Raft Island Improvement Association

2010 Bridge Inspection Report
For Raft Island Bridge

Pierce County, Washington

May, 2010

Prepared by:

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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. For 2010 the piles and bracing would be cleaned by the Raft Island Improvement Association.
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. The lead Inspector conducted a brief site visit on April 29, 2010 to check several bents at low tide. These were bents that were no inspected on April 27, 2010 do to a tide change.

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. It will include a bridge management format for the members, which give the quantities of the members and the condition state of the members.

INSPECTION LOG

Date:	April 27, 2010 (inspection started at 9:00am finishing at 3:00pm)
Weather:	Mostly cloudy with a few sun breaks and rain squalls, 50°
Tides:	Low -1.1 at 11:34am and high 12.8 at 6:10pm
Inspector:	Ron Smith and Greg Reid
Date:	April 29,2010 (inspection started at 3:00pm finishing at 4:00pm)
Weather:	Clear, 60°
Tides:	Low -2.4 at 12:52pm and high 13.6 at 7:53pm
Inspector:	Ron Smith

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.

INSPECTION RESULTS

The 2010 inspection focused on the substructure, which has been noted in previous reports to exhibit varying degrees of deterioration. For 2010 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 8: Girder E east web, 30" x 1" x ½" spall with exposed prestress strand. See photo 1. Span 16: Girder A soffit, three 3" diameter spalls with exposed rebar (2007). Span 29: Girder A has a 3" diameter spall with exposed rebar (2007). Span 36: Girder G has a 4" diameter spall with exposed rebar. Span 42: Girder G, spall with 5" exposed rebar.

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.

South of the expansion joint at Bent 16 there is a 15" x 12" x 2" deep pothole. See photo 2.

South of the expansion joint at Bent 32 there is a 24" x 12" x 2" deep pothole. See photo 3.

At the north abutment there is cracking full width with some smaller "D" cracking. It is anticipated that this cracking will worsen as the rotten timber cap deteriorates.


PHOTO 2 – SPAN 15 POTHOLE
04/27/2010 01:58PM


PHOTO 3 – SPAN 31 POTHOLE
04/27/2010 02:36PM

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. See photo 4.

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.

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.

PHOTO 4 – SOUTH APPROACH EXPANSION JOINT REPAIR

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 recent joint repair. See photo 4. The North Approach has several large patches and is approximately ¾" higher than the bridge which is causing moderate impact to the bridge.

SUBSTRUCTURE

Piles

For 2010 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. At piles 5D (new 2010), 8D, 13A (new 2010), 15C, 16D (new 2010), 19D (new 2010), 21D (new 2010), 22A, 22D, 27D, 29B (new 2010), 30B (new 2010), 31C (new 2010), 35A, 37D (new 2010), 38A, 38D and 39A (new 2010) holes from marine borers were found near the ground line. Pile 22D had a surface rot pocket 12" high x 3" wide x 1" deep at the ground line and a small pocket of center rot. Pile 35A had a surface rot pocket 4" in diameter x 3" deep 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 5 to 17.

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 ½" wide at the maximum width, and tapers down to 0". At Pile 44A the splits are ½" wide at the top of the pile and extend through the full diameter. No rot was found at the splits.

Piles 5D, 8D, 15C, 16D, 19D, 21D, 22A, 27D, 29B, 30B, 31C, 37A, 37D and 38D were YELLOW TAGGED with flagging indicating that they should be MONITORED for additional damage during the next inspection. Piles 13A, 22D, 35A, 38A and 39A 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.

PHOTO 5 – PILE 5D – YELLOW TAGGED DUE TO MARINE BORER DAMAGE

PHOTO 6 – PILE 13A – RED TAGGED DUE TO MARINE BORER DAMAGE AND CENTER ROT


PHOTO 7 – PILE 16D – YELLOW TAGGED
DUE TO MARINE BORER DAMAGE
04/29/2010 02:45PM

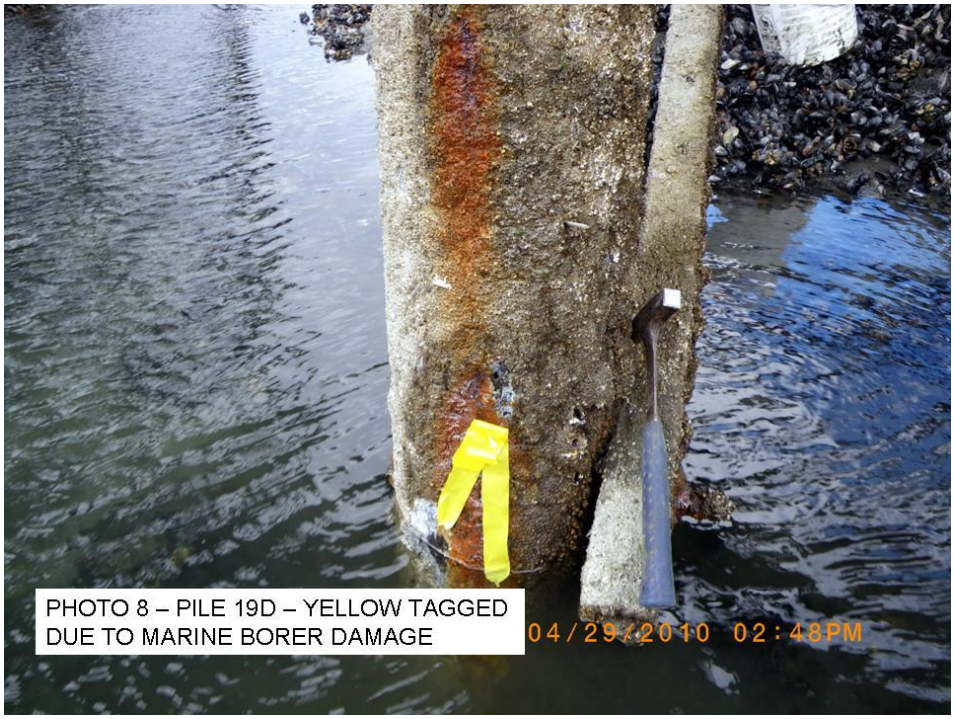


PHOTO 8 – PILE 19D – YELLOW TAGGED
DUE TO MARINE BORER DAMAGE
04/29/2010 02:48PM

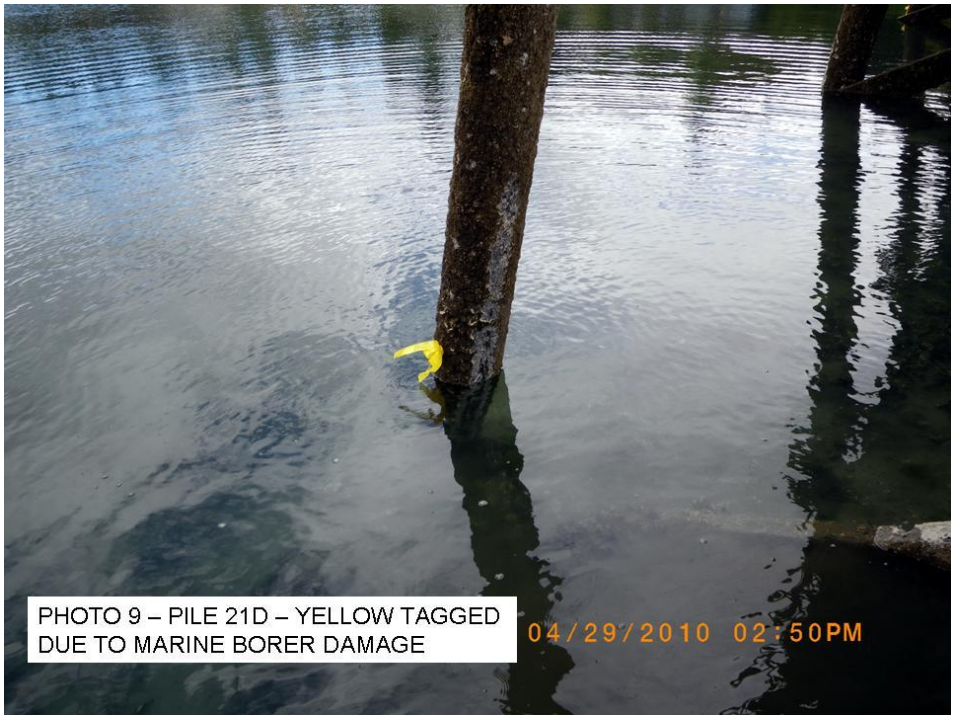


PHOTO 9 – PILE 21D – YELLOW TAGGED DUE TO MARINE BORER DAMAGE

PHOTO 10 – PILE 22D – RED TAGGED DUE TO MARINE BORER DAMAGE AND CENTER ROT

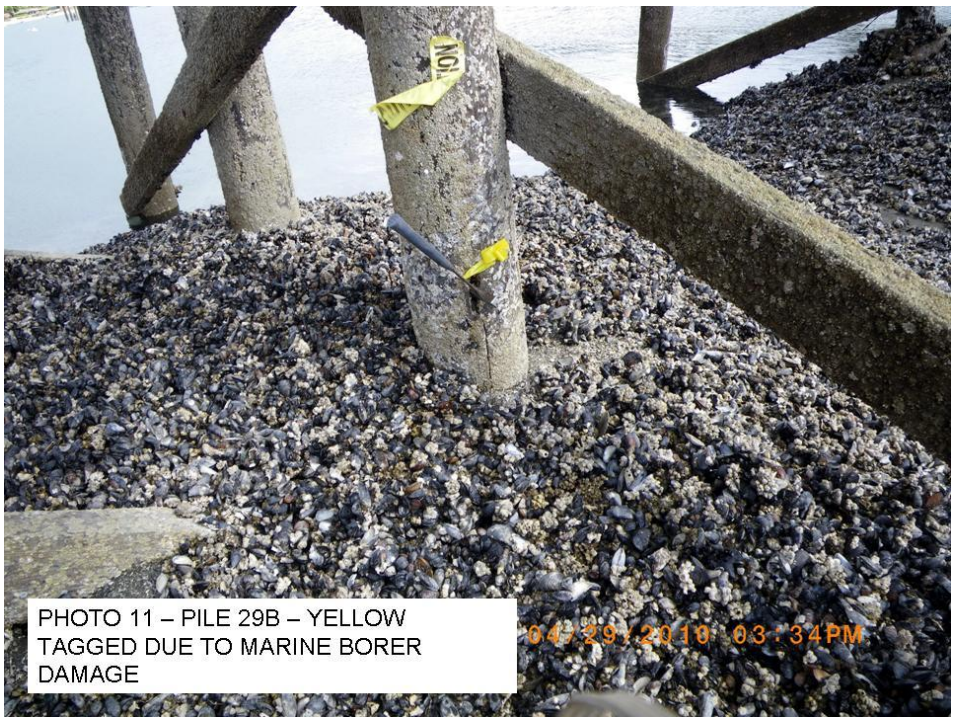


PHOTO 11 – PILE 29B – YELLOW TAGGED DUE TO MARINE BORER DAMAGE

PHOTO 12 – PILE 30B – YELLOW TAGGED DUE TO MARINE BORER DAMAGE

PHOTO 13 – PILE 31C – YELLOW TAGGED DUE TO MARINE BORER DAMAGE

PHOTO 14 – PILE 35A – RED TAGGED DUE TO MARINE BORER DAMAGE AND CENTER ROT

PHOTO 15 – PILE 37D – YELLOW TAGGED DUE TO MARINE BORER DAMAGE

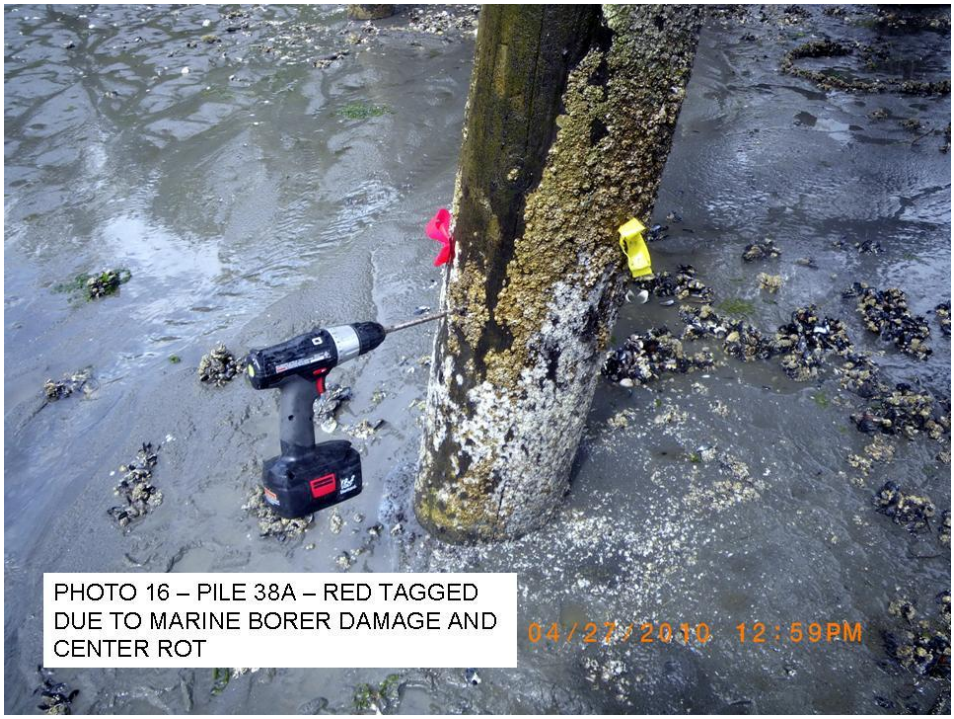


PHOTO 16 – PILE 38A – RED TAGGED DUE TO MARINE BORER DAMAGE AND CENTER ROT

PHOTO 17 – PILE 39A – RED TAGGED DUE TO MARINE BORER DAMAGE AND CENTER ROT

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. See photos 18, 19 and 20.

PHOTO 18 – NORTH ABUTMENT CAP – RED TAGGED DUE TO ROT

PHOTO 19 – NORTH ABUTMENT CAP – RED TAGGED DUE TO ROT

PHOTO 20 – NORTH ABUTMENT CAP – RED TAGGED DUE TO ROT

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. See photos 21 to 30.

PHOTO 21 – BENT 17 ROTTEN TRANSVERSE DIAGONAL BRACE


PHOTO 22 – BENT 31 ROTTEN
TRANSVERSE DIAGONAL BRACE
04/27/2010 12:10PM


PHOTO 23– BENT 32 ROTTEN
TRANSVERSE DIAGONAL BRACE
04/27/2010 12:43PM


PHOTO 24 – BENT 17 TO 18 ROTTEN LONGITUDINAL DIAGONAL BRACES
04/27/2010 11:03AM


PHOTO 25 – BENT 21 TO 22 ROTTEN LONGITUDINAL DIAGONAL BRACE
04/27/2010 11:13AM


PHOTO 26 – BENT 23 TO 24 ROTTEN
LONGITUDINAL DIAGONAL BRACE
04/27/2010 11:34AM


PHOTO 27 – BENT 23 TO 24 ROTTEN
LONGITUDINAL DIAGONAL BRACE
04/27/2010 11:38AM


PHOTO 28 – BENT 25 TO 26 ROTTEN
LONGITUDINAL DIAGONAL BRACE
04/27/2010 11:41AM


PHOTO 29 – BENT 27 TO 28 ROTTEN
LONGITUDINAL DIAGONAL BRACE
04/27/2010 11:51AM

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

LOCATION	ITEM	DEFICIENCIES DESCRIPTION
Span 8 Girder E	Girder	East web has a 30" x 1" x ½" deep spall with exposed prestress strand. See photo 1.
Bent 13 Pile A	Pile	Marine borer damage at groundline. 2" diameter hole 9" deep. 1" shell with 9" center rot. RED TAGGED. See photo 6.
Bent 22 Pile D	Pile	Marine borer damage at groundline. Also surface rot 12" x 3" x 1" deep. 1" shell with soft wet center. RED TAGGED. See photo 10.
Bent 35 Pile A	Pile	4" diameter x 3" deep rot pocket 3' above ground. RED TAGGED. See photo 14.
Bent 38 Pile A	Pile	Marine borer damage at groundline. 2" diameter hole 1" deep. 4" shell with 6" center rot. RED TAGGED. See photo 16.
Bent 39 Pile A	Pile	Marine borer damage at groundline. 2" diameter hole . 4" shell with center rot. RED TAGGED. See photo 17.

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. See photos 18, 19 and 20.
Bent 17	Transverse Diagonal Brace	Extensive rot. See photo 21.
Bent 31	Transverse Diagonal Brace	Extensive rot and brace loose from piles. See photo 22.
Bent 32	Transverse Diagonal Brace	Extensive rot. See photo 23.
Bents 17 to 18 Piles17B to 18B	Longitudinal Diagonal Brace	Extensive rot. See photo 24.
Bents 17 to 18 Piles17C to 18C	Longitudinal Diagonal Brace	Extensive rot. See photo 24.
Bents 21 to 22 Piles21B to 22B	Longitudinal Diagonal Brace	Extensive rot. See photo 25.
Bents 23 to 24 Piles23B to 24B	Longitudinal Diagonal Brace	Extensive rot. See photo 26.
Bents 23 to 24 Piles23C to 24C	Longitudinal Diagonal Brace	Extensive rot. See photo 27.
Bents 25 to 26 Piles25B to 26B	Longitudinal Diagonal Brace	Extensive rot. See photo 28.
Bents 27 to 28 Piles27B to 28B	Longitudinal Diagonal Brace	Extensive rot and broken off. See photo 29.
Bents 31 to 32 Piles31C to 32C	Longitudinal Diagonal Brace	Extensive rot. See photo 30.

PRIORITY 2 REPAIRS

LOCATION	ITEM	DEFICIENCIES DESCRIPTION
South of the expansion joint at Bent 16	Asphalt overlay	15" x 12" x 2" deep pothole. See photo 2.
South of the expansion joint at Bent 32	Asphalt overlay	24" x 12" x 2" deep pothole. See photo 3.

PRIORITY 4 REPAIRS

LOCATION	ITEM	DEFICIENCIES DESCRIPTION
Bent 5 Pile D	Pile	Marine borer damage at groundline. There is a 1" diameter hole. YELLOW TAGGED. See photo 5.
Bent 8 Pile D	Pile	3" of center rot with 4" shell near ground. YELLOW TAGGED.
Bent 15 Pile C	Pile	Marine borer holes near ground. Largest is 1" diameter. YELLOW TAGGED.
Bent 16 Pile D	Pile	Marine borer holes near ground. YELLOW TAGGED. See photo 7.
Bent 19 Pile D	Pile	Marine borer holes near ground. YELLOW TAGGED. See photo 8.
Bent 21 Pile D	Pile	Marine borer hole near ground. 2" diameter. YELLOW TAGGED. See photo 9.
Bent 22 Pile A	Pile	Marine borer damage at groundline. 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. See photo 11.
Bent 30 Pile B	Pile	Marine borer hole near ground. 2 holes. YELLOW TAGGED. See photo 12.
Bent 31 Pile C	Pile	Marine borer hole near ground. 2" diameter hole 6" deep. YELLOW TAGGED. See photo 13.
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 38 Pile A	Pile	Marine borer damage at groundline. There is a 3" x 1" hole and there is center rot with a 4" shell. YELLOW TAGGED. See photo 16.
Bent 38 Pile D	Pile	Marine borer damage at groundline. There is a 3" x 1" hole. YELLOW TAGGED.

Girder 8E has a 30” long spall in the web that is exposing a prestress strand. The strand should be cleaned and the spall patched with epoxy.

In 2009 marine borer damage or rot damage was identified in eight piles and repairs were recommended to two of the piles. In 2010 a total of nineteen piles were identified with marine borer damage or rot damage and repairs are recommended to five piles. This includes 2 of the piles from the 2009 inspection. Repairs are required at this time to piles 13A, 22D, 35A, 38A and 39A.

The timber cap and backwall at the north abutment have extensive rot. Temporary shoring to support the concrete girders should be added at this time. 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 requires replacement at this time.

The asphalt overlay has potholes in spans 15 and 31 that require patching.

Future inspections should include cleaning each piling at the ground line and conducting a visual and sounding inspection. In particular the YELLOW and RED 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 bridge inspection cycle should be maintained at 12 months due to the condition of the channel girders and timber pilings.

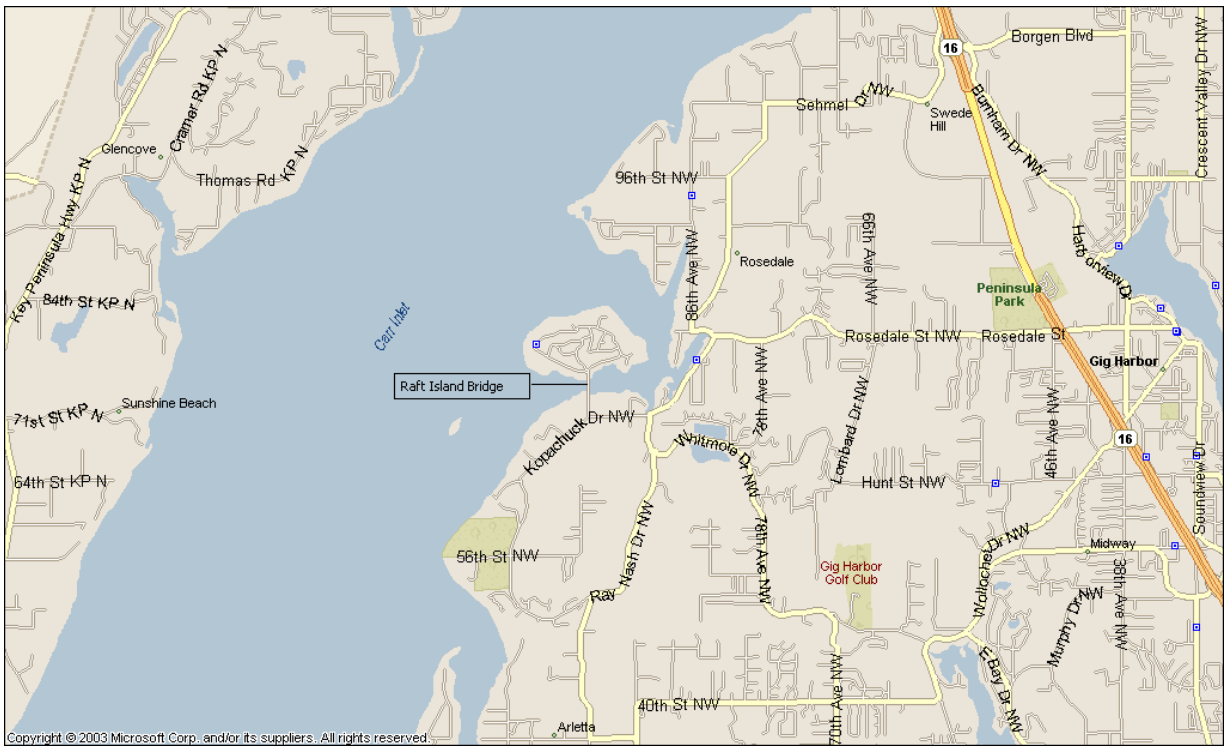
Verification of Recommended Repairs

The repair recommendations from the 2009 inspection were verified as complete with the following exception:

Repairs to piles 22D and 35A were not completed. These will be included with the additional pile repairs required in 2010.

PHOTO 31 – PILE 44A REPAIR

APPENDIX A
LOCATION MAP



APPENDIX B

EXISTING DRAWINGS

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 30” x 1” x ½” spall with exposed prestress strand. See photo 1. (2010)
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.
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. 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.
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. 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 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. 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. 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 patchs 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. 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 groundline. There is a 1" diameter hole. YELLOW TAGGED. See photo 5.
#8	Pile 8C has split open to 1/4" at bottom.
#8	Pile 8D has many checks. Pile has 3" of center rot with 4" 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 marine borer damage at groundline. 2" diameter hole 9" deep. 1" shell with 9" center rot. RED TAGGED (2010). See photo 6.
#13	Pile 13C has concrete filled splice at ground line with metal straps at cap.
#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 colar at cap connection.
#16	Pile 16D Marine borer holes near ground. YELLOW TAGGED. See photo 7.
#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). See photo 21.
#17-#18	Rotten Longitudinal Diagonal Brace Pile 17B to Pile 18B (17B is low end). See photo 24.
#17-#18	Rotten Longitudinal Diagonal Brace Pile 17C to Pile 18C (17C is low end). See photo 24.
#18	Pile 18C has metal strap at cap indicating pile is a replacement.
#19	Pile 19D marine borer holes near ground. YELLOW TAGGED. See photo 8.
#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 hole near ground. 2" diameter. YELLOW TAGGED. See photo 9.
#21-#22	Rotten Longitudinal Diagonal Brace Pile 21B to Pile 22B (22B is low end). See photo 25.
#22	Pile 22A has marine borer damage at groundline. Pile was YELLOW TAGGED (2007).
#22	Pile 22D has marine borer damage at groundline. Also surface rot 12" x 3" x 1" deep and minor center rot, less than 1" rot pocket, and a 3" shell. Pile was RED TAGGED (2009). REPAIR There is a diagonal brace located at ground that will require relocation if pile is encased. 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-#24	Rotten Longitudinal Diagonal Brace Pile 23B to Pile 24B (24B is low end). See photo 26.
#23-#24	Rotten Longitudinal Diagonal Brace Pile 23C to Pile 24C (24C is low end). See photo 27
#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 1/2" wide split at top.
#25-#26	Rotten Longitudinal Diagonal Brace Pile 25B to Pile 26B (26B is low end). See photo 28.
#27	Pile 27B has 1/2" wide split from top 20' long.
#27	Pile 27D has full height 1/2" wide check. There is marine borer damage at groundline. 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). See photo 29.
#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. 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 (31A is low end). See photo 22.
#31-#32	Rotten Longitudinal Diagonal Brace Pile 31C to Pile 32C (32C is low end). See photo 30.
#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.
#32	Rotten Transverse Diagonal Brace Pile 32A to 32D (32D is low end). See photo 23.
#33	Pile 33B has 3/8" wide split near ground. No rot found.
#34	Pile 34B has concrete filled splice at ground line with metal straps at cap.
#35	Pile 35A has 4" diameter x 3" deep rot pocket 3' above ground. RED TAGGED (2009). REPAIR See photo 14.
#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.
#37	Pile 37D 2" x 1" hole 4" deep near ground. YELLOW TAGGED. See photo 15.
#38	Pile 38A has marine borer damage at groundline. There is a 3" x 1" hole and there is center rot with a 4" shell. Pile was RED TAGGED (2010). REPAIR See photo 16.
#38	Pile 38D has marine borer damage at groundline. There is a 3" x 1" hole. No rot was found. Pile was YELLOW TAGGED (2008). REPAIR 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 marine borer damage at groundline. 2" diameter hole . 4" shell with center rot. RED TAGGED. See photo 17.
#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. See photo 31.
#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. See photos 18, 19 and 20.

APPENDIX E

INSPECTION REPORT