

Underwater Inspection Report



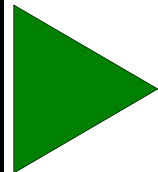
South Carolina Department of Transportation

US 21

Over

Harbor River

No Significant
Action Required



Bridge ID No. 0720002100200

Developed by:

Beaufort County, South Carolina
January 22, 2014



**INFRASTRUCTURE
ENGINEERS, INC.**

Job No. 12264SC00.01 - 101

This Underwater Inspection Report was Developed for:

Bridge No. 0720002100200

carrying

US 21 over Harbor River

in

Beaufort County, South Carolina

Infrastructure Engineers • 1460 John B White Sr. Blvd, Ste 1C • Spartanburg, SC 29306

2014 UNDERWATER INSPECTION REPORT EXECUTIVE SUMMARY

Inspection Date: January 22, 2014

NBIS Rating:

- The bridge's submerged components are in **satisfactory** and **fair** condition.

Significant Conditions Observed:

- A 1 in. wide vertical crack with rust staining on Pile 2 at Bent 45 and a 1/2-in. wide vertical crack with rust staining on Pile 5E at Pier B.
- 1/8-in. to 1/4-in. wide vertical cracks on piles at Bents 30, 33, 34, 36, 40, 44, 45, 48, 52 through 58, 61, 62, and Pier B.
- Spalling up to 1 ft. high by 5 ft. long with up to 6 in. of penetration in the caps at Bents 56 and 63.

Repair Recommendations:

- Vertical cracks wider than 1/16-in. should be cleaned and sealed.
- Clean spalls and voids to sound concrete and patch with a grout suitable for a marine environment.

1.0 INTRODUCTION

1.1 Purpose and Scope

SCDOT Bridge No. 0720002100200 carries US 21 over the Harbor River in Beaufort County. On January 22, 2014, Infrastructure Engineers, Inc. performed a routine underwater investigation at the bridge to evaluate the condition of all substructure units (SSUs) located in the water. This report includes a general description of the structure and the method of investigation, as well as a detailed description of the conditions noted. In addition, this report contains a condition assessment of the evaluated bridge components and presents recommendations for structural repairs.

The scope of the investigation included a visual inspection of all accessible SSUs located in the water from the high water mark to the channel bottom. Depth soundings were also taken along the bridge's upstream and downstream fascias to assist in scour identification and documentation.

1.2 General Description of the Structure

The report cover photograph shows an overall view of the bridge's upstream fascia, and Photograph 1 in Appendix B shows a downstream fascia view.

The bridge consists of seventy simply supported steel girder spans and a two span continuous steel thru truss swing span. The superstructure is supported by sixty-six intermediate bents, four piers, and a pivot pier. Bents 30 through 32, 35 through 39, 42 through 44, 45 through 47, 50 through 52, 55 through 58, and 61 through 63 each consist of four square prestressed concrete piles and a reinforced concrete cap. Bents 33, 34, 40, 41, 48, 49, 53, 54, 59, and 60 each consist of seven square prestressed concrete piles and a reinforced concrete cap. Piers A and E each consist of two rows of four prestressed concrete piles and a reinforced concrete cap. Piers B and D each consist of two rows of six prestressed concrete piles and a reinforced concrete cap. Pier

C consists of a reinforced concrete column and a reinforced concrete footing founded on submerged piles. Refer to Photographs 2 through 5 in Appendix B for a view of typical bents and piers.

The report's labeling convention designates the bents and piers following the SCDOT design drawings dated February 1997. The bents are labeled numerically from west to east; the piles are labeled numerically from north to south. Rows of piles are designated as west and east. Refer to Figures 1 through 3 in Appendix A for a bridge plan and elevation sketch.

1.3 Method of Investigation

A dive team, led by a South Carolina-registered professional engineer-diver, conducted the underwater inspection. The inspection team accessed the bridge site by boat, which was launched from a boat ramp adjacent to the bridge.

The underwater investigation generally consisted of a Level I "swim-by" visual inspection over 100 percent of the accessible SSU surfaces from the high water mark to the channel bottom. Divers performed a Level II visual/tactile inspection on at least 25 percent of the SSUs, which included cleaning marine growth at the waterline, mid-depth, and channel bottom to facilitate an evaluation of the underlying surfaces. Inspectors paid particular attention to any observed areas of excessive deterioration or apparent distress while noting the condition of any repairs.

The inspection team also assessed the waterway and streambed conditions in the bridge vicinity, noting the type of channel bottom material, as well as the location and extent of any observed scour, riprap, or debris.

Inspectors noted the waterline location with respect to a fixed reference on the bridge at the time of the inspection. Depth soundings were taken along the bridge fascias and around each SSU using a handheld fathometer.

2.0 INSPECTION FINDINGS

At the time the soundings were taken, the waterline was located 17.0 ft. below the top of the deck at Bent 30. SCDOT elevation data was not available at the time of inspection; therefore, the top of the deck was assigned a referenced elevation of 100.0 at Bent 30. This translates to a waterline elevation of 83.00. The Harbor River is tidally influenced and flowed with a velocity of up to 1 fps during the inspection. Bridge soundings indicate that the maximum water depth was 38.5 ft. at the upstream fascia at Bent 45. Refer to Table 1 in Appendix A for a listing of the sounding measurements relative to the bridge deck.

The banks along Harbor River in the bridge vicinity are in stable condition. Embankment protection in the form of riprap and vegetation is present on the west and east banks. There is no sign of active erosion. Refer to Photographs 6 and 7 in Appendix B for a view of the west and east embankments, respectively. The channel bottom in the bridge vicinity primarily consists of sand and shells.

The SSUs located in water at the time of inspection included Bents 30 through 63 and Piers A through E. All inspected substructure units have moderate to heavy marine growth in the form of oysters from the high water mark to the channel bottom. Piles at Bents 30, 33, 34, 36, 40, 44, 45, 48, 52 through 58, 61, 62, and Pier B have 1/8-in. to 1/4-in. wide by 3 ft. long vertical cracks with rust stains. Refer to Photograph 10 in Appendix B for a view of the vertical crack in Pile 2, Bent 45. Piles at Bents 30, 34, 43, 47, 51, 54, 55, 60, 61, and Piers B and E have vertical cracks up to 1/16-in. wide by up to 4ft. long with rust stains. Piles at Bents 45 and 61 have 1/2-in. to 1-in wide by up to 6 ft. long vertical cracks with rust stains.

An area of voiding, 1 ft. long by 1 1/2-in. wide with 4 in. of penetration, is located at the column/footing interface on the east face of Pier C. There is a spall, 2 ft. long by 1 ft. high with 4 in. of penetration with exposed reinforcing, on the east face of the cap at Bent 56. Refer to Photograph 11 in Appendix B for a view of the spall on the cap at Bent

56. There is a spall, 5 ft. long by 1 ft. high with 6 in. of penetration with exposed reinforcing, on the west face of the cap at Bent 63. Refer to Figure 1 in Appendix A for detailed inspection notes and a plan view showing the existing conditions at each of the inspected bents and piers.

3.0 EVALUATION AND ASSESSMENT

Overall, the submerged components of the bridge SSUs are in **satisfactory** and **fair** condition. The cracking in the piles, rust stains, voiding, and spalls in the caps do not affect the structural capacity of the bridge.

The inspected SSUs are rated as **satisfactory, Code 6**, and **fair, Code 5**, in accordance with the FHWA National Bridge Inspection Standards (NBIS) Coding information. Appendix C contains condition rating forms in both NBIS and Bridge Management System (BMS) formats for this bridge.

4.0 RECOMMENDATIONS

It is recommended that all cracks 1/16-in. and wide be cleaned and sealed. Spalls and voids should be cleaned down to sound concrete and patched with grout suitable for a marine environment. In accordance with NBIS recommendations, the next routine underwater inspection for this bridge should be conducted on an interval not to exceed 60 months. In addition, bridge soundings should be taken as part of biennial above-water inspections, as well as following significant flooding events.

Respectfully submitted,

INFRASTRUCTURE ENGINEERS, INC.



Jeffrey B. Rowe, P.E.

Table 1

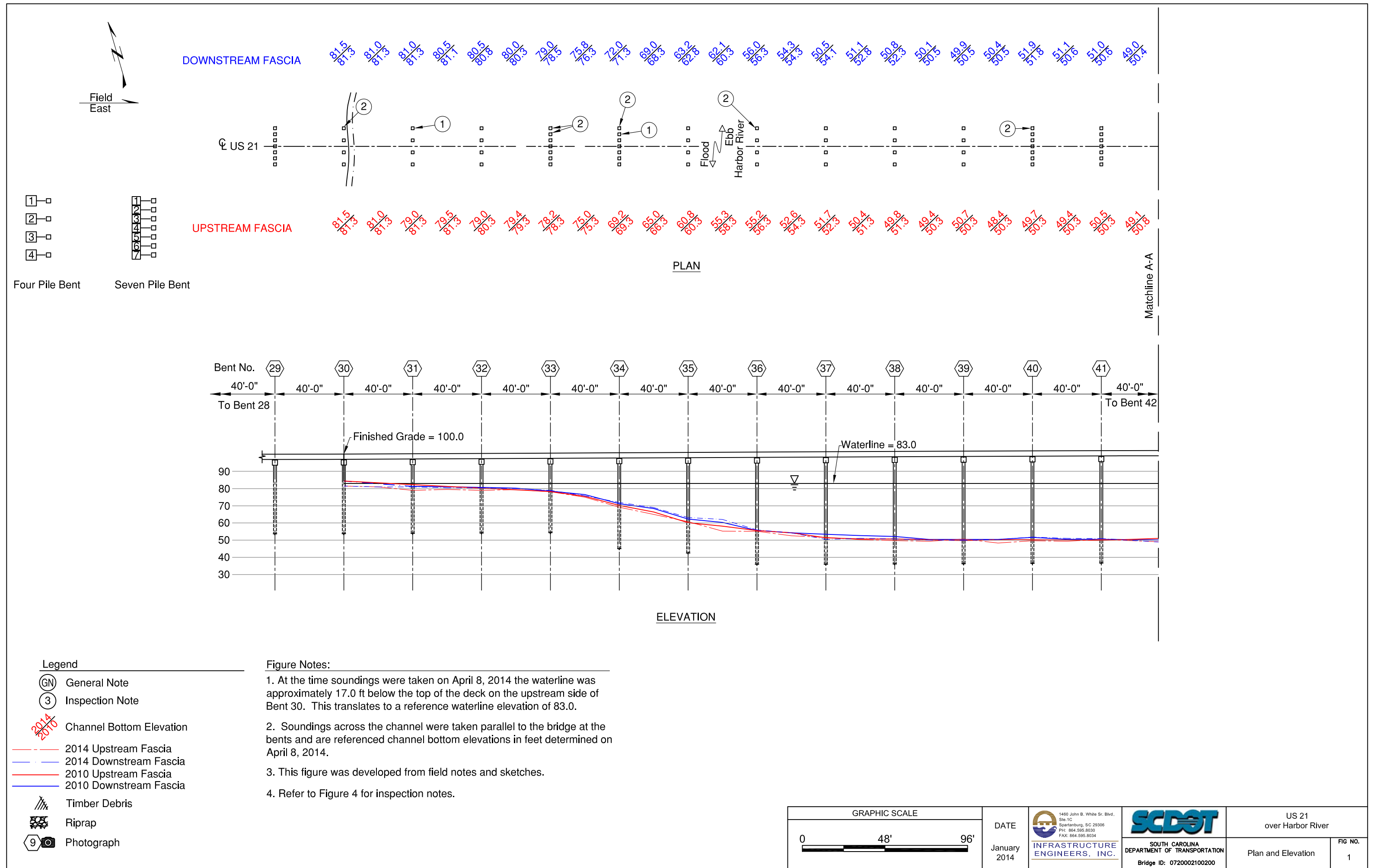
Bridge Soundings

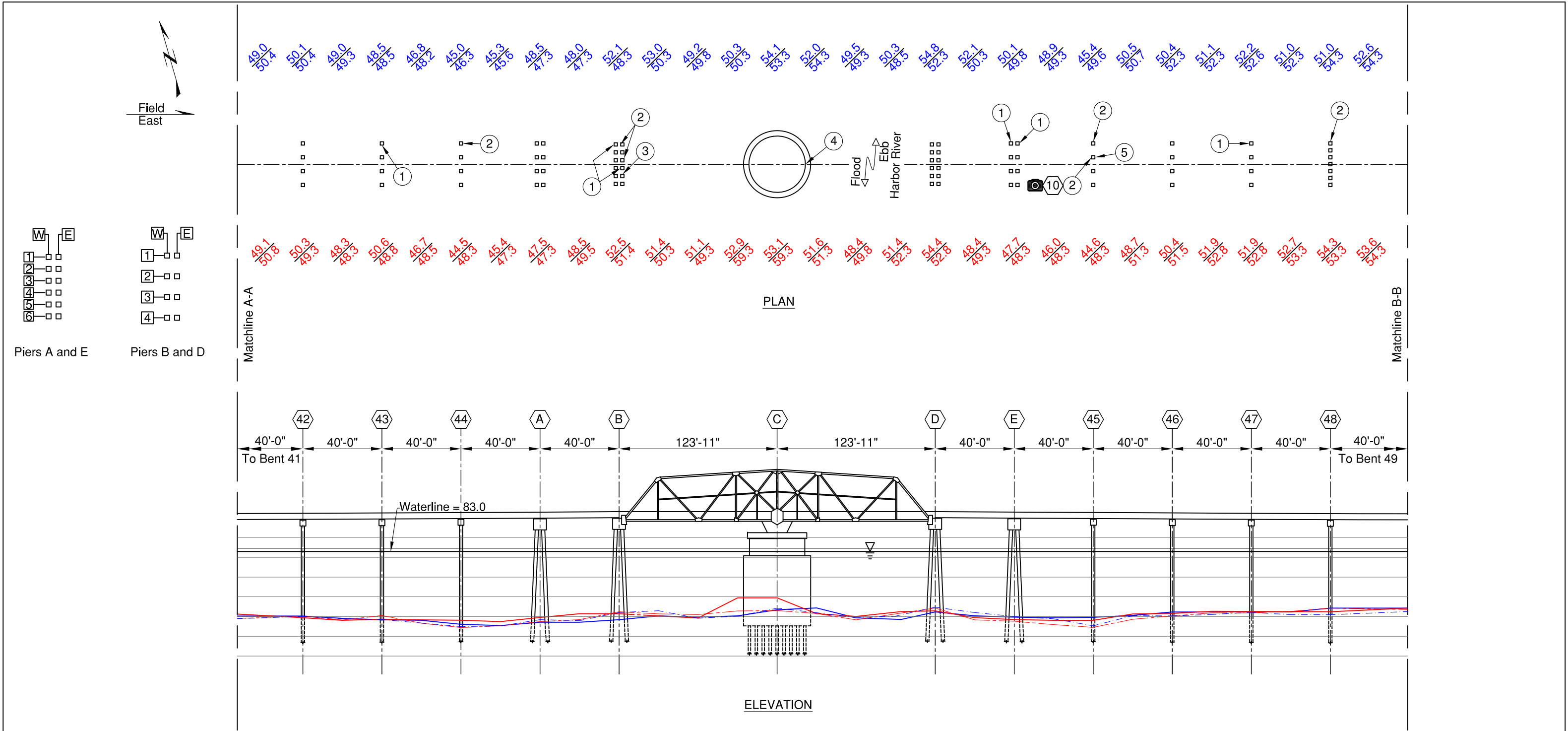
Bent	Upstream Fascia			Downstream Fascia		
	Waterline To Channel Bottom (ft)	Top of Deck To Waterline (ft)	Top of Deck To Channel Bottom (ft)	Waterline To Channel Bottom (ft)	Top of Deck To Waterline (ft)	Top of Deck To Channel Bottom (ft)
30	1.5	17.0	18.5	1.5	17.0	18.5
1/2	2.0	17.0	19.0	2.0	17.0	19.0
31	4.0	17.0	21.0	2.0	17.0	19.0
1/2	3.5	17.0	20.5	2.5	17.0	19.5
32	4.0	17.0	21.0	2.5	17.0	19.5
1/2	3.6	17.0	20.6	3.0	17.0	20.0
33	4.8	17.0	21.8	4.0	17.0	21.0
1/2	8.0	17.0	25.0	7.2	17.0	24.2
34	13.8	17.0	30.8	11.0	17.0	28.0
1/2	18.0	17.0	35.0	14.0	17.0	31.0
35	22.2	17.0	39.2	19.8	17.0	36.8
1/2	27.7	17.0	44.7	20.9	17.0	37.9
36	27.8	17.0	44.8	27.0	17.0	44.0
1/2	30.4	17.0	47.4	28.7	17.0	45.7
37	31.3	17.0	48.3	32.5	17.0	49.5
1/2	32.6	17.0	49.6	31.9	17.0	48.9
38	33.2	17.0	50.2	32.2	17.0	49.2
1/2	33.6	17.0	50.6	32.9	17.0	49.9
39	32.3	17.0	49.3	33.1	17.0	50.1
1/2	34.6	17.0	51.6	32.6	17.0	49.6
40	33.3	17.0	50.3	31.1	17.0	48.1
1/2	33.6	17.0	50.6	31.9	17.0	48.9
41	32.5	17.0	49.5	32.0	17.0	49.0
1/2	33.9	17.0	50.9	34.0	17.0	51.0
42	32.7	17.0	49.7	32.9	17.0	49.9
1/2	34.7	17.0	51.7	34.0	17.0	51.0
43	32.4	17.0	49.4	34.5	17.0	51.5
1/2	36.3	17.0	53.3	36.2	17.0	53.2
44	38.5	17.0	55.5	38.0	17.0	55.0

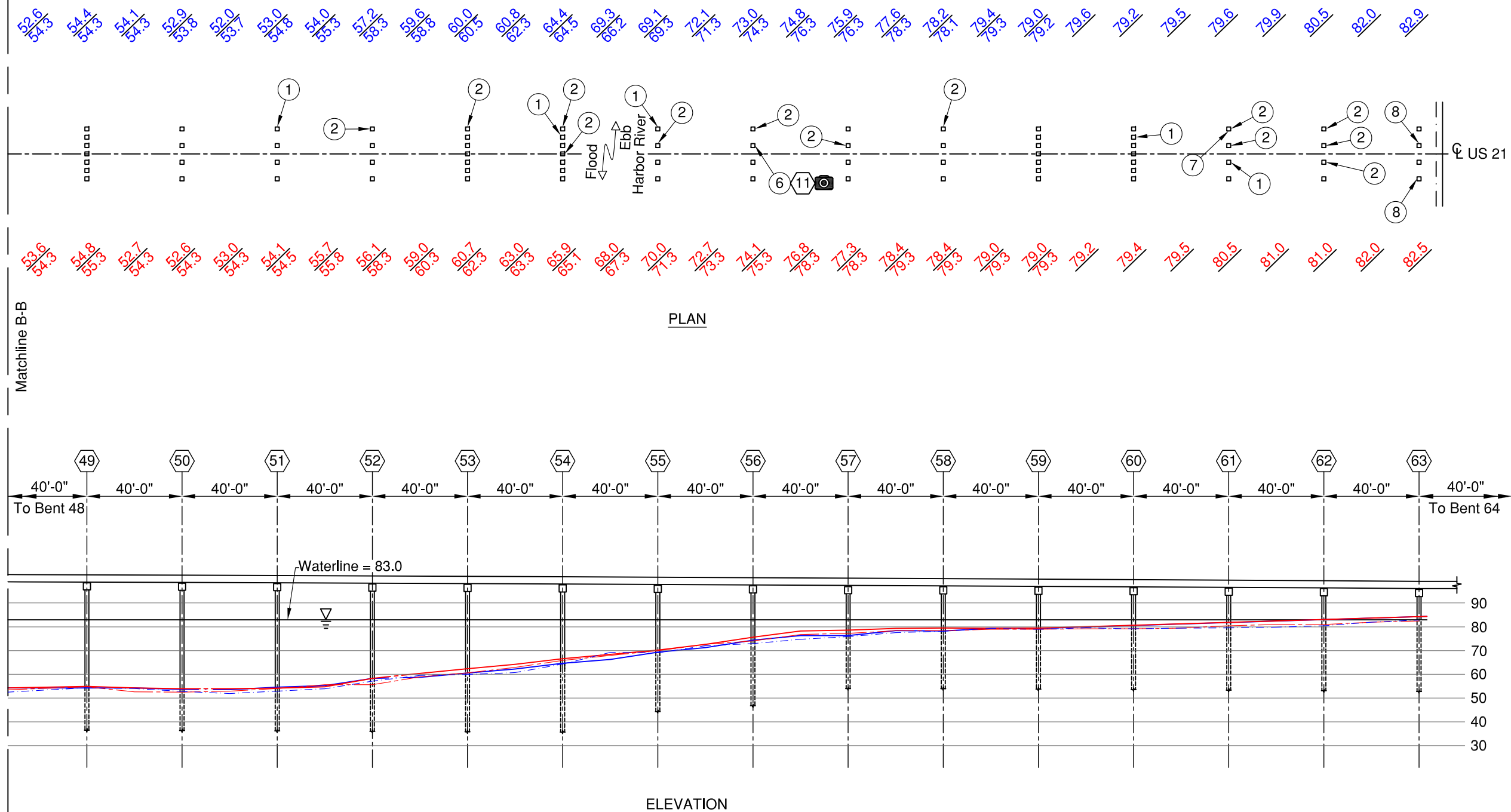
Bent	Upstream Fascia			Downstream Fascia		
	Waterline To Channel Bottom (ft)	Top of Deck To Waterline (ft)	Top of Deck To Channel Bottom (ft)	Waterline To Channel Bottom (ft)	Top of Deck To Waterline (ft)	Top of Deck To Channel Bottom (ft)
1/2	37.6	17.0	54.6	37.7	17.0	54.7
A	35.5	17.0	52.5	34.5	17.0	51.5
1/2	34.5	17.0	51.5	35.0	17.0	52.0
B	30.5	17.0	47.5	30.9	17.0	47.9
1/4	31.6	17.0	48.6	30.0	17.0	47.0
1/2	31.9	17.0	48.9	33.8	17.0	50.8
3/4	30.1	17.0	47.1	32.7	17.0	49.7
C	29.9	17.0	46.9	28.9	17.0	45.9
1/4	31.4	17.0	48.4	31.0	17.0	48.0
1/2	34.6	17.0	51.6	33.5	17.0	50.5
3/4	31.6	17.0	48.6	32.7	17.0	49.7
D	28.6	17.0	45.6	28.2	17.0	45.2
1/2	34.6	17.0	51.6	30.9	17.0	47.9
E	35.3	17.0	52.3	32.9	17.0	49.9
1/2	37.0	17.0	54.0	34.1	17.0	51.1
45	38.4	17.0	55.4	37.6	17.0	54.6
1/2	34.3	17.0	51.3	32.5	17.0	49.5
46	32.6	17.0	49.6	32.6	17.0	49.6
1/2	31.1	17.0	48.1	31.9	17.0	48.9
47	31.1	17.0	48.1	30.8	17.0	47.8
1/2	30.3	17.0	47.3	32.0	17.0	49.0
48	28.7	17.0	45.7	32.0	17.0	49.0
1/2	29.4	17.0	46.4	30.4	17.0	47.4
49	28.2	17.0	45.2	28.6	17.0	45.6
1/2	30.3	17.0	47.3	28.9	17.0	45.9
50	30.4	17.0	47.4	30.1	17.0	47.1
1/2	30.0	17.0	47.0	31.0	17.0	48.0
51	28.9	17.0	45.9	30.0	17.0	47.0
1/2	27.3	17.0	44.3	29.0	17.0	46.0
52	26.9	17.0	43.9	25.8	17.0	42.8
1/2	24.0	17.0	41.0	23.4	17.0	40.4
53	22.3	17.0	39.3	23.0	17.0	40.0

Bent	Upstream Fascia			Downstream Fascia		
	Waterline To Channel Bottom (ft)	Top of Deck To Waterline (ft)	Top of Deck To Channel Bottom (ft)	Waterline To Channel Bottom (ft)	Top of Deck To Waterline (ft)	Top of Deck To Channel Bottom (ft)
1/2	20.0	17.0	37.0	22.2	17.0	39.2
54	17.1	17.0	34.1	18.6	17.0	35.6
1/2	15.0	17.0	32.0	13.7	17.0	30.7
55	13.0	17.0	30.0	13.9	17.0	30.9
1/2	10.3	17.0	27.3	10.9	17.0	27.9
56	8.9	17.0	25.9	10.0	17.0	27.0
1/2	6.2	17.0	23.2	8.2	17.0	25.2
57	5.7	17.0	22.7	7.1	17.0	24.1
1/2	4.6	17.0	21.6	5.4	17.0	22.4
58	4.6	17.0	21.6	4.8	17.0	21.8
1/2	4.0	17.0	21.0	3.6	17.0	20.6
59	4.0	17.0	21.0	4.0	17.0	21.0
1/2	3.8	17.0	20.8	3.4	17.0	20.4
60	3.6	17.0	20.6	3.8	17.0	20.8
1/2	3.5	17.0	20.5	3.5	17.0	20.5
61	2.5	17.0	19.5	3.4	17.0	20.4
1/2	2.0	17.0	19.0	3.1	17.0	20.1
62	2.0	17.0	19.0	2.5	17.0	19.5
1/2	1.0	17.0	18.0	1.0	17.0	18.0
63	0.5	17.0	17.5	0.1	17.0	17.1
1/2	0.5	17.0	17.5	0.3	17.0	17.3
64	0.0	17.0	17.0	0.0	17.0	17.0
1/2	Dry	Dry	14.0	Dry	Dry	14.0

NOTE: The numbers listed in this table represent distances and not elevations. SCDOT design drawings were not available at the time of inspection; therefore a reference elevation of 100.0 was assigned to the bridge deck at Bent 30. The waterline elevation at the time of the readings was 83.0 based on a measurement taken in the field.



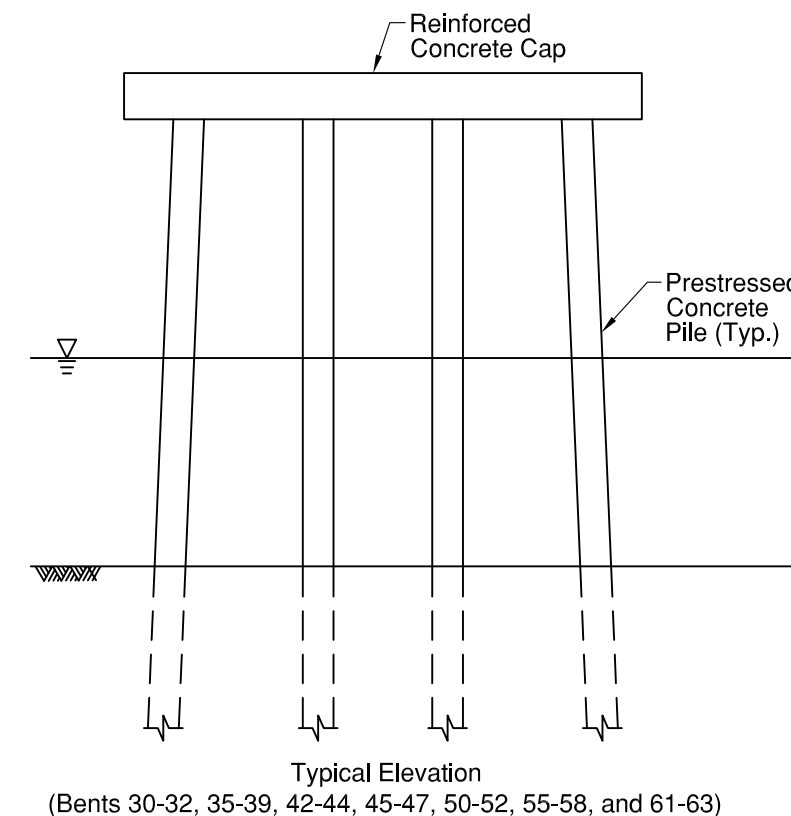
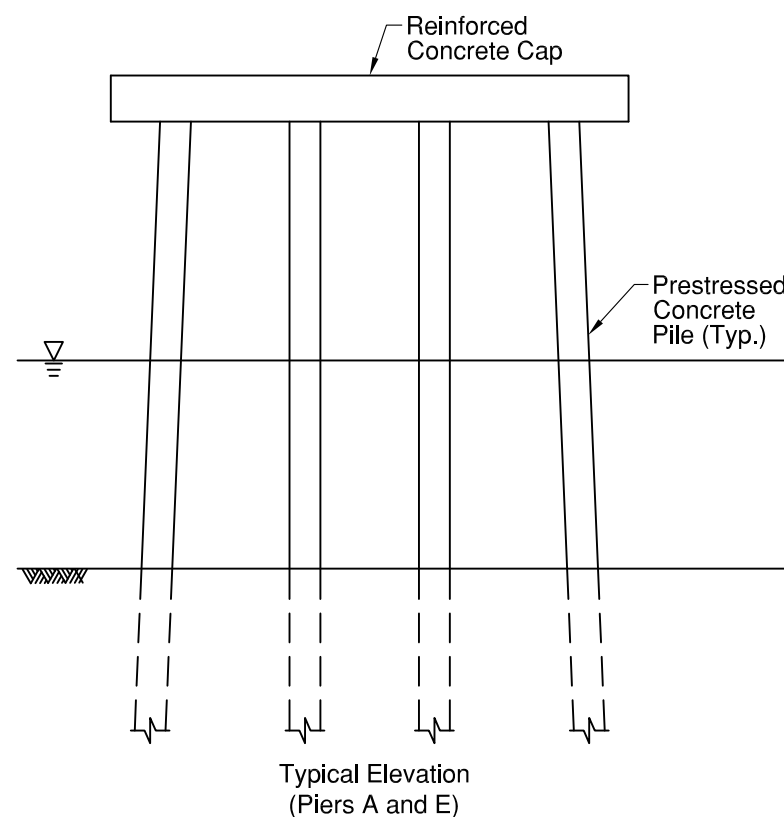
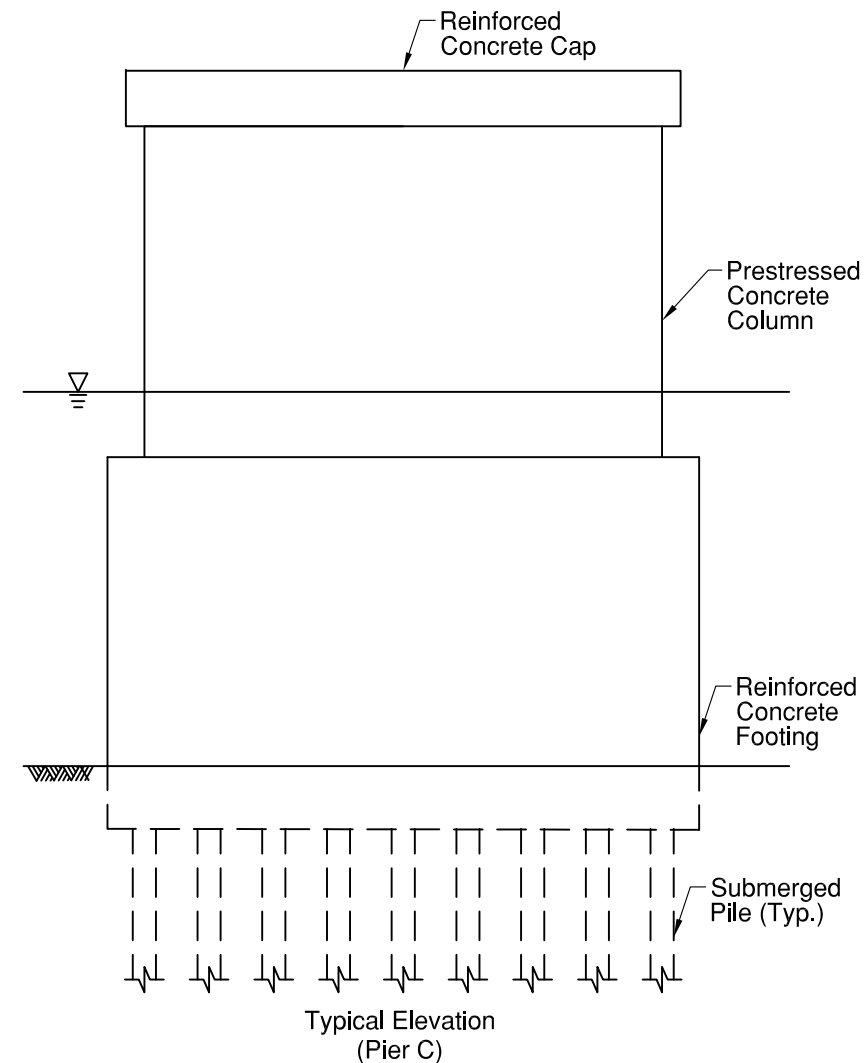
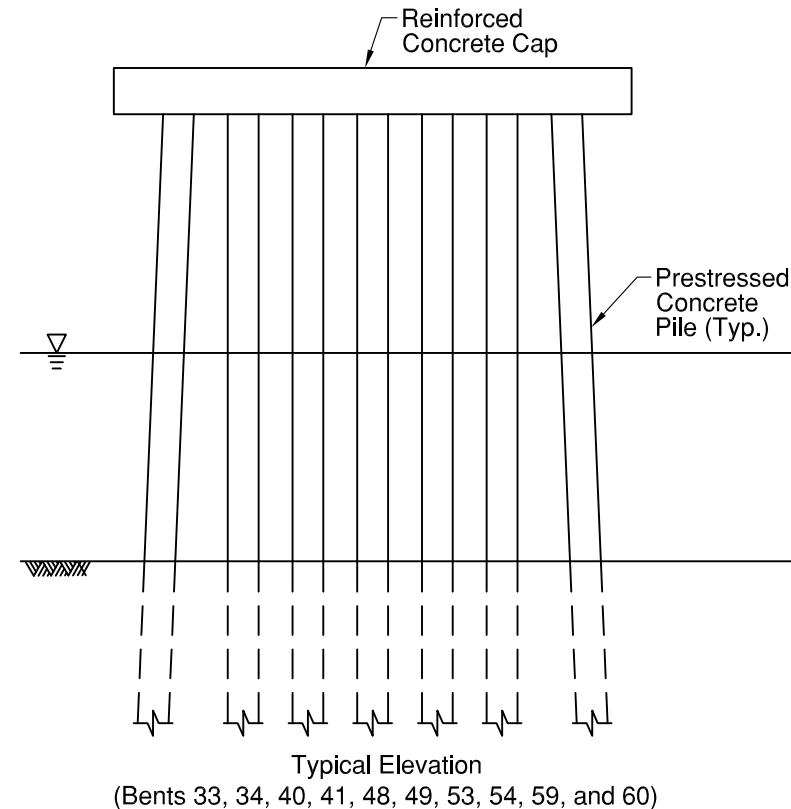
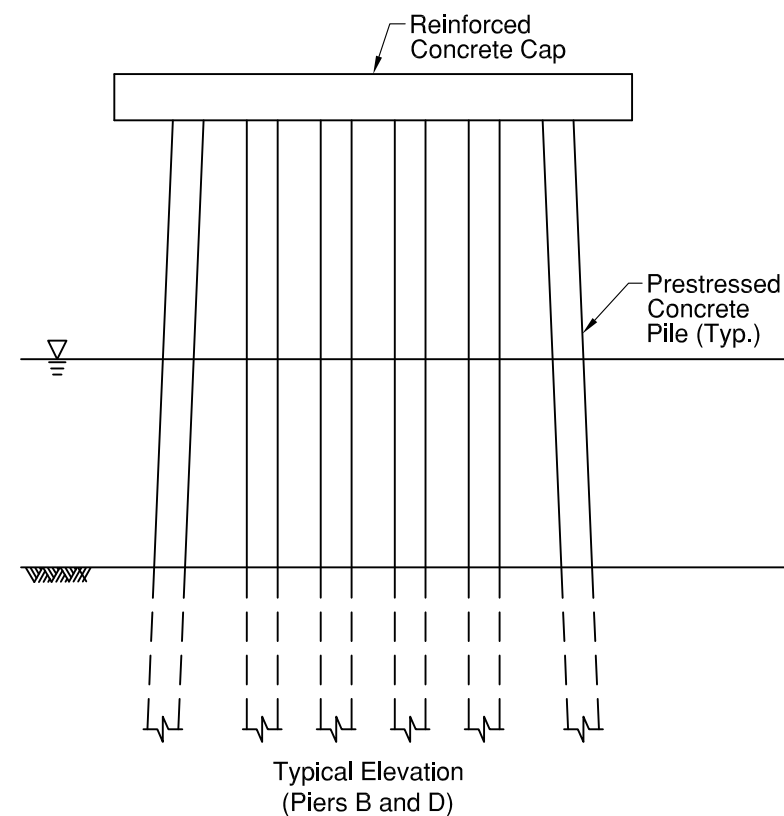




- Legend**
- (GN) General Note
 - (3) Inspection Note
 - ~~2014~~ 2010 Channel Bottom Elevation
 - 2014 Upstream Fascia
 - 2014 Downstream Fascia
 - 2010 Upstream Fascia
 - 2010 Downstream Fascia

- Timber Debris
- Riprap
- Photograph

- Figure Notes:**
- At the time soundings were taken on April 8, 2014 the waterline was approximately 17.0 ft below the top of the deck on the upstream side of Bent 30. This translates to a reference waterline elevation of 83.0.
 - Soundings across the channel were taken parallel to the bridge at the bents and are referenced channel bottom elevations in feet determined on April 8, 2014.
 - This figure was developed from field notes and sketches.
 - Refer to Figure 4 for inspection notes.



Inspection Notes:

- ① Hairline to 1/16-in. wide vertical cracks with rust stains extending from the marine growth up 3 ft.
- ② 1/8-in. to 1/4-in. wide vertical cracks with rust stains extending from the marine growth up 3 ft.
- ③ Up to 1/2-in. wide by 2 ft long vertical crack with rust stains on the north face at the waterline.
- ④ 1 ft long by 1 1/2-in. wide void with 4 in. of penetration in the column on the east face at the column/footing interface.
- ⑤ Up to 1 in. wide by 6 ft long vertical crack on the northeast corner at the waterline.
- ⑥ 2 ft long by 1 ft high spall with 4 in. of penetration and exposed reinforcing on the east face of the cap.
- ⑦ 1/2-in. wide by 4 ft long vertical crack with rust stains on the south face at the waterline.
- ⑧ 5 ft long by 1 ft high spall with 6 in. of penetration and exposed reinforcing on the west face of the cap.

GRAPHIC SCALE

Not to Scale

DATE
January
2014



SOUTH CAROLINA
DEPARTMENT OF TRANSPORTATION
Bridge ID: 0720002100200

US 21
over Harbor River

Typical Bent/Pier
Elevations and
Inspection Notes

FIG NO.
4



Photograph 1. Downstream Fascia.



Photograph 2. View of Bent 38, Typical of Bents 30, 32, 35-39, 42-44, 45-47, 50-52, 55-58, and 61-63.



Photograph 3. View of Pier A, Typical of Piers A and E.



Photograph 4. View of Bent 48, Typical of Bents 33, 34, 40, 41, 48, 49, 53, 54, 59, and 60.



Photograph 5. View of Pier C.



Photograph 6. West Embankment.



Photograph 7. East Embankment.



Photograph 8. View Upstream from Under Bridge.



Photograph 9. View Downstream from Under Bridge.



Photograph 10. 1/4-in. wide vertical crack in Pile 2 at Bent 45.



Photograph 11. Spall with 4 in. of penetration on the cap at Bent 56.

UNDERWATER INSPECTION CONDITION RATING FORM

BRIDGE NO. **0720002100200**
 WATERWAY: **Harbor River**
 INSPECTORS: **INFRASTRUCTURE ENGINEERS, INC.**
 INSPECTION DATE: **January 22, 2014**

NOTE: Condition ratings are assigned in accordance with the National Bridge Inspection Standards (NBIS) Coding Information, as presented in Federal Highway Administration Report No. FHWA-PD-96-001 "Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges," dated December 1995 (revised April 27, 2001).

CONDITION RATING

Unit	Substructure Code (Item 60)	Channel and Channel Protection Code (Item 61)	Underwater Inspection Code (Item 92B)	Scour Critical Bridge Code (Item 113)
Bent 30	5	8	Y60	6
Bent 31	5	8	Y60	6
Bent 32	6	8	Y60	6
Bent 33	5	8	Y60	6
Bent 34	5	8	Y60	6
Bent 35	6	8	Y60	6
Bent 36	5	8	Y60	6
Bent 37	6	8	Y60	6
Bent 38	6	8	Y60	6
Bent 39	6	8	Y60	6
Bent 40	5	8	Y60	6
Bent 41	6	8	Y60	6
Bent 42	6	8	Y60	6
Bent 43	5	8	Y60	6
Bent 44	5	8	Y60	6
Pier A	6	8	Y60	6
Pier B	5	8	Y60	6
Pier C	6	8	Y60	6
Pier D	6	8	Y60	6

Unit	Substructure Code (Item 60)	Channel and Channel Protection Code (Item 61)	Underwater Inspection Code (Item 92B)	Scour Critical Bridge Code (Item 113)
Pier E	5	8	Y60	6
Bent 45	5	8	Y60	6
Bent 46	6	8	Y60	6
Bent 47	6	8	Y60	6
Bent 48	5	8	Y60	6
Bent 49	6	8	Y60	6
Bent 50	6	8	Y60	6
Bent 51	5	8	Y60	6
Bent 52	5	8	Y60	6
Bent 53	5	8	Y60	6
Bent 54	5	8	Y60	6
Bent 55	5	8	Y60	6
Bent 56	5	8	Y60	6
Bent 57	5	8	Y60	6
Bent 58	5	8	Y60	6
Bent 59	6	8	Y60	6
Bent 60	5	8	Y60	6
Bent 61	5	8	Y60	6
Bent 62	5	8	Y60	6
Bent 63	5	8	Y60	6

Bridge is scour critical because abutment or pier foundation is rated as unstable due to observed scour at bridge site: _____ Yes _____ ☒ No

(Note: Bridges may also be scour critical if abutment or pier foundations are rated as unstable due to scour potential as determined by a scour evaluation study)

REMARKS: As the result of an underwater inspection, for Item 113, a structure may only be rated as 0, 1, 2, 4, or 6. Other ratings may be assigned only as the result of a scour analysis.

Whenever a rating factor of 2 or below is determined for Item 113 - Scour, the rating factor for Item 60 – Substructure needs to be the same to reflect the severity of actual scour and resultant damage to the bridge.

UNDERWATER INSPECTION BRIDGE MANAGEMENT SYSTEM CONDITION REPORT FORM

BRIDGE NO. **0720002100200**
 WATERWAY: **Harbor River**
 INSPECTORS: **INFRASTRUCTURE ENGINEERS, INC.**
 INSPECTION DATE: **January 22, 2014**

NOTE: Element Condition ratings are assigned in accordance with the AASHTO "Guide for Commonly Recognized (CoRe) Structural Elements", dated December 2010.

BMS CONDITION REPORT

Element	Total Quantity	Unit	Quantities in Condition State				
			1	2	3	4	5
CoRe Elements (Deck/Super/Sub)							
204 P/S Column or Pile Extension	206	EA	166	40			
205 R/C Concrete Column or Pile Extension	1	EA	1				
220 Submerged Pile Cap/Footing	1	EA	1				
Smart Flags							
361 Scour	1	EA	1				