Orford Bridge Replacement

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Project Background

Existing Structure:

- Located in rural Orford, NH over Brackett Brook
- 2-Span reinforced concrete slab bridge
- Carries two lanes of NH Route 25A
- 36'-7" total span
- Built in 1929, widened in 1979
- 45° skew

Figure 1: Existing Bridge

Based on recent 2020 NHDOT inspection report, the bridge deck and superstructure rated as "poor" signifying structural deficiencies.

The bridge currently stands on the NHDOT Red List at priority #51. A complete bridge replacement is recommended.

Site Location

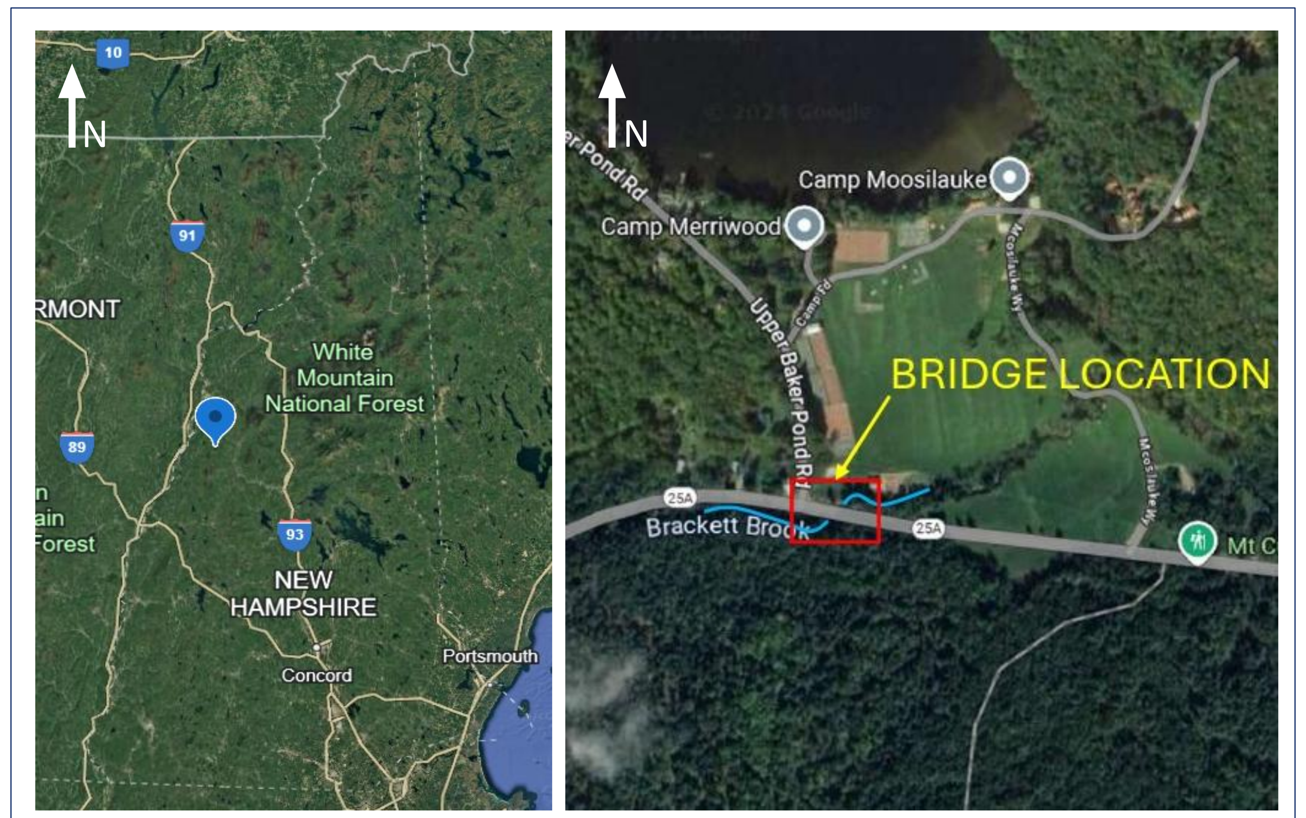

Figure 2: Locus Maps of Project Location

Deliverables/Disclaimer

Deliverables:

- Design superstructure to support traffic loads in the area
- Design substructure to support the bridge and bear on soil
- Develop transportation alignments including a vertical and horizontal curve
- Construction plan to control traffic during bridge reconstruction
- Preliminary cost estimate

Disclaimer:

The design of the steel girder is non-composite and therefore conservative. The girder section was selected based on the most critical HL-93 load placement, with the girder withstanding the entire dead and live load demand with no aid from the concrete deck.

Superstructure Design & Phased Construction

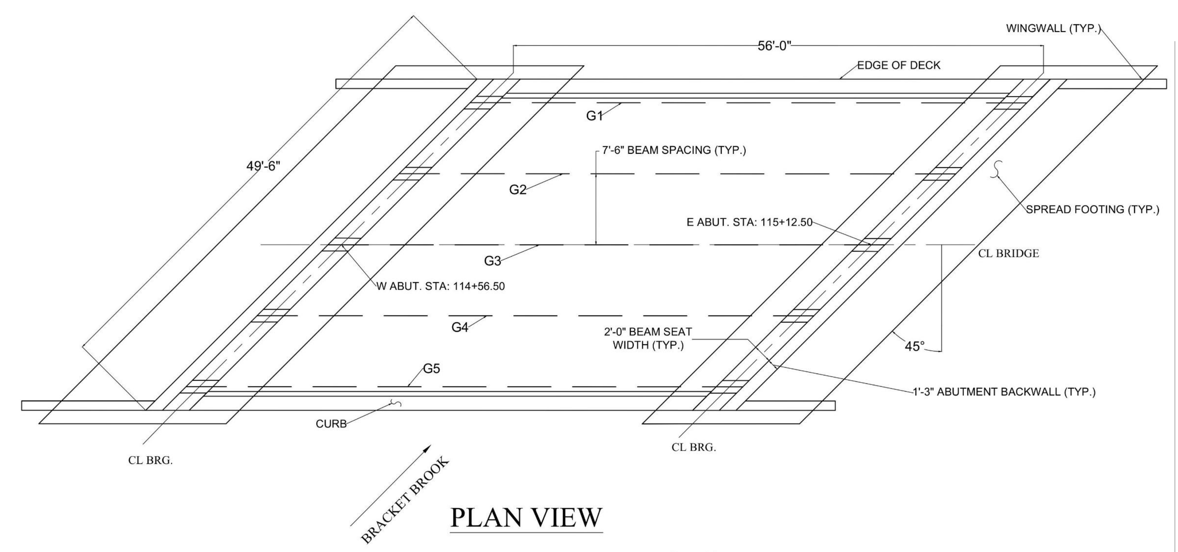

Figure 3: Plan View

- Maintained existing 45° skew
- Increased span to 56' to meet NHDES standards
- Utilized NHDOT and AASHTO Bridge Design Manuals to obtain deck geometry, girder quantity, and girder spacing

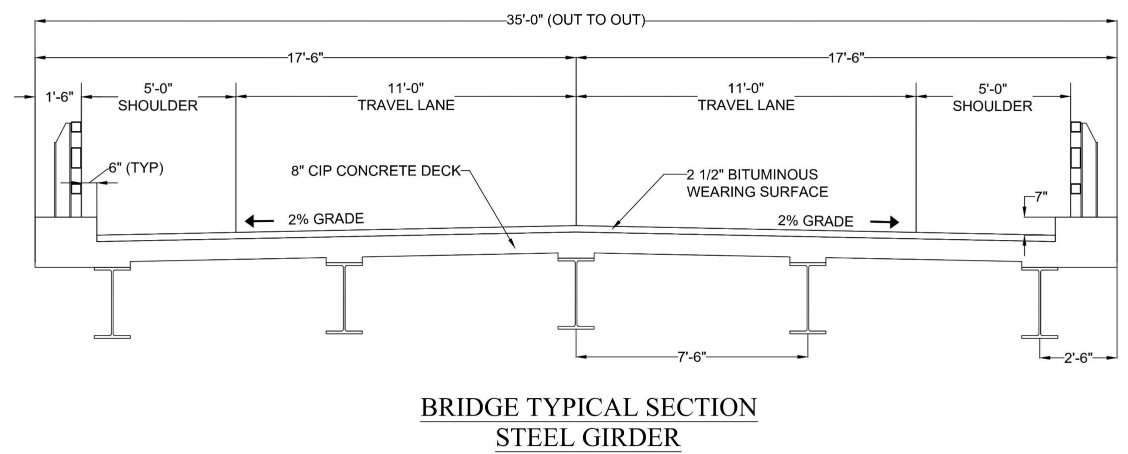

Figure 4: Typical Cross Section

W27x161 Steel Girder:

- Designed to withstand dead and live loading in transverse and longitudinal directions
- Designed in accordance with AISC Steel Manual and utilized AASHTO LRFD Bridge Design Manual for load factoring

*This is a non-composite girder design

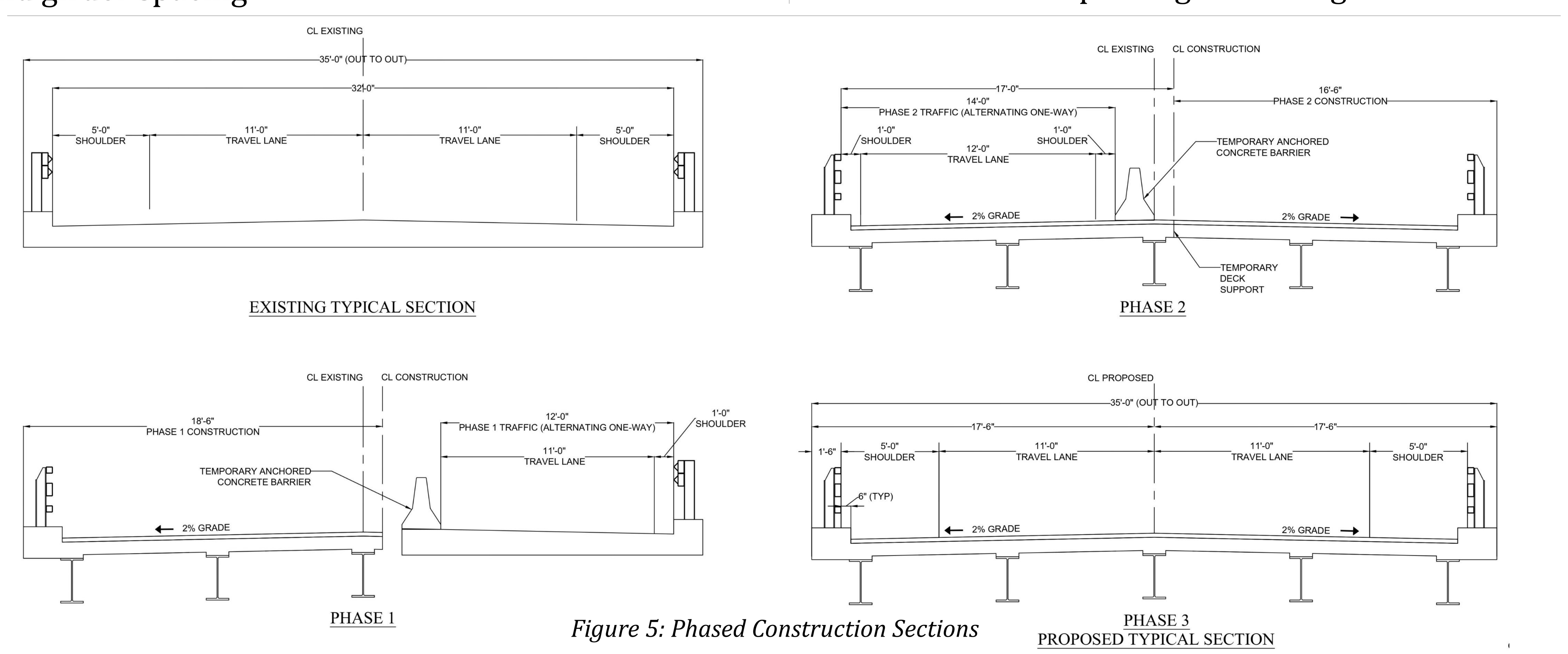

Figure 5: Phased Construction Sections

Phased Construction is recommended to allow for travel during construction as a state route detour added about an hour to travel in this area. The explored detour was not selected due to time and mileage additions, and the wear and tear of the roads from additional traffic. A temporary bridge was also explored but is not recommended as the surrounding site would need a lot of additional material and roadway approaches to be a feasible option.

Substructure Design

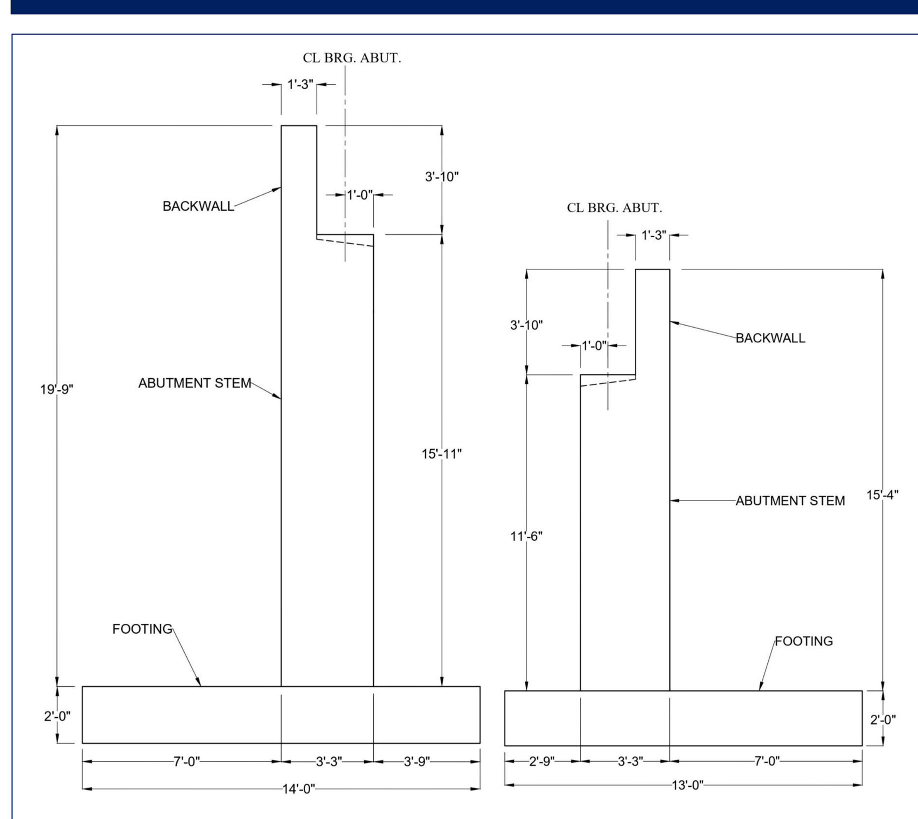

Figure 6: Abutment Sections

Cantilever Abutments

- These are the cantilever abutments acting as the substructure for the bridge
- Due to the change in elevation of the bridge girders and deck over the 56-foot span, the east and west abutments are not identical in geometry
- Both abutments have been designed to withstand sliding, overturning, and bearing forces acting on the bridge and the abutments
- The footings have been placed 8 feet below the streambed to protect against scour caused by Bracket Brook per a hydraulics report provided by H&H
- Geometry follows standards set by NHDOT Bridge Design Manual

Transportation

Vertical

- Bridge Grade Design: 4.25% grade was selected for the bridge between STA. 114+50.00 and STA. 115+25.00 to ensure structural and hydraulic efficiency
- West Approach: 500' sag curve with a K-value of 79' and a Stopping Sight Distance (SSD) of 360 feet was designed to transition smoothly from a steep 10.09% to the bridge tangent of 4.25%
- East Approach: 500' sag curve with a K-value of 79' and a Stopping Sight Distance of 360 feet was designed to transition the bridge tangent of 4.25% to a minimal 0.30% grade

Horizontal

- Analysis of the existing horizontal alignment, which includes two simple curves, confirmed it meets safety standards – allowing the existing geometry to be retained
- Retaining the current alignment minimizes reconstruction needs, making it the most economical option

Preliminary Cost Estimate

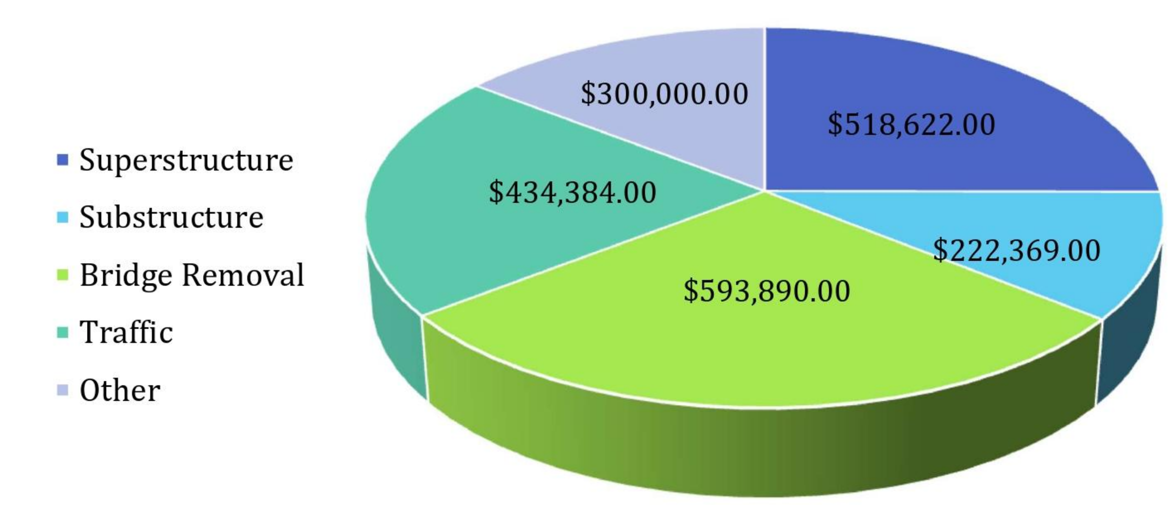

Figure 7: Preliminary Cost Estimate

At a 15% contingency factor, the total estimated cost is $2,379,660. The largest material component is structural steel at a unit weight of $6 per pound.

Acknowledgements

We would like to take the time to extend our gratitude to our sponsors, Sean Brown, PE and Fernanda Fischer, PE of H&H for their continuous support and guidance throughout this entire project. We would also like thank our Faculty Advisor, Philippe Kalmogo of University of New Hampshire for his aid in this project. In addition, we would like to thank Erin Bell for her expertise and knowledge on bridge design calculations.

References

AISC Steel Construction Manual (16th Edition)
AASHTO LRFD Bridge Design (9th Edition)
AASHTO "Green Book" (6th Edition)
NBSA Steel Bridge Design Handbook (Feb. 2022)
NHDOT Bridge Design Manual (Mar. 2016 V 2.0)
NHDOT Standard Specification Book (2016)
NHDOT Weight Average Unit Prices