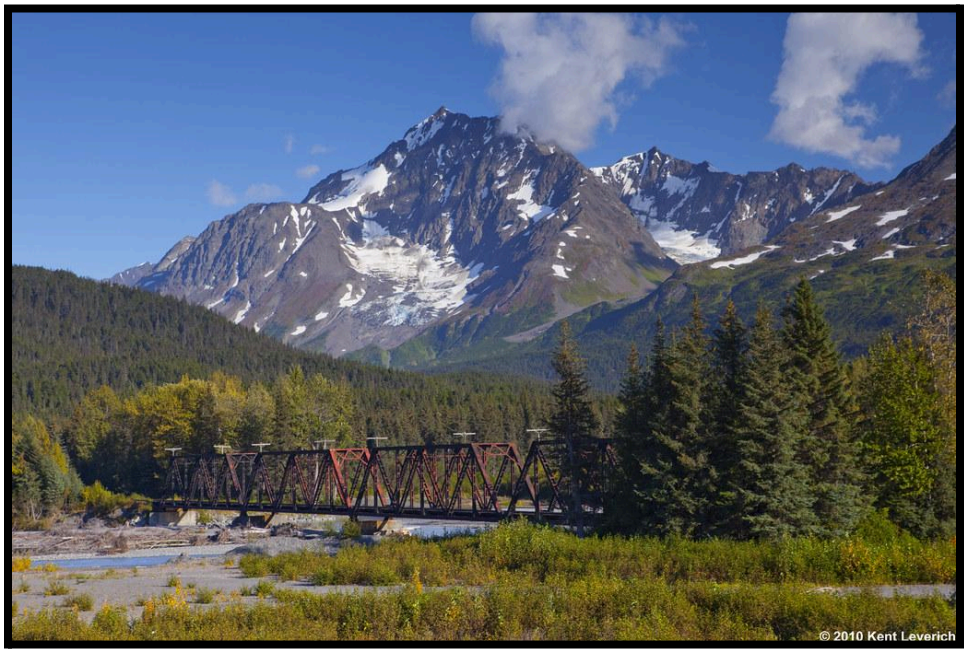
Snow River Bridge Raise
CED 2024.01

Design Study Report



Prepared for:

Alaska Railroad Corporation

Brian A. O'Dowd, P.E. Director-Engineering Services

Prepared by:

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Gus Schumacher, Hydrology & Geotech Engineer

List of Appendices

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List of Acronyms

ARRC	Alaska Railroad Corporation
AKDOT&PF	Alaska Department of Transportation and Public Facilities
ROW	Right of Way
ADFG	Alaska Department of Fish and Game
KPB	Kenai Peninsula Borough
MP	Milepost
MBI	Michael Baker International
DNR	Alaska Department of Natural Resources
USCG	United States Coast Guard
SWPP	Stormwater Pollution Prevention
USACE	United States Army Corp of Engineers

Executive Summary

The purpose of this project is to find an alternative that will raise the ARRC bridge at milepost 14.5 along the seward highway at a minimum of 4ft from its current elevation. The current bridge is at risk of damage due to the maximum estimated flood water levels in the Snow River flood plain in which it is located. To achieve this, UAAR consultants reviewed reports and other documents compiled provided by the ARRC. Five alternatives were considered as possible solutions. A non feasible no build was considered first. Then a bridge structure replacement, substructure replacement, bridge superstructure raise, and a realignment were all considered. Using a performance criteria including cost, it was found that the recommended alternative is a bridge superstructure raise. This would be achieved by incrementally raising the existing bridge

superstructure in 4 to 6 in increments using jacks on the existing piers. Steel grillage will be installed after each lift and once the minimum 4ft lift is achieved, the grillage will be encased in concrete.

1.0 Introduction

North of Seward, Alaska sits the Alaska Railroad (ARRC) bridge that crosses Snow River at ARRC milepost 14.5 (Alaska Department of Transportation and Public Facilities (AKDOT&PF) approximately Seward Highway milepost 14). With ARRC's projected future growth, flood surges stemming from Jökulhlaups (glacial lake outburst) associated with the Snow Glacier, and seasonal weather patterns; the existing track does not meet present day needs. UAAR Consultants Inc. has developed a 10% concept level design that raises the bridge by 4 feet to ensure current and future operations are sustainable and resilient for the foreseeable future.

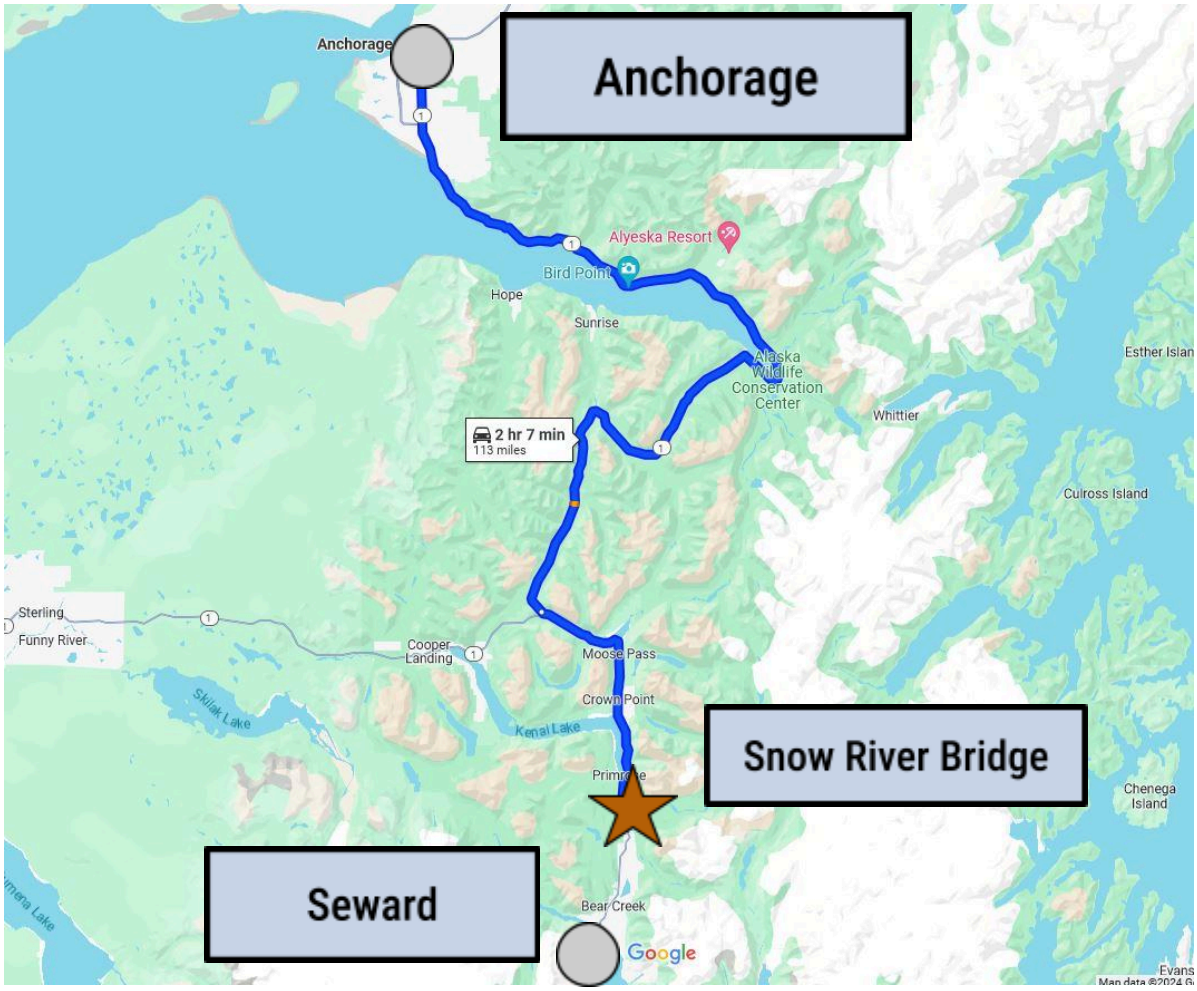

Figure 1: Map view location (Google Maps)

With the proposed track raise associated with the BR 14.5 raise, a steel multiplate structure owned by AKDOT&PF at ARRC MP 14.3 (south of BR 14.5) will need to be removed. Said multiplate structure will no longer conform to ARRC's right-of-way (ROW) guidelines. [TJ2] [BO3] This structure arches over the tracks, allowing vehicles traveling along the Seward Highway to pass unimpeded above the railway.

2.0 Existing Conditions

The existing bridge spans a total of 716'; consisting of four (4)-150' thru-truss spans with open decks, three (3)-29' I-Beam spans with ballast decks, and one (1)-29' I-Beam span with an open deck.

Currently, the existing bridge sits at an elevation that is too low for the maximum predicted flood water levels that the Snow Glacier floodplain is experiencing. Michael Baker International (MBI) has created a 2D Model Report of the Snow River Corridor showing recent glacier outburst flooding events. The report found that BR 14.5 could potentially be overtopped by a future maximum flood event or greater. This is leading to stresses that were not considered in the design of the bridge structure. The stress from the impact of water and debris on the low chord of the bridge could ultimately lead to failure of the structure.

3.0 Design Criteria

When analyzing alternatives for this project the following design criteria were considered:

- Raise the low chord of the thru-truss superstructures by a minimum of 4.0 feet;
- Minimize changes in alignment;
    - Maximum Degree of Curvature of 8°-1'-0";
    - Maximum spiral lengths based on the design track speed; and,
    - Maintain a maximum grade of 1.0%.
- Remove or replace the existing south approach spans;
- Rehabilitate or replace the existing north approach spans;
- Minimize costs while balancing constructability;
- Minimize impacts to rail traffic during construction; and,
- Minimize impacts to affected wetlands.

4.0 Design Alternatives

Five alternatives were evaluated against the above-mentioned criteria. All of the alternatives we looked at consisted of the following;

- Raise tracks and ballast to bridge level until it ties into the existing grade in the south direction;
- Raise tracks and ballast to bridge level for a minimum 50ft in the north direction before transitioning to a maximum downward grade of 1% until the proposed grade ties into the existing grade in the north direction;
- Place and key-in rip-rap along bridge abutments and piers to prevent scour; and,
- Removal of the AKDOT&PF steel multi-plate structure.

4.1 Alternative 1 - No Build

- No Build Option - all existing track and bridge structures remain in current configuration.

4.2 Alternative 2 - Bridge Structure Replacement

- Replace approach spans with precast concrete ballast deck structures with new concrete bulkheads on both ends;
- Fabricate new steel superstructures that utilize the existing substructures;
- Construct the new superstructures on temporary bents upstream of the existing structure;
- Modify existing substructures to achieve the target low chord elevation identified in the H&H report;
- Jack and slide the existing superstructures off the alignment and slide the new superstructures into place; and,
- Demolition and removal of the legacy superstructures.

4.3 Alternative 3 - Substructure Replacement

- Construct new piers outside the limits of the legacy superstructures;
- Jack the existing superstructures from temporary bents to allow for the installation of straddle caps over the existing pier;
- Affix the existing superstructures to the straddle caps.

4.4 Alternative 4 - Bridge Superstructure Raise

- Raise superstructure in 4” to 6” increments to its final elevation using jacks mounted on either the existing piers or temporary piers;
- Raise track outside of the superstructures in 4” to 6” increments concurrent with the superstructure raise; and,
- Removal and replacement of approach spans.

4.5 Alternative 5 - Realignment

- Controlled blasting of the rock face at the southern approach to allow for the realignment;
- Construct a new alignment downstream of the existing alignment;
- Construct new bridge;
- Abandon the existing rail alignment after tying into the new alignment; and,
- Demolish and remove the legacy structures on the old alignment.

4.6 Alternative Evaluation

Table 1 evaluates the alternatives based on their ability to satisfy the design criteria/requirements, constructability, and cost. The alternatives were ranked from 1 (being the best) to 4 (being the worst) against each established criteria. Scores were determined based on the following ranking system:

○ = 0 points (does not meet criteria or is least desirable of options)

◒ = 0.5 points (meets criteria, but a more desirable option is available)

● = 1 points (meets criteria and is the most desirable option)

Criteria	**Alternative 1 No build**	**Alternative 2 Superstructure Replacement**	**Alternative 3 Substructure Replacement**	**Alternative 4 Bridge Superstructure Raise**	**Alternative 5 Bridge Realignment and Rebuild**
New minimum low chord met	○	●	●	●	●
Construction ease/speed	○	○	○	●	◒
Geotechnical consideration	○	●	◒	●	◒
Effect on adjacent AKDOT&PF facilities	●	◒	◒	◒	○

Maintenance	○	●	◒	◒	●
Longevity	○	●	◒	◒	●
Reliability	○	●	◒	◒	●
Future growth of services	○	●	◒	◒	●
Wetland/ environmental impact	●	●	○	●	○
Criteria Evaluation Score	2	7.5	4	6.5	6
Probable Cost	$ 0	$ 26,154,360	$ 109,105,968	$ 13,949,040	$ 135,154,800
Cost Score (5=best, 1=worst)	5	3	2	4	1
Total Score	**7**	**10.5**	**6**	**10.5**	**7**
Concept Rank	**5**	**2**	**4**	**1**	**3**

5.0 Recommended Alternative

After evaluating these alternatives, it was determined that Alternative 4 generally meets all the given criteria for the project at the lowest cost. UAAR recommends proceeding forwards with Alternative 4.

5.1 Additional Considerations for Alternative 4

In proceeding with construction of Alternative 4, UAAR explored the following construction methods:

- Alternative 4a. Cast-in-place concrete: construct a reinforced concrete support on top of existing piers. Option to pour incrementally or monolithically.
- Alternative 4b.Precast concrete: Install precast concrete modules on top of existing piers with option to fabricate in sections or as a monolithic block. Secure to existing piers using dowels.
- Alternative 4c. Steel shims: install steel shims, attaching the initial shim to the existing piers using dowels, and then install remaining shims as the structure is jacked, interconnecting them as the raise progresses.
- Alternative 4d. Steel/Concrete hybrid: follow the same initial process as Alternative 4c. When the steel grillage is complete, form and pour concrete to encapsulate shims to add support and protect from weathering.

Criteria	**Alt. 4a: Cast-in-place Concrete**	**Alt. 4b: Precast Concrete**	**Alt. 4c: Steel Shims**	**Alt. 4d: Steel/Concrete hybrid**
Constructability	4	3	1	2
Performance/ Reliability	2	3	4	1
Cost	$ 12,500,000	$ 10,000,000	$ 9,000,000	$ 11,500,000
Rank	4	3	2	1

After evaluating these possible construction methods, Steel/Concrete hybrid provides the best solution to the given criteria for the problem at a competitive cost. Cast-in-place concrete is not a viable solution because the curing time is far too great with respect to available track outages. Precast concrete does not work because concrete modules are difficult to bind to one another and represent a high risk of being damaged during construction. Steel shims are not optimal because of their exposure to weathering and less stability, laterally and longitudinally, than the solutions involving concrete.

Benefits of Steel/Concrete hybrid include:

- Relatively easy construction, with the shims able to be prepared off-site and installed rapidly;
- No track outage time during the concrete encasement once the grillages are in place; and,
- Weathering resiliency from the concrete encasement of steel in a wet environment and special detailing to prevent water intrusion between concrete and steel elements.

Downsides:

- Increased cost compared to steel shims alone.

We recommend the hybrid material because of its more durable design and ability to better satisfy the maintenance, longevity, and reliability requirements.Variations to this option can be incorporated and we are able to provide changes if preferred.

6.0 Environmental Considerations

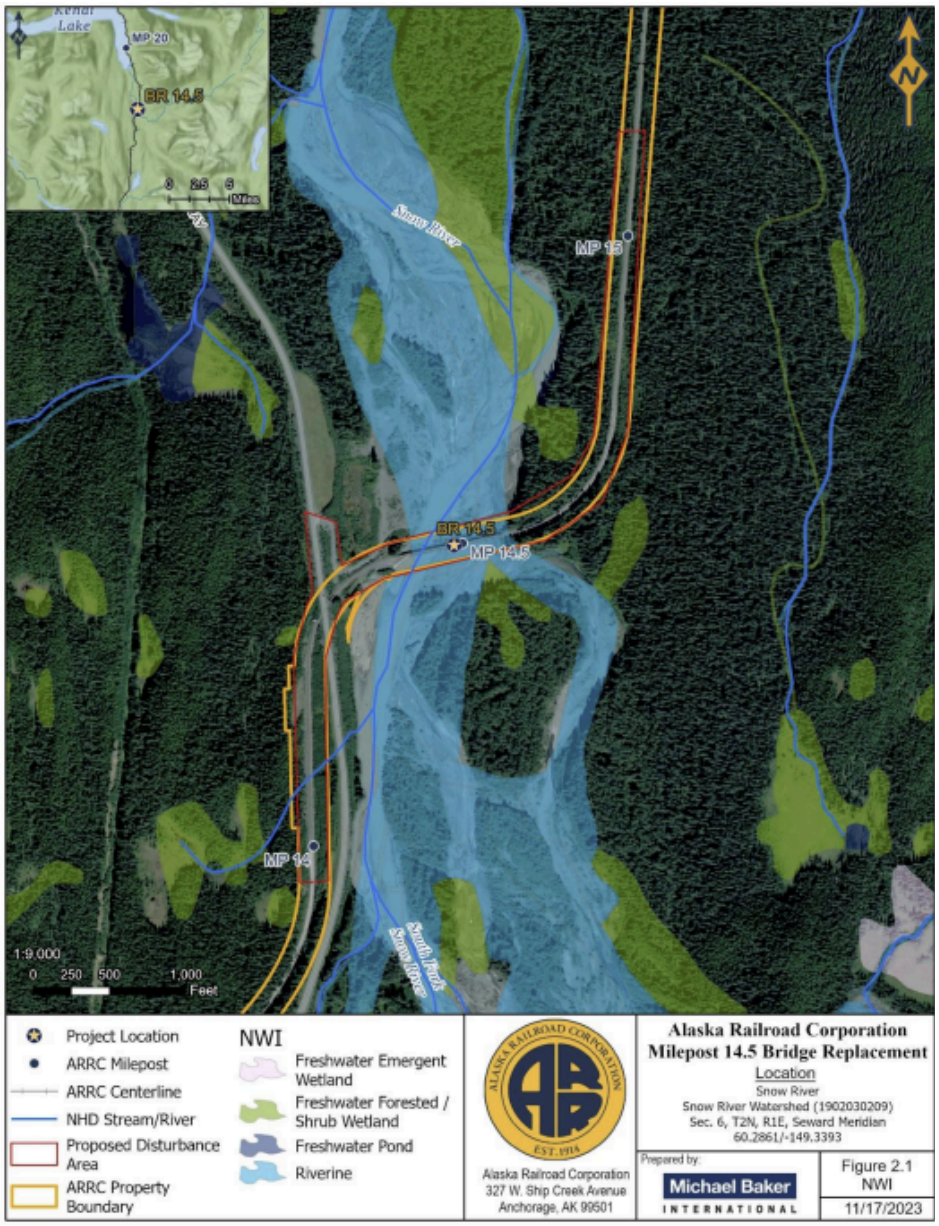

Figure 2: National Wetland Inventory and National Hydrography Dataset, provided by ARRC

The construction and area of potential impact of this project exists in a wetland area with wildlife habitat on all sides. Construction will be completed using Best Management Practices to mitigate environmental impacts.

Environmental Permitting & Approvals

Permits and approvals must be obtained from relevant authorities to facilitate construction, considering potential impacts. ADFG permits are necessary due to the presence of local wildlife affected by the project. Additionally, a FloodPlain permit from KPB is essential as the project is situated within the Borough's floodplain. Notification to the USCG is required due to the navigability of the river for motorized vessels. ARRC may also have specific permits to be addressed. DNR's permit is necessary for areas of forest impacted by the project. USACE notification is mandated by the Clean Water Act for wetland impact assessment. AK DOT&PF should be informed of planned construction activities to manage lane closures along the Seward Hwy. Finally, a SWPPP will be developed to address the project's impact on the river.

7.0 Conclusion and Recommendations

Flooding of the Snow River plain is becoming more frequent and severe due to Jökulhlaups (glacial outburst floods), as shown in a hydrology report conducted by MBI. The railroad bridge that crosses the Snow River at ARRC MP 14.5 has a low chord elevation that is at risk of overtopping in a major flood event. In 2019, a major washout event threatened the integrity of the bridge structure. These risks and potential future crises are being mitigated by a 4-ft track raise, as well as replacement of the approach spans and armor rock surrounding the bridge piers. To complete this work, we have proposed 5 alternatives based on design criteria. Our recommended alternative involves simply raising the existing bridge structure. This will be done in increments so track closure times can be kept to a minimum. All solutions with a track raise will also require a rebuild of the AKDOT&PF multiplate underpass structure to the south of the bridge. We recommend moving forward with Alternative 4, as it is the least costly option that generally meets all provided design criteria, and will allow the safe use of this infrastructure for decades to come.

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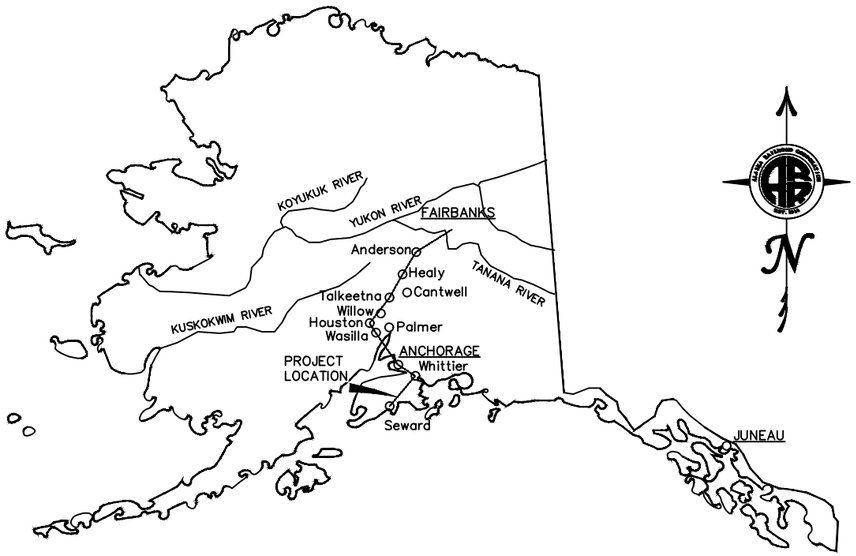
ALASKA RAILROAD CORPORATION
CAPITAL PROJECTS

P.O. BOX 107500, ANCHORAGE, ALASKA 99510-7500

CED 2024.01 SNOW RIVER BRIDGE 14.5 RAISE
FINAL 10% PLAN SET

APRIL 2024



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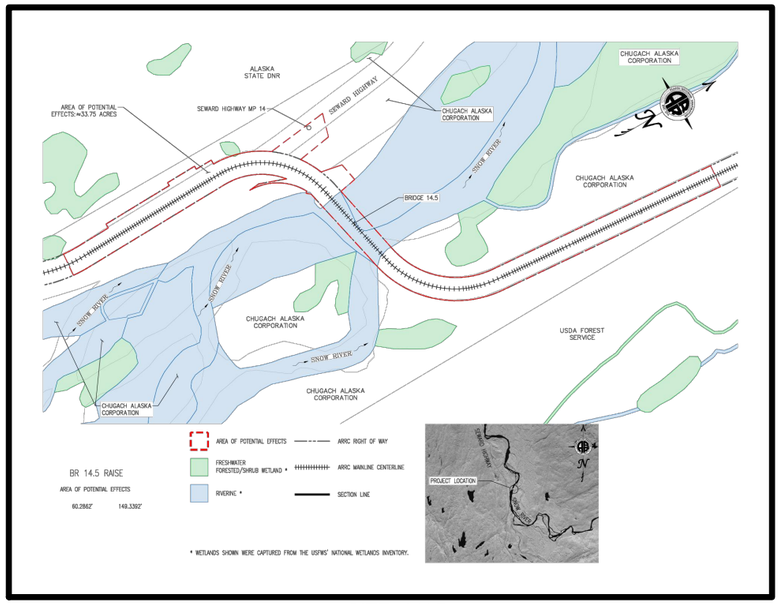

SITE MAP
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SHEET INDEX

AS-BUILT DRAWING REFERENCES:

ARRC – BRIDGE NO. 14.5 PLAN & PROFILE SET – 1955

DESIGNED BY:	UAAR
CHECKED BY:	DM
DRAFTED BY:	UAAR

10% SUBMITTAL NOT FOR CONSTRUCTION

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PROJECT: CED 2024.01 SNOW RIVER BRIDGE

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YEAR 2024

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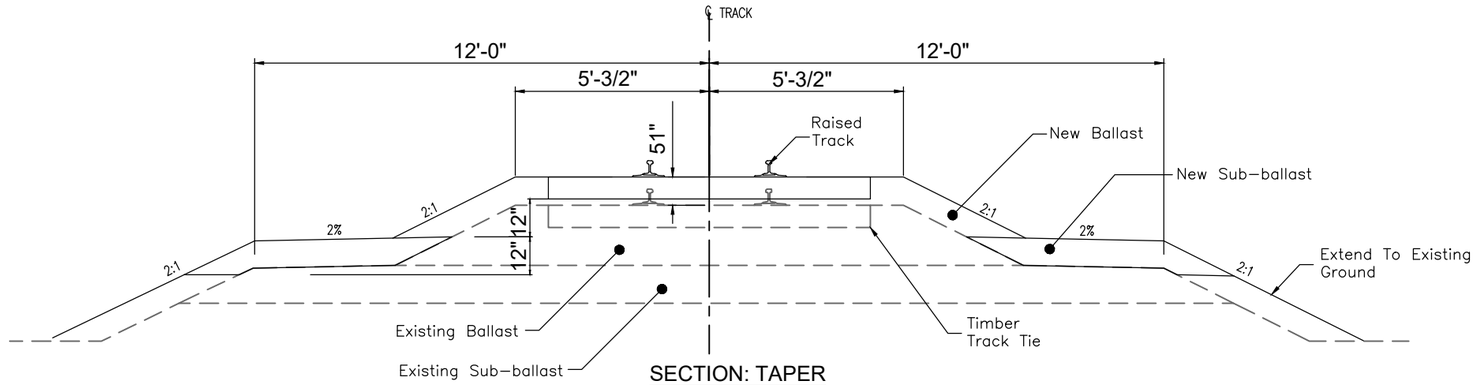

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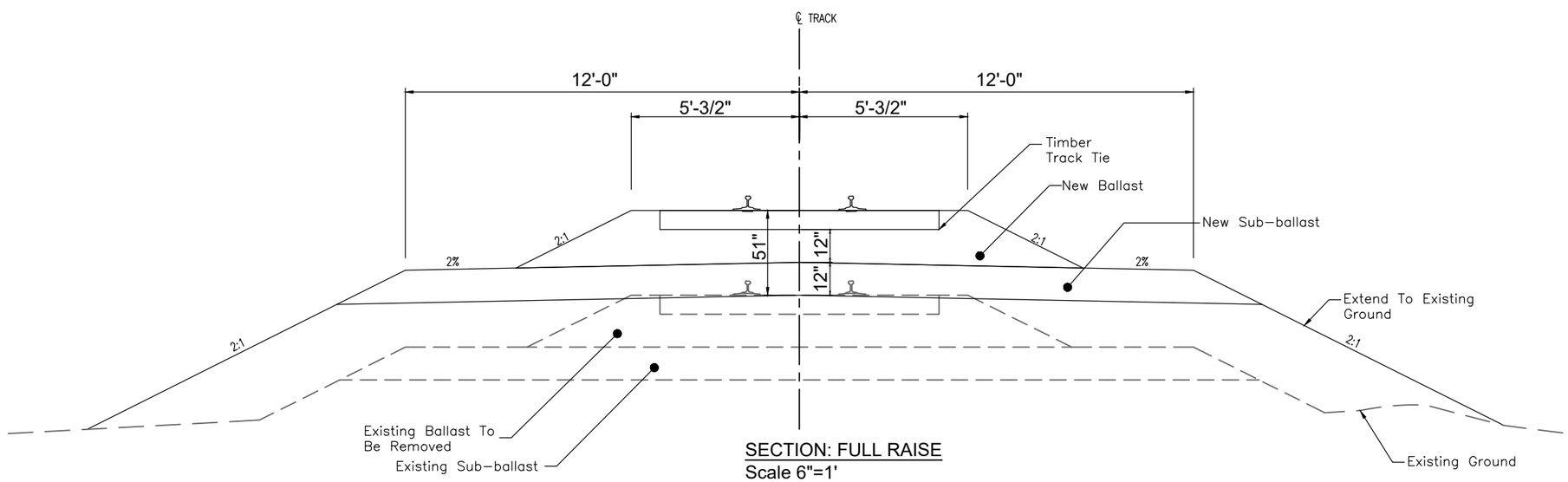

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SHEET TITLE: TRACK TYPICAL SECTION

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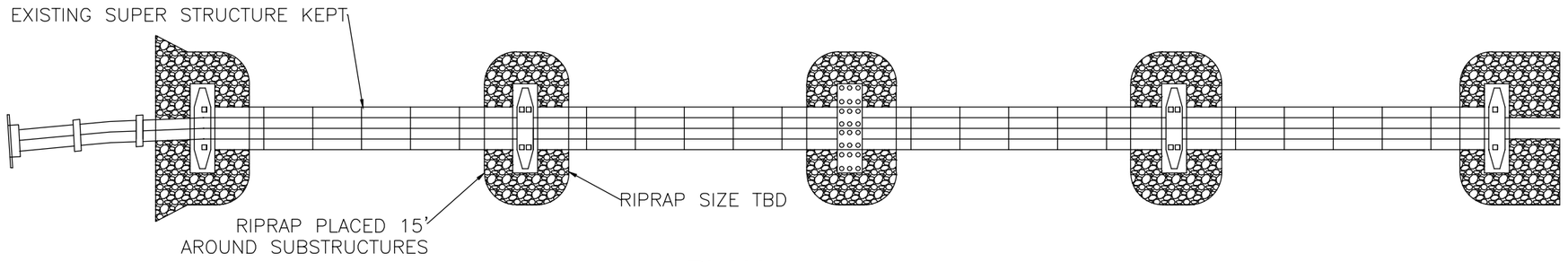

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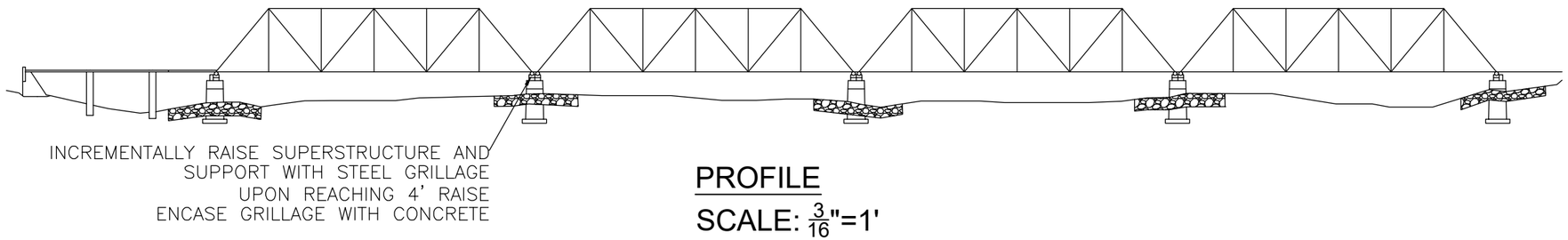

PROFILE

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PROJECT: CED 2024.01 SNOW RIVER BRIDGE

SHEET TITLE: BRIDGE RAISE PLAN AND PROFILE

YEAR 2024

SHEET 3 OF 5

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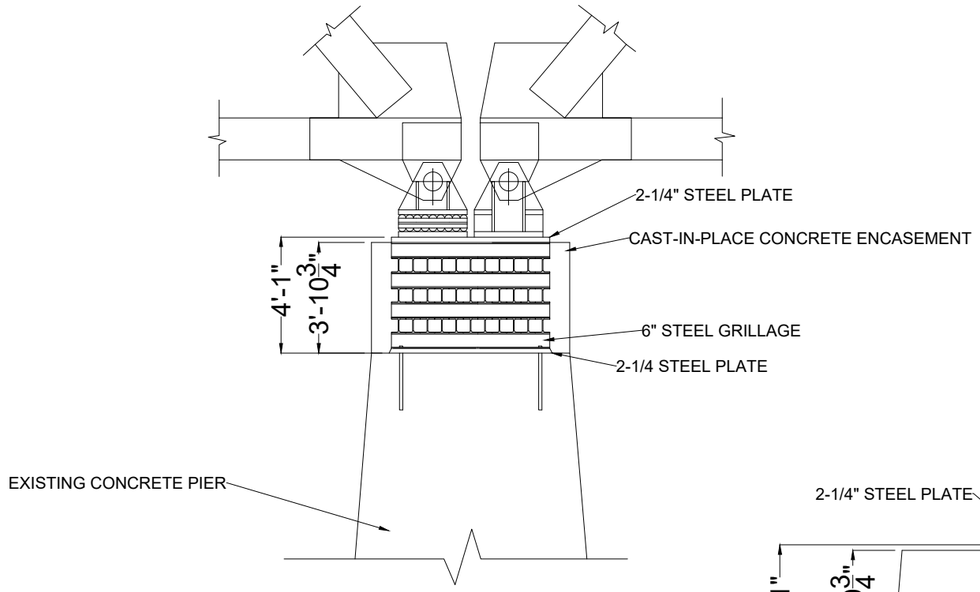

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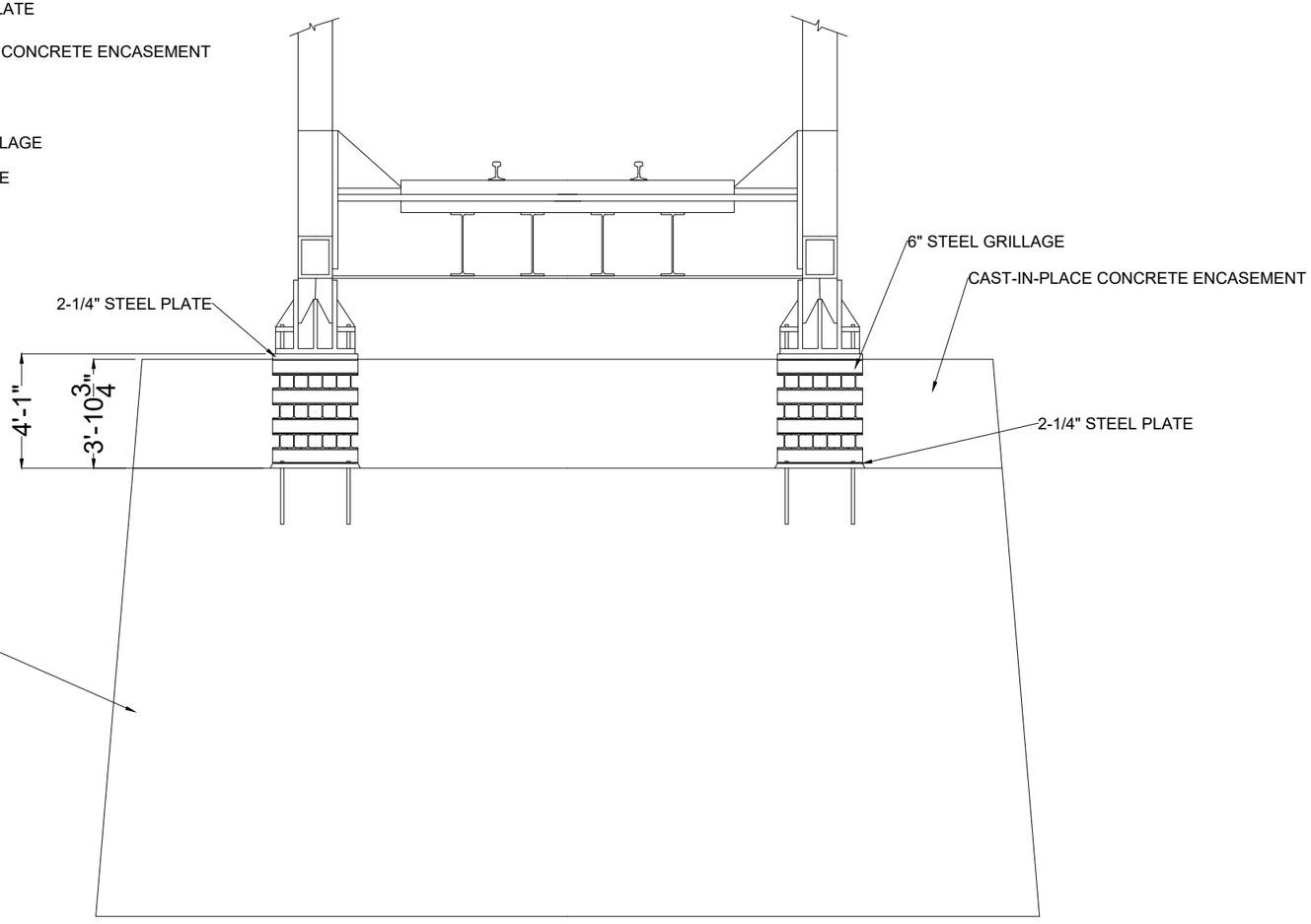

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YEAR 2024

SHEET 4 OF 5

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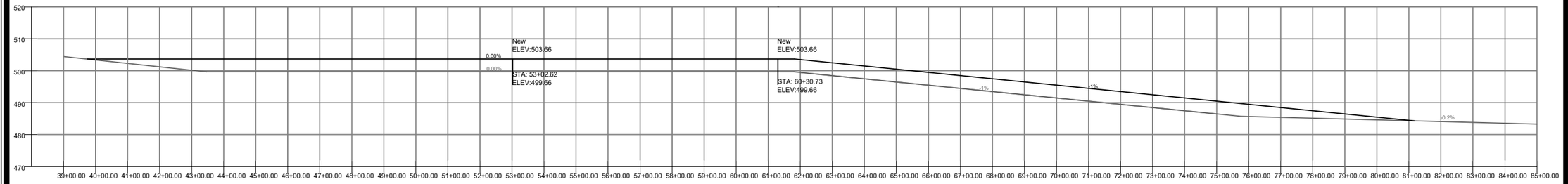

PROFILE VIEW
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ENGINEERING DEPARTMENT

PROJECT: CED 2024.01 SNOW RIVER BRIDGE

SHEET TITLE: CORRIDOR PROFILE GRADE

YEAR 2024

SHEET 5 OF 5

Alternative 1 - No Build						
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Alternative 2 - Bridge Structure Replacement						
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640.0001.1	Mobilization and Demobilization	LS	1	$ 4,351,560.00	$ 4,351,560.00	
201.0009.1	Clearing and Grubbing	ACRE	2	$ 400.00	$ 800.00	
202.0023.1	Removal of Bridge and Existing Structures	LS	1	$ 1,000,000.00	$ 1,000,000.00	
501.0007.1	Precast Concrete Member CAC-1	EACH	2	$ 45,000.00	$ 90,000.00	
501.0007.2	Precast Concrete Member CPC-1	EACH	6	$ 55,000.00	$ 330,000.00	
501.0004.1	Class A Concrete, Piles	CY	250	$ 400.00	$ 100,000.00	
503.0001.1	Reinforcing Steel, 24”ø Cage	LS	1	$ 80,000.00	$ 80,000.00	
504.0001.1	Steel Beam Superstructure, Fabricate and Furnish	EACH	4	$ 2,795,000.00	$ 11,180,000.00	
504.0001.2	Steel Beam Superstructure, Install	LS	1	$ 500,000.00	$ 500,000.00	
505.0001.1	Furnish Structural Steel Piles, 24”ø x 0.875”t, Galvanized	LF	6000	$ 500.00	$ 3,000,000.00	
505.0001.2	Drive Structural Steel Piles, 24”ø x 0.875”t	EACH	30	$ 12,000.00	$ 360,000.00	
505.0009.1	Furnish and Drive Structural Steel Sheet Piles, PS31	SF	5000	$ 110.00	$ 550,000.00	
505.0010.1	Socket Structural Steel Piles, 24”	EACH	15	$ 40,000.00	$ 600,000.00	
611.0001.1	Riprap, Class III	TON	630	$ 400.00	$ 252,000.00	
641.0002.1	Stormwater Maintenance and Management	LS	1	$ 50,000.00	$ 50,000.00	
501.0007.1	Precast Concrete Backwall	EACH	1	$ 100,000.00	$ 100,000.00	
503.0003.1	Drill and Bond Dowel (#10 Dowel x 3'-0" Embed)	EACH	50	$ 800.00	$ 40,000.00	
642.0001.1	Construction Surveying	LS	1	$ 50,000.00	$ 50,000.00	
643.002.1	Traffic Maintenance	LS	1	$ 100,000.00	$ 100,000.00	
643.0025.1	Traffic Control	LS	1	$ 100,000.00	$ 100,000.00	
643.0032.1	Flagging	LS	1	$ 50,000.00	$ 50,000.00	
504.0001.2	Raise Superstructure, Temp Lifting Beam Structure	EACH	5	$ 450,000.00	$ 2,250,000.00	
504.0001.3	Raise Superstructure, Grillage Furnish and Install	EACH	5	$ 35,000.00	$ 175,000.00	
501.0002.1	Pier Encasement	EACH	5	$ 160,000.00	$ 800,000.00	
	Contingency				$ 45,000.00	
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Alternative 3 - Substructure Replacement						
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611.0001.1	Riprap, Class III	TON	630	$ 400.00	$ 252,000.00	
201.0009.1	Clearing and Grubbing	ACRE	1	$ 400.00	$ 400.00	
202.0023.1	Removal of Bridge and Existing Structures	LS	1	$ 1,000,000.00	$ 1,000,000.00	
501.0007.1	Precast Concrete Member CAC-1	EACH	2	$ 45,000.00	$ 90,000.00	
501.0007.2	Precast Concrete Member CPC-1	EACH	6	$ 55,000.00	$ 330,000.00	
501.0004.1	Class A Concrete, Piles	CY	250	$ 400.00	$ 100,000.00	
504.0001.2	Raise Superstructure, Temp Lifting Beam Structure	EACH	5	$ 450,000.00	$ 2,250,000.00	
504.0001.3	Raise Superstructure, Grillage Furnish and Install	EACH	5	$ 35,000.00	$ 175,000.00	
503.0001.1	Reinforcing Steel, 24”ø Cage	LS	1	$ 80,000.00	$ 80,000.00	
642.0001.1	Construction Surveying	LS	1	$ 50,000.00	$ 50,000.00	
501.0002.1	Pier Encasement	EACH	5	$ 160,000.00	$ 800,000.00	
641.0002.1	Stormwater Maintenance and Management	LS	1	$ 50,000.00	$ 50,000.00	
643.002.1	Traffic Maintenance	LS	1	$ 516,740.00	$ 516,740.00	
643.0025.1	Traffic Control	LS	1	$ 100,000.00	$ 100,000.00	
501.0002.2	Pier Installation	EACH	5	$ 17,000,000.00	$ 85,000,000.00	
643.0032.1	Flagging	LS	1	$ 50,000.00	$ 50,000.00	
640.0001.1	Mobilization and Demobilization	LS	1	$ 18,176,828.00	$ 18,176,828.00	
	Contingency				$ 45,000.00	
				SUM	$ 109,105,968.00	

Alternative 4 - Bridge Superstructure Raise						
Item #	Item Description	UOM	QTY	Extended Price	Total	Comments
503.0003.1	Drill and Bond Dowel (#10 Dowel x 3'-0" Embed)	EACH	50	$ 800.00	$ 40,000.00	
611.0001.1	Riprap, Class III	TON	630	$ 400.00	$ 252,000.00	
504.0001.2	Raise Superstructure, Temp Lifting Beam Structure	EACH	5	$ 1,800,000.00	$ 9,000,000.00	
504.0001.3	Raise Superstructure, Grillage Furnish and Install	EACH	5	$ 35,000.00	$ 175,000.00	
503.0001.1	Reinforcing Steel, 24”ø Cage	LS	1	$ 80,000.00	$ 80,000.00	
642.0001.1	Construction Surveying	LS	1	$ 50,000.00	$ 50,000.00	
501.0002.1	Pier Encasement	EACH	5	$ 160,000.00	$ 800,000.00	
643.002.1	Traffic Maintenance	LS	1	$ 1,039,700.00	$ 1,039,700.00	
643.0025.1	Traffic Control	LS	1	$ 100,000.00	$ 100,000.00	
643.0032.1	Flagging	LS	1	$ 50,000.00	$ 50,000.00	
640.0001.1	Mobilization and Demobilization	LS	1	$ 2,317,340.00	$ 2,317,340.00	
	Contingency				$ 45,000.00	
				SUM	$ 13,949,040.00	

Alternative 5 - Bridge Realignment						
Item #	Item Description	UOM	QTY	Extended Price	Total	Comments
640.0001.1	Mobilization and Demobilization	LS	1	$ 22,518,300.00	$ 22,518,300.00	
201.0009.1	Clearing and Grubbing	ACRE	1	$ 400.00	$ 400.00	
202.0023.1	Removal of Bridge and Existing Structures	LS	1	$ 1,000,000.00	$ 1,000,000.00	
202.0024.1	Removal of Track	LF	200	$ 500,000.00	$ 100,000,000.00	
203.0003.1	Unclassified Excavation	CY	3000	$ 20.00	$ 60,000.00	
203.0006.1	Selected Material, Type A	TON	1500	$ 55.00	$ 82,500.00	
203.0003.1	Railroad Ballast, Type 3	TON	5040	$ 40.00	$ 201,600.00	
242.0001.1	Trackwork, 115# RE Rail	LF	700	$ 75.00	$ 52,500.00	
242.0001.2	Surfacing Mainline Track	LF	700	$ 25.00	$ 17,500.00	
301.0004.1	Aggregate Surface Course, Grading D-1	TON	200	$ 85.00	$ 17,000.00	
501.0007.1	Precast Concrete Member CAC-1	EACH	3	$ 45,000.00	$ 135,000.00	
501.0007.2	Precast Concrete Member CPC-1	EACH	3	$ 55,000.00	$ 165,000.00	
501.0004.1	Class A Concrete, Piles	CY	250	$ 400.00	$ 100,000.00	
503.0001.1	Reinforcing Steel, 24”ø Cage	LS	1	$ 80,000.00	$80,000.00	
504.0001.1	Steel Beam Superstructure, Fabricate and Furnish	EACH	1	$ 2,795,000.00	$ 2,795,000.00	
504.0001.2	Steel Beam Superstructure, Install	LS	1	$ 500,000.00	$ 500,000.00	
505.0001.1	Furnish Structural Steel Piles, 24”ø x 0.875”t, Galvanized	LF	4000	$ 500.00	$ 2,000,000.00	
505.0001.2	Drive Structural Steel Piles, 24”ø x 0.875”t	EACH	30	$ 12,000.00	$ 360,000.00	
505.0009.1	Furnish and Drive Structural Steel Sheet Piles, PS31	SF	5000	$ 110.00	$ 550,000.00	
505.0010.1	Socket Structural Steel Piles, 24”	EACH	15	$ 40,000.00	$ 600,000.00	
611.0001.1	Riprap, Class III	TON	400	$ 400.00	$ 160,000.00	
641.0002.1	Stormwater Maintenance and Management	LS	1	$ 50,000.00	$ 50,000.00	
501.0007.1	Precast Concrete Backwall	EACH	1	$ 100,000.00	$ 100,000.00	
503.0003.1	Drill and Bond Dowel (#10 Dowel x 3'-0" Embed)	EACH	50	$ 800.00	$ 40,000.00	
642.0001.1	Construction Surveying	LS	1	$ 50,000.00	$ 50,000.00	
643.002.1	Traffic Maintenance	LS	1	$ 100,000.00	$ 100,000.00	
643.0025.1	Traffic Control	LS	1	$ 100,000.00	$ 100,000.00	
643.0032.1	Flagging	LS	1	$ 50,000.00	$ 50,000.00	
504.0001.2	Raise Superstructure, Temp Lifting Beam Structure	EACH	5	$ 450,000.00	$ 2,250,000.00	
504.0001.3	Raise Superstructure, Grillage Furnish and Install	EACH	5	$ 35,000.00	$ 175,000.00	
501.0002.1	Pier Encasement	EACH	5	$ 160,000.00	$ 800,000.00	
	Contingency				$ 45,000.00	
				SUM	$ 135,154,800.00	

Alternative 4 Materials						
Concept 1 - Cast-in-place Concrete						
Item #	Item Description	UOM	QTY	Extended Price	Total	Comments
501.0004.1	Class A Concrete	LS	1	$ 2,500,000.00	$ 12,500,000.00	
Concept 2 - Precast Concrete						
501.0007.1	Precast Concrete Member	EACH	5	$ 2,000,000.00	$ 10,000,000.00	
Concept 3 - Steel shims						
503.0001.0000	Reinforcing Steel	LS	1	$ 9,000,000.00	$ 9,000,000.00	
Concept 4 - Steel/Concrete composite						
503.0001.0000	Reinforcing Steel	LS	1	$ 9,000,000.00	$ 9,000,000.00	
501.0004.1	Class A Concrete	LS	1	$ 2,500,000.00	$ 2,500,000.00	

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Appendix C:

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