Replacement of the I-84 Sandy River Bridges

Troutdale, Oregon

Presenter:

Doug Johnson, PE

September 4, 2013

DAVID EVANS AND ASSOCIATES INC.

OTIA Bundle 210: Location Map

Map of Project:

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OTIA Bundle 210: Scope of Work

Replace Sandy River Bridges

- Widen bridges to provide 2 – thru lanes & 1 auxiliary lane in each direction
- Provide Bike/Pedestrian Path on EB Bridge

Widen/Repair Jordan Road Bridges

- Widen bridges to provide 2 – thru lanes & 1 auxiliary lane in each direction
- Strengthen EB Bridge

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Existing Sandy River Bridges

Spans: 50’ RCDG - 122’ – 160’ – 122’ Steel Girders
48’ – 63’ – 48’ – 48’ – 63’ – 48’ RCDG

Total Length : 770’

EB Bridge Built 1949

WB Bridge Built 1959

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Sandy River Bridges – Deficiencies

- RCDG's have Stage 3 cracking (inadequate stirrup spacing)
- Vulnerable to Scour, Seismic Event
- Steel Spans Fracture Critical (2 Girders, Pin & Hangers)

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Sandy River Bridges – Deficiencies

- Substandard Roadway Width = 30’
- Pedestrian Usage

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Jordan Road Bridges

- Concrete Frame
- Single Span 29’-0”
- EB Built in 1949
- WB Built in 1959

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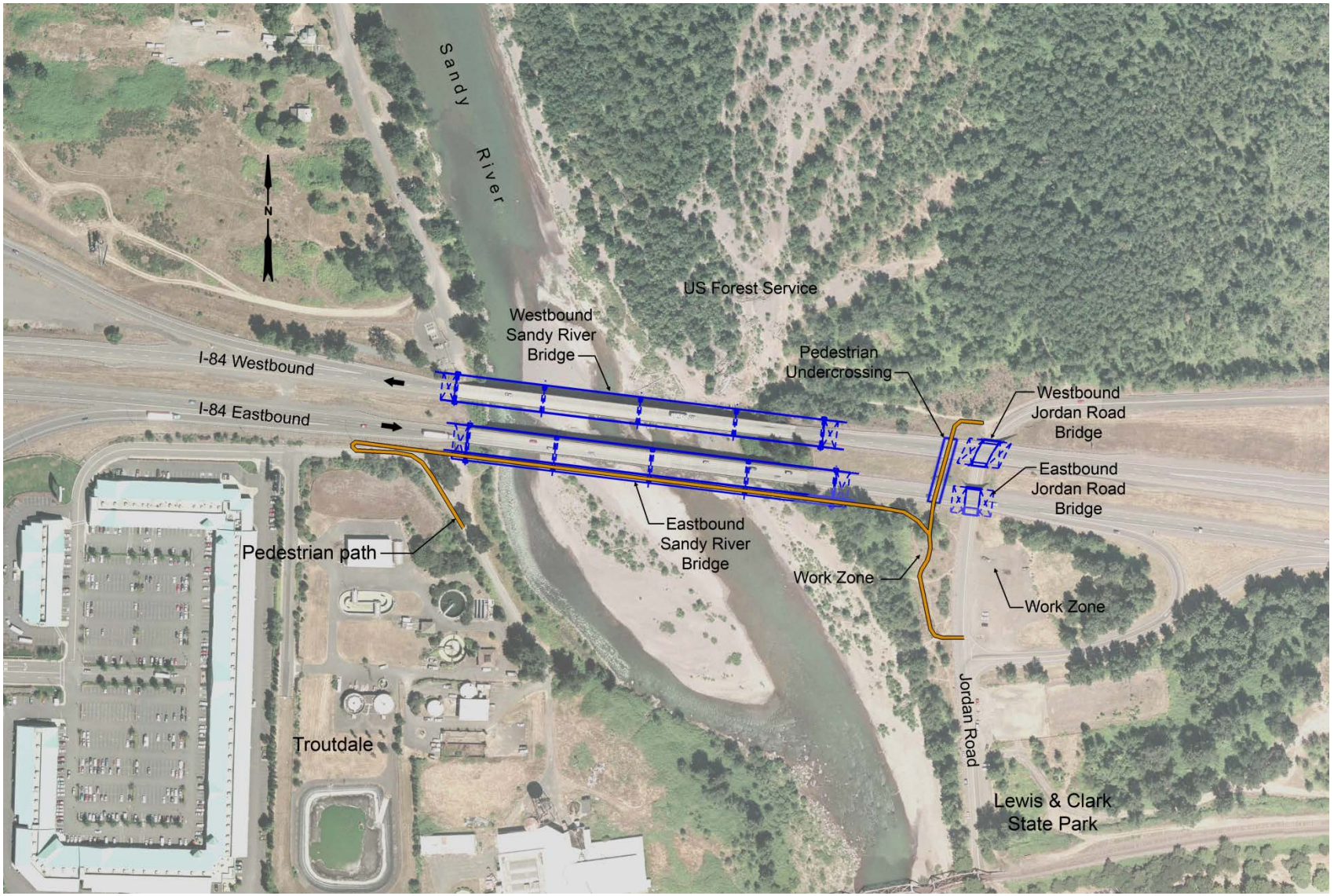

Bundle 210 – Aerial Photo

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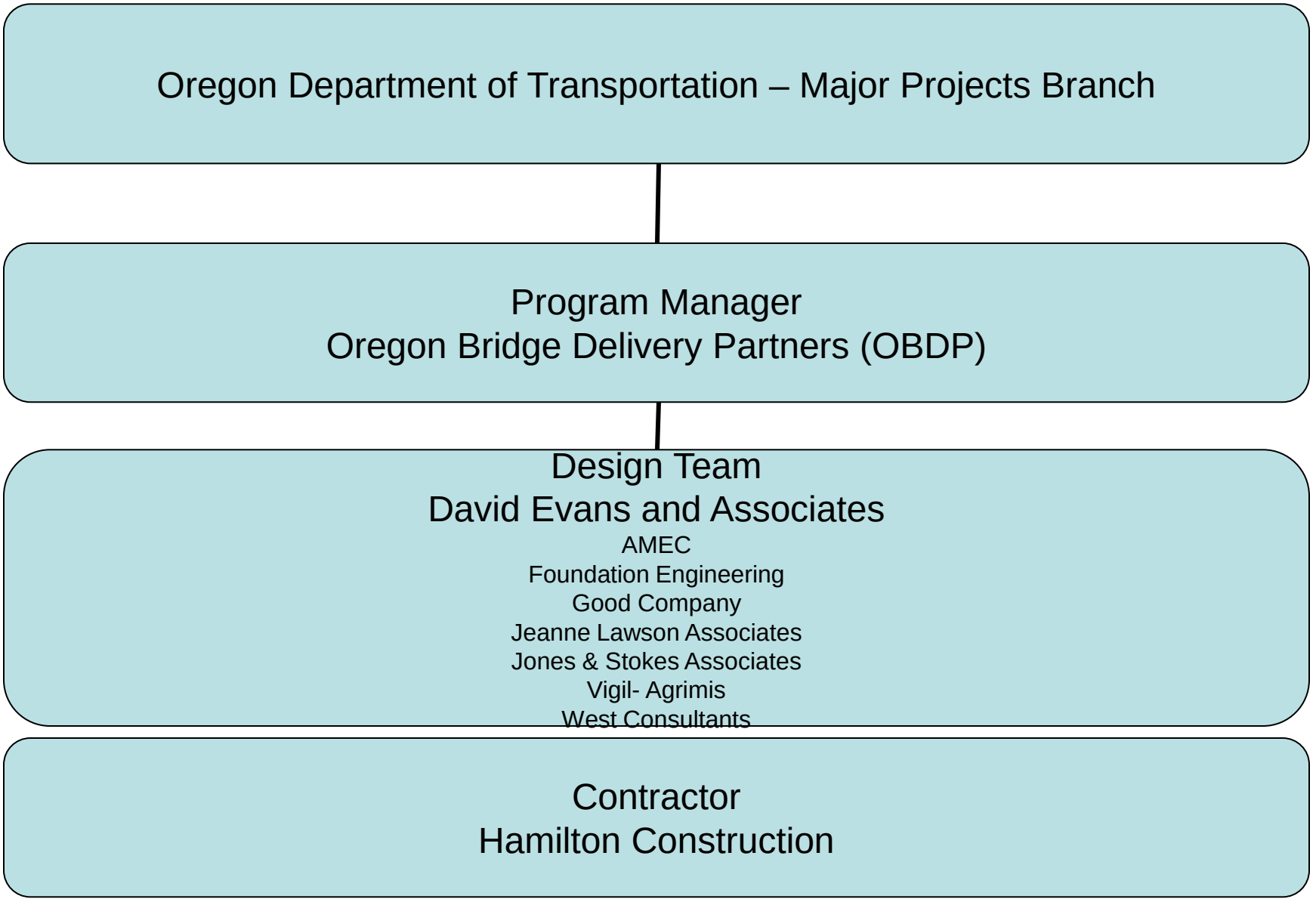
OTIA Bundle 210: Sandy River – Jordan Road



Design Challenges

- Sensitive Environmental Area
- Land Use – Columbia River Gorge NSA
- Aesthetics – “Gateway to Gorge”
- Scour/Drift
- Maintenance of Traffic (2 Lanes Each Way)
- 45-day In-Water Work Window
- Liquefaction
- Structural Design

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Environmental

- Environmental Baseline Document
- OTIA Programmatic Permits
- Wetland Delineation
- Pre-Construction Assessment (PCA)
- Fluvial Functional Assessment
- Fish Passage Plan
- Biological Assessment
- Joint Permit Application

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Fish Resources

Sandy River is designated Essential Fish Habitat by NMFS and Essential Salmonid Habitat by DSL

Federally listed fish species in the Sandy :

- Lower Columbia River (LCR) fall and spring run Chinook salmon
- LCR summer and winter run Steelhead
- LCR Coho Salmon
- Eulachon

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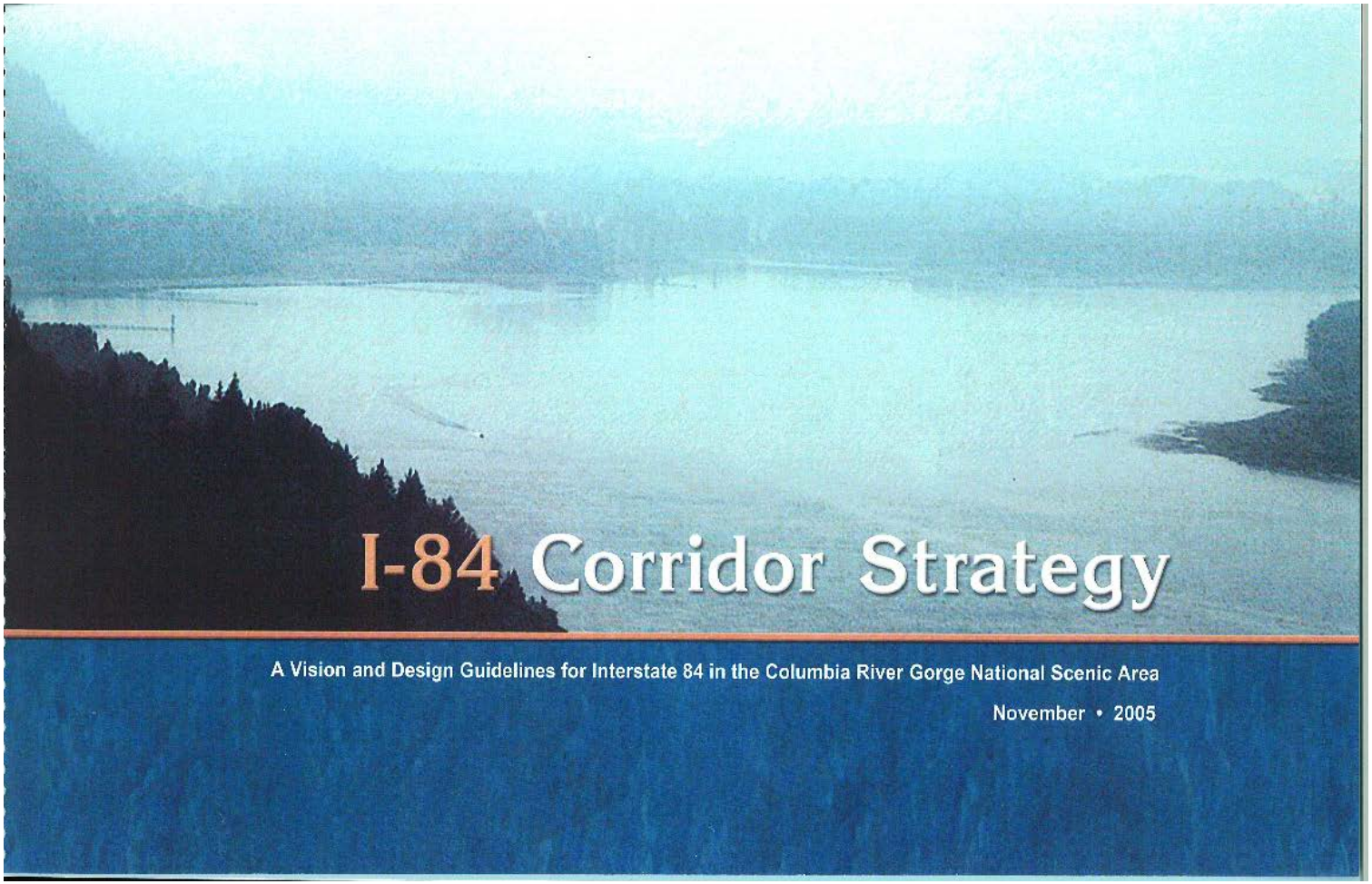
Photograph by Loren Stucker

Aesthetics



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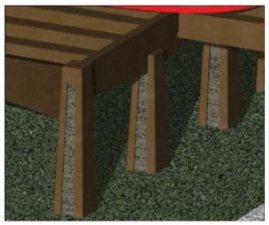
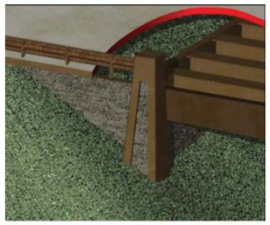
Contemporary Style

Contemporary Bridge Style

Contemporary single-span mainline bridge



Integrated tie beam detail



Abutment wall detail

Contemporary three-span mainline bridge

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Cascadian Style

Guideline Application Examples: Mainline Interstate 84 Bridges

As stated in the design objectives, designs will have the flexibility to vary according to site specific conditions and opportunities, while maintaining continuity. Two different bridge styles emerged through development of the guidelines and images to support the objectives.

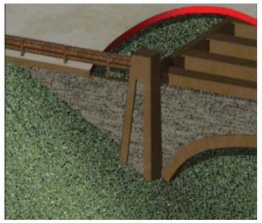
The following rendered images represent examples of how these guidelines and bridge styles could be applied to mainline Interstate 84 bridges, and are not intended to represent exact dimensions or designs for specific locations.

Cascadian Bridge Style

Cascadian single-span mainline bridge

Cascadian three-span mainline bridge

Mainspan pier detail



Abutment wall detail

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Key Hydraulic Findings

- 100 year flood elevation = 38.6
- Minimum span = 140’ for passage of debris
- General Scour Depth 5’- 6’
- Local Scour up to 40’ depth
- Bank Protection Required
- 1-foot clearance for 100-yr flood
- 3-foot clearance for 50-yr flood

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Bundle 210 Sandy River Bridges Outline Construction Schedule

2009

- March – NTP
- July-August (in-water work): Construct detour bridge and work bridge for EB
- August: Begin Stage 1 traffic detour
- Sept-October: Remove EB superstructure
- Sept- Jan: Construct EB end bents
- Sept-May: Fabricate EB superstructure units off-site

2010

- July-August (in-water work): Install sheet piling for EB in-water piers; Construct work bridge for WB; remove EB substructure
- July-November: Construct in-water EB foundations and piers
- Sept-May: Construct EB superstructure
- Oct-June: Fabricate EB superstructure units off-site

2011

- June: Begin Stage 2 traffic detour
- July-August (in-water work): Install sheet piling for WB in-water piers; remove WB superstructure and substructure
- July-December: Construct all WB foundations and piers
- September-July: Construct WB superstructure

2012

- July: Move traffic onto new WB structure
- July-August (in-water work): Remove work bridges and detour bridge
- September: Punch list/clean up

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Key Geotechnical Findings

- Variable alluvial deposits
- Dense Troutdale Formation >100’ deep
- Very prone to liquefaction up to 50’ depth
- Stone column soil remediation @ west embankment
- Recommended Foundation Types
  - Drilled shafts for interior bents
  - Driven piling for end bents

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Initial Bridge Type Selection Process

- Convene VE Team with representatives from DEA, OBDP, ODOT and FHWA
- VE Team to evaluate suggested bridge types
- DEA to further study top four bridge types recommended by VE Team

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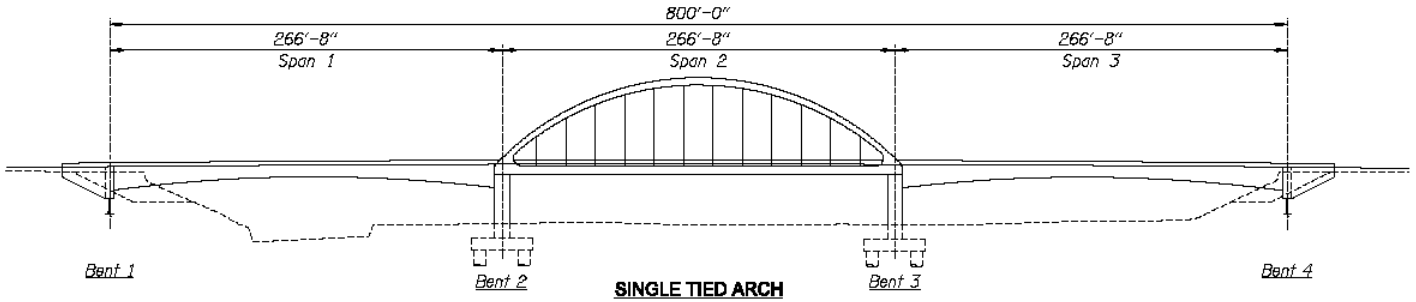
Alternative Bridge Types



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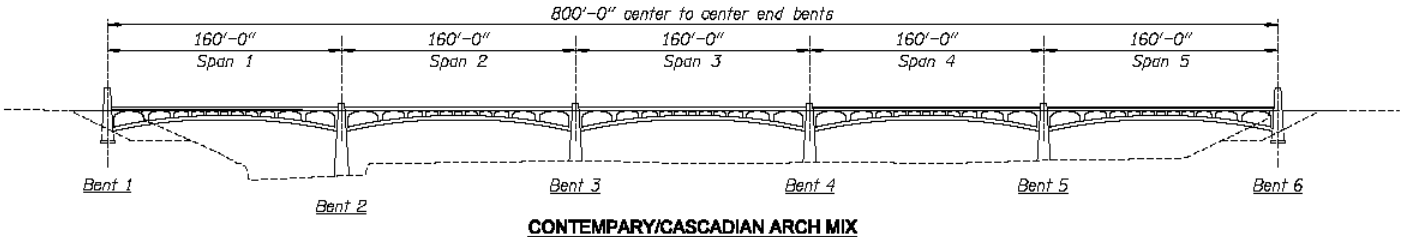
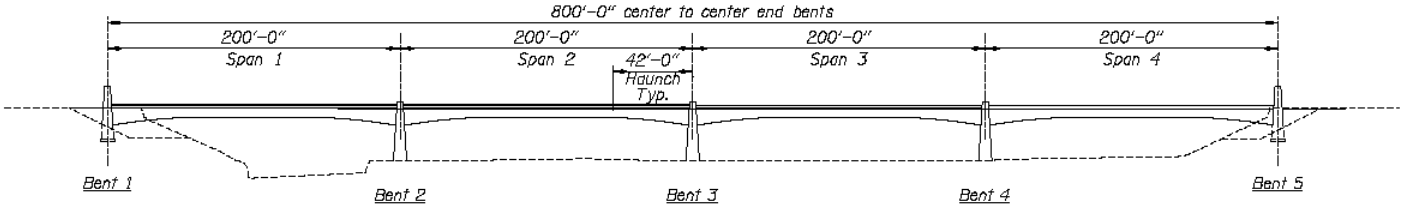
Alternative Bridge Types



CONTEMPARY/CASCADIAN ARCH MIX



STEEL GIRDERS

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2nd VE Group Recommendations

Investigate 4-Span Alternatives:

- Pre-cast Concrete Tub Girder
- CIP Concrete Box Girder
- Steel Tub Girder

Use post-grouting to increase end-bearing capacity of drilled shafts

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Stakeholder Outreach

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CIP Concrete Box Alternative

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Multi-use Path

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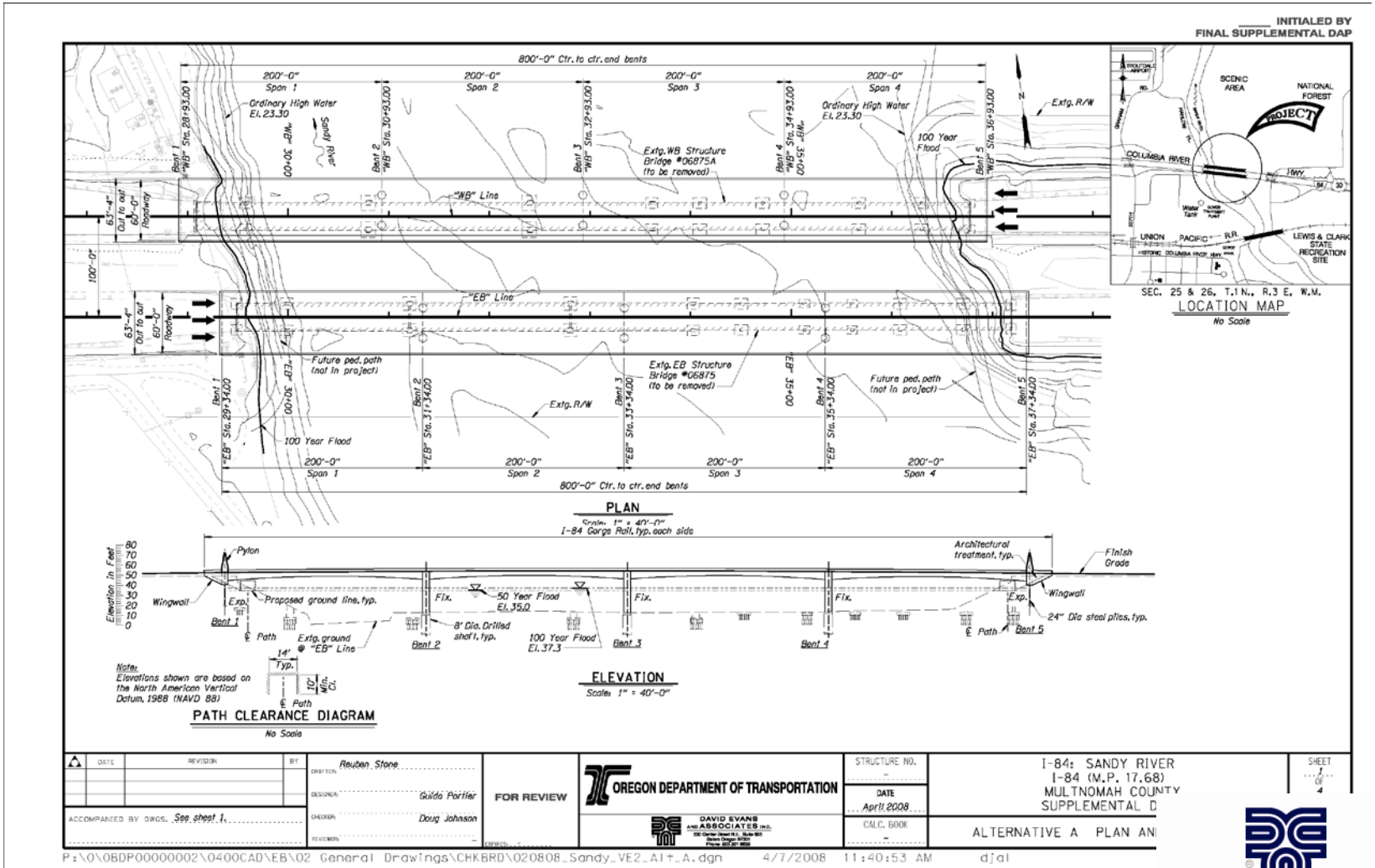
CIP Box Girder Design



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Environmental Issues

- Amount of Fill Below Ordinary High Water (OHW)
- Temporary Piles/ Piles Left in Place
- No Exposed Riprap below OHW
- Secant Pile Wall on east bank

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2009 Bridge Redesign

- Need to reduce project cost
- Delay bidding by one year
- Increase Bridge Length to 840’
- Redesign as steel box girder bridge
- Reduce Column/Shaft size
- Reduce number of temporary piles
- Eliminate secant pile wall

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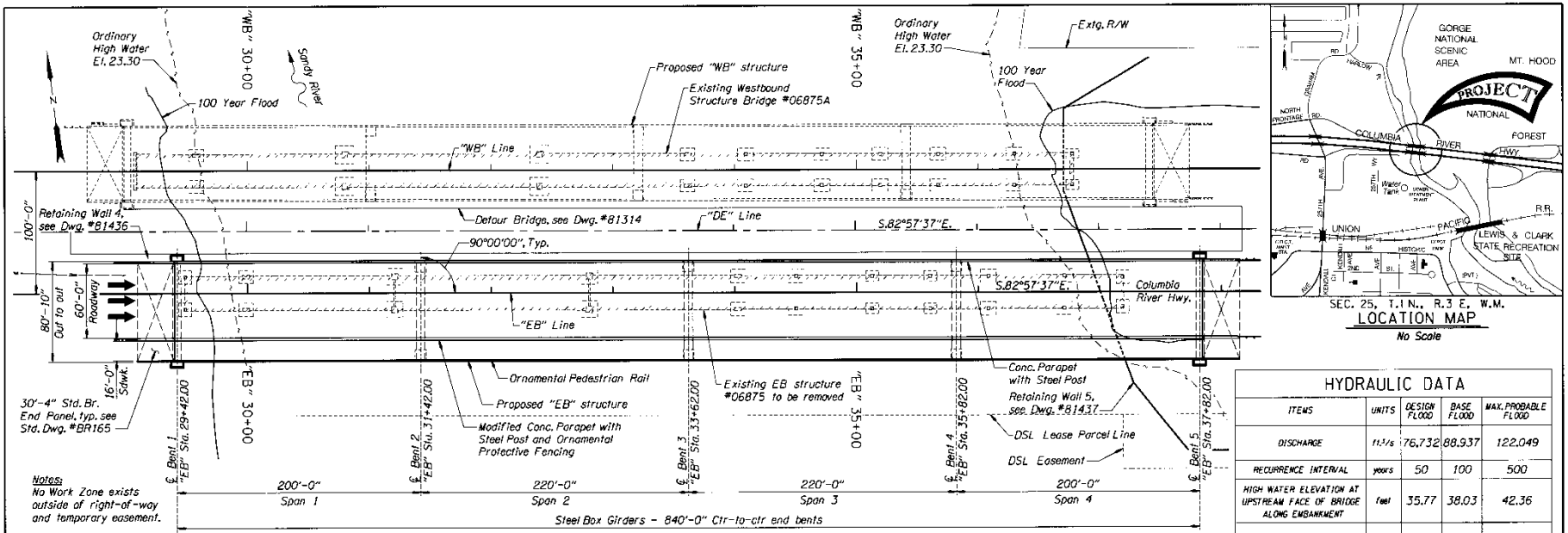
OREGON DEPARTMENT OF TRANSPORTATION
DAVID EVANS AND ASSOCIATES INC.



PLAN

Scale: 1" = 40'-0"

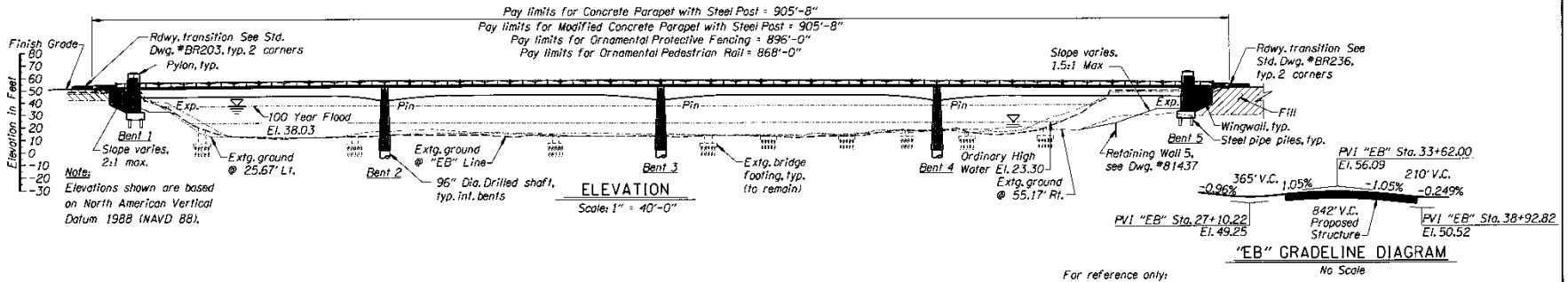
SEC. 25, T.1 N., R.3 E., W.M.

LOCATION MAP

No Scale

HYDRAULIC DATA

ITEMS	UNITS	DESIGN FLOOD	BASE FLOOD	MAX. PROBABLE FLOOD
DISCHARGE	ft³/s	76,732	88,937	122,049
RECURRENCE INTERVAL	years	50	100	500
HIGH WATER ELEVATION AT UPSTREAM FACE OF BRIDGE ALONG EMBANKMENT	feet	35.77	38.03	42.36
BACKWATER	feet	1.39	1.39	1.48



ELEVATION

Scale: 1" = 40'-0"

"EB" GRADELINE DIAGRAM

No Scale

For reference only:
Extg. Bridge No. 06875 Dwgs. 8232-8241, 8417, and 35283-35284

DATE	REVISION	BY

ACCOMPANIED BY DWGS. 81311-81318, 81320-81365, 83001, 81430-81437, BR165, BR203, BR214, BR236, RD815, 83002, 83003

DRAFTER: Reuben Stone
DESIGNER: Steve Starkey
CHECKER: Gernot Komar
REVIEWER: Guido Portier

REGISTERED PROFESSIONAL ENGINEER — STEVEN K. STARKEY — EXPIRES: 6/30/10

OREGON DEPARTMENT OF TRANSPORTATION

SCALE WARNING: If scale bar doesn't measure one inch then drawing is not to scale

DAVID EVANS AND ASSOCIATES INC. — 530 Center Street N.E., Suite 306, Salem, Oregon 97301, Phone: 503.361.8600

STRUCTURE NO. 20878

DATE Nov. 2009

CALC. BOOK 6168-6182

EASTBOUND I-84 OVER SANDY RIVER BRIDGE
I-84: SANDY RIVER - JORDAN RD - BUNDLE 210
COLUMBIA RIVER HWY, I-84 (MP 17.68)
MULTNOMAH COUNTY

PLAN AND ELEVATION

SHEET 1 OF 48

DRAWING NO. 81319

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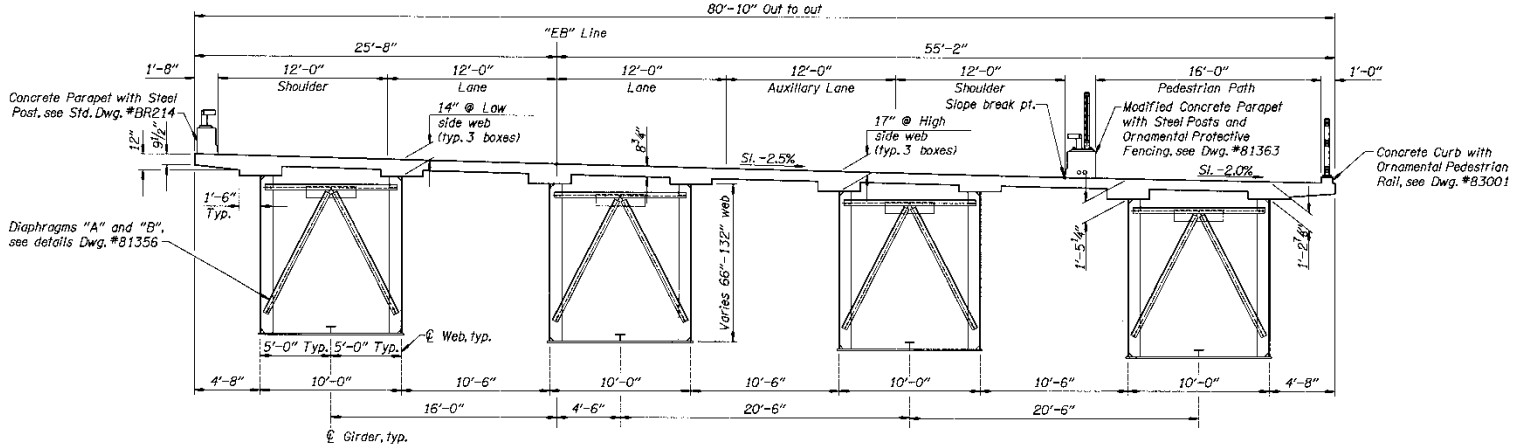
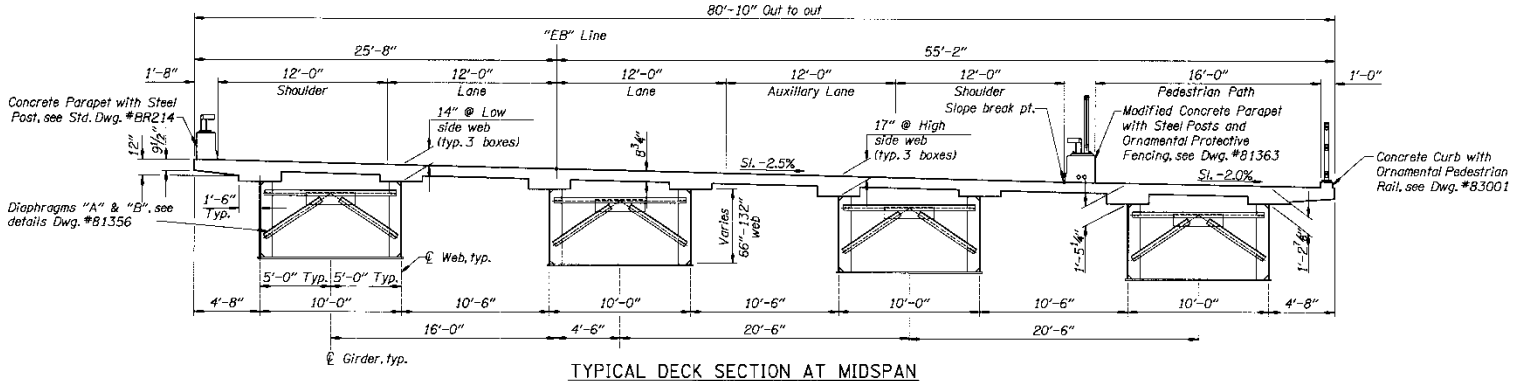


TYPICAL DECK SECTION NEAR INTERIOR BENT

Scale: ¼" = 1'-0"



TYPICAL DECK SECTION AT MIDSPAN

Scale: ¼" = 1'-0"

DATE	REVISION	BY

ACCOMPANIED BY DWGS. See Dwg. #81319

DRAFTER: Reuben Stone
DESIGNER: Steve Starkey
CHECKER: Yum Tam
REVIEWER: Guido Portier

REGISTERED PROFESSIONAL ENGINEER — OREGON — JULY 30, 2004 — STEVEN K. STARKEY
EXPIRES: 6/30/10

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620 Capitol Street N.E., Suite 300, Salem, Oregon 97301, Phone 503.361.8638

STRUCTURE NO.	DATE	CALC. BOOK
20878	Nov. 2009	6168-6182

EASTBOUND I-84 OVER SANDY RIVER BRIDGE
I-84: SANDY RIVER - JORDAN RD - BUNDLE 210
COLUMBIA RIVER HWY, I-84 (MP 17.68)
MULTNOMAH COUNTY

TYPICAL DECK SECTION

SHEET 22 OF 48

DRAWING NO. 81340

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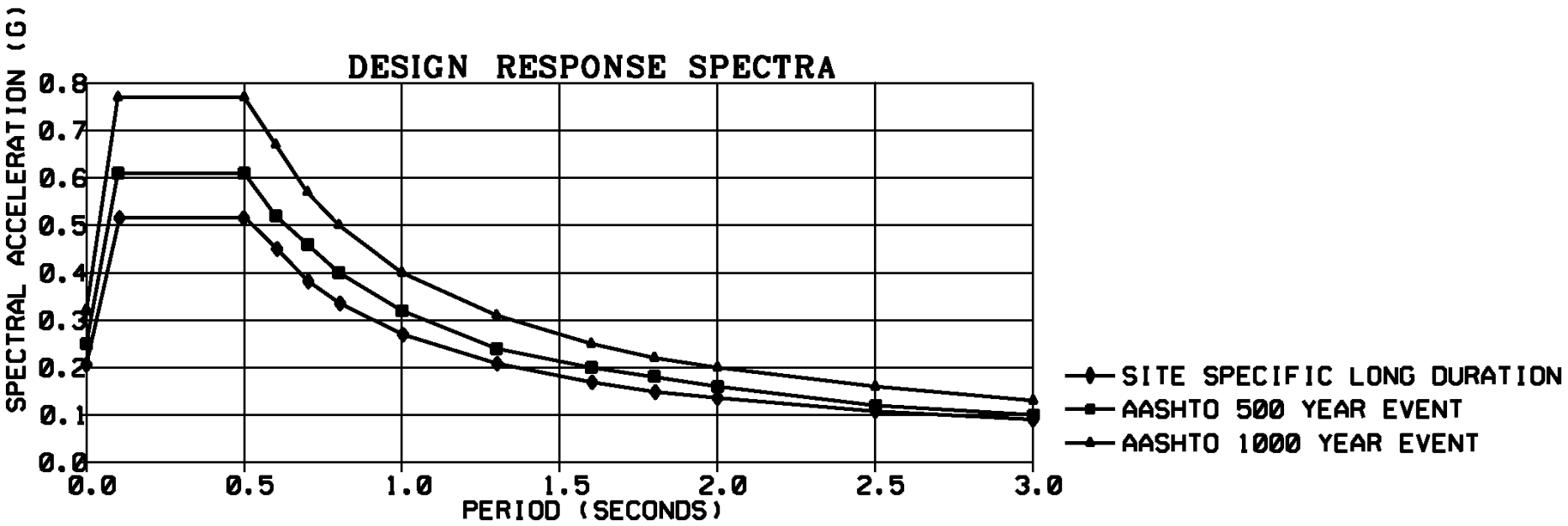
Seismic Site Analysis



- Site Specific Modeling using SHAKE 2000
- Crustal Events and Subduction Zone Events
- Validated AASHTO-derived Response Spectrum Curves

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Seismic Site Analysis

Liquefaction at Interior Bents:

- Crustal Event: 20’ – 35’ Liquefaction
- Subduction Zone Event: 55’ – 60’ Liquefaction
- Reflected in soil modeling using L-Pile

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Seismic Models

- Global 3-D structure model created in SAP2000
- Equivalent cantilever lengths were determined at each interior bent in each direction
- Cantilever lengths were iterated until displacements matched L-Pile results
- Separate models developed for no-liquefaction, crustal liquefaction, subduction liquefaction cases, with and without cofferdam seal

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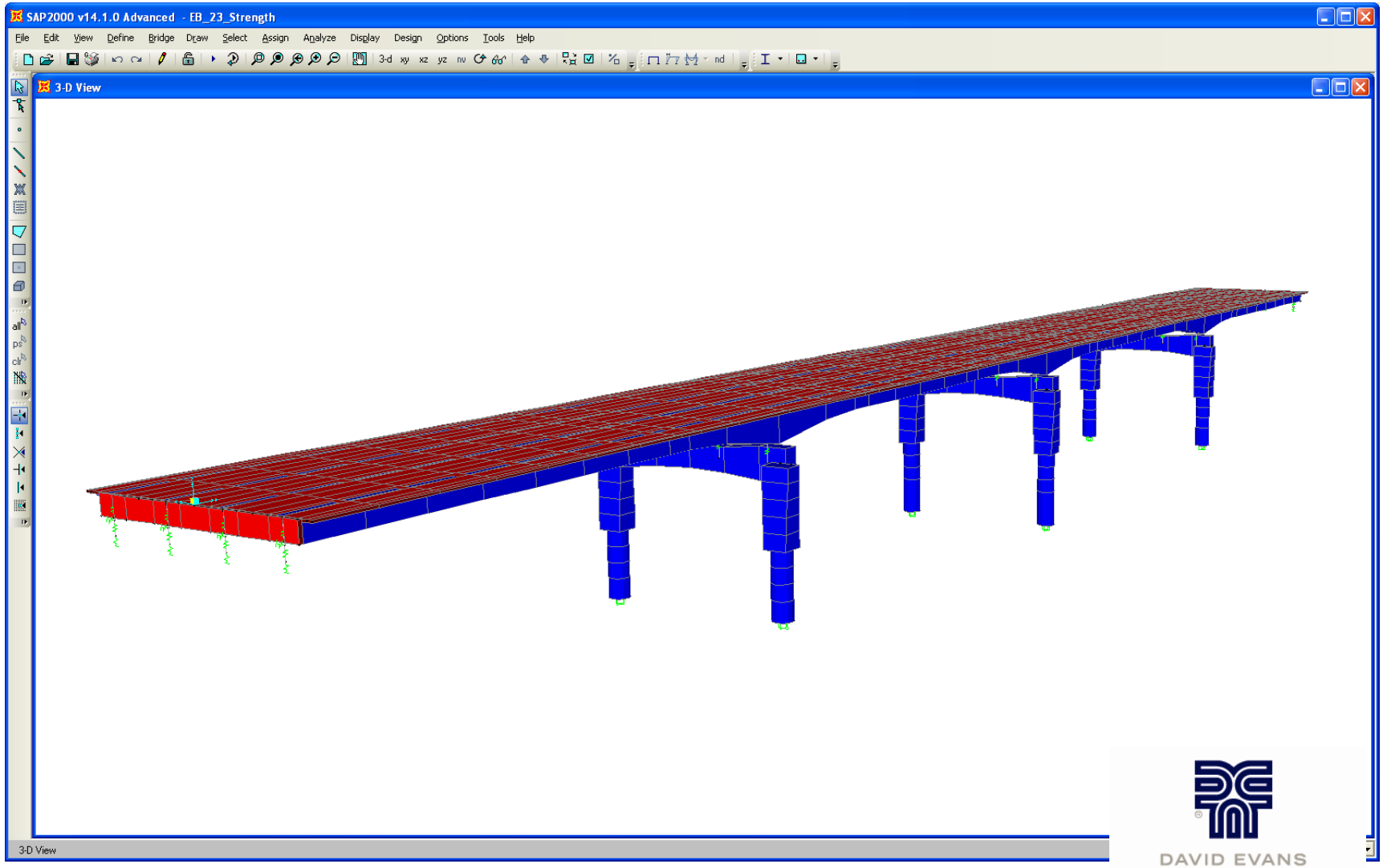
Seismic Model



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Seismic Bent Design

- 500-year Event – Serviceable (R=3.5)
- 1000-year Event – No Collapse (R=5.0)
- Hinge column tops in transverse direction
- Capacity Protection for Drilled Shafts through reduced column section

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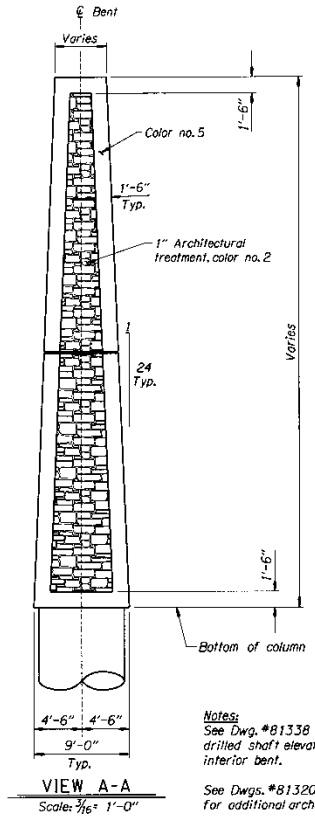
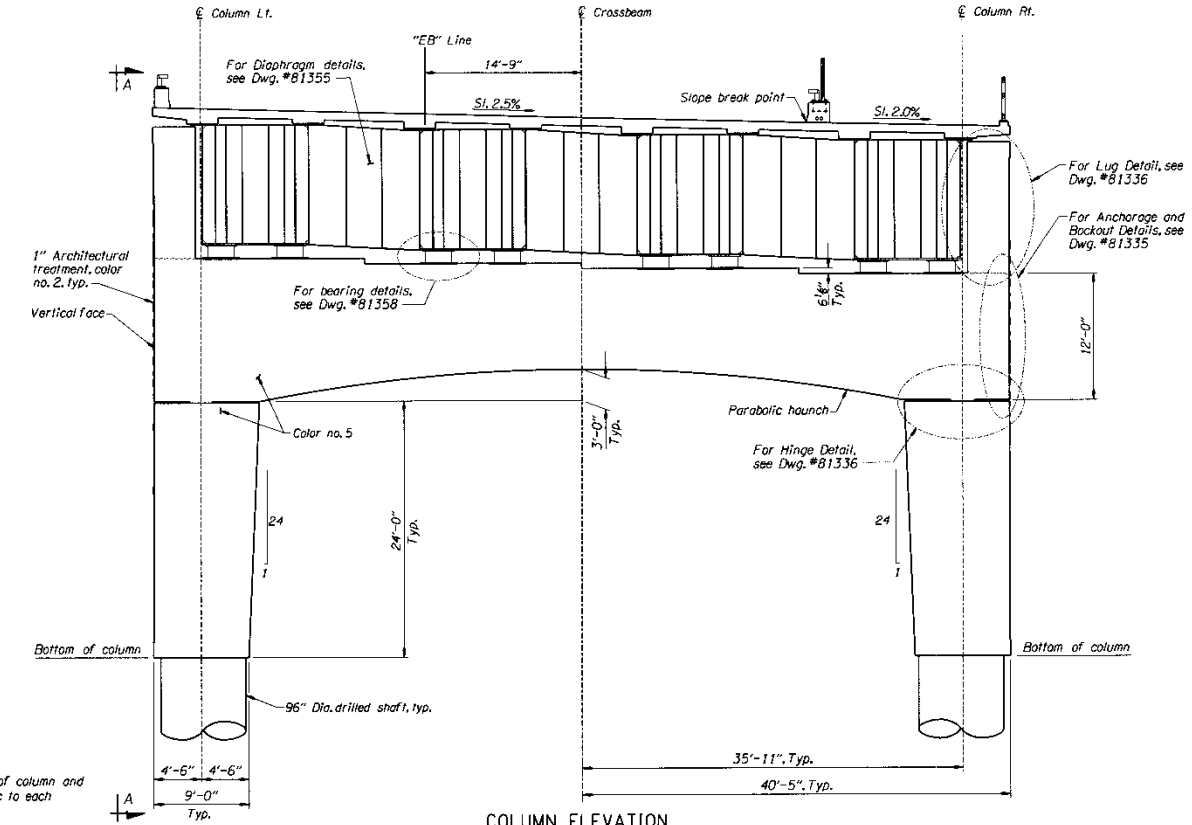


VIEW A-A
Scale: 3/16" = 1'-0"



COLUMN ELEVATION
Scale: 3/16" = 1'-0"

Notes:
See Dwg. #81338 for bottom of column and drilled shaft elevations specific to each interior bent.

See Dwgs. #81320, #81330 and #81332 for additional architectural details.

Cofferdam Seals not shown for clarity, see Dwg. #81323.

△	DATE	REVISION	BY

ACCOMPANIED BY DWGS. See Dwg. #81319

DRAFTER: Reuben Stone
DESIGNER: Eric Rau
CHECKER: Gernot Komar
REVIEWER: Guido Portier

REGISTERED PROFESSIONAL ENGINEER — OREGON — MARCH 9, 2004 — ERIC STEPHEN RAU
EXPIRES: 12/31/2010

OREGON DEPARTMENT OF TRANSPORTATION

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DAVID EVANS AND ASSOCIATES INC.
620 Center Street N.E., Suite 600
Salem, Oregon 97301
Phone: 503.361.8535

STRUCTURE NO.	DATE	CALC. BOOK
20878	Nov. 2009	6168-6182

EASTBOUND I-84 OVER SANDY RIVER BRIDGE
I-84: SANDY RIVER - JORDAN RD - BUNDLE 210
COLUMBIA RIVER HWY, I-84 (MP 17.68)
MULTNOMAH COUNTY

INTERIOR BENT ELEVATION

SHEET 15 OF 48
DRAWING NO. 81333

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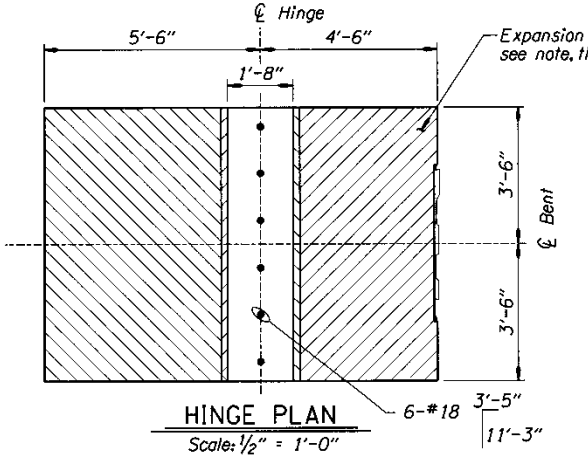
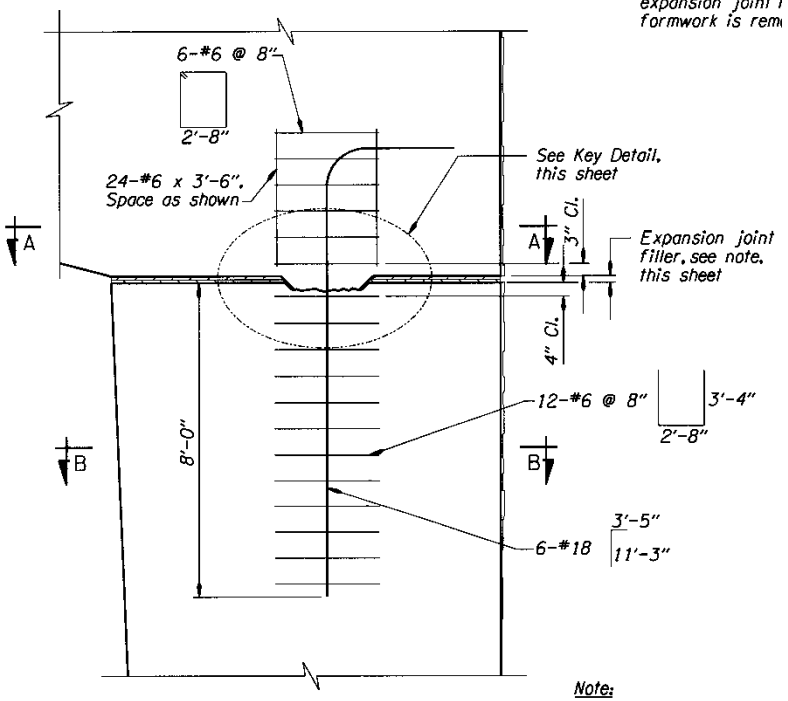


HINGE PLAN
Scale: ½" = 1'-0"



HINGE DETAIL
Scale: ½" = 1'-0"

Note:
Contractor to pro
open joint and f
expansion joint
formwork is rem

Note:
Column and Crossbeam
not shown for clarity.

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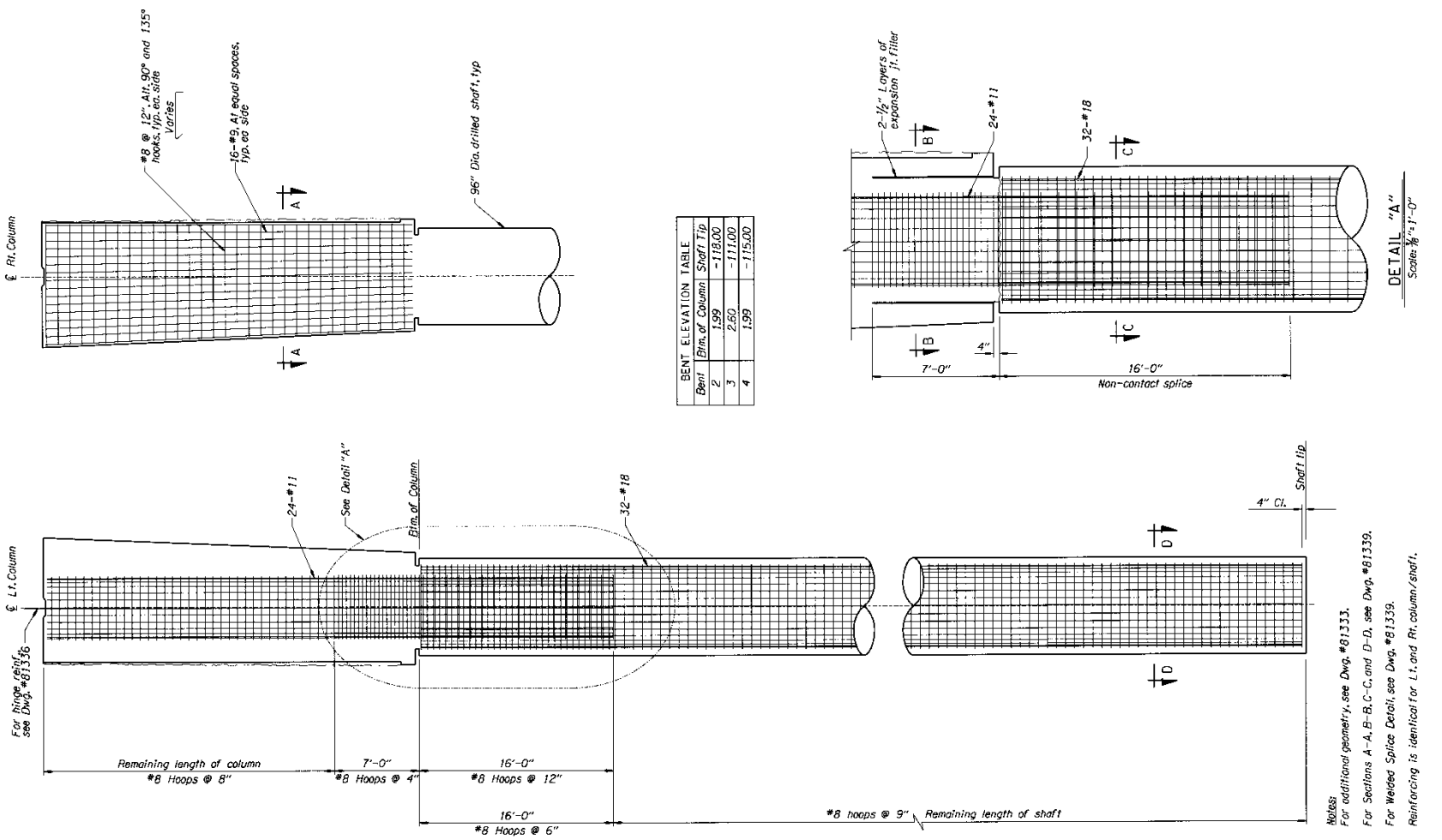

	DATE	REVISION	BY

ACCOMPANIED BY DWGS. See Dwg. #81319

DRAFTER: Cory Schreiner
DESIGNER: Mikal Mitchell
CHECKER: Gernot Komar
REVIEWER: Eric Rau

REGISTERED PROFESSIONAL ENGINEER — OREGON — MARCH 16, 2004 — ERIC STEPHEN RAU
EXPIRES: 12/31/2010

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520 Center Street N.E., Suite 400
Salem, Oregon 97301
Phone: 503.361.8635

STRUCTURE NO. 20878
DATE Nov. 2009
CALC. BOOK 6168-6182

EASTBOUND I-84 OVER SANDY RIVER BRIDGE
I-84: SANDY RIVER - JORDAN RD - BUNDLE 210
COLUMBIA RIVER HWY, I-84 (MP 17.68)
MULTNOMAH COUNTY

COLUMN AND DRILLED SHAFT ELEVATION

SHEET 20 OF 48
DRAWING NO. 81338

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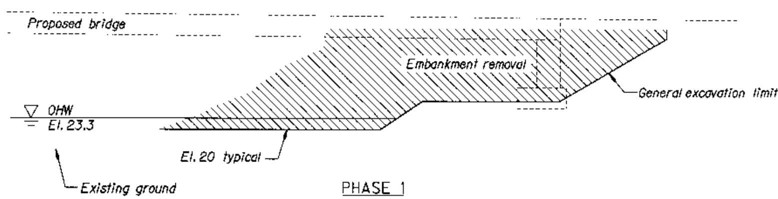
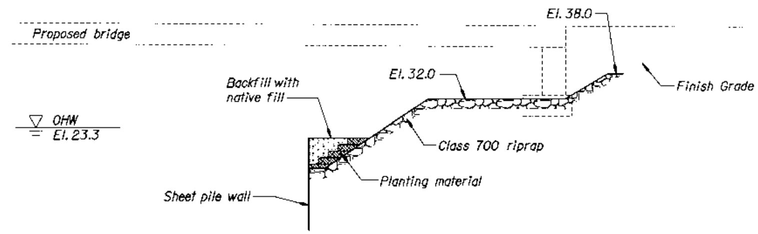


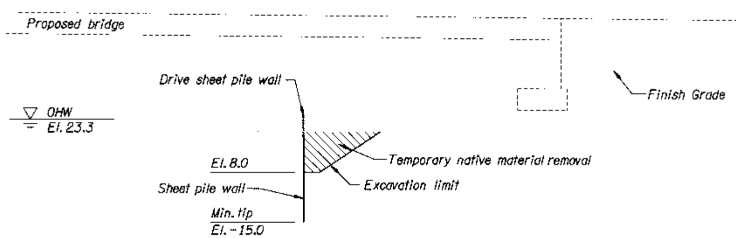
PHASE 1

1. Remove embankment general excavation.



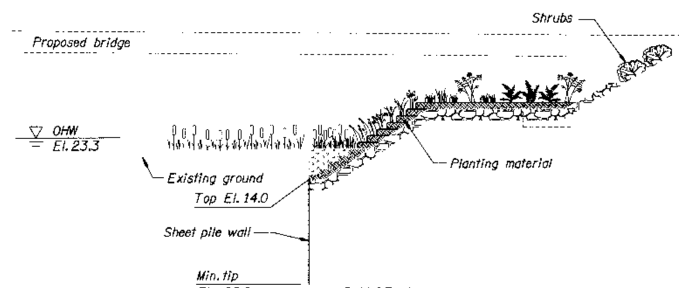
PHASE 3

1. Place Class 700 riprap.
2. Place planting material.
3. Drill 2" dia. weep holes in sheet pile wall.
4. Backfill with native fill.



PHASE 2

1. Drive sheet pile wall to temporary minimum tip elevation -15.0.
2. Remove native material to elevation 8.0.



PHASE 4

1. Drive sheet pile wall to final top elevation 14.0.
2. Place final planting material and plants.

Note:
Excavation below OHW (El. 23.3) performed in the dry and during the in-water work window.

STAGE CONSTRUCTION DETAILS

No Scale

△	DATE	REVISION	BY

ACCOMPANIED BY DWGS. 81311, 81428, 81431-81434, 81439, & 81440

DRAFTER: Reuben Stone
DESIGNER: Guido Portier
CHECKER: Darin Freeman
REVIEWER: Terry Stones

REGISTERED PROFESSIONAL ENGINEER 71821 OREGON JULY 18, 1997 GUIDO A. PORTIER
EXPIRES: 12-31-2010

OREGON DEPARTMENT OF TRANSPORTATION

SCALE WARNING: If scale bar doesn't measure one inch then drawing is not to scale

DAVID EVANS AND ASSOCIATES INC.

STRUCTURE NO. 21102
DATE Nov. 2009
CALC. BOOK 6183

RETAINING WALL, EASTBOUND (MP 17.77)
I-84: SANDY RIVER - JORDAN RD - BUNDLE 210
COLUMBIA RIVER HWY, I-84
MULTNOMAH COUNTY

WALL 5 STAGE CONSTRUCTION

SHEET 3 OF 3

DRAWING NO. 83003

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Construction Phase

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Bubble Curtain

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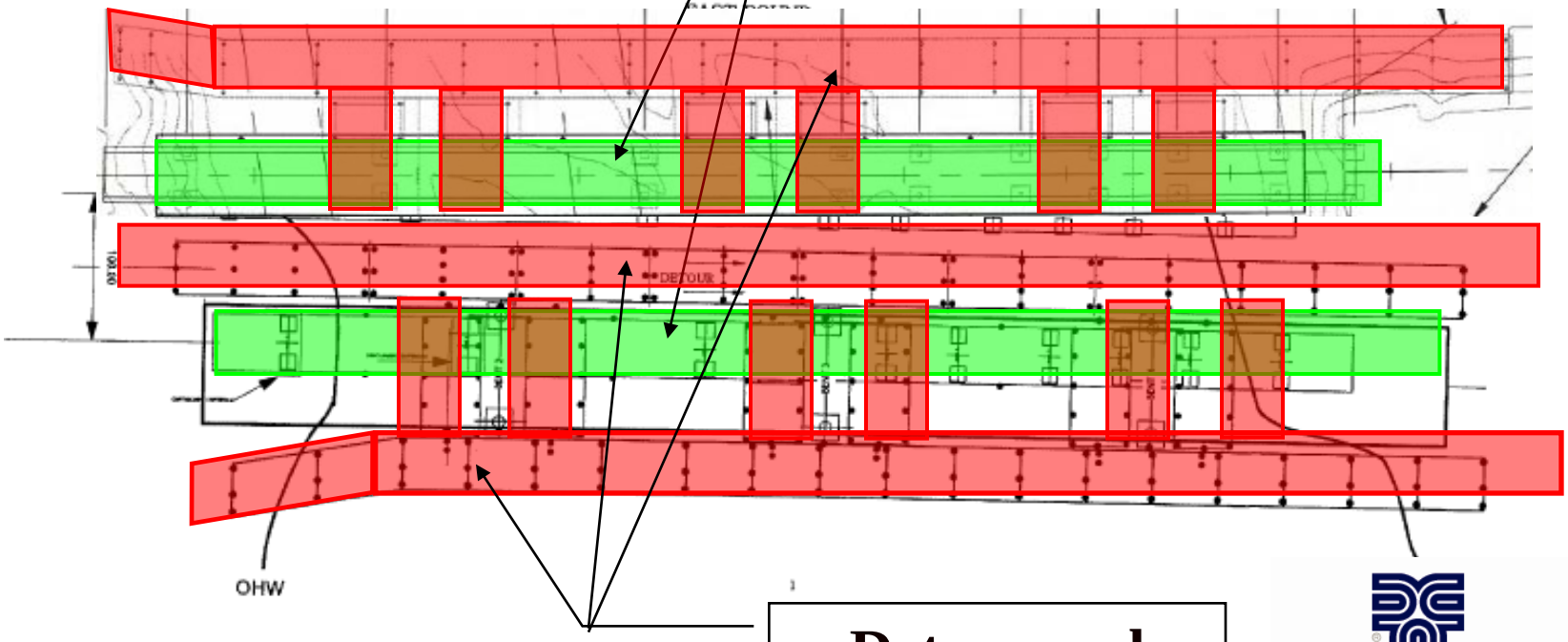
Contractor's Temporary Works

Temporary structures:

- 2010-2011: Detour bridge, EB work bridge
- 2011-2012: Detour bridge, WB and EB work bridges
- 2012-2013: Detour bridge, WB work bridge



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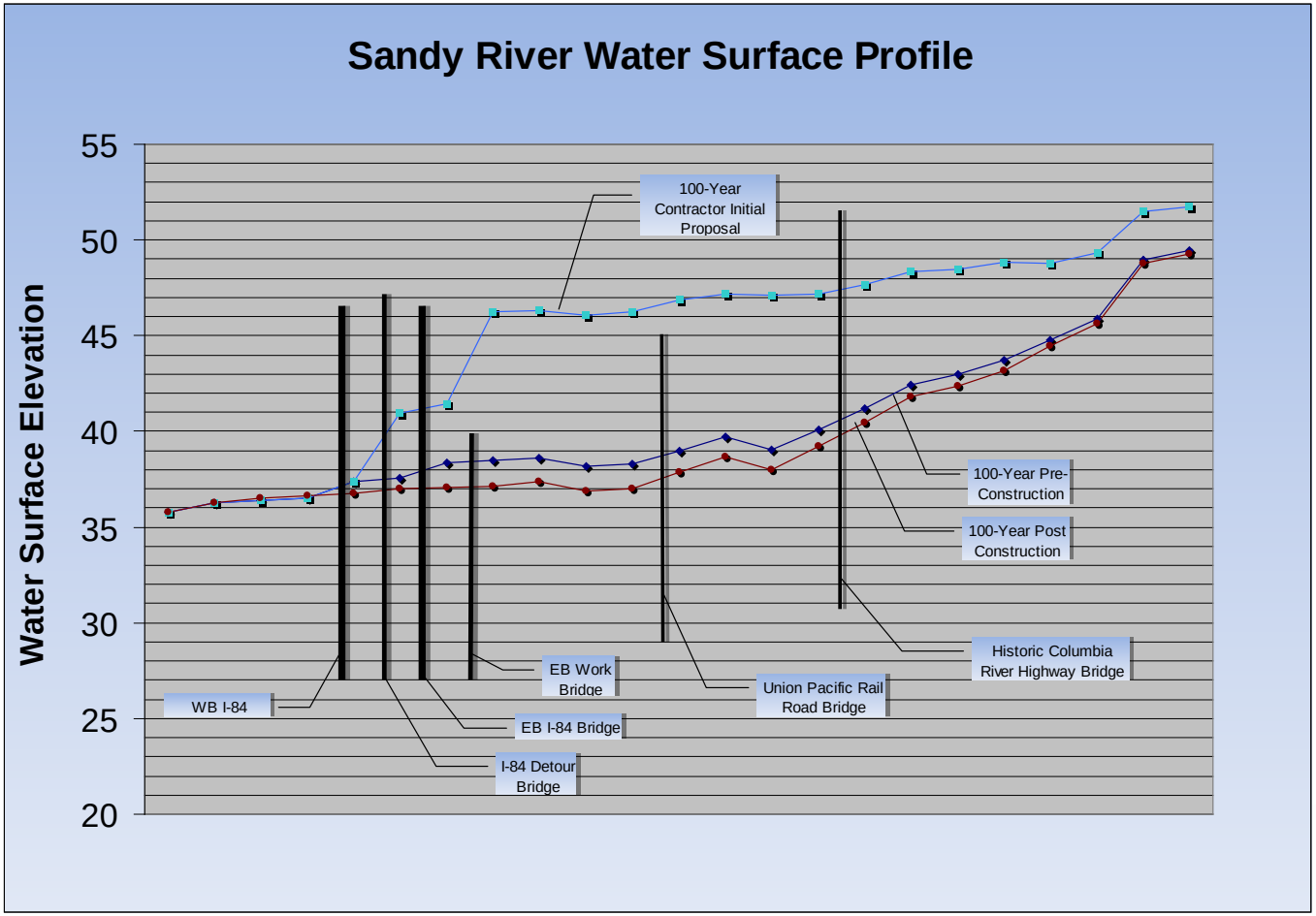
Hydraulic Analysis of Construction Conditions



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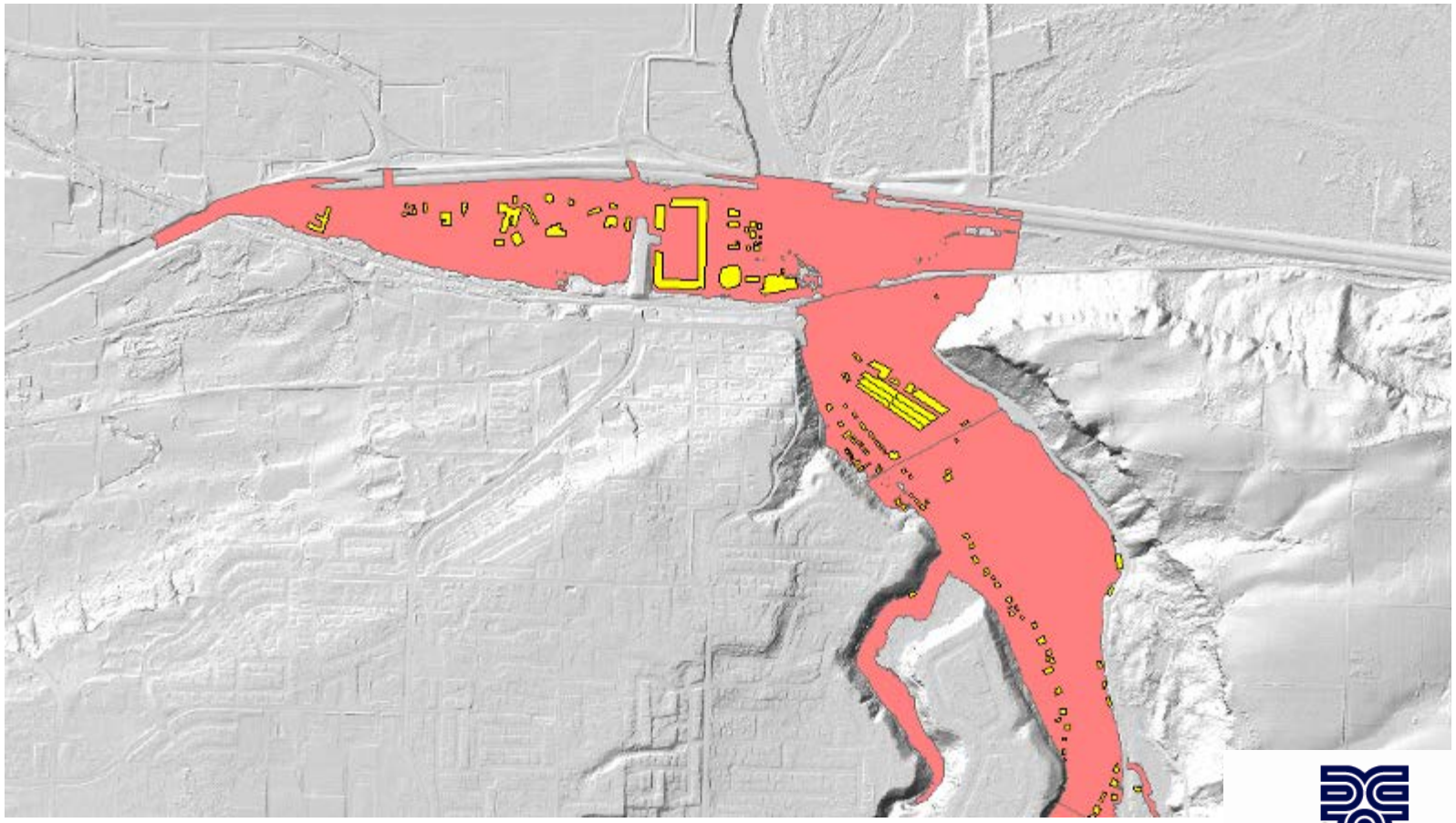
Impacted Area – Worst Case



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Temporary Flood Risk

Fall 2011 – Spring 2012			
Event	Structures Impacted	Value Impacted	3-Year Probability
10-yr	5	$5.0 M	27.1%
25-yr	48	$27.5 M	11.5%
100-yr	63	$69 M	3.0%

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Team Approach

- Analyze the Magnitude of Risk
- DEA/OBDP

- Brainstorm Alternatives
- DEA/OBDP/Hamilton/ODOT

- Re-assess impacts
- DEA/OBDP/ODOT

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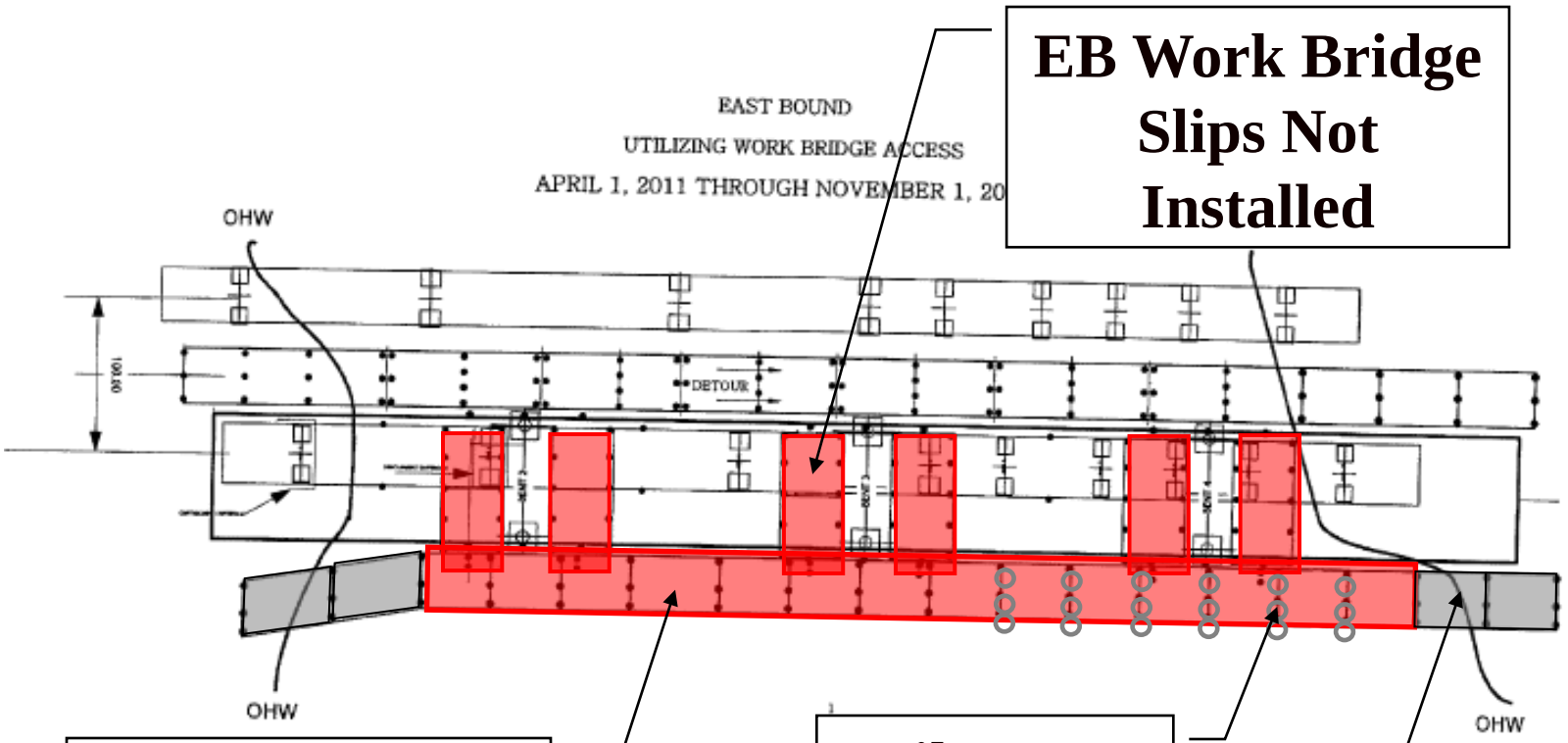
Solution –Partial Removals



EB Work Bridge Slips Not Installed

EB Work Bridge Deck Removed

Piles Cut

Deck Remaining at Ends

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Solution – Gantry Crane

Gantry crane process

To reduce the risk of flooding, ODOT is using a gantry crane to lift and position the bridge beams instead of using a new work bridge.

Steel beams are lifted from the staging area on the west bank by a gantry crane.

A gantry crane supports the beams as they slide into place.

Beginning at the east end of the bridge, the steel beams are lowered into place.

A gantry crane sets T-sections into place, where they are attached to the steel beams.

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Solution - Outreach

- Increased flood risk to 100 properties
- Engage elected officials
- Work with regulatory agencies to relax in-water work window requirements
- Work with emergency services
- Town hall meeting
- Work with residents impacted

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January 2011 Storm Event

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Firewood Sale

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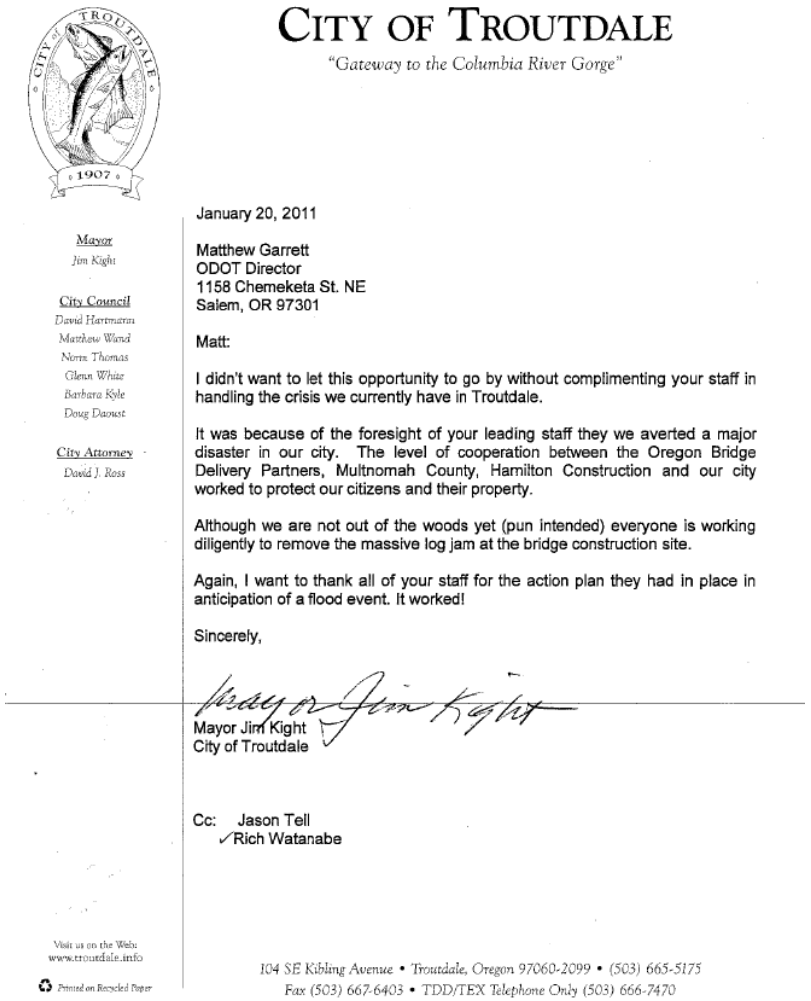
Community Response



CITY OF TROUTDALE

"Gateway to the Columbia River Gorge"

Mayor
Jim Kight

City Council
David Hartmann
Matthew Ward
Norm Thomas
Glenn White
Barbara Kyle
Doug Daoust

City Attorney
David J. Ross

January 20, 2011

Matthew Garrett
ODOT Director
1158 Chemeketa St. NE
Salem, OR 97301

Matt:

I didn't want to let this opportunity to go by without complimenting your staff in handling the crisis we currently have in Troutdale.

It was because of the foresight of your leading staff they we averted a major disaster in our city. The level of cooperation between the Oregon Bridge Delivery Partners, Multnomah County, Hamilton Construction and our city worked to protect our citizens and their property.

Although we are not out of the woods yet (pun intended) everyone is working diligently to remove the massive log jam at the bridge construction site.

Again, I want to thank all of your staff for the action plan they had in place in anticipation of a flood event. It worked!

Sincerely,

Mayor Jim Kight
City of Troutdale

Cc: Jason Tell
✓Rich Watanabe

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Drilled Shaft Construction

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Tip Grouting

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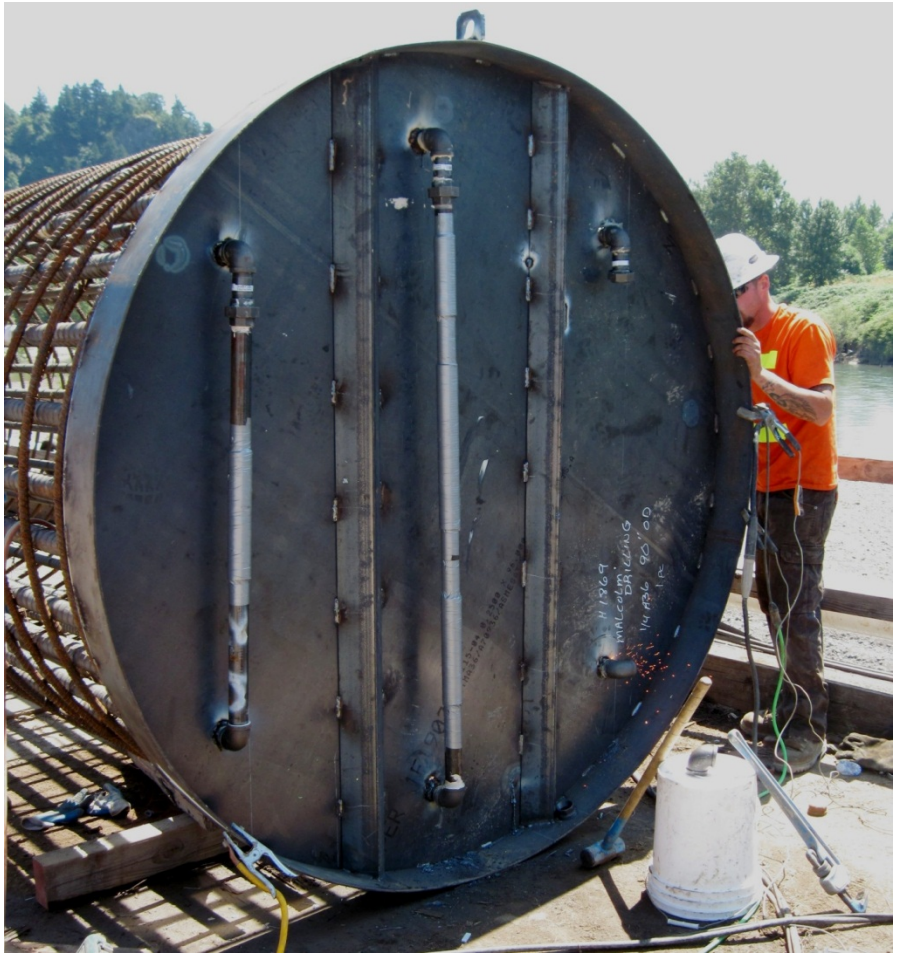
Tip Grouting



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Osterberg Cell Testing

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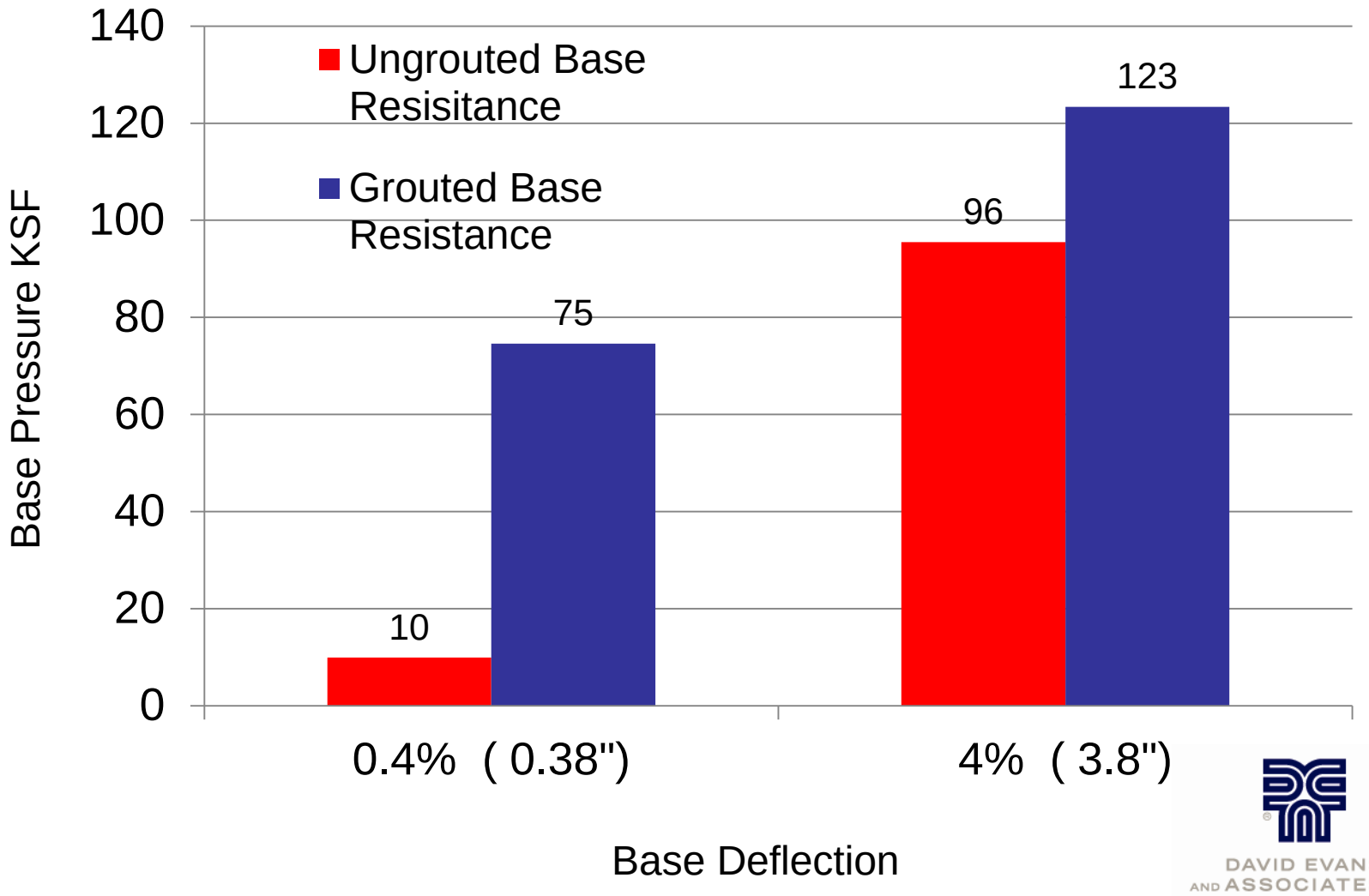
Grouted Vs. Ungrouted



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Column Construction

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Gantry Erection

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Gantry Erection

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Gantry Erection

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Questions?
Thank You!
Lewis and Clark
State Park
Oxbow Regional
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