UNDERWATER BRIDGE INSPECTION REPORT

I-65 (Interstate 65) over Cumberland River
Structure No. 19I00650145
Davidson County, Tennessee

August 2023
Project No. 16023014.07

Prepared for

Tennessee Department of Transportation
Suite 1200, James K. Polk Building
505 Deaderick Street, Nashville, TN 37243-0338

DocuSigned by:
Jacob A. Williams
0BD430B41433418...

JACOB A. WILLIAMS
REGISTERED ENGINEER
AGRICULTURE
COMMERCE
No. 107620
STATE OF TENNESSEE
10/13/2023

Team Leader: Matthew Tom, PE

Signature: DocuSigned by:
Matthew Tom
CA335752547A4B1...
10/13/2023

benesch

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EXECUTIVE SUMMARY

Project: TDOT Underwater Bridge Inspection – 2023 Benesch

Purpose of Project: To perform a detailed visual and tactile underwater investigation of On-System Bridges for Tennessee Department of Transportation

Bridge Information

Bridge Number:	19I00650145	***Coordinates***:	36.19133°N, 86.78453°W
Route:	Woodland Street	***Bridge Length:***	1198’-8”
Crossing:	Cumberland River	***No. of Spans:***	6
Year Built:	1967		
Structure Type:	Reinforced Concrete Piers		
Foundation Types:	Spread footings on rock foundation		

Inspection Information

Inspection Date:	August 23, 2023	***Diving Method:***	Surface Supplied Air
Inspection Team:	Team Leader – Matt Tom, PE Team Member – Will Dix Team Member – Kyle Rose Team Member – Joseph Perkins Team Member – Rebecca Witherspoon, EI		

Site Conditions

Weather:	Sunny	***Temperature***:	96^{o}F
Water Visibility:	2 ft	***Water Velocity***:	< 1ft/s
Water Temperature:	80 °F	***Type of Boat:***	25 ft Flat Bottom
Waterline Elevation:	384.8 ft		
Access Location:	Shelby Park Boat Dock		
Waterline Reference:	66.0 ft from top of Pier 3 (elev. 450.79 ft)		
Max. Depth at SSU:	25.2 ft – 10 ft west of Pier 3		
Shoreline Conditions:	The east and west shoreline upstream and downstream of the structure consisted of moderately sloped moderately vegetated embankments with minor erosion.		

Summary of Findings:

- **Pier 2:**
  - Top and sides of footing was observed, however, no undermining was detected.
  - Major debris build up on the upstream nose of the Pier was observed.
- **Pier 3:**
  - Top and sides of footing was observed, however, no undermining was detected.
  - Six construction voids were observed, three on the east and three on the west face.
- **Pier 4:**
  - Top and side of footing was observed, however, no undermining was detected.
  - One submerged vehicle was located on the downstream end of the Pier.
  - The sub footing was exposed approximately 1.5 feet on the upstream, channel side corner of the Pier.

Summary of Recommendations:

- Monitor debris accumulation at Pier 2.
- Monitor sub footing exposure at Pier 4.

Underwater Inspection Coding:

NBI Ratings:

Items	Description	Coding	Condition
60	Substructure	6 – Satisfactory Condition	Footing Exposure
61	Channel	7 – Good Condition	
62	Culvert	N/A	
92B	UW Insp. Frequency	60 Months	
93B	Insp. Date	August 23, 2023	
*113	Scour Critical Bridges	6 - Within Foundation Limits	Stable

*Note: NBI Condition Rating provided is only a recommendation and is based on field observations. The actual condition rating for Scour Appraisal (Item 113) is to be made considering hydraulic,51 geotechnical, and structural features.

SNBI Ratings:

Items ID	Component	Rating
B.C.03	Substructure	6
B.C.04	Culvert	N/A
B.C.09	Channel	7
B.C.10	Channel Protection	N/A
B.C.11	Scour	6
B.C.15	Underwater Inspection	6

AASHTO National Bridge Element (NBE) Ratings:

Reinforced Concrete Column							
Element Number	**Element Name**	**Units**	**Total Qty**	**Condition State 1**	**2**	**3**	**4**
210	Reinforced Concrete Pier Wall	LF	261	261	0	0	0

Reinforced Concrete Pile Cap / Footing							
Element Number	**Element Name**	**Units**	**Total Qty**	**Condition State 1**	**2**	**3**	**4**
220	Reinforced Concrete Pile Cap / Footing	LF	267	175	89	3	0
Defect Number	**Defect Type**	**Units**			**2**	**3**	**4**
1080	Delamination / Spall	LF			0	3	0
6000	Scour	LF			89	0	0

Note: Ratings were developed using the FHWA Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges. The recommended ratings consider inspected elements located within the waterway and conditions existing below the water surface only. Additional consideration is necessary for the assignment of overall condition ratings for this bridge.

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This report consists of the results of a detailed underwater investigation performed at the Interstate 65 Bridge over Cumberland River in Davidson County, TN. Mainstream Commercial Divers, Inc. (MCD) conducted the underwater investigation for Alfred Benesch & Company (Benesch) as part of the underwater inspection contract with the Tennessee Department of Transportation (TDOT) on August 23, 2023. The primary purpose of the investigation was as follows:

- Level I inspection on 100% of the underwater surfaces and a level II inspection of noted deficiencies.
- Testing of exposed piles under footings to determine the soundness of the piling.
- Obtain channel bottom depth measurements at 10 ft intervals for each end and side of pier facings for a distance of 50 ft and around the submerged substructure units.
- Identifying the channel bottom material (such as silty clay, firm clay, sand, rock, etc.)
- Investigate and determine the presence and extent of scour around the bridge piers.
- Determine if a sub-footing exists for each pier; if it does, measure the dimensions.
- Measure dimensions of the substructure elements and compare to plans and previous inspection reports, if available. Determine water surface elevation and channel bed elevation relative to the top of pier.
- Photographs were taken of typical inspected elements, the upstream and downstream elevations of the bridge, the channel upstream and downstream of the bridge, along with any significant defects.
- Paint the month and year of the inspection on the bridge.

In addition, a brief inspection was made of areas that could be submerged during periods of high water. The following report includes a description of the structure, the method of investigation, a description of existing conditions, an evaluation and recommendations based on the conditions, inspection figures, and photographs.

1.2 General Description of the Structure

Structure No. 19I00650145 spans 1199 ft, carrying Interstate 65 over Cumberland River. The bridge superstructure is constructed of four steel continuous beams. The roadway orientation of the longitudinal axis of the bridge is west to east. The substructure units are concrete column two post bents on steel pile foundation. They are labeled as Abutments 1 and 2, and Piers 1 through 5. Existing design drawings were available at the time of the inspection and were used to determine water surface elevation and foundation elevations. Refer to Figure 1 in Exhibit 1 for a Location Map of the bridge. Refer to Photographs 1 and 2 in Exhibit 2 for overall views of the bridge.

1.3 Method of Investigation

A detailed field inspection was conducted to determine the physical condition of the submerged bridge substructure units from the waterline to the channel bottom. A brief visual examination of the substructure units above the waterline was also made.

A five-person team consisting of team leader (Matt Tom, PE), a boat driver (Will Dix) a diver (Kyle Rose), a dive assistant (Joseph Perkins), and one designer (Rebecca Witherspoon, EI) conducted the underwater inspection. The inspection was conducted using surface supplied air. During the inspection the diver inspected the submerged substructure and communicated to the note taker in the boat via radio.

The underwater inspection consisted of a visual and tactile examination (Level I) of the accessible surfaces of the substructure units from the waterline to the channel bottom with particular attention given to any observed areas of deterioration or apparent distress. When significant defects were found, approximately 10 percent of the total area on the underwater surfaces of the substructure units as well as any areas of deterioration were cleaned (Level II) so that the condition could be more closely examined. Photographs were taken to document the general conditions and observed deficiencies. The type of channel bottom material, the presence or extent of scour, the presence or extent of riprap, the presence or extent of drift and debris, and the location of any foundation exposure or undermining were noted.

Channel bottom soundings were performed utilizing sonar. Soundings were collected at 10 ft intervals for each end and side of pier facings for a distance of 50 ft and around the submerged substructure units and the waterline was referenced to a known elevation on the bridge. A sounding plan was developed using the soundings and approximate location of the shorelines. Refer to Figure 2 in Exhibit 1 for the sounding plan that shows water depths around the structure.

2.0 EXISTING CONDITIONS

2.1 GENERAL CONDITIONS

At the time of the inspection, the waterline of 19I00650145 was located approximately 66 ft below the top of Pier 3, which corresponds to a waterline elevation of 384.8 ft. During the inspection, the waterway was flowing at approximately less than 1 ft per second. The bridge pier skew was consistent with the channel alignment and does not require attention at this time. The east and west shoreline upstream and downstream of the structure consisted of mildly sloped heavily vegetated embankments with minor erosion. The east and west shoreline at the structure consisted of gravel and riprap. Refer to Photographs 8 & 9 in Exhibit 2 for views of the shorelines near the structure. Refer to Photograph 10 in Exhibit 2 for a view of the stencil applied to Abutment 1.

2.2 SUBSTRUCTURE CONDITIONS

2.2.1 Pier 2

The channel bottom around Pier 2 consisted of sand, gravel, and riprap. Top and sides of footing was observed, however, no undermining was detected. Major debris build up around the upstream nose of the Pier was observed. Refer to Figure 3 through 5 in Exhibit 1 for detailed inspection notes of Pier 2. Refer to Photograph 5 in Exhibit 2 for views of Pier 2 and typical concrete condition at the waterline.

2.2.2 Pier 3

The channel bottom around Pier 3 consisted of sand and gravel. The top and sides of footing was observed, however, no undermining was detected. Moderate debris build up was observed on the east face of the Pier. Six voids were observed, three on the east face and three on the west face. Each void had approximate dimensions of 1’x1’x3”. The voids

were left over from construction and are not a structural concern. Refer to Figure 6 through 8 in Exhibit 1 for detailed inspection notes of Pier 3. Refer to Photograph 6 in Exhibit 2 for views of Pier 3 and typical concrete condition at the waterline.

2.2.3 Pier 4

The channel bottom around Pier 4 consisted of sand, gravel, and riprap. Top and side of footing was observed, however, no undermining was detected. A submerged vehicle was located on the downstream end of the Pier. The sub footing was exposed approximately 1.5 feet on the upstream, channel side corner of the Pier. Refer to Figure 9 through 11 in Exhibit 1 for detailed inspection notes of Pier 4. Refer to Photograph 6 in Exhibit 2 for views of Pier 4 and typical concrete condition at the waterline.

3.0 EVALUATION AND RECOMMENDATIONS

Overall, the inspected substructure units of Structure No. 19I00650145 were in satisfactory condition. The timber debris accumulation at Pier 2 did not significantly affect the channel flow, and as a result, does not require removal at this time. If the debris accumulation increases in size or density, it may be necessary to remove the debris to reduce excessive lateral loads on the pier, limit further debris accumulation, and reduce the likelihood of channel bottom degradation resulting from obstructed flow. The voids observed on Pier 3 are not a structural concern, they are left over after construction. This area should be monitored during future inspections for increasing the extent or severity of the voids. If the extent or severity of the voids is observed to be increasing or reinforcing steel becomes exposed, it may be necessary to repair the area at that time.

A comparison of the soundings recorded during the previous inspection on July 15, 2020 and the soundings taken during this inspection revealed a tolerable change in the channel bottom profile in the vicinity of the structure. The footing exposure at Piers 2 through 4 is not a concern at this time given that the bottom of the concrete seal was embedded a minimum of 1.5 feet below the current channel bottom and the pier is pile supported. The channel bottom configuration should continue to be closely monitored during future underwater inspections to verify that the footing exposure at Piers 2 through 4 is not increasing and that all footings remain adequately embedded in the channel bottom.

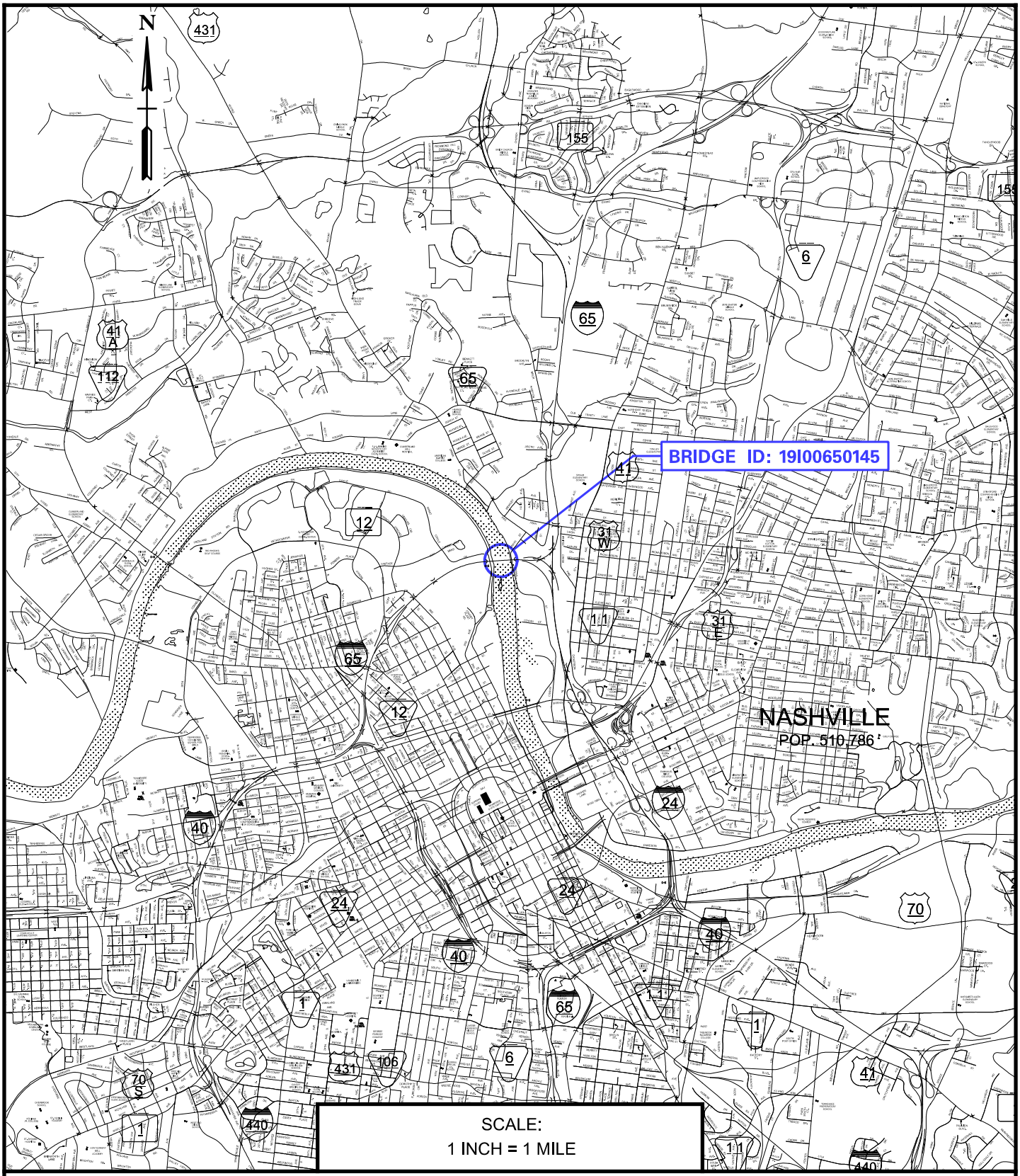
It is recommended that the submerged substructure units of Structure No. 19I00650145 be next inspected underwater at an interval not to exceed 60 months, no later than August 2028.

Respectfully Submitted,

Jake Williams, P.E.
Project Manager

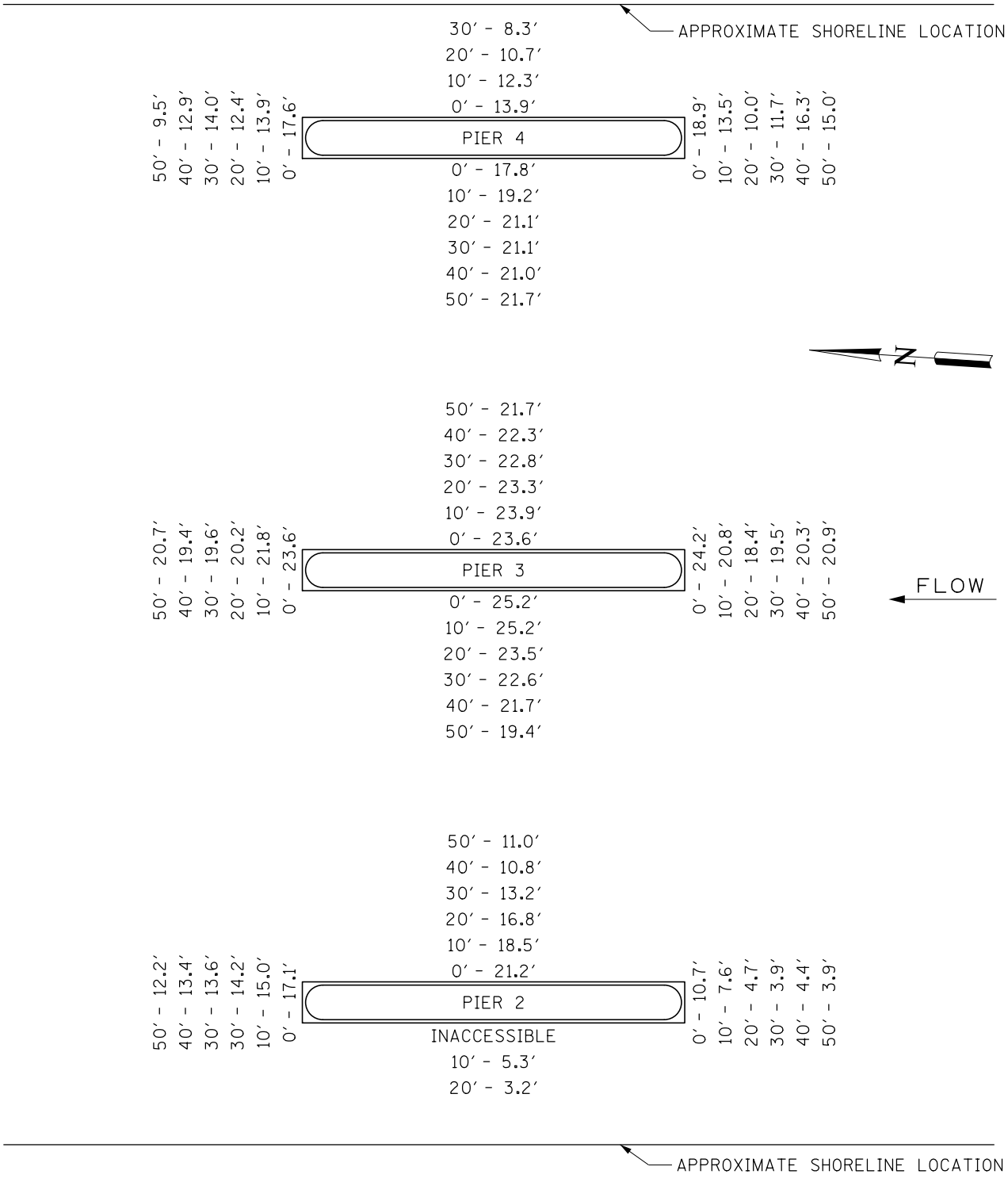
EXHIBIT 1 – FIGURES

LOCATION MAP



I65 (I0065) OVER CUMBERLAND RIVER & COWAN ST DAVIDSON COUNTY, TN
BRIDGE NUMBER: 19I00650145

SOUNDING PLAN

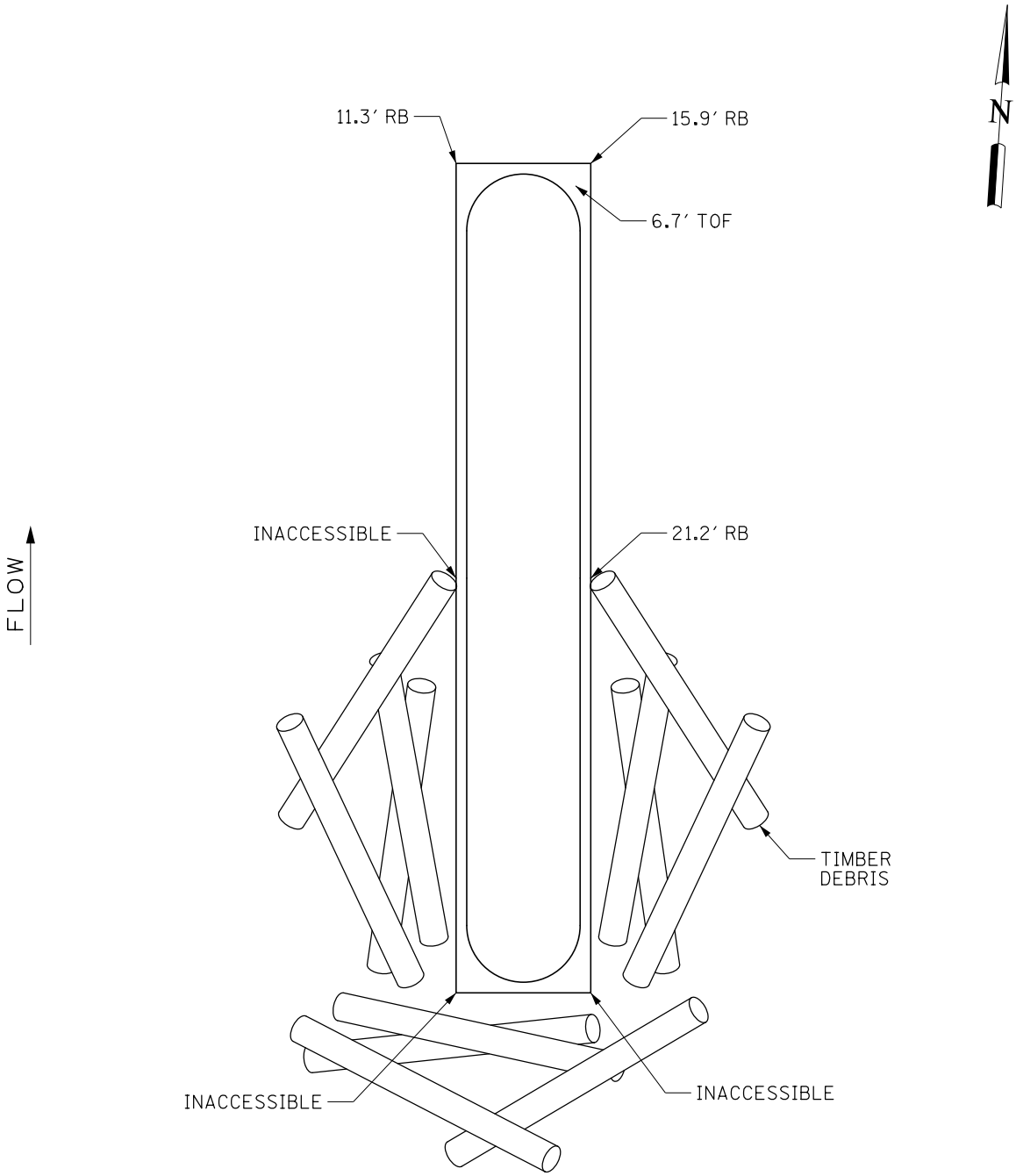


APPROX. W.S.E. = 384.8′

SOUNDING PLAN

INTERSTATE 65 (I-65) OVER CUMBERLAND RIVER & COWAN STREET DAVIDSON COUNTY, TN
BRIDGE NUMBER 19I00650145

PIER 2

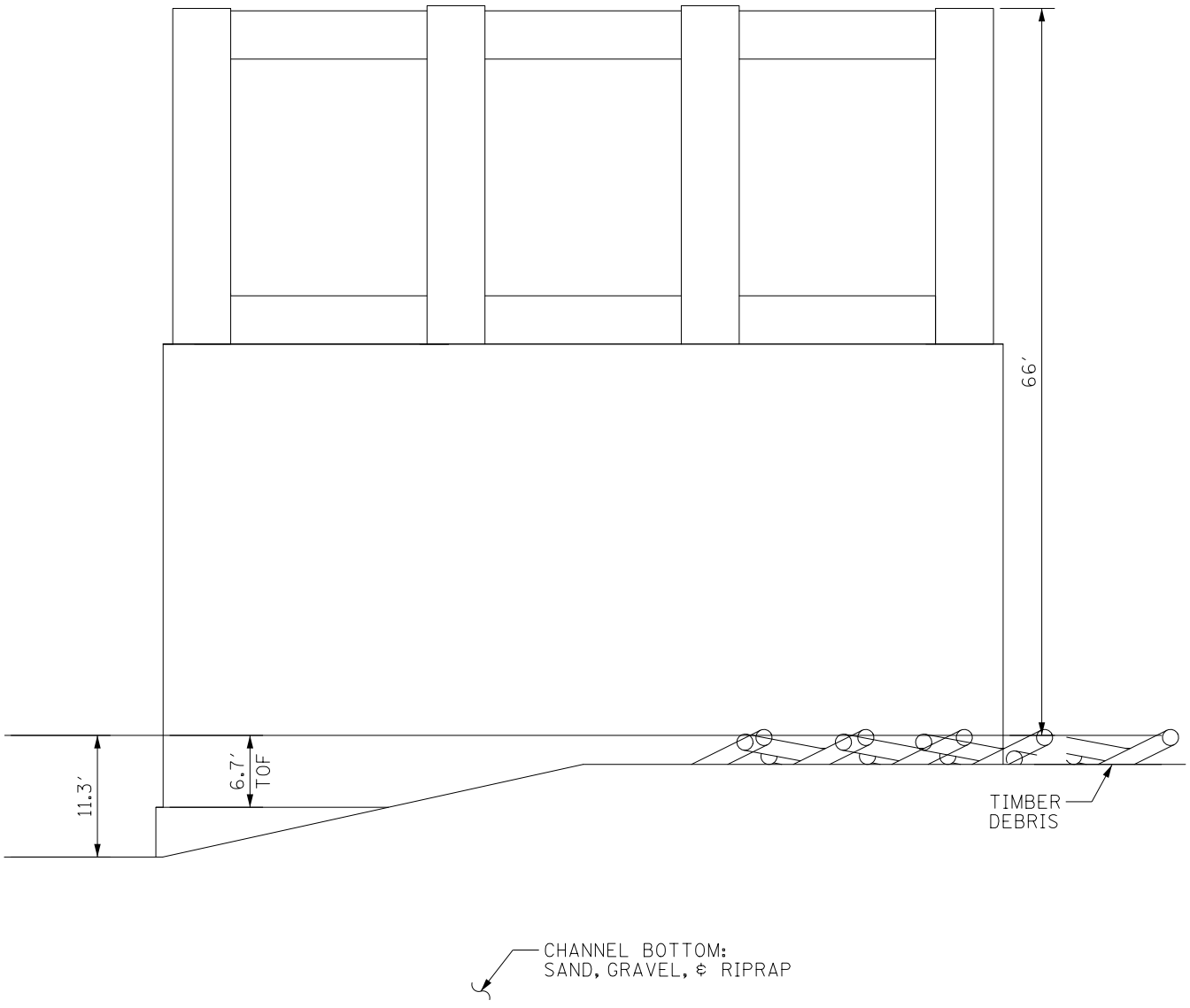


APPROX. W.S.E. = 384.8′

PIER 2 - FOOTING

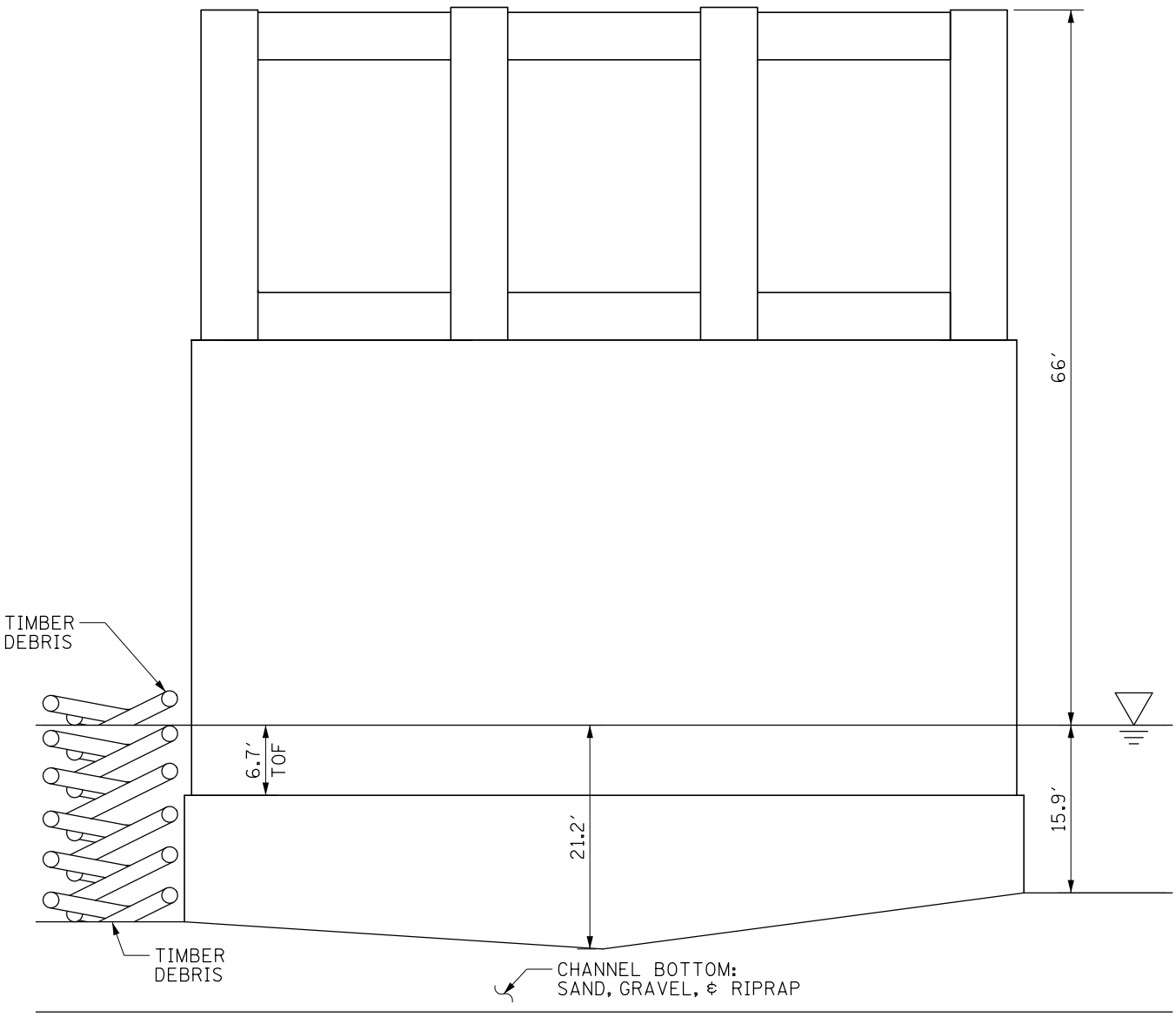
TOF - TOP OF FOOTING
RB - RIVER BOTTOM

INSTERSTATE 65 (I-65) OVER CUMBERLAND RIVER & COWAN STREET DAVIDSON COUNTY, TN
BRIDGE NUMBER: 19I00650145



PIER 2 - ELEVATION
LOOKING EAST

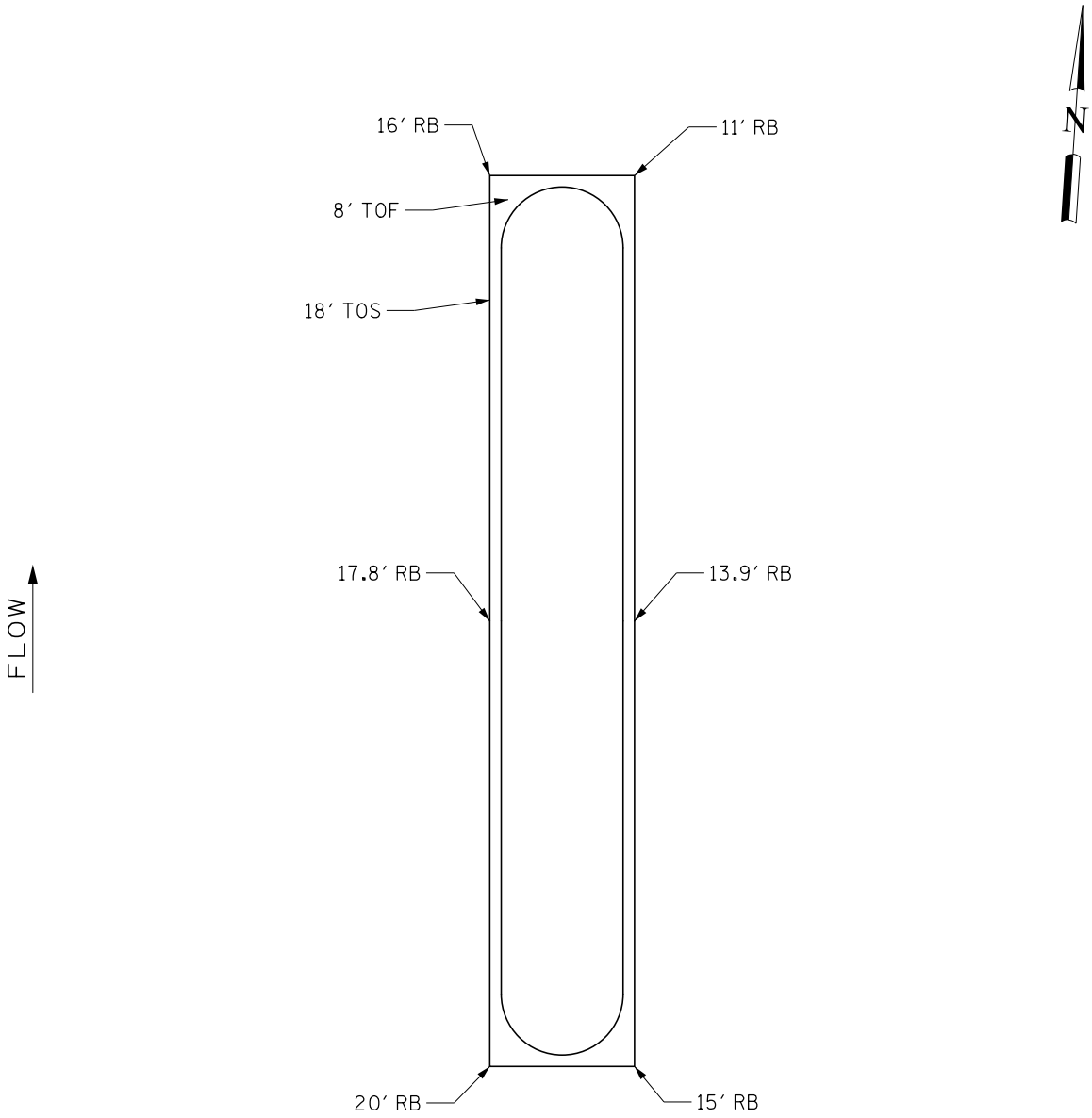
INTERSTATE 65 (I-65) OVER CUMBERLAND RIVER & COWAN STREET DAVIDSON COUNTY, TN
BRIDGE NUMBER: 19I00650145



PIER 2 - ELEVATION
LOOKING WEST

INTERSTATE 65 (I-65) OVER CUMBERLAND RIVER & COWAN STREET DAVIDSON COUNTY, TN
BRIDGE NUMBER: 19I00650145

PIER 3

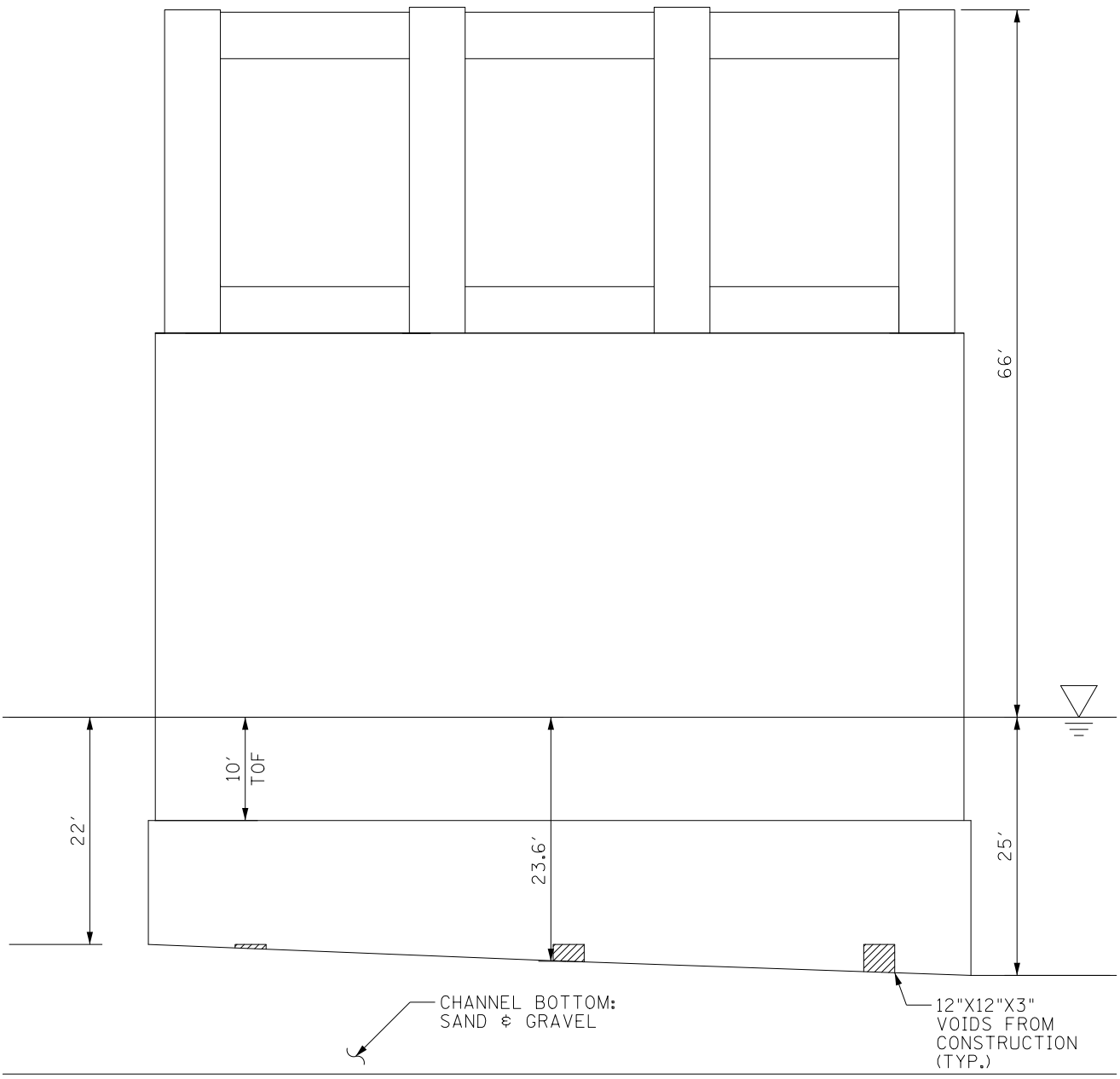


APPROX. W.S.E. = 384.8′

PIER 4 - FOOTING

TOF - TOP OF FOOTING
TOS - TOP OF SEAL
RB - RIVER BOTTOM

INSTERSTATE 65 (I-65) OVER CUMBERLAND RIVER & COWAN STREET DAVIDSON COUNTY, TN
BRIDGE NUMBER: 19I00650145

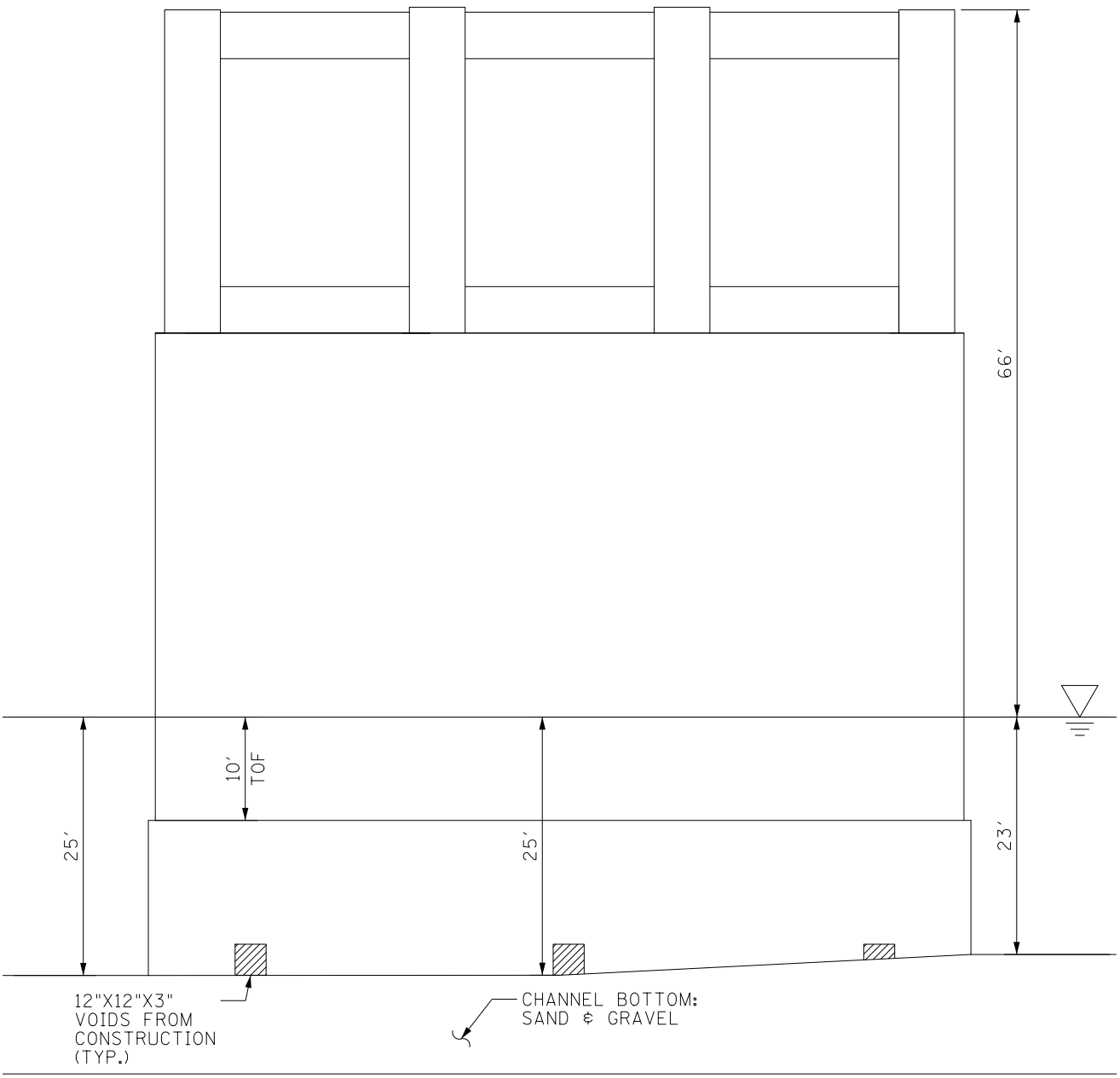


APPROX. W.S.E. = 384.8'

PIER 3 - ELEVATION
LOOKING EAST

FLOW

INTERSTATE 65 (I-65) OVER CUMBERLAND RIVER & COWAN STREET DAVIDSON COUNTY, TN
BRIDGE NUMBER: 19I00650145



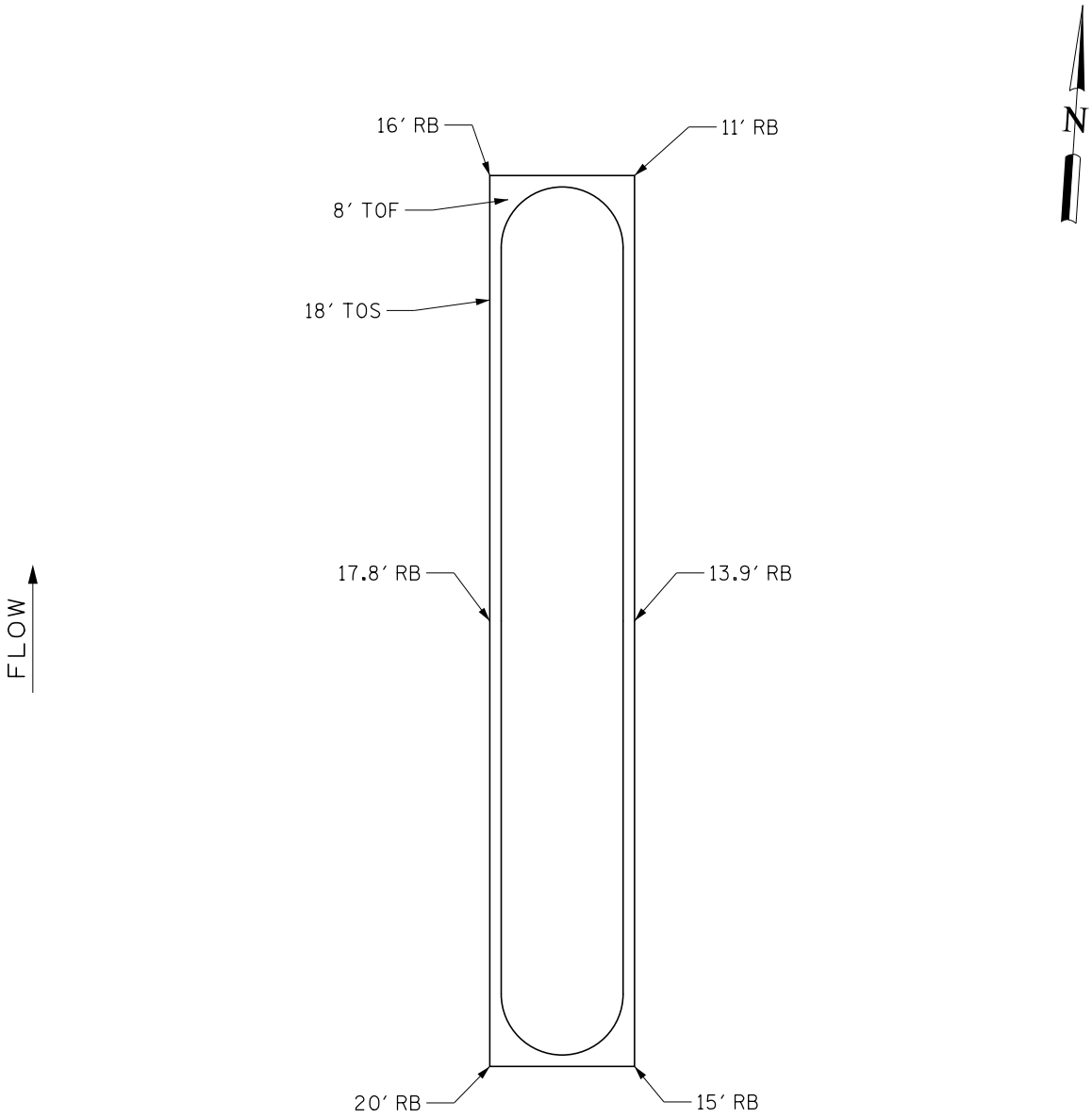
APPROX. W.S.E. = 384.8′

PIER 3 - ELEVATION
LOOKING WEST

FLOW

INTERSTATE 65 (I-65) OVER CUMBERLAND RIVER & COWAN STREET DAVIDSON COUNTY, TN
BRIDGE NUMBER: 19I00650145

PIER 4

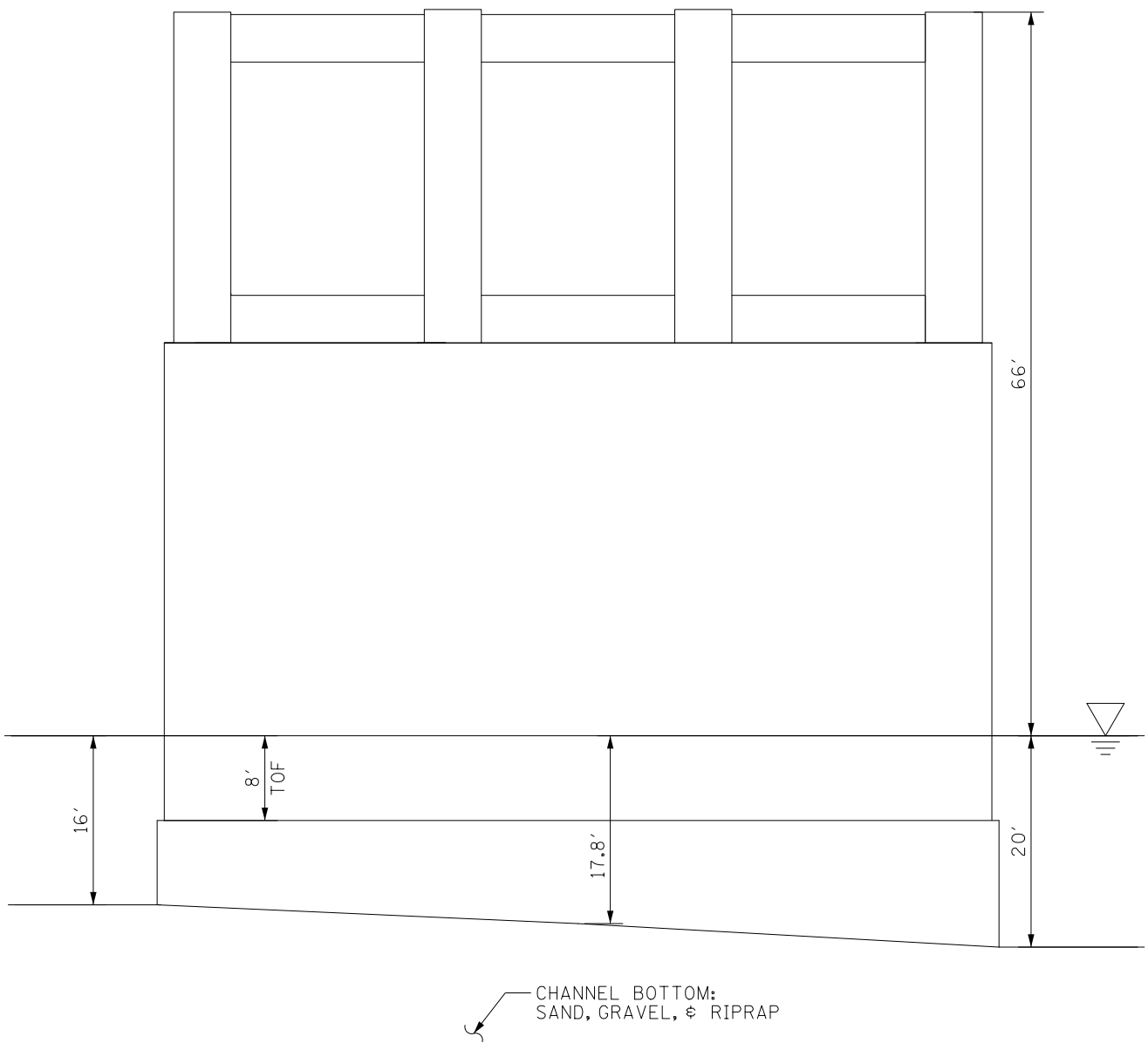


APPROX. W.S.E. = 384.8′

PIER 4 - FOOTING

TOF - TOP OF FOOTING
TOS - TOP OF SEAL
RB - RIVER BOTTOM

INSTERSTATE 65 (I-65) OVER CUMBERLAND RIVER & COWAN STREET DAVIDSON COUNTY, TN
BRIDGE NUMBER: 19I00650145

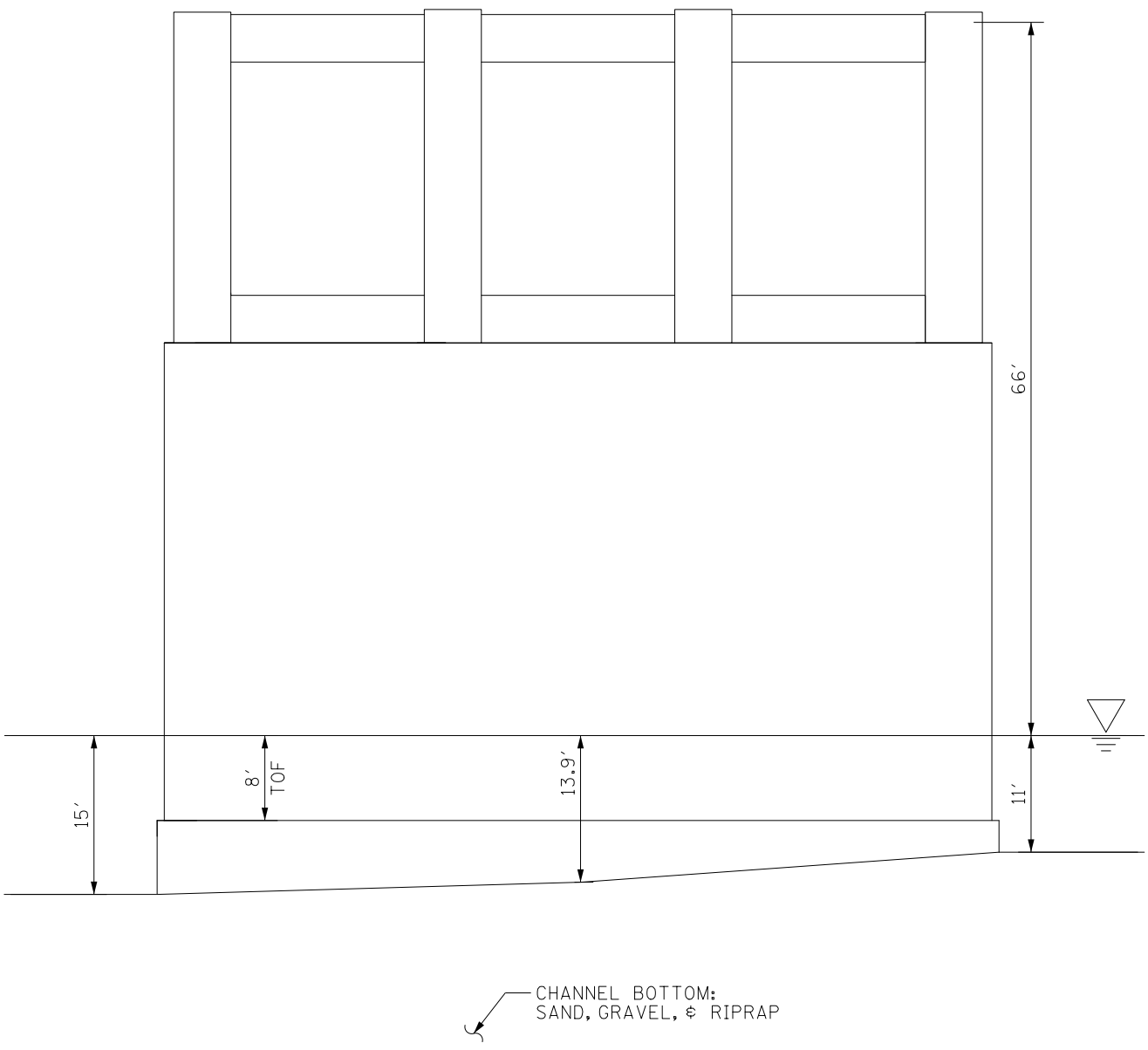


APPROX. W.S.E. = 384.8'

PIER 4 - ELEVATION
LOOKING EAST

FLOW

INTERSTATE 65 (I-65) OVER CUMBERLAND RIVER & COWAN STREET DAVIDSON COUNTY, TN
BRIDGE NUMBER: 19I00650145



APPROX. W.S.E. = 384.8'

PIER 4 - ELEVATION
LOOKING WEST

FLOW

INTERSTATE 65 (I-65) OVER CUMBERLAND RIVER & COWAN STREET DAVIDSON COUNTY, TN
BRIDGE NUMBER: 19I00650145

EXHIBIT 2 – INSPECTION PHOTOGRAPHS

Downstream Structure Profile

Upstream Structure Profile

Looking upstream, south

Looking downstream, north

Pier 2, looking west

Pier 3, looking east

Pier 4, looking east

East shoreline

West shoreline

Underwater inspection marking, Abutment 1

EXHIBIT 3 – UNDERWATER INSPECTION TEAM CERTIFICATES

U.S. Department
of Transportation
Federal Highway Administration

National Highway Institute

Certificate of Training

Matthew Tom

has Successfully Completed

FHWA-NHI-130053 Bridge Inspection Refresher Training

hosted by

Moffatt & Nichol

Date: *November 16-18, 2022*

Location: *Suffolk, VA*

Hours of Instruction: 18

Instructor

Instructor

Local Coordinator

Thomas Harman

Thomas Harman, Director
National Highway Institute

U.S. Department
Of Transportation
Federal Highway Administration

National Highway Institute

Certificate of Training

NATIONAL HIGHWAY INSTITUTE
Training Solutions for Transportation Excellence

MATTHEW TOM

has participated in

FHWA-NHI-130055
Safety Inspection of In-Service Bridges

hosted by

Indiana Department of Transportation

Date: **July 8-21, 2013**

Hours of Instruction: **67**

Location: **Indianapolis, IN**

Instructor

Instructor

Local Coordinator

Richard Barnaby, Director
National Highway Institute

Association of Diving Contractors International

Cert. # 57099

Expires 01/27/2028

ADCI

SURFACE-SUPPLIED AIR DIVING SUPERVISOR

WILLIAM L. DIX I.D. 0833

Commercial Diver Certification Card

U.S. Department of Transportation
Federal Highway Administration

National Highway Institute

NATIONAL HIGHWAY INSTITUTE

Certificate of Training

William Dix

has participated in

FHWA-NHI-130091 Underwater Bridge Inspection

hosted by

Terracon Consultants, Inc.

Date: *June 05-08, 2018*

Location: *Rocky Hill, CT*

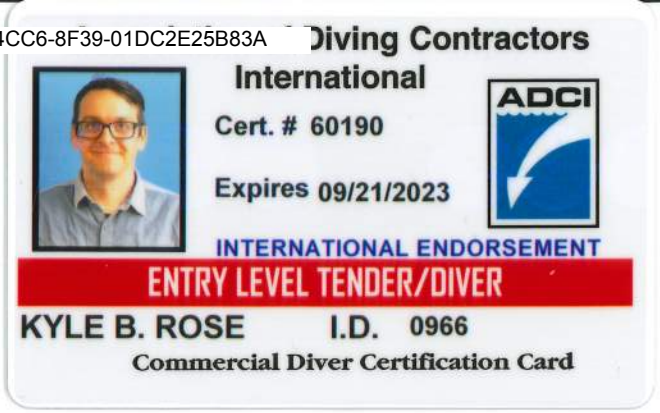
Hours of Instruction: 24

Instructor

Local Coordinator

Instructor

Valerie Briggs, Director
National Highway Institute



Diving Contractors International

Cert. # 60190

Expires 09/21/2023

ADCI

INTERNATIONAL ENDORSEMENT

ENTRY LEVEL TENDER/DIVER

KYLE B. ROSE I.D. 0966

Commercial Diver Certification Card

U.S. Department of Transportation
Federal Highway Administration

National Highway Institute

national highway institute

Certificate of Training

Kyle Rose

has participated in

FHWA-NHI-130091 Underwater Bridge Inspection

hosted by

MAINSTREAM COMMERCIAL DIVERS, INC.

Date: ***March 28-31, 2022***

Location: ***Murray, KY***

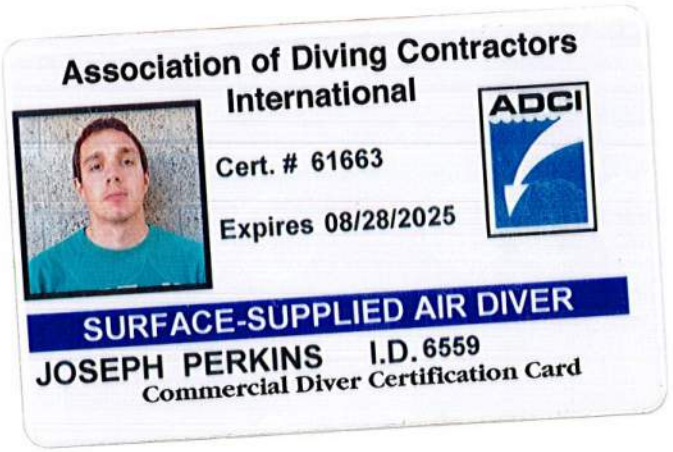
Hours of Instruction: **24**

David Carroll
Instructor

Shelley Kingston
Local Coordinator

Instructor

Thomas Harman
Thomas Harman, Director
National Highway Institute



U.S. Department of Transportation
Federal Highway Administration

National Highway Institute

national **highway institute**

Certificate of Training

Joseph Perkins

has participated in

FHWA-NHI-130091 Underwater Bridge Inspection

hosted by

MAINSTREAM COMMERCIAL DIVERS, INC.

Date: ***March 28-31, 2022***

Location: ***Murray, KY***

Hours of Instruction: **24**

David Carrick

Instructor

Brett J Sposito

Instructor

Shelley Kingston

Local Coordinator

Thomas Harman

Thomas Harman, Director
National Highway Institute