

Hydrology and Hydraulics Report

Mattagodus Brook Bridge #5185
over
Mattagodus Stream

Prentiss TWP T7 R3 NBPP, Maine

2753200
WIN 27532.00



Maine Department of Transportation Bridge Program

*Note: Hydrology Report and Hydraulics Report
originally included in Draft PDR submitted on
2025-07-02 and in Final PDR submitted on 2025-08-13.
Hydraulics Appendix originally included in Draft PDR
submitted on 2025-07-02.*

HYDROLOGY REPORT

Mattagodus Stream begins in a wetland located 4.5 river miles upstream of the bridge and ends 13.3 river miles downstream of the bridge at the Mattawamkeag River. There is no stream gage on Mattagodus Stream nor on other waterbodies near the bridge. No FEMA Flood Insurance Study nor Flood Insurance Rate Map (FIRM) has been completed which studies Mattagodus Stream in detail. Permitting for this crossing is partially governed by the Land Use Planning Commission (LUPC). As shown on the zoning map in the Supplemental Hydrology and Hydraulic Data (SHHD) document, the project site is within a Flood Prone Area Protection Subdistrict (P-FP) and is therefore subject to permitting requirements pertaining to base flood elevations outlined in Chapter 10 of *Land Use Districts and Standards For Areas Served by the Maine Land Use Planning Commission* (Reference 1, SHHD). The requirements outlined in Sub-Chapter III section 10.25,T within the above referenced document states that the cumulative effect of the proposed, existing, and anticipated development on the water surface elevation of the base flood will not increase more than 1'. It also states that, when possible, the lowest horizontal member is to be elevated 1' above the base flood elevation. Mattagodus Stream is not discussed in the *Historic Flooding in Major Drainage Basins, Maine* document published in 2007 (Reference 2, SHHD). There are no anecdotal reports of the existing bridge overtopping.

Because there are no stream gages on Mattagodus Stream, the peak flow values and drainage basin characteristics are taken from USGS StreamStats (Reference 3, SHHD). These characteristics are based on Lombard's and Hodgkin's *Estimating flood magnitude and frequency on gaged and un-gaged streams in Maine: U.S. Geological Survey Scientific Investigations Report 2020-5092*. StreamStats does not provide a discharge for the 1.1-year storm event; this flow value was estimated by dividing the 2-year flow value in half. The hydrology data is shown in Table 1 and the full StreamStats report is included in the SHHD.

Table 1 Hydrology Summary

Drainage Area	9.9	mi ²
Q1.1	156	ft ³ /s
Q10	587	ft ³ /s
Q25	737	ft ³ /s
Q50	855	ft ³ /s
Q100	977	ft ³ /s
Q500	1280	ft ³ /s

The bankfull width (BFW) for Mattagodus Stream is 22' per measurements taken by MaineDOT ENV staff taken during a joint site visit of MaineDOT and WSP staff, dated November 20, 2024. Per the Environmental Coordination table on page 5, the proposed BFW is 22' and the proposed clear span is 26' per the table in the "Summary of Expected Impacts" section.

Reported by: Kayla Hampe, PE
Date: June 30, 2025

HYDRAULIC REPORT

Two-dimensional (2D), steady state hydraulic analyses were performed to analyze the existing and proposed hydraulic conditions at Mattagodus Brook Bridge. The software package used to develop the SRH-2D (Sediment and River Hydraulics, Two-Dimensional) (Reference 4, SHHD) model for the crossing is Aquaveo's Surface-water Modeling System (SMS) Version 13.4 (Reference 5, SHHD). SMS incorporates the HY-8 Culvert Analysis Program, which was developed by the Federal Highway Administration (FHWA) as a culvert design tool. Culverts can be modeled using HY-8 within an SRH-2D simulation. HY-8 calculates the 1D flow through the culvert, while SRH-2D calculates the 2D flow dynamics around the culvert.

The modeling process consists of importing background data (including elevations, satellite imagery, GIS data, and CAD linework); defining a mesh, boundary conditions, material coverages, and monitoring points and lines; creating simulations and defining model control parameters for each flood event; and running the model. Additionally, since no calibration data is available, sensitivity analyses were performed to verify that the model accurately represents the hydraulic conditions of the project site. The model development process is described in detail in the SHHD.

Headwater elevations and stream velocities at peak flows are reported in Table 2 for both the existing and proposed structures. Supporting water surface elevation profile plots, and velocity and depth plan view images are included in the SHHD. Headwater depth values were taken at a location upstream of the culvert that is outside the influence of the structure and used to calculate HW/D ratios for Q50 and Q100. The proposed HW/D ratios are 0.90 and 0.94 for Q50 and Q100, respectively. Both ratios are less than or equal to the maximum limits of 0.9 for Q50 per Section 2.3.10.2A of the Bridge Design Guide (Reference 12, SHHD) and 1.0 for Q100 per Section 5.3 of the MAP Users Guide (Reference 13, SHHD).

The amount of freeboard at Q100 is 0.5', which is less than the desired freeboard of 1.0' for LUPC. However, due to site constraints and cost, it was deemed not practicable to achieve this freeboard. The proposed structure design is sufficient for other hydraulic and habitat connectivity design requirements and is therefore considered acceptable.

Since the proposed structure is a box culvert, scour analyses will not be performed.

Table 2 Hydraulics Summary

		Existing Structure	Proposed Structure
		Three 10' Diameter Sectional Plate Steel Pipe Culverts	26' Span and 11' - Rise Pre- Cast Reinforced Concrete Box Culvert
Total Area of Waterway Opening	ft ²	236	184
Headwater Elevation @ Q1.1	ft	358.4	358.3
Headwater Elevation @ Q10	ft	360.4	360.1
Headwater Elevation @ Q25	ft	360.8	360.6
Headwater Elevation @ Q50	ft	361.2	360.9
Headwater Elevation @ Q100	ft	361.6	361.3
Headwater Elevation @ Q500	ft	362.6	362.2
HW/D @ Q50		0.94	0.90
HW/D @ Q100		0.99	0.94
Flood of Record - Unknown			
Outlet Velocity @ Q1.1	ft/s	1.6	1.8
Outlet Velocity @ Q10	ft/s	3.1	5.0
Outlet Velocity @ Q25	ft/s	3.7	6.0
Outlet Velocity @ Q50	ft/s	4.1	6.8
Outlet Velocity @ Q100	ft/s	4.6	7.5
Outlet Velocity @ Q500	ft/s	5.6	9.1

Reported by: Kayla Hampe, PE

Date: June 30, 2025

Note: All elevations based on North American Vertical Datum (NAVD) of 1988.

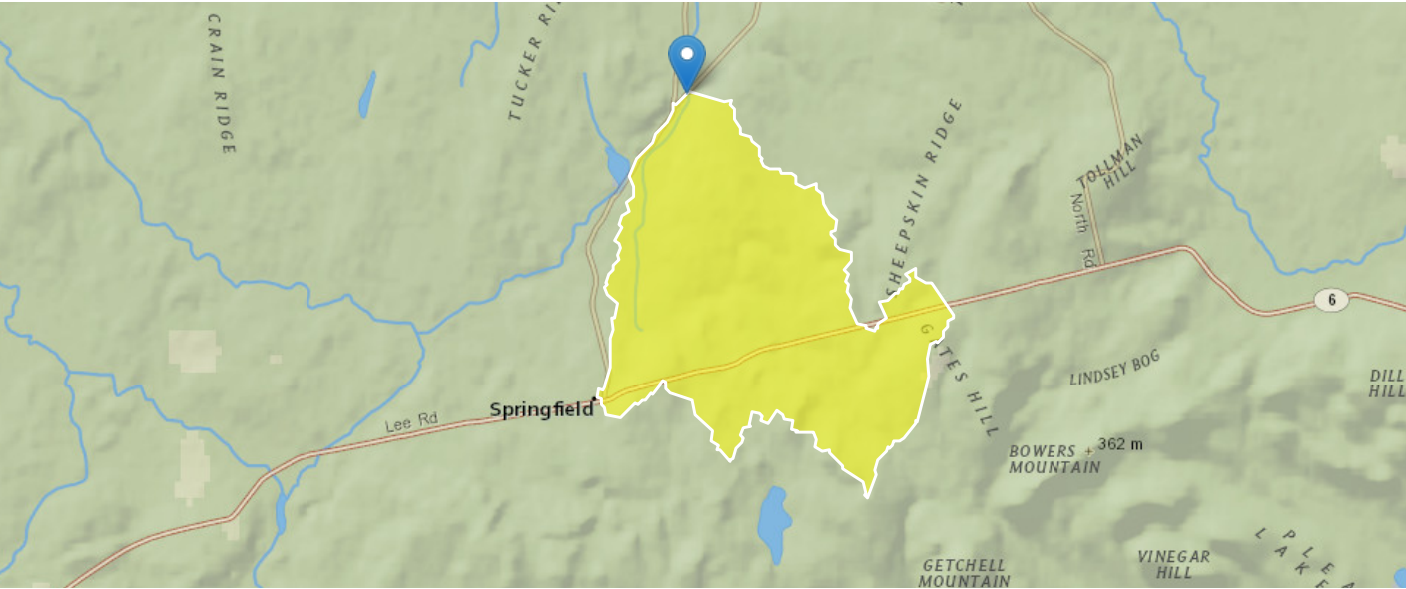
Appendix

Hydraulics Data

StreamStats Report

5185 StreamStats Report

Region ID: ME
Workspace ID: ME20250310195608833000
Clicked Point (Latitude, Longitude): 45.44649, -68.11380
Time: 2025-03-10 15:56:48 -0400



+ Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	9.94	square miles
ELEV	Mean Basin Elevation	609.2	feet
I24H100Y	Maximum 24-hour precipitation that occurs on average once in 100 years	5.52	inches
I24H10Y	Maximum 24-hour precipitation that occurs on average once in 10 years	3.77	inches
I24H200Y	Maximum 24-hour precipitation that occurs on average once in 200 years	6.09	inches
I24H25Y	Maximum 24-hour precipitation that occurs on average once in 25 years	4.46	inches
I24H2Y	Maximum 24-hour precipitation that occurs on average once in 2 years - Equivalent to precipitation intensity index	2.66	inches
I24H500Y	Maximum 24-hour precipitation that occurs on average once in 500 years	6.9	inches
I24H50Y	Maximum 24-hour precipitation that occurs on average once in 50 years	4.98	inches
I24H5Y	Maximum 24-hour precipitation that occurs on average once in 5 years	3.27	inches
JULAVPRE	Mean July Precipitation	3.9	inches
PCTSDNGRV	Percentage of land surface underlain by sand and gravel deposits	0.751	percent
SANDGRAVAF	Fraction of land surface underlain by sand and gravel aquifers	0.008	dimensionless
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	9.996	percent

➤ Peak-Flow Statistics

Peak-Flow Statistics Parameters [Statewide multiparameter peakflows SIR 2020 5092]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	9.94	square miles	0.26	5680
I24H100Y	24 Hour 100 Year Precipitation	5.52	inches	3.99	9.88
I24H10Y	24 Hour 10 Year Precipitation	3.77	inches	2.84	6.38
I24H200Y	24 Hour 200 Year Precipitation	6.09	inches	5.26	11.1
I24H25Y	24 Hour 25 Year Precipitation	4.46	inches	3.3	7.75
I24H2Y	24 Hour 2 Year Precipitation	2.66	inches	1.92	4.17
I24H500Y	24 Hour 500 Year Precipitation	6.9	inches	5.95	13.1
I24H50Y	24 Hour 50 Year Precipitation	4.98	inches	3.65	8.79
I24H5Y	24 Hour 5 Year Precipitation	3.27	inches	2.48	5.38
STORAGE	Percent Storage	9.996	percent	0	29.4

Peak-Flow Statistics Flow Report [Statewide multiparameter peakflows SIR 2020 5092]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct, RMSE: Root Mean Squared Error, PseudoR²: Pseudo R Squared (other -- see report)

Statistic	Value	Unit	PIL	PIU	ASEp
50-percent AEP flood	312	ft ³ /s	168	580	39.1
20-percent AEP flood	472	ft ³ /s	258	864	38.1
10-percent AEP flood	587	ft ³ /s	317	1090	38.9
4-percent AEP flood	737	ft ³ /s	392	1380	39.9
2-percent AEP flood	855	ft ³ /s	448	1630	39.7
1-percent AEP flood	977	ft ³ /s	515	1850	40.7
0.5-percent AEP flood	1100	ft ³ /s	561	2160	42.8
0.2-percent AEP flood	1280	ft ³ /s	644	2550	43.8

Peak-Flow Statistics Citations

Lombard, P.J., and Hodgkins, G.A., 2020, Estimating flood magnitude and frequency on gaged and ungaged streams in Maine: U.S. Geological Survey Scientific Investigations Report 2020–5092, 56 p. (<https://doi.org/10.3133/sir20205092>)

➤ Bankfull Statistics

Bankfull Statistics Parameters [Appalachian Highlands D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	9.94	square miles	0.07722	940.1535

Bankfull Statistics Parameters [New England P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	9.94	square miles	3.799224	138.999861

Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	9.94	square miles	0.07722	59927.7393

Bankfull Statistics Flow Report [Appalachian Highlands D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	39.4	ft
Bieger_D_channel_depth	2.17	ft
Bieger_D_channel_cross_sectional_area	86.8	ft^2

Bankfull Statistics Flow Report [New England P Bieger 2015]

Statistic	Value	Unit
Bieger_P_channel_width	48.1	ft
Bieger_P_channel_depth	2.28	ft
Bieger_P_channel_cross_sectional_area	112	ft^2

Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	27.8	ft
Bieger_USA_channel_depth	1.97	ft
Bieger_USA_channel_cross_sectional_area	59.1	ft^2

Bankfull Statistics Flow Report [Area-Averaged]

Statistic	Value	Unit
Bieger_D_channel_width	39.4	ft
Bieger_D_channel_depth	2.17	ft
Bieger_D_channel_cross_sectional_area	86.8	ft^2
Bieger_P_channel_width	48.1	ft
Bieger_P_channel_depth	2.28	ft
Bieger_P_channel_cross_sectional_area	112	ft^2
Bieger_USA_channel_width	27.8	ft
Bieger_USA_channel_depth	1.97	ft
Bieger_USA_channel_cross_sectional_area	59.1	ft^2

Bankfull Statistics Citations

Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G., 2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. (https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_campaign=PDFCoverPages)

➤ Base Flow Statistics

Base Flow Statistics Parameters [Maine August Unit Baseflow RivResAppl 2021]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
JULAVPRE	Mean July Precipitation	3.9	inches	3.3	4.9
PCTSDNGRV	Percent Underlain By Sand And Gravel	0.751	percent	0	73

Base Flow Statistics Flow Report [Maine August Unit Baseflow RivResAppl 2021]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct, RMSE: Root Mean Squared Error, PseudoR^2: Pseudo R Squared (other -- see report)

Statistic	Value	Unit	SE
Mean August unit baseflow	0.324	ft^3/s/mi^2	20.8

Base Flow Statistics Citations

2021, Pamela J. Lombard, Robert W. Dudley, Mathias J. Collins, Rory Saunders, Earnie Atkinson Model estimated baseflow for streams with endangered Atlantic Salmon in Maine, USA; John Wiley & Sons Ltd., River Research and Applications, Volume 37, Issue 9, pp 1254-1264. (<https://doi.org/10.1002/rra.3835>)

➤ Annual Flow Statistics

Annual Flow Statistics Parameters [Statewide Annual SIR 2015 5151]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	9.94	square miles	14.9	1419
ELEV	Mean Basin Elevation	609.2	feet	239	2120
SANDGRAVAF	Fraction of Sand and Gravel Aquifers	0.008	dimensionless	0	0.212

Annual Flow Statistics Disclaimers [Statewide Annual SIR 2015 5151]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Annual Flow Statistics Flow Report [Statewide Annual SIR 2015 5151]

Statistic	Value	Unit
Mean Annual Flow	22	ft^3/s

Annual Flow Statistics Citations

Dudley, R.W., 2015, Regression equations for monthly and annual mean and selected percentile streamflows for ungaged rivers in Maine: U.S. Geological Survey Scientific Investigations Report 2015–5151, 35 p. (<http://dx.doi.org/10.3133/sir20155151>)

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Application Version: 4.28.0

StreamStats Services Version: 1.2.22

NSS Services Version: 2.2.1

LUPC Zoning & Parcel Viewer Map

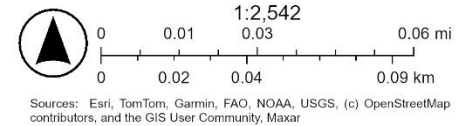
LUPC Zoning and Parcel Viewer



5/5/2025, 5:18:24 PM

 ArcGIS World Geocoding Service Maine and New Hampshire View
 Towns
LUPC Zones
 P-FP: Flood Prone Area Protection
World Imagery

Low Resolution 15m Imagery
High Resolution 60cm Imagery
High Resolution 30cm Imagery
Citations
60cm Resolution Metadata



2D Hydraulic Modeling Narrative

HYDRAULIC MODELING

Two-dimensional (2D), steady state hydraulic analyses were performed to analyze the existing and proposed hydraulic conditions at the Mattagodus Brook Bridge. The software package used to develop the SRH-2D (Reference 4) model for the crossing is Aquaveo's SMS Version 13.4 (Reference 5). The program allows the user to develop a 2D hydraulic, sediment, temperature, and vegetation model that incorporates the finite volume method in conjunction with implicit first- and second-order numerical schemes to approximate a solution for the 2D depth averaged Saint Venant equations. SMS incorporates the HY-8 Culvert Analysis Program, which was developed by FHWA as a culvert design tool. Culverts can be modeled using HY-8 within an SRH-2D simulation. HY-8 calculates the 1D flow through the culvert, while SRH-2D calculates the 2D flow dynamics around the culvert.

Surface Generation

A topographic and bathymetric survey (Reference 11) was completed for this project and incorporated into the model as an XML file. The survey included stream thalweg data, roadway elevations, and bank geometry near the existing bridge. A LiDAR surface was used to supplement the on-the-ground survey to incorporate areas within the extents of the model that the survey did not cover. LiDAR data was downloaded from the NOAA Data Access Viewer website (Reference 6). The model extents are shown below:

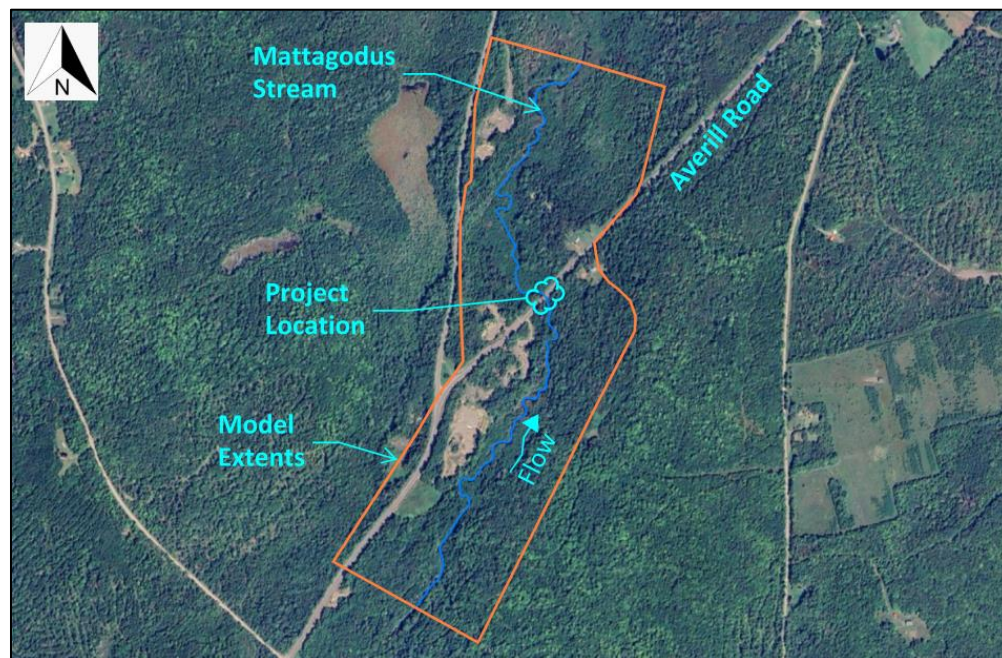


Figure C1: 2D Hydraulic Model Extents

The type of LiDAR used in this project does not penetrate through water; therefore, the water surface elevations are approximated by interpolation of streambank elevations across the stream. The surveyed streambed elevations were subtracted from the approximated water surface elevations to estimate the depth of the channel outside the limits of the surveyed stream.

By inspecting the difference between the LiDAR water surface and the survey data, as well as observations from a field visit on June 13, 2025, the channel bottom was taken to be 3.5' and 2.0' to 3.0' below the LiDAR water surface upstream and downstream of the survey, respectively. The feature stamping tool was used to define the channel outside the limits of the survey using these depths. The slopes of the approximated water surface were calculated as 0.0012 to 0.0025 ft/ft upstream and 0.0005 to 0.0011 ft/ft downstream and are assumed to also represent the slope of the streambed. The survey, LiDAR, and stamp data were combined to create an existing terrain surface for the existing conditions model. The existing surface was modified for the proposed conditions model to incorporate the proposed bridge and grading which includes the following features:

- An 70'-0" long box culvert (skewed 13 degrees) with a clear span of 26'-0" between culvert walls;
- a streambed cross-section with a 2' wide shelf on each side set at an elevation of 357' at the culvert inlet with a slope down at 0.005 ft/ft to an elevation of 356.65' at the culvert outlet, and a roughly u-shaped channel that is 4'-0" deep maximum at the centerline of the channel;
- and a streambed elevation of 353.00' at the culvert inlet and a slope down at 0.005 ft/ft to an elevation of 352.65' at the culvert outlet.

Mesh Development

The upstream limit of the model begins 3,250' (measured along the stream) upstream of the crossing. The downstream limit is 2,690' (measured along the stream) downstream of the crossing. Triangular mesh elements were used to model the floodplains and surrounding terrain, and a combination of triangular and quadrilateral mesh elements were used to model the stream and roads. Triangular mesh was used in multiple locations in the stream to better represent the surveyed bathymetry. The size of the elements was adjusted based on their proximity to the bridge and stream to optimize the model.

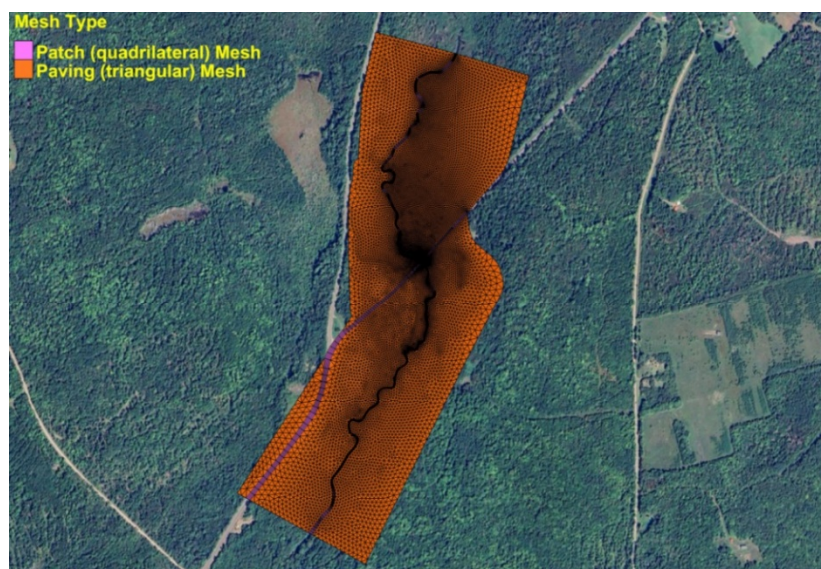


Figure C2: Plan View of Project Site and Mesh Elements

Material Properties

The material properties used were based on aerial imagery and observations from field visits made on November 20, 2024 and June 13, 2025, and input as Mannings' n roughness coefficients to the Materials SMS coverage. A roughness coefficient of 0.045 was used for Mattagodus Stream. A proposed Materials coverage was created by modifying the existing Materials coverage to include the streambed through the proposed box culvert using the same Manning's n value as the stream.

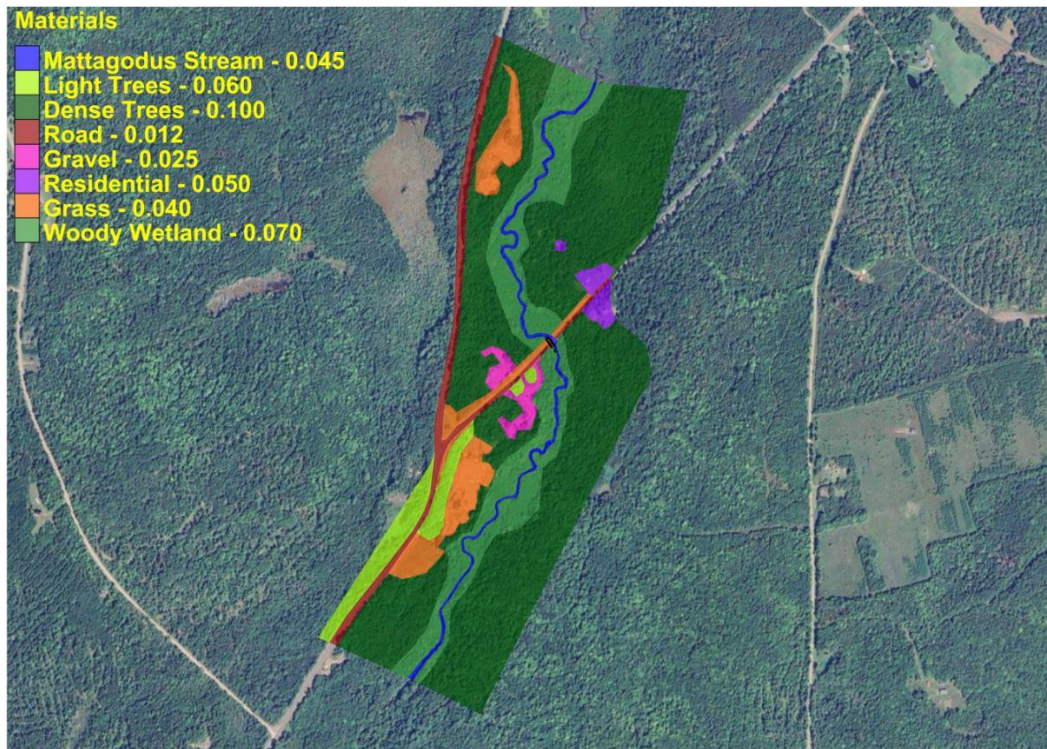


Figure C3: Plan View of Existing Materials

Boundary Conditions

The peak flows were input as constant discharge distributed at the inlet using conveyance for the upstream boundary conditions of Mattagodus Stream. The downstream boundary conditions were input as a water surface elevation calculated by the program based on: assuming subcritical flow and normal depth, a composite roughness coefficient of 0.046 at low flows and 0.050 at high flows, a normal slope of 0.00034 ft/ft, and the total discharge. The normal slope was based on the assumption that the water surface slope is an approximation of the energy grade line slope and the streambed slope. The water surface slope was calculated using estimated elevations from the LiDAR data near the downstream boundary.

The existing bridge was modeled using three pairs of HY-8 arcs, with one pair for each barrel. The geometric data for the existing bridge was taken from the latest bridge inspection report (Reference 8), the existing plans (Reference 10), the existing topographic and bathymetric survey (Reference 11), and observations made during the June 13, 2025 field visit.

Crossing Data - Barrel 1

Crossing Properties

Name:

Parameter	Value	Units
DISCHARGE D...	Optional--Model will determine val...	Optional Inf...
Discharge Method	Minimum, Design, and Maximum	
Minimum Flow	0.000	cfs
Design Flow	0.000	cfs
Maximum Flow	0.000	cfs
TAILWATER D...	Optional--Model will determine val...	Optional Inf...
Channel Type	Rectangular Channel	
Bottom Width	0.000	ft
Channel Slope	0.0000	ft/ft
Manning's n (channel)	0.000	
Channel Invert Elev...	0.000	ft
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.000	ft
Crest Length	10.000	ft
Crest Elevation	365.000	ft
Roadway Surface	Paved	
Top Width	22.000	ft

Culvert Properties

Barrel 1

[Add Culvert](#) [Duplicate Culvert](#) [Alternative Designs](#) [Delete Culvert](#)

Parameter	Value	Units
CULVERT DATA		
Name	Barrel 1	
Shape	Circular	
Material	Corrugated Steel	
Diameter	10.000	ft
Embedment Depth	18.000	in
Manning's n (Top/Sides)	0.024	
Manning's n (Bottom)	0.035	
Culvert Type	Straight	
Inlet Configuration	Mitered to Conform to Slope (Ke=0.7)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	ft
Inlet Elevation	351.710	ft
Outlet Station	47.300	ft
Outlet Elevation	351.660	ft
Number of Barrels	1	
Computed Culvert Slope	0.001057	ft/ft

Help Click on any [?](#) icon for help on a specific topic Low Flow AOP Energy Dissipation Analyze Crossing **OK** Cancel

Figure C4: Existing Culvert HY-8 Inputs for Barrel 1

Crossing Data - Barrel 2

Crossing Properties

Name:

Parameter	Value	Units
DISCHARGE D...	Optional--Model will determine val...	Optional Inf...
Discharge Method	Minimum, Design, and Maximum	
Minimum Flow	0.000	cfs
Design Flow	0.000	cfs
Maximum Flow	0.000	cfs
TAILWATER D...	Optional--Model will determine val...	Optional Inf...
Channel Type	Rectangular Channel	
Bottom Width	0.000	ft
Channel Slope	0.0000	ft/ft
Manning's n (channel)	0.000	
Channel Invert Elev...	0.000	ft
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.000	ft
Crest Length	10.000	ft
Crest Elevation	365.000	ft
Roadway Surface	Paved	
Top Width	22.000	ft

Culvert Properties

Culvert 2

[Add Culvert](#) [Duplicate Culvert](#) [Alternative Designs](#) [Delete Culvert](#)

Parameter	Value	Units
CULVERT DATA		
Name	Culvert 2	
Shape	Circular	
Material	Corrugated Steel	
Diameter	10.000	ft
Embedment Depth	12.000	in
Manning's n (Top/Sides)	0.024	
Manning's n (Bottom)	0.035	
Culvert Type	Straight	
Inlet Configuration	Mitered to Conform to Slope (Ke=0.7)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	ft
Inlet Elevation	351.920	ft
Outlet Station	48.000	ft
Outlet Elevation	352.430	ft
Number of Barrels	1	
Computed Culvert Slope	-0.010625	ft/ft

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Figure C5: Existing Culvert HY-8 Inputs for Barrel 2

Crossing Data - Barrel 3

Crossing Properties

Name:

Parameter	Value	Units
DISCHARGE D...	Optional--Model will determine val...	Optional Inf...
Discharge Method	Minimum, Design, and Maximum	
Minimum Flow	0.000	cfs
Design Flow	0.000	cfs
Maximum Flow	0.000	cfs
TAILWATER D...	Optional--Model will determine val...	Optional Inf...
Channel Type	Rectangular Channel	
Bottom Width	0.000	ft
Channel Slope	0.0000	ft/ft
Manning's n (channel)	0.000	
Channel Invert Elev...	0.000	ft
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.000	ft
Crest Length	10.000	ft
Crest Elevation	365.000	ft
Roadway Surface	Paved	
Top Width	22.000	ft

Culvert Properties

Culvert 3

[Add Culvert](#) [Duplicate Culvert](#) [Alternative Designs](#) [Delete Culvert](#)

Parameter	Value	Units
CULVERT DATA		
Name	Culvert 3	
Shape	Circular	
Material	Corrugated Steel	
Diameter	10.000	ft
Embedment Depth	12.000	in
Manning's n (Top/Sides)	0.024	
Manning's n (Bottom)	0.035	
Culvert Type	Straight	
Inlet Configuration	Mitered to Conform to Slope (Ke=0.7)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	ft
Inlet Elevation	352.110	ft
Outlet Station	47.770	ft
Outlet Elevation	351.960	ft
Number of Barrels	1	
Computed Culvert Slope	0.003140	ft/ft

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Figure C6: Existing Culvert HY-8 Inputs for Barrel 3

The proposed bridge was modeled using pressure arcs with a flat ceiling type and low chord elevations of 361.8' and 361.45' at the inlet and outlet, respectively. The Manning's n value of the ceiling of the box was set as 0.05. Other parameters for the proposed culvert were input using the feature stamping tool outlined in the Surface Generation above.

Sensitivity Analysis

A sensitivity analysis of the downstream model boundary conditions was performed to verify model convergence of the water surface profile downstream of the bridge. Convergence occurs when a downstream boundary condition, roughness, or mesh resolution is changed but the solution remains similar. For this study, the water surface elevation at the downstream boundary condition was changed for the 100-year flood event to demonstrate that the downstream boundary condition did not affect the solution at the project site. A sensitivity analysis of Manning's roughness coefficient was also completed to verify model convergence. The roughness coefficient of the channel was increased and decreased by 0.005 and evaluated for the 100-year flood event; the results show no appreciable effect on the water surface elevations or stream velocities near the bridge for these changes. Based on the sensitivity analyses, the model is taken to be reliable.

Scour Analysis

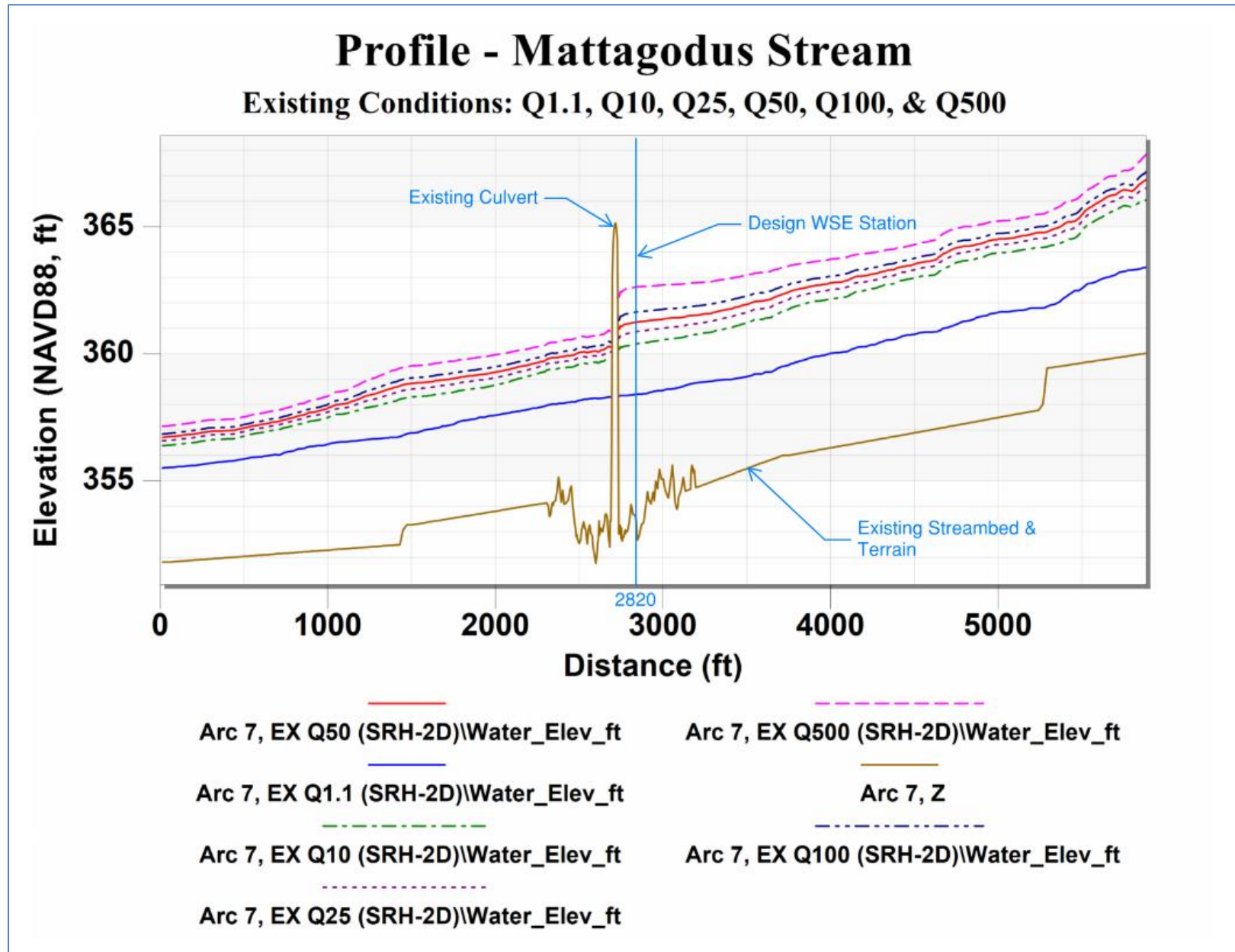
A scour analysis will be performed based on procedures outlined in FHWA publication HEC-18, 5th Edition (Reference 7). The 100-year and 500-year storm events will be analyzed for contraction scour and local scour at the proposed site, per the MaineDOT Bridge Design Guide (Reference 12). The complete scour analysis will be included in the final PDR. An evaluation of the mobility of the special fill inside the proposed box culvert is anticipated as part of the Habitat Connectivity Design.

References

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3. United States Geological Survey (USGS), USGS StreamStats Version 4.28.0
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4. US Bureau of Reclamation (USBR) Sediment and River Hydraulics, Two-Dimensional (SRH-2D), version 3.6.5
5. Aquaveo, LLC., Surface-Water Modeling System (SMS), Version 13.4
6. National Oceanic and Atmospheric Administration (NOAA), NOAA: Data Access Viewer
<https://coast.noaa.gov/dataviewer/#/> Accessed February 25, 2025 and May 28, 2025
7. Federal Highway Administration (FHWA), Hydraulic Engineering Circular No. 18 (HEC-18), Evaluating Scour at Bridges, Fifth Edition, Publication No. FHWA-HIF-12-003, April 2012
8. Highway Bridge Inspection Report for Structure Number: 5185, Maine Department of Transportation (MaineDOT), dated November 28, 2023
9. Highway Bridge Inspection Report for Structure Number: 5185, Underwater Inspection, Maine Department of Transportation (MaineDOT), dated July 18, 2023
10. Survey Plan Entitled "Mattagoodus Bridge over Mattagoodus Brook in the Plantation of Prentiss Penobscot Co. Maine" Prepared by: Maine Highway Commission Bridge Division, dated December 29, 1947 and July 1948
11. Topographic and Bathymetric Survey completed by MaineDOT, December 2024, supplemented by Bathymetric Survey completed by WSP, May 2025
12. MaineDOT Bridge Design Guide, August 2003 (Updated June 2018)
13. Maine Department of Transportation (MaineDOT), Federal Highway Administration (FHWA), US Army Corps of Engineers and Maine Turnpike Authority, "Programmatic Biological Assessment for Transportation Projects for the Gulf of Maine Distinct Population Segment of Atlantic Salmon and Designated Critical Habitat", dated May 2016

2D Hydraulic Modeling Existing Conditions Results

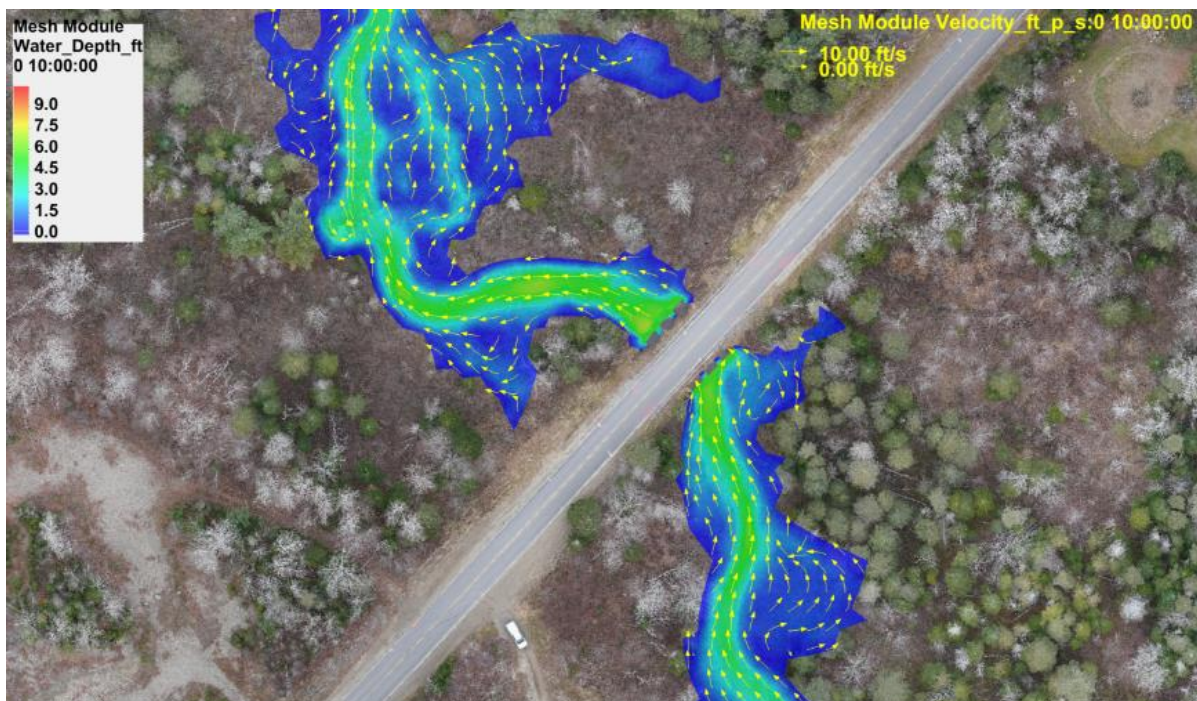
Existing Conditions Water Surface Elevation Profiles



Existing 1.1-Year Flood Event Water Depths with Flow Vectors



Domain



Bridge

Existing 1.1-Year Flood Event Velocities with Flow Vectors

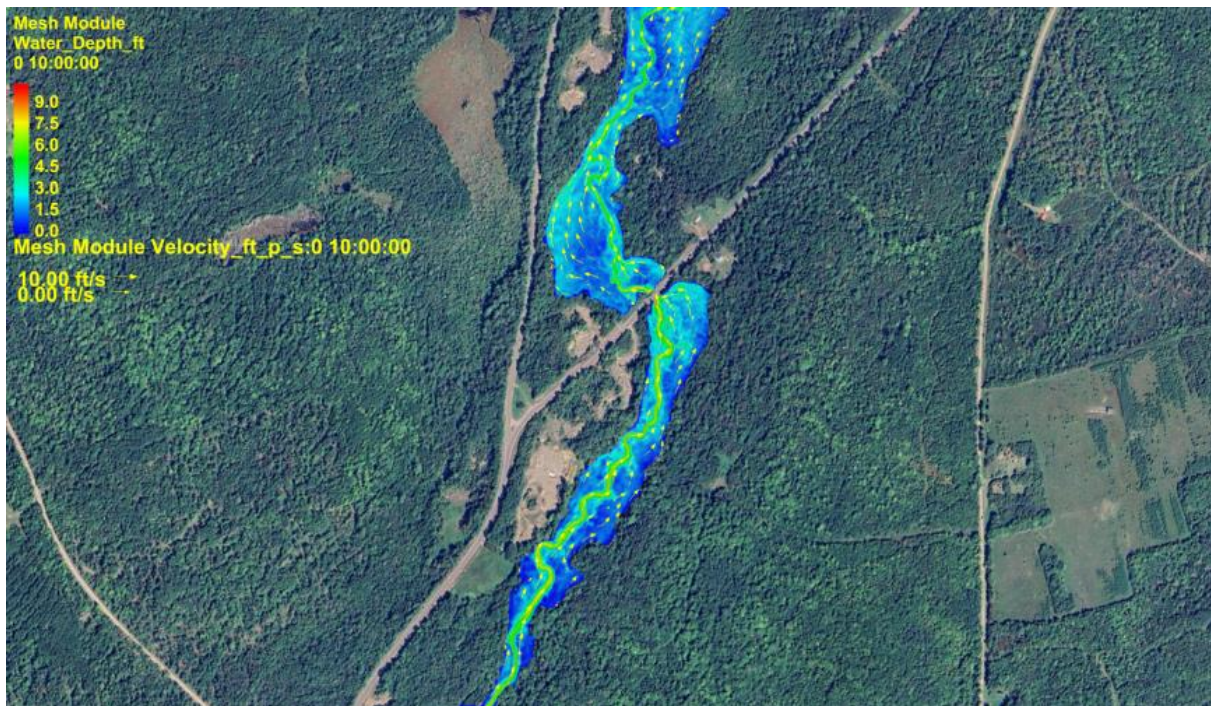


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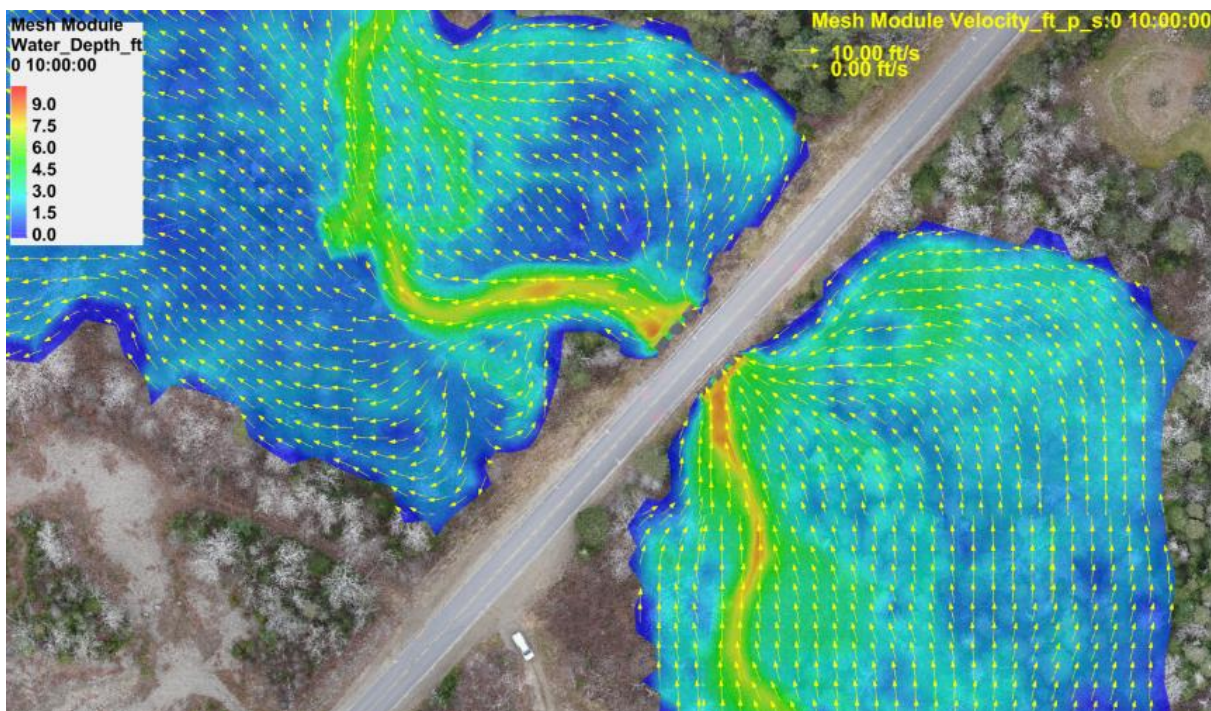


Bridge

Existing 50-Year Flood Event Water Depths with Flow Vectors

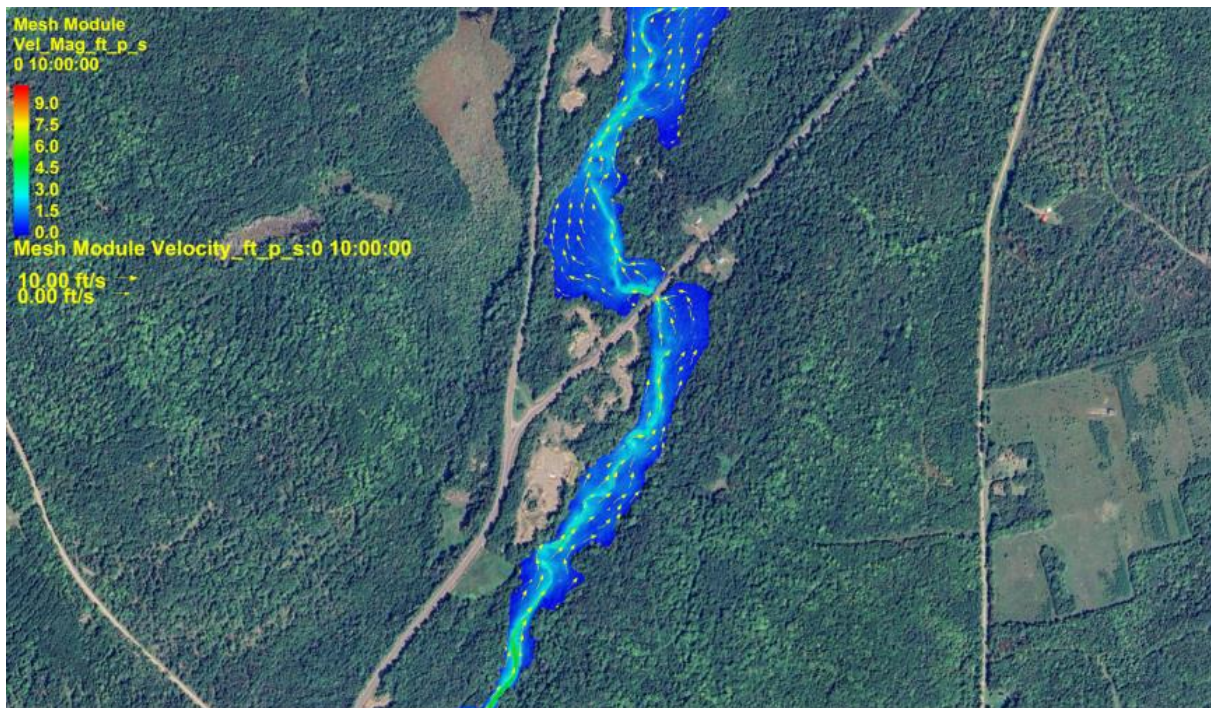


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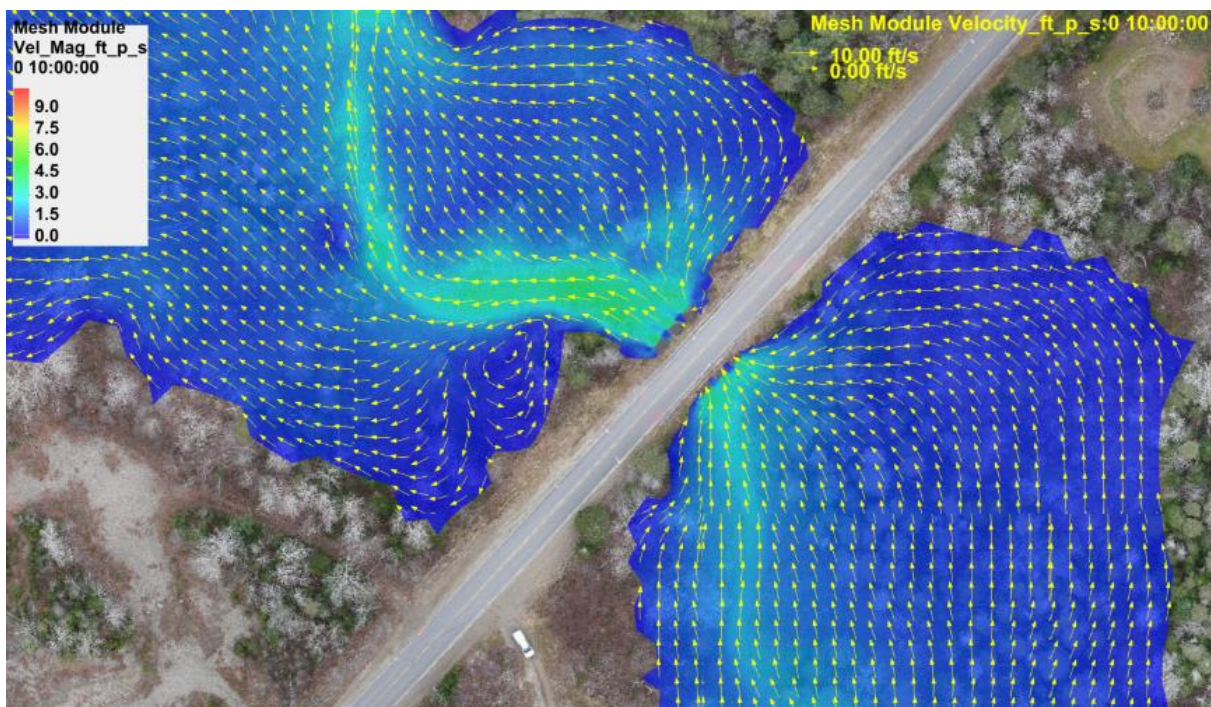


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Existing 50-Year Flood Event Velocities with Flow Vectors

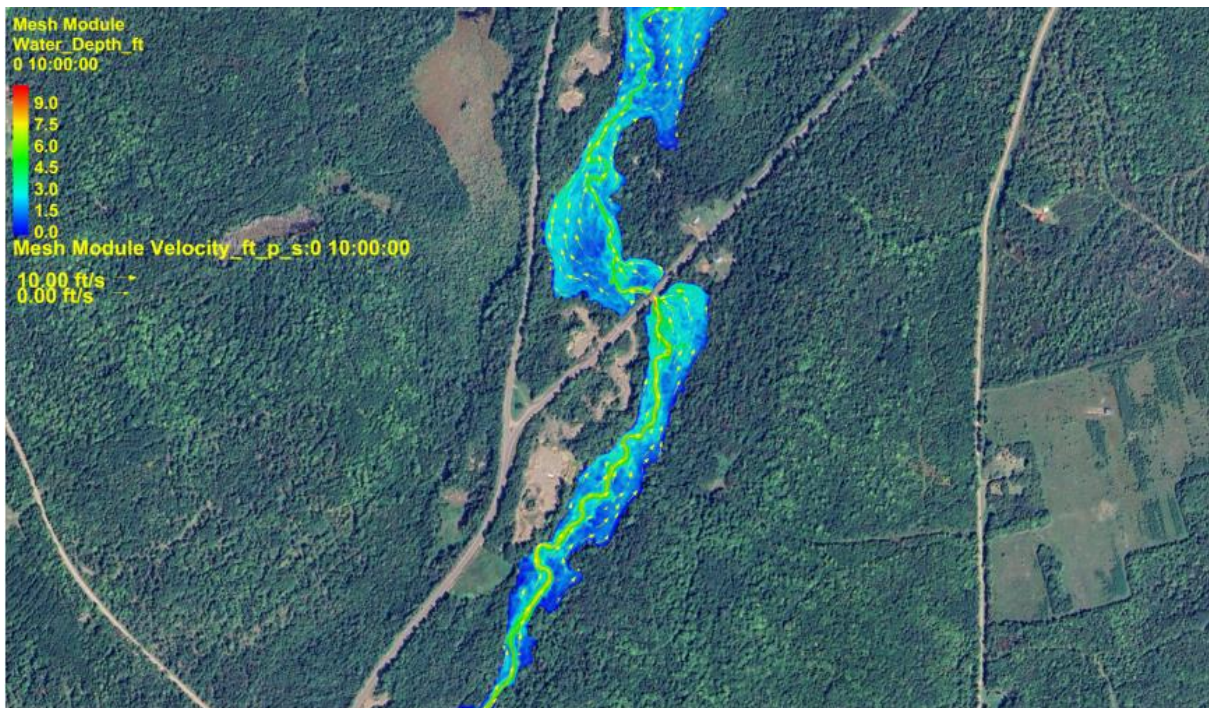


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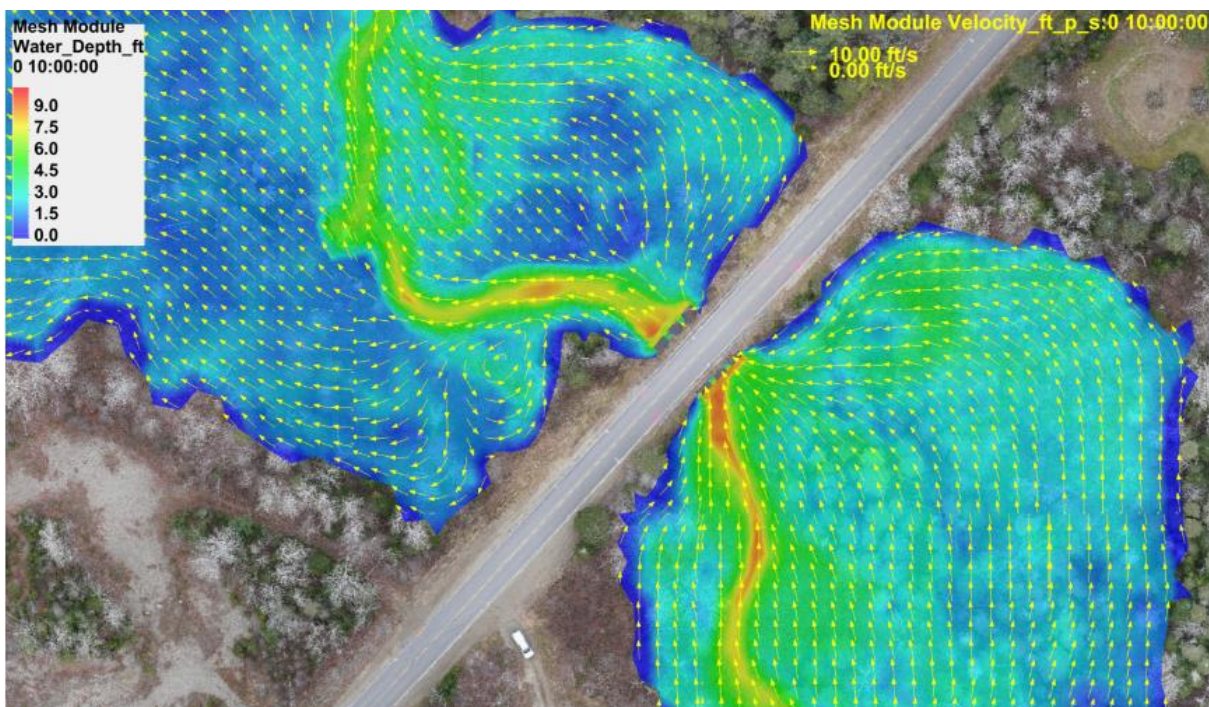


Bridge

Existing 100-Year Flood Event Water Depths with Flow Vectors

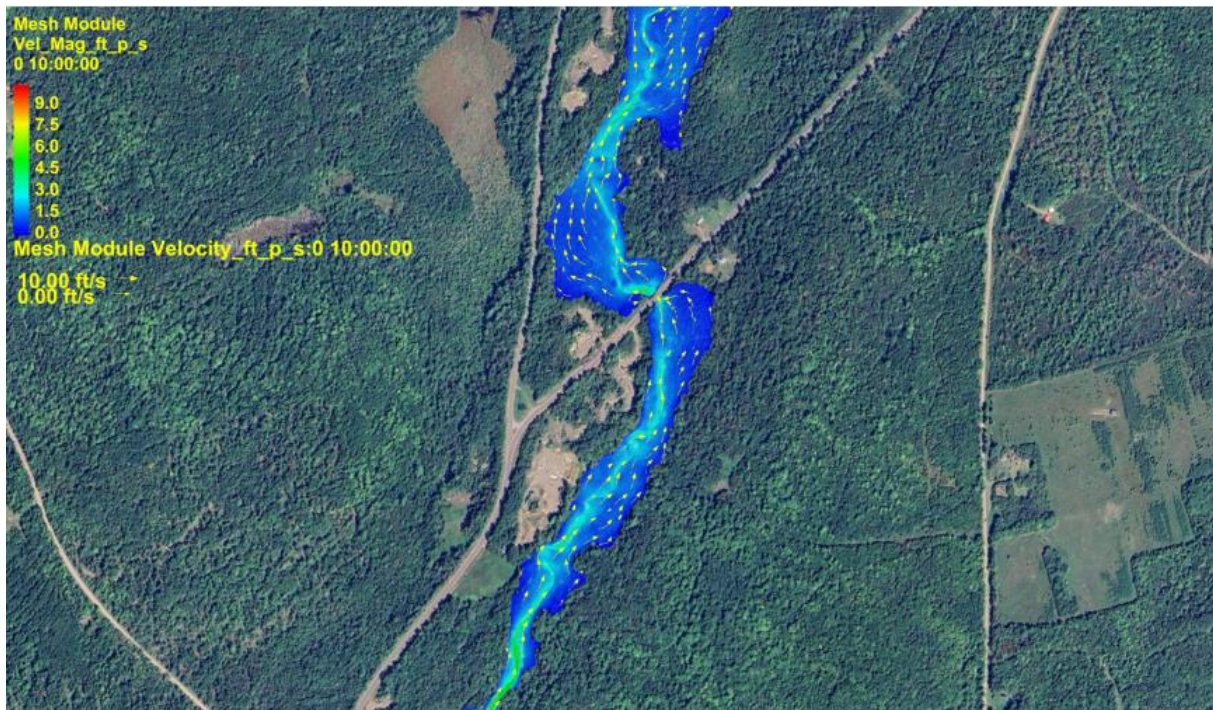


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Bridge

Existing 100-Year Flood Event Velocities with Flow Vectors



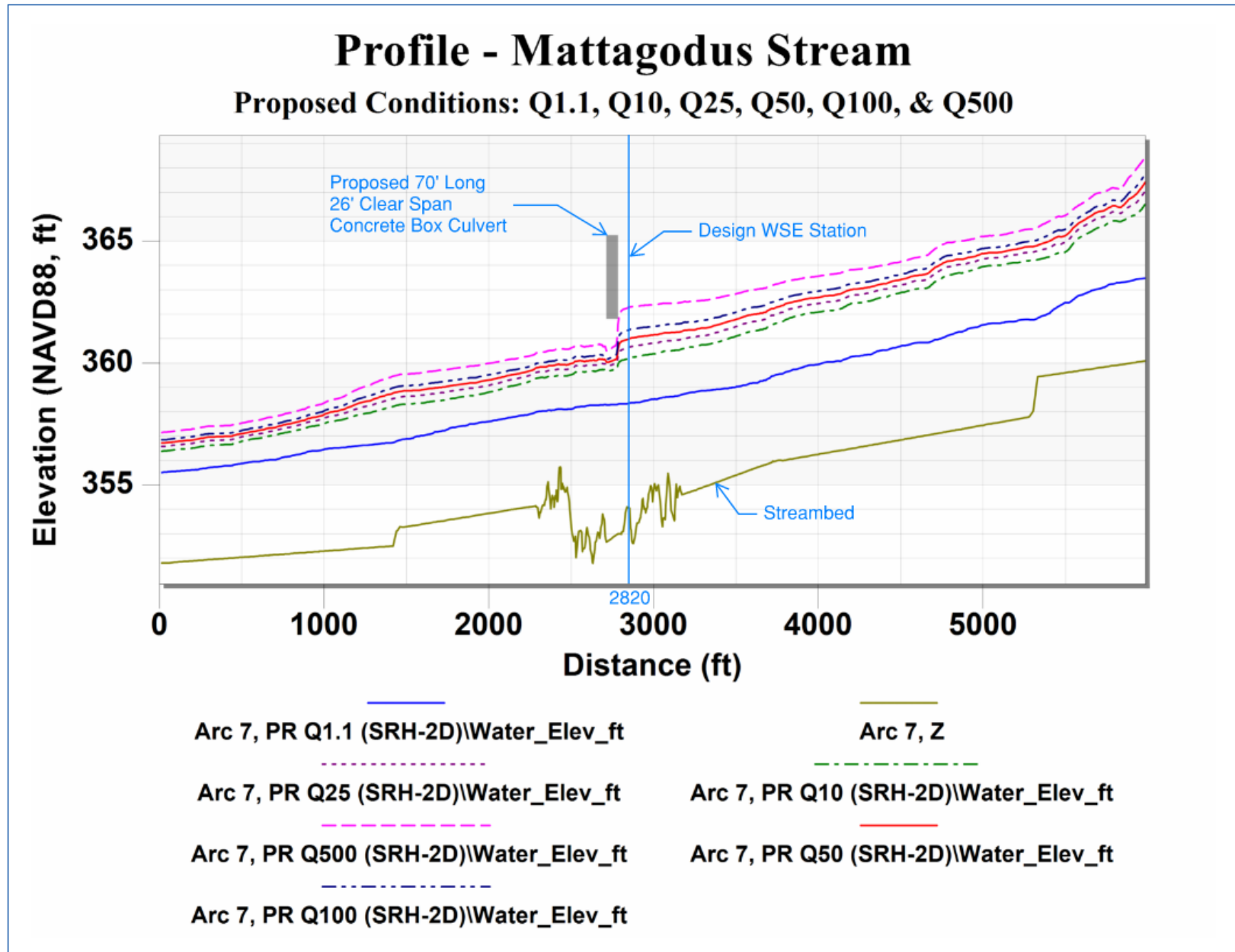
Domain



Bridge

2D Hydraulic Modeling Proposed Conditions Results

Proposed Conditions Water Surface Elevation Profiles



Proposed 1.1-Year Flood Event Water Depths with Flow Vectors



Domain



Bridge

Proposed 1.1-Year Flood Event Velocities with Flow Vectors

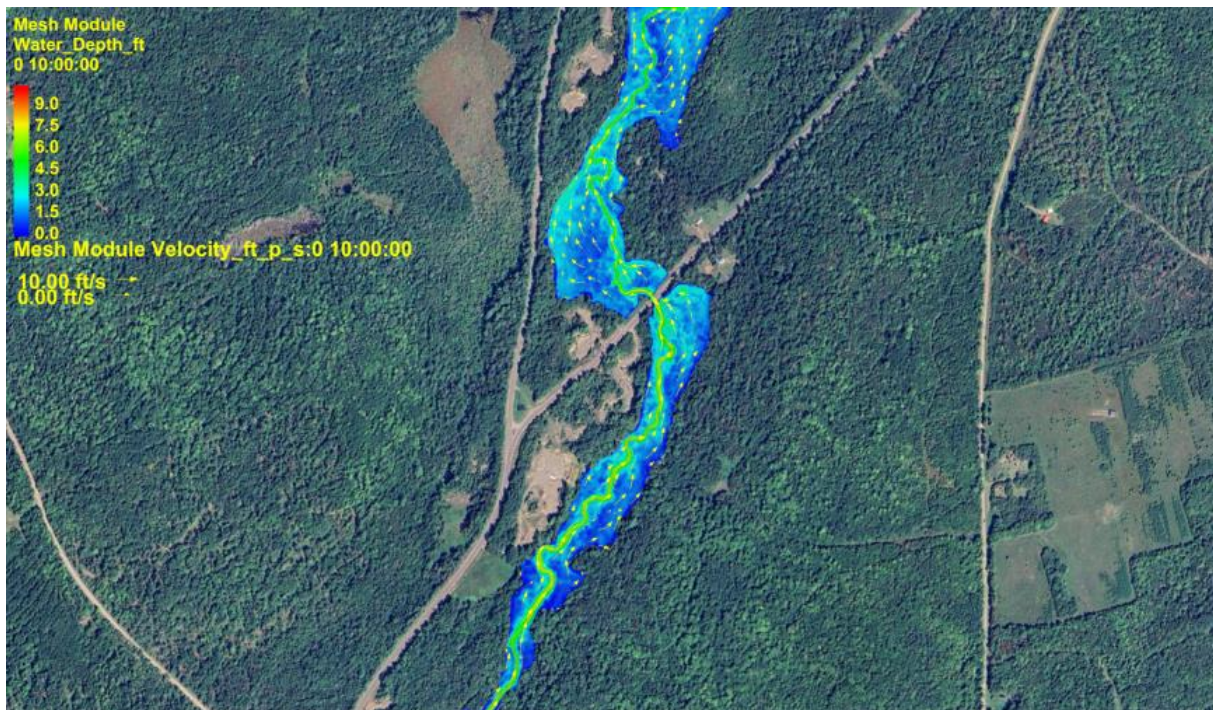


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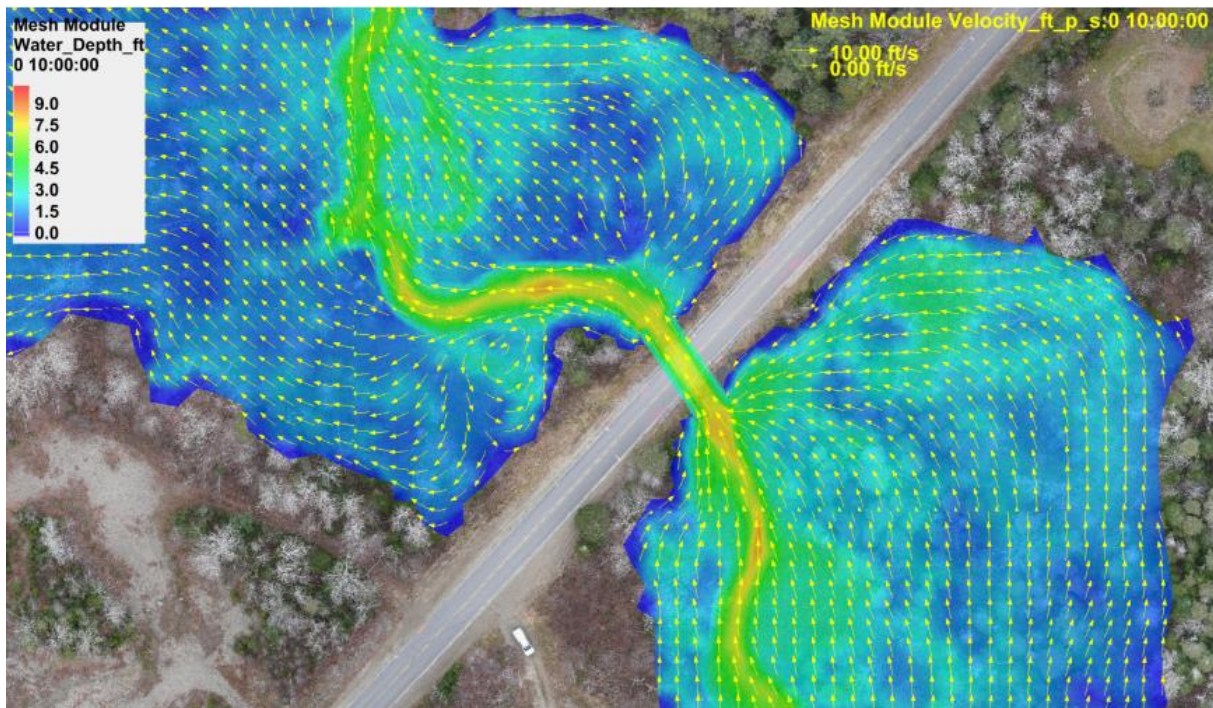


Bridge

Proposed 50-Year Flood Event Water Depths with Flow Vectors



Domain

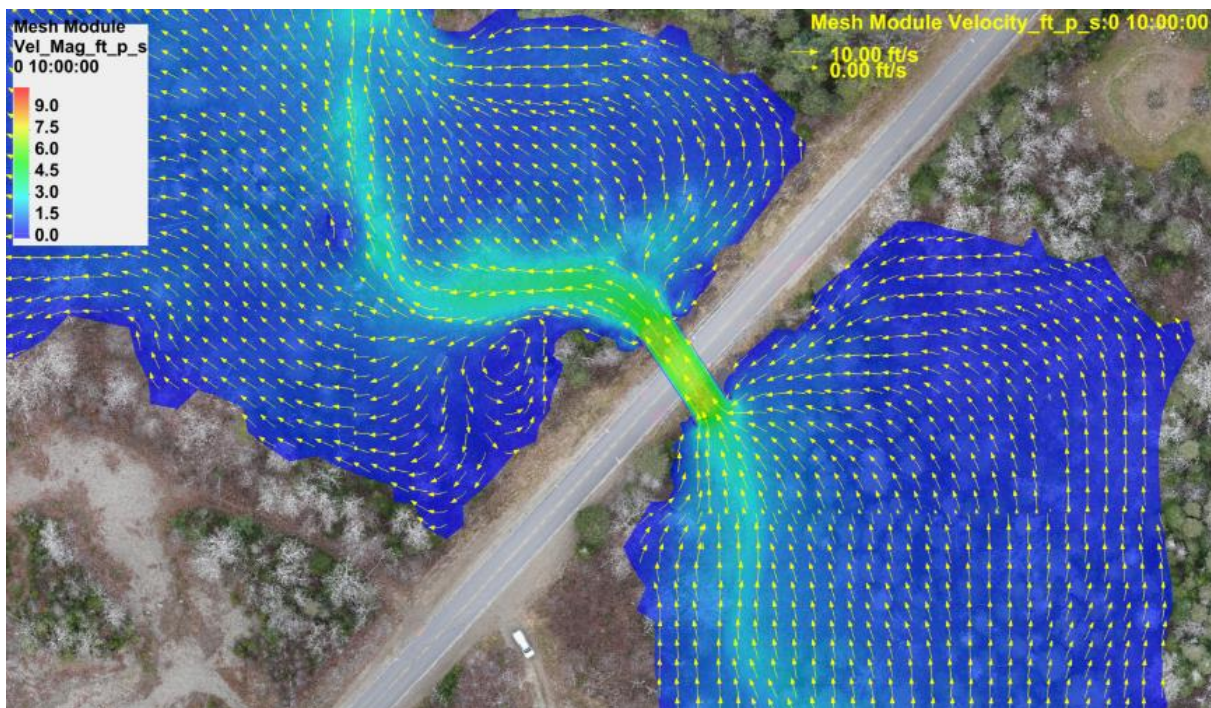


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Proposed 50-Year Flood Event Velocities with Flow Vectors

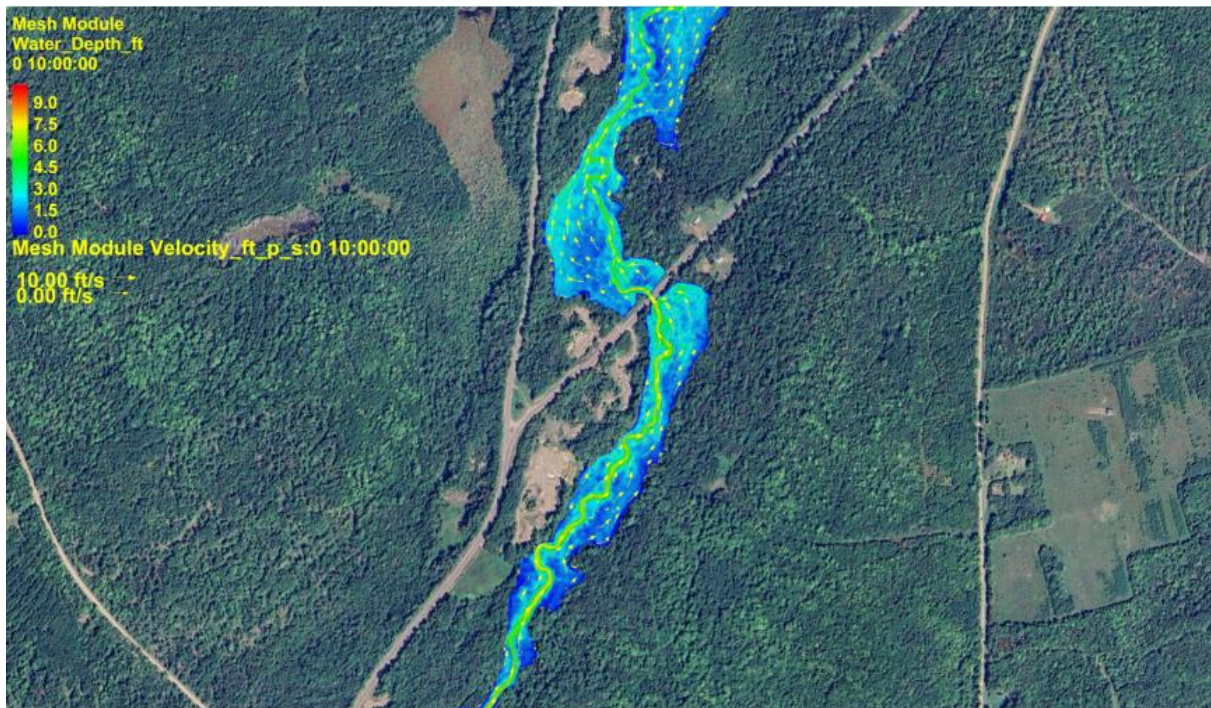


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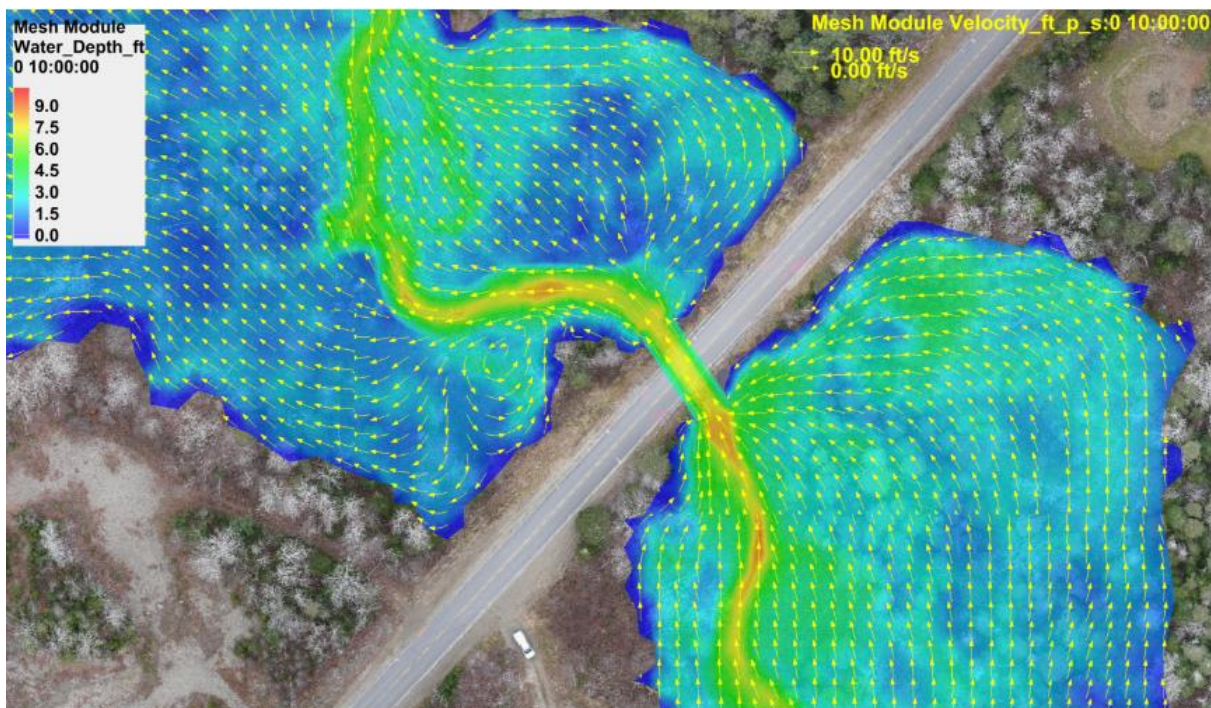


Bridge

Proposed 100-Year Flood Event Water Depths with Flow Vectors

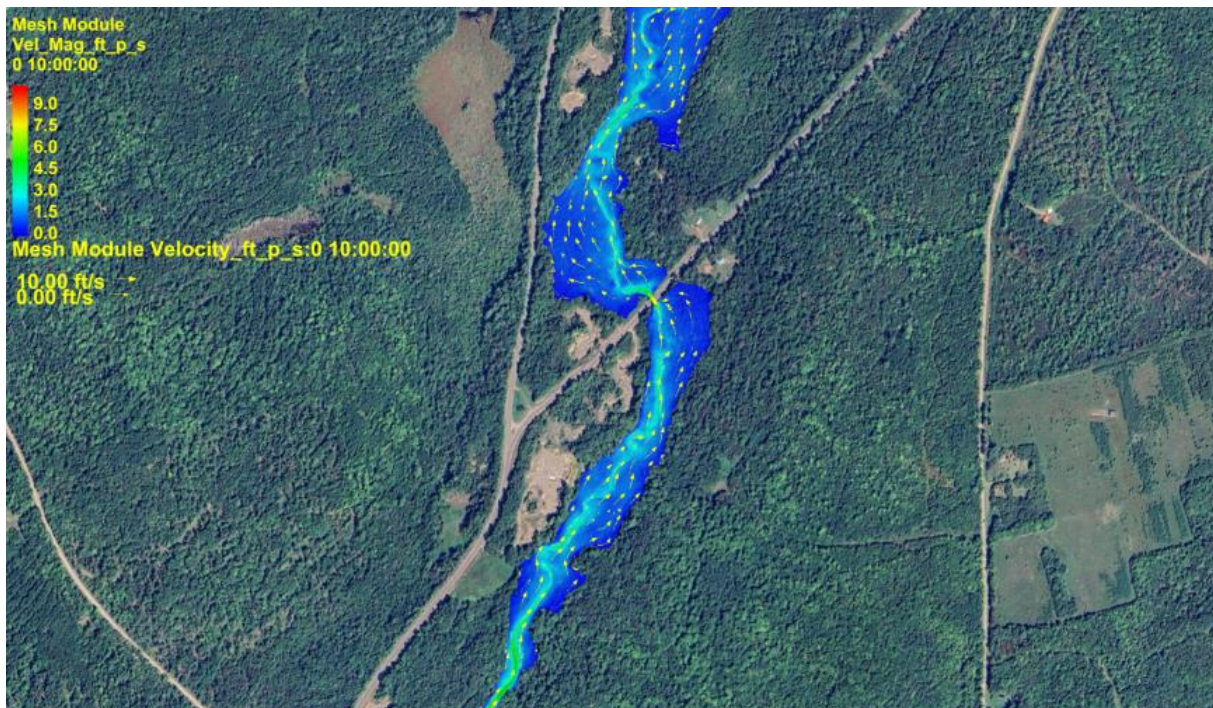


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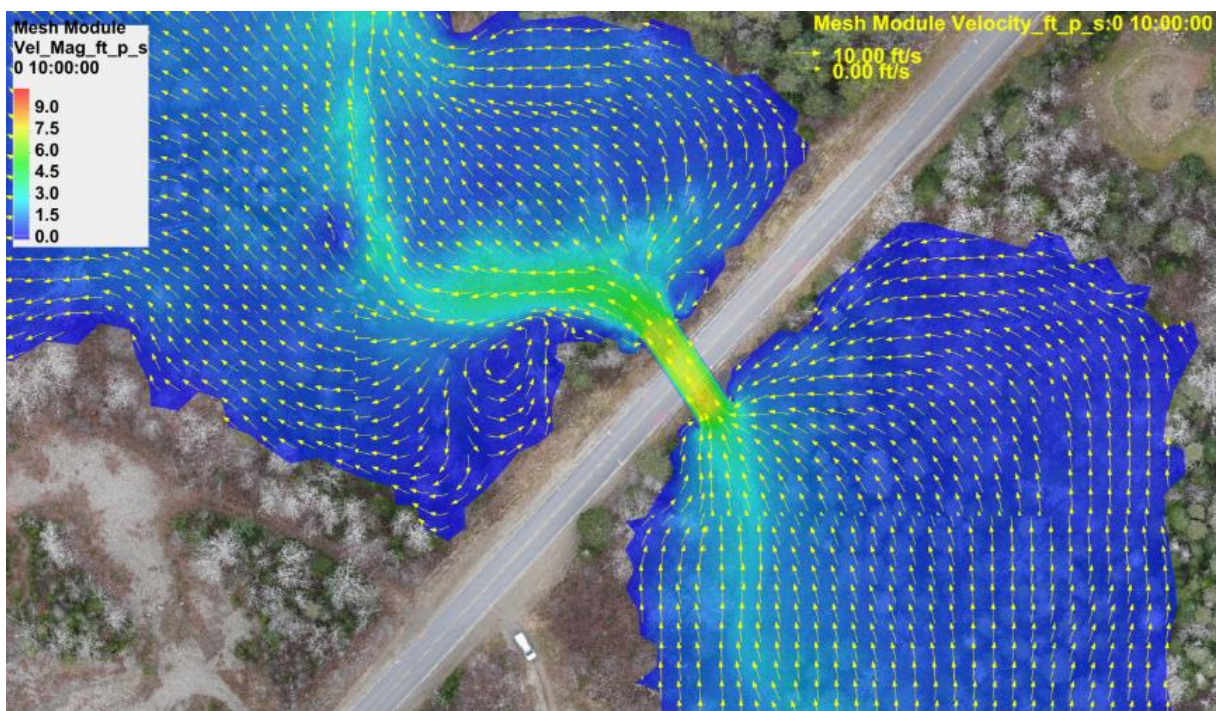


Bridge

Proposed 100-Year Flood Event Velocities with Flow Vectors

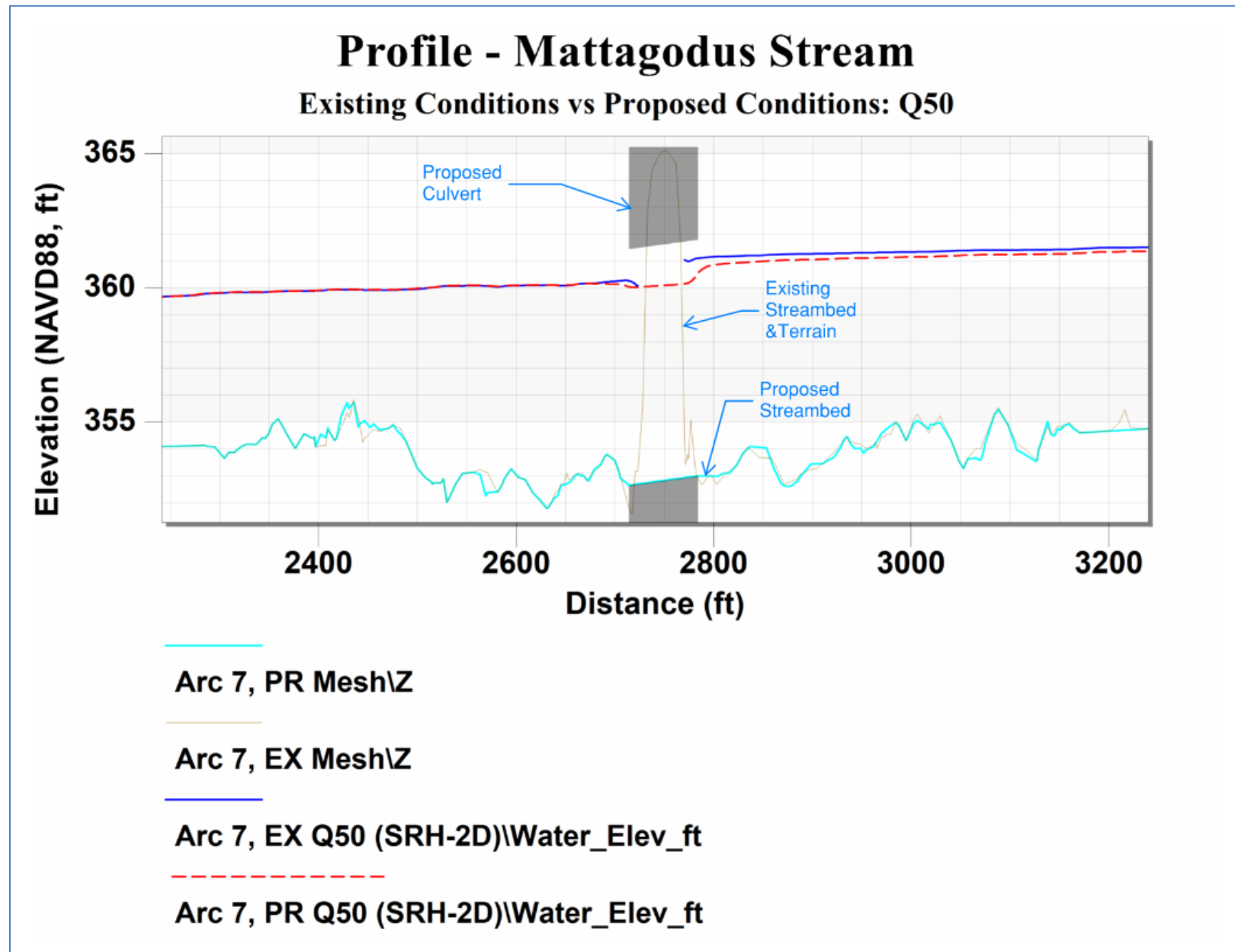


Domain



Bridge

Existing Conditions vs Proposed Conditions Water Surface Elevation Profiles



Existing Conditions vs Proposed Conditions Water Surface Elevation Profiles

