

906 Bridge Hydraulic Recommendations Sheet

906.1 General

A Bridge Hydraulic Recommendations Sheet (BHRS) is required for each proposed bridge structure; not bridge culverts. This sheet summarizes the findings and recommendations of the bridge hydraulic analysis contained within the Bridge Hydraulics Report. The BHRS consists of four sections:

- (1) Plan View
- (2) Profile View
- (3) Location Map and Drainage Area
- (4) Bridge Hydraulic Data Table

The BHRS is appended to the Bridge Hydraulics Report and included in the Structures Plans. This sheet may be produced on a standard-format sheet (11"x17") or a large-format sheet (24"x36"). Use landscape orientation regardless of sheet size selected.

See **Exhibit 906-1** for an example of a Bridge Hydraulic Recommendations sheet.

906.2 Plan View

The plan view is typically located in the upper left area of the sheet. A common horizontal scale for the plan view is 1" = 40' or 1" = 50'.

The plan view on the BHRS is often created by referencing the CADD file that was used to create the bridge plan view for the Plan and Elevation sheet included in the Structures Plans. Do not display information and graphic data from the reference file that is not germane.

Include the following information in the plan view:

- (1) Stationing, scale, and north arrow. Include the channel baseline if one was created.
- (2) Label bridge begin and end station, the name of the road and the water body (e.g., St. Johns River), and R/W lines.
- (3) Show contour lines (existing or proposed) with elevations, and arrows illustrating the direction of the flow through the channel opening.
- (4) Show limits of abutment protection.

906.3 Profile View

The profile view is typically located in the lower left area of the sheet. Profile view must include a background grid using the same horizontal scale that was used for the plan view, and a vertical scale of 1" = 10' (typical).

The profile view on the BHRS is often created by referencing the CADD file that was used to create the bridge profile view for the Plan and Elevation sheet included in the Structures Plans. Do not display information and graphic data from the reference file that is not germane, such as labeling of grade line and vertical curve data.

Include the following information in the profile view:

- (1) Show stationing along the bottom of the background grid and horizontal grid line elevations along both sides.
- (2) Display the proposed bridge, low member, piers, and approaches.
- (3) Label the begin and end stations for the proposed structure and indicate the Bridge Number.
- (4) Dimension and label the overall bridge length, and the width of each span and approach.
- (5) Label abutment locations (e.g., toe of slope).
- (6) Show limits of abutment protection and label the protection type.
- (7) For non-tidal crossings, indicate the Normal High Water (NHW) and Design Flood elevations. For tidal crossings, indicate the Mean High Water (MHW) and Design Flood Stage elevations.
- (8) When practical, show the profile of the expected design scour (contraction and long-term scour along the entire unprotected cross section and the local scour at the intermediate piers/bents). Display local scour holes as beginning at the foundation element edges at the design scour depth and extending up at a 1:2 slope to meet the contraction or long-term scour profile.

906.4 Location Map and Drainage Area

The location map is typically located in the upper right area of the sheet. When practicable, use a scale so that the entire drainage area for the proposed structure is shown.

Any suitable graphics file may be used to create the map. A common source is the county maps in MicroStation (*.dgn) format or in Portable Document format (PDF) that can be

downloaded from the [County General Highway Maps](#) web page. Place a north arrow on the right side of the map. Orient the map so that the north arrow points toward the top of the sheet.

Flag and label the bridge location as “Proposed Bridge”, and provide a google maps hyperlink (e.g., <https://goo.gl/maps/zmmkmmoLDvk>). Flag and label bridge structures located immediately upstream and downstream that affect the hydraulics of the proposed structure.

Display the drainage area boundaries using a very heavy dashed line, with the area (in acres or square miles) shown within the boundary.

906.5 Bridge Hydraulic Data Table

The Bridge Hydraulic Table consists of five sections:

- (1) Existing and Proposed Structures
- (2) Hydraulic Design Data
- (3) Hydraulic Recommendations
- (4) Scour Predictions
- (5) Remarks

906.5.1 Existing and Proposed Structures

Provide information on existing and proposed structures in the following table:

Table 906.5.1 Existing Structures

(REFERENCE)		EXISTING STRUCTURES				PROPOSED STRUCTURE
		(1)	(2)	(3)	(4)	
FOUNDATION	(1)	_____	_____	_____	_____	_____
OVERALL LENGTH (ft)	(2)	_____	_____	_____	_____	_____
SPAN LENGTH (ft)	(3)	_____	_____	_____	_____	_____
TYPE CONSTRUCTION	(4)	_____	_____	_____	_____	_____
AREA OF OPENING @ D.F. (sf)	(5)	_____	_____	_____	_____	_____
ELEV. LOW MEMBER (ft)	(6)	_____	_____	_____	_____	_____
ELEV. LOW MEMBER (ft)	(7)	_____	_____	_____	_____	_____

NOTES: Existing Structures - (1) structure being replaced or modified. (2), (3), and (4) are immediate upstream and downstream structures that affect the hydraulics of the proposed structure.

- (1) Foundation: Describe the type of foundation (e.g., timber piles, concrete piles).
- (2) Overall Length (ft): Provide the total length of the structure. The length is measured from the top of the abutment. Use the total length shown in the final plans for the proposed structure.
- (3) Span Length (ft): Provide the length of the main span of the structure.
- (4) Type Construction: Describe the construction material(s) used for the structure (e.g., steel, concrete, steel, and concrete).
- (5) Area of Opening (ft²) @ D.F.: Provide the area of opening below the design flood elevation at the bridge section. Subtract the pile area when pile area is significant.
- (6) Bridge Width (ft): Provide the distance from outside rail to outside rail.
- (7) Elev. Low Member (ft): Provide the elevation of the lowest point along the low member of the structure.

906.5.2 Hydraulic Design Data

Provide hydraulic design data for the proposed structure in the following table:

Table 906.5.2 Hydraulic Design Data

HYDRAULIC DESIGN DATA					
The hydraulic data shown in this table indicate the flood discharges and water surface elevations which may be anticipated in any given year. Engineering judgement and assumptions are necessary to determine this data with no assurance of precision.					
WATER SURFACE ELEVATIONS: (1)	N.H.W. (Non-Tidal)	_____	M.H.W. (Tidal)	_____	
	CONTROL (Non-Tidal)	_____	M.L.W. (Tidal)	_____	
FLOOD DATA:	MAX. EVENT OF RECORD	DESIGN FLOOD	BASE FLOOD	OVERTOPPING	GREATEST FLOOD
STAGE ELEV. NAVD (ft)	(2)	_____	_____	_____	_____
DISCHARGE (cfs)	(3)	_____	_____	_____	_____
AVERAGE VELOCITY (f/s)	(4)	_____	_____	_____	_____
EXCEEDANCE PROB. (%)	(5)	_____	_____	_____	_____
FREQUENCY (yr.)	(6)	_____	_____	_____	_____
NOTES:	Max. Event of Record: Maximum event recorded based on historical information (if available). Design Flood: Utilized to assure a desired level of hydraulic performance. Base Flood: Has a 1% chance of being exceeded in any given year (100 year frequency). Overtopping/Greatest Flood: Only show data for event with lower return period. Overtopping: Causes flow over the highway, watershed divide, or thru relief structures. Greatest flood: The most severe that can be predicted where overtopping is not practicable..				

- (1) **Water Surface Elevations (ft):** Provide elevation of the following water surfaces at the bridge section, when applicable:
 - (a) N.H.W. (Non-Tidal): The Normal High Water elevation applicable only to non-tidal areas.
 - (b) CONTROL (Non-Tidal): Water surface elevation controlled by the operation of pump stations, dams, or other hydraulic structures. This applies only to non-tidal areas.
 - (c) M.H.W. (Tidal): The Mean High Water elevation applicable only to tidal areas.
 - (d) M.L.W. (Tidal): The Mean Low Water elevation applicable only to tidal areas.
- (2) **Stage Elevation (ft):** For freshwater flow, provide stage elevation (NAVD 88 or NGVD 29) using data from hydraulic model at the approach section. For tidal flow, use the maximum elevation during the flood or ebb storm surge at the bridge. Add a remark that stage, discharge, and the velocity described in the flood data do not occur at the same time.
- (3) **Discharge (cfs):** For freshwater flow, provide total discharge using data from the simulations for the design flood, base flood, overtopping flood, and/or greatest flood. For tidal flow, use the maximum discharge during the flood or ebb storm surge at the bridge. Add a remark that stage, discharge, and the velocity described in the flood data do not occur at the same time.
- (4) **Average Velocity (fps):** For freshwater flow, provide average velocity using data from the simulations for the design flood, base flood, overtopping flood, and/or greatest flood. For tidal flow, use the maximum velocity during the flood or ebb storm surge at the bridge.
- (5) **Exceedance Prob. (%):** Provide the probability that the conditions will be exceeded. Probability is determined as 100% times unity over the return interval (e.g., $100\% \times (1/100) = 1\%$).
- (6) **Frequency (yr):** Provide the return period in years.

906.5.3 Scour Predictions

Provide scour predictions for the proposed structure in the following table:

Table 906.5.3 Scour Predictions for Proposed Structure

SCOUR PREDICTIONS FOR PROPOSED STRUCTURE				
(1) PIER INFORMATION		(2) TOTAL SCOUR ELEVATION (FT)		
NUMBERS	SIZE AND TYPE	LONG TERM SCOUR ELEVATION	WORST CASE < 100 yr. FREQ. (yr.) _____	WORST CASE < 500 yr. FREQ. (yr.) _____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

- (1) Pier Information: Provide the following pier information for the proposed structure:
 - (a) Numbers: Pier number(s) that correspond to the pier size, type, and scour elevations.
 - (b) Size and Type: Pier size and type that produce the greatest scour. If necessary, place a reference to the appropriate details of the bridge plans for clarity.

- (2) Total Scour Elevation (ft): Provide the following scour information for the proposed structure:
 - (a) Long-Term Scour elevation: Applicable only to structures required to meet extreme event vessel collision load. Place "N/A" when not applicable. Refer to Chapter 4 of the Drainage Design Guide for additional information on long-term scour.
 - (b) Worst-Case (< 100-year) Scour Elevation: The predicted total scour elevation for the worst-case scour condition up through the scour design flood frequency. This includes aggradation or degradation, channel migration, local scour (pier and abutment) and contraction scour.
 - (c) Worst-Case (< 500-year) Scour Elevation: The predicted total scour elevation for the worst-case scour condition up through the scour design check flood frequency. This includes aggradation or degradation, channel migration, local scour (pier and abutment), and contraction scour.

906.5.4 Hydraulic Recommendations

Provide hydraulic recommendations in the following table:

Table 906.5.4 Hydraulic Recommendations

HYDRAULIC RECOMMENDATIONS									
BEGIN BRIDGE STATION _____		END BRIDGE STATION _____		SKEW ANGLE BETWEEN BRIDGE AND ROADWAY _____					
CLEARANCE PROVIDED (ft): (1)	NAV: HORIZ. _____	VERT. _____	ABOVE EL. _____	DRIFT: HORIZ. _____	VERT. _____	ABOVE EL. _____			
MINIMUM CLEARANCE (ft): (2)	NAV: HORIZ. _____	VERT. _____	ABOVE EL. _____	DRIFT: HORIZ. _____	VERT. _____	ABOVE EL. _____			
ABUTMENTS: (3)	BEGIN BRIDGE			END BRIDGE					
RUBBLE GRADE:	_____			_____					
SLOPE:	_____			_____					
BURIED OR NON-BURIED HORIZ. TOE:	_____			_____					
TOE HORIZ. DISTANCE (ft):	_____			_____					
LIMIT OF PROTECTION (ft):	_____			_____					
DECK DRAINAGE: (4)	_____								

- (1) Clearance Provided (ft): Provide the following navigational and drift clearance information for the proposed structure:
- (a) Navigation Horizontal: The actual horizontal navigation clearance provided between fenders or piers.
 - (b) Navigation Vertical: The actual vertical navigational clearance in feet provided between fenders or piers.
 - (c) Navigation Above Elevation: For freshwater flow, use the elevation at the NHW elevation or control elevation. For tidal flow, use the elevation at MHW.
 - (d) Drift Horizontal: The actual minimum horizontal clearance provided.
 - (e) Drift Vertical: The actual minimum vertical clearance provided above the design flood elevation.
 - (f) Drift Above Elevation: The design flood elevation used to determine Drift Vertical clearance. For freshwater flow, use NHW elevation or control elevation. For tidal flow, use the maximum stage associated with an average velocity of 3.3 fps through the bridge section during the flood or ebb for the storm surge for the design flood. If the maximum velocity due to the storm surge is less than 3.3 fps, use the stage associated with the maximum velocity through the bridge section.

If either of these stages causes the profile to be higher than the profile of the bridge approaches, discuss having less drift clearance and designing the structure for debris loads with the District Structures Design Office:

- (2) Minimum Clearance (ft): Vertical and horizontal clearances are subject to regulatory agency requirements (e.g., Coast Guard, Corps of Engineers, Water Management District), and may exceed Department requirements. Provide the following minimum navigational and drift clearance information for the proposed structure:
 - (a) Navigation Horizontal: Provide a minimum 10-foot horizontal navigation clearance, or the minimum clearance specified by regulatory agency.
 - (b) Navigation Vertical: See **FDM 260.8** for information on minimum vertical clearance for navigational purposes.
 - (c) Drift Horizontal and Vertical: Consistent with debris conveyance needs and structure economy where no boat traffic is anticipated.
- (3) Provide the following information for the begin and end bridge abutments:
 - (a) Rubble Grade: Provide the type of rubble to be constructed at the begin and end bridge abutments.
 - (b) Slope: Provide the slope of the abutments at the begin and end bridge.
 - (c) Non-buried or Buried Horizontal Toe: Indicate whether the toe of the abutment will be non-buried or buried when extended horizontally from the bridge. The horizontal and vertical extents should be determined using the design guidelines contained in **HEC-23**.
 - (d) Toe Horizontal Distance (ft): Provide the horizontal extent of the rubble protection measured from the toe of the abutment. Refer to the Drainage Design Guide for additional information.
 - (e) Limit of Protection (ft): Provide the limits of protection, distance in feet measured parallel to the stationing, from the edge of the rubble protection to the begin or end bridge station. If the distance is different on each side, indicate both distances with their corresponding sides.
- (4) Deck Drainage: Describe how the rainfall runoff is collected and conveyed from the proposed structure deck (e.g., scuppers, storm drain system).

906.5.5 Remarks

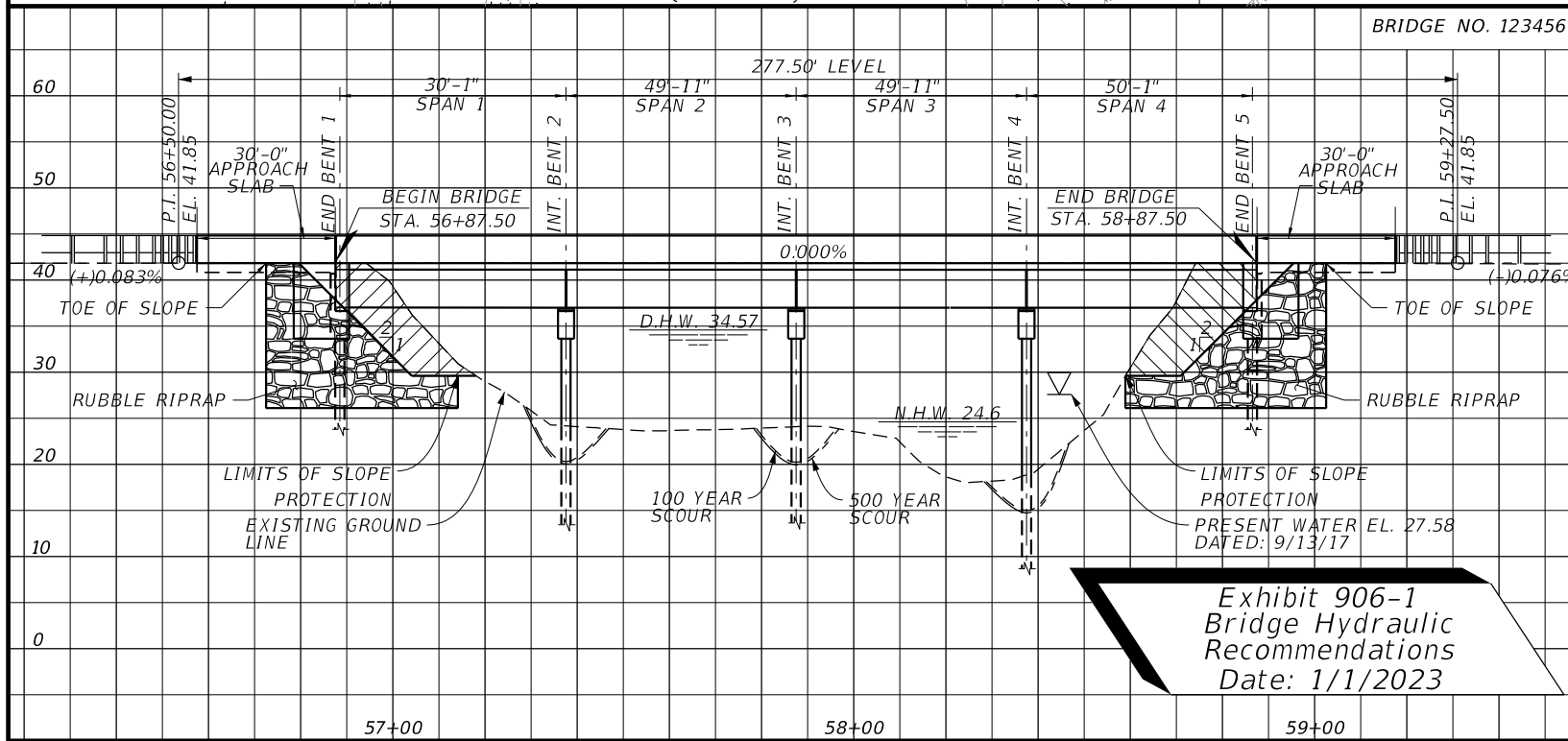
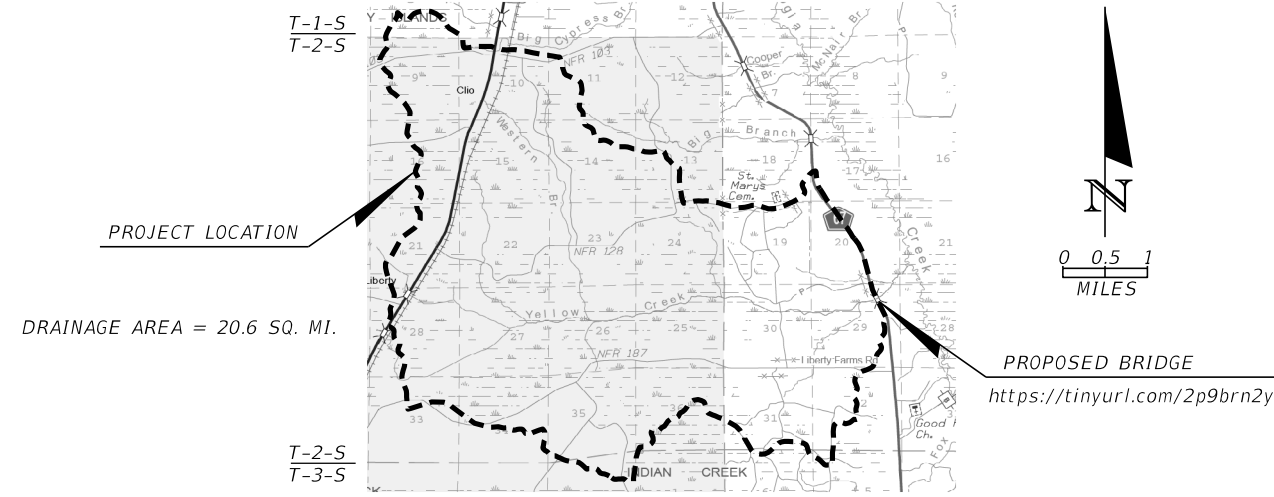
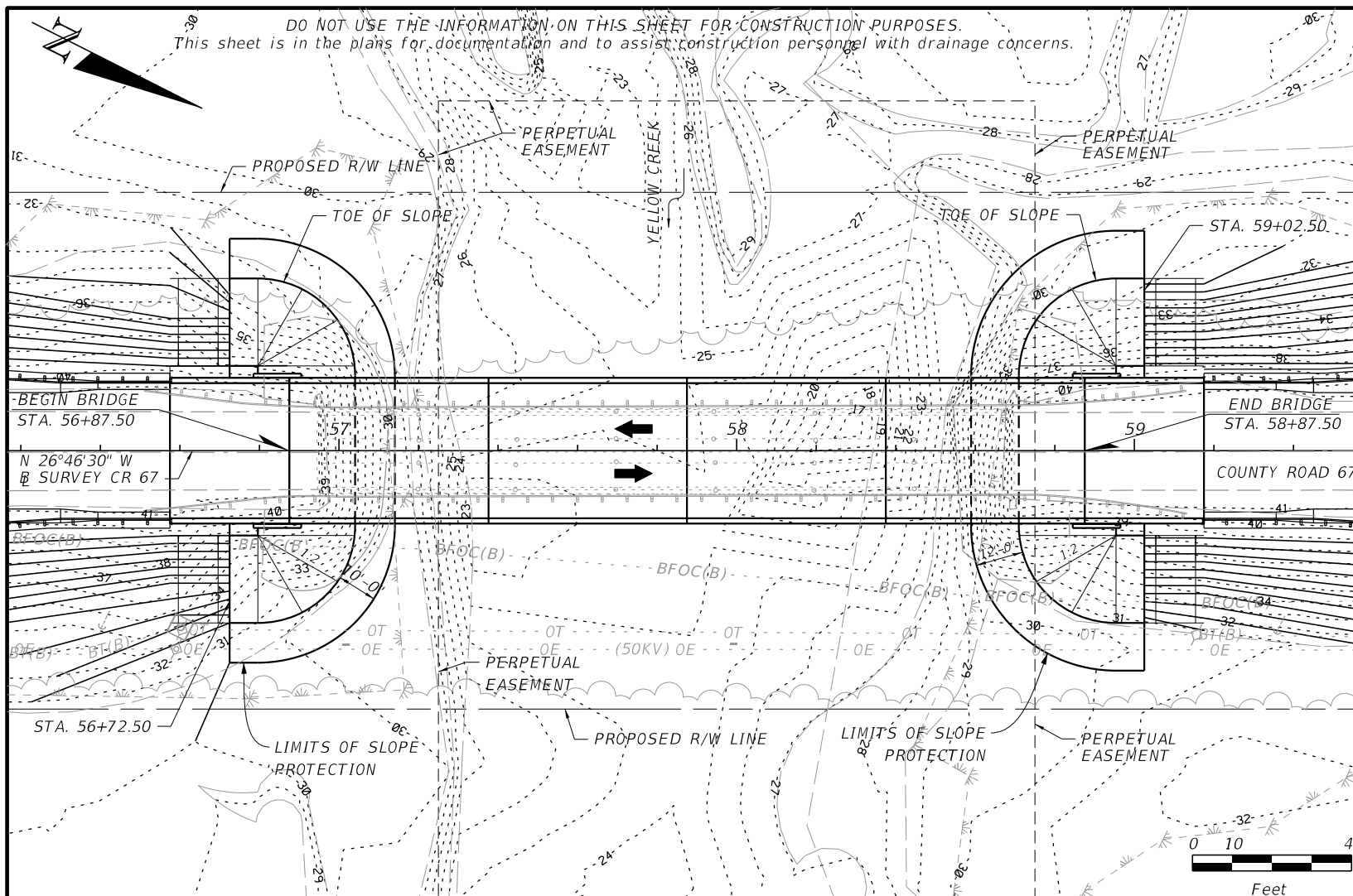
Provide any pertinent remarks for the proposed structure in the following table:

Table 906.5.5 Remarks

REMARKS	
(1)	ELEVATIONS ARE BASED ON NORTH AMERICAN VERTICAL DATUM 1988 (NAVD88)

Include information for the 100-year design wave crest elevation in feet, including the storm surge elevation and wind setup. The vertical clearance of the superstructure must be a minimum of 1 foot above the wave crest elevation.

DO NOT USE THE INFORMATION ON THIS SHEET FOR CONSTRUCTION PURPOSES.
This sheet is in the plans for documentation and to assist construction personnel with drainage concerns.



(REFERENCE)	EXISTING STRUCTURES				PROPOSED STRUCTURE
	(1)	(2)	(3)	(4)	
FOUNDATION	TIMBER PILE				24" **
OVERALL LENGTH (ft)	175'				200'
SPAN LENGTH (ft)	25'				50'
TYPE CONSTRUCTION	STEEL				CONCRETE
AREA OF OPENING @D.F. (sf)	1207.31				1343.41
BRIDGE WIDTH	20'				36'-8"
ELEV. LOW MEMBER (ft)	39.3				37.75

NOTES: Existing Structures - (1) structure being replaced or modified. (2), (3), and (4) are immediate upstream and downstream structures that affect the hydraulics of the proposed structure.

HYDRAULIC DESIGN DATA					
WATER SURFACE ELEVATIONS:	N.H.W. (Non-Tidal)	24.6	M.H.W. (Tidal)	N/A	
	CONTROL (Non-Tidal)	N/A	M.L.W. (Tidal)	N/A	
FLOOD DATA:	MAX EVENT OF RECORD	DESIGN FLOOD	BASE FLOOD	OVERTOPPING	GREATEST FLOOD
STAGE ELEV. NAVD (ft)	36.36 (REM. #2)	34.57* / 31.64	35.26* / 32.00		37.24* / 32.88
DISCHARGE (cfs)	UNKNOWN	1915	2204		2964
AVERAGE VELOCITY (f/s)	UNKNOWN	1.52* / 2.64	1.59* / 2.81		1.68* / 3.18
EXCEEDANCE PROB. (%)	UNKNOWN	2%	1%		0.2%
FREQUENCY (yr.)	UNKNOWN	50	100		500

NOTES: Max. Event of Record: Maximum event recorded based on historical information (if available).
Design Flood: Utilized to assure a desired level of hydraulic performance.
Base Flood: Has a 1% chance of being exceeded in any given year (100 year frequency).
Overtopping/Greatest Flood: Only show data for event with lower return period.
Overtopping: Causes flow over the highway, watershed divide, or thru relief structures.
Greatest flood: The most severe that can be predicted where overtopping is not practicable.

SCOUR PREDICTIONS FOR PROPOSED STRUCTURE DESCRIBED ABOVE	(1) PIER INFORMATION		(2) TOTAL SCOUR ELEVATION (FT)		
	NUMBERS	SIZE AND TYPE	LONG TERM SCOUR ELEVATION	WORST CASE <100 yr FREQ. 100 YR.	WORST CASE <500 yr FREQ. 500 YR.
	2 - 3	24" SO. PILES	N/A	20.10	19.90
4	24" SO. PILES	N/A	14.96	14.76	

HYDRAULIC RECOMMENDATIONS				
BEGIN BRIDGE STA. 56+87.50	END BRIDGE STA. 58+87.50	SKEW ANGLE BETWEEN BRIDGE AND ROADWAY 0°		
CLEARANCE PROVIDED (ft):	NAV: HORIZ. 50	NAV: VERT. 13.2	NAV: ABOVE EL. 24.6	
	DRIFT: HORIZ. 50	DRIFT: VERT. 3.2	DRIFT: ABOVE EL. 34.57	
MINIMUM CLEARANCE (ft):	NAV: HORIZ. 10	NAV: VERT. 6	NAV: ABOVE EL. 24.6	
	DRIFT: HORIZ. 10	DRIFT: VERT. 2	DRIFT: ABOVE EL. 34.57	
ABUTMENTS:	BEGIN BRIDGE		END BRIDGE	
RUBBLE GRADE:	BANK AND SHORE PROTECTION		BANK AND SHORE PROTECTION	
SLOPE:	1V:2H		1V:2H	
BURIED OR NON-BURIED HORIZ. TOE:	NON-BURIED		NON-BURIED	
TOE HORIZ. DISTANCE (ft):	10'		12'	
LIMIT OF PROTECTION (ft):	53.33 LT & RT		LT & RT	
DECK DRAINAGE:	SPREAD CONTAINED IN SHOULDER, DRAINED VIA 4" SCUPPERS.			

REMARKS

1. VALUE INCLUDES BACKWATER EFFECTS FROM PEAK STAGES OF TELOGIA CREEK
2. AS REPORTED BY J.T. HATHAWAY, LIBERTY COUNTY ROAD SUPERINTENDENT.

Exhibit 906-1
Bridge Hydraulic Recommendations
Date: 1/1/2023

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

LUKE S. WALKER, P.E.
LICENSE NUMBER: 99991
ROADWAY ENGINEERS, INC.
123 MAIN STREET
TALLAHASSEE, FL 32301

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO. CR 67 COUNTY LIBERTY FINANCIAL PROJECT ID 123456-1-52-01

SHEET TITLE: BRIDGE HYDRAULIC RECOMMENDATIONS

PROJECT NAME: BRIDGE OVER YELLOW CREEK

REF. DWG. NO. SHEET NO.

10/27/2022 4:02:31 PM P5972BW C:\Worksets\FDOT\123456\15201 Structures\B1BRIDGE\HYDR001.DGN

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