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HIGHWAY 85 BRIDGE REPLACEMENT:
OVER THE MISSOURI RIVER NEAR WILLISTON, ND

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Oil Activity in Western ND

- First horizontal well in 2004
- Currently over 16,000 wells
  - 1.2 million barrels of oil per day
  - ND became 2nd leading state in oil production behind Texas
- Full development – up to 36,000 more wells

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Bakken Map

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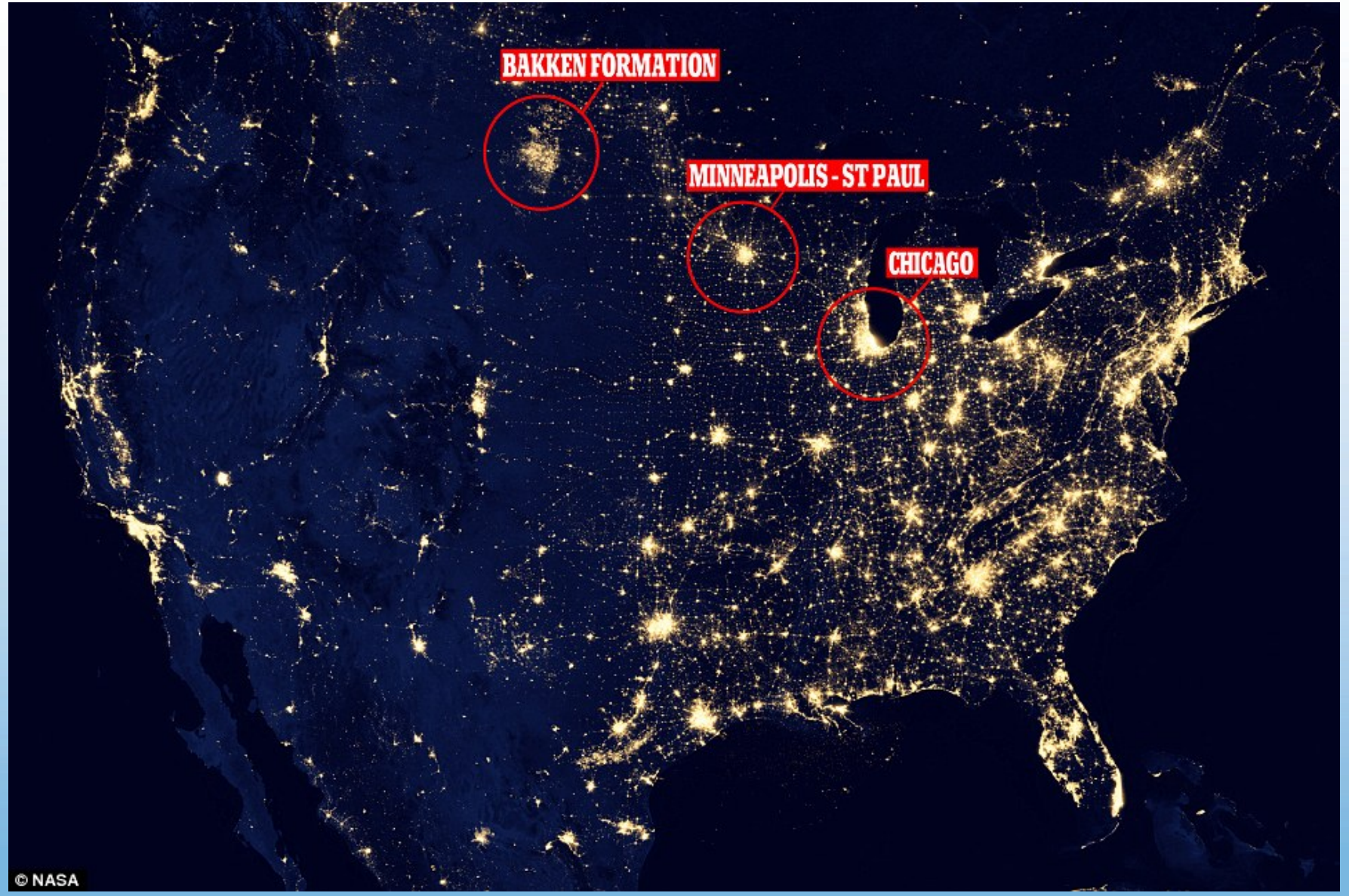
Night View



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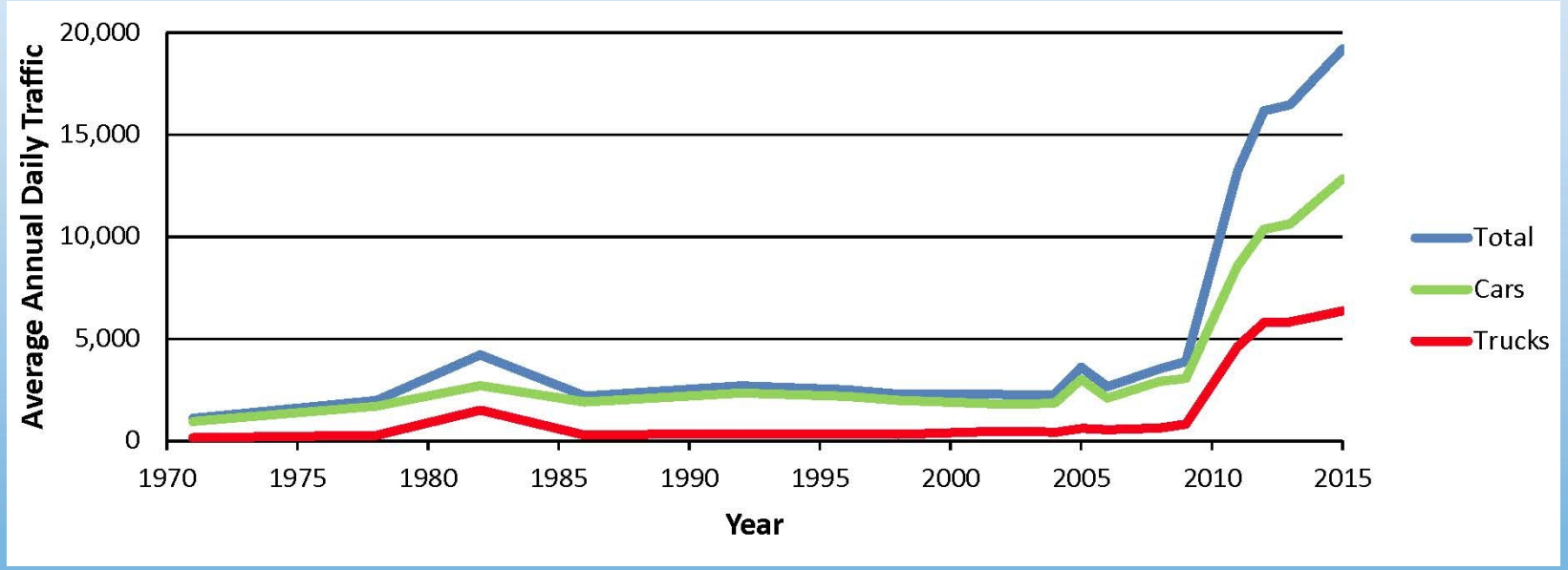
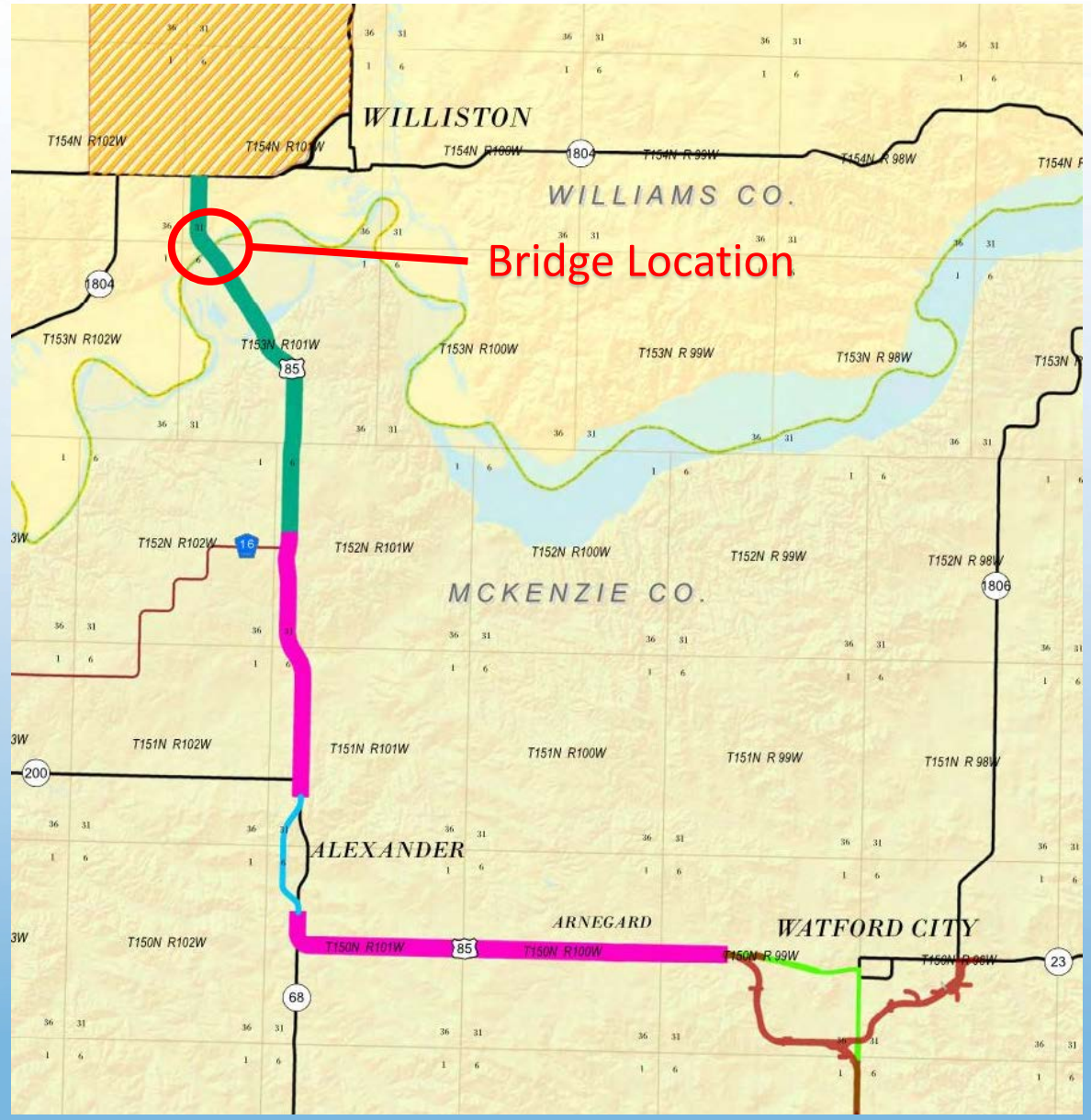
US Highway 85 Traffic over Bridge

- AADT increased from 3,800 in 2009 to 17,800 in 2014
- Projected: 22,000 by 2035
- 150 truckloads for drilling operations at each well
- 40% trucks along the corridor
- Designed for 1,100 AADT and 150 ADTT



Central Corridor



- US 85 from Watford City to Williston
  - Central Corridor for Bakken Oil Development
- Watford City Population
  - 2010 – 1,700
  - 2014 - 4,200, 147% Growth
- Williston Population
  - 2010 – 14,700
  - 2014 – 24,500, 67% Growth

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Missouri River Bridge Site

Existing Bridge

- 7 Spans
- 1,530 ft long
- 235 ft Max Span
- 36 ft Clear Roadway

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Existing Bridge

- 2 Welded Steel Plate Girders
- Cross Frame Trusses
- Fatigue Prone Details

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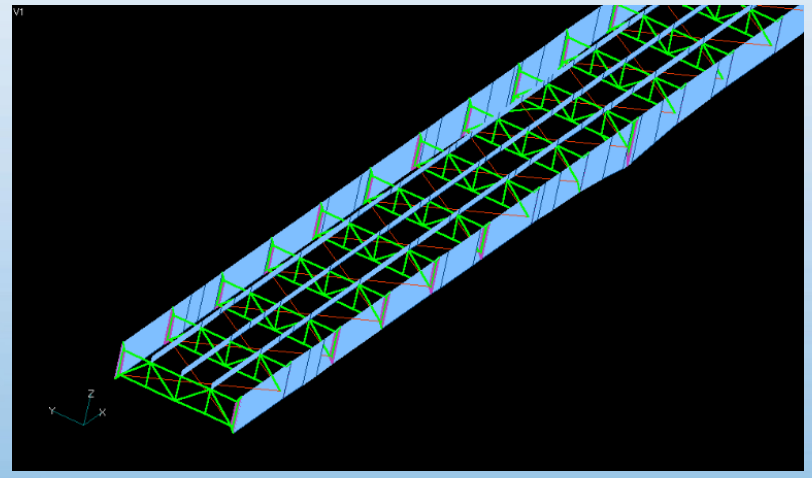
Bridge Analysis and Decisions

- Built in 1973, SR 91.3

- Initial Inspection
  - Generally Good Condition
  - Expansion Joints Failed
  - Spalling and Deterioration at Abutment Pedestals
  - Deck Deterioration

Bridge Analysis and Decisions

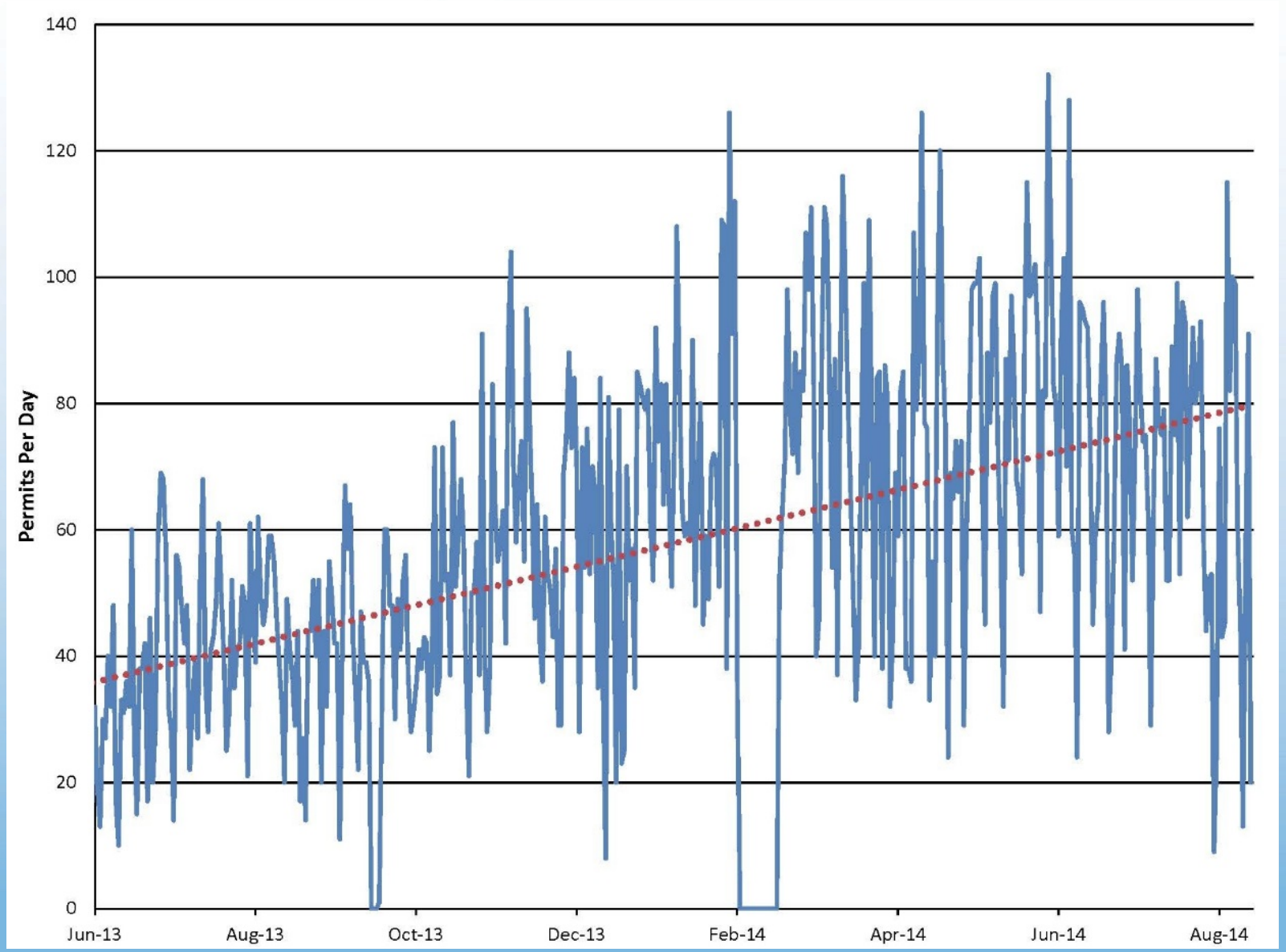
- Fatigue Analysis
  - 3-D Finite Element Computer Model
  - Calculated Stresses in Fatigue Prone Details
    - Historic Traffic Data and Future Traffic Projections
  - Fatigue Life is Close to Being Done



- Options
  - Rehab and Build New 2-Lane Adjacent
  - Remove and Replace with New 4-Lane

- Cost Analysis Showed Full Replacement Preferred

Permit Data



- 80 Permits per Day
- Heaviest – 400,000 lb
- Possible 1.4 million lb vehicle

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Bridge Options

- Bridge Type Study
- Initially Pursued Alternate Designs
  - Steel I-Girder
  - Concrete Segmental Box Girder
- Concrete Alternate Removed Due to Cost

Bridge Design Criteria

- Clearance
  - Navigation
  - RR
  - Hydraulics
- Utilities
- Water Intake
- Ice Loading

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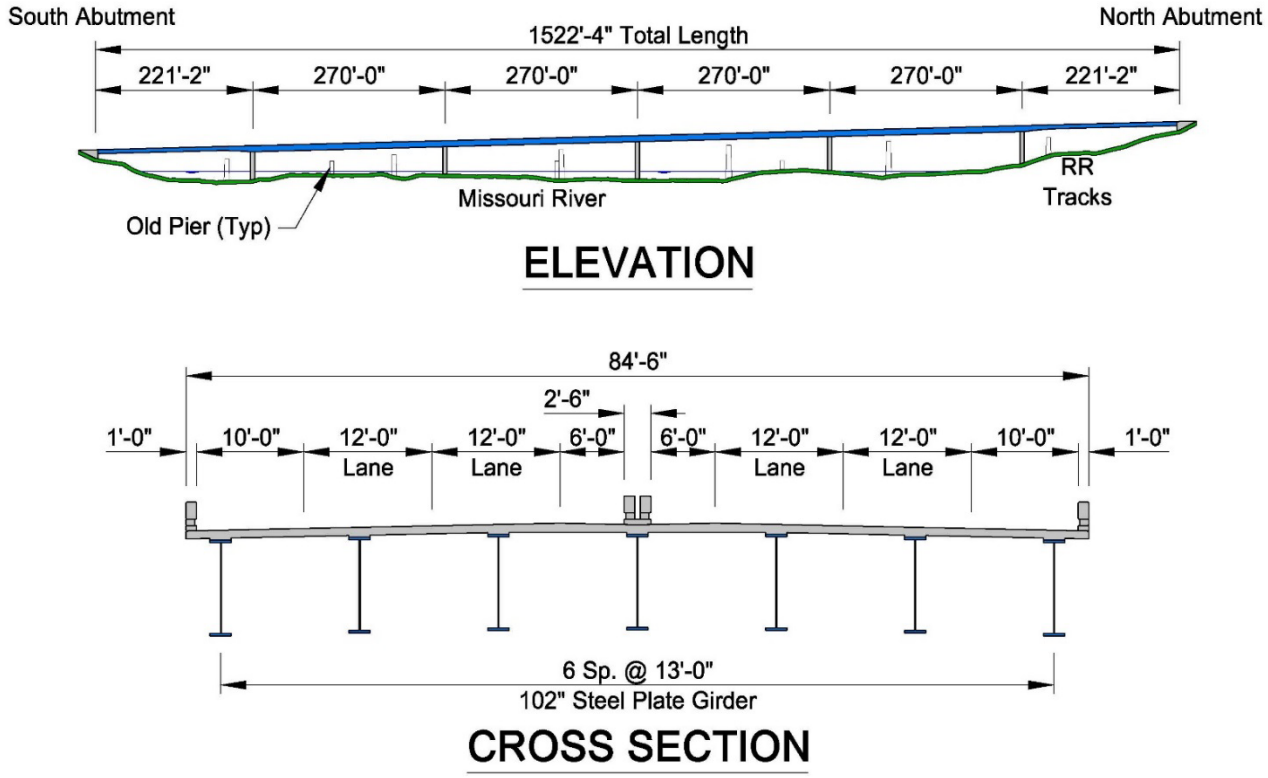
Proposed Bridge



- Span Optimization
  - Superstructure Cost
    vs.
    Substructure Cost
- Software
  - LRFD SIMON
  - MDX
  - BSDI

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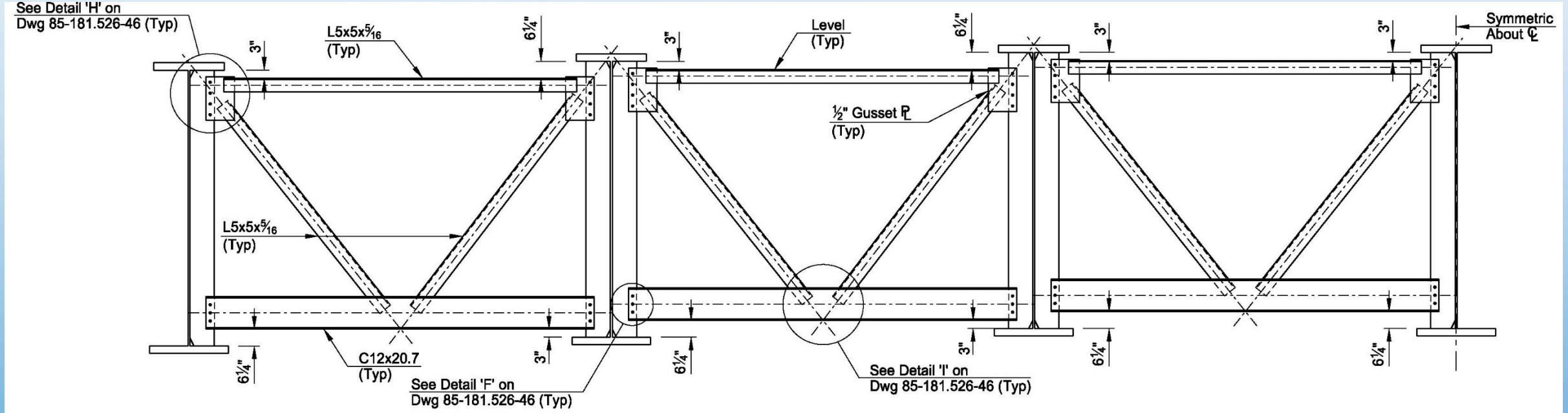
Cross Frame

- 25’ to 28’ Spacing
  - Span Optimization

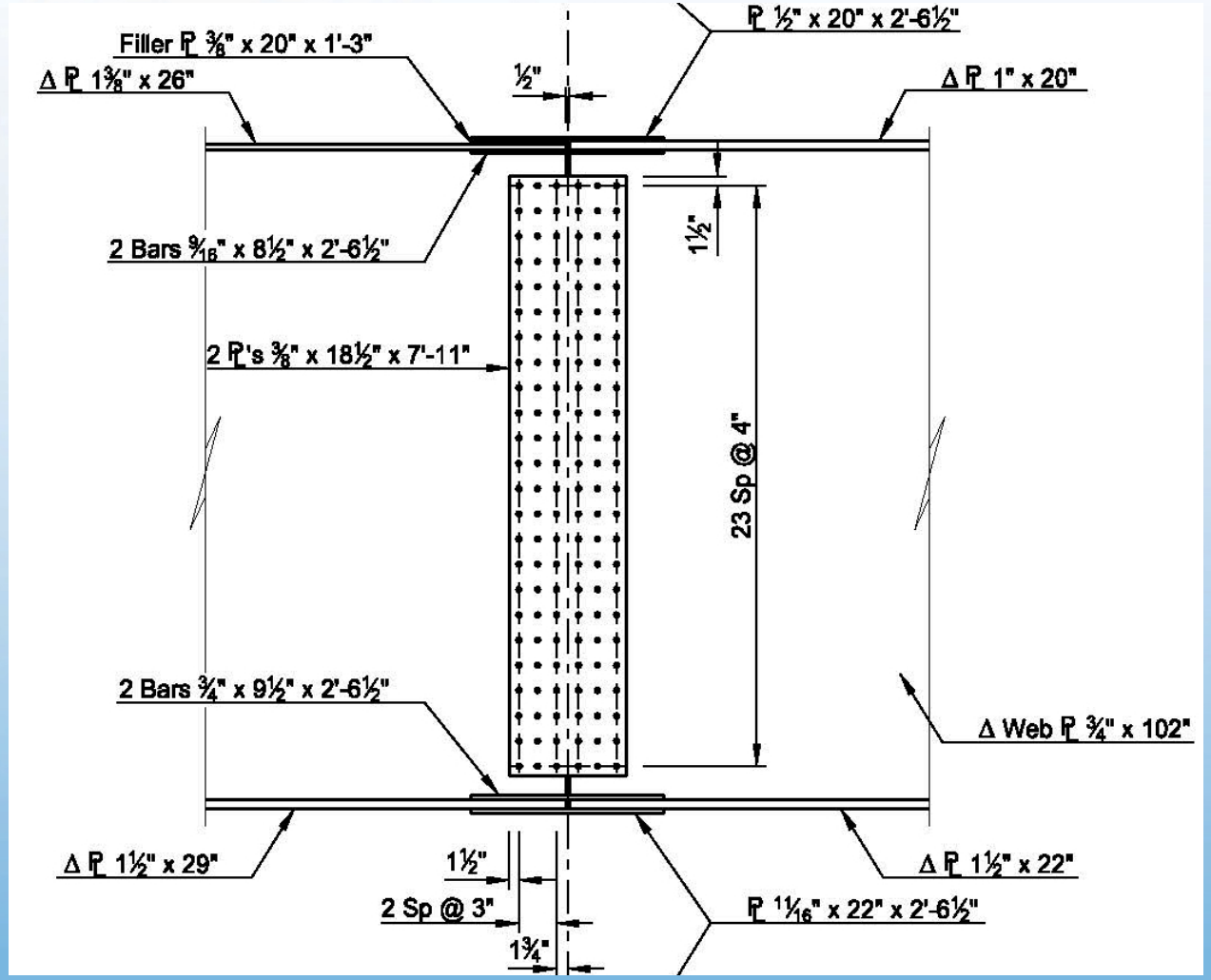


TYPICAL INTERMEDIATE CROSS FRAME

Proposed Bridge

- AASHTO M270 Grade 50W
- 102” Web
- Better Fatigue Details

Splice



- NSBA Splice
- Located at DL Contra-Flexure Points
- Used for Workable Girder Lengths and Section Changes
  - 161’-6” Max Length
  - 36 ton Max Weight

Joints & Bearings

- Disc Bearings
  - Fixed at Pier 4
  - Expansion at other 6 substructures

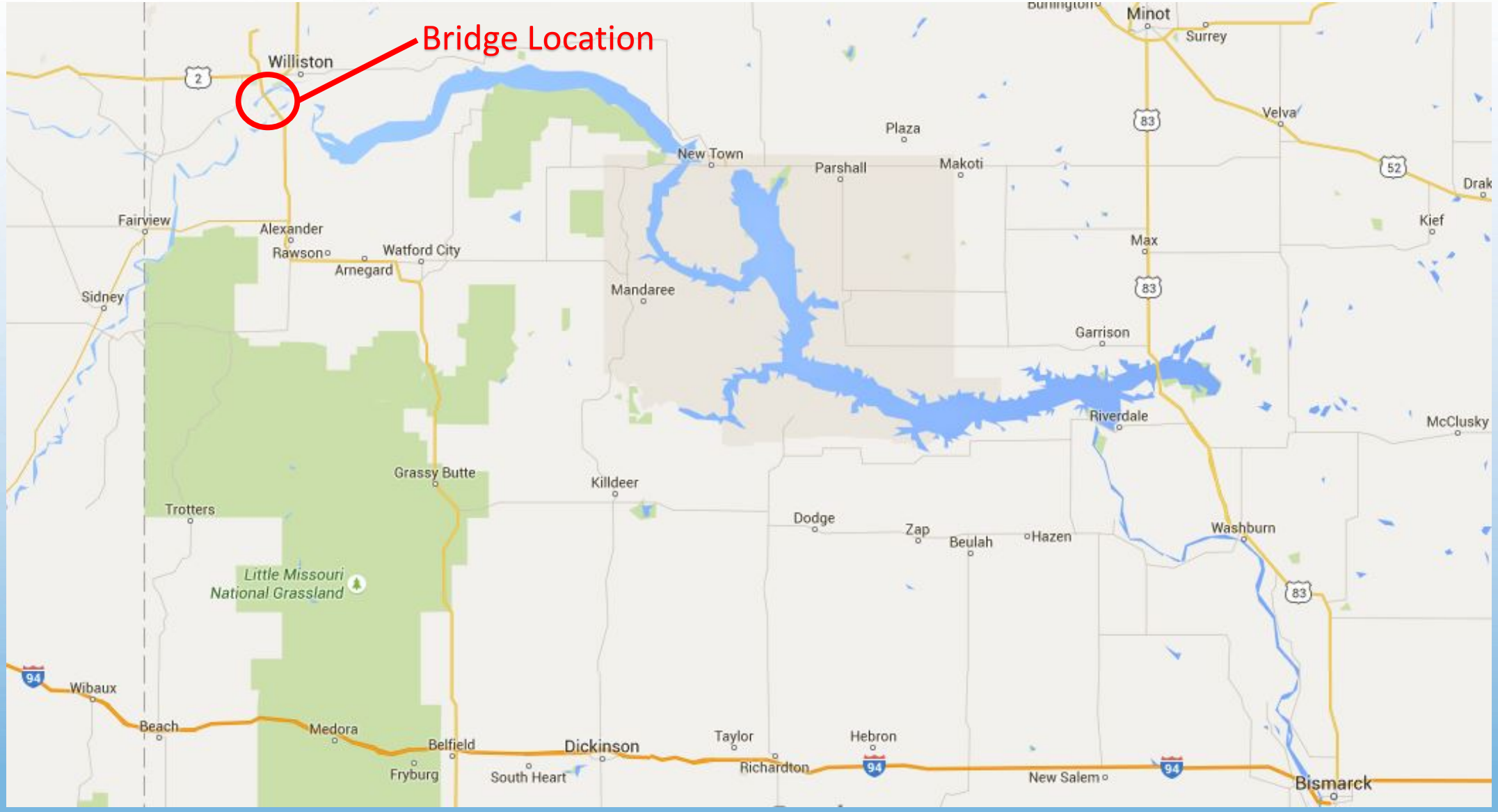
- Finger Expansion Joint
  - Abutments Only
  - 8⅞” Expansion

Hydraulics

- Published Hydrology Outdated
  - Gage at Bridge Records Stage Only
  - Did not take into Account Reservoir System Influence

- Developed Project Specific Hydrology

Lake Sakakawea



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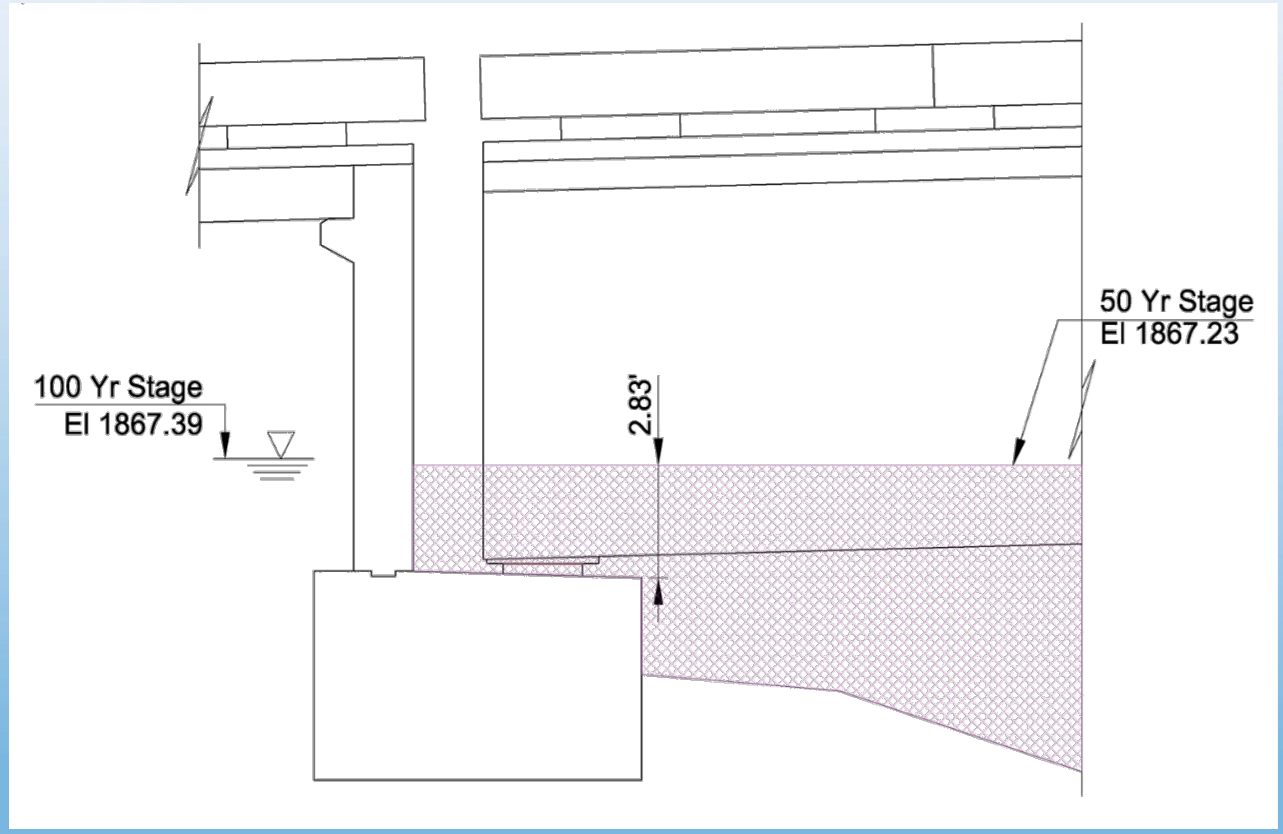
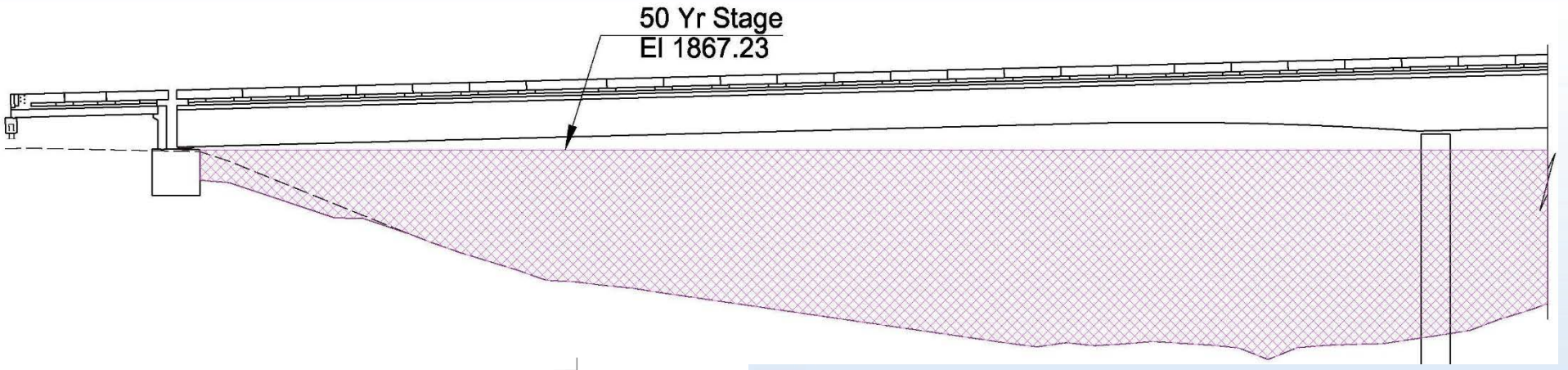
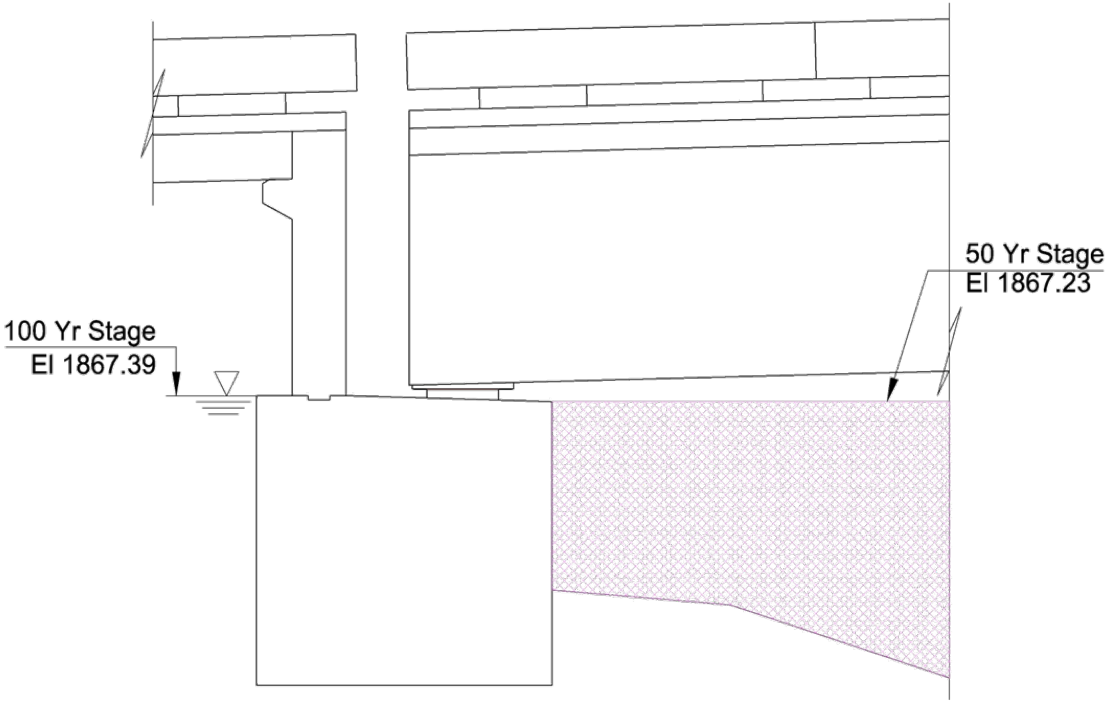
Hydraulics

- US Army Corps Aggradation Study
  - Water Surface During Flood Events Could Rise by Approximately 7 feet in 75 years
- Bearings Wet



Haunch





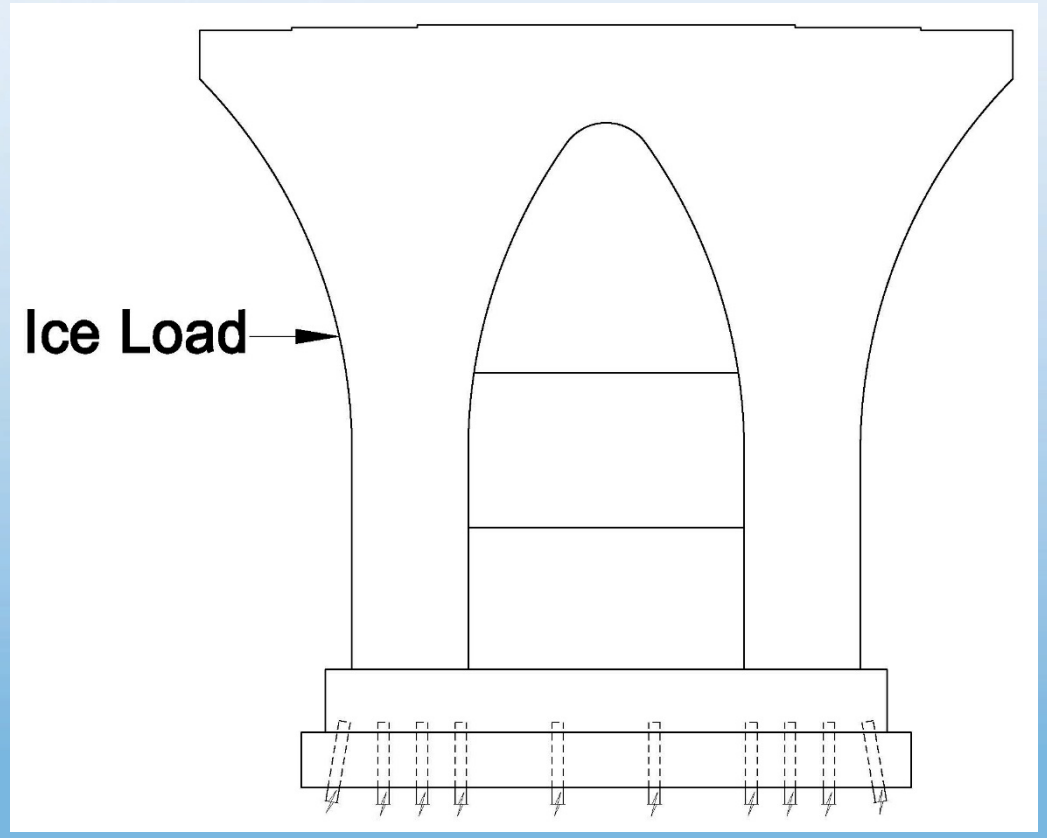
- Added Haunch to Steel Girder
- Haunch 102” web to 68” web
- Ideal Haunch Ratio

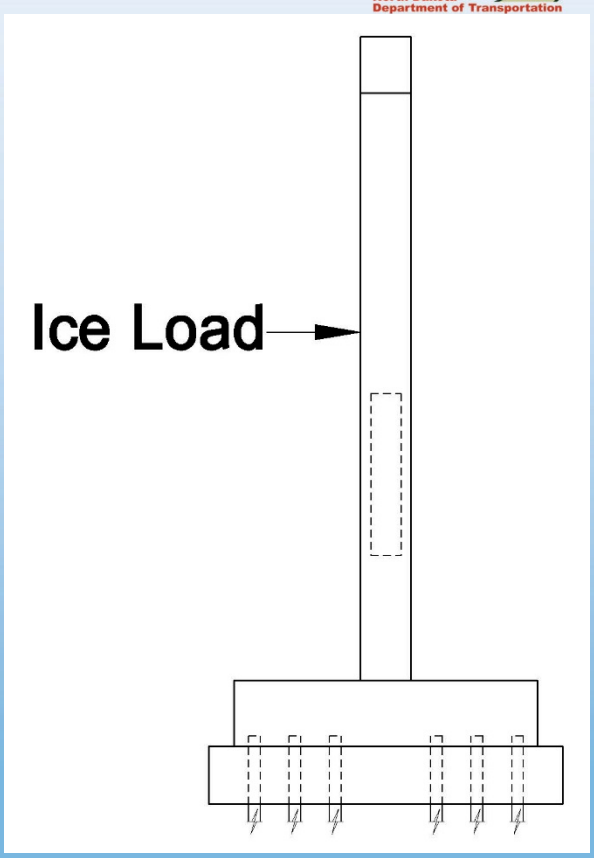
Piers

- Pier Shape
- Pier Strut

Loads

- Breaking Force (BR)
- Earth Pressure (EV)
- Water Pressure (WA)
- Wind (WS & WL)
- Friction (FR)
- Temperature (TU)
- Ice (IC)
  - 4.0’ Ice Thickness
  - 16.0 ksf Ice Crushing Strength





Load Cases

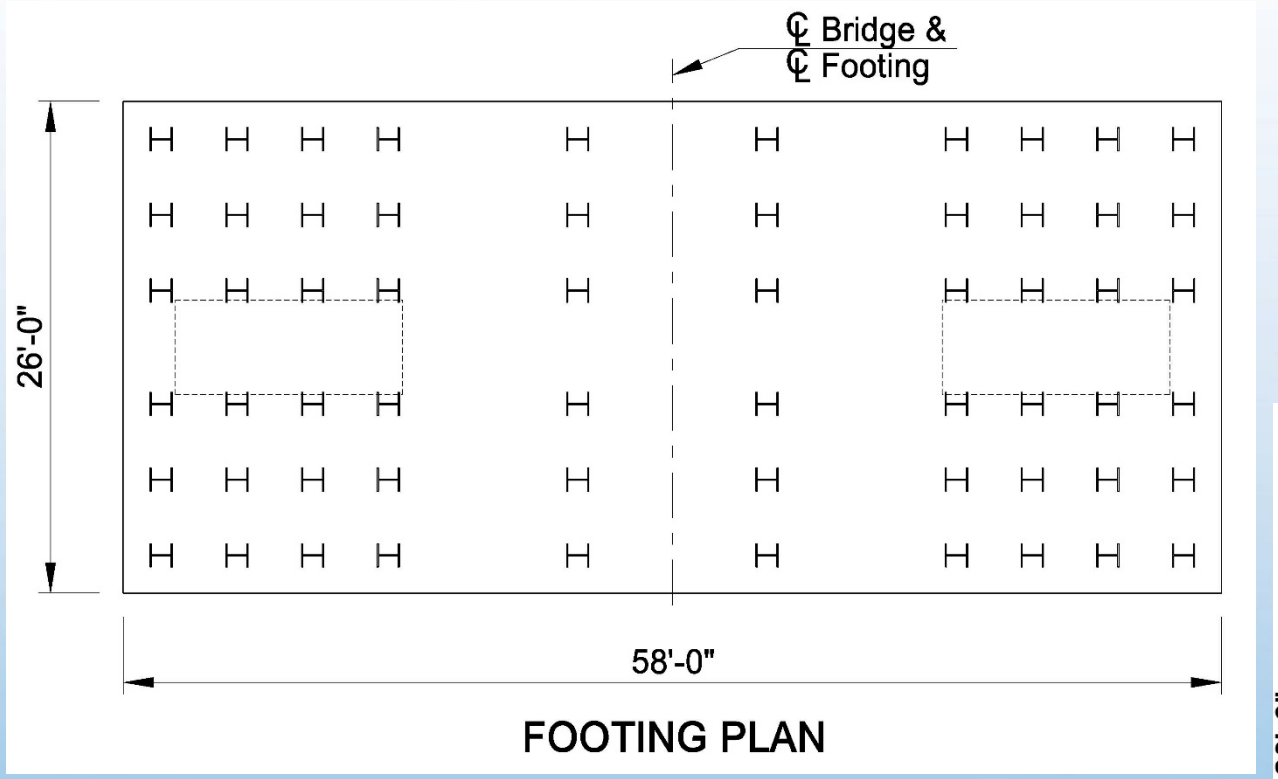
- 88 Load Cases

Table 3.4.1-1—Load Combinations and Load Factors

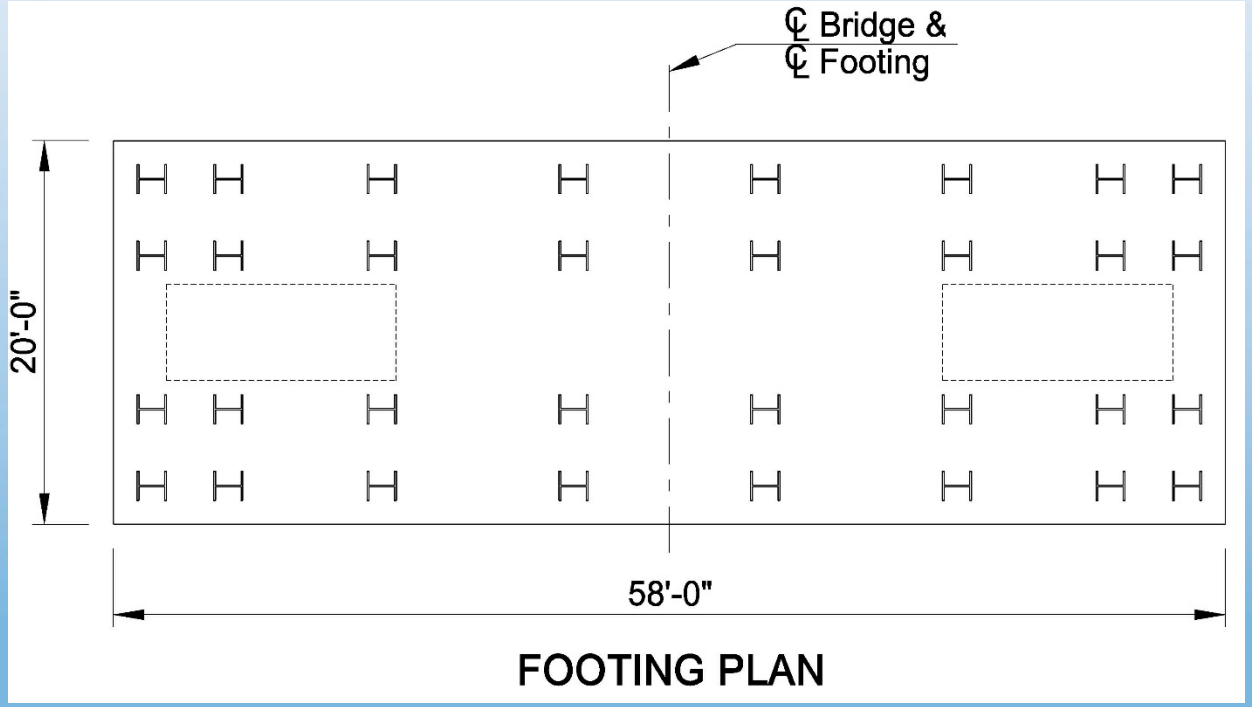
Load Combination Limit State	*DC DD DW EH EV ES EL PS CR SH*	*LL IM CE BR PL LS*	*WA*	*WS*	*WL*	*FR*	*TU*	*TG*	*SE*	Use One of These at a Time				
										EQ	*BL*	*IC*	*CT*	*CV*
Strength I (unless noted)	γ_p	1.75	1.00	—	—	1.00	0.50/1.20	γ_{TG}	γ_{SE}	—	—	—	—	—
Strength II	γ_p	1.35	1.00	—	—	1.00	0.50/1.20	γ_{TG}	γ_{SE}	—	—	—	—	—
Strength III	γ_p	—	1.00	1.40	—	1.00	0.50/1.20	γ_{TG}	γ_{SE}	—	—	—	—	—
Strength IV	γ_p	—	1.00	—	—	1.00	0.50/1.20	—	—	—	—	—	—	—
Strength V	γ_p	1.35	1.00	0.40	1.0	1.00	0.50/1.20	γ_{TG}	γ_{SE}	—	—	—	—	—
Extreme Event I	γ_p	γEQ	1.00	—	—	1.00	—	—	—	1.00	—	—	—	—
Extreme Event II	γ_p	0.50	1.00	—	—	1.00	—	—	—	—	1.00	1.00	1.00	1.00
Service I	1.00	1.00	1.00	0.30	1.0	1.00	1.00/1.20	γ_{TG}	γ_{SE}	—	—	—	—	—
Service II	1.00	1.30	1.00	—	—	1.00	1.00/1.20	—	—	—	—	—	—	—
Service III	1.00	0.80	1.00	—	—	1.00	1.00/1.20	γ_{TG}	γ_{SE}	—	—	—	—	—
Service IV	1.00	—	1.00	0.70	—	1.00	1.00/1.20	—	1.0	—	—	—	—	—
Fatigue I— *LL, IM & CE* only	—	1.50	—	—	—	—	—	—	—	—	—	—	—	—
Fatigue II— *LL, IM & CE* only	—	0.75	—	—	—	—	—	—	—	—	—	—	—	—

Pier Footings Pile Alternates

- HP14x102



- HP18x204



Time Frame

- Notice to Proceed – 7/30/12
- Inspection – 9/5/12
- Final Plans – 5/30/14
- Bid Opening – 7/15/14
- Open to Traffic – 8/30/16

Cost

- Total Project - $66.3 Million
- Bridge - $34.3 Million
- Steel - $1.97 / lb
- Collaboration with NSBA

Thank You

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