DAVID EVANS AND ASSOCIATES INC.

Executing a Major Urban Bridge Inspection

A Case Study on the West Marquam and East Fremont Interchanges

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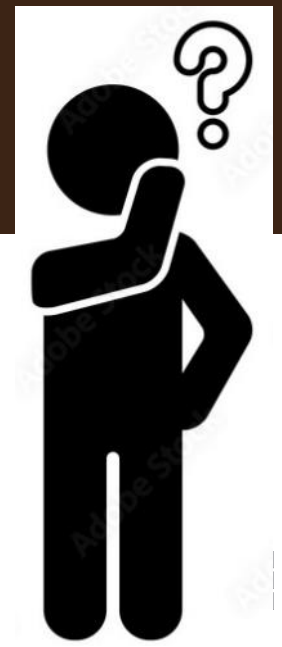
So…

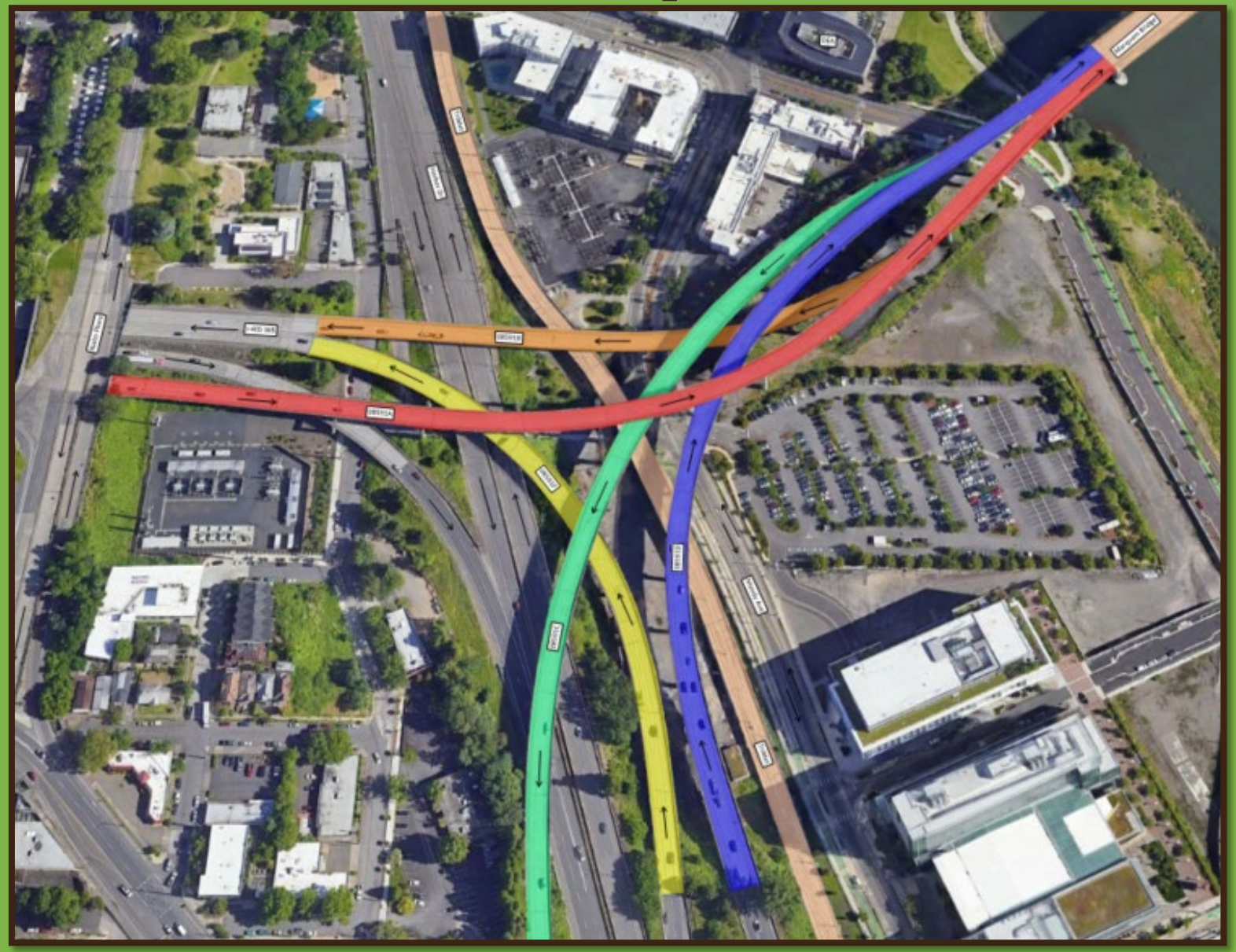
What makes a major bridge inspection different?



Local Agency Bridge

007C15
Length = 103ft
3 Spans

West Marquam Interchange



08591A
Length = 1,940ft
17 Spans

08591B
Length = 1,610ft
15 Spans

08591C
Length = 1,900ft
15 Spans

08591D
Length = 1,750ft
15 Spans

08591F
Length = 1,140ft
14 Spans

East Fremont Interchange

08958
Length = 655ft
3 Spans
Double-Decker

08958B
Length = 709ft
4 Spans
Double-Decker

08958D
Length = 1,580ft
12 Spans

08958E
Length = 2,460ft
17 Spans

08958F
Length = 1,030ft
8 Spans

08958G
Length = 782ft
6 Spans

08958H
Length = 1,040ft
6 Spans

08958I
Length = 1,040ft
7 Spans

Large Scale Inspections

- You are no longer trying to get 8-10 bridges done in a day… you are lucky to finish one
- Notes and photos must be very specific with Type, Size, and Location of defects
- You must be able to orient yourself at any point during the inspection
    - Bridge #, Span #, Girder #, North?, South?

Different Elements

Local Agencies

- Timber
- Concrete
- Steel

Major Bridge

- Steel
- Steel
- Steel

Steel Caps

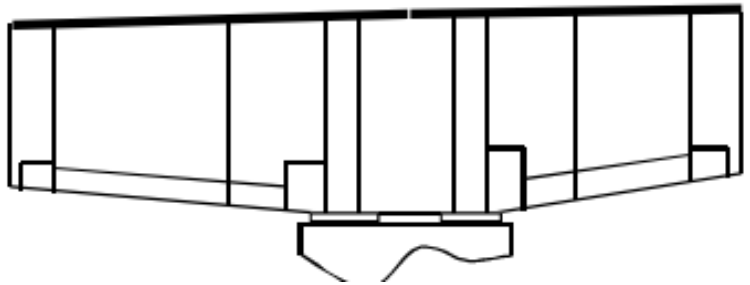
Pin & Hanger Assemblies

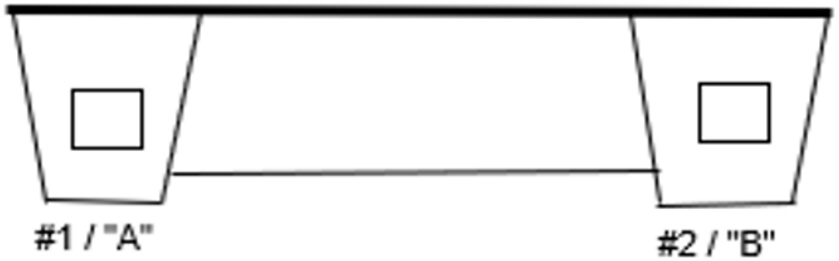
Steel Box Girders

Non-Redundant Steel Tension Members

- Three Requirements:
  - No Load Path Redundancy
  - Steel Elements
  - In Tension
  - FKA “fracture critical” members

- *“Failure would probably cause a portion of or the entire bridge to collapse.”*

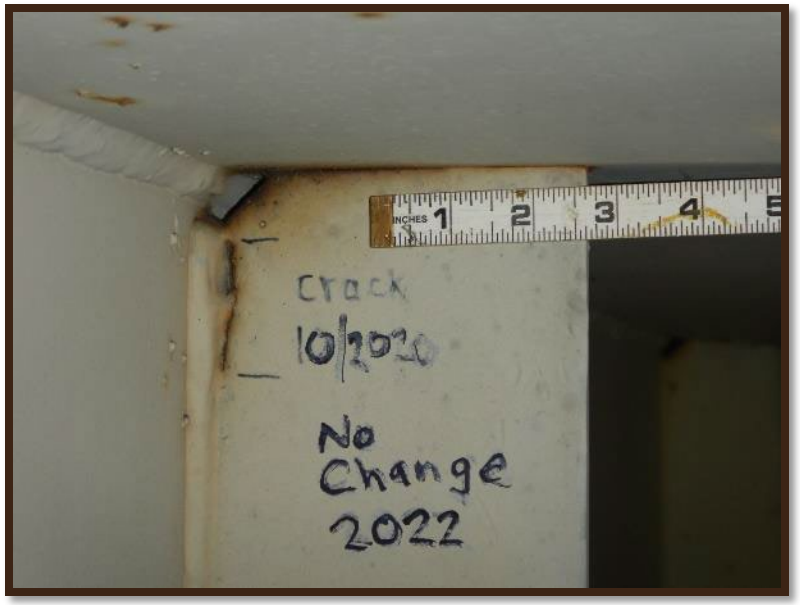




Fatigue Prone

- Poor steel details combined with high number of stress cycles (truck loads)
  - Welded and coped steel members
  - Field welds
  - Intersecting welds
  - Short, welded attachments

Steel Cracks



Crack in the top of a longitudinal stiffener

Crack in the toe of a longitudinal stiffener

Crack in the toe of cross-bracing

Steel Crack Repairs

Crack Arrest Hole

Ground Out Crack

Weld Replaced with Bolts

Steel Cracks

DO NOT GET COMPLACENT!

- Do NOT blindly trust the previous report
- When in doubt, note it
- If you have a question, ask it
- Even repairs can fail

Coordination

DAVID EVANS AND ASSOCIATES INC.

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Oregon Department of Transportation

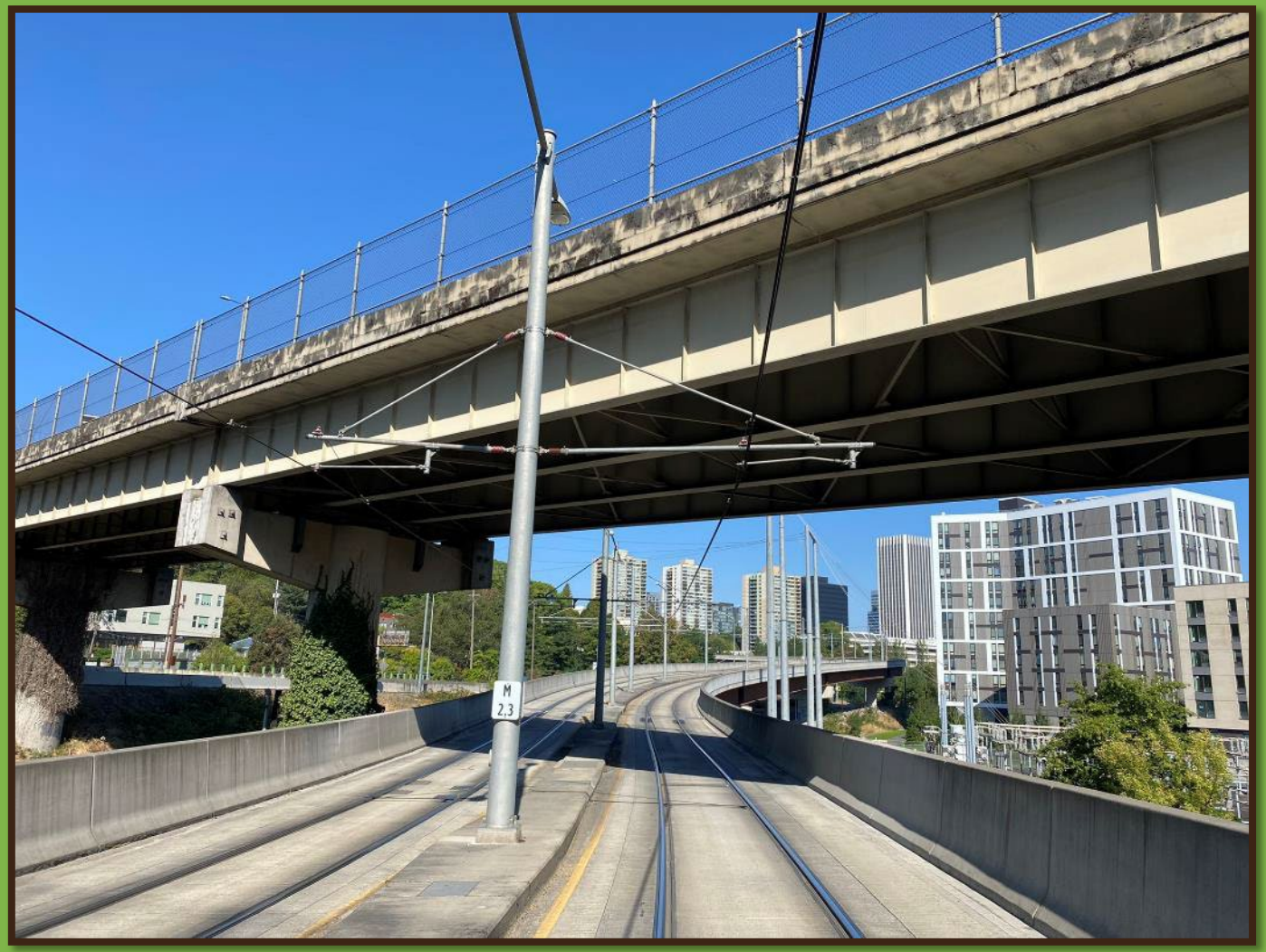
TRIMET

CITY OF PORTLAND, OREGON 1851

Multnomah County

UNION PACIFIC

Coordination with TriMet



Traffic Control

D&H FLAGGING
– WOMEN OWNED BUSINESS –

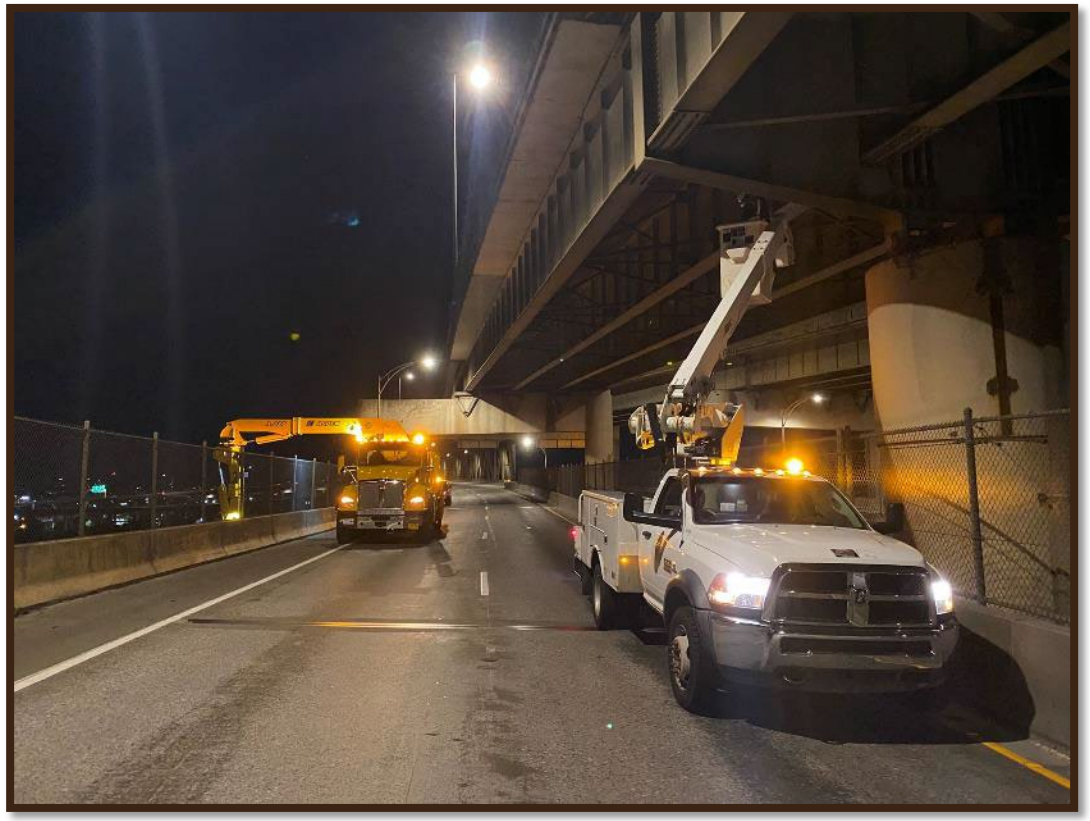
- Traffic control is one of the most important coordination items
- Engage your traffic control team EARLY and OFTEN
- Be willing to adapt
- Have an open line of communication during the inspection

Night	2022 Notes
1	Snooper (x2): 08958 Lower --> started 08958B Lower Bucket Truck: 08958B Upper Box: 08958 Lower (x2) Topside: 08958 Lower, 08958B Lower, 08958F
2	Snooper (x2): 08958B Lower --> 08958F, 08958H --> started 08958D Bucket Truck: 08958 Upper Box: 08958B (x2), started in 08958F (x3) Topside: 08958H, 08958D --> joined box teams
3	Snooper: 08958D --> joined box teams Bucket Truck: Varies Box: 08958F (x3) --> 08958H (x4) Topside: N/A Note: All teams left the bridge at 3:30AM. For BT I-5 SB closure, start with right lane then switch to left.
4	Snooper: 08958E (finished at 3:00AM) Bucket Truck: Varies --> joined box teams in first unit of E Box: 08958E (x4) (finished at 3:45AM) Topside: 08958E --> joined box teams in second unit of E
5	Snooper: 08958I, 08958G (finished at 4:00AM) Bucket Truck: Varies --> joined box teams in first unit of I Box: 08958I (x3) --> 08958D (x4) (finished at 3:30AM) Topside: 08958I, 08958B Upper --> joined box teams on D Note: D&H added for the snooper an alternating left/right lane closure on G (7643) that finished up snooper work a night early.
6	Snooper: N/A Bucket Truck: Varies --> joined box teams in second unit of G Box: 08958G (x4) --> 08958B Upper (x5) --> 08958 Upper (x5) Topside: 08958G, 08958B Upper, 08958 Upper --> joined box teams in B Note: Climbing team inspected only columns and crossbeams, finished at 4:30AM. Box teams finished at 3:45AM).
7	N/A

Traffic Control

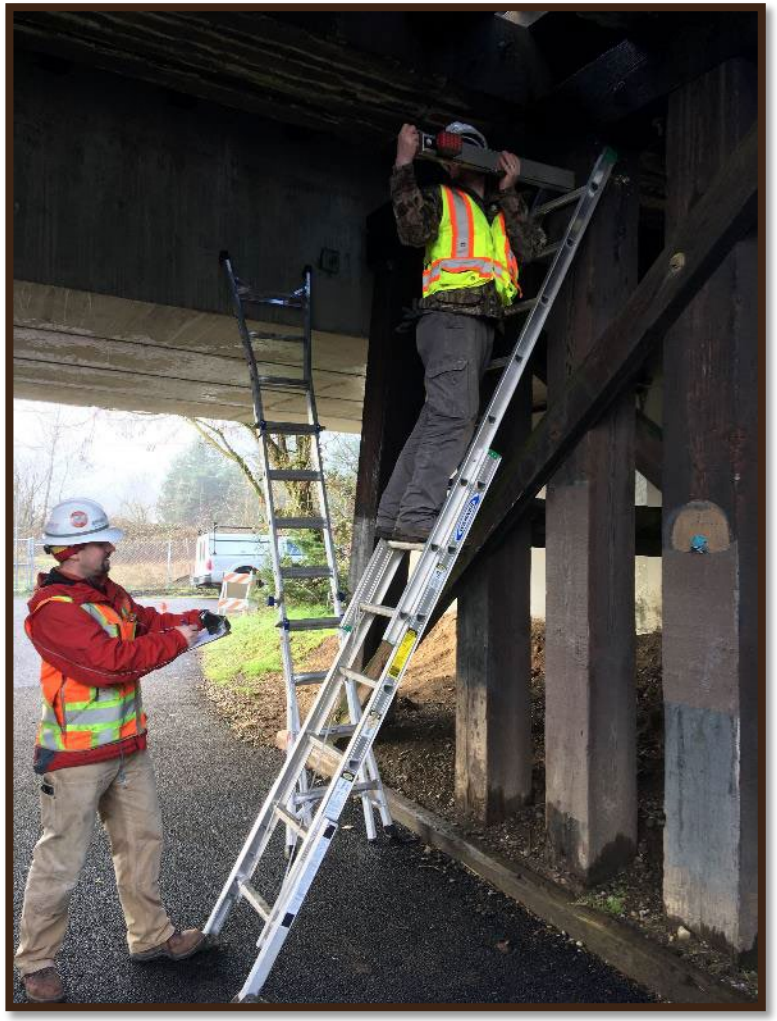
D&H FLAGGING
– WOMEN OWNED BUSINESS –

- Lane Closures vs Full Closures



Traffic Control

Teaming



Teaming

- Variety of new and experienced inspectors
- Orientation meetings before each night of work
  - Where? What? Who? When? How?
- ASK QUESTIONS

Equipment & Training

Reporting

Remarks

39-Prestressed Slab SU 1 ENV 3
~~Can not inspect Span 2 superstructure from banks.~~ Edge spalls on several slabs.

1080-Delamination/Spall/Patched Area
Edge spalls on Slabs 2 & 3 near Bent 1. Edge spall on Slab 3 near Bent 2.

1120-Efflorescence/Rust Staining
Minor leakage with efflorescence is present through the keyways, with buildup.

511-AC Wearing Surface

523-Waterproof Membrane
Minor leakage between keyways at isolated locations. ✓

215-Re Conc Abutment SU 1 ENV 3 ✓

225-Steel Pile SU 1 ENV 3
Concrete encased H-piles. Bent 2-Pile 1 exposed in the past, Bent 3-Pile 4 is exposed. See 10/2020 Underwater Report for details.

1000-Corrosion
Bent 2-Pile 1 has minor corrosion. Bent 3-Pile 4 has corrosion with section loss. ✓

517-Concrete Encased
Per the underwater report, Bent 2-Pile 1 has 2 SF patched coating. Bent 2-Pile 4 has 3 SF of spalls. Bent 3-Pile 4 is exposed for 1ft with 5 SF of missing coating. All piles at Bent 3 have failing patches.

234-Re Conc Pier Cap SU 1 ENV 3 ✓

306-Other Joint SU 1 ENV 3

2310-Leakage
Joints are cracked. Minor leakage through joints onto bent caps at Bents 2-4.

310-Elastomeric Bearing SU 1 ENV 3 ✓

330-Metal Bridge Railing SU 1 ENV 3
All the anchor cables are missing from the end terminations.
Splint cushion block at SE corner

7000- Damage: Impact scrapes along right rail

Reporting

Bridge Number: 00091A

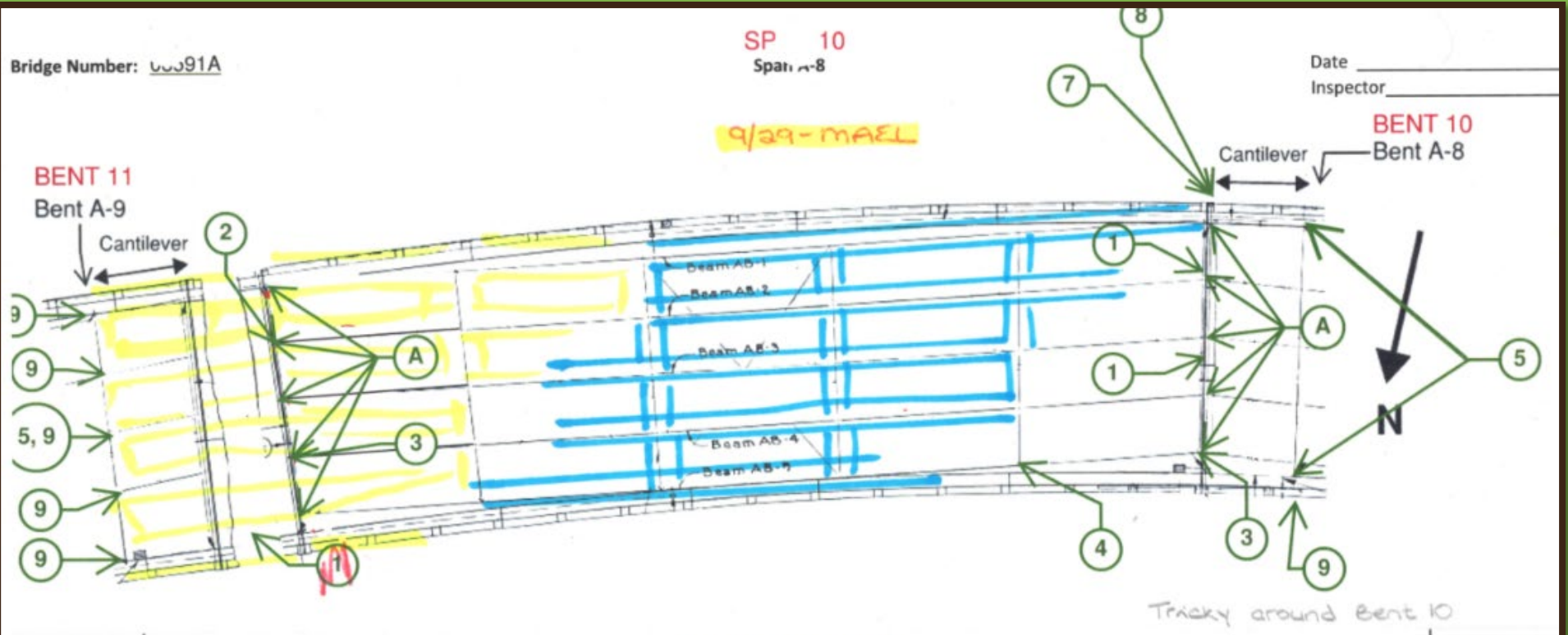
SP 10

Span A-8

Date

Inspector

9/29 - MAEL



#	Description/Findings	Photo #
General	**PAINTED BRIDGE ELEMENTS:** Chalking & moderate freckled rust in the paint system. Typical localized areas of the paint distress & paint failure include girder webs near leaking expansion joints, the underside of the girder top and bottom flanges, the underside of the girder lateral bracing gusset plates directly above the girder bottom flanges, and underside of rocker bearings.	
General	RC bent caps - cracks full length at less than 3' O.C., some cracks epoxy injected at Bent 10.	
General A	**P&H assembly:** The pin retention nut tack welds are typically cracked at the tack welded connections to the pins and the web doubler plates. Some wind tongues have fretting rust. All pin & minor assemblies have minor corrosion.	

Reporting

Begin	End	Comments/Features	Photo #	102 - Steel Closed Web Box Girder																				
				1000 - Corrosion			1010 - Cracking			1020 - Connection			1142 - Fire Damage			1900 - Distortion			7000 - Damage			518 - Steel Paint		
				CS2	CS3	CS4	CS2	CS3	CS4	CS2	CS3	CS4	CS2	CS3	CS4	CS2	CS3	CS4	CS2	CS3	CS4	CS2	CS3	CS4
				470	5	0	3	0	0	1	1	0	0	0	0	13	0	0	0	0	0	1915	33	9
Tub B (Girder 1) - SW spans																								
FB110	FB109																					1		
FB109	FB108	Bolt missing on FB109 connection to bottom flange.	4052								1													
FB108	FB107																							
FB107	FB106																							
FB106	FB105	Surface rust on top flange of FB106		1																			2	2
FB105	FB104																							
FB99	FB98																							
FB98	FB97																							
FB97	FB96																							
FB96	FB95																					1		
FB95	FB94	Freckled rust on top flange of floorbeam adjacent to Field Splice #15.		12																		12		
FB94	FB93			4																		4		
Exp. Jt 3	FB79	P&H: Surface rust and paint flaking. Minor pigeon debris. Tack welds at pins and nuts, evidence of past rotation. Freckled rust on top flange of FB79	5514	1																				
FB79	FB78																							
FB78	FB77																							
Exp. Jt 4	Pier 4 (Bent 14)	P&H: Minor buildup of pigeon debris. Evidence of rotation between the hangers and the nuts based on the paint. Hanger out of alignment 1/8" over 6" transversely. Bolt heads on outside of cover, able to open		1																		5		
Pier 4 (Bent 14)	FB38	Intersecting weld detail between lower metal bar to floorbeam diaphragm weld and diaphragm to web weld; also the intersecting weld detail is 1/2" away from the end of lower longitudinal stiffener weld.																						
Pier 2 (Bent 16)	FB20	At Pier 2, intersecting weld detail between floorbeam diaphragm to web weld and girder top flange to web weld.																						
FB14	FB13	Paint failure on Web B2 near FB13.																						4
FB13	FB12			7																				
FB12	FB11			5																				
FB11	Pier 1 (Bent 17)			5																				
Pier 1 (Bent 17)	FB10																							

Safety

- Health & Safety Plan
- Safety debriefing before each shift
  - What went well?
  - What needs to be improved?
- ANY employee at ANY time can call off the inspection for ANY safety-related reason

Safety

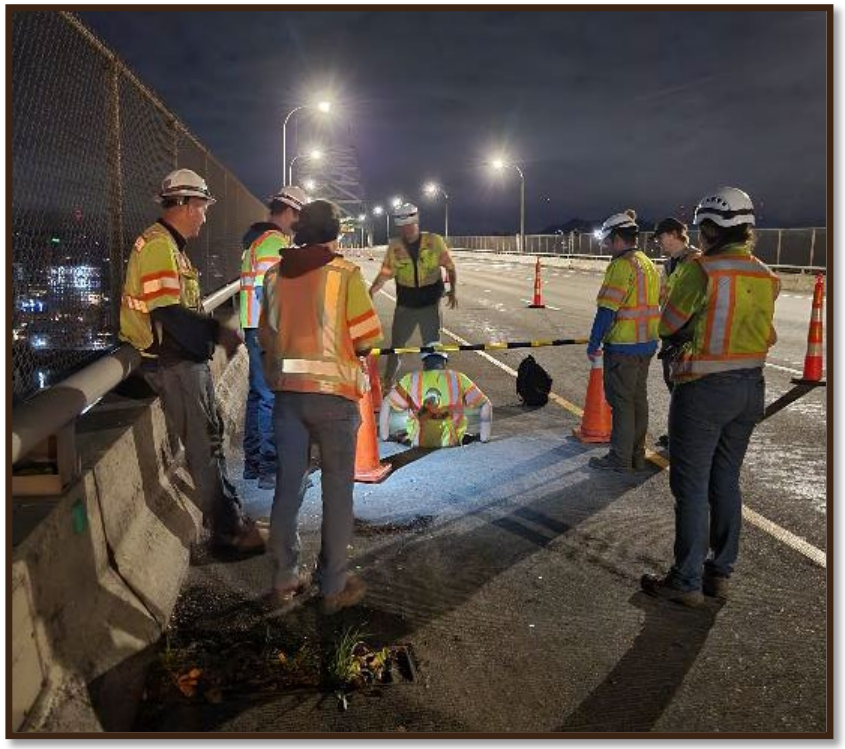
- Slips, Trips, and Falls

- Live Traffic

Safety

- Low Visibility

- Fatigue



Safety

- Urban Campers

- Pigeons…

Overall Lessons Learned

- Preparation, preparation, preparation
  - Have and know your plan, but be willing to adapt on the fly

Lessons Learned

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- Always build in an extra day (or two) in the schedule
  - Expect the best, prepare for the worst

Lessons Learned

- Preparation, preparation, preparation
  - Have and know your plan, but be willing to adapt on the fly
- Always build in an extra day (or two) in the schedule
  - Expect the best, prepare for the worst
- Incentives never hurt…


EXIT
EXIT
Carhartt

QUESTIONS?