REPORT OF

UNDERWATER INVESTIGATION

OF

THE HERBERT C. BONNER BRIDGE

OVER

OREGON INLET

Final Report Date: SEPTEMBER 19, 2006
Prepared for: ALPHA & OMEGA GROUP
By: H.W. LOCHNER, INC.

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Underwater Inspection Team Leader: Mark A. Bostick

Lochner Project 2155

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UNDERWATER INSPECTION EXECUTIVE SUMMARY

An underwater field investigation of the substructure of the Herbert C. Bonner Bridge was conducted by H.W. Lochner, Inc. (Lochner) as a subconsultant to Alpha & Omega for the North Carolina Department of Transportation (NCDOT) between April 4 and May 19, 2006. The purpose of the underwater field investigation was to assess the observed conditions of the substructure elements from the high water mark to the channel bottom. The investigation began with Bent 2 at the north end of the structure and included either a Level I and/or Level II inspection of all principal load-bearing elements of the substructure units through, and including, Bent 200 near the south end of the bridge. A Level I inspection was performed on all underwater elements and a Level II inspection was performed on at least two piles at each bent from Bent 90 south. The following paragraphs summarize the general results of the observed findings and the recommended repairs.

There is widespread vertical cracking throughout the original 22 in. octagonal prestressed concrete piles from Bent 55 southward typically up to 1/16 in. wide. Vertical cracks over 1/16 in. wide were observed on the following: Pile 1 of Bent 66, Pile 3 of Bent 95 and Pile 4 of Bent 95. It is recommended that cracks over 1/16 in. wide be sealed.

At Bents 108 through 123, the original bridge bents have been supplemented with steel H-pile crutch bents (on either side of the original bent). From the high water mark down, the steel H-piles have patches of corrosion loss and light to moderate areas of corrosion, but no significant loss of cross-section.

The original bridge between Bents 123 and 129 was replaced years ago after a vessel collision. The replacement substructure elements (Bents 124 through 128BF) appear in good condition with no observed deficiencies; however, Piles 5 and 6 at Bent 128A are jacketed below the waterline.

Bents 129 through 166 comprise the high level bents. The piles and the undersides of the pile caps for these bents were inspected. At six of the pile caps of these bents, the lower edges are spalled and exhibit exposed reinforcing steel. At more than half of these bents, the underside of the pile caps have cracks to ¼ in. wide which generally run parallel to the pile cap perimeter. Salt water is penetrating the concrete and causing corrosion of the reinforcing steel resulting in the large cracks and the spalls in the edges of the pile caps. It is recommended that the spalls in the pile cap edges be repaired.

The piles in the high level bents exhibit widespread vertical cracking, most of which is 1/16 in. wide or less. The most severe pile deterioration was at Bents 144 and 146. Piles 2 and 9 of Bent 144 and Piles 6, 12 and 16 of Bent 146 have significant spalling of the cover concrete (the outer 3-1/2 in.); Piles 6, 12 and 16

of Bent 146 have exposed reinforcing and prestressing strands. Similar spalling was observed on Pile 5 of Bent 129. It is recommended that these six piles be jacketed to repair the spalls. There is horizontal cracking to 1/8 in. wide in Pile 5 of Bent 129, Pile 13 of Bent 146 and Piles 17 and 20 at Bent 146 near the cap which should be sealed. Pile 7 of Bent 159 was observed to have apparent deterioration of two splices, below the waterline. It is recommended that the upper splice on Pile 7 of Bent 159 be repaired with a jacket. A total of seven piles are recommended to be repaired with jackets: Pile 5 of Bent 129, Piles 2 and 9 of Bent 144, Piles 6, 12 and 16 (two locations) of Bent 146 and Pile 7 of Bent 159.

At Bents 167 through 172, and Bents 187 through 200 the original bents have been supplemented with crutch bents. At each bent, the new crutch bent consists of several subcaps supporting the original bent cap which are resting on precast, American Association of State Highway and Transportation Officials (AASHTO) beam crossing girders. The AASHTO beam crossing girders are supported on two piles caps at the east and west ends of the bent. At each pile caps there are two 66 in. diameter concrete piles. As requested, only the 66 in diameter concrete piles and the portions of the pile caps that were below the high water mark were inspected by the dive team. No significant deficiencies were observed on the large diameter piles. Nearly all the caps, however, exhibit widespread horizontal cracks, typically to 3/16 in. wide but observed up to ¼ in. wide, which are generally located between 1 ft. and 1.5 ft. above the lower edges. The cracks are predominantly located in the north and south faces of the pile caps, but several of the cracks extend around the corners into the east and west faces. Similar to the high level bent pile caps, the cracks are likely caused by salt water infiltration into the concrete and will eventually lead to reinforcement corrosion and spalling of the lower edge. It is recommended that repairs be performed to the pile caps as spalls occur.

At Bents 173 through 186, the original bents have been supplemented with crutch bents comprised of 20 in. square prestressed piles to support the existing original pile bent cap. As requested, only the new square piles were inspected at these bents. Thirteen of the square piles exhibit cracks from hairline width up to 1/8 in. wide. The only observed crack over 1/16 in. wide is on Pile 6 of Bent 186. Pile 1 of Bent 174 has a delaminated area in its southwest edge near the waterline. It is recommended that the delamination in Pile 1 of Bent 174 be repaired.

There is heavy impact damage in the western half of the South Fender between four of the pile clusters which has resulted in a bent lower steel H-pile. The eastern steel pipe pile cluster of the South Fender is no longer tied together with wire wrap. Both fenders have widespread damaged/missing vertical timber rub strips, including marine borer damage through the tidal zone. The steel pipe piles and the wire wraps exhibit light to heavy corrosion. It is recommended that

the impact damage be repaired in the South Fender and the eastern steel pipe piles be tied with a new wire wrap. The damaged/missing vertical timber rub strips should be replaced. There are also timber pile dolphins (with a central steel pipe pile core) at the ends of the North Fender and one just off the east end of Bent 143 which appear to be in fair condition.

Refer to A&O's Assessment Report and NBIS Inspection Report, as well as Wiss Janey Elsner's Material Testing report and Ko and Assoc. and Lochner's Structural Assessment Report for additional and related information and repair recommendations.

FINAL REPORT OF UNDERWATER INVESTIGATION OF THE HERBERT C. BONNER BRIDGE - H.W. LOCHNER, INC. SEPTEMBER 19, 2006

1.0 INTRODUCTION

1.1 Scope

This report consists of the results of a detailed underwater investigation performed by H.W. Lochner, Inc. (Lochner) on the substructure of the Herbert C. Bonner Bridge over the Oregon Inlet in Dare County, North Carolina.

The underwater investigation was conducted by Lochner as a subconsultant to Alpha & Omega Group (A&O). A&O was the prime consultant to the North Carolina Department of Transportation (NCDOT) on this two phase project that included: 1) an NBIS Inspection of the structure from the high watermark up, and 2) a structural assessment that included the underwater investigation. The underwater investigation included a condition assessment inspection of the lower portion of the pile caps and pilings of Bents 2 through 200. The limits of the inspection were from the high water line to the mudline. At the onset of the project, it was agreed that Lochner would not make a scour assessment at the site; however, approximate water depth measurements were taken at each bent inspected during the underwater (diving) portion of the investigation. Limited water depth data was obtained during the walking inspection of the northern portion of the bridge over the marsh area (Bents 2 – 88).

The following sections of this report include a description of the structure, the method of investigation, the observed conditions, and an evaluation with recommendations based on the findings.

1.2 Description of the Structure

The Bonner Bridge was constructed in 1962 and carries NC Route 12 over the Oregon Inlet between Nags Head and Pea Island in North Carolina's Outer Banks. The bridge consists of 204 spans. The original bent numbering system follows the inventory route from north to south, with the north abutment identified as Bent 1 with the bent numbers increasing to the south. After a vessel collision, the original bents numbered 124 through 128 were removed and replaced with seven new pile bents. Since seven bents were used to replace the original five bents, these new bents were renumbered 124 through 128B from north to south. The original bent numbers were retained for the remaining bents south of Bent 128B, beginning with Bent 129. Bents 1 through 123 and the replacement Bents 124 through 128B (to the south of Bent 123) are considered to be the northern approach substructure elements. Bents 129 through 166 are designated as the high level bents and contain the vertical curve that spans over the navigation channel of the inlet. The navigation channel, as defined by the placement of the lighting and fender systems, is between Bents 144 and 145. Bents 167 through 203 are the southern approach substructure elements, but as indicated above, the underwater inspection ended with Bent 200. Bent numbering for the

inspection and for this report follows the numbering system painted on the substructure elements.

Two basic substructure configurations were used for the original approach bents: 1) in-line piles supporting the bent cap, and 2) a combination of in-line piles supplemented with a subcap supported by longitudinally oriented batter piles. In each configuration, all piles are 22 in. prestressed octagonal concrete piles and the outboard, in-line piles are batter piles. Throughout this bridge's life, there have been alterations and additions made to the approach bents including those due to scour problems and a vessel collision incident.

Each of the high level bents (Bents 129 through 166) consists of two reinforced concrete columns supported on a single rectangular reinforced concrete pile cap. There are either one or two struts between the columns, depending upon the column height. Each pile cap is founded on 22 in. prestressed octagonal concrete piles. The number of supporting piles at each bent ranges from 10 to 40. The piles are embedded 2 ft. into the pile cap according to the original construction drawings.

1.3 Purpose and Method of Investigation

The purpose of the underwater field investigation was to assess the observed conditions of the substructure elements from the high water mark to the channel bottom. This inspection was not part of the National Bridge Inspection Standards (NBIS) underwater inspection. Field activities were performed between April 4, 2006 and May 19, 2006 by a three-person inspection team. Personnel were rotated due to the length of the assignment, but at any given time, there were a minimum of two experienced, NBIS qualified team leaders present.

Most of the northern approach bents (Bents 2 through 88) were over marshland areas, so inspection personnel waded/walked this area. An underwater (diving) investigation was performed at Bents 89 through 200. A combination of surface-supplied air diving equipment and commercial SCUBA diving equipment was used and diving operations were staged from Lochner's 25 ft. long boat.

The underwater investigation consisted of two levels of inspection effort as defined by the Federal Highway Administration's Bridge Inspector's Reference Manual and Underwater Inspection of Bridges Manual.

A Level I inspection effort, consisting of a visual and tactile swim-by of the submerged elements with no surface cleaning, was performed on 100 percent of the piling in Bents 89 through 166. The higher numbered bents (Bents 167 through 200) all had additional support elements or crutch bents to supplement

the original substructure units. For these higher numbered bents, the scope of the investigation included Level I inspection of the most recent crutch bent elements. This effort is designed to detect major structural damage or distress. The inspectors used underwater lights and hammers during the inspection. Underwater photographs were taken using an Olympus digital camera in an Ikelite waterproof housing.

A Level II inspection effort was performed on a minimum of two piles at each pier. This technique included removal of marine growth in one foot high bands around the pile perimeter at three locations: the low water line, near the mudline, and midway between the low water line and the mudline. For the 66 in. diameter piles in the south approach crutch bents, two of the four piles were given a Level II inspection, which consisted of scraping one foot high by one foot wide patches at four locations around the pile perimeter, at three elevations: the low water line, near the mudline, and midway between the low water line and the mudline. Marine growth was removed using inspection hammers and pneumatic chipping guns fitted with a wide scraping blade. **Refer to the Table 1, "Level II Inspection Locations Table" in the Appendix** for a list of the piles given a Level II Inspection effort.

Level III inspection efforts which consist of performing physical measurements, non-destructive testing, or partially destructive testing on a limited but representative sampling of components were not within the scope of this investigation.

Soundings were not required nor were they taken along the bridge fascias; however, maximum water depths were obtained by the inspection divers at each bent using their depth gauges. Refer to **Table 2, "Approach Bent Water Depths" and Table 3, "High Level Bent Pile Exposure Heights" in the Appendix** for the water depth measurements obtained by the divers.

2.0 OBSERVED CONDITIONS

2.1 Bents 2 - 107

Bents 2 through 88 are in the marshland immediately south of the north abutment. These bents contain varying numbers of piles and the numbering conventions are identified in **Figure 1, "Approach Bent Numbering Conventions"** in the Appendix. The piles within these bents are either on dry land or in only a couple of feet of water. The underwater inspection team walked the bents looking for deficiencies in areas within the tidal zone.

There are vertical cracks within the tidal zone of 76 of the piles in Bents 2 through 107. Three of these piles, Pile 1 of Bent 66, Pile 3 of Bent 95, and Pile 4 of Bent 95, have vertical cracks that are between 1/16 in. and 1/8 in. wide. Some

of the pile cracks also exhibit corrosion staining. **Refer to Photos 1 and 2** for views of this wider cracking. On the remaining piles, the vertical cracking is hairline width to 1/16 in. wide. **Refer to Photos 3 and 4** for typical views of the 1/16 in. wide cracking.

Pile 1 of Bent 98 has a minor spall up to 1 in. deep, with no exposed reinforcing steel, near the top of the tidal zone.

For a summary of the approach pile bent inspection results, refer to **Table 4, "Pile Inspection Results – North & South Approaches"** in the Appendix.

2.2 Bents 108 - 123

Bents 108 through 123 consist of the standard original 6 and 7 pile configurations with prestressed 22 in. octagonal piles; however, these bents have been supplemented with steel crutch bents. At each bent in this range, there is a short steel H-pile subcap supporting the original bent cap. The ends of the subcap are supported by vertical steel H-piles. On each side of the original bent cap, horizontally mounted channel sections, just above the tidal zone, and steel angle diagonal bracing are welded to the vertical H-piles. The steel members have a marine coating. The numbering conventions used are provided in **Figure 1, "Approach Bent Numbering Conventions" in the Appendix**. Both the vertical steel H-piles and the original concrete piles were inspected in these bents. **Refer to Photo 5** for a typical view of the supplemental H-piles.

Within this bent range, 63 of the concrete piles exhibit vertical cracks, typically to 1/16 in. wide, similar to the cracking described above in the concrete piles of Bents 55 to 107. **Refer to Photo 6** for a typical view of the cracking in the concrete piles.

The steel H-piles exhibit patches of marine coating loss and light to moderate areas of corrosion from the high water mark down. There is no significant visible section loss in the steel piles. **Refer to Photo 7** for a typical view of the condition of the steel piles (from the high water mark down). Above the high water mark, the steel (pile, channels and angles) exhibit light to moderate corrosion, refer to the topside NBIS inspection report prepared by A&O for more details.

For a summary of the approach pile bent inspection results, refer to **Table 4, "Pile Inspection Results – North & South Approaches"** in the Appendix.

2.3 Bents 124 – 128B

The original bridge elements between Bents 123 and 129 (deck, superstructure, and substructure - Bents 124, 125, 126, 127 and 128) have been replaced due to a vessel impact. Seven new bents, labeled 124 through 128B,

were constructed to replace the original Bents 124 through 128. At each of these bents, there are six 24 in. square prestressed concrete piles. The piles in each bent are in-line, with the outboard piles battered away from the structure and the interior piles battered to the north and south in an alternating configuration. **Refer to Photo 8** for a view of Bents 124 through 128B. The numbering convention used is provided in **Figure 1, "Approach Bent Numbering Conventions"** in the Appendix.

There are no significant structural deficiencies on the piles of Bents 124 through 128B from the high water mark down. Piles 5 and 6 of Bent 128A are jacketed below the waterline.

For complete approach pile bent inspection results, refer to **Table 4, "Pile Inspection Results – North & South Approaches"** in the Appendix.

2.4 Bents 129 – 166 (High Level Bents)

Bents 129 through 166 consist of two reinforced concrete columns supporting a reinforced concrete cap. The concrete columns rest on a reinforced concrete pile cap supported by 22 in. prestressed octagonal piles. The number of piles varies from 10 piles to 40 piles depending on the location of the pier. Only the undersides and lower edges of the pile caps and the piles were inspected.

2.4.1 Pile Caps

At six of the pile caps, portions of the lower edges are spalled, exposing the reinforcing and/or the top of an outboard pile. These spalled pile caps are at Bents 139, 143, 151, 159, 163 and 164. The spalls vary in size; however, the largest spall is approximately 1.5 ft. high by 10 ft. long and is in the lower west edge of Bent 159. **Refer to Photos 9, 10 and 11.**

At more than half of the bents, the undersides of the pile caps exhibit cracks typically between 1/16 in. and 1/4 in. wide which run parallel to the edge of the pile cap perimeter. These cracks are approximately 1 ft. in from the edge of the pile cap and are typically located between piles. Corrosion staining is present at many of the cracks. Although the underwater investigation was limited to the underside of the pile caps, it was noted that the sides of numerous pile caps generally exhibit horizontal cracking to 1/8 in. wide approximately 1 ft. above their lower edges. **Refer to Photos 12, 13, 14 and 15** for typical views of this cracking**.**

There are random areas of honeycombing up to 1 in. deep in the undersides of a few of the pile caps. These areas appear to be as-built conditions and no reinforcing steel was observed. **Refer to Photo 16.**

At Bent 145, there is an area of incipient spalling, 2 ft. long by 2 ft. wide, in the underside of the pile caps between the four piles in the northeast corner. **Refer to Photo 17.**

For a summary of inspection results, refer to **Table 5, "High Level Bents 129 – 166 Inspection Findings"** in the Appendix.

2.4.2 Piling

The original pile numbering configurations were not known at the bents, so the underwater inspection team established numbering conventions for this investigation for each of the five basic bent pile configurations used for the high level bents. The numbering conventions used are provided in **Figure 2, "High Level Bent Pile Numbering Conventions"** in the Appendix.

The most severe pile deterioration was observed at Bents 144 and 146. At Bent 146, Piles 6, 12, and 16 all have reduced cross sections due to spalling of the concrete along with exposed and corroded prestressing strands. At Pile 16, the outer approximately 3-1/2 in. of concrete cover has spalled away in the upper 13 ft. beginning near the cap and in the 6 ft. above the mudline. **Refer to Photos 18 and 19.** At Piles 6 and 12, the cover concrete is spalling in the southern quadrant from the tidal zone down 6 ft. and 11 ft., respectively. The cover concrete can be pulled away from the pile around the edges of the deteriorated areas. **Refer to Photo 20.**

At Piles 2 and 9 of Bent 144, spalls up to 2 in. deep are present beginning in the tidal zone and extending downward. The spalls on Piles 2 and 9 are up to 10 ft. high. **Refer to Photo 21**.

Pile 5 of Bent 129 has two spalls up to 3 in. deep, one just below the pile cap and the other approximately 9 ft. below the pile cap. Previous underwater inspections noted a spall on this pile that was up to 4 in. deep with exposed reinforcing located at the mudline, but this spall was not observed during the current underwater inspection. With the constantly shifting channel bottom, the spall at the mudline may be buried or the marine growth may have obscured it.

There is a spall in the south quadrant of Pile 20 at Bent 145 extending from the pile cap underside down. This spall is approximately 2.5 ft. high by 14 in. wide and up to 2 in. deep with a small piece of reinforcing steel exposed. This spall has been documented since at least the September 15, 1993 underwater inspection and does not appear to have deteriorated significantly since that time.

There are minor spalls in the tidal zone at Pile 12 of Bent 131, Pile 1 of Bent 143, Piles 8 and 12 of Bent 144, Piles 21 and 26 of Bent 145, Piles 4 and 7

of Bent 147, Pile 4 of Bent 156, and Piles 6 and 9 of Bent 162. These spalls are typically 1 in. deep, but the spalls at Pile 1 of Bent 143 and Pile 4 of Bent 156 are up to 2 in. deep. Spalls on Pile 12 of Bent 131, Pile 1 of Bent 143, Pile 7 of Bent 147, and Pile 4 of Bent 156 were identified in the previous NCDOT underwater inspection and do not appear to have deteriorated significantly. Pile 7 of Bent 136 has rounded corners in the tidal zone which may be due to construction handling abrasion.

Of the 544 piles inspected at the high level bents, vertical cracking was observed on 71 piles (13 percent) during the Level I and II inspection effort. Of these 71 piles, 46 piles (65 percent) exhibit hairline width vertical cracks and the remaining 25 piles have cracks up to 1/16 in. wide. **Refer to Photos 22 and 23** for typical views of the cracking observed.

The underwater inspection reports prior to the 2001 NCDOT underwater inspection provide extensive lists of cracking in the piles. The 2001 NCDOT underwater inspection reduced the pile crack list considerably by only noting the cracks greater than 1/16 in. wide. Visual verification of all cracks previously identified is not possible using Level I and II inspection techniques due to the amount of marine growth.

In addition to the previously noted spalling, Pile 5 at Bent 129 exhibits a horizontal crack up to 1/8 in. wide around the pile circumference, just below the pile cap. **Refer to Photo 24**. Piles 13, 17 and 20 at Bent 146 also exhibit horizontal cracking from 1/16 in. to 1/8 in. wide located near the pile cap underside. The horizontal crack at Pile 17 of Bent 146 extends around the entire circumference of the pile, but the cracks at Piles 13 and 20 do not.

In Bent 159, Pile 7 exhibits two deteriorated splice sections. The first is located approximately 23 ft. below the underside of the pile cap and the second is at the mudline. At the upper splice, the deterioration is most severe with the pile exhibiting an hourglass shape. **Refer to Photo 25**. The splice at the mudline at this pile has minor deterioration. **Refer to Photo 26**. At Bent 160, Pile 4 also has a deteriorated splice near the mudline.

There is minor matrix loss at the mudline of Piles 2, 6, 9 and 12 of Bent 158 and at Pile 1 of Bent 159. At each of these piles, the lower 1 ft. to 2 ft. above the mudline was soft and could be removed with a chipping hammer down approximately ¼ in. to aggregate.

For a summary of inspection results, refer to **Table 5, "High Level Bents 129 – 166 Inspection Findings"** in the Appendix.

Diver-measured maximum water depths are provided in **Table 3, "High Level Bent Exposure Heights"** in the Appendix. The distance from the waterline (at the time of inspection) to the underside of the pile cap was added to

the maximum water depth to obtain a maximum pile exposure height. The maximum water depth of 42 ft. (and consequently the maximum pile exposure height of approximately 44 ft.) occurs at Bent 149.

2.5 Bents 167 – 172 (Within the South Approach)

Bents 167 through 172 consist of the standard approach octagonal pile bents, but they have been supplemented with crutch bents consisting of reinforced concrete subcaps supported by AASHTO beam crossing girders on two reinforced concrete rectangular pile caps. Each of the rectangular caps is founded on two 66 in. diameter reinforced concrete piles. **Refer to Photo 27** for a view of the typical bent configuration. Only the lower portions of the pile caps (in the tidal zone) and the 66 in. diameter concrete piles were inspected.

2.5.1 Pile Caps

At Bents 168 through 172, the "new" pile caps exhibit horizontal cracks, to 3/16 in. wide, typically located between 1 ft. and 1.5 ft. above the cap's lower edge. These cracks are predominantly in the north and south ends of the caps and sometimes wrap around the edges to the east and west sides. **Refer to Photo 28** for a typical view of the cracking.

For a summary of inspection results of the pile caps, refer to **Table 6, "'New' Pile Cap (Bents 167-172 & Bents 187-200) Inspection Findings"** in the Appendix.

2.5.2 Piling

Per the scope of this investigation, only the 66 in. diameter piles were inspected at Bents 167 through 172. These 66 in. diameter piles (four per bent) are all in good condition; no significant structural deficiencies were observed.

Water depths at Bents 166 through 172 are included in **Table 2, "Approach Bent Water Depths"** in the Appendix.

2.6 Bents 173 – 186 (Within the South Approach)

At Bents 173 through 186, the original pile bents have been supplemented with either six or eight, 20 in. square prestressed piles. Only these new square piles were included within the scope of the inspection. **Refer to Photo 29** for a typical view of the configuration of these bents.

On thirteen of the piles in these bents, vertical cracks ranging in size from hairline width to 1/8 in. wide were observed. On eight of the piles, the cracks are located near the mudline. The remaining cracks are in the tidal zone. The only

crack over 1/16 in. wide is on Pile 186-6 in the tidal zone. **Refer to Photo 30** for a view of the crack on Pile 186-6.

Pile 174-1 has an area of delamination, 2 ft. high by 8 in. wide, located in its southwest edge approximately 14 ft. below the original bent cap. No corrosion staining was observed. **Refer to Photo 31** for a view of the delaminated area.

For a summary of the approach pile bent inspection results, refer to **Table 4, "Pile Inspection Results – North & South Approaches"** in the Appendix.

2.7 Bents 187 – 200 (South Approach)

Bents 187 through 200 are configured similar to Bents 167 through 172 with the original bent caps having supplemental subcaps supported by AASHTO beam crossing girders which are in turn supported on two "new" reinforced concrete caps for four 66 in. diameter piles. Only the lower portions of the pile caps (in the tidal zone) and the 66 in. diameter concrete piles were inspected.

2.7.1 Pile Caps

At Bents 187 through 199, one or both of the "new" caps exhibit horizontal cracking similar to the caps for Bents 168 through 172. The "new" pile caps exhibit horizontal cracks which are mostly 1/8" wide; however, some are up to 1/4 in. wide. These horizontal cracks are located between 1 ft. and 1.5 ft. above the cap's lower edge. These cracks are predominantly in the north and south ends of the caps and often wrap around the edges to the east and west sides.

A few of the "new" caps exhibit map cracking that extends above the tidal zone. **Refer to Photo 32** for a view of some of this "new" cap cracking above the tidal zone.

At Bent 200, the lower 1 ft. of the web and the lower flange of the AASHTO crossing girders are within the tidal zone and in good condition.

For a summary of inspection results of the pile caps, refer to **Table 6, "'New' Pile Cap (Bents 167-172 & Bents 187-200) Inspection Findings"** in the Appendix.

2.7.2 Piling

The 66 in. diameter piles beneath the "new" caps were inspected at Bents 187 through 200. Overall, these 66 in. diameter piles (four per bent) appear in good condition. The northwest 66 in. diameter pile at Bent 197 has a void 2 in. high by 4 ft. long by 5 in. deep, with no reinforcing steel observed, located just below the underside of the "new" cap. This void appears to be construction-

related. The remaining 66 in. diameter piles do not exhibit any significant structural deficiencies. **Refer to Photo 33** for a view of this void.

For complete approach pile bent inspection results, refer to **Table 4, "Pile Inspection Results – North & South Approaches"** in the Appendix.

2.8 Fenders and Bent 143 Dolphin

The fender systems at Bents 144 and 145 each consist of sixteen three-pile clusters of 24 in. diameter, concrete filled pipe piles that support four steel I-beam wales. There are 12 in. x 12 in. horizontal timbers mounted to the steel wales. Vertical 6 in. x 12 in. timbers are mounted to the 12 in. x 12 in. timbers as rub strips. The existing fender configuration does not match the original drawings. Refer to **Figure 3, "Fender Configurations"** in the Appendix for the numbering conventions used during the underwater inspection.

2.8.1 North Fender

The pipe piles and wire wraps for the clusters typically exhibit light to moderate corrosion above the waterline. **Refer to Photo 34** for a typical view of the corrosion exhibited on the steel elements of both fenders.

Along the length of the north fender, there are approximately 23 missing or heavily damaged vertical timber rub strips. In addition, most of the timber rub strips have heavy to severe marine borer damage within the tidal zone. **Refer to Photos 35 and 36** for views of damaged timber elements of the North Fender.

At Clusters 8 and 9, the wire wraps exhibit heavy corrosion and the top wraps are loose.

At each end (east and west) of the North Fender, there is a dolphin that consists of a two-foot diameter steel pipe pile (concrete filled) at the center surrounded by an inner and outer ring of 12-inch diameter timber piles that are made up of 8 and 16 piles, respectively. There is one timber pile in the western quadrant of the west dolphin that is broken off at the top of the tidal zone. The remaining timber piles are in satisfactory condition. The wire wraps at each dolphin exhibit moderate corrosion.

2.8.2 South Fender

In general, the pipe piles and wire wraps for the clusters typically exhibit light to moderate corrosion above the waterline, similar to the North Fender. **Refer to Photo 34**.

At Cluster 1, the wire wraps are missing and the piles no longer act together as a cluster. The middle wire wrap is missing at Cluster 6. At Cluster 16, there is heavy corrosion to the wire wraps. **Refer to Photo 37** for a view of the loose piles at Cluster 1.

There is heavy impact damage to the lower steel wales, timber backing boards and timber rub strips between Clusters 10 and 13. **Refer to Photo 38** for a view of the impact damage.

Along the length of the South Fender, there are approximately 31 missing or heavily damaged vertical timber rub strips, not including the missing strips between Clusters 10 and 13. Numerous timber rub strips exhibit marine borer damage within the tidal zone. **Refer to Photo 39** for a view of the damaged vertical timber rub strips on the South Fender.

2.8.3 Bent 143 Dolphin

There is a timber pile cluster dolphin just off the east end of Bent 143. The timber piles of this Bent 143 Dolphin are in satisfactory condition. The top wire wrap is loose.

For a summary of findings of the fender and dolphin inspection, refer to **Table 7, "Fender Deficiencies"** in the Appendix.

3.0 EVALUATION AND RECOMMENDATIONS

There is widespread vertical cracking throughout the original 22 in. octagonal piling from Bent 55 south, most of which is within the tidal zone. The vertical cracks may be from shrinkage, age, manufacturing flaws, or some other unknown mechanism. The available plans indicate that there should be 3.5 in. of cover concrete for the reinforcing in the octagonal piles. An open crack in a pile, especially in the tidal zone, provides an avenue for intrusion of salt water into the pile, making the interior steel susceptible to corrosion. It is recommended that the open cracks, 1/16 in. or greater, be sealed. Prestressing strands lose their effectiveness more rapidly than regular reinforcing bars when corrosion sets in, so they need to be protected.

At the high level bent pile caps, the spalling of the lower edges and cracking in the underside and/or vertical face near the lower edges, is typical of spalls and cracks resulting from penetration of salt water, oxygen and chlorides into the concrete resulting in corrosion of the reinforcing steel. The underside of each pile cap is essentially the upper end of the tidal zone. The pile caps that currently exhibit cracking in their underside will likely exhibit spalls in the future, like those on the six bents identified in Section 2.1.1. The cracks provide avenues for salt water infiltration into the concrete which result in reinforcing steel corrosion. These deficiencies are occurring adjacent to the exterior piles and they effectively reduce the amount of embedment. All spalls in the pile cap lower edges should be repaired. As this structure ages, more of the lower edges will likely spall away. For this reason, repairs for the spalls should regularly be performed as a matter of routine maintenance.

The incipient spall on the underside of Bent 145 and the random honeycombing are not structurally significant at this time, but should be monitored during future inspections and possibly recommended for repair in the future.

Underwater inspection reports from September 15, 1993; September 11, 1997; and July 17, 2001 were made available by NCDOT. The most severe spalls observed and reported during this inspection, at Bents 144 and 146, do not appear to have been identified in the previous reports. Marine growth may have hindered the detection of the spalled piles during the previous inspections or the concrete may have spalled since the last inspection in 2001.

The spalls at Piles 6, 12 and 16 at Bent 146, and Pile 5 at Bent 129 should be repaired with a high priority. The capacity of these piles has been significantly reduced due to exposure and corrosion of the prestressing strands. Structural jackets are recommended to be installed on the piles, or if the overall reduction in bent capacity warrants, replacement or supplemental piles may be necessary.

Piles 2 and 9 at Bent 144 should be repaired with structural jackets with high priority. The deterioration is similar to that on Piles 6, 12 and 16 of Bent 146, but not as advanced at this time.

The spalls on Pile 12 of Bent 131, Pile 1 of Bent 143, Piles 8 and 12 of Bent 144, Piles 21 and 26 of Bent 145, Piles 4 and 7 of Bent 147, Pile 4 of Bent 156, and Piles 6 and 9 of Bent 162, and the rounded corners on Pile 7 of Bent 136 are minor deficiencies and no repair is necessary at this time. These piles should be carefully examined during future underwater inspections because the reduction in cover at the spall areas and the presence of cracks make them more susceptible to salt water intrusion.

The cause of the horizontal cracking in Pile 5 of Bent 129 and Piles 13, 17, and 20 at Bent 146 was not evident. The cracking did not appear to be at

splice locations. The horizontal cracks should be sealed similar to the open vertical cracks for the same reason.

The deteriorated splice at Pile 7 of Bent 159 reduces the capacity of the pile. It is recommended that the deteriorated splice, located approximately 23 ft. below the underside of the pile cap, be repaired with a structural jacket. No repair is recommended for the splice at the mudline at this time.

The matrix loss at the four piles at Bent 158 and one pile at Bent 159 is minor and appears to be isolated at this time. No repairs are recommended at this time for this condition.

The pile exposure heights obtained during this inspection are not hydrographic/fathometric survey-accurate but they provide a good representation of the actual conditions at the time of the inspection. The channel bottom at this site is highly susceptible to significant changes within relatively short timeframes according to NCDOT and as evidenced by the ongoing fathometric studies and the US Army Corps of Engineers' aggressive dredging operations in the main channel.

The cracking of the "new" pile caps for the 66 in. diameter piles at Bents 168 through 172 and Bents 187 through 199 is likely due to penetration of salt water, oxygen and chlorides into the concrete resulting in corrosion of the reinforcing steel, as with the pile caps of the high level bents. The cracks provide avenues for salt water infiltration into the concrete which result in reinforcing steel corrosion. This type of cracking will likely continue to propagate, eventually leading to spalling of the lower edges of these "new" caps. In general, these types of cracks do not need repair until a spall occurs and the reinforcing steel is exposed. However, cracks that are open more than ½ in. and still have not generated a spall should be opened and repaired because they are allowing about the same amount of exposure of the reinforcing steel to the outside environment as a spall. Repairs for the "new" caps should be accomplished as a matter of routine maintenance.

The delaminated area on Pile 174-1 does not appear to significantly affect the structural integrity of the pile at this time; however, the area should be repaired as a preventative measure against future corrosion. A repair performed at this time would also allow for verification whether the prestressing strands are exposed/corroded.

The void in the northwest 66 in. diameter pile at the western "new" cap at Bent 197 does not appear to be structurally significant at this time and no repairs are recommended at this time.

The effectiveness of the fender system is not substantially reduced because of the missing/damaged timber rub strips; however, small fishing boats

that operate around the fenders could potentially receive impact damage from the exposed steel elements of the fender system. The missing and damaged vertical rub strips are recommended to be replaced.

The piles of Cluster 1 of the South Fender are not tied together, so the lateral capacity of the fender is reduced at this location. New wire wraps are recommended to be installed at Cluster 1. In general, the wire wraps of all the clusters will require replacement over the next several years.

The impact damage between Clusters 10 and 13 of the South Fender is recommended to be repaired. The ability of the fender to resist impact at this location is lowered and the damaged areas could potentially inflict damage on small boats that are operating around the fender.

The timber dolphins at the east and west ends of the North Fender appear to be functioning as designed and therefore no repairs are recommended at this time. The wire wraps will likely continue to corrode and require future replacement.

It is recommended that NCDOT continue to have this structure and the channel inspected to monitor changing conditions and to identify areas that require further analysis and repairs.

APPENDIX G.1 – FIGURES

FIGURE 1. APPROACH BENT NUMBERING CONVENTIONS

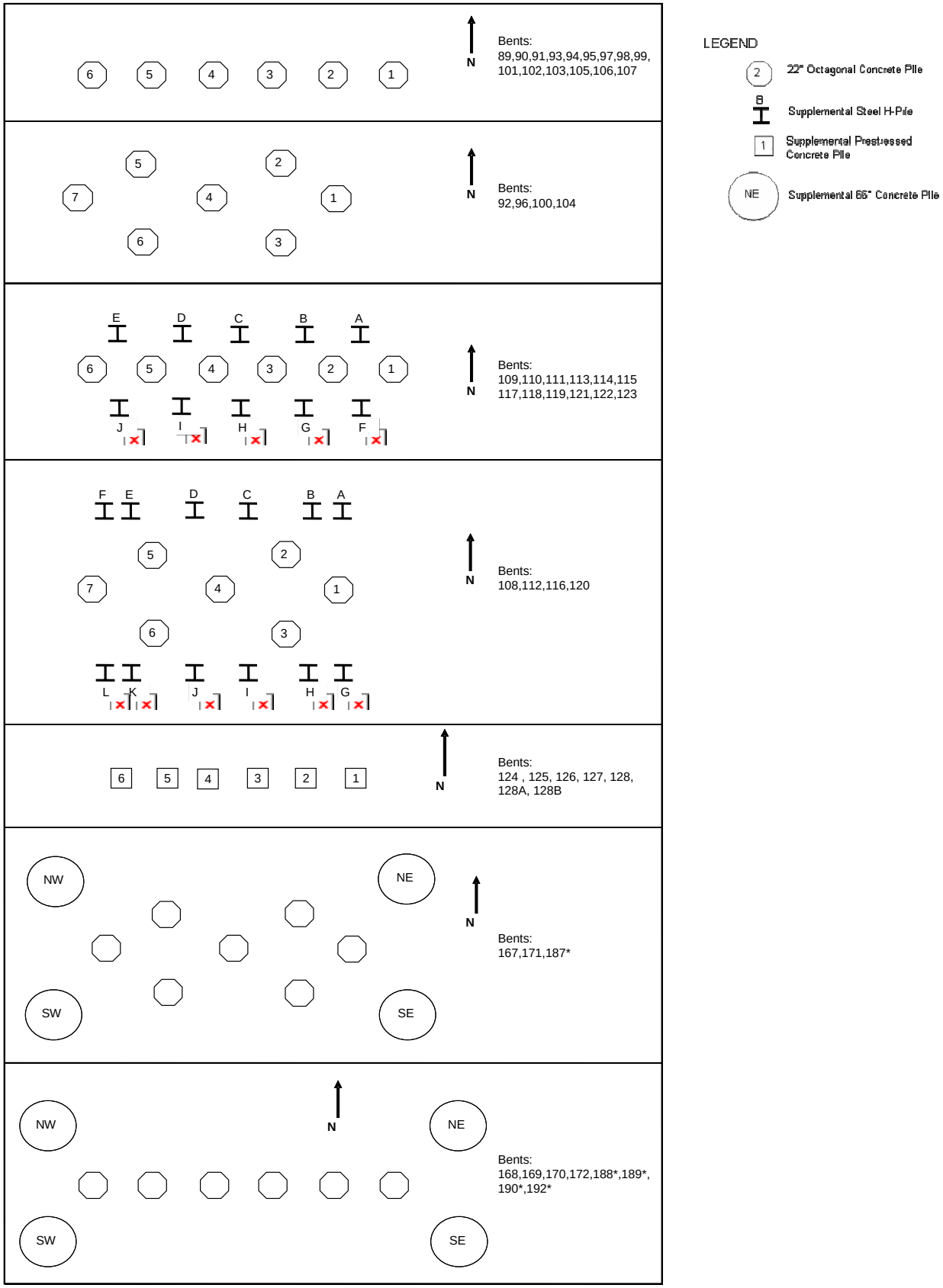
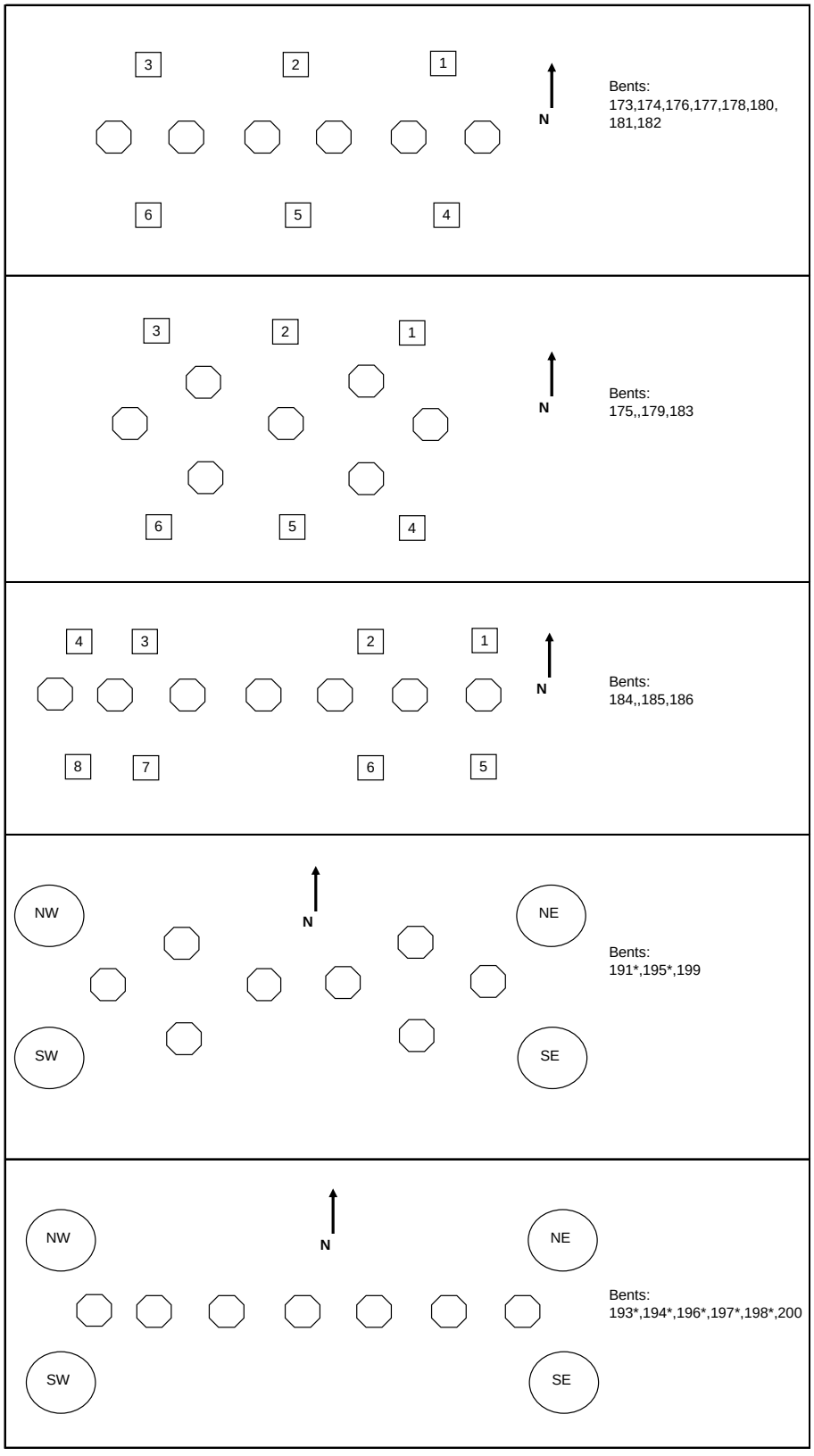


FIGURE 1. APPROACH BENT NUMBERING CONVENTIONS (CONT.)



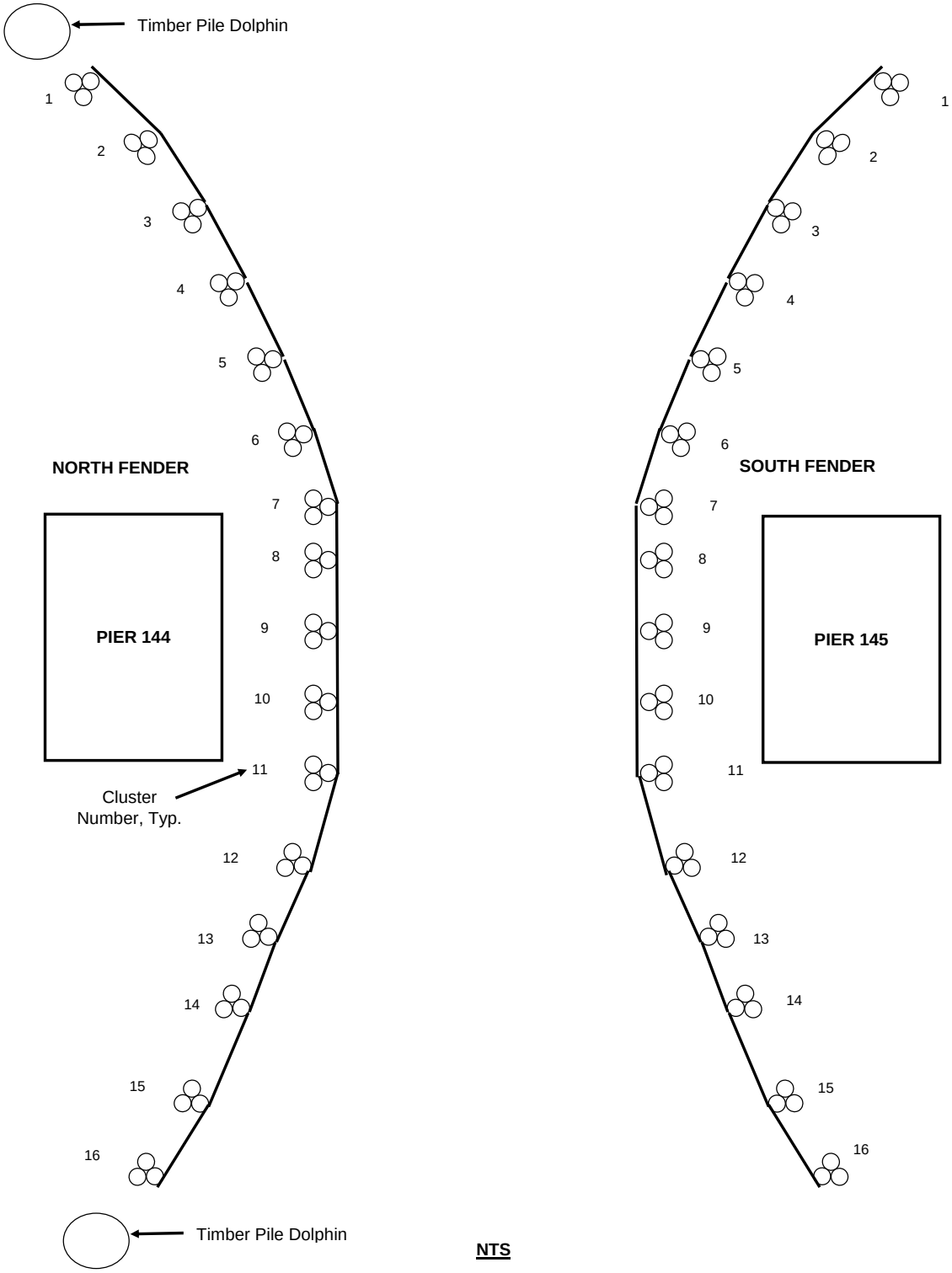
* - These bents also have deteriorated/ineffective steel H-pile and cap crutch bents in place (not shown)

FIGURE 2. HIGH LEVEL BENT PILE NUMBERING CONVENTIONS

LEGEND:

2 — 22" Octagonal Concrete Plle

FIGURE 3. FENDER CONFIGURATIONS



NTS

APPENDIX G.2 – PHOTOGRAPHS

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PHOTO 4	TYPICAL VERTICAL CRACKING AT PILE 6 OF BENT 55
PHOTO 5	TYPICAL CONFIGURATION OF APPROACH BENT SUPPLEMENTED WITH H-PILES (BENT 115 SHOWN)
PHOTO 6	CRACKING IN CONCRETE PILE AT PILE 2 OF BENT 115
PHOTO 7	TYPICAL CONDITION OF STEEL H-PILE IN TIDAL ZONE (PILE I OF BENT 115 SHOWN)
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PHOTO 15	HORIZONTAL CRACKING IN LOWER PORTION OF EAST FACE OF BENT 159 PILE CAP, TYPICAL
PHOTO 16	HONEYCOMBING IN UNDERSIDE OF BENT 144 PILE CAP
PHOTO 17	INCIPIENT SPALL IN UNDERSIDE OF BENT 145 PILE CAP IN NORTHEAST CORNER
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PHOTO 20	SPALLING (NOTE DELAMINATED CONCRETE) AT PILE 12 OF BENT 146
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PHOTO 29	SUPPLEMENTAL PILES AND CAPS AT BENTS 173 THROUGH 186
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PHOTO 32	CRACKING IN NORTH END OF EAST “NEW” CAP AT BENT 189 EXTENDING ABOVE THE TIDAL ZONE
PHOTO 33	VOID IN THE NORTHWEST 66 IN. DIAMETER PILE AT BENT 197 UNDER THE WEST “NEW” CAP
PHOTO 34	TYPICAL CORROSION ON STEEL ELEMENTS OF FENDER ABOVE THE HIGH WATER MARK, SOUTH FENDER SHOWN
PHOTO 35	DAMAGED TIMBER RUB STRIPS NEAR THE WEST END OF THE NORTH FENDER
PHOTO 36	DAMAGED TIMER RUB STRIPS AND BACKING TIMBER, NORTH FENDER SHOWN BETWEEN CLUSTERS 2 & 3
PHOTO 37	LOOSE PILES AT CLUSTER 1 OF THE SOUTH FENDER
PHOTO 38	IMPACT DAMAGE BETWEEN PILE CLUSTERS 10 AND 13 OF THE SOUTH FENDER
PHOTO 39	DAMAGED/MISSING TIMBER RUB STRIPS IN THE WEST END OF THE SOUTH FENDER

PHOTO 1: CRACKING TO 1/8 IN. WIDE WITH CORROSION STAINS AT PILE 3 OF BENT 95

PHOTO 2: CRACKING TO 1/8 IN. WIDE WITH CORROSION STAINS AT PILE 4 OF BENT 95

PHOTO 3: TYPICAL VERTICAL CRACKING AT PILE 1 OF BENT 106

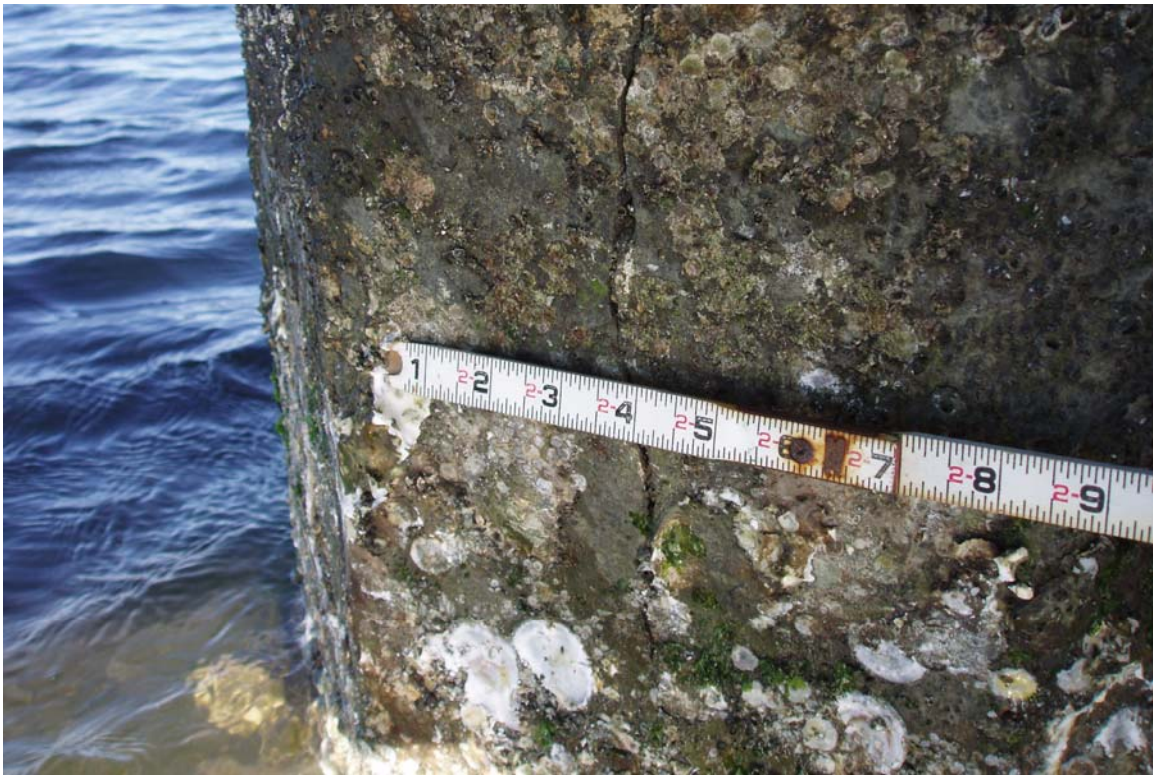

PHOTO 4: TYPICAL VERTICAL CRACKING AT PILE 6 OF BENT 55

PHOTO 5: TYPICAL CONFIGURATION OF APPROACH BENT SUPPLEMENTED WITH H-PILES (BENT 115 SHOWN)

PHOTO 6: TYPICAL CRACKING IN CONCRETE PILE AT PILE 2 OF BENT 115

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PHOTO 8: BENTS 124 THROUGH 128B, LOOKING NORTH

PHOTO 9: SPALL IN LOWER WEST EDGE OF BENT 143

PHOTO 10: SPALL IN LOWER WEST EDGE OF BENT 159

PHOTO 11: SPALL IN LOWER NORTHWEST CORNER OF BENT 164

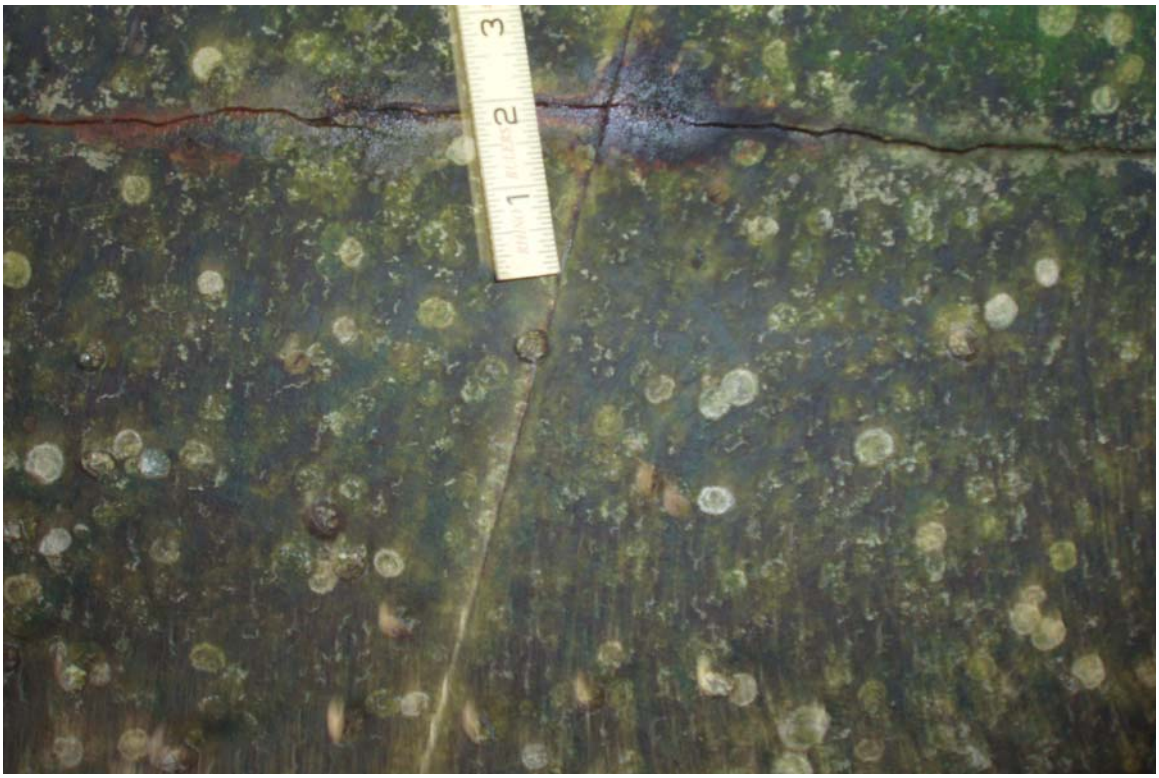

PHOTO 12: CRACKING IN UNDERSIDE OF BENT 144 PILE CAP

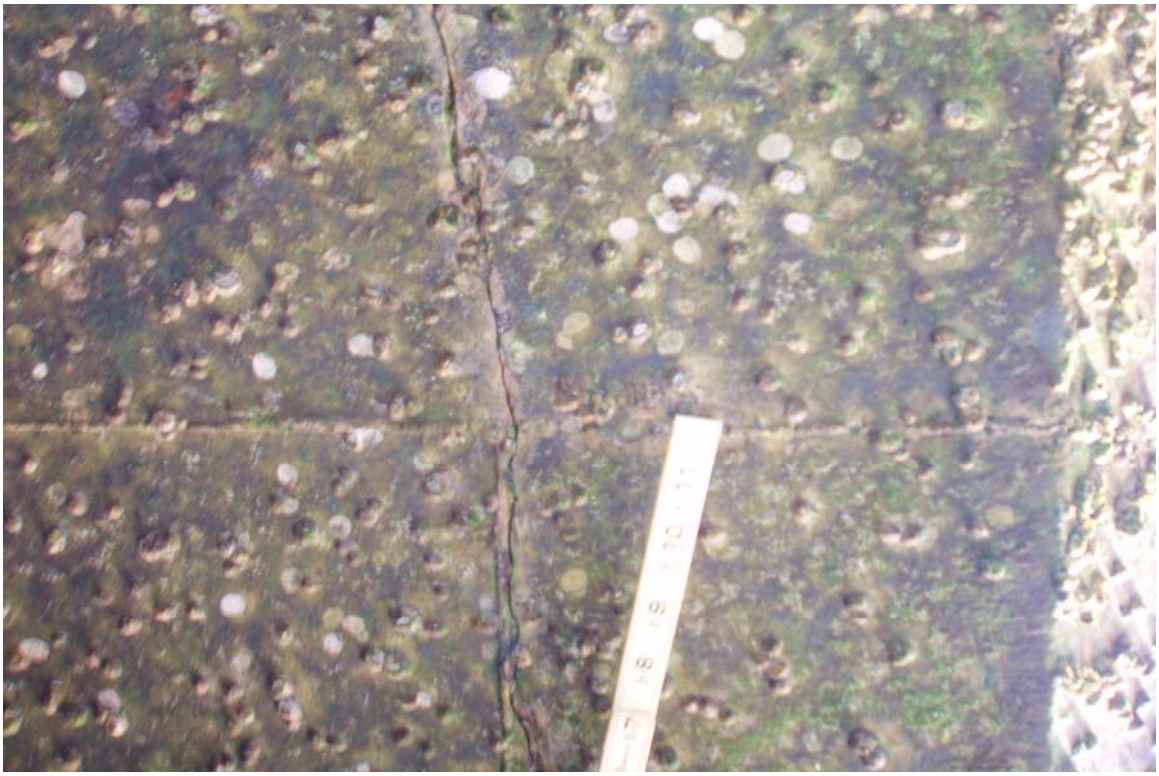

PHOTO 13: CRACKING IN UNDERSIDE OF BENT 147 PILE CAP

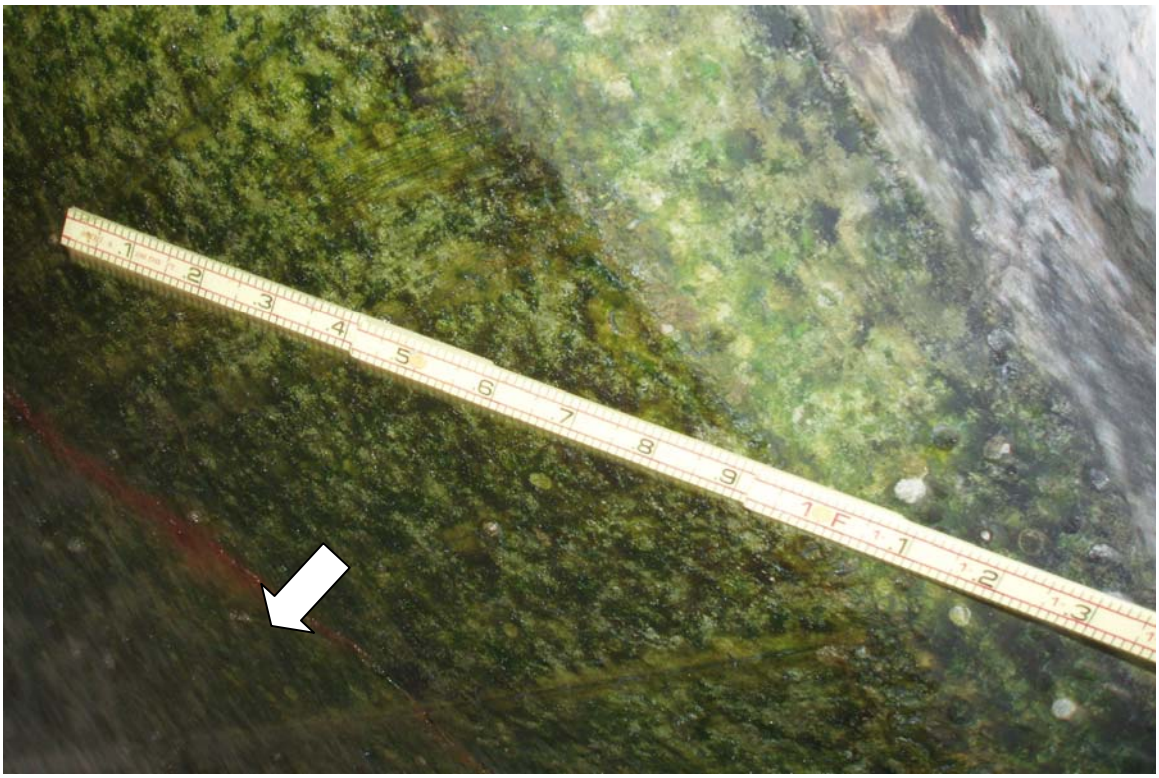

PHOTO 14: CRACKING IN UNDERSIDE OF BENT 160 PILE CAP

PHOTO 15: HORIZONTAL CRACKING IN LOWER PORTION OF EAST FACE OF BENT 159 PILE CAP, TYPICAL

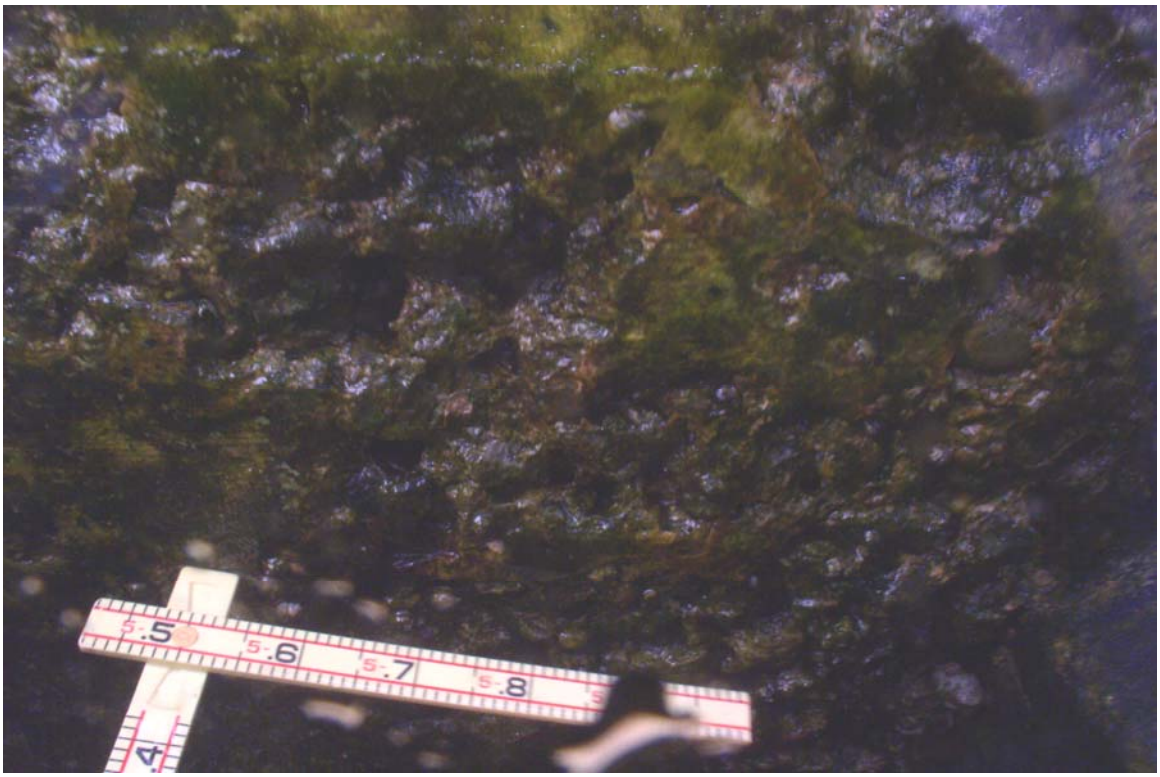

PHOTO 16: HONEYCOMBING IN UNDERSIDE OF BENT 144 PILE CAP

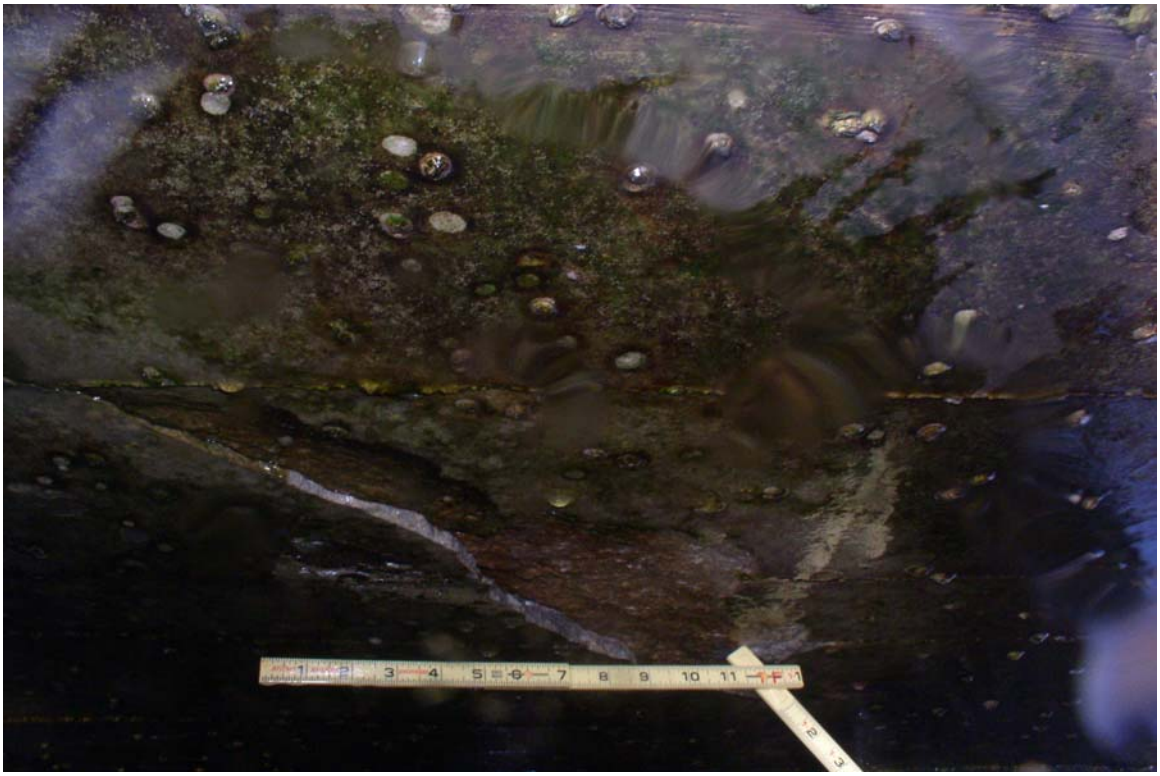

PHOTO 17: INCIPIENT SPALL IN UNDERSIDE OF BENT 145 PILE CAP IN NORTHEAST CORNER

PHOTO 18: SPALLING IN TIDAL ZONE AT PILE 16 OF BENT 146

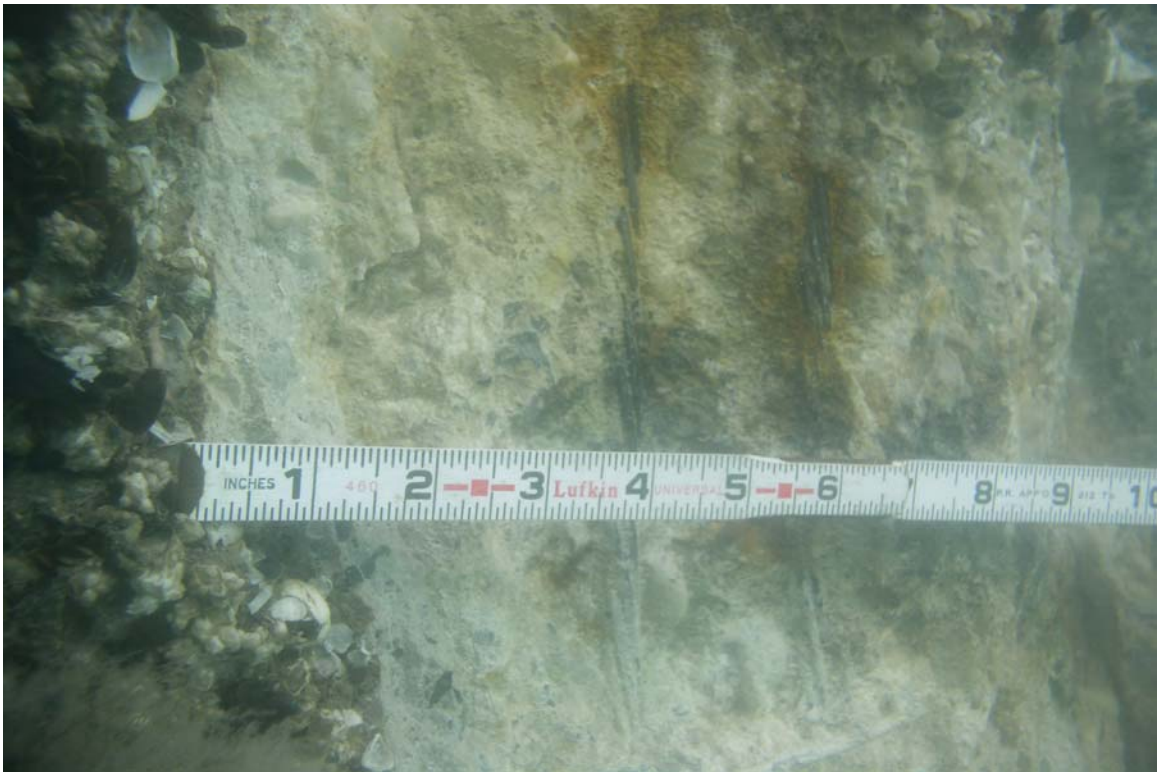

PHOTO 19: SPALLING WITH EXPOSED PRESTRESSING STRANDS BELOW WATER AT PILE 16 OF BENT 146

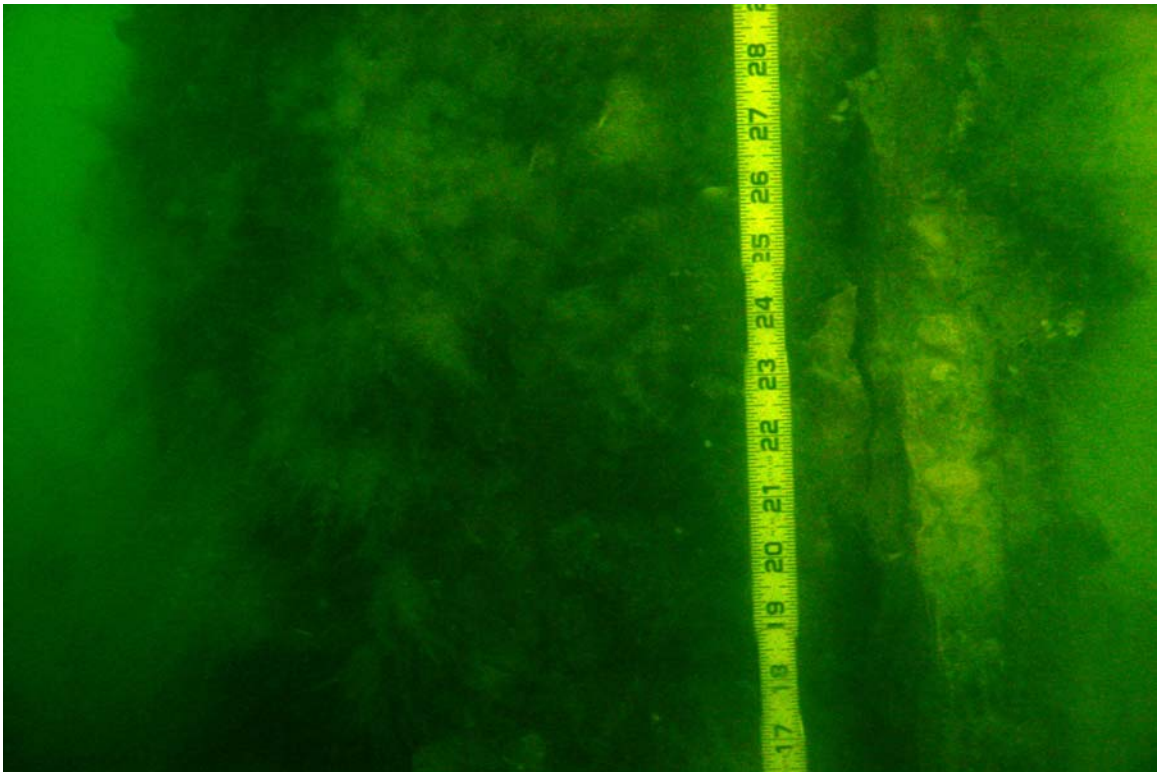

PHOTO 20: SPALLING (NOTE DELAMINATED CONCRETE) AT PILE 12 OF BENT 146

PHOTO 21: SPALL IN TIDAL ZONE AT PILE 9 OF BENT 144

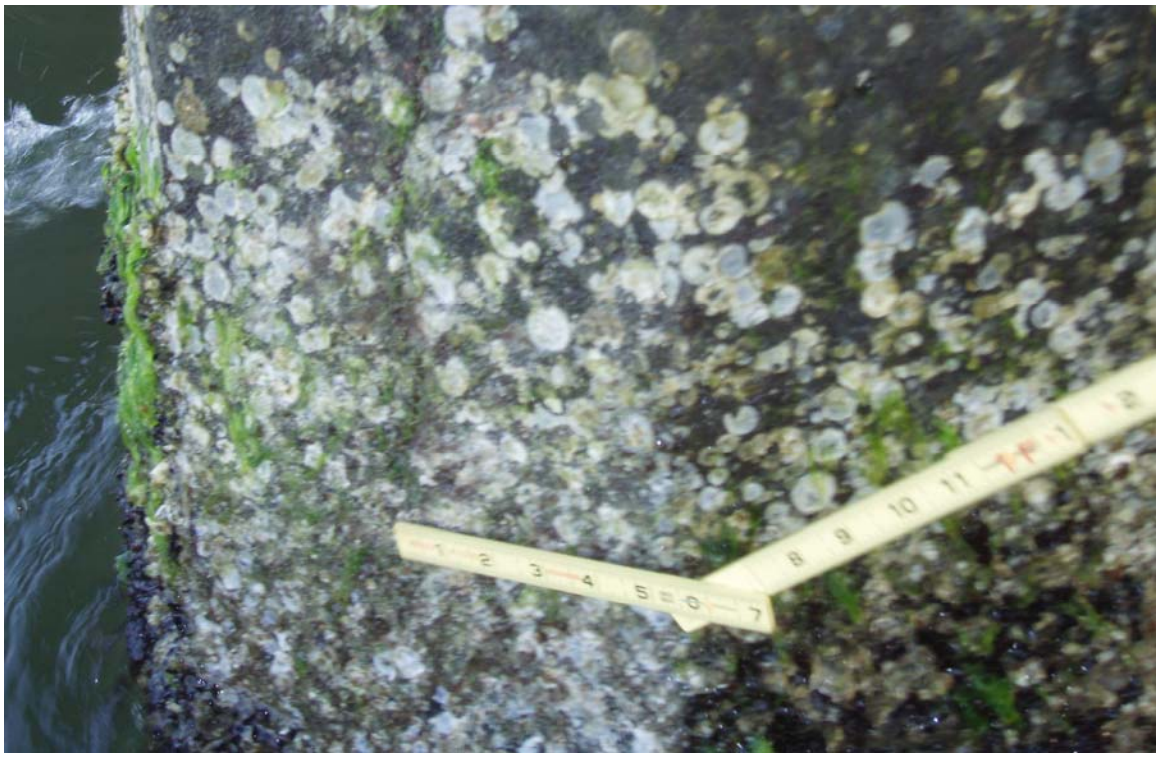

PHOTO 22: VERTICAL CRACKING IN THE TIDAL ZONE AT PILE 10 OF BENT 160

PHOTO 23: VERTICAL CRACKING IN THE TIDAL ZONE AT PILE 9 OF BENT 163

PHOTO 24: HORIZONTAL CRACKING AT TOP AT PILE 5 OF BENT 129

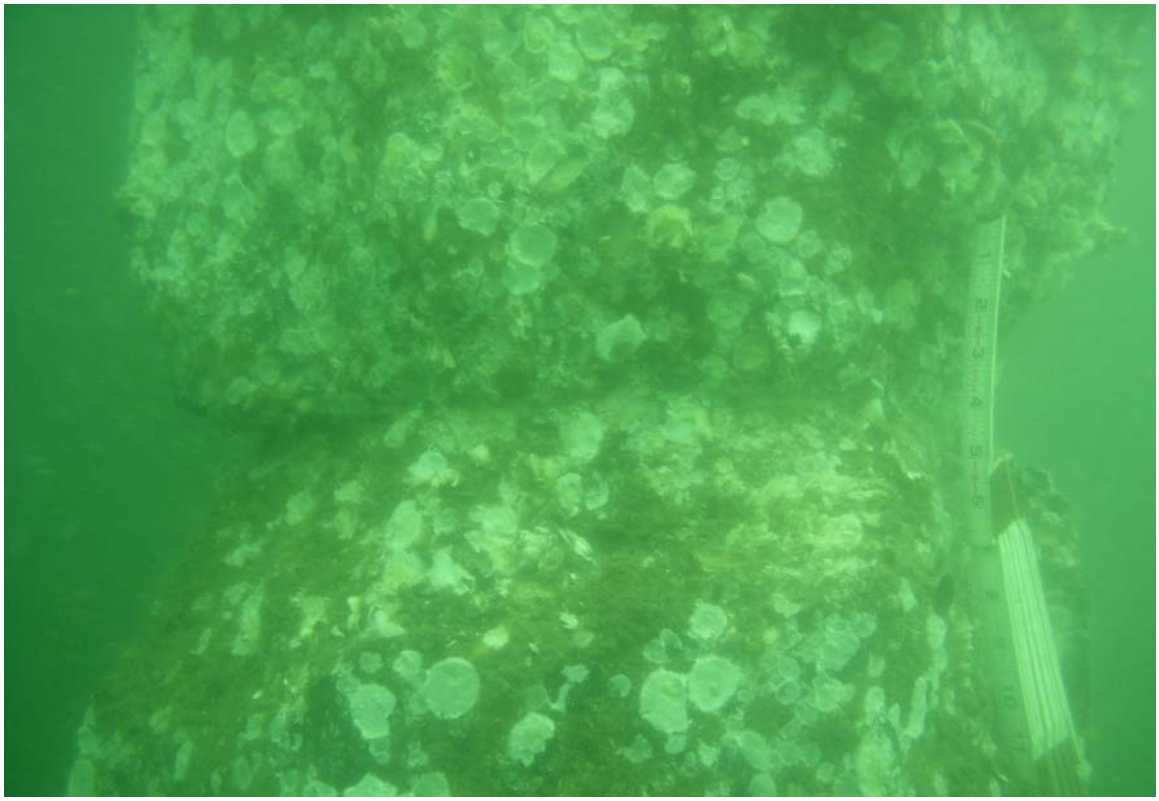

PHOTO 25: DETERIORATED SPLICE IN MID WATER COLUMN AT PILE 7 OF BENT 159

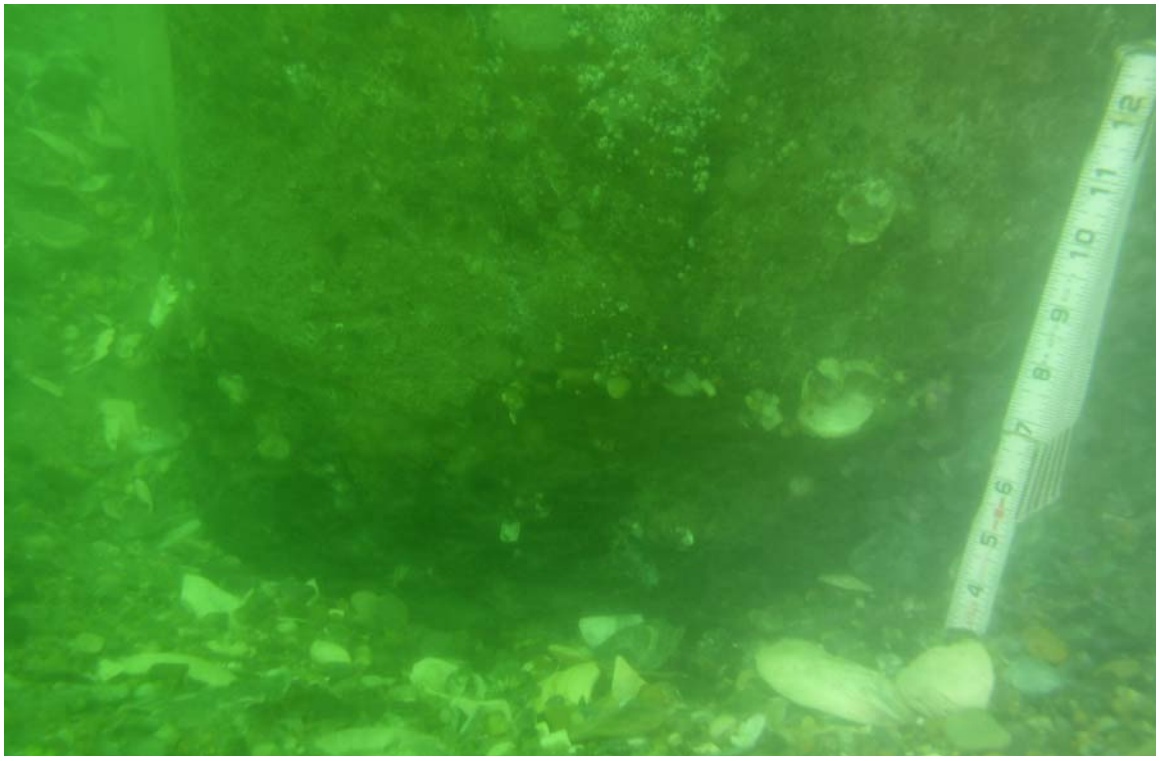

PHOTO 26: DETERIORATED SPLICE AT MUDLINE AT PILE 7 OF BENT 159

PHOTO 27: TYPICAL CONFIGURATION OF NEW SUBSTRUCTURE ELEMENTS (BENT 167 SHOWN)

PHOTO 28: CRACKING IN NORTH END OF EAST "NEW" CAP AT BENT 171

PHOTO 29: SUPPLEMENTAL PILES AND CAPS AT BENTS 173 THROUGH 186

PHOTO 30: CRACK IN FACE 4 (WEST FACE) AT PILE 6 OF BENT 186

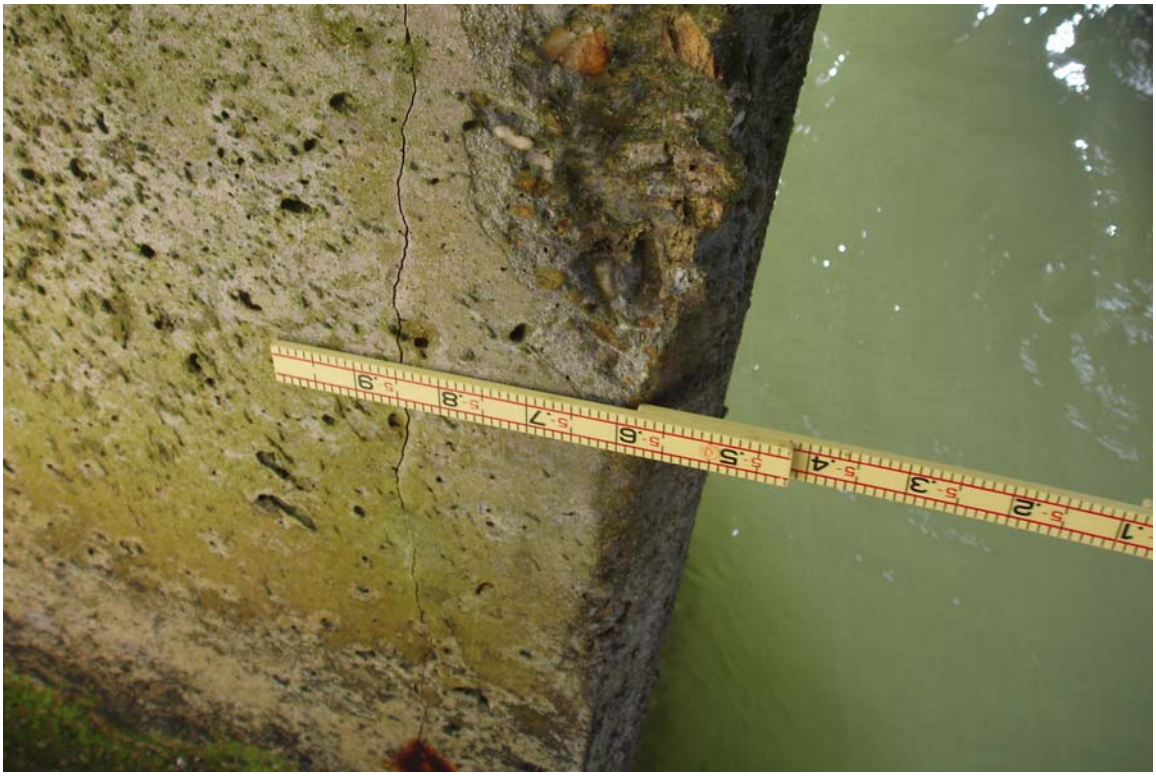

PHOTO 31: DELAMINATED SOUTHWEST EDGE AT PILE 1 OF BENT 174

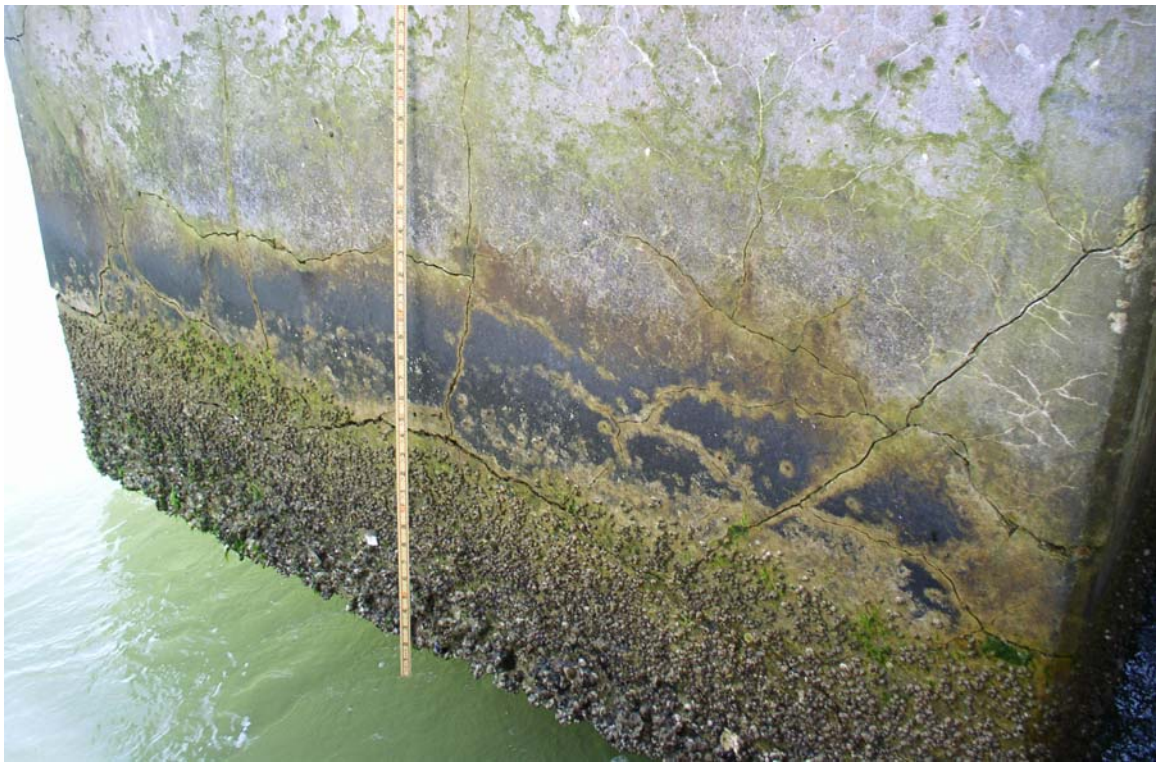

PHOTO 32: CRACKING IN NORTH END OF EAST "NEW" CAP AT BENT 189 EXTENDING ABOVE THE TIDAL ZONE

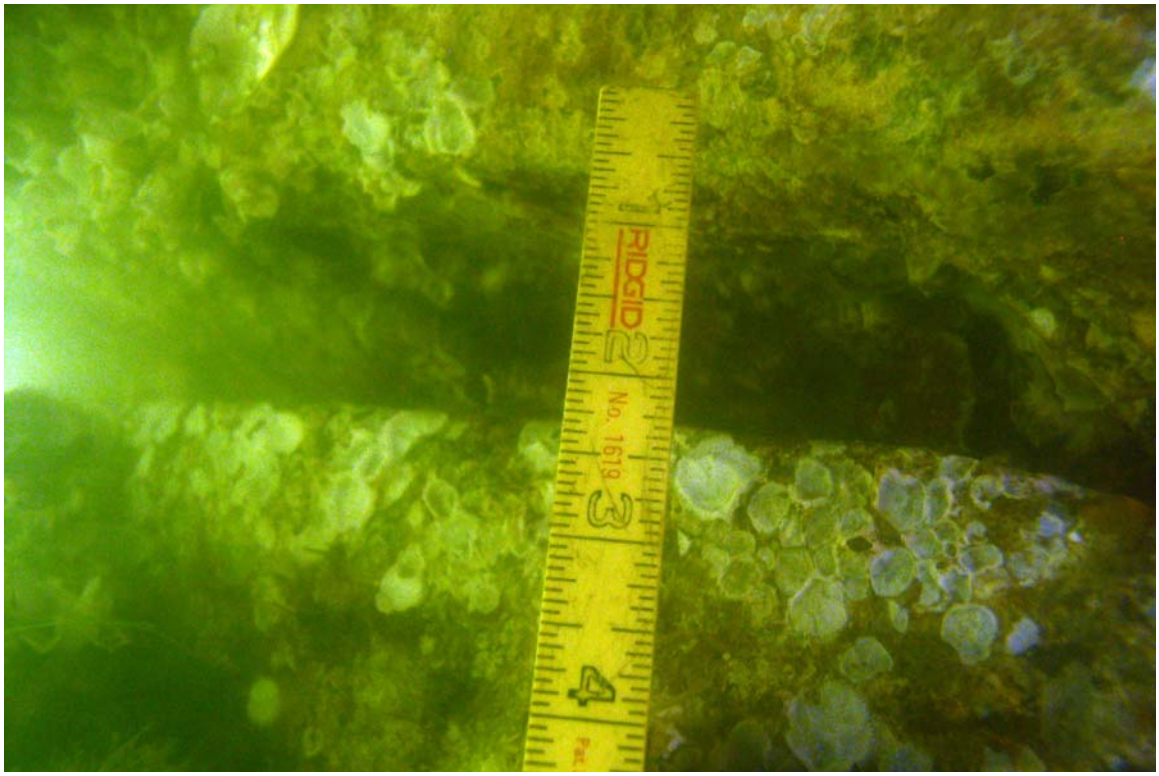

PHOTO 33: VOID IN THE NORTHWEST 66 IN. DIAMETER PILE AT BENT 197 UNDER THE WEST "NEW" CAP

PHOTO 34: TYPICAL CORROSION ON STEEL ELEMENTS OF FENDER SYSTEM ABOVE THE HIGH WATER MARK, SOUTH FENDER SHOWN

PHOTO 35: DAMAGED TIMBER RUB STRIPS NEAR THE WEST END OF THE NORTH FENDER.

PHOTO 36: DAMAGED TIMBER RUB STRIPS AND BACKING TIMBER, NORTH FENDER SHOWN BETWEEN CLUSTERS 2 & 3

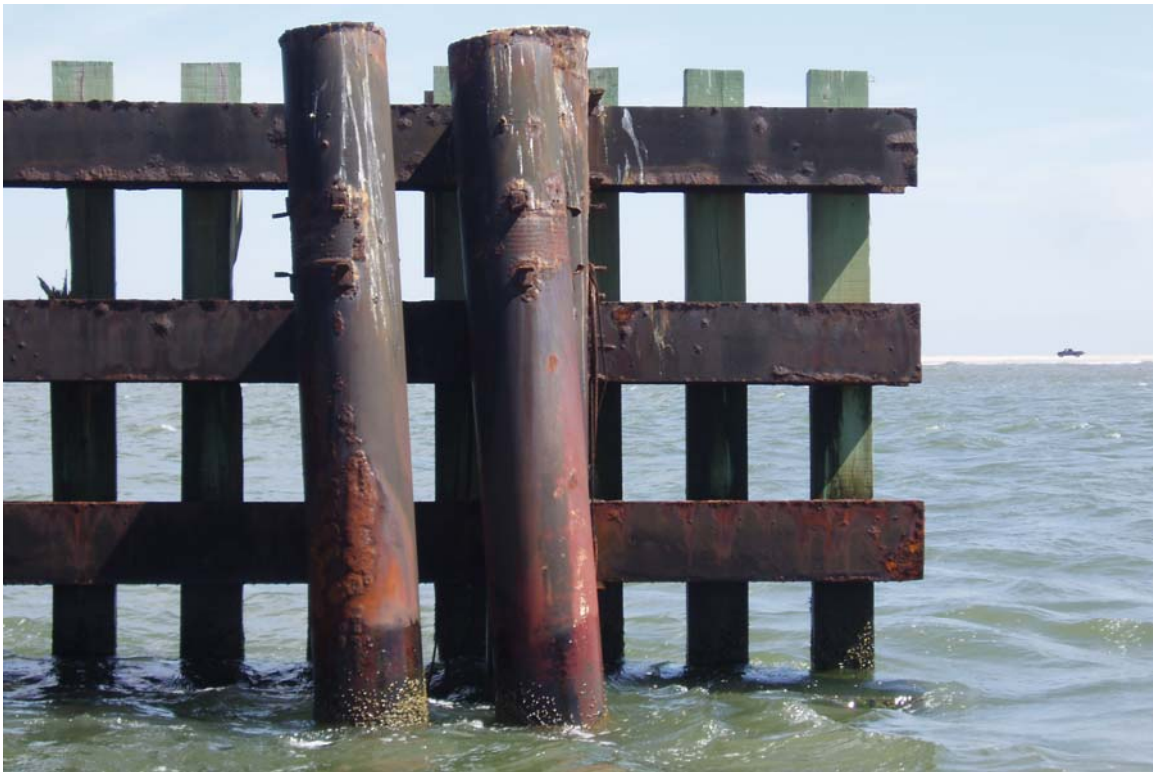

PHOTO 37: LOOSE PILES AT CLUSTER 1 OF THE SOUTH FENDER

PHOTO 38: IMPACT DAMAGE BETWEEN PILE CLUSTERS 10 AND 13 OF THE SOUTH FENDER

PHOTO 39: DAMAGED/MISSING TIMBER RUB STRIPS IN THE WEST END OF THE SOUTH FENDER

APPENDIX G.3 – INSPECTION DATA

TABLE 1. LEVEL II INSPECTION LOCATIONS

North Approach Bents

Bent	Piles
62	5,6
63	3,5
66	1,6
77	1,2
90	1,2
91	5,6
92	4,6
93	1,6
94	1,5
95	3,5
96	1,3
97	3,4
98	4,5
99	5,6
100	5,6
101	2,3
102	4,5
103	5,6
104	3,4
105	1,3
106	4,6
107	3,5
108	1,A
109	4,H
110	6,J
111	5,D
112	7,L
113	5,I
114	3,H
115	2,G
116	4,D
117	1,I
118	2,F
119	3,H
120	5,D
121	4,I
122	4,C
123	2,A
A	3,5
B	2,5
C	5,6
D	4,5
E	2,3
F	1,4
G	4,6

High Level Bents

Bent	Piles
129	6, 9
130	8, 9
131	7, 12
132	2, 3
133	6, 9
134	3, 10
135	1, 8
136	7, 12
137	1, 2
138	7, 12
139	2, 3
140	2, 7
141	6, 7
142	12, 13
143	13, 20
144	2, 8, 9, 32, 40
145	25, 33, 35
146	6, 7, 10, 12, 16
147	6, 7
148	8, 11
149	5, 9
150	7, 13
151	1, 11
152	6, 7
153	4, 12
154	3, 10
155	2, 9
156	4, 7
157	3, 12
158	5, 10
159	7, 8
160	4, 10
161	3, 8
162	4, 9
163	9, 10
164	4, 5
165	1, 2
166	6, 7

South Approach Bents

Bent	Piles
167	NE,NW*
168	NE,SE*
169	SE,SW*
170	NW,SW*
171	NW,SW*
172	NE,SE*
173	4,6
174	1,2
175	2,4
176	1,2
177	4,5
178	2,6
179	4,6
180	2,3
181	4,6
182	5,6
183	4,6
184	2,3
185	4,8
186	1,6
187	NW,SW*
188	NE,SE*
189	NW,NE*
190	NW,NE*
191	NE,SE*
192	NW,NE*
193	SW,SE*
194	NE,SE*
195	NW,SW*
196	NW,NE*
197	SW,SE*
198	NE,SE*
199	NW,SW*
200	NE,SE*

* - NE,NW,SE,SW - These are the 66" diameter piles (4 per Bent).

Abbreviations:

NE - Northeast
NW - Northwest
SE - Southeast
SW - Southwest

TABLE 2. APPROACH BENT WATER DEPTHS (In Feet) – Page 1 of 5

Bent	Reference	Original Bridge Seat Elev*	Original Cap Height*	Reference Elevation	Reference to WL	WL to ML (Gauge Water Depth)	Approx. ML Elevation
1	Orig. Pile Cap Soffit	10.32	2.5	7.82	NA	Dry	NA
2	Orig. Pile Cap Soffit	11.78	2.5	9.28	NA	Dry	NA
3	Orig. Pile Cap Soffit	12.64	2.5	10.14	NA	Dry	NA
4	Orig. Pile Cap Soffit	13.5	2.5	11	NA	Dry	NA
5	Orig. Pile Cap Soffit	14.37	2.5	11.87	NA	Dry	NA
6	Orig. Pile Cap Soffit	15.23	2.5	12.73	NA	Dry	NA
7	Orig. Pile Cap Soffit	15.98	2.5	13.48	NA	Dry	NA
8	Orig. Pile Cap Soffit	16.52	2.5	14.02	NA	Dry	NA
9	Orig. Pile Cap Soffit	16.85	2.5	14.35	NA	Dry	NA
10	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	Dry	NA
11	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	<1’	NA
12	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	Dry	NA
13	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	Dry	NA
14	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	Dry	NA
15	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	Dry	NA
16	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	Dry	NA
17	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	Dry	NA
18	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	Dry	NA
19	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	Dry	NA
20	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	Dry	NA
21	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	Dry	NA
22	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	1	NA
23	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	1	NA
24	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	Dry	NA
25	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	Dry	NA
26	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	Dry	NA
27	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	<1’	NA
28	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	<1’	NA
29	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	<1’	NA
30	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	<1’	NA
31	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	<1’	NA
32	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	<1’	NA
33	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	<1'	NA
34	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	<1'	NA
35	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	<1'	NA
36	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	<1'	NA
37	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	<1'	NA
38	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	<1'	NA
39	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	<1'	NA
40	Orig. Pile Cap Soffit	16.96	2.5	14.46	NA	<1'	NA
41	Orig. Pile Cap Soffit	16.97	2.5	14.47	NA	<1'	NA
42	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1'	NA

TABLE 2. APPROACH BENT WATER DEPTHS (In Feet) – Page 2 of 5

Bent	Reference	Original Bridge Seat Elev*	Original Cap Height*	Reference Elevation	Reference to WL	WL to ML (Gauge Water Depth)	Approx. ML Elevation
43	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	Dry	NA
44	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	Dry	NA
45	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	Dry	NA
46	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	Dry	NA
47	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	Dry	NA
48	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	Dry	NA
49	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	Dry	NA
50	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	Dry	NA
51	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	Dry	NA
52	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	Dry	NA
53	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	Dry	NA
54	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1’	NA
55	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1’	NA
56	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1’	NA
57	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1’	NA
58	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	1	NA
59	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	2.5	NA
60	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	1.5	NA
61	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	1.3	NA
62	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	3	NA
63	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	2	NA
64	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<2’	NA
65	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<2’	NA
66	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<2’	NA
67	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<2’	NA
68	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1’	NA
69	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1’	NA
70	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1’	NA
71	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1’	NA
72	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1’	NA
73	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1’	NA
74	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1’	NA
75	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1’	NA
76	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1’	NA
77	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1’	NA
78	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1’	NA
79	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	Dry	NA
80	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	Dry	NA
81	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	Dry	NA
82	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	Dry	NA
83	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1’	NA
84	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1’	NA

TABLE 2. APPROACH BENT WATER DEPTHS (In Feet) – Page 3 of 5

Bent	Reference	Original Bridge Seat Elev*	Original Cap Height*	Reference Elevation	Reference to WL	WL to ML (Gauge Water Depth)	Approx. ML Elevation
85	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1'	NA
86	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1'	NA
87	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	<1'	NA
88	Orig. Pile Cap Soffit	16.98	2.5	14.48	NA	Dry	NA
89	Orig. Pile Cap Soffit	16.98	2.5	14.48	12.7	1	0.8
90	Orig. Pile Cap Soffit	16.98	2.5	14.48	12.7	2	-0.2
91	Orig. Pile Cap Soffit	16.98	2.5	14.48	12.7	3	-1.2
92	Orig. Pile Cap Soffit	16.98	2.5	14.48	12.7	3	-1.2
93	Orig. Pile Cap Soffit	16.98	2.5	14.48	12.7	3	-1.2
94	Orig. Pile Cap Soffit	16.98	2.5	14.48	12.4	4	-1.9
95	Orig. Pile Cap Soffit	16.98	2.5	14.48	12.4	4	-1.9
96	Orig. Pile Cap Soffit	16.98	2.5	14.48	12.8	12	-10.3
97	Orig. Pile Cap Soffit	16.98	2.5	14.48	12.8	12	-10.3
98	Orig. Pile Cap Soffit	16.98	2.5	14.48	11	12	-8.5
99	Orig. Pile Cap Soffit	16.98	2.5	14.48	11	16	-12.5
100	Orig. Pile Cap Soffit	16.98	2.5	14.48	11	17	-13.5
101	Orig. Pile Cap Soffit	16.98	2.5	14.48	11	20	-16.5
102	Orig. Pile Cap Soffit	16.98	2.5	14.48	11	20	-16.5
103	Orig. Pile Cap Soffit	16.98	2.5	14.48	11	20	-16.5
104	Orig. Pile Cap Soffit	16.98	2.5	14.48	12	18	-15.5
105	Orig. Pile Cap Soffit	16.98	2.5	14.48	12	18	-15.5
106	Orig. Pile Cap Soffit	16.98	2.5	14.48	12	16	-13.5
107	Orig. Pile Cap Soffit	16.98	2.5	14.48	12	16	-13.5
108	Orig. Pile Cap Soffit	16.98	2.5	14.48	13.2	12.5	-11.2
109	Orig. Pile Cap Soffit	16.98	2.5	14.48	13.2	10	-8.7
110	Orig. Pile Cap Soffit	16.98	2.5	14.48	13.2	10	-8.7
111	Orig. Pile Cap Soffit	16.98	2.5	14.48	13.2	7	-5.7
112	Orig. Pile Cap Soffit	16.98	2.5	14.48	13.5	6	-5.0
113	Orig. Pile Cap Soffit	16.98	2.5	14.48	13.5	6	-5.0
114	Orig. Pile Cap Soffit	16.98	2.5	14.48	13.5	6.5	-5.5
115	Orig. Pile Cap Soffit	16.97	2.5	14.47	13.5	6	-5.0
116	Orig. Pile Cap Soffit	16.96	2.5	14.46	13.5	5	-4.0
117	Orig. Pile Cap Soffit	16.96	2.5	14.46	13	4	-2.5
118	Orig. Pile Cap Soffit	16.96	2.5	14.46	13	4	-2.5
119	Orig. Pile Cap Soffit	17.11	2.5	14.61	13.2	5	-3.6
120	Orig. Pile Cap Soffit	17.57	2.5	15.07	13.2	4	-2.1
121	Orig. Pile Cap Soffit	13.33	2.5	10.83	12.6	9	-10.8
122	Orig. Pile Cap Soffit	19.4	2.5	16.9	12.6	10	-5.7
123	Orig. Pile Cap Soffit	20.78	2.5	18.28	12.6	12	-6.3
A	Top of Marine Growth	NA	NA	3	1.6	15	-13.6
B	Top of Marine Growth	NA	NA	3	3	15	-15.0
C	Top of Marine Growth	NA	NA	3	3	15	-15.0

TABLE 2. APPROACH BENT WATER DEPTHS (In Feet) – Page 4 of 5

Bent	Reference	Original Bridge Seat Elev*	Original Cap Height*	Reference Elevation	Reference to WL	WL to ML (Gauge Water Depth)	Approx. ML Elevation
D	Top of Marine Growth	NA	NA	3	1	20	-18.0
E	Top of Marine Growth	NA	NA	3	1	20	-18.0
F	Top of Marine Growth	NA	NA	3	1	23	-21.0
G	Top of Marine Growth	NA	NA	3	0.5	26	-23.5
167	Orig. Pile Cap Soffit	19.41	2.5	16.91	14.5	28	-25.6
168	Orig. Pile Cap Soffit	18.35	2.5	15.85	14.5	24	-22.7
169	Orig. Pile Cap Soffit	17.89	2.5	15.39	15	22	-21.6
170	Orig. Pile Cap Soffit	17.13	2.5	14.63	13	20	-18.4
171	Orig. Pile Cap Soffit	16.98	2.5	14.48	13	20	-18.5
172	Orig. Pile Cap Soffit	16.98	2.5	14.48	13	20	-18.5
173	Orig. Pile Cap Soffit	16.98	2.5	14.48	14	18	-17.5
174	Orig. Pile Cap Soffit	16.98	2.5	14.48	14	18	-17.5
175	Orig. Pile Cap Soffit	16.98	2.5	14.48	14	16	-15.5
176	Orig. Pile Cap Soffit	16.98	2.5	14.48	14	16	-15.5
177	Orig. Pile Cap Soffit	16.98	2.5	14.48	14	18	-17.5
178	Orig. Pile Cap Soffit	16.98	2.5	14.48	14	16	-15.5
179	Orig. Pile Cap Soffit	16.98	2.5	14.48	14	14	-13.5
180	Orig. Pile Cap Soffit	16.98	2.5	14.48	13	18	-16.5
181	Orig. Pile Cap Soffit	16.98	2.5	14.48	13	18	-16.5
182	Orig. Pile Cap Soffit	16.98	2.5	14.48	13	14	-12.5
183	Orig. Pile Cap Soffit	16.98	2.5	14.48	13	14	-12.5
184	Orig. Pile Cap Soffit	16.98	2.5	14.48	12.5	18	-16.0
185	Orig. Pile Cap Soffit	16.98	2.5	14.48	12.5	19	-17.0
186	Orig. Pile Cap Soffit	16.98	2.5	14.48	12.3	19	-16.8
187	Orig. Pile Cap Soffit	16.98	2.5	14.48	13	24	-22.5
188	Orig. Pile Cap Soffit	16.98	2.5	14.48	13	25	-23.5
189	Orig. Pile Cap Soffit	16.98	2.5	14.48	12.8	26	-24.3
190	Orig. Pile Cap Soffit	16.98	2.5	14.48	12	26	-23.5
191	Orig. Pile Cap Soffit	16.98	2.5	14.48	12	27	-24.5
192	Orig. Pile Cap Soffit	16.97	2.5	14.47	12.1	27	-24.6
193	Orig. Pile Cap Soffit	16.96	2.5	14.46	12.7	31	-29.2
194	Orig. Pile Cap Soffit	16.96	2.5	14.46	12.7	32	-30.2
195	Orig. Pile Cap Soffit	16.8	2.5	14.3	12	24	-21.7
196	Orig. Pile Cap Soffit	16.34	2.5	13.84	10.5	34	-30.7
197	Orig. Pile Cap Soffit	15.57	2.5	13.07	11.1	30	-28.0
198	Orig. Pile Cap Soffit	14.48	2.5	11.98	10	30	-28.0
199	Orig. Pile Cap Soffit	13.25	2.5	10.75	8.3	24	-21.6
200	Orig. Pile Cap Soffit	12.02	2.5	9.52	7.5	24	-22.0

See next page for notes

TABLE 2. APPROACH BENT WATER DEPTHS (In Feet) – Page 5 of 5

The channel bottom elevations are approximations based on elevations/dimensions and the waterline datum in drawings along with readings from diver depth gauges. The numbers are not considered to be survey accurate, they are best approximations.

* - Elevations were obtained from original drawings. Note that the datum is not identified on the drawings.

Abbreviations:

ML - Mudline
NA - Not applicable
Orig. - Original
WL - Waterline

TABLE 3. HIGH LEVEL BENT EXPOSURE HEIGHTS (All Measurements in Feet)

	A	B	C	D	E = (C + D)	F = (A - B - E)	G	H	J = (G - H - E)
Pier	**Top of PC Elev.***	**PC Height**	**WL to PC Soffit**	**Gauge Max Depth**	**Approx. Pile Exposure**	**Estimated Channel Bottom Elev.**	**Plan Pile Length**	**PC Embed-ment Depth**	**Embedment into Channel**
129	7.32	4.25	1.3	25	26.3	-23.2	50.0*	1.5	22.2
130	7.10	4.25	1.2	27	28.2	-25.4	50.0	1.5	20.3
131	7.23	4.25	1.5	28	29.5	-26.5	50.0	1.5	19.0
132	7.35	4.25	1.5	30	31.5	-28.4	50.0	1.5	17.0
133	7.15	4.25	1.5	30	31.5	-28.6	55.0	1.5	22.0
134	7.27	4.25	2.0	30	32.0	-29.0	55.0	1.5	21.5
135	7.40	4.25	1.0	30	31.0	-27.9	60.0	1.5	27.5
136	7.19	4.25	1.0	29	30.0	-27.1	60.0	1.5	28.5
137	7.32	4.25	1.0	25	26.0	-22.9	65.0	1.5	37.5
138	7.11	4.25	1.0	24	25.0	-22.1	65.0	1.5	38.5
139	7.24	4.25	1.0	23	24.0	-21.0	65.0	1.5	39.5
140	7.03	4.25	1.2	22	23.2	-20.4	65.0	1.5	40.3
141	7.24	4.25	1.3	25	26.3	-23.3	65.0	1.5	37.2
142	7.18	4.25	1.8	30	31.8	-28.9	65.0	1.5	31.7
143	7.30	4.50	1.5	31	32.5	-29.7	65.0	1.5	31.0
144	7.96	4.75	1.8	34	35.8	-32.6	65.0	1.5	27.7
145	7.96	4.75	2.0	35	37.0	-33.8	65.0	1.5	26.5
146	7.30	4.50	1.3	35	36.3	-33.5	65.0	1.5	27.2
147	7.12	4.25	1.7	39	40.7	-37.8	65.0	1.5	22.8
148	7.24	4.25	1.8	41	42.8	-39.8	65.0	1.5	20.7
149	7.03	4.25	2.0	42	44.0	-41.2	65.0	1.5	19.5
150	7.24	4.25	2.0	40	42.0	-39.0	65.0	1.5	21.5
151	7.11	4.25	2.0	38	40.0	-37.1	65.0	1.5	23.5
152	7.32	4.25	2.7	34	36.7	-33.6	65.0	1.5	26.8
153	7.19	4.25	1.2	32	33.2	-30.3	65.0	1.5	30.3
154	7.40	4.25	1.4	35	36.4	-33.3	65.0	1.5	27.1
155	7.27	4.25	1.6	32	33.6	-30.6	65.0	1.5	29.9
156	7.15	4.25	1.0	30	31.0	-28.1	65.0	1.5	32.5
157	7.35	4.25	1.0	28	29.0	-25.9	65.0	1.5	34.5
158	7.23	4.25	1.0	40	41.0	-38.0	65.0	1.5	22.5
159	7.10	4.25	1.0	35	36.0	-33.2	65.0	1.5	27.5
160	7.32	4.25	1.7	34	35.7	-32.6	65.0**	1.5	27.8
161	7.19	4.25	2.2	32	34.2	-31.3	65.0	1.5	29.3
162	7.20	4.25	1.5	30	31.5	-28.6	65.0**	1.5	32.0
163	7.20	4.25	1.5	28	29.5	-26.6	65.0**	1.5	34.0
164	7.29	4.25	1.5	28	29.5	-26.5	65.0	1.5	34.0
165	7.30	4.25	1.7	22	23.7	-20.7	65.0	1.5	39.8
166	7.28	4.25	1.7	22	23.7	-20.7	65.0	1.5	39.8

* Can not be read from plans provided, but presumed to be 50' based on adjacent pier information.
** Can not be read from plans provided, but presumed to be 65' based on adjacent pier information.

The exposure heights and channel bottom elevations are approximations based on elevations/dimensions and the waterline datum in drawings along with readings from diver depth gauges. The numbers provided above are not to considered as being survey accurate, they are best approximations.

Abbreviations:

Elev - Elevation obtained from original plans (original datum not identified)
PC - Pile Cap
Max - Maximum

TABLE 4. PILE INSPECTION RESULTS - NORTH & SOUTH APPROACHES Page 1 of 5

Bent	Pile	Face/Edge	Deficiency	Size	Reference	Location (Relative to Reference) in ft.	Extends	Comment
55	1	All	Vert Cracks	1/16" or <	HWL	NA	Down	
55	6	All	Vert Cracks	1/16"or <	HWL	NA	Down	
56	4	7	Vert Cracks	1/16"or <	HWL	NA	Down	
56	5	6,7,8	Vert Cracks	1/16"or <	HWL	NA	Down	`
56	6	2,6,7,8	Vert Cracks	1/16"or <	HWL	NA	Down	
56	7	All	Vert Cracks	1/16"or <	HWL	NA	Down	
57	5	All	Vert Crack	1/16"or <	HWL	NA	Down	
57	6	All	Vert Crack	1/16"or <	HWL	NA	Down	
58	1	All	Vert Crack	1/16"or <	HWL	NA	Down	
58	2	All	Vert Crack	1/16"or <	HWL	NA	Down	
58	3	All	Vert Crack	1/16"or <	HWL	NA	Down	
58	5	All	Vert Crack	1/16"or <	HWL	NA	Down	
58	6	All	Vert Crack	1/16"or <	HWL	NA	Down	
59	3	All	Vert Crack	1/16"or <	HWL	NA	Down	
59	4	All	Vert Crack	1/16"or <	HWL	NA	Down	
59	5	All	Vert Crack	1/16"or <	HWL	NA	Down	
59	6	7	Vert Crack	1/16"or <	HWL	NA	Down	
60	2	All	Vert Crack	1/16"or <	HWL	NA	Down	
59	6	7	Vert Crack	1/16"or <	HWL	NA	Down	
60	2	All	Vert Crack	1/16"or <	HWL	NA	Down	
60	3	All	Vert Crack	1/16"or <	HWL	NA	Down	
60	4	All	Vert Crack	1/16"or <	HWL	NA	Down	
60	6	All	Vert Crack	1/16"or <	HWL	NA	Down	
61	4	All	Vert Crack	1/16"or <	HWL	NA	Down	
62	1	All	Vert Crack	1/16"or <	HWL	NA	Down	
62	2	1,2,7,8	Vert Crack	1/16"or <	HWL	NA	Down	
62	3	1,3,8	Vert Crack	1/16"or <	HWL	NA	Down	
63	3	All	Vert Crack	1/16"or <	HWL	NA	Down	
63	4	All	Vert Crack	1/16"or <	HWL	NA	Down	
63	5	All	Vert Crack	1/16"or <	HWL	NA	Down	
64		NA	Scour Swale	to 2' Deep	NA	NA	NA	Scour swales to 2' D around piles
65	2	All	Vert Crack	1/16"or <	HWL	NA	Down	
65	3	All	Vert Crack	1/16"or <	HWL	NA	Down	
65	5	1,2,4,6,7,8	Vert Crack	1/16"or <	HWL	NA	Down	
66	4	All	Vert Crack	1/16"or <	HWL	NA	Down	
66	5	All	Vert Crack	1/16"or <	HWL	NA	Down	
66	6	All	Vert Crack	1/16"or <	HWL	NA	Down	Level II on this pile
66	1	2	Vert Crack	1/8" or <	HWL	NA	Down	Level II on this pile
67	1	All	Vert Crack	1/16"or <	HWL	NA	Down	
67	5	All	Vert Crack	1/16"or <	HWL	NA	Down	
67	6	1,7	Vert Crack	1/16"or <	HWL	NA	Down	

TABLE 4. PILE INSPECTION RESULTS - NORTH & SOUTH APPROACHES Page 2 of 5

Bent	Pile	Face/Edge	Deficiency	Size	Reference	Location (Relative to Reference) in ft.	Extends	Comment
76	5	All	Vert Crack	1/16"or <	HWL	NA	Down	Level II on Piles 1,2
76	6	All	Vert Crack	1/16"or <	HWL	NA	Down	
89	1	3,4,5,6,7	Vert Crack	1/16" W x 4' L	Cap Underside	12.7	Up	
92	6	1,2,6,7,8	Vert Crack	HL x 4' L	Cap Underside	11.2	Down	
92	4	2,6,7,8	Vert Crack	HL x 4' L	Cap Underside	11.2	Down	
92	2	All	Vert Crack	HL x 3' L	Cap Underside	11.2	Down	
93	1	All	Vert Crack	HL to 1/16" W x 3' L	Cap Underside	9.7	Down	
93	2	All	Vert Crack	HL to 1/16" W x 3' L	Cap Underside	10.7	Down	
93	3	All	Vert Crack	HL to 1/16" W x 3' L	Cap Underside	10.7	Down	
93	4	All	Vert Crack	HL to 1/16" W x 3' L	Cap Underside	10.7	Down	
93	5	All	Vert Crack	HL to 1/16" W x 3' L	Cap Underside	10.7	Down	
93	6	All	Vert Crack	HL to 1/16" W x 3' L	Cap Underside	10.7	Down	
94	6	1,5,6	Vert Crack	1/16" W x 4' L	Cap Underside	10.9	Down	
94	5	All	Vert Crack	1/16" W x 4' L	Cap Underside	10.9	Down	
94	1	All	Vert Crack	1/16" W x 4' L	Cap Underside	10.9	Down	
95	6	NA	NA	NA	NA	NA	NA	Jacketed from 1' below Cap to 1.5' below HWL
95	1	All	Vert Crack	HL W x 2' H	Cap Underside	10.9	Down	
95	3	All	Vert Crack	HL W x 2' H	Cap Underside	10.9	Down	
95	3	2,7	Vert Crack	1/8" W x 4' L	Cap Underside	12.4	Up	
95	4	4,5	Vert Crack	1/8" W	Cap Underside	10.9	Up	REFER TO TOPSIDE INSPECTION (Crack width to 1/16" on Side 5, both W/Corr Staining)
96	7	5,6,7,8	Vert Crack	HL x 3' L	Cap Underside	11	Down	In Splash zone
96	5	6	Vert Crack	HL x 3' L	Cap Underside	11	Down	In Splash zone
96	4	6	Vert Crack	HL x 3' L	Cap Underside	11	Down	In Splash zone
96	2	2,7,8	Vert Crack	HL x 3' L	Cap Underside	11	Down	In Splash zone
96	1	6	Vert Crack	HL x 3' L	Cap Underside	11	Down	In Splash zone
97	4	1,2	Vert Crack	HL x 2.5' L	Cap Underside	11	Down	
97	3	2,3,5,6,7,8	Vert Crack	HL x 2.5' L	Cap Underside	11	Down	
97	2	2	Vert Crack	1/16" W x 2.5' L	Cap Underside	11	Down	
98	1	All	Vert Crack	1/16" W x 4' L	Cap Underside	11	Up	Corrosion Staining in Face 2
98	1	3,4	Spall	6" H x 5" W x 1" D	Cap Underside	10	Down	No Exposed Steel
103	1	All	Vert Crack	1/16" W x 4' L	Cap Underside	11	Down	Only Face 4 cracked to 1/16" W, rest HL
104	1	4,6	Vert Crack	1/16" W x 2' L	Cap Underside	12	Up	
104	3	1	Vert Crack	1/16" W x 2' L	Cap Underside	12	Up	
105	4	6	Vert Crack	1/16" W x 2.5' L	Cap Underside	11	Down	
106	6	5,6,7,8	Vert Crack	1/16" W x 3' L	Cap Underside	11	Down	
106	1	7	Vert Crack	1/16" W x 3' L	Cap Underside	11	Down	
106	3	3	Vert Crack	1/16" W x 3' L	Cap Underside	11	Down	
107	2	2,4	Vert Crack	1/16" W x 2.5' L	Cap Underside	11	Down	
107	5	6	Vert Crack	1/16" W x 2.5' L	Cap Underside	11	Down	

TABLE 4. PILE INSPECTION RESULTS - NORTH & SOUTH APPROACHES Page 3 of 5

Bent	Pile	Face/Edge	Deficiency	Size	Reference	Location (Relative to Reference) in ft.	Extends	Comment
107	6	8	Vert Crack	1/16" W x 2.5' L	Cap Underside	11	Down	
108	7	All	Vert Crack	HL x 2.5' L	Cap Underside	11	Down	
108	5	All	Vert Crack	1/16" W x 4' L	Cap Underside	11	Down	Crack in Face 8 to 1/16" W, rest HL width
108	6	2,4,8	Vert Crack	HL x 3' L	Cap Underside	11	Down	
108	4	3,4,6,8	Vert Crack	HL x 3' L	Cap Underside	11	Down	
108	3	All	Vert Crack	HL x 3' L	Cap Underside	11	Down	
109	1	5,7,8	Vert Crack	1/16" W x 2.5' L	Cap Underside	11	Down	
109	4	2	Vert Crack	1/32" W x 3' L	Cap Underside	11	Down	
109	5	3,8	Vert Crack	1/16" W x 3' L	Cap Underside	11	Down	
109	6	All	Vert Crack	1/32" W x 3' L	Cap Underside	11	Down	
110	1	1	Vert Crack	1/16" W x 3' L	Cap Underside	11.2	Down	
110	3	3,7,8	Vert Crack	1/16" W x 3' L	Cap Underside	10.7	Down	
110	6	7	Vert Crack	HL x 3' L	Cap Underside	10.7	Down	
111	5	1	Vert Crack	HL x 2.5' L	Cap Underside	11	Down	
111	4	1	Vert Crack	HL x 2.5' L	Cap Underside	11	Down	
112	2	All	Vert Crack	HL x 3' L	Cap Underside	11	Down	
112	3	2	Vert Crack	1/16" W x 2' L	Cap Underside	11	Down	
112	6	3,5	Vert Crack	HL x 2.5' L	Cap Underside	11	Down	
112	7	All	Vert Crack	HL x 2.5' L	Cap Underside	11	Down	
113	6	3,4,7	Vert Crack	1/32" W x 3' L	Cap Underside	11	Down	
113	4	1,4,6,7	Vert Crack	HL x 3' L	Cap Underside	11	Down	
113	2	1,4,5	Vert Crack	HL x 3' L	Cap Underside	11	Down	
113	1	5,7	Vert Crack	1/16" W x 3' L	Cap Underside	11	Down	
114	2	6	Vert Crack	HL x 2.5' L	Cap Underside	11	Down	
114	3	All	Vert Crack	HL x 2.5' L	Cap Underside	11	Down	
114	5	1,3,4,5,7,8	Vert Crack	1/16" W x 4' L	Cap Underside	11	Down	
114	6	1,2,4	Vert Crack	1/16" W x 3' L	Cap Underside	11	Down	
115	6	7	Vert Crack	HL x 3' L	Cap Underside	10.5	Down	
115	1	1,3,6,8	Vert Crack	HL x 3' L	Cap Underside	10.5	Down	
115	2	3,5	Vert Crack	HL to 1/16" W x 3' L	Cap Underside	10.5	Down	
115	3	1,2,7	Vert Crack	HL x 3' L	Cap Underside	10.5	Down	
115	4	2	Vert Crack	1/16" W x 3' L	Cap Underside	10.5	Down	HL cracks in other faces
115	5	3	Vert Crack	1/16" W x 3' L	Cap Underside	10.5	Down	HL cracks in other faces
116	2	All	Vert Crack	HL x 2' L	Cap Underside	11	Down	
116	3	3,4,7	Vert Crack	1/16" W x 4' L	Cap Underside	11	Down	
116	6	2,3,5,6,7	Vert Crack	1/16" W x 3' L	Cap Underside	11	Down	
116	4	All	Vert Crack	HL x 3' L	Cap Underside	11	Down	
117	1	3,5,8	Vert Crack	1/16" W x 2' L	Cap Underside	11	Down	
117	2	2,3	Vert Crack	3/64" W x 2' L	Cap Underside	11	Down	
117	3	1,2,3,4,5,6,7	Vert Crack	3/64" W x 2' L	Cap Underside	11	Down	

TABLE 4. PILE INSPECTION RESULTS - NORTH & SOUTH APPROACHES Page 4 of 5

Bent	Pile	Face/Edge	Deficiency	Size	Reference	Location (Relative to Reference) in ft.	Extends	Comment
117	4	2,6,7	Vert Crack	3/64" W x 2' L	Cap Underside	11	Down	
117	5	6	Vert Crack	3/64" W x 2' L	Cap Underside	11	Down	
118	2	6	Vert Crack	1/16" W x 2.5' L	Cap Underside	11	Down	Within Tidal Zone
119	1	All	Vert Crack	HL x 2' L	Cap Underside	11.2	Down	
119	4	6,8	Vert Crack	1/16" W x 2' L	Cap Underside	11.2	Down	
119	5	4,5,7	Vert Crack	1/16" W x 2' L	Cap Underside	11.2	Down	
120	3	1,2,3,7,8	Vert Crack	1/16" W x 2' L	Cap Underside	11.2	Down	
120	2	4,7,8	Vert Crack	1/16" W x 2' L	Cap Underside	11.2	Down	
120	4	All	Vert Crack	1/16" W x 2' L	Cap Underside	11.2	Down	
120	6	7,8	Vert Crack	1/16" W x 2' L	Cap Underside	11.2	Down	
120	7	1,6,8	Vert Crack	1/16" W x 2' L	Cap Underside	11.2	Down	
121	1	6,7,8	Vert Crack	HL x 2' L	Cap Underside	11	Down	
121	2	1	Vert Crack	HL x 2' L	Cap Underside	11	Down	
121	3	2,5	Vert Crack	1/16" W x 1.5' L	Cap Underside	11	Down	On Face 2, crack is HL width
121	4	4,6,1	Vert Crack	HL x 2' L	Cap Underside	11	Down	
121	5	7	Vert Crack	1/16" W x 2' L	Cap Underside	11	Down	
121	6	4	Vert Crack	HL x 2' L	Cap Underside	11	Down	
122	3	3,1	Vert Crack	1/16" W x 2' L	Cap Underside	11	Down	On Face 1, crack is HL width
122	4	1	Vert Crack	HL x 2' L	Cap Underside	11	Down	
122	1	4	Vert Crack	1/16" W x 2' L	Cap Underside	11	Down	
123	2	4	Vert Crack	HL x 2' L	Cap Underside	11	Down	
123	3	2,3,4,6	Vert Crack	HL x 2' L	Cap Underside	11	Down	
123	5	1,7,8	Vert Crack	HL x 2' L	Cap Underside	11	Down	
123	6	1,2,4,5,7,8	Vert Crack	1/16" W x 2' L	Cap Underside	11	Down	On Faces 1,2,5,8, crack width is HL
F	5	NA	NA	NA	NA	NA	NA	Jacket 1' below WL to 4' above ML (approx. 19' high)
F	6	NA	NA	NA	NA	NA	NA	Jacket 7' below WL to 6' above ML (approx. 10' high)
174	1	SW Edge	Delamination	2' H x 8" W	Cap Underside	14	Down	
175	2	1	Vert Crack	1/16" W x 3' L	Cap Underside	13	Down	
175	5	1,3,4	Vert Crack	HL x 2' L	Cap Underside	29	Up	Located at ML
176	3	All	Vert Crack	1/32" W x 2.5'L	Cap Underside	30	Up	Begins at ML
179	4	All	Vert Crack	HL x 3' L	Cap Underside	28	Up	Begins at ML
180	2	3,4	Vert Crack	HL x 2' L	Cap Underside	31	Up	Begins at ML
183	5	3	Vert Crack	1/32" W x 2.5'L	Cap Underside	27	Up	Begins at ML
184	5	All	Vert Crack	1/16" W x 20' L	Cap Underside	9	Down	
184	2	3	Vert Crack	HL x 3' L	Cap Underside	30.5	Up	Begins at ML
185	5	Corner 2/3	Spall	4" H x 3" W x 1" D	Cap Underside	11.7	Down	
185	2	3	Vert Crack	HL x 2.5' L	Cap Underside	21.5	Up	Begins at ML
185	4	3	Vert Crack	HL x 4.5' L	Cap Underside	21.5	Up	Begins at ML
186	6	All	Vert Crack	1/8" W x 23' L	Cap Underside	8.3	Down	
186	8	2,3,4	Vert Crack	1/16" W x 9' L	Cap Underside	8.3	Down	There is corrosion in crack above WL

TABLE 4. PILE INSPECTION RESULTS - NORTH & SOUTH APPROACHES Page 5 of 5

Bent	Pile	Face/Edge	Deficiency	Size	Reference	Location (Relative to Reference) in ft.	Extends	Comment
186	3	1	Vert Crack	1/16" W x 5' L	Cap Underside	9.3	Down	
197	NW	SW Quadrant	Gap	2" H x 4' L x 5" D	Cap Underside	0.4	Down	Gap is 5" below 66" pile cap underside

Abbreviations:

D - Deep
H - High
HL - Hairline
HWL - High water line
L - Length
ML - Mudline
NA - Not Applicable
NE - Northeast
NW - Northwest
SE - Southeast
SW - Southwest
W - Width
WL - Waterline

TABLE 5. HIGH LEVEL BENTS 129 - 166 INSPECTION FINDINGS Page 1 of 4

PIER	PILE CAP FINDINGS	PILE FINDINGS							
		Pile	Face/ Edge	Deficiency	Size	Reference	Ft. Below Reference	Extends	Comment
129	No Deficiencies observed	5	NW Quad	Spall	1.5' H x 2' W x 3" D	PC Soffit	-9	Down	No Steel
		5	All	Horiz Crack	1/8" W x Circumference	PC Soffit	-0.3	NA	
		5	All	Vert Crack	HL x 2' L	PC Soffit	0	Down	Pile Cap down
		5	South Quad	Spall	1' H x 2.5' W x 2" D	PC Soffit	0	Down	Pile Cap down
		8	4, 7, 8	Vert Crack	HL x 2' L	PC Soffit	0	Down	Pile Cap down
		10	All	Vert Crack	HL x up to 3' L	PC Soffit	0	Down	Pile Cap down
130	No Deficiencies observed	4	2, 6	Vert Crack	HL to < 1/16" X 1'	PC Soffit	0	Down	In Tidal Zone
		5	1, 2, 5, 6	Vert Crack	HL to < 1/16" X 1'	PC Soffit	0	Down	In Tidal Zone
		6	3, 8	Vert Crack	HL to < 1/16" X 1'	PC Soffit	0	Down	In Tidal Zone
		7	2, 5, 8	Vert Crack	HL to < 1/16" X 1'	PC Soffit	0	Down	In Tidal Zone
		10	5	Vert Crack	HL to < 1/16" X 1'	PC Soffit	0	Down	In Tidal Zone
		11	2, 3, 6	Vert Crack	HL to < 1/16" X 1'	PC Soffit	0	Down	In Tidal Zone
		12	1, 7	Vert Crack	HL to 1/16" X 1'	PC Soffit	0	Down	In Tidal Zone
131	No Deficiencies observed	3	8	Vert Crack	HL	PC Soffit	0	Down	In Tidal Zone
		6	All	Vert Crack	HL	PC Soffit	0	Down	In Tidal Zone
		7	2, 3, 4	Vert Crack	HL	PC Soffit	0	Down	In Tidal Zone
		8	NA	NA	NA	PC Soffit	-11.5	NA	Jacket/sleeve
		12	4, 5	Spall	2' H X 1'W X 1" D	PC Soffit	0	Down	In Tidal Zone
		12	1, 2	Spall	1' H X 4" W X 1" D	PC Soffit	-1.5	Down	Const. Related
132	No Deficiencies observed	3	5, 7	Vert Crack	Hairline	PC Soffit	0	Down	In Tidal Zone
		8	All	NA	Metal Collar	PC Soffit	-6	Down	
		12	All	NA	Metal Collar	PC Soffit	-6	Down	
133	No Deficiencies observed	3	8	Vert Crack	Hairline x 1' L	PC Soffit	-31.5	Up	from mudline
		8	All	NA	Metal Collar	PC Soffit	-7.5	Down	
		9	All	Vert Crack	<1/16"	PC Soffit	0	Down	In Tidal Zone
		12	All	NA	Metal Collar	PC Soffit	-7.5	Down	
135	1. Cracks to 1/8" W with efflorescence on pile cap underside near south side of Pile 10.	1	All	Vert Crack	<1/16"	PC Soffit	0	Down	In Tidal Zone
		2	3	Vert Crack	<1/16"	PC Soffit	-31	Up	from mudline
		2	All	Vert Crack	<1/16"	PC Soffit	0	Down	In Tidal Zone
136	No Deficiencies observed	7	8, 1, 2	Rounded corners	2.5' H x 1' W x 2" D	PC Soffit	0	Down	In Tidal Zone Soft Concrete Surrounds, Possibly a chain wrap was here.
138	No Deficiencies observed	12	1,6,7,8	Vert Crack	Full Height x <1/16"	PC Soffit	0	Down	Full Height
139	1. NE lower corner spalled 2' L (E) x 2' L (N) x 10" H x 3" D.	3	1	Vert Crack	HL x Full Ht.	PC Soffit	-24,-10,-3	Down	In cleaned areas
		10	1	Vert Crack	1/32" W x 1.2' H	PC Soffit	-24	Up	At ML in cleaned areas
		15	4	Vert Crack	1/32" W x 1.2' H	PC Soffit	-24	Up	At ML in cleaned areas
140	No Deficiencies observed	7	1,3,4	Vert Crack	1,3 - HL x 6' L; 4 - 1/16" W x 12' L	PC Soffit	0	Down	
		7	2,7,8	Vert Crack	HL x 1' L	PC Soffit	0	Down	
		9	4	Vert Crack	1/16" W x 2' L	PC Soffit	-23	Up	ML up
		13	4	Vert Crack	1/16" W x 2' L	PC Soffit	-23	Up	ML up

TABLE 5. HIGH LEVEL BENTS 129 - 166 INSPECTION FINDINGS Page 2 of 4

PIER	PILE CAP FINDINGS	PILE FINDINGS							
		Pile	Face/ Edge	Deficiency	Size	Reference	Ft. Below Reference	Extends	Comment
141	1. Soffit exhibits cracking to 1/4" W, approximately 1' in from edge, running parallel to the edge between the outer piles.	8	4	Vert Crack	1/32" W x 3' H	PC Soffit	-26.5	Up	ML up
		9	1,6,7,8	Vert Crack	HL x Full Height	PC Soffit	-26	Up	ML up
		15	NA	NA	Metal Collar	PC Soffit	-10	Down	
142	1. Soffit exhibits cracking to 1/16" to 1/8" W with corrosion staining, approximately 1' in from edge, running parallel to the edge between the outer piles.	5	4,5,6	Vert Crack	HL x 6' L	PC Soffit	-31.8	Up	W/effl from ML up
143	1. Soffit exhibits cracking to 1/4" W with corrosion staining, approximately 1' in from edge, running parallel to the edge between the outer piles.	1	1,2	Spall	6" Diam x 2" D	PC Soffit	-1	Down	
	2. West lower edge of pile cap spalled 8' L x 2' W x 4" D with exposed and corroded rebar.	20	All	Vert Crack	HL x 1' L	PC Soffit	0	Down	Pile Cap down
144	1. Soffit exhibits random areas of honeycombing to 1' L x 8" W x 1" D with exposed rebar.	2	1,7,8	Spall	10' H x 2.5' W x 2" D	PC Soffit	0	Down	No Steel
	2. Soffit also exhibits cracks to 1/4" W approximately 1' in from north edge, running parallel to edge between piles.	3	All	Vert Crack	HL x 2' L	PC Soffit	0	Down	
		8	2,3	Spall	2' H x 8" W x 1/2" D	PC Soffit	-1.5	Down	No Steel
		8	3,5,6,7	Vert Crack	HL	PC Soffit	0	Down	In top band
		9	6,7,8	Spall	10' H x 2' W x 1-1/2" D	PC Soffit	-1	Down	Soft Concrete
		9	2,5	Vert Crack	HL x 4' H	PC Soffit	-35	Up	ML up
		11	All	Vert Crack	HL x 2' L	PC Soffit	0	Down	
		12	5,6,7	Spall	2'H x 1.5' W x 1" D	PC Soffit	-1	Down	No Steel
		12	All	Vert Crack	HL x 2' L	PC Soffit	0	Down	In top band
		22	All	Vert Crack	HL	PC Soffit	0	Down	In top band
		29	All	Vert Crack	HL	PC Soffit	0	Down	In top band
		30	2,3,4	Vert Crack	HL	PC Soffit	0	Down	In top band
		34	All	Vert Crack	HL x 2' L	PC Soffit	0	Down	
		37	All	Vert Crack	HL	PC Soffit	0	Down	In top band
145	1. Soffit exhibits cracks to 1/16" W with corrosion staining, in from the north edge, running parallel to the edge, between piles.	1	1,2	Vert Crack	HL x 2' L	PC Soffit	0	Down	In splash zone
	2. Soffit has random areas of honeycombing to 2' L x 2' W x 3/4" D.	6	1	Vert Crack	1/16" W x 4' H	PC Soffit	-37	Up	
	3. At NE corner of pile cap soffit, there is a 2' L x 2' W area of delamination between piles.	20	5	Spall	2.5' L x 14" W x 2" D	PC Soffit	0	Down	Steel exposed
		21	2,3	Spall	4" H x 3" W x 1/2" D	PC Soffit	-0.3	Down	
		26	3	Spall	2' H x 7" W x 1" D	PC Soffit	0	Down	No Steel
		31	1	Vert Crack	1/32" W x 6" L	PC Soffit	0	Down	
		32	4	Vert Crack	1/16" W x 3' H	PC Soffit	-37	Up	ML up
146	1. Soffit exhibits cracking to 1/4" W, approximately 1' in from edge, running parallel to the edge between the outer piles.	6	4,5,6	Spall	6' H x 2' W x 3.5" D	PC Soffit	-2	Down	Corroded PS strands
		12	4,5,6	Void	11' H x 2.5' W x 3.5" D	PC Soffit	-1.3	Down	Corroded Reinforcing
		12	2,3	Vert Crack	HL x 2' L	PC Soffit	-1.3	Down	
		13	2,3	Horiz Crack	1/16" W x 1.3' L	PC Soffit	0	NA	Corrosion stains
		16	All	Spall	13' H x 3.5" D	PC Soffit	-1	Down	Corroded Reinforcing
		16	All	Spall	6' H x 3.5" D	PC Soffit	-36	Up	ML up
		17	All	Horiz Crack	1/8" W x Circumfer	PC Soffit	-1.3	NA	
		20	1,2,3	Horiz Crack	1/16" W x 2' L	PC Soffit	0	NA	

TABLE 5. HIGH LEVEL BENTS 129 - 166 INSPECTION FINDINGS Page 3 of 4

PIER	PILE CAP FINDINGS	PILE FINDINGS							
		Pile	Face/ Edge	Deficiency	Size	Reference	Ft. Below Reference	Extends	Comment
147	1. Soffit exhibits cracking to 1/4" W, approximately 1' in from edge, running parallel to the edge between the outer piles.	4	Corner 1/8	Spall		PC Soffit	0	Down	
		7	3,4	Spall	6" H x 2" W x 1" D	PC Soffit	0	Down	
148	1. Soffit exhibits cracking to 1/4" W, approximately 1' in from edge, running parallel to the edge between the outer piles.	NA	NA	NA	NA	NA	NA	NA	
149	1. Soffit exhibits cracking to 1/8" W, approximately 1' in from edge, running parallel to the edge between the outer piles.	9	4	Vert Crack	1/16" W x 13' L	PC Soffit	0	Down	W/efflor
		15	All		3' H	PC Soffit	-13	Down	Metal Collar
150	1. Soffit exhibits cracking to 1/4" W, approximately 1' in from edge, running parallel to the edge between the outer piles.	NA	NA	NA	NA	NA	NA	NA	
151	1. Soffit exhibits cracking to 1/4" W, approximately 1' in from edge, running parallel to the edge between the outer piles.	1	5	Vert Crack	1/32" W x 1' H	PC Soffit	-15	Down	
	2. Lower NE corner has a spall 5' L x 1.7' H x 10" D with exposed and corroded rebar.	1	3	Vert Crack	1/16" W x 4' H	PC Soffit	-40	Up	At ML
152	1. Soffit exhibits cracking to 1/4" W, approximately 1' in from edge, running parallel to the edge between the outer piles.	6	2,3	Vert Crack	HL x 4' H	PC Soffit	-36.7	Up	At ML W/efflor
		7	All	Vert Crack	HL x 1' H	PC Soffit	0	Down	Cap down W/efflor
153	1. Soffit exhibits cracking to 1/4" W, approximately 1' in from edge, running parallel to the edge between the outer piles.	1	NA	Corr bleed through	NA	PC Soffit	0	NA	At pile/cap juncture
		2	NA	Corr bleed through	NA	PC Soffit	0	NA	At pile/cap juncture
		4	2,3,4	Vert Crack	HL x 12' H	PC Soffit	0	Down	Cap down
154	1. Soffit exhibits cracking to 1/4" W, approximately 1' in from edge, running parallel to the edge between the outer piles.	3	All	Vert Crack	HL x 15' H	PC Soffit	0	Down	In Level II band
		10	All	Vert Crack	HL x 15' H	PC Soffit	0	Down	In Level II band
155	1. Soffit exhibits cracking to 1/4" W, approximately 1' in from edge, running parallel to the edge between the outer piles.	2	All	Vert Crack	HL	PC Soffit	-16	Down	In Level II band
156	No Deficiencies observed	4	1,2,3	Spall	2' H x 1.5' W x 2" D	PC Soffit	0	Down	
		4	7	Vert Crack	HL	PC Soffit	-15	Down	14' down W/efflor
		7	All	Vert Crack	HL	PC Soffit	-15	Down	14' down W/efflor
157	No Deficiencies observed	3	4,7	Vert Crack	HL	PC Soffit	-1	Down	In splash zone down to ML
		7	8	Vert Crack	1/32" W x 1' H	PC Soffit	-1	Down	
158	No Deficiencies observed	2	2,3,4	Matrix loss/ soft conc.	2' H x 1/4" D	PC Soffit	-35	Up	At ML
		6	2,3,4,5,6	Matrix loss/ soft conc.	1' H x 1/4" D	PC Soffit	-36	Up	
		9	6,7	Matrix loss/ soft conc.	1' H x 1/4" D	PC Soffit	-36	Up	At ML
		12	4,5,6,7	Matrix loss/ soft conc.	1' H x 1/4" D	PC Soffit	-38	Up	At ML
		12	NA	NA	NA	PC Soffit	-24	Down	3' H Sleeve
159	1. West face's lower edge exhibits a spall 1.5' H x 10' L (Entire face width) x 6" D.	1	1	Matrix loss/ soft conc.	2' H x 1/4" D	PC Soffit	-35	Up	
		6	6	Vert Crack	HL x 2' H	PC Soffit	-35	Up	W/efflor
		7	All	Poor splice	NA	PC Soffit	-23	Down	
		7	All	Poor splice	NA	PC Soffit	-39	Down	
		9	7	Vert Crack	HL x 8" H	PC Soffit	-36	Up	At ML

TABLE 5. HIGH LEVEL BENTS 129 - 166 INSPECTION FINDINGS Page 4 of 4

PIER	PILE CAP FINDINGS	PILE FINDINGS							
		Pile	Face/ Edge	Deficiency	Size	Reference	Ft. Below Reference	Extends	Comment
160	1. Soffit exhibits cracking to 1/4" W, approximately 1' in from edge, running parallel to the edge between the outer piles.	4	2,6,7,8	Deteriorated Splice	2" H x 1-1/2" D	PC Soffit	-35.7	Up	At ML
		4	4	Vert Crack	HL x 1.5' H	PC Soffit	-35.7	Up	At ML W/Corrosion Staining
		4	All	Vert Crack	HL	PC Soffit	0	Down	In tidal zone
		10	All	Vert Crack	HL	PC Soffit	0	Down	In tidal zone & ML
		10	6	Vert Crack	1/16" W x 2'	PC Soffit	0	Down	
161	1. Soffit exhibits cracking to 1/4" W, approximately 1' in from edge, running parallel to the edge between the outer piles.	NA	NA	NA	NA	NA	NA	NA	
162	1. Soffit exhibits cracking to 1/16" W, approximately 1' in from edge, running parallel to the edge between the outer piles.	9	5	Spall	1' H x 3" W shallow	PC Soffit	0	Down	
		8	2	Vert Crack	HL x 1' L	PC Soffit	0	Down	With efflorescence
		6	2	Vert Crack	HL x 1' L	PC Soffit	0	Down	With efflorescence
		6	4	Spall	6" H x 8" W x 3/4" D	PC Soffit	0	Down	Const. Related
		6	7	Vert Crack	HL x 4' H	PC Soffit	-31.5	Up	
163	1. Soffit exhibits cracking to 1/16" W, approximately 1' in from edge, running parallel to the edge between the outer piles.	9	1,2,3,4	Vert Crack	HL to 1/16"W x 14' L	PC Soffit	0	Down	With efflorescence
	2. Lower SE edge exhbits a spall 3' L x 1.5' L x 1.5' H x 6" D.	10	6,7	Vert Crack	1/16" W	PC Soffit	-1.5		With efflorescence in top band
		1	7,8	Vert Crack	HL x 1' H	PC Soffit	0	Down	
164	1. NW lower corner exhibits a 1.5' H x 1.5' W x 6" D spall.	2	6	Vert Crack	HL x 4' H	PC Soffit	-25	Up	
165	No Deficiencies observed	2	1,6,7,8	Vert Crack	HL	PC Soffit	0	Down	
		6	4	Vert Crack	HL	PC Soffit	-1.5	Down	
		10	8	Vert Crack	HL x 1' L	PC Soffit	0	Down	
166	1. Soffit exhibits cracking to 1/8" W, approximately 1' in from edge, running parallel to the edge between the outer piles.	7	6	Vert Crack	HL	PC Soffit	-1.7	Down	In top band
	2. Soffit exhibits random honeycombing to 1" D.	NA	NA	NA	NA	NA	NA	NA	

General Note: Pile caps typically exhibit horizontal cracking to 1/8" wide in the lower 1'. Refer to Above Water NBI Inspection.

Abbreviations:

Conc - Concrete
Const - Construction
Corr - Corrosion
D - Deep
Efflor - Efflorescence
Ft - Feet
H - High
HL - Hairline
L - Long
ML - Mudline
NA - Not Applicable
NE - Northeast
NW - Northwest
PC – Pile Cap
Quad - Quadrant
SE - Southeast
SW - Southwest
Vert - Vertical
W - Wide
WL - Waterline
W/ - With

TABLE 6. "NEW" PILE CAP (BENTS 167-172 & BENTS 187-200) INSPECTION FINDINGS Page 1 of 2

Bent	Pile Cap Side	Face	Deficiency	Size	Location	Comment
168	East	East	Horiz. Crack	1/16" W	1' above lower edge of cap	With Corrosion Stains
	East	Underside	Transverse Crack	To 1/8" W	Adjacent to lower south edge	
	East	West	Vert. Crack	1/16" W x 1' L	Lower edge up	
169	East	North	Horiz. Crack	1/8" W	1' above lower edge of cap	
170	West	North and South	Horiz. Crack	1/16" to 1/8" W	1' to 1.5' above lower edge	Cracks extend around corners on East and West faces.
	East	North and South	Horiz. Crack	1/16" to 1/8" W	1' to 1.5' above lower edge	
171	East	All	Horiz. Crack	1/16" to 3/16" W	1' above lower edge of cap	Cracks heaviest on North and South faces, but extend around corners to middle of East and West faces.
	West	North and South	Horiz. Crack	1/16" W	1' above lower edge of cap	
172	East	North and South	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	With Corrosion Stains
	West	North	Horiz. Crack	1/16" W	1' to 1.5' above lower edge	Wrap around NW and NE edges.
187	East	North and South	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	Cracks wrap around edges to mid-pile.
	West	North	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	
188	West	South	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	Crack wraps around SE and SW edges for up to 4'.
	West	South	Map Cracks	HL	NA	With efflorescence
	East	North and South	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	Cracks wrap around edges.
	East	North	Vert. Crack	1/8" W	NA	
189	West	North and South	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	Cracks wrap onto west face up to 8' L
	West	North	Map Cracks	HL	NA	With Efflorescence and some diagonal cracking.
	East	North and South	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	Cracks wrap onto west face up to 8' L
190	West	North and South	Horiz. Crack	3/16" W	1' to 1.5' above lower edge	
191	East	North and South	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	
	West	North	Horiz. Crack	3/16" W	1' to 1.5' above lower edge	Crack extends into east and west faces.
	West	South	Horiz. Crack	1/16" W	1' to 1.5' above lower edge	
192	East	North and South	Horiz. Crack	1/16" W	1' to 1.5' above lower edge	
	West	South	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	Cracks exhibit efflorescence.
193	West	North and South	Horiz. Crack	1/16" W	1' to 1.5' above lower edge	North face cracks exhibit corrosion staining.
194	East	North	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	
	East	South	Horiz. Crack	1/16" W	1' to 1.5' above lower edge	
	West	North and South	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	
195	East	North and South	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	
	West	North and South	Horiz. Crack	1/16" W	1' to 1.5' above lower edge	
	West	South	Vert. Crack	1/32" W	Cap top down	
196	East	North	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	
	East	South	Horiz. Crack	1/16" W	1' to 1.5' above lower edge	
	West	North and South	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	
197	West	South	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	With Corrosion Stains
	West	North	Horiz. Crack	1/4" W	1' to 1.5' above lower edge	Cracks extend on west side to cross girder/cap seat
	East	North and South	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	
198	West	North and South	Horiz. Crack	1/16" W	1' to 1.5' above lower edge	
	East	North and South	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	

TABLE 6. "NEW" PILE CAP (BENTS 167-172 & BENTS 187-200) INSPECTION FINDINGS Page 2 of 2

Bent	Pile Cap Side	Face	Deficiency	Size	Location	Comment
199	East	North	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	Crack is intermittent
	West	South	Horiz. Crack	1/8" W	1' to 1.5' above lower edge	Crack is intermittent

At Bent 200, the lower 1' of web and lower flange of each cross girders (4 total) are submerged and in good condition.
Underwater inspection ended at Bent 200.

Abbreviations:

HL - Hairline
Horiz - Horizontal
L - Long
Vert - Vertical
W - Wide

TABLE 7. FENDER DEFICIENCIES

Fender	Location	Deficiency
North	Between Clusters 2 &3	5 Vertical timber rub strips heavily damaged. Third (from top) timber wale rub strip and connnecting hardware are damaged.
	Between Clusters 3 & 4	2 Vertical timber rub strips heavily damaged.
	Between Clusters 5 & 6	1 Vertical timber rub strip has the lower 3' missing.
	Between Clusters 6 & 7	2 Vertical timber rub strips heavily damaged.
	Between Clusters 7 & 8	2 Vertical timber rub strips have the upper 5' missing.
	Between Clusters 8 & 9	1 Vertical timber rub strip has the upper 2' missing.
	Between Clusters 9 & 10	4 Vertical timber rub strips are heavily damaged.
	Between Clusters 12 & 13	2 Vertical timber rub strips exhibit heavy damage in their lower half.
	Between Clusters 13 & 14	1 Vertical timber rub strip exhibits heavy damage in the upper 6'.
	Between Clusters 14 & 15	1 Vertical timber rub strip exhibits heavy damage in the upper 3'.
	Between Clusters 15 & 16	2 Vertical timber rub strips exhibit heavy damage.
South	Between Clusters 1 & 2	2 Vertical timber rub strips exhibit heavy damage in their upper half.
	Between Clusters 2 &3	1 Vertical timber rub strip exhibits damage.
	Between Clusters 3 & 4	3 Vertical timber rub strips exhibit splitting in the lower 3'.
	Between Clusters 5 & 6	1 Vertical timber rub strip exhibits damage in the upper 1'.
	Between Clusters 6 & 7	2 Vertical timber rub strips exhibit damage in upper 2' and 1 Vertical timber rub strip is missing.
	Between Clusters 7 & 8	1 Vertical timber rub strip exhibits damage in the upper 2'.
	Between Clusters 8 & 9	1 Vertical timber rub strip exhibits damage in the upper 3'.
	Between Clusters 9 & 10	3 Vertical timber rub strips exhibit heavy damage.
	Between Clusters 10 & 13	Heavy impact damage has resulted in damage/loss of all vertical timber rub strips and the third (from top) steel wale is bent between Clusters 10 and 12.
	Between Clusters 13 & 14	5 Vertical timber rub strips have the lower 5' missing.
	Between Clusters 14 & 15	5 Vertical timber rub strips exhibit heavy damage.
	Between Clusters 15 & 16	3 Vertical timber rub strips exhibit heavy damage in the lower 4'.
	West of Cluster 16	3 Vertical timber rub strips exhibit heavy damage in the lower half.

NOTES:

1) In general, all steel elements (piles, wire wraps) exhibit light to moderate corrosion above the waterline.
2) At Cluster 8 of the North Fender, the middle and bottom wire wraps are heavily corroded.
3) At Clusters 8 & 9 of the North Fender, the top wraps are heavily deteriorated and loose.
4) At the dolphin at the west end of the North Fender, 1 pile in the west quadrant is broken at the waterline.
5) At Cluster 1 of the South Fender, the top wire wrap is missing.
6) At Cluster 6 of the South Fender, the middle wire wrap is missing.
7) At Cluster 16 of the South Fender, the wire wraps exhibit heavy corrosion.
8) At the dolphin at the east end of Bent 143, the top wrap is loose.

APPPENDIX G.4 – REFERENCES

REFERENCES:

1. Bridge Inspector's Reference Manual, FHWA NHI 03-001, Federal Highway Administration, October 2002.

2. Underwater Inspection of Bridges, FHWA-DP-80-1, Federal Highway Administration, November 1989.

3. Substructure Drawings, Sheets S-75 through S-122, State of North Carolina State Highway Commission, Project No. 821306, November 1961.

4. Standard 22" Prestressed Octagonal Concrete Pile", Sheet S-132, State of North Carolina State Highway Commission, Project No. 821306, July 1959.

5. Valery M. Buslov, "Marine Concrete – When to Repair, What to Repair," Concrete International, May 1992.