

# CALIFORNIA HIGH-SPEED TRAIN

## Engineering Report

Preliminary Engineering  
for Procurement (PE4P)  
Record Set

### **Fresno to Bakersfield**

Permitting Phase I  
U.S. Army Corps of Engineers  
408 Determination  
for Kings River Complex

October 2013



**CALIFORNIA**  
High-Speed Rail Authority





**Permitting Phase 1  
Proposed Preliminary Design  
U.S. Army Corps of Engineers  
408 Determination for  
Kings River Complex**

*Prepared by:*

URS/HMM/Arup Joint Venture

October 2013



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### List of Abbreviations and Acronyms

Authority	California High-Speed Rail Authority
cfs	cubic feet per second
CHSTP	California High-Speed Train Project
Crit	Critical flow
FB	Fresno to Bakersfield
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
H	Hanford East
HST	High-Speed Train
Ineff	Ineffective flow area
KRCD	Kings River Conservation District
KRWA	Kings River Water Association
O&M	operations and maintenance
SR	State Route
USACE	U.S. Army Corps of Engineers
WS / WSE	water surface elevations

# **Section 1.0**

## **Introduction**



## **1.0 Introduction**

### **1.1 Project Overview**

In 1996, the state of California established the California High-Speed Rail Authority (Authority). The Authority is responsible for studying alternatives to construct a rail system that will provide intercity high-speed train (HST) service on over 800 miles of track throughout California. This rail system will connect the major population centers of Sacramento, the San Francisco Bay Area, the Central Valley, Los Angeles, the Inland Empire, Orange County, and San Diego. The Authority is coordinating the project with the Federal Railroad Administration. The California High-Speed Train Project (CHSTP) is envisioned as a state-of-the-art, electrically powered, high-speed, steel-wheel-on-steel-rail technology that will include state-of-the-art safety, signaling, and automated train-control systems.

The statewide CHSTP has been divided into a number of sections for the planning, environmental review, coordination, and implementation of the project. This 408 Determination report for Kings River Complex is focused on the section of the CHSTP between Fresno and Bakersfield, specifically between the CHSTP stations in downtown Fresno and downtown Bakersfield. During the initial planning process, the CHSTP alignment alternatives are dynamic and subject to revision.

### **1.2 Project Description**

#### **1.2.1 Fresno to Bakersfield High-Speed Train Section**

The proposed Fresno to Bakersfield (FB) Section of the HST is approximately 114 miles long and traverses a variety of land uses, including farmland, large cities, and small cities. The FB Section includes viaducts and segments where the HST will be on embankment or in cut. The route of the FB Section passes by or through the rural communities of Bowles, Laton, Armona, and Allensworth and the cities of Fresno, Hanford, Selma, Corcoran, Wasco, Shafter, McFarland, and Bakersfield.

The FB Section extends southeast from north of Stanislaus Street in Fresno, paralleling the south side of the BNSF railroad. The FB Section meets the northernmost limit of the Bakersfield to Palmdale Section of the HST at Oswell Street in Bakersfield.

#### **1.2.2 Purpose**

Within the FB Section, the crossing of the Kings River Complex — which includes Cole Slough, Dutch John Cut, and the Kings River Old Channel — has been identified to require a Section 408 Determination by the U.S. Army Corps of Engineers (USACE).

The purpose of this report is to summarize available hydraulic information for the proposed HST crossing of the Kings River Complex and to present the hydraulic impacts caused by the proposed encroachment at regulatory flow rates. In addition, the report provides information about operations and maintenance (O&M) considerations.

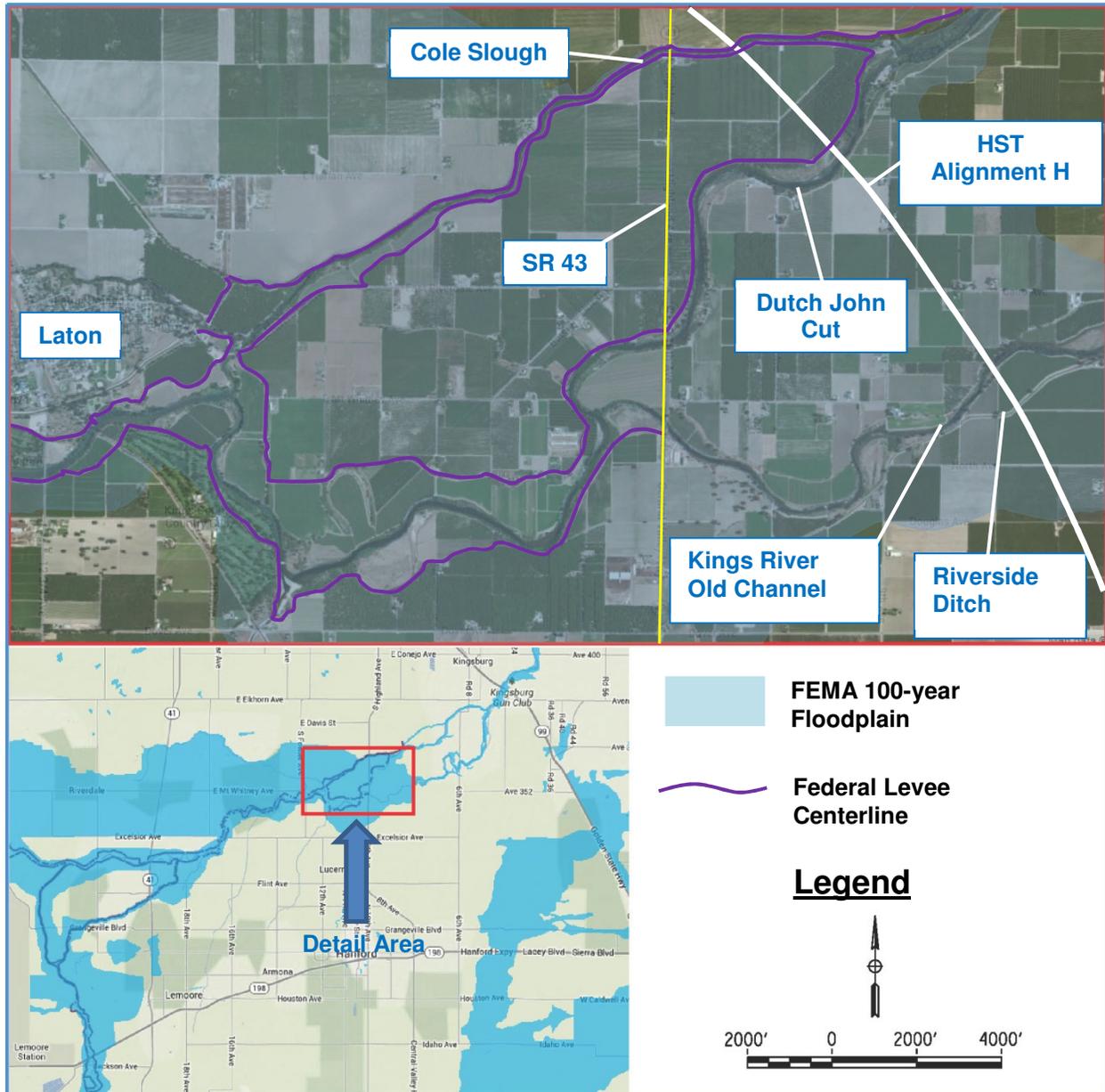
#### **1.2.3 Crossing Location**

The proposed crossing of the Kings River Complex on the Hanford East (H) alignment is located approximately 8 miles north of the city of Hanford and 4 miles east of the town of Laton (Figure 1.2-1).

### **1.2.4 Geometry at Crossing Location**

At the proposed crossing, the channel widths of Cole Slough, Dutch John Cut, and the Kings River Old Channel are approximately 180 feet, 540 feet, and 410 feet, respectively, with skew angles less than 15 degrees. The H Alignment of the HST is proposed to cross the Kings River Complex and the 13,700-foot-wide floodplain (Zone A) on an 11,684-foot-long elevated viaduct and a 2,700-foot-long embankment, with other hydraulic crossings within the remaining floodplain for wildlife and floodwater passage.

The current design concept of the viaduct foundation configuration consists of 10-foot-diameter columns that are generally spaced 100 to 121.5 feet on center. The northern abutment of the viaduct is located to the north of the Cole Slough levee, outside of the Kings River Complex floodplain. The southern abutment is located to the south of the Kings River Old Channel, within the Kings River Complex floodplain. Four segments of the viaduct are truss bridges. One truss bridge crosses over Cole Slough with a 357-foot-long single span. The second truss bridge crosses over Dutch John Cut with two spans of 357 feet each and a two-column pier located in the overbank area on the north side of the main channel. The third truss bridge crosses over the Kings River Old Channel immediately downstream of an existing earthen low-flow crossing, with two spans of 322 feet each and a two-column pier located in the main channel. The fourth truss bridge is a single-span bridge of 318.5 feet in length that crosses over Riverside Ditch. The cross-sectional geometry of the Kings River Complex at the crossing is based on the topographic map prepared for this project. Exhibits showing the structural plan and profiles at the crossing can be found in Appendix A.



**Figure 1.2-1**  
 Site Vicinity and Location Map for the HST Crossing

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## **Section 2.0**

### **Hydraulic Impacts**



## 2.0 Hydraulic Impacts

General information regarding the hydraulic analysis and impacts at the Kings River Complex crossing is provided in the following sections.

Three additional reports also provide hydrology information about the area. The *Hydrology, Hydraulics, and Drainage Report* describes hydrologic and hydraulic analysis methods and preliminary drainage design concepts for natural channels, sloughs, and man-made drainage features that will be crossed by the proposed HST alignments between Central Fresno and Oswell Street in Bakersfield. Discussions regarding potential impacts to floodplains are prepared under separate cover titled *Floodplain Impacts Report*. Discussions on stormwater quality are under a separate cover titled *Stormwater Quality Management Report*.

### 2.1 Modeled Flow Rates

The USACE O&M flows for each tributary of the Kings River Complex (**Table 2.1-1**) were used for the bridge hydraulic analysis for the H alignment. This flow is based on the levee design flow documented in the USACE document SPKED-F, Kings River Channel Improvement Project, Letter Supplement No. 1 to Design Memo No. 3, dated February 1975.

**Table 2.1-1**  
 USACE O&M Flows for Kings River Complex

Cole Slough (cfs)	Dutch John Cut (cfs)	Kings River Old Channel (cfs)
3,300	7,100	600

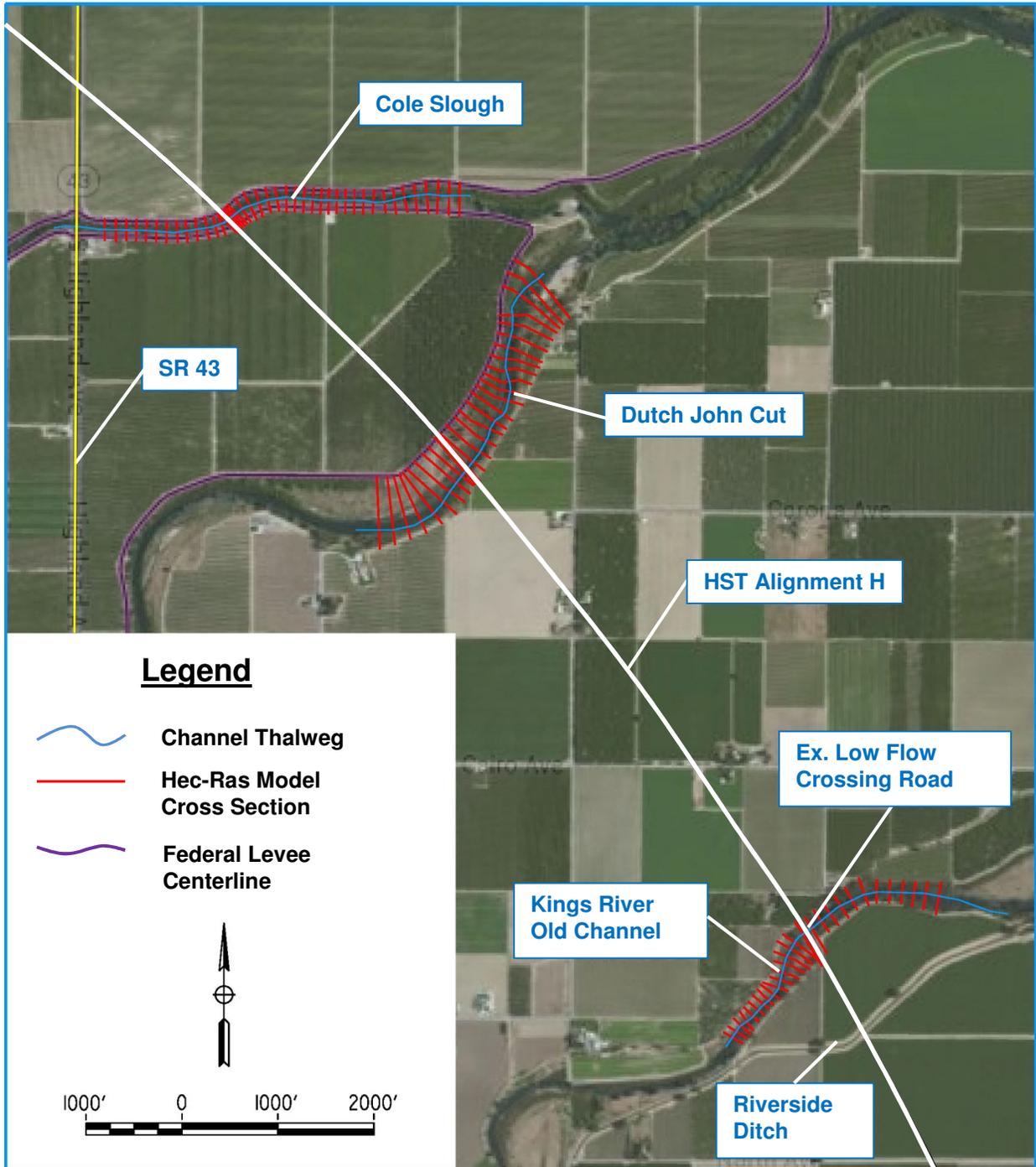
The Federal Emergency Management Agency (FEMA) 100-year flow of 19,900 cubic feet per second (cfs) was used for the Kings River floodplain hydraulic modeling. This 100-year flow was obtained from FEMA Flood Insurance Study for Tulare County, California and Incorporated Areas, dated June 16, 2009.

### 2.2 Limits of Analysis: HEC-RAS Model

The hydraulic analysis for the USACE O&M flows is limited within the H alignment project mapping area. Since the O&M flows are confined within the channels, the cross sections were set to cover the top width of the channel for each of the three branches of the Kings River Complex. Figure 2.2-1 presents location of the HEC-RAS cross sections and **Table 2.2-1** lists the most upstream and downstream cross sections, which are limited within the project topographic mapping area.

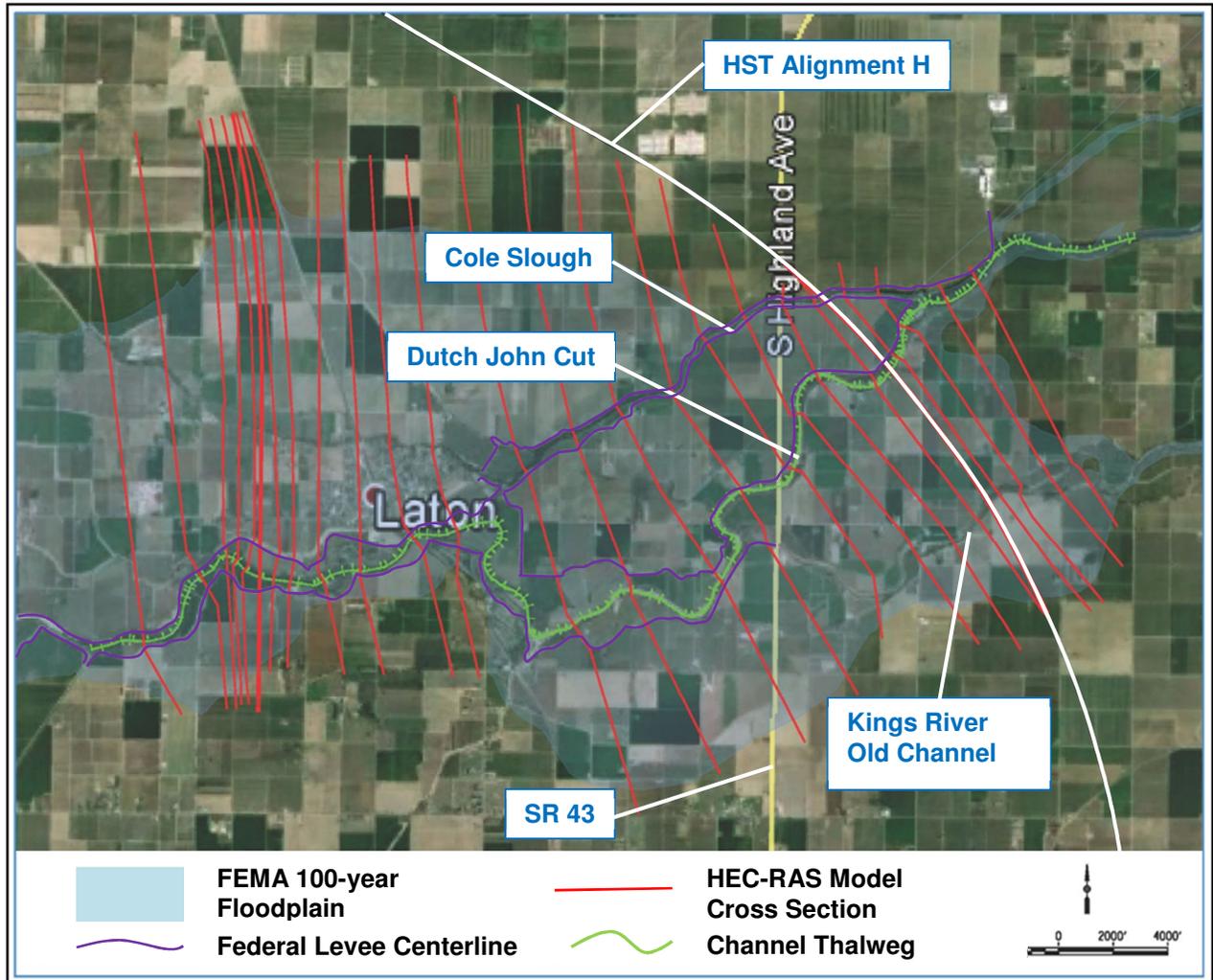
**Table 2.2-1**  
 Limits of the Cross Sections

Branch	Most upstream cross section, approx. distance upstream of alignment centerline (ft)	Most downstream cross section, approx. distance downstream of alignment centerline (ft)
Cole Slough	2,490	1,520
Dutch John Cut	2,270	1,180
Kings River Old Channel	1,520	1,370



**Figure 2.2-1**  
Location of HEC-RAS Cross Sections for USACE O&M Flow Model

For the FEMA 100-year flood modeling at Kings River Complex, the analysis covers the existing FEMA floodplain width, extends from approximately 4,700 feet upstream of the H alignment to approximately 6,300 feet downstream of the Hanford West alignment, which is about 1 mile southwest of the town of Laton. These limits were used because it covers the area where topographic mapping and the 100-year peak flow information are available. The maps used for the HEC-RAS modeling of the floodplain consist of project topographic maps and LiDAR maps for areas outside the project topographic maps. (See Figure 2.2-2 for location of the HEC-RAS cross sections for the FEMA 100-year flood modeling).



**Figure 2.2-2**  
 Location of HEC-RAS Cross Sections for 100-Year Flow Model

## 2.3 Bridge Scour

Bridge pier scour was estimated per the procedure documented in the Federal Highway Administration (FHWA) Hydraulic Engineering Circular No. 18 (HEC No. 18), Fifth Edition. The bridge pier location and configuration is based on the bridge design drawings presented in Appendix A. The estimated scour at the piers includes contraction scour, and the scour for the pier column and the south abutment of the viaduct. Since the north abutment of the viaduct is out of the floodplain, no scour was estimated for that location.

For the preliminary study, assumptions were used in the scour analysis for the sediment gradation and debris amount:

- The diameter that represents the 50th percentile of the sediment particle size ( $D_{50}$ ) is assumed to be 0.71 mm and the diameter that represents the 95th percentile of the sediment particle size ( $D_{90}$ ) is assumed to be 2.50 mm. No site-specific site investigation has been carried out at this location.
- For the USACE O&M flow, the debris was assumed to be 2 feet on each side of the pier column. For the FEMA 100-year peak flow, the debris was assumed to be 20 feet wide and 4 feet thick.

## 2.4 Model Results

The HEC-RAS modeling results are summarized in Table 2.4-1 and Table 2.4-2. The tables provide the water surface elevations (WSE) at each upstream cross section of the bridges and estimated contraction scour, pier scour and abutment scour depths. The total estimated scour depths at the viaduct/bridge foundations listed in the tables do not include long-term channel aggradation or degradation and should be measured from the channel's bottom elevation.

**Table 2.4-1**  
 Summary Results of HEC-RAS Model with USACE O&M Flow

Bridge Location	USACE O&M Flow (cfs)	WSE Existing Condition (ft)	WSE Proposed Condition (ft)	Pier Dimension (ft)	Contraction Scour Depth (ft)	Pier Scour Depth (ft)	Total Estimated Scour at Pier (ft)
Cole Slough	3,300	268.30	268.30	N/A	--	N/A	N/A
Dutch John Cut	7,100	267.82	267.84	Two 10-foot-diameter columns	0.1	23.8	23.9
Kings River Old Channel	600	262.59	262.72	Two 10-foot-diameter columns	0	12.7	12.7

**Table 2.4-2**  
 Summary Results of HEC-RAS Model with FEMA 100-Year Flow

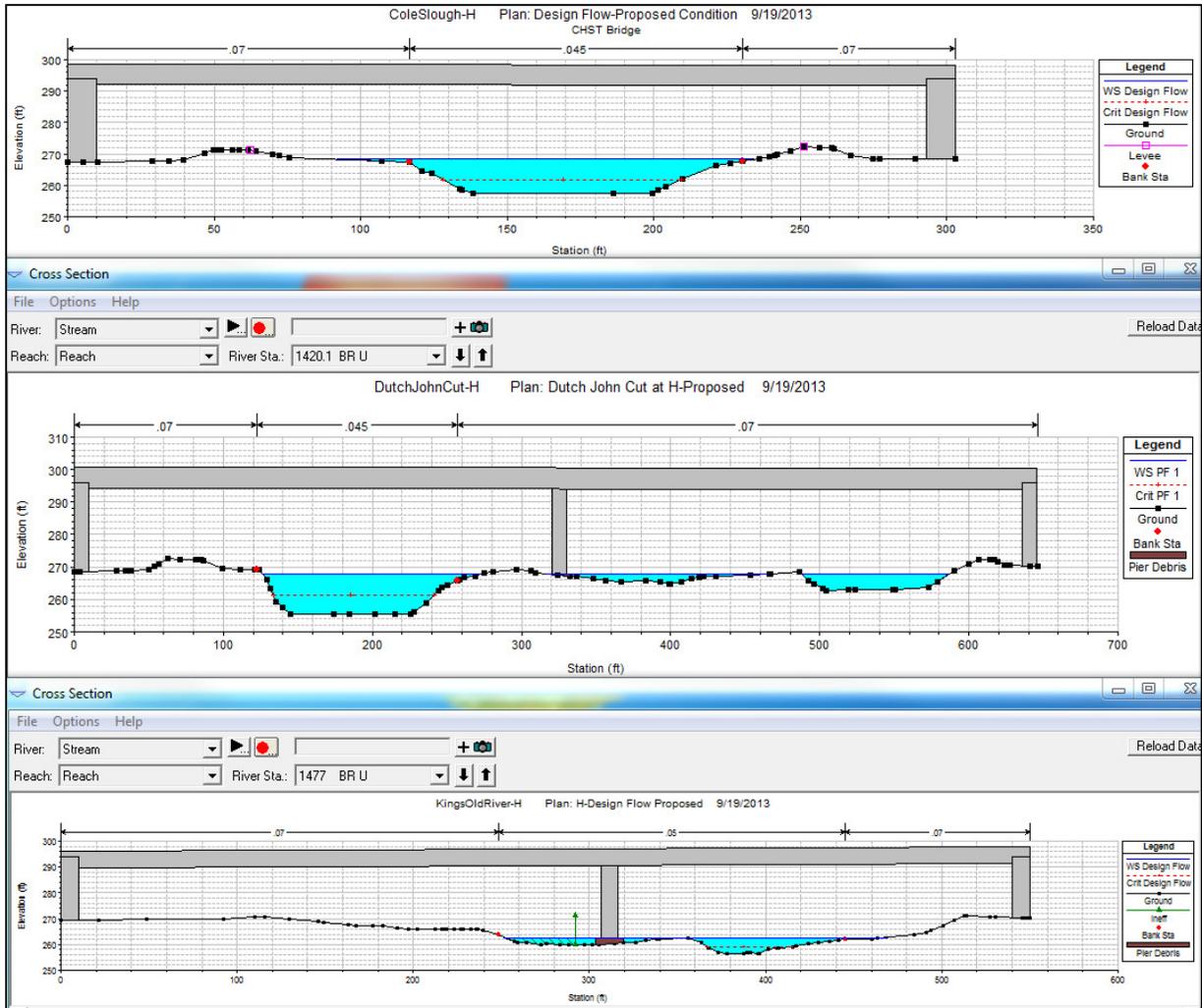
Bridge Foundation Location	FEMA 100-Year Peak Flow (cfs)	WSE Existing Condition (ft)	WSE Proposed Condition (ft)	Contraction Scour Depth (ft)	Local Scour (ft)	Total Scour at Foundation (ft)
Cole Slough	19,900	270.58	270.59	0	NIA	N/A
Pier in Dutch John Cut				0	24.1	24.1
Pier in Kings River Old Channel				0	16.2	16.2
Scour at Bents out of Channels				0	≤13.0	≤13.0
Southern Abutment				0	4.8	4.8

As summarized in Tables 2.3-1 and 2.3-2, the increase in the WSE will not be significant. For the USACE O&M flow, the WSE at the upstream cross section of the HST bridge at Cole Slough and Dutch John Cut will be raised less than 0.1 feet. The WSE at the Kings River Old Channel will be raised by 0.13 feet, but this will only extend for a short section between the HST bridge and the existing low-flow crossing road. For FEMA 100-year flow, the WSE impact is negligible, at 0.01 feet. With the proposed truss bridges, clearances of around 20 feet will be maintained between the 100-year WSE and the bridge soffit at the three channels of the Kings River Complex. The resulting WSE at the upstream face of the bridges with the USACE O&M flows are shown in Figure 2.5-1. The resulting WSE at the upstream face of the viaduct (including the four truss bridges) with the FEMA 100-year flow is shown in Figure 2.5-2.

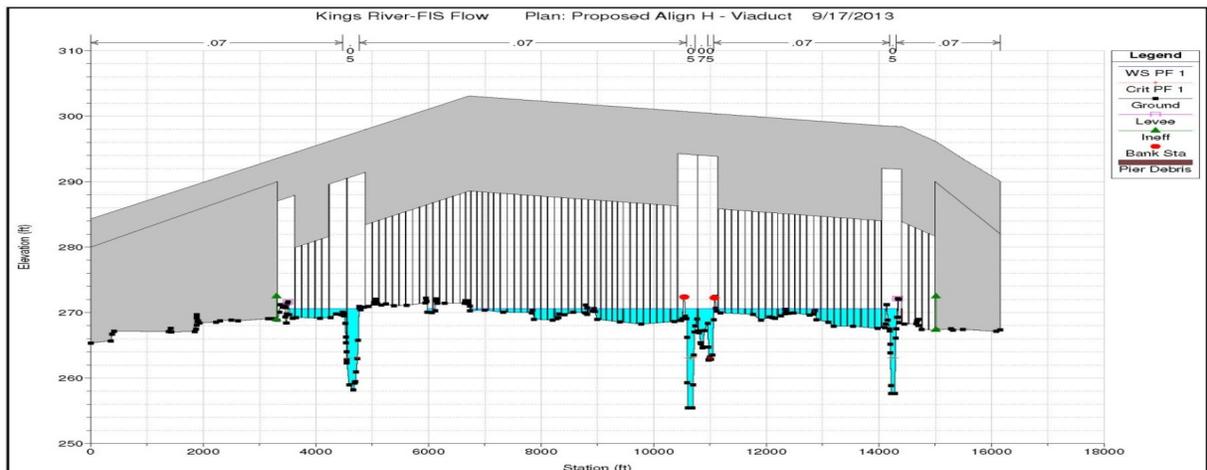
## 2.5 Scour Countermeasures

The scour countermeasure will be designed, constructed and maintained per the procedure and methods documented in FHWA Hydraulic Engineering Circular No. 23 (HEC No. 23). Except for effectiveness, the selection of an appropriate scour countermeasure for the pier column and the abutment should be based on channel configuration, flow velocity and depth, construction and maintenance requirements, potential for vandalism, and costs.

The viaduct foundation design will take into account the scour depth. The cap of the column should be placed at least 5 feet below grade to accommodate contraction scour and potential long-term scour. The pile length should be determined to ensure that no significant damage will be suffered from the consequences of a 200 year flood flow. Guide bank with rock riprap or other revetment armor could be considered at the South Abutment to protect the HST embankment, and move local scour to the upstream end of the guide bank.



**Figure 2.5-1**  
 USACE O&M Flow in HEC-RAS Model at Three Kings River Channels



**Figure 2.5-2**  
 FEMA 100-Year Flood in HEC-RAS Model

**Section 3.0**  
**Operations and**  
**Maintenance Considerations**



## **3.0 Operations and Maintenance Considerations**

### **3.1 Procedures**

At the proposed HST crossings of the Kings River Complex, there are federal levees on each side of Cole Slough and on the north bank of Dutch John Cut (Figure 3.1-1) which were constructed by USACE in the 1970s.

The maintenance of Kings River channels and the levees are the delegated responsibility of Kings River Conservation District (KRCD). Per USACE's maintenance requirements documented under the Section 4-02 of the Operation and Maintenance Manual for Kings River Channel Improvement, dated December 1972, access roads to the levee shall be maintained in such condition that they will be accessible at all times to trucks used to transport equipment and supplies for maintenance and flood fighting.

Currently, the crossing at the two USACE levees at Cole Slough can be accessed for maintenance from State Route (SR) 43 (S Highland Avenue), which is about 1,600 feet west of the proposed HST crossing. The levee at the north side of Cole Slough can also be accessed from an unnamed local road that connects to Davis Avenue and is about 7,000 feet east of the proposed HST crossing. The crossing at the levee at the north side of Dutch John Cut can be accessed from SR 43, which is about 3,700 feet west of the proposed HST crossing. On the east side of the HST alignment, the levee on the north side of Dutch John Cut connects the levee on the south side of Cole Slough in the location where Dutch John Cut diverts from Cole Slough. Currently there is no access to the crossings of these two levees from the east side of the proposed HST alignment. However, the Dutch John Cut channel could be accessed through 9<sup>th</sup> Avenue from the east side of the HST alignment. The Kings River Old Channel could be accessed from both south and north banks through 8<sup>th</sup> Avenue, which is about 3,000 feet east of the HST alignment, and through 9<sup>th</sup> Avenue, which is about 3,400 feet west of the HST alignment (see Figure 3.1-1 for the maintenance access of the levees and channels of the Kings River Complex).

The truss bridges crossing the three Kings River Complex channels will be constructed so as not to impact the federal levees or the river banks. The bridge pier and abutment foundations will have 15 feet of horizontal setback from the toe of the levee. The minimum vertical clearance from the top of the levee to the bridge soffit is 18 feet.



**Figure 3.1-1**  
Aerial Showing Maintenance Access from the North and South Sides of the Kings River Complex

## **3.2 Coordination with Local Maintaining Agency**

The Kings River is a federal flood control project operated and maintained by the KRCD. KRCD is a public agency that is involved with maintenance, water quality monitoring, and groundwater development projects. KRCD does not have water supply rights or entitlement on the Kings River.

The Kings River Water Association (KRWA) is a private association that manages 28 member agencies (or "units") that have water rights on the Kings River. These units are public districts or canal companies with rights to use Kings River water for irrigation on nearly 20,000 San Joaquin Valley farms and 1 million acres in portions of Fresno, Kings, and Tulare Counties.

### **3.2.1 Discussions with Local Maintaining Agency**

A meeting was held on October 29, 2012, between the Authority, project engineering team members, KRCD, KRWA, and Third-Party Agreement Team (see Appendix B for meeting notes). During this meeting, KRCD representatives stated that with an 18-foot clearance, no impact on the levee maintenance would be foreseen. KRCD would be able to maintain and handle facilities. If a clearance is proposed of less than 18 feet, more study would be required. The preliminary design of bridge structures has been carried out to achieve 18 feet of vertical clearance above the top of levee.

It is noted that vertical clearance and setback of the bridge foundation to the toe of levee were discussed with KRCD at an earlier meeting on December 15, 2011 (see Appendix C for meeting notes).

### **3.2.2 Operations and Maintenance Requirements and Local Maintaining Agency Conditions**

As stated above, coordination with the Local Maintaining Agency determined that a minimum 18-foot vertical clearance from the top of the levee to the viaduct soffit is recommended. No additional study is required.

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## **Section 4.0**

### **Conclusion**



## 4.0 Conclusion

Based on the hydraulic analysis performed for the proposed HST crossing of the Kings River Complex and the corresponding O&M considerations presented in the previous sections, we recommend that this crossing meets the 408 Minor process guidelines, as follows:

- Based on model results of the USACE O&M flows, the proposed crossing will cause less than a 0.1-foot rise in the WSE within the levees at Cole Slough and Dutch John Cut. The WSE at the Kings River Old Channel, where no federal levee exists, will be raised by 0.13 feet, but this will only extend for a short section between the HST bridge and the existing low-flow crossing road.
- Under the FEMA 100-year peak flow, the proposed crossing will cause less than a 0.1-foot rise in the WSE of the floodplain.
- Based on the preliminary design, around 20 feet of clearance will be maintained between the 100-year flood WSE and the HST crossing soffit. This freeboard provides capability to accommodate potential waves, floating debris, and any uncertainty of the parameters and data used in modeling.
- Based on the preliminary design, at least 18 feet of vertical clearance is maintained between the top of the USACE levees and the HST viaduct soffit at the crossing.
- Based on the preliminary design, at least 15 feet of horizontal clearance is maintained between the viaduct foundation and the toe of the levees.
- Access and adequate clearance for O&M vehicles is available from both sides of the river and both east and west directions to provide for inspection, operations, and maintenance of the river channel and areas under the viaduct.

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# **Section 5.0**

## **References**



## 5.0 References

URS/HMM/Arup Joint Venture. 2013. Draft 15% Design Submission Fresno to Bakersfield: Hydrology, Hydraulics, and Drainage Report. October 2013.

URS/HMM/Arup Joint Venture. 2013. Draft 15% Design Submission Fresno to Bakersfield: Floodplain Impacts Report. October 2013.

URS/HMM/Arup Joint Venture. 2013. Draft 15% Design Submission Fresno to Bakersfield: Stormwater Quality Management Report. October 2013.

United States Army Corps of Engineers (USACE). 1975. Kings River Channel Improvement Project, Letter Supplement No. 1 to Design Memo No. 3, February 1975.

Federal Emergency Management Agency (FEMA), Flood Insurance Study for Tulare County, California and Incorporated Areas, June 16, 2009.

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**Appendix A**  
**15% Design Level Drawings**  
**of the HST Crossing**



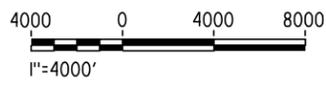
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**LEGEND**

---+---+---+ EXISTING FREIGHT RAILROAD

———— PROPOSED CHST



REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY  
M. FISHER

DRAWN BY  
E. SUDHAUSEN

CHECKED BY  
A. ARMSTRONG

IN CHARGE  
R. COFFIN

DATE  
10/11/13

**DRAFT 15%  
DESIGN SUBMISSION**

**NOT FOR  
CONSTRUCTION**



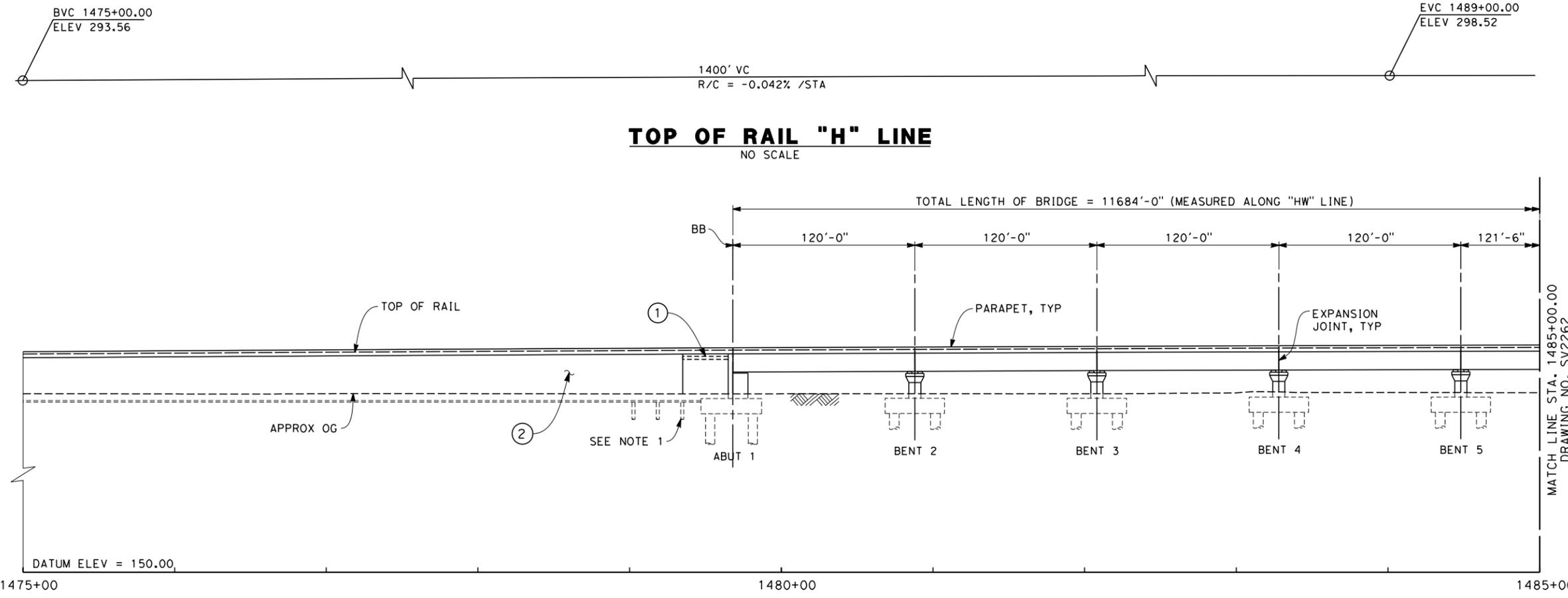
**CALIFORNIA HIGH-SPEED TRAIN PROJECT**  
**FRESNO TO BAKERSFIELD**  
 HANFORD SUBSECTION  
 ALIGNMENT H  
 KINGS RIVER VIADUCT  
 KEY MAP

CONTRACT NO.  
HSR 06-0003

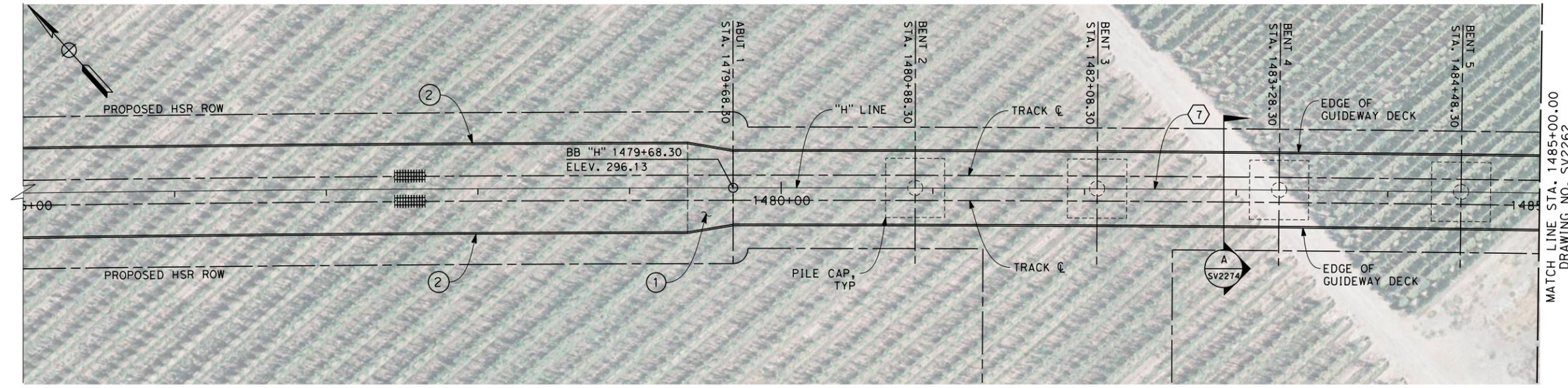
DRAWING NO.  
SV2260

SCALE  
AS SHOWN

SHEET NO.  
1 OF 16



**ELEVATION**  
SCALE 1" = 40'



**PLAN**  
SCALE 1" = 40'

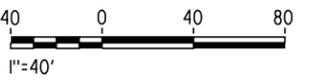
- NOTES**
- NOT ALL PILES SHOWN
  - PILE LENGTH TO BE DETERMINED
  - SUPERSTRUCTURE CONSTRUCTION, UON
    - SIMPLE SPANS - MSS OR FLPM
    - CONTINUOUS SPANS - BCC - PRECAST IN-SITU
    - STEEL TRUSS - INSITU, SLID OR LAUNCHED
    - ELEVATED SLABS - PC BEAM AND INSITU SLAB
  - PIER PROTECTION
    - NO PROTECTION REQUIRED
    - Y >= 25' MAIN ROUTES
    - Y >= 15' SPURS
    - PROTECTION REQUIRED
    - 25' > Y > 9' MAIN ROUTES
    - 15' > Y > 9' SPURS
  - UTILITY LOCATIONS TO BE DETERMINED
  - ACCESS STAIRWAYS ARE PROVIDED AT SYSTEMS SITES (APPROX. 2.5 MILE INTERVALS). LADDER ACCESS TO VIADUCTS IS PROVIDED AT 2500 FT INTERVALS WITH ACCESS ROAD AND TURNING CIRCLE WHERE NECESSARY.

- LEGEND:**
- ① STRUCTURE APPROACH SLAB
  - ② RETAINING WALL
  - \* ESTIMATED 100-YEAR FLOOD ELEVATION, SEE "FRESNO TO BAKERSFIELD CORRIDOR HYDROLOGY, HYDRAULICS AND DRAINAGE 15% DRAFT REPORT".

**CURVE DATA**

⑦

R = 36500.00'  
 $\Delta = 58^\circ 05' 38.8"$   
 T = 20271.5'  
 L = 37008.6'



10/9/2013 10:58:10 PM c:\pwworking\hmm\external\frank.palermo@arup.com\d0128411\FB-SV-2261-H.dgn

REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY  
M. FISHER

DRAWN BY  
D. ORIZA

CHECKED BY  
A. ARMSTRONG

IN CHARGE  
R. COFFIN

DATE  
10/11/13

**DRAFT 15%  
DESIGN SUBMISSION**

**NOT FOR  
CONSTRUCTION**



**CALIFORNIA HIGH-SPEED TRAIN PROJECT**  
**FRESNO TO BAKERSFIELD**  
 HANFORD SUBSECTION  
 ALIGNMENT H  
 KINGS RIVER VIADUCT  
 PLAN AND PROFILE

CONTRACT NO.  
HSR 06-0003

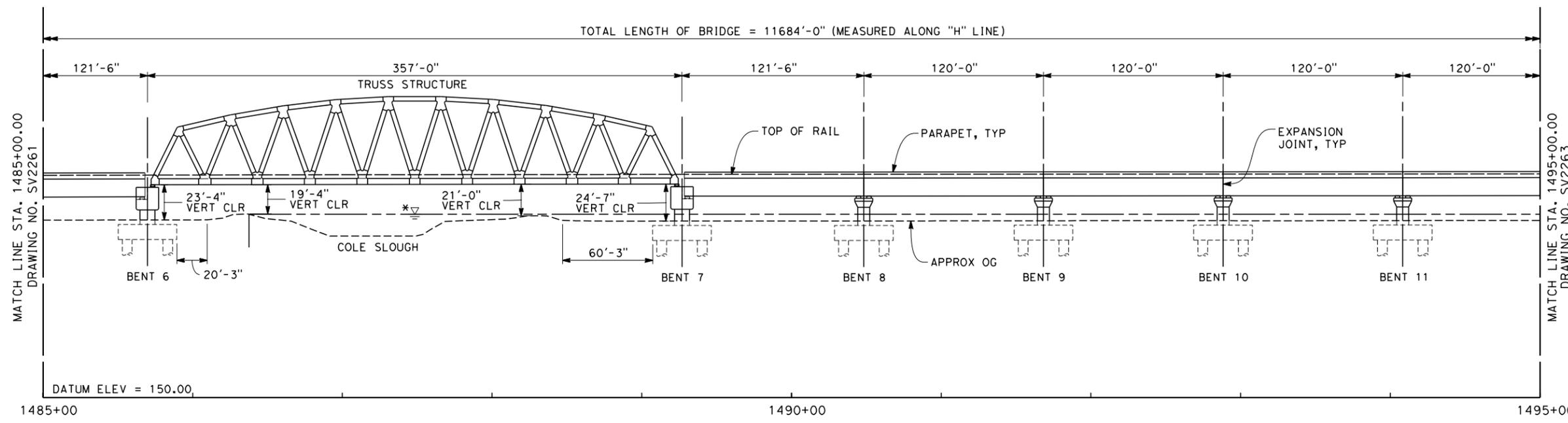
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SV2261

SCALE  
AS SHOWN

SHEET NO.  
2 OF 16



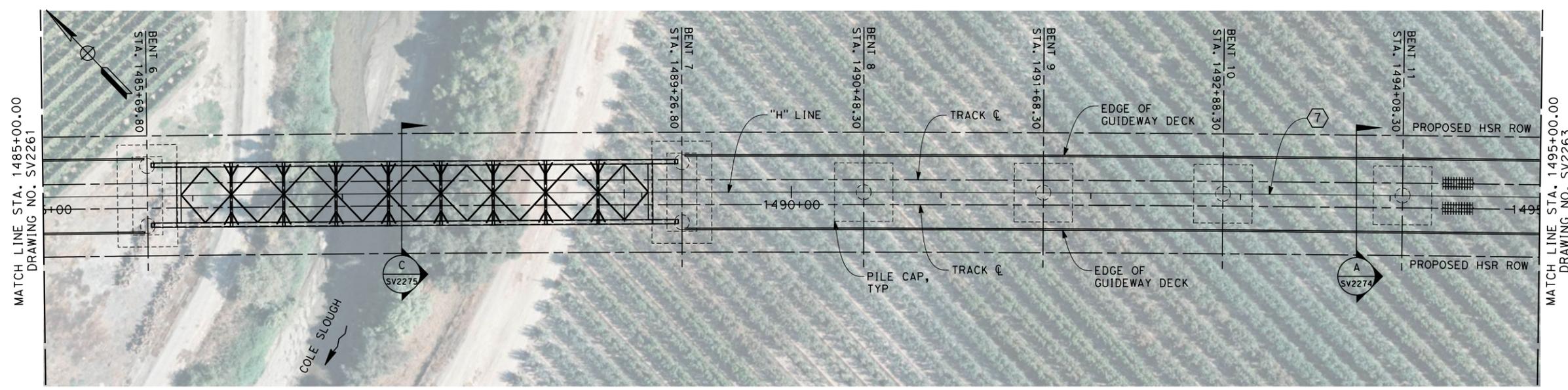
**TOP OF RAIL "H" LINE**  
NO SCALE



**ELEVATION**  
SCALE 1" = 40'

- NOTES**
- NOT ALL PILES SHOWN
  - PILE LENGTH TO BE DETERMINED
  - SUPERSTRUCTURE CONSTRUCTION, UON
    - SIMPLE SPANS - MSS OR FLPM
    - CONTINUOUS SPANS - BCC - PRECAST IN-SITU
    - STEEL TRUSS - INSITU, SLID OR LAUNCHED
    - ELEVATED SLABS - PC BEAM AND INSITU SLAB
  - PIER PROTECTION
    - NO PROTECTION REQUIRED
    - Y >= 25' MAIN ROUTES
    - Y >= 15' SPURS
    - PROTECTION REQUIRED
    - 25' > Y > 9' MAIN ROUTES
    - 15' > Y > 9' SPURS
  - UTILITY LOCATIONS TO BE DETERMINED
  - ACCESS STAIRWAYS ARE PROVIDED AT SYSTEMS SITES (APPROX. 2.5 MILE INTERVALS). LADDER ACCESS TO VIADUCTS IS PROVIDED AT 2500 FT INTERVALS WITH ACCESS ROAD AND TURNING CIRCLE WHERE NECESSARY.

- LEGEND:**
- ① STRUCTURE APPROACH SLAB
  - ② RETAINING WALL
  - \* ESTIMATED 100-YEAR FLOOD ELEVATION, SEE "FRESNO TO BAKERSFIELD CORRIDOR HYDROLOGY, HYDRAULICS AND DRAINAGE 15% DRAFT REPORT".
- CURVE DATA**
- ⑦
- R = 36500.00'  
 Δ = 58° 05' 38.8"  
 T = 20271.5'  
 L = 37008.6'



**PLAN**  
SCALE 1" = 40'



10/9/2013 10:58:47 PM c:\pwworking\hmm\external\frank.palermo\arup.com\d0128411\FB-SV-2262-H.dgn

REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY  
**M. FISHER**

DRAWN BY  
**D. ORIZA**

CHECKED BY  
**A. ARMSTRONG**

IN CHARGE  
**R. COFFIN**

DATE  
**10/11/13**

**DRAFT 15%  
DESIGN SUBMISSION**

**NOT FOR  
CONSTRUCTION**



**CALIFORNIA HIGH-SPEED TRAIN PROJECT**  
**FRESNO TO BAKERSFIELD**  
 HANFORD SUBSECTION  
 ALIGNMENT H  
 KINGS RIVER VIADUCT  
 PLAN AND PROFILE

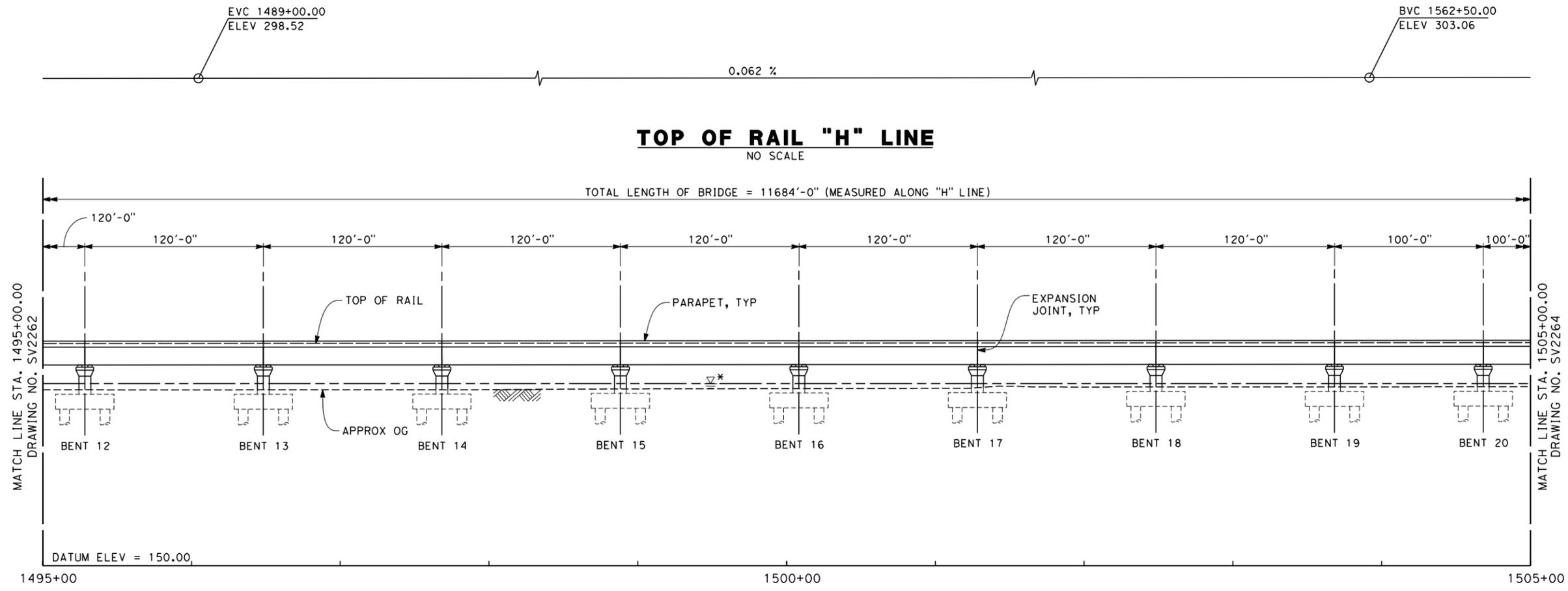
CONTRACT NO.  
HSR 06-0003

DRAWING NO.  
SV2262

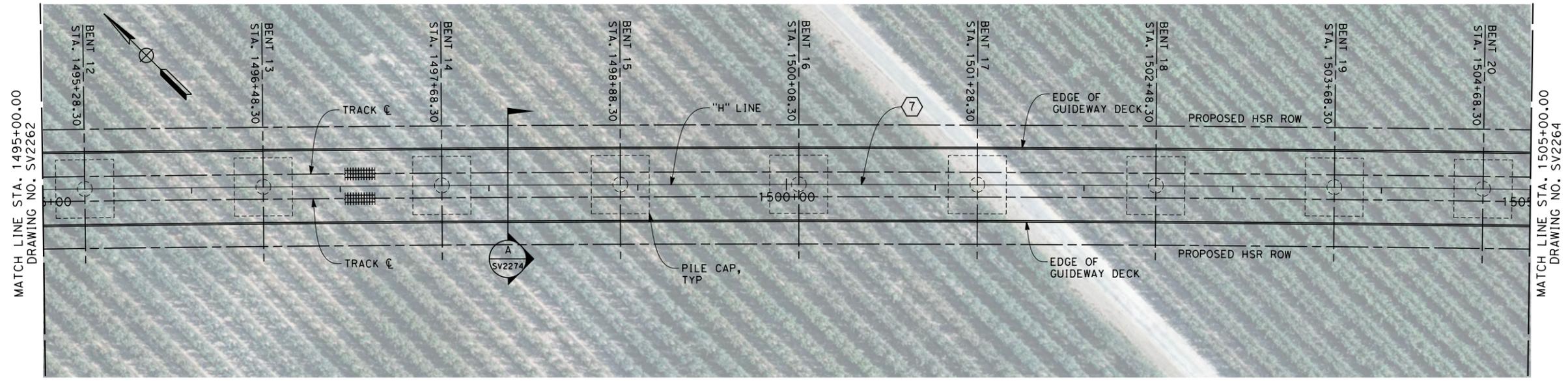
SCALE  
AS SHOWN

SHEET NO.  
3 OF 16

10/9/2013 10:59:13 PM c:\pwworking\hmm\external\frank.palermo@arup.com\d0128411\FB-SV-2263-H.dgn



**ELEVATION**  
SCALE 1" = 40'



**PLAN**  
SCALE 1" = 40'

- NOTES**
- NOT ALL PILES SHOWN
  - PILE LENGTH TO BE DETERMINED
  - SUPERSTRUCTURE CONSTRUCTION, UON
    - SIMPLE SPANS - MSS OR FLPM
    - CONTINUOUS SPANS - BCC - PRECAST IN-SITU
    - STEEL TRUSS - INSITU, SLID OR LAUNCHED
    - ELEVATED SLABS - PC BEAM AND INSITU SLAB
  - PIER PROTECTION
    - NO PROTECTION REQUIRED
    - Y >= 25' MAIN ROUTES
    - Y >= 15' SPURS
    - PROTECTION REQUIRED
    - 25' > Y > 9' MAIN ROUTES
    - 15' > Y > 9' SPURS
  - UTILITY LOCATIONS TO BE DETERMINED
  - ACCESS STAIRWAYS ARE PROVIDED AT SYSTEMS SITES (APPROX. 2.5 MILE INTERVALS). LADDER ACCESS TO VIADUCTS IS PROVIDED AT 2500 FT INTERVALS WITH ACCESS ROAD AND TURNING CIRCLE WHERE NECESSARY.

- LEGEND:**
- ① STRUCTURE APPROACH SLAB
  - ② RETAINING WALL
  - \* ESTIMATED 100-YEAR FLOOD ELEVATION, SEE "FRESNO TO BAKERSFIELD CORRIDOR HYDROLOGY, HYDRAULICS AND DRAINAGE 15% DRAFT REPORT".
- CURVE DATA**
- ⑦
- R = 36500.00'  
 Δ = 58° 05' 38.8"  
 T = 20271.5'  
 L = 37008.6'



REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY  
M. FISHER

DRAWN BY  
D. ORIZA

CHECKED BY  
A. ARMSTRONG

IN CHARGE  
R. COFFIN

DATE  
10/11/13

**DRAFT 15%  
DESIGN SUBMISSION**

**NOT FOR  
CONSTRUCTION**



**CALIFORNIA HIGH-SPEED TRAIN PROJECT**  
**FRESNO TO BAKERSFIELD**  
 HANFORD SUBSECTION  
 ALIGNMENT H  
 KINGS RIVER VIADUCT  
 PLAN AND PROFILE

CONTRACT NO.  
HSR 06-0003

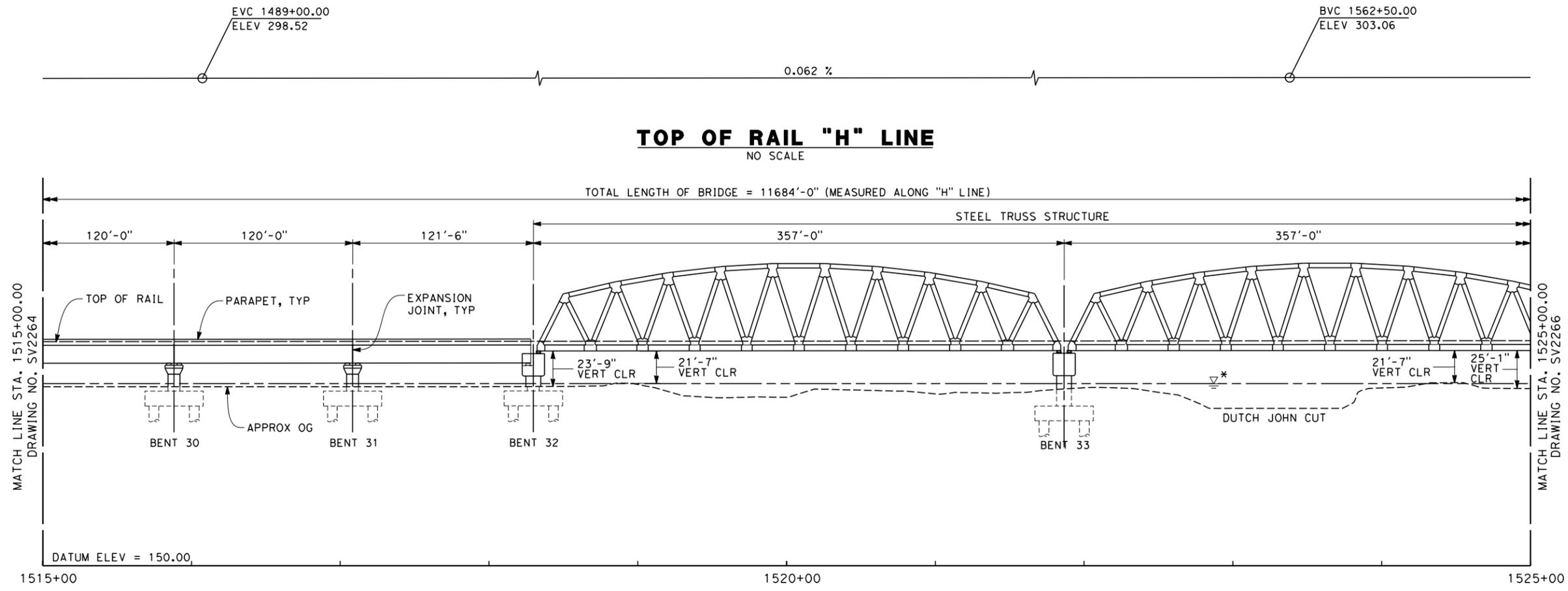
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SV2263

SCALE  
AS SHOWN

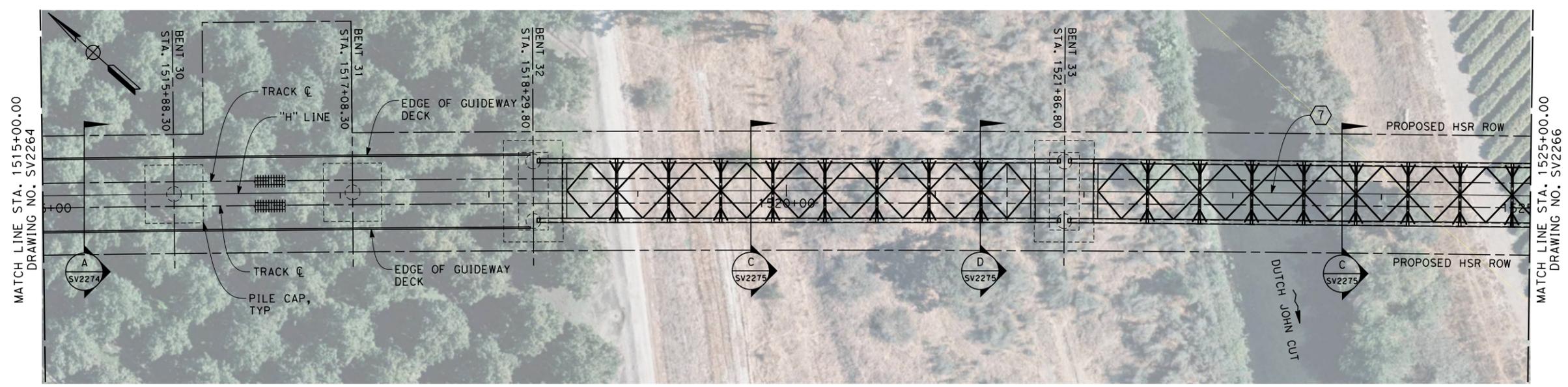
SHEET NO.  
4 OF 16



10/9/2013 10:59:54 PM c:\pwworking\hmm\external\frank.palermo\arup.com\d0128411\FB-SV-2265-H.dgn



**ELEVATION**  
SCALE 1" = 40'



**PLAN**  
SCALE 1" = 40'

- NOTES**
- NOT ALL PILES SHOWN
  - PILE LENGTH TO BE DETERMINED
  - SUPERSTRUCTURE CONSTRUCTION, UON
    - SIMPLE SPANS - MSS OR FLPM
    - CONTINUOUS SPANS - BCC - PRECAST IN-SITU
    - STEEL TRUSS - INSITU, SLID OR LAUNCHED
    - ELEVATED SLABS - PC BEAM AND INSITU SLAB
  - PIER PROTECTION
    - NO PROTECTION REQUIRED
    - Y >= 25' MAIN ROUTES
    - Y >= 15' SPURS
    - PROTECTION REQUIRED
    - 25' > Y > 9' MAIN ROUTES
    - 15' > Y > 9' SPURS
  - UTILITY LOCATIONS TO BE DETERMINED
  - ACCESS STAIRWAYS ARE PROVIDED AT SYSTEMS SITES (APPROX. 2.5 MILE INTERVALS). LADDER ACCESS TO VIADUCTS IS PROVIDED AT 2500 FT INTERVALS WITH ACCESS ROAD AND TURNING CIRCLE WHERE NECESSARY.

- LEGEND:**
- ① STRUCTURE APPROACH SLAB
  - ② RETAINING WALL
  - \* ESTIMATED 100-YEAR FLOOD ELEVATION, SEE "FRESNO TO BAKERSFIELD CORRIDOR HYDROLOGY, HYDRAULICS AND DRAINAGE 15% DRAFT REPORT".
- CURVE DATA**
- ⑦
- R = 36500.00'  
 Δ = 58° 05' 38.8"  
 T = 20271.5'  
 L = 37008.6'



REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY  
M. FISHER

DRAWN BY  
D. ORIZA

CHECKED BY  
A. ARMSTRONG

IN CHARGE  
R. COFFIN

DATE  
10/11/13

**DRAFT 15%  
DESIGN SUBMISSION**

**NOT FOR  
CONSTRUCTION**



**CALIFORNIA HIGH-SPEED TRAIN PROJECT  
FRESNO TO BAKERSFIELD**

HANFORD SUBSECTION  
ALIGNMENT H  
KINGS RIVER VIADUCT  
PLAN AND PROFILE

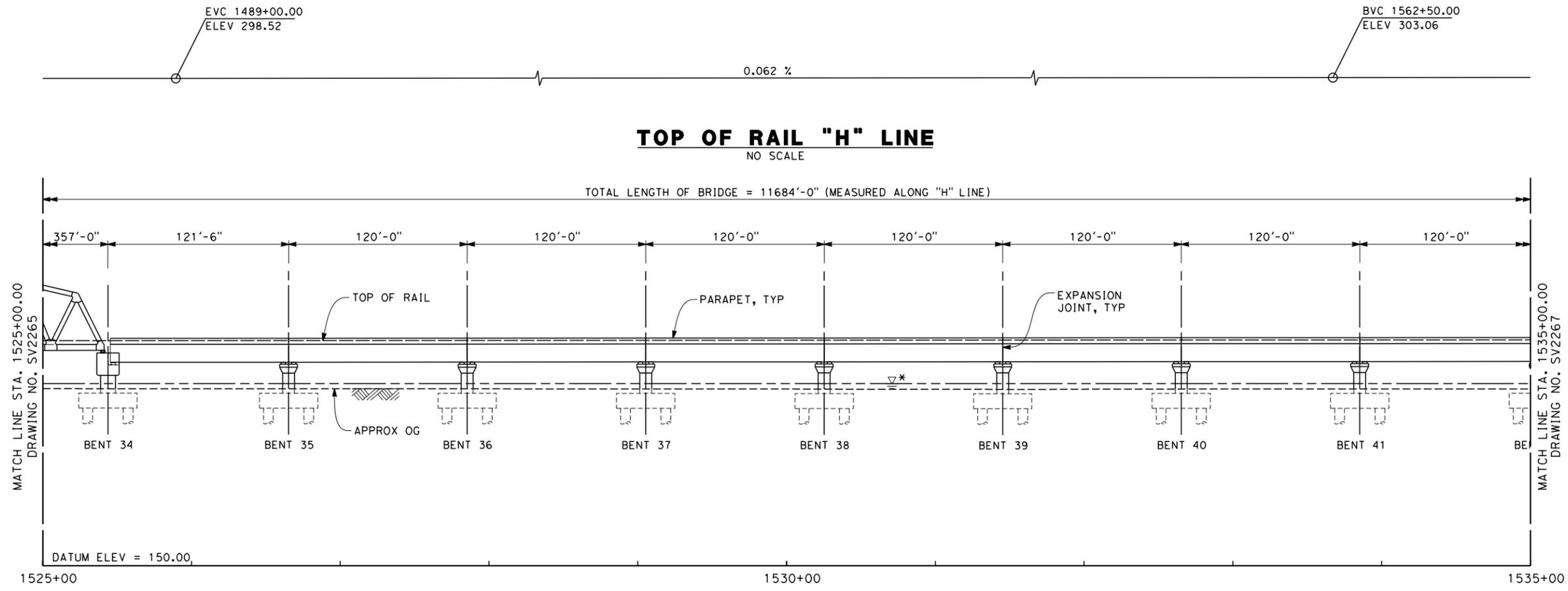
CONTRACT NO.  
HSR 06-0003

DRAWING NO.  
SV2265

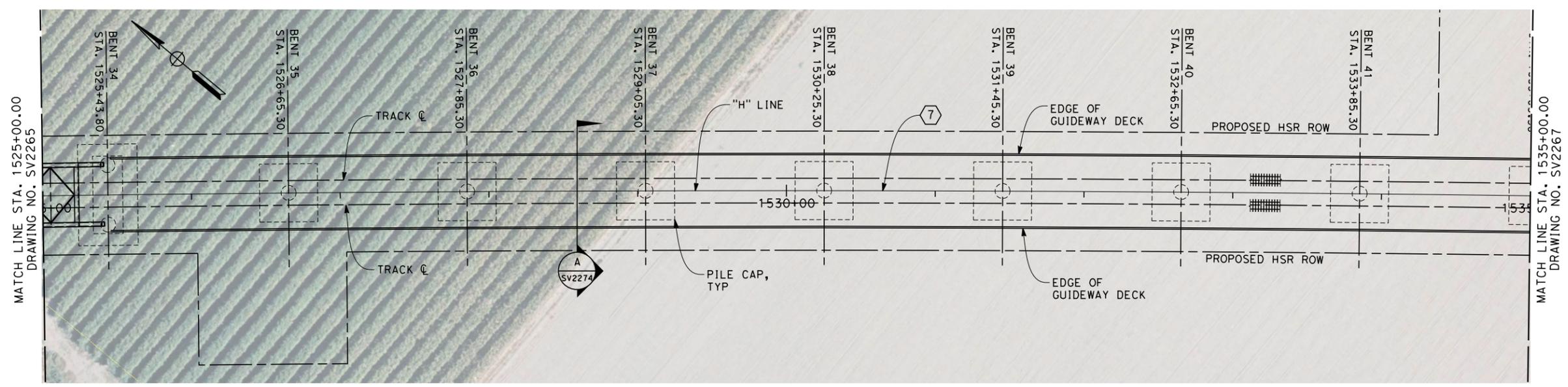
SCALE  
AS SHOWN

SHEET NO.  
6 OF 16

10/9/2013 11:00:09 PM c:\pwworking\hmm\external\frank.palermo@arup.com\d0128411\FB-SV-2266-H.dgn



**ELEVATION**  
SCALE 1" = 40'



**PLAN**  
SCALE 1" = 40'

- NOTES**
- NOT ALL PILES SHOWN
  - PILE LENGTH TO BE DETERMINED
  - SUPERSTRUCTURE CONSTRUCTION, UON
    - SIMPLE SPANS - MSS OR FLPM
    - CONTINUOUS SPANS - BCC - PRECAST IN-SITU
    - STEEL TRUSS - INSITU, SLID OR LAUNCHED
    - ELEVATED SLABS - PC BEAM AND INSITU SLAB
  - PIER PROTECTION
    - NO PROTECTION REQUIRED
    - Y >= 25' MAIN ROUTES
    - Y >= 15' SPURS
    - PROTECTION REQUIRED
    - 25' > Y > 9' MAIN ROUTES
    - 15' > Y > 9' SPURS
  - UTILITY LOCATIONS TO BE DETERMINED
  - ACCESS STAIRWAYS ARE PROVIDED AT SYSTEMS SITES (APPROX. 2.5 MILE INTERVALS). LADDER ACCESS TO VIADUCTS IS PROVIDED AT 2500 FT INTERVALS WITH ACCESS ROAD AND TURNING CIRCLE WHERE NECESSARY.

- LEGEND:**
- ① STRUCTURE APPROACH SLAB
  - ② RETAINING WALL
  - \* ESTIMATED 100-YEAR FLOOD ELEVATION, SEE "FRESNO TO BAKERSFIELD CORRIDOR HYDROLOGY, HYDRAULICS AND DRAINAGE 15% DRAFT REPORT".

**CURVE DATA**

⑦

R = 36500.00'  
 Δ = 58° 05' 38.8"  
 T = 20271.5'  
 L = 37008.6'



REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY  
M. FISHER

DRAWN BY  
D. ORIZA

CHECKED BY  
A. ARMSTRONG

IN CHARGE  
R. COFFIN

DATE  
10/11/13

**DRAFT 15%  
DESIGN SUBMISSION**

**NOT FOR  
CONSTRUCTION**



**CALIFORNIA HIGH-SPEED TRAIN PROJECT**  
**FRESNO TO BAKERSFIELD**  
 HANFORD SUBSECTION  
 ALIGNMENT H  
 KINGS RIVER VIADUCT  
 PLAN AND PROFILE

CONTRACT NO.  
HSR 06-0003

DRAWING NO.  
SV2266

SCALE  
AS SHOWN

SHEET NO.  
7 OF 16

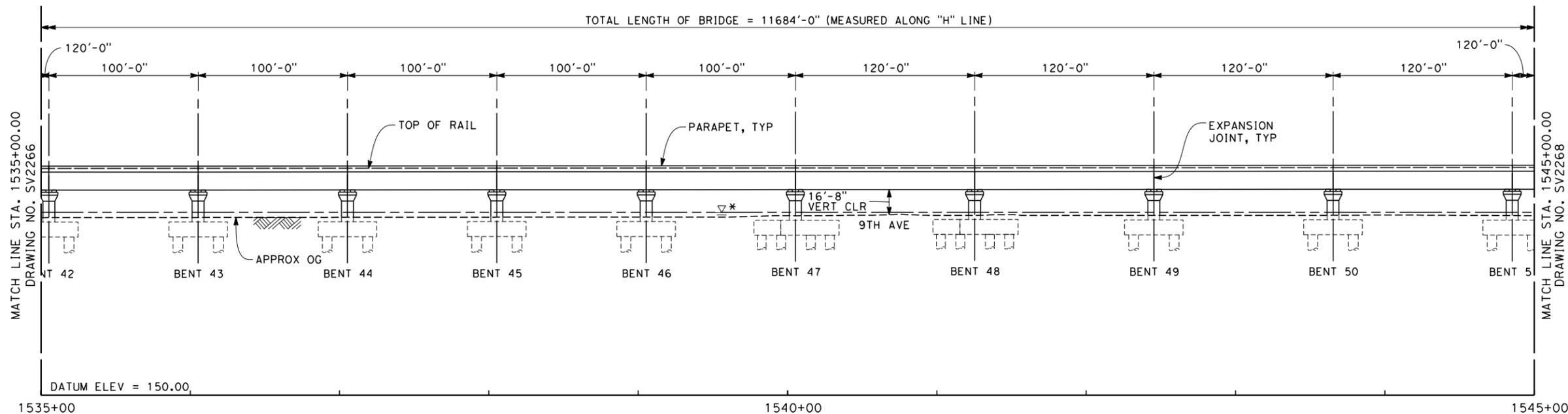
EVC 1489+00.00  
ELEV 298.52

BVC 1562+50.00  
ELEV 303.06

0.062 %

**TOP OF RAIL "H" LINE**  
NO SCALE

TOTAL LENGTH OF BRIDGE = 11684'-0" (MEASURED ALONG "H" LINE)



**ELEVATION**  
SCALE 1" = 40'

**NOTES**

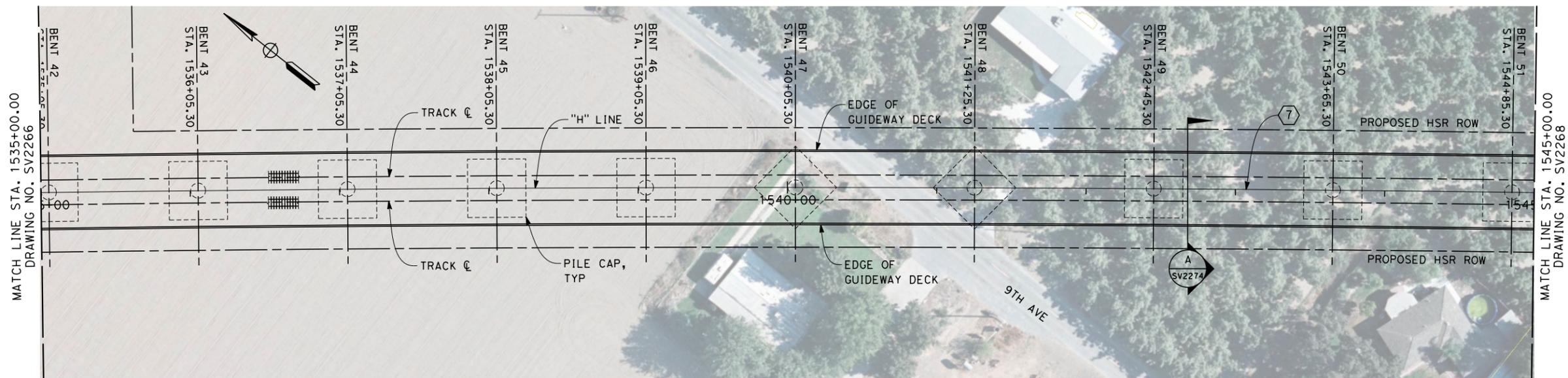
- NOT ALL PILES SHOWN
- PILE LENGTH TO BE DETERMINED
- SUPERSTRUCTURE CONSTRUCTION, UON  
SIMPLE SPANS - MSS OR FLPM  
CONTINUOUS SPANS - BCC - PRECAST IN-SITU  
STEEL TRUSS - INSITU, SLID OR LAUNCHED  
ELEVATED SLABS - PC BEAM AND INSITU SLAB
- PIER PROTECTION  
NO PROTECTION REQUIRED  
Y >= 25' MAIN ROUTES  
Y >= 15' SPURS  
PROTECTION REQUIRED  
25' > Y > 9' MAIN ROUTES  
15' > Y > 9' SPURS
- UTILITY LOCATIONS TO BE DETERMINED
- ACCESS STAIRWAYS ARE PROVIDED AT SYSTEMS SITES (APPROX. 2.5 MILE INTERVALS). LADDER ACCESS TO VIADUCTS IS PROVIDED AT 2500 FT INTERVALS WITH ACCESS ROAD AND TURNING CIRCLE WHERE NECESSARY.

**LEGEND:**

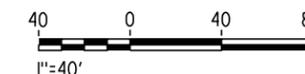
- ① STRUCTURE APPROACH SLAB
- ② RETAINING WALL
- \* ESTIMATED 100-YEAR FLOOD ELEVATION, SEE "FRESNO TO BAKERSFIELD CORRIDOR HYDROLOGY, HYDRAULICS AND DRAINAGE 15% DRAFT REPORT".

**CURVE DATA**

⑦  
R = 36500.00'  
Δ = 58° 05' 38.8"  
T = 20271.5'  
L = 37008.6'



**PLAN**  
SCALE 1" = 40'



10/9/2013 11:00:25 PM c:\pwworking\hmm\external\frank.palermo\arup.com\d0128411\FB-SV-2267-H.dgn

REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY  
M. FISHER  
DRAWN BY  
F. PALERMO  
CHECKED BY  
A. ARMSTRONG  
IN CHARGE  
R. COFFIN  
DATE  
10/11/13

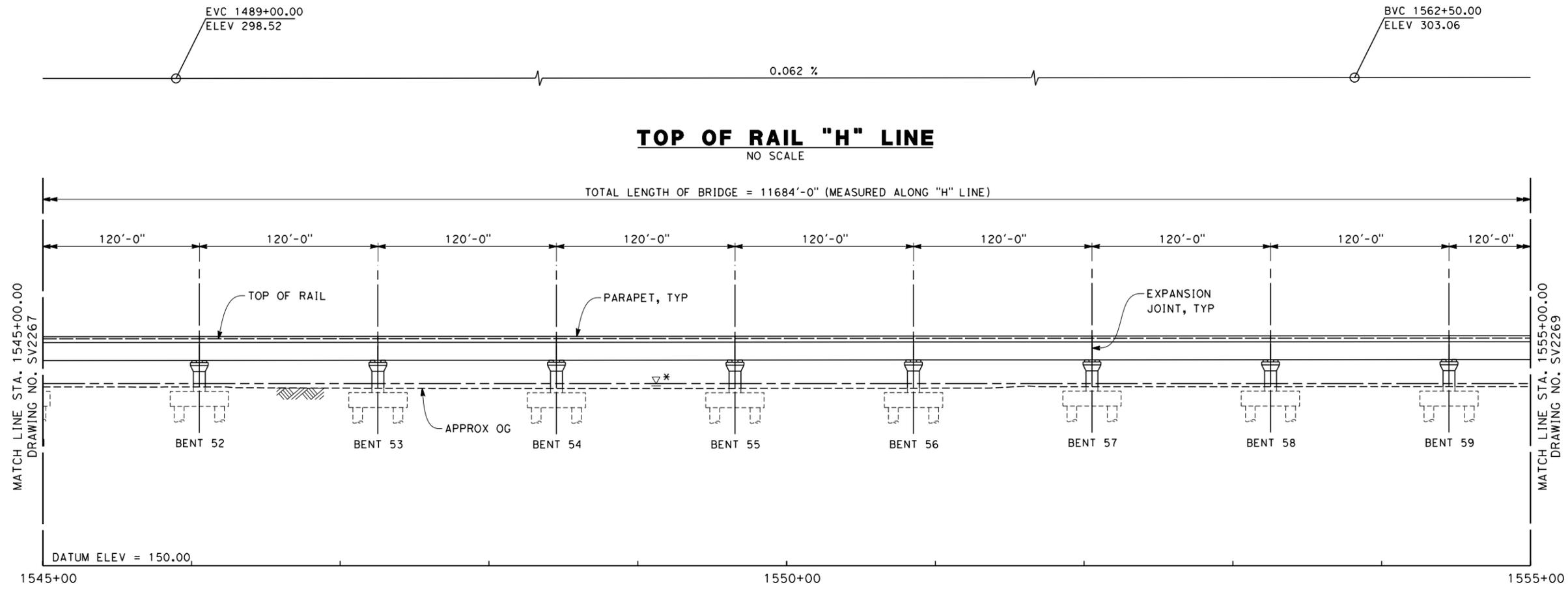
**DRAFT 15%  
DESIGN SUBMISSION**  
  
**NOT FOR  
CONSTRUCTION**



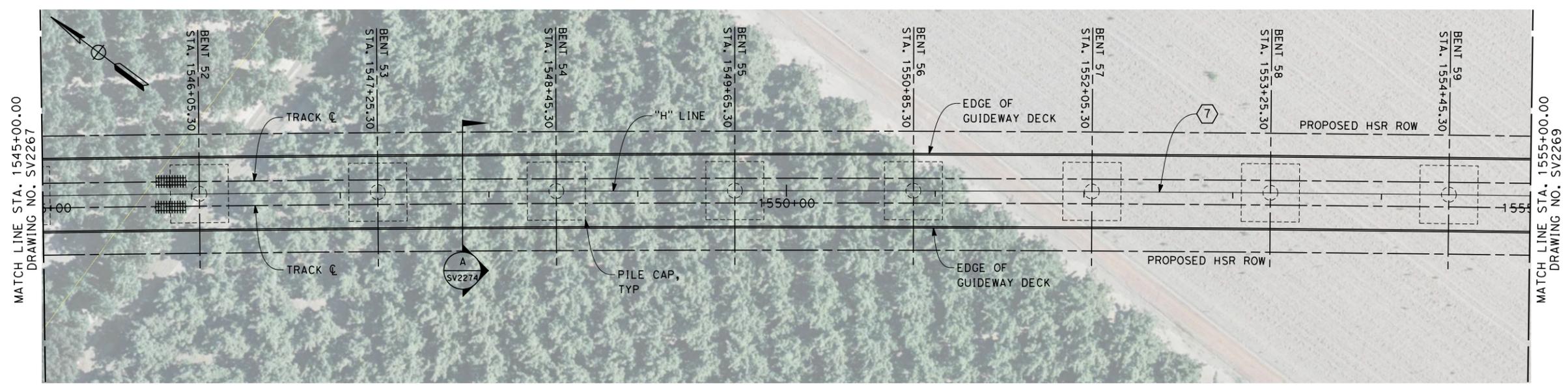
**CALIFORNIA HIGH-SPEED TRAIN PROJECT  
FRESNO TO BAKERSFIELD**  
HANFORD SUBSECTION  
ALIGNMENT H  
KINGS RIVER VIADUCT  
PLAN AND PROFILE

CONTRACT NO.  
HSR 06-0003  
DRAWING NO.  
SV2267  
SCALE  
AS SHOWN  
SHEET NO.  
8 OF 16

10/9/2013 11:00:41 PM c:\pwworking\hmm\external\frank.palermo@arup.com\d0128411\FB-SV-2268-H.dgn



**ELEVATION**  
SCALE 1" = 40'



**PLAN**  
SCALE 1" = 40'

- NOTES**
- NOT ALL PILES SHOWN
  - PILE LENGTH TO BE DETERMINED
  - SUPERSTRUCTURE CONSTRUCTION, UON
    - SIMPLE SPANS - MSS OR FLPM
    - CONTINUOUS SPANS - BCC - PRECAST IN-SITU
    - STEEL TRUSS - INSITU, SLID OR LAUNCHED
    - ELEVATED SLABS - PC BEAM AND INSITU SLAB
  - PIER PROTECTION
    - NO PROTECTION REQUIRED
    - Y >= 25' MAIN ROUTES
    - Y >= 15' SPURS
    - PROTECTION REQUIRED
    - 25' > Y > 9' MAIN ROUTES
    - 15' > Y > 9' SPURS
  - UTILITY LOCATIONS TO BE DETERMINED
  - ACCESS STAIRWAYS ARE PROVIDED AT SYSTEMS SITES (APPROX. 2.5 MILE INTERVALS). LADDER ACCESS TO VIADUCTS IS PROVIDED AT 2500 FT INTERVALS WITH ACCESS ROAD AND TURNING CIRCLE WHERE NECESSARY.

- LEGEND:**
- ① STRUCTURE APPROACH SLAB
  - ② RETAINING WALL
  - \* ESTIMATED 100-YEAR FLOOD ELEVATION, SEE "FRESNO TO BAKERSFIELD CORRIDOR HYDROLOGY, HYDRAULICS AND DRAINAGE 15% DRAFT REPORT".
- CURVE DATA**
- ⑦
- R = 36500.00'  
 Δ = 58° 05' 38.8"  
 T = 20271.5'  
 L = 37008.6'



REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY  
M. FISHER

DRAWN BY  
F. PALERMO

CHECKED BY  
A. ARMSTRONG

IN CHARGE  
R. COFFIN

DATE  
10/11/13

**DRAFT 15%  
DESIGN SUBMISSION**

**NOT FOR  
CONSTRUCTION**



**CALIFORNIA HIGH-SPEED TRAIN PROJECT**  
**FRESNO TO BAKERSFIELD**  
 HANFORD SUBSECTION  
 ALIGNMENT H  
 KINGS RIVER VIADUCT  
 PLAN AND PROFILE

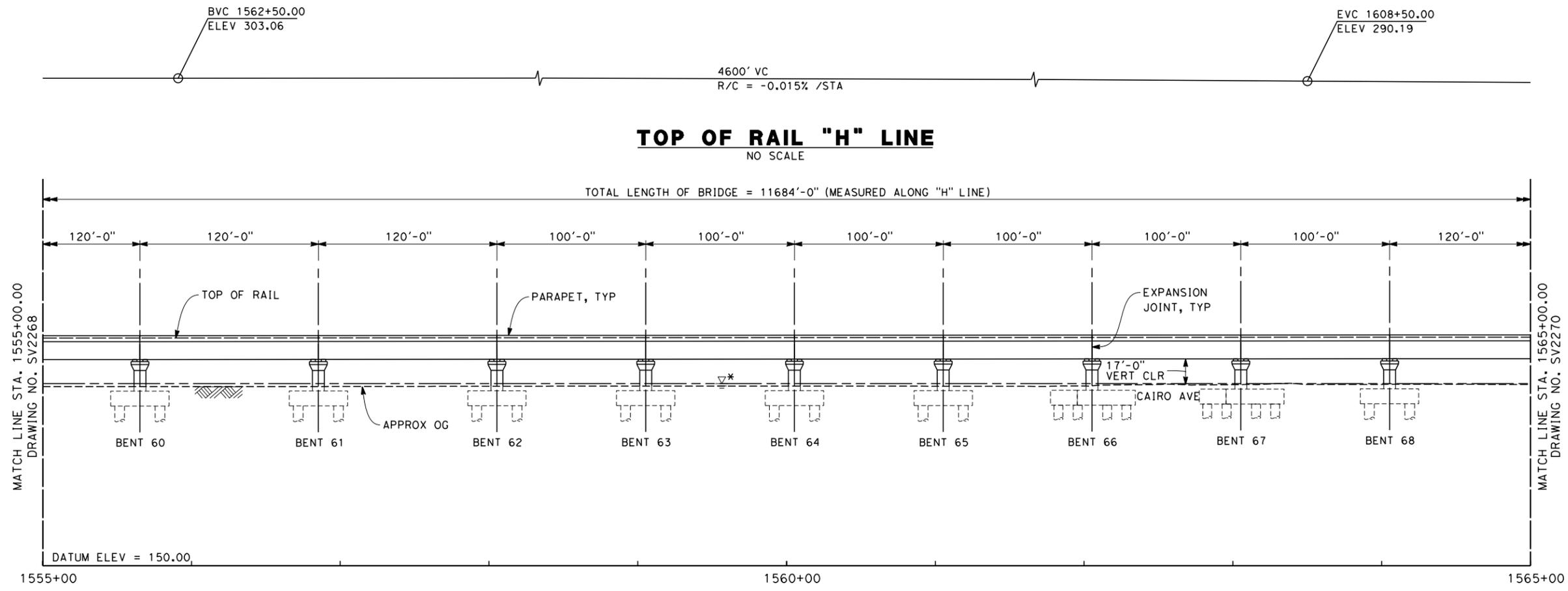
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HSR 06-0003

DRAWING NO.  
SV2268

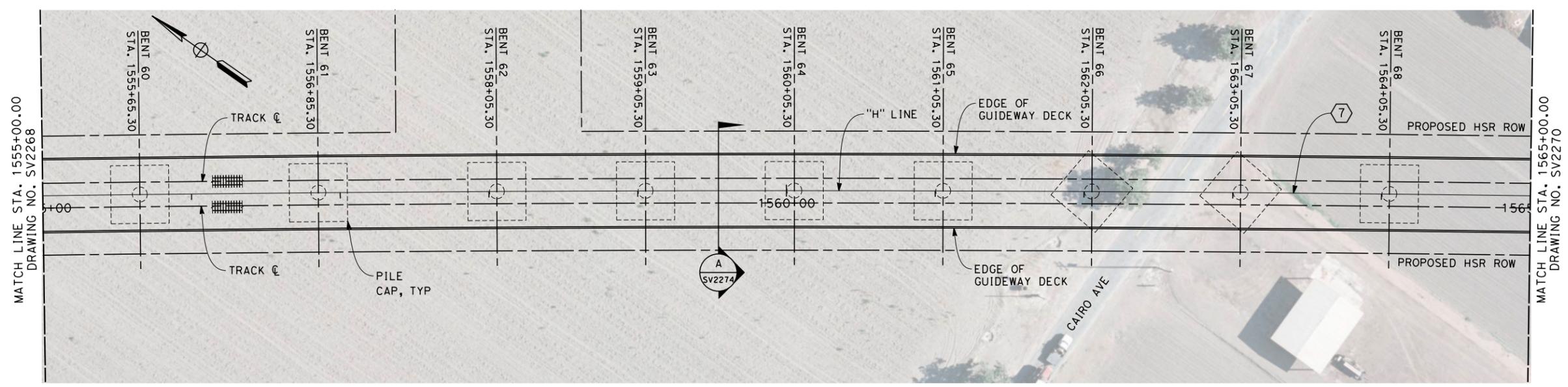
SCALE  
AS SHOWN

SHEET NO.  
9 OF 16

10/9/2013 11:00:56 PM c:\pwworking\hmm\external\frank.palermo@arup.com\d0128411\FB-SV-2269-H.dgn



**ELEVATION**  
SCALE 1" = 40'



**PLAN**  
SCALE 1" = 40'

- NOTES**
- NOT ALL PILES SHOWN
  - PILE LENGTH TO BE DETERMINED
  - SUPERSTRUCTURE CONSTRUCTION, UON
    - SIMPLE SPANS - MSS OR FLPM
    - CONTINUOUS SPANS - BCC - PRECAST IN-SITU
    - STEEL TRUSS - INSITU, SLID OR LAUNCHED
    - ELEVATED SLABS - PC BEAM AND INSITU SLAB
  - PIER PROTECTION
    - NO PROTECTION REQUIRED
    - Y >= 25' MAIN ROUTES
    - Y >= 15' SPURS
    - PROTECTION REQUIRED
    - 25' > Y > 9' MAIN ROUTES
    - 15' > Y > 9' SPURS
  - UTILITY LOCATIONS TO BE DETERMINED
  - ACCESS STAIRWAYS ARE PROVIDED AT SYSTEMS SITES (APPROX. 2.5 MILE INTERVALS). LADDER ACCESS TO VIADUCTS IS PROVIDED AT 2500 FT INTERVALS WITH ACCESS ROAD AND TURNING CIRCLE WHERE NECESSARY.

- LEGEND:**
- ① STRUCTURE APPROACH SLAB
  - ② RETAINING WALL
  - \* ESTIMATED 100-YEAR FLOOD ELEVATION, SEE "FRESNO TO BAKERSFIELD CORRIDOR HYDROLOGY, HYDRAULICS AND DRAINAGE 15% DRAFT REPORT".
- CURVE DATA**
- ⑦
- R = 36500.00'  
 Δ = 58° 05' 38.8"  
 T = 20271.5'  
 L = 37008.6'



REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY  
M. FISHER

DRAWN BY  
F. PALERMO

CHECKED BY  
A. ARMSTRONG

IN CHARGE  
R. COFFIN

DATE  
10/11/13

**DRAFT 15%  
DESIGN SUBMISSION**

**NOT FOR  
CONSTRUCTION**



**CALIFORNIA HIGH-SPEED TRAIN PROJECT**  
**FRESNO TO BAKERSFIELD**  
 HANFORD SUBSECTION  
 ALIGNMENT H  
 KINGS RIVER VIADUCT  
 PLAN AND PROFILE

CONTRACT NO.  
HSR 06-0003

DRAWING NO.  
SV2269

SCALE  
AS SHOWN

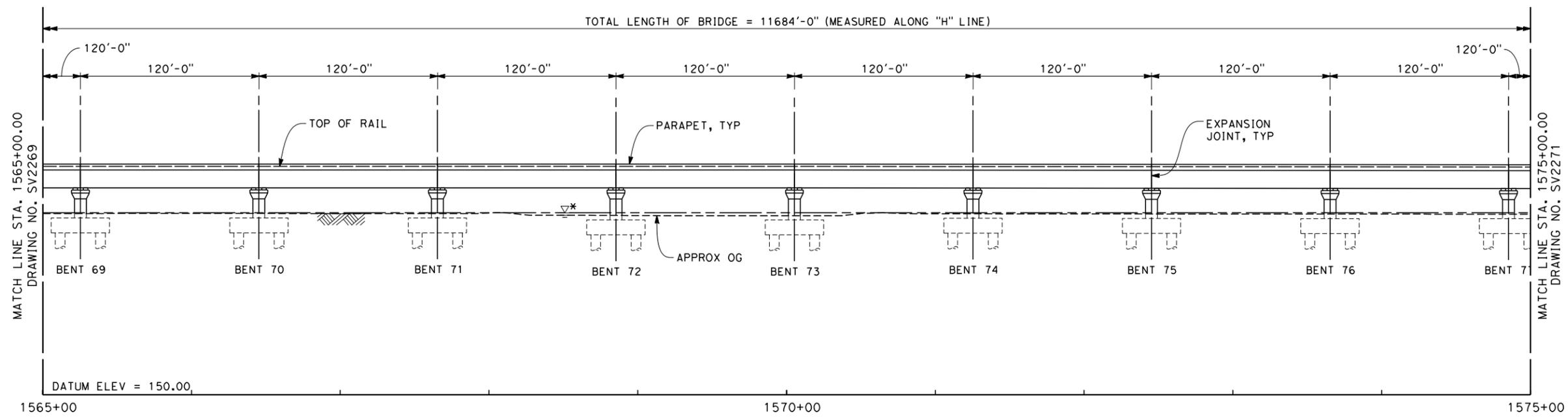
SHEET NO.  
10 OF 16

BVC 1562+50.00  
ELEV 303.06

EVC 1608+50.00  
ELEV 290.19

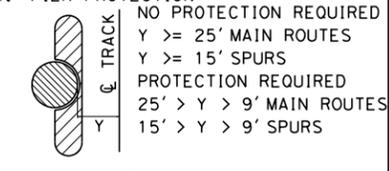
4600' VC  
R/C = -0.015% /STA

**TOP OF RAIL "H" LINE**  
NO SCALE



**ELEVATION**  
SCALE 1" = 40'

- NOTES**
- NOT ALL PILES SHOWN
  - PILE LENGTH TO BE DETERMINED
  - SUPERSTRUCTURE CONSTRUCTION, UON
    - SIMPLE SPANS - MSS OR FLPM
    - CONTINUOUS SPANS - BCC - PRECAST IN-SITU
    - STEEL TRUSS - INSITU, SLID OR LAUNCHED
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  - UTILITY LOCATIONS TO BE DETERMINED
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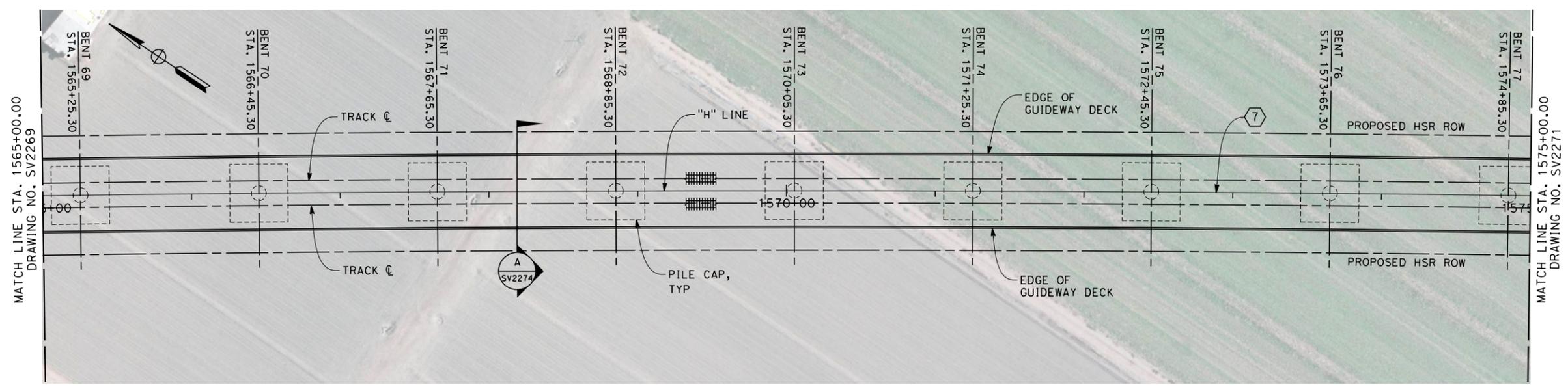


- LEGEND:**
- ① STRUCTURE APPROACH SLAB
  - ② RETAINING WALL
  - \* ESTIMATED 100-YEAR FLOOD ELEVATION, SEE "FRESNO TO BAKERSFIELD CORRIDOR HYDROLOGY, HYDRAULICS AND DRAINAGE 15% DRAFT REPORT".

**CURVE DATA**

⑦

R = 36500.00'  
Δ = 58° 05' 38.8"  
T = 20271.5'  
L = 37008.6'



**PLAN**  
SCALE 1" = 40'



10/9/2013 11:01:11 PM c:\pwworking\hmm\external\frank.palermo@arup.com\d0128411\FB-SV-2270-H.dgn

REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY  
**M. FISHER**

DRAWN BY  
**D. ORIZA**

CHECKED BY  
**A. ARMSTRONG**

IN CHARGE  
**R. COFFIN**

DATE  
**10/11/13**

**DRAFT 15%  
DESIGN SUBMISSION**

**NOT FOR  
CONSTRUCTION**



**CALIFORNIA HIGH-SPEED TRAIN PROJECT**  
**FRESNO TO BAKERSFIELD**  
HANFORD SUBSECTION  
ALIGNMENT H  
KINGS RIVER VIADUCT  
PLAN AND PROFILE

CONTRACT NO.  
HSR 06-0003

DRAWING NO.  
SV2270

SCALE  
AS SHOWN

SHEET NO.  
11 OF 16

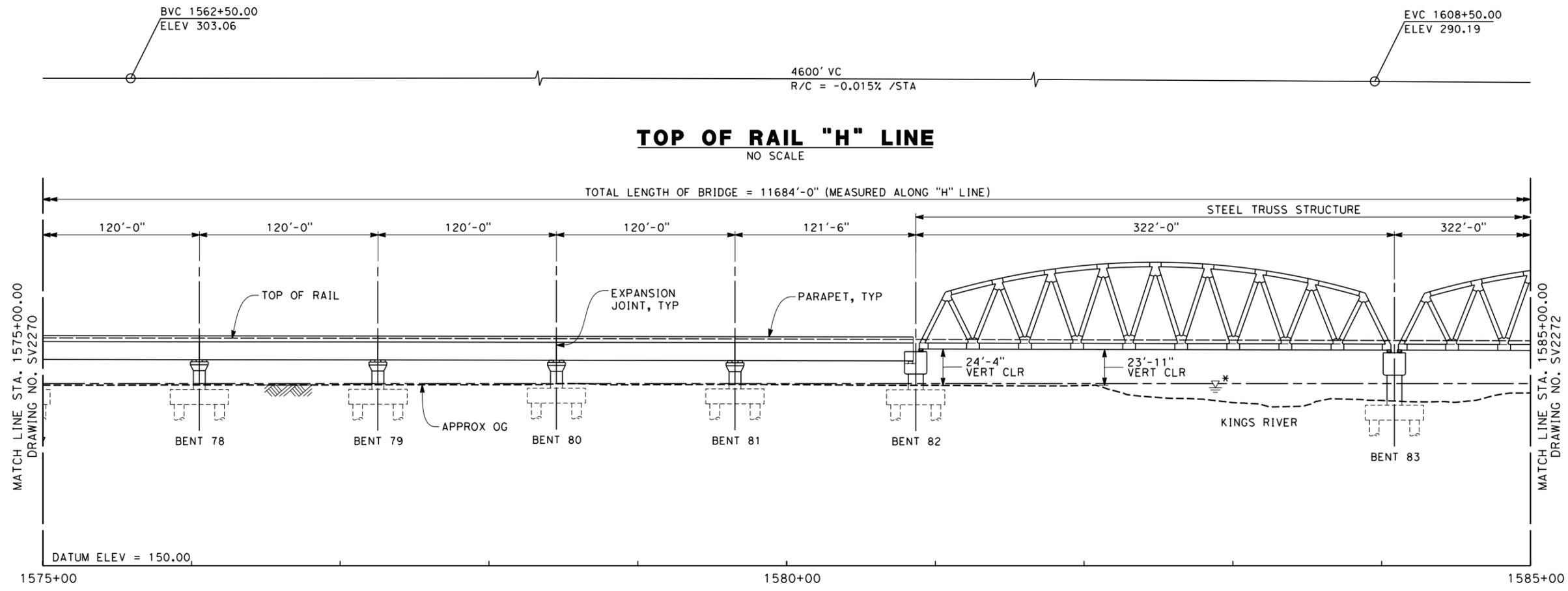
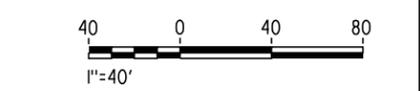
- NOTES**
- NOT ALL PILES SHOWN
  - PILE LENGTH TO BE DETERMINED
  - SUPERSTRUCTURE CONSTRUCTION, UON
    - SIMPLE SPANS - MSS OR FLPM
    - CONTINUOUS SPANS - BCC - PRECAST IN-SITU
    - STEEL TRUSS - INSITU, SLID OR LAUNCHED
    - ELEVATED SLABS - PC BEAM AND INSITU SLAB
  - PIER PROTECTION
    - NO PROTECTION REQUIRED
      - Y >= 25' MAIN ROUTES
      - Y >= 15' SPURS
    - PROTECTION REQUIRED
      - 25' > Y > 9' MAIN ROUTES
      - 15' > Y > 9' SPURS
  - UTILITY LOCATIONS TO BE DETERMINED
  - ACCESS STAIRWAYS ARE PROVIDED AT SYSTEMS SITES (APPROX. 2.5 MILE INTERVALS). LADDER ACCESS TO VIADUCTS IS PROVIDED AT 2500 FT INTERVALS WITH ACCESS ROAD AND TURNING CIRCLE WHERE NECESSARY.

- LEGEND:**
- ① STRUCTURE APPROACH SLAB
  - ② RETAINING WALL
  - \* ESTIMATED 100-YEAR FLOOD ELEVATION, SEE "FRESNO TO BAKERSFIELD CORRIDOR HYDROLOGY, HYDRAULICS AND DRAINAGE 15% DRAFT REPORT".

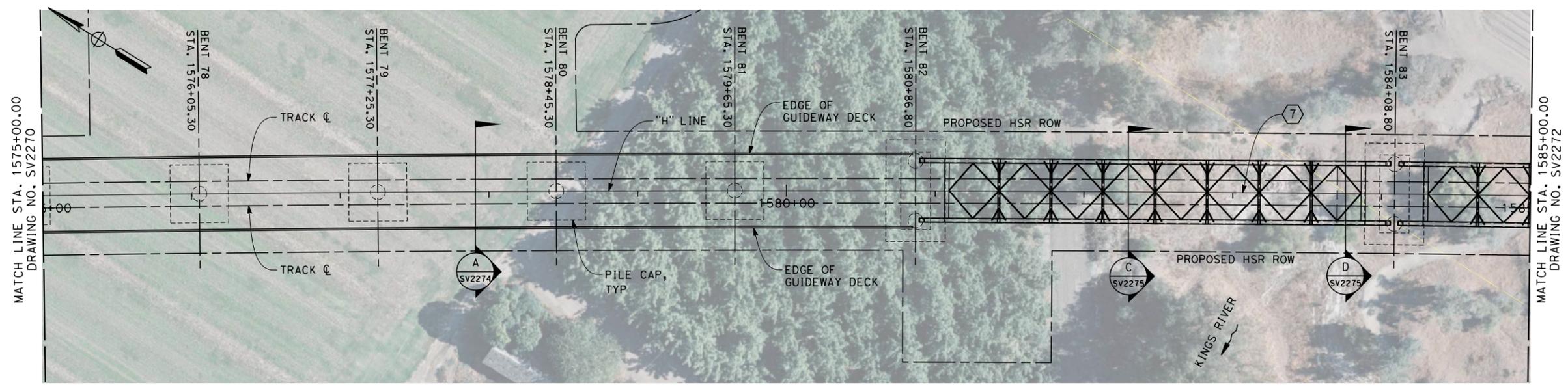
**CURVE DATA**

⑦

R = 36500.00'  
 $\Delta = 58^{\circ} 05' 38.8''$   
 T = 20271.5'  
 L = 37008.6'



**ELEVATION**  
SCALE 1" = 40'



**PLAN**  
SCALE 1" = 40'

10/9/2013 11:40:35 PM c:\pwworking\hmm\external\frank.palermo@arup.com\d0128411\FB-SV-2271-H.dgn

REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY  
M. FISHER

DRAWN BY  
F. PALERMO

CHECKED BY  
A. ARMSTRONG

IN CHARGE  
R. COFFIN

DATE  
10/11/13

**DRAFT 15%  
DESIGN SUBMISSION**

**NOT FOR  
CONSTRUCTION**



**CALIFORNIA HIGH-SPEED TRAIN PROJECT  
FRESNO TO BAKERSFIELD**

HANFORD SUBSECTION  
ALIGNMENT H  
KINGS RIVER VIADUCT  
PLAN AND PROFILE

CONTRACT NO.  
HSR 06-0003

DRAWING NO.  
SV2271

SCALE  
AS SHOWN

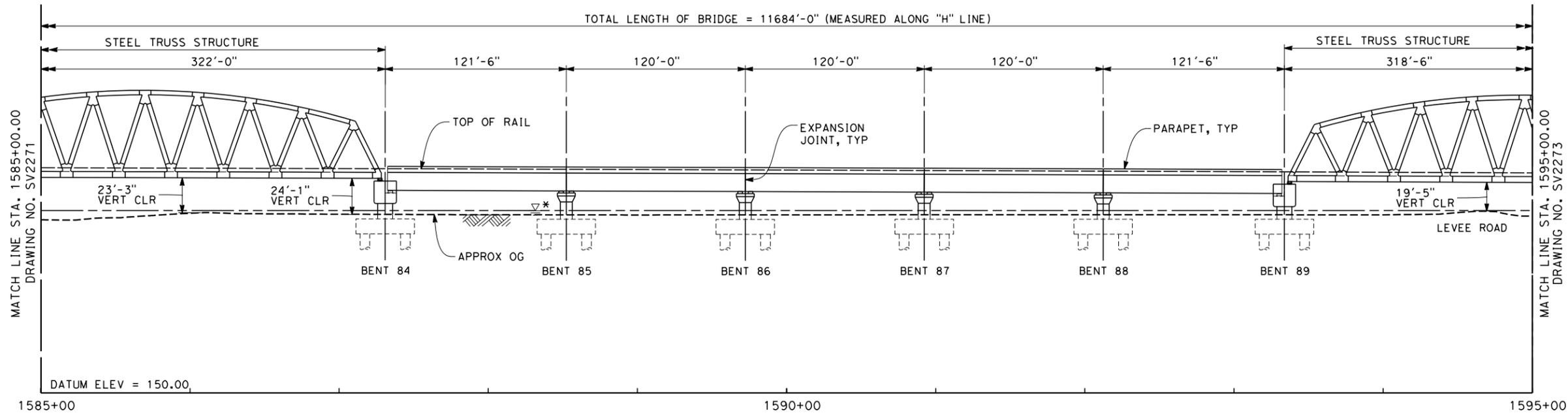
SHEET NO.  
12 OF 16

BVC 1562+50.00  
ELEV 303.06

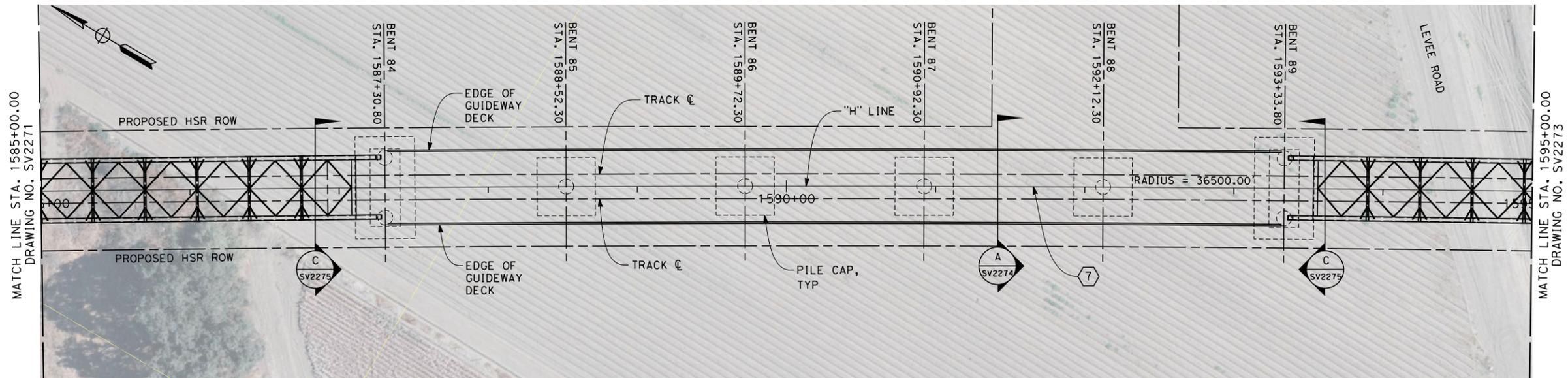
EVC 1608+50.00  
ELEV 290.19

4600' VC  
R/C = -0.015% /STA

**TOP OF RAIL "H" LINE**  
NO SCALE



**ELEVATION**  
SCALE 1" = 40'



**PLAN**  
SCALE 1" = 40'

**NOTES**

- NOT ALL PILES SHOWN
- PILE LENGTH TO BE DETERMINED
- SUPERSTRUCTURE CONSTRUCTION, UON
  - SIMPLE SPANS - MSS OR FLPM
  - CONTINUOUS SPANS - BCC - PRECAST IN-SITU
  - STEEL TRUSS - INSITU, SLID OR LAUNCHED
  - ELEVATED SLABS - PC BEAM AND INSITU SLAB
- PIER PROTECTION
  - NO PROTECTION REQUIRED
  - Y >= 25' MAIN ROUTES
  - Y >= 15' SPURS
  - PROTECTION REQUIRED
  - 25' > Y > 9' MAIN ROUTES
  - 15' > Y > 9' SPURS
- UTILITY LOCATIONS TO BE DETERMINED
- ACCESS STAIRWAYS ARE PROVIDED AT SYSTEMS SITES (APPROX. 2.5 MILE INTERVALS). LADDER ACCESS TO VIADUCTS IS PROVIDED AT 2500 FT INTERVALS WITH ACCESS ROAD AND TURNING CIRCLE WHERE NECESSARY.

**LEGEND:**

- ① STRUCTURE APPROACH SLAB
- ② RETAINING WALL
- \* ESTIMATED 100-YEAR FLOOD ELEVATION, SEE "FRESNO TO BAKERSFIELD CORRIDOR HYDROLOGY, HYDRAULICS AND DRAINAGE 15% DRAFT REPORT".

**CURVE DATA**

⑦  
R = 36500.00'  
Δ = 58° 05' 38.8"  
T = 20271.5'  
L = 37008.6'



10/9/2013 11:40:48 PM c:\pwworking\hmm\external\frank.palermo@arup.com\d0128411\FB-SV-2272-H.dgn

REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY  
M. FISHER  
DRAWN BY  
F. PALERMO  
CHECKED BY  
A. ARMSTRONG  
IN CHARGE  
R. COFFIN  
DATE  
10/11/13

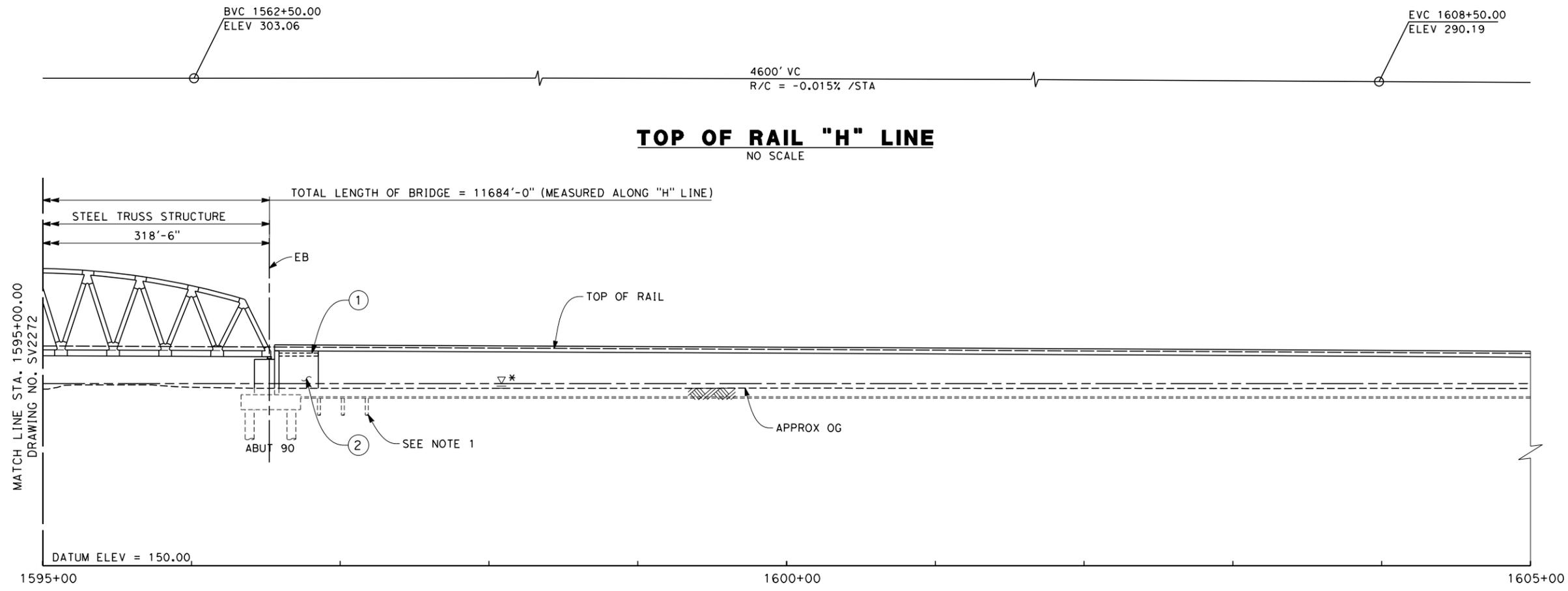
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DESIGN SUBMISSION**  
  
**NOT FOR  
CONSTRUCTION**



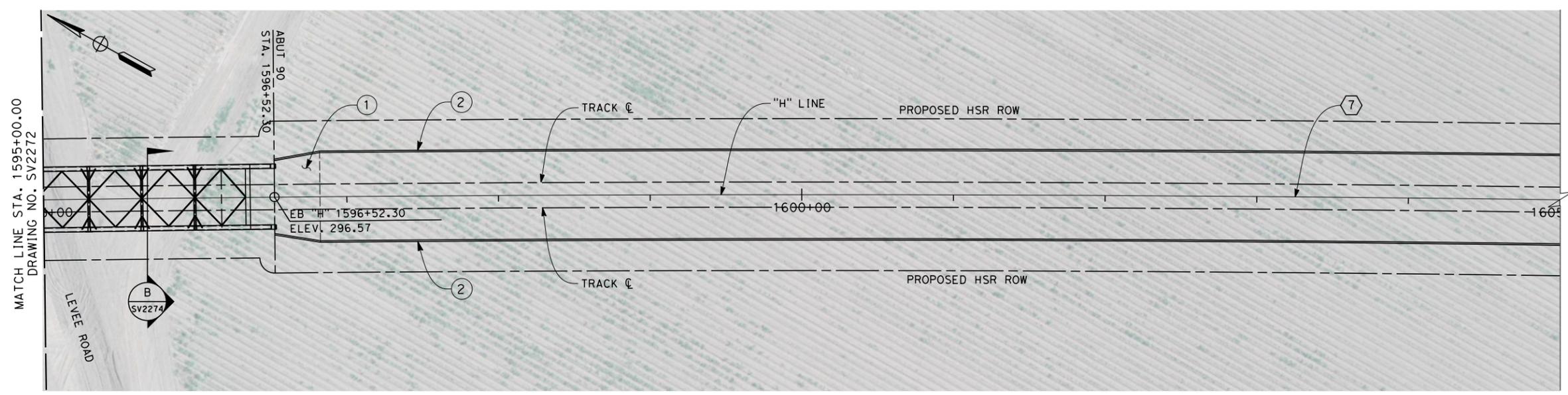
**CALIFORNIA HIGH-SPEED TRAIN PROJECT  
FRESNO TO BAKERSFIELD**  
HANFORD SUBSECTION  
ALIGNMENT H  
KINGS RIVER VIADUCT  
PLAN AND PROFILE

CONTRACT NO.  
HSR 06-0003  
DRAWING NO.  
SV2272  
SCALE  
AS SHOWN  
SHEET NO.  
13 OF 16

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**ELEVATION**  
SCALE 1" = 40'



**PLAN**  
SCALE 1" = 40'

- NOTES**
- NOT ALL PILES SHOWN
  - PILE LENGTH TO BE DETERMINED
  - SUPERSTRUCTURE CONSTRUCTION, UON
    - SIMPLE SPANS - MSS OR FLPM
    - CONTINUOUS SPANS - BCC - PRECAST IN-SITU
    - STEEL TRUSS - INSITU, SLID OR LAUNCHED
    - ELEVATED SLABS - PC BEAM AND INSITU SLAB
  - PIER PROTECTION
    - NO PROTECTION REQUIRED
    - Y >= 25' MAIN ROUTES
    - Y >= 15' SPURS
    - PROTECTION REQUIRED
    - 25' > Y > 9' MAIN ROUTES
    - 15' > Y > 9' SPURS
  - UTILITY LOCATIONS TO BE DETERMINED
  - ACCESS STAIRWAYS ARE PROVIDED AT SYSTEMS SITES (APPROX. 2.5 MILE INTERVALS). LADDER ACCESS TO VIADUCTS IS PROVIDED AT 2500 FT INTERVALS WITH ACCESS ROAD AND TURNING CIRCLE WHERE NECESSARY.

- LEGEND:**
- ① STRUCTURE APPROACH SLAB
  - ② RETAINING WALL
  - \* ESTIMATED 100-YEAR FLOOD ELEVATION, SEE "FRESNO TO BAKERSFIELD CORRIDOR HYDROLOGY, HYDRAULICS AND DRAINAGE 15% DRAFT REPORT".
- CURVE DATA**
- ⑦
- R = 36500.00'  
 $\Delta = 58^{\circ} 05' 38.8''$   
 T = 20271.5'  
 L = 37008.6'



REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY  
M. FISHER

DRAWN BY  
F. PALERMO

CHECKED BY  
A. ARMSTRONG

IN CHARGE  
R. COFFIN

DATE  
10/11/13

**DRAFT 15%  
DESIGN SUBMISSION**

**NOT FOR  
CONSTRUCTION**



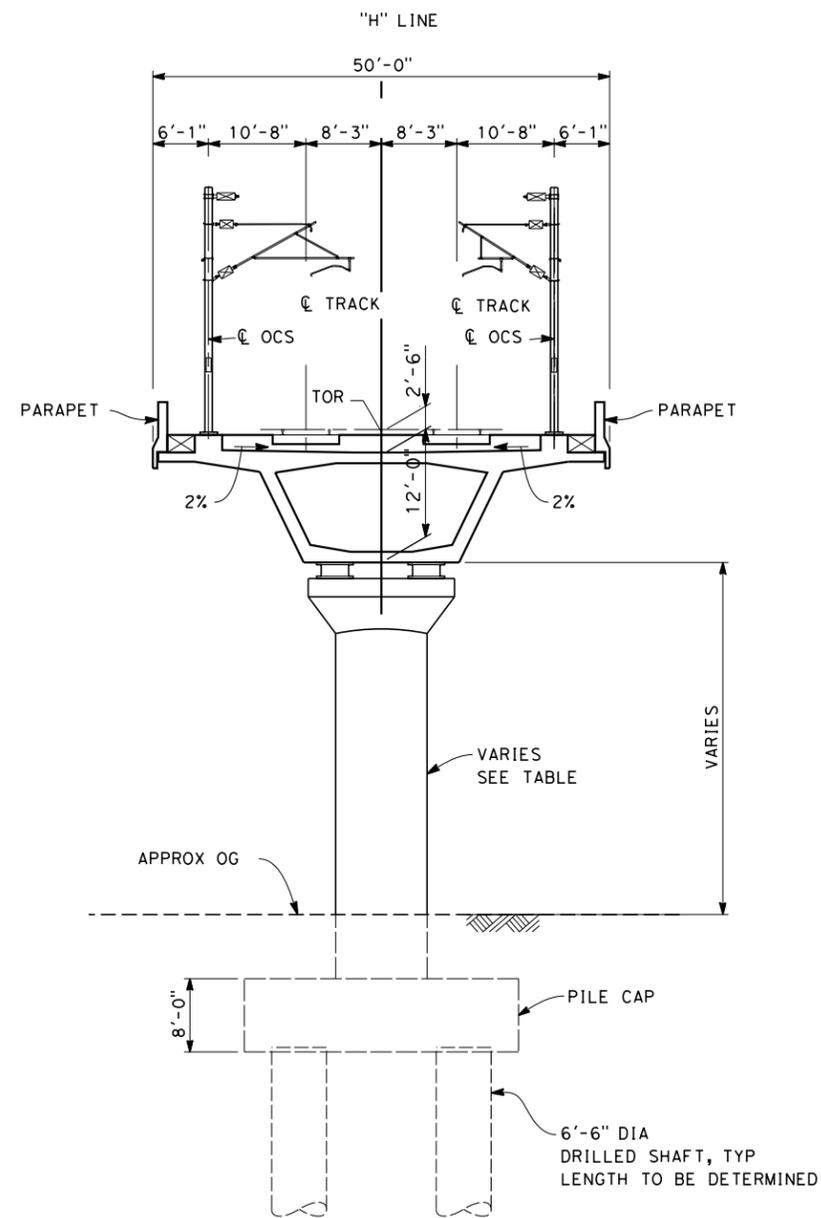
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**FRESNO TO BAKERSFIELD**  
 HANFORD SUBSECTION  
 ALIGNMENT H  
 KINGS RIVER VIADUCT  
 PLAN AND PROFILE

CONTRACT NO.  
HSR 06-0003

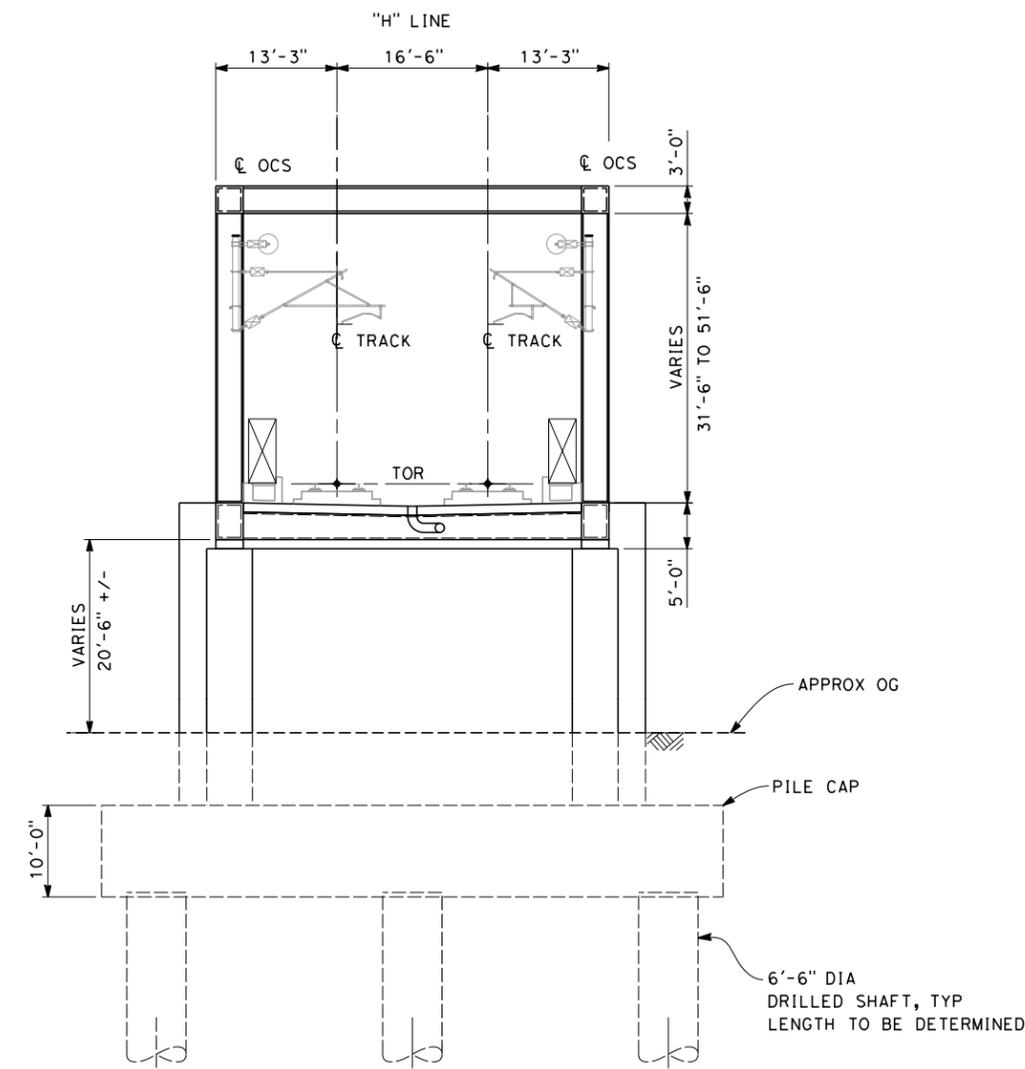
DRAWING NO.  
SV2273

SCALE  
AS SHOWN

SHEET NO.  
14 OF 16



COLUMN DIAMETERS	
COLUMN HEIGHT	DIAMETER
0-20	8 FT
20-40	10 FT
40-50	12 FT
50-60	15 FT
60-80	20 FT
80-100	25 FT



**SECTION A**

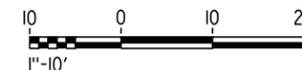
SCALE: 1" = 10'

STA 1479+68 THROUGH 1485+70  
 STA 1489+27 THROUGH 1518+30  
 STA 1525+44 THROUGH 1580+87  
 STA 1587+31 THROUGH 1593+34

**SECTION B**

SCALE: 1" = 10'

STA 1596+52 (ABUT 90)



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REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY Y. REN
DRAWN BY D. ORIZA
CHECKED BY A. ARMSTRONG
IN CHARGE R. COFFIN
DATE 10/11/13

**DRAFT 15%  
 DESIGN SUBMISSION**

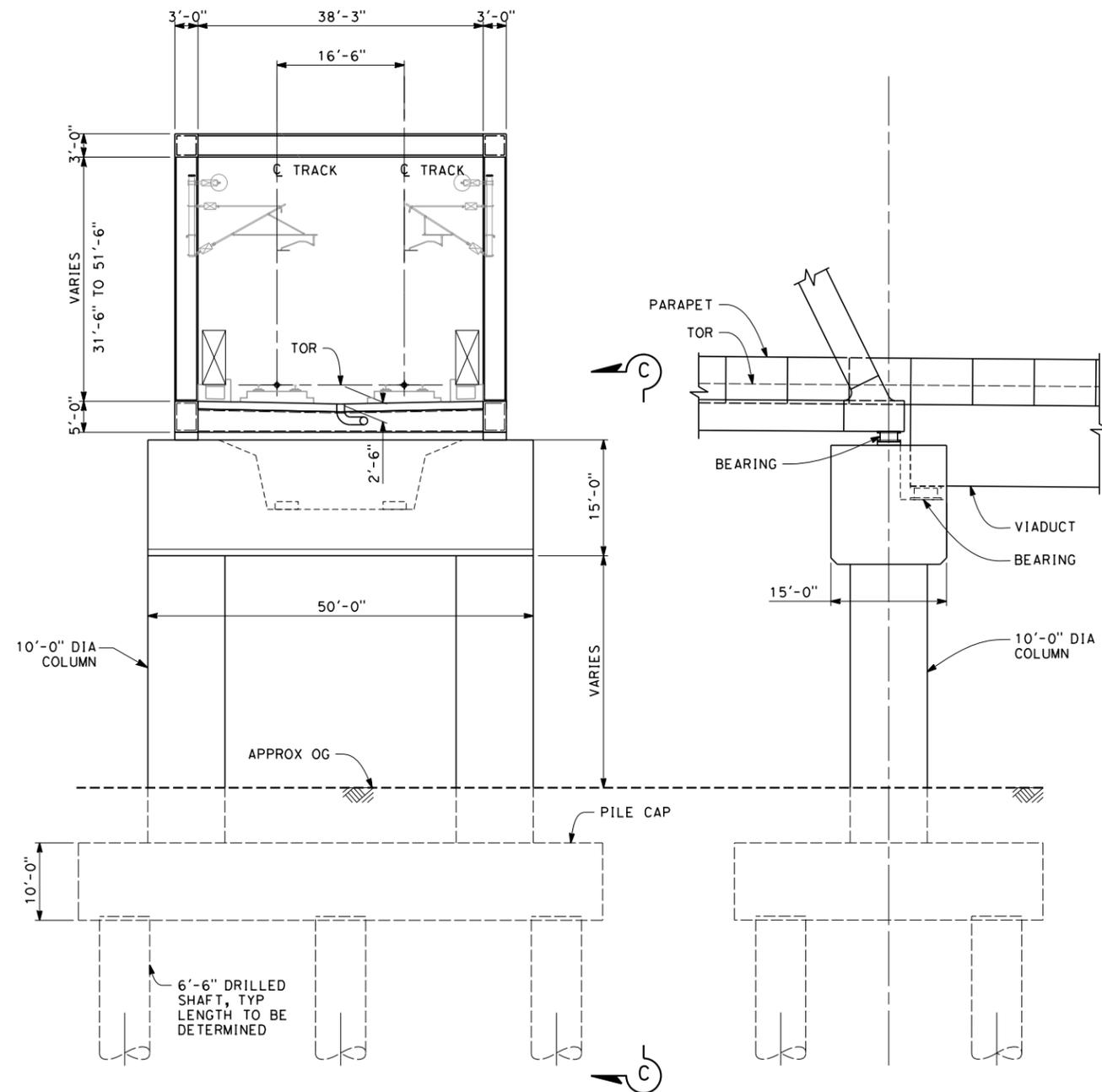
**NOT FOR  
 CONSTRUCTION**



**CALIFORNIA HIGH-SPEED TRAIN PROJECT  
 FRESNO TO BAKERSFIELD**

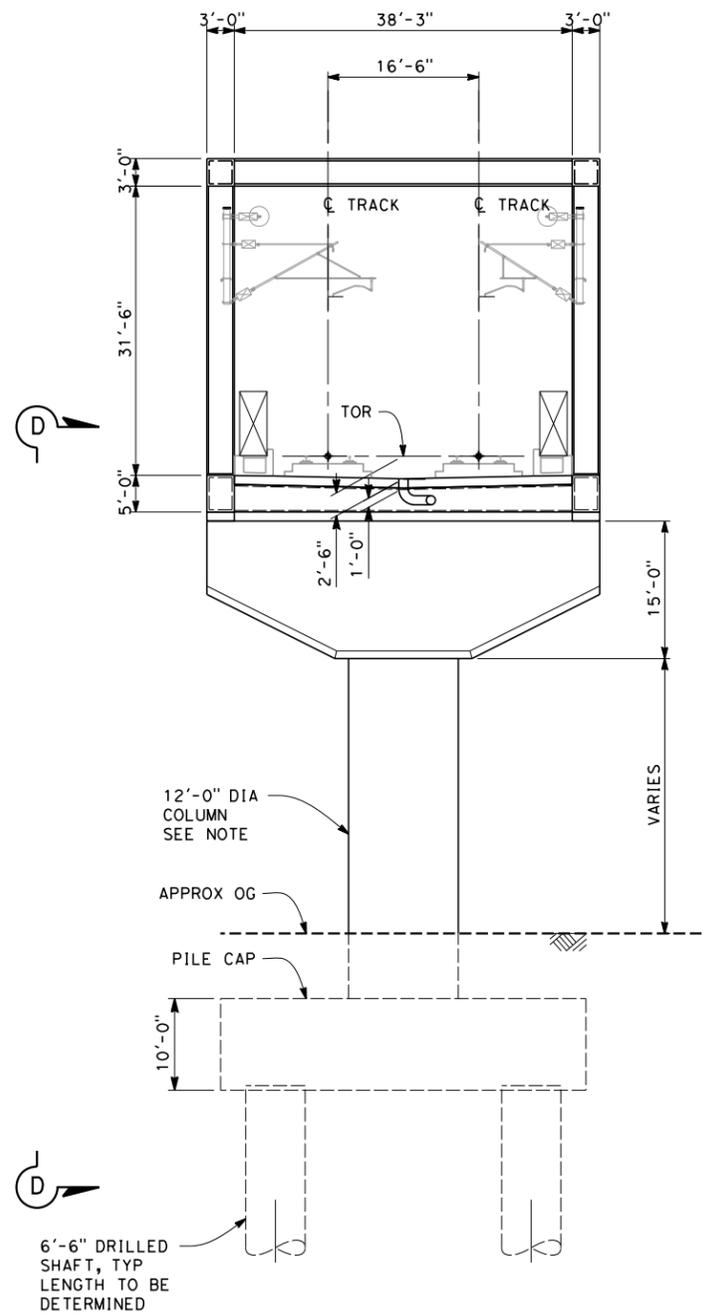
HANFORD SUBSECTION  
 ALIGNMENT H  
 KINGS RIVER VIADUCT  
 TYPICAL SECTIONS

CONTRACT NO. HSR 06-0003
DRAWING NO. SV2274
SCALE AS SHOWN
SHEET NO. 15 OF 16



**SECTION C**  
SCALE: 1" = 10'

STA 1485+70 THROUGH 1489+27  
 STA 1518+30 THROUGH 1525+44  
 STA 1580+97 THROUGH 1587+31  
 STA 1593+34 THROUGH 1596+52



**SECTION D**  
SCALE: 1" = 10'

STA 1521+87 (BENT 33)  
 STA 1584+09 (BENT 83)



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REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY Y. REN
DRAWN BY D. ORIZA
CHECKED BY A. ARMSTRONG
IN CHARGE R. COFFIN
DATE 10/11/13

**DRAFT 15%  
 DESIGN SUBMISSION**  
  
**NOT FOR  
 CONSTRUCTION**



**CALIFORNIA HIGH-SPEED TRAIN PROJECT  
 FRESNO TO BAKERSFIELD**  
 HANFORD SUBSECTION  
 ALIGNMENT H  
 KINGS RIVER VIADUCT  
 TYPICAL SECTIONS

CONTRACT NO. HSR 06-0003
DRAWING NO. SV2275
SCALE AS SHOWN
SHEET NO. 16 OF 16

## **Appendix B**

**Kings River Conservation District and  
Kings River Water Association  
October 29, 2012, Meeting Notes**



**KINGS RIVER CONSERVATION DISTRICT & KINGS RIVER WATER ASSOCIATION  
October 29, 2012  
Meeting Notes**

**HST Section:** Fresno to Bakersfield

**Meeting Date:** October 29, 2012

**Location:** 4888 E Jensen Avenue, Fresno, CA 93725

**Purpose:** To discuss engineering design progress

**Participants:** Kings River Conservation District: Steve Stadler, Deputy General Manager Water Resources

Kings River Water Association: Steve Haugen, Watermaster

California High-Speed Rail Authority: Bobby Pentorali, Project Engineer

Third-Party Agreement Team: Murray Peters and Tony Valdez

Joint Venture: Grant Schlereth and Cheryl Lehn

**Prepared by:** Cheryl Lehn

**Action Items:**

1. Steve Stadler will provide information as to the type and the dimensions of equipment typically needed to perform levee and channel maintenance, including the equipment needed in flooding conditions.
2. Grant Schlereth will follow up with the Joint Venture (JV) bridge design team regarding debris removal and share the results with KRCD.

**Decisions:** None.

**Discussion of Issues:**

**General Kings River Conservation District/Kings River Water Association Discussion**

The Kings River Conservation District (KRCD) is a leading resource management agency for the Kings River, serving 1.2 million acres in portions of Fresno, Kings, and Tulare counties.

## **KINGS RIVER CONSERVATION DISTRICT & KINGS RIVER WATER ASSOCIATION October 29, 2012 Meeting Notes**

The Kings River is a federal flood control project operated by the U.S. Army Corps of Engineers (USACE), and the maintenance of the Kings River levees is the responsibility of the KRCD. KRCD provides flood protection, and conducts maintenance, water quality monitoring, and groundwater projects. KRCD Water Resources Deputy General Manager Steve Stadler pointed out that the irrigation flows are less than the design capacities for flood flows.

The Kings River Water Association (KRWA) manages 28 member agencies (or “units”) that have water rights on the Kings River. KRCD has no water supply, nor entitlement on the Kings River. These units are public districts or canal companies with rights to provide Kings River water for irrigation use on nearly 20,000 San Joaquin Valley farms, and 1 million acres in portions of Fresno, Kings, and Tulare counties.

KRWA’s management protection of these rights is limited to the channels associated with the Kings River. Outside of the Kings River corridor, management is left to the member units. The River’s peak season is typically a July snow-melt event and peak irrigation run.

Kings River Watermaster Steve Haugen, said the KRWA’s timing differs from the KRCD’s timing. The typical irrigation run lasts 60 to 150 days; however, in 2011, the season lasted 11 months, due to a very wet year. In 1983, the river ran for 400 days without stopping.

Haugen said that each one of the units manages their own water supply. KRWA tracks and monitors their supply. KRWA suggested that—discounting “wet” years—typically, the best time for construction to take place is at the end of irrigation season (November) and before stormwater season (December).

Haugen said a spring run for Lemoore Canal and Irrigation Company is typically 200 to 300 cubic feet per second (cfs). This water can be directed into one of the channels. In the summer, when demand for irrigation water is high, the Dutch John Cut and the Cole Slough are needed. Coordination for work within the channels should take place with KCWA. A water diversion plan and false-work plan must be submitted prior to construction. It was emphasized that the contracts must plan for the full range of flows within the channel regardless of the season.

Stadler discussed how the Central Valley Flood Protection Board (CVFPB) handles encroachment permits and proposed water conditions for the handling of flows in a flood release condition. For instance, if there is a bridge project and if a member unit may be at risk (during flood release conditions), the flows are controlled by the USACE; however, the amount of influence that KRWA and KRCD have over USACE flood flow releases is limited. Additionally, there are a number of uncontrolled creeks below Pine Flat Dam, including Mill Creek, that are prone to flash floods, adding anywhere up to 5,000 cfs into the Kings River.

## **KINGS RIVER CONSERVATION DISTRICT & KINGS RIVER WATER ASSOCIATION October 29, 2012 Meeting Notes**

Considering this, Stadler said that construction sites must plan for all possible outcomes and diversions around construction activities. In the past, equipment has had to be moved to let a flow pass.

Haugen said in some dry years, they could be using only one channel of the Kings River, to save in water seepage losses. It will be important for the contractor to coordinate with KRCD and KRWA to determine the best times to enter the channel and conduct work.

### **Alignment Crossing/Clearance Discussion**

In response to the KRCD Draft EIR/EIS comments on the 3-foot clearance over the Kings River on the BNSF alignment, Schlereth provided an exhibit with three proposed crossings over the Kings River. This included an 18½-foot viaduct structural crossing, the 3-foot crossing, and a 13-foot retained-fill crossing.

Pentorali said the CHSRA wants to understand the needs of the KRCD during a flood release condition, and strike a balance between accessing and maintaining the levees; impacting the surrounding properties; and capital costs. The 13-foot option was therefore the preferred option; and to help determine its appropriateness, Schlereth asked for the sizes of equipment that may be needed during flood conditions, as well as sizes of equipment needed to maintain the facilities.

Stadler said with an 18-foot clearance, no impact was foreseen. KRCD would be able to maintain and handle facilities. If a clearance is proposed of less than 18 feet, more study would be required. An engineering analysis of what equipment may be needed (during flood or emergency conditions), and what equipment may be available to borrow or rent to handle that activity is necessary. In times of emergency conditions, many water districts and ditch companies are looking for the biggest equipment they can find to handle the emergency situation. Schlereth offered to conduct a study to understand how typically used equipment could pass beneath the proposed 13-foot clearance option. Stadler was requested to provide a list of typical equipment.

Stadler said another significant concern is the flows across the flood plain. This flooding could "pond" against the alignment if it is on embankment, crossing perpendicular to the flood flows. Additionally, Stadler said because of the features along the river, being agricultural land, time is needed to get people out and off of their land during flooding conditions. By putting a dam across the floodplain, the character of the threat is changed, which is a driving concern.

Schlereth responded that the JV studied cross-drainage structures that would be required to be embedded within the embanked structure to pass a 100-year flood flow event.

## **KINGS RIVER CONSERVATION DISTRICT & KINGS RIVER WATER ASSOCIATION October 29, 2012 Meeting Notes**

Stadler raised the topic of the proposed Highway 43 underpass; and that due to the proximity to the floodplain; it could potentially flood, cutting off access. Schlereth said the underpass issue has been raised and that backup pumps would be needed to pump out floodwater; however the proposed Highway 43 underpass is out of the FEMA designated floodplain. Pentorali suggested that an access road branch off of Highway 43 north of the underpass, and follow parallel to the proposed HST alignment to the northern side of Cole Slough to provide an alternative route to the levees.

Stadler commented that when the USACE improved the levees in the 1960s, there was no flood plain study to go along with the design. The Federal Emergency Management Agency (FEMA) is in the process of accrediting the levees. Stadler's concern is that FEMA may say the levees need to be higher, and he does not want to be constrained by the HST structure. The 18-foot height of the HST structure above the levees is an arbitrary number that was considered by KRCD to prevent this kind of conflict.

Haugen suggested an all-weather service road be considered for equipment access and repairs on the land-side toe of the levees. Stadler said a paved road is against the USACEs' standards; however, rock is acceptable.

Haugen is concerned as to the center pier in the Dutch John Cut channel and in particular, how debris would be removed. Stadler stated that when BNSF is removing debris, they hoist a railcar over the bridge crossing during flood flows.

Haugen and Stadler shared a concern regarding responsibility of maintenance along the right-of-way, including vegetation removal over and under the HST system, both during construction, and permanently. Their concern included whether the California Department of Fish and Game would permit certain maintenance. Pentorali said this has not been decided.

Schlereth asked if KRCD would give their endorsement for clearances determined in a study currently being prepared to obtain a USACE 408 determination. Stadler said if the impacts are addressed, KRCD would support the findings.

Valdez asked if KRCD facilitators are in consultation with the USACE. Stadler stated that if the CHSRA requested an encroachment permit from KRCD, KRCD would endorse; however, because the CHSRA is submitting a permit request to the USACE, the USACE will ask for KRCD's opinion.

Schlereth said that the design/build contractor would be ultimately applying for the permits.

Haugen commented that the Dutch John Cut Weir is maintained by the Last Chance Water Ditch Company; and the Cole Slough is maintained by the Laguna Irrigation District.



URS/HMM/Arup Joint Venture

California High-Speed Train Project  
Fresno - Bakersfield

**KINGS RIVER CONSERVATION DISTRICT & KINGS RIVER WATER ASSOCIATION  
October 29, 2012  
Meeting Notes**

Pentorali said that the preferred alignment will be recommended in December 2012 by the CHSRA board.

Stadler stated that if the Hanford West alignment is chosen, there will be fewer issues from a flood control perspective.



**Appendix C**  
**Kings River Complex**  
**(Hanford East and Hanford West)**  
**December 15, 2011, Meeting Notes**



## **Kings River Complex (Hanford East and Hanford West) December 15, 2011 Meeting Notes**

**HST Section:** Fresno to Bakersfield

**Meeting Date:** December 15, 2011

**Location:** Kings River Conservation District (KRCD) Office

**Purpose:** Discussion with KRCD in regards to the Hanford West Alignment over Kings River.

**Participants:** KRCD – Steve Stadler, Keith Seligman  
URS/HMM/ARUP JV (JV) – Teddy Ramil, Eric Moran, Grant Schlereth, Bart Bohn, Quentin Earle, Matt Korve  
PMT – Johnny Kuo

**Prepared by:** Teddy Ramil and Grant Schlereth

This meeting started with introductions of the participants. The meeting then got underway with Steve S. giving a brief introduction of King River Conservation District history and jurisdictions.

### Discussion and Decisions:

JV presented profile and structural drawings pertaining to a portion of the preliminary Hanford West alignment crossing Murphy Slough, Grant Canal, and Kings River.

- **Murphy Slough and Grant Canal Crossing**

Steve S. mentioned that Murphy Slough and Grant Canal Crossings are not a flood control channel and are maintained by the Laguna Irrigation District (LID). The contact for LID is Scott Sills.

- **Kings River Crossing**

During the general discussion of the levee alignment, Steve S. mentioned that the District requires 18.5 feet of clearance above the levee crown for maintenance purposes.

- The 18.5 feet of clearance does not take into account future levee improvements, such as raising the levee to protect from events beyond the 100 year flood.
- If the vertical clearance is less than the 18.5 feet, the District will require the applicant to demonstrate that maintenance can still be achieved at a lower height.
- The District indicated that maintenance periodically takes place along portions of the entire levee system, often using an excavator to replace or repair sections. Levee damage is often a result of rodents.
- The vertical clearance issue will not be looked at until an Encroachment Permit is filed.
- In agreement with the KRCD response to the Utility "A" Letter (dated August 16, 2011), the KRCD would accept an "at-grade" alignment going through the levee, similar to the existing HW 41 river crossing structure. However, a crossing that is 3 feet above the levee crown would not be acceptable to KRCD as there would not be sufficient room to replace or repair the levee.

## **Kings River Complex (Hanford East and Hanford West) December 15, 2011 Meeting Notes**

Grant S. asked the District what their preferences were on levee armoring.

- Steve S. and Keith S. mentioned that the District does not like to armor the levee as armor provides rodents with a refuge.
- This principle applies for both reinforced concrete and rip-rap.

Eric M. discussed the setback of the bridge abutment to the levees.

- Steve S. said that the District's easement is ~10 feet from the toe of the levee.
- Steve S. also mentioned that the ~30 feet, as we are currently showing on our HW drawings, was preferred. The additional space will help during possible maintenance procedures.

Grant S. asked what the possible HSR maintenance responsibilities the District would require.

- Steve S. mentioned a condition in the permit would require the HSR to keep the structure free from debris.
- The district currently requires Caltrans and BNSF to keep their structures free from any debris.

Steve S. and Keith S. made comments on how the Hanford West Alignment was more favorable toward the potential King River flood risks for the following reasons:

- Steve S. discussed how the Hanford East Alignment would create an embankment that could raise water levels higher than previously shown prior to the alignment. River modeling would definitely need to take place at the Hanford East Alignment. It should be noted that existing USACE models for the Kings River are out dated (1955) and the KRCD can only comment on river flows. KRCD is applying for a grant to update the river model, but not work has been completed to date.
- Steve S. said the proposed Highway 43 underpass could potentially be flooded, which could cut-off access to portions of the KRCD levee system.
- Teddy R. mentioned that Highway 43 underpass is not located in the FEMA 100yr floodplain.
- Steve S. said the NFIP mapping in the area of the HSR was out dated and that the modeling done for the mapping was not detailed. The flood mapping used an approximate method and that the area of the proposed HW 43 underpass has periodically flooded due to levee failures.

Steve S. made a final comment encouraging the team to start the encroachment permit process as soon as possible.

### **Action Items:**

- The JV should contact Laguna Irrigation District for a coordination meeting and discuss the preliminary Hanford West Alignment.
- The JV Team should contact other water agencies that are affected by Hanford West Alignment for possible coordination meetings.