


REHABILITATION STUDY REPORT
Bridge Numbers 24N & 24S

I-91 Over Green Mountain Railroad & Williams River
Rockingham, Vermont

Prepared for:
Vermont Agency of Transportation

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March, 2014
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EXECUTIVE SUMMARY

Introduction

Bridge Nos. 24N / 24S carries Interstate 91 over the Green Mountain Railroad and the Williams River in the town of Rockingham. The bridges are two identical parallel bridges, one supporting I-91 Northbound and the other supporting I-91 Southbound. The bridges are Structurally Deficient due to the poor condition of the existing concrete deck (Rating = 4). The superstructure is in satisfactory condition (Rating = 6) based upon the "Inspection, Inventory and Appraisal Sheet" dated March 1, 2012.

An evaluation of the load rating for these structures was completed in May, 2013 and it was determined that the structures do not have a satisfactory load rating when compared to current design standards. The Vermont Agency of Transportation (VTrans) has requested that this study be conducted to evaluate rehabilitation alternatives for these bridges. The following rehabilitation tasks have been evaluated:

1. Replace the bridge deck with a new half-filled steel grid deck.
2. Replace the bridge deck with a new half-filled steel grid deck – with widened shoulders.
3. Replace the bridge railing system with a concrete parapet designed to TL-5.
4. Blast clean and paint the steel superstructure.
5. Replace the entire bridge including superstructure and substructure.

Maintenance and Protection of Traffic

It is anticipated that the existing traffic operations on Interstate 91 will be maintained for each rehabilitation alternative by operating a single lane of bi-directional traffic on one bridge while construction is completed on the adjacent bridge. The loading condition for bi-directional traffic with a precast barrier on the existing deck has been evaluated. The HS-20 live load rating increases for this temporary condition due to more uniform distribution of live loads. Therefore, it appears reasonable to maintain bi-directional traffic on one bridge while the rehabilitation or replacement of the adjacent bridge is constructed.

Deck Replacement Alternatives

Two deck replacement alternatives were evaluated. Due to the low load rating of the structure, both alternatives involve replacing the decks with half-filled steel grid decking, filled with lightweight concrete. The evaluation includes a deck with a sacrificial wearing surface. This will reduce the dead load of the deck from 94 psf to 57 psf. Each alternative included replacing the existing metal bridge railing with a concrete parapet rated for AASHTO TL-5.

The first alternative is to replace the deck with the same width, 30-feet curb-to-curb. This will result in an increase of the controlling rating factor from 0.56 to 0.89 (HS-20) at gusset plate U1. The estimated construction cost for this alternative is $19,200,000. This estimate includes $6,000,000 for painting the structural steel.

The second alternative is to replace the deck to accommodate a wider shoulder on the right side of each bridge. This will result in a curb-to-curb width of 36-feet. The controlling rating factor will increase from 0.56 to 0.59 (HS-20) at gusset plate U1. The estimated construction cost for this alternative is $21,600,000. This estimated cost also includes painting the structural steel.

Bridge Replacement Alternatives

Three bridge replacement alternatives were evaluated for these structures. The alternatives include replacement of the entire structure. The three alternatives include the following:

1. Continuous steel multi-girder superstructure.
2. Prestressed concrete multi-girder superstructure made continuous for live load.
3. Continuous Segmental concrete box girder superstructure.

A new cast-in-place substructure is assumed for each of the bridge replacement alternatives. Each of the alternatives was evaluated to determine the feasibility of the structure type, to identify any technical limitations and to identify estimated budget costs. In summary, all of these structure types are feasible for this location. Each structure type has advantages and disadvantages, however, these factors essentially balance out and a decision regarding the most appropriate structure type should be made based upon the preferences of VTrans and the market conditions at the time of design/bid or design/build. The costs for each type are summarized in Section 3.1 of this report.

Concluding Statement

This report has evaluated two alternatives for replacing the existing concrete decks for these two bridges and has evaluated three alternatives for replacing the bridges. The deck replacement alternatives are being considered because it is prudent to evaluate rehabilitation versus replacement due to the significant difference in cost to the Agency. The deck replacement alternatives can be expected to provide a service life of approximately 25-50 years. Replacing the entire bridge can be expected to provide a service life of approximately 75-100 years.

It appears that the deck replacement alternative with the widened deck is not a prudent alternative because the rating factor will remain essentially unchanged. Therefore, if VTrans determines that budget limitations dictate that the rehabilitation be restricted to a deck replacement, then the 30-foot wide deck, or some minor widening, will be the most appropriate alternative.

If VTrans determines that replacing the bridge is in the long-term best interest of the agency, then it appears that all of the replacement alternatives evaluated in this study are feasible. The cost estimates vary by approximately 15-percent. However, it is important to note that the total length of these bridges is at the bottom limit for the segmental precast concrete structure to be economical. Therefore, there is a higher degree of uncertainty regarding the estimate for that alternative. In addition, the span lengths for the concrete girders will require the use of deep Bulb Tee-type girders which may have less availability from New England-based precast manufacturers. A more in-depth evaluation of costs may be prudent prior to moving forward with either of those alternatives. If the project is delivered using design-build, then the market will determine the most economical alternative.

1.0 INTRODUCTION & EXISTING CONDITIONS

Bridge No. 24N / 24S supports Interstate 91 over the Green Mountain Railroad and the Williams River in the town of Rockingham. This study has been initiated to determine the best alternative for rehabilitating the bridge. The study consists of three sections. The first section will describe the condition of the existing structure and other relevant features to be considered in this study. The second section will describe the alternatives for rehabilitating or replacing the structure. Finally, the last section will evaluate the alternatives.

1.1 PROJECT LOCATION & DESCRIPTION

Bridge No. 24N / 24S is located on Interstate 91 in the town of Rockingham. The bridge is approximately 0.3 miles north of the I-91 Exit 6. For a location map of Bridge No. 24N / 24S, refer to Figure 1 in Appendix A.

The bridges consist of four equal spans over the Green Mountain Railroad and the Williams River. The clearances required for the bridge include the 100-year flood elevation and the railroad clearances as determined by AREMA or the Green Mountain Railroad. At this location, a review of the flood mapping of the Williams River shows that the 100-year flood elevation (El. 302) appears to be contained within the channel between existing Pier Nos. 2 and 3.

The existing horizontal and vertical clearances to the railroad tracks exceed the minimum required clearances.

The bridges are located on a horizontal tangent with curves located on each approach to the bridges. The bridges are aligned vertically on a tangent with a -5.0% grade from south-to-north.

1.2 EXISTING SUPERSTRUCTURE

The existing bridge superstructures consist of a four-span steel deck-truss with a concrete slab supported by longitudinal stringers and transverse floor beams. The slab has integral concrete curbs and a metal bridge railing on both sides. The deck slab is in poor condition (Rating = 4) with areas of advanced deterioration.

The existing steel truss superstructure is in satisfactory condition (Rating = 6). For a general plan, elevation and typical cross section of the existing bridge, refer to Figure Nos. 2-3 in Appendix A.

1.3 EXISTING SUPERSTRUCTURE LOAD RATING

The load rating was computed for the as-built condition of the original structure based upon the assumption that there is no appreciable section loss of any component of the existing bridge. The rating was reported to VTrans in a report dated June, 2013. Primary members, including stringers, floorbeams and truss chords were evaluated. For a summary of the as-built load rating, refer to Table 1 in Appendix C.

In summary, the most critical rating occurs at the U1 gusset of the deck trusses, with a rating factor of 0.56 (HS-20). This rating is controlled by the horizontal shear of the gusset plate. Therefore, this component is not readily upgraded. It is also important to note that the rating assumes no section loss. Experience has shown that some amount of section loss is likely to exist.

1.4 EXISTING SUBSTRUCTURE

The existing bridge substructure consists of cast-in-place concrete abutments which are founded on H-piles driven to bedrock. The existing piers consist of cast-in-place concrete columns and pier walls. The columns vary in height from 81-feet to 91-feet and are supported on stem walls which vary in height from 20-feet to 35-feet. Pier Nos. 1 and 2 are founded on spread footings on bedrock. Pier No. 3 is founded on steel H-piles driven to bedrock. The substructure is in satisfactory condition (Rating = 6).

2.0 REHABILITATION ALTERNATIVES

The bridges are structurally deficient due to the poor condition of the concrete decks. Two alternatives have been considered for rehabilitation of these bridges, including replacing the decks and replacing the entire bridges.

For the deck replacement, two alternatives have been evaluated. The evaluation has included structural analysis of the as-built structure for the lighter bridge deck to determine the new live load capacity. This has been completed for two deck arrangements with two different deck widths.

For the total bridge replacement, three structure types have been evaluated. The structure types were selected based upon what is commonly believed to be most economical for the given span arrangements. The purpose is to identify the feasibility of replacement and to provide a budget cost estimate. Should the replacement alternative be advanced, a more detailed structure type study is recommended.

2.1 ALTERNATIVE 1A – DECK REPLACEMENT – EXISTING WIDTH

The proposed scope of this Alternative involves replacing the concrete deck. The existing bridge has a substandard load capacity, therefore, an alternative deck type will be considered. The deck will consist of a steel grid which will be half-filled with lightweight concrete. The lighter deck system will be used to reduce the dead load and increase the bridge live load capacity. For this alternative, the proposed deck width will match the existing, 34’-10” out-to-out. The anticipated design life of the new deck is 25-50 years. For a typical cross section of this alternative, refer to Figure 4 in Appendix A.

2.1.1 SUPERSTRUCTURE

The rehabilitation under this alternative includes the following tasks and features:

- Remove the concrete deck and railing system.
- Install new half-filled steel grid deck with lightweight concrete. The new bridge deck will have the same overall width and will consist of two 12-foot wide travel lanes and both shoulders will be widened from 3’-0” to 3’-8.”
- Install 42-in. F-Shape concrete parapet.
- Blast clean and paint entire area of the steel superstructure.
- Repair deteriorated floor beams and through-truss members as needed.
- Repair gusset and splice plates as needed.
- Clean, paint and reset the expansion rocker bearings at both abutments as needed.

2.1.2 SUBSTRUCTURE

The substructure is in satisfactory condition and rehabilitation of the substructure components are expected to include patching concrete surfaces. Based upon a review of the bridge in the field and a review of the latest inspection report, it is expected that the quantity of repairs is not significant.

The record drawings of the existing bridge piers have been reviewed to evaluate the design details of the column reinforcing. It appears that the column reinforcing does not comply with current standards for providing proper concrete confinement for seismic events. The rehabilitation should include a detailed evaluation of the seismic demands on these columns. If deemed appropriate, the columns could be retrofitted. For this study, no pier modifications have been considered for seismic retrofit.

2.1.3 ROADWAY

This alternative proposes to widen the existing roadway on the bridge from 30’-0” to 31’-4” which includes a minor widening of each shoulder. The reconstruction of the approach roadways is expected to include minor widening of each shoulder to transition the width to the new gutterline on the bridges. The roadway work is also expected to include milling and resurfacing each approach roadway for the entire road width. The length of this resurfacing is expected to be approximately 250-feet on each approach, equating to 1,000-feet for both bridges.

2.1.4 LOAD RATING

The anticipated live load rating for this alternative has been computed and is summarized in Table 9 in Appendix C. In summary, we expect the load capacity to increase from 20.1-tons to 32-tons (HS-20, Inventory).

2.1.5 PRELIMINARY CONSTRUCTION COST ESTIMATE

The Preliminary Construction Cost Estimate for this rehabilitation alternative is $19,200,000. For a summary of this estimate, refer to Table 2 in Appendix B.

2.2 ALTERNATIVE 1B – DECK REPLACEMENT – WIDE DECK

The proposed scope of this Alternative involves replacing the concrete deck. Similar to the first alternative, the deck will consist of a steel grid which will be half-filled with lightweight concrete. The lighter deck system will be used to reduce the dead load and increase the bridge live load capacity. For this alternative, the proposed deck width will be widened to provide an 8-foot wide right shoulder and a 4’-0” left shoulder. The anticipated design life of the new deck is 25-50 years. For a typical cross section of this alternative, refer to Figure 5 in Appendix A.

2.2.1 SUPERSTRUCTURE

Similar to the first alternative, the rehabilitation under this alternative includes the following tasks and features:

- Remove the concrete deck and railing system.
- Install new half-filled steel grid deck with lightweight concrete. The new bridge deck will have the wider overall width and include a 4-foot wide left shoulder, two 12-foot travel lanes, and an 8-foot wide right shoulder.

- Install 42-in. F-Shape concrete parapet.
- Blast clean and paint entire areas of the steel superstructure.
- Repair deteriorated floor beams and through-truss members as needed.
- Repair gusset and splice plates as needed.
- Clean, paint and reset the expansion rocker bearings at both abutments as needed.

2.2.2 SUBSTRUCTURE

Rehabilitation of the substructure for this alternative shall be the same as the previous alternative as described in Section 2.1.2.

2.2.3 ROADWAY

This alternative proposes to widen the existing roadway on the bridge from 30'-0" to 36'-0" which includes a minor widening of the left shoulder to 4'-0" and a widening of the right shoulder to 8'-0." The reconstruction of the approach roadways is expected to include widening of each shoulder to transition the width to the new gutterline on the bridges. The roadway work is also expected to include milling and resurfacing each approach roadway for the entire road width. The length of this resurfacing is expected to be approximately 250-feet on each approach, equating to 1,000-feet for both bridges.

2.2.4 LOAD RATING

The anticipated live load rating for this alternative has been computed and is summarized in Table 10 in Appendix D. In summary, we expect the load capacity to increase from 20.1-tons to 20.5-tons (HS-20, Inventory).

2.2.5 PRELIMINARY CONSTRUCTION COST ESTIMATE

The Preliminary Construction Cost Estimate for the rehabilitation of Bridge No. 24N / 24S is $21,600,000. For a summary of this estimate, refer to Table 3 in Appendix B.

2.3 ALTERNATIVE 2A – BRIDGE REPLACEMENT – STEEL MULTI-GIRDER

The scope of this alternative is to replace the existing bridge with a four-span continuous steel multi-girder superstructure on new abutments and piers. This alternative will provide a structure that will require minimal long-term maintenance.

2.3.1 SUPERSTRUCTURE

The proposed superstructure will consist of a four-span continuous steel multi-girder with a composite concrete deck. For this alternative, the structure span length is approximately 186 feet measured center-to-center of bearings.

The deck will have an out-to-out width of 39.5 feet and will consist of a composite reinforced concrete deck. For this classification of roadway, the current VTrans practice is to use stainless steel reinforcing for this span. For a general plan, elevation and typical section of the proposed structure, refer to Figure Nos. 7 and 8 in Appendix A.

2.3.2 SUBSTRUCTURE

The existing abutments and wingwalls will be replaced with cast-in-place concrete pile foundations through the roadway embankment, similar to the existing abutments. It appears the span length of the structure may not be appropriate for fully integral abutments, however, semi-integral abutments could be considered during final design. The existing piers will be replaced with cast-in-place concrete piers on spread footings or pile foundations, similar to the existing piers.

2.3.3 ROADWAY

This alternative consists of a full bridge replacement. The horizontal and vertical alignments will match existing. The proposed roadway width on the bridge is expected to match the approach roadway with a total curb-to-curb width of 36-feet, including a 4-foot wide left shoulder, two 12-foot wide travel lanes, and an 8-foot wide right shoulder. The travel lanes will align with the current lane arrangement on the bridge. A 42-in F-Shape concrete parapet will be installed along the both edges of the bridge with appropriate approach guide railings on all four corners of each bridge.

2.3.4 MAINTENANCE OF TRAFFIC

The existing traffic operations on Interstate 91 will be maintained. Similar to the deck replacement alternatives, it is anticipated that one of the existing bridges will support two-way traffic with a temporary concrete barrier dividing the travel lanes.

2.3.5 ERECTION / CONSTRUCTION CONSIDERATIONS

Construction issues are expected to be relatively minor. The issues will include:

- Coordination with Green Mountain Railroad operations. During construction, temporary track outages will be required when erecting steel over the tracks.
- Access for delivery of materials and equipment. The main access below the bridge is via a rural residential roadway. This may require a robust public outreach effort for notifying residents and addressing their concerns.

2.3.6 PRELIMINARY CONSTRUCTION COST ESTIMATE

The Preliminary Construction Cost Estimate for the replacement of Bridge No. 24N / 24S with a steel multi-girder superstructure is $45,000,000. For a summary of this estimate, refer to Table 4 in Appendix B.

2.4 ALTERNATIVE 2B – BRIDGE REPLACEMENT – PRESTRESSED CONCRETE MULTI-GIRDER

The scope of this alternative is to replace the existing bridge with a six-span continuous prestressed concrete multi-girder superstructure supported on new abutments and piers. This alternative will also provide a structure that will require minimal long-term maintenance.

2.4.1 SUPERSTRUCTURE

The proposed superstructure will consist of a six-span continuous prestressed concrete multi-girder with a composite concrete deck. For this alternative, the structure span lengths are approximately 160-feet on three center spans and 110-feet for three end spans. This span arrangement is dictated by the need to clear the river and railroad and to keep maximum girder lengths within reasonable transportation limits.

The deck arrangement will be essentially identical to the previous alternative with an out-to-out width of 39.5 feet and will consist of a composite reinforced concrete deck. For this classification of roadway, the current VTrans practice is to use stainless steel reinforcing for this span. The typical cross section of the bridge consists of five prestressed concrete girders. For a general plan, elevation and typical section of the proposed structure, refer to Figure Nos. 9 and 10 in Appendix A.

2.4.2 SUBSTRUCTURE

The existing abutments and wingwalls will be replaced with cast-in-place concrete abutments on pile foundations. The existing piers will be replaced with cast-in-place concrete piers on either spread footings or pile foundations.

2.4.3 ROADWAY

This alternative consists of a full bridge replacement. The horizontal and vertical alignments will match existing. The proposed roadway geometry for this alternative will match that proposed for Alternative 2A.

2.4.4 MAINTENANCE OF TRAFFIC

The existing traffic operations on Interstate 91 will be maintained in the same manner as proposed for Alternative 2A.

2.4.5 ERECTION / CONSTRUCTION CONSIDERATIONS

Due to transport limitations for the prestressed girders, a maximum length of approximately 160-feet is anticipated. The close proximity of the railroad to one of the proposed piers may require temporary shoring of the railroad for construction of the pier foundation.

Other issues will be the same as those identified for Alternative 2A.

2.4.6 PRELIMINARY CONSTRUCTION COST ESTIMATE

The Preliminary Construction Cost Estimate for the replacment of Bridge No. 24N / 24S with a prestressed concrete multi-girder superstructure is $39,400,000. For a summary of this estimate, refer to Table 5 in Appendix B.

2.5 ALTERNATIVE 2C – BRIDGE REPLACEMENT – SEGMENTAL CONCRETE BOX GIRDER

The scope of this alternative is to replace the existing bridge with a three-span continuous segmental concrete box girder superstructure supported on new abutments and piers.

2.5.1 Superstructure

The proposed superstructure will consist of a three-span continuous segmental box girder. For this alternative, the structure span length, center to center of bearings of each span varies, for a total length of 790 feet.

The deck will have an out-to-out width of 39.5 feet. For a general plan, elevation and typical section of the proposed structure, refer to Figure Nos. 11 and 12 in Appendix A.

2.5.2 Substructure

The existing abutments and wingwalls will be replaced with cast-in-place concrete abutment on pile foundations. The existing piers will be replaced with cast-in-place concrete piers on spread footings or pile foundations.

2.5.3 Roadway

This alternative consists of a full bridge replacement. The horizontal and vertical alignments will match existing. The proposed roadway geometry for this alternative will match that proposed for Alternative 2A.

2.5.4 Maintenance Of Traffic

The existing traffic operations on Interstate 91 will be maintained in the same manner as proposed for Alternative 2A.

2.5.5 Erection / Construction Considerations

The segmental concrete superstructure may be constructed using precast or cast-in-place techniques. The precast options would most likely be constructed using a launching gantry. The cast-in-place technique will most likely be constructed using a balanced cantilever method. The close proximity of the railroad to one of the proposed piers may require temporary shoring of the railroad for construction of the pier foundation.

Other issues will be the same as those identified for Alternative 2A.

2.5.6 Preliminary Construction Cost Estimate

The Preliminary Construction Cost Estimate for the replacement of Bridge No. 24N / 24S with a segmental concrete box girder superstructure is $45,500,000. For a summary of this estimate, refer to Table 6 in Appendix B.

3.0 CONCLUSIONS

This report has considered two alternatives for rehabilitating Bridge No. 24N / 24S. The following sections provide a summary of the alternatives and a concluding statement regarding the evaluation and a recommendation for rehabilitation.

3.1 INITIAL COST CONSIDERATIONS

The following is a summary of preliminary construction cost estimates for each rehabilitation alternative.

Description		***Cost***
Rehabilitation	Alternative 1A – Half-Filled Steel Grid Deck – 34.83-ft. Wide	$19,200,000
	Alternative 1B – Half-Filled Steel Grid Deck – 39.5-ft. Wide	$21,600,000
Replacement	Alternative 2A – Steel Multi-Girder Superstructure	$45,000,000
	Alternative 2B – Concrete Multi-Girder Superstructure	$39,400,000
	Alternative 2C – Segmental Concrete Superstructure	$45,500,000

Table 1 – Summary of Costs

3.2 CONSTRUCTABILITY

There are no significant constructability issues concerning rehabilitation of this bridge. Both alternatives will require coordination of construction activities with the railroad and may require temporary service interruptions on the railroad when lifting girders into place.

3.3 CONCLUSIONS

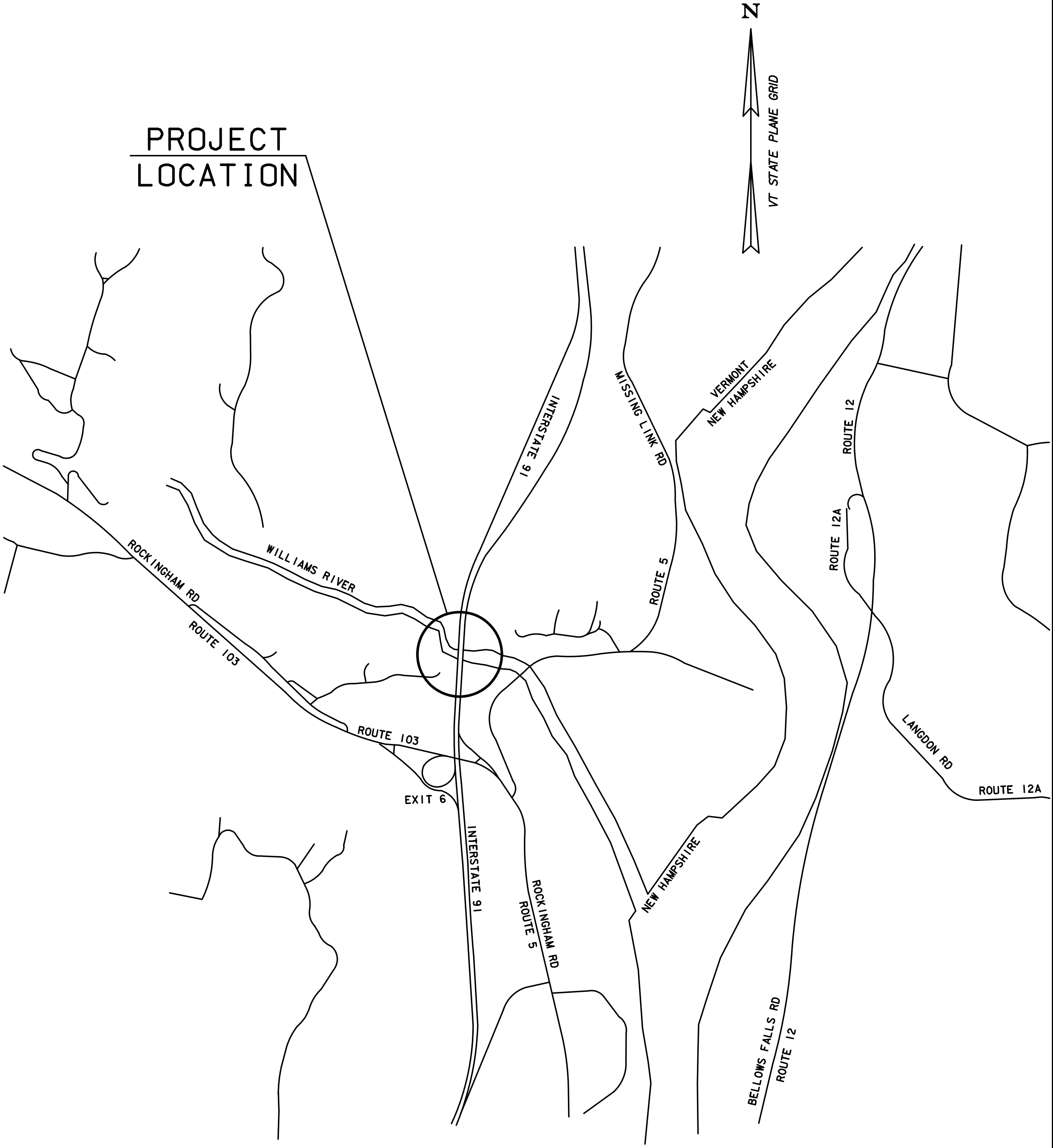
The primary deficiencies of this structure are the poor condition of the concrete deck and low load capacity rating of floorbeams, truss gusset plates and truss splice plates. Alternative 1A will address these issues by replacing the deck with light-weight system and by painting the entire bridge and repairing the truss members as needed. The anticipated deck system will reduce the dead load and improve the load capacity of the bridge. The design life of the new deck will be approximately 50-years. Selective repainting of the truss may be required in as little as 15 to 20 years. The new 42-inch F-Shape parapet, which will be designed to conform to AASHTO TL-5, will improve safety for motorists.

The other deck replacement alternative, Alternative 1B, does not appear to be a reasonable solution. The light-weight deck will allow the bridge to be widened to provide an 8-foot wide shoulder while maintaining the existing load capacity. However, it appears that the benefit of wider shoulders does not offset the adverse effect of not improving the inadequate load capacity.

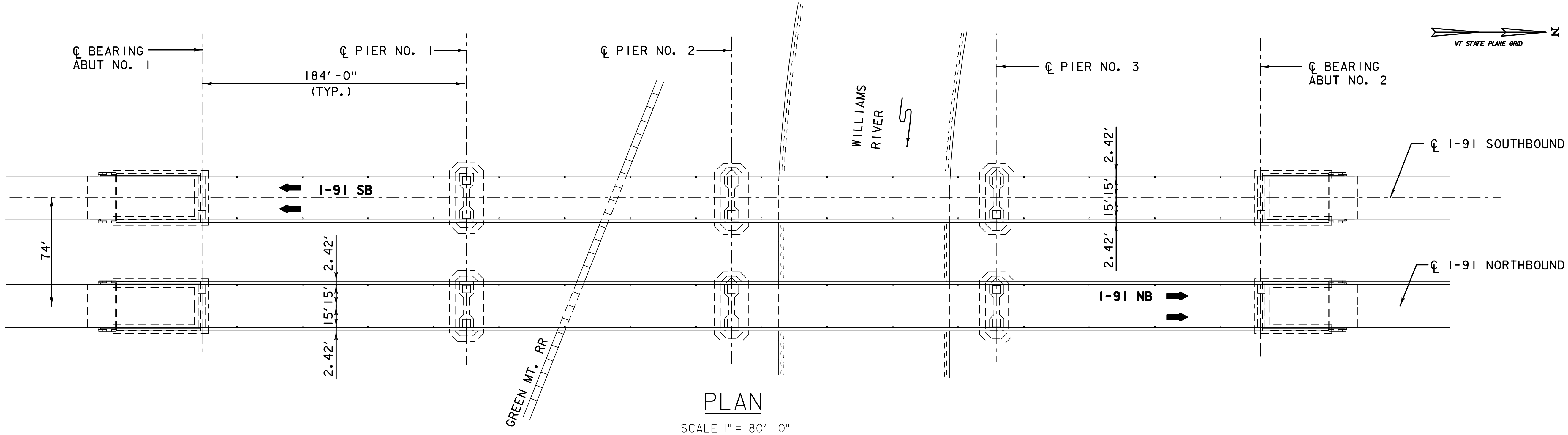
Alternative 2 includes entirely replacing both of the bridges. The primary advantages of replacing the bridges include eliminating the non-redundant truss superstructure, eliminating joints at intermediate supports and providing a low-maintenance structure with a long service life. In addition, the overall safety of the bridge will be increased by providing sufficient load capacity in accordance with current AASHTO standards and will provide safety features such as sufficient shoulder widths, design for seismic events, and bridge railings conforming to AASHTO TL-5.

Three alternative for replacing the bridge were evaluated. Based on cost, it appears that the prestressed concrete girder alternative may be the most economical. The difference in cost between the least expensive and the most expensive alternatives is $6,100,000, or approximately 15%. It is possible that the prices of each alternative may be closer depending upon market conditions at the time of bid. However, the quantity of structure required for the segmental concrete alternative is at the low end of what is typically economical for mobilizing to construct this structure type. Hence, there is a greater degree of uncertainty for the estimate for this alternative.

Appendix A – Figures

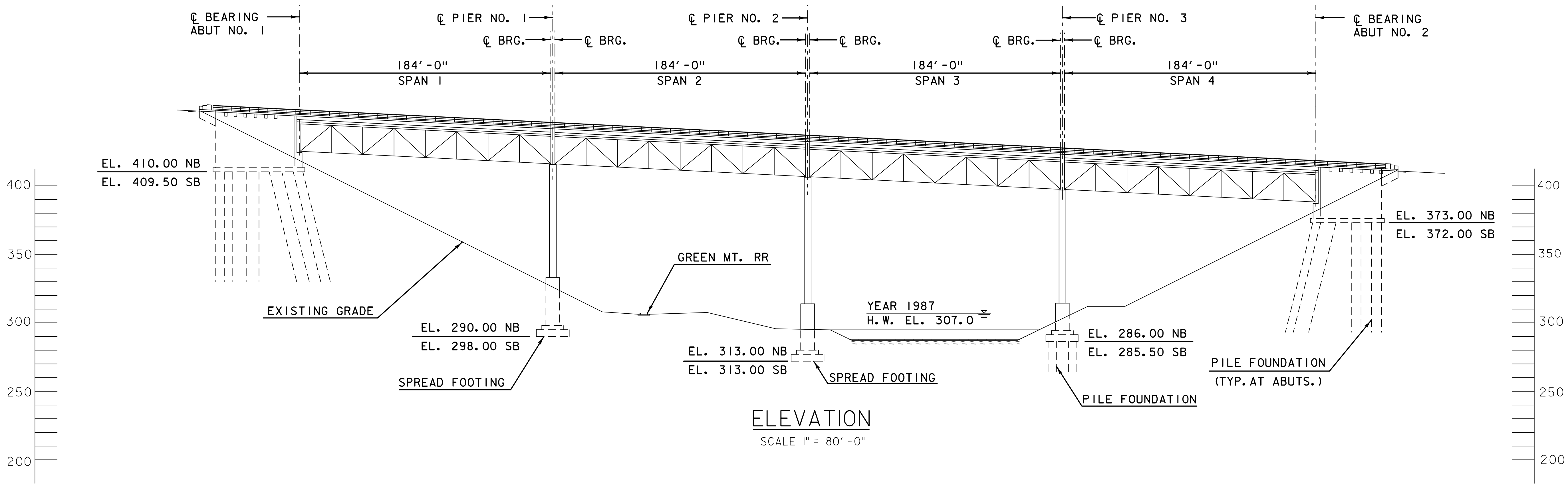


URS	REHABILITATION STUDY REPORT I-91 OVER WILLIAMS RIVER ROCKINGHAM, VERMONT	LOCATION MAP	BR. NO.: 24N & 24S DATE: MARCH, 2014 FIGURE NO.: 1



PLAN

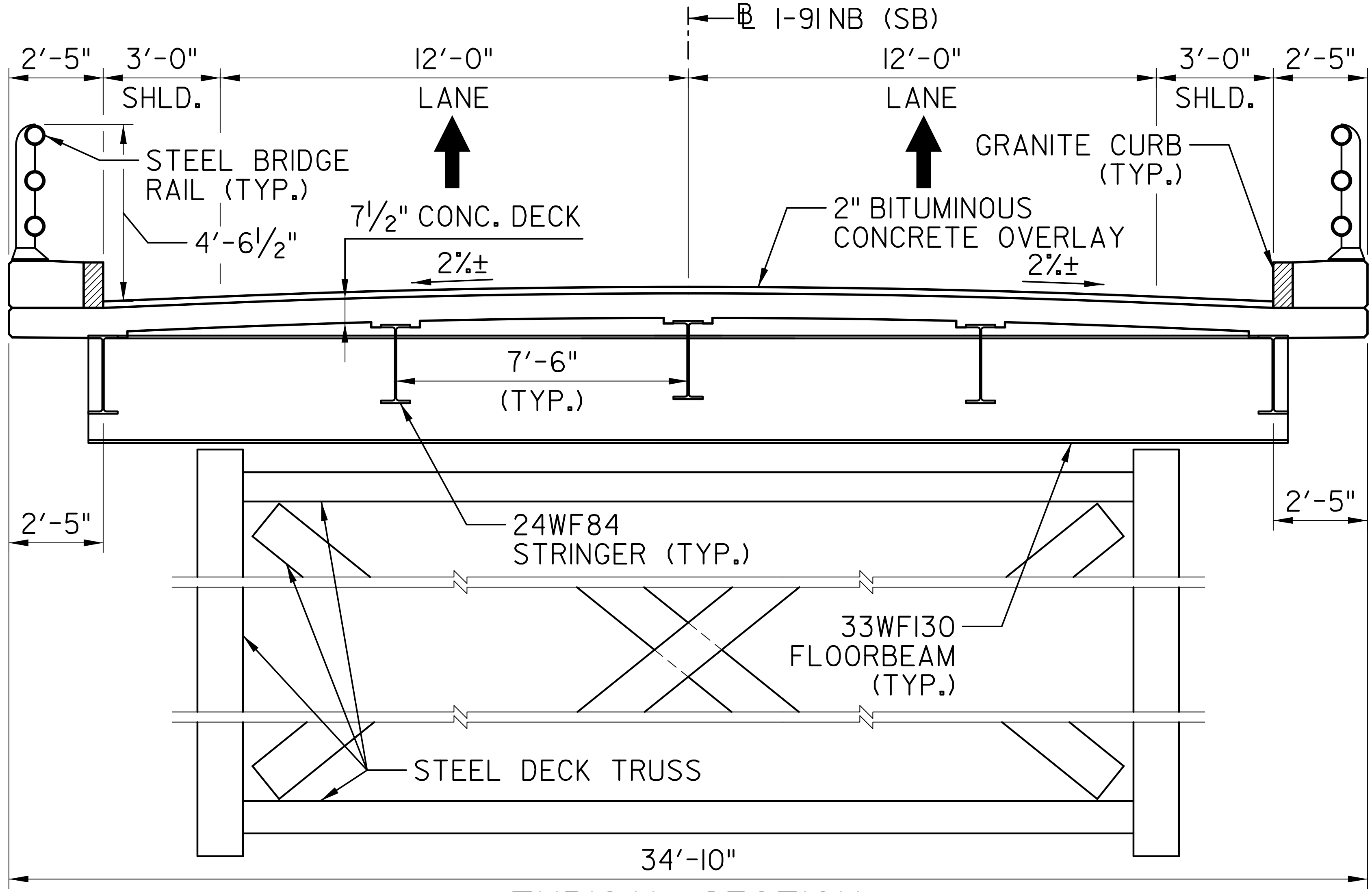
SCALE 1" = 80'-0"



ELEVATION

SCALE 1" = 80'-0"

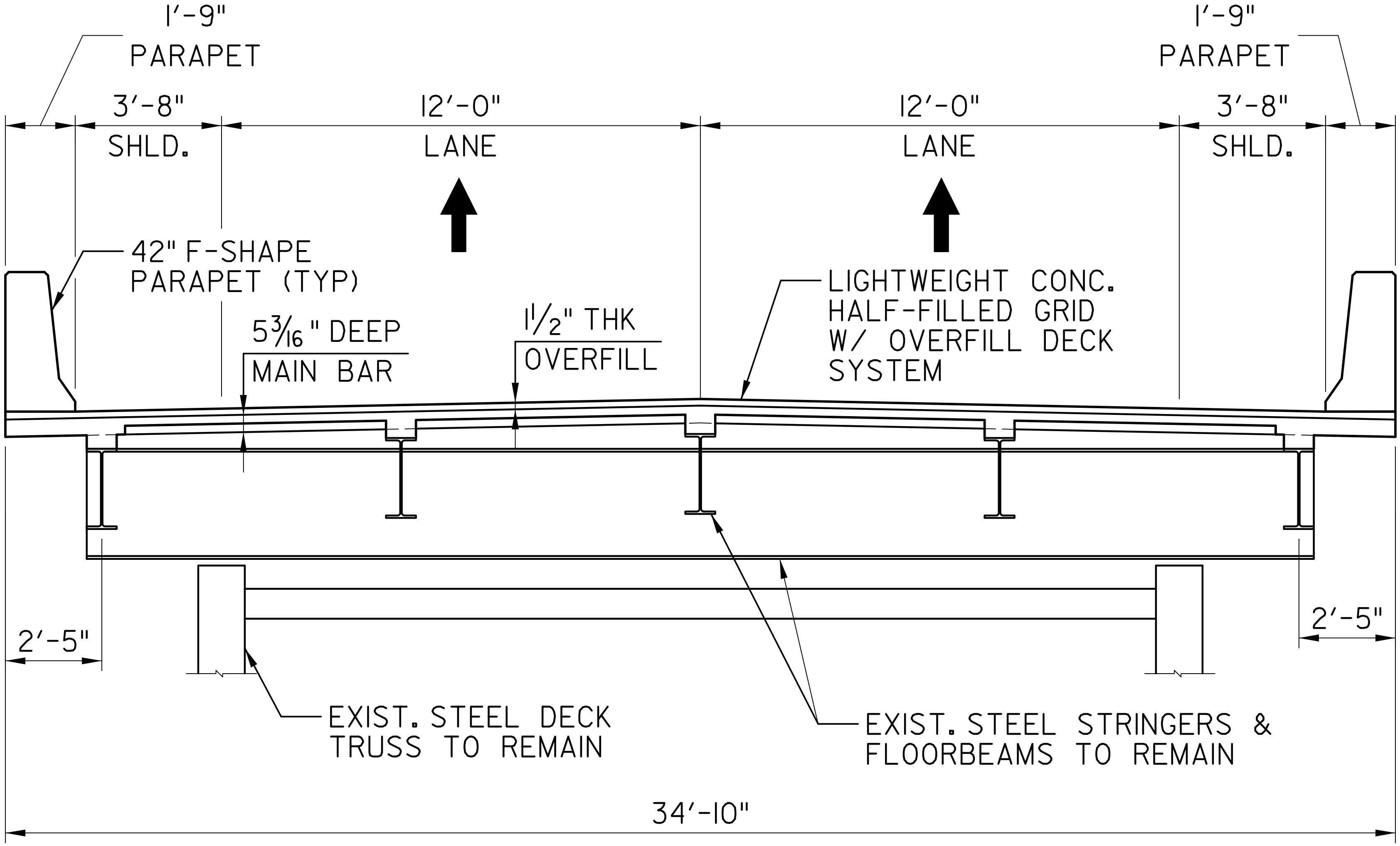
URS	REHABILITATION STUDY REPORT I-91 OVER WILLIAMS RIVER ROCKINGHAM, VERMONT	EXISTING BRIDGE GENERAL PLAN AND ELEVATION	BR. NO.: 24N & 24S DATE: MARCH, 2014 FIGURE NO.: 2



TYPICAL SECTION

SCALE: 1/4" = 1'-0"

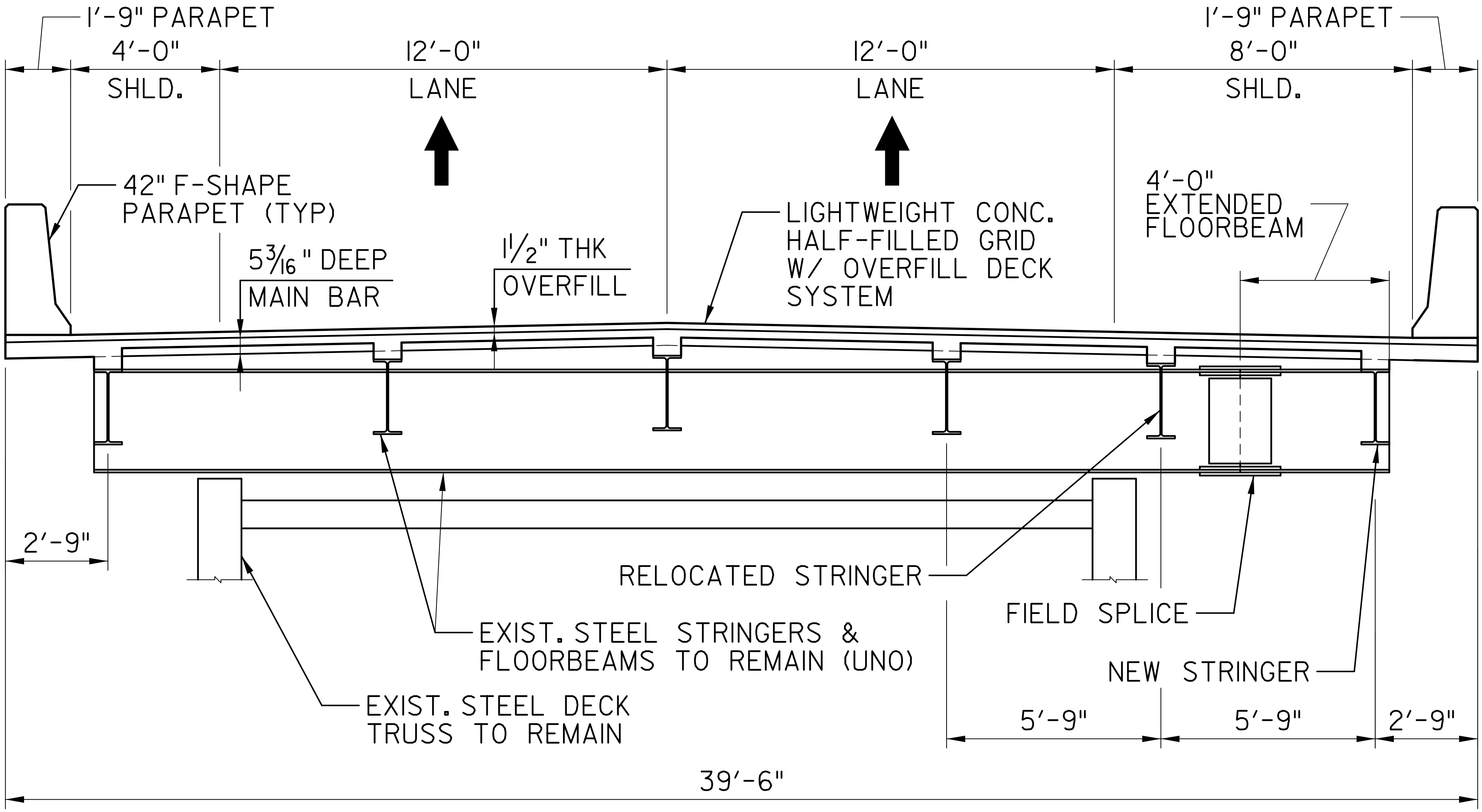
URS	REHABILITATION STUDY REPORT I-91 OVER WILLIAMS RIVER ROCKINGHAM, VERMONT	EXISTING BRIDGE SUPERSTRUCTURE TYPICAL SECTION	BR. NO.: 24N / 24S DATE: MARCH, 2014 FIGURE NO.: 3



TYPICAL SECTION

SCALE: 1/4" = 1'-0"

URS	REHABILITATION STUDY REPORT I-91 OVER WILLIAMS RIVER ROCKINGHAM, VERMONT	BRIDGE REHABILITATION TYPICAL SECTION ALTERNATIVE 1A	BR. NO.: 24N / 24S DATE: MARCH, 2014 FIGURE NO.: 4



TYPICAL SECTION

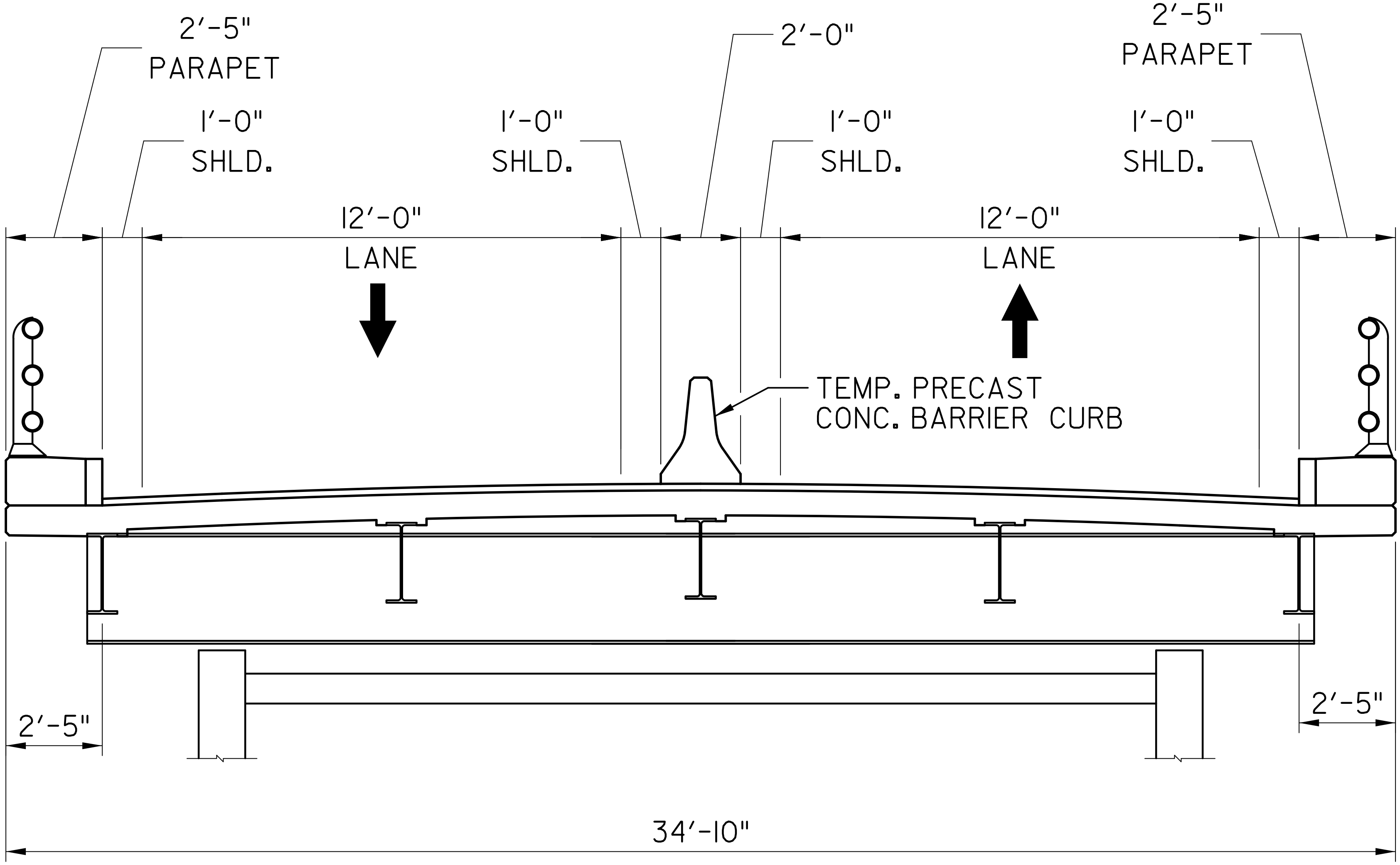
SCALE: 1/4" = 1'-0"

URS

REHABILITATION STUDY REPORT
I-91 OVER
WILLIAMS RIVER
ROCKINGHAM, VERMONT

BRIDGE REHABILITATION
TYPICAL SECTION
ALTERNATIVE 1B

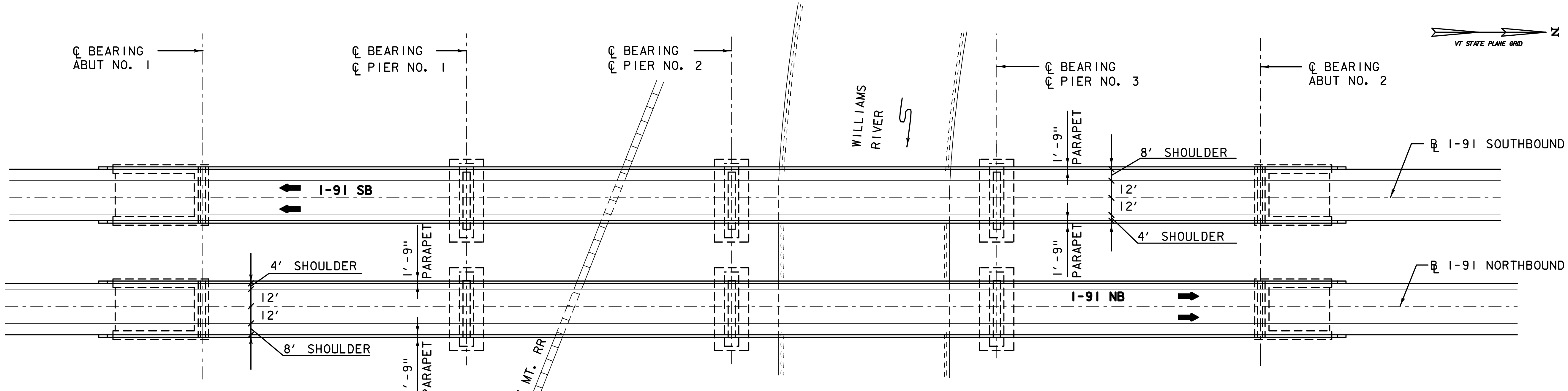
BR. NO.: 24N / 24S
DATE: MARCH, 2014
FIGURE NO.: 5



TYPICAL SECTION

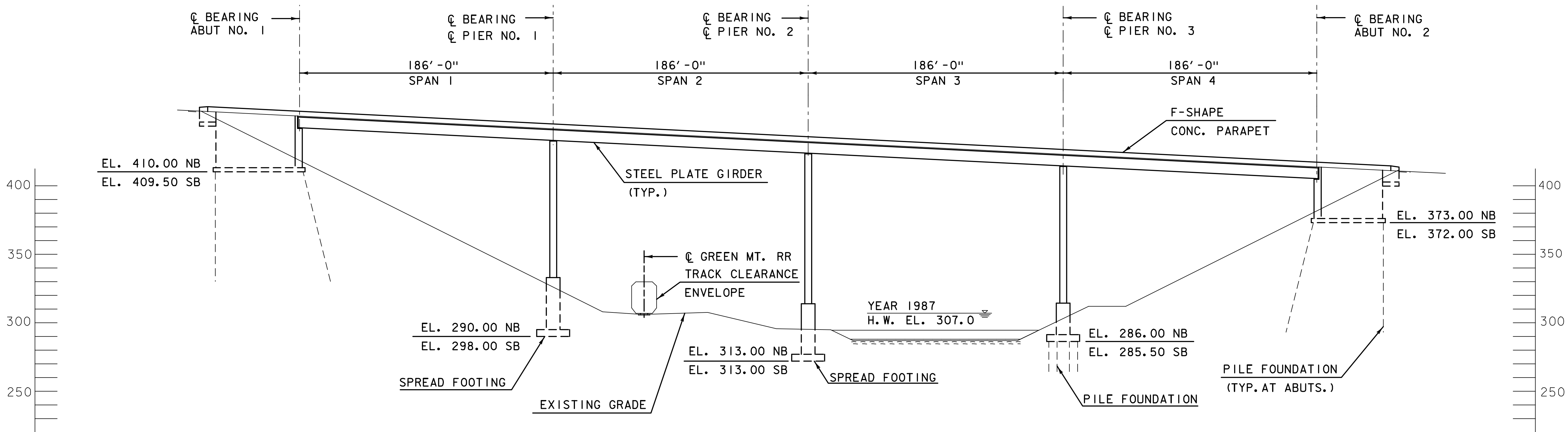
SCALE: 1/4" = 1'-0"

URS	REHABILITATION STUDY REPORT I-91 OVER WILLIAMS RIVER ROCKINGHAM, VERMONT	BRIDGE REHABILITATION TYPICAL SECTION TWO-WAY TRAFFIC MP&T	BR. NO.: 24N / 24S DATE: MARCH, 2014 FIGURE NO.: 6



PLAN

SCALE 1" = 80'-0"



ELEVATION

SCALE 1" = 80'-0"

URS

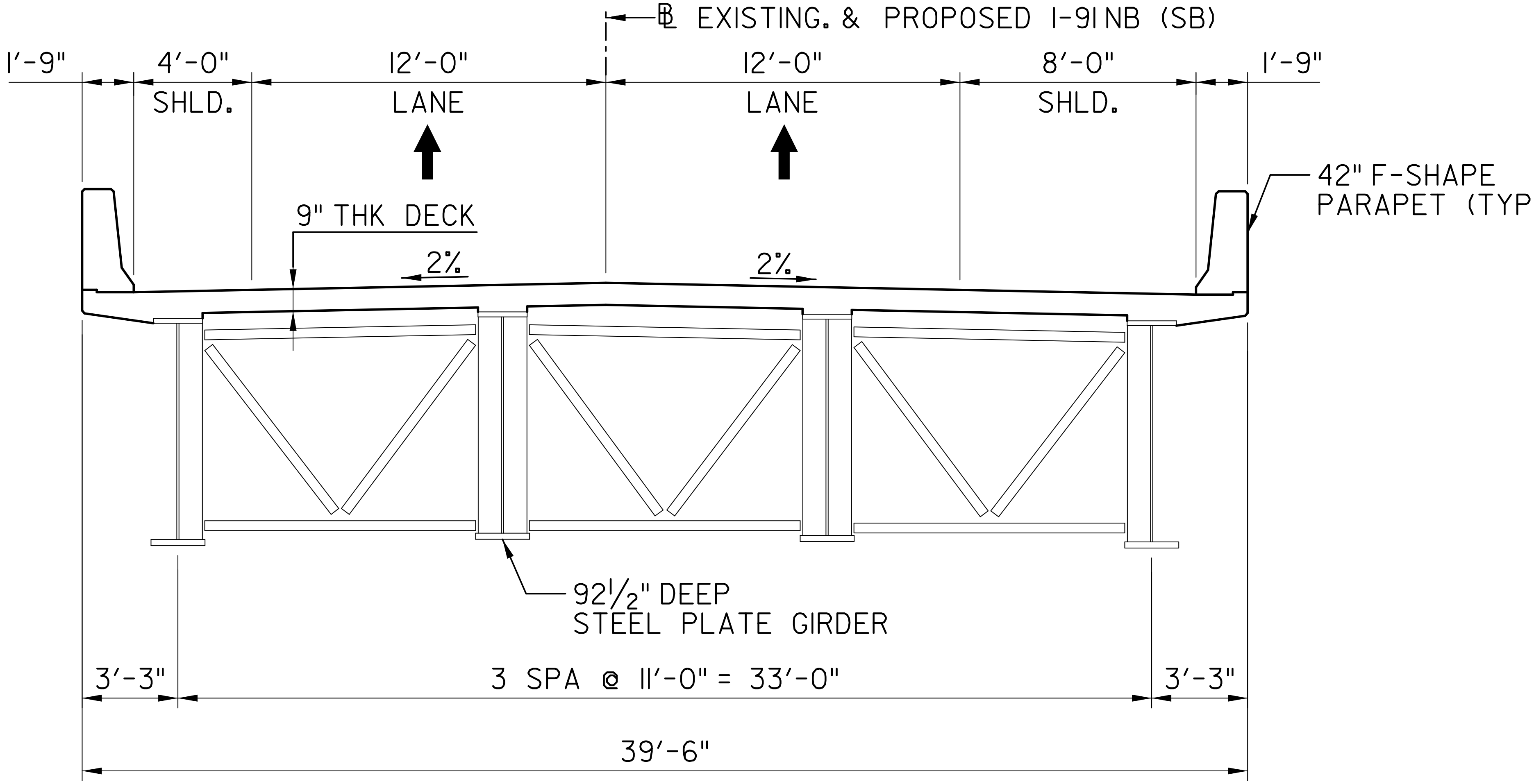
REHABILITATION STUDY REPORT
I-91 OVER
WILLIAMS RIVER
ROCKINGHAM, VERMONT

BRIDGE REPLACEMENT
GENERAL PLAN & ELEVATION
ALTERNATIVE 2A

BR. NO.: 24N & 24S

DATE: MARCH, 2014

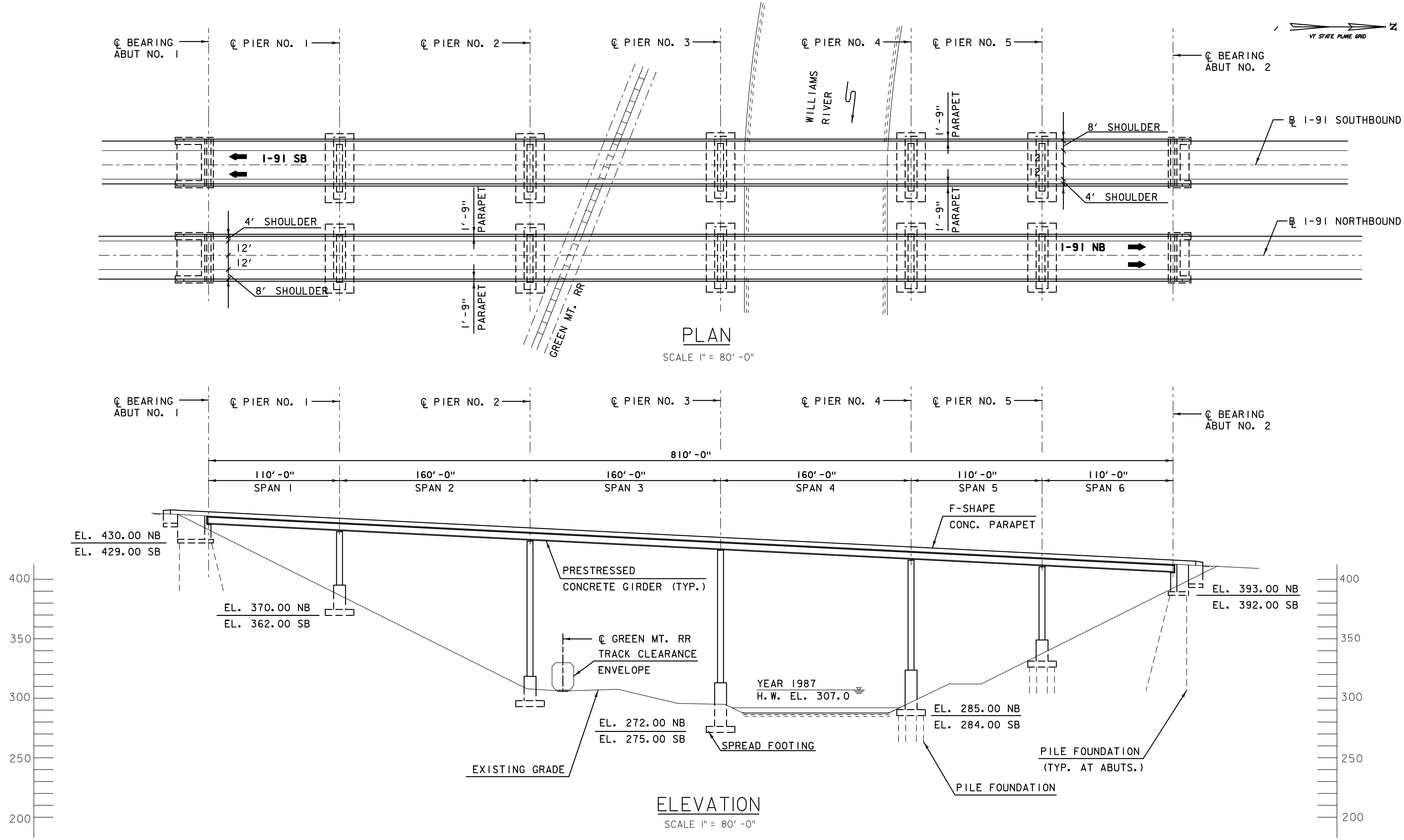
FIGURE NO.: 7



TYPICAL SECTION

SCALE: 3/16" = 1'-0"

URS	REHABILITATION STUDY REPORT I-91 OVER WILLIAMS RIVER ROCKINGHAM, VERMONT	BRIDGE REPLACEMENT TYPICAL SECTION ALTERNATIVE 2A	BR. NO.: 24N / 24S DATE: MARCH, 2014 FIGURE NO.: 8



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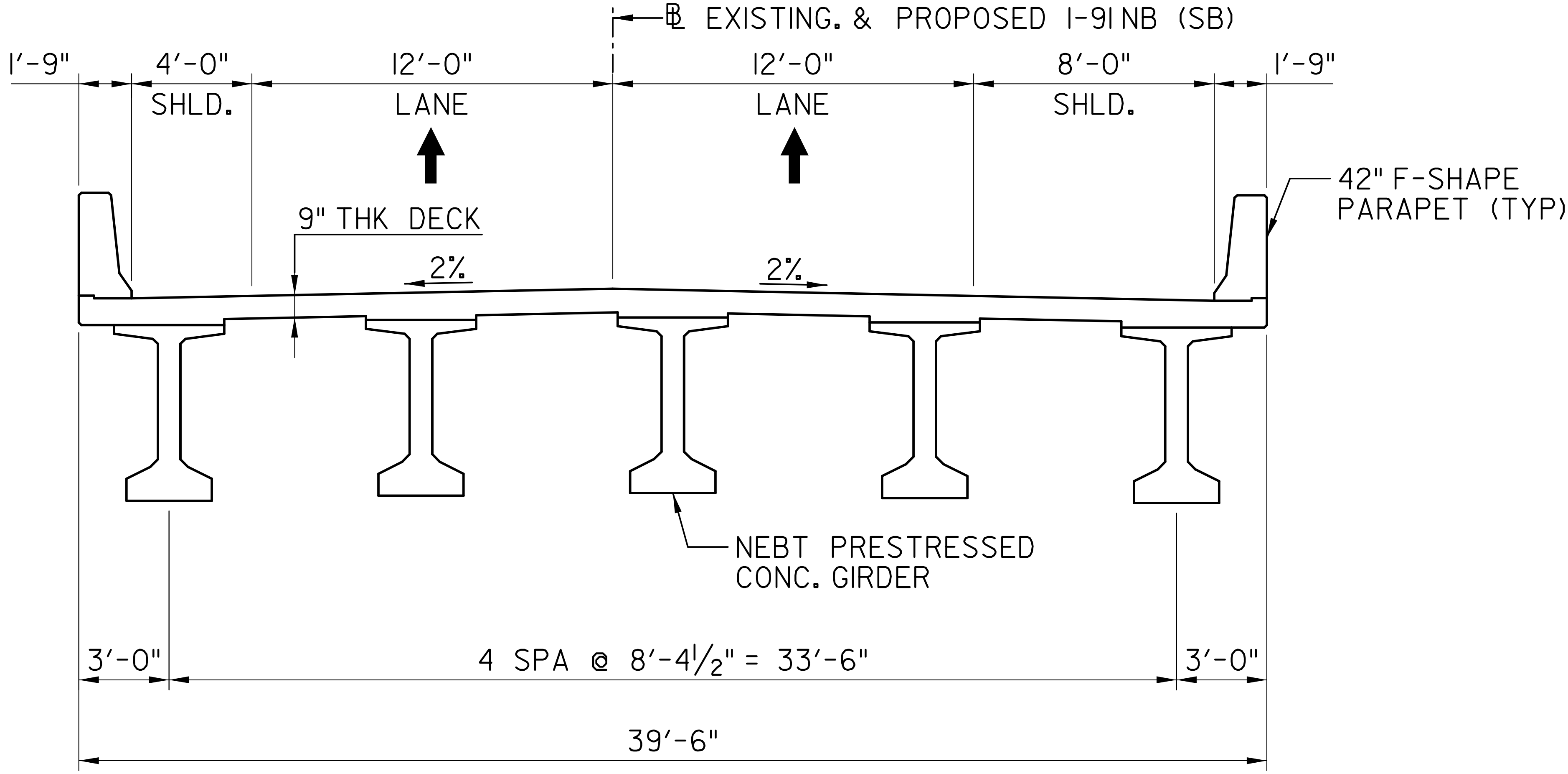
REHABILITATION STUDY REPORT
I-91 OVER
WILLIAMS RIVER
ROCKINGHAM, VERMONT

BRIDGE REPLACEMENT
GENERAL PLAN & ELEVATION
ALTERNATIVE 2B

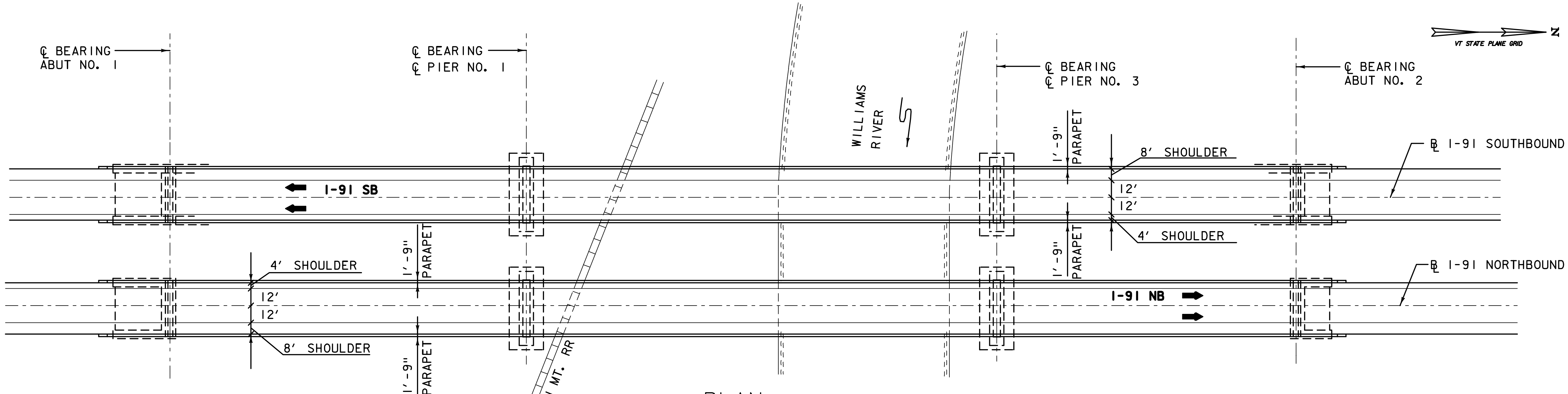
BR. NO.: 24N & 24S
DATE: MARCH, 2014
FIGURE NO.: 9



TYPICAL SECTION

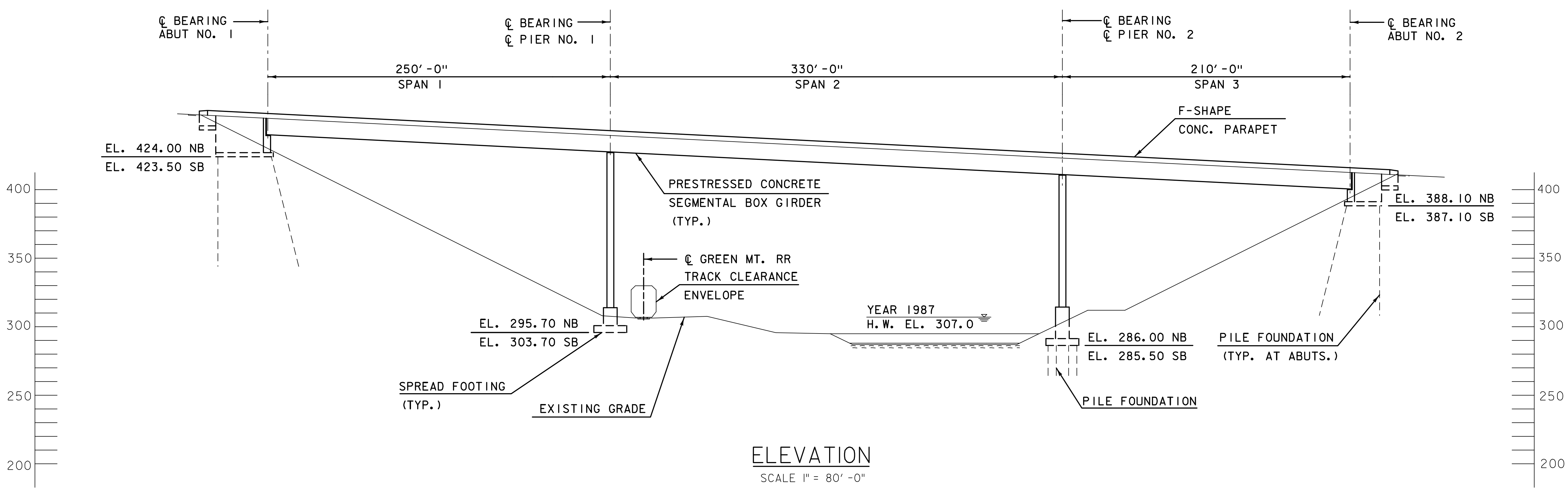
SCALE: 3/16" = 1'-0"

URS	REHABILITATION STUDY REPORT I-91 OVER WILLIAMS RIVER ROCKINGHAM, VERMONT	BRIDGE REPLACEMENT TYPICAL SECTION ALTERNATIVE 2B	BR. NO.: 24N / 24S DATE: MARCH, 2014 FIGURE NO.: 10



PLAN

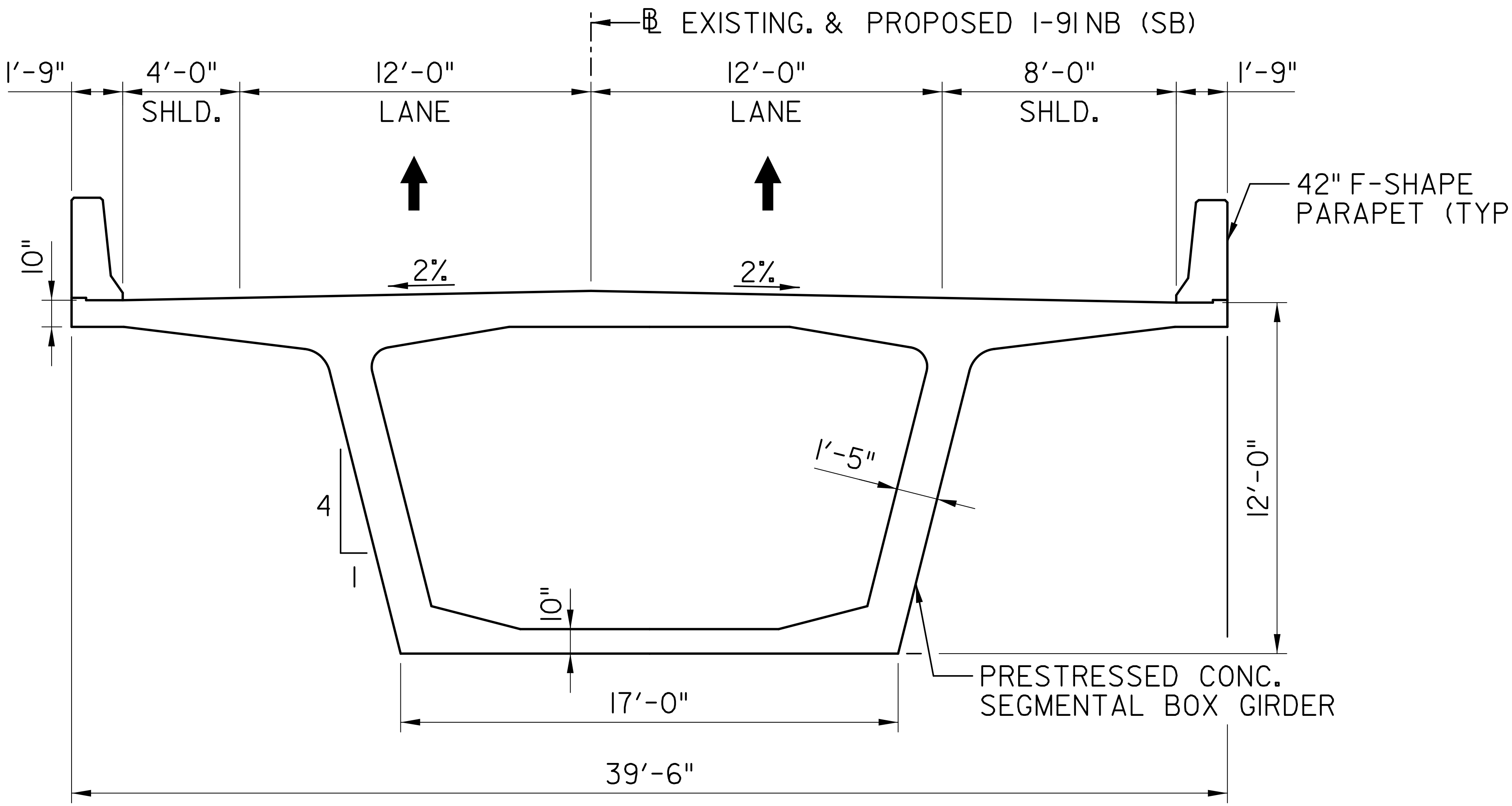
SCALE 1" = 80'-0"



ELEVATION

SCALE 1" = 80'-0"

URS	REHABILITATION STUDY REPORT I-91 OVER WILLIAMS RIVER ROCKINGHAM, VERMONT	BRIDGE REPLACEMENT GENERAL PLAN & ELEVATION ALTERNATIVE 2C	BR. NO.: 24N & 24S DATE: MARCH, 2014 FIGURE NO.: 11



TYPICAL SECTION

SCALE: 3/16" = 1'-0"

URS	REHABILITATION STUDY REPORT I-91 OVER WILLIAMS RIVER ROCKINGHAM, VERMONT	BRIDGE REPLACEMENT TYPICAL SECTION ALTERNATIVE 2C	BR. NO.: 24N / 24S DATE: MARCH, 2014 FIGURE NO.: 12

Appendix B – Cost Estimate

TABLE 2 - PRELIMINARY COST ESTIMATE
ALTERNATIVE 1A - DECK REPLACEMENT - EXISTING WIDTH

Description	*Unit*	*Qty.*	*Unit Cost*	*Cost*
ROADWAY ITEMS				
COLD MIXED RECYLCED BITUMINOUS PAVEMENT	SY	3,900	$ 35.00	$ 136,500
CONSTRUCT TEMPORARY CROSS OVER	LS	1	$ 750,000.00	$ 750,000
TEMPORARY P.C.B.C.	LF	4,800	$ 75.00	$ 360,000
REMOVE AND RESET TEMPORARY TRAFFIC BARRIER	LF	4,800	$ 20.00	$ 96,000
UNIFORMED TRAFFIC OFFICERS	HR	3,000	$ 75.00	$ 225,000
REMOVE AND RESET GUARDRAIL	LF	3,400	$ 10.00	$ 34,000
			Roadway Items Subtotal (A) =	$ 1,601,500
STRUCTURE ITEMS				
STRUCTURAL STEEL	LBS	27,500	$ 20.00	$ 550,000
BRIDGE RAILING, CONCRETE F-SHAPE	LF	3,400	$ 190.00	$ 646,000
TEMPORARY TRAFFIC BARRIER - STRUCTURE	LF	800	$ 75.00	$ 60,000
REMOVE AND RESET TEMPORARY TRAFFIC BARRIER - STRU(	LF	800	$ 30.00	$ 24,000
HALF-FILLED GRID DECK	SF	51,900	$ 70.00	$ 3,633,000
REMOVAL OF EXISTING BRIDGE DECK	LS	1	$ 500,000.00	$ 500,000
CLEAN & PAINT EXISTING STEEL STRUCTURES, BARE STEEL	LS	1	$ 3,000,000.00	$ 3,000,000
CONTAINMENT & DISPOSAL OF LEAD PAINT CLEANING RESIDUES	LS	1	$ 3,000,000.00	$ 3,000,000
			Structure Items Subtotal (B)=	$ 11,413,000
MINOR ITEMS/CONTINGENCIES				
20% OF ROADWAY+STRUCTURE COST (A+B)	LS	1	$ 2,602,900.00	$ 2,602,900
LUMP SUM ITEMS				
CLEARING AND GRUBBING (1.0%)	LS	1	$ 156,174.00	$ 156,174
M&P OF TRAFFIC (4.0%)	LS	1	$ 624,696.00	$ 624,696
MOBILIZATION (7%)	LS	1	$ 1,093,218.00	$ 1,093,218
CONSTRUCTION STAKING (1.0%)	LS	1	$ 156,174.00	$ 156,174
ESCALATION				
2%/YR FOR 4 YEARS	LS	1	$ 1,454,167.35	$ 1,454,167

TOTAL COST $ 19,101,829

ROUNDED TOTAL COST $ 19,200,000

TABLE 3 - PRELIMINARY COST ESTIMATE
ALTERNATIVE 1B - DECK REPLACEMENT - WIDE DECK

Description	*Unit*	*Qty.*	*Unit Cost*	*Cost*
ROADWAY ITEMS				
COLD MIXED RECYLCED BITUMINOUS PAVEMENT	SY	4,400	$ 35.00	$ 154,000
CONSTRUCT TEMPORARY CROSS OVER	LS	1	$ 750,000.00	$ 750,000
TEMPORARY P.C.B.C.	LF	4,800	$ 75.00	$ 360,000
REMOVE AND RESET TEMPORARY TRAFFIC BARRIER	LF	4,800	$ 20.00	$ 96,000
UNIFORMED TRAFFIC OFFICERS	HR	3,000	$ 75.00	$ 225,000
REMOVE AND RESET GUARDRAIL	LF	3,400	$ 10.00	$ 34,000
			Roadway Items Subtotal (A) =	$ 1,619,000
STRUCTURE ITEMS				
STRUCTURAL STEEL	LBS	226,316	$ 7.50	$ 1,697,370
BRIDGE RAILING, CONCRETE F-SHAPE	LF	3,400	$ 190.00	$ 646,000
TEMPORARY TRAFFIC BARRIER - STRUCTURE	LF	800	$ 75.00	$ 60,000
REMOVE AND RESET TEMPORARY TRAFFIC BARRIER - STRU(	LF	800	$ 30.00	$ 24,000
HALF-FILLED GRID DECK	SF	58,900	$ 70.00	$ 4,123,000
REMOVAL OF EXISTING BRIDGE DECK	LS	1	$ 500,000.00	$ 500,000
CLEAN & PAINT EXISTING STEEL STRUCTURES, BARE STEEL	LS	1	$ 3,000,000.00	$ 3,000,000
CONTAINMENT & DISPOSAL OF LEAD PAINT CLEANING RESIDUES	LS	1	$ 3,000,000.00	$ 3,000,000
			Structure Items Subtotal (B)=	$ 13,050,370
MINOR ITEMS/CONTINGENCIES				
20% OF ROADWAY+STRUCTURE COST (A+B)	LS	1	$ 2,933,874.00	$ 2,933,874
LUMP SUM ITEMS				
CLEARING AND GRUBBING (1.0%)	LS	1	$ 176,032.44	$ 176,032
M&P OF TRAFFIC (4.0%)	LS	1	$ 704,129.76	$ 704,130
MOBILIZATION (7%)	LS	1	$ 1,232,227.08	$ 1,232,227
CONSTRUCTION STAKING (1.0%)	LS	1	$ 176,032.44	$ 176,032
ESCALATION				
2%/YR FOR 4 YEARS	LS	1	$ 1,639,073.26	$ 1,639,073

TOTAL COST $ 21,530,739

ROUNDED TOTAL COST $ 21,600,000

TABLE 4 - PRELIMINARY COST ESTIMATE
ALTERNATIVE 2A - STEEL MULTI-GIRDERS

Description	*Unit*	*Qty.*	*Unit Cost*	*Cost*
ROADWAY ITEMS				
EARTH EXCAVATION 500-2,500 CY	CY	537	$ 70.00	$ 37,590
BORROW >5,000 CY	CY	9,518	$ 25.00	$ 237,950
SEDIMENTATION CONTROL SYSTEM	LF	1,214	$ 10.00	$ 12,140
CONSTRUCT TEMPORARY CROSS OVER	LS	1	$ 750,000.00	$ 750,000
TEMPORARY P.C.B.C.	LF	4,800	$ 75.00	$ 360,000
REMOVE AND RESET TEMPORARY TRAFFIC BARRIER	LF	4,800	$ 20.00	$ 96,000
COLD MIXED RECYLCED BITUMINOUS PAVEMENT	SY	4,000	$ 35.00	$ 140,000
METAL BEAM RAIL (TYPE R-B 350)	LF	635	$ 28.00	$ 17,780
R-B 350 BRIDGE ATTACHMENT	EA	8	$ 2,500.00	$ 20,000
TURF ESTABLISHMENT >5,000 SY	SY	6,500	$ 4.50	$ 29,250
UNIFORMED TRAFFIC OFFICERS	HR	3,000	$ 75.00	$ 225,000
			Roadway Items Subtotal (A) =	$ 1,925,710
STRUCTURE ITEMS				
GRANULAR BACKFILL FOR STRUCTURES	CY	1,560	$ 50.00	$ 78,000
COFFERDAM	LS	1	$ 300,000.00	$ 300,000
CONCRETE, HIGH PERFORMANCE CLASS A	CY	2,580	$ 1,200.00	$ 3,096,000
CONCRETE, HIGH PERFORMANCE CLASS B	CY	9,910	$ 800.00	$ 7,928,000
FURNISHING EQUIPMENT FOR DRIVING PILING	LS	1	$ 40,000.00	$ 40,000
STEEL PILING	LF	23,090	$ 40.00	$ 923,600
STRUCTURAL STEEL, PLATE GIRDER	LBS	3,576,000	$ 1.82	$ 6,508,320
REINFORCING STEEL, LEVEL I	LBS	981,000	$ 1.33	$ 1,304,730
REINFORCING STEEL, LEVEL III	LBS	645,000	$ 4.80	$ 3,096,000
WATER REPELLENT, SILANE	GAL	300	$ 74.14	$ 22,242
BRIDGE EXPANSION JOINT, ASPHALTIC PLUG	LF	80	$ 125.00	$ 10,000
BRIDGE EXPANSION JOINT, FINGER PLATE	LF	80	$ 1,300.00	$ 104,000
REMOVAL OF EXISTING BRIDGE	LS	1	$ 5,000,000.00	$ 5,000,000
BEARING DEVICE ASSEMBLY, HIGH LOAD MULTI-ROTATIONAL	EA	40	$ 3,500.00	$ 140,000
RIPRAP	CY	310	$ 55.00	$ 17,050
TEMPORARY TRAFFIC BARRIER - STRUCTURE	LF	800	$ 75.00	$ 60,000
REMOVE AND RESET TEMPORARY TRAFFIC BARRIER - STRU(	LF	800	$ 30.00	$ 24,000
			Structure Items Subtotal (B)=	$ 28,651,942
MINOR ITEMS/CONTINGENCIES				
20% OF ROADWAY+STRUCTURE COST (A+B)	LS	1	$ 6,115,530.40	$ 6,115,530
LUMP SUM ITEMS				
CLEARING AND GRUBBING (1.0%)	LS	1	$ 366,931.82	$ 366,932
M&P OF TRAFFIC (4.0%)	LS	1	$ 1,467,727.30	$ 1,467,727
MOBILIZATION (7%)	LS	1	$ 2,568,522.77	$ 2,568,523
CONSTRUCTION STAKING (1.0%)	LS	1	$ 412,757.92	$ 412,758
ESCALATION				
2%/YR FOR 4 YEARS	LS	1	$ 3,420,351.67	$ 3,420,352

TOTAL COST $ 44,929,474

ROUNDED TOTAL COST $ 45,000,000

TABLE 5 - PRELIMINARY COST ESTIMATE
ALTERNATIVE 2B - PRESTRESSED CONCRETE MULTI-GIRDERS

Description	*Unit*	*Qty.*	*Unit Cost*	*Cost*
ROADWAY ITEMS				
EARTH EXCAVATION 500-2,500 CY	CY	537	$ 70.00	$ 37,590
BORROW >5,000 CY	CY	9,518	$ 25.00	$ 237,950
SEDIMENTATION CONTROL SYSTEM	LF	1,214	$ 10.00	$ 12,140
CONSTRUCT TEMPORARY CROSS OVER	LS	1	$ 750,000.00	$ 750,000
TEMPORARY P.C.B.C.	LF	4,800	$ 75.00	$ 360,000
REMOVE AND RESET TEMPORARY TRAFFIC BARRIER	LF	4,800	$ 20.00	$ 96,000
COLD MIXED RECYLCED BITUMINOUS PAVEMENT	SY	4,000	$ 35.00	$ 140,000
METAL BEAM RAIL (TYPE R-B 350)	LF	635	$ 28.00	$ 17,780
R-B 350 BRIDGE ATTACHMENT	EA	8	$ 2,500.00	$ 20,000
TURF ESTABLISHMENT >5,000 SY	SY	6,500	$ 4.50	$ 29,250
UNIFORMED TRAFFIC OFFICERS	HR	3,000	$ 75.00	$ 225,000
			Roadway Items Subtotal (A) =	$ 1,925,710
STRUCTURE ITEMS				
GRANULAR BACKFILL FOR STRUCTURES	CY	1,560	$ 50.00	$ 78,000
COFFERDAM	LS	1	$ 300,000.00	$ 300,000
CONCRETE, HIGH PERFORMANCE CLASS A	CY	2,660	$ 1,200.00	$ 3,192,000
CONCRETE, HIGH PERFORMANCE CLASS B	CY	10,320	$ 800.00	$ 8,256,000
FURNISHING EQUIPMENT FOR DRIVING PILING	LS	1	$ 40,000.00	$ 40,000
STEEL PILING	LF	23,090	$ 40.00	$ 923,600
PRESTRESSED CONCRETE GIRDER (Tx70)	LF	8,100	$ 275.00	$ 2,227,500
REINFORCING STEEL, LEVEL I	LBS	1,007,000	$ 1.33	$ 1,339,310
REINFORCING STEEL, LEVEL III	LBS	665,000	$ 4.80	$ 3,192,000
WATER REPELLENT, SILANE	GAL	320	$ 74.14	$ 23,725
BRIDGE EXPANSION JOINT, ASPHALTIC PLUG	LF	80	$ 125.00	$ 10,000
BRIDGE EXPANSION JOINT, FINGER PLATE	LF	80	$ 1,300.00	$ 104,000
REMOVAL OF EXISTING BRIDGE	LS	1	$ 5,000,000.00	$ 5,000,000
BEARING DEVICE ASSEMBLY, STEEL REINFORCED ELASTOMERIC PAD	EA	50	$ 2,500.00	$ 125,000
RIPRAP	CY	310	$ 55.00	$ 17,050
TEMPORARY TRAFFIC BARRIER - STRUCTURE	LF	810	$ 75.00	$ 60,750
REMOVE AND RESET TEMPORARY TRAFFIC BARRIER - STRU(	LF	810	$ 30.00	$ 24,300
			Structure Items Subtotal (B)=	$ 24,913,235
MINOR ITEMS/CONTINGENCIES				
20% OF ROADWAY+STRUCTURE COST (A+B)	LS	1	$ 5,367,788.96	$ 5,367,789
LUMP SUM ITEMS				
CLEARING AND GRUBBING (1.0%)	LS	1	$ 322,067.34	$ 322,067
M&P OF TRAFFIC (4.0%)	LS	1	$ 1,288,269.35	$ 1,288,269
MOBILIZATION (7%)	LS	1	$ 2,254,471.36	$ 2,254,471
CONSTRUCTION STAKING (1.0%)	LS	1	$ 322,067.34	$ 322,067
ESCALATION				
2%/YR FOR 4 YEARS	LS	1	$ 2,998,833.39	$ 2,998,833

TOTAL COST $ 39,392,443

ROUNDED TOTAL COST $ 39,400,000

TABLE 6 - PRELIMINARY COST ESTIMATE
ALTERNATIVE 2C - SEGMENTAL CONCRETE BOX GIRDERS

Description	*Unit*	*Qty.*	*Unit Cost*	*Cost*
ROADWAY ITEMS				
EARTH EXCAVATION 500-2,500 CY	CY	537	$ 70.00	$ 37,590
BORROW >5,000 CY	CY	9,518	$ 25.00	$ 237,950
SEDIMENTATION CONTROL SYSTEM	LF	1,214	$ 10.00	$ 12,140
CONSTRUCT TEMPORARY CROSS OVER	LS	1	$ 750,000.00	$ 750,000
TEMPORARY P.C.B.C.	LF	4,800	$ 75.00	$ 360,000
REMOVE AND RESET TEMPORARY TRAFFIC BARRIER	LF	4,800	$ 20.00	$ 96,000
COLD MIXED RECYLCED BITUMINOUS PAVEMENT	SY	4,000	$ 35.00	$ 140,000
METAL BEAM RAIL (TYPE R-B 350)	LF	635	$ 28.00	$ 17,780
R-B 350 BRIDGE ATTACHMENT	EA	8	$ 2,500.00	$ 20,000
TURF ESTABLISHMENT >5,000 SY	SY	6,500	$ 4.50	$ 29,250
UNIFORMED TRAFFIC OFFICERS	HR	3,000	$ 75.00	$ 225,000
			Roadway Items Subtotal (A) =	$ 1,925,710
STRUCTURE ITEMS				
GRANULAR BACKFILL FOR STRUCTURES	CY	1,560	$ 50.00	$ 78,000
COFFERDAM	LS	1	$ 203,280.00	$ 203,280
CONCRETE, HIGH PERFORMANCE CLASS A	CY	520	$ 1,200.00	$ 624,000
CONCRETE, HIGH PERFORMANCE CLASS B	CY	5,980	$ 800.00	$ 4,784,000
FURNISHING EQUIPMENT FOR DRIVING PILING	LS	1	$ 40,000.00	$ 40,000
STEEL PILING	LF	23,090	$ 40.00	$ 923,600
SEGMENTAL CONCRETE BOX GIRDER SUPERSTRUCTURE	SF	62,410	$ 250.00	$ 15,602,500
REINFORCING STEEL, LEVEL I	LBS	589,000	$ 1.33	$ 783,370
REINFORCING STEEL, LEVEL III	LBS	130,000	$ 4.80	$ 624,000
WATER REPELLENT, SILANE	GAL	320	$ 74.14	$ 23,725
BRIDGE EXPANSION JOINT, ASPHALTIC PLUG	LF	80	$ 125.00	$ 10,000
BRIDGE EXPANSION JOINT, FINGER PLATE	LF	80	$ 1,300.00	$ 104,000
REMOVAL OF EXISTING BRIDGE	LS	1	$ 5,000,000.00	$ 5,000,000
HIGH CAPACITY MULTI-ROTATIONAL POT BEARING	EA	8	$ 20,000.00	$ 160,000
RIPRAP	CY	310	$ 55.00	$ 17,050
TEMPORARY TRAFFIC BARRIER	LF	800	$ 75.00	$ 60,000
REMOVE AND RESET TEMPORARY TRAFFIC BARRIER	LF	800	$ 30.00	$ 24,000
			Structure Items Subtotal (B)=	$ 29,061,525
MINOR ITEMS/CONTINGENCIES				
20% OF ROADWAY+STRUCTURE COST (A+B)	LS	1	$ 6,197,446.96	$ 6,197,447
LUMP SUM ITEMS				
CLEARING AND GRUBBING (1.0%)	LS	1	$ 371,846.82	$ 371,847
M&P OF TRAFFIC (4.0%)	LS	1	$ 1,487,387.27	$ 1,487,387
MOBILIZATION (7%)	LS	1	$ 2,602,927.72	$ 2,602,928
CONSTRUCTION STAKING (1.0%)	LS	1	$ 371,846.82	$ 371,847
ESCALATION				
2%/YR FOR 4 YEARS	LS	1	$ 3,462,340.09	$ 3,462,340

TOTAL COST $ 45,481,030

ROUNDED TOTAL COST $ 45,500,000

Appendix C –Load Rating Summaries

Table 7 - Load Rating Summary Existing Superstructure

Truss Chord Load Rating

As-Built Condition		Design Load Rating Factor				Legal Load Rating Factor									
		H-20 Rating		HS-20 Rating		3S2		6 Axle Trailer		3 Axle Straight		4 Axle Straight		5 Axle Semi	
		Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating
Load Factor Method	Strength	2.04	3.41	1.83	3.05	2.29	3.82	1.31	2.18	1.81	3.03	1.66	2.77	2.09	3.49
		Capacity / Demand Ratio													
		1.41		1.41		1.50		1.18		1.52		1.44		1.46	

Stringer Load Rating (Interior stringer control)

As-Built Condition		Design Load Rating Factor				Legal Load Rating Factor									
		H-20 Rating		HS-20 Rating		3S2		6 Axle Trailer		3 Axle Straight		4 Axle Straight		5 Axle Semi	
		Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating
Load Factor Method	Strength	1.30	2.17	1.30	2.17	1.56	2.60	**0.75***	1.26	1.05	1.75	**0.95***	1.59	1.47	2.45
		Capacity / Demand Ratio													
		1.38		1.38		1.55		0.92		1.19		1.10		1.49	

Floorbeam Load Rating

		Design Load Rating Factor				Legal Load Rating Factor									
		H-20 Rating		HS-20 Rating		3S2		6 Axle Trailer		3 Axle Straight		4 Axle Straight		5 Axle Semi	
		Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating
Load Factor Method	Strength	1.02	1.71	**0.87***	1.46	1.25	2.08	**0.65***	1.09	**0.87***	1.45	**0.79***	1.32	1.01	1.69
		Capacity / Demand Ratio													
		1.02		0.90		1.17		0.72		0.90		0.84		1.01	

Gusset Plate Load Rating

As-Built Condition		Design Load Rating Factor		Capacity/Demand Ratio
		HS-20		
Location		Inventory	Operating	
U0	Strength	1.73	2.88	1.69
U1		**0.56***	**0.93***	0.93
U2		**0.99***	1.65	1.1
U3		**0.98***	1.64	1.1
U4		**0.97***	1.62	1.09
L0		1.13	1.88	1.17
L1		-	-	-
L2		**0.99***	1.65	1.10
L3		-	-	-
L4		**0.97***	1.62	1.09

Splice Plate Load Rating

As-Built Condition		Design Load Rating Factor		Capacity/Demand Ratio
		HS-20		
Location		Inventory	Operating	
U0 - U1	Strength	-	-	-
U3 - U4		**0.60***	1.01	0.95
L2 - L3		**0.74***	1.23	1.00

* RATING FACTOR < 1.0 indicates that the allowable member capacity is exceeded for the load condition.

Table 8 - Load Rating Summary Two-Way Traffic on One Bridge

Truss Chord Load Rating

As-Built Condition		Design Load Rating Factor				Legal Load Rating Factor									
		H-20 Rating		HS-20 Rating		3S2		6 Axle Trailer		3 Axle Straight		4 Axle Straight		5 Axle Semi	
		Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating
Load Factor Method	Strength	2.44	4.07	2.21	3.68	2.73	4.56	1.56	2.60	2.19	3.65	2.00	3.34	2.50	4.17
		Capacity / Demand Ratio													
		1.46		1.46		1.54		1.27		1.58		1.53		1.51	

Stringer Load Rating (Interior stringer control)

As-Built Condition		Design Load Rating Factor				Legal Load Rating Factor									
		H-20 Rating		HS-20 Rating		3S2		6 Axle Trailer		3 Axle Straight		4 Axle Straight		5 Axle Semi	
		Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating
Load Factor Method	Strength	1.46	2.43	1.46	2.43	1.74	2.91	**0.84***	1.41	1.18	1.96	1.07	1.78	1.64	2.74
		Capacity / Demand Ratio													
		1.47		1.47		1.64		1.00		1.27		1.19		1.58	

Floorbeam Load Rating

		Design Load Rating Factor				Legal Load Rating Factor									
		H-20 Rating		HS-20 Rating		3S2		6 Axle Trailer		3 Axle Straight		4 Axle Straight		5 Axle Semi	
		Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating
Load Factor Method	Strength	1.17	1.95	1.00	1.66	1.42	2.37	**0.75***	1.24	**0.99***	1.65	**0.91***	1.51	1.15	1.92
		Capacity / Demand Ratio													
		1.11		1.31		1.27		0.80		0.99		0.93		1.10	

Gusset Plate Load Rating

As-Built Condition		Design Load Rating Factor		Capacity/Demand Ratio
		HS-20		
Location		Inventory	Operating	
U0	Strength	2.1	3.5	1.92
U1		**0.57***	**0.95***	0.96
U2		1.17	1.96	1.22
U3		1.13	1.89	1.17
U4		1.15	1.93	1.21
L0		1.28	2.14	1.21
L1		-	-	-
L2		1.17	1.96	1.20
L3		-	-	-
L4		1.15	1.93	1.21

Splice Plate Load Rating

As-Built Condition		Design Load Rating Factor		Capacity/Demand Ratio
		HS-20		
Location		Inventory	Operating	
U0 - U1	Strength	-	-	-
U3 - U4		**0.63***	1.05	0.98
L2 - L3		**0.79***	1.32	1.04

* RATING FACTOR < 1.0 indicates that the allowable member capacity is exceeded for the load condition.

Table 9 - Load Rating Summary Deck Replacement Alternative 1A

Truss Chord Load Rating

As-Built Condition		Design Load Rating Factor				Legal Load Rating Factor									
		H-20 Rating		HS-20 Rating		3S2		6 Axle Trailer		3 Axle Straight		4 Axle Straight		5 Axle Semi	
		Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating
Load Factor Method	Strength	2.20	3.67	1.88	3.14	2.46	4.11	1.41	2.35	1.87	3.12	1.71	2.85	2.18	3.63
		Capacity / Demand Ratio													
		1.60		1.60		1.73		1.26		1.62		1.52		1.66	

Stringer Load Rating (Interior stringer control)

As-Built Condition		Design Load Rating Factor				Legal Load Rating Factor									
		H-20 Rating		HS-20 Rating		3S2		6 Axle Trailer		3 Axle Straight		4 Axle Straight		5 Axle Semi	
		Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating
Load Factor Method	Strength	1.39	2.31	1.39	2.31	1.66	2.76	**0.80***	1.34	1.12	1.86	1.01	1.69	1.56	2.60
		Capacity / Demand Ratio													
		1.52		1.52		1.73		0.99		1.29		1.19		1.66	

Floorbeam Load Rating

		Design Load Rating Factor				Legal Load Rating Factor									
		H-20 Rating		HS-20 Rating		3S2		6 Axle Trailer		3 Axle Straight		4 Axle Straight		5 Axle Semi	
		Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating
Load Factor Method	Strength	1.12	1.87	**0.96***	1.60	1.37	2.29	**0.72***	1.20	**0.95***	1.59	**0.87***	1.45	1.11	1.85
		Capacity / Demand Ratio													
		1.10		0.97		1.28		0.76		0.96		0.89		1.09	

Gusset Plate Load Rating

As-Built Condition		Design Load Rating Factor		Capacity/Demand Ratic
		HS-20		
Location		Inventory	Operating	
U0	Strength	1.75	2.92	1.76
U1		**0.89***	1.49	1.06
U2		1.08	1.8	1.17
U3		1.18	1.97	1.22
U4		1.06	1.77	1.16
L0		1.41	2.35	1.32
L1		-	-	-
L2		1.08	1.8	1.17
L3		-	-	-
L4		1.06	1.77	1.16

Splice Plate Load Rating

As-Built Condition		Design Load Rating Factor		Capacity/Demand Ratic
		HS-20		
Location		Inventory	Operating	
U0 - U1	Strength	-	-	-
U3 - U4		**0.94***	1.57	1.08
L2 - L3		1.06	1.78	1.14

* RATING FACTOR < 1.0 indicates that the allowable member capacity is exceeded for the load condition.

Table 10 - Load Rating Summary Deck Replacement Alternative 1B

Truss Chord Load Rating

As-Built Condition		Design Load Rating Factor				Legal Load Rating Factor									
		H-20 Rating		HS-20 Rating		3S2		6 Axle Trailer		3 Axle Straight		4 Axle Straight		5 Axle Semi	
		Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating
Load Factor Method	Strength	1.65	2.76	1.44	2.41	1.85	3.09	1.06	1.77	1.43	2.39	1.31	2.19	1.67	2.79
		Capacity / Demand Ratio													
		1.35		1.32		1.46		1.04		1.32		1.23		1.39	

Stringer Load Rating (Interior stringer control)

As-Built Condition		Design Load Rating Factor				Legal Load Rating Factor									
		H-20 Rating		HS-20 Rating		3S2		6 Axle Trailer		3 Axle Straight		4 Axle Straight		5 Axle Semi	
		Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating
Load Factor Method	Strength	1.40	2.33	1.40	2.33	1.67	2.78	**0.81***	1.35	1.13	1.88	1.02	1.70	1.57	2.62
		Capacity / Demand Ratio													
		1.55		1.55		1.76		1.00		1.31		1.21		1.69	

Floorbeam Load Rating

		Design Load Rating Factor				Legal Load Rating Factor									
		H-20 Rating		HS-20 Rating		3S2		6 Axle Trailer		3 Axle Straight		4 Axle Straight		5 Axle Semi	
		Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating	Inventory	Operating
Load Factor Method	Strength	1.40	2.34	1.03	1.73	1.48	2.46	**0.77***	1.29	1.03	1.71	**0.94***	1.57	1.20	2.00
		Capacity / Demand Ratio													
		1.34		1.03		1.39		0.80		1.02		0.95		1.17	

Gusset Plate Load Rating

As-Built Condition		Design Load Rating Factor		Capacity/Demand Ratio
		HS-20		
Location		Inventory	Operating	
U0	Strength	1.36	2.26	1.42
U1		**0.57***	**0.96***	0.89
U2		**0.8***	1.34	0.95
U3		**0.84***	1.41	1.01
U4		**0.79***	1.32	0.94
L0		**0.99***	1.66	1.11
L1		-	-	-
L2		**0.8***	1.34	0.95
L3		-	-	-
L4		**0.79***	1.32	0.94

Splice Plate Load Rating

As-Built Condition		Design Load Rating Factor		Capacity/Demand Ratio
		HS-20		
Location		Inventory	Operating	
U0 - U1	Strength	-	-	-
U3 - U4		**0.61***	1.02	0.91
L2 - L3		**0.71***	1.18	0.96

* RATING FACTOR < 1.0 indicates that the allowable member capacity is exceeded for the load condition.