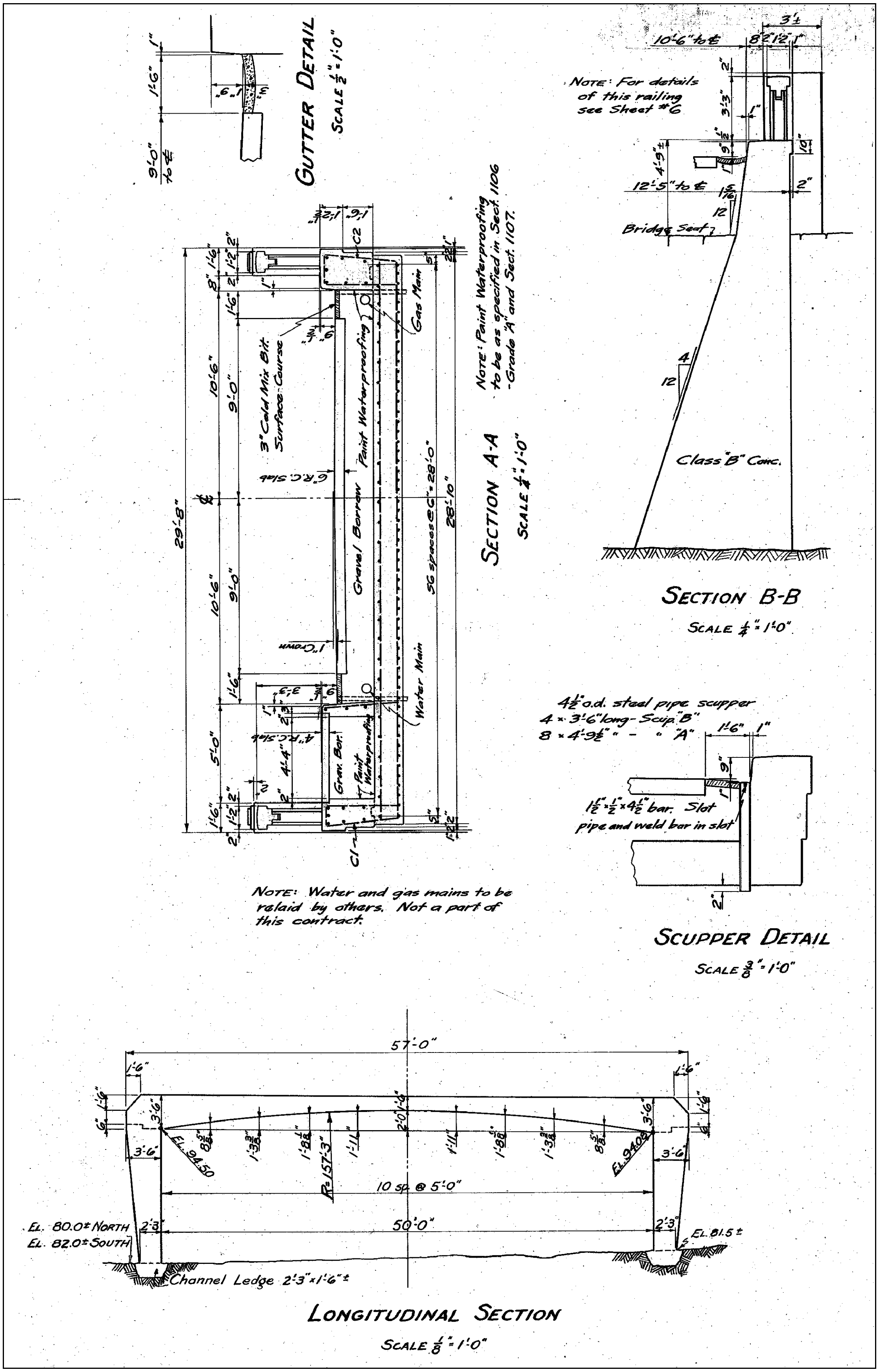



**FIGURE 15:** Original bridge plan, Sheet 2 of 7, 1935, showing: transverse Section A-A thru deck; Section B-B thru northwest abutment; Longitudinal Section thru rigid frame. Note legs socketed into ledge to insure rigidity, a structural requirement of the CRF bridge type (NHDOT Bridge Plan File No. T-16).

| Date photos taken: 08 January 2015 | | |
|---|---|---|

| Photo :# | 2 | Description: East span and Kimball's Island section, upstream side, from Exeter Library. |
|---|---|---|
| Reference (file name or frame #): EXE0084_002 | | Direction: W |

| Date photos taken: 08 January 2015 | | |
|---|---|---|

| Photo :# | 3 | Description: East span, upstream side, from Exeter Library. |
|---|---|---|
| Reference (file name or frame #): EXE0084_003 | | Direction: E |

Date photos taken: 08 January 2015

| | | |
|---|---|---|
| Photo :# | 4 | Description: East span, downstream side, showing "Lower Falls" and Kimball's Island (at right). |

Reference (file name or frame #): EXE0084_004 Direction: SE

Date photos taken: 08 January 2015

| | | |
|---|---|---|
| Photo :# | 5 | Description: Kimball's Island, downstream side, at base of Lower Falls, the end of Squamscott River and head of tide of Exeter River. The island is largely manmade, consisting of fill inside stone retaining walls bearing on the original ledge outcrop in the middle of the river. |

Reference (file name or frame #): EXE0084_005 Direction: S

Date photos taken: 08 January 2015

| Photo :# | 6 | Description: East span, downstream side, showing connection to stone retaining walls (partly collapsed) of Kimball's Island. |
|---|---|---|

Reference (file name or frame #): EXE0084_006 Direction: S

Date photos taken: 08 January 2015

| Photo :# | 7 | Description: East span, downstream side, from Kimball's Island, showing east abutment, junction with Chestnut Street and Exeter Library in background. |
|---|---|---|

Reference (file name or frame #): EXE0084_007 Direction: E

Date photos taken: 08 January 2015

| Photo :# | 8 | Description: Road section over Kimball's Island and west span, showing continuous sidewalk and railing and rear of buildings facing Water Street and village center. |
|---|---|---|

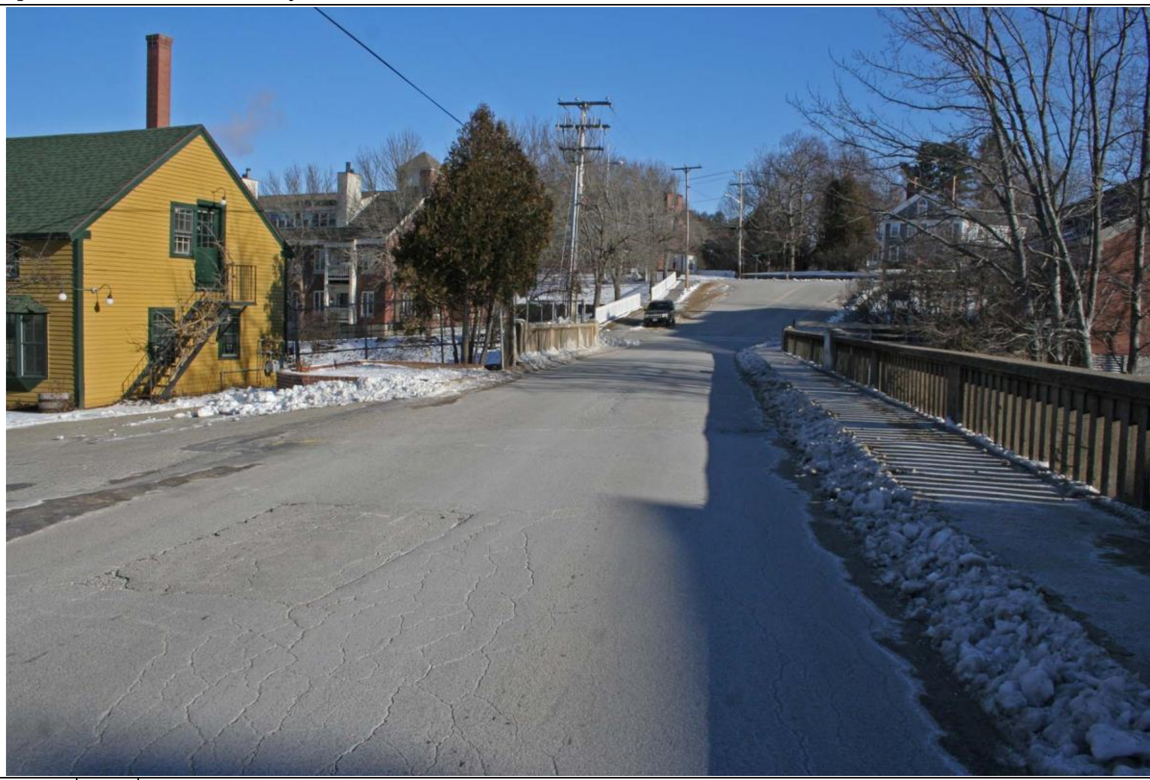
Reference (file name or frame #): EXE0084_006 Direction: S

Date photos taken: 08 January 2015

| Photo :# | 9 | Description: West span approach and roadway from Water Street. |
|---|---|---|

Reference (file name or frame #): EXE0084_007 Direction: NE

Date photos taken: 08 January 2015



| | | |
|---|---|---|
| Photo :# | 10 | Description: Road section on island, sidewalk, railing and east span, from island. |

Reference (file name or frame #): EXE0084_006 Direction: NE

Date photos taken: 08 January 2015

| | | |
|---|---|---|
| Photo :# | 11 | Description: Overall context view of upstream side from "Upper Falls" near Great Bridge. |

Reference (file name or frame #): EXE0084_007 Direction: NW

Date photos taken: 08 January 2015

| Photo :# | 12 | Description: | Great Bridge carrying High Street over Squamscott R., built 1934, rebuilt 2003. Originally a CRF like String Bridge, it was rebuilt with prestressed I-beams (PIB). A low-arched concrete fascia was added to emulate the original CRF bridge deck. |
|---|---|---|---|
| Reference (file name or frame #): | EXE0084_006 | Direction: | S |

PHOTO KEY IS LOCATED ON PAGE_3__

I, the undersigned, confirm that the photos in this inventory form have not been digitally manipulated and that they conform to the standards set forth in the NHDHR Photo Policy. These photos were printed at the following commercial printer OR were printed using the following printer, ink, and paper: CVS Pharmacy, Fall River MA.
(Color photos must be professionally printed.)
The negatives or digital files are housed at/with: _Historic Documentation Company, Inc., 490 Water St., Portsmouth, RI 02871

**SIGNED**:

_[signature]_

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If this inventory form is being submitted for consideration of New Hampshire State Register listing, have you included:
____ a photo CD with digital images included in the nomination (does not apply if film photography was used)
____ the State Register Contact Information sheet