

# **Raft Island Improvement Association**

## **2011 Bridge Inspection Report For Raft Island Bridge**

**Pierce County, Washington**

**July, 2011**



**Prepared by:**



**Exeltech Consulting, Inc.  
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Lacey, WA 98516**

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## Statement of Purpose

Exeltech Consulting, Inc. was retained by the Raft Island Improvement Association to provide services to evaluate the Raft Island Bridge as part of its annual routine inspection. The scope of work as proposed by the Raft Island Improvement Association is to determine the current condition of the existing structure and then provide maintenance recommendations for repair, as necessary. These services include completing an on-site visit to visually inspect the existing bridge structure and provide a written assessment report of the current condition of the bridge structure. The assessment report will include maintenance recommendations.

The following assumptions were made for this project:

1. The inspection will be a visual inspection and observation of the bridge superstructure and substructure, not requiring special equipment, other than a ladder.
2. No non-destructive or destructive testing will be conducted during the inspection of the bridge superstructure and substructure, except hammer soundings will be made near the mud line on all timber piling, and borings will be taken where indicated by the soundings. All borings will be plugged with treated timber dowels.
3. Inspection around heavily-vegetated areas will be conducted without major disturbance to the existing vegetation.
4. A chemical composition evaluation will not be conducted on the existing bridge superstructure or substructure.
5. Inspection of the structure will be conducted over a one day period, during low tide. A two person team inspected the structure on 7/13/2011.

The scope of services agreed to for this project is as follows:

1. Existing Plans and Reports: The previous inspection reports as well as the as-built drawings will be reviewed prior to the on-site visit. Review of the previous inspection reports and plans will provide the inspector with a baseline condition of the structure, for which an assessment can be made of the current condition of the bridge.
2. Field Visit Inspection: A visual field inspection will be conducted, at a mutually-agreeable time.
3. Inspection Report: A written assessment report document will be provided, which summarizes the results of the visual inspection conducted during the on-site visit.

## INSPECTION LOG

Date: July 13, 2011 (inspection started at 8:30AM finishing at 3:00pm)  
Weather: Cloudy in morning with some rain. Sun in afternoon and 70°  
Tides: Low -2.4 at 10:49am and high 13.3 at 6:28pm  
Inspector: Ron Smith and James Collins

## GENERAL DESCRIPTION

Bridge Name: *Raft Island Bridge*  
Location: *Pierce County, WA*  
Over: **Existing inlet**  
Type: **Prestressed concrete channel girders supported by timber bents**

Superstructure:

45 - ~17 ft. prestressed concrete channel girders  
(7 channel girders for each span)  
1 - ~23 ft. prestressed concrete channel girders  
(7 channel girders for each span)

Substructure:

47 - 4 Timber Pile Bents

Number of Lanes: 2 lane structure

Orientation: Longitudinal axis of bridge is oriented South-North as indicated per the design plans. For conformity and inspection designation purposes, Bent 1 is the South Abutment and Span 1 is designated as the first span adjacent to the mainland. The piles and channel girders are numbered left to right with "A" furthest left while looking North towards Raft Island. This sign convention follows the recommendations of the WSDOT Bridge Inspection Manual.

Posting: The bridge is posted for 16 Tons for a Type 3 load, 28 Tons for a Type 3S2 and 30 Tons for a Type 3-3.  
The speed posting is 15 mph.

## HISTORICAL PERSPECTIVE OF THE STRUCTURES

The Raft Island Bridge serves as the main access to Raft Island and its residents from the mainland. The bridge consists of 46 prestressed concrete channel girders supported on 4-pile timber bents. The bridge measures 788 feet and consisting of 45-17' spans and 1-23' span, per the as built plans. The bridge spans across a waterway that serves as a major thruway for boats anchored in the inlet. Most of the boat traffic utilize the opening under the 23' span. At high tide, the water is 10' to 20' deep under the 23' span. At low tides of approximately -2' and lower, the entire substructure above the mud line is exposed and accessible.

The original drawings indicate that bridge was built in the 1957 with a H15-44 design live load. The clear width of the structure between curbs is 20', while the out-to-out width of the structure is 21'. The bridge railing system consists of painted metal W beam attached to the inside face of 8"x8" treated timber posts. The posts are attached to the sides of the exterior channel girders and to 6"x9" cast-in-place curbs. Expansion joints are present at the South Abutments and at Bent 16 and Bent 32. The existing deck is composed of an asphalt concrete overlay over a waterproof membrane.

Based upon the review of previous reports, a major rehabilitation project was conducted on the bridge in the 1992. The work consisted of splicing in 10 new piles, replacing approximately 12 braces and the placement of 2" of new asphalt over a new membrane. In 1994 some minor work was conducted, consisting of encapsulating a couple of decaying piles and the replacement of some bracing members. Additional maintenance work has also been completed over the years including the last recorded maintenance work performed in 2009 where diaphragms at Bents 16 and 32 were replaced and areas of spalled concrete and exposed reinforcement were patched. At the present there is a contract to encase 5 piles, replace 11 braces, install shoring at the north abutment and patch the spall in 1 girder.

## INSPECTION RESULTS

The 2011 inspection focused on the substructure, which has been noted in previous reports to exhibit varying degrees of deterioration. For 2011 all piles were sounded at the ground line and to a height of approximately 7 ft.

The superstructure elements were inspected by walking the deck and from the ground below. A kayak was not used for this years inspection since only very minor spalling of the precast deck elements was observed.

The following is a summary of the findings from the field inspection.

## SUPERSTRUCTURE

### Prestressed Concrete Channel Girders

The following is a summary of the concrete spalls with exposed steel reinforcement or prestress strand, and cracks in the concrete found during the field inspection of the prestressed concrete channel girders:

Summary of Results

Description	Location
Spalled concrete on soffit with exposed steel reinforcement	Span 9: Girder G has a 3” diameter spall with exposed rebar. Span 16: Girder A soffit, three 3” diameter spalls with exposed rebar (2007). There was one new spall in 2011, for a total of four. Span 19: Girder G soffit, three spalls with exposed rebar. Max. is 6” x 4”. Span 22: Girder A has a 4” x 2” spall with exposed rebar. Span 23: Girder A has a spall with exposed rebar. Span 29: Girder A has a 3” diameter spall with exposed rebar (2007). There was one new spall in 2011, for a total of two. Span 36: Girder G has a 4” diameter spall with exposed rebar. (2010) Span 37: Girder G has a 4” diameter spall with exposed rebar. Span 42: Girder G, spall with 5” exposed rebar. (2010)

The spall with exposed prestress strand in Span 8 Girder E has been repaired. See photo 1.



PHOTO 1 – GIRDER 8E SPALL REPAIR

See APPENDIX C for a more detailed list of channel girder defects.

**Deck Overlay**

The asphalt depth is approximately 2”. The majority of the distresses were located near the expansion joints, which consists of alligator cracks and visible signs of deterioration of the existing asphalt patches. There is also alligator cracking in a strip that varies from 1 ft. to 2 ft. wide along the centerline of bridge. See photo 2.

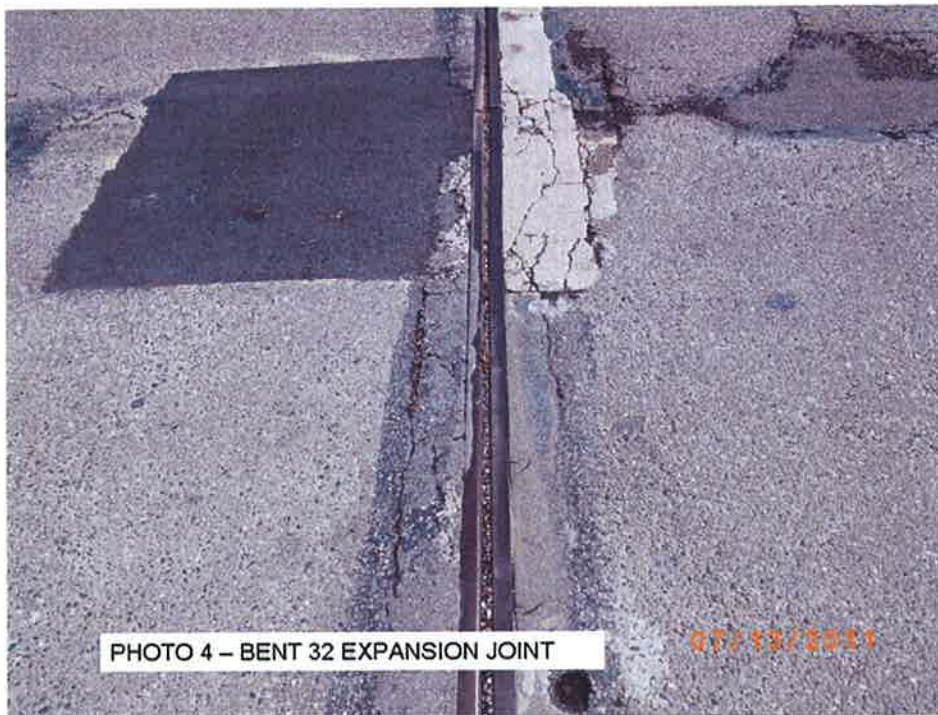


PHOTO 2 – ALLIGATOR CRACKING NEAR BENT 33

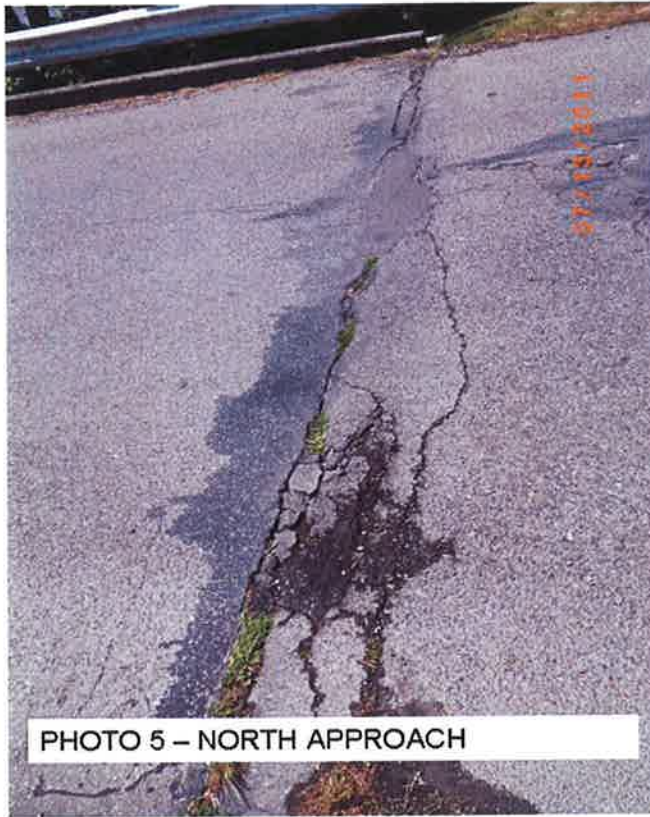
At Bent 16 expansion joint there are new asphalt patches on both sides of the joint. See photo 3.



At Bent 32 expansion joint there are new asphalt patches on both sides of the joint. The old patch along the north side of the joint is breaking up. See photo 4.



At the north abutment there is cracking full width with some “D” cracking. In the northbound lane the asphalt is breaking up. It is anticipated that this cracking will worsen as the rotten timber cap deteriorates. See photo 5.



### **Expansion Joints**

The expansion joint at the South Abutment is an armored compression seal. The joint was repaired in November 2009 using the material Lokcrete Elastomeric Concrete for the header. Prior to installing the header the steel armor was attached to new anchor bolts. The surface is smooth and level with no visible defects.

The expansion joints at Bent 16 is a strip seal with a measured opening of approximately 3/4” between the steel extrusions. The joint was repaired in 2008 using the material Set 45 as a new header on the south side of the joint. There are seven 2” diameter patches where ports were created to pour the new diaphragms. The old header on the north side of the joint is cracked and spalled. See photo 3.

The expansion joint at Bent 32 is a strip seal with a measured opening of approximately 3/4” between the steel extrusions. There is an old concrete patch at centerline that is cracked and starting to break up. There are seven 2” diameter patches where ports were created to pour the new diaphragms. The old header on the north side of the joint is cracked and breaking up. See photo 4.

**Bridge Rail**

The rail on the structure is W beam mounted on 8" x 8" timber posts. The top of the W beam is approximately 28" above the asphalt overlay. There is no approach rail. The East Rail in Span 17 is bent out 2" over the 5'-8" post spacing due to traffic impact.

**Approach Roadway**

The South Approach is smooth due to the joint repair in 2009. See photo 4. The North Approach has several large patches and is approximately  $\frac{3}{4}$ " higher than the bridge which is causing moderate impact to the bridge. See photo 5.

## SUBSTRUCTURE

### Piles

For 2011 the piles and bracing were cleaned by the Raft Island Improvement Association. This provided access for soundings with a rock hammer and for visual inspection for marine borers.

The sounding results indicated some audible signs of rot and/or marine borer damage. In 2009 nine piles were found to have damage. In 2010 nineteen piles were found to have damage. In 2011 5 piles were being repaired by adding fiberwrap jackets filled with grout. There were 14 piles remaining that were found to have damage with one deleted from the 2010 list and one new addition. Piles 5D, 8D, 16D, 19D, 21D, 22A, 27D, 29B, 30B, 31C, 33B (new in 2011), 37D and 33D have damage from marine borers near the ground line. Pile 37A had a ½" wide split at mid height with center rot, 4" shell with 2" rot pocket. See photos 6 and 7.



PHOTO 6 – PILE 21D SHOWING WATER  
RUNNING FROM DRILL HOLE



At several bent locations, there were checks, also referred to as “splits”, present that typically extends from the top of the timber pile to around mid-length of the timber pile. The checks were approximately  $\frac{1}{2}$ ” wide at the maximum width, and tapers down to 0”. At Pile 44A the splits are  $\frac{1}{2}$ ” wide at the top of the pile and extend through the full diameter. No rot was found at the splits.

Piles 5D, 8D, 16D, 19D, 27D, 29B, 30B, 31C, 33B, 37A, 37D and 38D were YELLOW TAGGED with flagging indicating that they should be MONITORED for additional damage during the next inspection. Piles 21D and 22A were RED TAGGED indicating they should be repaired.

Some substructure repairs have been made over the years as part of the routine maintenance of the bridge. At several locations, there are pile repairs that consist of placing a metal “sleeve” or barrel around the spliced area of the timber pile and encasing the area with concrete to create a “splint” for the timber pile. At the top of the new section of timber piling the timber is secured to the pile cap with metal straps and lag screws or bolts. No noticeable deterioration of the splice, other than layer of rust is present on the surface of the metal sleeve.

## Pile Caps

The North abutment cap has extensive rot. The front face has a 2" to 4" shell with rot through the remaining portion of the member. Fill was removed from above the west end and rot was found along the top. The backwall planks are also rotten. The cap was RED TAGGED for replacement. A repair to add temporary shoring is in the current contract. The fill from in front of the wall has been excavated down approx. 3 ft. below the cap and a minimum of 12" out from the front of the cap.

## Bracing

In addition to the timber pile repairs, some lateral bracing had been replaced over the years. Most of the bracing members are in fair condition but three transverse diagonals and eight longitudinal diagonals have extensive rot or are broken and were TAGGED for replacement in 2010. An additional longitudinal brace between piles 22C and 21C was added in 2011. See photo 8.



See APPENDIX D for a more detailed list of substructure defects.

## **Utilities**

### **Gas**

On the west side there is a newer 4½-inch-diameter steel gas line on hangers mounted on the exterior face of the girders.

### **Other**

On the east side there are 2½-inch and 3-inch-diameter steel conduits mounted on the inside of the rail posts and a 4½-inch-diameter PVC conduit mounted outside of the rail posts.

## REPAIR RECOMMENDATIONS

The recommendations made here are to first provide for safety of use at the posted weight and speed and secondly to stabilize and slow down the deterioration of the bridge.

The timeline for the priority of the repairs is based on expected deterioration of the known defects and the corresponding decrease in safety factors. The following priority of repairs and timeline follow guidelines established in the Washington State Bridge Inspection Manual dated December 2006 page 3.06-A-21.

- Priority 1: These are repairs that affect the structural integrity of the bridge or potentially unsafe conditions for vehicle or pedestrian traffic. This type of repair should be completed as soon as possible but with a maximum of 1 year. The time may be shortened in order to verify that repairs have been completed and that safety concerns have been addressed.
- Priority 2: This type of repair is for deficiencies in structural components. These defects do not cause major impact to the safe operations of vehicles or pedestrians. This type of repair should be completed within 2 years.
- Priority 3: These repairs are usually not structural in nature. They are generally “housekeeping” type of repairs. This type of repair has no set timeline.
- Priority 4: These are repairs that require no action other than a monitor of the problem/defect. They are conditions that could evolve into a higher priority repair. A reduced inspection frequency may be necessary to monitor the problem/defect.

**PRIORITY 1 REPAIRS**

<b>LOCATION</b>	<b>ITEM</b>	<b>DEFICIENCIES DESCRIPTION</b>
Bent 21 Pile D	Pile	Marine borer damage at groundline. 2" diameter hole. 2" shell with 6" center rot. Water poured from drill hole. RED TAGGED. See photo 6.
Bent 22 Pile A	Pile	Marine borer damage at groundline. 2" diameter hole. 2" shell with 6" center rot. RED TAGGED. See photo 7.
North Abutment	Cap	The front face has a 2" to 4" shell with rot through the remaining portion of the member. West end has extensive rot along the top. The backwall planks are also rotten. The cap was RED TAGGED. A repair to add temporary shoring is in the current contract.
Bent 17	Transverse Diagonal Brace	Extensive rot. A repair to replace the bracing is in the current contract.
Bent 31	Transverse Diagonal Brace	Extensive rot and brace loose from piles. A repair to replace the bracing is in the current contract.
Bent 32	Transverse Diagonal Brace	Extensive rot. A repair to replace the bracing is in the current contract.
Bents 17 to 18 Piles 17B to 18B	Longitudinal Diagonal Brace	Extensive rot. A repair to replace the bracing is in the current contract.
Bents 17 to 18 Piles 17C to 18C	Longitudinal Diagonal Brace	Extensive rot. A repair to replace the bracing is in the current contract.
Bents 21 to 22 Piles 21B to 22B	Longitudinal Diagonal Brace	Extensive rot. A repair to replace the bracing is in the current contract.
Bents 21 to 22 Piles 21C to 22C	Longitudinal Diagonal Brace	Extensive rot. A repair to replace the bracing is in the current contract.
Bents 23 to 24 Piles 23B to 24B	Longitudinal Diagonal Brace	Extensive rot. A repair to replace the bracing is in the current contract.
Bents 23 to 24 Piles 23C to 24C	Longitudinal Diagonal Brace	Extensive rot. A repair to replace the bracing is in the current contract.
Bents 25 to 26 Piles 25B to 26B	Longitudinal Diagonal Brace	Extensive rot. A repair to replace the bracing is in the current contract.
Bents 27 to 28 Piles 27B to 28B	Longitudinal Diagonal Brace	Extensive rot and broken off. A repair to replace the bracing is in the current contract.
Bents 31 to 32 Piles 31C to 32C	Longitudinal Diagonal Brace	Extensive rot. A repair to replace the bracing is in the current contract.

**PRIORITY 2 REPAIRS**

LOCATION	ITEM	DEFICIENCIES DESCRIPTION
North of the expansion joint at Bent 32	Header	The header on the north side of the joint is cracked and breaking up. See photo 4.

**PRIORITY 4 REPAIRS**

LOCATION	ITEM	DEFICIENCIES DESCRIPTION
Dech Overlay	Asphalt	There is also alligator cracking in a strip that varies from 1 ft. to 2 ft. wide along the centerline of bridge. See photo 2.
Bent 5 Pile D	Pile	Marine borer damage at groundline. There is a 1" diameter hole. YELLOW TAGGED.
Bent 8 Pile D	Pile	3" of center rot with 4" shell near ground. YELLOW TAGGED.
Bent 16 Pile D	Pile	Marine borer holes near ground. YELLOW TAGGED.
Bent 19 Pile D	Pile	Marine borer holes near ground. YELLOW TAGGED.
Bent 27 Pile D	Pile	Full height 1/2" wide split. There is marine borer damage at groundline. YELLOW TAGGED
Bent 29 Pile B	Pile	Marine borer hole near ground. 2" diameter. YELLOW TAGGED.
Bent 30 Pile B	Pile	Marine borer hole near ground. 2 holes. YELLOW TAGGED.
Bent 31 Pile C	Pile	Marine borer hole near ground. 2" diameter hole 6" deep. YELLOW TAGGED.
Bent 33 Pile B	Pile	Rot pocket with 5" shell 7' above ground. YELLOW TAGGED.
Bent 37 Pile A	Pile	1/2" wide split at midheight to top with center rot, 4" shell with 2" center rot. YELLOW TAGGED.
Bent 37 Pile D	Pile	Marine borer damage at groundline. There is a 2" x 1" hole 6" deep. YELLOW TAGGED.
Bent 38 Pile D	Pile	Marine borer damage at groundline. There is a 3" x 1" hole with a 6" shell and 3" center rot. YELLOW TAGGED

Repairs are required at this time to piles 21D and 22A.

The timber cap and backwall at the north abutment have extensive rot. Temporary shoring to support the concrete girders is in the current contract.. A more permanent repair will be required if bridge replacement is not planned within 5 years.

Transverse diagonal bracing at three locations and longitudinal diagonal bracing at eight locations is in the current contract. One additional longitudinal brace should be added to that repair.

The header on the north side of the joint at bent 32 is cracked and breaking up. It should be rebuilt with new anchors and header material.

Future inspections should include cleaning each piling at the ground line and conducting a visual and sounding inspection. In particular the YELLOW TAGGED piles should be monitored for damage. Also the RED TAGGED timber cap at the North abutment should be monitored for any additional deterioration.

The overlay should be monitored for any additional distress.

The bridge inspection cycle should be maintained at 12 months due to the condition of the channel girders and timber pilings.

## Verification of Recommended Repairs

There is a current contract to make the recommended repairs from the 2010 inspection.

The repair to patch the concrete spall in Girder 8E was complete.



Repairs to piles 13A, 35A, 38A and 39A were complete.





PHOTO 14 – PILE 38A REPAIR



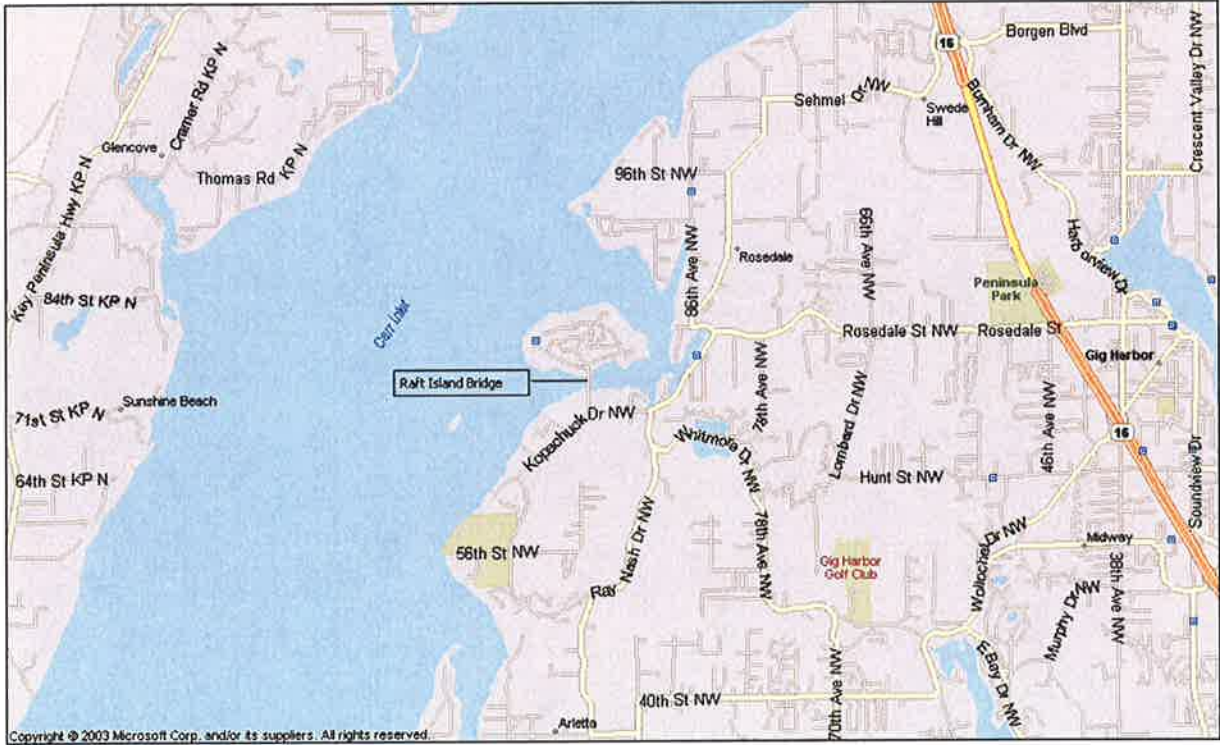
PHOTO 15 – PILE 39A REPAIR

The fiberwrap jacket was installed for Pile 22D and 1 ft. of grout. The repair was scheduled for completion on the following day.



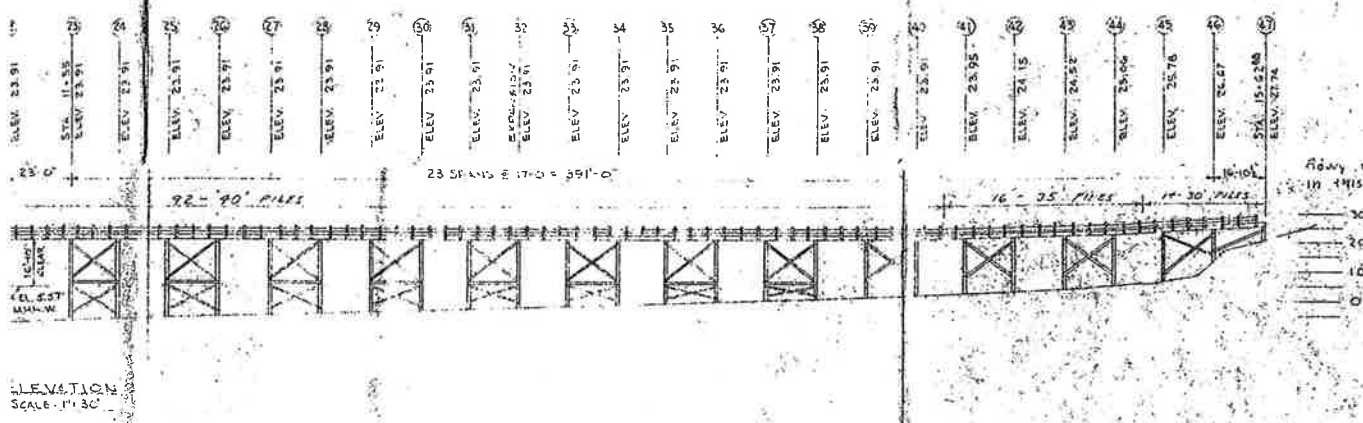
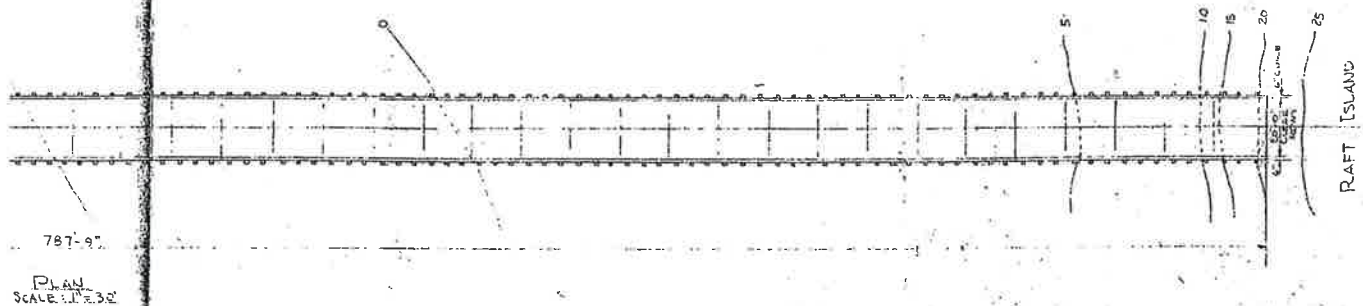
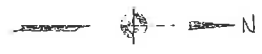
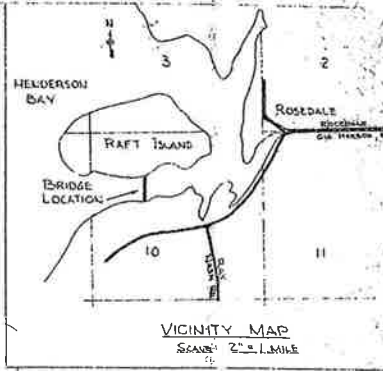
The contractor has scheduled the bracing repairs and abutment shoring during the next set of low tides in 2 weeks.

# APPENDIX A LOCATION MAP



**APPENDIX B**  
**EXISTING DRAWINGS**





**GENERAL NOTES**

1. ALL MATERIAL AND WORKMANSHIP SHALL BE SUBJECT TO THE REQUIREMENTS OF THE SPEC OR VARIATIONS THEREOF AS APPROVED BY THE ENGINEER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE APPROPRIATE AGENCIES AND AGENCIES OF THE STATE OF WASHINGTON.

2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE APPROPRIATE AGENCIES AND AGENCIES OF THE STATE OF WASHINGTON.

3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE APPROPRIATE AGENCIES AND AGENCIES OF THE STATE OF WASHINGTON.

4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE APPROPRIATE AGENCIES AND AGENCIES OF THE STATE OF WASHINGTON.

5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE APPROPRIATE AGENCIES AND AGENCIES OF THE STATE OF WASHINGTON.

STRENGTH SHALL BE TO THE FULLY DEVELOPED STRENGTH OF THE MATERIALS USED. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE APPROPRIATE AGENCIES AND AGENCIES OF THE STATE OF WASHINGTON.

NOTE: DURING USE OF BRIDGE, ALL EXCESSIVE LOADS SHALL BE PROHIBITED.

**APPROXIMATE QUANTITIES**

CONCRETE	16,312 cu. yd. (Not in Contract)
STEEL	1,100 tons
WOOD	1,500 cu. ft.
GRAVEL	1,200 cu. yd.
CRUSHED STONE	363 cu. yd.
CRUSHED BRICK	100 cu. yd.
CRUSHED LIME	100 cu. yd.
CRUSHED SAND	100 cu. yd.
CRUSHED SLAG	100 cu. yd.
CRUSHED COKE	100 cu. yd.
CRUSHED LIGNITE	100 cu. yd.
CRUSHED PEAT	100 cu. yd.
CRUSHED TORF	100 cu. yd.
CRUSHED MOSS	100 cu. yd.
CRUSHED BARK	100 cu. yd.
CRUSHED HULLS	100 cu. yd.
CRUSHED SEEDS	100 cu. yd.
CRUSHED WASTE	100 cu. yd.
CRUSHED SLUDGE	100 cu. yd.
CRUSHED ASH	100 cu. yd.
CRUSHED LIME	100 cu. yd.
CRUSHED SAND	100 cu. yd.
CRUSHED SLAG	100 cu. yd.
CRUSHED COKE	100 cu. yd.
CRUSHED LIGNITE	100 cu. yd.
CRUSHED PEAT	100 cu. yd.
CRUSHED TORF	100 cu. yd.
CRUSHED MOSS	100 cu. yd.
CRUSHED BARK	100 cu. yd.
CRUSHED HULLS	100 cu. yd.
CRUSHED SEEDS	100 cu. yd.
CRUSHED WASTE	100 cu. yd.
CRUSHED SLUDGE	100 cu. yd.
CRUSHED ASH	100 cu. yd.

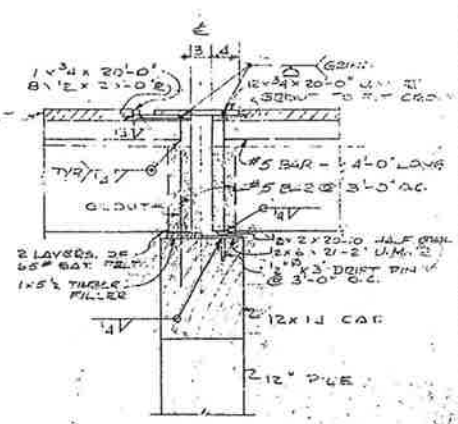
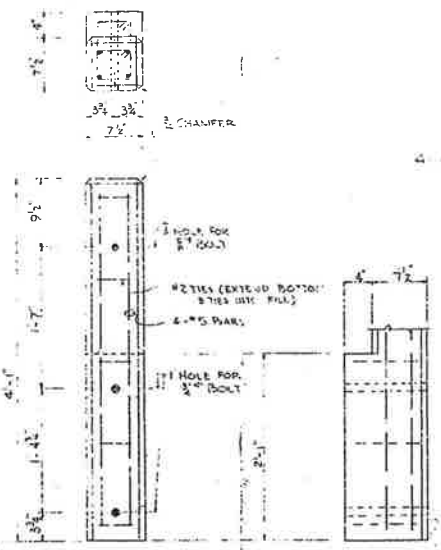
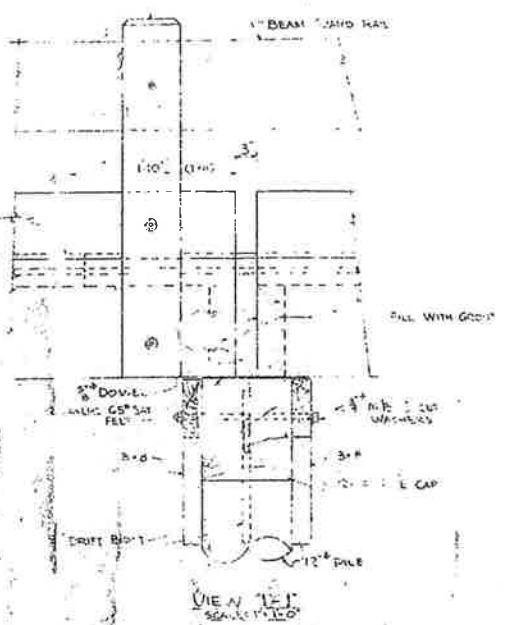


H-15-44 LOADING	
PROFILE FOR RAFT ISLAND BRIDGE FOR	
ARTHUR M. MATTHEWS, 2014 No. 2014, TACOMA, WASH.	
SEITZ & HILL PROFESSIONAL ENGINEERS, 1530 CENTER ST., TACOMA, WASH.	
DRAWN BY T.	CHECKED BY J. J. J. J.
SCALE AS NOTED	SG 254.1
DATE: 8-28-27	

FILE 1028



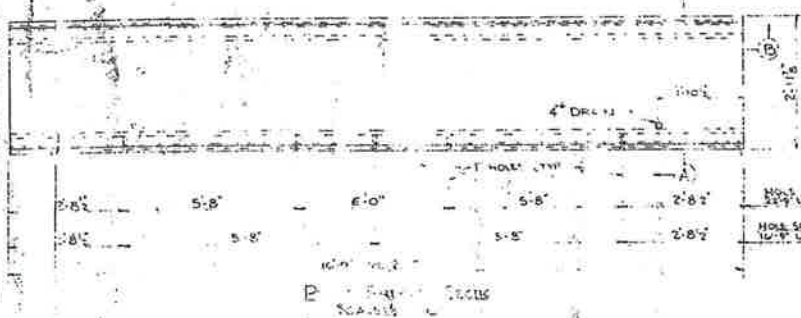
RC JNC. 100% ON 8" A  
545 WOUND ROV. 2A



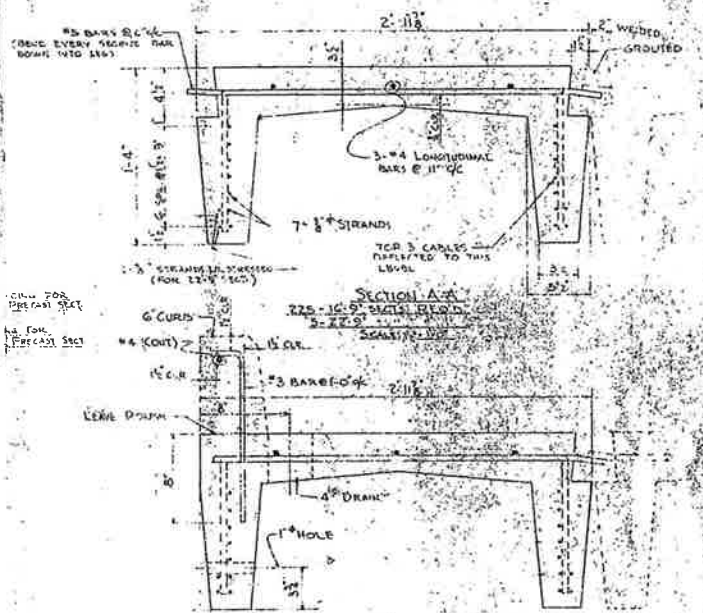
EXPANSION JOINT DETAILS  
AT BENTS #16 & #32

PRECAST CONCRETE POST  
278  
SCALE 1" = 1'-0"

2x2 HALF OVAL  
2x2 LEG  
WELDED 1/2 x 2 x 1/4" FB  
OUTSIDE FACE 5/8"  
EXTERIOR LEG



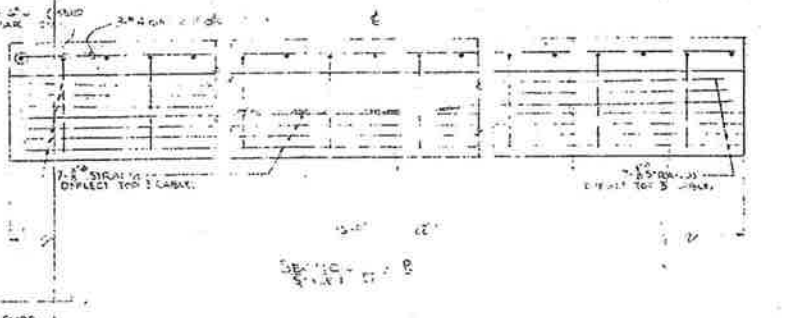
PRECAST CONCRETE POST  
278  
SCALE 1" = 1'-0"



SECT. A-A WITH CURB DOWELS  
90" HIGH STEEL HIGH WITH A 4" DRAIN  
2" x 2" x 1/4" DRAIN  
SCALE 1/2" = 1'-0"



SITTS & HILL  
Professional Engineers  
2000 4th Ave. S.W.  
BOSTON, WASH. 2000



END BENT  
SCALE 1/2" = 1'-0"

FRAMING DETAILS		
FOR RAFT ISLAND BRIDGE		
FOR ARCHIE MATTHEW 3814 N.W. MONROE TACOMA		
SITTS & HILL PROFESSIONAL ENGINEERS CIVIL & STRUCTURAL TACOMA, WASH.		
DRAWN BY: G.L.T.	CHECKED BY: K.O.J.	APP'D BY: [Signature]
SCALE: AS NOTED	56-54-2	
DATE: 8-16-57		

FILE 1028

# APPENDIX C

## SUMMARY OF CHANNEL GIRDER DEFECTS

SPAN	DESCRIPTION
1	Girder A has epoxy patches along soffit centerline.
2	Girder A has epoxy patches along soffit centerline.
3	Girders A and G have epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
4	Efflorescence present at various locations along the bottom edge of the webs. Between Girders D and E there is presence of moisture and some minor rust stains visible.
5	Girders A and G have epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
6	Girder A has epoxy patches along soffit centerline and some efflorescence is present along the bottom edge of the webs at various locations. Cracks are present along the corners of the south end diaphragms of Girders A, B and C.
7	Girders A and G have epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs. East web of Girder G has 5" delamination along lower corner.
8	Girder E east web has a new repair patch. See photo 1. (2011)
8	Girder G has 3" diameter delamination near drain. Moisture and efflorescence present at various locations along the bottom edge of the webs. End diaphragm at north end of Girder B has 4" diameter spall.
9	Girder A and G have epoxy patches along soffit centerline. Moisture and some efflorescence is present along the bottom edge of the webs at various locations. Girder G has a 4" diameter spall with exposed rebar near the drain. (2011)
10	Girders A and G have epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
11	Girders A and G have epoxy patches along soffit centerline. Girder A East web has 8" x 4" x 1" spall. Efflorescence present at various locations along the bottom edge of the webs.
12	Girders A, C and D have small spalls along bottom of webs. Girder

	G has epoxy patches along soffit centerline. Moisture and some efflorescence is present along the bottom edge of the webs at various locations.
13	Girder A has epoxy patches along soffit centerline. Girder F has a 5' long rust stained leaching crack. Girder G has epoxy patches along soffit centerline. Moisture, efflorescence and rust stains present at various locations along the bottom edge of the webs.
14	Girder F has hairline leaching cracking along soffit. Moisture and some efflorescence is present along the bottom edge of the webs at various locations.
15	The girder diaphragms which were identified as cracked and displaced in 2008 at the North end over Bent 16 have been replaced with new concrete diaphragms. Moisture, efflorescence and rust stains present at various locations along the bottom edge of the webs.
16	Three 3" diameter shallow spalls with exposed rebar in soffit of Girder A. There was one additional spall in 2011. Girder G East web has epoxy patch. Moisture, efflorescence and rust stains present at various locations along the bottom edge of the webs.
17	Girder A has epoxy patches along soffit centerline. Moisture, efflorescence and rust stains present at various locations along the bottom edge of the webs. Girders A, B and C have rust stains from the transverse bars leaching through the concrete cover. Girder C shows early signs of concrete delamination at some of these locations.
18	Girder A has epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
19	Girder A has epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs. Three spalls with exposed rebar max. size 6" x 4" with exposed rebar in soffit of Girder G (2011).
20	Girder G has epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
21	Girder A has epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
22	Girder A has epoxy patches along bottom west web and a 4" x 2" spall with exposed rebar (2011). Girder G East web has epoxy patches of spalls identified in 2008. Efflorescence present at various locations along the bottom edge of the webs.

23	Girder A has a spall with exposed rebar (2011). Girder B has 12" long shallow spall and delamination along centerline. Girder G has epoxy patches along soffit centerline. Girder B has exposed steel plate on bottom of West web. Efflorescence present at various locations along the bottom edge of the webs.
24	Girder A has epoxy patches. The West web of Girder E has been patched where there had been exposed prestress strands. Moisture, efflorescence and rust stains present at various locations along the bottom edge of the webs.
25	The west web and soffit of Girder G has been patched. Moisture, efflorescence and rust stains present at various locations along the bottom edge of the webs.
26	Girder A has epoxy patches. The East web of Girder C has been patched where there had been exposed prestress strands. The patch has hairline cracks. Moisture, efflorescence and rust stains present at various locations along the bottom edge of the webs.
27	Girders A and G have epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
28	Girder A has epoxy patches. (2008). Girder G has epoxy patches along soffit centerline. Moisture and some efflorescence is present along the bottom edge of the webs at various locations.
29	A 3" diameter shallow spalls with exposed rebar in soffit of Girder A. There was one additional 3" diameter spall in 2011. This was identified for repair in 2007 but the spall is small and repair is not necessary. Girder A has epoxy patches along soffit centerline. Moisture and some efflorescence is present along the bottom edge of the webs at various locations.
30	Girders A and G have epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
31	The girder diaphragms which were identified as missing in 2008 at the North end over Bent 32 have been replaced with new concrete diaphragms. Girder A has epoxy patches. Girder G has epoxy patches along soffit centerline and a 4" diameter spall with exposed rebar (2011). The web cracks of Girders A and G have been patched at the expansion joint at Bent 32. Moisture and some efflorescence is present along the bottom edge of the webs at various locations.

32	The webs of Girders C, D and G have been patched where there had been exposed prestress strands. There are steel girders under the soffit of Girders A and G to strengthen the girders. There is light rust on the steel girders.
33	Girder G has epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
34	Girder A has epoxy patches along soffit centerline. Spalls identified in 2008 have been patched. Girder G has a small delamination. Moisture, efflorescence and rust stains present at various locations along the bottom edge of the webs.
35	Girder G has epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
36	Girder A has epoxy patches in bottom of west and east web. There is a steel girder under the soffit of Girder A to strengthen the girder. There is light rust on the steel girder. The west web of Girder G has been patched and there is an 8" long spall on the bottom of the web. There is no exposed rebar. The soffit has a 4" diameter spall with exposed rebar (2009). Moisture, efflorescence and rust stains present at various locations along the bottom edge of the webs.
37	Girder A has epoxy patches along soffit centerline. Girder G has a 4" diameter spall with exposed rebar (2011). Efflorescence present at various locations along the bottom edge of the webs.
38	Girders A and G have epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
39	Girders A and G have epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
40	Girders A and G have epoxy patches along soffit centerline. Girder G also has patches on both webs. Efflorescence present at various locations along the bottom edge of the webs.
41	Girder A has epoxy patches along soffit centerline. The west web of Girder A has been patched. The East web of Girder G has been patched. Girder G soffit has several small spalls. Moisture, efflorescence and rust stains present at various locations along the bottom edge of the webs.

42	The west web of Girder A has been patched. There is a steel girder under the soffit of Girder A to strengthen the girder. The girder appears to be coated with a rust inhibitor paint. Girder E has epoxy patches in the soffit. Girder G has a spall in the soffit near the drain with 5" of exposed rebar. Moisture, efflorescence and rust stains present at various locations along the bottom edge of the webs.
43	Girder G west web has a 6" x 3" x 1" deep spall. Moisture, efflorescence and rust stains present at various locations along the bottom edge of the webs.
44	Girder A spalls identified in 2007 have been patched. (2008). Girder A has epoxy patches along soffit centerline. Moisture and some efflorescence is present along the bottom edge of the webs at various locations.
45	Girder A has epoxy patches along soffit centerline. The west web of Girder D has been patched. Moisture, efflorescence and rust stains present at various locations along the bottom edge of the webs.
46	Moisture and some efflorescence is present along the bottom edge of the webs at various locations.

## APPENDIX D

### SUMMARY OF SUBSTRUCTURE DEFECTS

BENT	DESCRIPTION
#2	Longitudinal brace is split at connection to Pile 2A.
#4	Pile 4A has 1/4" wide split over upper 2/3 of length. No rot found.
#4	Pile 4B has 1/4" wide split over upper 3/4 of length. No rot found.
#4	Pile 4C has 1/8" splits on two sides over upper 3/4 of length. No rot found.
#4	Cap has 12" long end split on bottom west end.
#5	Pile 5A has check open to 1/4" at top.
#5	Pile 5D Marine borer damage at 5' above groundline. There is a 1" diameter hole. YELLOW TAGGED.
#8	Pile 8C has split open to 1/4" at bottom.
#8	Pile 8D has many checks. Pile has 4" of center rot with 2" shell near ground. Pile was YELLOW TAGGED (2008).
#9	Cap has full length split along bottom. No rot found.
#11	Pile 11D has concrete filled splice at ground line with metal straps at cap.
#12	Pile 12A has soft surface at bottom and split open to 1/4". No rot found.
#12	Cap has split along bottom on west end open to 1/4".
#13	Pile 13A has been repaired with a fiberwrap jacket and concrete grout. See photo 9.
#13	Pile 13C has concrete filled splice at ground line with metal straps at cap. Several worm holes 7' from ground.
#14	Pile 14B has 1/4" wide split over 7' of length above the horizontal brace. No rot found.
#15	Pile 15B has timber splice 5' below cap.
#15	Pile 15C has marine borer holes near ground. Largest is 1" diameter. No rot found.
#16	Pile 16A has steel collar at cap connection.
#16	Pile 16D Marine borer holes near ground. 2" x 2" x 2" deep hole. YELLOW TAGGED.
#17	Pile 17D has 1/4" wide split from ground 10' long. No rot found.
#17	Rotten Transverse Diagonal Brace Pile 17A to 17D (17D is low end).
#17-#18	Rotten Longitudinal Diagonal Brace Pile 17B to Pile 18B (17B is low end).
#17-#18	Rotten Longitudinal Diagonal Brace Pile 17C to Pile 18C (17C is low end).
#18	Pile 18C has metal strap at cap indicating pile is a replacement.
#19	Pile 19D marine borer holes near ground. 2" diameter x 1" deep. YELLOW TAGGED.
#20	Pile 20A has concrete filled splice at ground line with metal straps at cap.
#20	Pile 20B has 3/16" wide split from ground 10' long. No rot found.
#20	Pile 20C has concrete filled splice at ground line with metal straps at cap.
#21	Pile 21A has concrete filled splice at ground line.

#21	Pile 21D. Marine borer damage at groundline. 2" diameter hole. 2" shell with 6" center rot. Water poured from drill hole. RED TAGGED. See photo 6. This was added to the current repair contract.
#21-#22	Rotten Longitudinal Diagonal Brace Pile 21B to Pile 22B (22B is low end).
#21-#22	Rotten Longitudinal Diagonal Brace Pile 21C to Pile 22C (22C is low end). See photo 8.
#22	Pile 22A. Marine borer damage at groundline. 2" diameter hole. 2" shell with 6" center rot. RED TAGGED. See photo 7. This was added to the current repair contract.
#22	Pile 22D has been repaired with a fiberwrap jacket and concrete grout. See photo 10.
#22	Cap has full length split along bottom.
#23	Pile 23A has concrete filled splice at ground line with metal straps at cap.
#23	Pile 23C had several small worm holes 7 ft above ground.
#23-#24	Rotten Longitudinal Diagonal Brace Pile 23B to Pile 24B (24B is low end).
#23-#24	Rotten Longitudinal Diagonal Brace Pile 23C to Pile 24C (24C is low end).
#24	Pile 24C has 3/16" wide split from ground 15' long. No rot found.
#24	Diagonal brace at top west end has end rot and corner is missing.
#25	Pile 25B has metal strap at cap indicating pile is a replacement.
#25	Pile 25D has concrete filled splice at ground line. There is a small worm hole 4 ft above the repair. There is a 1/2" wide split at top.
#25-#26	Rotten Longitudinal Diagonal Brace Pile 25B to Pile 26B (26B is low end).
#27	Pile 27B has 1" wide split from top 20' long. This is a ring split and appears to be increasing as the split was reported as 1/2" in 2010.
#27	Pile 27D has full height 1/2" wide check. There is marine borer damage at groundline. Hole is small with no rot found. Pile was YELLOW TAGGED (2007).
#27	Diagonal brace at top east end is split with rot.
#27-#28	Rotten Longitudinal Diagonal Brace Pile 27B to Pile 28B (28B is low end).
#28	Pile 28C has concrete filled splice at ground line with metal straps at cap.
#28	Diagonal brace at top west end has rot and is split at the lower connection to Pile 28D.
#29	Pile 29B marine borer hole near ground. 2" diameter and 5" shell with center rot. YELLOW TAGGED.
#30	Pile 30B marine borer hole near ground. 2 holes. YELLOW TAGGED. See photo 12.
#30	Pile 30C has concrete filled splice at ground line with metal straps at cap.
#31	Pile 31A has 3/16" wide split from ground 15' long. No rot found.
#31	Pile 31B has a fiberglass wrap at the groundline.
#31	Pile 31C marine borer hole near ground. 2" diameter hole 6" deep. YELLOW TAGGED. See photo 13.
#31	Diagonal brace at top west end has rot.
#31	Rotten Transverse Diagonal Brace Pile 31A to 31D (31D is low end).
#31-#32	Rotten Longitudinal Diagonal Brace Pile 31C to Pile 32C (32C is low end).
#32	Pile 32A has metal strap at cap indicating pile is a replacement.
#32	Pile 32B has metal strap at cap indicating pile is a replacement.
#32	Pile 32C has concrete filled splice at ground line with metal straps at cap.

	There is a 1/2" wide split over the middle length of the pile.
#32	Pile 32D has metal strap at cap indicating pile is a replacement. There are several small worm holes.
#32	Rotten Transverse Diagonal Brace Pile 32A to 32D (32A is low end).
#33	Pile 33B marine borer hole 7' above ground. 5" shell with center rot. YELLOW TAGGED. There is a 3/8" wide split near ground. No rot found.
#34	Pile 34B has concrete filled splice at ground line with metal straps at cap.
#34	Pile 34C has 1/2" wide split from ground 8' long. No rot found.
#35	Pile 35A has been repaired with a fiberwrap jacket and concrete grout. See photo 13.
#35	Pile 35C has marine borer hole 3' from ground. 1" diameter. No rot found.
#35	Rotten diagonal west end top.
#36	Pile 36C has concrete filled splice at ground line with metal straps at cap.
#37	Pile 37A 1/2" wide split at midheight to top with center rot, 4" shell with 2" center rot. YELLOW TAGGED.
#37	Pile 37C has 1/2" wide split from ground 10' long. No rot found.
#37	Pile 37D 2" x 1" hole 6" deep near ground. YELLOW TAGGED.
#38	Pile 38A has been repaired with a fiberwrap jacket and concrete grout. See photo 14.
#38	Pile 38D has marine borer damage at groundline. There is a 3" x 1" hole. Pile has 6" shell with 3" rot pocket. Pile was YELLOW TAGGED (2008). There is a horizontal brace located 6' above ground that will require relocation if pile is encased.
#38	Diagonal brace at top west end has end rot.
#39	Pile 39A has been repaired with a fiberwrap jacket and concrete grout. See photo 15.
#39	Pile 39C has concrete filled splice at ground line with metal straps at cap.
#40	Pile 40B has concrete filled splice at ground line with metal straps at cap.
#41	Pile 41B has concrete filled splice at ground line with metal straps at cap.
#42	Pile 42C has 1/2" wide split at midheight.
#42	Diagonal brace at top west end has rot.
#43	Rotten diagonal end at both the west top and east top.
#44	Pile 44A has 1/2" wide split starting at top extending down 2/3 the length. The split extends through the full diameter at the top. The pile was repaired in 2009. .
#45	Rotten diagonal east end top.
#47	Cap front face has a 2" to 4" shell with rot through the remaining portion of the member. West end has extensive rot along the top. The backwall planks are also rotten. The cap was RED TAGGED.