305 Drainage Map and Bridge Hydraulic Recommendation Sheet

305.1 Drainage Map

Drainage maps are required for all projects that add mainline capacity or changes to the drainage hydraulics. Maps may be developed using a photographic (aerial or other) base map and included in the construction plans.

Preformatted drainage map sheet cells are located in the FDOT CADD Software. The upper (grid) portion of each sheet is used for plotting the project profile. The standard grid pattern for the profile portion of the sheet is five lines per inch, both in the horizontal and vertical. This will accommodate most scales. An optional grid with four lines per inch is available. This optional grid may be used if appropriate for scale.

Locate the topography of the project area in the remaining portion of the sheet. Utilize a horizontal and vertical scale of the profile so that the stations and elevations can be read directly from the grid without the use of a scale. Use the same horizontal scale for both the plan and profile views. Recommended scales for facility types are as follows:

Location	Horizontal Scale	Vertical Scale
Inside Urban Boundary	1” = 200’/500’	1" = 5'/1"=10'
Outside Urban Boundary	1"=1000'/2000'	1" = 10'/1"=20'

305.1.1 Plan View

The plan view must comply with the following requirements:

(1) Show stationing every 500 feet for scales of 1" = 100'/200', every 1000 feet for a scale of 1" = 500' and every 5000 feet for scales of 1" = 1000'/2000'. For additional information see ***FDM 311***.

Show horizontal alignment station equations and exceptions. Also show begin and end stations of project, construction, bridge, and bridge culverts.

(2) Clearly label existing physical land features affecting drainage, such as lakes, streams, and swamps, by name and direction of flow. Show past high water elevations with date of occurrence, if available, and present water elevations with date of reading.

Where applicable, show drainage divides and other information (such as pop-off elevations and spot elevations) to indicate the overland flow of water. Show drainage areas on maps in acres.

Use inserts to show areas that are of such magnitude that the boundaries cannot be plotted at the selected scale.

(3) Label existing road numbers and street names, drainage structures with type, size, flow line elevations, flow arrows and any other pertinent data. Refer to the FDOT CADD Software for correct symbols for existing drainage facilities. In a situation of limited space, all data relating to existing drainage structures and pipes may be compiled in a table format and shown in either the plan or profile portion of the sheet. Should the space limitations be such that a table will not fit within the plan or profile view, a supplemental drainage data sheet is acceptable.

(4) Show proposed drainage structures, cross drains, storm drain pipes, outfall structures and retention/detention pond locations. Label cross drains by pipe size and structure number. Label structures by structure number, storm drain pipes by pipe size, and ponds by pond number and area size. Show arrows to indicate direction of flow along proposed ditches.

(5) Label Section, Township, Range, and county lines for rural and urban projects when occurring within the project limits.

(6) Include a north arrow and scale, typically in the upper right corner of the plan view.

(7) If the drainage map is to be included in the contract plans set, include the following note:

> *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.*

305.1.2 Profile View

The profile view, if shown, must comply with the following requirements:

(1) The recommended vertical scale for rural and urban projects is 1" = 5' in level terrain and 1" = 10' in rolling terrain. A scale of 1" = 20' may sometimes be used for rural projects through rough terrain to avoid numerous profile breaks. The profile can be broken for rolling terrain in urban areas; however, a scale of 1" = 20' should never be used at locations of proposed storm drain systems.

(2) Station numbers are to be shown along the bottom edge of the profile view.

(3) Show elevation datum at each side of the sheet. In cases where the profile block is insufficient and excess space is available on the plan portion of the sheet, the profile block may be expanded.

(4) Plot and label the profile of the existing natural ground, and note the existing elevation at each end, just above the station numbers.

(5) Plot the proposed profile grade line. Percent of grade need not be shown. Plot the PC, PI, and PT of vertical curves using their respective standard symbols; however, no data (station, elevation, length of curve) needs be noted. Label begin and end project, construction, bridge and bridge culvert stations, station equations, and exceptions. Show profile grade line elevations at begin and end project stations and at the beginning and end of each additional drainage sheet.

(6) Plot proposed cross drains and identify by structure number. Do not show skew or pipe slope in plotting, but plot to elevation and location at point of crossing the construction centerline.

(7) For projects with storm drain systems, show only the mainline structure and pipes. Laterals need not be shown. Label each structure with its appropriate structure number, and flow line elevations noted for the incoming and outgoing pipes.

(8) Show high water elevations affecting base clearance or roadway grades.

305.1.3 Flood Data Summary Box

The Project Drainage Engineer must provide the information required to complete the Flood Data Summary box.

Place the Flood Data Summary box on the drainage map, either in the plan or in the profile portion. Place the Flood Data Summary box on the General Notes sheet when the drainage map is not included in the plans.

Design, base and overtopping or greatest flood discharge and stage values are required for all cross structures (culverts and bridges), regardless of size, under the following conditions:

(1) New cross structures

(2) Existing cross structures that are being modified, where modifications affect the existing hydraulic calculations.

(3) Existing cross structures that have a history of flooding or other hydraulic problems, even if the structure is not to be modified; or

(4) Existing cross structures that are not being modified but are being impacted by a modification to another cross structure within the same drainage basin.

Place the following under the Summary of Flood Data table to avoid misuse and possible responsibility for changes in the flood information values over which the Department has no control:

> Note: This hydraulic data is a summary of design calculations and is provided for informational purposes only. The user is cautioned against the assumption of precision for the discharge rates and water surface elevations. The units are in cubic feet per second (cfs) and the design stages are in feet, **[Insert datum reference here]**.
>
> Definitions:
>
> > Design Flood: Utilized to assure a standard level of hydraulic performance.
> >
> > Base Flood: Has a 1% chance of being exceeded in any year (100 yr. frequency).
> >
> > Overtopping Flood: Causes flow over the highway, over a watershed divide or through emergency relief structures.
> >
> > Greatest Flood: The most severe that can be predicted where overtopping is not practicable.

A preformatted summary box with disclaimer and definitions is located in the FDOT CADD Software.

305.1.4 Interchange Drainage Map

If projects include interchanges or rest areas, include a drainage map on a 1" = 200' or 1" = 500' scale. The purpose of this detail is to show the small areas needed to calculate pipe sizes for the tabulation of drainage structures within these special areas. Should major drains pass through one of these areas, include a cross reference note indicating the proper sheet which reflects the drainage area for that through-structure.

305.2 Bridge Hydraulic Recommendation Sheet

When a Bridge Hydraulic Recommendation Sheet (BHRS) is required (see ***Drainage Manual, Topic No. 625-040-002***), it must be prepared on a preformatted sheet. The cell

for this sheet is located in the FDOT CADD Software. Place the BHRS in the structures plans.

Parallel (dual) bridges may be shown on one sheet; however, it typically requires a second sheet to clearly convey the fit of the bridge to the stream bank. When two sheets are used, only the plan and profile information is required on the second sheet.

The preformatted BHRS is divided into the four regions listed below. The required information for each region is described in the following sections.

(1) Plan View

(2) Profile View

(3) Location Map and Drainage Area

(4) Existing Structures, Hydraulic Design Data and Hydraulic Recommendations

A completed BHRS is shown as ***Exhibit 305-1***.

305.2.1 Plan View

The plan view is to include the following:

(1) Stationing, scale, and north arrow. Include the channel baseline if one was created.

(2) Existing topography including existing bridge(s)) and contours to show elevations. Show sufficient detail in the vicinity of the proposed bridge to depict how the structure will tie to natural ground.

(3) Label the name of the water body (e.g., St. Johns River).

(4) Arrows showing the direction of the flow.

(5) Proposed bridge begin and end station.

(6) Limits of riprap.

(7) R/W lines

305.2.2 Profile View

The profile view is to include the following:

(1) Stationing and scale.

(2) One cross section which most represents the section at the proposed crossing.

(3) Road profile for the proposed structure (i.e., stationing and elevation).

(4) Proposed bridge with begin and end station, low member, and pier locations.

(5) Abutment locations (e.g., toe of slope) and abutment protection.

(6) Flood elevations. For non-tidal crossings, show the Normal High Water (NHW) and Design Flood elevations. For tidal crossings, show the Mean High Water (MHW) and Design Flood Stage elevations.

(7) Present water elevation with month, day and year of survey.

(8) Bridge Number (for the proposed structure).

305.2.3 Location Map and Drainage Area

Provide a location map similar to that used on the key sheet. Include an arrow showing the project location, north arrow and Range and Township.

Use an appropriate scale for the map so that the entire drainage area for the proposed structure is shown. (For projects with very large drainage areas, use a scale for the map that clearly shows the project location rather than a scale that shows the entire drainage area).

Show the drainage area boundaries using a very heavy, broken line, with the area (in acres or square miles) shown within the boundary. The proposed structure location should be shown. Existing structures over the same water body and those structures that affect the hydraulics of the proposed structure should be located and numbered and corresponding existing structure information listed in the appropriate columns.

305.2.4 Existing Structures Data, Hydraulic Design Data, and Hydraulic Recommendations

The ***Drainage Design Guide*** , Section 5.6.9 provides additional guidance for this section.

The following information is required for this section:

Existing Structures: Column contains information pertaining to the existing structures. Structure 1 refers to the structure being replaced or modified. Structures 2, 3 & 4 refer to relief structures, immediate upstream and downstream structures and those structures that affect the hydraulics of the proposed structure.

Proposed Structure: Column contains information pertaining to the proposed structure.

Foundation: Provide information describing the type of foundation (e.g., timber piles, concrete piles).

Overall Length (ft): Provide the total length of the structure in feet. The length is measured from the top of the abutments. Use the total length shown in the final plans for the proposed structure.

Span Length (ft): Provide the span length of the structure in feet (i.e, the length of the main span).

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

Area of Opening (ft^2) @ D.F.: Provide the area of opening in square feet below the design flood elevation at the bridge section. Subtract the assumed pile area if pile area is significant.

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

Elev. Low Member (ft): Provide the elevation in feet of the lowest point along the low member of the structure.

Water Surface Elevations (ft): Provide elevation in feet of the following water surfaces at the bridge section, when applicable:

- Normal High Water (N.H.W): This applies only to non-tidal areas.
- Control: Water surface elevation controlled by the operation of pump stations, dams or other hydraulic structures. This applies only to non-tidal areas.
- Mean High Water (M.H.W.): This applies only to tidal areas.

- Mean Low Water (M.L.W.): This applies only to tidal areas.

Max. Event of Record: Column contains information related to the maximum event recorded based on historical information, when available.

Design Flood: Column contains information related to the design flood.

Base Flood: Column contains information related to the base flood.

Overtopping Flood/Greatest Flood: Column contains information related to the overtopping or greatest flood event. If the overtopping flood has a lower return period than the greatest flood, then the block indicating overtopping flood is checked and the information related to the overtopping flood is shown. Otherwise, the block indicating greatest flood is checked and the information related to the greatest flood is shown.

Stage Elevation (ft): Provide stage elevation in feet (NAVD 88 or NGVD 29) for the Maximum Event of Record, Design Flood, Base Flood and Overtopping or Greatest Flood. Use data from hydraulic model for freshwater flow. Use maximum elevation during the flood or ebb storm surge tidal flow.

Discharge (cfs): Provide total discharge in cubic feet per second. Use data from hydraulic model for freshwater flow. Use maximum elevation during the flood or ebb storm surge tidal flow.

Average Velocity (fps): Provide average velocity in feet per second. Use data from hydraulic model for freshwater flow. Use maximum elevation during the flood or ebb storm surge tidal flow.

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%*(1/100) = 1%).

Frequency (yr): Provide the return period of the conditions in years of the worst case scour condition up through the design return period flow conditions.

Pier Information: Provide the following pier information for the proposed structure:

- Pier Numbers: Pier number(s) which correspond to the pier size and type and the scour elevations.
- Pier Size and Type: Pier size and type which produces the greatest scour. If necessary for clarity, place a reference to the appropriate details of the bridge plans. If the space provided is not adequate, place the information in the plan or profile view.

Scour Elevations (ft): Provide the following scour information for the proposed structure:

- Long-Term Scour: Applicable only to structures required to meet extreme event vessel collision load. Place “N/A” when not applicable.
- Total Scour Elevation (< 100-year): The predicted total scour elevation in feet 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.
- Total Scour Elevation (< 500-year): The predicted total scour elevation in feet 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.

Begin Bridge Station: Provide the station for the beginning of the bridge.

End Bridge Station: Provide the station for the end of the bridge.

Skew Angle (degrees): Provide the angle in degrees at which the centerline of the structure is skewed from the centerline of construction.

Clearance Provided (ft): Provide the following navigational and drift clearance information for the proposed structure:

- Navigation Horizontal: The horizontal distance provided between fenders or piers.
- Navigation Vertical: The vertical distance between low beam member and design flood water elevation.
- Navigation Above Elevation: The Design flood water elevation in feet (NAVD 88 or NGVD 29) used to determine Navigation Vertical clearance. Use normal high water (NHW) elevation or control elevation for freshwater flow. Use mean high water (MHW) for tidal flow.
- Drift Horizontal: The actual minimum horizontal clearance provided.
- Drift Vertical: The actual minimum vertical clearance in feet provided above the design flood water elevation.
- Drift Above Elevation: The Design flood water elevation in feet (NAVD 88 or NGVD 29) used to determine Drift Vertical clearance. Use normal high water (NHW) elevation or control elevation for freshwater flow. In many cases, it is reasonable to use the elevation at the Approach Section, realizing that this will be slightly higher than actual elevation at the bridge. For tidal flow, use the maximum stage associated with an average velocity of 3.3 feet per second 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, consider other alternatives such as:

- o Discuss with personnel in the Structures Design Office, the potential of having less drift clearance and designing the structure for debris loads.
- o Do a more rigorous and site specific analysis to set the stage above which to provide the standard drift clearance. Investigate and address these situations on a site specific basis.

Minimum Clearance (ft): Provide the following minimum navigational and drift clearances in feet. Vertical and horizontal clearances will also be subject to the requirements of the Coast Guard, Corps of Engineers, Water Management District, and any other regulatory agency having appropriate statutory jurisdiction or authority. Such regulatory agency requirements may exceed Department requirements.

- Navigation Horizontal: Crossings subject to small boat traffic, must provide a minimum 10-foot horizontal navigation clearance. Other agencies may have minimum clearance requirements.
- Navigation Vertical: See ***FDM 260.8.1*** for information on vertical clearances over water.
- Drift Horizontal and Vertical: Consistent with debris conveyance needs and structure economy where no boat traffic is anticipated.

Rubble Grade: Provide the type of rubble to be constructed at the begin and end bridge abutments; e.g., Riprap (Bank & Shore). References can be made to details sheets if non-standard riprap is employed.

Slope: Provide the slope of the abutments at the begin and end bridge; e.g., 1H:2V.

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.

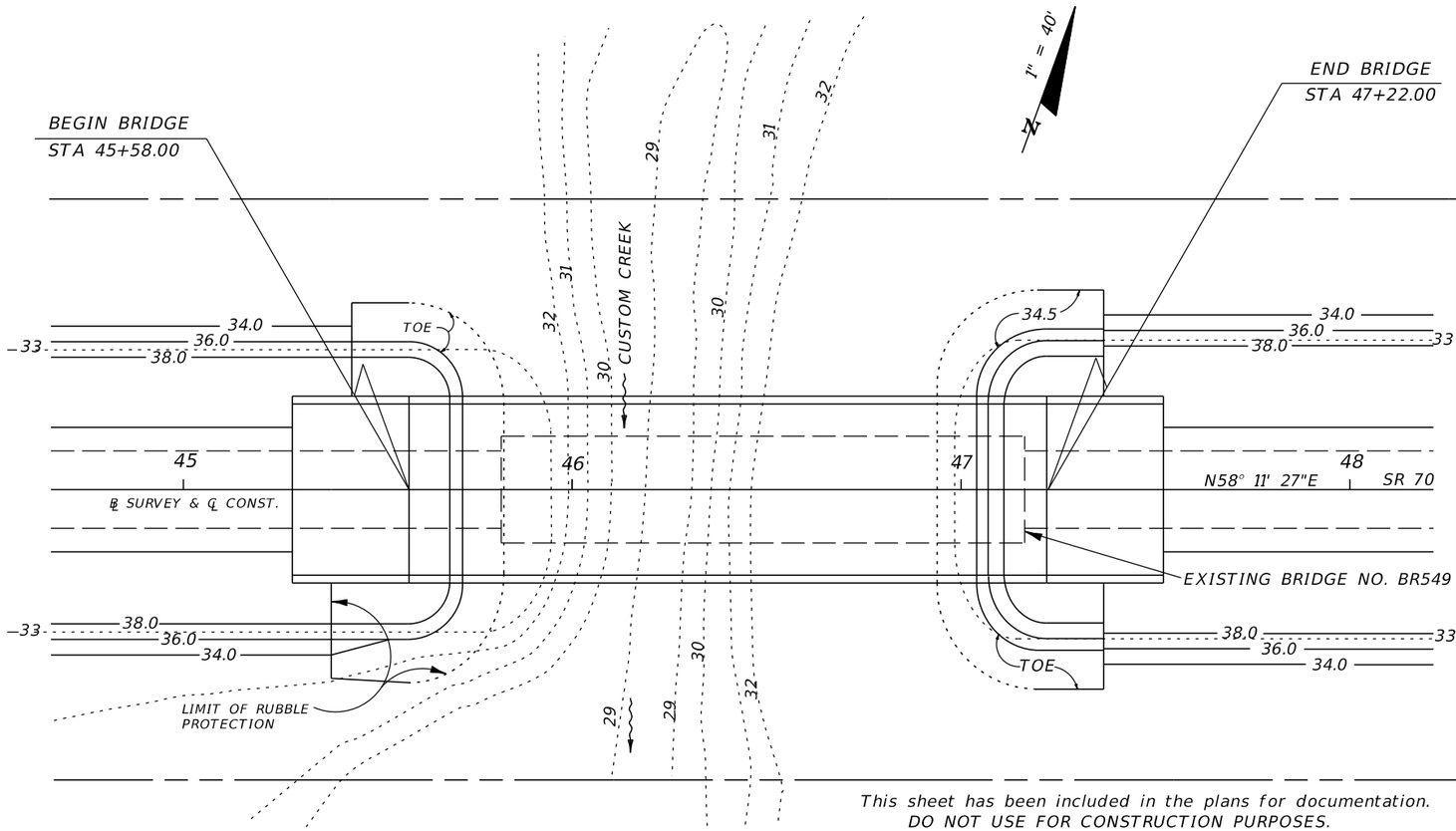
Toe Horizontal Distance (ft): Provide the horizontal extent in feet of the rubble protection measured from the toe of the abutment. The horizontal and vertical extents should be determined using the design guidelines contained in HEC-23.

Limit of Protection (ft): Provide the limits of protection, measured parallel to the stationing, from the edge of the rubble protection to the bridge begin/end station. If the distance is different on each side, indicate both distances with their corresponding sides.

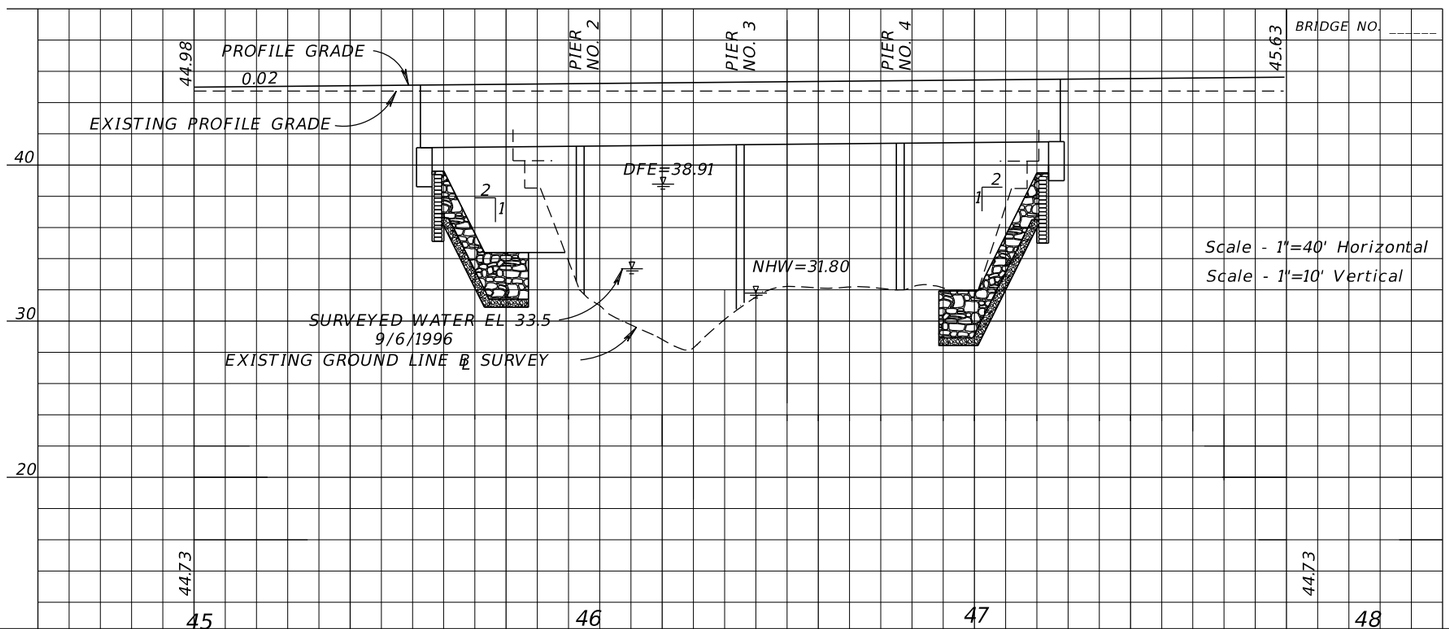
Deck Drainage: Describe how the rainfall runoff is collected and conveyed from the proposed structure deck; e.g., scuppers, storm drain system.

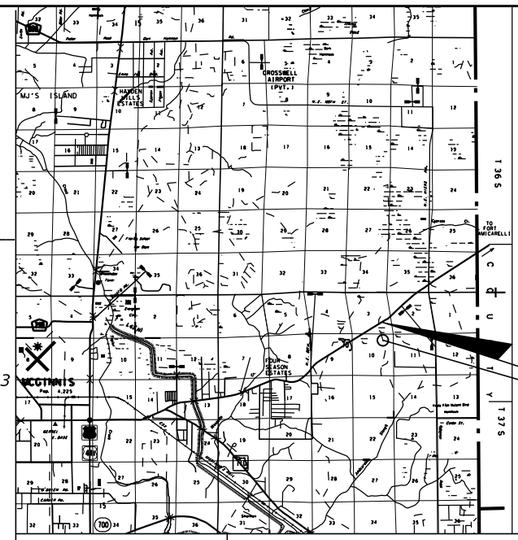
Remarks: Provide any pertinent remarks.

- Wave Crest Elevation (ft) (when applicable): Provide the 100-year design wave crest elevation 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.



This sheet has been included in the plans for documentation.
DO NOT USE FOR CONSTRUCTION PURPOSES.





(REFERENCE)	EXISTING STRUCTURES (1)	(2)	(3)	(4)	PROPOSED STRUCTURE
FOUNDATION	Conc. Piles	Timber			Conc. Piles
OVERALL LENGTH	135	200			164 (rem. #1)
SPAN LENGTH	5 @ 27	20 @ 10			4 @ 41
TYPE CONSTRUCTION	Concrete	Timber			Concrete
AREA OF OPENING @ D.F.	1000	Unknown			1020
BRIDGE WIDTH	28'	Railroad (South)			44'
ELEV. LOW MEMBER	40.35	38.32			41.17

HYDRAULIC DESIGN DATA

NOTE:
This hydraulic data is a summary of design calculations and is provided for informational purposes only. The user is cautioned against the assumption of precision for the discharge rates and water surface elevations. The units are in cubic feet per second (cfs) and the design stages, feet-NAVD 1988.

TERMS:
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 Flood: Causes flow over the highway, over a watershed divide, or thru emergency relief structures.
Greatest Flood: The most severe that can be predicted where overtopping is not practicable.

WATER SURFACE ELEVATIONS: N.H.W. (Non-Tidal) 31.80 M.H.W. (Tidal) _____
CONTROL (Non-Tidal) _____ M.L.W. (Tidal) _____

☐ OVERTOPPING or ☒ GREATEST FLOOD

FLOOD DATA:	MAX. EVENT OF RECORD	DESIGN FLOOD	BASE FLOOD	☒ GREATEST FLOOD
STAGE ELEV. NAVD (ft)	38.7 (rem. #2)	38.91	39.27	39.57
DISCHARGE (cfs)	unknown	3280	3950	4630
AVERAGE VELOCITY (ft/s)	"	3.22	3.58	4.13
EXCEEDANCE PROB. (%)	"	2	1	0.2
FREQUENCY (yr.)	"	50	100	500

SCOUR PREDICTIONS FOR PROPOSED STRUCTURE DESCRIBED ABOVE:

PIER INFORMATION NUMBERS	SIZE AND TYPE	LONG TERM SCOUR ELEV.	TOTAL SCOUR ELEVATION WORST CASE < 100 yr. FREQ. (yr.) 100	WORST CASE < 500 yr. FREQ. (yr.) 500
2 & 3	24" Conc. Piles	N/A	18.4	16.4
4 (rem. #3)	24" Conc. Piles	N/A	27.6	25.6

HYDRAULIC RECOMMENDATIONS

1. BEGIN BRIDGE STATION 45+58.00 END BRIDGE STATION 47+22.00 SKEW ANGLE 0°
2. CLEARANCE PROVIDED: NAV: HORIZ. 39.0 VERT. 8.04 ABOVE EL. 33.14 DRIFT: HORIZ. 39.0 VERT. 2.26 ABOVE EL. 38.91
3. MINIMUM CLEARANCE: NAV: HORIZ. 10.0 VERT. 6.0 ABOVE EL. 33.14 DRIFT: HORIZ. N/A VERT. 2.0 ABOVE EL. 38.91
4. ABUTMENTS:

	BEGIN BRIDGE	END BRIDGE
RUBBLE GRADE:	Bank and Shore	Bank and Shore
SLOPE:	1:2	1:2
BURIED OR NON-BURIED HORIZ. TOE:	Non-Buried	Non-Buried
TOE HORIZ. DISTANCE:	10	10
LIMIT OF PROTECTION:	15' Lt., 20' Rt.	15' Lt. and Rt.

5. DECK DRAINAGE: Spread is contained in shoulder. Runoff captured by inlets at begin bridge.

REMARKS:
(1) Bridge lengthened to accommodate predicted channel migration to the west.
(2) Based on mark provided by local resident of 43 years.
(3) Due to predicted channel migration to the west and lack of meander cutoff, Pier No. 4 will not experience main channel scour depths.

Exhibit 305-1
Date: 1/1/19

THE OFFICIAL RECORD OF THIS SHEET IS THE ELECTRONIC FILE DIGITALLY SIGNED AND SEALED UNDER RULE 61G15-23.004, F.A.C.

REVISIONS DATE	DESCRIPTION	DATE	DESCRIPTION

LUKE S. WALKER, P.E.
P.E. NO.: 99991
ROADWAY ENGINEERS, INC.
123 MAIN STREET
TALLAHASSEE, FL 32301
CERTIFICATE OF AUTHORIZATION: 12345

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 22	BAY	123456-1-52-01

BRIDGE HYDRAULIC RECOMMENDATIONS SHEET

SHEET NO.

10/31/2018 10:47:39 AM