PARSONS

Memorandum

File ID: 200213_Memo_Rum_River_Type_Report.docx

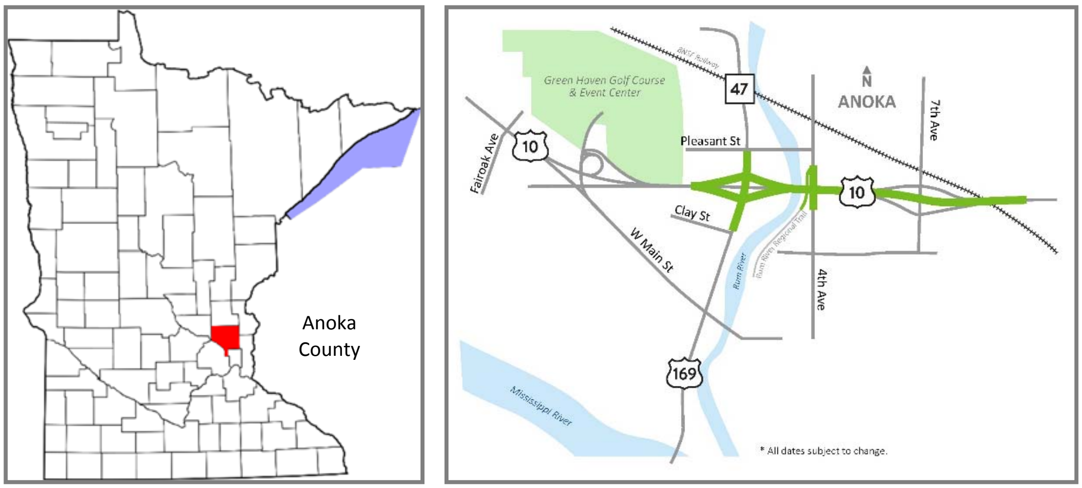
To: Nick Olson, P.E.
North Area Engineer – MnDOT Metro District

From: Vince Gastoni,PE
Principal, Parsons Transportation Group

Date: February 13, 2020

Subject: SP 0215-76; TH 10 Rum River Bridge Replacement, Bridge Replacement Type Study.

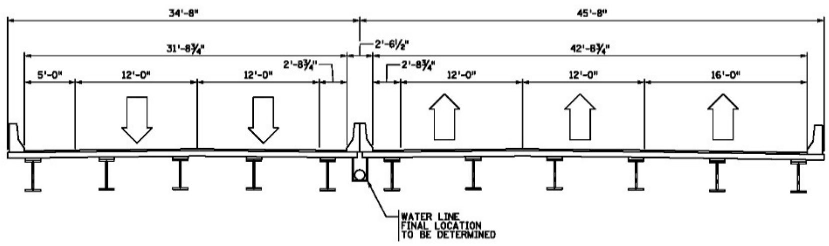
Introduction: This memorandum is to document the type study evaluation process for the replacement of the TH 10 bridge over the Rum River (Br. No. 9700) in Anoka, MN and address issues related to the development of the Environmental Assessment documents and the Type, Size and Locations Plans for the recommended bridge type.



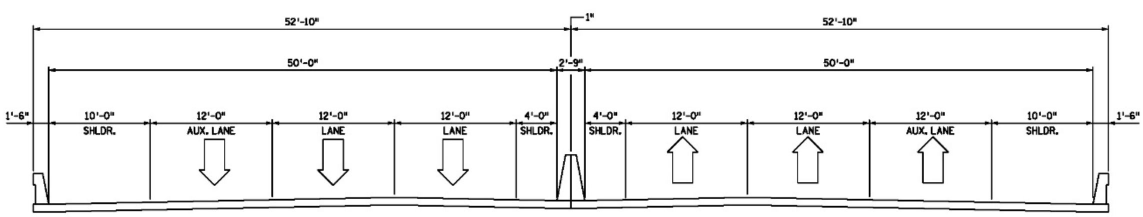
Location Map

Existing Bridge Site

Overview: The existing continuous steel girder bridge (Br. No. 9700) was built in 1962 with three spans of 82.5-100.0-82.5 feet. Bridge No. 9700 has two through lanes in each direction plus tapers for entering and exiting traffic and current average daily traffic is 68,000 vehicles per day. The bridge is structurally deficient, with a sufficiency rating of 46 and a superstructure rating of 5 (Fair Condition). To replace the existing bridge, a new structure with two through lanes, one auxiliary lane, and full shoulders is planned. Due to the high level of daily traffic, minimizing impacts to the traveling public is essential. Accelerated Bridge Construction (ABC) techniques were considered as part of this study to address flexibility in the construction staging and minimize schedule impacts.



Transverse Section- Existing Bridge



Transverse Section- Replacement Bridge
(Outside shoulders are currently planned to be 12' to accommodate a future constrained 3-lane condition)

Project Criteria & Evaluation Matrix: As part of the evaluation process an alternatives matrix was developed to evaluate structure types. The matrix evaluated project specific criteria for multiple alternatives to capture and document the screening analysis in support of the Environmental Assessment process. The following criteria were used to develop the Bridge Type Evaluation Summary Matrix (See Exhibit 1):

- Schedule Impacts (Durations/Conflicts with ABC Opportunities)
- MOT/Staged Construction Impacts (Alignment Shift/Profile Revisions)
- Waterway Clearance Conflicts
- Constructability Issues (Impact due to Construction Operations
- Future Expansion Impacts
- Maintenance and Inspection Impacts (Including Life Cycle Costs)
- Environmental impacts (Superstructure/Foundations)
- Geotechnical Complexity (Foundation Complexity/Criteria)
- Hydraulic Issues (Flood Plain/Scour/Drainage Impacts)
- Aesthetics
- Construction Cost

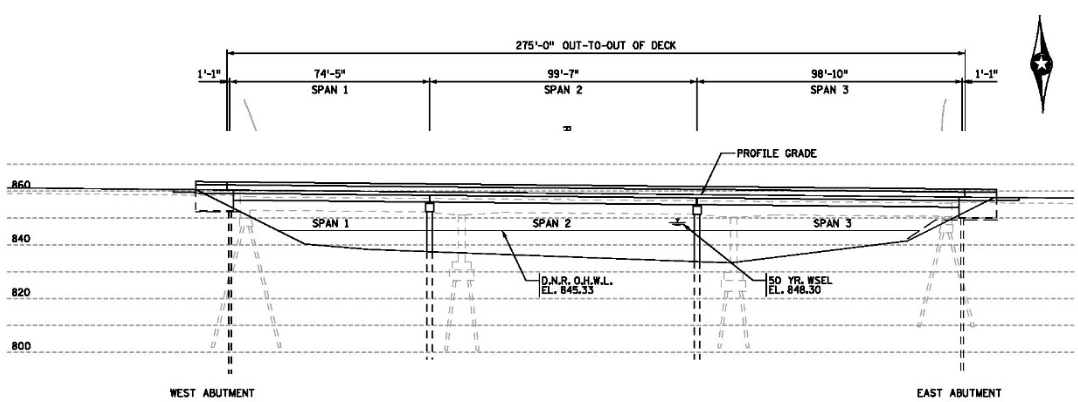
Bridge Concepts Evaluated: The matrix utilizes the screening criteria to provide a relative comparison of the alternatives based on issues and impacts; a "Low" impact ranking is the most desirable. A broad spectrum of structure types was selected as part of the process and to also serve as a public information tool. Structure types included in the study were:

- Prestressed Concrete Beams (2-Spans)
- Prestressed Concrete Beams (3-Spans)
- Prestressed Concrete Beams (4-Spans)
- Prestressed Concrete Beams (5-Spans)
- Steel Plate Girders (3-Spans)
- Steel Plate Girders (4-Spans)
- Steel Rolled Girders (5-Spans)
- Variable Depth Prestressed Concrete Beams (3-Spans)
- Variable Depth Prestressed Concrete Beams (4-Spans)

Bridge Type Recommendation: A bridge type matrix was presented at the Project Management Team Meeting #2 on June 24, 2019 for review and comment. After comments were incorporated, each bridge type was evaluated for the project specific criteria list above. The completed matrix was presented at the Project Management Team Meeting #3 on July 25, 2019. Based on the meeting review and comment a final recommendation of either a 3-span or 4-span prestressed concrete beam bridge was presented at the Project Management Team #4 on August 29, 2019. After review and discussion of the recommended bridge type the 3-span bridge was selected. The selected bridge type:

3-Span Prestressed Concrete Beams: Advance as recommended alternative that best meets the overall project criteria. Alternative presents a low schedule risk, optimal construction flexibility, simple foundations, low maintenance, lowest cost and easy accommodation of future expansion.

The Project Management Team accepted the recommendation based on its lowest overall impact in comparison to the other alternatives. This alternative also provides ABC opportunities to mitigate environmental and/or schedule risks.



Elevation- Three Span Concrete Beam Replacement Bridge

CONSIDERATIONS FOR RECOMMENDED BRIDGE TYPE

The following section summarizes the concept evaluation of the recommended alternative 3-span prestressed concrete beam structure for use in the preliminary engineering phase of the project. Detailed engineering analysis, refined concept evaluation and collaboration with other disciplines for each of these items will shape the final concept toward the development of the Preliminary Bridge Plan.

Geometrics and Deck: The bridge is on a tangent alignment with a mild vertical curve. The structure will include three 12-foot general purpose through lanes, one 12-foot outside shoulder and 4-foot inside shoulder in each direction. The deck and median barrier will be split. Standard concrete barriers will be utilized with a glare screen median barrier. See “Exhibit 2-Type, Size & Location Plan” for more detailed information of geometrics and the bridge transverse section.

Clearances: The current TH 10 geometrics will need to be raised approximately 2.1-feet to provide a 2- foot under bridge clearance increase request by MnDOT Maintenance. The grade raise can be tied in before the Ferry Street bridge but will require the replacement of the Rum River Regional Trail and 4th Avenue bridges due to reduced vertical clearances. The Rum River is not a waterway over which the Coast Guard exercises jurisdiction (USCG Letter dated April 25, 2018), so vertical clearance is controlled by minimum clearance required for maintenance and inspection.

Aesthetics: Aesthetics for this bridge will be “Level C” and will be developed through the Visual Quality Planning Process.

Utilities: A water line carried under the deck of the existing bridge will be relocated to the proposed new bridge. Roadway lighting and ITS conduits are expected to be included in the final design.

Maintenance and Durability: The nature of the prestressed concrete beam bridge type makes it very accessible for inspection and long-term maintenance. MnDOT Maintenance has confirmed the complete underside of the proposed bridge will be accessible from an inspection “snooper” vehicle

Staging: In order to maintain maximum traffic capacity during the project, staged construction will be necessary. The alignment remains unchanged, so the westbound bridge can be constructed in its entirety with the eastbound bridge providing one lane of traffic in each direction. Traffic can then be moved to the new westbound bridge allowing for the demolition and construction of the eastbound bridge. This will tie in with staging for roadway work on each end of the bridge.

The existing water main is assumed supported in the current location during the westbound bridge construction. It will then be moved to the north side of the westbound bridge, prior to the current eastbound bridge’s demolition.

Alternative staging could reverse the order of operations with the eastbound constructed first followed by westbound if necessary.

3433 Broadway Street NE, Suite 325 • Minneapolis, Minnesota 55413 • (612) 656-7000 • Fax: (612) 656-7001 • www.parsons.com

Construction Schedule: The schedule is currently constrained by:

- o DNR in water work restriction (March 15 to June 15)
- o Commitment to maintain two lanes of traffic in each direction in between construction seasons (winters).
- o Coordination with the adjacent projects.

Assuming a Spring 2022 letting and utilizing standard construction practices, the west bound bridge would be constructed during the summer/fall 2022 construction season. The east bound bridge would then be constructed during the summer/fall 2023 construction season.

See Accelerated Bridge Construction section for other schedule opportunities.

Geotechnical: Geotechnical information for the existing bridge is difficult to read due to poor quality of documents. A geotechnical investigation program is completed. The boring program focused on the 3-span bridge configuration but included midchannel borings a mitigation measure if a change in span configuration occurs during preliminary design.

Hydraulics: Summary of known hydraulic data provided by the Minnesota Department of Natural Resources is:

Feature		NAV29 (*)	NAVD88	Reference
Conversion		---	+ 0.33	Benchmarks 0215A and J256
TH10 (BR 9700)	Low Member	851.02	851.35	1961 Bridge Plans (MnDOT)
	Design H.W. Elev.	847.70	848.03	
Pleasant Street (BR 02531)	Low Member	853.24	853.57	1980 Bridge Plans (Anoka County)
	Design H.W. Elev.	847.80	848.13	
FEMA flood profiles	50-yr WSEL	---	848.30	2/9/15 email from Nicki Bartelt
	50-yr WSEL + 3'	---	851.30	
	100-yr WSEL	---	849.00	

* Assume both existing bridges elevations are NAV29.

Constructability: Special constructability considerations for this bridge type and site are:

- Pier will be located to avoid conflicts with the existing piers and minimize in-river work.
- Existing bridge shall be removed completely upon completion of the project. All piers shall be removed to an elevation at least 2-feet below the river bottom.
- Access will need to be reviewed with the potential need for rock blanket working pads in the river adjacent to the shoreline to allow access for pier construction and girder erection. Maintaining recreational navigational clearance in the river during construction will be a consideration.

3433 Broadway Street NE, Suite 325 • Minneapolis, Minnesota 55413 • (612) 656-7000 • Fax: (612) 656-7001 • www.parsons.com

Construction Costs: A cost analysis commensurate with the level of this conceptual type study was performed. All data is provided in 2019 dollars without any additional risk contingencies added.

Total Const. Cost (2019 $'s)	$5,280,000
Cost per Square Foot of Bridge:	175 $/SF

Accelerated Bridge Construction: Accelerated Bridge Construction (ABC) applies design, materials selection and construction methods to reduce the onsite construction time in the construction or rehabilitation of bridges. ABC techniques include global methods such as slide-in, float-in and launching as well prefabricated bridge elements and systems. Evaluation of ABC techniques and elements should be considered where project challenges exist, or benefits can be achieved for the following needs:

- Increased safety
- Minimized traffic disruption
- Improved quality
- Reduced environmental impacts

Due to the staging of the additional work on this project and adjacent projects, the benefits of ABC are not anticipated to be realized. However, the following table summarizes the review of ABC opportunities and recommendations for further consideration for the recommended prestressed concrete beam structure type.

ABC Technique	Recommendation
Progressive Bridge Slide (Existing)	Limited Applicability-Complicating substructure construction and multiple closure pours may eliminate any schedule benefit.
Full Bridge Slide (New)	Limited Applicability-Complexity of staging in limited space may outweigh any cost or schedule benefits.
Launching	Limited Applicability-No significant environmental constraints identified warranting additional cost associated with launching.
Prefabricated Elements (Substructure)	Limited Applicability-Review during next phase of project for opportunities such as precast pier caps and abutments.
Prefabricated Elements (Deck Systems)	Limited Applicability-Review applicability of systems during next phase of project for opportunities due to schedule.

3433 Broadway Street NE, Suite 325 • Minneapolis, Minnesota 55413 • (612) 656-7000 • Fax: (612) 656-7001 • www.parsons.com

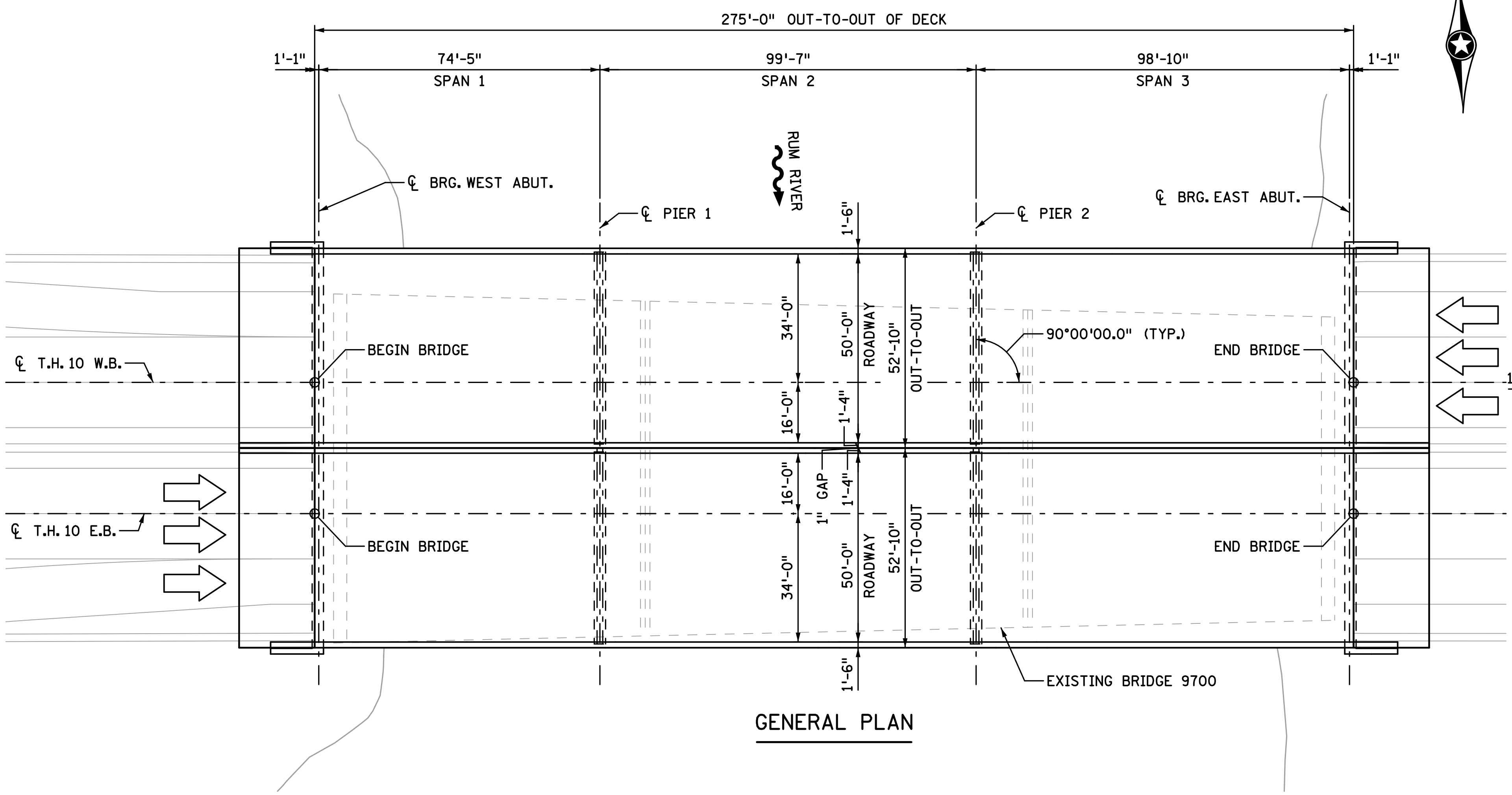
Bridge Criteria Evaluation Matrix

The table below provides a comparison of the alternates based on selected criteria of issues and impacts. In all criteria the "Low" ranking is most desirable.

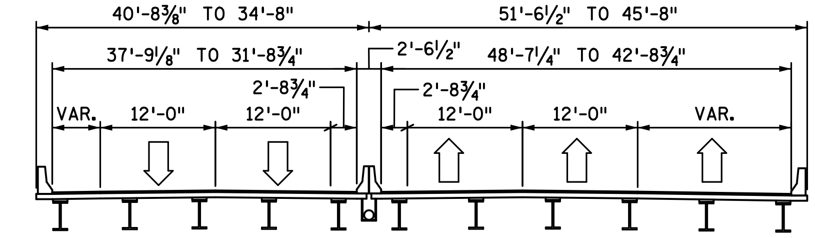
Low Impact	**Greatest benefit to project** least impacts, costs or risk
Moderate Impact	**Good benefit to project** with average impacts, costs or risk
Moderate/High Impact	**Marginal benefit to project with impacts** higher cost and more risk than other alternatives
High Impact	**Does not meet project criteria** significant impacts, costs or risks related to other alternatives.

Bridge Type	Span Lengths	No. of Spans	No. of Piers	Schedule Impacts		MOT/Staged Construction Impacts		Waterway Clearance	Constructability (impacts due to construction operations)	Future Expansion Capacity	Maintenance and Inspection Impacts	Environmental impacts		Geotechnical Complexity	Hydraulics			Aesthetics	Construction Cost (Avg $/SF 2021$) Total Br. Cost $M's (2021$)
				Durations	ABC Opportunities	Alignment Shift	Profile Modification (Raise to Meet Min. Waterway Clearance)					Superstructure	Foundations	Foundation Complexity/ Criteria	Flood Plain Impacts	Scour	Drainage		
Prestressed Concrete Beams (MN45, Str D=60") Substructure: Integral abut, pile footing and concrete pier	138'-138'	2	1	Low - standard	Low - multiple ABC opportunities	Low - flexible	High - Min increase 4' +/-	Low - meets all clearance requirements	Moderate/High - traditional, one pier, cofferdam required for footing construction	Low - can accommodate	Low - minimized	Low - minimized	Low - single foundation	Moderate/High - cofferdam required for larger single river foundation	Low - less substructure area	Low - less substructure area	Low - can accommodate	Low - simple configuration	Low ($200/SF) $6.18M
Prestressed Concrete Beams (30MH, Str D=45") Substructure: Integral abut & concrete encased pile bents	100'-75'-100'	3	2	Low - standard	Low - multiple ABC opportunities	Low - flexible	Moderate - Min increase 2.1' +/-	Low - meets all clearance requirements	Low - traditional, two piers	Low - can accommodate	Low - minimized	Low - minimized	Low - two foundations	Low - simple pile bent foundations	Low - similar substructure area	Low - similar substructure area	Low - can accommodate	Low - simple configuration	Low ($210/SF) $6.333M
Prestressed Concrete Beams (27M, Str D=40") Substructure: Integral abut & concrete encased pile bents	69'-69'-69'-69'	4	3	Low - standard	Low - multiple ABC opportunities	Low - flexible	Moderate - Min increase 1.7' +/-	Low - meets all clearance requirements	Moderate - traditional, three piers	Low - can accommodate	Low - minimized	Low - minimized	Moderate - three foundations	Low - simple pile bent foundations	Moderate - 0.00 to 0.01' +/- rise, can be mitigated, DNR is open to 4 piers.	Low - very low velocity due to back water conditions.	Low - can accommodate	Low - simple configuration	Moderate ($230/SF) $7.15M
Prestressed Concrete Beams (22RB, Str D=35") Substructure: Integral abut & concrete encased pile bents	55'-55'-55'-55'-55'	5	4	Low - standard	Low - multiple ABC opportunities	Low - flexible	Moderate - Min increase 1.2' +/-	Low - meets all clearance requirements	Moderate/High - traditional, four piers	Low - can accommodate	Low - minimized	Low - minimized	High - four foundations	Low - simple pile bent foundations	High - 0.02' +/- rise with additional debris snags and reduced navigation	Moderate - more substructure area	Low - can accommodate	Low - simple configuration	Moderate ($230/SF) $7.023M
Steel Plate Girders (40" Web, Str D=54") Substructure: Integral abut & concrete encased pile bents	83'-110'-83'	3	2	Moderate - steel fabrication lead time	Low - multiple ABC opportunities	Low - flexible	Moderate/High - Min increase 2.8' +/-	Low - meets all clearance requirements	Low - traditional, two piers	Low - can accommodate	Low - minimized	Moderate - multiple girder splices require work over water	Low - two foundations	Low - simple pile bent foundations	Low - similar substructure area	Low - similar substructure area	Low - can accommodate	Low - simple configuration	Moderate/High ($260/SF) $7.935M
Steel Plate Girders (28" Web, Str D=42") Substructure: Integral abut & concrete encased pile bents	59'-79'-79'-59'	4	3	Moderate - steel fabrication lead time	Low - multiple ABC opportunities	Low - flexible	Moderate - Min increase 1.8' +/-	Low - meets all clearance requirements	Moderate - traditional, three piers	Low - can accommodate	Low - minimized	Moderate - multiple girder splices require work over water	Moderate - three foundations	Low - simple pile bent foundations	Moderate - 0.00 to 0.01' +/- rise, can be mitigated, DNR is open to 4 piers.	Low - very low velocity due to back water conditions.	Low - can accommodate	Low - simple configuration	Moderate ($230/SF) $7.15M
Steel Rolled Girders (W24, Str D=40") Substructure: Integral abut & concrete encased pile bents	46'-61'-61'-61'-46'	5	4	Moderate - steel fabrication lead time	Low - multiple ABC opportunities	Low - flexible	Moderate - Min increase 1.3' +/-	Low - meets all clearance requirements	Moderate/High - traditional, four piers	Low - can accommodate	Low - minimized	Moderate - multiple girder splices require work over water	High - four foundations	Low - simple pile bent foundations	High - 0.02' rise with additional debris snags and reduced navigation	Moderate - more substructure area	Low - can accommodate	Low - simple configuration	Moderate/High ($250/SF) $7.816M
Variable Depth Prestressed Concrete Beams (35MH, Str D=48" - 108' Spans) (18RB, Str D=31" - 60' Span) Substructure: Integral abut & concrete encased pile bents	108'-60'-108'	3	2	Low - standard	Low - multiple ABC opportunities	Low - flexible	Low - Min increase 0.9' +/-	Moderate - ends spans do not provide maintenance inspection access	Low - traditional, two piers	Low - can accommodate	Moderate/High - minimized, reduced inspection clearance	Low - minimized	Low - two foundations	Low - simple pile bent foundations	Low - similar substructure area	Low - similar substructure area	Low - can accommodate	Moderate - variable depth	Low ($200/SF) $6.18M
Variable Depth Prestressed Concrete Beams (30MH, Str D=43" - 93' Span) (14RB, Str D=27" - 45' Span) Substructure: Integral abut & concrete encased pile bents	93'-45'-45'-93'	4	3	Low - standard	Low - multiple ABC opportunities	Low - flexible	Low - Min increase 0.6' +/-	Moderate - ends spans do not provide maintenance inspection access	Moderate - traditional, three piers	Low - can accommodate	Moderate/High - minimized, reduced inspection clearance	Low - minimized	Moderate - three foundations	Low - simple pile bent foundations	Moderate - 0.00 to 0.01' +/- rise, can be mitigated, DNR is open to 4 piers.	Low - very low velocity due to back water conditions.	Low - can accommodate	Moderate - variable depth	Low ($210/SF) $6.333M

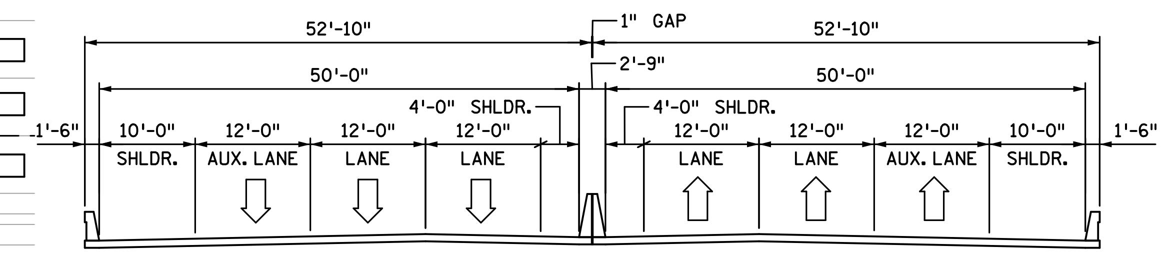
Exhibit 1



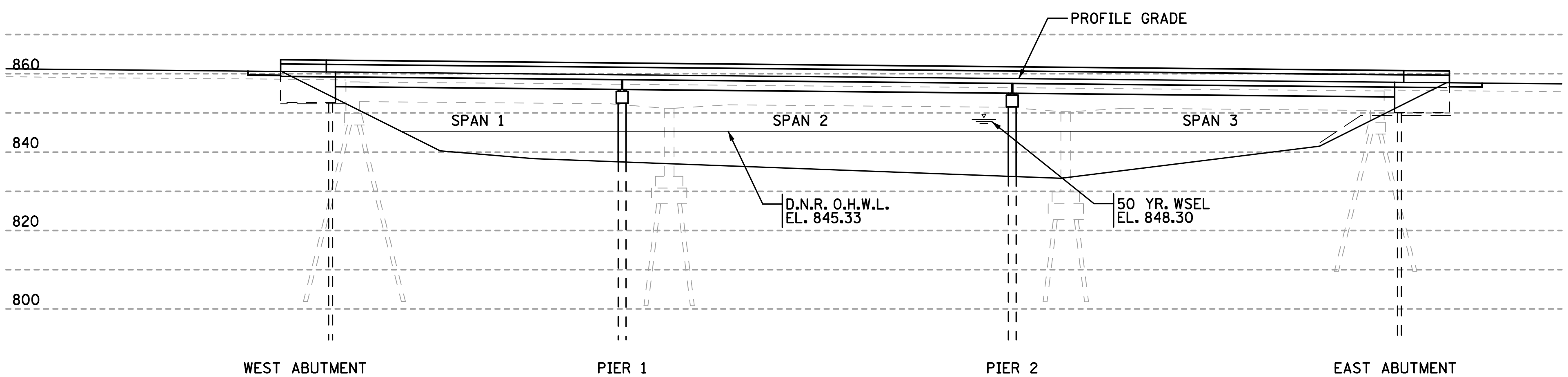
GENERAL PLAN



EXISTING BRIDGE



FINAL BRIDGE CONFIGURATION



GENERAL ELEVATION

Exhibit 2

PARSONS

TITLE: T.H.10 RUM RIVER BRIDGE 3 SPAN OPTION

BRIDGE NO. 9700

Plotted By: p0010292
Date Plotted: 14-AUG-2019
Time Plotted: 3:16:00 PM
Pen Table: MnDOT-Iplot.pen
File Path: TH10Bridge_GeneralPlanAndElevation_3Span.dgn