Tab G. Alternatives Discussion

1. Memorial Bridge (Including Maine Approach)[39]

a. Preferred Alternative: "Modified" Replacement In-Kind of the Lift Span

This proposed action will involve complete replacement of the movable lift span and rehabilitation of the flanking fixed trusses and towers of the Memorial Bridge. The proposed replacement of the lift span will largely mirror the historic appearance of the existing lift span, by replicating the structure's most visible character-defining laced members. Under this "modified" replacement in-kind, a new truss for the lift-span will be constructed whose members will consist of both replications of the historic laced members and new modern, rolled, welded shapes. Consultation with the cultural resource agencies in both states was performed in identifying the bridge elements to be replicated in the new lift span. Specifically, the historic laced member appearance will include the vertical and diagonal members at the sides of the trusses and the sway bracing and upper lateral bracing between the trusses (Figure G-1, Figure G-2, Figure G-3, Figure G-4). The top and bottom chords will be a box of rolled shapes with welded plates. The flooring system below the deck will also consist of modern rolled members with bolting and welding as necessary. The existing bridge has riveted steel connections, which is no longer a prudent practice. The new lift span will have gusseted connections secured with bolts, nuts, and welding. The mechanical components of the lift span (machinery, sheaves, trunnions, and ropes) and electrical components of the bridge will be completely replaced, while the lift span is raised in the up position.

Structural rehabilitation of the adjoining truss spans will consist of replacement or strengthening of the severely deteriorated roadway steel framing and replacement of the deck. The project will include blast cleaning and painting of all structural steel. The original bridge was designed to accommodate the equivalent of today's HS-15 design loading (a 27-ton three-axle tractor truck with semi-trailer). The proposed rehabilitation will increase the live loading on all spans of the bridge to HS-20 live loading (a three-axle truck weighing 36 tons). The roadway cross-section will remain the same, with two 14' travel lanes and two 6' sidewalks. The lift span replacement is not anticipated to require any structural steel repairs or painting for at least twenty years.

[39] Information in this section is based on the 12/2007 Draft Environmentl Study/Draft Section4(f) Evalutation prepared by HNTB for the NHDOT.

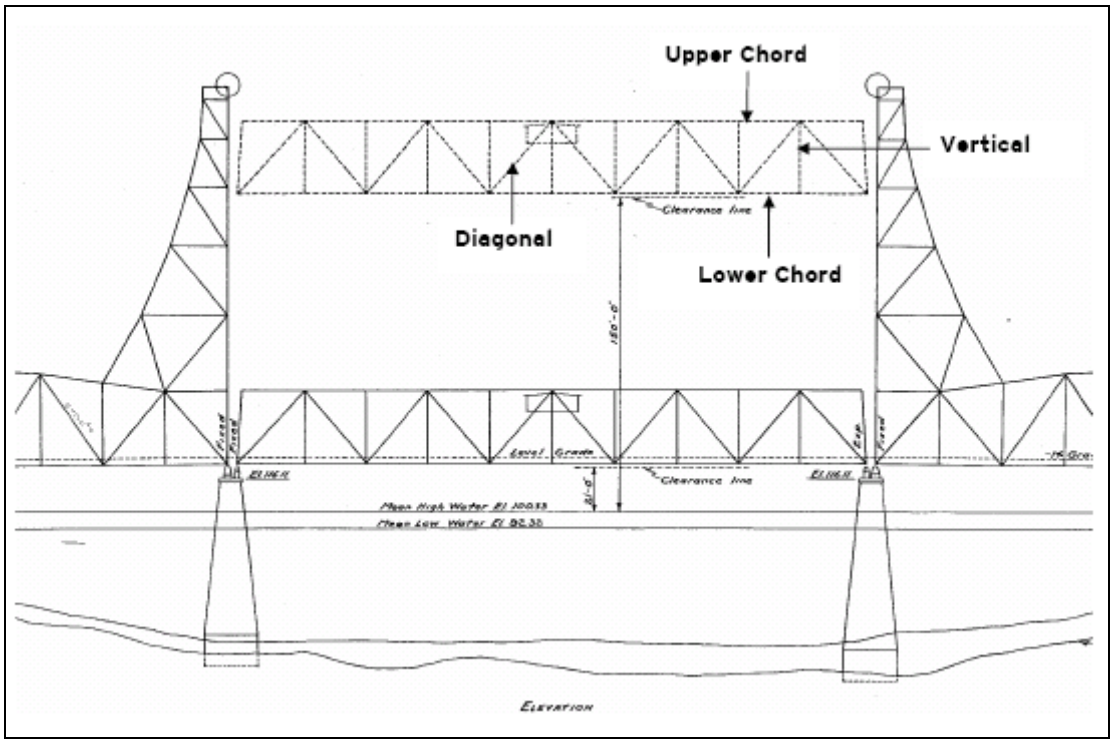

Figure G-1: Elevation View of Lift Span Identifying Elements of the Truss System

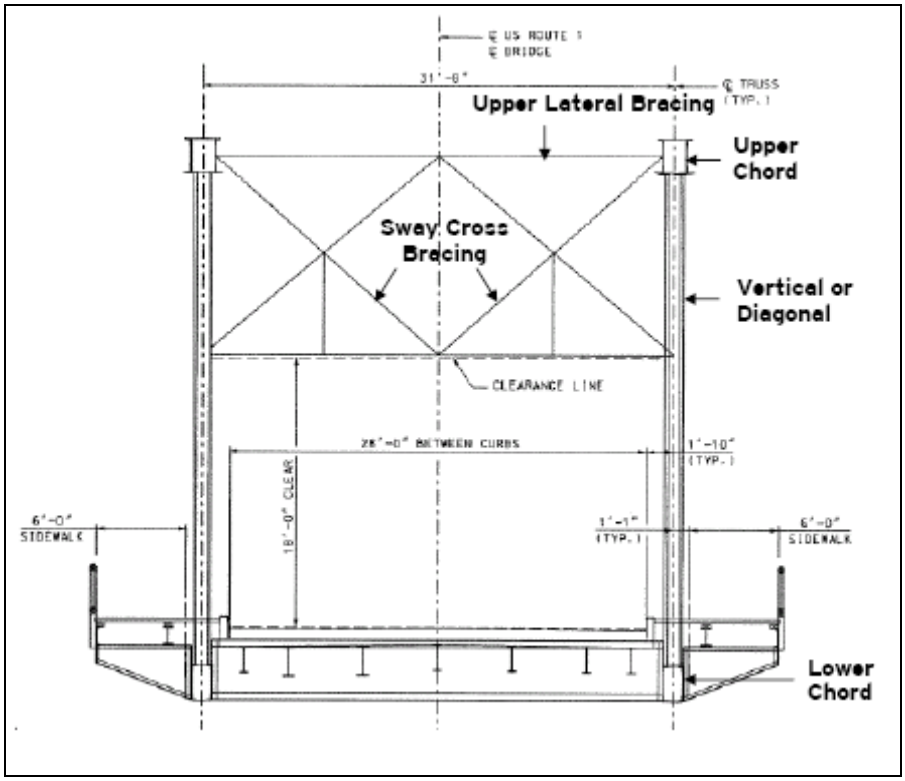

Figure G-2: Cross-section View Identifying Elements of the Truss System

Figure G-3: View Looking Northeast of Existing Memorial Bridge Lift Span

Figure G-4: Photo-simulation of Proposed New Lift Span

As part of the project, the operator's control house will be relocated from its current location atop the lift span to the south tower above the approach roadway to improve safety, access to sanitary facilities, and operator visibility.

Roadway and sidewalk safety will be enhanced by the replacement of the open steel grid decking on the lift span with a solid surface, full deck replacement on the flanking trusses, and repair of the bridge railing and replacement of the timber planking on sidewalks to provide better slip resistance on the truss spans and Kittery Approach spans. The deck on the Kittery Approach spans will be repaired. Concrete patching and repairs on the bridge piers will be staged from a barge or will be performed by workers on foot on the Badgers Island shoreline. The project also includes minor repairs to the bridge fenders that will involve repairs above the waterline of the Piscataqua River.

b. Alternatives to the Proposed Action

A wide range of alternatives for the Memorial Bridge were considered during the conceptual and preliminary design phases of the project. The conceptual design study considered a range of build alternatives, from limited bridge rehabilitation to full bridge replacement. The conceptual design study resulted in screening of the build options to two bridge rehabilitation options for further consideration during preliminary design: lift span rehabilitation and lift span replacement. During the preliminary design phase, concern for Section 4(f)/Section 106 resources led to evaluation of a number of variations on these two alternatives to minimize cultural resource impacts.

Alternatives that were considered during conceptual design included:

- No build
- Lift span replacement
- Lift span rehabilitation
- Limited lift span rehabilitation
- New on-line vertical lift bridge
- New on-line bascule bridge
- New tunnel
- Bridge replacement off alignment

Of these alternatives, the lift span rehabilitation and lift span replacements alternatives were carried forward. A number of variations on these alternatives were evaluated as part of the Section 106 consultation process during preliminary design. These include:

- Preserving upper portion of the lift span, floating it off site, and replacing lift span structure below deck
- Fabricating a new deck and steel framing system on land, floating it out to the existing bridge, and joining it to the existing truss
- Providing a secondary support truss to brace the existing bridge
- Floating out the lift span for rehabilitation off site, and floating the rehabilitated lift span back into place
- Replacing in-kind the existing lift span
- "Modified" replacement in-kind of the existing lift span (proposed action).

A more in-depth discussion of each alternative follows.

NO BUILD

Under the No Build alternative, structural deterioration of the Memorial Bridge and the Portsmouth Approach Span will continue, posing a safety hazard and requiring more frequent closures for emergency repairs or mechanical failures. Structural inspections were performed in 2003, which identified the need for emergency repairs, and inspections have been performed every six months since that time. Emergency repairs on the Memorial Bridge were performed in 2004, allowing the weight limit of the bridge to be raised from six tons to twenty tons. Inspections performed through the fall of 2007 identified the need for an emergency contract to replace three counterweight ropes, which is scheduled for 2008.

Continued structural deterioration would eventually affect the load ratings for the bridge, which already prevent, or impede some emergency responders from using it. The bridge is the most direct route between Kittery and downtown Portsmouth. Further weight restrictions could completely prohibit access to the bridge by larger emergency vehicles and larger trucks. Kittery, the Portsmouth Naval Shipyard, and the City of Portsmouth, and other surrounding communities (including Newington and Rye) have cooperative emergency response agreements, and the preferred route of first responders between downtown Portsmouth and Kittery is the Memorial Bridge. Over time, if no repairs are performed, the bridge could be permanently closed to vehicular traffic and may not be operational to accommodate navigation on the Piscataqua River.

Failure of the mechanical components of the bridge would result in the bridge being stuck in either the open or closed position, which could represent a substantial disruption to roadway and/or navigational traffic in the region. Failure in the closed position could impact critical wintertime fuel deliveries for the New England region, shipments to upstream industrial users, and commercial fisheries. During the summer, the channel is also heavily used for recreation and tourism charters. Failure of the bridge in the open position would disrupt the flow of traffic to and from the Portsmouth downtown area that adjoins the bridge site. The bridge is heavily used by local vehicular traffic making trips between Portsmouth, Badgers Island, and Kittery, including commuters to the Portsmouth Naval Shipyard. The bridge is an important corridor for pedestrians and cyclists and represents the only crossing of the Piscataqua River in this region for these users.

Because the bridge is a critical transportation route for vehicular and navigational traffic, this alternative does not meet the project purpose and need.

MODERN LIFT SPAN REPLACEMENT

Replacement of the lift span using modern construction was considered. Instead of the lacing on the verticals, diagonals, sway bracing, and upper laterals, these steel elements on the new lift span would consist of solid rolled members. This alternative would be less expensive than the proposed action and would be less costly to maintain than the lift span rehabilitation. However, based on consultations with cultural resource agencies and the Section 106 consulting party, this alternative was dismissed because of the aesthetic impacts on the National Register-eligible Memorial Bridge Historic District and the National Register-eligible Portsmouth Historic District. Other variations of this alternative that replicate the lacing on the original structure to varying degrees were further developed and considered.

LIFT SPAN REHABILITATION

An alternative that would involve only rehabilitation of the movable lift span portion of the Memorial Bridge was evaluated. After the initial evaluation of alternatives, this alternative was carried forward, along with the proposed lift span replacement, for further consideration. This alternative would increase the live loading on the bridge to HS-20 (a three-axle truck weighing 36 tons), but the lift span rehabilitation would have a considerably shorter design life than the replacement lift span. This alternative would have fewer impacts to the historic bridge, which is eligible for listing in the National Register of Historic Places.

However, the lift span rehabilitation will require miscellaneous steel repairs within ten years and at a frequency of every five years after that. This alternative is also anticipated to require more frequent painting and repair activities and is estimated to require repairs ten years earlier than the lift span replacement. This is primarily due to the built-up steel members that allow moisture to infiltrate the gaps between steel members and cause deterioration.

The drawback to this alternative is the shorter design life relative to the decrease in construction cost, which is estimated to be approximately $4.7 million less than that for the replacement of the lift span (proposed action). Long-term maintenance costs for the lift span rehabilitation over 54 years are estimated to be approximately $12.6 million more than the proposed action. Moreover, even with these expenditures, the structural integrity would be compromised by retaining the original steel of the bridge that has been infiltrated with chlorides, particularly the critical lower chord of the lift span, and retaining other deterioration at panel points connecting the diagonal members. It is not possible to replace these without compromising the structural integrity of the structure. This older structure is particularly fracture-critical below the existing lift span deck, due to corrosive effects of de-icing salts over the years. The rehabilitation would be performed by adding new steel, which will increase strength, but not prevent continued deterioration of the existing steel.

This alternative is not prudent based on the higher maintenance costs when compared to the lift span replacement comprised of solid members. It is also not prudent based on the risk of future deterioration of the lower truss chord that could be detrimental to safe bridge usage. For these reasons, this alternative was not selected.

Limited Bridge Rehabilitation: The limited bridge rehabilitation would rehabilitate, but would not replace, the decking and steel grid and steel roadway framing. A major drawback of this alternative is that it would have the shortest life span of the alternatives evaluated and would require additional investments in fifteen years. It also would maintain the poor ride quality and would not eliminate inherent safety concerns of the existing open steel grid deck. Under this alternative, the requirement would remain for cyclists to walk their bicycles over the bridge. For these reasons, this alternative was not carried beyond conceptual design for further consideration.

Bridge Replacement (Vertical Lift Bridge and Bascule Bridge) On Existing Alignment: A new replacement bridge (both a vertical lift bridge and bascule bridge) on the same alignment as the existing bridge was considered. The bascule bridge option would involve a double-leaf bascule design. This option would involve a lower vertical clearance than the existing bridge when in the closed position, unless considerable right-of-way was acquired. For these reasons, the bascule bridge option was determined to not be a reasonable replacement option. The vertical lift bridge would involve a Warren truss lift span supported by concrete lift towers. For the vertical lift bridge option, both flanking spans of the Memorial Bridge and the Kittery

Approach spans would be replaced. The drawbacks to the replacement bridge alternative include increased costs and impacts. A new bridge would incur greater impacts on the National Register-eligible bridge historic district and other eligible resources. Bridge replacement would also require a long-term bridge closure and disturbance to the river bottom for construction of new bridge piers. For these reasons, the alternative for a new replacement bridge was not carried beyond conceptual design for further consideration.

Tunnel: A tunnel alternative under the Piscataqua River was evaluated to replace the existing bridge crossing. A major drawback of this alternative is that it would be the most costly to construct (approximately $40 million more than the proposed action) and would require a long-term closure of the river crossing. Other major disadvantages of the tunnel alternative are the changes to the historic character of the area and the need for substantial right-of-way takings for construction of the tunnel entrance and exit, particularly on the Portsmouth business district. For these reasons, this alternative was not carried beyond conceptual design for further consideration.

Bridge Replacement Off Alignment: Replacing the Memorial Bridge on an alternative alignment may avoid the use of the historic bridge, but would incur substantially greater impacts to the surrounding areas, including the National Register-eligible Portsmouth Historic District. The area surrounding the Memorial Bridge is densely developed, particularly on the Portsmouth side, where multi-level development extends to the waterfront areas on the west side of the bridge. A new bridge on a westerly alignment would impact the Harbour Place development and marina, and an easterly alignment would impact historic Prescott Park. On Badgers Island, a new alignment to either the west or east would impact several businesses and residential properties along U.S. Route 1. This alternative would also involve greater impacts to natural resources in the Piscataqua River and could also impact the John Paul Jones Memorial Park in Kittery. A new alignment would require constructing new piers within the river and building approach roadways along the shorelines in both New Hampshire and Maine. An entirely new bridge structure on a new alignment would also be substantially more costly than the proposed action and would take longer to construct, resulting in extended conflicts with marine traffic. Moreover, this alternative would not address the repairs that are needed to the existing bridge to allow it to operate or remain in place. For these reasons, this alternative was not selected.

Preserving Upper Portion of Lift Span, Floating It Off Site, and Replacing Lift Span Structure Below Deck: Preserving the upper portion of the lift span, floating it off site for rehabilitation, and replacing the lift span below deck was considered. However, this alternative would pose logistical concerns regarding the float-in/float-out scenario, the availability of an off-site construction staging location, and the structural welding of the newly constructed lower bridge with the rehabilitated lift span structure. This alternative would also involve greater traffic disruptions due to the length of time required for the float-in/float-out scenario and welding of the rehabilitated lift span and new substructure. This alternative is also estimated to cost approximately $2.7 million more than the proposed action. For these reasons, this alternative was not carried forward for further consideration.

Fabricating a New Deck and Steel Framing System On Land, Floating It Out to the Existing Bridge, and Joining It to the Existing Truss: This alternative would involve retaining the lift span truss and fabrication of a new deck off site. This alternative would provide the same improvements to the lift span as the lift span rehabilitation alternative. It only varies in the method used to reconstruct the roadway deck and associated steel framing. There are a number of issues associated with this alternative. If the entire existing roadway is removed to allow for a new deck system to be floated into place, no members would span from the upstream

side of the truss to the downstream side of the truss for a 300-foot length. This would create a temporarily unstable bridge structure that may collapse. Temporary bracing schemes were investigated to maintain stability of the truss during a complete deck removal, and these were determined to be impractical since the contractor would not be able to work around the required temporary bracing. Another issue is the tolerance required for the connections of a new deck system to the existing lower chord of the truss. The ability to align all the structural steel members with the existing framing would be virtually impossible. Even the use of slotted holes and oversized washers would not be sufficient to overcome the construction tolerance issues. For these reasons, this alternative was not deemed feasible, and was not carried forward for further consideration.

Providing a Secondary Support Truss to Brace the Existing Bridge: This alternative would provide the same improvements to the lift span as the lift span rehabilitation alternative. It only varies in the method used to maintain the structural integrity of the truss during construction. Additionally, the final constructed condition would result in wider bridge piers in the river. This alternative would require widening the piers in the Piscataqua River to support the secondary truss. This alternative would present environmental concerns for work in the river, related to disturbance of the river bottom and potential impacts on water quality and aquatic life. For this reason, this alternative was not carried forward for further consideration.

Float out of the Lift Span for Rehabilitation Off Site and Floating Rehabilitated Lift Span Back Into Place: This alternative is the same as the lift span rehabilitation, only the rehabilitation work would be performed off site. The time that would be required to remove the lift span, float it to a land-based repair staging area, create temporary shoring, perform the repairs, and float the span back out to the bridge is anticipated to take at least seven months. If the lift span were to be removed, the contractor would rely on barges and detour routes to move materials and workers around the project site, and the lift span would not be available for construction access to the site. During this time period, the lift span would also not be available for use by motorists or pedestrians. Because of the increased risks associated with handling the truss, inefficient construction access (and the associated cost premium), and inconvenience to the public, this alternative was not deemed to be prudent and was not carried forward for further consideration.

REPLACEMENT IN-KIND OF THE LIFT SPAN

An alternative that would completely replace and replicate the structural framework on the historic moveable lift span portion of the Memorial Bridge was evaluated. This alternative is similar to the "modified" in-kind replacement (proposed action), except that all of the structural steel elements would be replicated. This alternative would also replace in-kind the upper and lower chords, situated at the tops and bottoms of the trusses, and the lower laterals, between the trusses and below the roadway deck. The drawbacks to this alternative are the increased costs, which would be approximately $2.3 million greater than that of the proposed "modified" replication in-kind of the lift span. The cultural resource agencies agreed that the "modified" in-kind replacement replicates the highly visible character-defining structural elements of the lift span. In addition to increased costs, reasons for not replicating the upper and lower chords include the fact that the cross lattice members would present an increased opportunity for pack rust and corrosion and would also leave the chords open for roosting by birds. This roosting would contribute to corrosion, as the droppings are corrosive. For these reasons, this alternative was not selected.

c. Preferred Alternative Sketches

Memorial Bridge

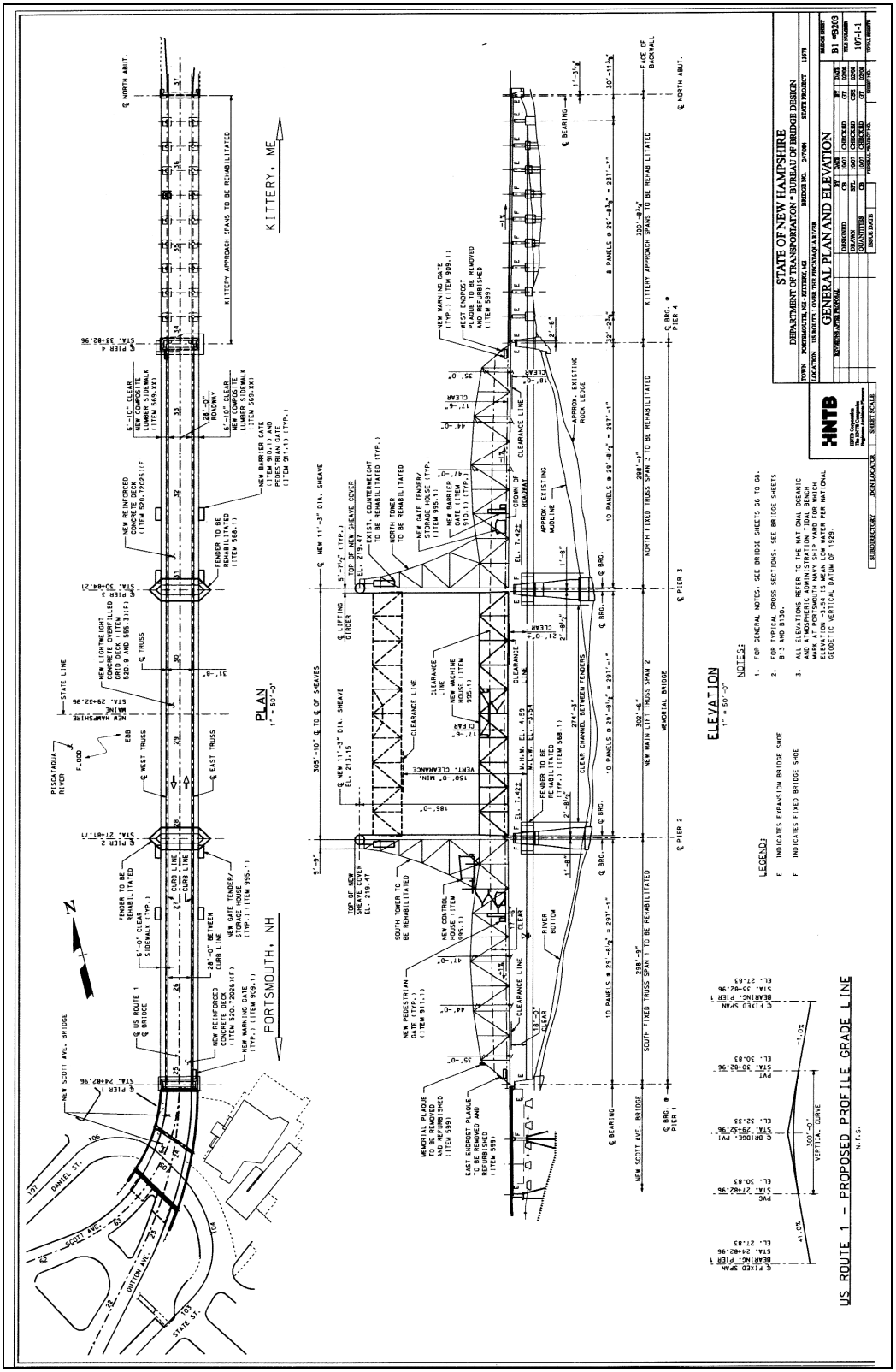

Figure G-5: General Plan and Elevation

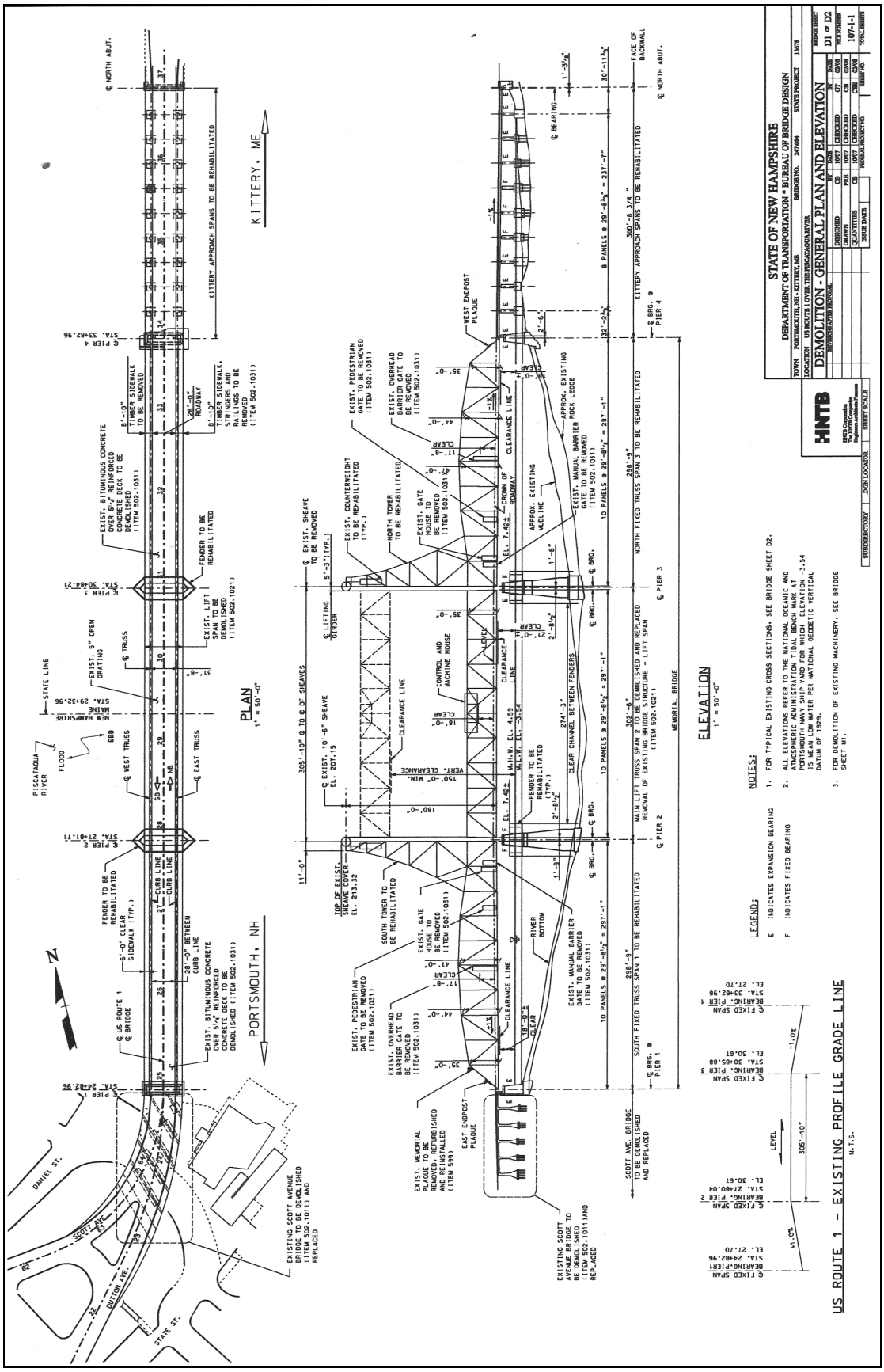

Figure G-6: Demolition: General Plan and Elevation

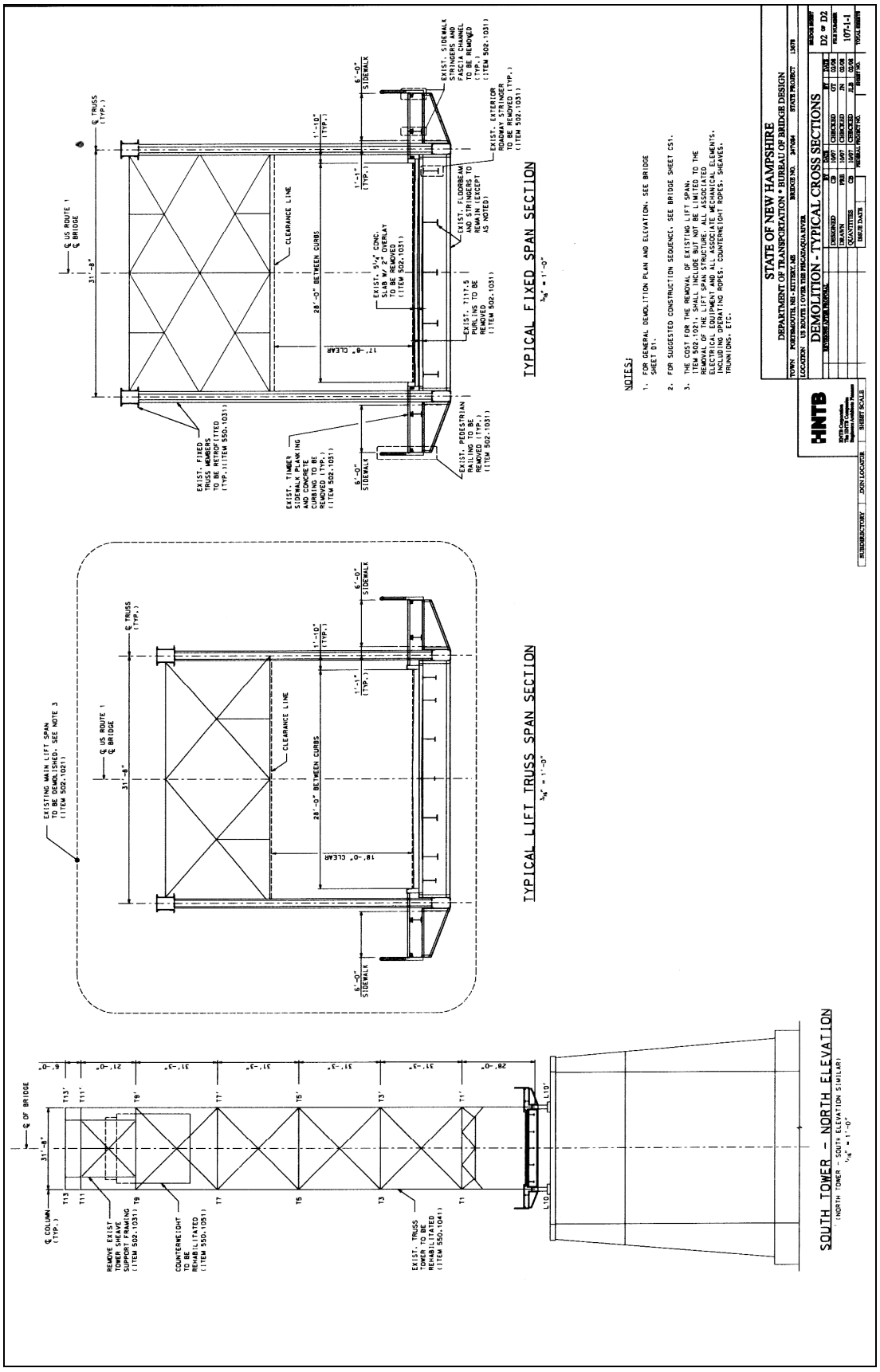

Figure G-7: Demolition: Typical Cross Sections

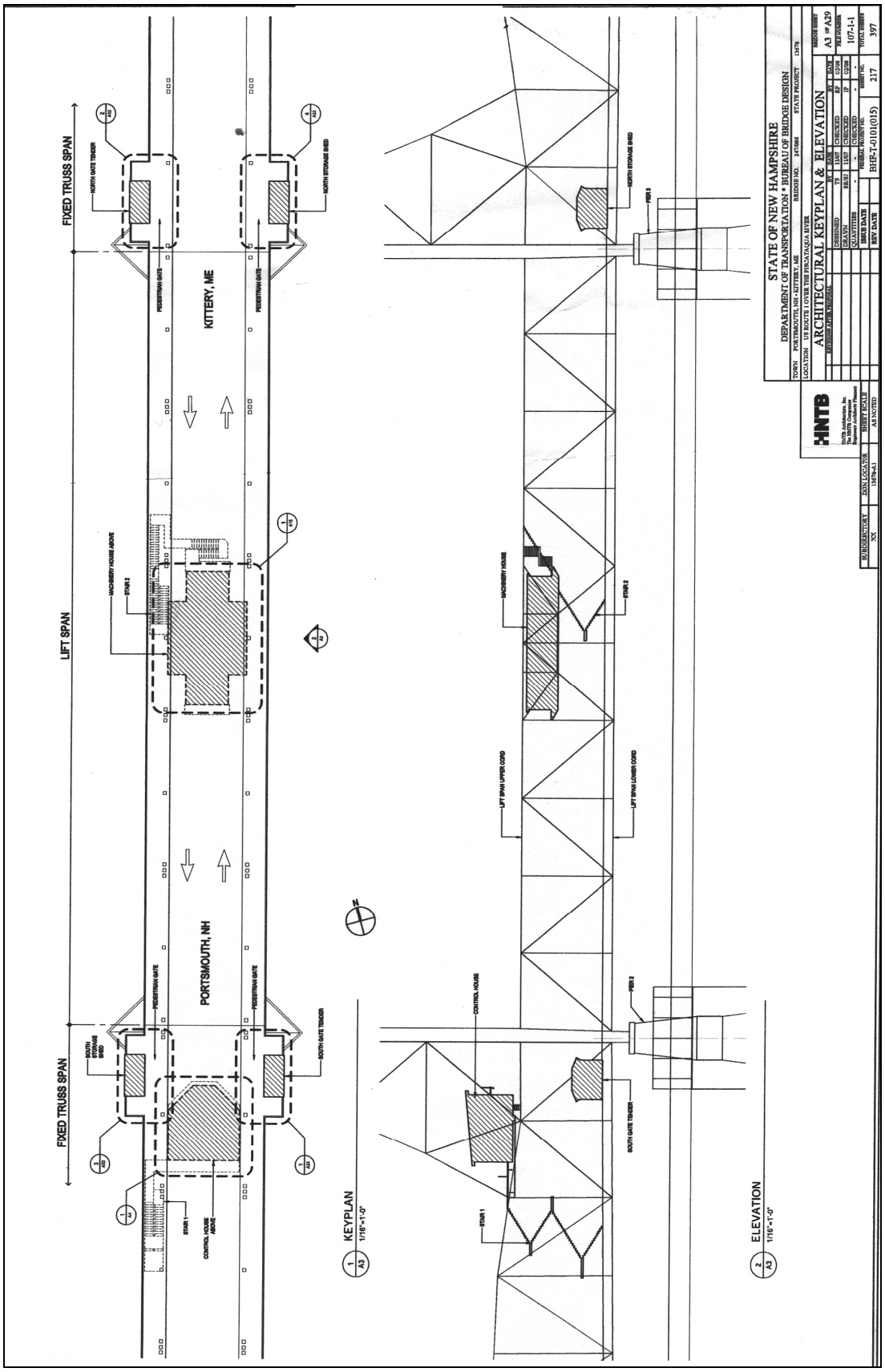

Figure G-8: Architectural Key plan & Elevation

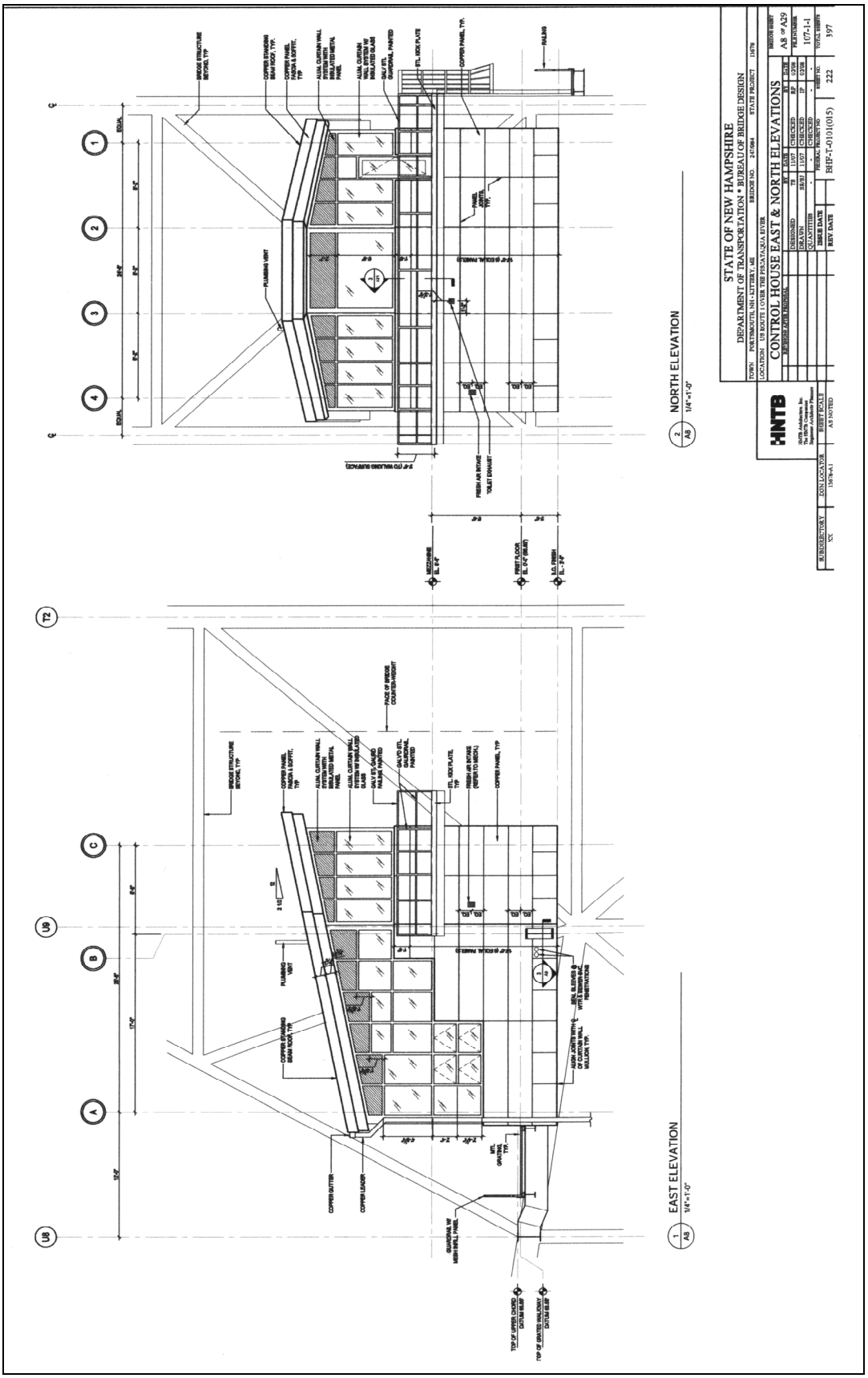

Figure G-9: Control House East & North Elevations

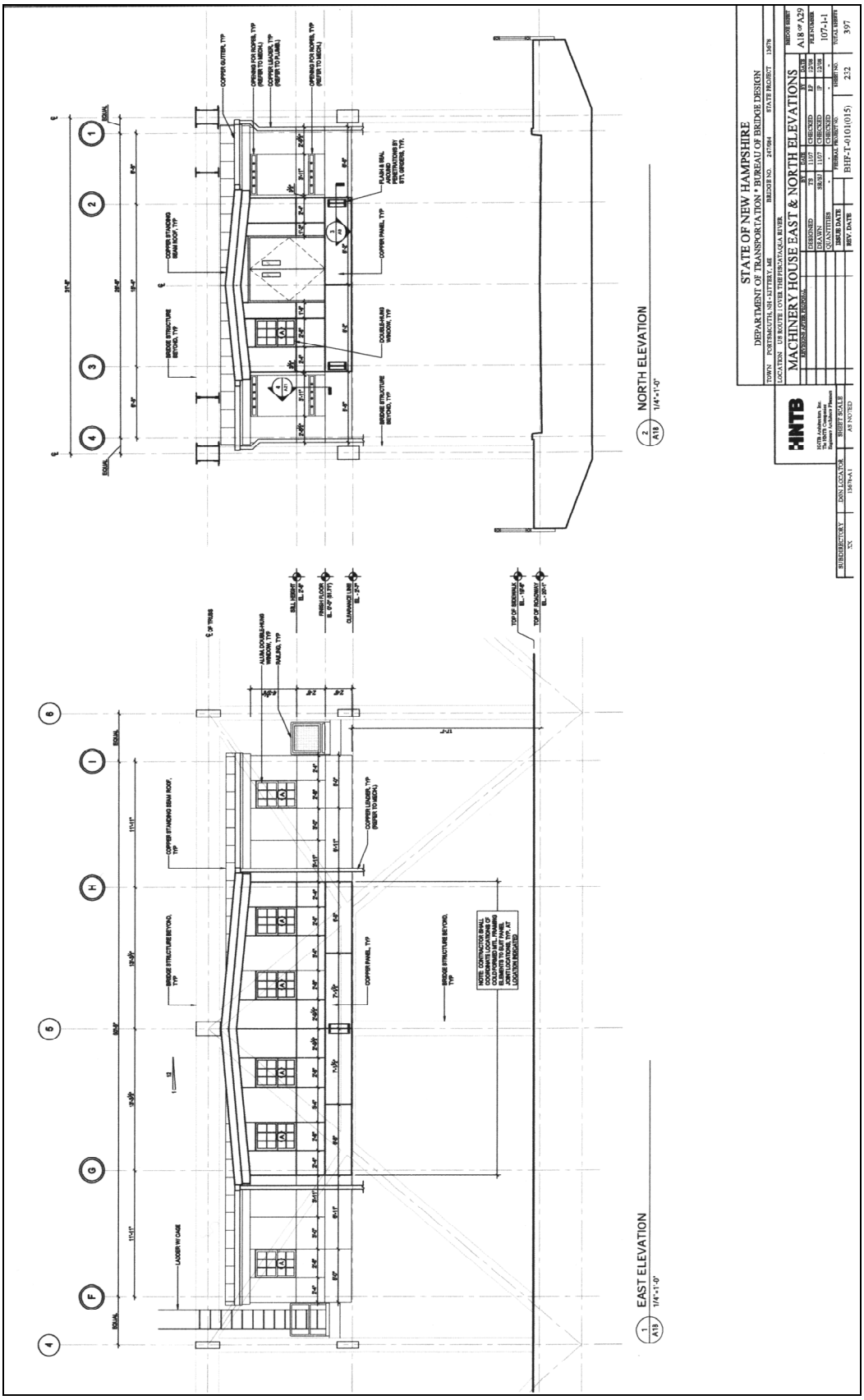

Figure G-10: Machinery House East & North Elevations

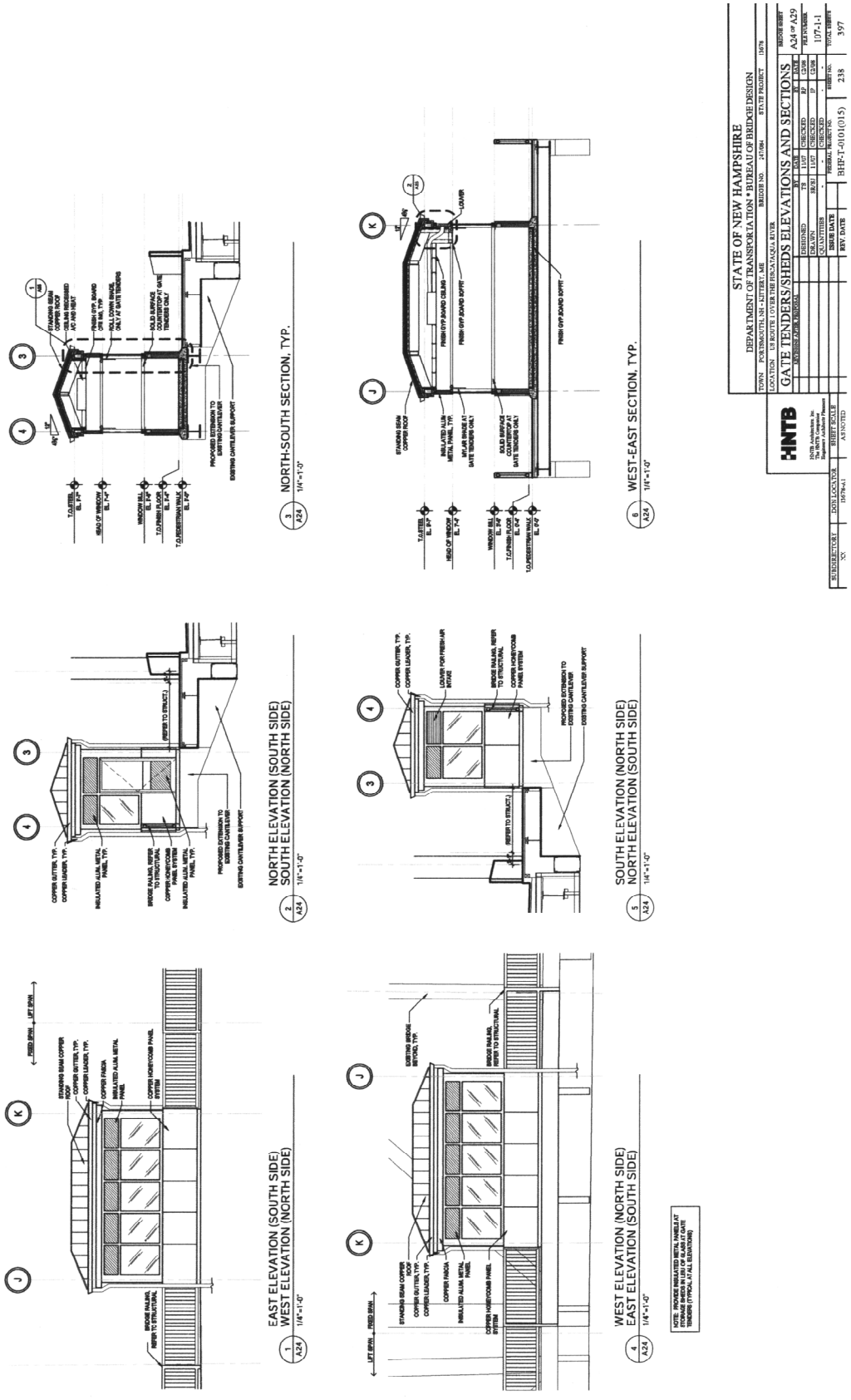

Figure G-11: Gate Tenders-Sheds Elevations and Sections

Kittery Approach

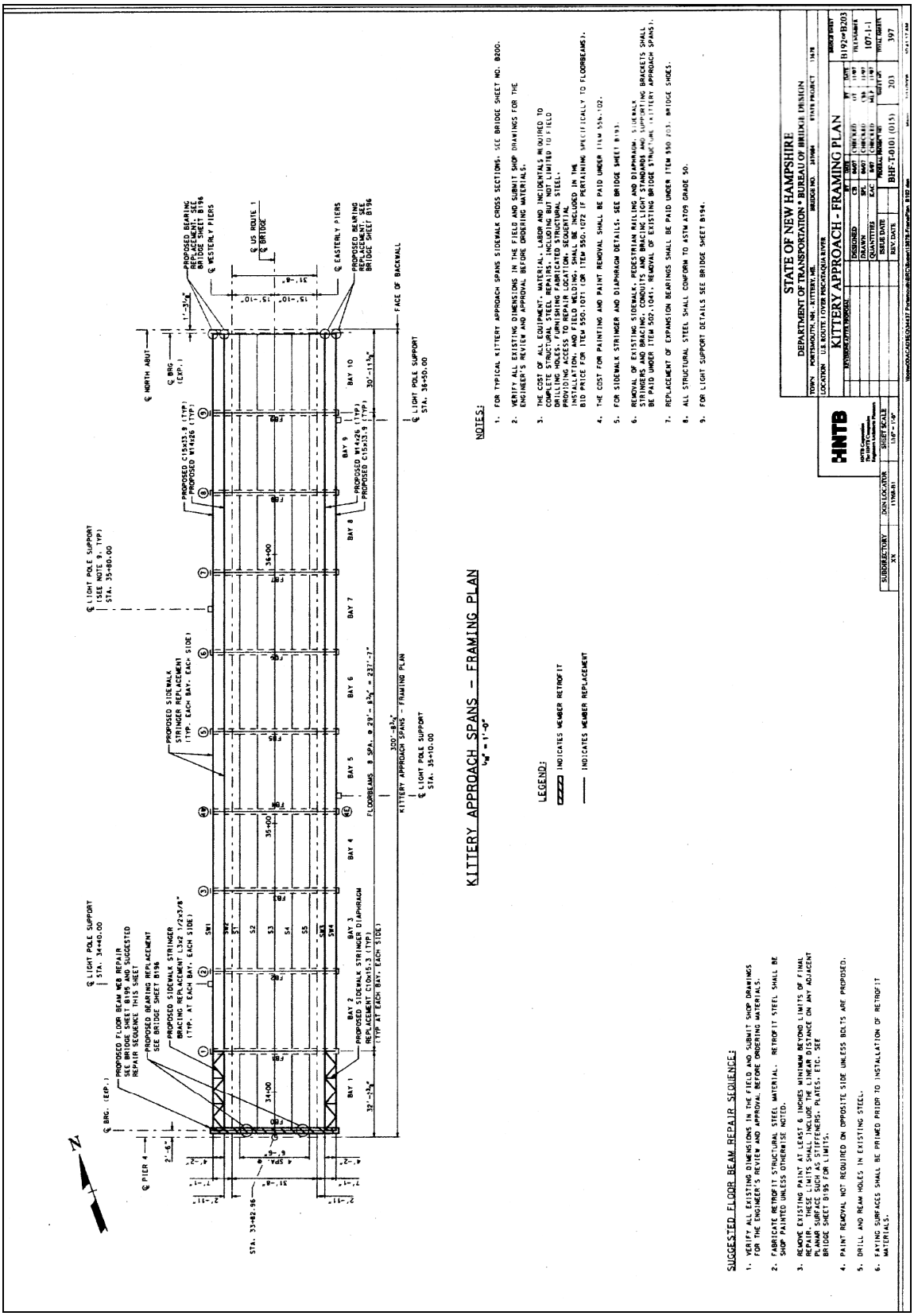

Figure G-12: Kittery Approach – Framing Plan

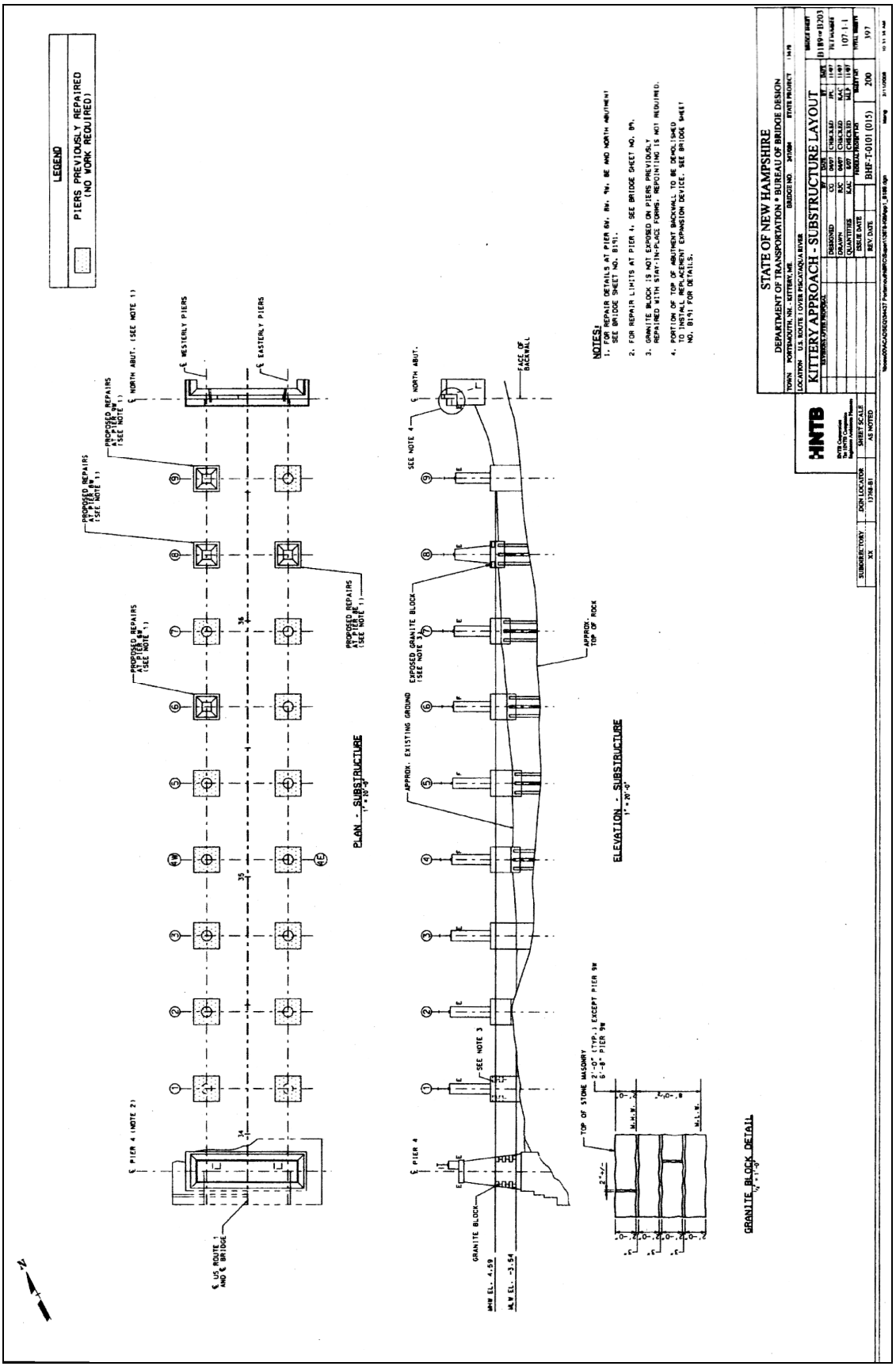

Figure G-13: Kittery Approach – Substructure Layout

2. Portsmouth Approach Span

a. Preferred Alternative

The project includes complete replacement of the existing five-span Scott Avenue Bridge, with a two-span steel beam structure with a cast-in-place concrete deck. The existing bridge is 120' in length and is curved. The roadway on the bridge varies in width from 28' curb to curb (two 14' travel lanes), at the north end to 47' at the south end, where the road approaches and diverges at Memorial Park. The road continues on either side of the park as Scott Avenue (U.S. Route 1 southbound) and Dutton Avenue (U.S. Route 1 northbound). The width of the sidewalks on either side of the overpassing Memorial Bridge approaches will remain at 6', and the steel grating will be replaced with solid decking. The underpassing roadway will incorporate two 12' travel lanes with two 4' shoulders. The vertical clearance will remain the same or will be slightly increased over the existing (12'–2") clearance.

The existing south abutment for the Memorial Bridge will be modified to support the north end of the Scott Avenue Bridge. All of the other foundations for the existing Scott Avenue Bridge (south abutment and five piers) will be partially removed as necessary to construct the proposed Scott Avenue Bridge. This partial removal shall consist of removing the respective abutment and pier stems to a few feet below the ground surface. Existing footings and/or piles will only be removed when in direct conflict with a proposed footing or pile element to minimize excavations.

This design will result in fewer piers under the bridge, with the five sets of existing bridge piers replaced by one bridge pier. This will also increase the horizontal clearances under the bridge and will remove bridge piers from the middle of the roadway and from the roadside clear zone. The new configuration will provide fewer impediments to drivers and will create a more open environment along the waterfront area for pedestrians. This configuration will also allow incorporation of two 4' shoulders and a sidewalk along the north side of Daniel/State Streets under the bridge. Fewer bridge piers will also decrease the construction duration and cost.

Figure G-14: Existing (left) and Proposed Portsmouth Approach Spans

The area under the Portsmouth Approach is currently used for parking by the bridge operator and gatetenders, and this parking will be reconfigured. The proposed design includes the addition of an emergency generator under the Approach, adjacent to the Memorial Bridge abutment, which will be used in the event of a power failure on the Memorial Bridge. This generator will be housed in an enclosure to reduce noise.

The cost of this component of the proposed action is approximately $1.7 million (in 2007 dollars).

b. Alternatives to the Proposed Action

Four alternatives for the Portsmouth Approach replacement were considered during the conceptual design phase, as described in the following section. Discussion of these alternatives is somewhat limited as consensus was reached early on the prudency and feasibility of the proposed treatment of the Portsmouth Approach.

No Build/Rehabilitation of the Existing Bridge

Structural inspections of the bridge identified the deteriorated condition of the bridge and the active deterioration of the concrete. The bridge was found to be structurally obsolete. The No Build alternative does not meet the project purpose and need, and, based on the results of the structural inspections, the rehabilitation alternative was not considered to be feasible, given the deteriorated state of the existing bridge.

Three-Span Steel Beams with Cast-in-Place Concrete Deck

This alternative would construct two piers under the Portsmouth Approach, or one more pier than the proposed action. This alternative is estimated to cost approximately $50,000 less than the two-span alternative (proposed action). This alternative would slightly increase the vertical clearance of the bridge by 3" to 12'–5", but would place a pier in the 7' clear zone for the roadway. This pier would present a hazard to drivers and would also prevent installation of a sidewalk along the eastbound roadway. For these reasons, this alternative was not selected.

Three-Span Cast-in-Place Rigid Frame

This alternative would slightly increase the bridge vertical clearance by 4" to 12'–6". This alternative would construct two piers under the Portsmouth Approach, or an additional pier within the 7' clear zone that would also prevent sidewalk installation along the eastbound roadway. This alternative was estimated to cost approximately $250,000 more than the proposed action. For these reasons, this alternative was not selected.

Four-Span Cast-in-Place Rigid Frame

This alternative would involve the greatest vertical clearance, at 13'–2", but would increase the impediments to vehicular and pedestrian traffic under the bridge. This alternative would construct three piers under the Portsmouth Approach, which would include a pier dividing the two travel lanes and a pier within the 7' clear zone. This alternative would result in the greatest number of piers under the bridge, which would prevent sidewalk installation. This alternative is also the most costly, at approximately $350,000 more than the proposed action. For these reasons, this alternative was not selected.

c. Preferred Alternative Sketches

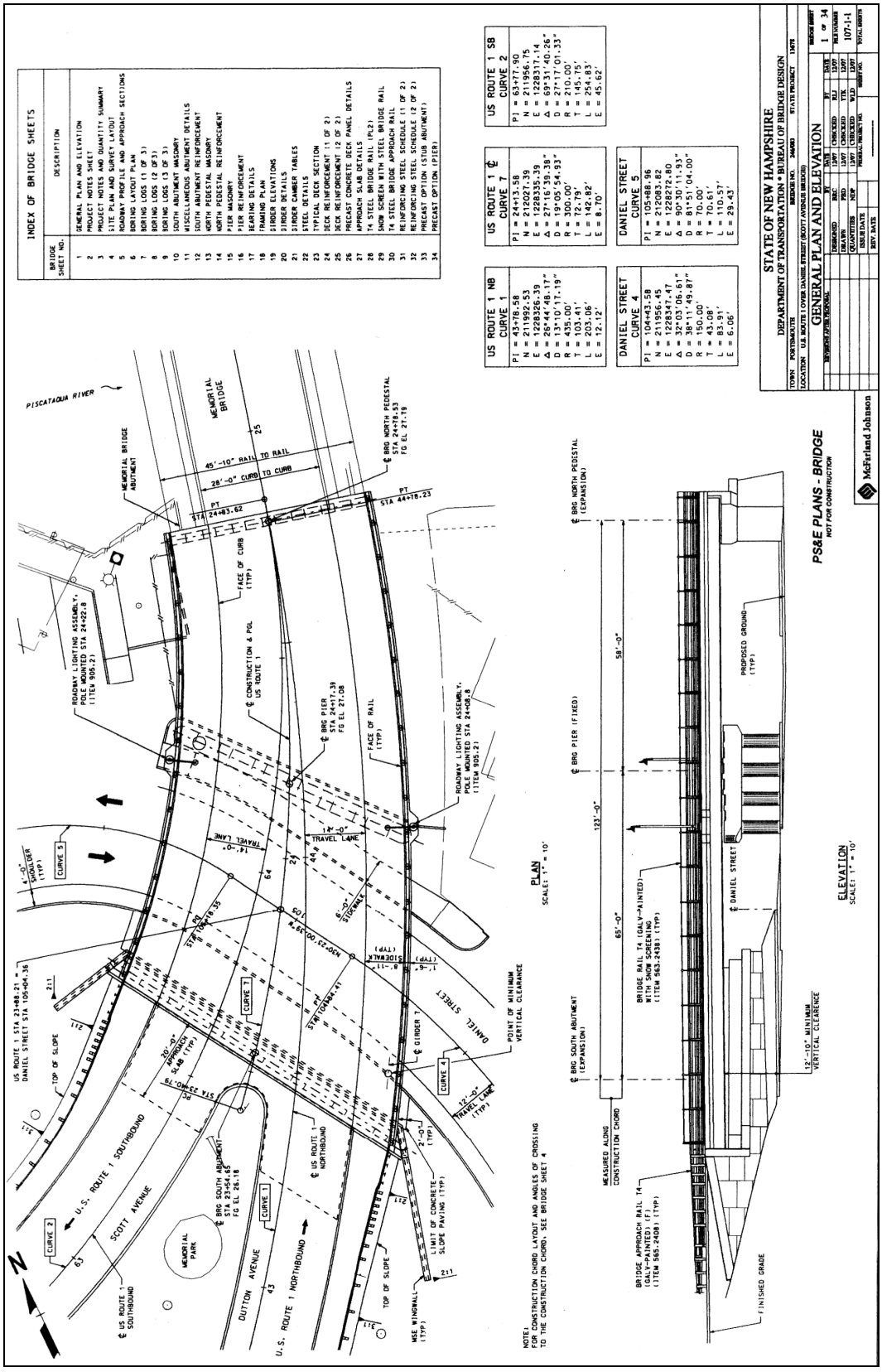

Figure G-15: Portsmouth Approach – General Plan and Elevation