ID 9210-15-00

MASON STREET BRIDGE OVER THE FOX RIVER

STRUCTURE B-05-134

GREEN BAY, WISCONSIN

REHABILITATION/REPLACEMENT STUDY UPDATE:

REVISED COST ESTIMATE AND LIFE CYCLE COST ANALYSIS

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INTRODUCTION

The Wisconsin Department of Transportation (WisDOT) Northeast Region is developing conceptual alternatives for rehabilitating or replacing the Mason Street Bridge over the Fox River in the City of Green Bay, Brown County. The bridge, structure number B-05-134, is located on WIS 54 in the city's central business district (see Figure 1).

The purpose of this report is to update the Rehabilitation-Replacement Report completed in June 3, 2015 (Project ID 9210-15-00). It documents updated costs associated with four alternatives to repair or replace the bridge and associated roadway segments. They range from rehabilitating the structuralcomponents of the bridges to reconstruction of the bridges including total reconstruction of the mainline roadway, side roads and ramps. This report also includes a Life Cycle Costs Analysis of the alternatives.

FIGURE 1: PROJECT LOCATION

PROJECT OVERVIEW

The Mason Street Bridge (also known as the Don A. Tilleman Bridge), Structure Number B-05-134, carries Wisconsin State Trunk Highway (STH) 54 over the Fox River in downtown Green Bay in Brown County, Wisconsin. The bridge and its interchanges include several local streets on both sides of the waterway, and a railroad mainline and spur track on the west side. The bridge mainline is approximately 4,600 feet long, and is comprised of a movable span with two adjacent fixed steel anchor spans and a series of fixed concrete approach spans on either side of the waterway. The movable span is a double-leaf trunnion-style bascule structure, and the mainline portion of the approach structure consists of 23 spans west of the bascule span and 20 to the east. Additional multi-span units carry four entrance and exit ramps on each side of the river to underpassing local streets.

The purpose of this study is to evaluate the feasibility of future "build" alternatives to rehabilitate or replace the bridge and associated roadway segments. The conceptual alternatives presented in this report are intended to summarize overall scopes of recommended work for bridge rehabilitation and replacement alternatives that would be further refined during subsequent design phases of the project.

CONCEPTUAL ALTERNATIVES AND COST ESTIMATE REFINEMENT

Three conceptual alternatives were developed for comparison. These alternatives were evaluated in the June 3, 2015 Rehabilitation-Replacement Report. They included a complete replacement alternative, a complete rehabilitation alternative, and a hybrid alternative replacing the approach spans and rehabilitating the movable span. Following review by the Wisconsin Department of Transportation, these alternatives were refined to modify shoulder widths, and a subsequent fourth conceptual alternative was identified by the WisDOT Bureau of Structures (BOS). With the development of this fourth alternative, cost assumptions were re-evaluated for all four alternatives.

The existing shoulder widths on the bridge are less than desirable (2'-9" in most places vs. 6'-0" current standard), both along the median and the outside shoulder. Alternative 2 proposes 6'-0" shoulders for the approach spans, which will then taper down to the 2'-9" widths on the rehabilitated Anchor and Bascule spans.

A fourth alternative, called "BOS Alternative 2 Modification," is similar to Alternative 2, except it would not widen any shoulders in the approach spans.

In addition, the original scope for the structural cost estimate was limited to the ends of the wingwalls off of the abutments. The scope was then expanded to include six retaining walls (RW5-2 through RW5-7 as shown in the existing plans), totaling approximately 2,140 feet in length. Four of these walls are on the mainline and are located behind the east and west abutments. The other two walls are on the ramps for S. Broadway. The retaining wall costs include the following items:

- Concrete
- Reinforcing Steel

- Removal of Existing Walls
- Excavation for Structures
- Backfill Granular
- Piling Steel, Conduits
- Junction Boxes
- Light Poles.

The retaining wall costs are only applied to Alternatives 2, 2A and 3. It is assumed that regardless of the bridge layout chosen, any alternative where the approach spans are replaced will include replacing the retaining walls as well.

Roadway costs assume removing the existing pavement and curb and gutter and replacing it with 9-inch concrete pavement over a 9-inch base. New 30-inch curb and gutter, landscaped terraces and 5-inch sidewalk over 2-inch base would also be included. The concrete barrier, where it currently exists, would be replaced with new single-faced or double-faced concrete barrier as appropriate. Signals at the eastbound and westbound Mason Street ramps with Ashland Avenue would be replaced with new monotube systems. In addition, the roadway costs include updating drainage and storm sewer systems, replacing signing, new pavement marking, replacing lighting, traffic control during construction, erosion control and landscaping, utility improvements, and the potential for community sensitive solutions upgrades.

Costs for all alternatives are summarized in the evaluation matrix, Table 5 on page 9.

LIFE CYCLE COST ANALYSIS

Following FHWA guidelines, a life cycle cost analysis (LCCA) was performed to compare the rehabilitation and replacement alternatives. The LCCA took into account the initial capital cost of each alternative in addition to future rehabilitation and/or replacement work that would be required within the analysis period. All assumptions are consistent with those detailed in the Rehabilitation-Replacement Report of November 2014.

- Rehabilitation Year = 2025
- Replacement Year = 2025
- Replacement design life and service life (bascule span) = 90 years
- Replacement design life and service life (Approach Spans) = 90 years
- Rehabilitated structure design life = 38 years, rounded up to 40 years in this analysis; bridge would be replaced in 2065
- Reinforced concrete bridge deck service life = 50 years
- Open steel grid bridge deck on bascule span service life = 50 years
- Closed bridge deck system on bascule service life= 90 years
- Bridge deck service life before first overlay (All Spans) = 30 years
- Paint systems for structural steel are assumed to last for 30 years with no interim repairs.
- Mechanical and Electrical repairs and/or rehabilitations are required every 25 years

- Annual Maintenance and operating costs are assumed to be the same for each alternative and are therefore neglected since any difference would have minimal impact on life cycle costs. A separate line item for deck repairs is included in the analysis.
- Highway user delay costs are neglected
- No cost is factored in for obsolescence
- Analysis period = 90 years
- Discount rate = 5%
- Real Dollars = 2014 Dollars

Tables 1-4 below summarize the results of the LCCA for a 90-year analysis period, using a discount rate of 5.0%. Four alternatives are analyzed:

1. Alternative 1. Complete Rehabilitation: bascule and approach spans are rehabilitated in year 0; both are replaced in year 40.

2. Alternative 2. Approach Replacement and Bascule Rehabilitation: bascule span is rehabilitated in year 0; approach spans are replaced in year 0; bascule span in replaced in year 40.
3. BOS Alt 2 Modification. Approach Replacement and Bascule Rehabilitation: bascule span is rehabilitated in year 0; approach spans are replaced in year 0; bascule span in replaced in year 40 with no shoulder widening on approach spans
4. Alternative 3. Complete Replacement: bascule and approach spans are replaced in year 0.

Table 5, on page 9, summarizes the costs and impacts of all four alternatives.

TABLE 1: LCCA SUMMARY – COMPLETE REHABILITATION (ALTERNATIVE 1)

Cost Component Activity	Year	Cost	Net Present Value (5.0%)
Rehabilitation (Bascule & Anchor Spans)	0	$9,486,050	$9,486,050
Rehabilitation (Approach Spans)	0	$33,806,920	$33,806,920
Roadway Reconstruction (Concrete)	0	$5,590,000	$5,590,000
Roadway Pavement Joint & Crack Repair	20	$200,000	$75,378
Deck Repairs (Partial & Full Depth)	20	$425,000	$160,178
Mechanical Repairs	25	$321,700	$94,999
Electrical Repairs	25	$3,071,000	$906,875
Abrasive Blast & Paint Steel	30	$3,146,400	$728,006
Roadway Pavement Joint & Crack Repair	30	$200,000	$46,275
Deck Overlay (App & Anc Spans)	30	$6,345,000	$1,468,090
Bridge Replacement	40	$124,559,000	$17,693,068
Roadway Mill and Overlay	40	$1,000,000	$142,046
Roadway Reconstruction (Concrete)	50	$5,590,000	$487,469
Deck Repairs (Partial & Full depth)	60	$425,000	$22,753
Mechanical Repairs	65	$321,700	$13,494
Electrical Repairs	65	$2,334,000	$97,903
Abrasive Blast & Paint Steel	70	$3,146,400	$103,410
Deck Overlay (All Spans)	70	$7,155,000	$235,157
Roadway Pavement Joint & Crack Repair	70	$200,000	$6,573
Roadway Pavement Joint & Crack Repair	80	$200,000	$4,035
Mechanical Repairs	90	$677,600	$8,393
Electrical Repairs	90	$3,438,000	$42,586
Deck Replacement (Approach & Anchor Spans)	90	$32,308,000	$400,196
Roadway Mill and Overlay	90	$1,000,000	$12,387
Remaining Service Life Value	90	($55,360,000)	($685,739)
		Net Present Value (NPV)	**$70,946,503**
		Equivalent Uniform Annual Costs (EUAC)	**$3,591,817**

TABLE 2: LCCA SUMMARY – APPROACH REPLACEMENT & BASCULE REHABILITATION (ALTERNATIVE 2)

Cost Component Activity	Year	Cost	Net Present Value (5.0%)
Rehabilitation (Bascule & Anchor Spans)	0	$9,486,050	$9,486,050
Replacement (Approach Spans)	0	$69,204,900	$69,204,900
Roadway Reconstruction (Concrete)	0	$5,590,000	$5,590,000
Deck Repairs (Partial & Full Depth)	20	$425,000	$160,178
Roadway Pavement Joint & Crack Repair	20	$200,000	$75,378
Mechanical Repairs	25	$321,700	$94,999
Electrical Repairs	25	$3,071,000	$906,875
Abrasive Blast & Paint Steel	30	$3,146,400	$728,006
Deck Overlay (Approach & Anchor Spans)	30	$7,155,000	$1,655,506
Roadway Pavement Joint & Crack Repair	30	$200,000	$46,275
Bascule & Anchor Span Replacement	40	$62,800,000	$8,920,469
Roadway Mill & Overlay	40	$1,000,000	$142,046
Deck Replacement (Approach Spans)	50	$32,308,000	$2,817,378
Roadway Reconstruction (Concrete)	50	$5,590,000	$487,469
Mechanical Repairs	65	$321,700	$13,494
Electrical Repairs	65	$2,334,000	$97,903
Abrasive Blast & Paint Steel	70	$3,146,400	$103,410
Deck Repairs (Approach & Anchor Spans)	70	$425,000	$13,968
Roadway Pavement Joint & Crack Repair	70	$200,000	$6,573
Roadway Pavement Joint & Crack Repair	80	$200,000	$4,035
Mechanical Repairs	90	$677,600	$8,393
Electrical Repairs	90	$3,438,000	$42,586
Roadway Mill & Overlay	90	$1,000,000	$12,387
Remaining Service Life Value (Bascule & Anchor Spans)	90	($27,900,000)	($345,595)
Remaining Service Life Value (Approach Spans)	90	$0	$0
		Net Present Value (NPV)	**$100,272,684**
		Equivalent Uniform Annual Costs (EUAC)	**$5,076,517**

TABLE 3: LCCA SUMMARY – APPROACH REPLACEMENT & BASCULE REHABILITATION, NO SHOULDER WIDENING (BOS ALT 2 MODIFICATION)

Cost Component Activity	Year	Cost	Net Present Value (5.0%)
Rehabilitation (Bascule & Anchor Spans)	0	$9,486,050	$9,486,050
Replacement (Approach Spans)	0	$62,831,860	$62,831,860
Roadway Reconstruction (Concrete)	0	$5,590,000	$5,590,000
Deck Repairs (Partial & Full Depth)	20	$425,000	$160,178
Roadway Pavement Joint & Crack Repair	20	$200,000	$75,378
Mechanical Repairs	25	$321,700	$94,999
Electrical Repairs	25	$3,071,000	$906,875
Abrasive Blast & Paint Steel	30	$3,146,400	$728,006
Deck Overlay (Approach & Anchor Spans)	30	$6,234,000	$1,442,407
Roadway Pavement Joint & Crack Repair	30	$200,000	$46,275
Bascule & Anchor Span Replacement	40	$62,800,000	$8,920,469
Roadway Mill & Overlay	40	$200,000	$28,409
Deck Replacement (Approach Spans)	50	$28,149,000	$2,454,698
Roadway Reconstruction (Concrete)	50	$5,590,000	$487,469
Mechanical Repairs	65	$321,700	$13,494
Electrical Repairs	65	$2,334,000	$97,903
Abrasive Blast & Paint Steel	70	$3,146,400	$103,410
Deck Repairs (Approach & Anchor Spans)	70	$425,000	$13,968
Roadway Pavement Joint & Crack Repair	70	$200,000	$6,573
Roadway Pavement Joint & Crack Repair	80	$200,000	$4,035
Mechanical Repairs	90	$677,600	$8,393
Electrical Repairs	90	$3,438,000	$42,586
Roadway Mill & Overlay	90	$1,000,000	$12,387
Remaining Service Life Value (Bascule & Anchor Spans)	90	($27,900,000)	($345,595)
Remaining Service Life Value (Approach Spans)	90	$0	$0
		Net Present Value (NPV)	**$93,210,228**
		Equivalent Uniform Annual Costs (EUAC)	**$4,718,965**

TABLE 4: LCCA SUMMARY – COMPLETE REPLACEMENT (ALTERNATIVE 3)

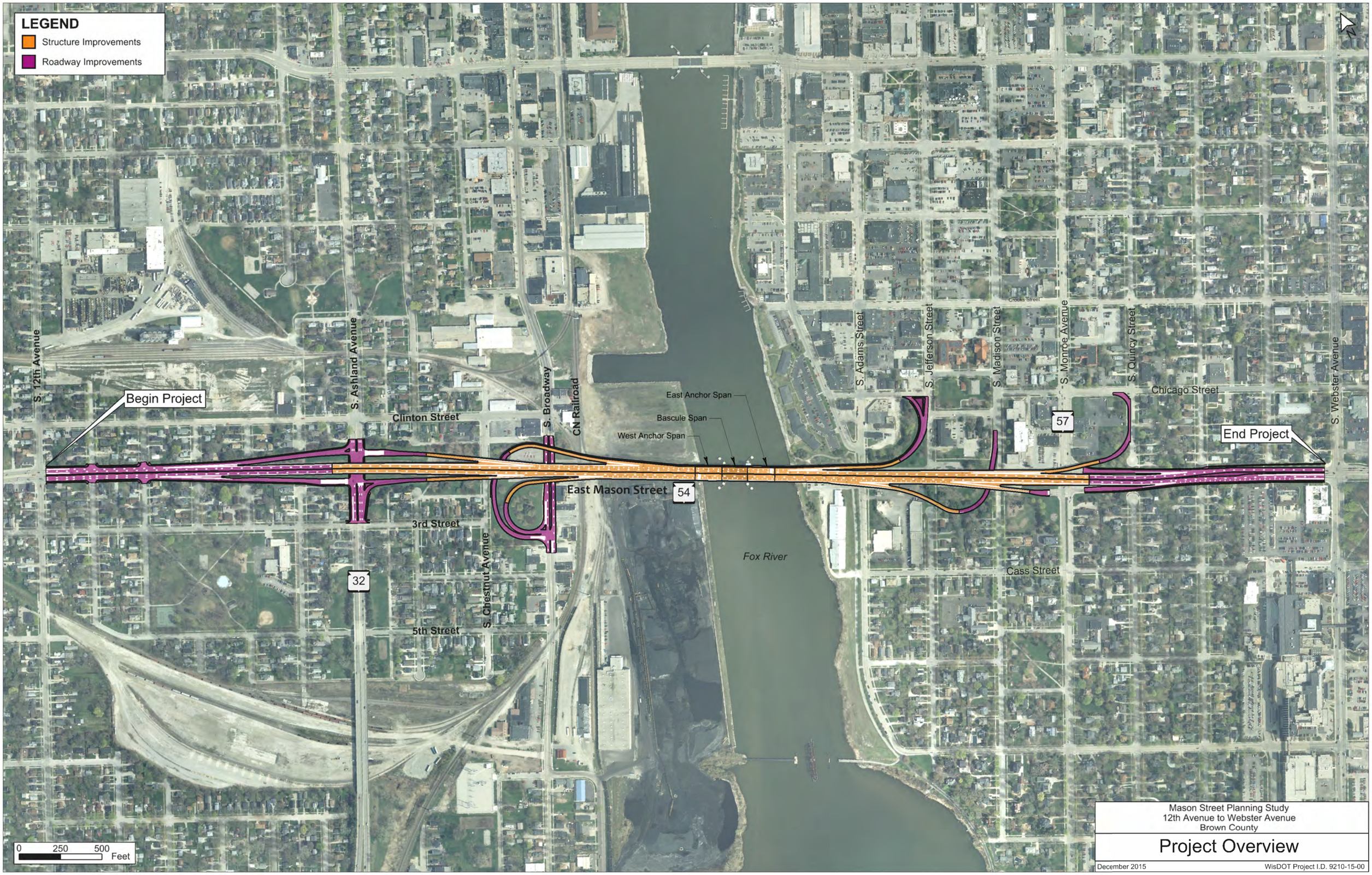
Cost Component Activity	Year	Cost	Net Present Value (5.0%)
Replacement (Bascule & Anchor Spans)	0	$62,800,000	$62,800,000
Replacement (Approach Spans)	0	$61,790,130	$61,790,130
Roadway Reconstruction (Concrete)	0	$5,590,000	$5,590,000
Deck Repairs (Partial & Full Depth)	20	$425,000	$160,178
Roadway Pavement Joint & Crack Repair	20	$200,000	$75,378
Mechanical Repairs	25	$321,700	$94,999
Electrical Repairs	25	$2,334,000	$689,237
Abrasive Blast & Paint Steel	30	$3,146,400	$728,006
Deck Overlay (All Spans)	30	$7,155,000	$1,655,506
Roadway Pavement Joint & Crack Repair	30	$200,000	$46,275
Roadway Mill and Overlay	40	$1,000,000	$142,046
Mechanical Repairs	50	$677,600	$59,089
Electrical Repairs	50	$3,438,000	$299,806
Deck Replacement (Approach & Anchor Spans)	50	$32,308,000	$2,817,378
Roadway Reconstruction (Concrete)	50	$5,590,000	$487,469
Abrasive Blast & Paint Steel	60	$3,146,400	$168,444
Deck Repairs (Approach & Anchor Spans)	70	$425,000	$13,968
Roadway Pavement Joint & Crack Repair	70	$200,000	$6,573
Mechanical Repairs	75	$321,700	$8,284
Electrical Repairs	75	$2,334,000	$60,104
Roadway Pavement Joint & Crack Repair	80	$200,000	$4,035
Roadway Mill and Overlay	90	$1,000,000	$12,387
Remaining Service Life Value	90	$0	$0
		Net Present Value (NPV)	**$137,709,293**
		Equivalent Uniform Annual Costs (EUAC)	**$6,971,824**

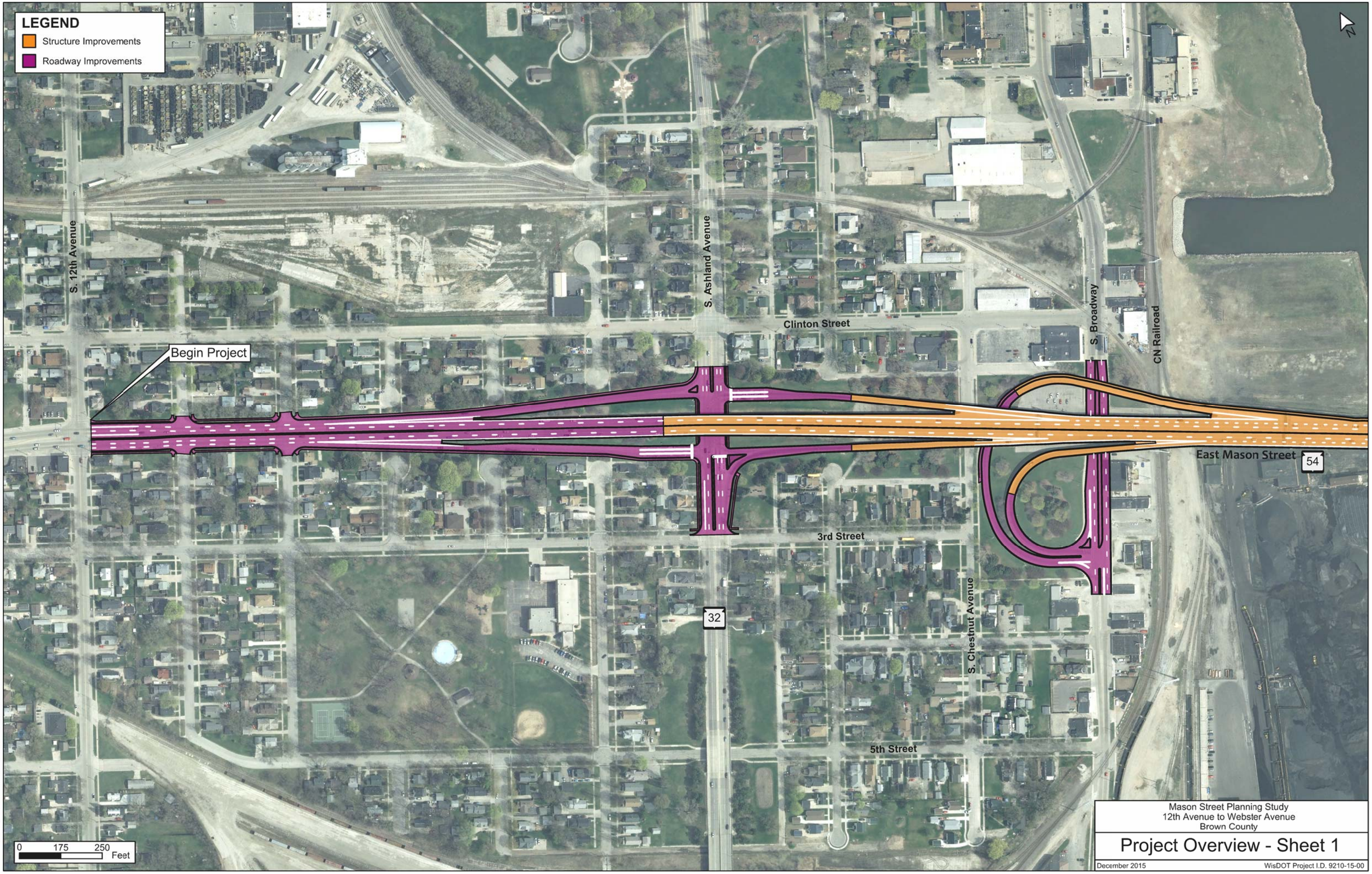
TABLE 5: ALTERNATIVES EVALUATION

Criterion	Alternative 1 *Complete Rehabilitation*	Alternative 2 *Concrete Approach Replacement and Bascule Rehabilitation*	BOS Alt 2 Modification *Concrete Approach Replacement and Bascule Rehabilitation*	Alternative 3 *Complete Replacement*
Construction Cost[1]	$48,900,000	$84,300,000	$78,000,000	$130,200,000
Life Cycle Costs	NPV: $71,000,000 EUAC: $3,600,000	NPV: $100,300,000 EUAC: $5,100,000	NPV: $93,300,000 EUAC: $4,800,000	NPV: $137,800,000 EUAC: $7,000,000
Functionality	No improvement	Wider roadway deck on approach spans promotes convenience and utility	No improvement	Wider shoulders on all decks and sidewalks on both sides of bridge provide utility and convenience
Structural Capacity	Improved capacity of some spans receiving replacement PPC girders, but no overall controlling capacity improvement	Approach spans would be built to current codes and have capacity to carry current design loads	Approach spans would be built to current codes and have capacity to carry current design loads	A new bridge would be built to current codes and have capacity to carry current design loads
Long Term Reliability	The bridge will be more than 50 years old in the year 2025 and will be more prone to unexpected problems than a new bridge. Concerns about deterioration of girder ends and pier caps under deck joints fully addressed	Approach spans would be fully rebuilt to current codes and requirements, and with modern higher quality materials	Approach spans would be fully rebuilt to current codes and requirements, and with modern higher quality materials	A new bridge would be fully rebuilt to current codes and requirements, and with modern higher quality materials
Construction Disruption	Lasts one calendar year	Lasts two calendar years	Lasts two calendar years	Lasts 1 ½ calendar years
Color Coding Key: Relative Impacts	**Large impact: less desirable**	**Moderate impact**	**Small impact: more desirable**	

[1] Costs include total reconstruction of mainline roadways, side roads and ramps and other contingencies and are rounded up to nearest $100,000; all costs in 2014 dollars to ensure consistency with earlier reports.

APPENDIX A: EXHIBITS


LEGEND
Structure Improvements
Roadway Improvements
S. 12th Avenue
S. Ashland Avenue
S. Broadway
CN Railroad
S. Adams Street
S. Jefferson Street
S. Madison Street
S. Monroe Avenue
S. Quincy Street
S. Webster Avenue
Crooks Street
Chicago Street
Begin Project
Clinton Street
East Anchor Span
Bascule Span
West Anchor Span
57
End Project
East Mason Street
54
3rd Street
S. Chestnut Avenue
Fox River
Cass Street
32
5th Street
0 250 500 Feet
Mason Street Planning Study
12th Avenue to Webster Avenue
Brown County
Project Overview
December 2015
WisDOT Project I.D. 9210-15-00

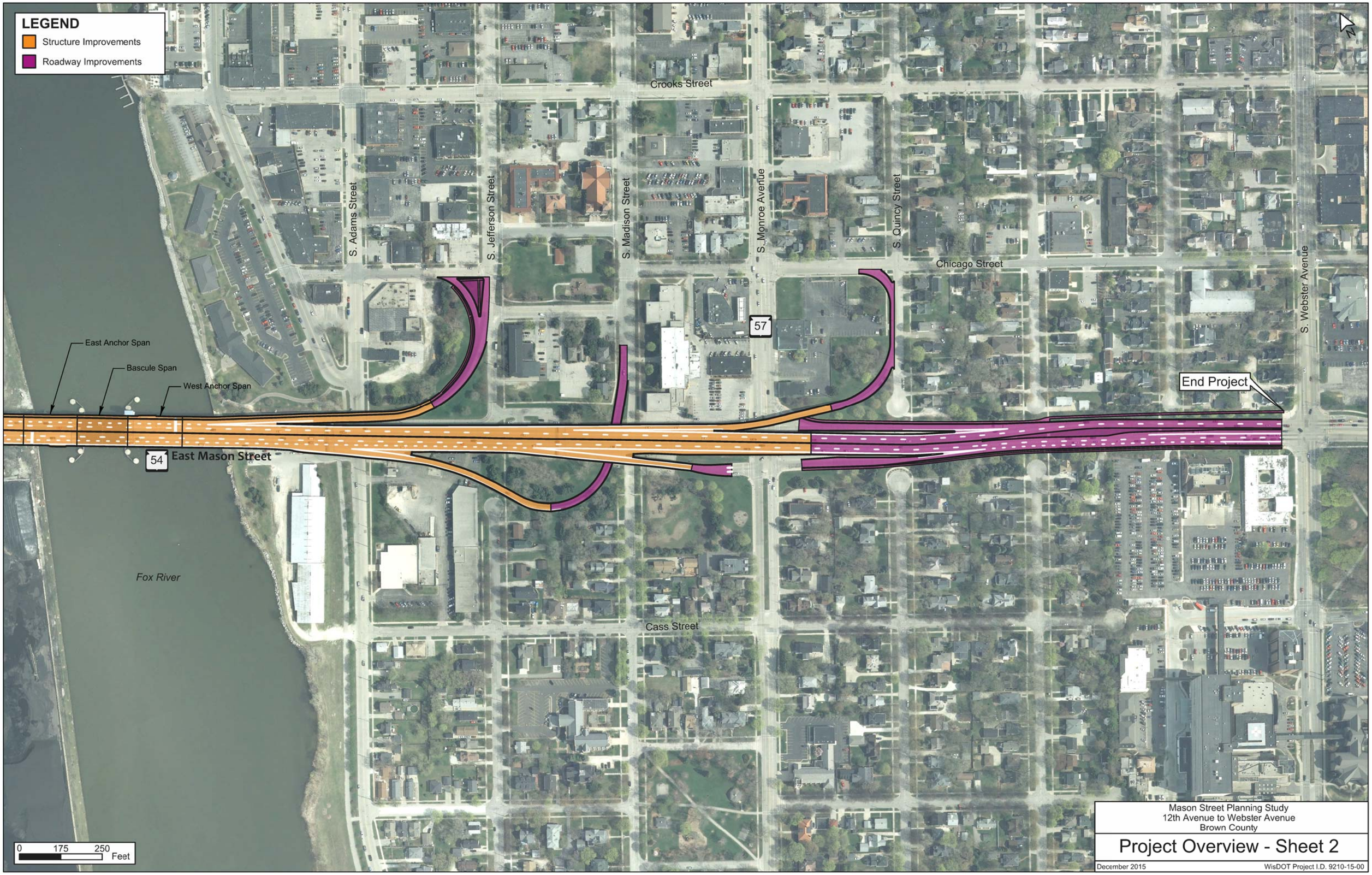


Mason Street Planning Study
12th Avenue to Webster Avenue
Brown County

Project Overview - Sheet 1

December 2015

WisDOT Project I.D. 9210-15-00



Mason Street Planning Study
12th Avenue to Webster Avenue
Brown County

Project Overview - Sheet 2

December 2015 WisDOT Project I.D. 9210-15-00

LEGEND

- Structure Improvements
- Roadway Improvements

West Anchor Span

Bascule Span

East Anchor Span

East Mason Street 54

175' Taper

175' Taper

Fox River

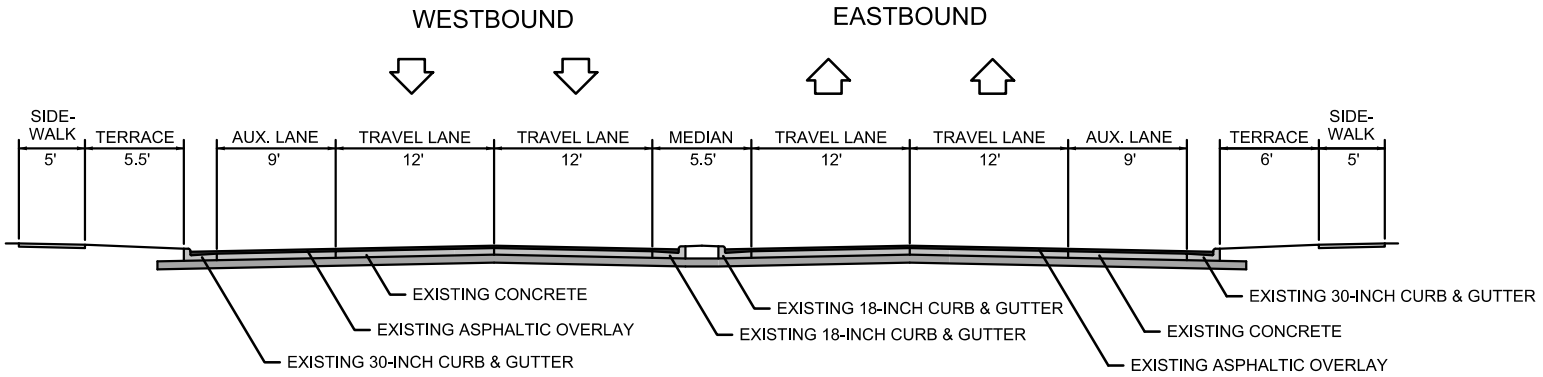
0 25 50 Feet

Mason Street Planning Study
12th Avenue to Webster Avenue
Brown County

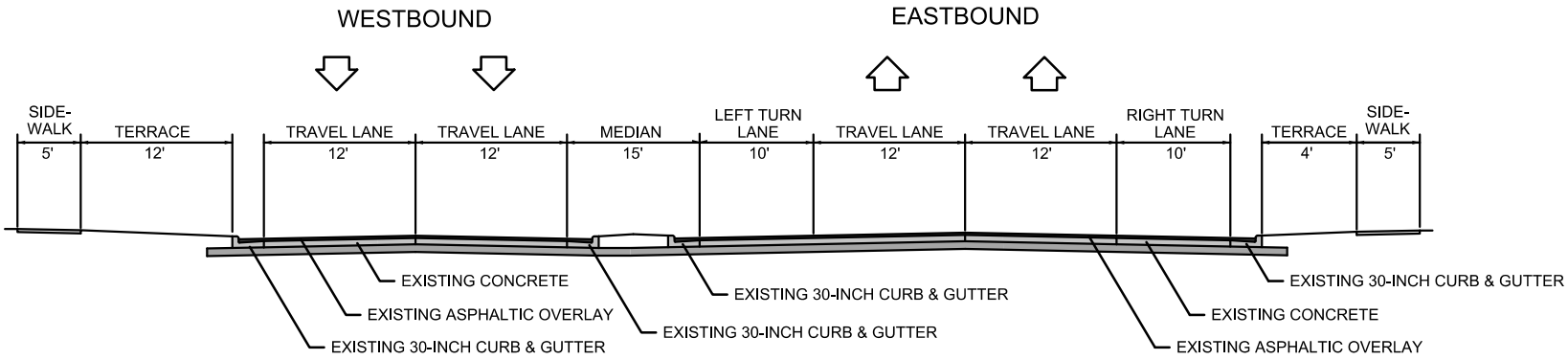
Alternative 2 - Bascule Span

December 2015

WisDOT Project I.D. 9210-15-00



Mason Street - West Roadway

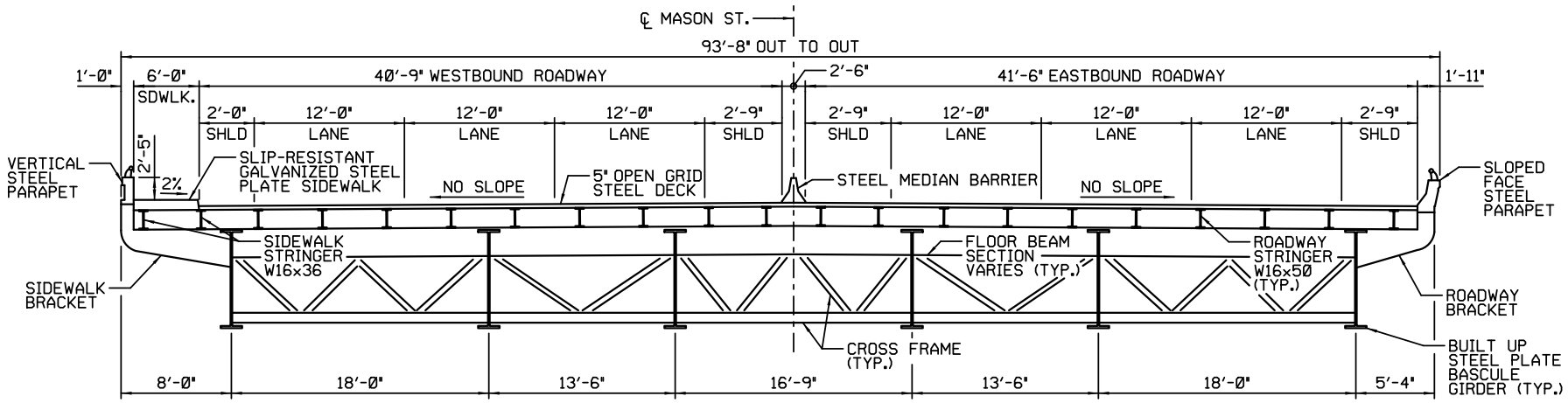


Mason Street - East Roadway

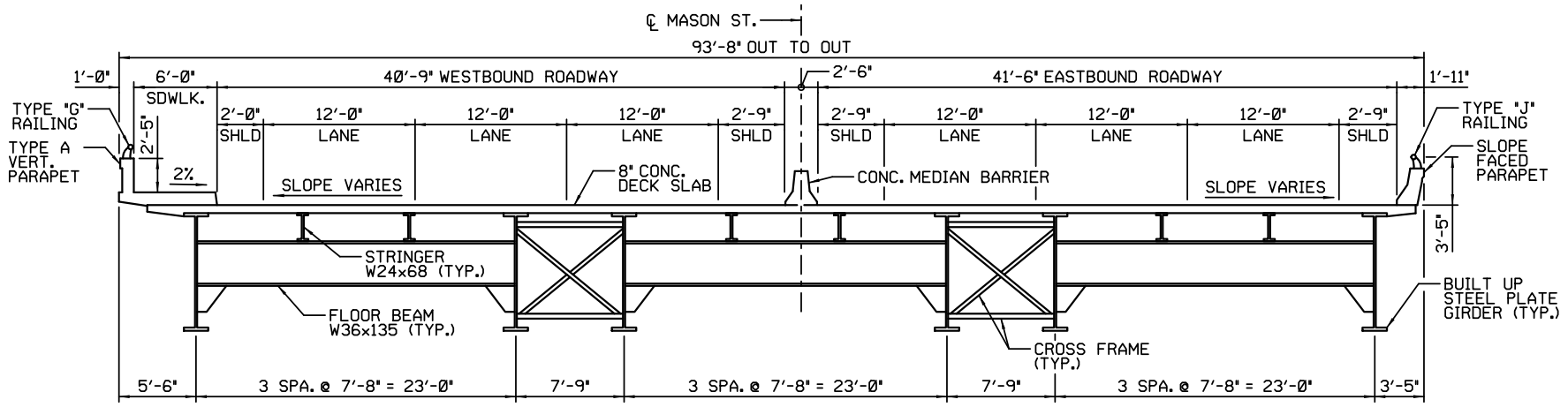
Mason Street Planning Study
12th Avenue to Webster Avenue
Brown County

Existing Typical Sections

December 2015 WisDOT Project I.D. 9210-15-00



Mason Street - Bascule Span



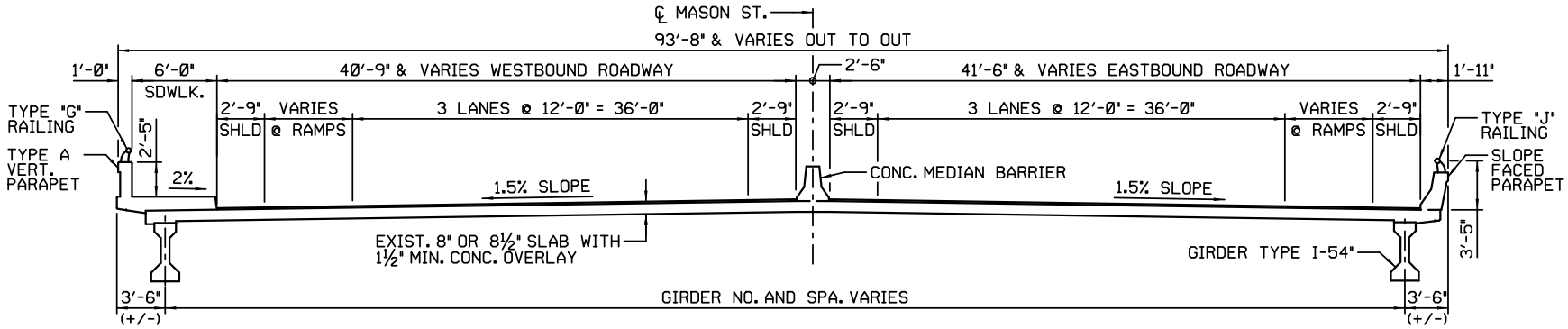
Mason Street - Anchor Spans

Mason Street Planning Study
12th Avenue to Webster Avenue
Brown County

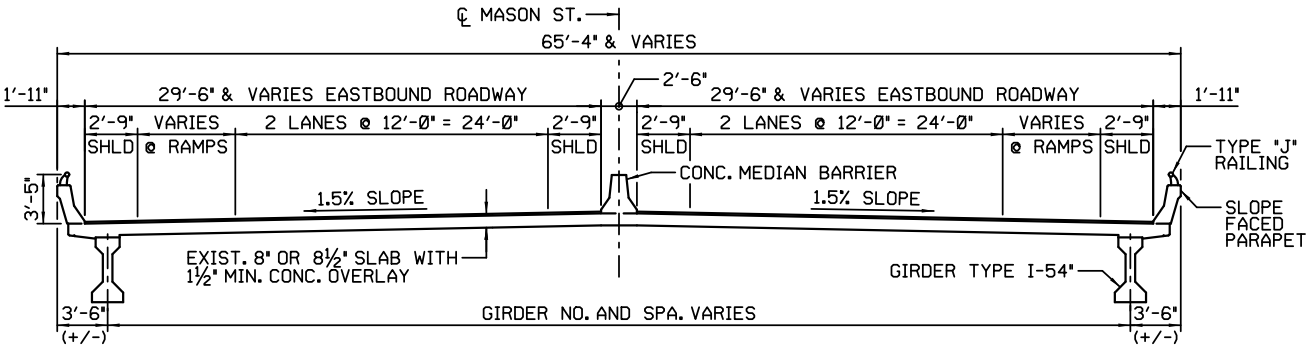
Existing Typical Sections

December 2015

WisDOT Project I.D. 9210-15-00



Mason Street - Approach Spans Adjacent to Anchor Spans

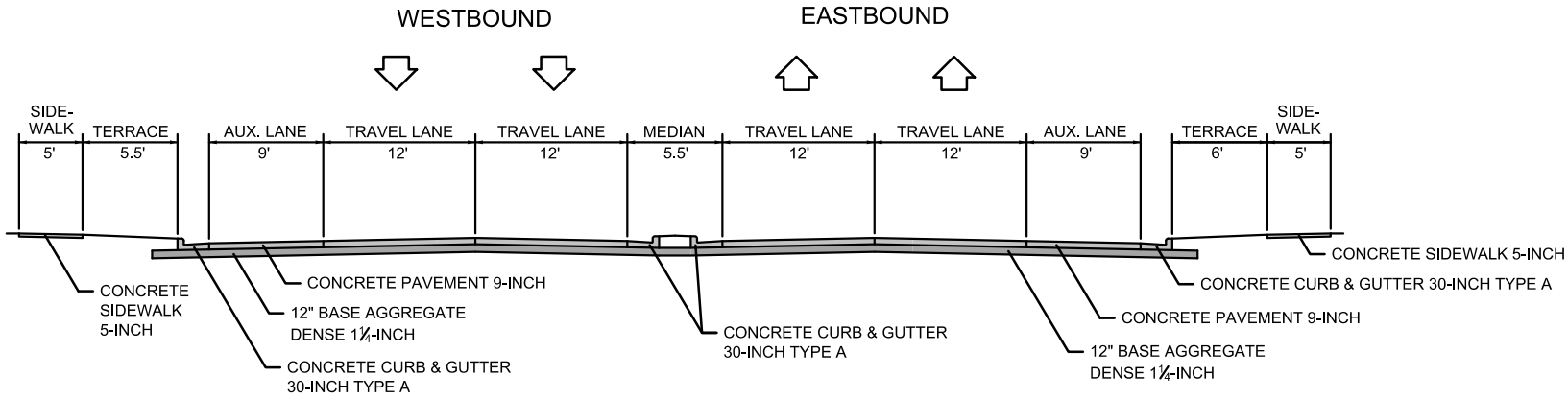


Mason Street - Approach Spans

Mason Street Planning Study
12th Avenue to Webster Avenue
Brown County

Existing Typical Sections

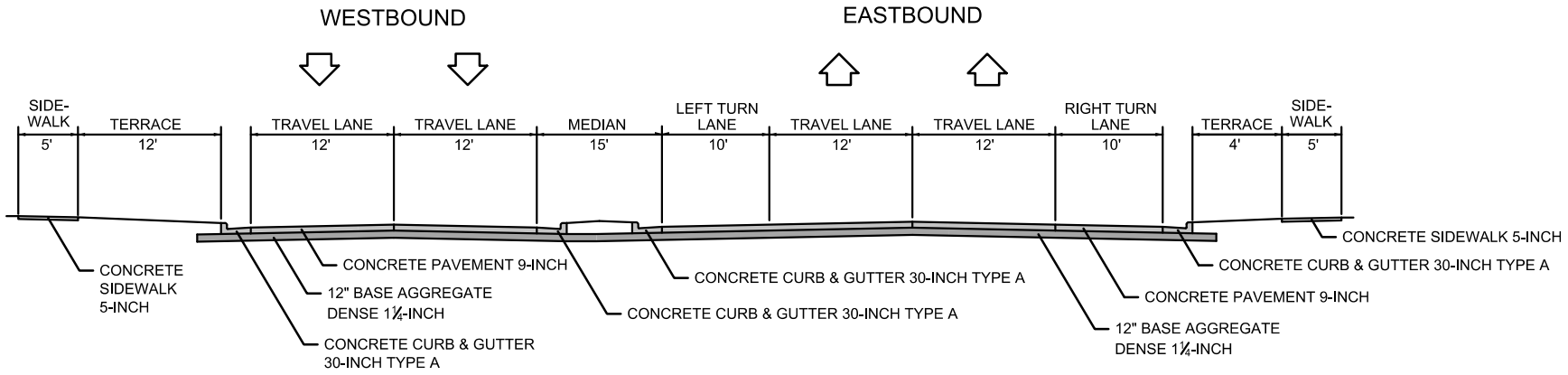
December 2015 WisDOT Project I.D. 9210-15-00



Mason Street - West Roadway

Alternatives 1, 2, 3, and BOS Mod 2

(Total Reconstruction)



Mason Street - East Roadway

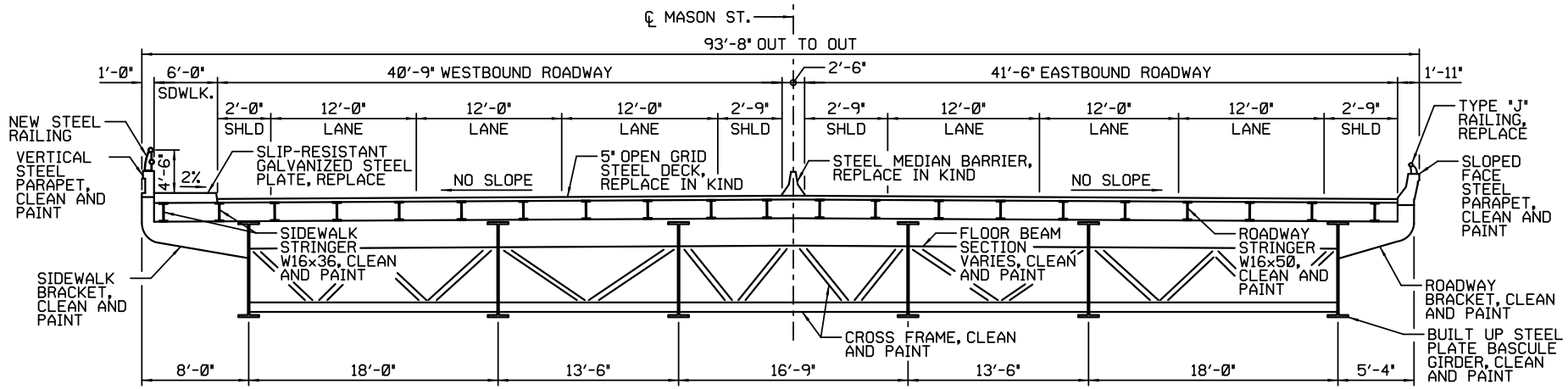
Alternatives 1, 2, 3, and BOS Mod 2

(Total Reconstruction)

Mason Street Planning Study
12th Avenue to Webster Avenue
Brown County

Proposed Typical Sections

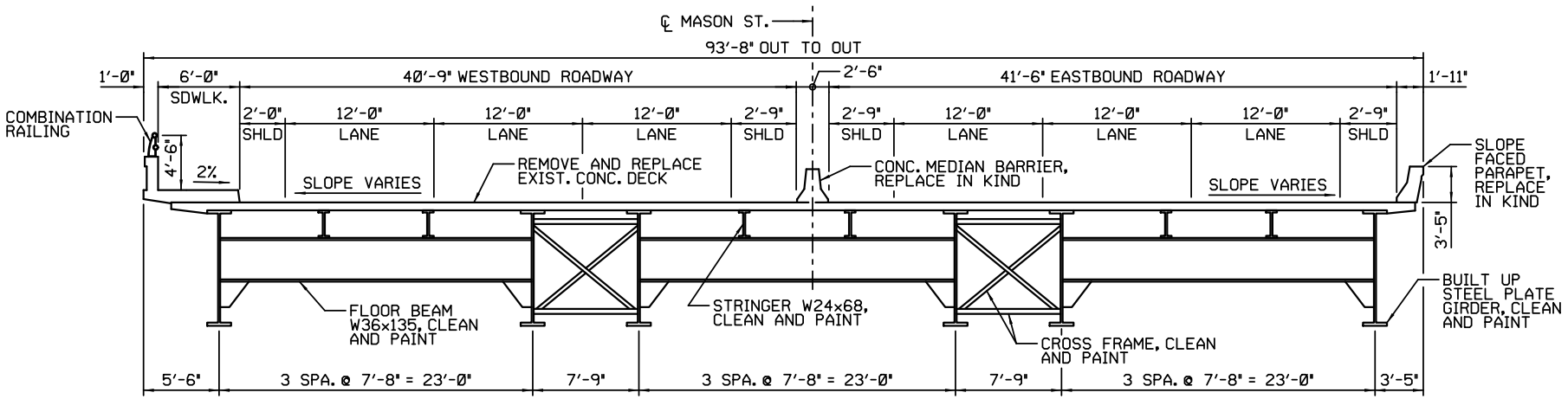
December 2015 WisDOT Project I.D. 9210-15-00



Mason Street - Bascule Span

Alternative 1

(Bascule Rehabilitation)



Mason Street - Anchor Spans

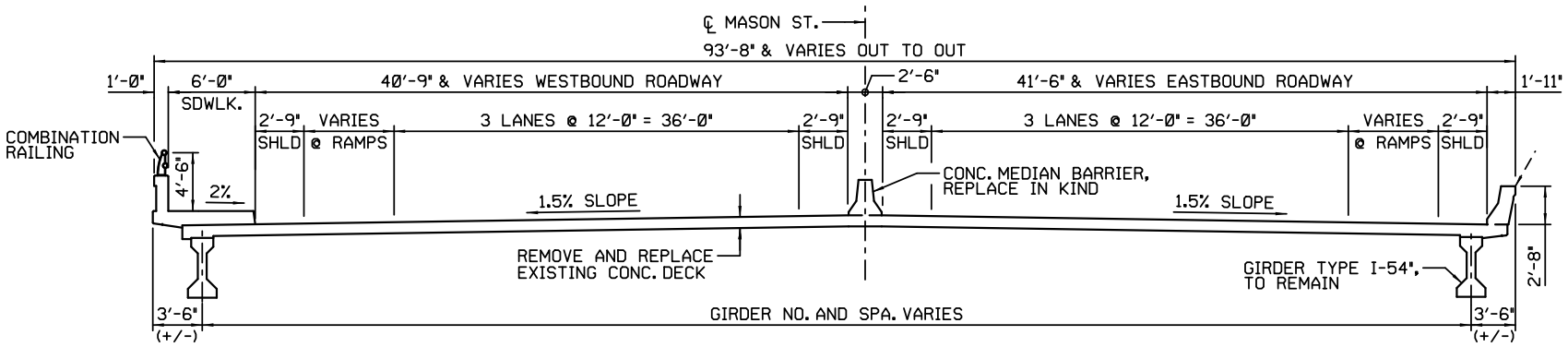
Alternative 1

(Anchor Span Rehabilitation)

Mason Street Planning Study
12th Avenue to Webster Avenue
Brown County

Proposed Typical Sections

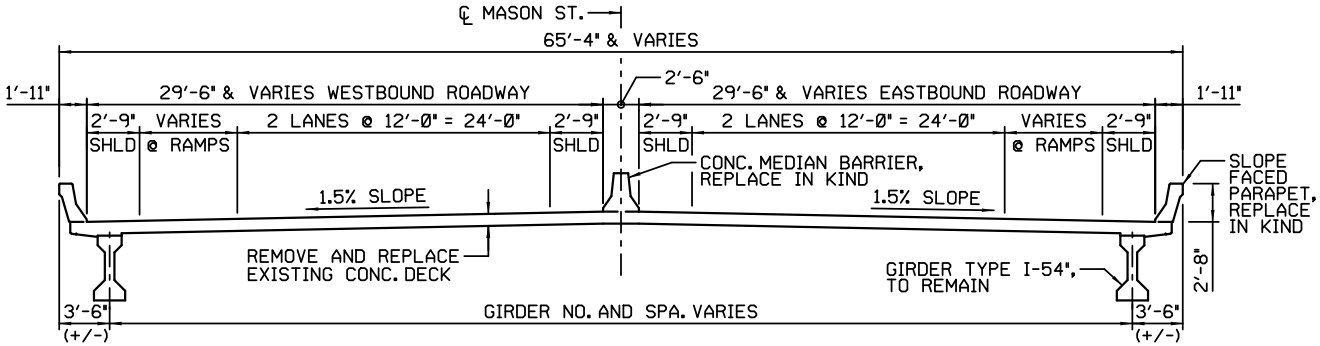
December 2015 — WisDOT Project I.D. 9210-15-00



Mason Street - Approach Spans Adjacent to Anchor Spans

Alternative 1

(Approach Spans Rehabilitation)



Mason Street - Approach Spans

Alternative 1

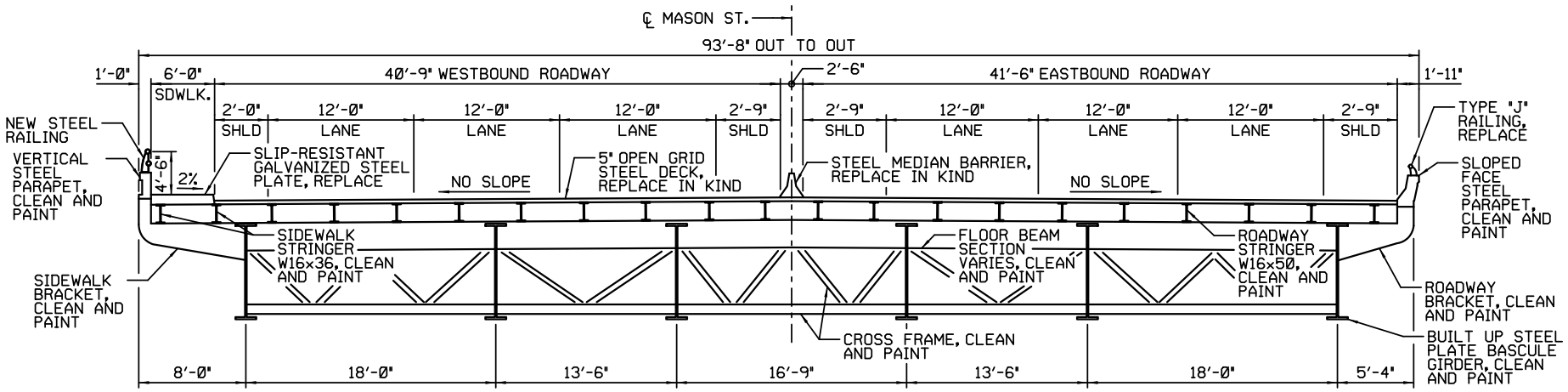
(Approach Spans Rehabilitation)

Mason Street Planning Study
12th Avenue to Webster Avenue
Brown County

Proposed Typical Sections

December 2015

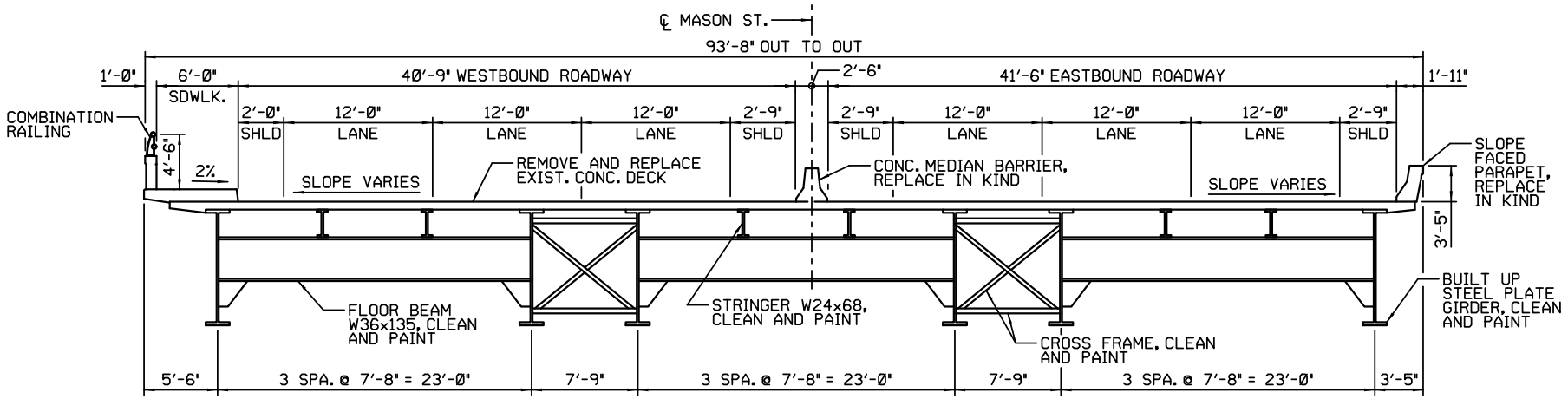
WisDOT Project I.D. 9210-15-00



Mason Street - Bascule Span

Alternative 2

(Basule Span Rehabilitation)



Mason Street - Anchor Spans

Alternative 2

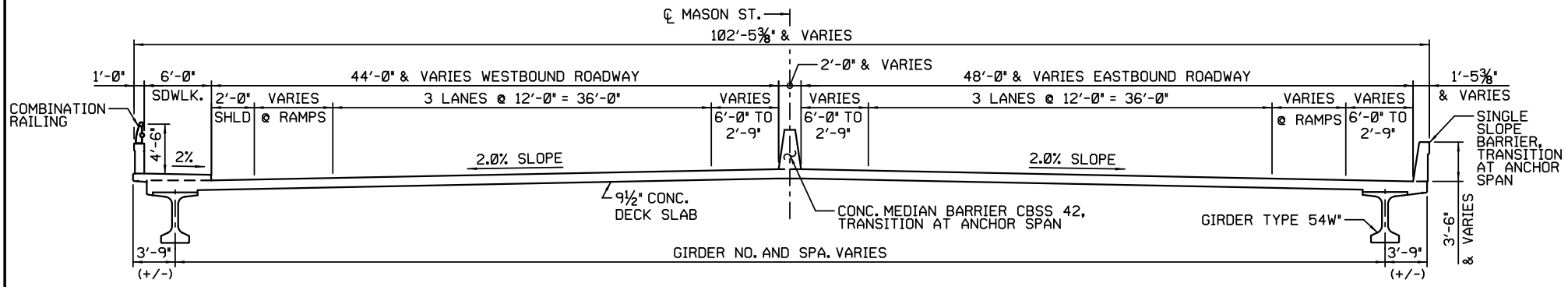
(Anchor Span Rehabilitation)

Mason Street Planning Study
12th Avenue to Webster Avenue
Brown County

Proposed Typical Sections

December 2015

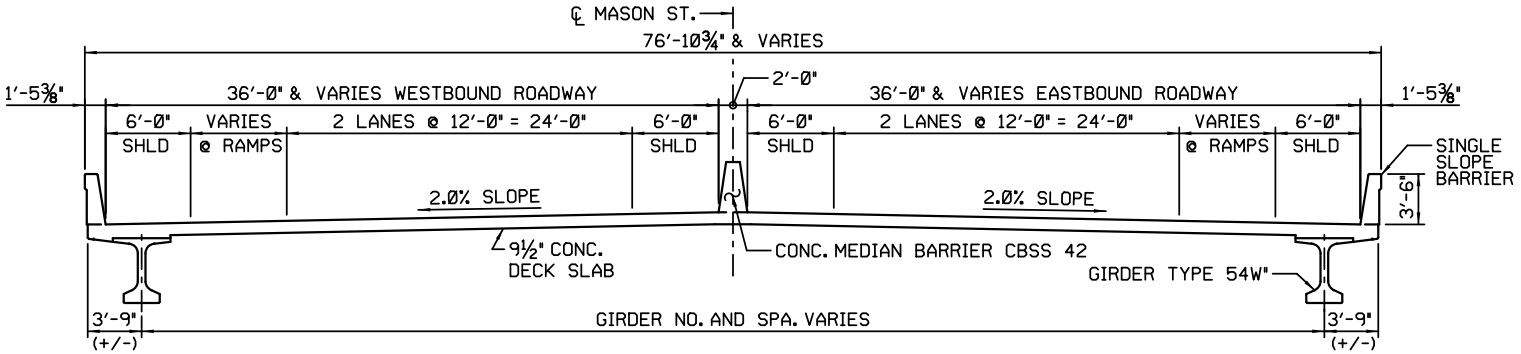
WisDOT Project I.D. 9210-15-00



Mason Street - Approach Spans Adjacent to Anchor Spans

Alternative 2

(Approach Span Reconstruction)



Mason Street - Approach Spans

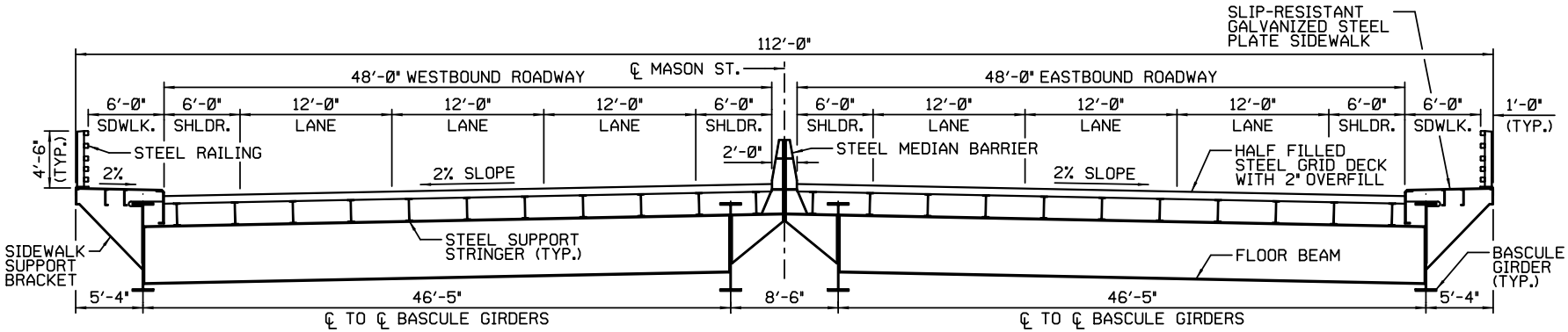
Alternative 2

(Approach Span Reconstruction)

Mason Street Planning Study
12th Avenue to Webster Avenue
Brown County

Proposed Typical Sections

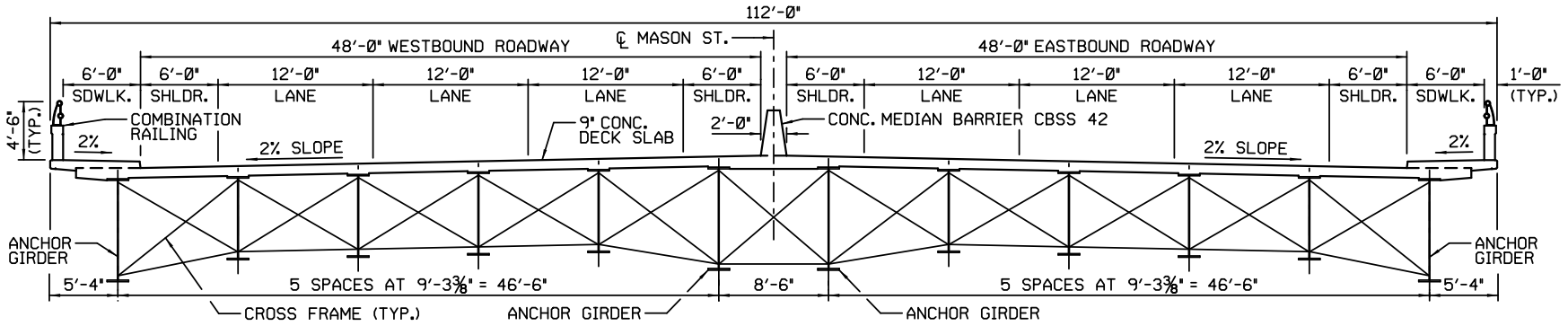
December 2015 WisDOT Project I.D. 9210-15-00



Mason Street - Bascule Span

Alternative 3

(Bascule Span Reconstruction)



Mason Street - Anchor Spans

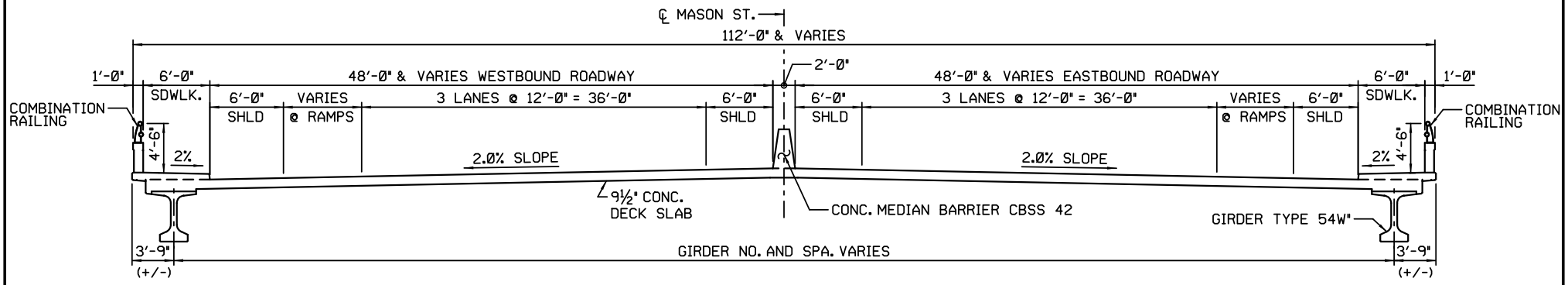
Alternative 3

(Anchor Span Reconstruction)

Mason Street Planning Study
12th Avenue to Webster Avenue
Brown County

Proposed Typical Sections

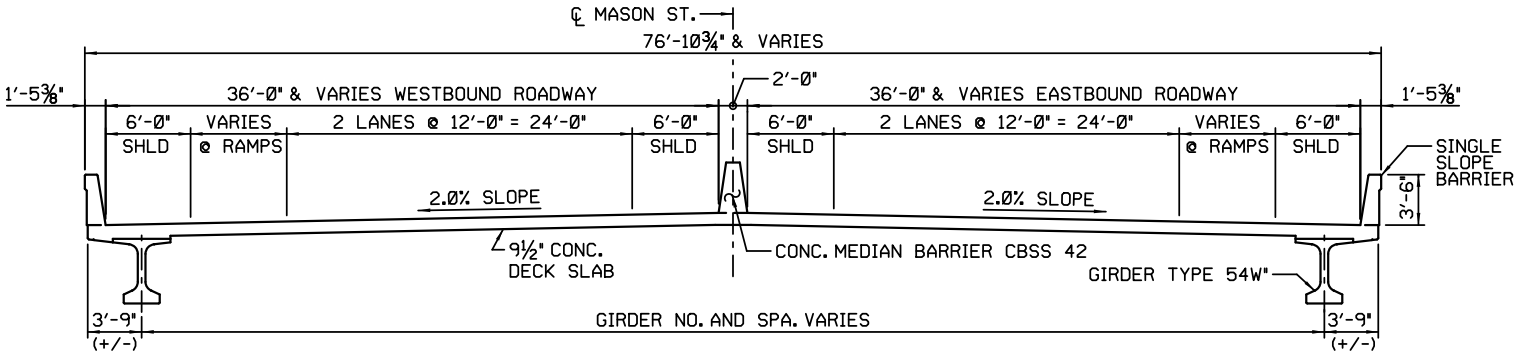
December 2015 WisDOT Project I.D. 9210-15-00



Mason Street - Approach Spans Adjacent to Anchor Spans

Alternative 3

(Approach Span Reconstruction)



Mason Street - Approach Spans

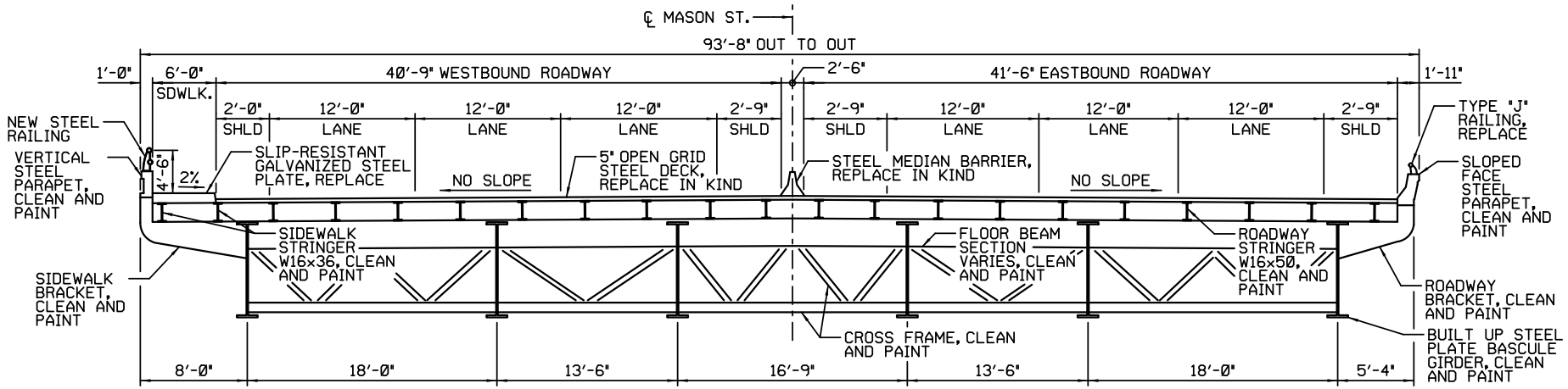
Alternative 3

(Approach Span Reconstruction)

Mason Street Planning Study
12th Avenue to Webster Avenue
Brown County

Proposed Typical Sections

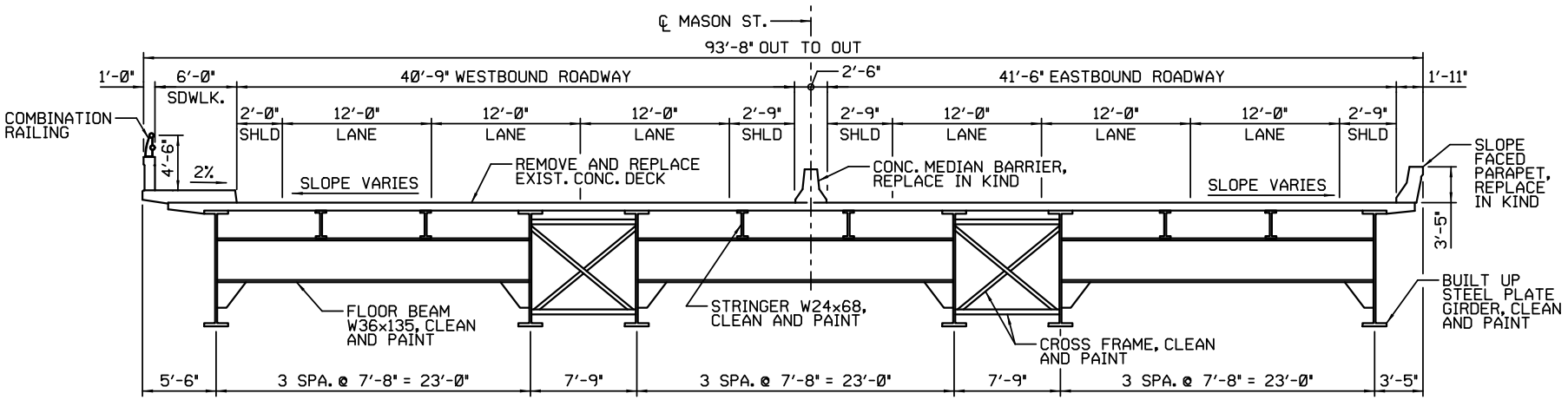
December 2015 WisDOT Project I.D. 9210-15-00



Mason Street - Bascule Span

Alternative BOS Mod 2

(Bascule Span Rehabilitation)



Mason Street - Anchor Spans

Alternative BOS Mod 2

(Anchor Span Rehabilitation)

Mason Street Planning Study
12th Avenue to Webster Avenue
Brown County

Proposed Typical Sections

December 2015

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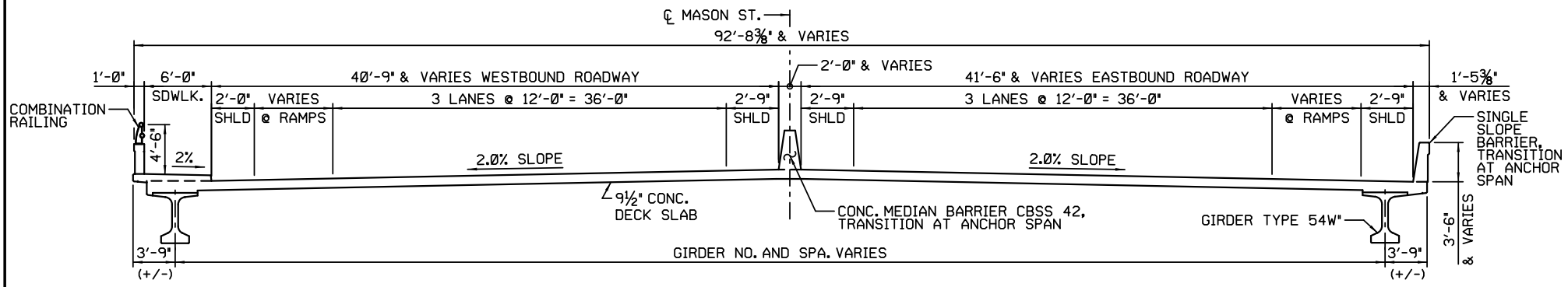
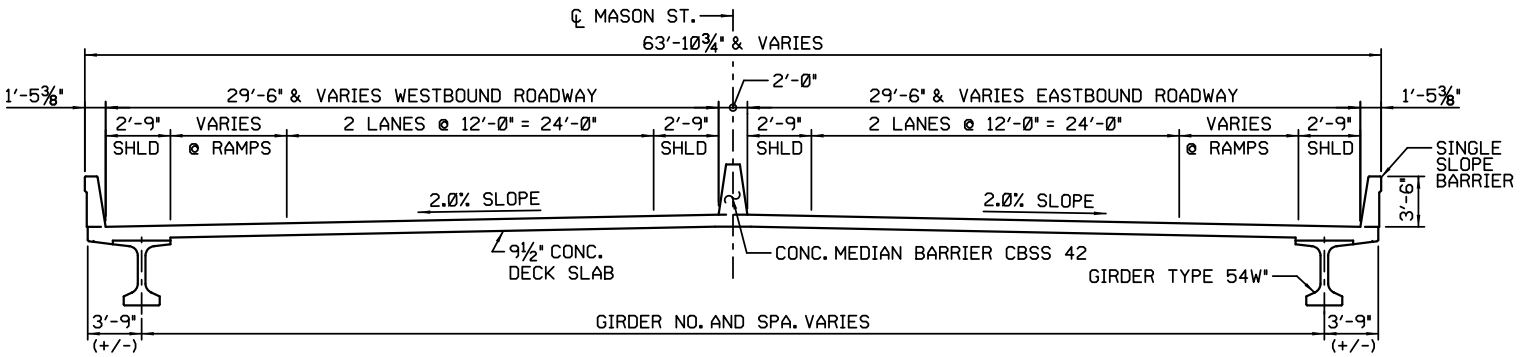


Mason Street - Approach Spans Adjacent to Anchor Spans

Alternative BOS Mod 2

(Approach Span Reconstruction)

Replace In-Kind



Mason Street - Approach Spans

Alternative BOS Mod 2

(Approach Span Reconstruction)

Replace In-Kind

Mason Street Planning Study
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December 2015

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