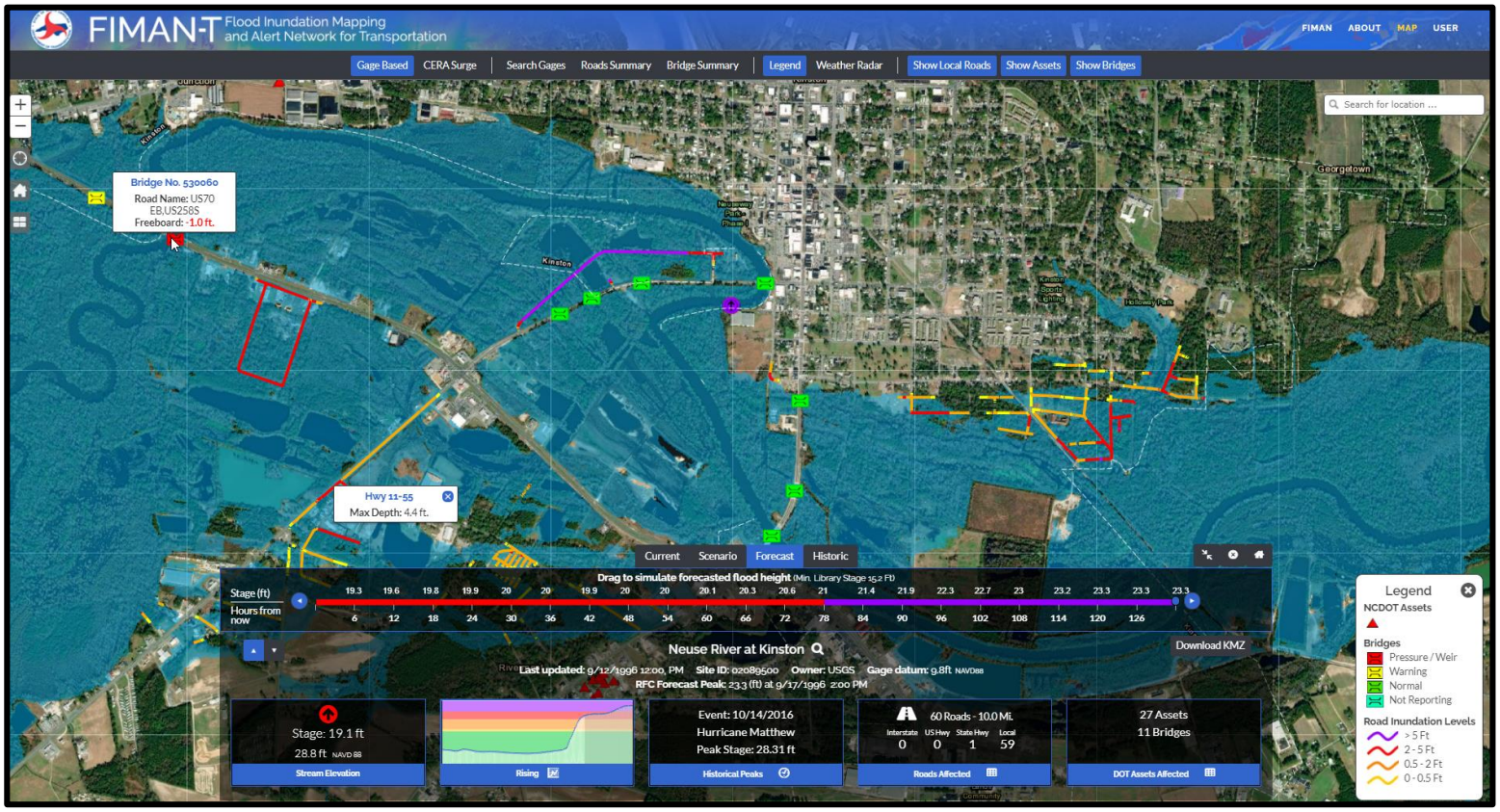
FIMAN-T: QUICK GUIDE

Flood Inundation Mapping and Alert Network for Transportation

North Carolina Department of Transportation



FIMAN-T

Version 3.0
November 2021

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Application Overview and Purpose:

One unique component of the North Carolina Floodplain Mapping Program (NCFMP) is the real-time flood warning system known as FIMAN (Flood Inundation Mapping and Alert Network). Beginning with the 2019 hurricane season, NCEM in conjunction with NCDOT are developing a companion site to FIMAN that will provide enhanced functionality to the current FIMAN system (referred to throughout as FIMAN-T). The primary objectives for FIMAN-T will be to provide additional visualization and metrics for roadway inundation, bridge hydraulic performance and identify potentially impacted NCDOT assets. In addition, the FIMAN-T Pilot project will expand (upstream and downstream) selected inundation libraries where possible to provide additional coverage inundation coverage beyond the current FIMAN system. The overarching goal of FIMAN-T is to become a valuable tool that enhances NCDOT's responsiveness during flooding events. The purpose of this document is to provide FIMAN-T Users with a reference for utilizing the features and functionalities within FIMAN-T.

This document will provide an overview of the basic functionality of FIMAN-T for users during the pilot roll out of the software during the 2019 Hurricane Season. User access to the FIMAN-T system is provided though the State of North Carolina authentication system NCID (https://ncid.nc.gov). Once provided authorization by a system administrator, users can access FIMAN-T from the main homepage by using their NCID username and password. For more support with the NCID system, users should contact NCID at https://ncid.nc.gov A screen shot of the login screen is shown below in Figure 1

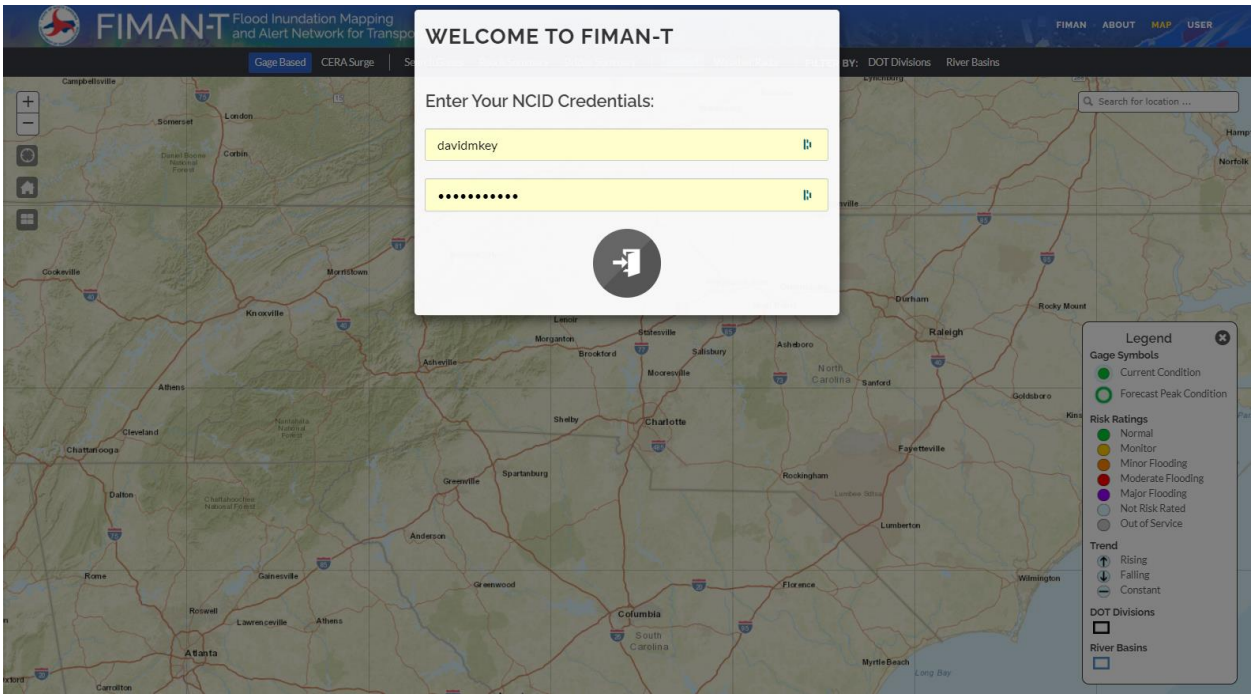


Figure 1: Log-in Page on FIMAN-T using the NCID Authentication.

Once users gain access to the FIMAN-T site, they are presented with a site disclaimer note.

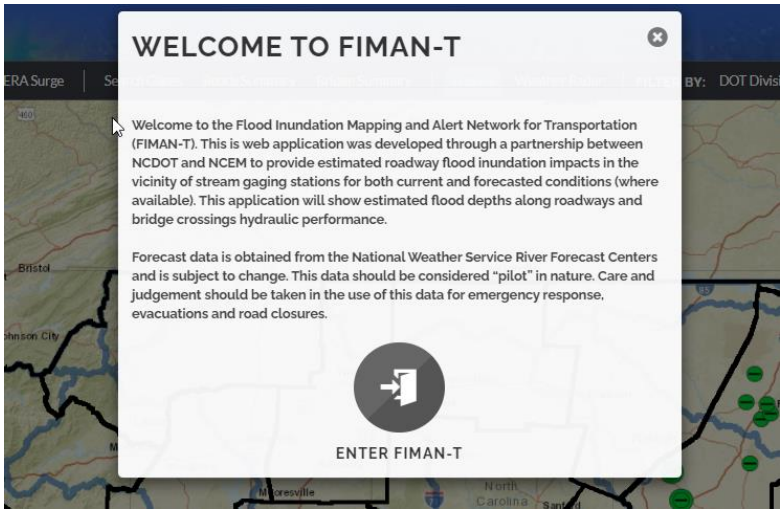


Figure 2: FIMAN-T Site Disclaimer Note.

FIMAN-T Home Page and Landing Map:

After accepting the FIMAN-T disclaimer, users will see the FIMAN-T Home Page and Landing Map. The landing map contains a map of the State of North Carolina and shows all sites in FIMAN-T with active real-time / forecast inundation mapping and asset impacts available. Available FIMAN-T sites are shown as circular symbols that are color coded based on the current and future flood impacts.

At any time, users can return to the FIMAN-T home page and landing map by clicking on the button in the upper left corner of the map. An example of the home page and landing map is shown in the figure below.

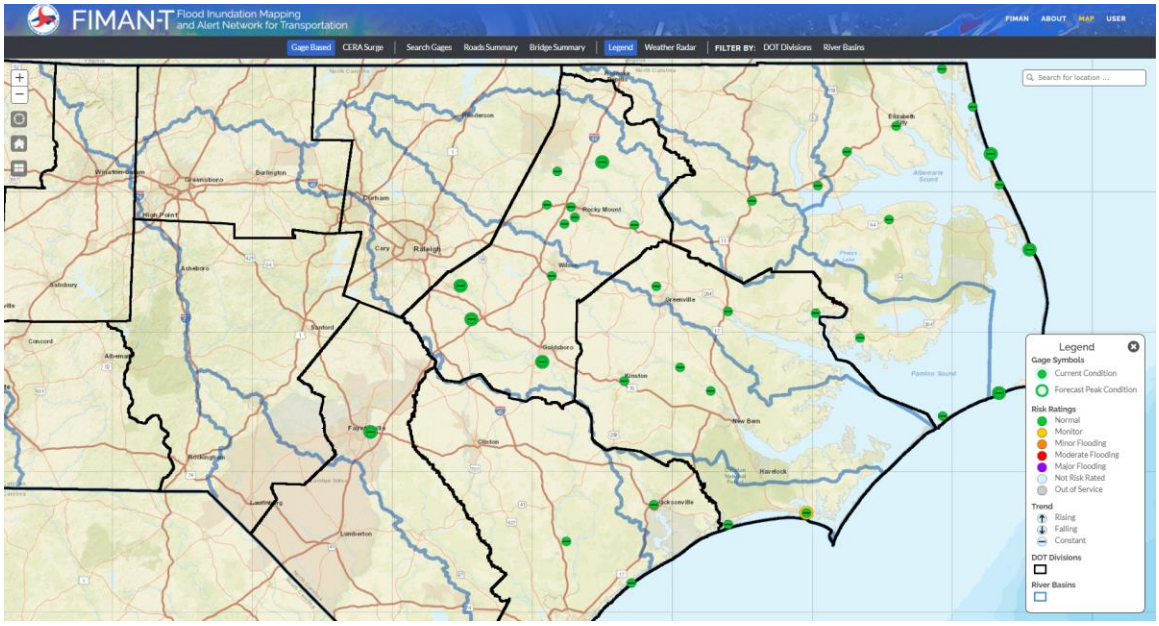


Figure 3: Example FIMAN-T Home Page and Landing Map.

Stream gages will be displayed on the map and rendered according to current and forecasted flood severity from "normal" to "major" flooding. The legend for the stream gages is shown in the figure below. Stream gages with an outer circular ring indicate that a forecast is currently available from the River Forecast Center. The color of the "outer ring" of these gages indicated the flood severity of the forecasted values (stage).

The home page and landing map follows typical online mapping navigation with zoom, "find me", return home and base map commands located in the upper left corner of the map. The default base map for FIMAN-T is the NCEM custom base map used in FIMAN. However, uses can select three other base map options including Imagery, ESRI Streets and Topographic (see below).

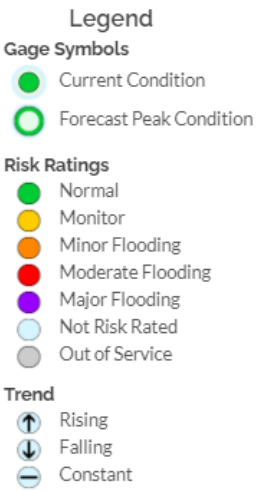


Figure 4: FIMAN-T Gage Legend

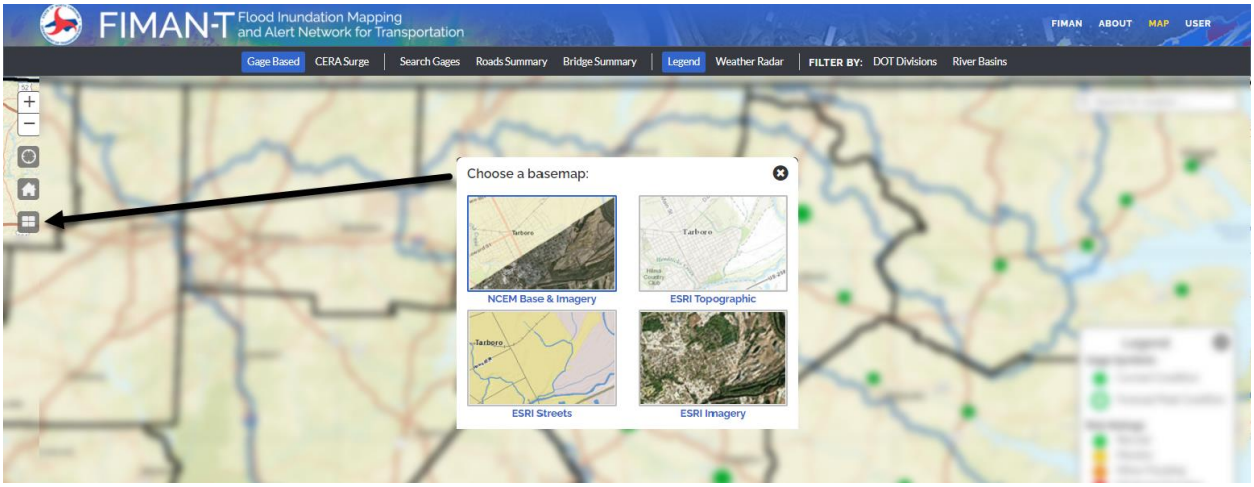


Figure 5: Base Map Selector - FIMAN-T Home Page and Landing Map

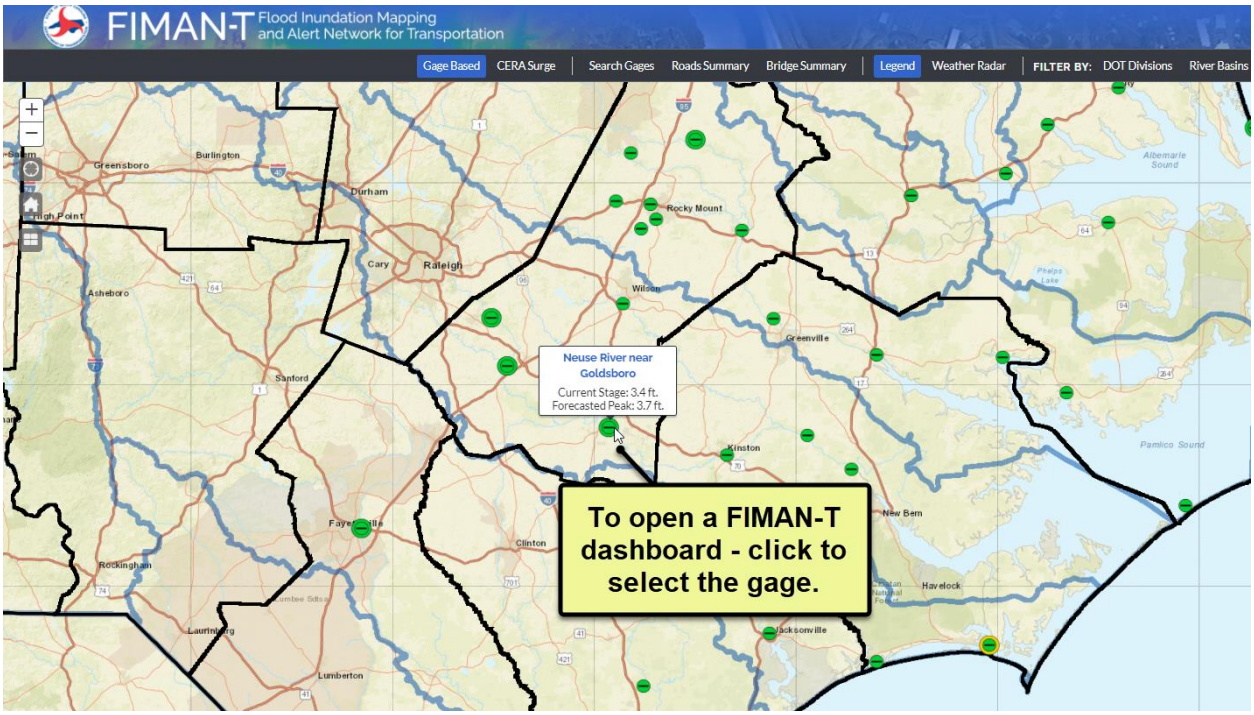
Additional Landing Map Controls

Other landing map controls include gage search tools, statewide impact reports, visibility toggles for legend and weather radar, map filters including river basins and NCDOT Divisions and address / location search widget. These controls are shown in the figure below.

Figure 6: Additional FIMAN-T Landing Map Controls

Interacting with FIMAN-T Gages and Viewing Inundation and Impacts

In FIMAN-T, the inundation and transportation asset impacts for each site can be viewed by activating the Dashboard for a selected site. Hovering over a gage will display the current stream stage reading and forecasted stage (in feet) if available. To activate a site (or gage) in FIMAN-T from the landing map, users will click on the gage.



Once the FIMAN-T gage has been selected, the system will zoom to the gage on the map and open the dashboard for the site. Depending on the data available for the gage (forecast, historical floods, etc.), the dashboards may appear different between various sites).

Inundation Display Options:

For each gage, FIMAN-T has a maximum of four possible options on the dashboard:

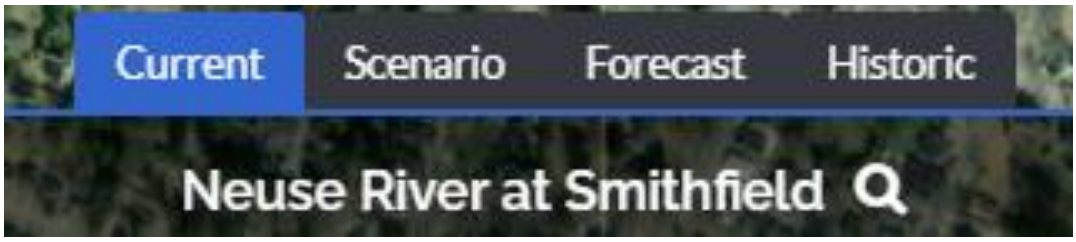


Figure 7: Tabs along the top of each dashboard control the map and other dashboard information.

Current: This view displays real-time river stage and associated inundation extents and impacts. The current dashboard tab is active by default when each site is selected. The active tab will be highlighted in a blue color as shown below. It should be noted that no inundation mapping or roadway impacts are displayed unless the river/gage has passed a minimum stage threshold indicating flooding.

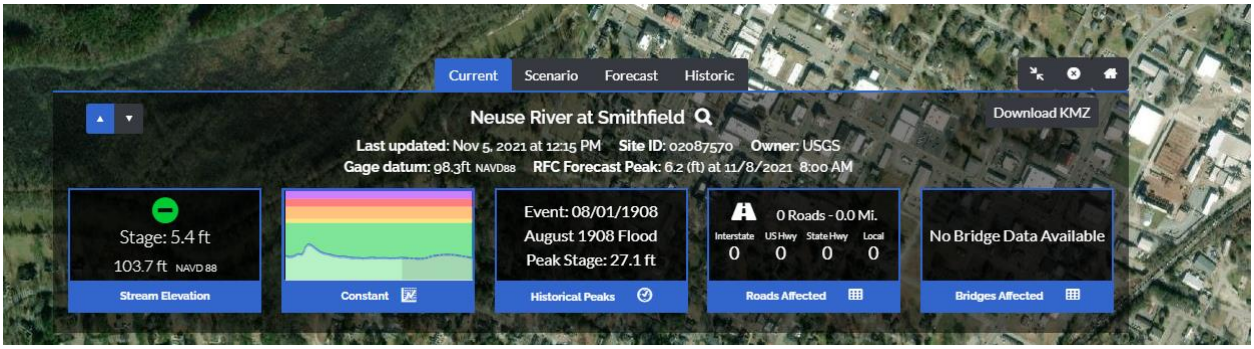


Figure 8: Current Conditions Dashboard Tab

Scenario: This dashboard tab is used to simulate potential impacts at various flood severities with the use of an interactive slider that advances in both stage and elevation, left to right. Color coding in the slider indicates the associated risk level coinciding with the legend from the "Stream Elevation" widget (discussed below). This functionality can be used for planning at any time, regardless of current river stage. Note that in addition to displaying the inundation and affected roads in the map view, the "Roads Affected" and "DOT Bridges" widgets and tables will interactively update based on the selected scenario.

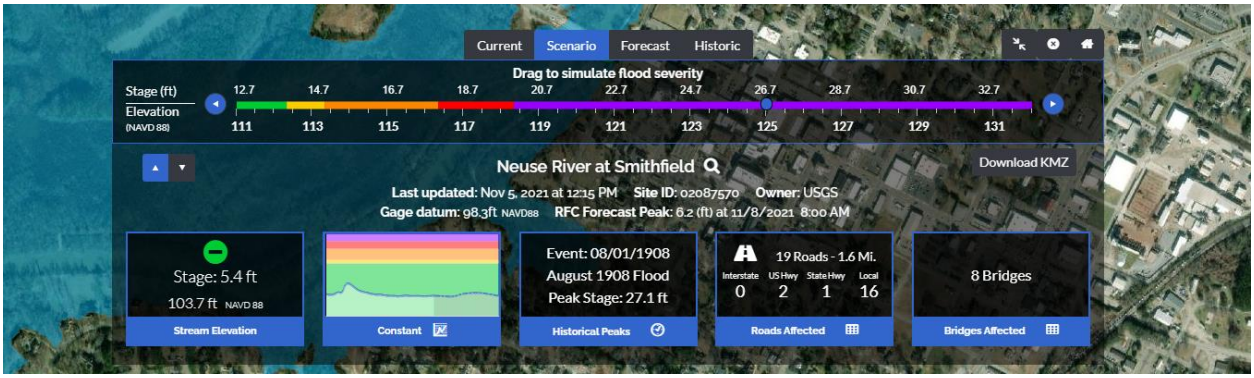


Figure 9: Scenario Dashboard Tab and Interactive Slider

Forecast: This dashboard tab is used to visualize forecasted flood inundation and transportation impacts. Using the NWS forecasted hydrograph, potential inundation and impacts are shown, along with timing, with the use of an interactive slider that advances in time, left to right. Color coding in the slider indicates the associated risk level coinciding with the legend from the "Stream Elevation" widget (discussed below). Note that in addition to displaying the inundation and affected roads in the map view, the "Roads Affected" and "Bridges Affected" widgets and tables will interactively update based on the selected forecast time.

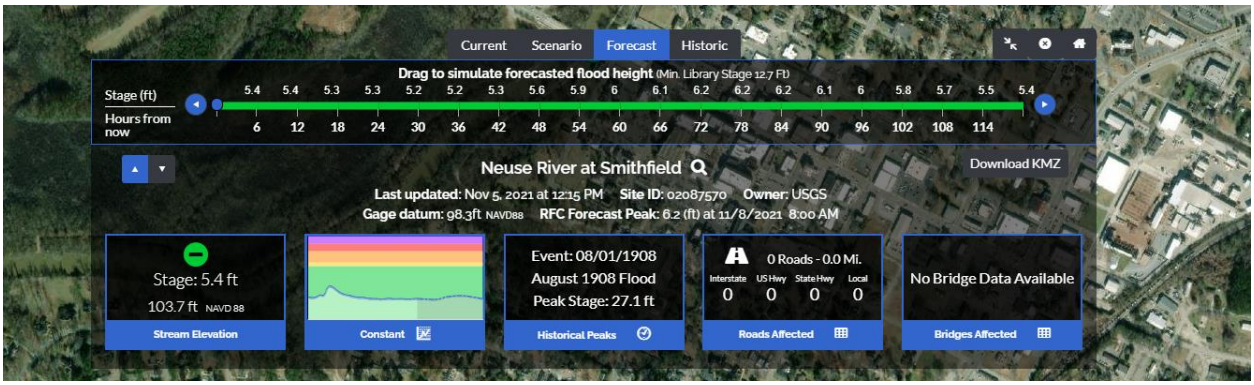


Figure 10: Forecast Dashboard Tab and Interactive Slider Bar

Historic: When data is available. The Historic tab is used to view historic flood inundation and impacts using data obtained from the USGS, NWS, and other various sources, the map displays flood inundation and impacts for select historic events (e.g., Hurricane Florence). The user can toggle between past flood events by selected the past event in the Historic Flood Summary Table (see figure below) to visualize the impact to the area of interest and have access to details such as stage and elevation. Note that in addition to displaying the inundation and affected roads in the map view, the "Roads Affected" and "DOT Bridges" widgets and tables will update based on the selected historic event.

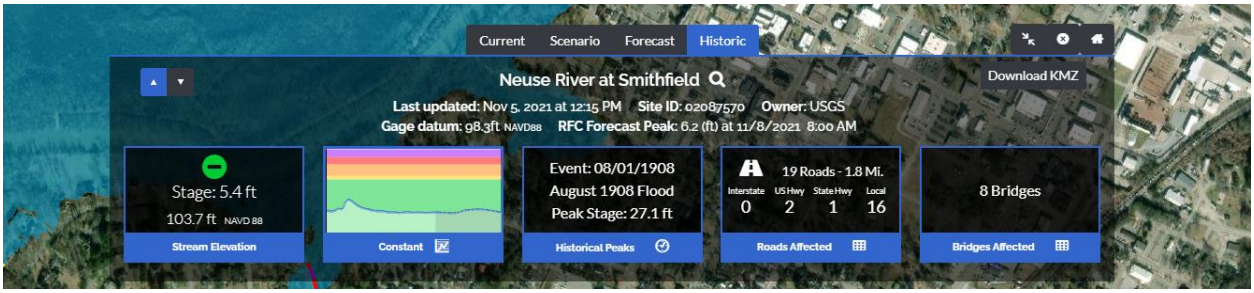


Figure 11: Historic Flood Dashboard Tab

It should be noted that not all sites will have historic flood information. If information exists and is loaded into the FIMAN-T database, the "Historic" tab will be visible. If information is not available, the "Historic" tab will not be visible.

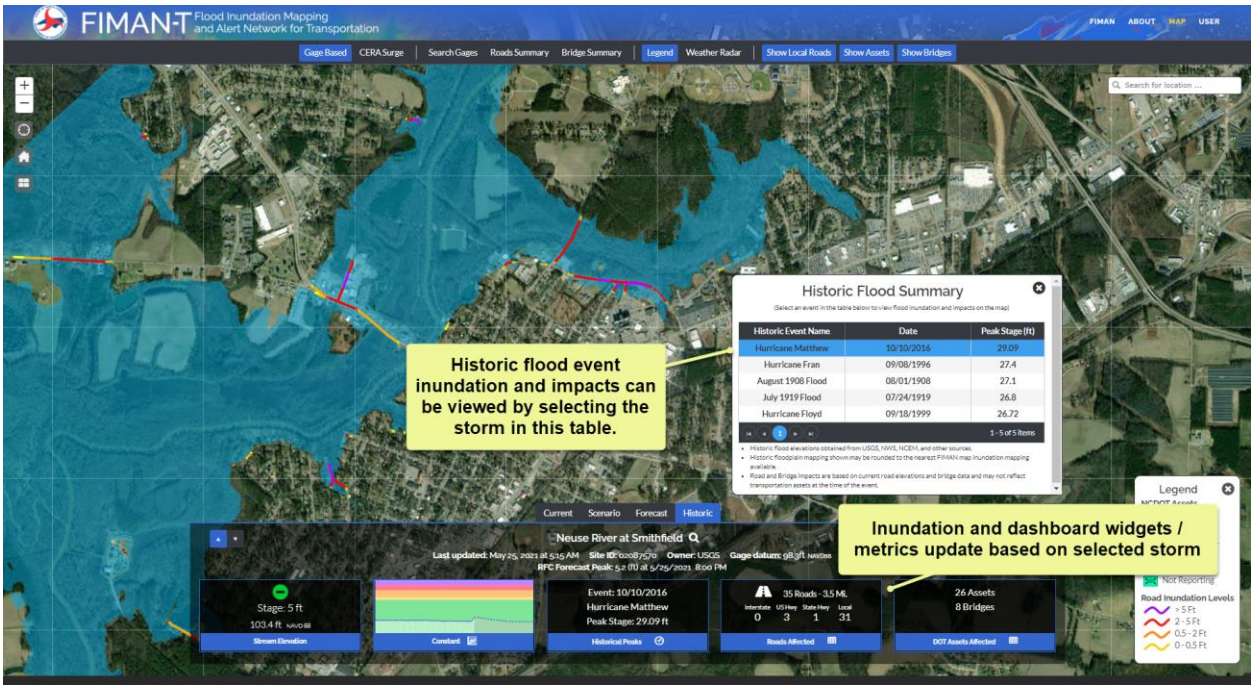


Figure 12: Interactively view past storm inundation and impacts in FIMAN-T.

Dashboard and Widgets:

FIMAN-T functionality closely follows the user functionality in the current production version of FIMAN. Users are initially presented a map of stream gages color coded by both current and future conditions (as available) risk rating (normal, monitor, minor, major, etc). Users then click on a stream gage to bring up the current conditions flood inundation mapping and interactive dashboard for that site.

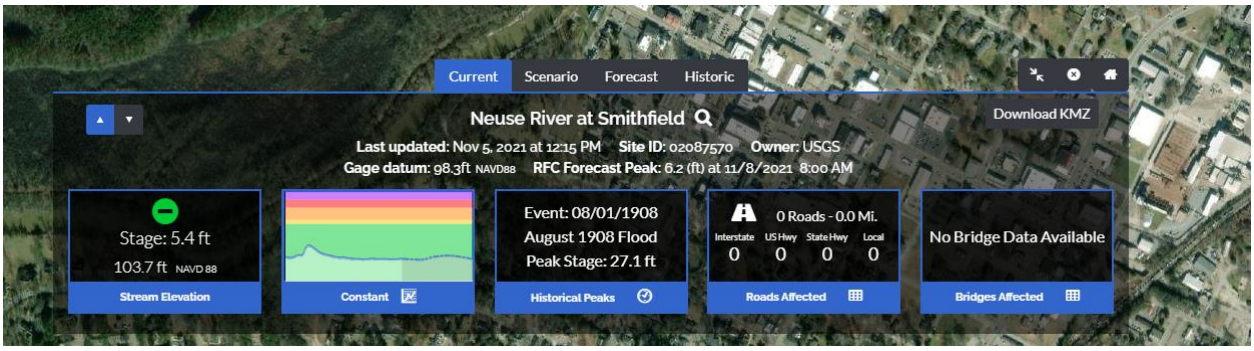


Figure 13: FIMAN-T Dashboard and Widgets

The dashboard has interactive "info-widgets" that, when clicked on, display additional information for the user. An example of this is shown below in the interactive stage hydrograph (Figure 14).

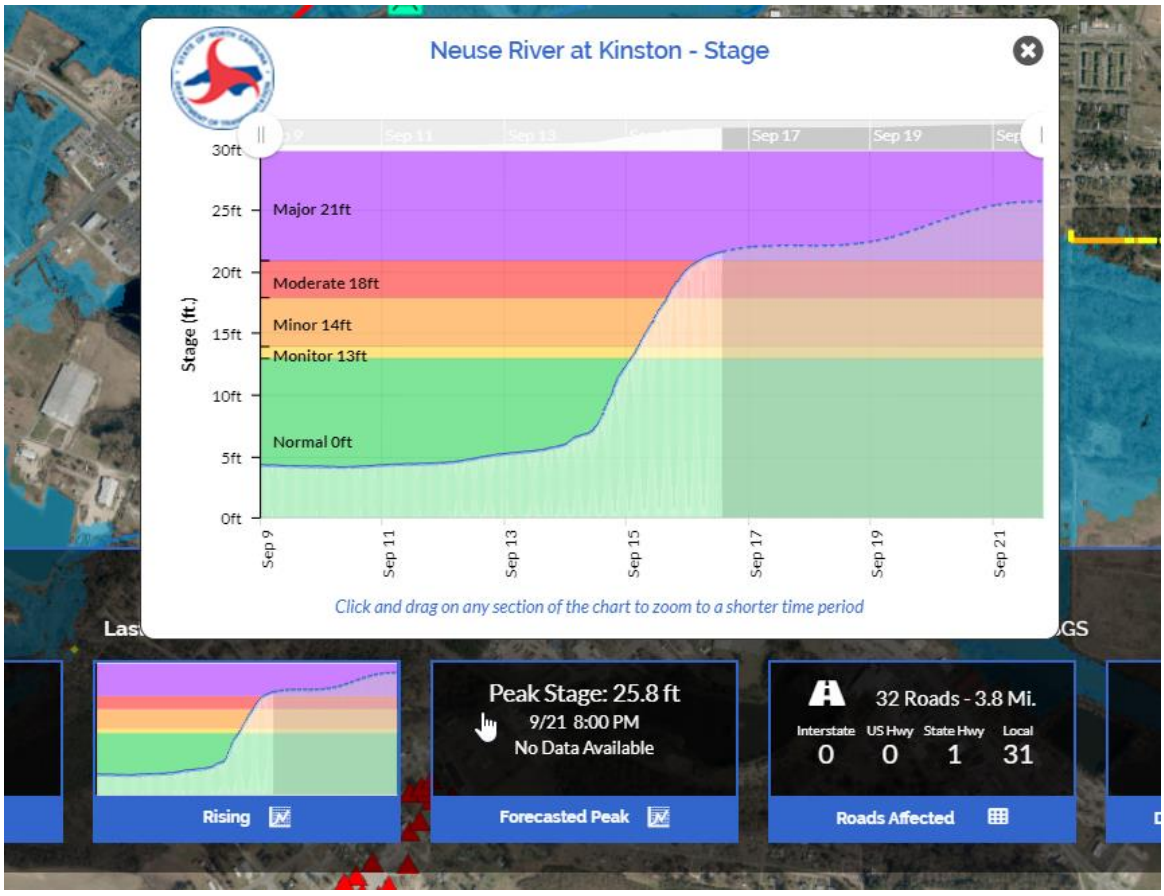


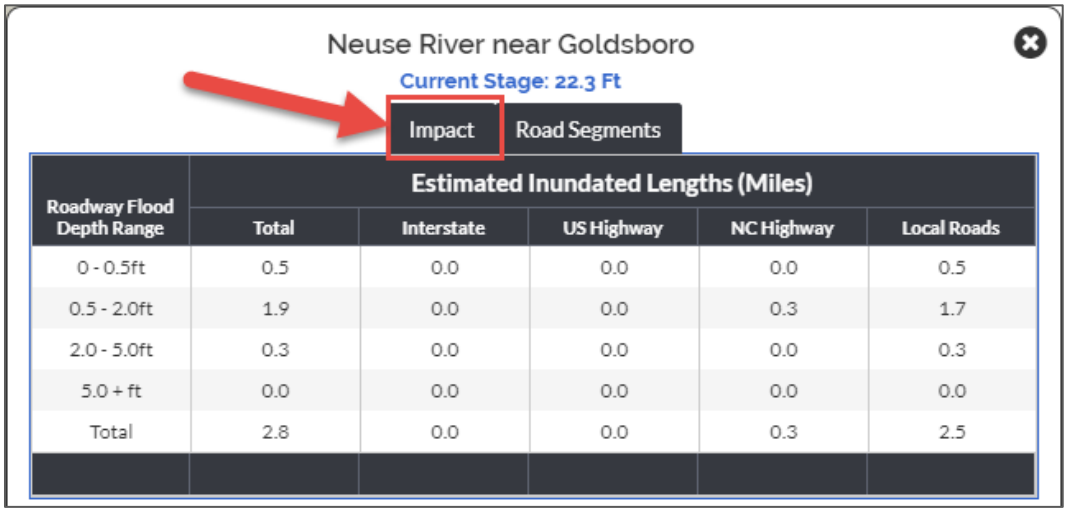
Figure 14: FIMAN-T Interactive Gage Stage Information Widget

Stream Elevation: This information widget displays current stage and elevation. Clicking on this widget brings up a legend that defines the risk rating levels for that gage.

Gage Information (will show "Rising", "Constant" or "Falling" based on Trend: This information widget displays the gage reading and indicates if the river is rising or falling. Clicking on this widget brings up a stage hydrograph with an interactive scrolling feature. If forecasting is available for the gage, that information is provided in the greyed-out portion of the chart to the right.

Forecasted Peak: This information widget is only available if forecasting information from the National Weather Service is available at the selected gage. This widget displays current projected peak stage anticipated at the gage. Clicking on this widget brings up a stage hydrograph with an interactive scrolling feature.

Roads Affected (FIMAN-T Specific): This is a new info widget developed specifically for FIMAN-T. This widget will display two tables. The tables are displayed by selected either the "Impact" or "Road Segments" tab. The "Impact" tab will show a summary of all impacted roads within the inundation extent of the selected gage. This table includes a summary of inundated lengths of roadways broken down by classification (Local, NC Highway, US Highway, Interstate) and range of flooding. An example of the "Impact" table is shown below in Figure 15.



Roadway Flood Depth Range	Estimated Inundated Lengths (Miles)				
	Total	Interstate	US Highway	NC Highway	Local Roads
0 - 0.5ft	0.5	0.0	0.0	0.0	0.5
0.5 - 2.0ft	1.9	0.0	0.0	0.3	1.7
2.0 - 5.0ft	0.3	0.0	0.0	0.0	0.3
5.0 + ft	0.0	0.0	0.0	0.0	0.0
Total	2.8	0.0	0.0	0.3	2.5

Figure 15: Road Impacts Table

Additionally, the "Road Segments" tab in this info widget will display another interactive table for FIMAN-T users. The road segments table will show a sortable and filterable table showing all impacted roadway segments in the respective gage's inundation area. Users can also use the magnifying glass to zoom to the particular road segment of interest. The "Road Segments" tab also contains exports for Excel and KMZ files. Note that this widget provides road information based on the currently displayed inundation level. Using "Scenario" or "Forecast" modes (as described above) will allow the user to see possible road impacts beyond "Current" conditions.

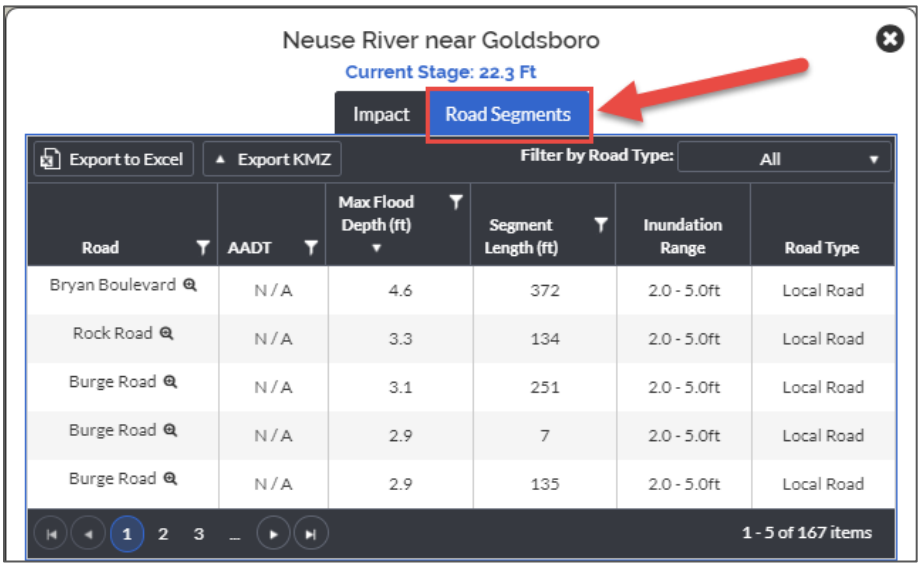


Figure 16: Inundated Road Segments Table

Bridges Affected: This information widget displays the number of affected mainstem bridges within the gage inundation area. Clicking on this widget allows the user to display the **Bridges** table. This contains sortable (by clicking column header) attributes including freeboard (to low chord elevation), relative to the currently displayed flood stage. Zoom to functionality is also enabled for all bridges using the magnifying glass. An example of the "Bridges" Table is shown in Figure 17. The popup also contains an Export to Excel function. It should be noted the tables in FIMAN-T include representative values for bridge elevations (roadway and low chord). Discrepancies may exist due to roadway grades, super-elevation, and other on-site conditions. In addition, flood water surface elevation values reported in the table represents a computed water surface elevation based on scenario HEC-RAS models and represent upstream computed elevations. Elevations may vary from actual flooding conditions due to local variability, debris or other un-modeled conditions. All values should be used for informational purposes only.

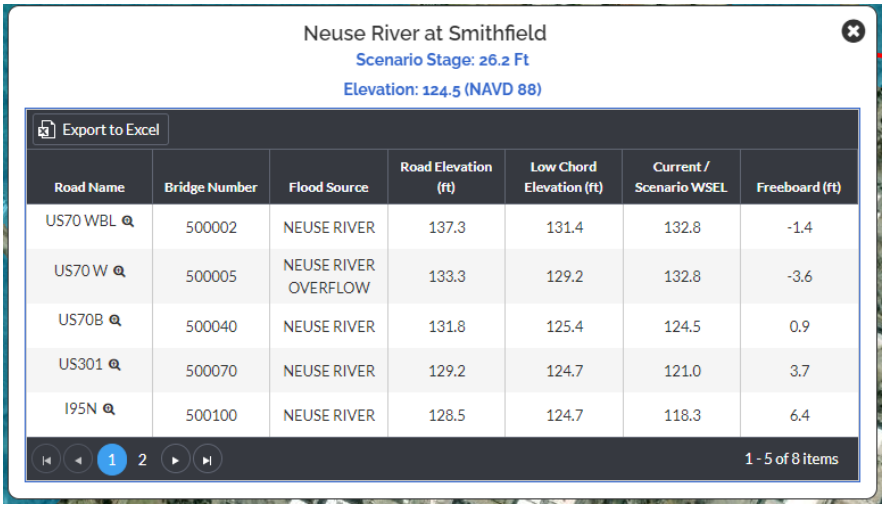


Figure 17: Bridge Impacts Table

Impacted Roads and Bridge Display and Rendering

Roads and Bridges and Assets are displayed by default on the user interface for selected gages. Impacted road segments and bridge hydraulic performance is shown and rendered color coded symbology (see figure below). The Bridge icons are color coded indicating the estimated freeboard for both current and forecasted conditions. Based on the difference between the low chord elevation and the current flood level, the icon will be a specific color noted in the legend below. If the freeboard is more than 1.0 ft, the icon will remain green; if the freeboard less than 1.0 ft, then the symbol will display as yellow, once the freeboard is negative (water above low chord) the bridge symbol will display red. This color rendering applies for all inundation and impact views (Current, Scenario, Forecast and Historic).

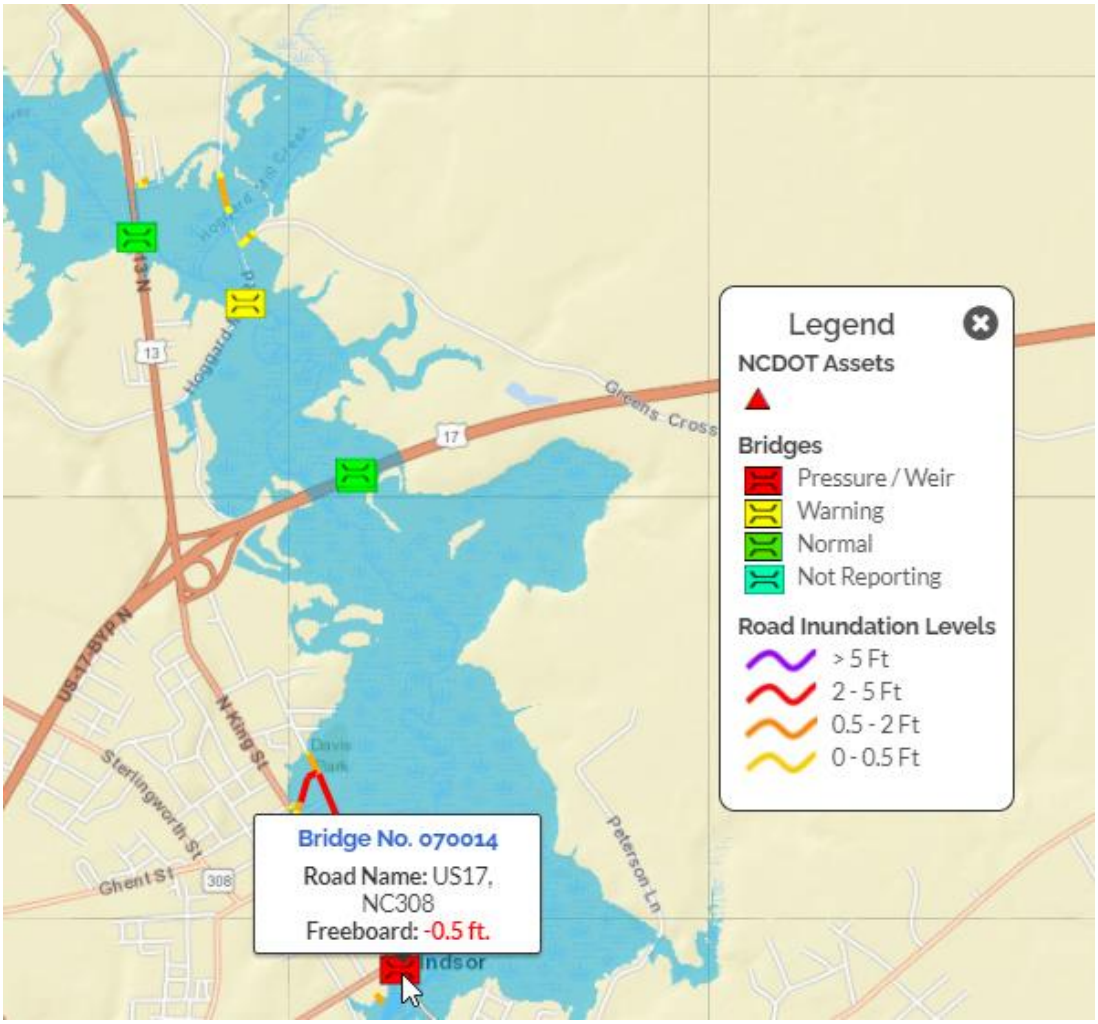


Figure 18: Roads and Bridges are color rendered in FIMAN-T.

- Clicking on a road segment will display Road Name and Maximum Depth along that segment.
- Hovering over a bridge will display the bridge number, road name, and current freeboard. Negative freeboard values are indicated in red font (ex -1.1).
- Hovering over an asset will display the name of the DOT asset.

Exporting Data:

Google Earth KMZ Exports: All four inundation display options (current, scenario, forecast, historic) can be exported as a KMZ file and downloaded into Google Earth. The google earth file maps the corresponding inundation extents directly from the FIMAN-T site. With grouped layers of flood inundation and flooded roadways, the user can interact with the data in google earth as described in the figure below. Adjust the layer transparency of the flood inundation overlay to view the mapped areas of interest with the associated impacts still visible. Flooded roads layers can be toggled on and off as well.

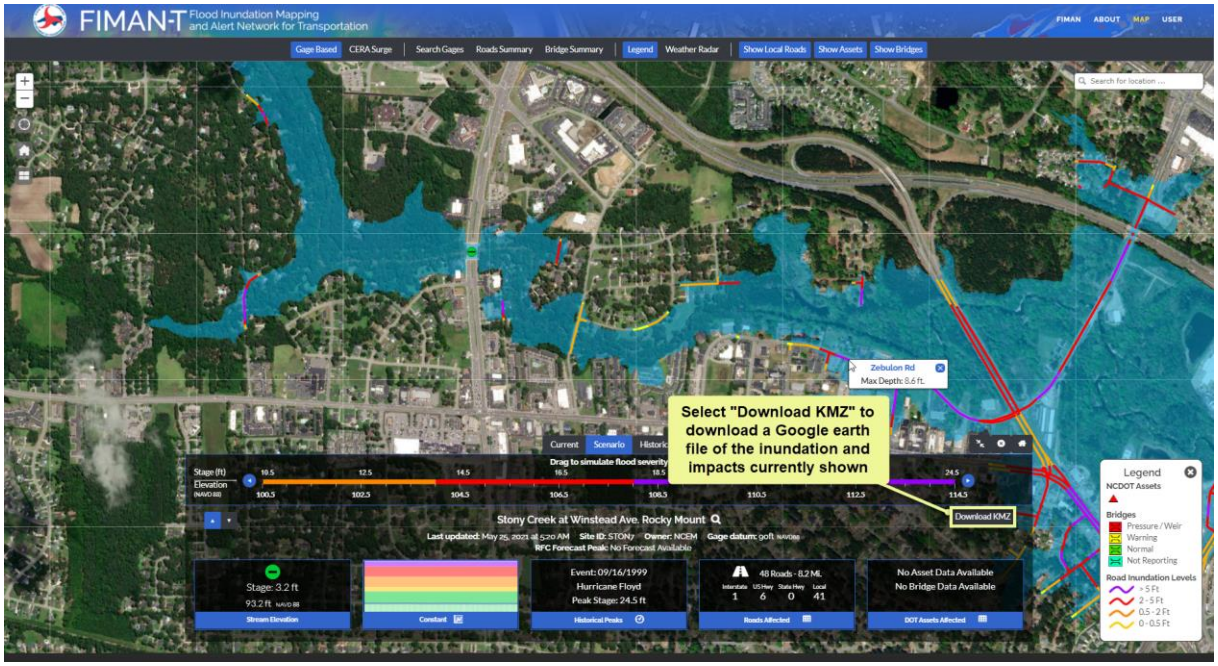


Figure 19: Google Earth (kmz) files can be downloaded for all displayed flood levels.

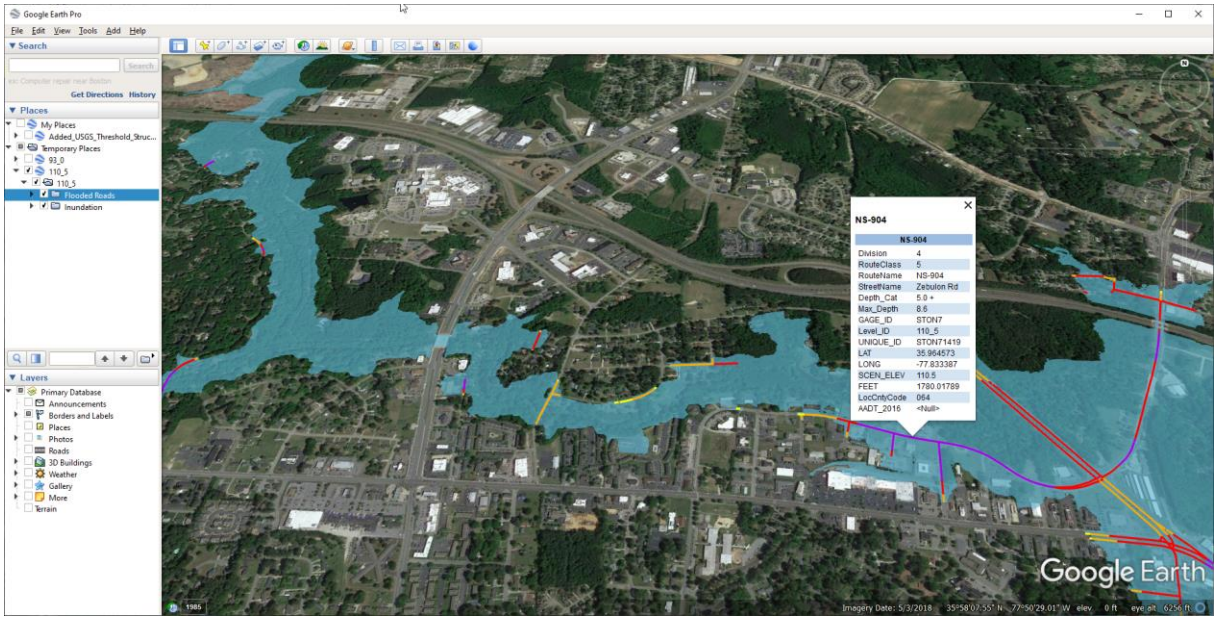


Figure 20: FIMAN-T Inundation and Impacts visualized in Google Earth (Stony Creek, Rocky Mount).

Microsoft Excel Exports: Data from the Road Segments table in FIMAN-T can also be exported to Microsoft Excel for processing and reporting outside of FIMAN-T. The "Road Segments" tab includes an "Export to Excel" function that will export the currently displayed roadway segment data and open in an Excel file (see the figure below).

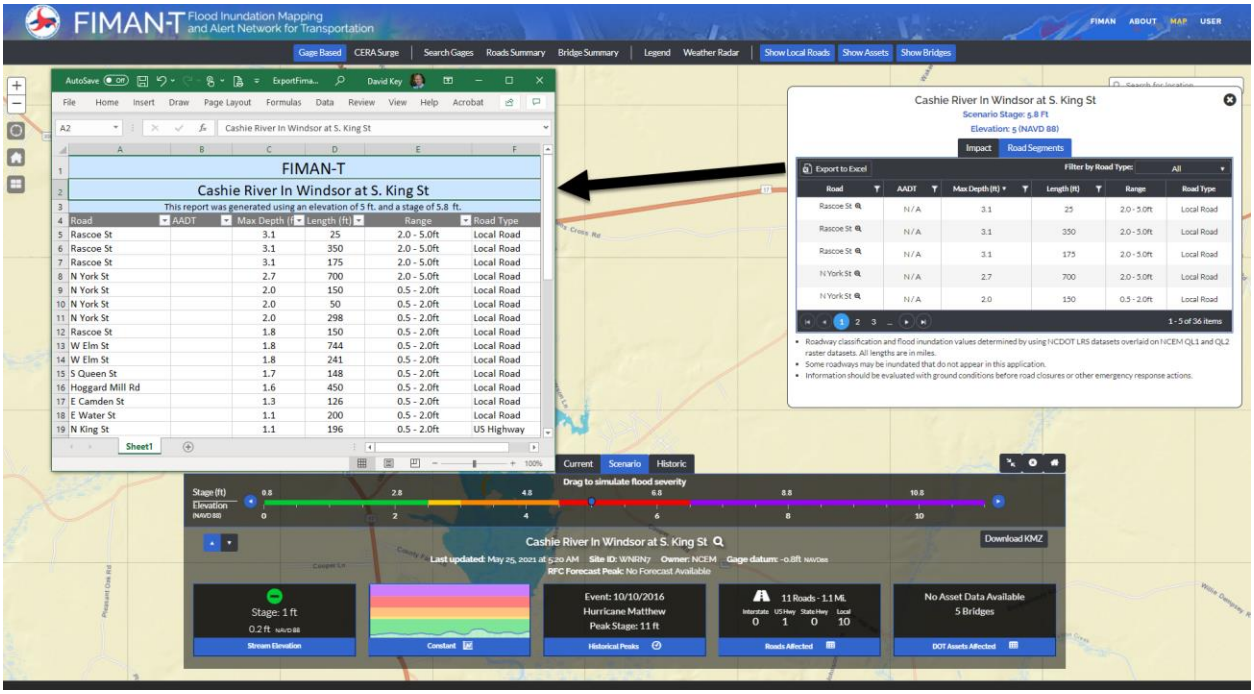
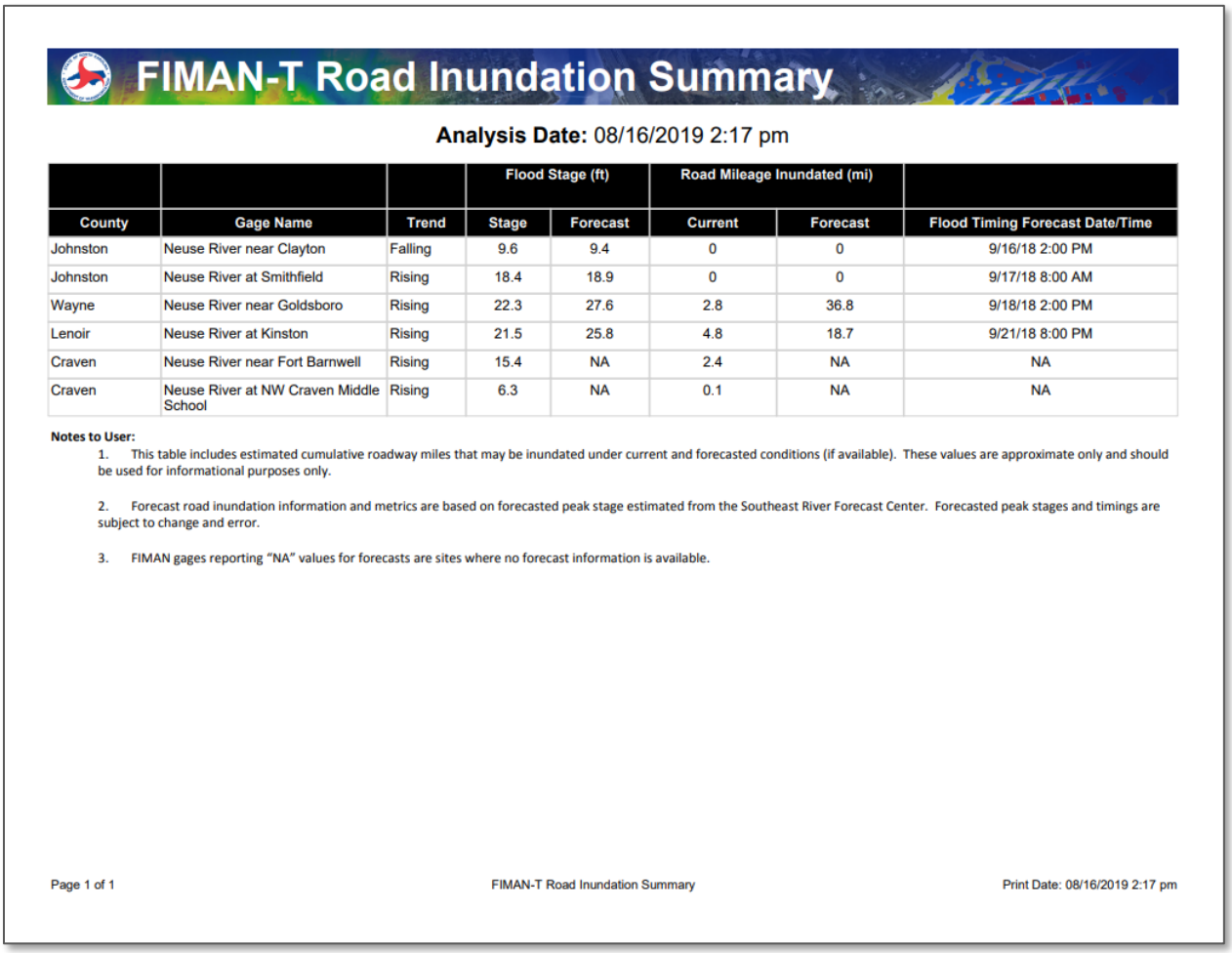


Figure 21: FIMAN-T Export to Excel Utilities

Reporting:

FIMAN-T provides two new summary level, systemwide reports for NCDOT and NCEM stakeholders. The following is a description of each report.

Roads Summary: Generates a summarized report by gage (pdf or Microsoft Excel format) quantifying the length of impacted roads for both current and forecasted (if available) peak.



FIMAN-T Road Inundation Summary

Analysis Date: 08/16/2019 2:17 pm

			Flood Stage (ft)		Road Mileage Inundated (mi)		
County	Gage Name	Trend	Stage	Forecast	Current	Forecast	Flood Timing Forecast Date/Time
Johnston	Neuse River near Clayton	Falling	9.6	9.4	0	0	9/16/18 2:00 PM
Johnston	Neuse River at Smithfield	Rising	18.4	18.9	0	0	9/17/18 8:00 AM
Wayne	Neuse River near Goldsboro	Rising	22.3	27.6	2.8	36.8	9/18/18 2:00 PM
Lenoir	Neuse River at Kinston	Rising	21.5	25.8	4.8	18.7	9/21/18 8:00 PM
Craven	Neuse River near Fort Barnwell	Rising	15.4	NA	2.4	NA	NA
Craven	Neuse River at NW Craven Middle School	Rising	6.3	NA	0.1	NA	NA

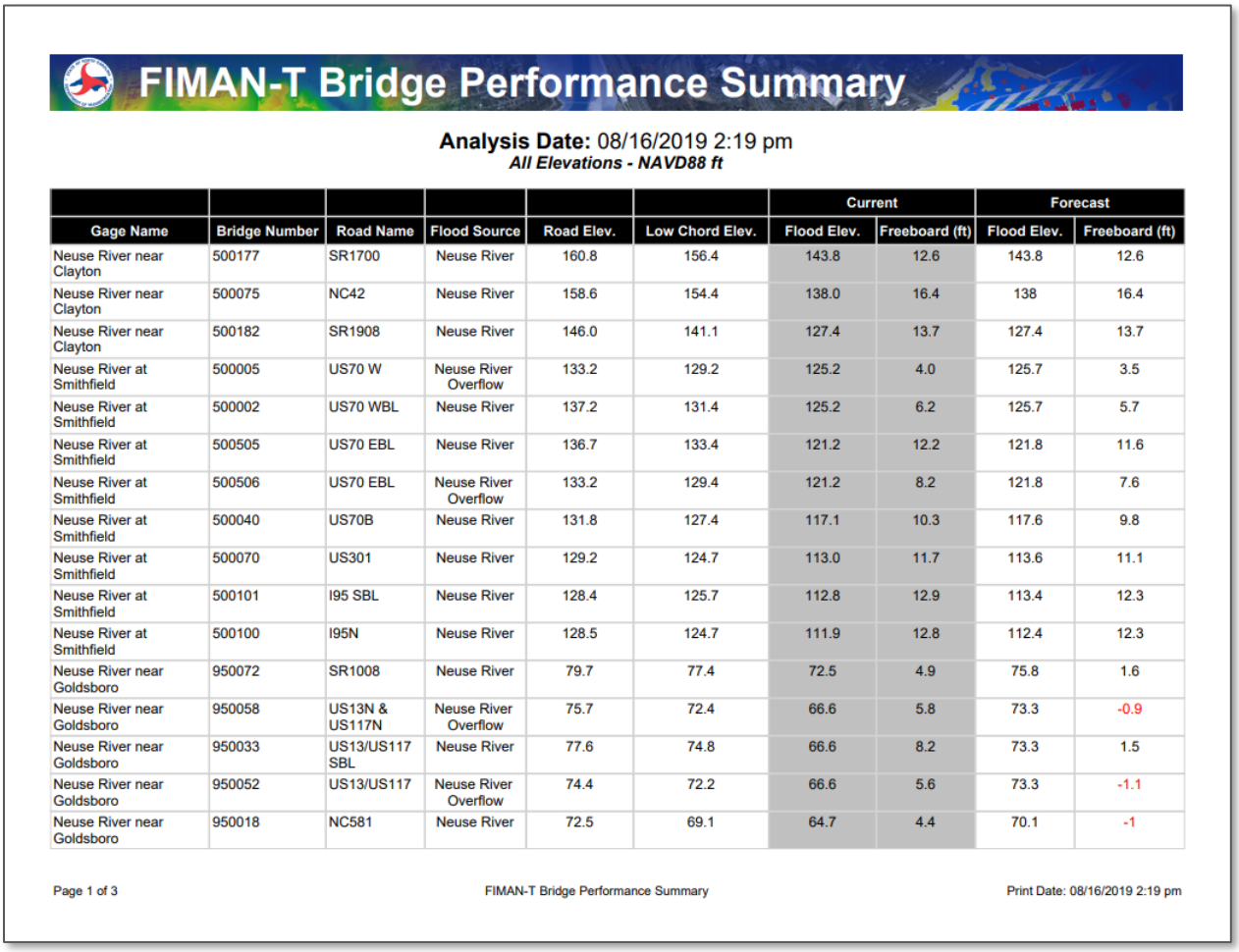
Notes to User:

1. This table includes estimated cumulative roadway miles that may be inundated under current and forecasted conditions (if available). These values are approximate only and should be used for informational purposes only.
2. Forecast road inundation information and metrics are based on forecasted peak stage estimated from the Southeast River Forecast Center. Forecasted peak stages and timings are subject to change and error.
3. FIMAN gages reporting "NA" values for forecasts are sites where no forecast information is available.

Page 1 of 1 FIMAN-T Road Inundation Summary Print Date: 08/16/2019 2:17 pm

Figure 22: Example of FIMAN-T Road Inundation Summary Report

Bridge Summary: Generates a report (pdf or Microsoft Excel format) on mainstem bridges within the gage inundation library area for both current and forecasted (if available) peaks conditions. This report shows the estimated representative roadway and low chord elevation at each bridge. In addition, based on the FIMAN inundation library modeling and mapping, the report will estimate the current and forecasted (if available) flood elevations on the upstream side of each bridge. The estimated freeboard for both current and forecasted conditions is computed based on the difference between the low chord elevation and the current flood level. Negative freeboard (ft) is indicated in a red font (-1.1) and indicates that the low chord of the bridge may be inundated (in current conditions or at the forecasted peak).



FIMAN-T Bridge Performance Summary

Analysis Date: 08/16/2019 2:19 pm
All Elevations - NAVD88 ft

						Current		Forecast	
Gage Name	Bridge Number	Road Name	Flood Source	Road Elev.	Low Chord Elev.	Flood Elev.	Freeboard (ft)	Flood Elev.	Freeboard (ft)
Neuse River near Clayton	500177	SR1700	Neuse River	160.8	156.4	143.8	12.6	143.8	12.6
Neuse River near Clayton	500075	NC42	Neuse River	158.6	154.4	138.0	16.4	138	16.4
Neuse River near Clayton	500182	SR1908	Neuse River	146.0	141.1	127.4	13.7	127.4	13.7
Neuse River at Smithfield	500005	US70 W	Neuse River Overflow	133.2	129.2	125.2	4.0	125.7	3.5
Neuse River at Smithfield	500002	US70 WBL	Neuse River	137.2	131.4	125.2	6.2	125.7	5.7
Neuse River at Smithfield	500505	US70 EBL	Neuse River	136.7	133.4	121.2	12.2	121.8	11.6
Neuse River at Smithfield	500506	US70 EBL	Neuse River Overflow	133.2	129.4	121.2	8.2	121.8	7.6
Neuse River at Smithfield	500040	US70B	Neuse River	131.8	127.4	117.1	10.3	117.6	9.8
Neuse River at Smithfield	500070	US301	Neuse River	129.2	124.7	113.0	11.7	113.6	11.1
Neuse River at Smithfield	500101	I95 SBL	Neuse River	128.4	125.7	112.8	12.9	113.4	12.3
Neuse River at Smithfield	500100	I95N	Neuse River	128.5	124.7	111.9	12.8	112.4	12.3
Neuse River near Goldsboro	950072	SR1008	Neuse River	79.7	77.4	72.5	4.9	75.8	1.6
Neuse River near Goldsboro	950058	US13N & US117N	Neuse River Overflow	75.7	72.4	66.6	5.8	73.3	-0.9
Neuse River near Goldsboro	950033	US13/US117 SBL	Neuse River	77.6	74.8	66.6	8.2	73.3	1.5
Neuse River near Goldsboro	950052	US13/US117	Neuse River Overflow	74.4	72.2	66.6	5.6	73.3	-1.1
Neuse River near Goldsboro	950018	NC581	Neuse River	72.5	69.1	64.7	4.4	70.1	-1

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Figure 23: Example of FIMAN-T Bridge Performance Summary Report