# 906 Bridge Hydraulic Recommendations Sheet

## 906.1 General

A Bridge Hydraulic Recommendations Sheet (BHRS) is required for each proposed bridge structure; not for 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.

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 the bridge begin and end station, the name of the road, the waterbody (e.g., St. Johns River), and the 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 the limits of abutment protection.

## 906.3 Profile View

The profile view is typically located in the lower left area of the sheet. The 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 the 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 the abutment locations (e.g., toe of slope).

(6) Show the 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*** webpage. Place a north arrow on the right side of the map. Orient the map so the north arrow points toward the top of the sheet.

Flag and label the proposed bridge location as “Proposed Bridge”. Provide a Project Location URL of the bridge location using the Work Program GIS. Create the full URL using a set string, with the first seven digits of the FPID number appended. For example, FPID number 217932-1-52-01 would display as: ***https://owpbstandardmap.fdot.gov/?query=WorkProgram_Tbl15_Dissolved_2004,itemseq,2179321***.

Optional: Convert the full URL to a condensed URL using ***https://tinyurl.com/app/*** (or equivalent). The converted URL displays as ***https://tinyurl.com/367v2589***.

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 Data 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**

| | | EXISTING STRUCTURES | | | | |
|---|---|---|---|---|---|---|
| (REFERENCE) | | (1) | (2) | (3) | (4) | PROPOSED STRUCTURE |
| 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 (feet): 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 (feet): Provide the length of the main span of the structure.

(4) Type of Construction: Describe the construction material(s) used for the structure (e.g., steel, concrete, steel and concrete).

(5) Area of Opening (feet$^2$) @ D.F.: Provide the area of opening below the design flood elevation at the bridge section. Subtract the pile area when the pile area is significant.

(6) Bridge Width (feet): Provide the distance from outside rail to outside rail.

(7) Elevation of Low Member (feet): 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.
All water surface elevations are based on vertical datum of _____ (1)

WATER SURFACE ELEVATIONS: (2) N.H.W. (Non-Tidal) _____ M.H.W. (Tidal) _____
CONTROL (Non-Tidal) _____ M.L.W. (Tidal) _____

SEA LEVEL RISE: (3) _____

| FLOOD DATA: | | MAX EVENT OF RECORD | DESIGN FLOOD | BASE FLOOD | OVERTOPPING | GREATEST FLOOD |
|---|---|---|---|---|---|---|
| STAGE ELEV. NAVD (ft) | (4) | | | | | |
| DISCHARGE (cfs) | (5) | | | | | |
| AVERAGE VELOCITY (f/s) | (6) | | | | | |
| EXCEEDANCE PROB. (%) | (7) | | | | | |
| FREQUENCY (yr.) | (8) | | | | | |

NOTES:
Sea level rise is that expected over the target service life of the bridge.
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: mHas 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) **Vertical Datum:** Provide the vertical datum of the water surface elevations.

(2) **Water Surface Elevations (feet):** Provide the elevations 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): The 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.

(3) **Sea Level Rise (feet):** Provide the projected sea level rise over the target service life of the bridge that was used for design.

(4) **Stage Elevation (feet):** For freshwater flow, provide the stage elevation (NAVD 88 or NGVD 29) using data from the 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 the stage, discharge, and velocity described in the flood data do not occur at the same time.

(5) **Discharge (cfs):** For freshwater flow, provide the 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 the stage, discharge, and velocity described in the flood data do not occur at the same time.

(6) **Average Velocity (fps):** For freshwater flow, provide the 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.

(7) **Exceedance Probability (%):** Provide the probability that the conditions will be exceeded. Probability is determined as 100% times unity over the return interval (e.g., 100%*(1/100) = 1%).

(8) **Frequency (year):** 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 (feet): 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 (feet): Provide the following navigational and drift clearance information for the proposed structure:

(a) Navigation Horizontal (feet): The actual horizontal navigation clearance provided between fenders or piers.

(b) Navigation Vertical (feet): The actual vertical navigational clearance 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 (feet): The actual minimum horizontal clearance provided.

(e) Drift Vertical (feet): 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 the 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 (feet): Vertical and horizontal clearances are subject to regulatory agency requirements (e.g., Coast Guard, Corps of Engineers, Water Management Districts) and may exceed Department requirements. Provide the following minimum navigational and drift clearance information for the proposed structure:

(a) Navigation Horizontal (feet): Provide a minimum 10-foot horizontal navigation clearance, or the minimum clearance specified by regulatory agency.

(b) Navigation Vertical (feet): See ***FDM 260.8*** for information on the 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 FHWA's HEC-23.

(d) Toe Horizontal Distance (feet): 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 (feet): Provide the limits of protection 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.

# Exhibit 906-1: Bridge Hydraulic Recommendations