

**Underwater Inspection Report for:**

The Hope Memorial Bridge over the Cuyahoga River in Cleveland, Ohio  
(Thirteen-span, Steel Cantilever Deck Truss Bridge with Concrete Piers)

**Contractor personnel on site during inspection:**

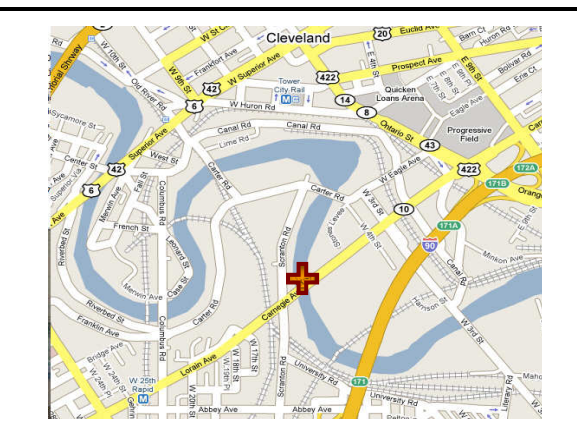
1. Capt. Travis M. Clower, MBA, P.E. (Diver / Lead Inspector)
2. Derek Zilka, (Backup Diver / Inspector)
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*General Elevation View*



*Location Map*

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**DESCRIPTION**

The Hope Memorial Bridge, also known as the Lorain Carnegie Bridge or CUY-10-16.13 carries four lanes of Carnegie Avenue across the Cuyahoga River on the southwest side of Cleveland, Ohio. The bridge was completed in 1932 and renovated in the early 1980's.

The structure consists of a thirteen-span, steel cantilever deck truss bridge supported by twelve reinforced concrete piers and two abutments. Each pier consists of four reinforced concrete vertical columns. Only the piers adjacent to the riverbanks were partially submerged and considered part of this inspection. Following the nomenclature established in the original plans and used up to the 2000-02 rehabilitation, Pier 9 is on the east shore and Pier 10 is on the west shore. Likewise the columns will be lettered A to D from north to south.

Adjacent to each of these two piers is a partially failed timber pile fender system. Although referenced to in this report, the remaining timber fender system was not part of this inspection.

**INSPECTION OPERATIONS**

KCI's three-person dive team performed an underwater inspection on October 9<sup>th</sup>, 2010. The underwater inspection was conducted by a Licensed Professional Engineer and National Highway Institute (NHI) Certified Bridge Inspector. All dives were conducted by an Association of Diving Contractors International (ADCI) certified commercial diver in accordance with the Occupational Safety and Health Administration (OSHA) guidelines. A visual inspection was performed from 1-foot above the waterline (splash zone) to the mudline. Where the diver's visibility was limited, tactile methods were used. Soundings were taken along all substructure units and up to 30 feet north and south of the bridge using an ultrasonic depth sounder. Sounding data was verified using a survey rod.

The top surface of the timber retaining wall between Columns C and D on Pier 10 (West Pier) was chosen as the hydrographic reference point. This was the same location used in both the 2005 and 2008 Underwater Inspection Reports. The water surface was measured to be 5.9 feet below this point (see Photo 10).

Hazards Encountered:	<i>Visibility less than 1-foot with debris on the bottom.</i>
Inspection Mode:	<i>Surface supplied diving with hard wire communications</i>
Flow Direction / Velocity:	<i>The flow was from south to north. Little to no current.</i>
Order of Inspection:	<i>The diver inspected Pier 10 first, followed by Pier 9.</i>
Bottom Composition:	<i>Mud, small stones and debris.</i>
Scour Checked By:	<i>Soundings, probing and tactile methods.</i>
Equipment Used:	<i>Superlite 27 dive helmet and drysuit</i>
Elements Cleaned:	<i>Little to no growth present at the time of inspection. No significant cleaning required.</i>
Hydrographic Reference:	<i>The top surface of the timber retaining wall between Columns C and D on Pier 10 (West Pier). The water surface was measured to be 5.9 feet below this point.</i>

## **OBSERVATIONS**

### **GENERAL**

- Little to no biological growth was present at the time of inspection. No significant cleaning required.
- Visibility was less than 1-foot.
- The concrete surfaces were sounded with a hammer and found to be in good condition.

### **CHANNEL**

- Little to no current present at the time of inspection.
- The south side of Pier 10, Column D has large (2-foot diameter) riprap stone around it. This is discussed below. The bottom composition in all other areas consists of mud, small stone and timber debris.
- The channel alignment is not perpendicular to the bridge piers. At this specific location, the Cuyahoga flows directly north. However the bridge is aligned from northeast to southwest at approximately a 30-degree angle.
- Upstream and downstream of the bridge steel sheet pile walls direct the flow. Additionally, upstream there are two abandoned concrete piers (from a previous bridge) that influence the flow. Downstream of these abandoned piers, timber pile fender systems extend to the north side of the Hope Memorial Bridge. The timber pile fender system on the east river bank has failed and is leaning into the river. Wire rope and shackles are present on both fender systems, suggesting they have been used to moor barges in the past. The timber pile fender system on the west bank was unable to be completely installed originally because of the size and location of the bridge pier footing. Neither of these timber fenders is fully capable of protecting the bridge piers from erosion and/or impact damage. These timber pile fender systems are beyond the scope of this inspection.

## **DEFECTS & DEFICIENCIES**

### **PIER 9 (EAST PIER), COLUMN A**

- The concrete surfaces had up to 1 ½-inch deep scaling with exposed aggregate at the waterline. This condition was up to 2 inches deep in the splash zone at the northwest and southwest corners. The northwest corner is protected with an 8-inch wide galvanized steel angle to prevent impact damage. The steel angle stops 2.6 feet above the water line and is in good condition (Photos 5 and 6).
- Just above the waterline on the west face there is a 10-inch diameter hole formed in the concrete. This was the location of a scupper drainpipe outlet. Pier 10 has a steel pipe in this location; however no pipe was present on Pier 9. This is shown in Photo 6.
- The 2008 adjusted sounding taken below this scupper pipe was 5.1 feet. The sounding taken during this inspection in the same location was 6.1 feet. It appears that up to 1.0 foot of material has slid down the steep slope towards the center of the channel.
- Photo 6 also shows the stone and concrete that was dumped between Columns A and B for shore protection. The material between the columns under this concrete has up to 3.7 feet of undermining. The undermining found during the 2008 inspection was only 1.0-

foot. This also supports that material is sliding down the steep slope towards the center of the channel.

- Large concrete riprap is present around the north side of Column A. The bottom material around the west and south faces is steep sloping small stones and sticks.
- No exposed footing was present and no other defects were found at the time of inspection.

#### **PIER 9 (EAST PIER), COLUMN B**

- The concrete surfaces had up to 1-inch deep scaling with exposed aggregate at the waterline. Only parts of the north and west sides were exposed to the water (Photo 6). The water at the northwest corner of this column was only 0.2 feet deep.
- The bottom consisted of small stones and timber debris sloping towards the center of the channel. This is shown in Photo 6.
- No exposed footing was present and no other defects were found at the time of inspection.

#### **PIER 9 (EAST PIER), COLUMNS C AND D**

- Dry.

#### **PIER 10 (WEST PIER), COLUMN A**

- Dry.

#### **PIER 10 (WEST PIER), COLUMN B**

- Only the south and east faces were exposed to water.
- The concrete surfaces had up to 1 ½-inch deep scaling with exposed aggregate at the waterline. This condition was up to 2 inches deep in the splash zone at the southeast corner and is shown in Photo 8.
- Soft mud and timber debris has accumulated on the bottom between Columns B and C. The bottom material on the east face is mud and small stone steeply sloping towards the center of the channel.
- No exposed footing was present and no other defects were found at the time of inspection.

#### **PIER 10 (WEST PIER), COLUMN C**

- The concrete surfaces had up to 1 ½-inch deep scaling with exposed aggregate at the waterline. This condition was up to 2 inches deep in the splash zone at the east corners and is also shown in Photo 8.
- Soft mud and timber debris has accumulated on the bottom between Columns C and D. The bottom material on the east face is mud and small stone steeply sloping towards the center of the channel.
- The timber retaining wall between Columns B and C was sounded with a hammer and found to be in good condition.

- No exposed footing was present and no other defects were found at the time of inspection.

#### **PIER 10 (WEST PIER), COLUMN D**

- The concrete surfaces had up to 1 ½-inch deep scaling with exposed aggregate at the waterline. This condition was up to 2 inches deep in the splash zone at the northeast corner. The southeast corner is protected with an 8-inch wide galvanized steel angle to prevent impact damage. The steel angle extends 5.1 feet below the water surface and is in good condition.
- The timber retaining wall between Columns C and D was sounded with a hammer and found to be in good condition. This area was used as the hydrographic reference point in the 2005, 2008 and the 2010 underwater inspections. The distance from the top of the timber wall to the water surface was measured to be 5.9 feet for this inspection and 6.3 feet for the 2008 underwater inspection. When comparing the 2010 soundings to the 2008 soundings, a 0.4 feet adjustment will be added to the 2008 numbers.
- Photo 7 shows the 10-inch diameter steel scupper pipe exiting the east face of Pier 10, Column D just above the water line. This is similar to the 10-inch scupper hole found on the west face of Pier 9, Column A.
- The southeast corner of the pier footing is exposed along the east face of Column D (Figures 1 and 2). The maximum vertical exposure was measured to be 3.7 feet in 2010 and 3.2 feet during the 2008 inspection. 9.5 horizontal feet of footing are exposed along the south side and 17 horizontal feet are exposed on the east face of the footer. The timber piles are driven into the river bottom tight up against the footing on both the south and east intersection points. This is shown above water in Photo 7. No footing undermining was detected.
- Viewing from above, the footer extends 7.3 feet east of the east face of Column D. Likewise in plan view, the footer extends 7.7 feet south of the south face of Column D. The top of footer was 23.4 feet below the water surface. The flat concrete of the southeast corner top of footer has numerous 2-foot diameter boulders laying on it that were not present during the 2008 inspection. This very large riprap material was stacked to form a nearly vertical wall eleven feet west of the exposed southeast corner during the 2008 inspection. It has since fallen down increasing the sounding midway on the south face of Pier 10, Column D from 8.0 feet in 2008 (adjusted) to 18.5 feet in 2010. This diver had the opportunity to do both the 2008 and 2010 inspections and was surprised to find this much material had fallen towards the center of the channel and was spread out across the top of the footer.
- No other defects were found at the time of inspection.

## **COMPARISON TO PREVIOUS REPORTING AND SUMMARY**

The concrete surfaces of both Pier 9 (East Pier) and Pier 10 (West Pier) were sounded with a hammer and found to be in good condition. At the waterline, the surfaces of both piers showed up to 1 ½-inch scaling with exposed aggregate. This condition was up to 2 inches deep on the corners exposed to splashing and ice buildup. Exposed reinforcing steel was not found anywhere. No significant cracks, spalls, or impact damage was found underwater on any of the pier columns.

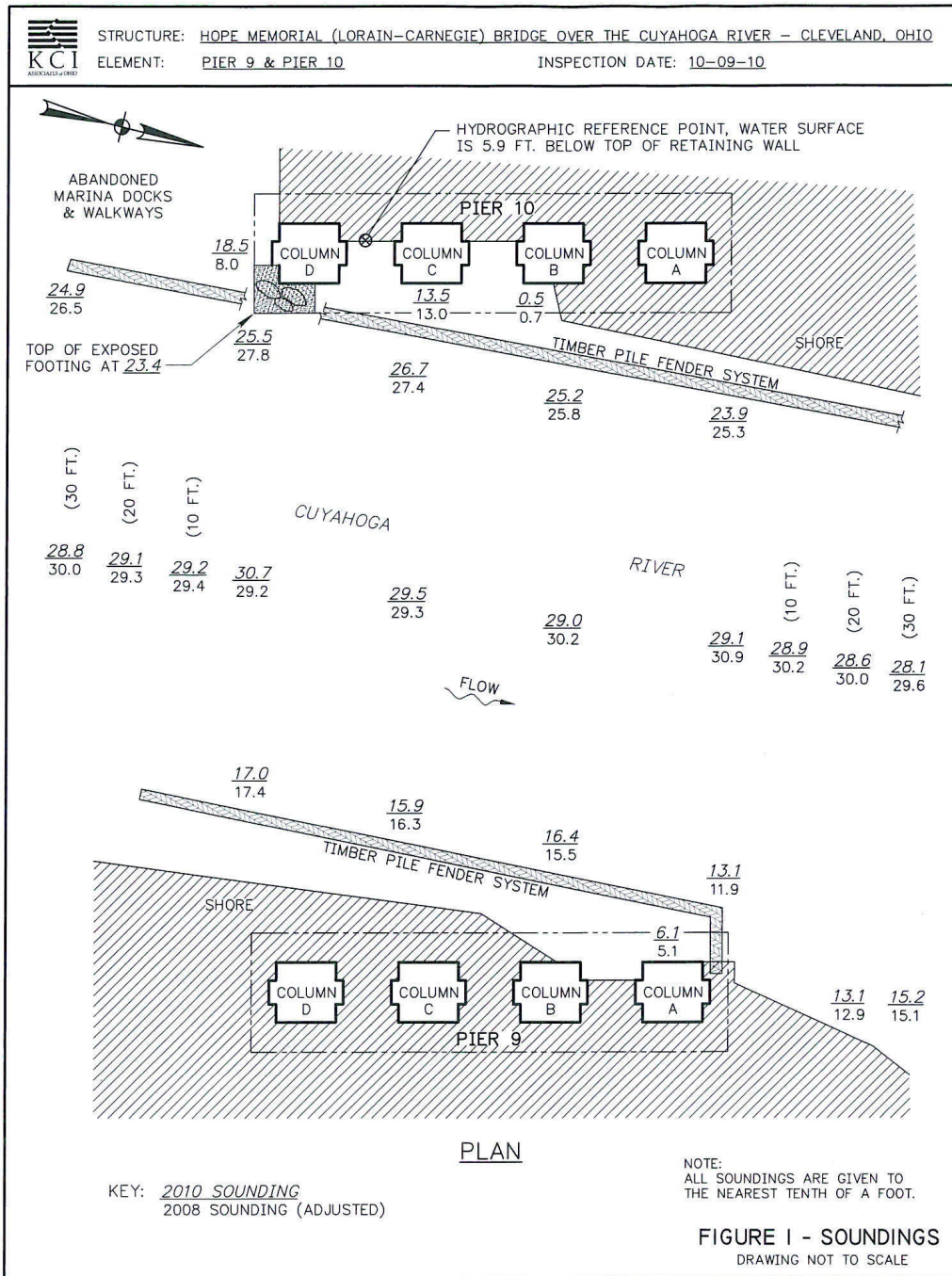
Pier 9 (East Pier) did not have footing exposed. Both the Column A soundings and the above water loss of material between Columns A and B support that up to 1-foot of material has slid down the steep slope towards the center of the channel since the 2008 inspection. As the timber pile fender system continues to fall apart, more of this material will be removed. This is true for both Pier 9 and Pier 10. No exposed footer was found on Pier 9.

Similar to the 2008 inspection findings, the southeast corner of Pier 10 (West Pier) footing is exposed along the east face of Column D. The maximum vertical exposure was 3.7 feet in 2010 and 3.2 feet during the 2008 inspection. The flat concrete of the southeast corner top of footer has numerous 2-foot diameter boulders laying on it that were not present during the 2008 inspection. This very large riprap material was stacked to form a nearly vertical wall eleven feet west of the exposed southeast corner during the 2008 inspection. It has since fallen down increasing the sounding midway on the south face of Pier 10, Column D from 8.0 feet in 2008 (adjusted) to 18.5 feet in 2010. The large difference in soundings along this south face of Column D is an isolated incident resulting from rotting timber piles holding back a steep, unstable stack of extremely large riprap. This is not a scour issue, nor is it cause for concern. However, future inspections should continue to monitor the exposed footer in this corner.

## **RECOMMENDATIONS**

The material on the steep slopes around both piers continues to slide towards the center of the channel. As long as the timber pile fender system continues to break down, this will remain the case. It may increase in years with high water events and a year that the shipping channel is dredged. Typically, armor matting, grout bags or large riprap stone are used for erosion protection. Unfortunately those fixes would only be temporary and very dependent on the condition of the failing timber pile fender system. The only suggestion at this time would be to continue to monitor the exposed footer with underwater inspections and continue to compare soundings.





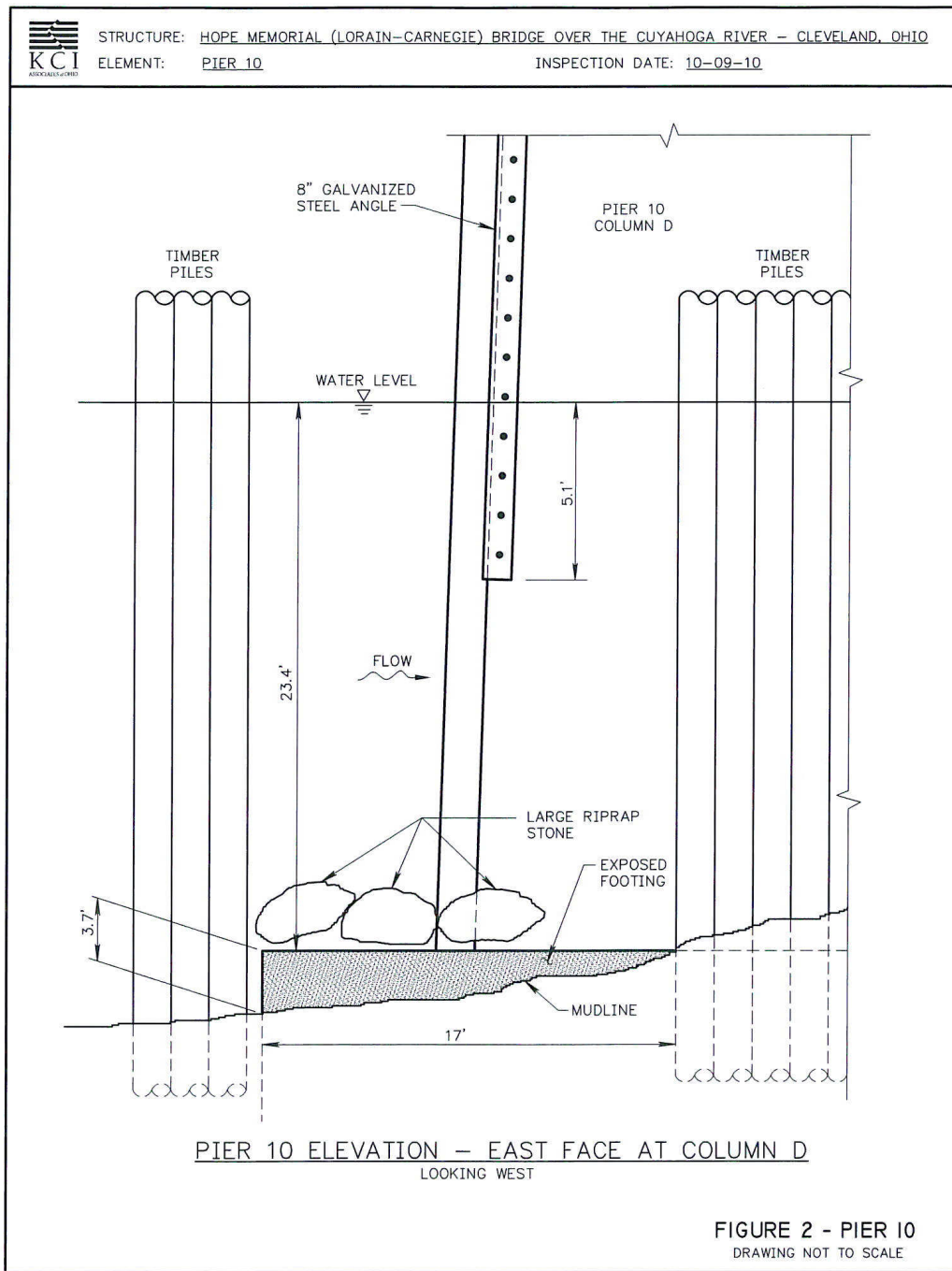






Photo by T. Clower, 10/9/10

Photo 1 – Facing North. South Elevation of the bridge.



Photo by T. Clower, 10/9/10

Photo 2 – Facing South. North Elevation of the bridge.



Photo by T. Clower, 10/9/10

Photo 3 – Facing North (downstream) from the bridge.



Photo by T. Clower, 10/9/10

Photo 4 – Facing South (upstream) from the bridge.



Photo by T. Clower, 10/9/10

Photo 5 – Facing East. West face of Pier 9.



Photo by T. Clower, 10/9/10

Photo 6 – Facing Northeast. West face of Pier 9, Columns A and B.





Photo by T. Clower, 10/9/10

Photo 7 – Facing West. East face of Pier 10.



Photo by T. Clower, 10/9/10

Photo 8 – Facing Northwest. East face of Pier 10, Columns C, B and A.



Photo by T. Clower, 10/9/10

Photo 9 – Facing North. South face of Pier 10, Column D.



Photo by T. Clower, 10/9/10

Photo 10 – Facing West. Hydrographic Reference Point  
Timber Retaining Wall 5.9 feet above water surface.