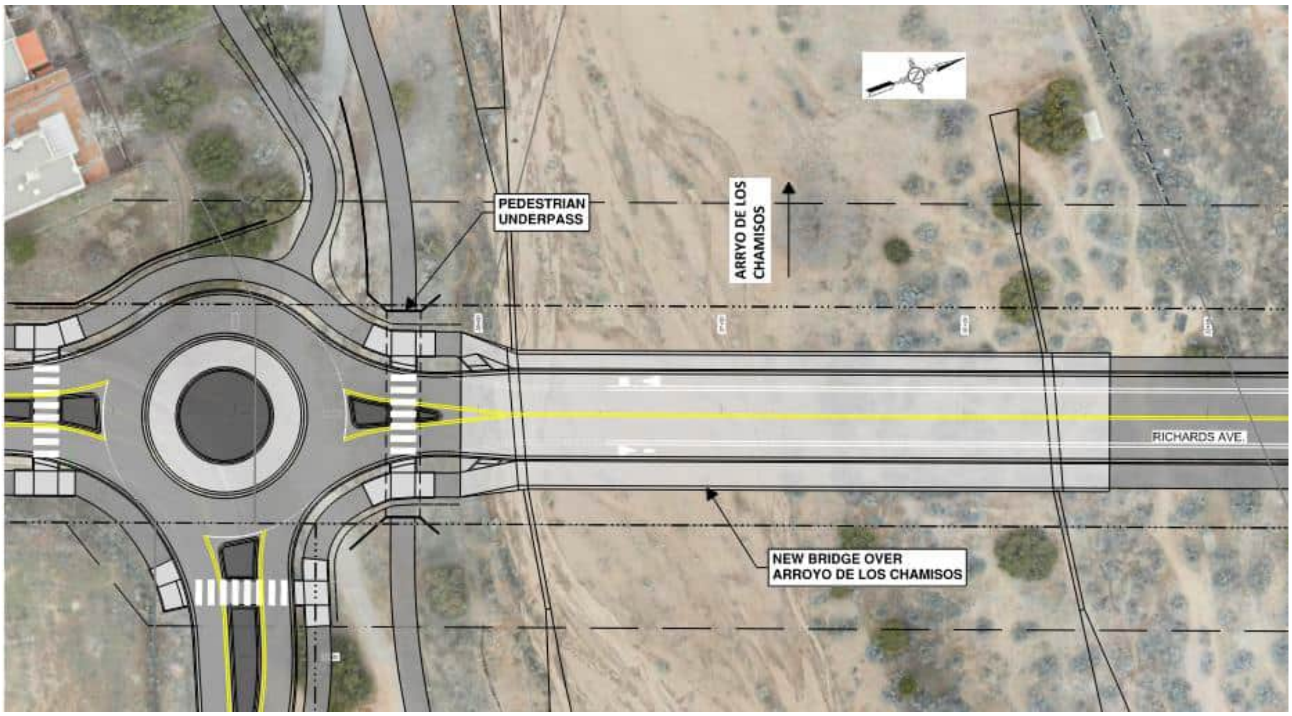
BRIDGE TYPE SELECTION REPORT

RICHARDS AVENUE OVER ARROYO DE LOS CHAMISOS

City Project CIP 876B; NMDOT CN LP50039



Submitted to:

CITY OF SANTA FE

Public Works Department

Submitted by:

WSP

RAY M. TRUJILLO
NEW MEXICO
13514
REGISTERED PROFESSIONAL ENGINEER
9/6/2024

September 6, 2024

BRIDGE TYPE SELECTION REPORT

RICHARDS AVENUE OVER ARROYO DE LOS CHAMISOS

***City Project CIP 876B;* NMDOT CN LP50039**

September 6, 2024

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EXECUTIVE SUMMARY

The purpose of this project is to improve and extend Richards Avenue from Rodeo Road to Cerrillos Road in Santa Fe, New Mexico. Richards Avenue is proposed to be extended from approximately GCCC Road to south of Siringo Road which will require a new span bridge to cross over the Arroyo de Los Chamisos (ADLC) as shown in **Figure 1.** WSP was tasked with developing a Bridge Type Selection (BTS) report to evaluate and identify a preferred bridge type to cross over the ADLC. A span bridge was determined to be the preferred alternative in Chapter 5 of WSP's Phase IB report versus a concrete box culvert bridge. A span bridge would provide the nearby community with more openness, attracting nearby pedestrians to interact with the area and provide a positive environment for the neighborhood, along with limiting confined spaces to house transient communities in and around the arroyos.

The new bridge typical section will consist of two 10'-6" driving lanes, two 5'-0" bike lanes, a 6'-8" raised sidewalk on the west side, a 10'-0" multi-use trail on the east side, a metal pedestrian rail on the east side, plus NMDOT Type A42 metal bridge rails for a total width of 57 feet as shown in **Figure 2**.

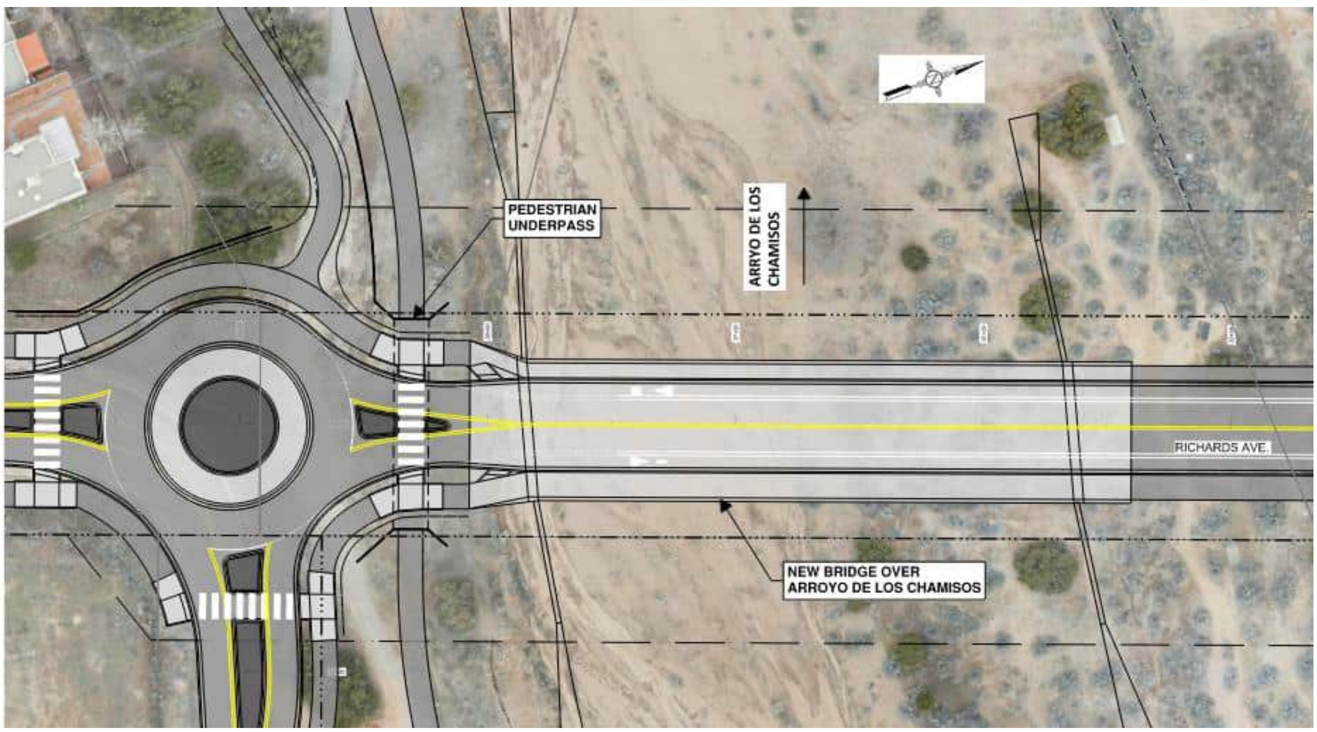


Figure 1: Plan View of Bridge over ADLC

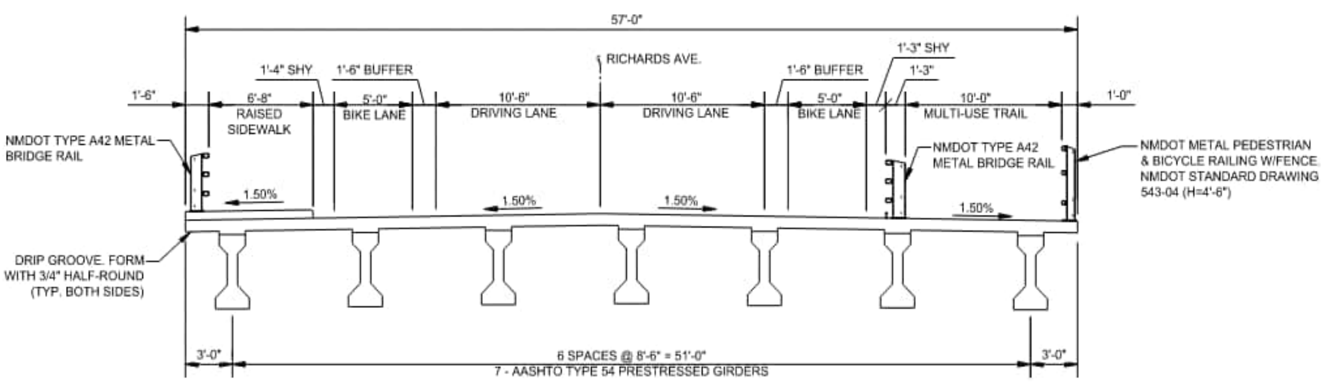


Figure 2: Proposed Bridge Transverse Section

This BTS report documents an engineering feasibility study for a new bridge across the ADLC. Three bridge type alternatives were considered in this BTS assessment. They are:

1. Single-span 70” deep steel girder bridge spanning 152’-8”
2. Two-span Type 45 prestressed concrete girder bridge spanning 152’-8”
3. Two-span Type 54 prestressed concrete girder bridge spanning 222’-8”

A comparison was made of the bridge type alternatives listed above based on functional requirements, economics, future maintenance, construction feasibility, and aesthetics per the NMDOT *Bridge Procedures and Design Guide*. A comparison matrix was developed to rank the bridge alternatives. The bridge types are known to be serviceable and constructible while meeting the project’s functional requirements. The most significant differences between the three bridge type alternatives are construction type (steel girder versus prestressed concrete girder), span lengths, area of opening for drainage, and cost.

Based on the evaluation, Alternative 3 -Two-Span Type 54 prestressed concrete girder bridge spanning 222’-8” is the highest rated alternative. The bridge would consist of two equal span lengths totaling 222’-8” from end to end of bridge as shown in **Figure 3**. Conceptual Drawings for each alternative can be found in **Appendix A**. Cost estimates & estimated quantities for each alternative can be found in **Appendix B**.

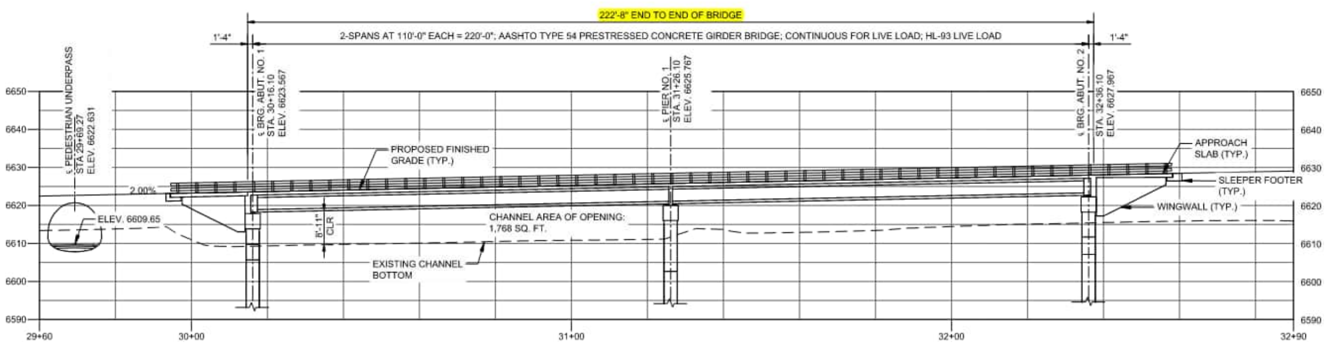


Figure 3: Proposed Bridge Profile

INTRODUCTION

The purpose of this project is to improve and extend Richards Avenue from Rodeo Road to Cerrillos Road in Santa Fe, New Mexico. Richards Avenue is proposed to be extended from approximately GCCC Road to south of Siringo Road which will require a new bridge across the ADLC. WSP was tasked with developing a BTS report to evaluate and identify a preferred bridge type to cross over the Arroyo de Los Chamisos (see **Figure 1**). The BTS report will evaluate each alternative based on existing conditions and geometric constraints, functional requirements, economics, future maintenance, construction feasibility, and aesthetics. The selection of the preferred bridge type must satisfy the functional requirements and optimize the evaluation criteria as outlined in the 2018 NMDOT Bridge Procedures and Design Guide. The bridge types evaluated in detail are known to be serviceable, constructible, and economical while meeting the project's functional requirements.

Note that the potential social issues associated with a span bridge are beyond the scope of this BTS report. With increased activity in the area, a span bridge with vertical abutments was suggested by the City of Santa Fe to help reduce encampments under the bridge at ADLC.

PROJECT DESCRIPTION

The purpose of this project is to extend Richards Avenue from Rodeo Road to Cerrillos Road in Santa Fe, NM. A new bridge will be required to cross over the ADLC to allow storm water to pass under Richards Avenue without impacts to traffic.

The new bridge typical section will consist of two 10'-6" driving lanes, two 5'-0" bike lanes, a 6'-8" raised sidewalk on the west side, a 10'-0" multi-use trail on the east side, a metal pedestrian rail on the east side, plus NMDOT Type A42 metal bridge rails for a total width of 57 feet as shown back in **Figure 2**.

The proposed bridge location profile is shown back in **Figure 3** and the proposed bridge location plan is shown in **Figure 4**. The proposed bridge will be built at a 5° skew to the centerline of roadway.

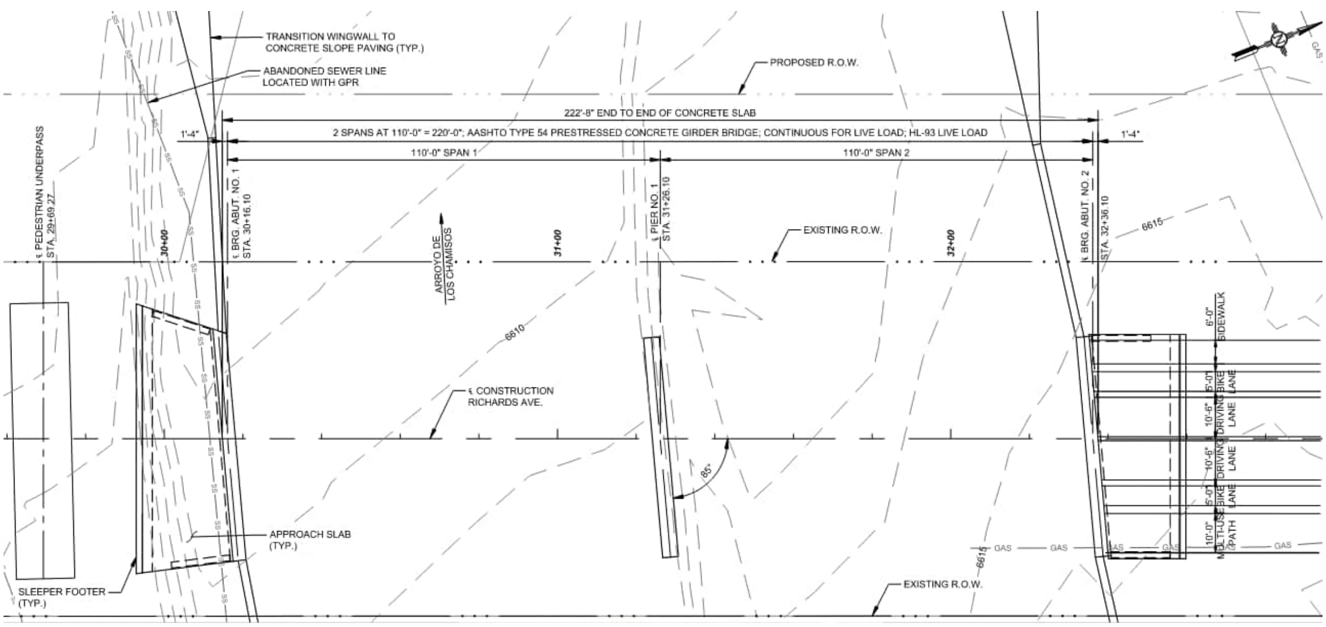


Figure 4: Proposed Bridge Location Plan

DESIGN CRITERIA

The proposed bridge would be designed in accordance with the design criteria contained in the following sources:

- AASHTO *LRFD Bridge Design Specifications, 9th Edition,* 2020.
- NMDOT *Bridge Procedures and Design Guide*, February 2018, and Amendments.
- NMDOT *Standard Specifications for Highway and Bridge Construction*, 2019 as modified by current supplemental specifications, special provisions, and Standard Drawings.

In addition to the bridge alternatives evaluated, key considerations associated with providing a new bridge crossing which are applicable to the three bridge alternatives include:

- Potential utility conflicts
- Ability to pass flows under the bridge while minimizing a local rise in water surface elevation.

BRIDGE ALTERNATIVES

Three bridge alternatives were considered in this feasibility study. They are:

1. Single-span 70" deep steel girder bridge spanning 152'-8"
2. Two-span Type 45 prestressed concrete girder bridge spanning 152'-8"
3. Two-span Type 54 prestressed concrete girder bridge spanning 222'-8"

Cross sections of each bridge alternative are shown below. An evaluation of the alternatives is discussed afterwards.

Bridge Type Alternative 1 – Single-Span 70" Deep Steel Girder Bridge

This alternative is a single-span 152'-8" long x 70" deep steel girder bridge as shown in **Figure 5**. The superstructure depth for this alternative is approximately 6'-8".

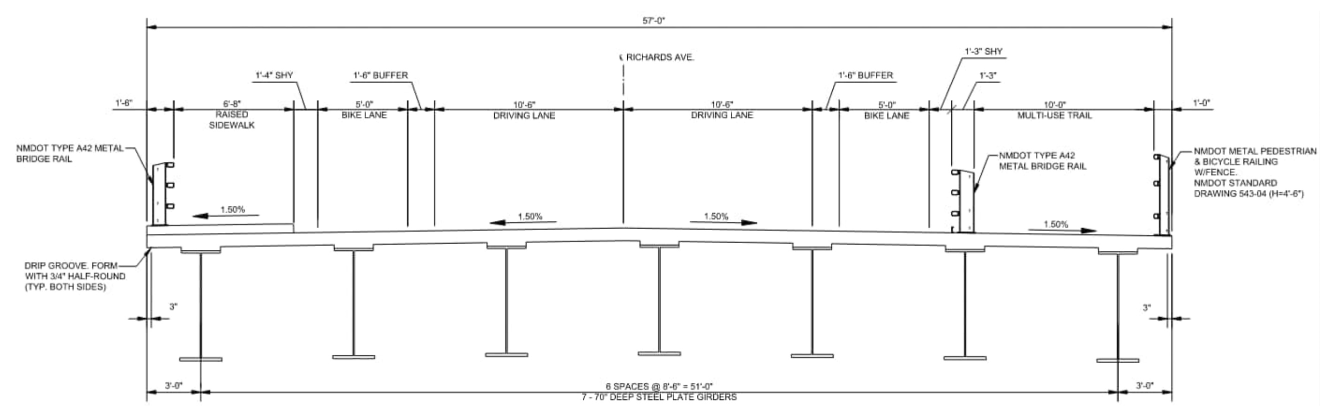


Figure 5: Proposed Single-Span 70" Deep Steel Girder Typical Section

Bridge Type Alternative 2 – Two-Span AASHTO Type 45 Prestressed Concrete Girder Bridge

This alternative is a two-span 152'-8" long x 45" deep prestressed concrete girder bridge continuous for live load as shown in **Figure 6**. The superstructure depth for this alternative is approximately 4'-7".

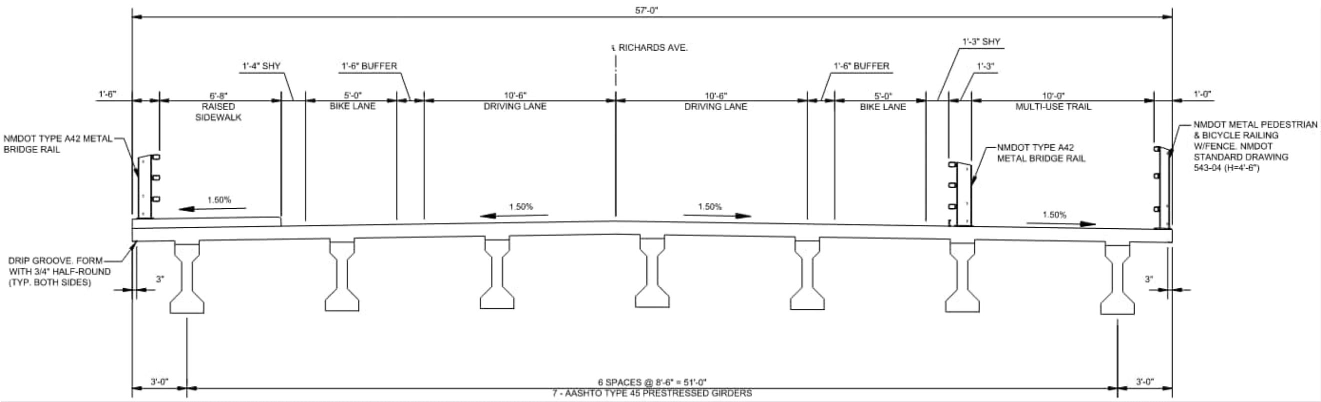


Figure 6: Proposed Two-Span Type 45 Prestressed Concrete Girder Typical Section

Bridge Type Alternative 3 – Two-Span AASHTO Type 54 Prestressed Concrete Girder Bridge

This alternative is a two-span 222'-8" long x 54" deep prestressed concrete girder bridge continuous for live load as shown in **Figure 7**. The superstructure depth for this alternative is approximately 5'-4".

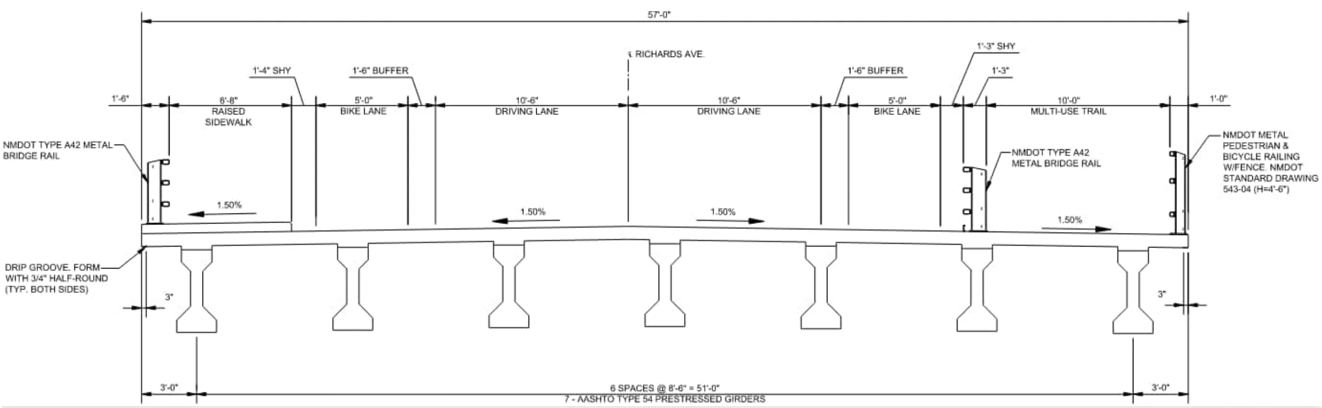


Figure 7: Proposed Two-Span Type 54 Prestressed Concrete Girder Typical Section

STRUCTURAL EVALUATION OF ALTERNATIVES

The NMDOT *Bridge Procedures and Design Guide* requires a weighted decision matrix that considers, at a minimum, functional requirements, economics, future maintenance, construction feasibility, and aesthetics. These evaluation metrics are described below. The weighted decision matrix rates each bridge alternative based on a weighting factor and a raw score scale as shown in **Table 1** and **Table 2**. The ratings start at 5 and adjustments (i.e., Point Deductions) are applied as discussed below.

The weighting factors in **Table 1** are based on engineering judgement considering the site conditions and characteristics of the proposed location. Functional requirements and economics are considered the priorities for this study. Future maintenance, construction feasibility and aesthetics are key considerations with less emphasis. Construction of the new bridge would have impact on traffic because the Richards Avenue extension does not exist (construction feasibility).

Table 1: Evaluation Criteria Weighting Factors

Criteria	Weighting Factor
Functional Requirements	10
Economics	10
Future Maintenance	7
Construction Feasibility	7
Aesthetics	7

Table 2: Raw Score Scale

Excellent →		5	4	3	2	1	← Poor

Functional Requirements

The three bridge alternatives selected are compatible with the existing topography and each satisfy the required geometric constraints. These constraints include capacity ratings, potential utility conflicts, waterway conveyance, and freeboard requirements as major issues. Although all bridge alternatives presented inherently meet the minimum criteria, some provide greater functionality.

Capacity ratings: All alternatives will meet the minimum NMDOT load rating requirements of HS 25 Inventory Rating and HS 42 Operating Rating based on past bridge projects with similar span configurations and girder types.

Potential Utility Conflicts: Based on utility investigations, there is an existing abandoned sanitary storm sewer line that crosses on the south side of the proposed bridge Abutment No. 1 as shown back in **Figure 4**. Drilled shafts are anticipated for the abutments which will not impact the sanitary storm sewer line.

Water conveyance and freeboard requirements: The hydraulic analysis of the existing and proposed conditions of ADLC was analyzed to ensure all FEMA and City of Santa Fe requirements are met. Within the Zone AE floodplain, any flooding from the development is not to exceed 1-foot anywhere in the community. A hydraulic analysis was performed for each alternative for the 50-year, 100-year and 500-year flood events to see if the area of opening under the bridge for each alternative is adequate to pass each flood event as shown in **Table 3.** To satisfy 44 CFR 60.3(c)(10), Base Flood Elevations (BFE) were observed approximately 1,000 ft up and downstream of the proposed bridges. For each proposed bridge, the BFEs were observed to converge back to existing conditions.

When comparing alternatives in relation to the freeboard between the three alternatives, all alternatives pass the 50-year and 100-year events. Alternative 1 does not pass the 500-year event under the bridge. This will create pressure flow and negatively affect the scour in Alternative 1 for the 500-year event. It will cause a rise in water surface elevation greater than 1-foot on the upstream side of the bridge and have the most impact on flooding of the pedestrian trail and underpass to the south of the bridge. A 1.5-point deduction was taken for Alternative 1.

Alternative 2 and Alternative 3 pass the 500-year event. Alternative 3 has the largest area of opening under the bridge, the greatest freeboard for the 500-year event, the lowest impact on water surface elevation, and the least impact on flooding of the pedestrian trail and underpass. Based on the hydraulic analysis, Alternative 3 is preferred over Alternative 2 when comparing the scenarios to the existing flooding extents as it is most like existing conditions. A 1.25-point deduction was given to Alternative 2.

Table 3: Preliminary Drainage Analysis Results for Each Alternative

Bridge Alternative	Bridge Description	Area of Opening under the Bridge (sq.ft.)	50-Year Freeboard (ft.)	100-Year Freeboard (ft.)	500-Year Freeboard (ft.)
1	**Single Span 150' Long 70" Deep Steel Plate Girders**	1,076	2.53	2.39	Does Not Pass
2	**Two-Span 150' Long AASHTO Type 45 Prestressed Girders**	1,344	4.66	4.38	0.72
3	**Two-Span 220' Long AASHTO Type 54 Prestressed Girders**	1,768	2.42	2.32	1.20

Point Deduction Summary:
Alternative 1: 1.5 points
Alternative 2: 1.25 points
Alternative 3: 0.0 points

Economics

Costs associated with the bridge type, materials and labor were analyzed. Since there is no existing roadway across the ADLC, traffic control costs and user delay costs were not included in the weighted decision matrix. Bridge costs were obtained from recently bid bridge projects of similar type on NMDOT's Bid Express.

Substructure Alternatives

In order to determine bridge costs for each alternative, various substructure alternatives were evaluated for the proposed bridge as described below. These substructure alternatives are common abutment types in New Mexico. Shallow foundations were not evaluated due to their scour potential. Once Phase II-Design begins, the deep foundations will be designed to withstand scour.

- Spill-through abutments and piers on a deep foundation
- Full-height vertical abutment walls and piers on a deep foundation

For this bridge, full-height vertical abutments were suggested by the City of Santa Fe to help reduce encampments under the bridge at ADLC. All alternatives considered in this report similarly assume full-height vertical abutments, and a pier on a deep foundation. For the cost estimates, drilled shafts are assumed as the foundation for the abutments and piers based on the preliminary Geotechnical Report provided by YeDoma Consultants, LLC dated July 17, 2023.

Table 4 shows a summary of the total bridge costs for each alternative. The total cost is for comparison purposes only and not for budget or funding estimation. It excludes mobilization, roadway paving, earthwork, aesthetics, taxes, and contingencies among other things.

The most cost-effective bridge alternative is the two-span 150' AASHTO Type 45 bridge alternative which is given a raw score of 5. Alternative 1 has the highest cost and given a 1.5-point deduction. Alternative 3 has the 2nd lowest cost and given a 1-point deduction.

Point Deduction Summary:
Alternative 1: 1.5 points
Alternative 2: 0.0 points
Alternative 3: 1.0 point

Table 4: Summary of Total Bridge Costs

Bridge Alternative	Bridge Description	Bridge Width	Bridge Length	Total Cost
1	Single Span 150' Long 70" Deep Steel Plate Girders	57'-0"	152'-8"	$6,749,218
2	Two-Span 150' Long AASHTO Type 45 Prestressed Girders	57'-0"	152'-8"	$5,347,055
3	Two-Span 220' Long AASHTO Type 54 Prestressed Girders	57'-0"	222'-8"	$6,277,590

Note: see ***Appendix C*** *for cost information*

Future Maintenance

The alternatives included in this study were chosen considering future maintenance. Alternatives with fewer girder lines and substructure units are advantageous from a future maintenance perspective because fewer girders, and bearing devices will need to be inspected and potentially repaired or replaced throughout the life of the bridge. Weathering steel is assumed for the steel girder alternative to eliminate the maintenance costs associated with the recoating of painted steel.

Multi-span bridges require more girders and bearing devices and piers to maintain and inspect versus single-span bridges. A one-point deduction was taken from the raw score for Alternative 2 and Alternative 3.

Alternative 1 has the least area of opening for conveyance of flows under the bridge. It is estimated the water surface elevations for flows higher than the 100-year event may come in contact with the girders and bearing devices. Some damage and corrosion from high flow events could occur resulting in unanticipated maintenance of the girders and bearings. A 0.5-point deduction was taken from the raw score for Alternative 1.

Point Deduction Summary:
Alternative 1: 0.5 point
Alternative 2: 1.0 point
Alternative 3: 1.0 point

Construction Feasibility

The construction sequence and access (a.k.a., constructability) would be similar for all alternatives. Pedestrians would be detoured around the current pedestrian alignment so that the new bridge may be installed. The proposed right-of-way for the extension of Richards Avenue and adjacent City-owned property could be used as a staging and storage area during construction. Construction activities would take place outside of and in the ADLC channel for all alternatives.

All bridge alternatives are constructible, but some alternatives will take longer to construct, and some are less feasible. Prestressed concrete girders can be provided by precast fabricators in New Mexico, whereas steel girders would come from outside New Mexico.

Steel girders require large lead times to ensure girders are fabricated and arrive to the construction site on time. They also require close coordination between the contractor and steel girder fabricator to ensure there are no delays in girder erection. A half-point deduction from the raw score was given for the steel girder alternative as they would come from out of state, require longer lead time, and likely require additional staging for the splices and specialized bracing.

Point Deduction Summary:
Alternative 1: 0.5 point
Alternative 2: 0.0 points
Alternative 3: 0.0 points

Aesthetics

Each bridge alternative can be made aesthetically pleasing. Bridge rails, exterior deck edges and exterior surface of the girders with color treatments may be designed to provide the desired aesthetic treatment. Since all bridges are girder bridges, the aesthetic treatment will be equal for all bridge alternatives and therefore no point deductions given to any of the alternatives.

Point Deduction Summary:
Alternative 1: 0.0 point
Alternative 2: 0.0 point
Alternative 3: 0.0 points

EVALUATION MATRIX

The comparative evaluation of the three structure type alternatives is summarized in **Table 5**. As noted in **Table 2**, a raw score of 5 is considered most desirable and a raw score of 1, least desirable. Functional requirements, economics, future maintenance, construction feasibility, and aesthetics were previously discussed. While the weighting factors could be refined, based on the point deductions applied, Alternative 3 would be the highest-ranked structure type.

Table 5: Bridge Alternative Decision Matrix

Alternatives		70" Deep Steel Girder (Single-Span)		AASHTO Type 45 Girder (Two-Span)		AASHTO Type 54 Girder (Two-Span)	
Evaluation Criteria	Weighting Factor	Raw Score	Weighted	Raw Score	Weighted	Raw Score	Weighted
Functional Requirements	10	3.50	35.0	3.75	37.5	5.00	50.0
Economics	10	3.50	35.0	5.00	50.0	4.00	40.0
Future Maintenance	7	4.50	31.5	4.00	28.0	4.00	28.0
Construction Feasibility	7	4.50	31.5	5.00	35.0	5.00	35.0
Aesthetics	7	5.00	35.0	5.00	35.0	5.00	35.0
	Total Score	168.0		185.5		188.0	

Raw score will vary from 1 to 5 with 5 being the highest score. Maximum score is 205.

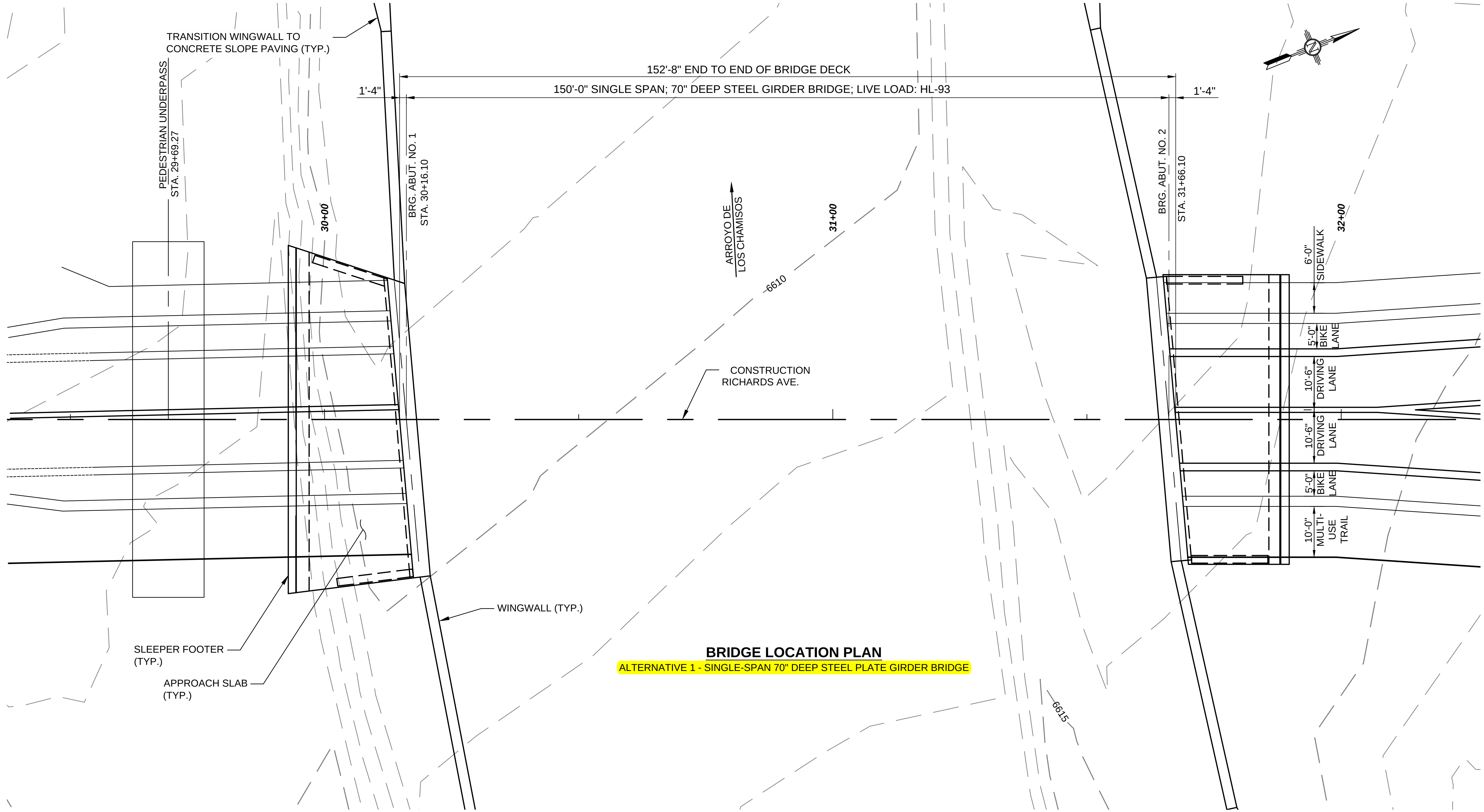
CONCLUSION

The purpose of this BTS report was to evaluate the appropriate bridge structure type for the new bridge over ADLC and document the selected bridge type. Bridge type alternatives that were considered include:

1. Single-span 70" deep steel girder bridge spanning 152'-8"
2. Two-span Type 45 prestressed concrete girder bridge spanning 152'-8"
3. Two-span Type 54 prestressed concrete girder bridge spanning 222'-8"

The bridge alternative that scored highest in the decision matrix was Alternative 3 - Two-span bridge with Type 54 prestressed concrete girders. This alternative offers the best overall bridge type for the ADLC crossing. The design team will need a definitive decision from the City of Santa Fe as to which bridge type to advance to final design.

APPENDIX A
Conceptual Drawings for Each Alternative



BRIDGE LOCATION PLAN

ALTERNATIVE 1 - SINGLE-SPAN 70" DEEP STEEL PLATE GIRDER BRIDGE

30% NOT FOR CONSTRUCTION

STA. 30+91.10
BRIDGE NO. XXXXX

CITY OF SANTA FE

NO.	DESCRIPTION	DATE	BY
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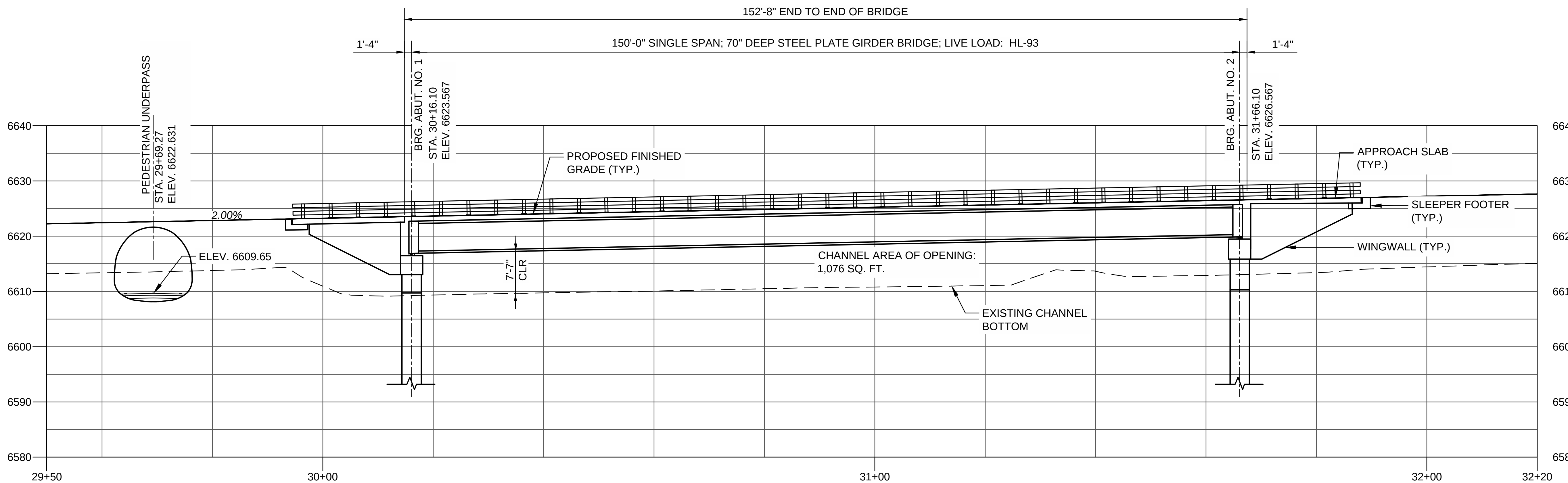
2			
3			
4			

RICHARDS AVE. OVER ADLC
NEW BRIDGE
ALTERNATIVE 1 - STEEL PLATE GIRDER BRIDGE



PROPOSED BRIDGE PROFILE

ALTERNATIVE 1 - SINGLE-SPAN 70" DEEP STEEL PLATE GIRDER BRIDGE

30% NOT FOR CONSTRUCTION

STA. 30+91.10
BRIDGE NO. XXXXX

CITY OF SANTA FE

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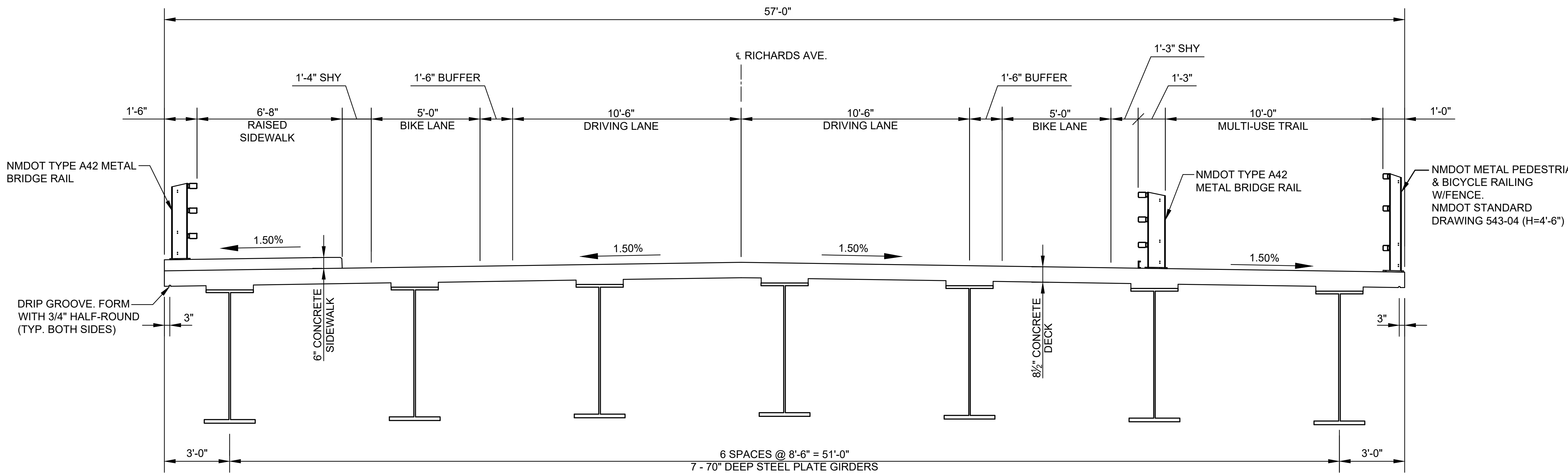
RICHARDS AVE. OVER ADLC
NEW BRIDGE
ALTERNATIVE 1 - STEEL PLATE GIRDER BRIDGE



PROPOSED BRIDGE TRANSVERSE SECTION

ALTERNATIVE 1 - SINGLE-SPAN 70" STEEL PLATE GIRDER BRIDGE

30% NOT FOR CONSTRUCTION

STA. 30+91.10
BRIDGE NO. XXXXX

CITY OF SANTA FE

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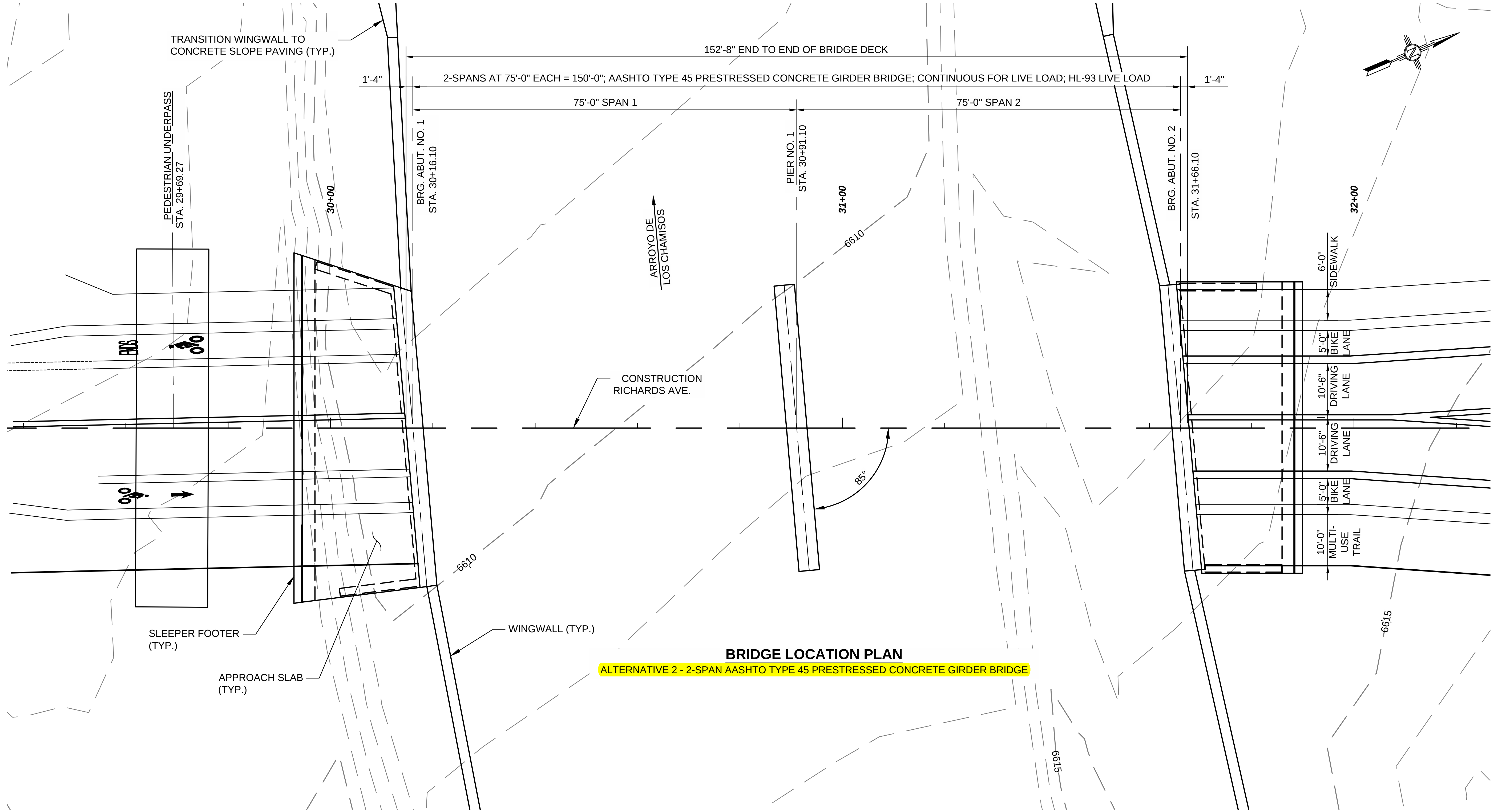
RICHARDS AVE. OVER ADLC
NEW BRIDGE
ALTERNATIVE 1 - STEEL GIRDER BRIDGE



BRIDGE LOCATION PLAN

ALTERNATIVE 2 - 2-SPAN AASHTO TYPE 45 PRESTRESSED CONCRETE GIRDER BRIDGE

30% NOT FOR CONSTRUCTION

STA. 30+91.10
BRIDGE NO. XXXXX

CITY OF SANTA FE

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RICHARDS AVE. OVER ADLC
NEW BRIDGE
ALTERNATIVE 2 - PRESTRESSED GIRDER BRIDGE

EDDINGS, DONALD
4-Jun-24

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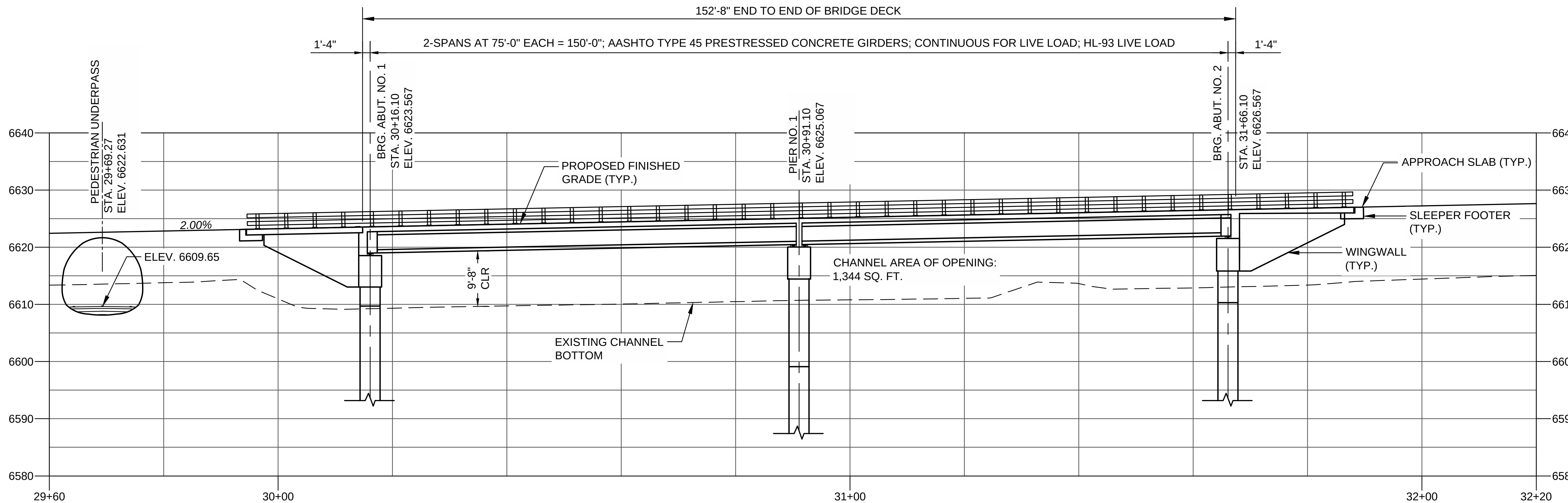

PROPOSED BRIDGE PROFILE

ALTERNATIVE 2 - 2-SPAN AASHTO TYPE 45 PRESTRESSED CONCRETE GIRDER BRIDGE

30% NOT FOR CONSTRUCTION

STA. 30+91.10
BRIDGE NO. XXXXX

CITY OF SANTA FE

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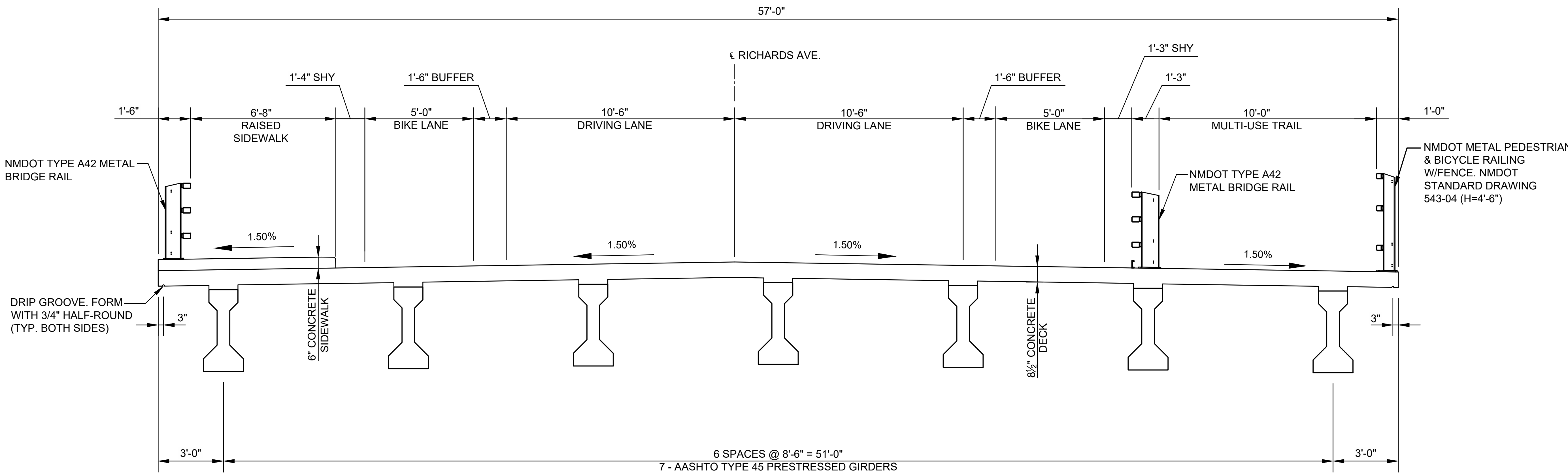
RICHARDS AVE. OVER ADLC
NEW BRIDGE
ALTERNATIVE 2 - PRESTRESSED GIRDER BRIDGE

CITY OF SANTA FE



PROPOSED BRIDGE TRANSVERSE SECTION

ALTERNATIVE 2 - 2-SPAN AASHTO TYPE 45 PRESTRESSED CONCRETE GIRDER BRIDGE

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30% NOT FOR CONSTRUCTION

STA. 30+91.10
BRIDGE NO. XXXXX

RICHARDS AVE. OVER ADLC
NEW BRIDGE
ALTERNATIVE 2 - PRESTRESSED GIRDER BRIDGE

TRUJILLO, RAYMOND
7-Jun-24

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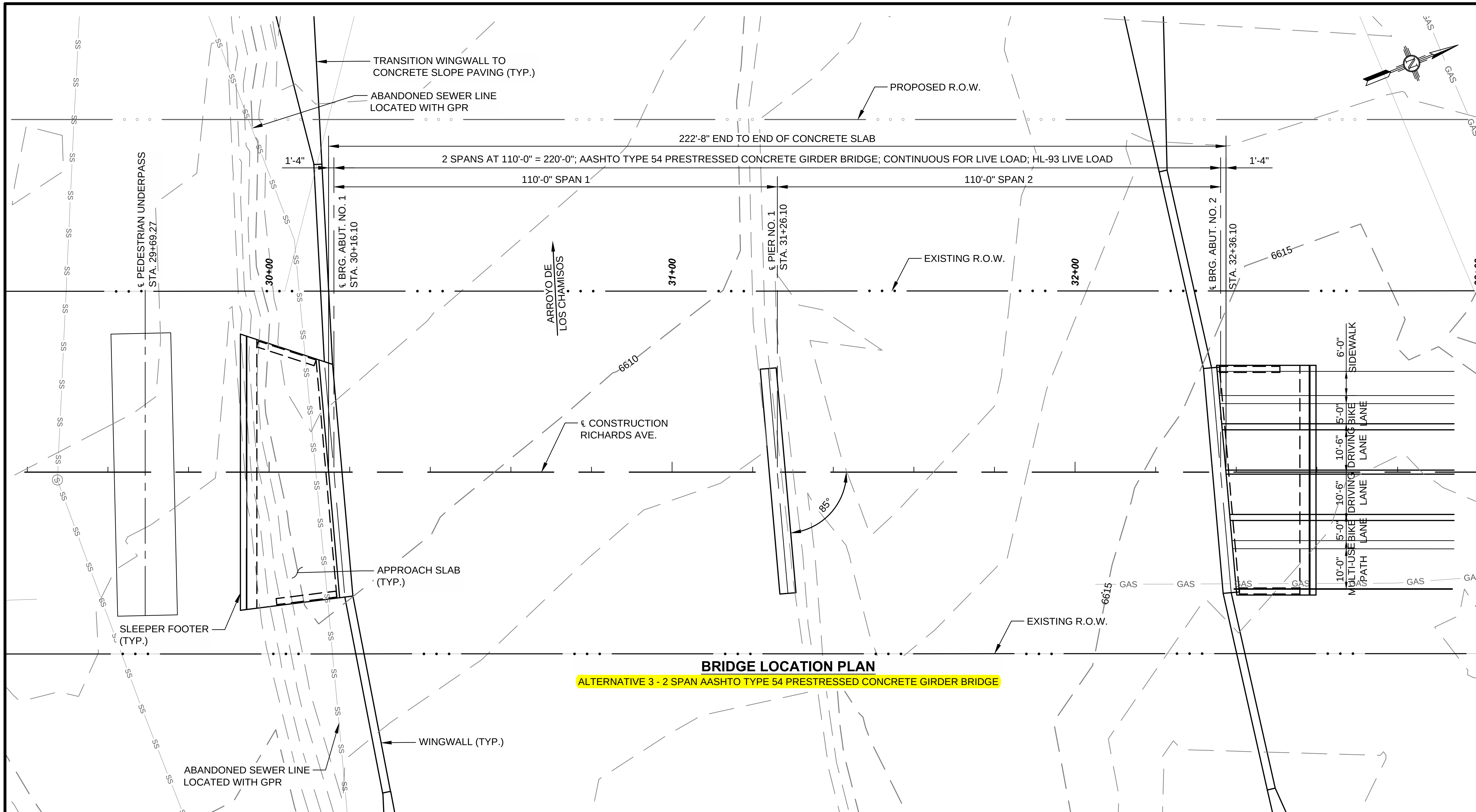

BRIDGE LOCATION PLAN

ALTERNATIVE 3 - 2 SPAN AASHTO TYPE 54 PRESTRESSED CONCRETE GIRDER BRIDGE

30% NOT FOR CONSTRUCTION

STA. 31+26.10
BRIDGE NO. XXXXX

CITY OF SANTA FE

NO.	DESCRIPTION	DATE	BY
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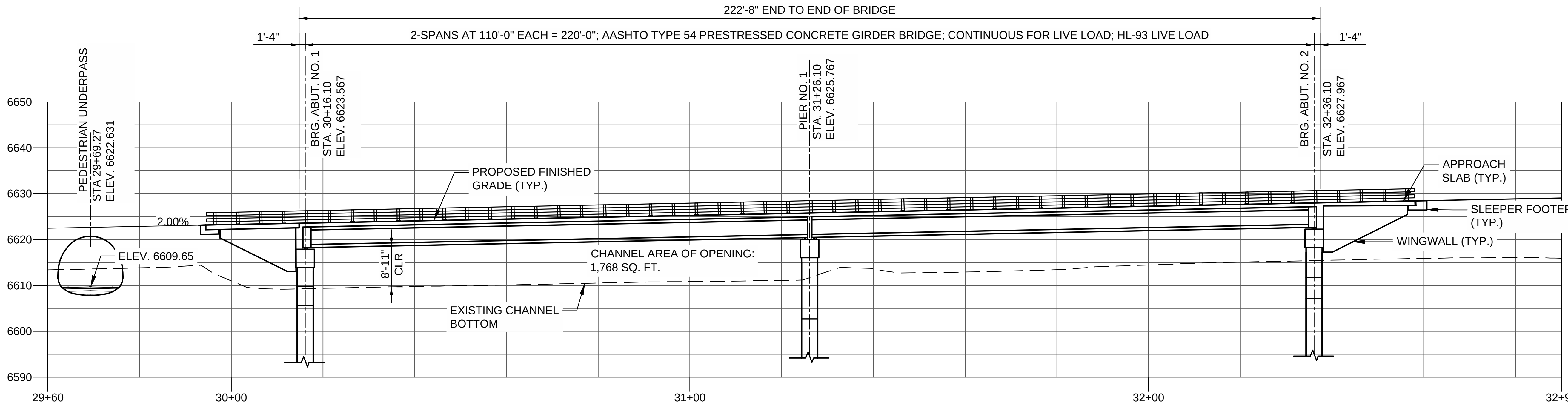
RICHARDS AVE. OVER ADLC
NEW BRIDGE
ALTERNATIVE 3 - PRESTRESSED GIRDER BRIDGE



PROPOSED BRIDGE PROFILE

ALTERNATIVE 3 - 2-SPAN AASHTO TYPE 54 PRESTRESSED CONCRETE GIRDER BRIDGE

CITY OF SANTA FE

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RICHARDS AVE. OVER ADLC
NEW BRIDGE
ALTERNATIVE 3 - PRESTRESSED GIRDER BRIDGE

30% NOT FOR CONSTRUCTION

STA. 31+26.10
BRIDGE NO. XXXXX

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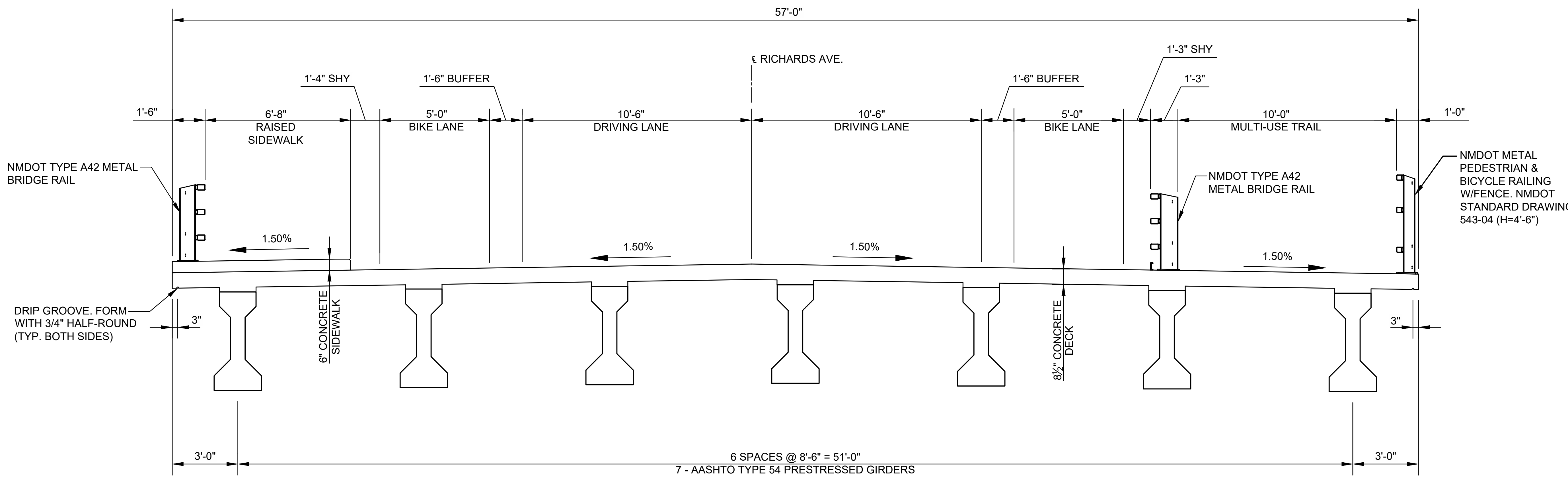

PROPOSED BRIDGE TRANSVERSE SECTION

ALTERNATIVE 3 - 2-SPAN AASHTO TYPE 54 PRESTRESSED CONCRETE GIRDER BRIDGE

30% NOT FOR CONSTRUCTION

STA. 31+26.10
BRIDGE NO. XXXXX

CITY OF SANTA FE

NO.	DESCRIPTION	DATE	BY
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RICHARDS AVE. OVER ADLC
NEW BRIDGE
ALTERNATIVE 3 - PRESTRESSED GIRDER BRIDGE

APPENDIX B
Cost Estimate and Quantities for Each Alternative

CN LP50039 - City of Santa Fe

Richards Ave. over Arroyo de Los Chamisos

Alternative 1: Single Span 70" Deep Steel Plate Girder, 152'-8" Long x 57'-0" Wide

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
210002	MAJOR STRUCTURE EXCAVATION	C.Y.	710	$ 75.00	$ 53,250.00
210003	MAJOR STRUCTURE BACKFILL	C.Y.	1,200	$ 105.00	$ 126,000.00
502042	DRILLED SHAFT FOUNDATION 42" DIAMETER	L.F.	500	$ 1,300.00	$ 650,000.00
502600	OBSTRUCTION REMOVAL	L.F.	50	$ 950.00	$ 47,500.00
505000	CROSSHOLE SONIC LOGGING CONSULTANT TESTING	EACH	10	$ 2,100.00	$ 21,000.00
505011	LOW STRAIN INTEGRITY CONSULTANT TESTING	EACH	10	$ 1,600.00	$ 16,000.00
511000	STRUCTURAL CONCRETE, CLASS A	C.Y.	296	$ 1,650.00	$ 488,400.00
511070	STRUCTURAL CONCRETE, CLASS HPD	C.Y.	526	$ 1,500.00	$ 789,000.00
535100	CONCRETE SURFACE TREATMENT	S.Y.	1,117	$ 45.00	$ 50,265.00
540060	REINFORCING BARS GRADE 60	LB	145,400	$ 4.00	$ 581,600.00
540061	GALVANIZED BARS GRADE 60	LB	96,800	$ 4.50	$ 435,600.00
541100	STRUCTURAL STEEL FOR STEEL BRIDGES	LB	559,000	$ 5.50	$ 3,074,500.00
543002	METAL RAILING, TYPE A42	L.F.	394	$ 500.00	$ 197,000.00
543100	METAL RAILING, PEDESTRIAN	L.F.	197	$ 325.00	$ 64,025.00
560000	ELASTOMERIC BEARING PADS	EACH	14	$ 700.00	$ 9,800.00
562000	BRIDGE JOINT STRIP SEAL	L.F.	119	$ 350.00	$ 41,650.00
563099	POLYMER BRIDGE JOINT SEALS	L.F.	115	$ 60.00	$ 6,900.00
604002	GEOTEXTILE CLASS 2	S.Y.	576	$ 8.00	$ 4,608.00
604300	GEOGRID REINFORCEMENT	S.Y.	1,892	$ 10.00	$ 18,920.00
608006	CONCRETE SIDWALK 6"	S.Y.	183	$ 400.00	$ 73,200.00

TOTAL COST: $ 6,749,218.00

SUBJECT: Estimated Quantities for Alternative 1 - Single -span 70' steel plate girder Bridge over ADLC

BRIDGE TYPE: 150' Long Single Span Bridge, Concrete Deck on seven Steel Plate Girders. Concrete Abutment Caps on Drilled Shafts

BRIDGE ELEMENT DIMENSIONS

Deck thickness = $t_{deck} := 8.5\ in = 0.708\ ft$

Width of the deck (out to out) = $W_{deck} := 57\ ft$

Girder depth = $d_{girder} := 70\ in = 5.833\ ft$

Haunch thickness = $t_{haunch} := 2.75\ in = 0.229\ ft$

Abutment cap depth = $D_{AC} := 4.5\ ft$

Width of abutment cap = $W_{AC} := 4\ ft$

Length of the approach slab = $L_{AS} := 22\ ft$ Assumed average on a 5° skew and squared off at ends

Bearing device thickness = $BD_{thk} := 4\ in$

Sole plate thickness = $SP_{thk} := 1.75\ in$

502042 - DRILLED SHAFT FOUNDATION 42" DIAMETER

Estimation based on prior projects

No. of drilled shaft at each abutment = $N_{DS\_Abut} := 5$

Length of 1 drilled shaft at Abut. No. 1 = $L_{DS\_A1} := 50\ ft$

Total length at Abut. No. 1 = $T_{DS\_A1} := L_{DS\_A1} \cdot N_{DS\_Abut}\ ft = 250\ ft^2$

Length of 1 drilled shaft at Abut. No. 2 = $L_{DS\_A2} := 50\ ft$

Total length at Abut. No. 2 = $T_{DS\_A2} := L_{DS\_A2} \cdot N_{DS\_Abut} \cdot ft = 250\ ft^2$

Total length of drilled shafts = $TL_{DS} := T_{DS\_A1} + T_{DS\_A2} = 500\ ft^2$

Use 250 L.F. for Abut. 1 and 250 L.F. for Abut. 2

Use 500 L.F. for Item No. 502042

SUBJECT: Estimated Quantities for Alternative 1 - Single -span 70' steel plate girder Bridge over ADLC

502600 - OBSTRUCTION REMOVAL

Per NMDOT direction, using 10% of drilled shaft length at each substructure unit.

Use 25 L.F. for each abutment.

Use 50 L.F. for Item No. 502600

505000 - CROSSHOLE SONIC LOGGING CONSULTANT TESTING

Per NMDOT direction, using 1 at each drilled shaft.

No. of supports = $N_S := 2$

Total no. of testing = $T_{S.L} := \left(2 \cdot N_{DS\_Abut}\right) = 10$

Use 10 EACH for Item No. 505000 Use 5 at each Abutment

505011 - LOW STRAIN INTEGRITY CONSULTANT TESTING

Per NMDOT direction, using 1 at each drilled shaft.

Use 10 EACH for Item No. 505011 Use 5 at each Abutment

511000 - STRUCTURAL CONCRETE, CLASS A

Length of Abutment = $L_{AC} := \dfrac{56}{\cos\left(5°\right)} \cdot ft = 56.21\ ft$

Volume of One Abutment = $V_{AC} := W_{AC} \cdot D_{AC} \cdot L_{AC} = 37.48\ yd^3$

Length of Abutment Vertical Wall = $L_{AW} := L_{AC} = 56.21\ ft$

Height of Abutment Vertical Wall = $H_{AW} := 6\ ft + 10 \cdot in$

Thickness of Abutment Vertical Wall = $T_{AW} := 3.5\ ft$

Volume of One Abutment Wall = $V_{AW} := L_{AW} \cdot H_{AW} \cdot T_{AW} = 49.79\ yd^3$

Volume of Class A concrete for 2 abutments = $V_{AConc} := \text{Ceil}\left(2 \cdot \left(V_{AC} + V_{AW}\right), 1\ yd^3\right) = 175\ yd^3$

Use 88 C.Y. for each Abutment + 30 CY for each Wingwall = 148 CY for each Abutment

Use 176 C.Y. for Item No. 511000

SUBJECT: Estimated Quantities for Alternative 1 - Single -span 70' steel plate girder Bridge over ADLC

511070 - STRUCTURAL CONCRETE, CLASS HPD

Deck Concrete

Length of deck = $L_{deck} := 152\ ft + 8\ in$

Total volume of deck = $V_{deck} := t_{deck} \cdot L_{deck} \cdot W_{deck} = 228\ yd^3$

Haunches

Girder top flange width = $b_{tf} := 26\ in = 2.167\ ft$

Girder Bearing length = $BL_{girder} := 150\ ft$

No. of girders = $N_G := 7$

Haunch Volume = $V_{haunch} := N_G \cdot \left(b_{tf} \cdot t_{haunch} \cdot \left(BL_{girder} - 3\ ft + 1.75\ in\right)\right) = 18.9\ yd^3$

Abutment Diaphragms

End diaphragm width = $W_{ED} := W_{AC} - 0.5\ ft = 3.5\ ft$

End diaphragm height = $d_{ED} := d_{girder} + t_{haunch} + BD_{thk} + SP_{thk} = 6.542\ ft$

Area of girders= $G_A := (26\ in \cdot 1.5\ in) + (70\ in \cdot 0.625\ in) + (28\ in \cdot 2\ in) = 0.964\ ft^2$

Total volume of girders inside end diaphragm = $V_{G@Abut} := N_G \cdot G_A \cdot (1.75\ ft + 0.5\ ft) = 0.562\ yd^3$

Area of end diaphragm including girders at abutment = $Area.A_{E.D} := L_{AC} \cdot d_{ED} = 367.73\ ft^2$

Blockout at bearing = $BO_1 := 4\ ft \cdot 1.5\ ft \cdot 2.67\ ft \cdot N_G = 4.15\ yd^3$

Blockout at anchor rod = $BO_2 := (1\ ft + 5\ in) \cdot 1.5\ ft \cdot 8.5\ in \cdot \left(N_G - 1\right) = 0.33\ yd^3$

Volume of end diaphragm at abutment = $Vol.A_{E.D} := Area.A_{E.D} \cdot W_{ED} - V_{G@Abut} - BO_1 - BO_2 = 42.62\ yd^3$

Sidewalk

Length of Sidewalk = $L_{SW} := L_{deck} + \left(2 \cdot L_{AS}\right) = 196.667\ ft$

Width of Sidewalk = $W_{SW} := 6\ ft + 8 \cdot in$

SUBJECT: Estimated Quantities for Alternative 1 - Single -span 70' steel plate girder Bridge over ADLC

Thickness of Sidewalk = $T_{SW} := 6 \cdot in$

Volume of One Sidewalk = $V_{SW} := L_{SW} \cdot W_{SW} \cdot T_{SW} = 24.28\ yd^3$

Wingwall

Volume of wingwall = $V_{WW} := (3.167\ ft \cdot 12.75\ ft + (0.5 \cdot 10.29\ ft \cdot 13.75\ ft))\ 1.5\ ft = 6.17\ yd^3$

Total Superstructure Concrete = $V_{SS} := \text{Ceil}\left(V_{deck} + V_{haunch} + (2 \cdot Vol.A_{E.D}) + 4 \cdot V_{WW} + 2 \cdot V_{SW}, 1\ yd^3\right) = 406\ yd^3$

Use 406 C.Y. for Superstructure

Approach Slabs

Volume of Approach Slab No. 1 = $V_{AS1} := (L_{AS} \cdot 62\ ft \cdot 1\ ft) = 50.519\ yd^3$ Width varies. Use 62' width

Volume of Approach Slab No. 2 = $V_{AS2} := (L_{AS} \cdot 57\ ft \cdot 1\ ft) = 46.444\ yd^3$ Width is constant at 57'

Sleeper Footer

Volume of Sleeper Footer No. 1 = $V_{SF1} := (1\ ft \cdot 4\ ft + 1\ ft \cdot 1.5\ ft) \cdot 59\ ft = 12.019\ yd^3$

Volume of Sleeper Footer No. 2 = $V_{SF2} := (1\ ft \cdot 4\ ft + 1\ ft \cdot 1.5\ ft) \cdot 54\ ft = 11\ yd^3$

$V_{AS} := \text{Ceil}\left(V_{AS1} + V_{AS2} + V_{SF1} + V_{SF2}, 1\ yd^3\right) = 120\ yd^3$

Use 120 C.Y. for approach slabs

$V_{HPD} := V_{SS} + V_{AS} = 526\ yd^3$

Use 526 C.Y. for Item No. 511070

535100 - CONCRETE SURFACE TREATMENT

Bridge deck area = $ST_D := \text{Ceil}\left(L_{deck} \cdot (W_{deck} - 6\ ft - 8 \cdot in), 1\ yd^2\right) = 854\ yd^2$

Approach Slabs + Sleeper Footers = $ST_{AS} := 2 \cdot ((L_{AS} + 1.5 \cdot ft) \cdot (W_{deck} - 6\ ft - 8 \cdot in)) = 262.9\ yd^2$

Total Overlay Area = $ST_{total} := (ST_D + ST_{AS}) = 1116.9\ yd^2$

Use 854 S.Y. for superstructure and 263 S.Y. for approach slabs

Use 1,117 S.Y. for Item No. 534100

540060 - REINFORCING BARS GRADE 60

Abutment Caps

From NM 96 project, for 62 CY of Class A concrete, 50.900 LB of Reinforcing Bars were used which equates to 821 LB/CY of concrete. Since there will be abutment walls extending into the ground, use 830 LB/CY.

$$W_R := V_{AConc} \cdot 830 \cdot \frac{lb}{yd^3} = 145250\ lb$$

Use 72,650 LB for Abut. No. 1 and 72,650 LB for Abut. No. 2

Use 145,300 LB for Item No. 540060

540061 - GALVANIZED BARS GRADE 60

From NM 96 project, for 452 CY of Class A concrete, 78,100 LB of Reinforcing Bars were used which equates to 178 LB/CY of concrete. Since there will be sidewalks with reinforcing bars on the bridge, use 184 LB/CY. Use 85% for Superstructure and 15% for Approach Slabs and Sleeper Footers.

$$W_{GR} := V_{HPD} \cdot 184 \cdot \frac{lb}{yd^3} = 96784\ lb$$

Use 82,600 for Superstructure and 14,200 LB for Approach Slabs

Use 96,800 LB for Item No. 540061

541100 STRUCTURAL STEEL FOR STEEL BRIDGES

Plate Girder

Top Flange Volume = $T.F_V := 151\ ft \cdot 26\ in \cdot 1.5\ in = 40.9\ ft^3$

Web Volume = $W_V := 151\ ft \cdot 70\ in \cdot 0.625\ in = 45.9\ ft^3$

Bottom Flange Volume = $BF_V := 151\ ft \cdot 28\ in \cdot 2\ in = 58.7\ ft^3$

Total Girder weight = $W_G := \left(T.F_V + W_V + BF_V\right) \cdot N_G \cdot 490\ \frac{lb}{ft^3} = 499047.1\ lb$

Weight for Cross Frames, Shear Studs, Connection Plates, Bearing Stiffeners, Nuts, Bolts and Washers

From US 84 over Arroyo Canjilon project, total girder weight was 553,170 LB of Structural Steel. Total weight of all Structural Steel was 631,360 LB. Girders were 88% of the weight, so add an additional 12% for all other steel.

$W_{OS} := W_G \cdot 0.12 = 59885.66\ lb$

$W_{SS} := W_{OS} + W_G = 558932.8\ lb$

Use 559,000 LB Item No. 541100

543002 - METAL RAILING, TYPE A42

Length of single barrier rail = $L_{BR} := L_{deck} + (2 \cdot L_{AS}) = 196.7\ ft$

No. of barrier rail = $N_{BR} := 2$

Total length of barrier rail = $T.L_{B.R} := \text{Ceil}(L_{BR} \cdot N_{BR}, 1\ ft) = 394\ ft$

298 L.F. on Superstructure, 96 L.F. on Approach Slabs

Use 394 L.F. for Item No. 514042

543100 - METAL RAILING, PEDESTRIAN

Length of metal railing : $L_{P.R} := \text{Ceil}((L_{BR}), 1\ ft) = 197\ ft$

Use 197 L.F. for Item No. 543100 Use 219 L.F. for Superstructure and 48 L.F. for Approach Slabs

560000 - ELASTOMERIC BEARING PADS

No. of bearing pads per girder = $N_{B.P\_Girder} := 2$

Total no. of bearing pads = $T.N_{B.P} := N_{B.P\_Girder} \cdot N_G = 14$

Use 14 Each for Item No. 560000

562000 - BRIDGE JOINT STRIP SEAL

Placed between Approach Slab and Sleeper Footer joint.

No. of bridge joint strip seals = $N_{B.J\_Seal} := 2$

Extension beyond approach slab edges = $Ext := 1\ ft$

Total length of polymer joint seal = $T.L_{B.J\_Seal} := \left(N_{B.J\_Seal} \cdot \dfrac{W_{deck}}{\cos(5°)}\right) + 4 \cdot Ext = 118.4\ ft$

Use 119 L.F. for Item No. 562000

SUBJECT: Estimated Quantities for Alternative 1 - Single -span 70' steel plate girder Bridge over ADLC

563099 - POLYMER BRIDGE JOINT SEALS

Placed between Bridge Deck and Approach Slab joints.

No. of polymer bridge joint seals = $N_{P.J\_Seal} := 2$

Total length of polymer joint seal = $T.L_{P.J\_Seal} := \left(N_{P.J\_Seal} \cdot \dfrac{W_{deck}}{\cos(5°)}\right) = 114.4\ ft$

Use 115 L.F. for Item No. 563099

604002 - GEOTEXTILE CLASS 2

Based on ratio with Alt 3 - Type 54 Girder

Length of geotextile = $L_{GT} := (57\ ft + 7\ in) = 57.58\ ft$

Area of geotextile = $A_{GT} := \text{Ceil}\left(2 \cdot L_{GT} \cdot 45\ ft, 1\ yd^2\right) = 576\ yd^2$

Use 576 S.Y. for Item No. 604002 Use 288 S.Y. for each abutment

604300 - GEOGRID REINFORCEMENT

Based on ratio with NM 337 Project

Length of geogrid reinforcement = $L_{GG1} := (30\ ft + 8\ in) \cdot 2 + 2 \cdot (8\ ft) = 77.33\ ft$

Area of geogrid = $A_{GG} := \text{Ceil}\left(2 \cdot L_{GG1} \cdot 110\ ft, 1\ yd^2\right) = 1891\ yd^2$

Use 946 S.Y. for each abutment

Use 1,892 S.Y. for Item No. 604300

608006 - CONCRETE SIDEWALK 6"

Sidewalk concrete deck : $SW_D := \text{Ceil}\left(8.333\ ft \cdot L_{deck}, 1\ yd^2\right) = 142\ yd^2$

Sidewalk concrete AS : $SW_{AS} := \text{Ceil}\left(2 \cdot 8.333\ ft\ L_{AS}, 1\ yd^2\right) = 41\ yd^2$

Total sidewalk concrete : $SW_C := SW_D + SW_{AS} = 183\ yd^2$

Use 142 S.Y. for Superstructure and 41 S.Y. for Approach Slabs

Use 183 S.Y. for Item No. 608006

CN LP50039 - City of Santa Fe

Richards Ave. over Arroyo de Los Chamisos

Alternative 2: Two-Span, AASHTO Type 45 P/S Girders, 152'-8" Long x 57'-0" Wide

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
210002	MAJOR STRUCTURE EXCAVATION	C.Y.	500	$ 80.00	$ 40,000.00
210003	MAJOR STRUCTURE BACKFILL	C.Y.	940	$ 110.00	$ 103,400.00
502042	DRILLED SHAFT FOUNDATION 42" DIAMETER	L.F.	450	$ 1,325.00	$ 596,250.00
502048	DRILLED SHAFT FOUNDATION 48" DIAMETER	L.F.	275	$ 1,625.00	$ 446,875.00
502154	PERMANENT CASING 54" DIAMETER	L.F.	75	$ 1,000.00	$ 75,000.00
502600	OBSTRUCTION REMOVAL	L.F.	74	$ 800.00	$ 59,200.00
505000	CROSSHOLE SONIC LOGGING CONSULTANT TESTING	EACH	15	$ 2,000.00	$ 30,000.00
505011	LOW STRAIN INTEGRITY CONSULTANT TESTING	EACH	15	$ 1,500.00	$ 22,500.00
511000	STRUCTURAL CONCRETE, CLASS A	C.Y.	394	$ 1,500.00	$ 591,000.00
511070	STRUCTURAL CONCRETE, CLASS HPD	C.Y.	472	$ 1,600.00	$ 755,200.00
518045	PRESTRESSED CONCRETE BRIDGE MEMBER TYPE 45	L.F.	1,064	$ 950.00	$ 1,010,800.00
535100	CONCRETE SURFACE TREATMENT	S.Y.	1,117	$ 45.00	$ 50,265.00
540060	REINFORCING BARS GRADE 60	LB	196,600	$ 3.75	$ 737,250.00
540061	GALVANIZED BARS GRADE 60	LB	86,900	$ 5.00	$ 434,500.00
541000	STRUCTURAL STEEL FOR CONCRETE BRIDGES	LB	11,640	$ 10.00	$ 116,400.00
543002	METAL RAILING, TYPE A42	L.F.	394	$ 500.00	$ 197,000.00
543100	METAL RAILING, PEDESTRIAN	L.F.	197	$ 325.00	$ 64,025.00
560000	ELASTOMERIC BEARING PADS	EACH	28	$ 600.00	$ 16,800.00
562000	BRIDGE JOINT STRIP SEAL	L.F.	119	$ 350.00	$ 41,650.00
563099	POLYMER BRIDGE JOINT SEALS	L.F.	115	$ 60.00	$ 6,900.00
604002	GEOTEXTILE CLASS 2	S.Y.	474	$ 9.00	$ 4,266.00
604300	GEOGRID REINFORCEMENT	S.Y.	1,634	$ 11.00	$ 17,974.00
608006	CONCRETE SIDEWALK 6"	S.Y.	183	$ 400.00	$ 73,200.00

TOTAL COST: $ 5,347,055.00

152'-8" Long Two Span Bridge, Concrete Deck on 7- AASHTO Type 45 Prestressed Concrete Girders. Concrete Abutment & Pier on Drilled Shafts

BRIDGE ITEMS

Width of abutment cap = $W_{AC} := 4\ ft$

Depth of abutment cap = $D_{AC} := 4.5\ ft$

Deck width out to out = $W_{deck} := 57\ ft$

Length of abutment cap = $L_{Abut} := 56.5\ ft$

Length of pier cap = $L_{Pier} := 56.5\ ft$

Length of Approach slabs = $L_{AS} := 22\ ft$ Assumed average on a 5° skew

502042 - DRILLED SHAFT FOUNDATION 42" DIAMETER

Estimation based on previous projects.

No. of drilled shaft at each abutment = $N_{DS\_Abut} := 5$

Length of 1 drilled shaft at Abut. No. 1 = $L_{DS\_A1} := 45\ ft$

Total length at Abut. No. 1 = $T_{DS\_A1} := L_{DS\_A1} \cdot N_{DS\_Abut} = 225\ ft$

Length of 1 drilled shaft at Abut. No. 2 = $L_{DS\_A2} := 45\ ft$

Total length at Abut. No. 2 = $T_{DS\_A2} := L_{DS\_A2} \cdot N_{DS\_Abut} = 225\ ft$

Total length of drilled shafts = $TL_{DS} := T_{DS\_A1} + T_{DS\_A2} = 450\ ft$

Use 225 L.F. for Abut. 1 and 225 L.F. for Abut. 2

Use 450 L.F. for Item No. 502042

502048 - DRILLED SHAFT FOUNDATION 48" DIAMETER

Estimation based on previous projects.

No. of drilled shaft at each pier = $N_{DS\_Pier} := 5$

Length of 1 drilled shaft at pier no. 1 = $L_{DS\_P1} := 55\ ft$

Total length at pier no. 1 = $T_{DS\_P1} := L_{DS\_P1} \cdot N_{DS\_Pier} = 275\ ft$

Use 275 L.F. for Item No. 502048

502154 - PERMANENT CASING 54" DIAMETER

Estimation based on previous projects.

Length of casing per shaft $L_{PermC} := 15\ ft$

Total length at pier no. 1 = $T_{PC\_P1} := L_{PermC} \cdot N_{DS\_Pier} = 75\ ft$

Use 75 L.F. for Item No. 502148

502600 - OBSTRUCTION REMOVAL

Per NMDOT direction, using 10% of drilled shaft length at each substructure unit.

Use 23 L.F. for each abutment. Use 28 L.F for Pier No. 1

Use 74 L.F. for Item No. 502600

505000 - CROSSHOLE SONIC LOGGING CONSULTANT TESTING

Per NMDOT direction, using 1 at each drilled shaft.

Use 5 EA. for each abutment. Use 5 Ea. for Pier No. 1

Use 15 EACH for Item No. 505600

505011 - LOW STRAIN INTEGRITY CONSULTANT TESTING

Per NMDOT direction, using 1 at each drilled shaft.

Use 5 EA. for each abutment. Use 5 Ea. for Pier No. 1

Use 15 EACH for Item No. 505011

511000 STRUCTURAL CONCRETE, CLASS A

Abutments

Length of Abutment = $L_{AC} := \frac{56}{\cos(5°)} \cdot ft = 56.21\ ft$

Volume of One Abutment = $V_{AC} := W_{AC} \cdot D_{AC} \cdot L_{AC} = 37.48\ yd^3$

Length of Abutment Vertical Wall = $L_{AW} := L_{AC} = 56.21\ ft$

Height of Abutment Vertical Wall = $H_{AW} := 8.75\ ft$

Thickness of Abutment Vertical Wall = $T_{AW} := 3.5\ ft$

Volume of One Abutment Wall = $V_{AW} := L_{AW} \cdot H_{AW} \cdot T_{AW} = 63.76\ yd^3$

Volume of Class A concrete for 2 abutments = $V_{AConc} := \text{Ceil}\left(2 \cdot \left(V_{AC} + V_{AW}\right), 1\ yd^3\right) = 203\ yd^3$

<u>Pier</u>

Pier cap width = $PC_{width} := 4\ ft$

Pier cap depth = $PC_{depth} := 4.5\ ft$

Pier cap length = $PC_{length} := 56.5\ ft$

Pier column diameter = $PCol_{dia} := 42\ in$

Avg. pier column length = $PCol_{length} := 5.75\ ft$

Volume of Pier =

$$V_{Pier} := \text{Ceil}\left(\left(\left(PC_{width} \cdot PC_{depth} \cdot PC_{length}\right)\right) + \left(\frac{\left(\pi \cdot PCol_{dia}\right)^2}{4} \cdot PCol_{length} \cdot N_{DS\_Pier}\right), 1\ yd^3\right) = 70\ yd^3$$

Volume of Class A concrete = $V_{Class\_A} := V_{AConc} + V_{Pier} = 273\ yd^3$

USE 102 C.Y. for each Abutment + 30 CY for each Wingwall = 162 CY for each Abutment

USE 70 C.Y. for Pier No. 1

Use 394 C.Y. for Item No. 511000

<u>511070 - STRUCTURAL CONCRETE, CLASS HPD</u>

<u>Deck Concrete</u>

Length of deck = $L_{deck} := 152\ ft + 8\ in$

Deck thickness = $Deck_{thk} := 9\ in$

Total Volume of deck = $V_{deck} := Deck_{thk} \cdot L_{deck} \cdot W_{deck} = 241.7\ yd^3$

Haunches

Girder top flange width = $G_{t.f} := 1\ ft + 4\ in = 1.333\ ft$

Girder bearing length, span 1 = $G_{b.l} := 75\ ft$

No. of girders per span = $N_g := 7$

Haunch thickness = $Haunch_{thk} := 2\ in$

Haunch Volume =

$$V_{haunch} := 2 \cdot N_g \cdot \left(G_{t.f} \cdot Haunch_{thk} \cdot \left(G_{b.l} - 2\ ft - 0\ in\right)\right) = 8.4\ yd^3$$

Abutment Diaphragms

End diaphragm width = $E.D_{width} := 3.25\ ft$

Girder depth = $G_{depth} := 3.75\ ft$

Bearing depth device = $B.D_{depth} := 3\ in$

Sole plate = $S.P_{depth} := 1.75\ in$

End diaphragm depth = $E.D_{depth} := B.D_{depth} + G_{depth} + Haunch_{thk} + S.P_{depth} = 4.313\ ft$

Area of girders = $G_{area} := 560\ in^2$

Total volume of girders inside end diaphragm = $V_{G@abut} := N_g \cdot G_{area} \cdot 1.75\ ft = 1.764\ yd^3$

Total volume of blockout excluding bottom flange = $V_{B\_O@A} := N_g \cdot \left(\left(42\ in \cdot 13\ in - \left(8\ in \cdot 26\ in\right)\right) \cdot 1.75\ ft\right) = 1.065\ yd^3$

Area of end diaphragm including girders at abutment = $Area.A_{E.D} := L_{AC} \cdot E.D_{depth} = 242.422\ ft^2$

Volume of end diaphragm at abutment = $Vol.A_{E.D} := Area.A_{E.D} \cdot E.D_{width} - V_{G@abut} - V_{B\_O@A} = 26.351\ yd^3$

Pier diaphragm

Pier diaphragm width = $P.D_{width} := 3.5\ ft$

Total volume of girders inside pier diaphragm = $V_{G@pier} := N_g \cdot 2 \cdot G_{area} \cdot 1.25\ ft = 2.521\ yd^3$

Area of pier diaphragm including girders = $Area_{P.D} := 38.167\ ft \cdot E.D_{depth} = 164.595\ ft^2$

Total volume of blockout excluding bottom flange = $V_{B\_O@P} := N_g \cdot 2 \cdot (42\ in \cdot 13\ in - (8\ in \cdot 26\ in)) \cdot 1.25\ ft = 1.521\ yd^3$

Total volume of DYW. blockout = $V_{B\_DYW} := 6 \cdot (8.5\ in \cdot 25\ in \cdot 17\ in) = 0.465\ yd^3$

Volume of end diaphragm at pier = $V_{P.D} := Area_{P.D} \cdot P.D_{width} - V_{G@pier} - V_{B\_O@P} - V_{B\_DYW} = 16.83\ yd^3$

Sidewalk

Length of Sidewalk = $L_{SW} := L_{deck} + (2 \cdot L_{AS}) = 196.667\ ft$

Width of Sidewalk = $W_{SW} := 6\ ft + 8 \cdot in$

Thickness of Sidewalk = $T_{SW} := 6 \cdot in$

Volume of One Sidewalk = $V_{SW} := L_{SW} \cdot W_{SW} \cdot T_{SW} = 24.28\ yd^3$

Wingwalls

Volume of wingwall = $V_{W.W} := ((11\ ft \cdot 2\ ft + 2\ ft \cdot 6.833\ ft + (.5 \cdot 6.833\ ft \cdot 8.833\ ft)) \cdot 1.5\ ft) = 3.658\ yd^3$

Total Superstructure Concrete = $V_{SS} := \mathrm{Ceil}(V_{deck} + V_{haunch} + (2 \cdot (Vol.A_{E.D} + V_{P.D})) + (4 \cdot V_{W.W}), 1\ yd^3) = 352\ yd^3$

Use 352 C.Y. for superstructure

Approach Slabs

Volume of Approach Slab No. 1 = $V_{AS1} := (22\ ft \cdot 62\ ft \cdot 1\ ft) = 50.519\ yd^3$

Volume of Approach Slab No. 2 = $V_{AS2} := (22\ ft \cdot 57\ ft \cdot 1\ ft) = 46.444\ yd^3$

Sleeper Footer

Volume of Sleeper Footer No. 1 = $V_{SF1} := (1\ ft \cdot 4\ ft + 1\ ft \cdot 1.5\ ft) \cdot 59\ ft = 12.019\ yd^3$

Volume of Sleeper Footer No. 2 = $V_{SF2} := (1\ ft \cdot 4\ ft + 1\ ft \cdot 1.5\ ft) \cdot 54\ ft = 11\ yd^3$

$V_{AS} := \text{Ceil}\left(V_{AS1} + V_{AS2} + V_{SF1} + V_{SF2}, 1\ yd^3\right) = 120\ yd^3$

Use 120 C.Y. for approach slabs

$V_{HPD} := V_{SS} + V_{AS} = 472\ yd^3$

Use 472 C.Y. for Item No. 511070

518045 - PRESTRESSED CONCRETE BRIDGE MEMBER TYPE 45

Length of single girder = $L_{girder1} := G_{b.l} + 1\ ft = 76\ ft$

Combined length of all girders = $L_{all\_girders} := 2 \cdot L_{girder1} \cdot N_g = 1064\ ft$

Use 1,064 L.F. for Item No. 518045

535100 - CONCRETE SURFACE TREATMENT

Bridge deck area = $ST_D := \text{Ceil}\left(L_{deck} \cdot (W_{deck} - 6\ ft - 8 \cdot in), 1\ yd^2\right) = 854\ yd^2$

Approach Slabs + Sleeper Footers = $ST_{AS} := 2 \cdot \left((L_{AS} + 1.5 \cdot ft) \cdot (W_{deck} - 6\ ft - 8 \cdot in)\right) = 262.9\ yd^2$

Total Overlay Area = $ST_{total} := (ST_D + ST_{AS}) = 1116.9\ yd^2$

Use 854 S.Y. for superstructure and 263 S.Y. for approach slabs

Use 1,117 S.Y. for Item No. 534100

540060 - REINFORCING BARS GRADE 60

Abutment Caps

From NM 96 project, for 62 CY of Class A concrete, 50,900 LB of Reinforcing Bars were used which equates to 821 LB/CY of concrete. Since there will be abutment walls extending into the ground, use 830 LB/CY to be conservative.

$W_{AR} := V_{AConc} \cdot 830 \cdot \frac{lb}{yd^3} = 168490\ lb$

Use 84,300 LB for Abut. No. 1 and 84,300 LB for Abut. No. 2

Pier Caps, Columns and Drilled Shafts

Volume of substructure concrete = $V_{Sub\_concrete} := V_{Pier} = 70\ yd^3$

Weight of substructure steel = $W_{Pier} := \left(400\ \frac{lb}{yd^3} \cdot V_{Sub\_concrete}\right) = 28000\ lb$

Use 28,000 LB for Pier. No. 1

$W_{Rebar} := W_{Pier} + W_{AR} = 196490\ lb$

Use 196,600 LB for Item No. 540060

540061 - GALVANIZED BAR GRADE 60

From NM 337 project, for 452 CY of Class HPD concrete, 78,100 LB of Reinforcing Bars were used which equates to 178 LB/CY of concrete. Since there will be sidewalks with reinforcing bars on the bridge, use 184 LB/CY. For the Approach Slab and Sleeper footers, use the same weight for the Type 54 computation. Use 85% for Superstructure and 15% for Approach Slabs and Sleeper Footers.

$$W_{GR} := V_{HPD} \cdot 184 \cdot \frac{lb}{yd^3} = 86848\ lb$$

Use 70,100 for Superstructure and 16,800 LB for Approach Slabs

Use 86,900 LB for Item No. 540061

541000 - STRUCTURAL STEEL FOR CONCRETE BRIDGES

Interior Diaphragms

Diaphragm unit weight for Type 45 = $U.W_{Dia} := 28\ \frac{lb}{ft}$

Clip angle weight = $W_{C.A} := 16\ lb$

Back plate weight = $W_{B.P} := 7\ lb$

Girder spacing = $G_S := 8.5\ ft$

Web thickness of girder = $Web_{thk} := 7\ in$

Dim. A = $Dim_A := 10\ in$

Weight of single diaphragm = $W_{single\_Dia} := U.W_{Dia} \cdot (G_S - Dim_A) + (2 \cdot W_{C.A}) = 246.667\ lb$

Total No. of diaphragms = $N_{Dia} := 24$

Total diaphragm weight for bridge = $T.W_{Dia} := \text{Ceil}\left(W_{single\_Dia} \cdot N_{Dia}, 1\ lb\right) = 5920\ lb$

Use 5,920 lbs

Sole Plates

Length of sole plate = $L_{S.P} := 12\ in$

Width of sole plate = $Wd_{S.P} := 26\ in$

Sole plate thickness = $T_{S.P} := 1.75\ in$

No. of Sole plates = $N_{S.P} := N_g \cdot 2 \cdot 2 = 28$

Weight of all sole plates = $W_{S.P} := \text{Ceil}\left(490\ \frac{lb}{ft^3} \cdot L_{S.P} \cdot Wd_{S.P} \cdot T_{S.P} \cdot N_{S.P}, 1\ lb\right) = 4336\ lb$

Use 4,336 lbs

Keeper bars

No. of keeper bars = $N_{K.B} := N_g \cdot 4 \cdot 2 = 56$

Weight of all keeper bars = $W_{K.B} := \text{Ceil}\left(490\ \frac{lb}{ft^3} \cdot 0.5\ in \cdot 1\ in \cdot 26\ in \cdot N_{K.B}, 1\ lb\right) = 207\ lb$

Use 207 lbs

Strip seal cover plates

Total weight for all cover plates = $T.W_{S.S\_CP} := \text{Ceil}\left(4 \cdot 18\ in \cdot 1\ ft \cdot 0.375\ in \cdot 490\ \frac{lb}{ft^3}, 1\ lb\right) = 92\ lb$

Use 92 lbs

Anchor Rods

Total weight of 18 1.75" dia. X 6'-3" anchor rods = $T.W_{AR} := \text{Ceil}\left(\left(\left(18 \cdot \pi \cdot \frac{(1.75\ in)^2}{4} \cdot 75\ in\right) + (18 \cdot 8\ in \cdot 8\ in \cdot 0.5\ in)\right) \cdot 490\ \frac{lb}{ft^3}, 1\ lb\right) = 1085\ lb$

Use 1,085 lbs

Total weight for steel = $W_{S.S} := T.W_{Dia} + W_{S.P} + W_{K.B} + T.W_{S.S\_CP} + T.W_{AR} = 11640\ lb$

Use 11,640 LB for Item No. 541000

543002 METAL RAILING, TYPE A42

Approach slab length = $AS_L := 22\ ft$

Length of single barrier rail = $L_{B.R} := L_{deck} + 2 \cdot AS_L = 196.7\ ft$

No. of barrier rail = $N_{B.R} := 2$

Total length of barrier rail = $T.L_{B.R} := \text{Ceil}\left(L_{B.R} \cdot N_{B.R}, 1\ ft\right) = 394\ ft$

Use 394 L.F. for Item No. 543002 Use 298 L.F. for Superstructure and 96 L.F. for Approach Slabs

543100 - METAL RAILING, PEDESTRIAN

Length of metal railing : $L_{P.R} := \text{Ceil}\left(\left(L_{B.R}\right), 1\ ft\right) = 197\ ft$

Use 197 L.F. for Item No. 543100 Use 149 L.F. for Superstructure and 48 L.F. for Approach Slabs

560000 - ELASTOMETRIC BEARING PADS

No. of bearing pads per girder = $N_{B.P\_Girder} := 2$

No. of spans= $N_{Span} := 2$

Total no. of bearing pads = $T.N_{B.P\_Girder} := N_{B.P\_Girder} \cdot N_g \cdot N_{Span} = 28$

Use 28 Each for Item No. 560000

562000 - BRIDGE JOINT STRIP SEAL

No. of bridge joint strip seals = $N_{B.J\_Seal} := 2$

Joint extension length = $L_{J.E} := 1\ ft$

Total length of bridge joint strip seal = $T.L_{B.J\_Seal} := N_{B.J\_Seal} \cdot \frac{\left(W_{deck} + 2 \cdot L_{J.E}\right)}{\cos\left(5°\right)} = 118.451\ ft$

Use 119 L.F. for Item No. 562000

563099 - POLYMER BRIDGE JOINT SEALS

No. of polymer bridge joint seals = $N_{P.J\_Seal} := 2$

Total length of polymer joint seal = $T.L_{P\_Seal} := N_{P.J\_Seal} \cdot \frac{W_{deck}}{\cos(5°)} = 114.435\ ft$

Use 115 L.F. for Item No. 563099

604002 - GEOTEXTILE CLASS 2

Based on ratio with NM 337 Project

Length of geotextile = $L_{GT} := (57\ ft + 7\ in) = 57.583\ ft$

Area of geotextile = $A_{GT} := \text{Ceil}\left(2 \cdot L_{GT} \cdot 37\ ft, 1\ yd^2\right) = 474\ yd^2$

Use 237 S.Y. for each abutment

Use 474 S.Y. for Item No. 604002

604300 - GEOGRID REINFORCEMENT

Based on ratio with NM 337 Project

Length of geogrid reinforcement = $L_{GG1} := (30\ ft + 8\ in) \cdot 2 + 2 \cdot (8\ ft) = 77.333\ ft$

Area of geogrid = $A_{GG} := \text{Ceil}\left(2 \cdot L_{GG1} \cdot 95\ ft, 1\ yd^2\right) = 1633\ yd^2$

Use 817 S.Y. for each abutment

Use 1,634 S.Y. for Item No. 604300

608006 - CONCRETE SIDEWALK 6"

Sidewalk concrete deck : $SW_D := \text{Ceil}\left(8.333\ ft \cdot L_{deck}, 1\ yd^2\right) = 142\ yd^2$

Sidewalk concrete AS : $SW_{AS} := \text{Ceil}\left(2 \cdot 8.333\ ft \cdot L_{AS}, 1\ yd^2\right) = 41\ yd^2$

Total sidewalk concrete : $SW_C := SW_D + SW_{AS} = 183\ yd^2$

Use 142 S.Y. for Superstructure and 41 S.Y. for Approach Slabs

Use 183 S.Y. for Item No. 608006

CN LP50039 - City of Santa Fe

Richards Ave. over Arroyo de Los Chamisos

Alternative 3: Two-Span, AASHTO Type 54 P/S Girders, 222'-8" Long x 57'-0" Wide

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
210002	MAJOR STRUCTURE EXCAVATION	C.Y.	550	$ 80.00	$ 44,000.00
210003	MAJOR STRUCTURE BACKFILL	C.Y.	1,000	$ 110.00	$ 110,000.00
502042	DRILLED SHAFT FOUNDATION 42" DIAMETER	L.F.	500	$ 1,300.00	$ 650,000.00
502048	DRILLED SHAFT FOUNDATION 48" DIAMETER	L.F.	300	$ 1,600.00	$ 480,000.00
502154	PERMANENT CASING 54" DIAMETER	L.F.	75	$ 1,000.00	$ 75,000.00
502600	OBSTRUCTION REMOVAL	L.F.	80	$ 800.00	$ 64,000.00
505000	CROSSHOLE SONIC LOGGING CONSULTANT TESTING	EACH	15	$ 2,000.00	$ 30,000.00
505011	LOW STRAIN INTEGRITY CONSULTANT TESTING	EACH	15	$ 1,500.00	$ 22,500.00
511000	STRUCTURAL CONCRETE, CLASS A	C.Y.	378	$ 1,500.00	$ 567,000.00
511070	STRUCTURAL CONCRETE, CLASS HPD	C.Y.	609	$ 1,500.00	$ 913,500.00
518054	PRESTRESSED CONCRETE BRIDGE MEMBER TYPE 54	L.F.	1,554	$ 1,000.00	$ 1,554,000.00
535100	CONCRETE SURFACE TREATMENT	S.Y.	1,509	$ 35.00	$ 52,815.00
540060	REINFORCING BARS GRADE 60	LB	185,800	$ 3.50	$ 650,300.00
540061	GALVANIZED BARS GRADE 60	LB	112,100	$ 4.00	$ 448,400.00
541000	STRUCTURAL STEEL FOR CONCRETE BRIDGES	LB	13,581	$ 9.00	$ 122,229.00
543002	METAL RAILING, TYPE A42	L.F.	534	$ 450.00	$ 240,300.00
543100	METAL RAILING, PEDESTRIAN	L.F.	267	$ 300.00	$ 80,100.00
560000	ELASTOMERIC BEARING PADS	EACH	28	$ 600.00	$ 16,800.00
562000	BRIDGE JOINT STRIP SEAL	L.F.	119	$ 350.00	$ 41,650.00
563099	POLYMER BRIDGE JOINT SEALS	L.F.	115	$ 60.00	$ 6,900.00
604002	GEOTEXTILE CLASS 2	S.Y.	512	$ 8.00	$ 4,096.00
604300	GEOGRID REINFORCEMENT	S.Y.	1,720	$ 10.00	$ 17,200.00
608006	CONCRETE SIDEWALK 6"	S.Y.	248	$ 350.00	$ 86,800.00

TOTAL COST: $ 6,277,590.00

222'-8" Long Two-Span Bridge, Concrete Deck on 7-AASHTO Type 54 Prestressed Concrete Girders. Concrete Abutment & Pier on Drilled Shafts

BRIDGE ITEMS

Width of abutment cap = $W_{AC} := 4\ ft$

Depth of abutment cap = $D_{AC} := 4.5\ ft$

Deck width out to out = $W_{deck} := 57\ ft$

Length of abutment cap = $L_{Abut} := 56.5\ ft$

Length of pier cap = $L_{Pier} := 56.5\ ft$

Length of Approach slabs = $L_{AS} := 22\ ft$ Assumed average on a 5° skew

502042 - DRILLED SHAFT FOUNDATION 42" DIAMETER

Abutments

Estimation based on previous projects.

No. of drilled shaft at each abutment = $N_{DS\_Abut} := 5$

Length of 1 drilled shaft at Abut. No. 1 = $L_{DS\_A1} := 50\ ft$

Total length at Abut. No. 1 = $T_{DS\_A1} := L_{DS\_A1} \cdot N_{DS\_Abut} = 250\ ft$

Length of 1 drilled shaft at Abut. No. 2 = $L_{DS\_A2} := 50\ ft$

Total length at Abut. No. 2 = $T_{DS\_A2} := L_{DS\_A2} \cdot N_{DS\_Abut} = 250\ ft$

Total length of drilled shafts = $TL_{DS} := T_{DS\_A1} + T_{DS\_A2} = 500\ ft$

Use 250 L.F. for Abut. 1 and 250 L.F. for Abut. 2

Use 500 L.F. for Item No. 502042

502048 - DRILLED SHAFT FOUNDATION 48" DIAMETER

No. of drilled shaft at pier = $N_{DS\_Pier} := 5$

Length of 1 drilled shaft at pier no. 1 = $L_{DS\_P1} := 60\ ft$

Total length at pier no. 1 = $T_{DS\_P1} := L_{DS\_P1} \cdot N_{DS\_Pier} = 300\ ft$

Use 300 L.F. for Item No. 502042

502154 - PERMANENT CASING 54" DIAMETER

Estimation based on previous projects.

Length of casing per shaft $L_{PermC} := 15\ ft$

Total length at pier no. 1 = $T_{PC\_P1} := L_{PermC} \cdot N_{DS\_Pier} = 75\ ft$

Use 75 L.F. for Item No. 502148

502600 - OBSTRUCTION REMOVAL

Per NMDOT direction, using 10% of drilled shaft length at each substructure unit.

Use 25 L.F. for each abutment. Use 30 L.F for Pier No. 1.

Use 80 L.F. for Item No. 502600

505000 - CROSSHOLE SONIC LOGGING CONSULTANT TESTING

Per NMDOT direction, using 1 at each drilled shaft.

Use 5 EA. for each abutment. Use 5 Ea. for Pier No. 1

Use 15 EACH for Item No. 505600

505011 - LOW STRAIN INTEGRITY CONSULTANT TESTING

Per NMDOT direction, using 1 at each drilled shaft.

Use 5 EA. for each abutment. Use 5 Ea. for Pier No. 1

Use 15 EACH for Item No. 505011

511000 STRUCTURAL CONCRETE, CLASS A

Abutments

Length of Abutment = $L_{AC} := \frac{56}{\cos(5°)} \cdot ft = 56.21\ ft$

Volume of One Abutment = $V_{AC} := W_{AC} \cdot D_{AC} \cdot L_{AC} = 37.48\ yd^3$

Length of Abutment Vertical Wall = $L_{AW} := L_{AC} = 56.21\ ft$

Height of Abutment Vertical Wall = $H_{AW} := 8\ ft$

Thickness of Abutment Vertical Wall = $T_{AW} := 3.5\ ft$

Volume of One Abutment Wall = $V_{AW} := L_{AW} \cdot H_{AW} \cdot T_{AW} = 58.3\ yd^3$

Volume of Class A concrete for 2 abutments = $V_{AConc} := \text{Ceil}\left(2 \cdot \left(V_{AC} + V_{AW}\right), 1\ yd^3\right) = 192\ yd^3$

Pier

Pier cap width = $PC_{width} := 4\ ft$

Pier cap depth = $PC_{depth} := 4.5\ ft$

Pier cap length = $PC_{length} := 56.5\ ft$

Pier column diameter = $PCol_{dia} := 42\ in$

Avg. pier column length = $PCol_{length} := 5\ ft$

Volume of Pier =

$$V_{Pier} := \text{Ceil}\left(\left(\left(PC_{width} \cdot PC_{depth} \cdot PC_{length}\right)\right) + \left(\frac{\left(\pi \cdot PCol_{dia}\right)^2}{4} \cdot PCol_{length} \cdot N_{DS\_Pier}\right), 1\ yd^3\right) = 66\ yd^3$$

Volume of Class A concrete = $V_{Class\_A} := V_{AConc} + V_{Pier} = 258\ yd^3$

USE 96 C.Y. for each Abutment + 30 CY for each Wingwall = 156 CY for each Abutment

USE 66 C.Y. for Pier No. 1

Use 378 C.Y. for Item No. 511000

511070 - STRUCTURAL CONCRETE, CLASS HPD

Deck Concrete

Length of deck = $L_{deck} := 222\ ft + 8\ in$

Deck thickness = $Deck_{thk} := 9\ in$

Total Volume of deck = $V_{deck} := Deck_{thk} \cdot L_{deck} \cdot W_{deck} = 352.6\ yd^3$

Haunches

Girder top flange width = $G_{t.f} := 1\ ft + 8\ in = 1.667\ ft$

Girder bearing length, span 1 = $G_{b.l} := 110\ ft$

No. of girders per span = $N_g := 7$

Haunch thickness = $Haunch_{thk} := 2.5\ in$

Haunch Volume =

$$V_{haunch} := 2 \cdot N_g \cdot \left(G_{t.f} \cdot Haunch_{thk} \cdot \left(G_{b.l} - 2\ ft - 0\ in\right)\right) = 19.4\ yd^3$$

Abutment Diaphragms

End diaphragm width = $E.D_{width} := 3.25\ ft$

Girder depth = $G_{depth} := 4.5\ ft$

Bearing depth device = $B.D_{depth} := 3.25\ in$

Sole plate = $S.P_{depth} := 1.75\ in$

End diaphragm depth = $E.D_{depth} := B.D_{depth} + G_{depth} + Haunch_{thk} + S.P_{depth} = 5.125\ ft$

Area of girders = $G_{area} := 789\ in^2$

Total volume of girders inside end diaphragm = $V_{G@abut} := N_g \cdot G_{area} \cdot 1.75\ ft = 2.486\ yd^3$

Total volume of blockout excluding bottom flange = $V_{B\_O@A} := N_g \cdot \left(\left(42\ in \cdot 13\ in - \left(8\ in \cdot 26\ in\right)\right) \cdot 1.75\ ft\right) = 1.065\ yd^3$

Area of end diaphragm including girders at abutment = $Area.A_{E.D} := L_{AC} \cdot E.D_{depth} = 288.096\ ft^2$

Volume of end diaphragm at abutment = $Vol.A_{E.D} := Area.A_{E.D} \cdot E.D_{width} - V_{G@abut} - V_{B\_O@A} = 31.127\ yd^3$

Pier diaphragm

Pier diaphragm width = $P.D_{width} := 3.5\ ft$

Total volume of girders inside pier diaphragm = $V_{G@pier} := N_g \cdot 2 \cdot G_{area} \cdot 1.25\ ft = 3.551\ yd^3$

Area of pier diaphragm including girders = $Area_{P.D} := 38.167\ ft \cdot E.D_{depth} = 195.606\ ft^2$

Total volume of blockout excluding bottom flange = $V_{B\_O@P} := N_g \cdot 2 \cdot (42\ in \cdot 13\ in - (8\ in \cdot 26\ in)) \cdot 1.25\ ft = 1.521\ yd^3$

Total volume of DYW. blockout = $V_{B\_DYW} := 6 \cdot (8.5\ in \cdot 25\ in \cdot 17\ in) = 0.465\ yd^3$

Volume of end diaphragm at pier = $V_{P.D} := Area_{P.D} \cdot P.D_{width} - V_{G@pier} - V_{B\_O@P} - V_{B\_DYW} = 19.819\ yd^3$

Sidewalk

Length of Sidewalk = $L_{SW} := L_{deck} + (2 \cdot L_{AS}) = 266.667\ ft$

Width of Sidewalk = $W_{SW} := 6\ ft + 8 \cdot in$

Thickness of Sidewalk = $T_{SW} := 6 \cdot in$

Volume of One Sidewalk = $V_{SW} := L_{SW} \cdot W_{SW} \cdot T_{SW} = 32.92\ yd^3$

Wingwalls

Volume of wingwall = $V_{W.W} := ((12\ ft \cdot 2\ ft + 2\ ft \cdot 6.833\ ft + (.5 \cdot 6.833\ ft \cdot 8.833\ ft)) \cdot 1.5\ ft) = 3.769\ yd^3$

Total Superstructure Concrete = $V_{SS} := \text{Ceil}\left(V_{deck} + V_{haunch} + (2 \cdot (Vol.A_{E.D} + V_{P.D})) + (4 \cdot V_{W.W}), 1\ yd^3\right) = 489\ yd^3$

Use 489 C.Y. for superstructure

Approach Slabs

Volume of Approach Slab No. 1 = $V_{AS1} := (22\ ft \cdot 62\ ft \cdot 1\ ft) = 50.519\ yd^3$

Volume of Approach Slab No. 2 = $V_{AS2} := (22\ ft \cdot 57\ ft \cdot 1\ ft) = 46.444\ yd^3$

Sleeper Footer

Volume of Sleeper Footer No. 1 = $V_{SF1} := (1\ ft \cdot 4\ ft + 1\ ft \cdot 1.5\ ft) \cdot 59\ ft = 12.019\ yd^3$

Volume of Sleeper Footer No. 2 = $V_{SF2} := (1\ ft \cdot 4\ ft + 1\ ft \cdot 1.5\ ft) \cdot 54\ ft = 11\ yd^3$

$V_{AS} := \text{Ceil}\left(V_{AS1} + V_{AS2} + V_{SF1} + V_{SF2}, 1\ yd^3\right) = 120\ yd^3$

Use 120 C.Y. for approach slabs

$V_{HPD} := V_{SS} + V_{AS} = 609\ yd^3$

Use 609 C.Y. for Item No. 511070

518054 - PRESTRESSED CONCRETE BRIDGE MEMBER TYPE 54

Length of single girder = $L_{girder1} := G_{b.l} + 1\ ft = 111\ ft$

Combined length of all girders = $L_{all\_girders} := 2 \cdot L_{girder1} \cdot N_g = 1554\ ft$

Use 1,554 L.F. for Item No. 518054

535100 - CONCRETE SURFACE TREATMENT

Bridge deck area = $ST_D := \text{Ceil}\left(L_{deck} \cdot \left(W_{deck} - 6\ ft - 8 \cdot in\right), 1\ yd^2\right) = 1246\ yd^2$

Approach Slabs + Sleeper Footers = $ST_{AS} := 2 \cdot \left(\left(L_{AS} + 1.5 \cdot ft\right) \cdot \left(W_{deck} - 6\ ft - 8 \cdot in\right)\right) = 262.9\ yd^2$

Total Overlay Area = $ST_{total} := \left(ST_D + ST_{AS}\right) = 1508.9\ yd^2$

Use 1,246 S.Y. for superstructure and 263 S.Y. for approach slabs

Use 1,509 S.Y. for Item No. 534100

540060 - REINFORCING BARS GRADE 60

Abutment Caps

From NM 96 project, for 62 CY of Class A concrete, 50,900 LB of Reinforcing Bars were used which equates to 821 LB/CY of concrete. Since there will be abutment walls extending into the ground, use 830 LB/CY to be conservative.

$$W_{AR} := V_{AConc} \cdot 830 \cdot \frac{lb}{yd^3} = 159360\ lb$$

Use 79,700 LB for Abut. No. 1 and 79,700 LB for Abut. No. 2

Pier Caps, Columns and Drilled Shafts

Volume of substructure concrete = $V_{Sub\_concrete} := V_{Pier} = 66\ yd^3$

Weight of substructure steel = $W_{Pier} := \left(400\ \frac{lb}{yd^3} \cdot V_{Sub\_concrete}\right) = 26400\ lb$

Use 26,400 LB for Pier. No. 1

$W_{Rebar} := W_{Pier} + W_{AR} = 185760\ lb$

Use 185,800 LB for Item No. 540060

540061 - GALVANIZED BAR GRADE 60

From NM 337 project, for 452 CY of Class HPD concrete, 78,100 LB of Reinforcing Bars were used which equates to 178 LB/CY of concrete. Since there will be sidewalks with reinforcing bars on the bridge, use 184 LB/CY. Use 85% for Superstructure and 15% for Approach Slabs and Sleeper Footers. Use 85% for Superstructure and 15% for Approach Slabs and Sleeper Footers.

$W_{GR} := V_{HPD} \cdot 184 \cdot \frac{lb}{yd^3} = 112056\ lb$

Use 95,300 for Superstructure and 16,800 LB for Approach Slabs

Use 112,100 LB for Item No. 540061

541000 - STRUCTURAL STEEL FOR CONCRETE BRIDGES

Interior Diaphragms

Diaphragm unit weight for Type 54 = $U.W_{Dia} := 36\ \frac{lb}{ft}$

Clip angle weight = $W_{C.A} := 20\ lb$

Back plate weight = $W_{B.P} := 9\ lb$

Girder spacing = $G_S := 8.5\ ft$

Web thickness of girder = $Web_{thk} := 8\ in$

Dim. A = $Dim_A := 11\ in$

Weight of single diaphragm = $W_{single\_Dia} := U.W_{Dia} \cdot \left(G_S - Dim_A\right) + \left(2 \cdot W_{C.A}\right) = 313\ lb$

Total No. of diaphragms = $N_{Dia} := 24$

Total diaphragm weight for bridge = $T.W_{Dia} := \text{Ceil}\left(W_{single\_Dia} \cdot N_{Dia}, 1\ lb\right) = 7512\ lb$

Use 7,512 lbs

Sole Plates

Length of sole plate = $L_{S.P} := 12\ in$

Width of sole plate = $W_{S.P} := 28\ in$

Sole plate thickness = $T_{S.P} := 1.75\ in$

Weight of sole plates = $W_{SP} := \text{Ceil}\left(490\ \frac{lb}{ft^3} \cdot L_{S.P} \cdot W_{S.P} \cdot T_{S.P} \cdot N_g \cdot 2 \cdot 2, 1\ lb\right) = 4669\ lb$

Use 4,669 lbs

Keeper bars

No. of keeper bars = $N_{K.B} := N_g \cdot 4 \cdot 2 = 56$

Weight of all keeper bars = $W_{K.B} := \text{Ceil}\left(490\ \frac{lb}{ft^3} \cdot 0.5\ in \cdot 1\ in \cdot 28\ in \cdot N_{K.B}, 1\ lb\right) = 223\ lb$

Use 223 lbs

Strip seal cover plates

Total weight for cover plates = $T.W_{S.S\_CP} := \text{Ceil}\left(4 \cdot 18\ in \cdot 1\ ft \cdot 0.375\ in \cdot 490\ \frac{lb}{ft^3}, 1\ lb\right) = 92\ lb$

Use 92 lbs

DYWIDAG bars

Total weight of 18 1.75" dia. X 6'-3" anchor rods = $T.W_{DYW} := \text{Ceil}\left(\left(\left(18 \cdot \pi \cdot \frac{(1.75\ in)^2}{4} \cdot 75\ in\right) + \left(18 \cdot 8\ in \cdot 8\ in \cdot 0.5\ in\right)\right) \cdot 490\ \frac{lb}{ft^3}, 1\ lb\right) = 1085\ lb$

Use 1085 lbs

Total weight for steel = $W_{S.S} := T.W_{Dia} + W_{SP} + W_{K.B} + T.W_{S.S\_CP} + T.W_{DYW} = 13581\ lb$

Use 13,581 LB for Item No. 541000

543002 METAL RAILING, TYPE A42

Approach slab length = $AS_L := 22\ ft$

Length of single barrier rail = $L_{B.R} := L_{deck} + 2 \cdot AS_L = 266.7\ ft$

No. of barrier rail = $N_{B.R} := 2$

Total length of barrier rail = $T.L_{B.R} := \text{Ceil}\left(L_{B.R} \cdot N_{B.R}, 1\ ft\right) = 534\ ft$

Use 534 L.F. for Item No. 543002 Use 438 L.F. for Superstructure and 96 L.F. for Approach Slabs

543100 - METAL RAILING, PEDESTRIAN

Length of metal railing : $L_{P.R} := \text{Ceil}\left(\left(L_{B.R}\right), 1\ ft\right) = 267\ ft$

Use 267 L.F. for Item No. 543100 Use 219 L.F. for Superstructure and 48 L.F. for Approach Slabs

560000 - ELASTOMETRIC BEARING PADS

No. of bearing pads per girder = $N_{B.P\_Girder} := 2$

No. of spans= $N_{Span} := 2$

Total no. of bearing pads = $T.N_{B.P\_Girder} := N_{B.P\_Girder} \cdot N_g \cdot N_{Span} = 28$

Use 28 Each for Item No. 560000

562000 - BRIDGE JOINT STRIP SEAL

No. of bridge joint strip seals = $N_{B.J\_Seal} := 2$

Joint extension length = $L_{J.E} := 1\ ft$

Total length of bridge joint strip seal = $T.L_{B.J\_Seal} := N_{B.J\_Seal} \cdot \dfrac{\left(W_{deck} + 2 \cdot L_{J.E}\right)}{\cos\left(5°\right)} = 118.451\ ft$

Use 119 L.F. for Item No. 562000

563099 - POLYMER BRIDGE JOINT SEALS

No. of polymer bridge joint seals = $N_{P.J\_Seal} := 2$

Total length of polymer joint seal = $T.L_{P\_Seal} := N_{P.J\_Seal} \cdot \dfrac{W_{deck}}{\cos(5°)} = 114.435\ ft$

Use 115 L.F. for Item No. 563099

604002 - GEOTEXTILE CLASS 2

Based on ratio with NM 337 Project

Length of geotextile = $L_{GT} := (57\ ft + 7\ in) = 57.583\ ft$

Area of geotextile = $A_{GT} := \text{Ceil}\left(2 \cdot L_{GT} \cdot 40\ ft, 1\ yd^2\right) = 512\ yd^2$

Use 256 S.Y. for each abutment

Use 512 S.Y. for Item No. 604002

604300 - GEOGRID REINFORCEMENT

Based on ratio with NM 337 Project

Length of geogrid reinforcement = $L_{GG1} := (30\ ft + 8\ in) \cdot 2 + 2 \cdot (8\ ft) = 77.333\ ft$

Area of geogrid = $A_{GG} := \text{Ceil}\left(2 \cdot L_{GG1} \cdot 100\ ft, 1\ yd^2\right) = 1719\ yd^2$

Use 860 S.Y. for each abutment

Use 1,720 S.Y. for Item No. 604300

608006 - CONCRETE SIDEWALK 6"

Sidewalk concrete deck : $SW_D := \text{Ceil}\left(8.333\ ft \cdot L_{deck}, 1\ yd^2\right) = 207\ yd^2$

Sidewalk concrete AS : $SW_{AS} := \text{Ceil}\left(2 \cdot 8.333\ ft\ L_{AS}, 1\ yd^2\right) = 41\ yd^2$

Total sidewalk concrete : $SW_C := SW_D + SW_{AS} = 248\ yd^2$

Use 207 S.Y. for Superstructure and 41 S.Y. for Approach Slabs

Use 248 S.Y. for Item No. 608006