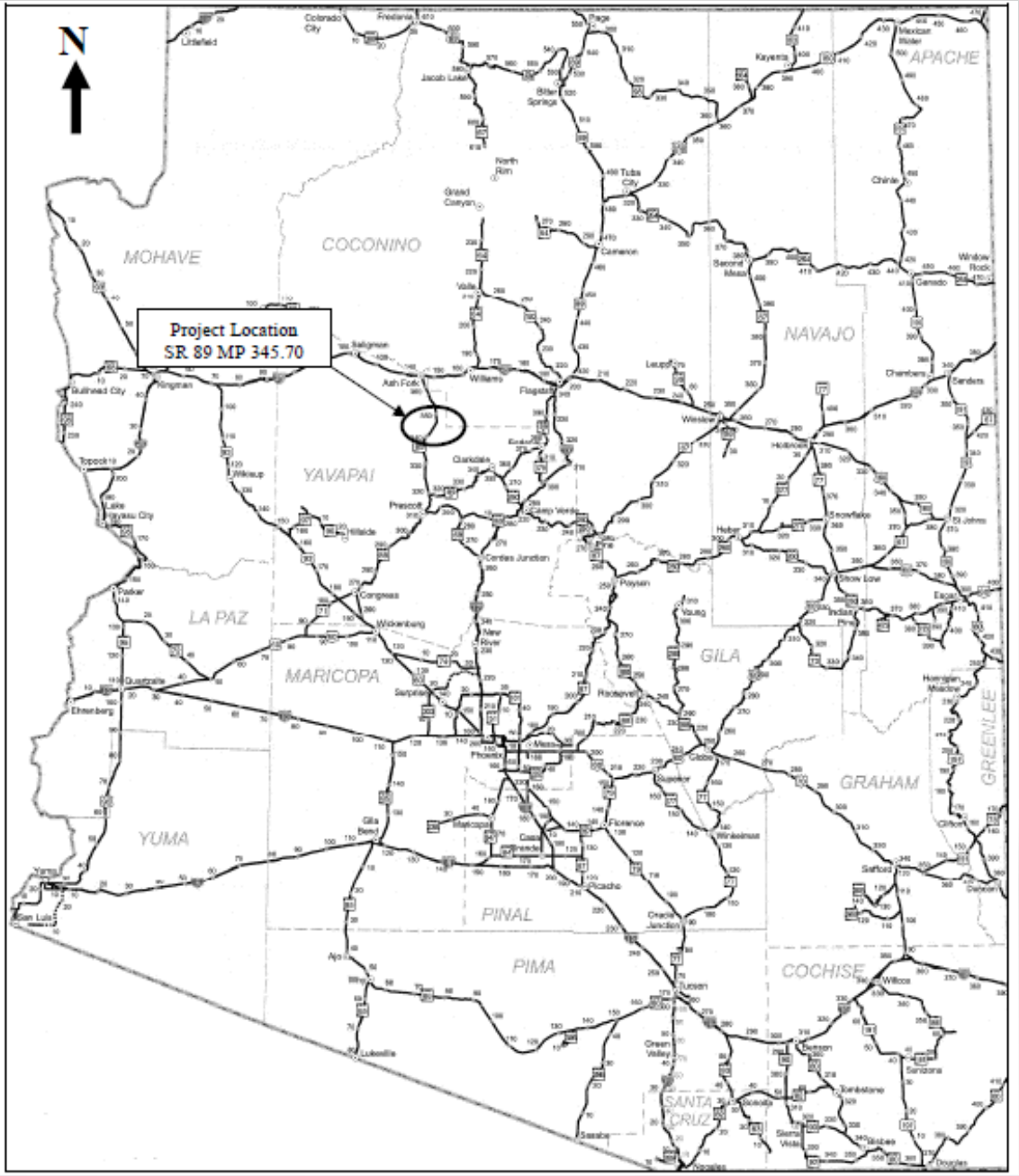
SR-89 Hell Canyon Bridge

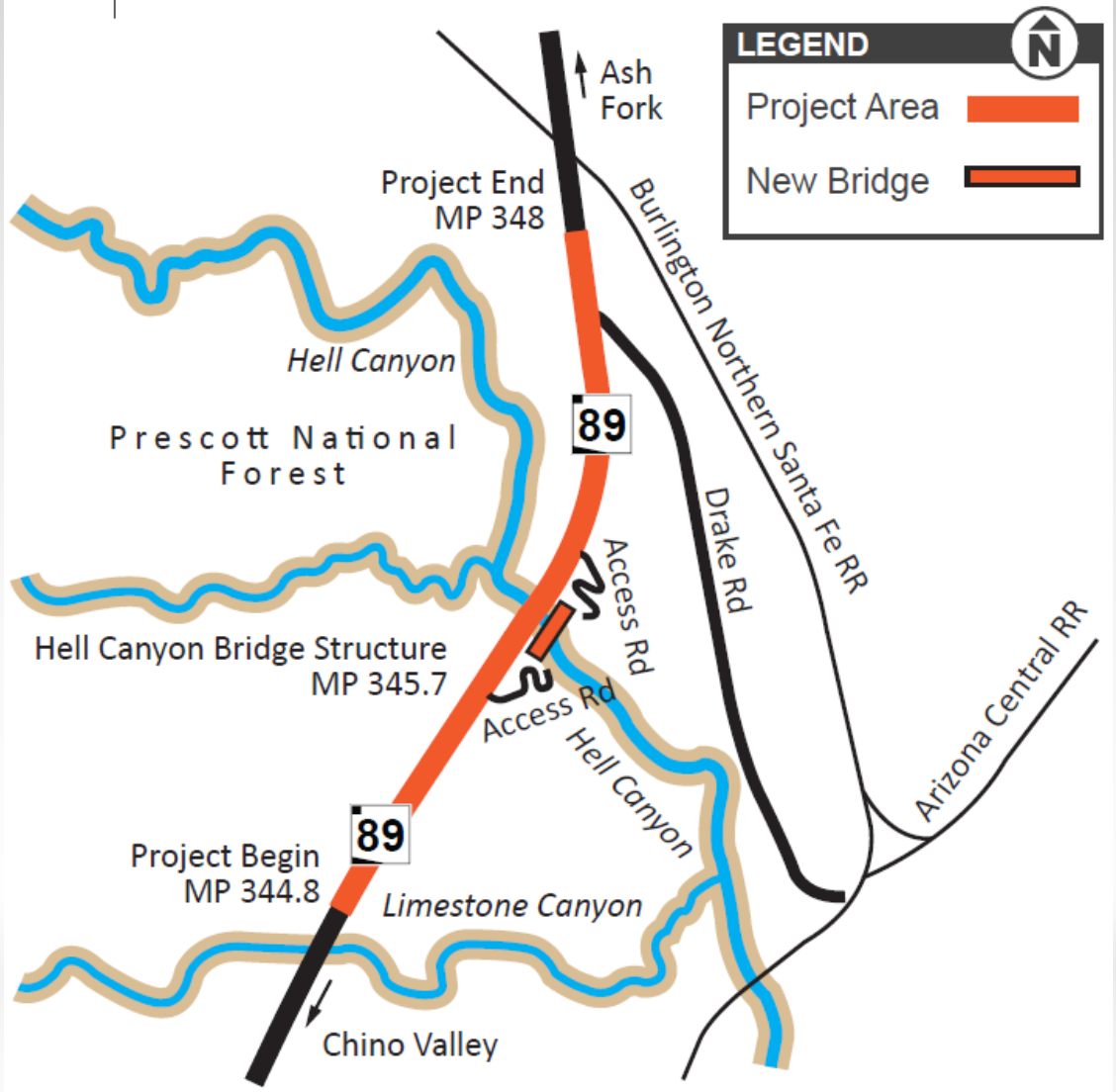
MP 345.70

Presentation by Mike Morrison

September 11, 2015

V1.1

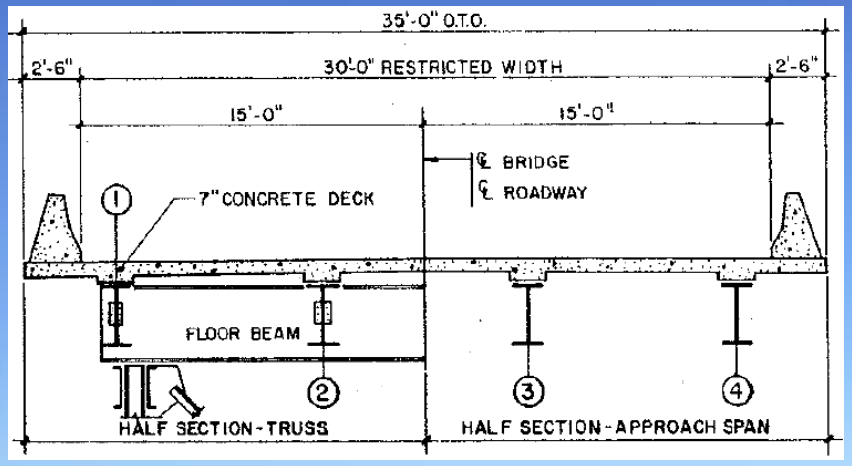

N
Project Location
SR 89 MP 345.70
MOHAVE
COCONINO
APACHE
NAVAJO
YAVAPAI
LA PAZ
MARICOPA
GILA
GREENLEE
GRAHAM
YUMA
PINAL
PIMA
COCHISE
SANTA CRUZ

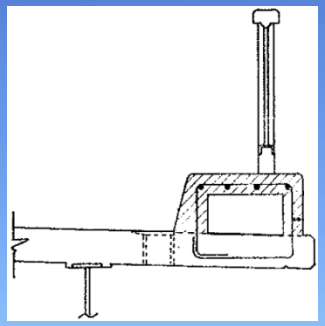


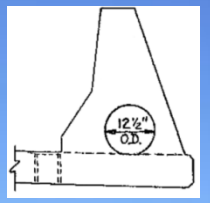
- Yavapai County
- 16 miles south of Ash Fork, 18 miles north of the town of Chino Valley
- 3.2 miles of roadway work

- Built in 1954 (Arizona Highway Department)
- Three-span cantilevered pratt deck truss with steel girder end spans
- Concrete piers on spread footings
- Steel Trusses fabricated by Kansas City Structural Steel Company (KCSS)
- Current Rating: Structurally Deficient and Functionally Obsolete

- Sufficiency Rating: S 38.00
- Inventory Rating: 51 Tons
- Operating Rating: 75 Tons







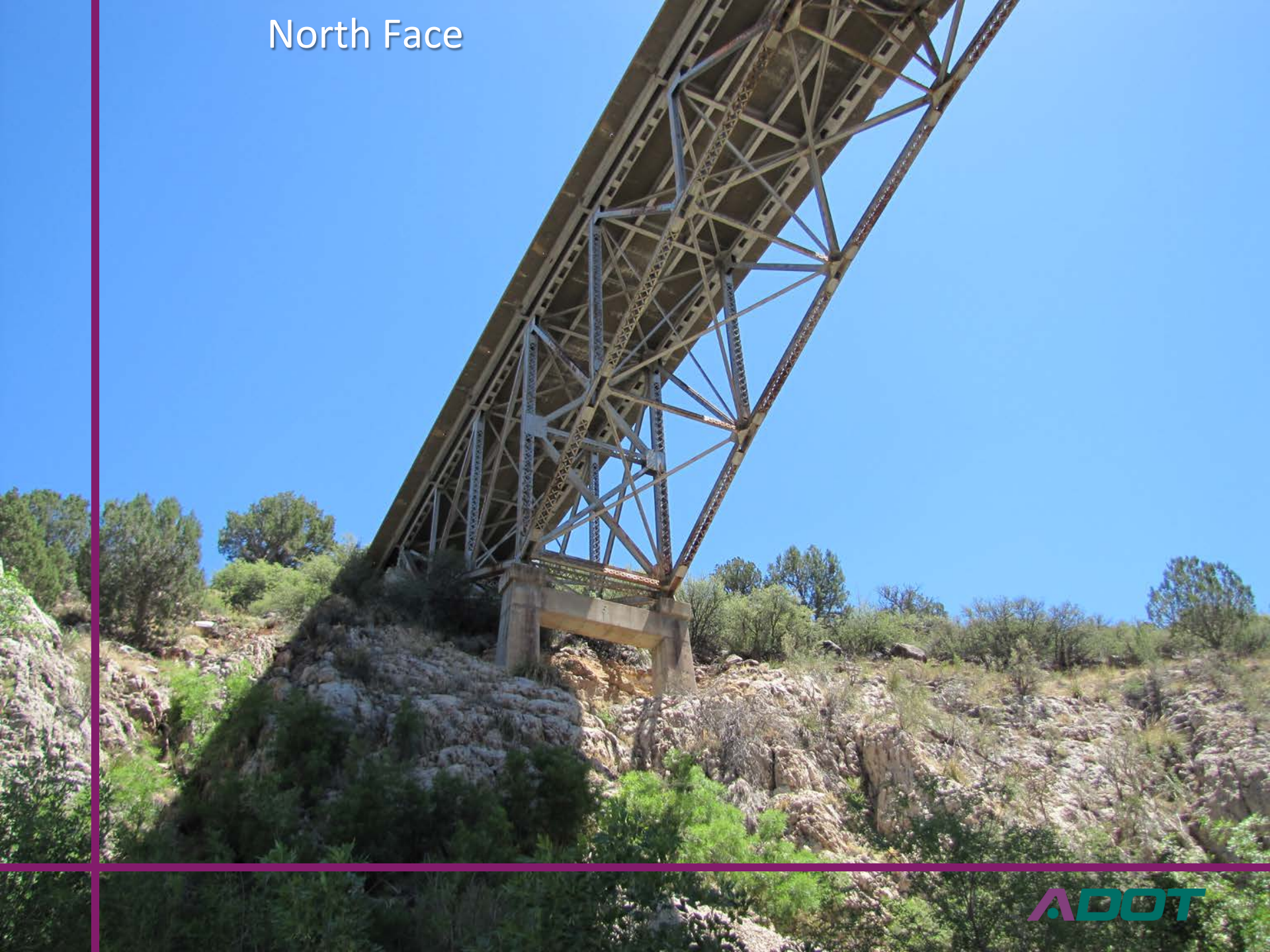
- 585’-6” Total Length
- 35’ Out-to-Out Deck Width (30’ Clear Roadway)
- Two 12-Foot Lanes
- Three-Foot Shoulders
- Barriers Replaced in 1984
- ADT = 3400 (2029 Projected ADT = 6400)
- Minor Arterial

Stringers with Floorbeams Supported by Truss

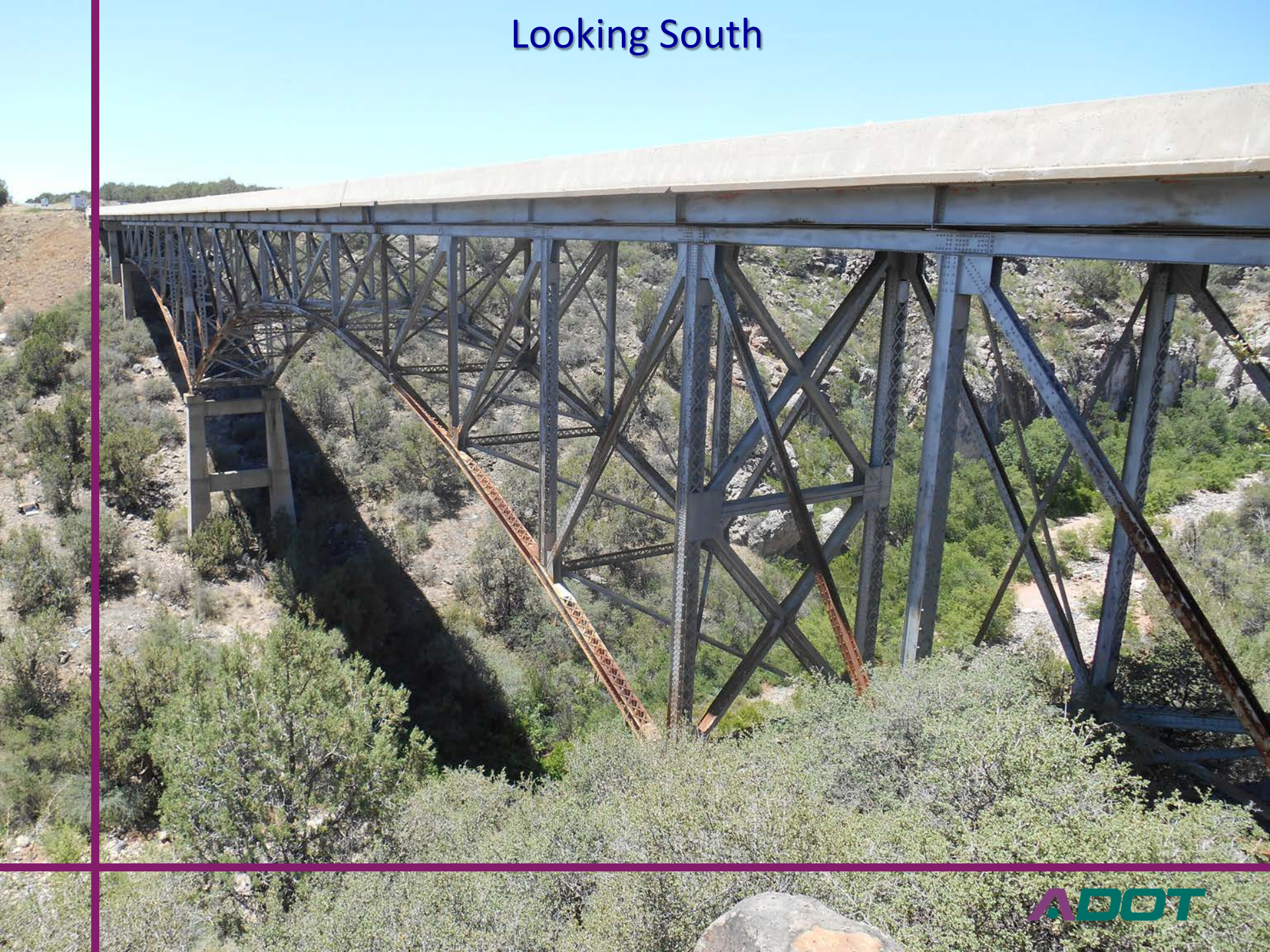
North Face

30-foot layer of volcanic Basalt capping Redwall Limestone

North Face


North Face

Looking South



Looking South

Deck Condition

- Top of Deck: Poor
- Deck Undersurface: Poor
- Deck Overall Rating: Poor

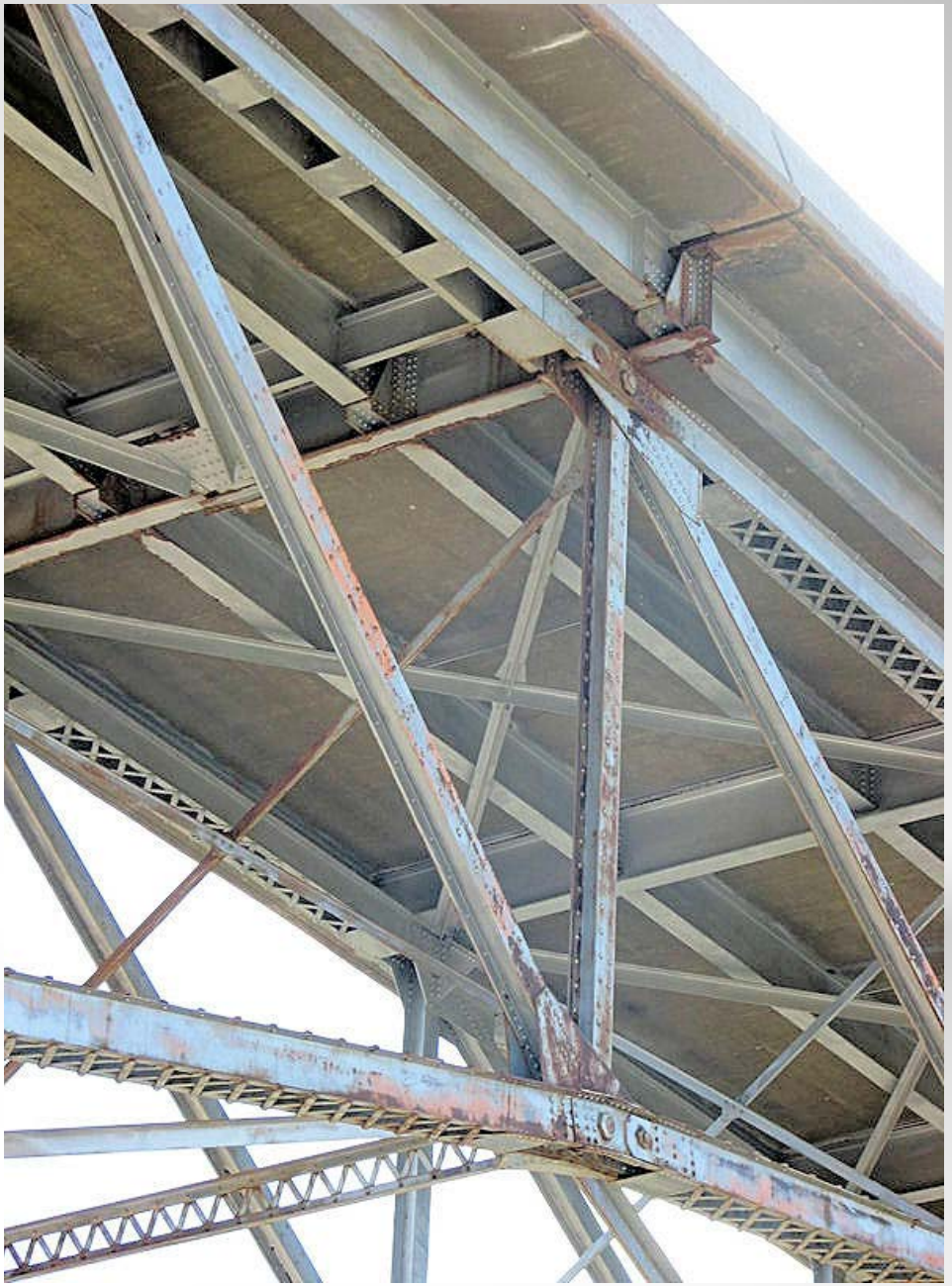
Transverse Cracks

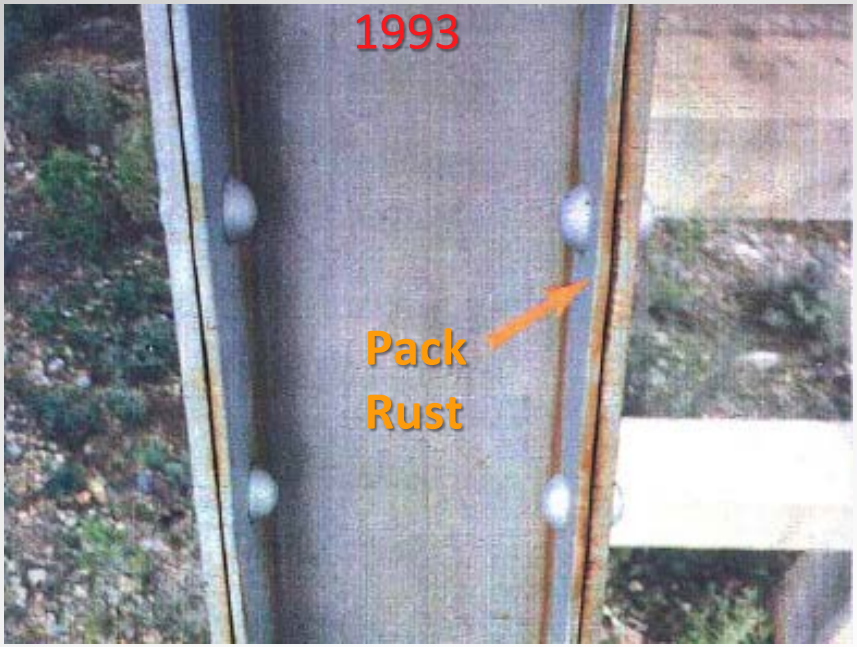
2013 Emergency Deck Repair

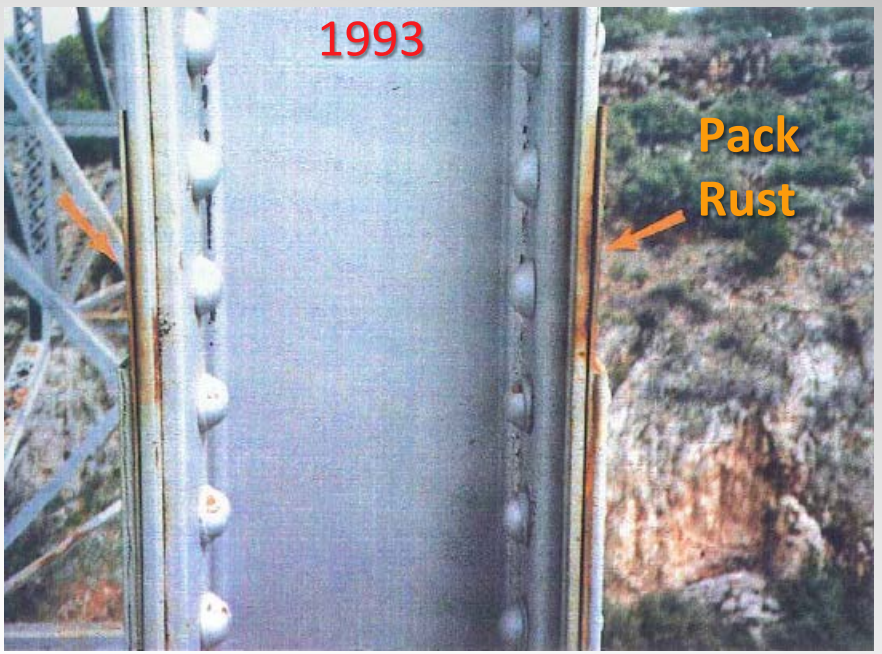
9’x12’ Deck Patch

Superstructure

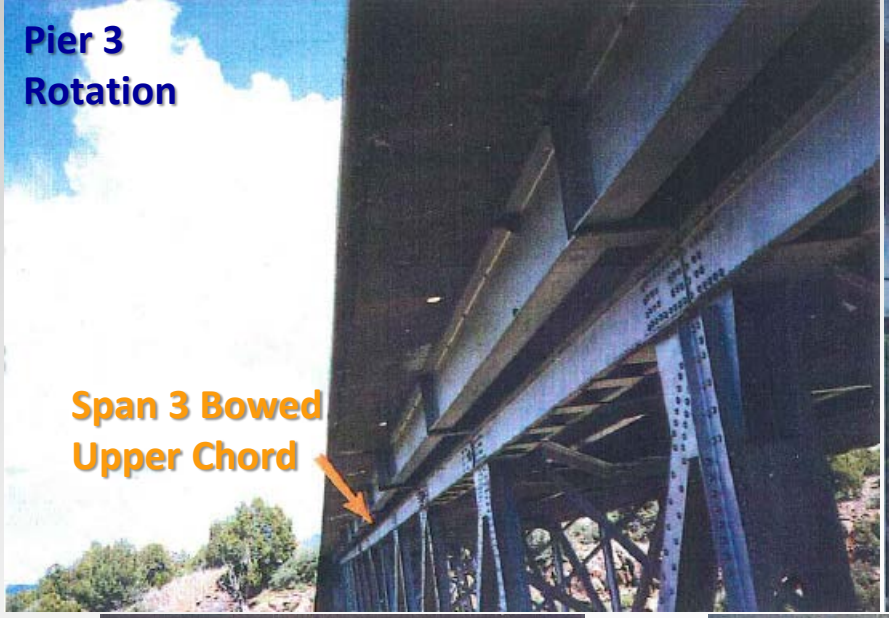
- Main Members: Poor
- Secondary Members: Fair

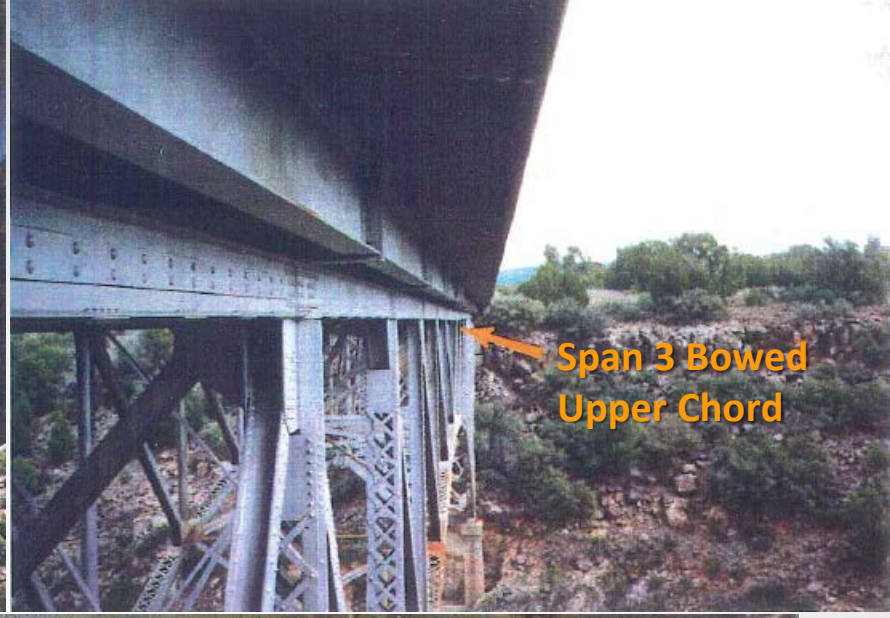


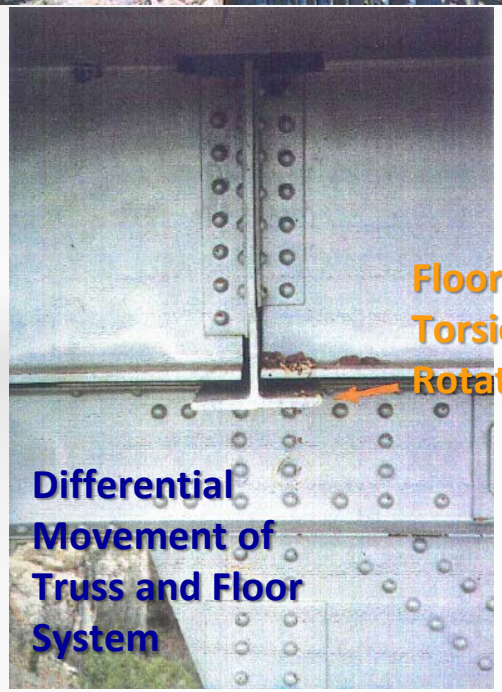


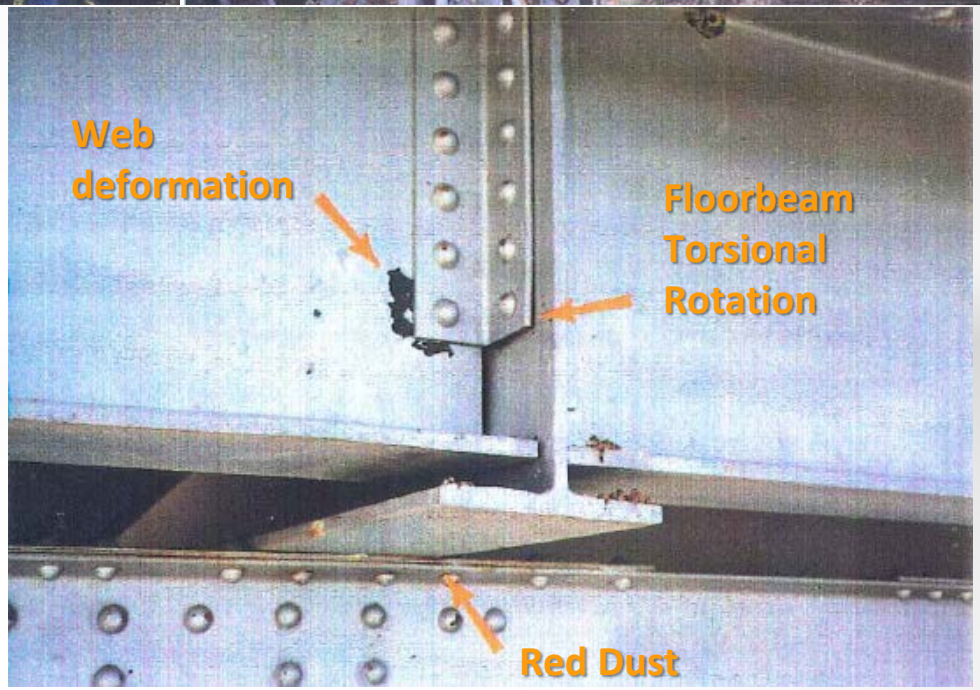


ADOT


Pier 3
Rotation
Span 3 Bowed
Upper Chord

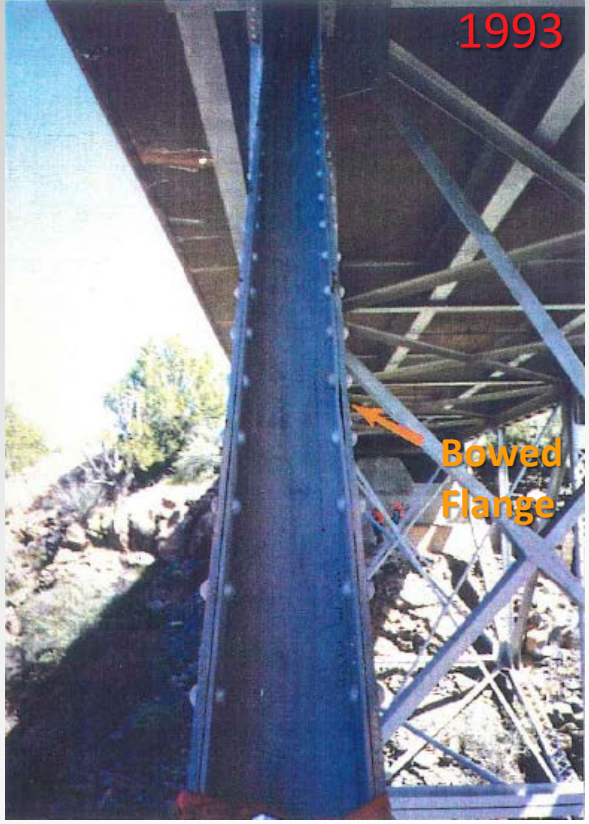

Span 3 Bowed
Upper Chord

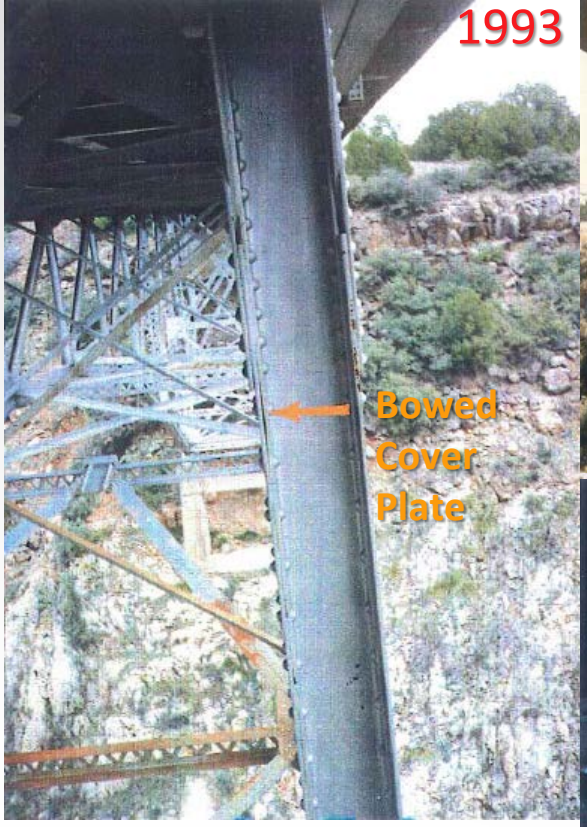

Floorbeam
Torsional
Rotation
Differential
Movement of
Truss and Floor
System


Web
deformation
Floorbeam
Torsional
Rotation
Red Dust

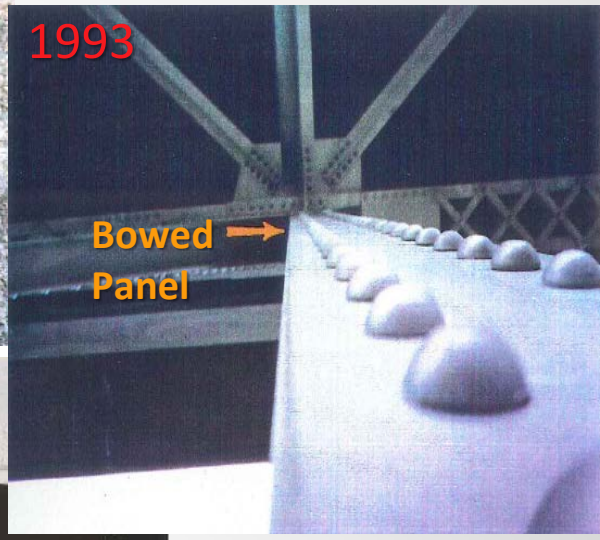
1993

ADOT


1993
Bowed
Flange


1993
Bowed
Cover
Plate


Deformed Web
1986


1993
Bowed
Panel

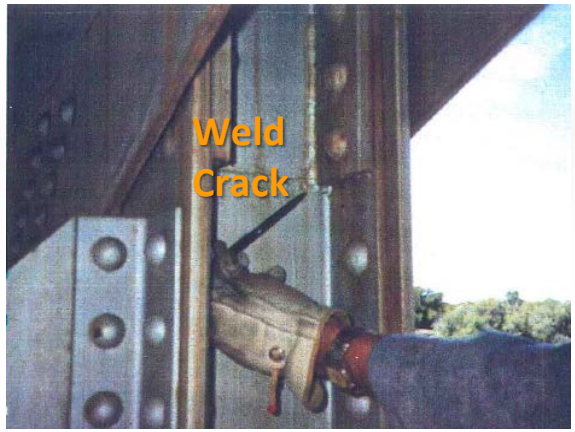

1986

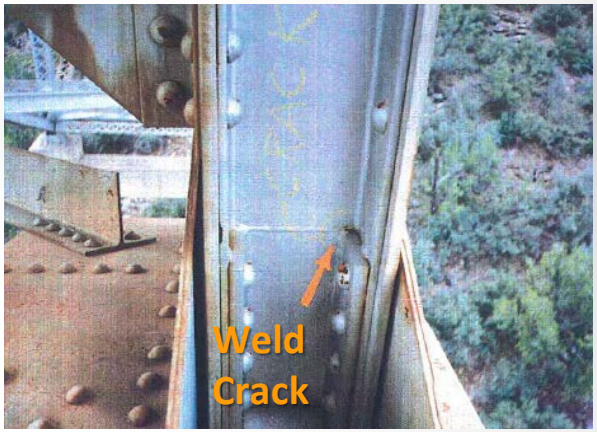

1986


L3
W. Truss

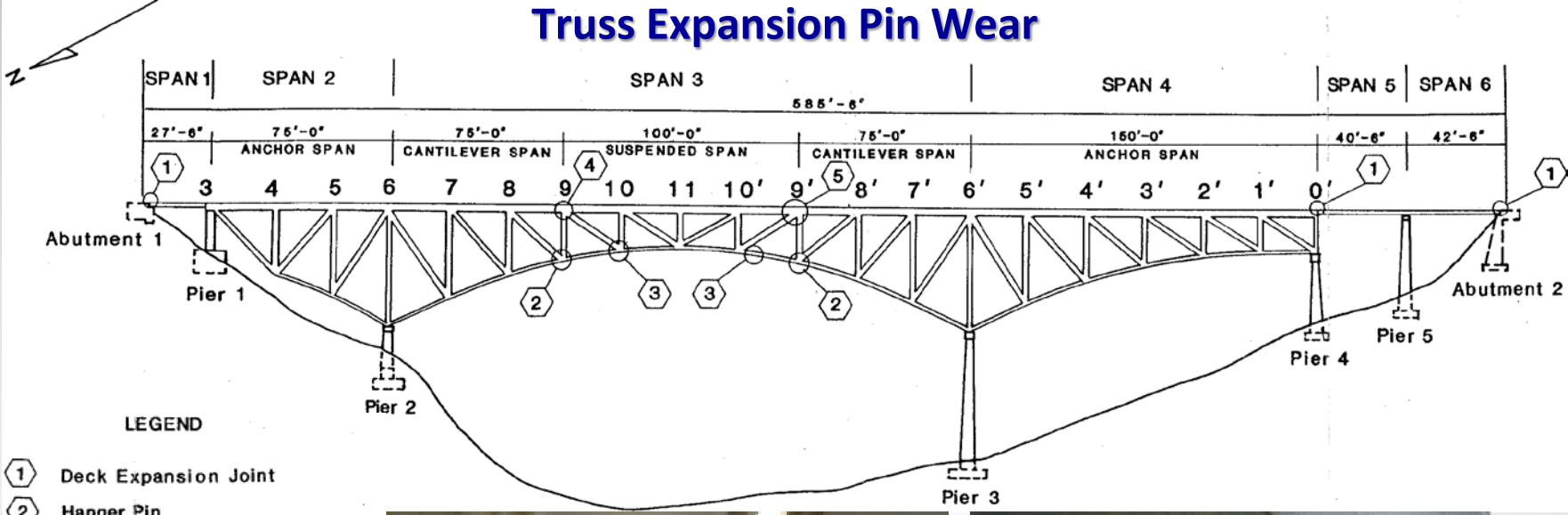

L8 D.S.
Missing
Rivet


L6
E. Truss

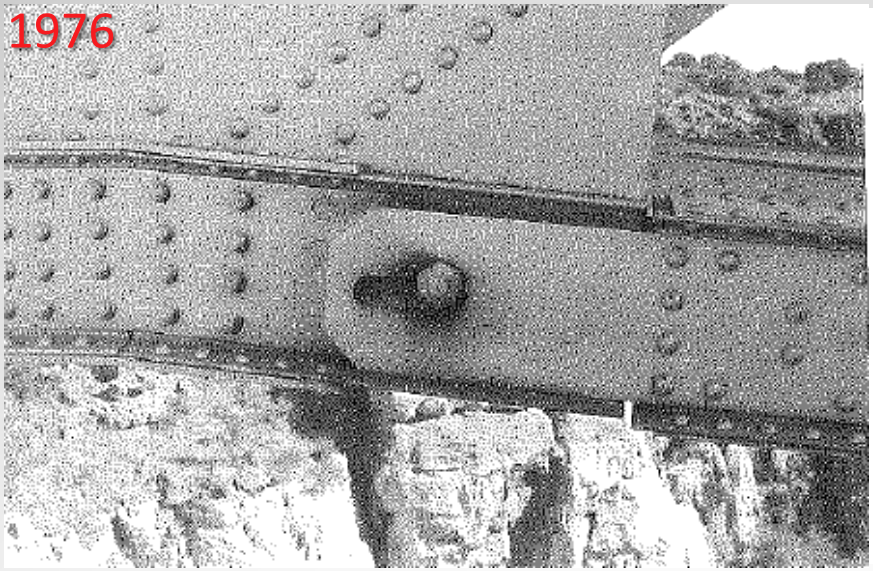

Weld
Crack


Weld
Crack

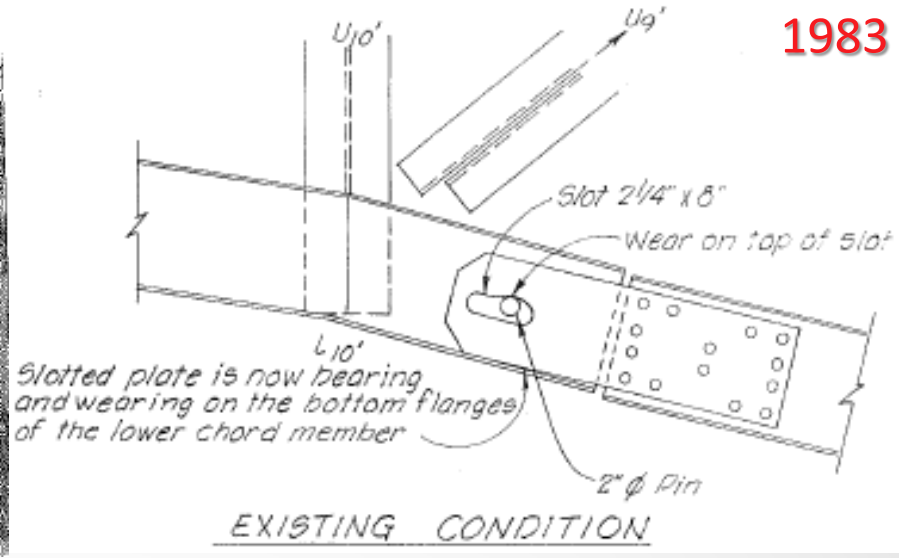
Truss Expansion Pin Wear



1976

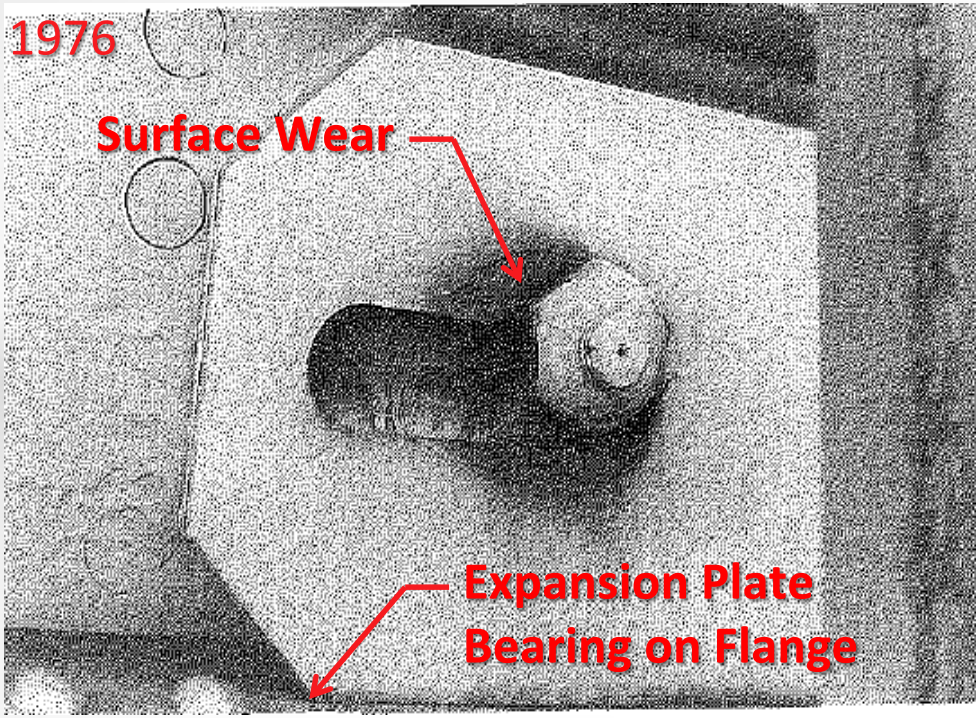


1983

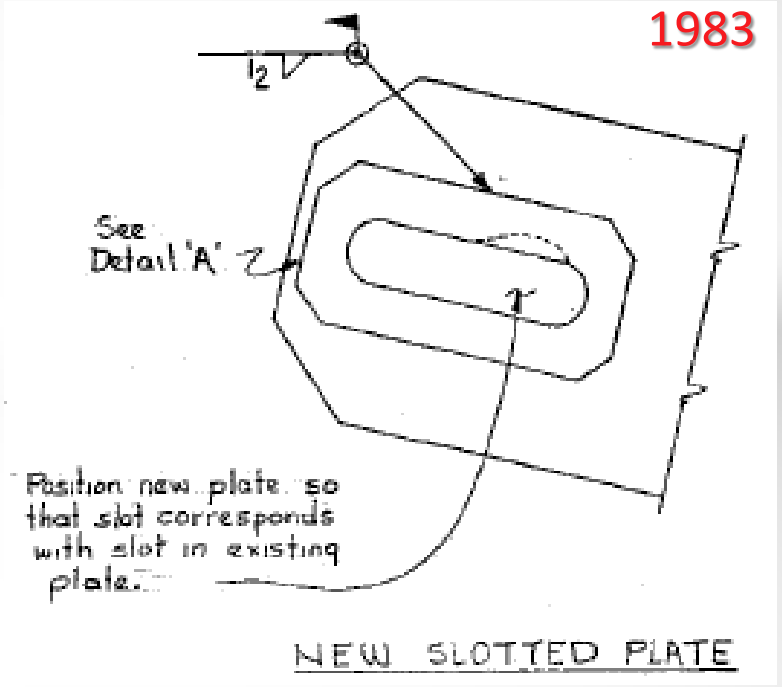


EXISTING CONDITION

1976

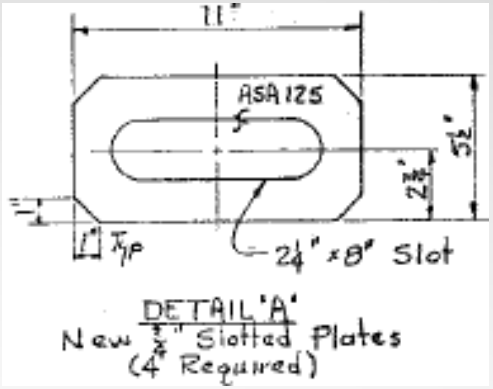


1983

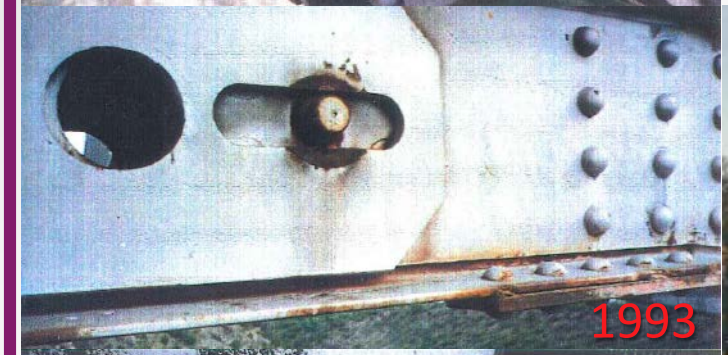


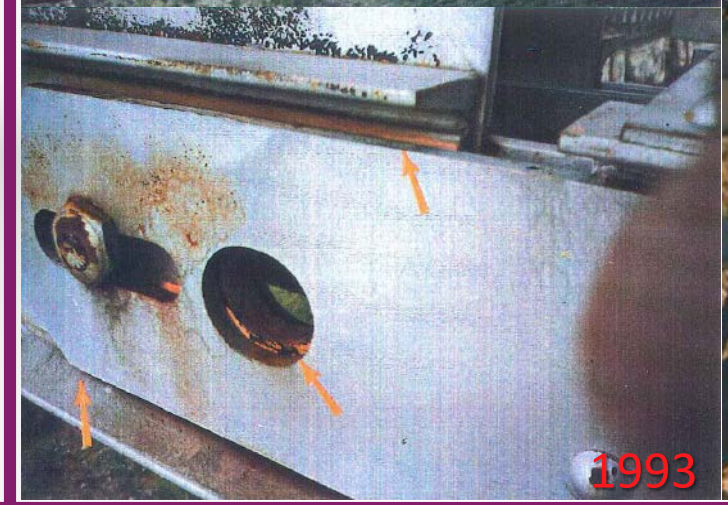
NEW SLOTTED PLATE


1993


11"
ASA 125
5"
5½"
2¾"
1"
Typ
2¼" x 8" Slot
DETAIL 'A'
New ¾" Slotted Plates
(4" Required)

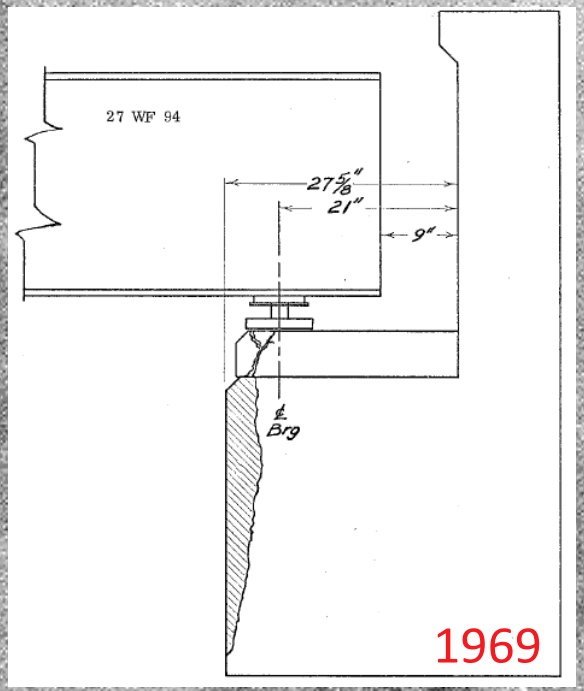

1985


1993


1993

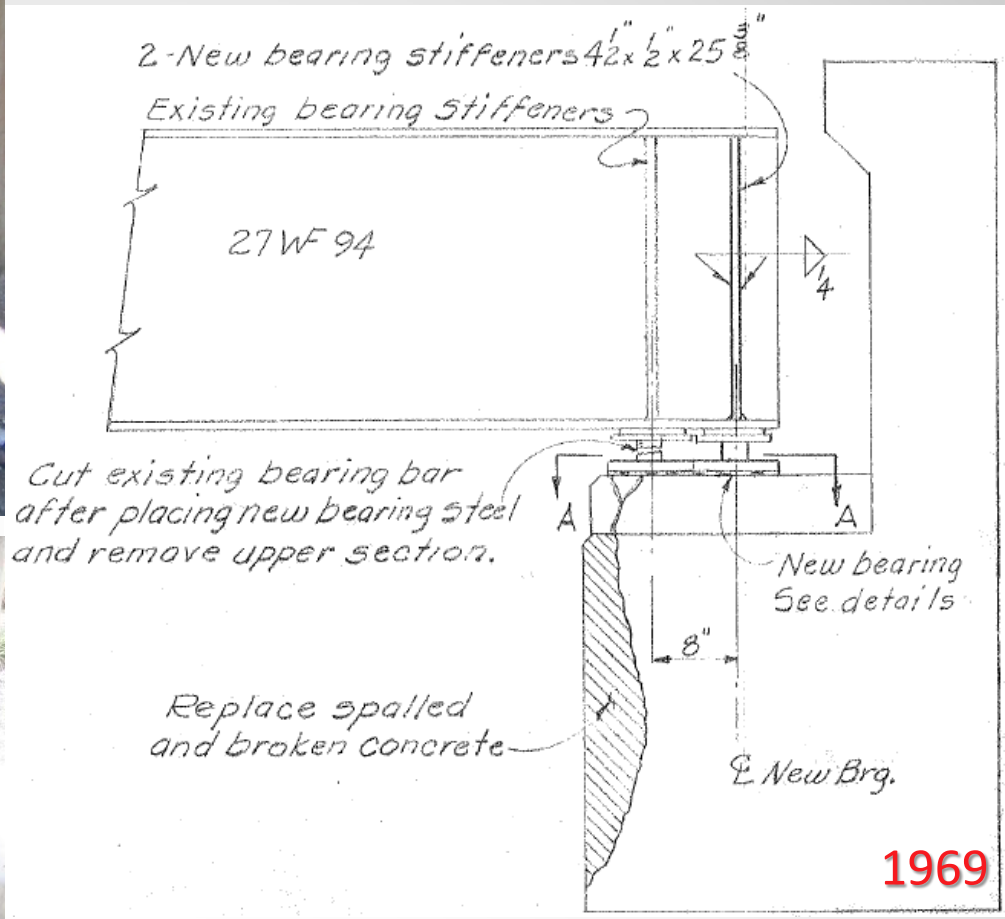

1985

Abutment 2



Bearing Surfaces: Poor

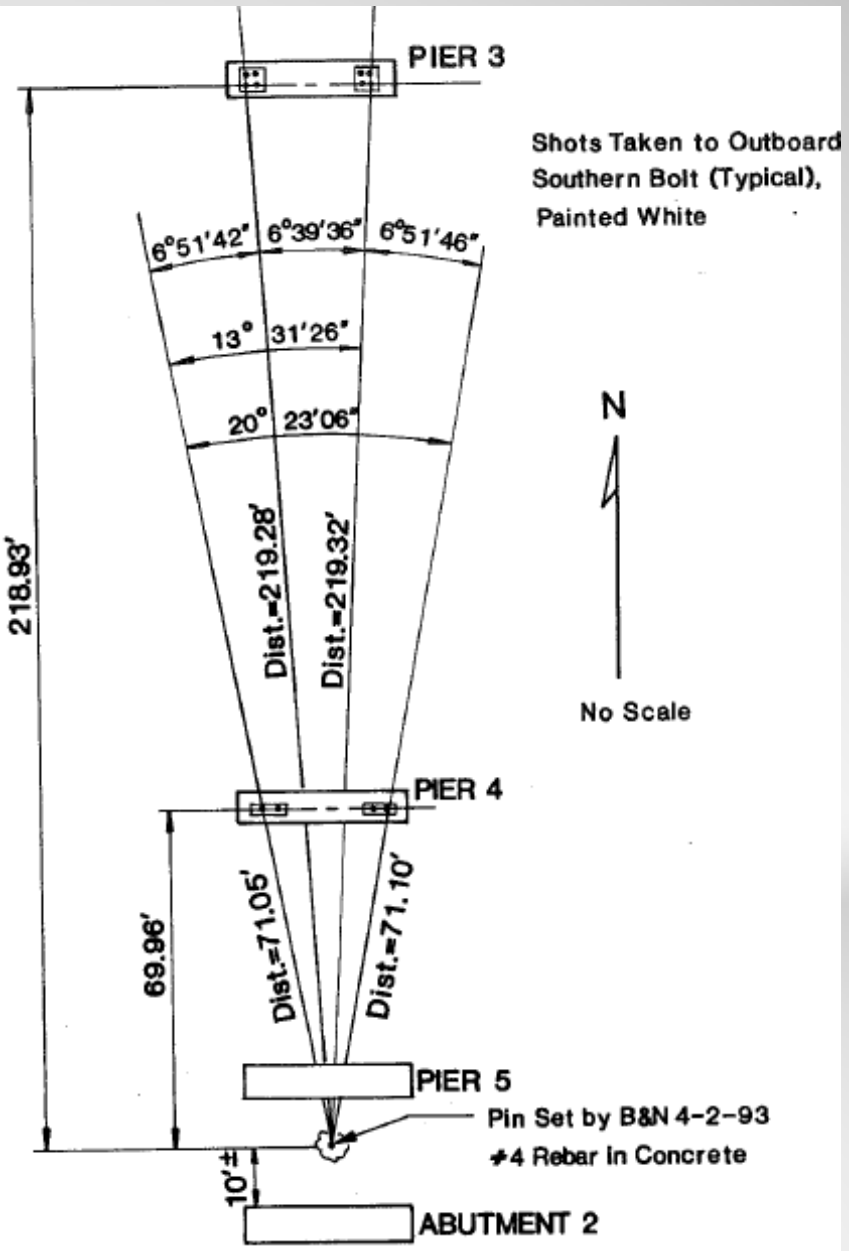
Abutment 2


2-New bearing stiffeners 4½" x ½" x 25 5/8"
Existing bearing Stiffeners
27WF 94
¼
Cut existing bearing bar after placing new bearing steel and remove upper section.
A
A
New bearing See details
8"
Replace spalled and broken concrete
℄ New Brg.
1969

Substructure

Overall Rating: Fair


Pier 3 Rotation


PIER 3
Shots Taken to Outboard Southern Bolt (Typical), Painted White
6°51'42"
6°39'36"
6°51'46"
13° 31'26"
20° 23'06"
N
218.93'
Dist.=219.28'
Dist.=219.32'
No Scale
PIER 4
69.96'
Dist.=71.05'
Dist.=71.10'
PIER 5
Pin Set by B&N 4-2-93
#4 Rebar In Concrete
10'±
ABUTMENT 2

1993

ADOT

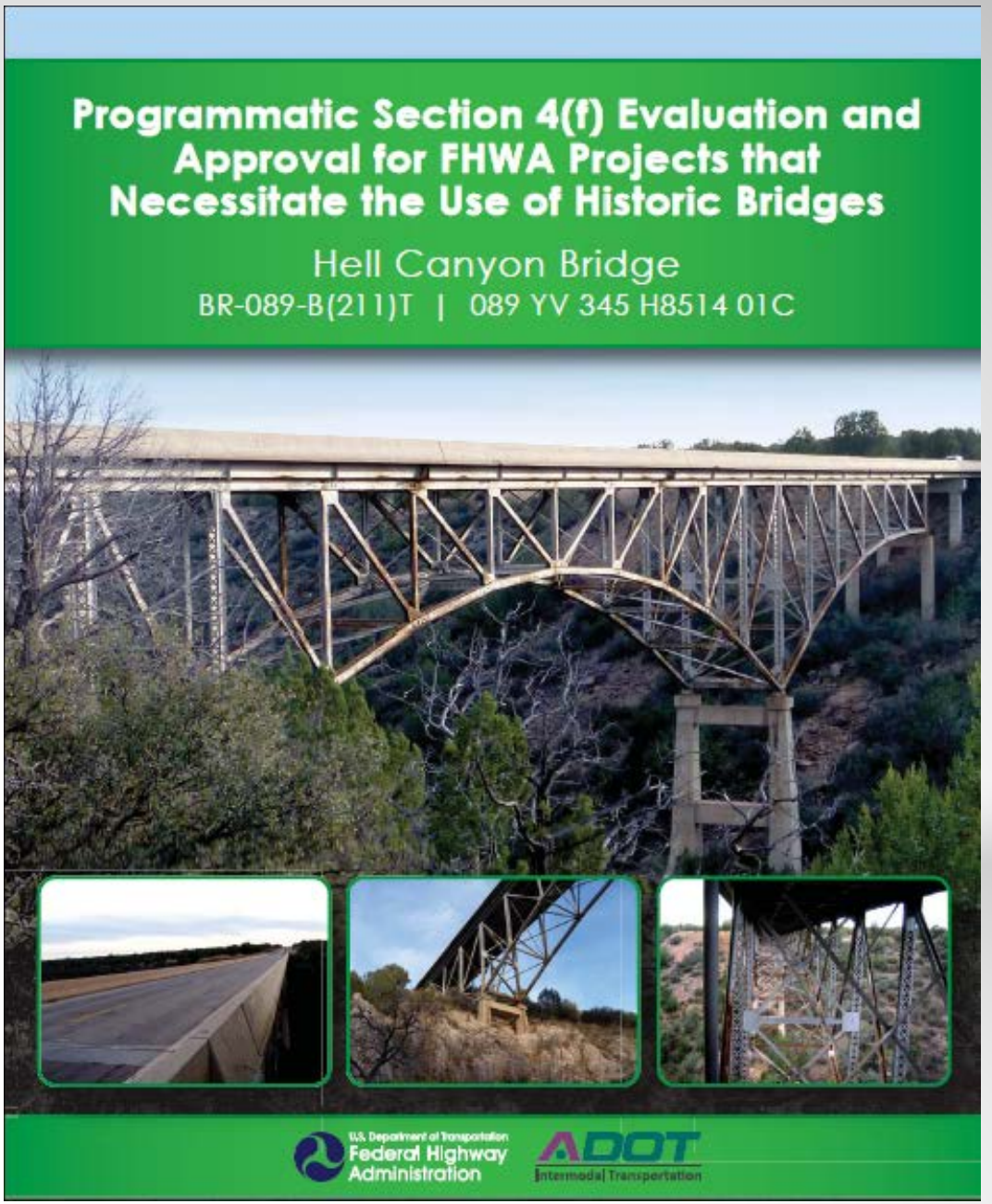
Hell Canyon Bridge is considered a Section 4(f) property for its historic significance.

4(f) Programmatic Evaluation

- There are no feasible and prudent alternatives for the use of the historic Hell Canyon Bridge.
- The project includes all possible planning to minimize harm resulting from the use of the historic Hell Canyon Bridge.
- The project meets the applicability criteria for the programmatic Section 4(f) evaluation for projects, issued by FHWA, that necessitate the use of historic bridges.

Per 23 Code of Federal regulations (CFR) Section 774, a "use" of a Section 4(f) resource, occurs:

1. when land is permanently incorporated into a transportation facility,
2. when there is a temporary occupancy of land that is adverse in terms of the statute's preservationist purposes,
3. or when there is a constructive use of land.



(The bridge is to be replaced or rehabilitated using Federal funds.)

ADOT

Course of Action

Do nothing?

- Ruled out

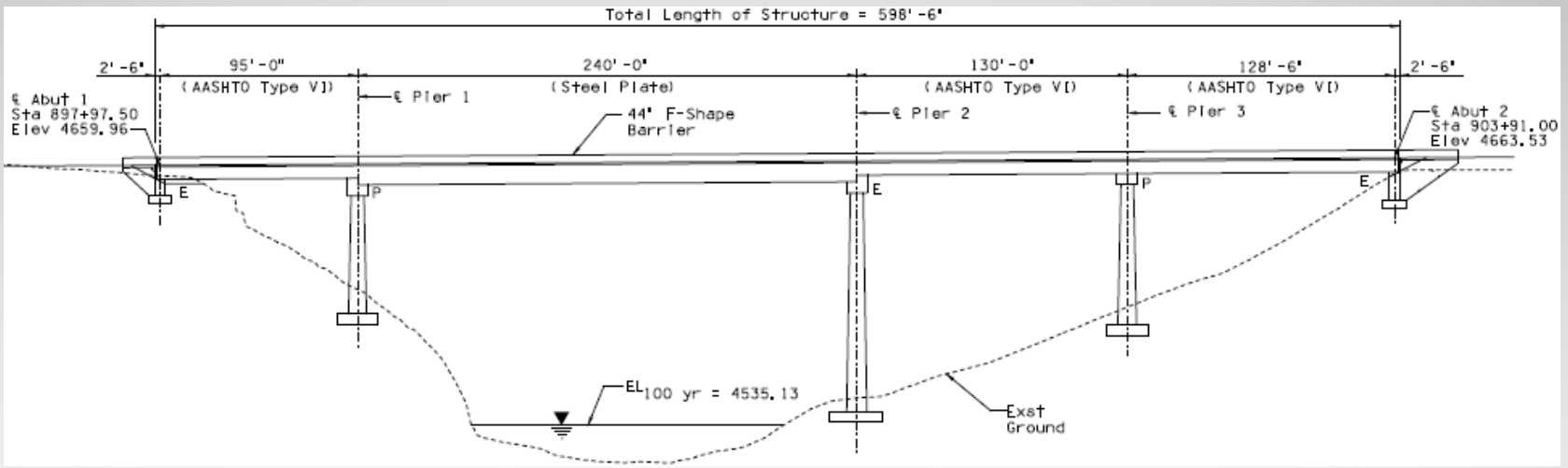
Rehab existing bridge to meet current AASHTO and ADOT guidelines?

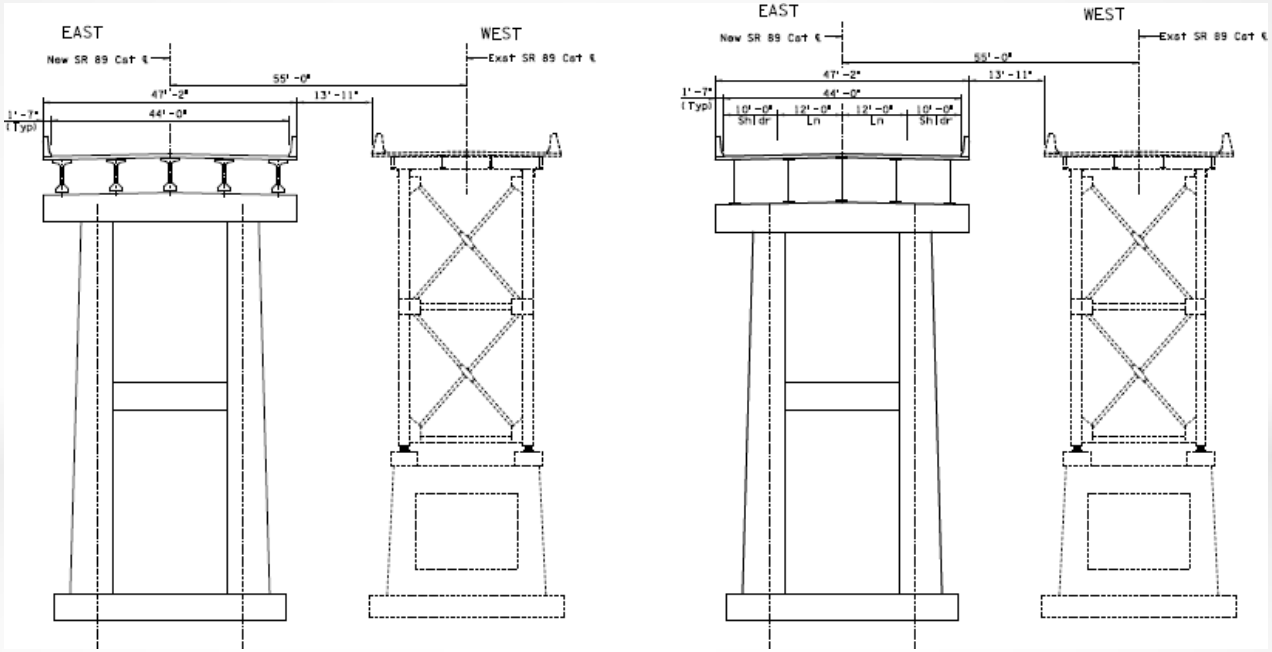
- Replace superstructure with steel plate girders.
- Widen the deck to 54 feet.
- Widening the superstructure would require a 10-foot shift of SR-89 centerline.
- Substantial modification to substructure
- Construction phasing
- Partial removal of existing bridge while in service?
- Traffic delays
- More expensive than complete replacement alternatives

Replace existing bridge with new structure?

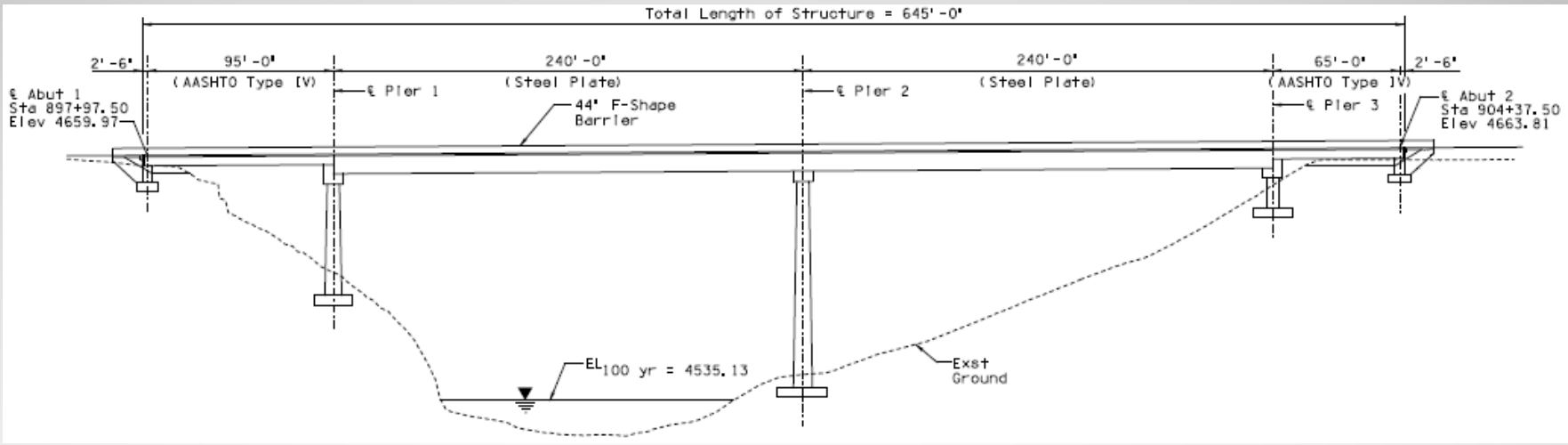
- Several options to consider
    - Arch?
    - Truss?

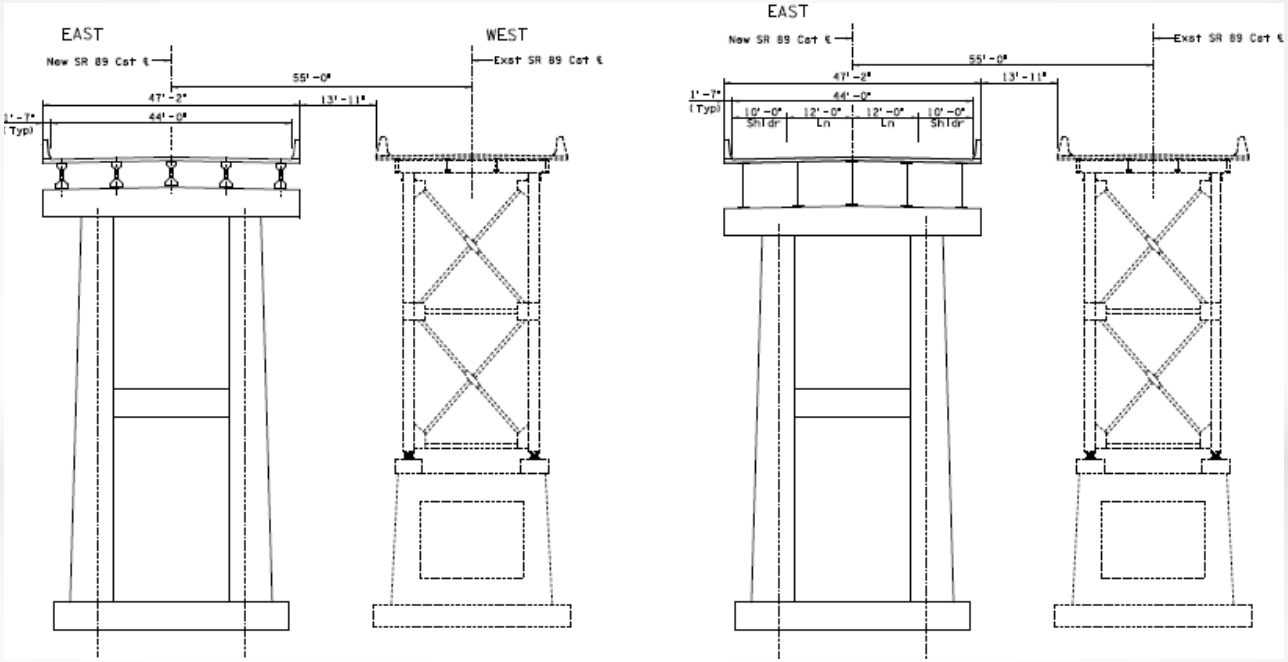
ADOT





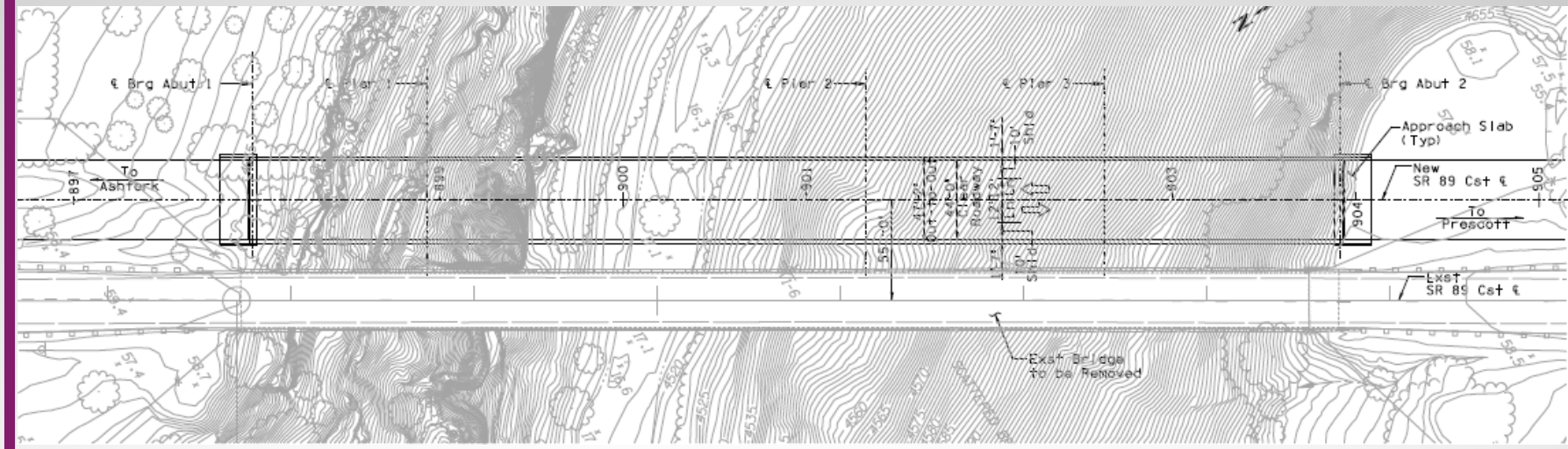
- Single 240-Foot Simply Supported Steel Plate Girder
- AASHTO Type VI Precast Girders

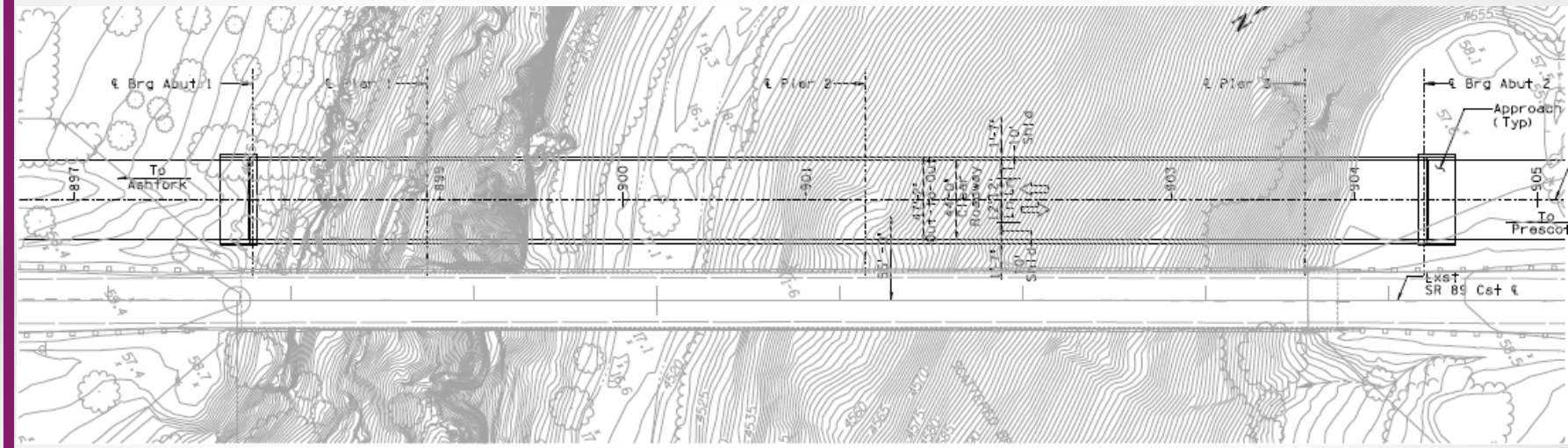




- Steel Plate Girders (Two 240-Foot Spans)
- AASHTO Type V & Type VI Precast Girders

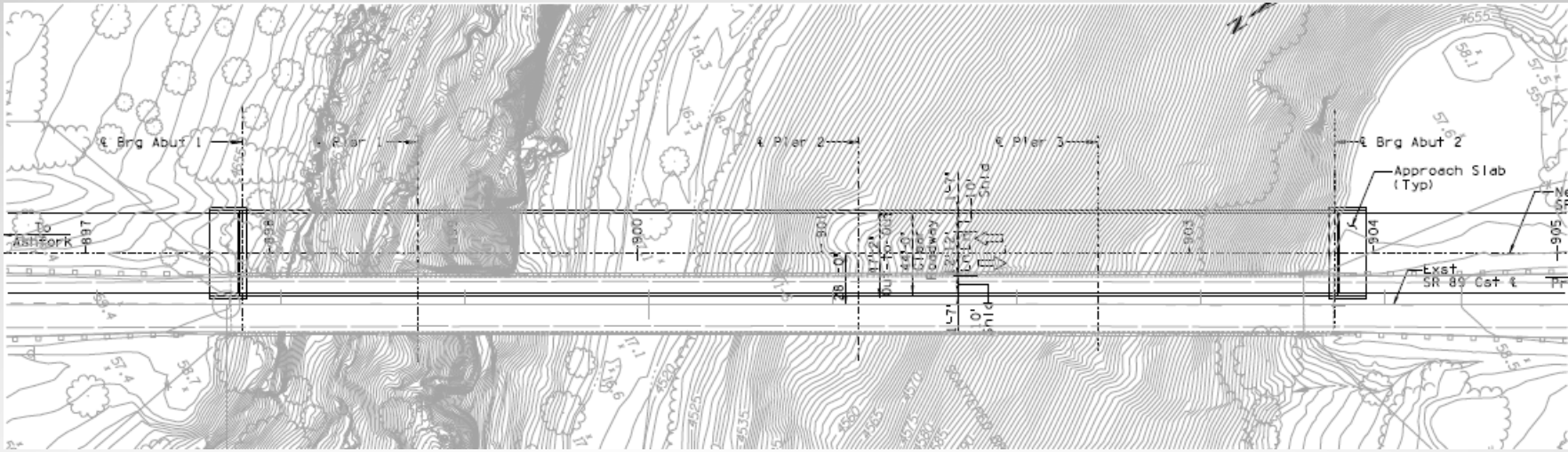
55-Foot Centerline Offset

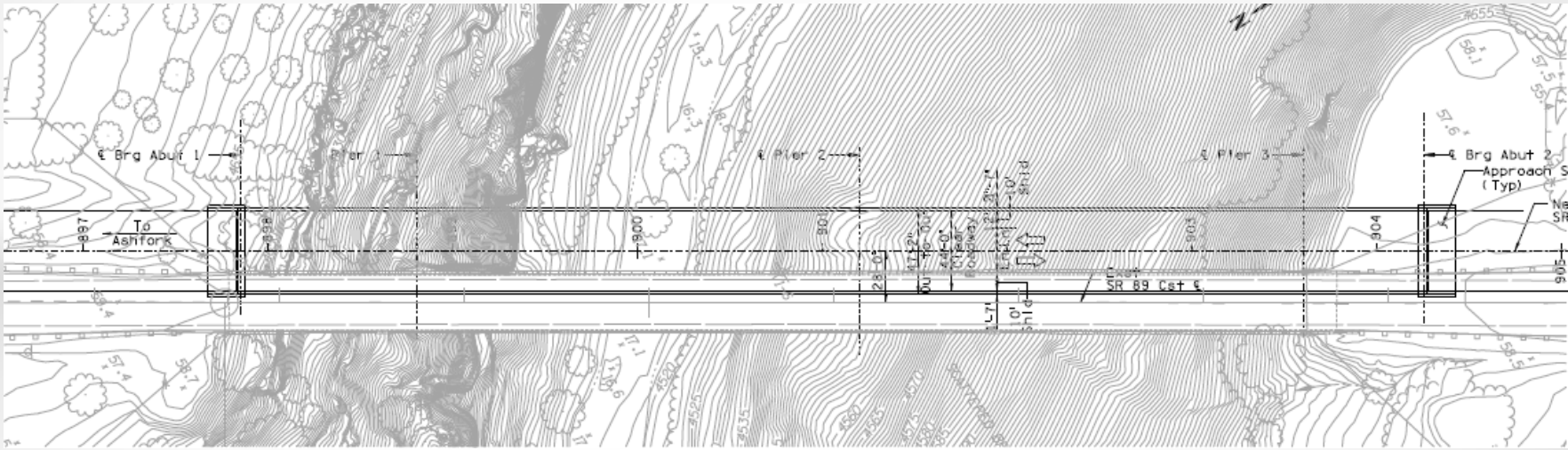




- Requires Additional Right-of-Way
- No Phasing

28-Foot Centerline Offset

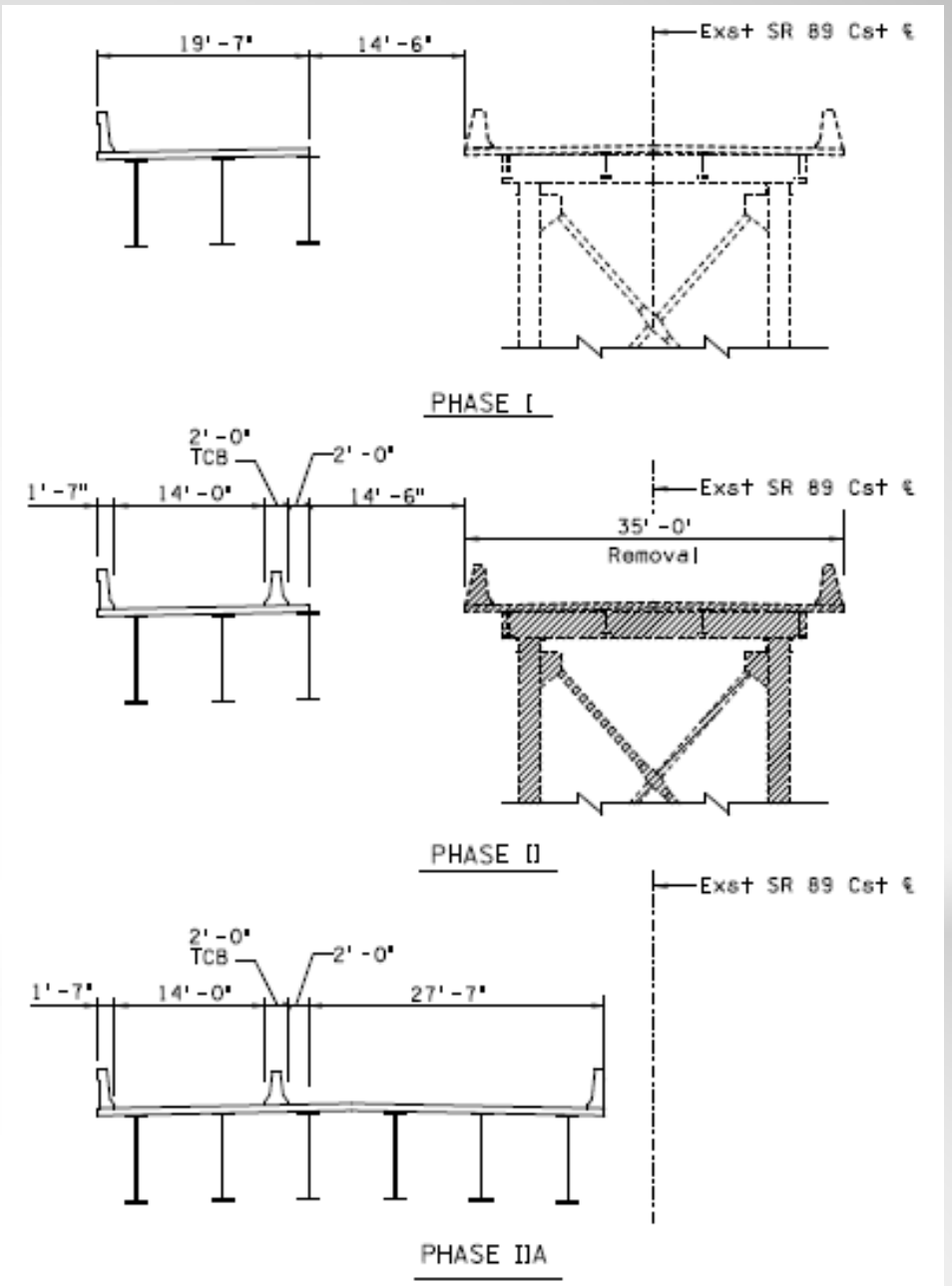


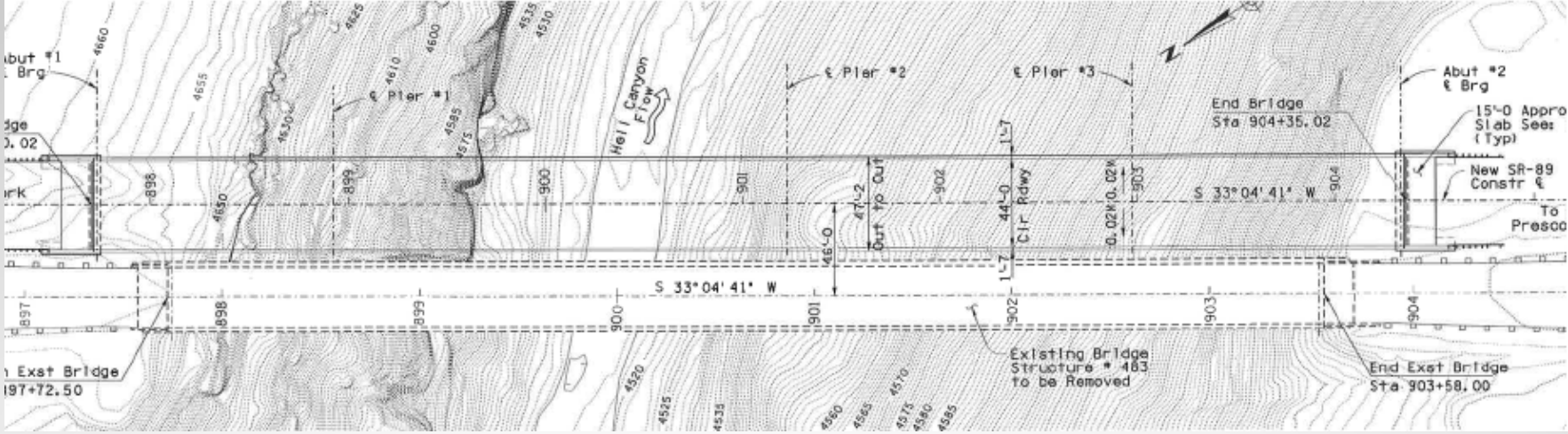


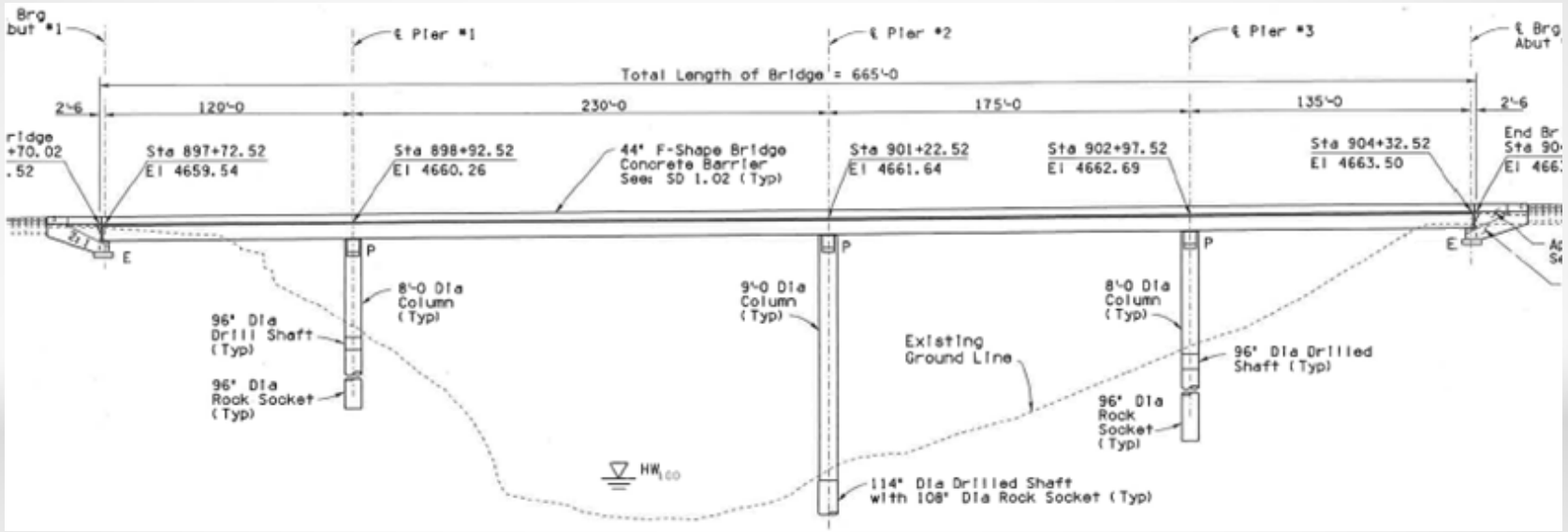
- No New Right-of-Way Needed
- Phasing Required

Construction Phasing

- Additional Cost
- Longer Construction Duration
- Greater Impact to Public
- Significant Traffic Control and Signalization

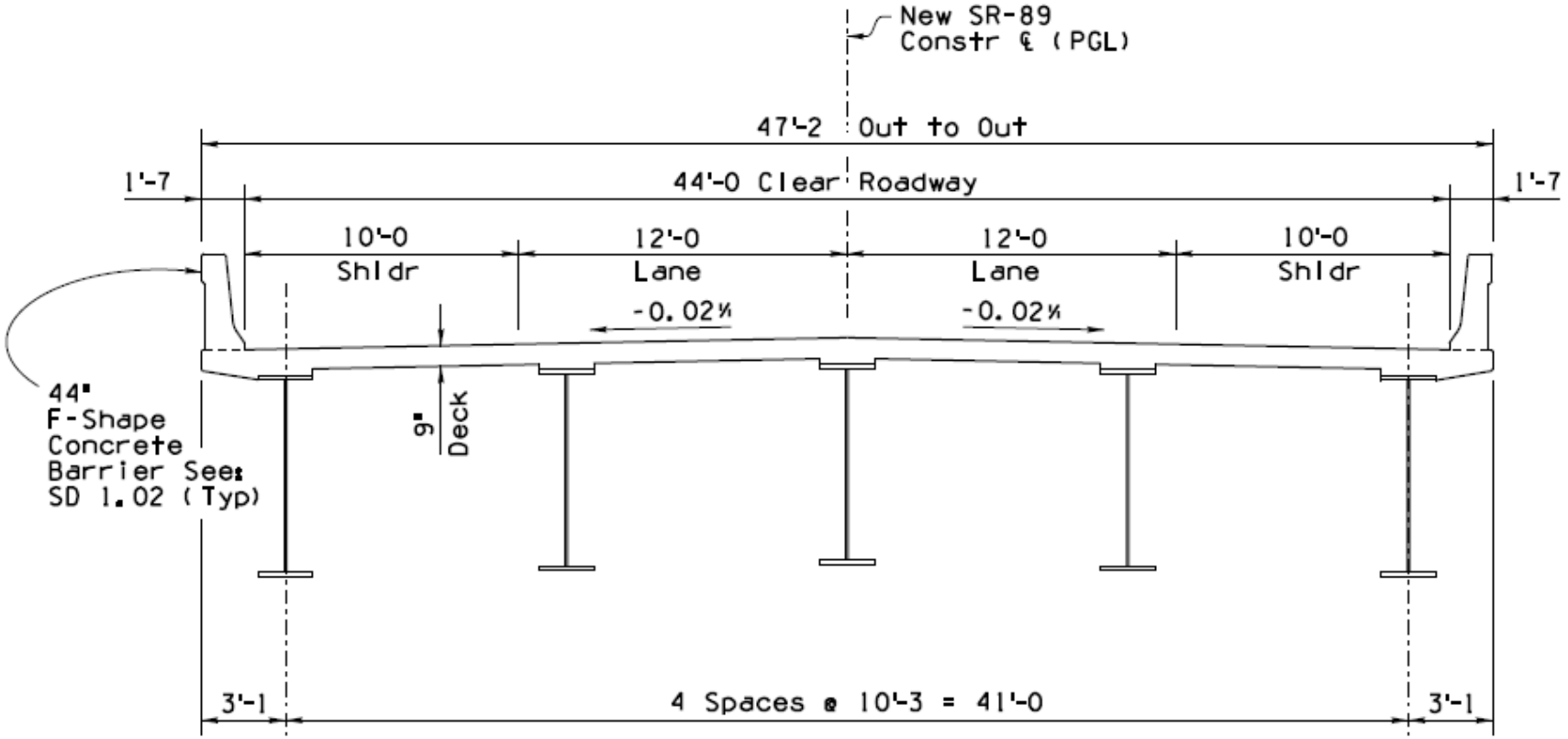






Selected Alternative

- Continuous Steel Plate Girder Bridge
- 46-Foot Centerline Offset (No Phasing Required)



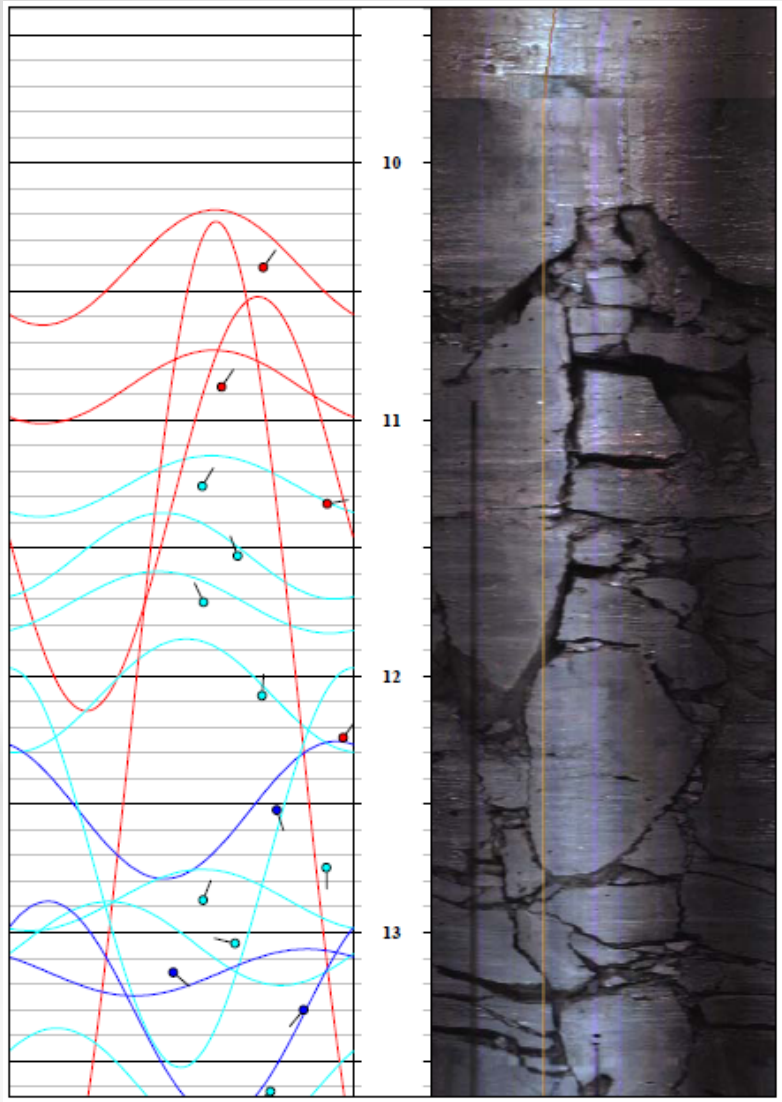
TYPICAL SECTION-SPANS 1

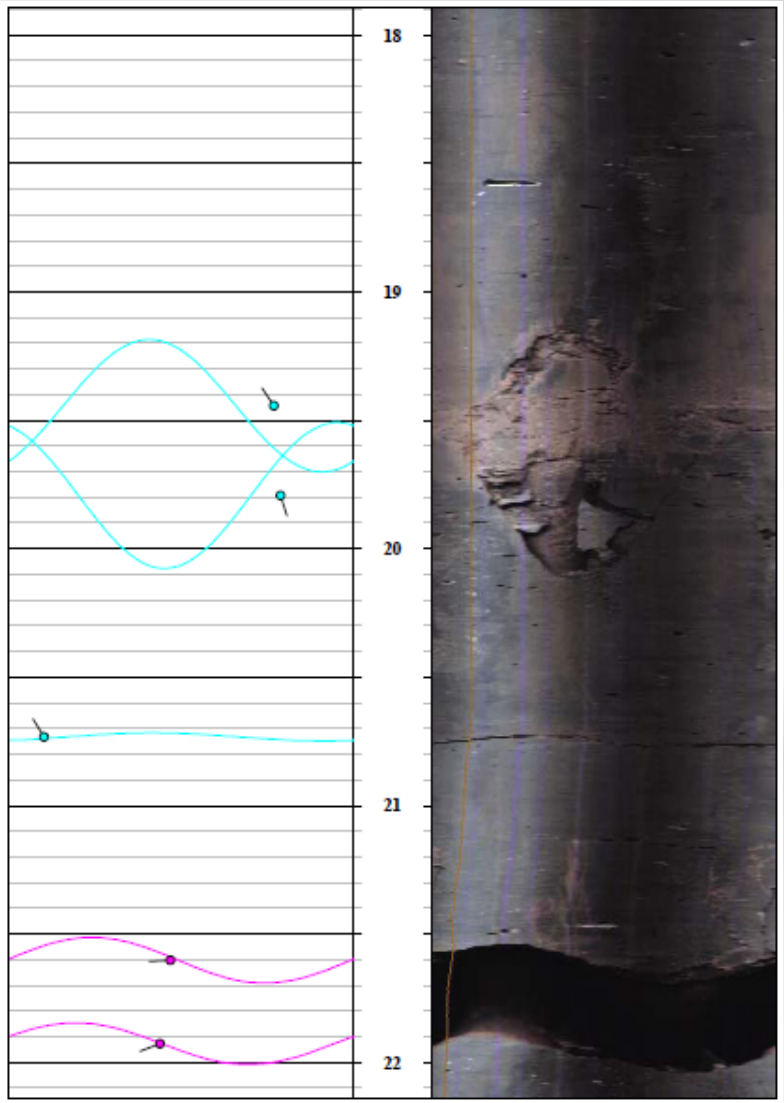
5-Steel Plate Girders - ASTM A709 (9" Deck)
Scale: 1/4" = 1'-0

- Single Phase
- Continuous Steel Plate Girders
- Five Girder Lines (No Skew)
- Partially Stiffened Web
- A709 50W Unpainted Weathering Steel
- 47'-2" Deck Width
- 9" Thick Deck
- 10'-3" Girder Spacing
- 3'-1" Overhang
- 10-Foot Shoulders

Subsurface Investigation

Optical Televiewer

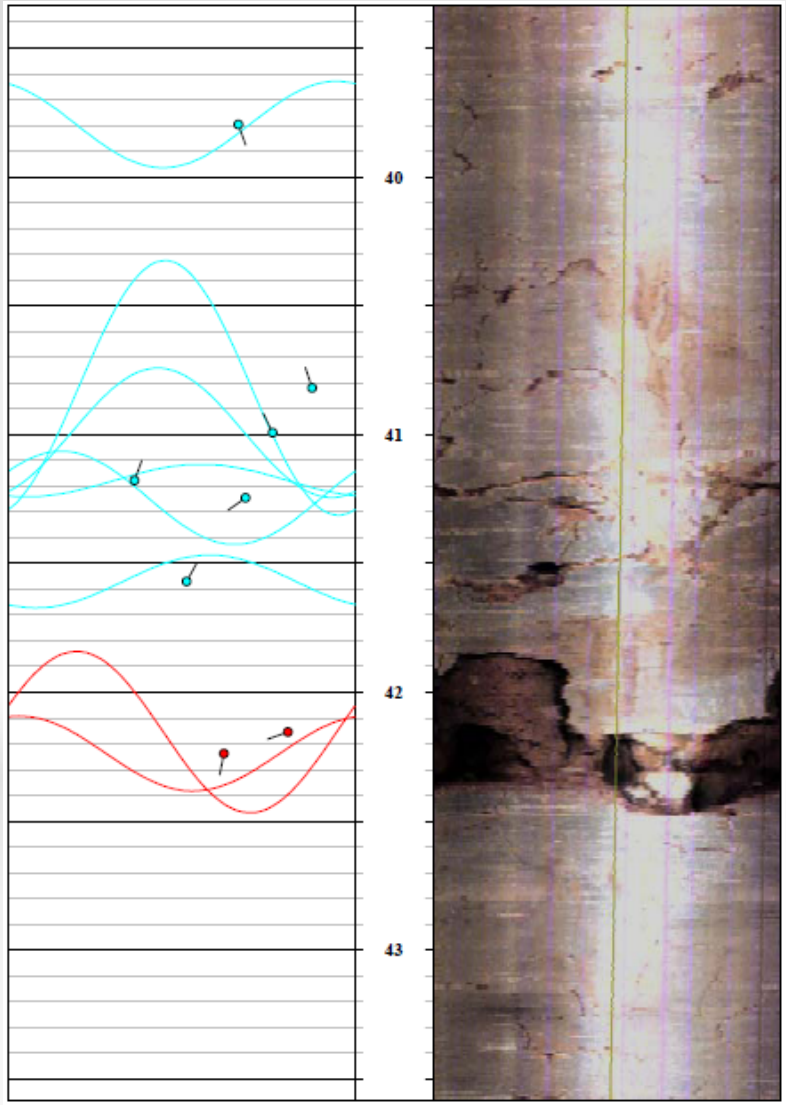


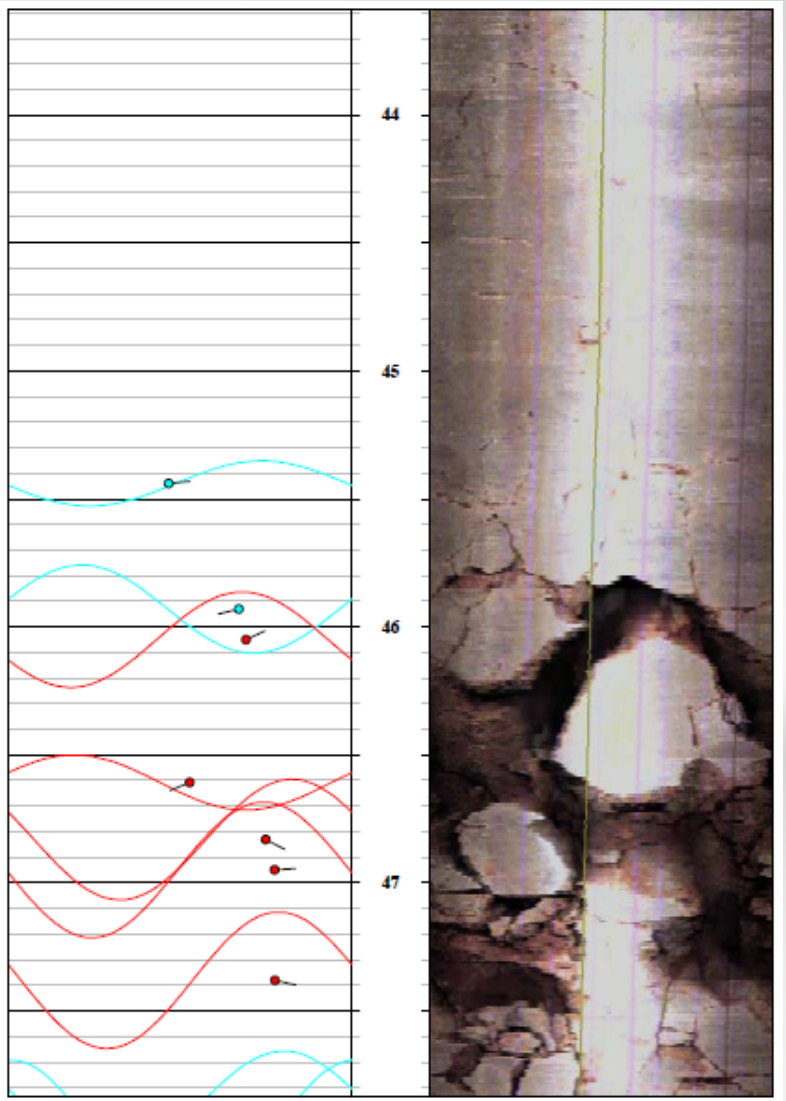


Basalt (20,000 psi)(RMR 58)

Subsurface Investigation

Optical Televiewer

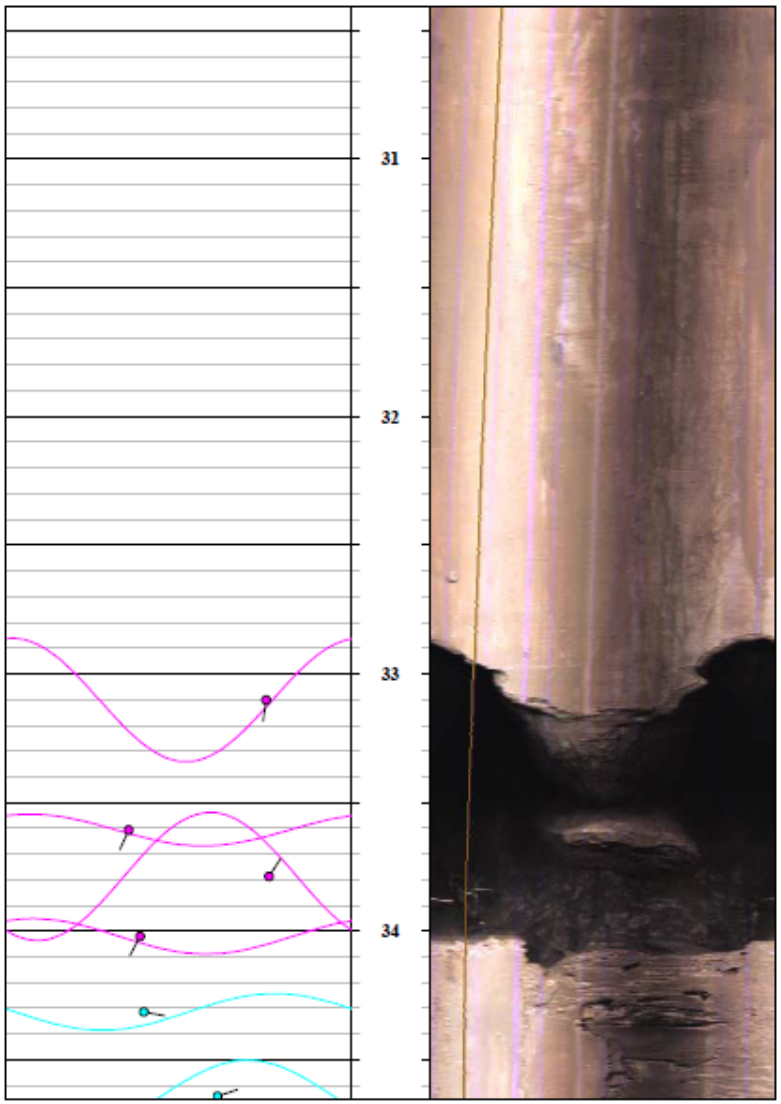


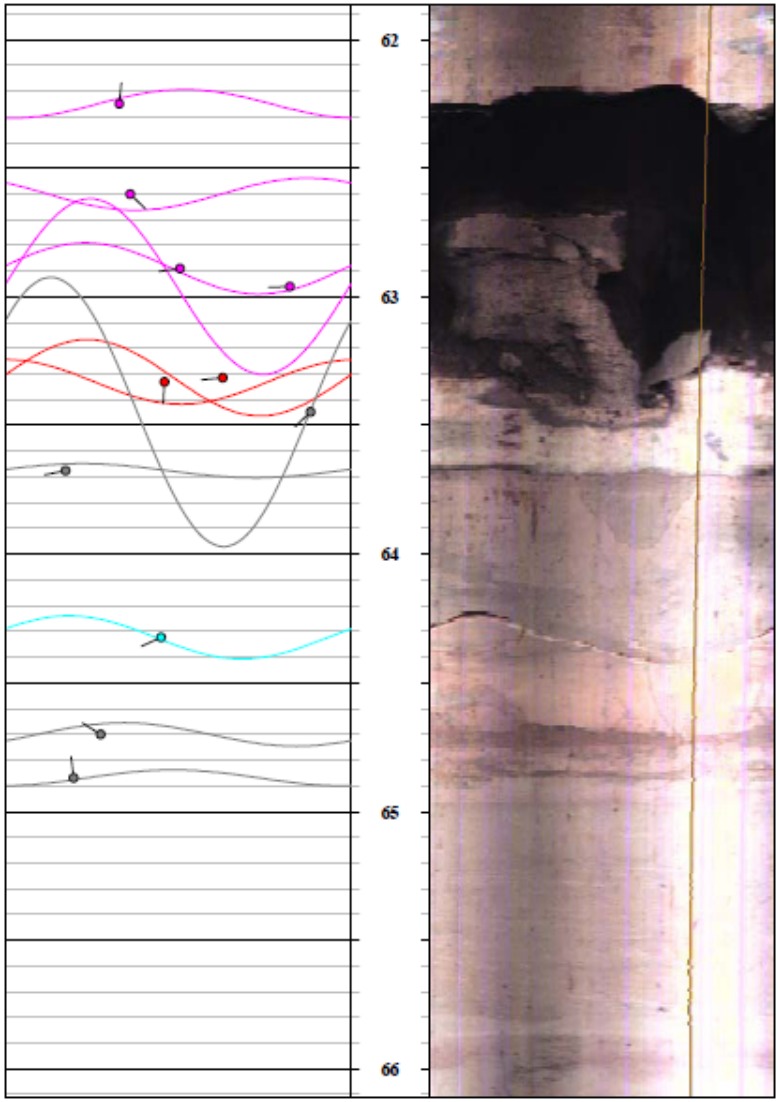


Limestone (5,000 psi to 11,000 psi)(RMR 23 to 62)

Subsurface Investigation

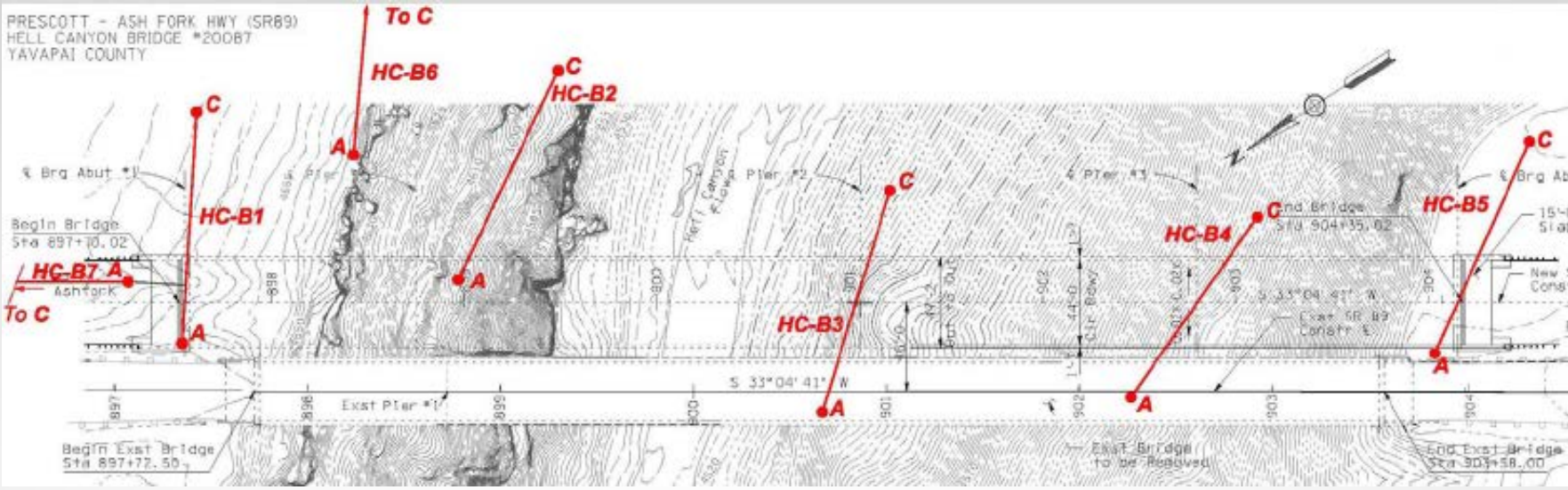
Optical Televiewer





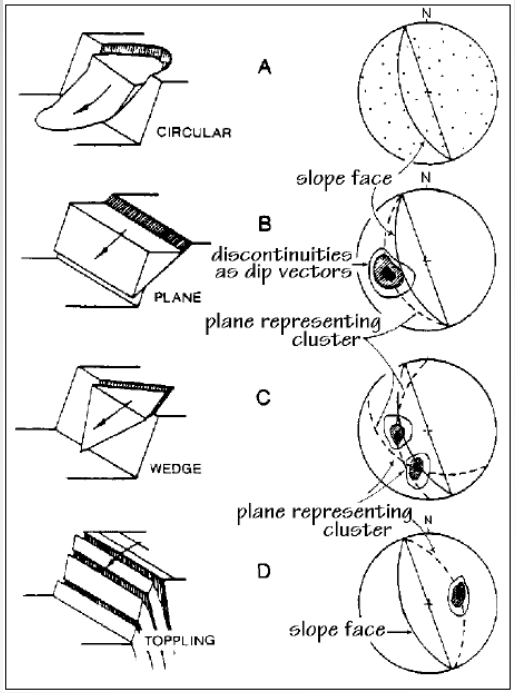
Limestone (5,000 psi to 11,000 psi)(RMR 23 to 62)

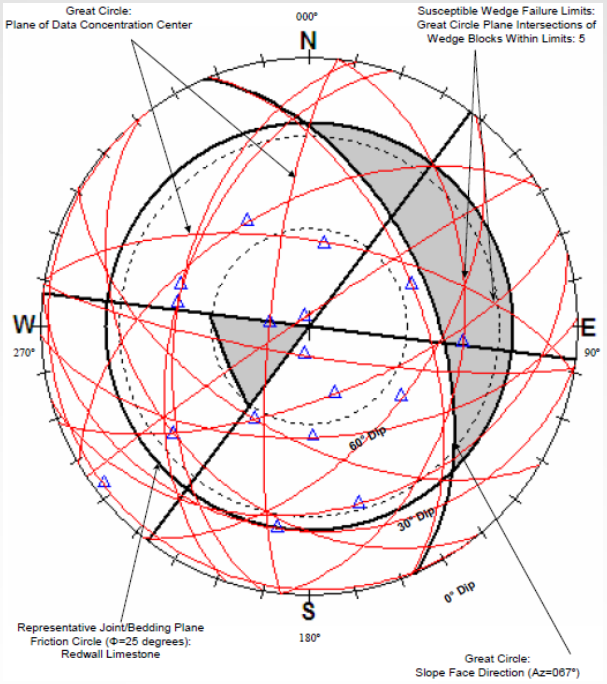
Seismic Refraction Survey

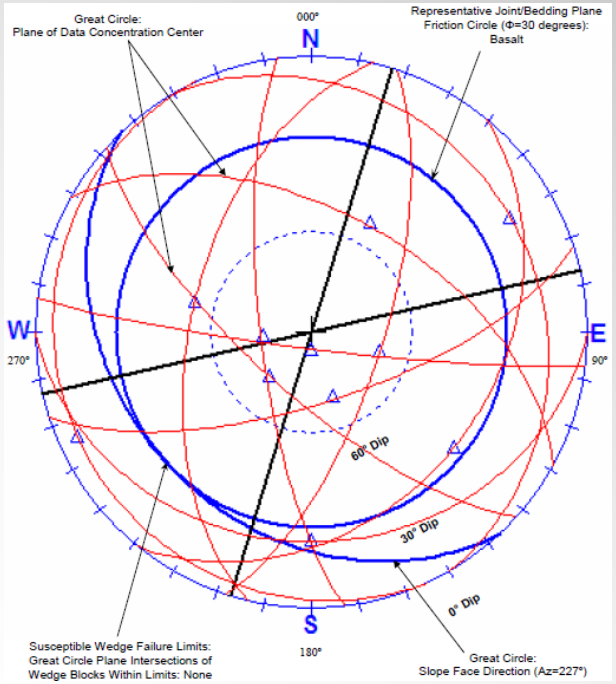


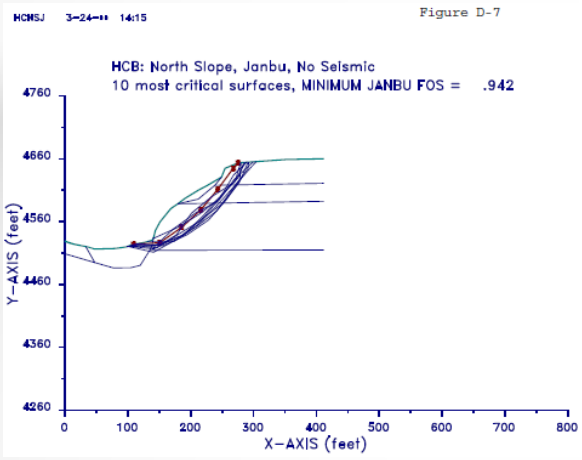
ADOT

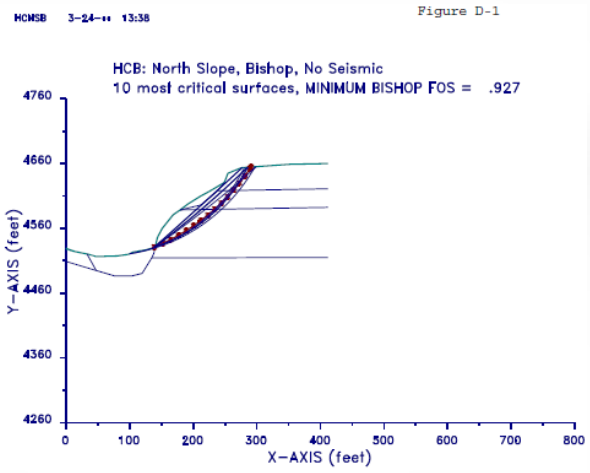
Slope Stability Analysis

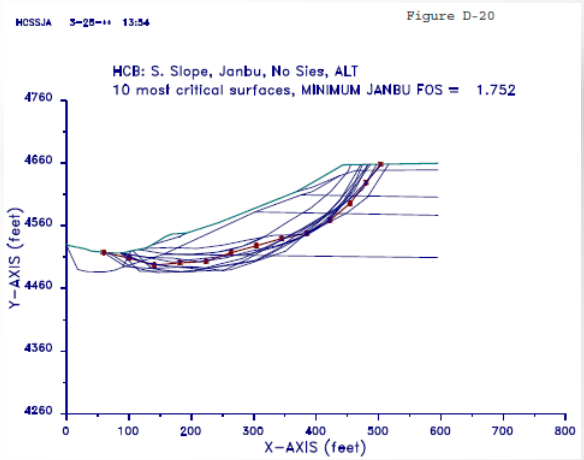












Stereonet Kinematic Slope Stability Analysis

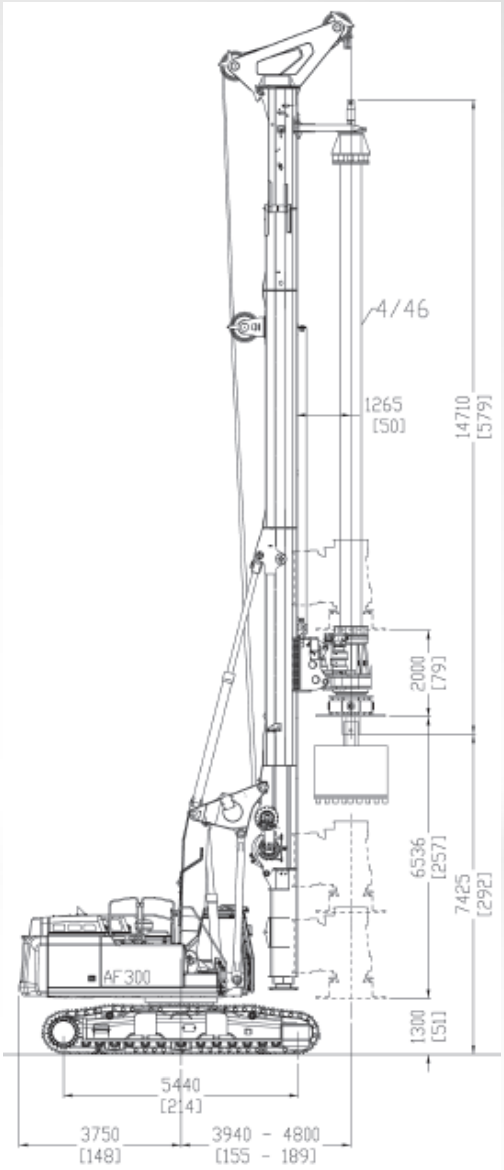
Geophysical logging

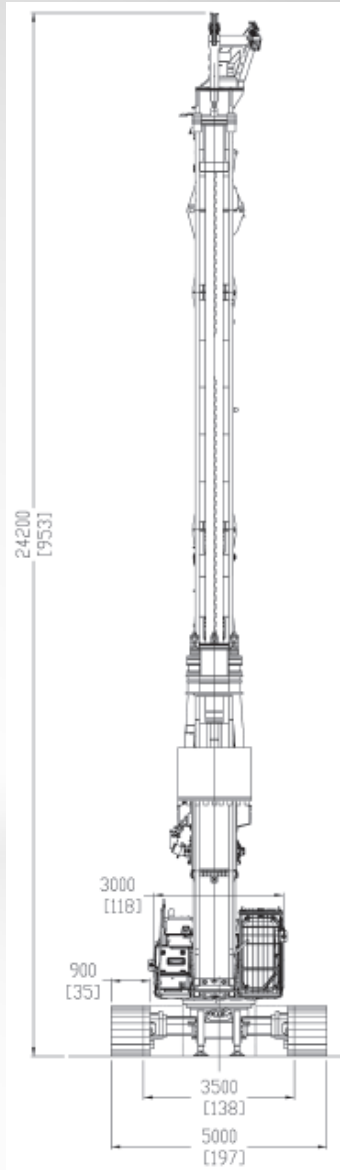
ADOT

Bridge Foundations

Abutments: Spread Footings

Piers: Rock Socketed Drilled Shafts





Seismic Design Parameters

Seismic Design Parameters

Project Site Coordinates		Site Class	Seismic Zone	Ground Motion Parameter 7 % in 75 years		Adjust Peak Acceleration (A_s)
Latitude	Longitude			PGA	F_{pga}	
34.99	- 112.39	B	1	0.097	1.0	0.097

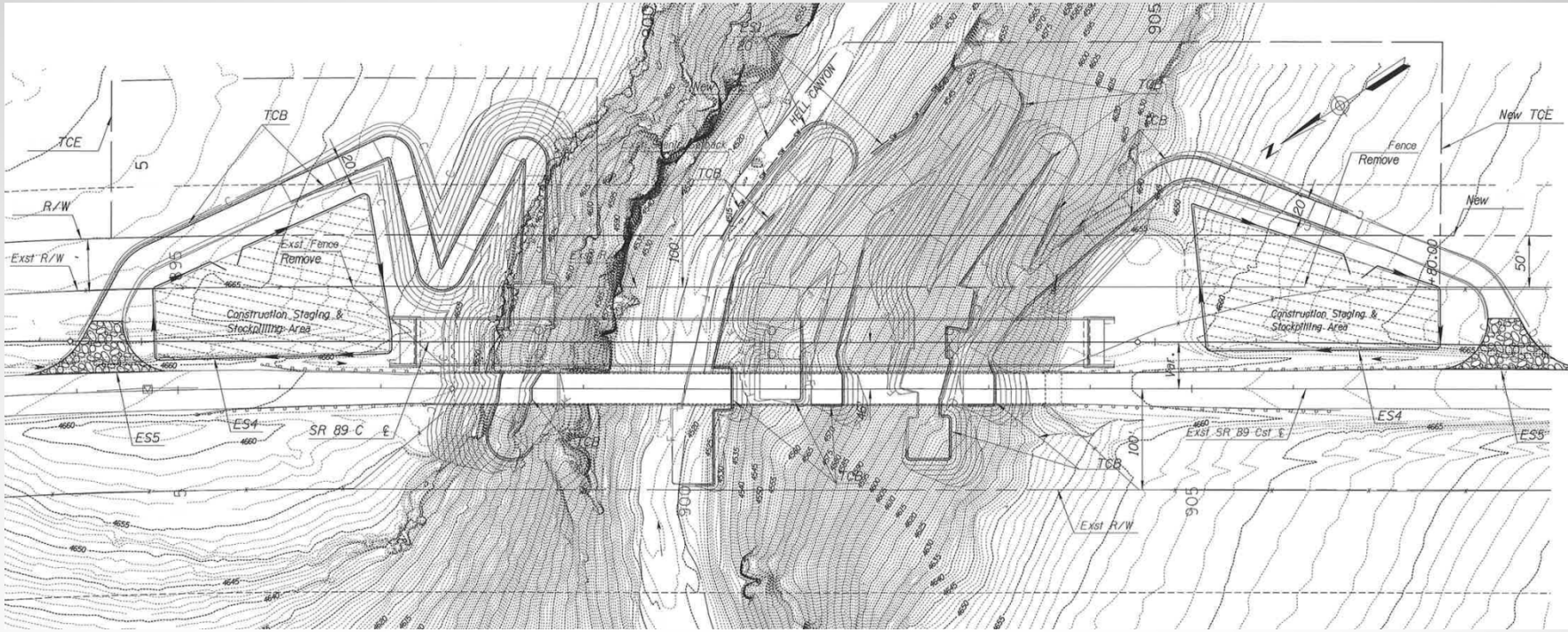
Table 1

Seismotectonic Source Areas Near the Hell Canyon Bridge Project Area

SR-89 HELL CANYON BRIDGE, MP 345.7

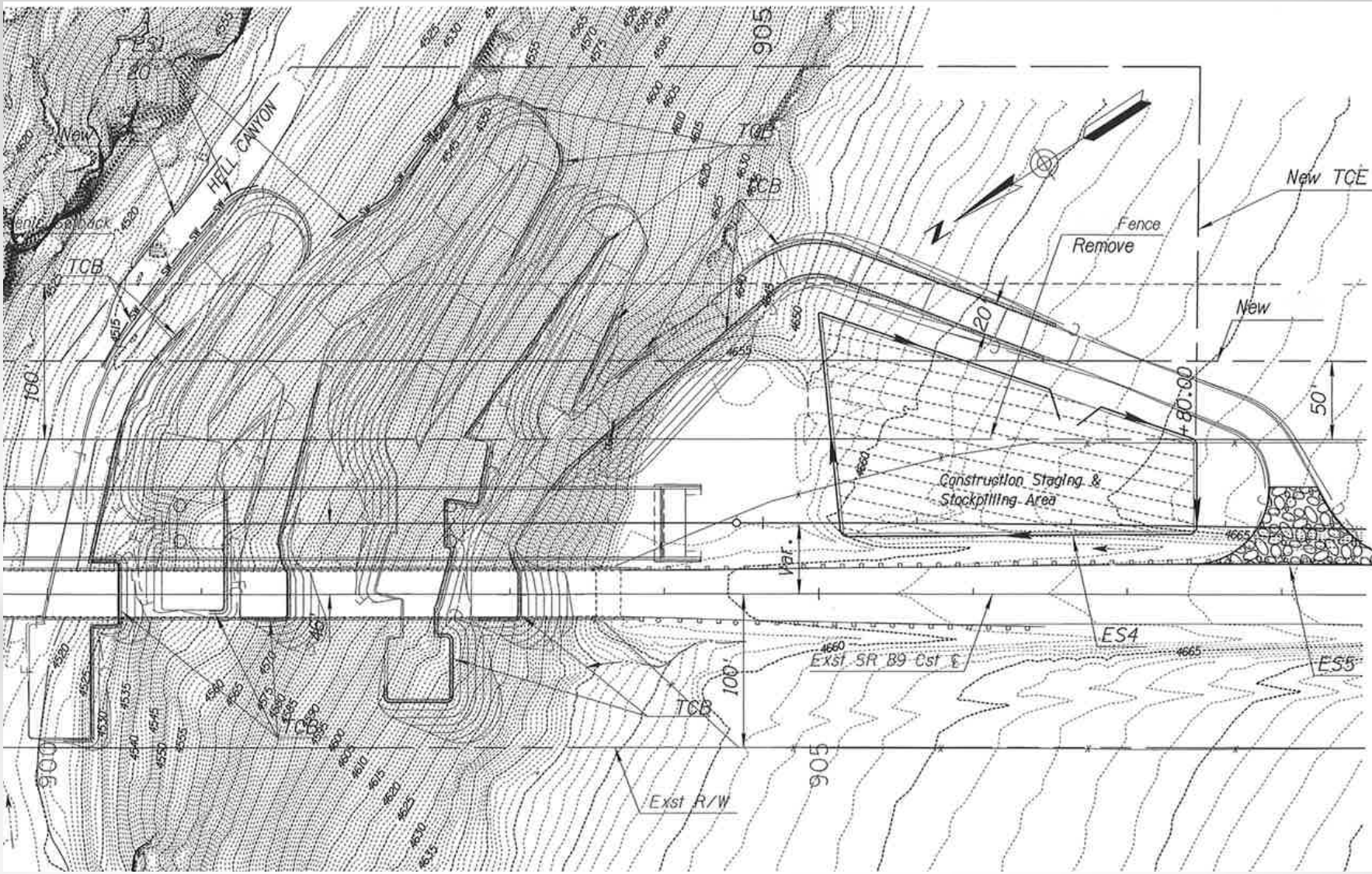
Seismotectonic Zone or Discreet Source	Zone Area (ZA)(Sq. Mi) or Discreet Source (DS) (Miles)	Historic Earthquakes Magnitude 4.0+	Maximum Credible Earthquake
Arizona Mountains Zone	38,000 (ZA)	4 to 5.2	$M_w = 6.75$
Big Chino Fault	35 (DS)	--	$M_w = 7.25$
Verde Fault	38 (DS)	--	$M_w = 7.25$
Aubry Fault	32 (DS)	--	$M_w = 7.25$

Construction Access

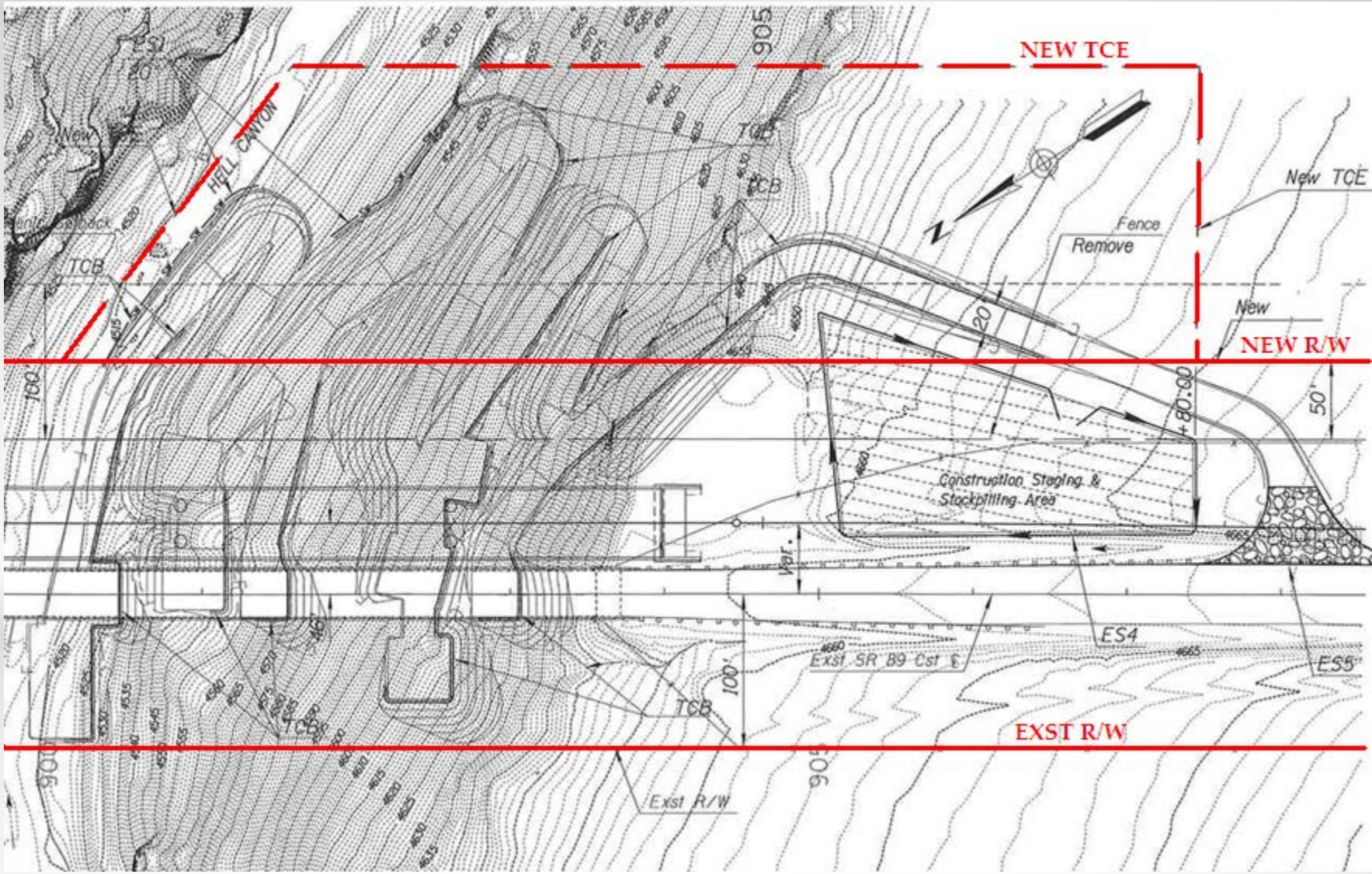


- TCE's needed for access roads
- Grade and turn radius limitations to accommodate heavy equipment
- Substantial material removal and storage
- Environmental concerns
- Canyon restoration at project completion

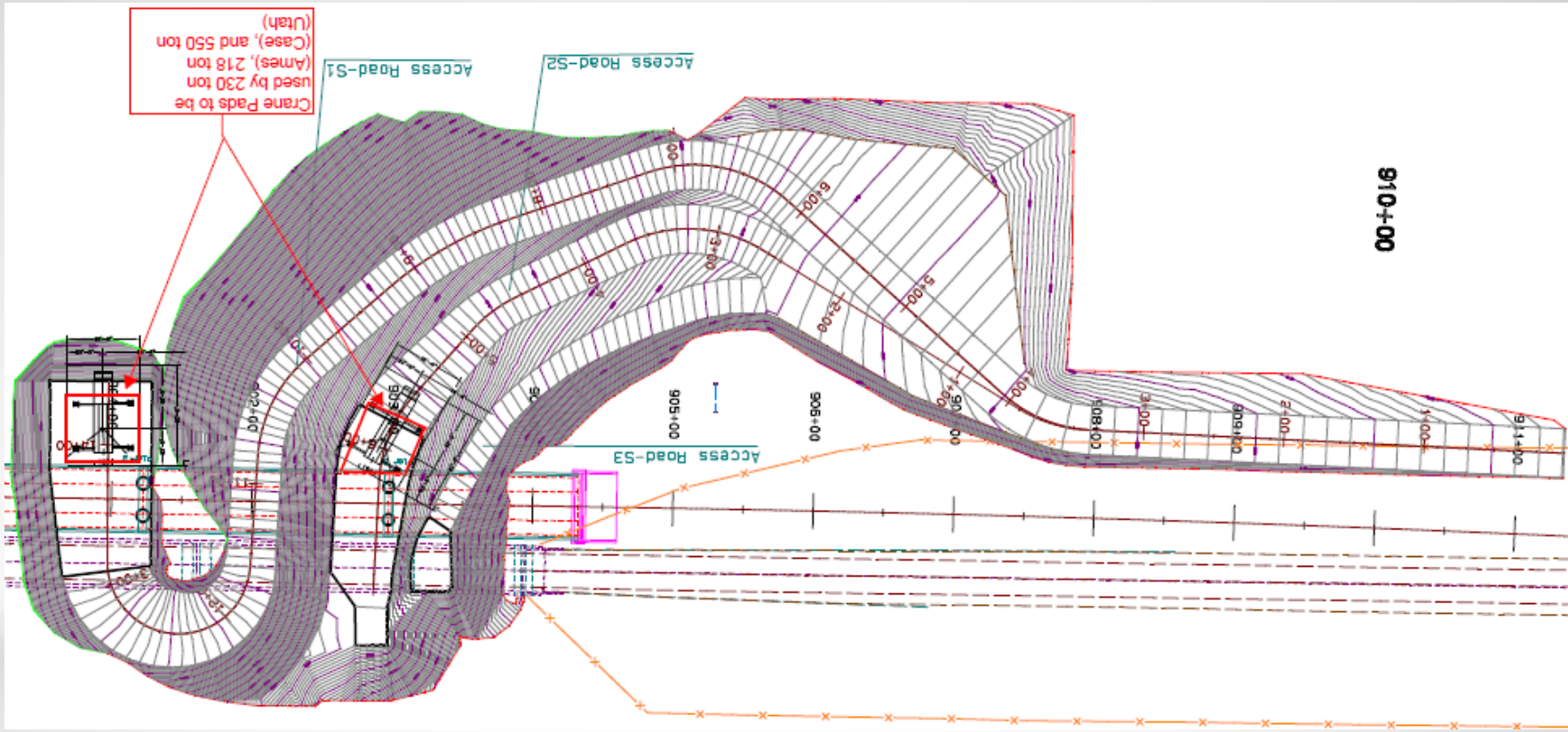
South Face


ES1
HELL CANYON
TCB
New TCE
Fence
Remove
New
Construction Staging &
Stockpiling Area
Var.
ES4
ES5
Exst SR 89 Cst ℄
Exst R/W
100'
50'
+80.00
905
900

South Face


NEW TCE
New TCE
Fence
Remove
New
NEW R/W
HELL CANYON
TCB
TCB
TCB
TCB
160'
20
+80.00
50'
Construction Staging &
Stockpiling Area
Var.
100'
ES4
ES5
Exst SR 89 Cst ℄
EXST R/W
Exst R/W
905
905

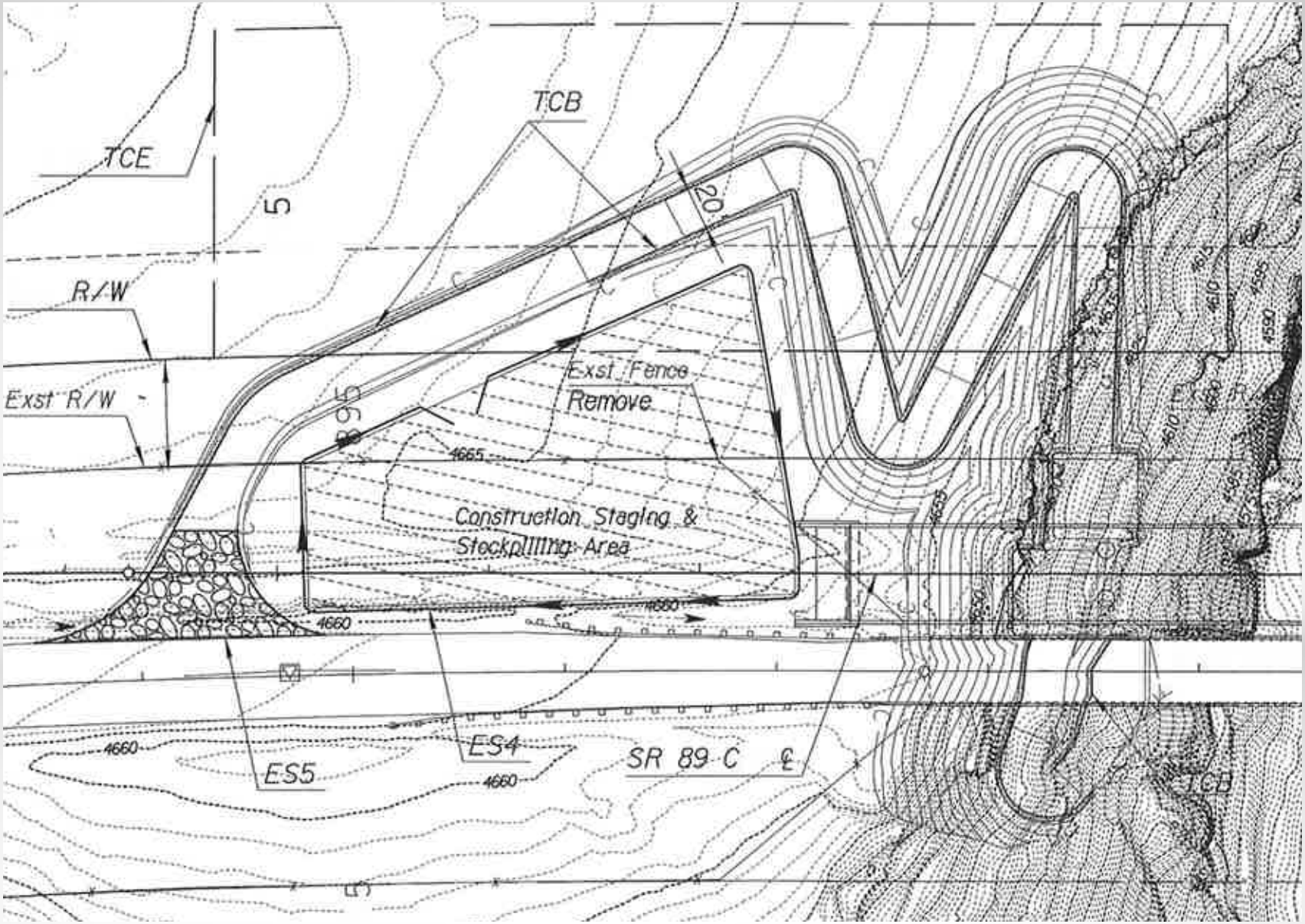
South Face



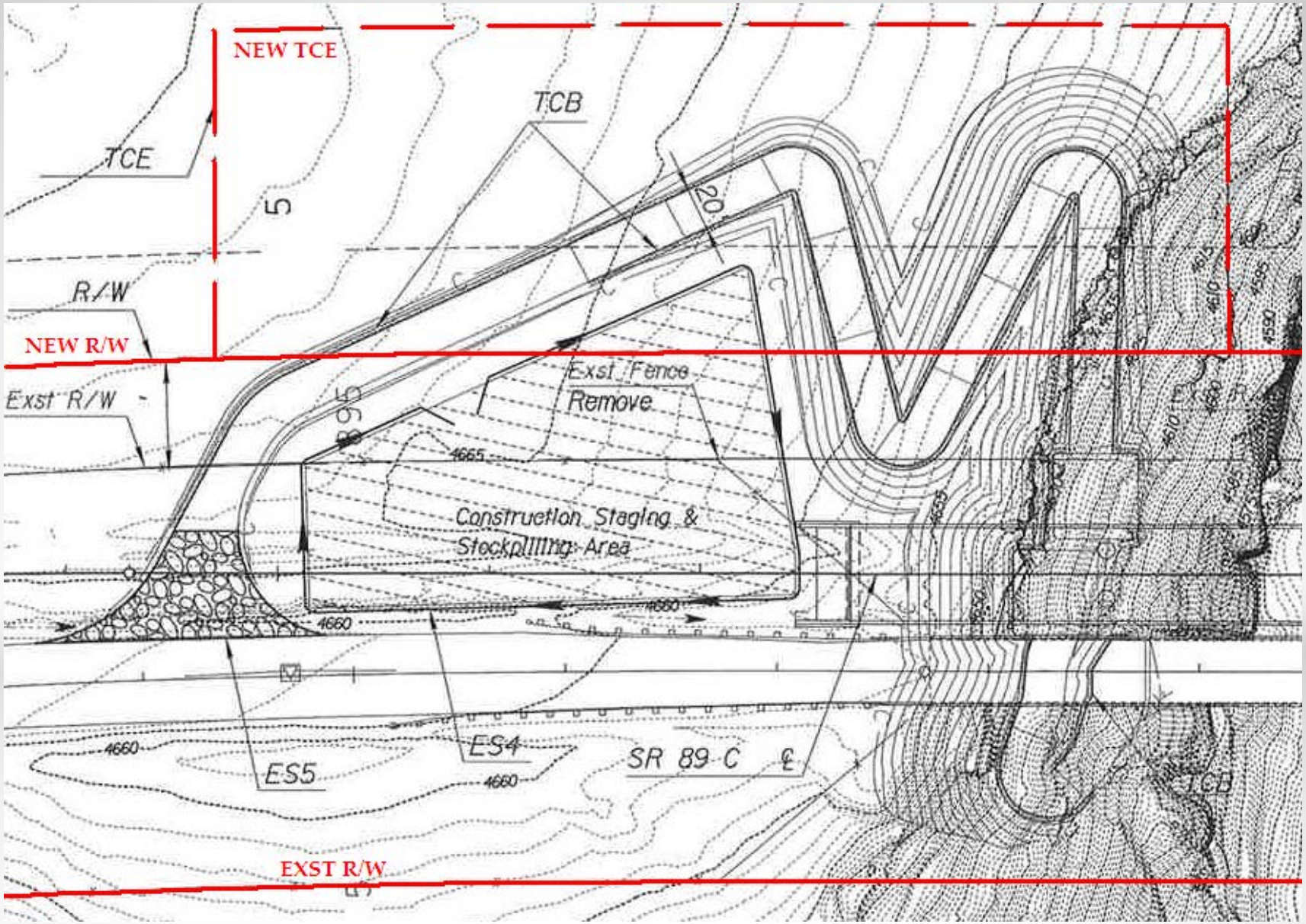
Contractor's Redesign

South Face

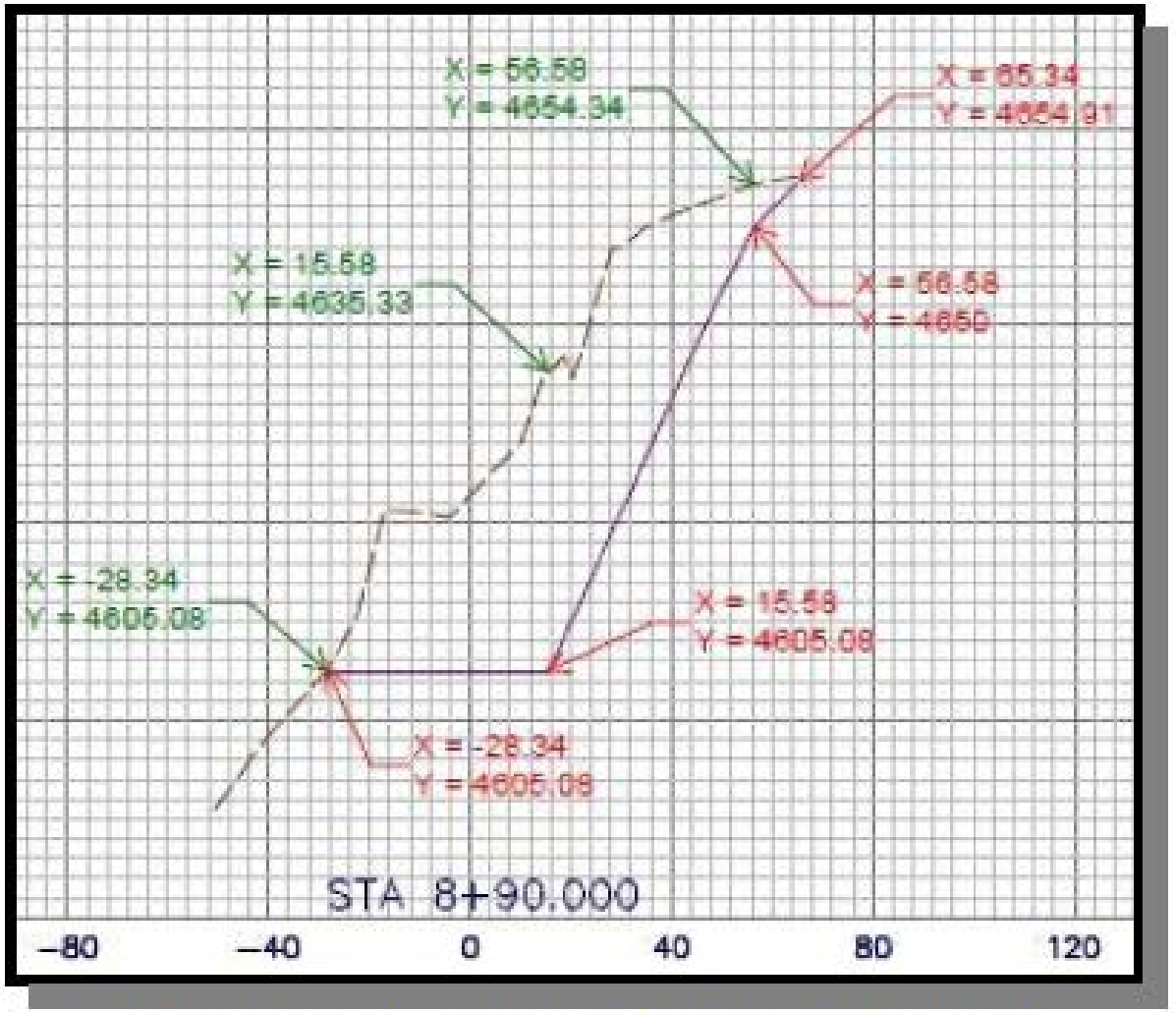
North Face


TCE
TCB
R/W
Exst R/W
Exst Fence
Remove
Construction Staging &
Stockpiling Area
ES5
ES4
SR 89 C
4660
4665
4655
4650
4645
4640
4635
4630
4625
4620
4615
4610
4605
4600
4595
4590
4585
4580
4575
4570
4565
4560

North Face


NEW TCE
TCB
TCE
5
20
R/W
NEW R/W
Exst R/W
Exst Fence
Remove
4665
Construction Staging &
Stockpiling Area
4660
4660
4660
ES5
ES4
SR 89 C ℄
TCB
EXST R/W

STATION 8+90 NORTH EMBANKMENT



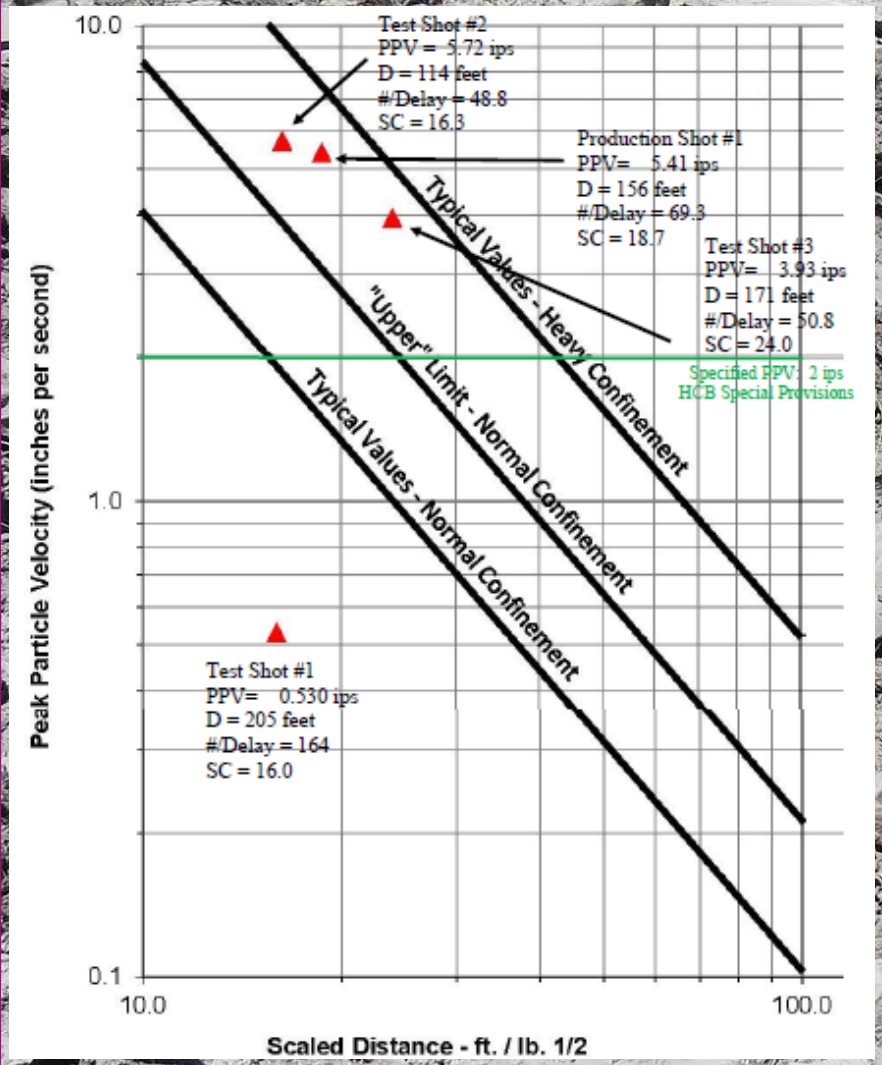
Cross-Section at Station 8+90 North Embankment

- Significant Material Removal for Access Road
- 30’ Layer of Strong Volcanic Basalt (20,000 psi)(RMR 58)

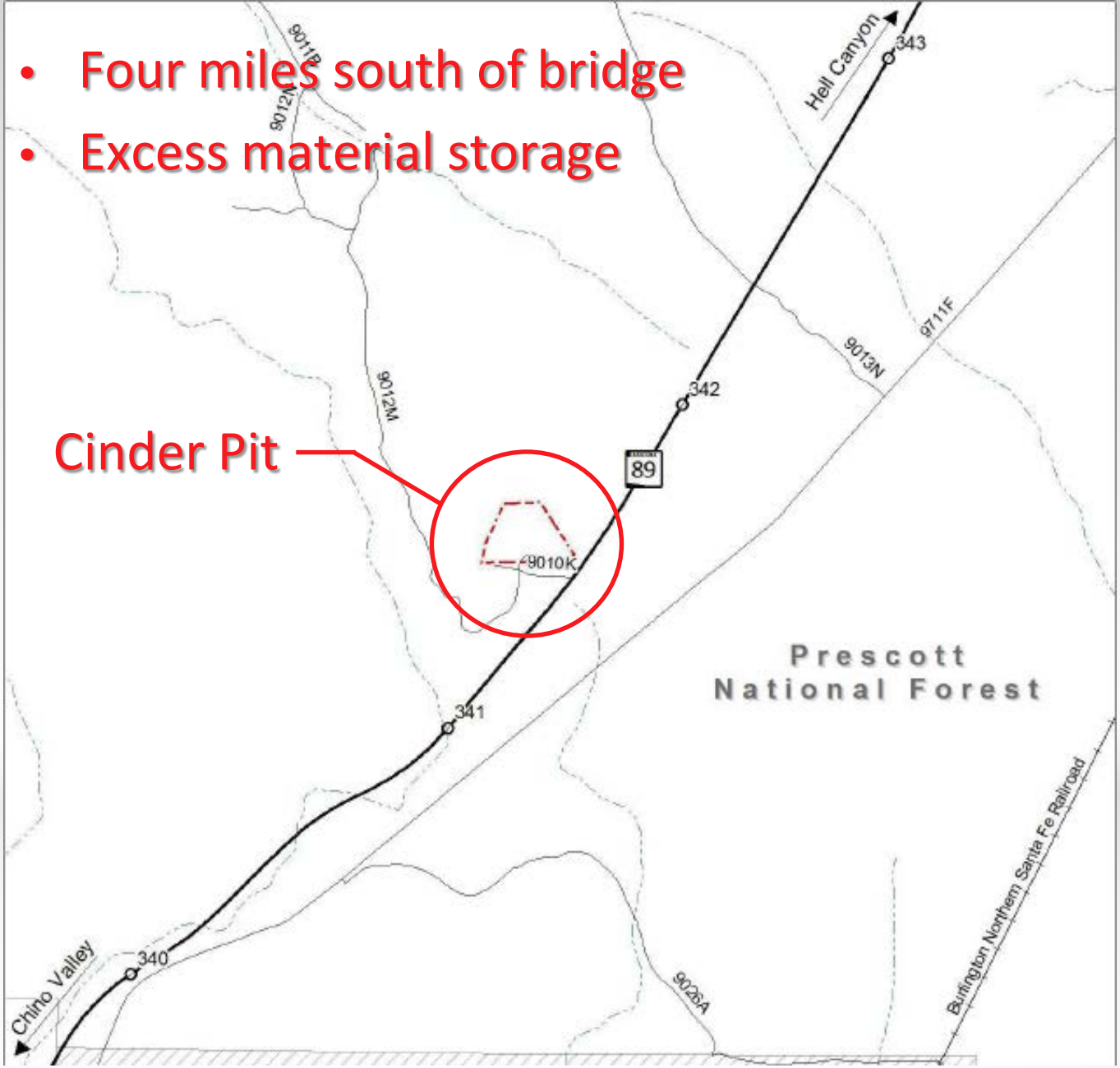
Blasting

- Monitoring Existing Bridge During Blasting
- Close Proximity to Existing Bridge

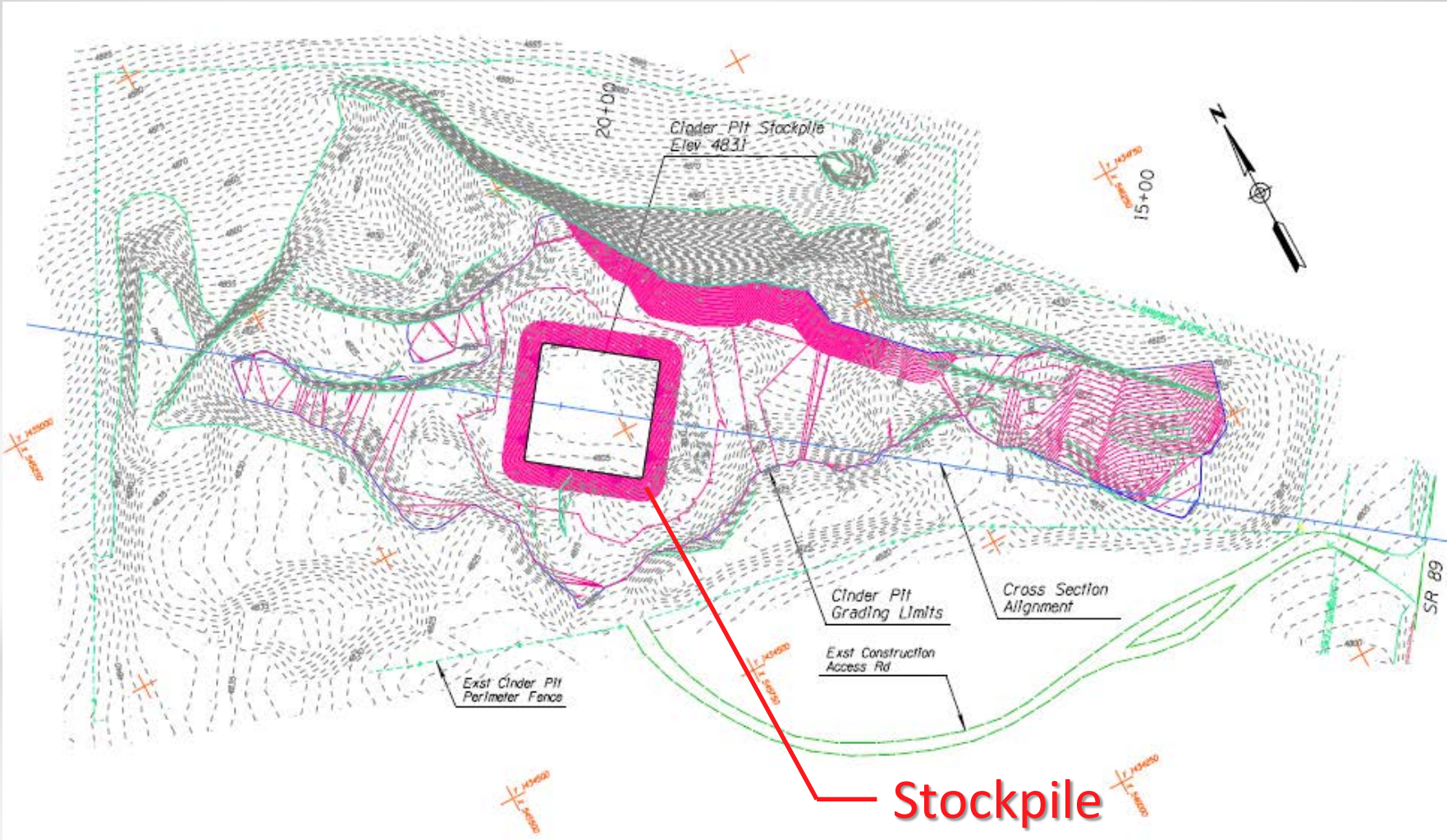
Peak Particle Velocity



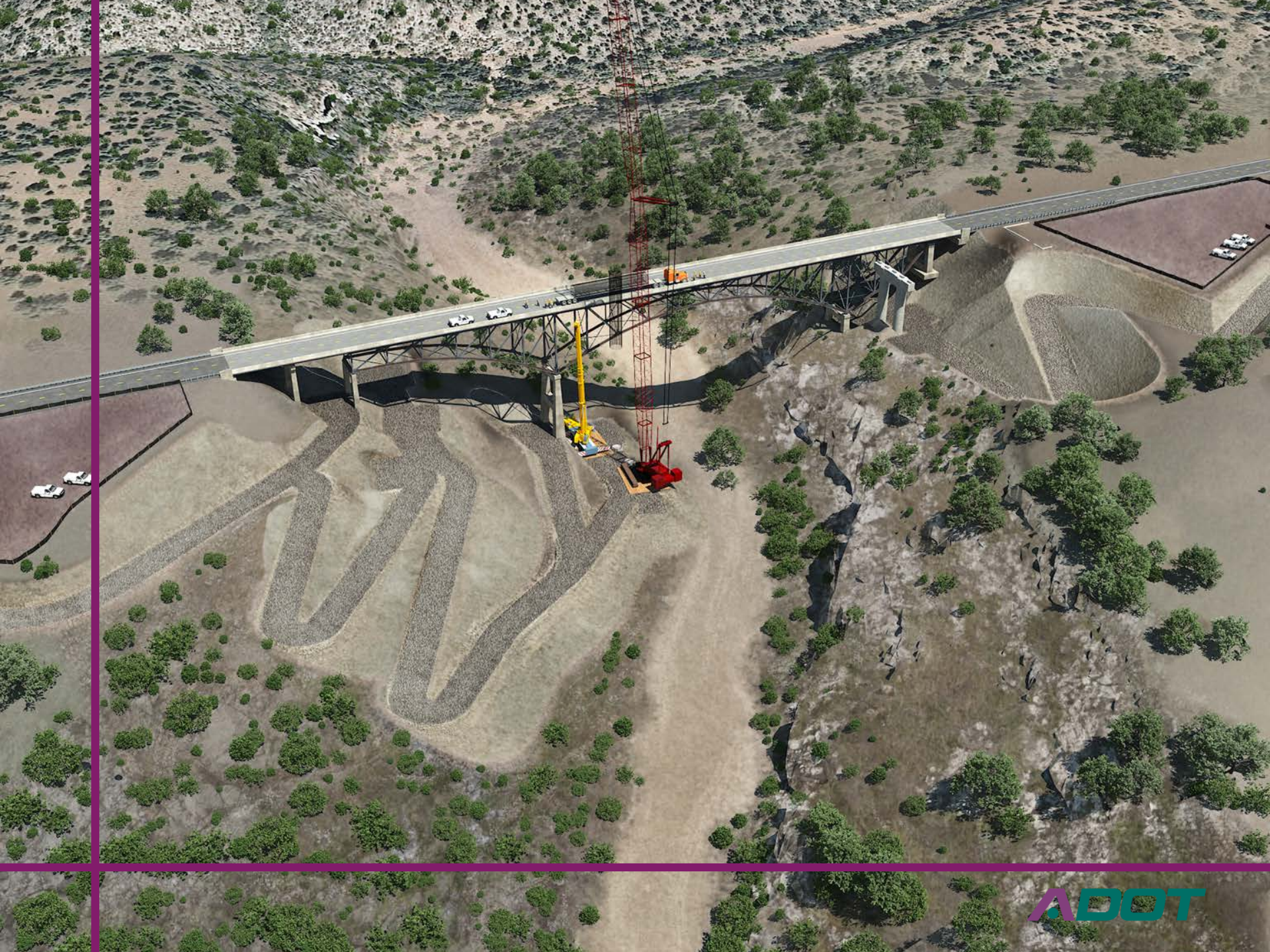
- Four miles south of bridge
- Excess material storage

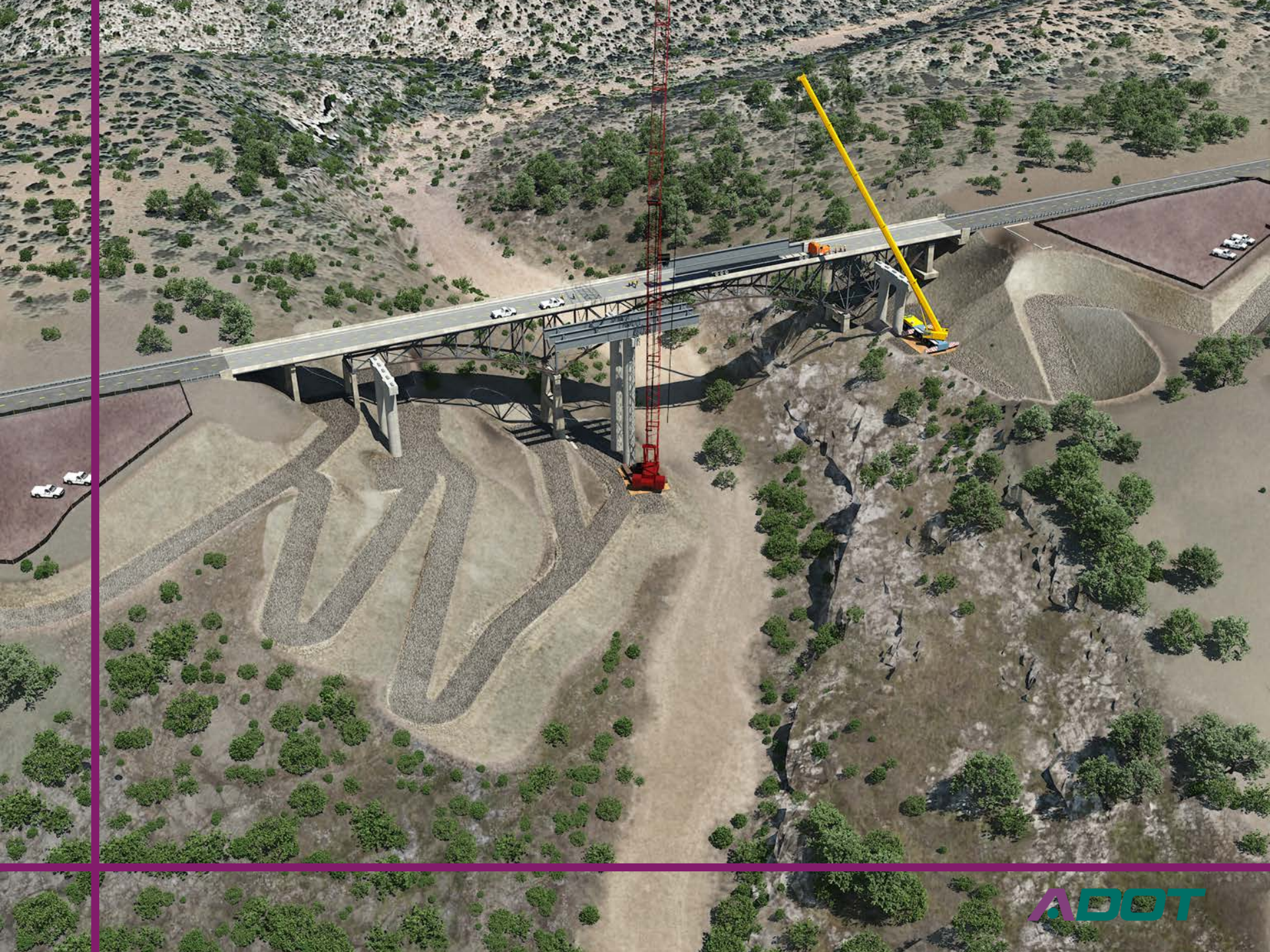


Cinder Pit


29+89
Cinder Pit Stockpile
Elev. 4831
15+00
N
Cinder Pit
Grading Limits
Cross Section
Alignment
Exst Construction
Access Rd
Exst Cinder Pit
Perimeter Fence
SR 89
Stockpile


09/22/2014
ADOT





Schedule

- New Bridge Open to Traffic: Fall 2016
- Existing Bridge Removal: Three Months
- Project Completion: Late 2016


Questions?