This document was prepared in cooperating with the MPO Technical lAdvisory Committee and Louisiana Department of Transportation and Development.

ALEXANDRIA-PINEVILLE
METROPOLITAN PLANNING ORGANIZATION

Improving Transportation Through Stormwater Mitigation Study

Rapides Area Planning Commission
Halff & Associates

May 2025

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Alexandria-Pineville Metropolitan Planning Organization

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For more information about the Alexandria-Pineville MPO or to learn about ways to get involved please contact:

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Preface

The MPA Stormwater Study represents a strategic and collaborative effort led by the Rapides Area Planning Commission (RAPC) to proactively address the rising challenges posed by urban flooding and stormwater management within the Alexandria-Pineville Metropolitan Planning Area (MPA). This study was conceived in response to the region's growing exposure to flood-related hazards, which increasingly threaten public safety, infrastructure integrity, and economic stability.

As the designated Metropolitan Planning Organization (MPO) for Central Louisiana, RAPC recognizes that flood risk is no longer an isolated environmental concern—it is a fundamental transportation planning issue. Flooded roadways, damaged culverts, and storm-damaged infrastructure disrupt mobility, isolate communities, and strain local resources. With this in mind, the MPA Stormwater Study was developed not only to assess vulnerability, but to provide a clear, data-driven framework for resilient infrastructure investment.

This document is the product of extensive technical analysis, broad-based public input, and ongoing intergovernmental coordination. At its core, the study emphasizes the need to integrate stormwater considerations directly into transportation project development and policy decision-making. It includes high-resolution hydrologic and hydraulic (H&H) models, a comprehensive inventory of drainage infrastructure, and a suite of community-informed mitigation strategies.

Throughout the planning process, RAPC engaged residents, local engineers, public officials, and regional stakeholders to ensure that the study reflects both scientific rigor and local realities. Public engagement was not an afterthought—it was foundational. The study's recommendations are informed by those who live and work in the MPA every day and who understand firsthand the impacts of repetitive flooding.
This preface is offered with gratitude to all those who contributed their time, insight, and data to this important effort. The findings presented here are intended to inform not only near-term improvements, but to shape the long-term resilience of the transportation system and the communities it serves.

We invite all stakeholders—policy makers, planners, engineers, and citizens—to use this study as a tool for dialogue, collaboration, and action.

Executive Summary

PURPOSE AND SCOPE

The *Improving Transportation Through Stormwater Mitigation Study (MPA Stormwater Study)* was initiated by the Rapides Area Planning Commission (RAPC) to address growing concerns regarding stormwater flooding and its impacts on the transportation network within the Alexandria-Pineville Metropolitan Planning Area (MPA). The study supports the long-range goals of the Metropolitan Transportation Plan (MTP 2045) by integrating flood resilience into transportation planning, project development, and infrastructure investment.

Study Goals

- Identify flood-prone roadways using disaster data and technical models.
- Develop mitigation strategies for vulnerable transportation assets.
- Integrate stormwater infrastructure planning into the Transportation Improvement Program (TIP).
- Support emergency preparedness through hydrologic and hydraulic (H&H) modeling.
- Promote equitable and sustainable planning via public and stakeholder engagement.

STUDY AREA OVERVIEW

The MPA encompasses portions of Rapides and Grant Parishes, including Alexandria, Pineville, Ball, and surrounding communities. The area is characterized by aging stormwater infrastructure, high rainfall, and impervious urban surfaces that exacerbate flooding. Many systems predate modern standards, contributing to repeated flooding inside and outside FEMA-designated flood zones.

TECHNICAL APPROACH

The study developed comprehensive 2D hydrologic and hydraulic models for key watersheds using HEC-RAS and HEC-HMS software, supported by LiDAR terrain, survey data, and FEMA datasets. Modeling evaluated current and future flood risks under multiple storm frequencies, including peak-on-peak scenarios (Red River flooding concurrent with local rainfall).

Key technical deliverables included:

- Inundation and velocity mapping
- Depth x velocity risk rasters
- Level of Service (LOS) assessment of storm drains
- Mitigation scenario comparisons

COMMUNITY & STAKEHOLDER ENGAGEMENT

Public participation was central to the study. The engagement identified localized flooding concerns, critical infrastructure, and community priorities. Public feedback shaped project recommendations and reinforced the need for sustainable, equitable solutions.

Engagement included:

- Three rounds of public open houses
- Community flooding surveys
- GIS-based feedback tools
- H&H Model Training for local engineers
- Technical Advisory Committee (TAC) workshops

Executive Summary

KEY FINDINGS

- Frequent localized flooding in areas such as Downs Lane, McKeithen Drive, and the Horseshoe Canal.
- Undersized or degraded stormwater infrastructure in both urban and rural zones.
- High concentration of Severe Repetitive Loss (SRL) properties, particularly in Alexandria.
- Strong public support for green infrastructure, routine maintenance, and funding diversification.
- Technical feasibility of flood mitigation projects such as culvert upgrades, detention basins, and pump retrofits.

RECOMMENDATIONS

1. Incorporate stormwater mitigation into MPO project selection and funding frameworks.
2. Target flood-prone corridors (e.g., Augusta Avenue, Roanoke Street) for drainage upgrades.
3. Prioritize investments using Pairwise Ranking scores derived from TAC input.
4. Standardize stormwater ordinances across jurisdictions to support regional planning and FEMA/MS4 compliance.
5. Continue public education on flood insurance, mitigation options, and resilience strategies.

CONCLUSION

The *MPA Stormwater Study* presents a data-driven, community-informed roadmap to enhance transportation resiliency in the Alexandria-Pineville MPA. By integrating advanced modeling with local knowledge, the study lays the foundation for coordinated, long-term investments that protect infrastructure, promote sustainability, and increase regional preparedness for future flood events.

Table of Contents

Table of Contents

LIST OF TABLES

Table of Contents

LIST OF FIGURES

Table of Contents

Section 1 |

About the Study

The Rapides Area Planning Commission (RAPC), the designated local metropolitan planning organization, is leading a study to integrate stormwater mitigation and flood prevention into transportation planning across for the Alexandria-Pineville Metropolitan Planning Area (MPA). With increasing instances of flooding—driven by excessive rainfall and the region's geography—this initiative supports the MPO's long-range transportation plan's (MTP 2045) goal of preserving and maintaining the transportation system.

Central Louisiana's vulnerability stems from its high rainfall (averaging 60 inches annually), vast floodplains, and impervious surfaces like roads and rooftops that exacerbate stormwater runoff. This runoff not only damages infrastructure but also pollutes waterways. The study will:

- Identify flood-prone roadways using a decade's worth of disaster data;
- Propose mitigation strategies;
- Outline funding sources for stormwater-related infrastructure;
- Develop a hydrologic and hydraulic modeling tool to inform investment and emergency preparedness; and
- Integrate stormwater management into the MPO's Transportation Improvement Program (TIP).

Building on recent planning documents like MTP 2045 and the 2017 Rapides Parish Resiliency Plan, the MPA Stormwater Study will use community input and scientific data to provide actionable, data-driven recommendations that enhance resiliency, protect roadways, and guide sustainable regional development.

ABOUT THE ALEXANDRIA-PINEVILLE METROPOLITAN PLANNING ORGANIZATION

Since 1975, the Rapides Area Planning Commission (RAPC) has served as the designated Metropolitan Planning Organization (MPO) for the Alexandria-Pineville region, overseeing transportation and transit planning across the metropolitan planning area (MPA), which includes portions of Rapides and Grant Parishes.

In compliance with federal transportation planning requirements, RAPC is responsible for implementing a comprehensive, coordinated, and continuous planning process. The MPO's governance structure ensures balanced representation, preventing any single jurisdiction from dominating decisions. Voting members include five local governments—Rapides Parish, City of Alexandria, City of Pineville, Town of Ball, and the Central Louisiana Regional Port—along with England Airpark and Louisiana DOTD District 08. Non-voting partners include the Louisiana DOTD Planning Division, Federal Highway Administration (FHWA), and Federal Transit Administration (FTA).

Functioning as a regional policy-making body, RAPC fosters collaboration among local, state, and federal stakeholders to develop both long-range and short-range transportation plans. These plans guide infrastructure investment and policy decisions to support regional mobility, safety, and economic development. Public engagement, intergovernmental coordination, and expert input are central to this process. The MPO has final approval authority over the use of federal transportation funds within the urbanized area, including approximately $3 million in discretionary capital funds available annually for transportation projects and studies. These funds require a local match (typically 20%) and must comply with all federal regulations. All federally funded transportation projects must be included in the region's Transportation Improvement Program (TIP), ensuring transparency and alignment with regional priorities.

Section 1 |

STUDY AREA OVERVIEW

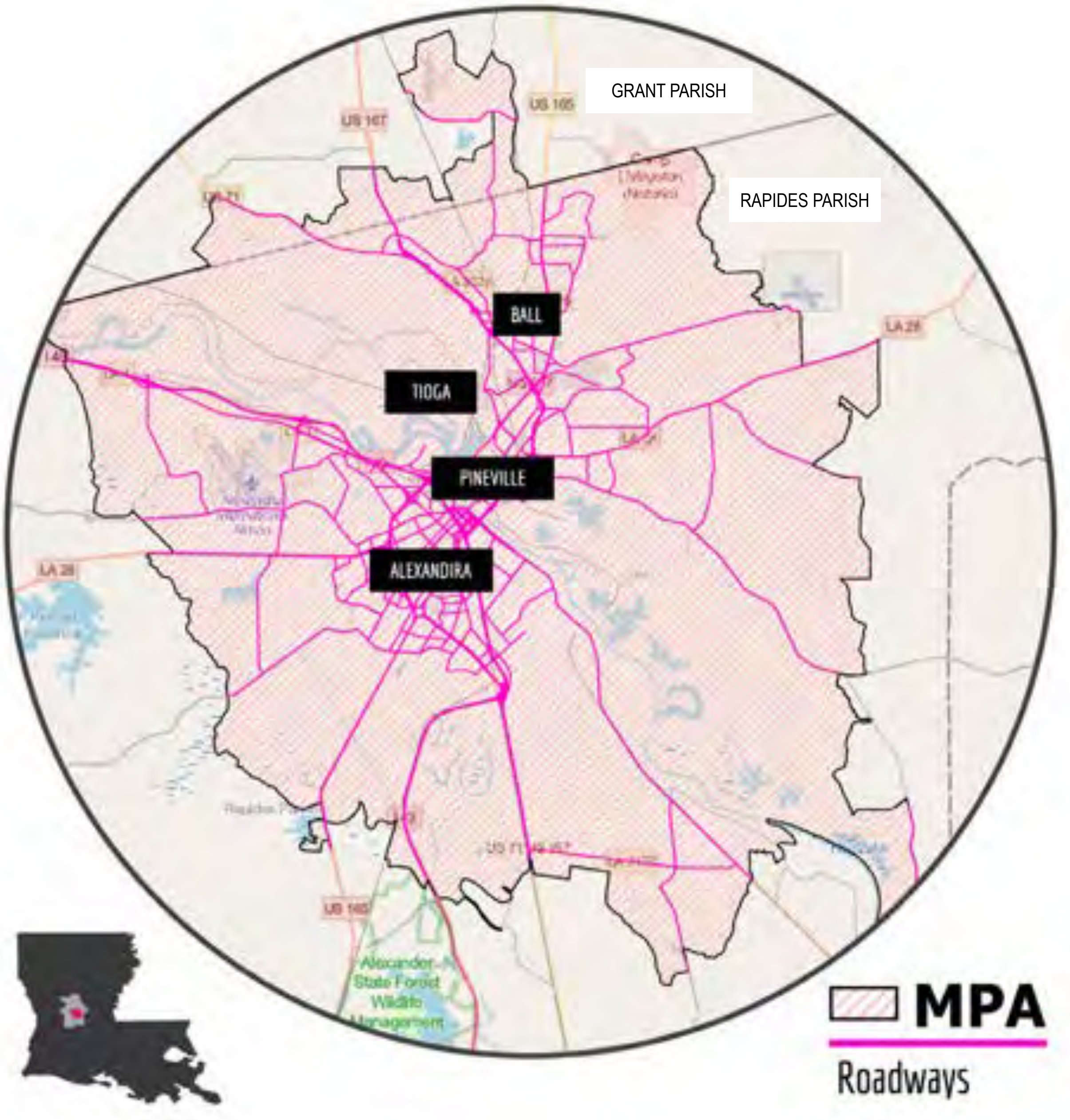
The study area encompasses the Metropolitan Planning Area (MPA), which includes the 2010 U.S. Census-defined Alexandria-Pineville urban area and adjacent regions expected to experience development over the next 25 years. Located in central Louisiana, the MPA covers portions of Rapides Parish—including the cities of Alexandria and Pineville, the Town of Ball, and the unincorporated community of Tioga—and a portion of Grant Parish. As the economic, governmental, educational, and medical hub of central Louisiana, the MPA plays a vital regional role.

The region is characterized by a complex and aging stormwater infrastructure network, including street conveyance systems, underground pipes, box culverts, pump stations, and natural waterways that ultimately drain toward the Red River—a major navigable waterway flowing into the Mississippi River. Much of the MPA lies within FEMA-designated 100-year floodplains; however, flooding frequently occurs outside of mapped zones due to outdated or undersized drainage systems, impervious surfaces, and increasingly intense rainfall events.
Rapid urbanization, coupled with outdated infrastructure, has amplified stormwater management challenges. Many drainage systems were constructed prior to the adoption of current design standards, leading to frequent localized flooding. In response, the Rapides Area Planning Commission (RAPC) and the Louisiana Department of Transportation and Development (LaDOTD) have initiated targeted planning efforts, mitigation strategies, and public outreach to address these issues.

As part of a proactive approach, the MPA has funded both detailed and limited-detail drainage studies in three central Louisiana HUC-8 watersheds—Bayou Teche, Little, and Lower Red-Lake Iatt—all of which are connected to the Red River. These efforts aim to guide future infrastructure improvements, ensure compliance with modern drainage standards, and reduce the severity and frequency of flooding throughout the region.

Section 1 |

FIGURE 1: ALEXANDRIA-PINEVILLE METROPOLITAN PLANNING AREA



HISTORY OF FLOODING

Since 1965, 46 disasters have been declared by FEMA in Rapides Parish. Of these 46 disasters, 38 fell under the categories of tropical storms, floods, or severe storms as defined by FEMA. The most disasters declared in Rapides Parish in a single year under these three categories were in 2020 when seven separate disasters were recorded due to historical storms such as Hurricane Laura and Delta. In August of 2020, Hurricane Laura, a Category 2 hurricane, brought winds with velocities of 80 to 100 miles per hour and caused the entire city of Alexandria to lose electricity. The parish spent approximately $8.5 million solely on cleanup from the storm. Just six weeks later, another Category 2 hurricane, Hurricane Delta, brought rainfall to Rapides Parish comparable to a 100-year storm with winds up to 61 miles per hour.

Stormwater System Analysis & Modeling Objective

The purpose of the level of service analysis and modeling phase of the project is to assess flood risks with comprehensive hydrologic and hydraulic models and to consider approaches that reduce impacts on transportation. Detailed two-dimensional models were developed for existing conditions of each HUC.

The main objectives of this phase included:

- Integrate as-built data and GIS digital data provided by the MPA and the City of Alexandria to resolve discrepancies with field data collection and field survey
- Perform a detailed existing conditions analysis for each HUC
- Verify detailed analysis floodplains against datasets used in select project areas
- Analyze cause(s) of flooding and develop conceptual mitigation alternatives to reduce flooding in the project areas

DATA COLLECTION

Several datasets were collected for this resiliency study to identify objectively hazardous areas in need of mitigation from stormwater flooding. The datasets include:

- 2018 state LiDAR topography
- Base Level Engineering (BLE) hydraulic models for the Bayou Teche, Lower Red, Lower Red – Lake Iatt, Upper Calcasieu, Whisky Chitto, and Little HUC-8 watersheds
- Rainfall, soil classification, land use and other hydrologic parameters and precipitation data from the relevant HUC-8 BLE models listed
- Previously collected survey data for bridge and culvert crossings in Drainage Districts 01 and 02
- High water marks from Drainage District 02
- Cyclomedia pavement assessment dataset
- National Flood Hazard Layer (NFHL) effective mapping layers
- Department of Transportation and Development (DOTD) traffic count data for all major roadways
- Repetitive Loss and Severe Repetitive Loss data

One (1) terrain was developed for this resiliency study. The terrain was developed based on the 2018 USGS Bayou Nezpique LiDAR and 2018 USGS Sabine River LiDAR. From these two LiDAR datasets, a three-foot DEM file was created. This file was reprojected to the project projection as well as being clipped to each HUC area. Missing or conflicting data was resolved with information gathered through field survey and reconnaissance.

Section 1 |

SURVEY & FIELD RECONNAISSANCE

Field survey was conducted from October 2022 through April 2023 to collect structural information needed as input into the hydraulic models for areas with high flood risk. Data gathered in the field was given precedence over any existing GIS data. A total of 219 structures were surveyed with detailed survey requirements. The structures included 138 culverts, 77 bridges, one dam, one concrete canal, one culvert with lock gates, and one control structure. The data for each structure included a survey information form, pictures of the structure and surrounding conditions, and coordinates and elevations for structural components necessary for the modeling of the structure. These coordinates and elevations were represented as points in GIS. The points collected for culverts included the upstream and downstream inverts of the culvert, the centerline of the roadway, and both edges of the roadway. Examples of points collected for the surveyed bridges included the centerline of the bridge, the top of the bridge deck on both the upstream and downstream side, and the upstream and downstream inverts of the bridge. An example of a survey information form for a culvert and a bridge and their corresponding pictures are shown in Figures 2-13.

In addition to the detailed surveyed structures, 90 structures were designated with limited-detailed survey requirements. These structures were initially determined as not hydrologically significant due to their size or location within flood zones, but further review determined minimal survey data was still required. This limited-detail effort included three bridges, 63 culverts, and 24 visual classifications. The data for each of the bridges and culverts included a reduced version of the survey information form compared to the detailed survey form, pictures of the structure and surrounding conditions, and coordinates and elevations for structural components necessary for the modeling of the structure. The structures categorized as visual classifications were structures with minimal hydrological significance. Unlike the limited-detailed bridges and culverts, these did not require any type of survey information form. These 24 visual classifications consisted of eight culverts, five storm drains, and seven locations where low flow conveyance structures were expected but not present. Once in the field, Halff surveyors determined that all three of the limited-detailed bridges, 12 of the limited-detailed culverts, and four of the visual classification culverts required detailed survey due to their size and hydrologic significance.

FIGURE 2: EXAMPLE DETAILED SURVEY FORM OF A CULVERT

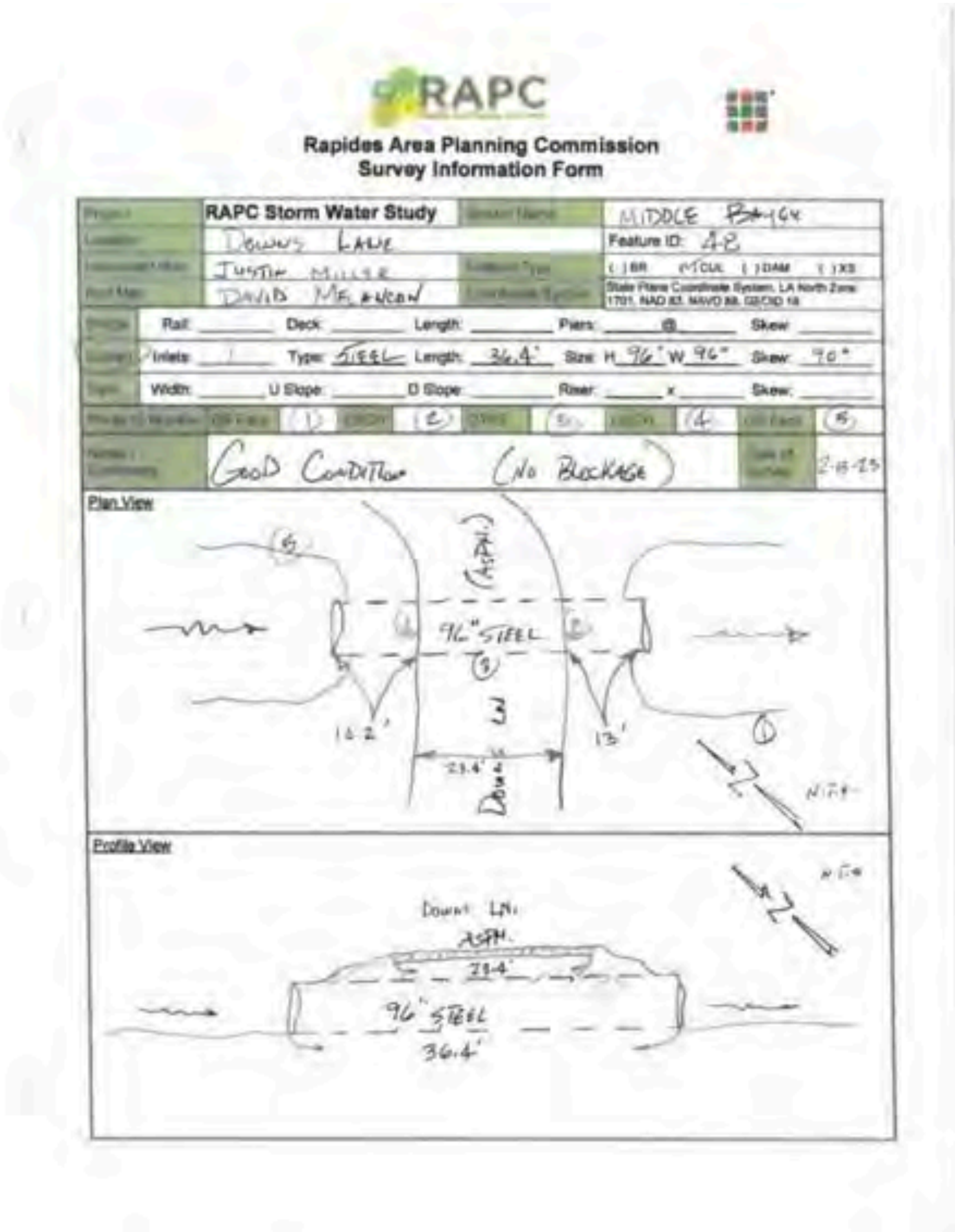


FIGURE 3: DOWNSTREAM FACE OF CULVERT

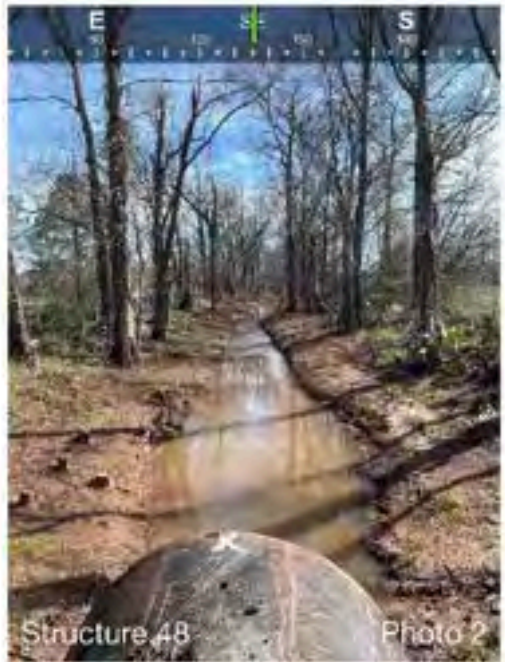


FIGURE 4: DOWNSTREAM VIEW OF CHANNEL

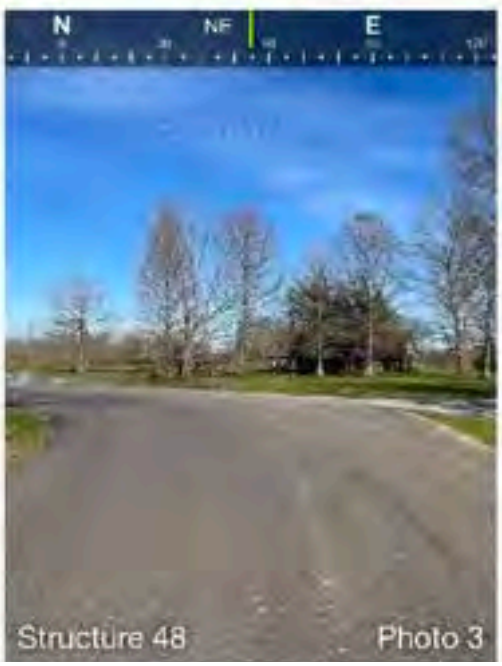


FIGURE 5: VIEW OF ROAD

FIGURE 6: UPSTREAM VIEW OF CHANNEL

FIGURE 7: UPSTREAM VIEW OF CULVERT

FIGURE 8: EXAMPLE DETAILED SURVEY FORM OF A BRIDGE

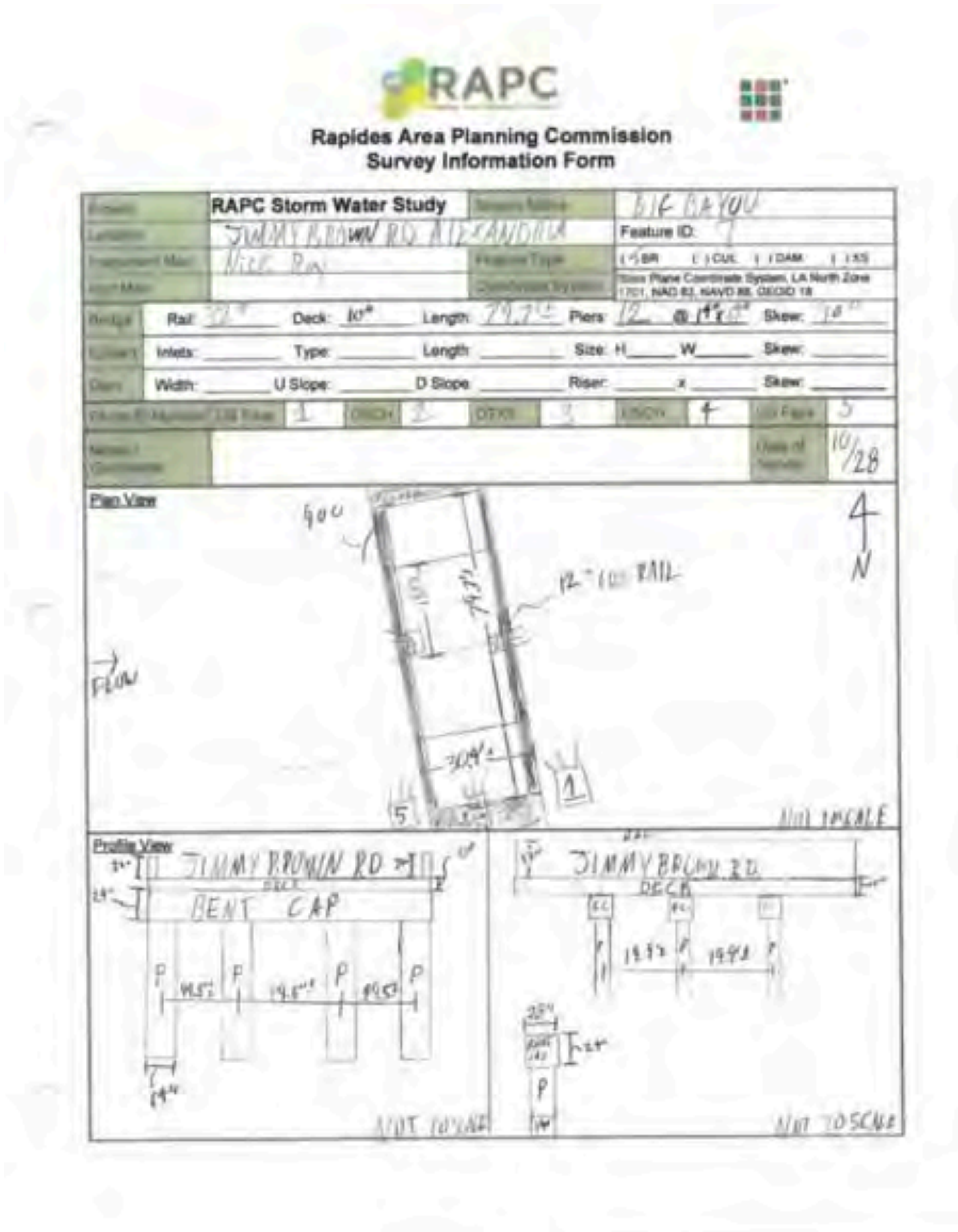


FIGURE 9: DOWNSTREAM FACE OF BRIDGE

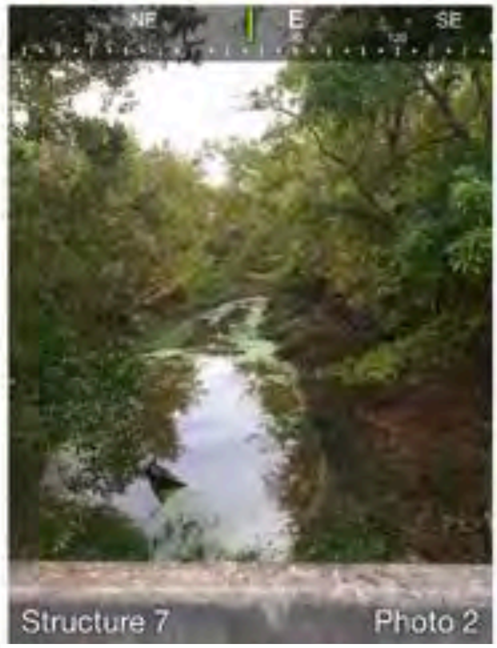


FIGURE 10: DOWNSTREAM VIEW OF CHANNEL

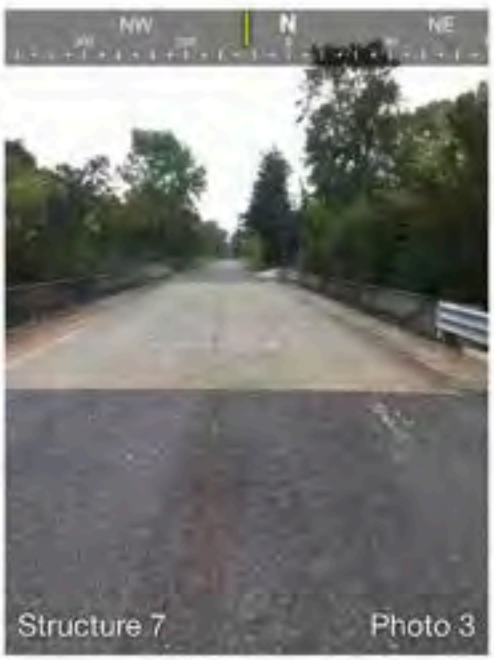


FIGURE 11: VIEW OF ROAD

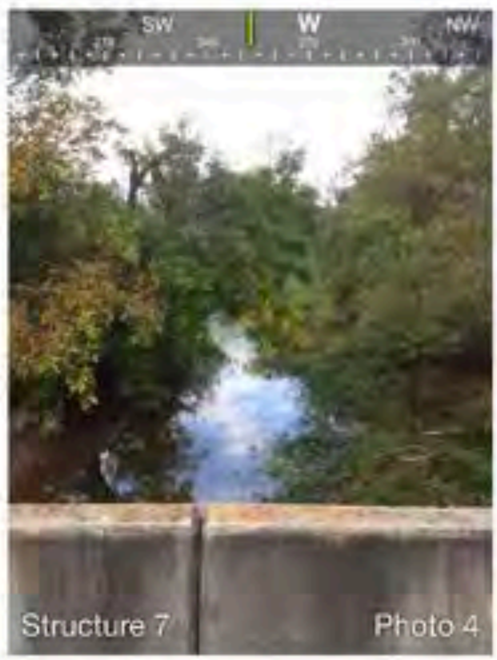


FIGURE 12: UPSTREAM VIEW OF CHANNEL

FIGURE 13: UPSTREAM FACE OF BRIDGE

Survey Spatial Database Engine (SDE)
The survey SDE consists of the survey data that was packaged together. This includes the survey points, survey forms, photos of the structures, and the shapefiles that contained information for the structures along with the path to the form location. This data for each structure can be uploaded to a web map for readily accessible forms, information, and photos.

The brochure for SDE can be found in APPENDIX K: ADDITIONAL RESOURCES.

Existing Conditions Stormwater Modeling

Comprehensive technical modeling standards were created for this project to define a hydrologic and hydraulic approach which can be found later in this report. The modeling standards comply with local standards as stated in the FEMA's Guidance for Flood Risk Analysis and Mapping dated February 2019 and December 2020 and provide guidance specific to hydrology, rainfall run-off analysis, two-dimensional (2D) analysis, floodway analysis and mapping. A detailed explanation for any adjustments and modeling exceptions that do not agree with governing standards or the technical modeling standards are provided for each study area later in this report.

Detailed 2D models were developed for the existing conditions of each HUC using HEC-RAS version 6.3.1. The 2D modeling results account for both pluvial and fluvial flood risks and resulting water surface elevation rasters were exported to GIS for inundation mapping.

Mapping benefits include the opportunity to visually see potential for erosion, inundation of a building, and water surface elevation differential on either side of a structure; however, HEC-RAS limitations include the inability to model underground detention and underground infrastructure. Before beginning the modeling efforts, some considerations were made.

These include the mesh boundaries; the breaklines used along roadways, high ground, or to help align cells; cell size of the mesh along with refinement regions, if used; and boundary condition lines to connect the separate models. 2D models were chosen to fully show the pluvial flooding impacts in the area and not just on the main waterways. The benefit of using 2D models is that pluvial modeling can be performed for the entire watershed, and flow paths within the entire study area are shown, whereas a 1D model only represents channels or main stems.

PURPOSE
The following modeling standards define a comprehensive hydrologic and hydraulic model approach to be used for the RAPC Transportation Resiliency Through Storm Water Mitigation in A/P MPO UZA project. The modeling standards comply with FEMA's "Guidance for Flood Risk Analysis and Mapping Hydrology: Rainfall-Runoff Analysis" (February 2019), "General Hydrologic Consideration" (February 2019), "Hydraulics: Two-Dimensional Analysis" (December 2020), "Floodway Analysis and Mapping" (December 2020), and local government regulations. A detailed explanation for any adjustments and methods used that do not agree with these standards within this document shall be stated in the study report documentation.

SOFTWARE
These modeling standards were developed for HEC-HMS 4.10, HEC-RAS 6.3.1, HEC-RAS 6.4.1, ArcMap 10.8.1, and ArcMap 10.8.2. The model utilized US Customary units. Models were based on NAD 83 State Plane Louisiana North (1701) feet and NAVD88 feet.

HEC-RAS VALIDATION
The model was validated to identify run errors. HEC-RAS validation errors were then corrected, and comments were added for all remaining warning errors. Halff included all pertinent model run descriptions including parameter adjustments, structure assumptions, unsteady flow plan, precipitation data, and model revision time and dates.

BACKGROUND LAYERS
Halff compared selected sections of the 2018 USGS LiDAR dataset with the LiDAR datasets that were utilized in each of FEMA's Base Level Engineering (BLE) hydraulic models available for the Metropolitan Planning Area (MPA). Files, including latest aerial imagery, roads, building footprints, and parcel layers with coverage throughout the study area, will be loaded into the model and included with the model submittal files. Road data came from the Louisiana Department of Transportation and Development (LADOTD) and the Topologically Integrated Geographic Encoding and Referencing (TIGER) system. Building footprints were supplied by the National Structure Inventory. Files are available through the RAPC GIS Services website: https://www.rapc.info/gis-online-mapping.

Runs and Scenarios

RUN CONFIGURATION & SIMULATION PARAMETERS
The naming convention for each simulation is as follows: "[first four letters of HUC]_[storm frequency]yr" (example: "Bert_100yr"). The start date and time is 00:00 01/01/2023. The minimum suggested timestep is one (1) second and the maximum suggested is one (1) minute. The time step was adjusted to achieve a stable result at peak. An alternative variable time step method based on the Courant number was tested; however, the normal time step was used because of improved stability during simulations.

The Courant number is computed by multiplying the velocity from each cell face by the time step and dividing that number by the length between the two cell centers across that face. If the maximum Courant number is exceeded, the time step is cut in half for the following time interval. If the Courant number at all locations falls below the minimum Courant number, then the time step is doubled. A normal time step was preferred over this option due to its improved stability throughout the simulations.

Additional computation settings include the hydrograph output interval, detailed output interval, and the mapping output interval. The hydrograph output interval was selected to define the shape of the computed hydrographs for peak flow and volume with sufficient detail. The detailed output interval computes profiles of water surface elevations and flow at a given interval. The mapping output interval dictates the frequency at which mapped results can be viewed within RAS Mapper. Suggested intervals for these settings are one hour. Users have the option to run the simulation duration for any number of days. The start date and end date vary between models as needed for each simulation's hydrograph to return to base flow and connect to any upstream or downstream models.

Hydrologic Methods

Applied hydrology represented by hydrographs were utilized to calculate discharges within the model. Hydrographs were applied to the model as boundary condition lines drawn at locations where inflow or outflow values are required within adjacent or inflow models and copying the time series flow data into a flow hydrograph.

RUNOFF SOURCE

Runoff Hydrograph Method
Rainfall routing was developed using the SCS Unit Hydrograph Method and SCS Curve Number Infiltration using fully developed runoff characteristics. Halff developed Hydrologic Soil Groupings (HSG) and fully developed land use for each study area watershed. An average Antecedent Runoff Condition (ARC II) was used for all areas. The ARC II and infiltration were modeled in HEC-RAS 6.3.1.

Rainfall
Halff utilized the SCS Type III rainfall distribution with a 24-hour duration. Atlas 14 rainfall depths for the 2-, 10-, 25-, 50-, 100-, and 500-year storm frequencies were obtained from NOAA's National Weather Service Precipitation Frequency Data Server and applied to the model.

Depths
Table 1 below shows the current Atlas 14 rainfall depths within the Bayou Robert HUC in the city of Alexandria at Lat: 31.3127°, Long: -92.4457° using the NOAA webhost server: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html. The Atlas 14 rainfall depths below are an example of the rainfall depths used for the Bayou Robert HUC. Additional depths for the remaining HUCs can be found within the HEC-HMS file titled "RAPC_Hydrology".

TABLE 1: CURRENT ATLAS 14 RAINFALL DEPTHS WITHIN THE BAYOU ROBERT HUC IN ALEXANDRIA, LA

Storm Event	Depth (in)
2-year/50%	5.21
10-year/10%	8.06
25-year/4%	10.3
50-year/2%	12.3
100-year/1%	14.4
500-year/0.2%	20.4

Rainfall Input

A rainfall event was set up in HEC-HMS for each modeled storm event. The naming convention followed “[storm frequency]yr” (example: “025yr”). The Atlas 14 rainfall depth grids were imported into HEC-HMS for the appropriate frequency event. The Frequency Precipitation Calculator was used to automatically compute depth-duration values. The “Spatial Distribution” was set to “Uniform for All Subbasins” if running on a single subbasin, or it was set to “Variable by Subbasin” if running for multiple subbasins. The “Intensity Duration” was set to five minutes. The frequency depths computed for all subbasins were verified with a comparison to the Atlas 14 Precipitation Frequency Data Server (PFDS).

A “precipitation” boundary condition was created within the “View/Edit Unsteady Flow Data” window in HEC-RAS. The precipitation hydrograph used data from the DSS file titled “RAPC_Hydrology”, which was pulled directly from the HMS model.

Infiltration Losses

Weighted curve numbers were calculated for each drainage area based on current land uses and the applicable Hydrologic Soil Groups (HSGs). HSG classifications were obtained from the 2019 NRCS Soil Survey Geographic (SSURGO) database for the Metropolitan Planning Area. Curve numbers for each HSG that were used to develop a composite curve number were obtained from the Department of Transportation and Development (DOTD) design criteria. The land use and soil data were merged in GIS and imported into HEC-RAS to create the infiltration layer within the hydraulic model.

TABLE 2: RUNOFF CURVE NUMBERS

Soil Type	MinInfRate (in/hr)
A	0.3
B	0.225
C	0.1
D	0.025

Section 1 |

Hydraulic Methods

HEC-RAS 2D modeling methodology was selected for this stormwater model to best represent pluvial flood risk and account for uncertain dynamic flow changes. This methodology also provides a significant advantage in urban settings where riverine flood sources are not necessarily the prominent risk factor.

DATA SOURCE HIERARCHY

The hierarchy of data sources to be used for HEC-RAS geometry is as follows, with 1 being the most preferred data source and 5 being the least preferred:

Survey Data and Field Reconnaissance
Surveyed and observed structure feature information including horizontal location, vertical elevation data, pictures, and field notes were used as the priority geometry data source. Survey data was collected for up to 219 structures.

As-Built Drawings
Where field survey data or observation was not available, structure geometry data was supplemented with information from as-built drawings provided by the Metropolitan Planning Area (MPA) and the City of Alexandria.

Local GIS Data
Where field survey or as-built data was not available, structure geometry data was supplemented with information from local GIS data provided by the MPA and the City of Alexandria.

Terrain
Where field survey, as-built data or local GIS data was not available, structure elevation data was supplemented with or derived from ground elevation information from 2018 LiDAR terrain data at individual structures.

Assumed Data
For culverts with missing upstream or downstream invert elevation survey points, a 1% slope assumption was made to model the invert.

2D NETWORK

Topography
The 2018 USGS Bayou Nezpique LiDAR and 2018 USGS Sabine River LiDAR were downloaded from the National Map database. A three-foot digital elevation model (DEM) file was derived from merging these two datasets. This file's coordinate system was adjusted to match the regional projection used for this specific area and clipped to each HUC area.

Terrain Modifications
To ensure proper representation of the channels, terrain modifications were made in HEC-RAS. These modifications were created from interpolated stream centerline points obtained from survey and water's edge polygons in GIS. The interpolated points were designed with a GIS tool that finds the lowest survey value in a group of survey points and snaps that lowest point to the stream centerline at the nearest location on the line. That point was then used to interpolate elevation values at 10-foot increments along the stream centerline between the other snapped survey points upstream and downstream of that point.

If the upstream and/or downstream end points of the centerlines do not have survey points snapped to them, then the tool will create a point and extract the elevation from the terrain. The water's edge polygons were defined at the flat elevation depicting standing water in the channel. These modifications replaced channel LiDAR data that captured water surface elevations rather than the correct depths of the channels. The addition of the channel elevations also ensured accurate portrayal of the depths of culverts and bridges. Baseflows were reapplied in channels during calibration.

Mesh Properties
Within HEC-RAS, a mesh was generated to perform the analysis of the surface flows using the built-in HEC-RAS mesh creation process. The recommended maximum cell area of the mesh was 40,000 square feet. The 2D mesh was set using an initial 1,000-foot buffer around the study area. Overlap regions existed between adjacent model domains to ensure flow conveyance between models was appropriately captured and mapping tie-ins occurred. The buffer was manually adjusted to ensure boundary inflow/outflow, and tie-ins were addressed. Recommended baseline parameters for the 2D flow area are shown below:

Generate Computation Points on Regular Interval with All Breaklines
Computation Point Spacing: Spacing DX = 200, Spacing DY = 200
Cell Volume Filter Tol (0=OFF)(ft): 0.01
Cell Minimum Surface Area Fraction (0=OFF): 0.01
Face Profile Filter Tol (0=OFF)(ft): 0.01
Face Area-Elev Filter Tol (0=OFF)(ft): 0.01
Face Conveyance Tol Ratio (min=0.0001): 0.02
Face Laminar Depth (0=OFF)(ft): 0.2

These properties were adjusted in certain areas to reflect detail or intricacies within the model extents.

Breaklines
Breaklines were added to the mesh to better represent areas where flow was conveyed or impeded, such as streams, dams, levees, and roads. Breaklines were drawn along the terrain with the minimal number of vertices to describe the feature. Breaklines placed next to one another or directly adjacent (touching) were drawn with snapping enabled and the end/start points of each break line exactly coincident. To ensure that roads were being aligned properly with cells, the breaklines were enforced at either the mesh cell size or a reduced cell size. Water is conveyed between the faces (or flat sides) of the cells. When the cell faces are not aligned along a channel or a roadway, water can spill into surrounding cells that are not flooding in a real-world situation, and this can cause errors when calibrating or community planning. Enforcing breaklines over roads or other high ground (berms, railroads, etc.) initiates cell recomputation so that floodwaters may not convey between cells without overtopping this high ground. Without reinforcement, floodwaters can "leak" downstream and misrepresent real-world conditions.

Breaklines were also used to help align cells along a stream so they would not "spill" water into surrounding cells, minimizing incorrect pooling or flooding in the model. If a structure was modeled, breaklines (shown on the next page in blue) were placed on either side if the structure was through a roadway or railway. This can be seen in Figure 14. This kept the cell alignment in place for the structure and the roadway. Figure 15 shows the location of breaklines that represent the roadway, as well as the berm (high ground) and the channel to keep cells aligned.

FIGURE 14: STRUCTURE AND BREAKLINE ALIGNMENT

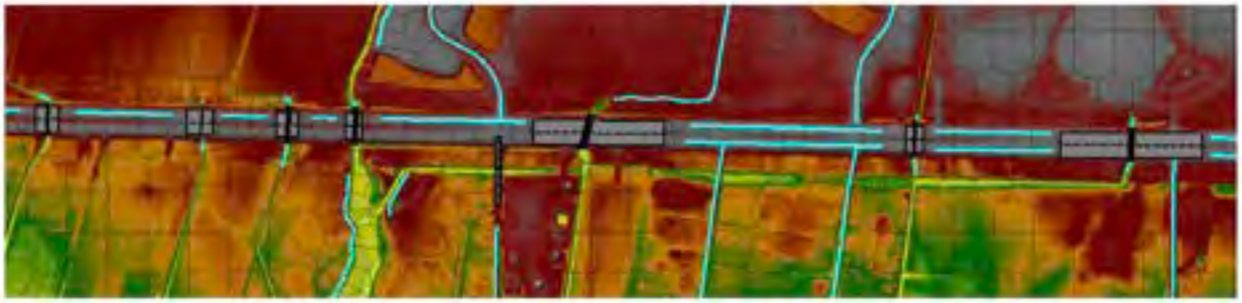
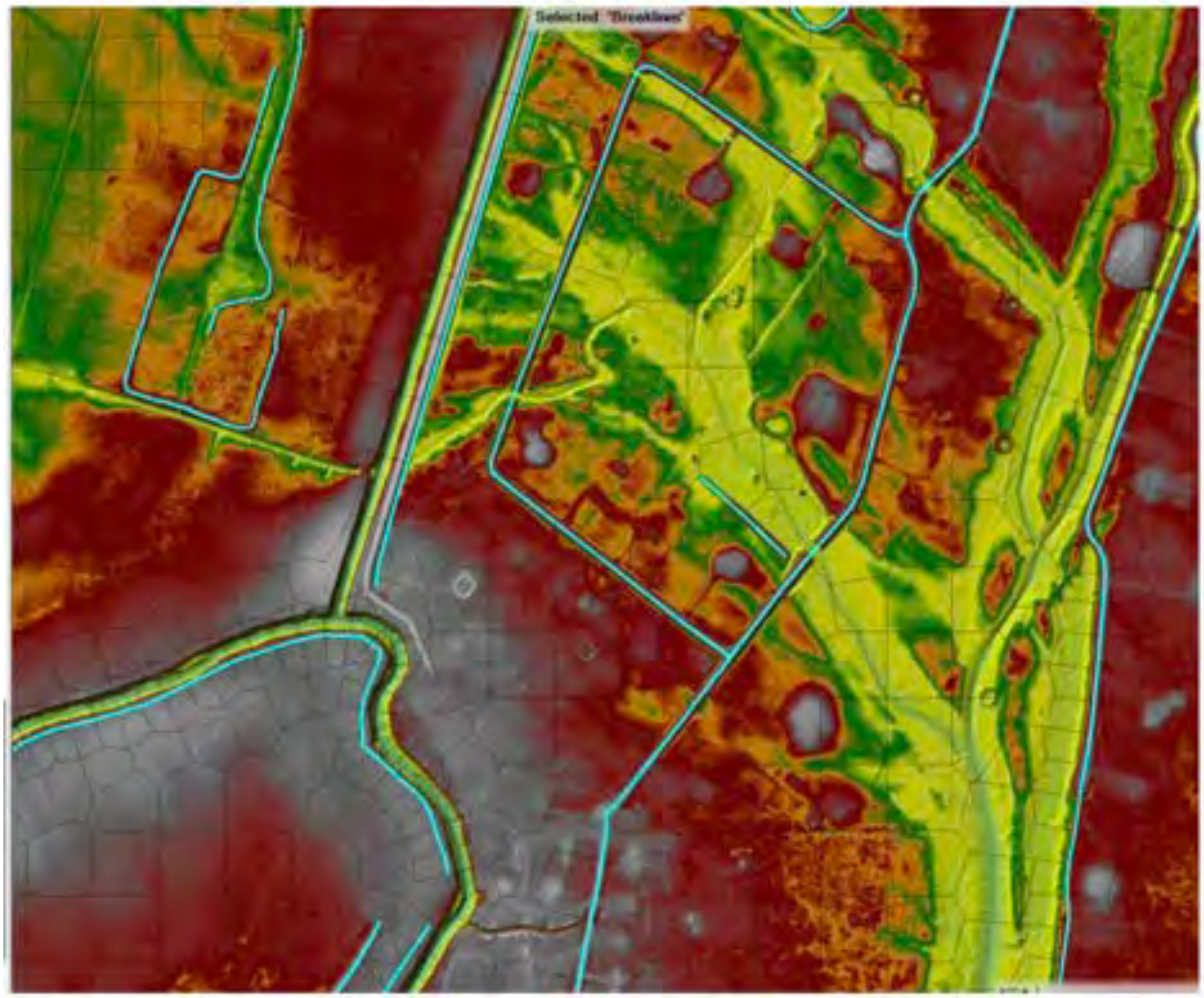


FIGURE 15: BREAKLINE LAYOUT EXAMPLE



2D CONNECTIONS

Culverts
Culverts were modeled in HEC-RAS as 2D connections with the guidance of survey information forms, survey points, and pictures. Modelers used these sources of information to model the correct dimensions, positions and elevations of the upstream and downstream inverts, entrance/exit loss coefficients, Manning's n-values for the top and bottom of the structure, etc.

The Manning's roughness parameters used for culverts were 0.015 for concrete box culverts, 0.013 for concrete circular culverts, and 0.024 for corrugated metal circular culverts.

The number of barrels under the "Culvert Group" within the "Culvert" tab in the "SA/2D Connection Data Editor" tab was utilized to model multiple culverts and parallel pipes as one structure. The x- and y- coordinates of the individual barrels were added into HEC-RAS to ensure proper placement and length.

Bridges
Bridges were modeled in HEC-RAS as 2D connections with the guidance of survey information forms, survey points, and pictures. Modelers used these sources of information to model the correct dimensions, positions and elevations of the piers and guardrails, etc. Piers and guardrails were modeled along structures as they are hydraulically significant impediments during high-flow events. The internal cross sections of bridges used a Manning's roughness value of 0.04, which assumes an inner bank condition.

Boundary Conditions
Boundary conditions were added at all locations where flow enters and leaves the 2D mesh area. The majority of the boundary condition lines were set to Normal Depth to ensure accurate velocities across the boundary. The energy grade slopes were assumed parallel to receiving channel bed slopes. Boundary condition inflow hydrographs were placed just outside of the 2D mesh to allow all flow to be applied within the modeled area. Boundary condition lines that connected models to each other pulled data directly from the linked models DSS file. Each time a model was run, the DSS file was automatically updated by the HEC-RAS software and any connected models would therefore pull the most up to date data. This allows for easy updating of runs without the need to update all linked models boundary condition lines to match the latest data.

Roughness Zones
Land use data from the 2019 update of the National Land Cover Database (NLCD) was used to specify the correct roughness value assigned to different areas within the study area. The Manning's n-values corresponding to the NLCD land uses are as shown below in Table 3.

TABLE 3: MANNING'S N-VALUE OF 2D MESH BASED ON LAND USE

NLCD Land Use	Manning's N
Open water	0.035
Developed, Open Space	0.08
Developed, Low Intensity	0.1
Developed, Medium Intensity	0.1
Developed, High Intensity	0.12
Barren Land	0.03
Deciduous Forest	0.12
Evergreen Forest	0.12
Mixed Forest	0.12
Shrub/Scrub	0.1
Herbaceous	0.04
Hay/Pasture	0.04
Cultivated Crops	0.04
Woody Wetlands	0.12
Emergent Wetlands	0.06

Calibration & Validation
This project utilized modeling of a significant historical event simulation of the flooding that occurred during April of 2017 as a basis for comparison to local data. Effective map comparisons and repetitive loss and severe repetitive loss (RL/SRL) data was used in comparison to confirm if the model results were within range. If the comparison demonstrated unreasonable results, the potential items adjusted included the following: overland roughness, initial losses, infiltration parameters, tailwater conditions, 2D mesh resolution, breaklines, and the computation interval. USGS gages were not available at the time of model calibration.

Quality Assurance / Quality Control (QAQC)

QAQC was conducted for both hydrologic and hydraulic components of the model according to the Quality Management Plan and checklists developed by Halff. The Quality Management Plan consists of multiple interim reviews throughout the creation of the model, an evaluation of HEC-RAS results by the project manager, a backcheck by an independent reviewer, and an additional round of independent review after model calibration was completed. Examples of these documents are in APPENDIX L: ACRONYMS AND DEFINITIONS.

VOLUME ACCOUNTING ERROR
The volume accounting error should be less than 0.5% but can be up to 1%. This parameter can be reviewed by opening the "Unsteady Flow Analysis" window, selecting "Options", and selecting "View Runtime Messages" after a run has been completed. This window provides the messages accumulated during the simulated run. The volume accounting error is given in both acre feet and as a percentage. If the error is above 1%, the modeler can refer to the "Unsteady Input Summary" table above the volume accounting error for potential cells to revise.

This table presents the time interval and cell where the maximum number of iterations occurred, along with the WSEL and percent error at the cell.

2D WSEL AND VELOCITY STABILITY

WSEL errors were checked by the modeler within RAS Mapper by reviewing the "WSE" raster for the simulation. The modeler viewed the max value of the WSEL and looked throughout the mesh for areas with unrealistic spikes and dips that could represent errors in the velocity. Areas of "cupping" where water fits a steep slope along the bank were corrected. Additionally, instances where the difference in the WSEL was greater than 0.5 feet at tie-ins between models, the model(s) was addressed.

Velocity errors were checked within RAS Mapper by creating the "Velocity" output raster located below the results of the simulated run. The modeler reviewed the max value of the velocity and looked throughout the mesh for areas with unrealistic spikes.

All boundary conditions were reviewed for stability. Areas with unrealistic spikes and dips in the flow hydrographs were evaluated and corrected.

CALIBRATION

The modeling results during Phase II were compared to the existing BLE elevations. Three sets of Manning's n-values were associated into the models and the set of Manning's n-values producing results closest to the BLE elevations were selected as the final Manning's n-values.

Classification polygons were also implemented to calibrate the area by specifically updating the values in areas like open channels.

Assumptions

TERRAIN MODIFICATIONS

Terrain modifications, such as inlets, channel regrades, and burns through high terrain, were applied in these models to better represent either existing conditions or to show and create alternatives.

SMALL STRUCTURES

For small structures that were not surveyed but could be seen in person or on aerial or Google Street View, the terrain was burned out to allow water to flow per the existing conditions. The terrain burns were used with small dimensions so as not to overestimate water flowing through the area.

UNDERGROUND MODELING

Underground modeling was not conveyed in these models.

STRUCTURES

- Gates, levees, and pumps were implemented using operational data and assumptions when necessary.

- Gates were designed with coding to open and close the gates at the appropriate heights to represent existing operations.

- Levees were shown using breaklines to create cells that align with the levee; however, no additional edits were made to the terrain at these breaklines.

- Pumps were modeled and coded to allow flowrates to match those found in the relevant operation and maintenance manuals available to the public.
- Structures or channels that were not field surveyed were added to the model based on assumptions and the locations were confirmed by modelers either by field visits or by using Google Street View.

Results

FREQUENCY RUNS

The frequency runs conducted for these models were 2-, 10-, 25-, 50-, 100-, and 500-year storm events.

PEAK ON PEAK

The modeling efforts included producing models, results, and rasters to be able to show the user what a "peak-on-peak" event would do to the MPA. In this case, the first peak would be has the Red River at a higher-than-normal elevation and the second peak is the surrounding area experiencing a storm event. The increase in the Red River's water surface elevation makes the conveyance of water from the Alexandria and Pineville areas more difficult due to tailwater conditions and backwatering effects.

This type of peak-on-peak storm event does not have a high probability of occurrence. But it is important for the public and officials to understand the risk of backwater effects of the river, so they can plan accordingly when it does happen. Each city on either side of the Red River will be affected based on levee protection. Both sides of the Red River were modeled separately to show the different impacts that this type of event could have on the areas.

In Alexandria, there is a levee along the Red River to provide flood protection. When the river is high, the gates in Alexandria close and the pumps at the gate turn on and are utilized to remove water from the area. During this stage, the outfall from Alexandria is no longer a gravity-controlled outfall system but instead relies on two pumps to discharge stormwater to the river.

The Pineville side of the Red River has a levee, although there is no protection southeast of Highway 167 (Pineville Expressway), and therefore no protection from Red River flooding. There is a railroad track that continues south of the highway with similar elevation height as the levee. However, bridges along the track allow stormwater to drain back into Pineville, so no de facto levee protection is provided.

For each of the affected models, there are three rasters to be exported: the 2-, 10-, 100-year storms. The affected models in Alexandria are Robert and Bertrand, and the affected models in Pineville are Wiggins and Pineville. For the Red River high scenario, the Red River is modeled to be at a peak elevation as if the storm to cause it to be high has already happened. Then the models surrounding Robert and Bertrand were updated with boundary conditions to be stage hydrographs to connect to the Red River high model representing the increased river elevation instead of the normal river elevation. For each storm event for the "peak-on-peak" storms, the Red River is modeled to have the peak for that specific storm event, i.e. the 2-year event has the flood elevation for the Red River during a 2-year event, not a 100-year event.

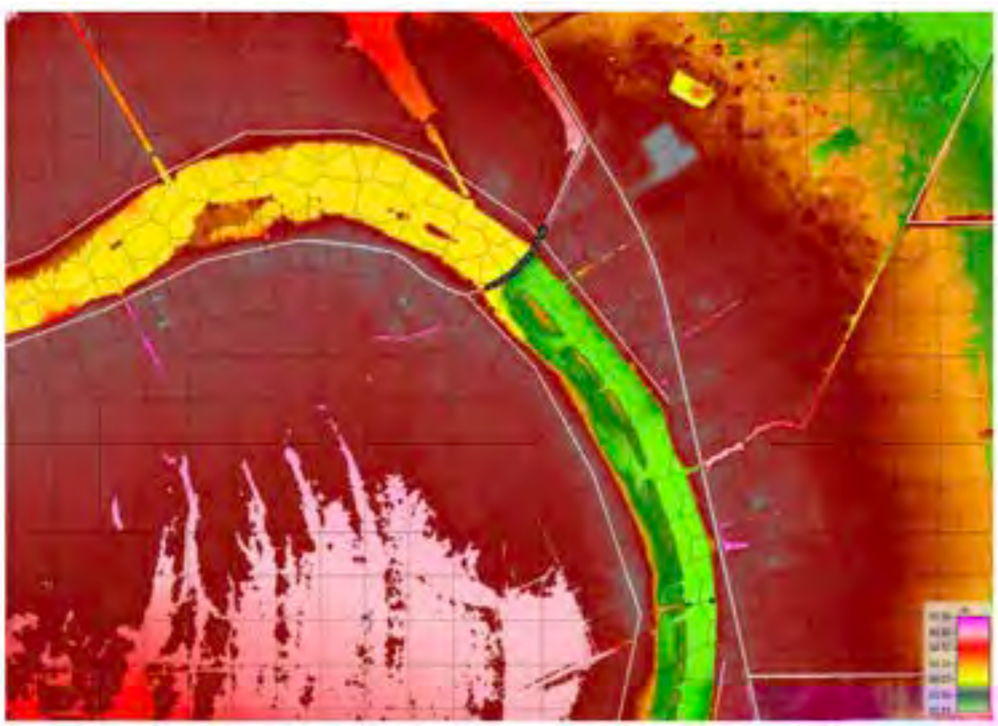
Section 1 |

Assumptions made for this modeling effort mainly included the flows within the Red River model. The Red River model included a review of the gage data for Alexandria and a gage analysis was conducted using HEC-SSP to calculate the peaks for the different storm events previously mentioned.

The Red River model was also trimmed down from its full extent to allow the model to run at a faster rate. The flow hydrograph was then pulled from the cross section from where the model was trimmed north of Alexandria and then compared to the results of the gage analysis in HEC-SSP. The results on the cross section for the 100-year event were very close and considered acceptable. As for the remaining storm event values, the flow hydrograph was scaled down based on the difference between the storm event needed and the higher storm event. For example, the 25-year event was scaled by taking the difference between the 50-year storm event and the 25-year HEC-SSP peaks and then divided by the 50-year peak to get a percentage difference. This percentage difference was then applied to the entire flow hydrograph of the 50-year event to create the 25-year event. This process was utilized for all remaining events needed.

EXPORTED RASTERS AND SHAPEFILES
The exported rasters include the depth and water surface elevation (WSEL) rasters.
The WSEL raster is used to represent the water's depth on top of the terrain elevation, giving the total water surface elevation. This raster can be used to investigate and understand existing flood depths and limits and to provide insight into potential locations for drainage improvements based on the elevation changes shown. Figure 16 shows a WSEL reduction, or head loss, occurring as water passes through a structure in the model.

FIGURE 16: HEAD LOSS CAN BE SEEN BY THE ELEVATION CHANGE UPSTREAM AND DOWNSTREAM OF THE STRUCTURE



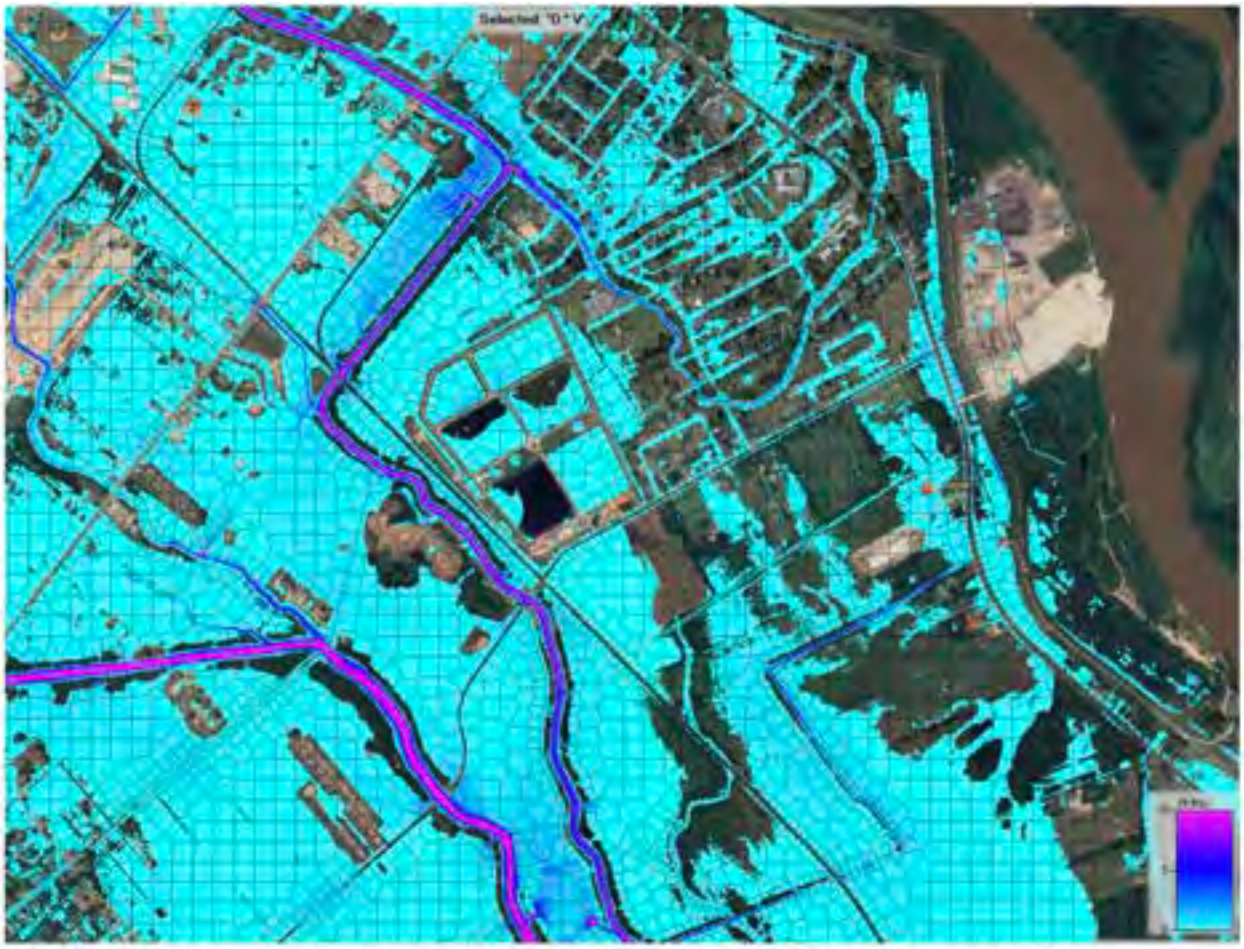
Section 1 |

Depth rasters represent the difference between WSEL and terrain to show the depth of the flood waters in the different areas of the model. These results can help identify channelization, inform on benefits to structure elevations, outline specific levels of inundation to be expected during specific storm events, and help with community planning. An example of a depth raster in a neighborhood can be seen below in Figure 17.

FIGURE 17: DEPTH RASTER EXAMPLE

The depth times velocity raster presents great benefits to the community planning decisions. It can highlight areas of fast-moving water of significant depth which could create significant damage from erosion, and weaponize debris causing damage to vehicles, buildings, and personnel. This raster can be used to help the community plan before a storm hits to help those in the vulnerable areas stay informed or evacuate in advance. An example of the visual benefit for a depth times velocity raster is shown in Figure 18.

FIGURE 18: DEPTH X VELOCITY RASTER EXAMPLE



One other common raster used for verification of results is the Courant raster. This dimensionless raster represents the time that a particle stays in a cell in the mesh. It is used to limit the flow of water from skipping over cells between computations by keeping the courant value below 1.0. The maximum and minimum courant values can be set, and the number of doubling and halving can be based on time step as well. These options can be seen in below.

For this project, there were eight watershed models on the Alexandria side of the river, five models on the Pineville side of the river provided by the Cooperating Technical Partners (CTP) contract, and one USACE model inside the Red River. The eight on the Alexandria side were built separately but ran with connections on the boundary conditions. The five on the Pineville side were built separately as well and connected with boundary conditions where appropriate. This made it possible for the models to exchange data between them to run as one model and provide overall model output results. These models individually produced rasters that were then exported and mosaiced together in ArcGIS to create one result raster for the MPA.

Shapefiles were either imported into HEC-RAS as map layers, or data from HEC-RAS was exported as shapefiles and imported into ArcGIS. Typical shapefiles were the outline of a HUC boundary, structure layout, map zones, or focus areas. The typical map layers to be exported from HEC-RAS are profile lines, boundary conditions, and updated mesh outlines. Using shapefiles between the two programs is beneficial when transferring data and updates and when clipping data.

Section 1 |

Concrete and Abstract Model Benefits and Auxiliary Benefit to Residence and Non-Transportation Related Projects

As shown in the alternative models for Downs Lane and McKeithen Drive, there are benefits to not only transportation-related projects, but also to existing and future residential development areas. Figure 19 is an aerial view of the Downs Lane area that was considered in alternative modeling efforts. In Figure 20, the existing conditions show that the roads are being overtopped and structures are experiencing flooding. The alternative conditions in Figure 21 show that the water no longer overtops the roads and fewer structures are inundated. The two sets of results in Figure 22 show the benefit of the mitigation alternative. Preventing the roadway from overtopping from flooding will allow residents living within the Downs Lane neighborhood to evacuate during a storm event and travel to emergency evacuation route Highway 28.

FIGURE 19: SATELLITE VIEW OF THE NEIGHBORHOOD ON DOWNS LANE

Section 1 |

FIGURE 20: EXISTING CONDITIONS RESULTS

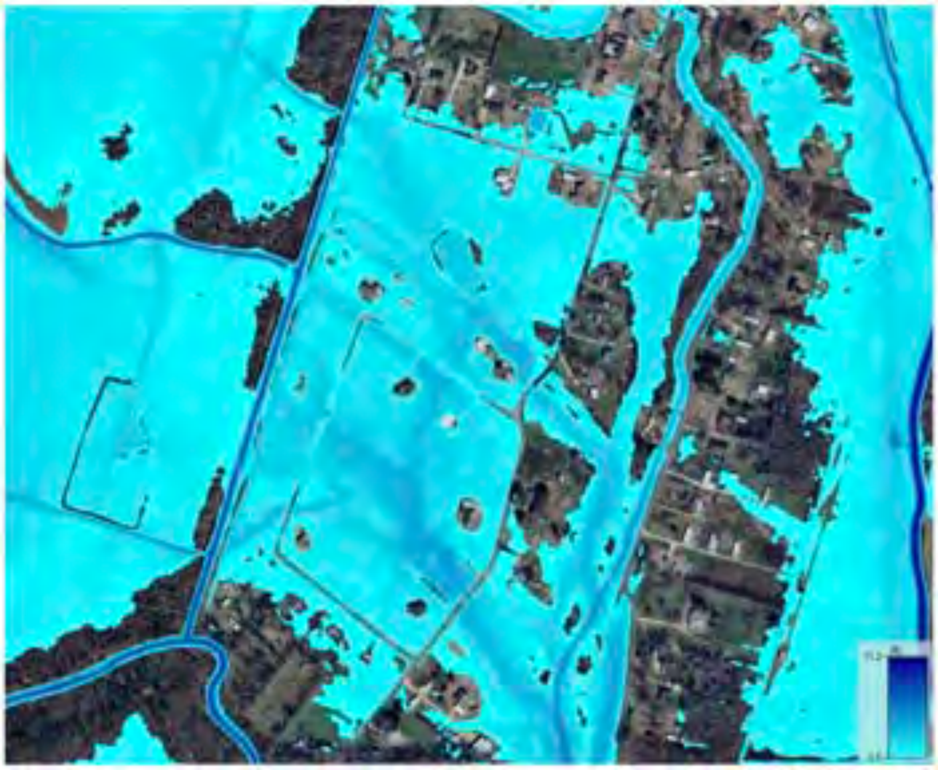
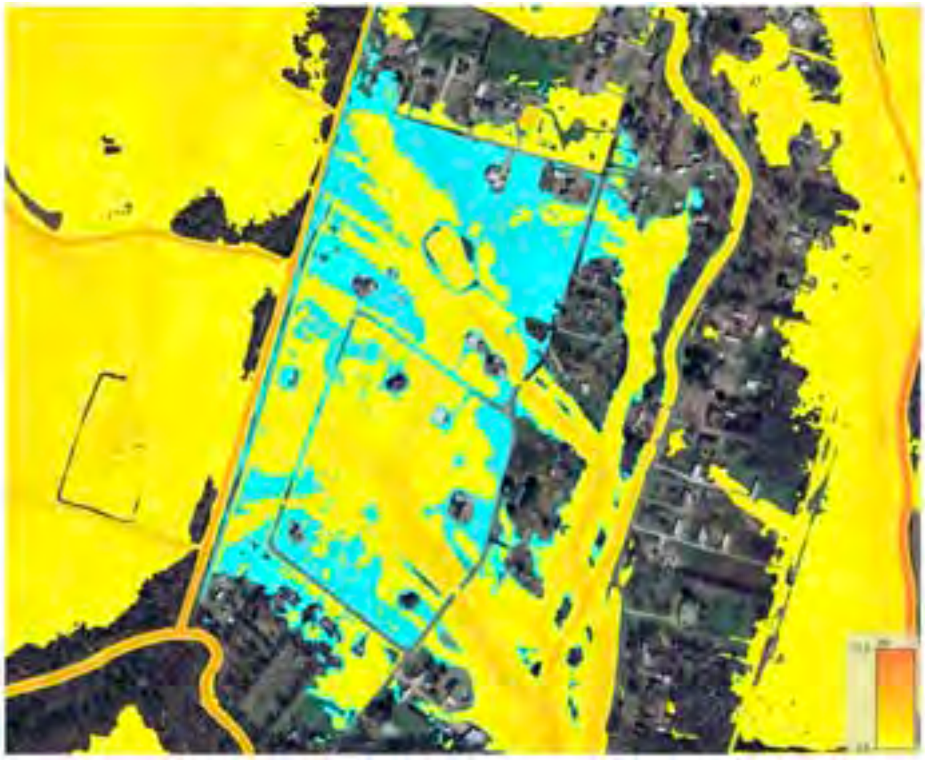


FIGURE 21: PROPOSED ALTERNATIVE CONDITIONS RESULTS

FIGURE 22: DOWNS LANE ALTERNATIVE COMPARING EXISTING CONDITIONS (BLUE) AND ALTERNATIVE CONDITIONS (YELLOW)



LEVEL OF SERVICE INVESTIGATION AND EXHIBITS

The Level of Service (LOS) analysis in downtown Alexandria was completed by using a new artificial intelligence and machine learning (AI/ML) model to analyze the current state of the drainage system. The properties of the pipes and culverts were determined and then used in the AI/ML model. The model determined the maximum discharge for the pipes and culverts in the drainage system. This information was compared to the existing cell face flows from the 2D HEC-RAS model to determine the LOS of the pipes underneath the roadways.

Data Collection

This AI/ML model was developed using detailed H&H studies, along with additional studies completed by Halff to confirm that the model produces correct results. To complete the analysis, the AI/ML model requires the size and slope of the pipes and culverts to be surveyed. Once the survey data was compiled, the properties were assigned to the individual pipes in a shapefile. The following information from the shapefile was formatted to be used in the AI/ML model.

- The identification number of the pipe
- The percent slope of the pipe
- The cross-sectional area of the pipe
- The length of the pipe
- The downstream invert of the pipe
- The upstream invert of the pipe

Section 1 |

The AI/ML model used the information to determine the maximum discharge, in cubic feet per second, of the drainage system. To determine the LOS of the drainage system, the results were compared with the maximum face flows of the cell that contained the upstream end of the pipe in the 2D HEC-RAS model.

The results from the AI/ML model were compared against the cell face flows for the 10-year and the 25-year storm event analyzed in the 2D HEC-RAS model to determine the level of service of the pipe or culvert. If the maximum discharge found in the AI/ML model was less than the discharge of the face flow of the 10-year storm from the HEC-RAS 2D model, the pipe or culvert was rated for less than a 10-year storm. If the discharge was in between a 10-year and a 25-year storm, it was rated for a 10-year storm event. If the discharge was greater than or equal to a 25-year storm, it was rated for a 25-year storm event. Finally, if the discharge was significantly greater than a 25-year storm, it was rated for greater than a 25-year storm event. Figure 23 and Figure 24 show the results from the study.

FIGURE 23: STORM DRAIN PIPE LEVEL OF SERVICE ANALYSIS WITH SATELLITE VIEW

FIGURE 24: STORM DRAIN PIPE LEVEL OF SERVICE ANALYSIS WITH STREET VIEW

This study reveals that, although there are sections of downtown Alexandria that can handle large storm events very well, many of the side streets cannot even provide adequate drainage for a 10-year storm. However, the results are reasonable when compared to the properties of the drainage systems. Foisy Street is rated for a storm event greater than a 25-year due to the large culvert running underneath the street. Many of the side streets are rated for storms less than a 10-year, as the pipes and culverts are very small. The study reveals that additional measures should be taken to increase the drainage capacity along the side streets.

Unique Infrastructure Considerations & Modeling Approach

DAM AND GATE OPERATION CONSIDERATIONS

There are dams in the modeled area, but they were not built into structures. Because of this, the operations of each dam were not taken into consideration. Instead, the dams are represented by breaklines along the high ground of the terrain where the dam is located.

The Bayou Rapides waterway that is controlled by a gate and pumping station is located within the Red River, Atchafalaya, and Bayou Boeuf (RRABB) Levee District. The RRABB district has 252 miles of levees that consist of eight levees in the district along with 18 flood gates. The Operation and Maintenance Manual for the Bayou Rapides Flood Gates and Pumping Station was used to help model the system more accurately per existing conditions. The manual can be found in APPENDIX K: ADDITIONAL RESOURCES.

Because these models assume peak rainfall in all eight watersheds, flow was shown backwatering up Bayou Rapides from the Robert watershed to the Bertrand watershed at the location of the gate. According to RRABB, this is a highly unlikely scenario; therefore, the boundary conditions between these two watersheds at this location are not connected by stage DSS files to show more accurate flow within these two watersheds.

PUMP LOCATIONS

There were pumps modeled in both the Bertrand and Hynson models. The pumps that convey water from Bayou Rapides into the Red River were modeled in the Bertrand model along with the gate structure that is present. When the pumps are disabled in the model, the gate is open. When the WSEL reaches 71.5 feet, the gate closes, and one pump turns on at a flow rate of 111 cubic feet per second. At WSEL 72 feet, the second pump activates to pump another 111 cubic feet per second. When the WSEL decreases to 71 feet, the pumps turn off and the gates re-open. The Operation and Maintenance Manual for this gate and pump system can be found in APPENDIX K: ADDITIONAL RESOURCES.

The pumps in the Hynson model represent the existing pumps that convey discharge around the I-49 area. There are both gravity and pressure pumps in the area. Assumptions were made when modeling the pumps in this area using the as-builts which showed that they are designed for a 10-year storm event. The locations in the model were estimated using CADD drawings provided by the City of Alexandria as well as satellite imagery. Because there was no readily available data for the two gravity pumps, the line locations and dimensions were defined using the CADD file provided by the City of Alexandria. Otherwise, the dimensions, discharges, and pump sizes were modeled to match the pressure pumps. The as-builts for the pressure pumps can be found in APPENDIX K: ADDITIONAL RESOURCES.

I-49 Pumps

The I-49 modeling efforts showed that the current pressure pumps are designed for a 10-year storm event. There isn't a great way to model pumps with two controlling elevations, so the model was be manipulated to show the pumps working. Because HEC-RAS is unable to model underground conveyance and on-grade inlets, the results are limited. A more detailed effort would benefit this area such as Storm CAD or ICM to gain a better understanding of the existing impact of the pumps. If the detailed study can be performed and flooding is still present in the area, this would indicate that the pumps are undersized. However, if the detailed study shows no flooding during the 10-year storm or if there has been an increase in impervious ground since the pumps' construction in 1988, this will indicate that the on-grade inlets are undersized or clogged, corrosion buildup is present, or additional pumps may be required.

Section 1 |

Local Stormwater Ordinance Review

As part of RAPC's ongoing efforts to develop a hydrologic and hydraulic modeling tool aimed at reducing roadway flooding and enhancing infrastructure resiliency, a comparative review of municipal and parish ordinances was conducted. This assessment focuses on three key jurisdictions within the Metropolitan Planning Area:

- City of Pineville
- City of Alexandria
- Rapides Parish

The objective of this analysis is to evaluate the administrative, technical, and regulatory differences in local stormwater management ordinances. The results will inform regional consistency improvements and the integration of local codes into a centralized GIS database used for infrastructure investment planning.

METHODOLOGY
The comparison included a review of relevant ordinance language across multiple policy categories, including administration, definitions, prohibited discharges, and structural requirements. Each jurisdiction's municipal code was examined for consistency, completeness, and unique practices relevant to stormwater management.

Key Findings by Policy Category:

Administration
- Pineville: Stormwater policies are enforced by a compliance officer.
- Alexandria: Oversight is managed by the director of planning and development.
- Rapides Parish: Administration falls under the director of public works.

Definitions and Roles
- Pineville: Lacks an engineering designation in legal language.
- Alexandria: Identifies city engineer explicitly.
- Rapides Parish: No mention of a city attorney or engineer, suggesting potential gaps in role clarity.

Prohibited Discharges and Specific Requirements
- All jurisdictions include language concerning non-stormwater discharges, although:
  - Pineville and Rapides Parish detail mobile power washing and washdown activities.
  - Alexandria separates prohibited sources into a dedicated section, enhancing clarity.

Technical & Structural Criteria
- Differences in language describing detention, retention, curb inlet protections, and maintenance frequency were noted.
- Only some jurisdictions reference BMPs (Best Management Practices) or align with EPA MS4 permitting standards.

Key Takeaways:

- There is inconsistent terminology across jurisdictions (e.g., use of "compliance officer" vs. "engineer").
- Rapides Parish lacks specificity in several categories, such as definitions and enforcement responsibility.
- Alexandria exhibits the most structured ordinance language, often separating concerns clearly and referencing modern BMPs.

Recommendations

This ordinance comparison will be integrated into the GIS-based MPA Stormwater H&H model alongside physical infrastructure data from recently completed and planned drainage improvements. This holistic approach ensures that both policy frameworks and physical systems are evaluated in tandem to guide future capital investment and emergency planning decisions. Based on this review, the following actions are recommended:

1. **Standardization of Roles:** Define and align terms like “compliance officer” and “director” across jurisdictions for clarity and accountability.
2. **Expand Definitions:** Ensure comprehensive language that includes all pollutant types, discharges, and responsible parties.
3. **Enhance Consistency:** Coordinate across jurisdictions to harmonize ordinance sections related to prohibited discharges and non-stormwater sources.
4. **Incorporate Modern BMP Standards:** Adopt language that reflects current EPA and MS4 compliance expectations region-wide.
5. **Align local codes** with EPA MS4 and FEMA standards to support funding eligibility and resilience modeling

Hotspot Flood Areas

This report synthesizes address-level SRL (Severe Repetitive Loss) property data to identify geographic hotspot areas of frequent flood damage. These insights will inform regional mitigation priorities under the ongoing Transportation Resiliency Through Stormwater Mitigation (MPA Stormwater) Study, which aims to guide investment and modeling tools for stormwater and transportation infrastructure.

METHODOLOGY

The FEMA and LSUAG Center datasets were analyzed including 100+ flood-prone properties in Rapides Parish and nearby communities. Focus was placed on entries with an SRL indicator to determine clusters of recurring flood damage. Table 4 identifies areas with properties inside the MPA marked as Severe Repetitive Loss (SRL) by FEMA. These locations have experienced frequent flooding and are targeted for mitigation such as elevation or demolition.

Key Attributes:

- **Address:** Physical location of the SRL property
- **Flood Zone:** FEMA-classified flood risk (e.g., AE, B/X)
- **Mitigation Recommendation:** FEMA-advised action (e.g., Elevation, Elevation/Demo)
- **Nearby Landmarks:** Street-level flood clusters
- **Notes:** Details from LSUAG maps or flood assessments

TABLE 4: MPA SEVERE REPETITIVE LOSS (RPL) PROPERTY AREAS

Flood Zone	SRL Property Mitigation Recommendation	Area	Notes
AE	Elevation	Willow Glen River, 14th, 15th - LSUAG Map shows flooding	subject to inundation by the 1%-annual-chance flood event
AE	Elevation	Plantation, Elizabeth, Horseshoe Canal - LSUAG Map shows flooding	subject to inundation by the 1%-annual-chance flood event
AE		Mil Mar, Spencer, East Prong Bayou - LSUAG Map shows flooding	subject to inundation by the 1%-annual-chance flood event
AE	Elevation	Prescott, Mohon, Roanoke, Horseshoe Canal - LSUAG Map shows flooding	subject to inundation by the 1%-annual-chance flood event
B/X (LSUAG)	Elevation	Enterprise, Paris, RR tracks parallel I-49 - LSUAG Map shows no flooding	moderate risk within .2% annual chance floodplain, area of 1% annual chance flooding - avg depths less than 1 ft and contributing drainage area less than 1 sq mile, and protected by levee
AE	Elevation	Prescott, Mohon, Kimberly, Horseshoe Canal - LSUAG Map shows flooding	subject to inundation by the 1%-annual-chance flood event
AE	Elevation / Demo	MilMar, Ellis, Joyce, Kirkpatrick (Martin Park Subdiv) - LSUAG Map shows flooding	subject to inundation by the 1%-annual-chance flood event
X (LSUAG)	Elevation	Masonic, Andrews, Cypress, Boyce, Simmons, Prescott - LSUAG Map shows no flooding but across Masonic at Mall side (X protected by levee)	minimal risk areas outside the 1-percent and .2-percent-annual-chance floodplains; Zone X (unshaded)
AE	Elevation	Wycliffe, Wakefield, Bayou Rapides Diversion Channel - LSUAG Map shows flooding	subject to inundation by the 1%-annual-chance flood event
A/AE (LSUAG)		Adams & Tyler Rds - LSUAG Map shows flooding	subject to inundation by the 1% annual chance flood event
B/X (LSUAG)	Elevation	Ball, Larkspur, Redbird, Meadowlark, Skylark, Cloverlef - LSUAG Map shows no flooding (X protected by levee)	moderate risk within .2% annual chance floodplain, area of 1% annual chance flooding - avg depths less than 1 ft and contributing drainage area less than 1 sq mile, and protected by levee
AE	Elevation / Demo	Masonic, Penny, Bowie - LSUAG Map shows flooding	subject to inundation by the 1% annual chance flood event
AE	Elevation / Demo	Masonic, Penny, Bowie - LSUAG Map shows flooding	subject to inundation by the 1% annual chance flood event
A8	Elevation / Demo	(not certain it is a mobile home) Old Boyce, Lanny, Kathy - LSUAG Map shows flooding	Mobile Home w/Additions/Below Grade
A6	Elevation	Downs, Sandy, Middle & Flat Bayou - LSUAG Map shows flooding	Multiple Structures/Slab Below Grade

7010 ISABELLA DR	AE	Elevation / Demo	Masonic, Penny, Bowie - LSUAG Map shows flooding	subject to inundation by the 1% annual chance flood event
7022 ISABELLA DR	AE	Elevation / Demo	Masonic, Penny, Bowie - LSUAG Map shows flooding	subject to inundation by the 1% annual chance flood event
1406 KARLA STREET	A8	Elevation / Demo	(not certain it is a mobile home) Old Boyce, Lanny, Kathy - LSUAG Map shows flooding	Mobile Home w/Additions/ Below Grade
550 SHARON LN	A6	Elevation	Downs, Sandy, Middle & Flat Bayou - LSUAG Map shows flooding	Multiple Structures/Slab Below Grade

MPA Flood Hotspots

Street-level analysis within Alexandria highlights frequently flooded corridors. These hotspots represent the most flood-prone areas within the MPA and should be prioritized for stormwater mitigation, elevation programs, or buyout efforts. These corridors are repeatedly cited in SRL documentation and should be prioritized in mitigation modeling and drainage infrastructure planning:

- Augusta Avenue & Willow Glen River area
- Roanoke & Kimberly Street corridor
- Ellis–Spencer–Joyce neighborhood (Martin Park vicinity)
- Downing Street near Horseshoe Canal

Recommendations

Severe repetitive loss properties are a direct indicator of chronic flood risk. Flood hotspot areas inside the MPA identified in the MPA Stormwater Study — especially within Alexandria — should be considered top-priority locations for stormwater infrastructure improvements, grant targeting, and policy action.

- Zone AE in Alexandria should be prioritized for structural and hydrologic modeling to identify precise drainage deficiencies.

- Targeted elevation projects or buyout programs may be warranted for clusters of SRL properties.

- Integration of SRL data into the TR-SWM modeling tool will enhance predictive capabilities and help visualize risk hotspots.

Section 1 |

Recently Completed & Planned Drainage Improvements

As part of the Transportation Resiliency Through Stormwater Mitigation Study, the Rapides Area Planning Commission (RAPC) is undertaking a regional effort to assess vulnerabilities in the transportation network due to water-related natural disasters. A key objective of this initiative is to:

- Identify roadways most at risk of flooding and stormwater impacts within the Metropolitan Planning Area (MPA),
- Support the development of a hydrologic and hydraulic modeling tool to optimize infrastructure investment and emergency preparedness,
- Compile a comprehensive GIS database of existing and planned stormwater and transportation improvements.

To support this effort, RAPC issued a request to local agencies to contribute data on drainage and flood mitigation projects conducted between 2010 and 2025. The dataset includes detailed project records related to drainage improvement, flood mitigation, and road infrastructure enhancement. These projects are part of a broader effort to increase regional preparedness and reduce vulnerability to flooding and extreme weather events.

This section provides a summary of completed and planned flood mitigation projects aimed at improving stormwater management and transportation resilience throughout the region. The assessment highlights proactive planning and response by regional authorities.

PROJECT INVENTORY OVERVIEW
Based on submitted records and internal research, RAPC compiled a dataset of 96 flood mitigation improvement projects from 4 of the 12 participating regional entities. These projects reflect both recently completed and planned enhancements to the stormwater drainage system and transportation infrastructure, designed to increase resilience and reduce roadway flooding risks.

Key Statistics:
- Total Projects: 96
- Participating Jurisdictions: 4/12
- Project Timeline Range: 2010–2025
- Dominant Improvement Type: Drainage Infrastructure (66%)

Project Typologies and Geographic Focus

Table 5 provides a breakdown recently implemented or planning drainage projects by most common project types. The dataset encompasses a diverse set of projects ranging from culvert upgrades to major flood control structures. The focus on implementing drainage-related upgrades highlights a regional emphasis on resolving localized flooding and improving culvert capacity. Drainage Improvement accounts for nearly 66% of all documented projects, emphasizing the region’s commitment to addressing chronic flooding and runoff issues. Many projects are also tied to FEMA hazard mitigation grants, emphasizing strategic planning and funding alignment.

TABLE 5: REGIONAL FLOOD MITIGATION PROJECTS BY TYPE

Project Type	Count
Drainage Improvement	63
FEMA-Funded Future Drainage Projects (F-28–F-36)	9
Road & Bridge Elevation / Surface Enhancements	8
Pump Stations, Flood Control Structures, Levees	7
Misc. Canal, Weir, and Outfall Work	9

INTEGRATION INTO MODELING AND PLANNING TOOLS
These collected improvements are being integrated into the MPA Stormwater Study's GIS-based existing conditions database and will:

- Provide baseline conditions for current and future flooding analysis,
- Support the hydrologic and hydraulic (H&H) modeling framework, and
- Enable local governments to identify at-risk zones and prioritize capital improvement planning based on historical and future needs.

Recommendations

The study team thanks all participating agencies for their continued support and contribution to this vital regional effort. The compiled database serves as a critical foundation for understanding regional vulnerabilities and targeting strategic mitigation investments. The dataset highlights a concentrated effort across multiple jurisdictions to mitigate stormwater impacts through a wide range of infrastructure projects.

Key takeaways:
- **High Priority on Drainage Solutions:** The majority of projects involve culvert replacement and drainage enhancements, which directly address localized flooding issues.
- **Strong Regional Coordination:** The involvement of 12 distinct entities reflects a broad, coordinated strategy for infrastructure resiliency.
- **Future Planning Included:** Several upcoming projects, particularly those linked to FEMA funding, indicate a sustained pipeline of resiliency efforts.

RAPC will continue collaborating with local jurisdictions to:
- Update the inventory as new projects are completed,
- Continue inventory expansion to include more jurisdictions,
- Calibrate the H&H model with local drainage data to identify critical needs and investment priorities,
- Develop resilient infrastructure strategies tailored to high-risk corridors.

Section 2 |

Project Outreach, Public & Stakeholder Engagement

Public engagement is essential to the success of the study. Federal regulation requires metropolitan planning organizations (MPOs) "to provide meaningful citizen input for the transportation planning and programming process through effective citizen involvement activities, open and accessible information, and opportunities for participation." The Alexandria-Pineville MPO (APMPO) intends to help stakeholders and the public learn about the planning process and participate in study development.

Public Engagement Strategy

Throughout the entire planning process, the APMPO reached out to the public through meetings, workshops, and surveys to receive feedback on each section of the plan. The general process is outlined below. Each point of public outreach was advertised across multiple mediums to ensure that all citizens and stakeholders have an opportunity to participate in the planning process.

Goals:

1. Engage the public at all levels throughout the development of the study.
2. Ensure a variety of public engagement strategies are implemented to establish inclusive public input.
3. Enhance relationships with local governments, agencies, and stakeholder groups to ensure equal outreach to all regional jurisdictions.

Engagement Tools & Promotion:

APMPO staff and other stakeholders worked together to promote public engagement opportunities through:

- ***Project Website:*** APMPO established the MPA Stormwater Study website to serve as the project information hub, where information and updates on the study and engagement opportunities can be found.
- ***Media Coverage:*** Press releases, meeting notices, and ads. The APMPO has an existing list of media contacts for various publications. All notices were designed to inform the public about upcoming participation events.
- ***Email Notices:*** The APMPO used its email subscriber database and also had an option for the public to sign-up for project email notifications.
- ***Partner Social Media Platforms:*** Although RAPC does not have a social media presence, the APMPO used to promote meetings, surveys, and public comment periods by encouraging entities inside the MPA to share posts on their organizations' social media platforms.

Methods of Participation:

- ***Public Open House Events:*** APMPO staff solicited direct feedback from the public at engagement events held across the metro area to facilitate in-person feedback.
- ***Online Survey & Mapping Tools:*** Online surveys were used collect spatial and qualitative input available on the RAPC and MPA Stormwater Study website so anyone can share their input,

such as values and priorities, regarding stormwater flooding and roadway drainage. A mapping tool using ESRI Survey123 will be available on the project webpage so anyone can show us where they see opportunities and identify flooding and transportation concerns.

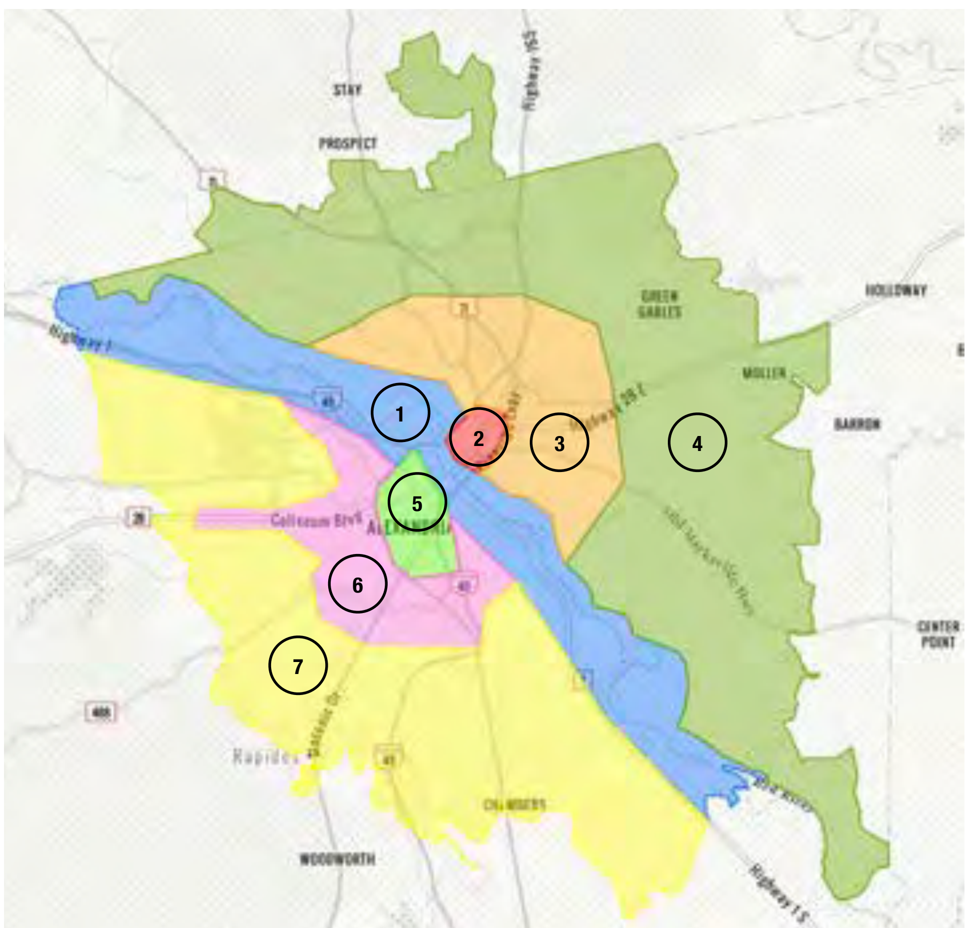
- ***Stakeholder Committees:*** Ongoing coordination throughout the planning process with the APMPO's Technical Advisory (TAC) and Transportation Policy Committees (TPC) to provide feedback on plan development.

Subwatershed Zones

A watershed is a land area that drains to a common outlet, such as a river or bayou. For the purposes of public engagement inside the MPA Stormwater Study, the area was subdivided into seven subwatersheds (MPA Study Zones) based on hydrologic features, flood sources, land use, population and structure density. These Zones correspond to 12-digit Hydrologic Unit Codes (HUC12s) as defined by the United States Geological Survey (USGS) through the Watershed Boundary Dataset (WBD).

MPA Study Zones were used to organize and analyze public feedback and stakeholder input geographically. The MPA includes 7 zones, and survey responses were received from residents in each zone, offering a representative sample of households across the MPA.

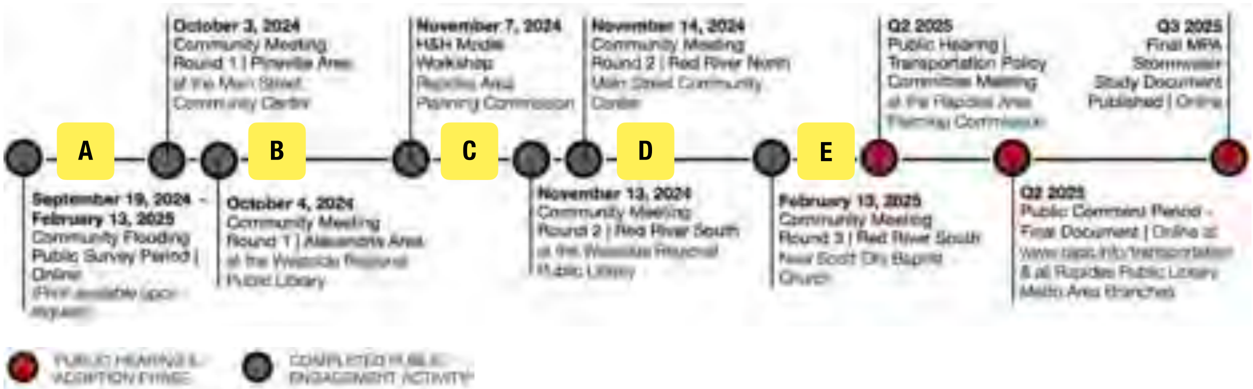
FIGURE 25: MPA STUDY ZONES



Public Engagement Timeline

The MPA Stormwater Study employed a phased, structured, and inclusive public engagement strategy designed to involve residents, technical advisors, and stakeholders in shaping the study's direction, identifying key stormwater challenges, and evaluating potential solutions. Figure 26 presents a timeline highlighting the various stages of public input, technical collaboration, and transparent decision-making that guided the planning process.

FIGURE 26: PUBLIC ENGAGEMENT TIMELINE



Public Survey and Mapping: (A)
Gathered input from the general public and stakeholders regarding local stormwater issues, priorities, and conditions. The feedback collected is being incorporated into the study's analysis.

Public Events Round 1: (B)
Introduced the project, presented existing conditions, and gathered public preferences regarding stormwater issues and strategic priorities.

H&H Model Workshop: (C)
Trained local engineers on the use of the newly developed hydrologic and hydraulic (H&H) model, including guidance on data input and model application for planning purposes.

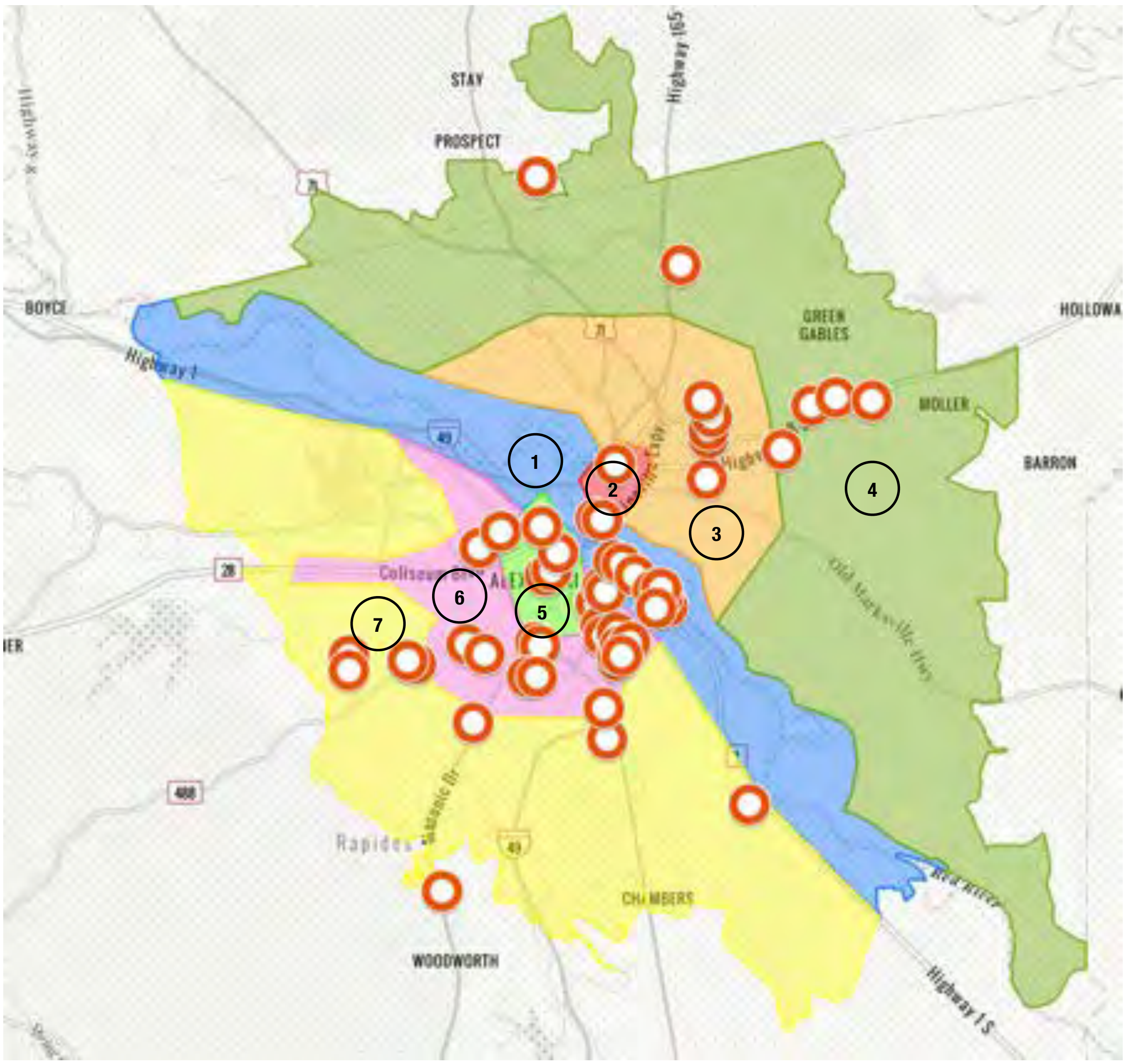
Public Events Round 2: (D)
Presented results from Round 1, showcased identified stormwater solutions and drainage improvements, and discussed funding options.

Public Events Round 3: (E)
Provided a final opportunity for the public to review and provide input on proposed solutions, funding strategies, and project scenarios.

Public Open House Events

The Alexandria-Pineville Metropolitan Planning Organization (APMPO) conducted three rounds of public engagement consisting of five open house events throughout the MPA - three on the south side and two on the north side of the Red River. These drop-in style events allowed participants to arrive at their convenience, interact with stations, ask questions, and provide feedback in minutes. Feedback from these meetings was summarized and used in further study development. Figure 27 denotes residential or business location of the public who participated in open house events (Rounds 1-3).

FIGURE 27: PUBLIC OPEN HOUSE PARTICIPANT LOCATION BY STUDY ZONE



Round 1 | Summary

The Alexandria-Pineville Metropolitan Planning Organization (APMPO) launched the first round of public outreach events to support the MPA Stormwater Study. The goal is to improve transportation resiliency in the region by addressing stormwater management and drainage concerns. Two public open house meetings were held:

- **Open House 1 – Red River North**
  October 3, 2024 – Main Street Community Center, Pineville, LA
- **Open House 2 – Red River South**
  October 4, 2024 – Westside Regional Library, Alexandria, LA

Round 1 | Format & Activities

Round 1 open house events were structured around five interactive stations designed to both inform and collect feedback from attendees:

Station 1: Sign-in & Project Orientation

- Participants signed in, identified where they live using dot stickers on a map, and shared personal flooding experiences at kiosks.
- Project background and study objectives were presented.

Station 2: Hydraulic & Hydrologic (H&H) Model

- Educated attendees on how the H&H model identifies flood-vulnerable areas.
- Emphasized the technical foundation for recommending drainage improvements.

Station 3: Drainage Improvement Focus Areas

- Displayed different areas in need of drainage work.
- Participants prioritized areas for initial improvements using dot stickers.

Station 4: Preferred Drainage Improvements

- Showcased different types of stormwater solutions along with their pros and cons.
- Community members voted for preferred solutions with stickers.

Station 5: Next Steps

- Provided information on upcoming transportation projects (2023–2026) and the MPO's planning process.

FIGURE 28: ROUND 1 OPEN HOUSE EVENTS COMPOSITE IMAGE

Round 1 | Results

- The meetings collected input from residents across the metro area, many of whom reported personal flooding experiences.
- Participants offered specific locations of concern, supported a mix of green infrastructure and traditional drainage systems, and highlighted areas most in need of attention.
- Priorities from participants included:
    - Immediate action in flood-prone neighborhoods.
    - Emphasis on maintenance of existing infrastructure.
    - Support for long-term, sustainable solutions.

Round 1 | Conclusion & Next Steps

This first round of engagement successfully gathered valuable local knowledge and preferences. The feedback will guide the next phases of the stormwater study, focusing on prioritizing drainage improvement projects and further modeling.

Section 2 |

Round 2 | Summary

The Alexandria-Pineville Metropolitan Planning Organization (MPO) conducted the second round of public engagement events in November 2024 to share updates from the initial round and present proposed drainage improvement projects. The goal remained centered on enhancing transportation resiliency through stormwater mitigation.

Two public open house meetings were held:

- **Open House 1 – Red River South**
  November 13, 2024 - Westside Regional Library, Alexandria, LA
- **Open House 2 – Red River North**
  November 14, 2024 - Main Street Community Center, Pineville, LA

Round 2 | Format & Activities:

Round 2 open house events were divided into **four stations**, each designed to inform and engage the public:

Station 1: Sign-in & Project Orientation

- Participants identified where they live using dot stickers.
- Provided with general background and goals of the MPA Stormwater Study.

Station 2: Feedback & Identified Projects

- Reviewed existing flooding conditions and drainage vulnerabilities.
- Explored priority drainage projects selected based on data and feedback from Round 1.
- Explained how these projects are expected to reduce flooding impacts.

Station 3: Future Projects Funding

- Outlined potential funding mechanisms for stormwater infrastructure, including capital improvements and maintenance.
- Participants indicated their preferences for funding approaches (e.g., local taxes, grants, partnerships).

Station 4: Next Steps

- Presented information on the MPO's ongoing planning process and transportation projects scheduled between 2023 and 2026.
- Participants were invited to complete the Community Flooding Survey to document personal experiences and reinforce project priorities.

FIGURE 29: ROUND 2 OPEN HOUSE EVENTS COMPOSITE IMAGE

Round 2 | Results

- Community feedback continued to emphasize the need for:
  - Prioritized investment in high-risk flood areas.
  - Transparent communication on how project funding will be secured and used.
  - Inclusion of both large-scale and neighborhood-scale drainage solutions.
- Attendees responded positively to the identified priority projects and offered suggestions for funding strategies and additional project areas.

Round 2 | Conclusion & What's Next

This second round of outreach confirmed public support for identified solutions and provided critical input on funding preferences. The insights gathered will guide the final recommendations in the MPA Stormwater Study and support the MPO's effort to secure implementation funding.

Round 3 | Summary

The third round of public outreach events offered community members another opportunity to weigh in on proposed stormwater solutions, priority improvement areas, and funding strategies. The Alexandria-Pineville Metropolitan Planning Organization (MPO) continues to advance this study to enhance transportation resiliency across the region through stormwater mitigation.

One public open house meeting was originally scheduled for January 21, 2025, the event was postponed due to a severe winter weather event. It was rescheduled and held on:

- **Open House – Red River South**
  February 13, 2025 - New Scott Olly Baptist Church, Alexandria, LA

Round 3 | Format & Activities:

The Round 3 open house event featured five interactive stations that guided attendees through various aspects of the project and captured community input:

Station 1: Sign-in & Project Orientation

- Residents marked where they live in the planning area.
- Overview of the MPA Stormwater Study and Hydrologic & Hydraulic (H&H) model.
- Identified flood-vulnerable areas based on the model.

Station 2: Drainage Improvement Focus Areas

- Participants reviewed areas needing drainage improvements.
- Used dot stickers to indicate where efforts should be prioritized.

Station 3: Preferred Drainage Improvements

- Information on different types of stormwater solutions, with pros and cons.
- Participants selected their preferred improvement methods using stickers.

Station 4: Future Projects Funding

- Explored options for funding stormwater infrastructure and maintenance.
- Participants shared preferences for funding mechanisms (e.g., local taxes, partnerships).

Station 5: Next Steps & About the MPO

- Details on MPO programs and upcoming transportation/hazard mitigation initiatives.
- Attendees completed:
  - *Community Flooding Survey (frequency & impact of flooding experiences).*
  - *Public Participation Survey (how they prefer to be contacted or stay involved).*

FIGURE 30: ROUND 3 OPEN HOUSE EVENT IMAGE

Round 3 | Results

- Continued public concern for recurrent flooding in specific neighborhoods.
- Strong support for:
    - Green infrastructure (e.g., rain gardens, permeable surfaces).
    - Routine maintenance of existing systems.
- Community interest in exploring diverse funding options that balance cost and impact.
- Growing engagement in MPO planning efforts, especially among flood-impacted households.

Round 3 | Conclusion & What's Next

Round 3 reinforced earlier feedback and helped refine project priorities and funding strategies. The input gathered will be crucial in finalizing the MPA Stormwater Study and advancing implementable solutions to improve drainage and community resiliency.

Flood Insurance Survey

Flooding carries not just financial costs but long-term social and environmental consequences. Repeated flooding can depress property values, increase insurance premiums and deductibles, and strain community resilience. Nationally, an estimated 40% of small businesses[1] never reopen following a major flood. Environmentally, floodwaters contribute to streambank erosion and introduce sediment and pollutants into local water bodies such as the Red River and Bayou Rapides, degrading water quality and aquatic habitats.

As part of the MPA Stormwater Study's public open house events, residents were surveyed about their monthly flood insurance premiums. The purpose was to better understand the financial impact of flood risk on households throughout the Alexandria-Pineville Metropolitan Area. Responses were grouped by RAPC Zone, based on color-coded regional identifiers and cross-referenced with official zone boundaries.

Key Findings by RAPC Zone:

- **Zone 1:**
  - Reported the highest number of responses, with residents paying across a range of premium levels.
  - Majority of responses indicated premiums between $1–$100 per month, and one respondent paying $100–$150.
  - Suggests both higher engagement and higher flood insurance uptake in this zone.
- **Zone 4:**
  - Also showed a notable number of responses, primarily within the $1–$100 monthly premium range.
  - Indicates moderate insurance coverage and potential affordability concerns in this zone.
- **Zone 5:**
  - A single respondent reported paying $50–$100 monthly, with no additional data from the zone.
- **Zones 2:**
  - No recorded flood insurance cost responses were reported from these zones.

Implications: These results highlight the uneven distribution of flood insurance coverage across the region, with stronger participation and premium data from Zones 1 and 4. The absence of responses from several zones may indicate lower awareness, affordability barriers, or fewer properties currently carrying flood insurance.

- Targeted outreach may be necessary in Zones 2, 3, and 5 to assess insurance needs and raise awareness of available resources.
- Insurance cost data should be factored into stormwater project prioritization, especially where affordability and vulnerability intersect.

Section 2 |

Community Flood Survey

It's essential to understand where flooding occurs, why it happens, and how it affects residents and businesses in order to allocate resources effectively and develop informed flood mitigation strategies. While mapping tools from FEMA and the Louisiana FloodMaps Portal offer a foundation for this work, community-level feedback remains crucial. Surveys and reports from residents can reveal the real-world scope and impacts of localized and urban flooding events. Combining technical data with direct input from property owners is vital in shaping a more resilient future for the MPA.

To support informed decision-making and long-term resilience, a Community Flood Survey was created to help identify the location, frequency, and impacts of flooding—both within and beyond mapped flood hazard zones inside the MPA. Findings from the survey, along with hydrologic data and community feedback, will inform the development of the Transportation Resiliency Through Flood Mitigation Study (MPA Stormwater Study). This plan will offer data-driven recommendations to reduce flood risk, improve drainage infrastructure, enhance water quality, and guide future development throughout the MPA.

Survey Area

The survey area follows the MPA boundaries defined by the Alexandria-Pineville Metropolitan Planning Organization based on U.S. Census Bureau's 2010 Urbanized Area and reflects the region's population density, built environment, and development patterns. The Community Flood Survey was made available online to the public (residents and property owners), who live within the MPA, which includes the cities of Alexandria and Pineville, as well as the surrounding communities of Ball, Tioga, and portions of Woodworth. A print version of the survey was also made available to the public on request and at all study community outreach events.

Survey responses submitted with addresses located outside of the MPA were excluded from the final analysis to ensure that data accurately reflected conditions within the designated planning boundary.

Survey Design

The MPA Stormwater Study Community Flood Survey included 12 questions addressing various aspects of flooding, such as frequency and duration of flooding, contributing causes (e.g., heavy rain, drainage issues), types and costs of damage, and flood insurance coverage.

Best practices in survey design were used to maximize participation:

- **Clear purpose:** The survey stated that the Rapides Area Planning Commission (RAPC) and its partners are working to identify and reduce flooding in the MPA to protect homes, businesses, and public infrastructure.
- **Simple submission:** Respondents with online access could complete their response via mobile devices or computers. Printed copies of the survey were made available upon request to RAPC and at all public outreach events conducted as part of the study.
- **Privacy assurance:** The first page of the survey included a privacy statement assuring participants that their responses would remain confidential and would only be used to inform flood mitigation and planning efforts.

Survey Distribution and Outreach

The survey was available on the web via RAPC's website www.rapc.info/tranaportation as well as the MPA Stormwater Study website. The survey link was also sent to email addresses of interested people and organizations. Some of the recipients of the emailed link may have forwarded it to others.

Flyers containing a QR code link to complete the survey online were also distributed promoting the study and the community flooding survey at all branches of the Rapides Public Library system located inside the MPA as well as Alexandria City Hall, Alexandria Customer Service Building, Pineville City Hall, Ball Town Hall, Rapides Parish Courthouse, Rapides Tax Assessor's Office, and Rapides Parish Police Jury.

The survey was publicized at using public notices distributed to local media organizations, announcements on the RAPC website, individual and group stakeholder meetings, public open houses, and other members of the Rapides Area Planning Commission.

Survey Results Mapping

For those respondents who provided an address using the online survey tool were mapped. The response data was grouped and mapped by Zones based on watersheds inside the MPA. Further geographic breakdown of the response data, such as by Census block, was not possible while maintaining the privacy of respondents' locations.

Data Limitations

It is likely that people who have experienced flooding were more likely to reply to the survey then those who have not experienced flooding. Of those who did complete the survey, some may not have owned the property for all of the previous 10 years, meaning their estimates are underestimates of frequency and cost. Unclear handwriting may also have led to data entry errors.

Community Flood Survey Results

The Community Flooding Survey was conducted across the Alexandria Metropolitan Planning Area (MPA) aimed to assess the frequency, causes, and impacts of flooding as well as community awareness, preparedness, and mitigation efforts. Insights from the survey are intended to inform flood resilience planning and infrastructure investments as part of the MPA Stormwater Study.

Response Rate

A total of 44 unique surveys were completed and returned from the metropolitan planning study area. Most were completed online or during public outreach events.

The number of responses did not meet the initial goal of 150 surveys. With this sample size and a 2023 population size of 30,322 households, survey results, survey results are accurate with +/-5% but represent a portion of the Alexandria-Pineville Metropolitan Planning Area (MPA) study area.

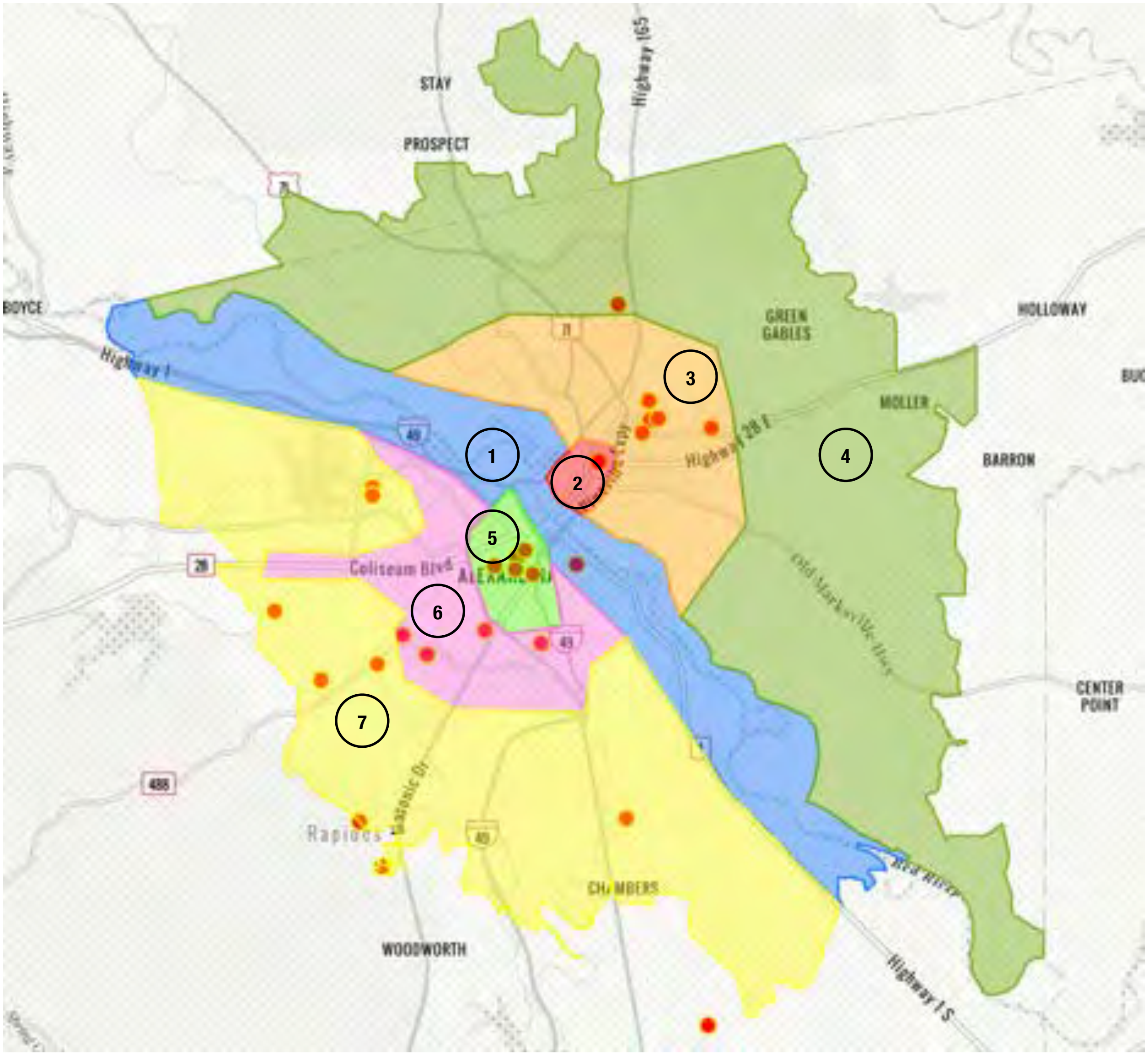
Section 2 |

Survey responses were received from throughout the study area. The study area is divides the MPA into seven (7) zones based on watersheds. Forty-two percent (42%) of survey responses came from Zone 3 (13%), Zone 5 (11%) Zone 7 (18%). The number of respondents in Zone 1, Zone 2, Zone 4, and Zone 6 replying that they had been flooded ranged between one (1) and four (4). Thirty-six percent (36%) of survey respondents skipped this question.

TABLE 6: MPA STUDY ZONE SURVEY RESPONDENTS

MPA ZONE	RESPONDENTS IN STUDY AREA	
Zone 1	1	2%
Zone 2	1	2%
Zone 3	6	13%
Zone 4	1	2%
Zone 5	5	11%
Zone 6	4	9%
Zone 7	8	18%
Outside MPA	3	7%
No answer	15	36%
TOTAL	**44**	**100%**

FIGURE 31: SURVEY RESPONDENT LOCATION BY STUDY ZONE

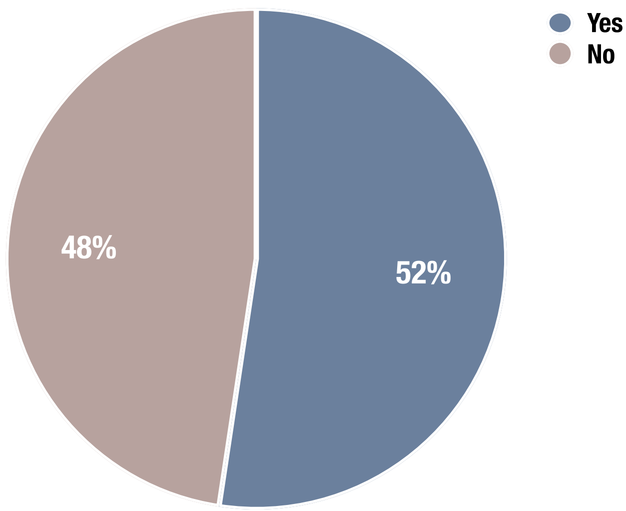


Section 2 |

Prevalence

Fifty percent of respondents (50%) replied that they had experienced flooding in the past 10 years. The highest proportions of respondents with flooding were found in census tracts 201, 203, 207), with multiple events per year were reported.

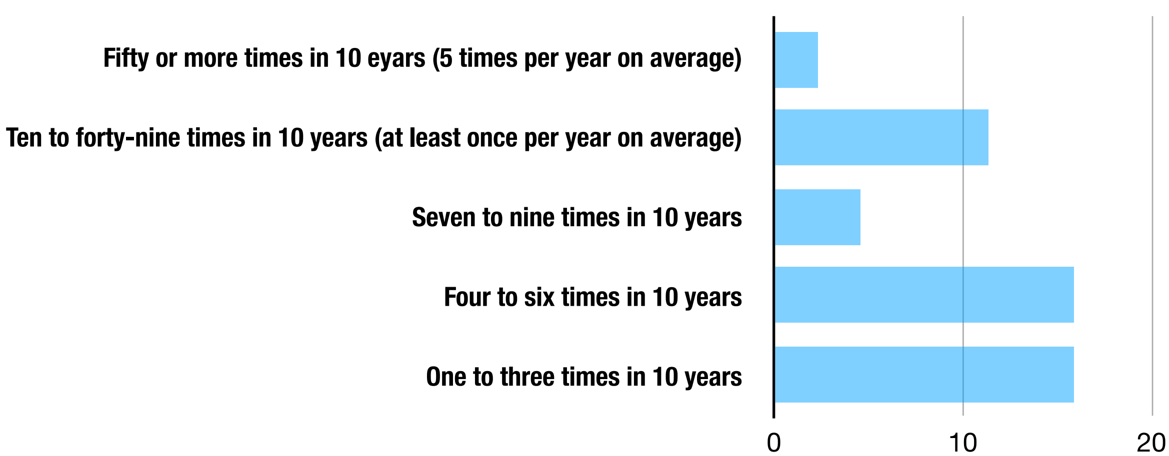
FIGURE 32: PERCENT OF RESPONDENTS WITH FLOODING IN THE LAST 10 YEARS



Frequency

Of the respondents who had experienced flooding in the last 10 years, 11.36% experienced flooding at least once per year in the last 10 years. The two most popular responses regarding flooding frequency were one to three times in 10 years (15.91%), and four to six times in 10 years (15.91%). The greatest frequency of flooding reported by respondents on their property is shown in Figure 33.

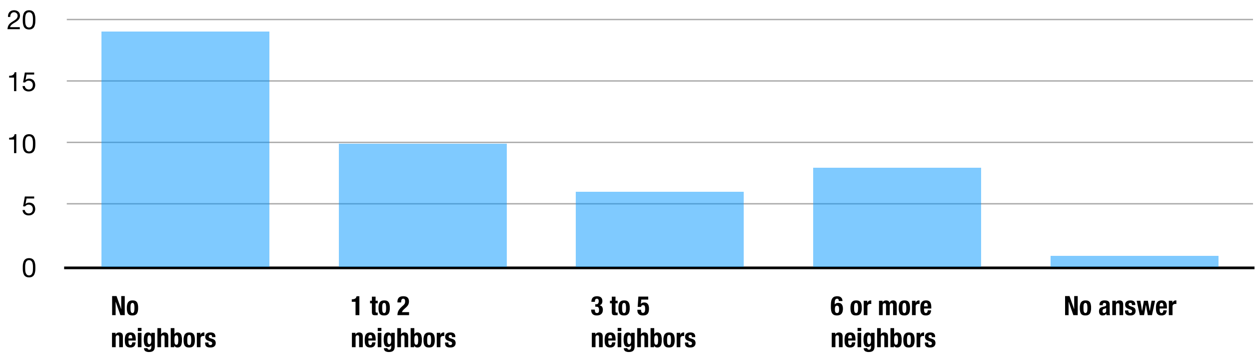
FIGURE 33: FLOODING FREQUENCY OVER LAST 10 YEARS



Neighbors with Flooding

Fifty-five percent (54.5%) or the respondents who had experienced flooding on their own property said their neighbors had also been flooded in the last ten years. Twenty-three percent (22.7%) of respondents were aware of flooding on one or two neighboring properties. Eighteen percent (18.1%) of all survey respondents were aware of flooding on six or more neighboring properties.

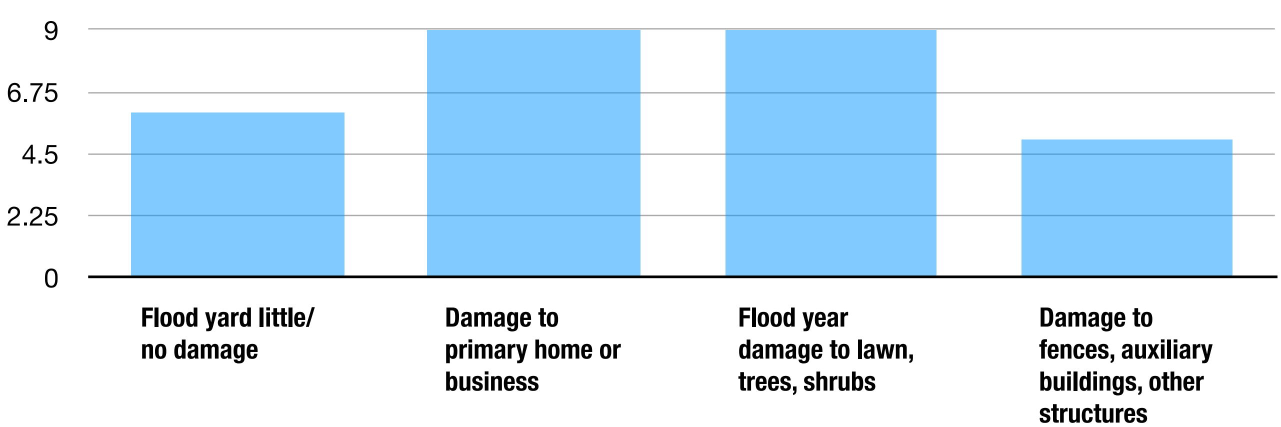
FIGURE 34: RESPONDENTS' NEIGHBORS THAT ALSO HAD FLOODING IN THE LAST 10 YEARS



Extend of Flood Damage

Of those who had been flooded in the last 10 years, 14% had little to no yard damage; 20% said that the flooding had damaged their primary home or business; 20% had damage to yards and landscaping; and 11% had damage to fences, auxiliary buildings, and other structures.

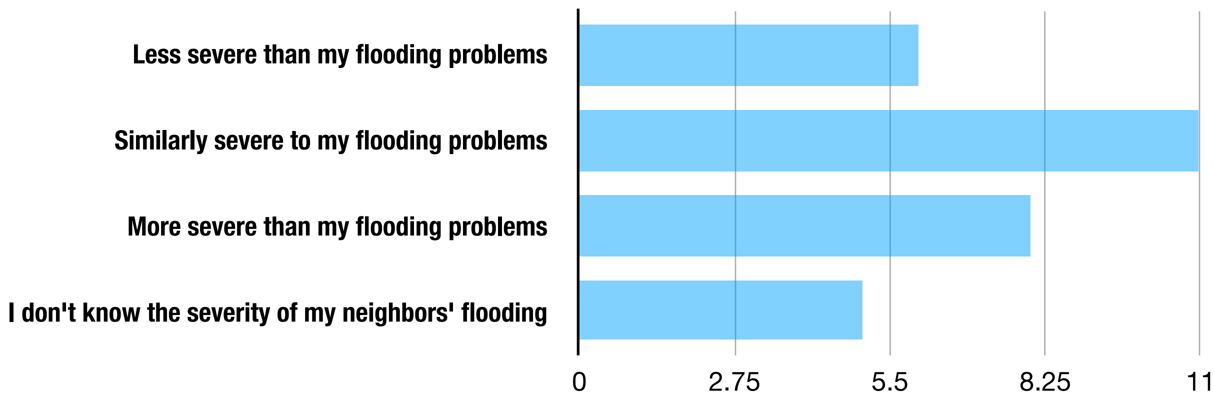
FIGURE 35: EXTENT OF FLOOD DAMAGE IN THE LAST 10 YEARS



Severity of Neighbors' Flood Damage

Fifty-seven percent (56.8%) of the respondents who had been flooded said that their neighbors had also been flooded in the last 10 years. Of these, 25% said that the extend of their neighbors' flooding was similar to their own, while 14% said it was less severe. This indicates that the flood damage reported by respondents about their own pottery may be representative or an understatement of the wider effects of flooding on their communities.

FIGURE 36: EXTENT OF NEIGHBORS' FLOODING



Causes of Flooding

Approximately 36% of respondents who had been flooded said that heavy rainstorms were a cause of their flooding. Other causes identified were a lack of drainage facilities (Swales, ditches, storm sewers, etc.) (16%); flooding from a nearby river, stream, lake, ditch, or pond (14%); and a blocked or unmaintained pipe, culvert, or ditch (16%). For this question, respondents could choose more than one answer, so these responses were not mutually exclusive.

TABLE 7: CAUSES OF RESPONDENTS' FLOODING

CAUSE	RESPONSES	
Heavy rainstorm	16	36.36%
Flooding from nearby river, stream, lake, ditch, or pond	6	13.64%
Obstruction in nearby river, stream, lake, ditch, or pond	8	18.18%
Pipe (not sewer), culvert, or ditch that was blocked or needs maintenance	7	15.91%
Lack of drainage facilities (swales, ditches, storm sewers, etc.) to drain water from the property	7	15.91%
Sewer backup	1	2.27%
I don't know	0	0

Reporting

At least 18% of respondents who were flooded did not report their flooding to anyone. Respondents that did report it were most likely to contact their parish or local government (20%), or their insurance company (14%).

TABLE 8: HOW RESPONDENTS REPORTING FLOODING

REPORTED FLOODING TO	RESPONSES	
I did not report my flooding to anyone	8	20.45%
My parish or local government	9	13.64%
My insurance company	6	18.18%
My local public works to inspect sub surface drainage structures*	1	2.27%

** Written in under 'Other'*

Impacts and Effects from Flooding

The most commonly reporting impact from flooding was monetary loss, and partial loss of access to property. Nine percent (9%) of respondents noted no significant impact as a result from flooding. Twenty-three respondents skipped this question.

TABLE 9: EFFECTS OF FLOODING ON RESPONDENTS

EFFECT FROM FLOODING	RESPONSES	
Monetary loss due to repair of flood damage	13	29.55%
Monetary loss due to lost valuables or equipment	7	15.91%
Partial loss of access to property	6	13.64
Lost business income (business closed, lost productivity)	2	4.55%
Loss of crops	0	0%
No significant effect	4	9.09%

Correlation with Floodplains

FEMA-designated floodplains cover 30% (261,504 acres) of the total acreage in Rapides Parish. Twenty percent (20%) of surveys came from parcels wholly or partly within these floodplains.

FIGURE 37: RESPONDENTS' LOCATION IN RELATION TO FLOODPLAIN

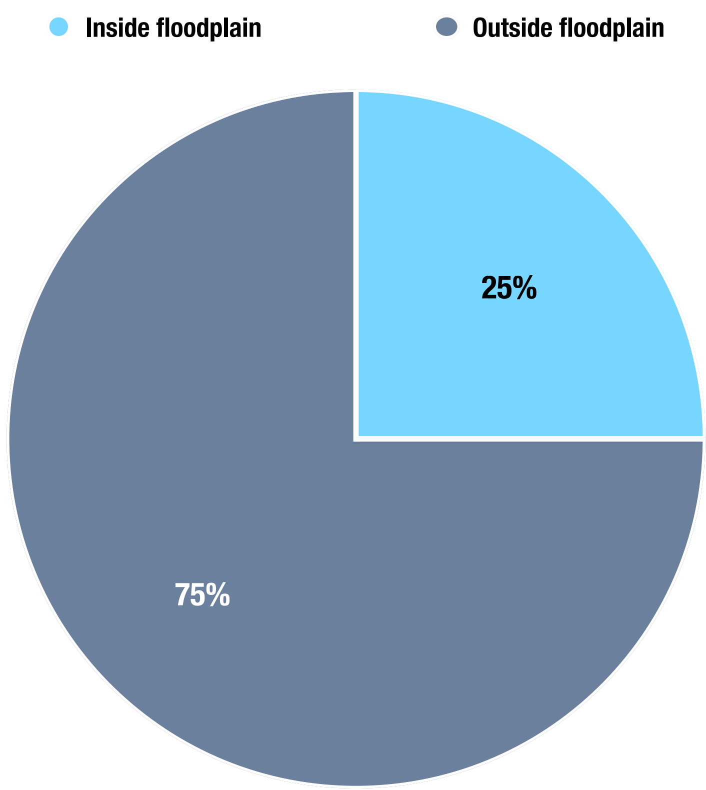
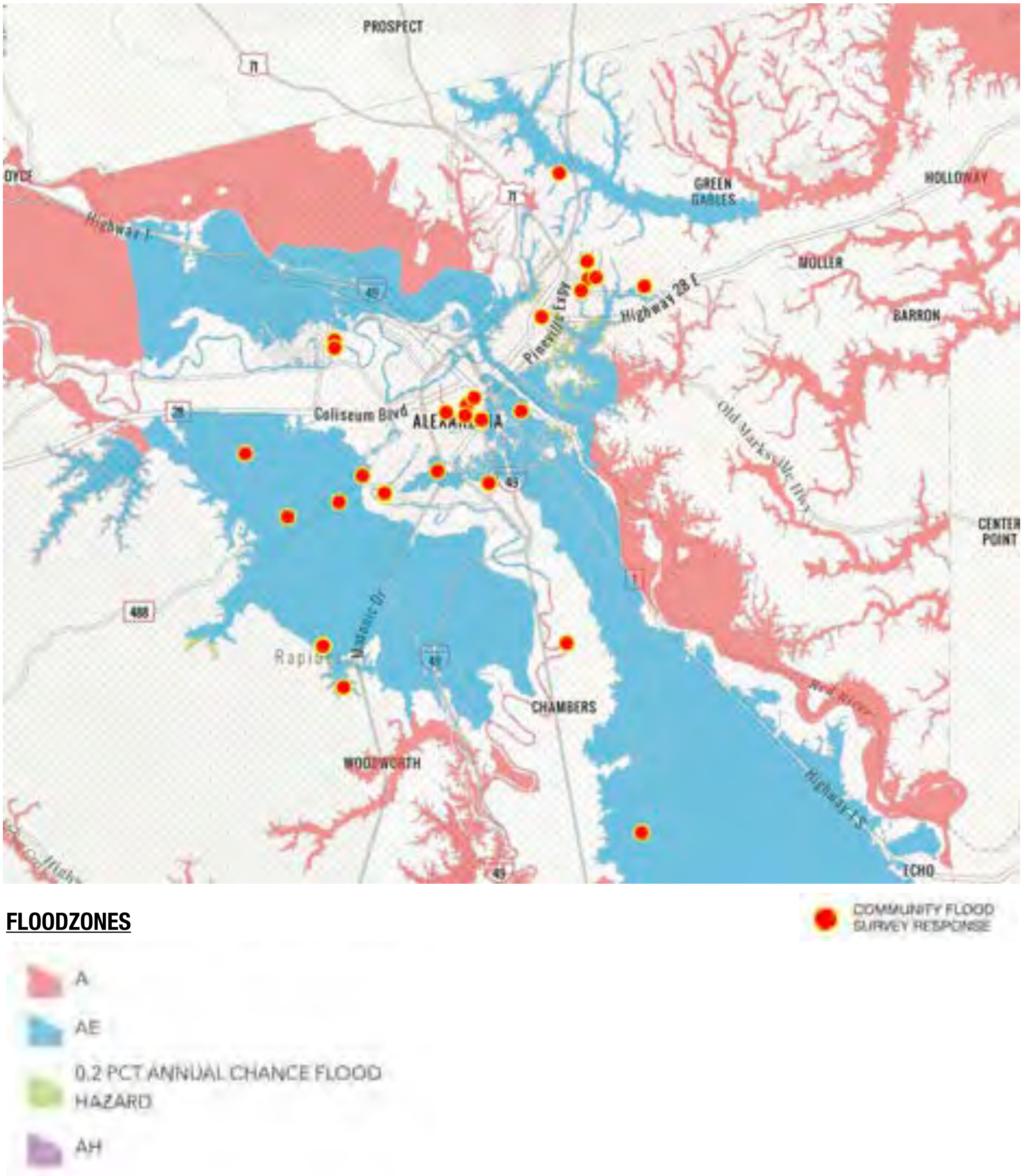


FIGURE 38: SURVEY RESPONDENT LOCATION IN FLOODPLAIN

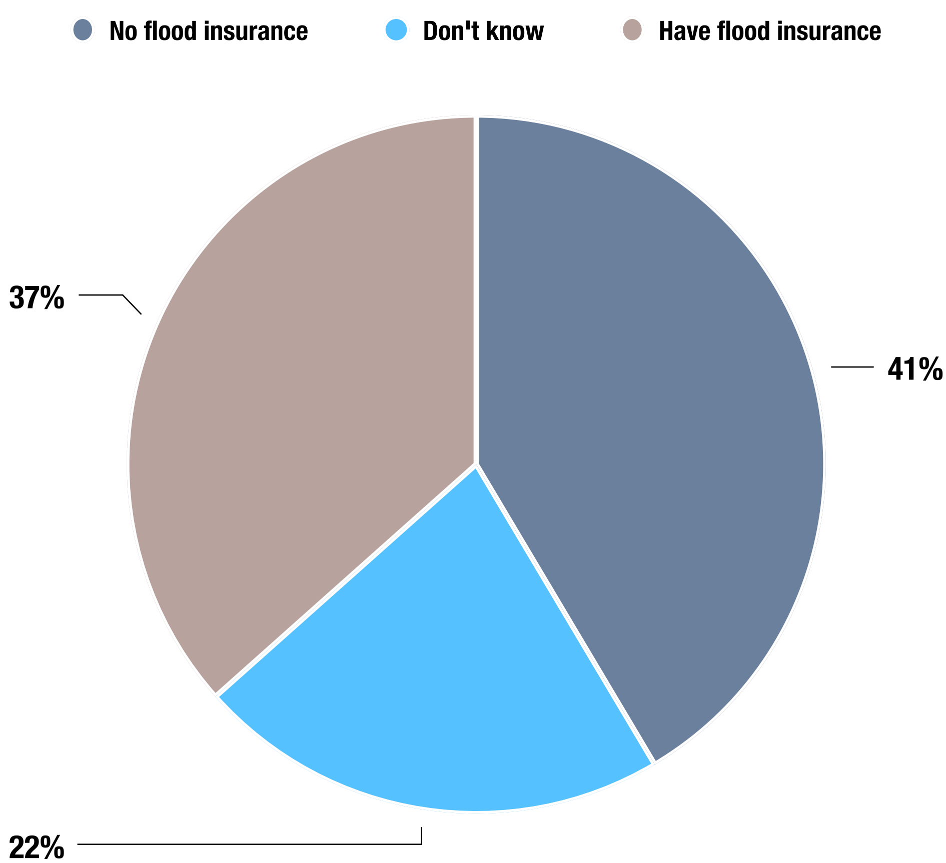


Flood Insurance Coverage

The average annual flood insurance premium in Louisiana is approximately $826 for a policy offering around $283,000 in coverage, as per the National Flood Insurance Program (NFIP). Rapides Parish and the City of Alexandria are both enrolled in the National Flood Insurance Program (NFIP), allowing floodplain residents to purchase flood insurance for their properties. There are approximately 1,491 Flood Policies in Rapides Parish. The average flood insurance premium paid by Rapides Parish residents is $673 per year. Nationwide, approximately 20% of NFIP claims are for properties located outside floodplains, some of which are from flooding caused by local drainage problems.

Sixty-one percent (34%) of respondents (15 people) said that they have flood insurance. Of these, 11.4% of respondents have filed a flood insurance claim in the last 10 years. Eighteen percent (18.2%) of flooding incidents were not reported to any authority.

FIGURE 39: RESPONDENTS' FLOOD INSURANCE COVERAGE



Measures to Prevent Future Flooding

Eighteen (18) respondents, or 41%, said they had made one or more improvements in an attempt to prevent future flooding/flood damage. Sixteen percent (16%) said they planted native vegetation or buffer strips, or another conservation measure. Creating or enlarging ponds, detention, or retention basins and raising one or more buildings were the next most popular options, at seven percent (14%) of respondents. Respondents were given the option to write in other improvements they had made. Several noted that they graded landscape, installed sump pumps. Most respondents (59%) skipped this question.

TABLE 10: TOP ACTIONS TAKEN BY RESPONDENTS TO PREVENT FUTURE FLOODING

ACTION TAKEN	RESPONSES	
Planted native vegetation, buffer strips, or other conversation measures	7	16%
Created or enlarged a pond or retention/detention basin, ditch or swale	6	14%
Raised one or more buildings	6	14%
Installed permeable paving	1	2%
Installed a rain garden	3	7%
Created levee around property	5	11%
No response	26	59%

Key Takeaways

The Community Flooding Survey reveals significant flooding impacts across multiple tracts within the study area (MPA), with many residents underinsured and unaware of mitigation options. A focused approach combining infrastructure upgrades, education, and community engagement is critical to enhancing regional flood resilience.

The findings of this survey will be incorporated into the MPA Stormwater Study. Some data about the location and extent of flooding in the watershed has already been gathered from stakeholders including mayors, local engineers, LA DOTD, property owners, and landowners. The results of this survey will be considered alongside this data as recommendations for mitigating flooding issues. Additionally, the survey results will be considered alongside the hydraulic and hydrologic model to assess flood impacts across multiple watersheds in the metropolitan planning area.

Further research into flooding issues and their solutions may include gathering data from private insurers about flood insurance claims. Insurance data would allow for the calculation of the distribution of flood insurance and the costs of flooding through verified policies and claims, rather than best estimates.

Section 2 |

H&H Model Workshop

The Rapides Area Planning Commission (RAPC), in collaboration with Halff, hosted a specialized Hydraulic and Hydrologic Model Workshop at the RAPC office on November 7, 2024. This workshop was a key component of the public engagement phase of the MPA Stormwater Study, aiming to provide local engineering professionals with a comprehensive understanding of the newly developed H&H model.

Led by Halff's technical team, the sessions were designed to support engineers in using the H&H model as a roadmap tool for infrastructure decision-making and stormwater planning across the MPA. The workshop welcomed twelve engineers and planners from across the Metropolitan Planning Area (MPA) and featured two focused training sessions:

MORNING SESSION: ARCPRO GIS-BASED PLANNING

The ArcPro training consisted of the typical tools used to do various tasks in the program. This included adding basemap layers, bookmark views, the ribbon tool bar, adding the editor extension, and the catalog tool. The training detailed how to export rasters from HEC-RAS and then import them into ArcPro along with clipping the rasters down and setting the symbology for each raster.

At the end of the presentation, the topic of precipitation and how to use it for flood planning was explained. An overview was provided on NOAA Atlas 14 rainfall, where the precipitation data comes from, and how this data is used to predict frequency year storm events. Examples were given showing a three-hour storm with four inches of rain and a 30-minute storm with three inches of rain and the corresponding frequency storm these two individual events represented. This determination can assist RAPC plan for a disaster and close roads before the storm comes as necessary or have a route planned to disperse sandbags before the storm.

Attendees were trained on:

- Navigating and visualizing flood data rasters
- Using tools like symbology, attribute tables, and storm data overlays (e.g., Atlas 14)
- Exporting and manipulating HEC-RAS results within ArcGIS
- Practical tools for prioritizing stormwater infrastructure improvements based on modeled storm scenarios

AFTERNOON SESSION: HEC-RAS TECHNICAL APPLICATIONS

Halff provide HEC-RAS technical training on accessing the data source library, navigating RAS results, interpreting those results, exporting the data to other software, and project feasibility assessments.

The purpose of this training was to give an overview of how to navigate through the HEC-RAS program using the various tools available. This includes the plot tolerance window, time steps, particle tracing, layer properties, map layers, rasters to export, importance of breaklines, the use of terrain modifications, structures, geometry associations, and how to view the results and compare them.

Topics included:

- Reviewing water surface elevation and depth rasters
- Comparing base and future-condition models to assess flood impacts
- Incorporating terrain modifications, calibration techniques, and breaklines
- Evaluating adverse impacts and identifying erosion risks via velocity rasters

FIGURE 40: HYDROLOGIC & HYDRAULIC MODEL WORKSHOP

Stakeholder Engagement

Overview

Thought the planning process RAPC and Halff actively reached out to stakeholders and potential implementation partners to better understand and guide this effort. Direction from local stakeholders helped identify missing data for the H&H Model and develop a comprehensive database of all recently completed or planned improvements related to the transportation system and stormwater drainage to inform future local and regional planning efforts.

The Rapides Area Planning Commission (RAPC) actively engaged stakeholders and potential partners to:

- Understand local stormwater and flood mitigation needs.
- Identify data gaps and improve study outcomes through collaboration.
- Guide planning efforts for the Metropolitan Planning Area (MPA) Stormwater Study.

Stakeholders

The effort includes input from the MPO's TAC featuring a broad range of public and technical entities:

- Rapides Parish Police Jury
- Grant Parish Police Jury
- City of Alexandria
- City of Pineville
- Town of Ball
- Town of Boyce
- LA Department of Transportation & Development District 08
- Red River, Atchafalaya,& Bayou Boeuf Levee District
- Red River Waterway Commission
- US Army Corp of Engineers - Vicksburg District
- Louisiana Engineering Society
- Rapides Parish Gravity Drainage District No. 1
- Rapides Parish Gravity Drainage District No. 2

Stakeholder Input Activities

The APMPO's Technical Advisory Committee (TAC) consists of local planners, engineers, as well as LADOTD, FTA, FHWA staff and provides input on transportation matters from a technical perspective on projects inside the metropolitan planning area. Halff attended four TAC meetings to update RAPC and local engineers on project progress.

Focus:

- Pairwise ranking of priorities (e.g., road flooding, emergency access, environmental impacts).
- Reviewing survey data, model assumptions, and data validation.
- Shared hydrologic and hydraulic (H&H) model progress and collected feedback.

The TAC served as the primary vehicle for stakeholder input and engaged throughout the entirely of this project. Presentations were developed to provide technical materials including PowerPoint slides and exhibits for stakeholders to view. The TAC discussed Pairwise ranking and overall area needs as well as reviewing RAS models and provided input on survey data representation in Web Maps. TAC meetings provided an opportunity to share the data collected, explain the benefits of the prepared model, demonstrate the accelerated ability to model mitigation alternatives, and collect feedback.

TABLE 11: STAKEHOLDER MEETINGS

Entity	Date	Meeting Focus
COA	April 18, 2022	Collected underground conveyance structures from the City of Alexandria Engineering Division.
TAC	Aug 24, 2022	Introduced Pairwise Ranking to prioritize criteria such as mobility, property damage, cost, and funding .
RRABB	April 22, 2023	Discussed the best approach to model flood gates and other complex structures within Rapides Parish.
TAC	May 31, 2023	Reviewed RAS models and GIS datasets. Gathered TAC preferences on model development .
DOTD08	Aug 15, 2024	Reviewed plans for pumps under I-49 for H&H existing conditions and alternatives.
TAC	Feb 7, 2024	Discussed H&H modeling alternatives including short and long diversion solutions for flood-prone areas.
TAC	Nov 6, 2024	Planned meeting to finalize deliverables, summarize public input, and discuss model access/utilization.
DOTD08	Dec 27, 2024	Discussed feasibility of alternatives for Pineville model.

Louisiana Engineering Society (LES) also hosted meetings to discuss the planning efforts with local engineers. These meetings provided additional opportunities to request local data and validate what was already collected. Stakeholder input also helped RAPC and Halff to identify and establish the individual stakeholders' understanding of their natural hazard risks and understand the stakeholders' willingness for mitigation.

Stakeholder Identified Key Flood-Prone Areas & Proposed Solutions:

- **Chatlin Lake Canal:** Long vs. short diversion options. Pumping and detention recommended.
- **Elliot Street/I-49 Area:** Ponding issues; proposed road crown increase, upsized inlets, and underground detention.
- **McKeithen Drive Area:** Pluvial and backwater flooding; culvert upgrades and bridge widening proposed.
- **Camellia Place Subdivision:** Undersized inlets; propose upgrades and debris clearing.
- **Horseshoe Drainage Canal:** Erosion due to flow transition; channel hardening proposed.

Pairwise Ranking

The study team employed a Pairwise Evaluation Criteria Ranking method to support the Technical Advisory Committee (TAC) in prioritizing transportation-related flood mitigation projects. This framework enhances the objectivity, transparency, and equity of decision-making by quantitatively weighting evaluation criteria based on expert input. The goal is to apply this approach to guide stormwater infrastructure planning and investment decisions within the Metropolitan Planning Area (MPA) Stormwater Study.

Methodology

The Pairwise ranking process involves comparing every evaluation criterion against each other using a structured scale as 1: Less important, 2: Equally important, or 3: More important. Each criterion is placed in a matrix and compared across all others to assess priority. The criteria span four thematic categories featured in Table 12.

TABLE 12: MPA STORMWATER STUDY PAIRWISE EVALUATION

Category	Criteria
Public Safety	Road Flooding and Mobility, Property/Infrastructure Flooding, Emergency Access
Social Impact	Public Acceptance, Social Vulnerability, Community Benefits
Economic	Project Cost, Economic Development Impacts, Funding Source (Grant Potential)
Environmental	Environmental Impacts

Pairwise Ranking Results

Figure 41 features TAC input using the Pairwise ranking matrix. TAC input into the matrix was used to create weights (e.g., Road Flooding and Mobility = 18% importance, Emergency Access = 15%, etc.) that reflect the TAC's priorities.

Top-Priority Criteria based on the Pairwise Average Responses provided by the TAC included:

- Road Flooding and Mobility received consistently high comparative scores (rated higher than or equal to 8 of 9 other criteria).

- Emergency Access was also highly valued, often rated equal or more important than other categories.
- Community Benefits and Social Vulnerability scored well in relevance, reflecting strong community-centered priorities.

FIGURE 41: PAIRWISE RANKING PROJECT PRIORITIZATION CHART & RESULTS

	Criteria	Road Flooding and Mobility	Property/Infrastructure Flooding	Emergency Access	Public Acceptance	Social Vulnerability	Community Benefits	Project Cost	Economic Development Impacts	Funding Source (Grant Potential)	Environmental Impacts
1	Road Flooding and Mobility		2	1	3	3	3	3	2	3	2
2	Property/Infrastructure Flooding	3		1	3	3	3	3	2	2	2
3	Emergency Access	2	2		3	3	3	3	3	3	3
4	Public Acceptance	1	2	1		2	2	1	1	2	1
5	Social Vulnerability	1	1	1	2		2	2	1	1	1
6	Community Benefits	2	1	1	2	2		1	1	2	2
7	Project Cost	2	2	1	2	1	2		2	1	3
8	Economic Development Impacts	1	1	1	2	2	2	2		2	1
9	Funding Source (Grant Potential)	1	1	1	3	3	2	2	2		1
10	Environmental Impacts	2	1	1	1	1	1	1	3	2	

MPA Stormwater Study Application

As illustrated in Table 13, the TAC's Pairwise input results in a rigorous yet flexible prioritization tool for the MPA Stormwater Study. It ensures that flood mitigation investments focus on outcomes with the highest community and safety benefits. Projects identified in the MPA Stormwater Study can now be scored against each criterion and weighted using the TAC-derived rankings.

TABLE 13: RESULTS APPLICATION TO MPA STORMWATER STUDY

Criteria-Weighted Scoring System	Project Screening and Tiering	Grant Alignment and Policy Justification
This ensures prioritization aligns with the region's values around: • Mobility and safety during flood events • Access to emergency services • Protection of vulnerable populations • Enhancement of overall community benefits	**Using this method, planners can:** • Rank proposed stormwater improvements based on a total weighted score. • Identify "high-return" projects (e.g., those that score well in top-weighted categories) for early implementation or grant targeting. • Group projects into tiers (High, Medium, Low Priority) for phased capital improvement planning.	**By tying project rankings to transparent, community-driven priorities:** • The results support justification for federal/ state funding applications. • The process strengthens public trust and interagency coordination, reinforcing that decisions are data-driven and equity-aware.

Key Findings & Implications

The MPA Stormwater Study's public engagement process has produced valuable, geographically specific data to inform future transportation and stormwater planning. Community members across the Alexandria-Pineville Metropolitan Area provided feedback on preferred drainage improvements and critical focus areas. Figures 42 and 43 denote public representation inside the MPA by combining survey and open house participation by RAPC Zone and Floodplain.

FIGURE 42: TOTAL PUBLIC REPRESENTATION BY STUDY ZONE

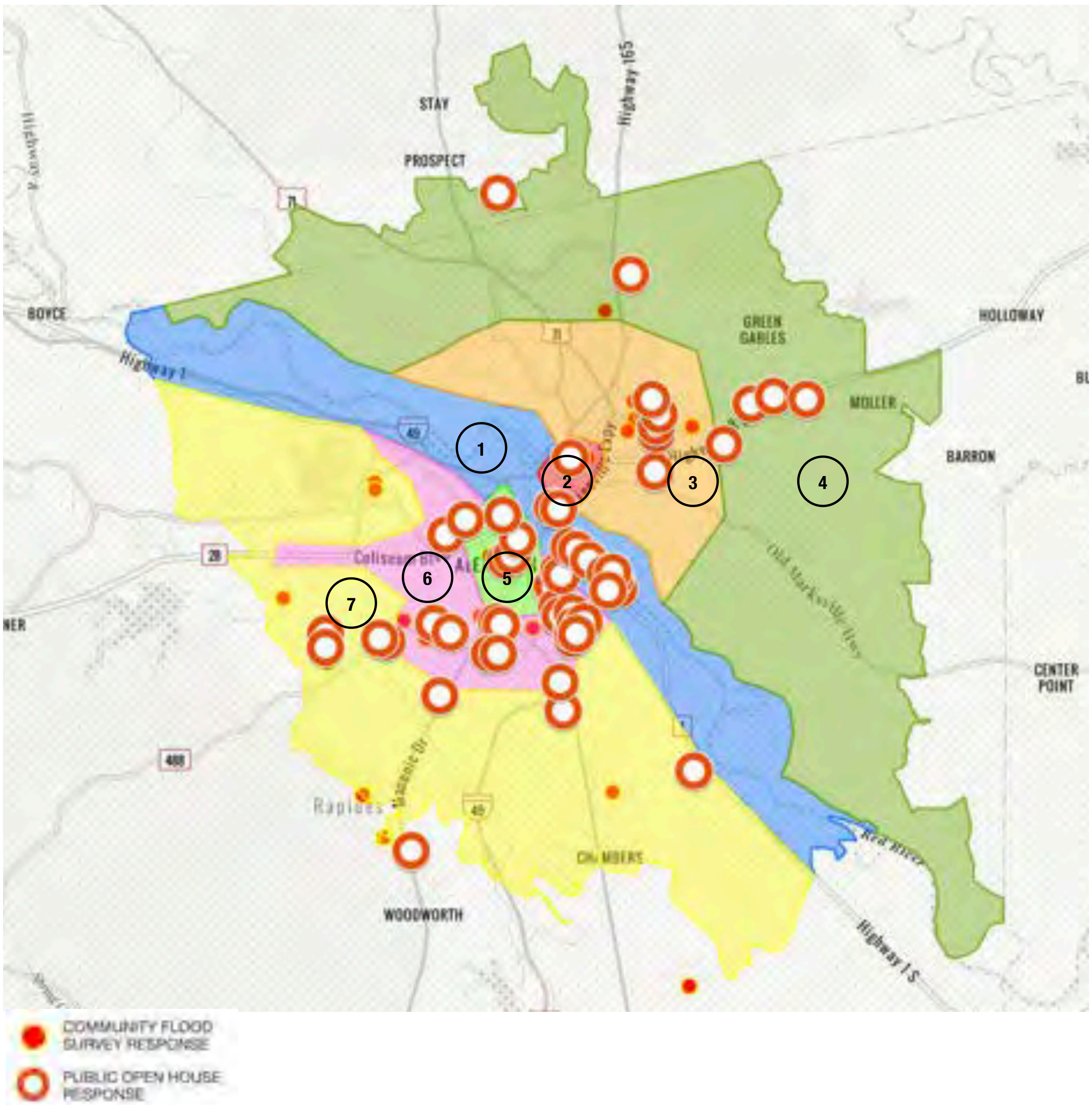
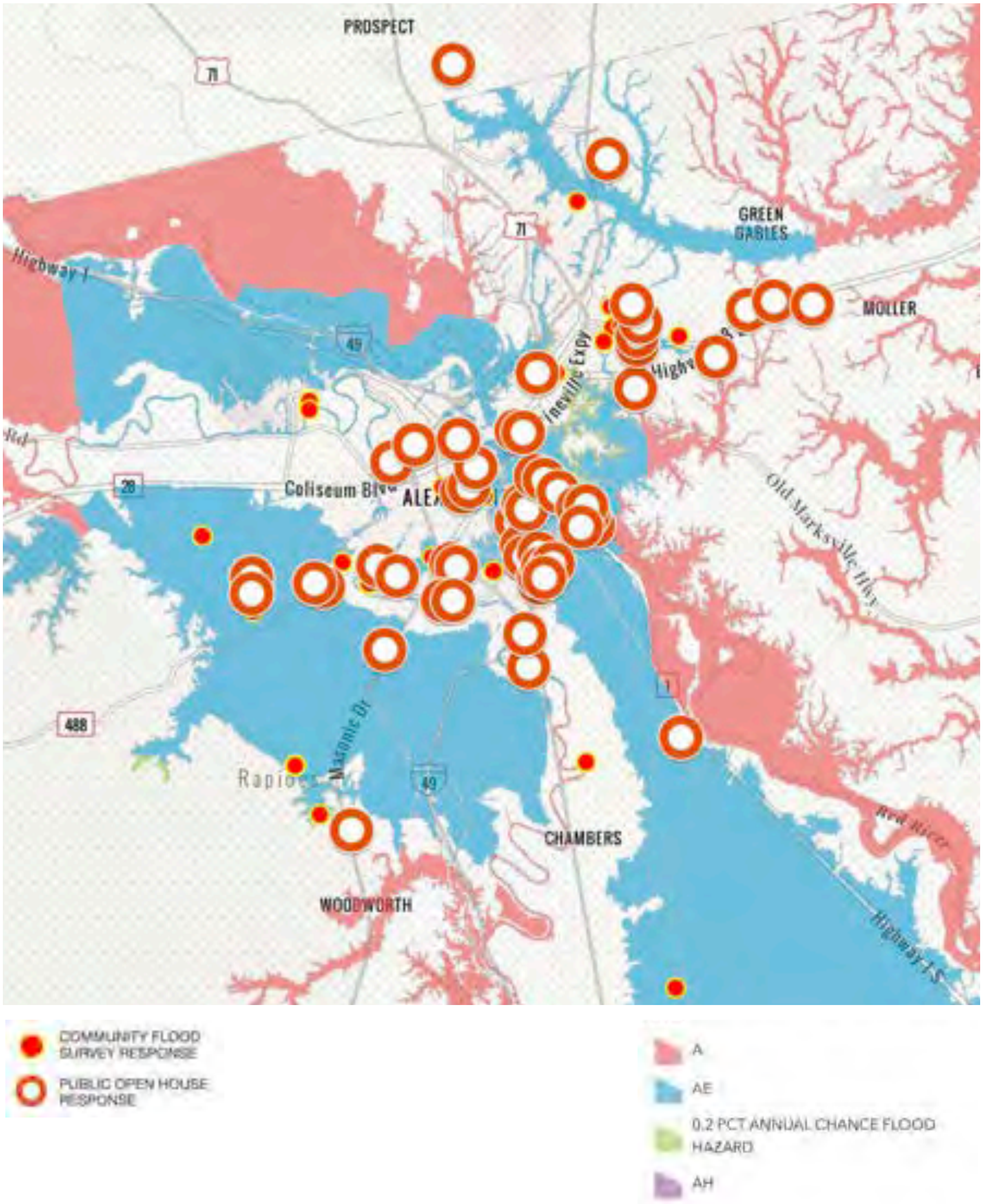


FIGURE 43: TOTAL PUBLIC REPRESENTATION IN FLOODPLAIN



Summary of Stormwater Metrics Comparison by RAPC Zone

The charts below summarize this input, aggregated by RAPC Zone, and compares key stormwater-related metrics.

FIGURE 44: PREFERRED DRAINAGE IMPROVEMENT FOCUS AREAS BY ZONE

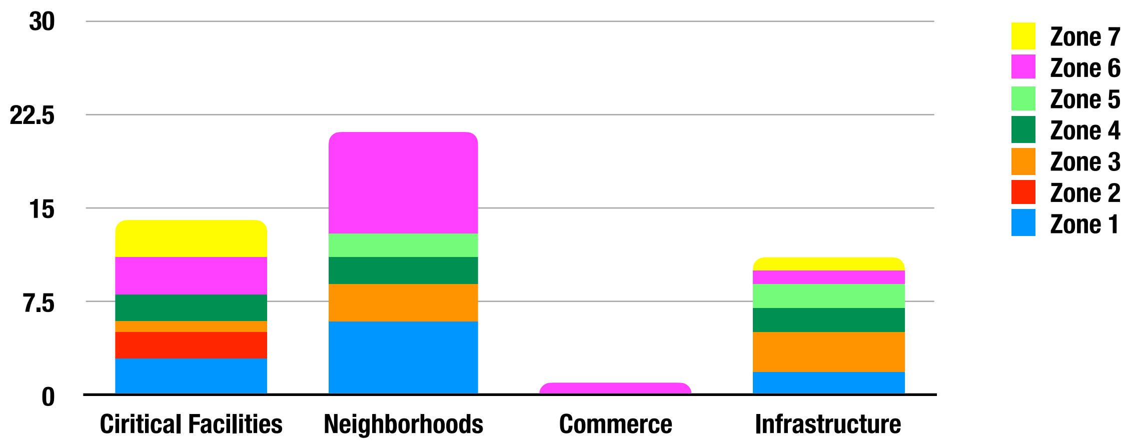


Figure 44 illustrates community preferences and priorities where they believe future stormwater drainage improvements should begin, based on four key categories: Critical Facilities, Neighborhoods, Commercial Areas, and Infrastructure.

Key Insights:

- Zone 1 received the most community support, especially around neighborhoods and essential services.
- Participants clearly expressed that not all areas can be addressed at once, but targeted improvements should begin in zones with the highest vulnerability or most public-facing impacts.
- Feedback provides a community-driven roadmap to guide phased implementation of stormwater improvements.

FIGURE 45: PREFERRED COMMERCE FLOOD MITIGATION FOCUS BY ZONE

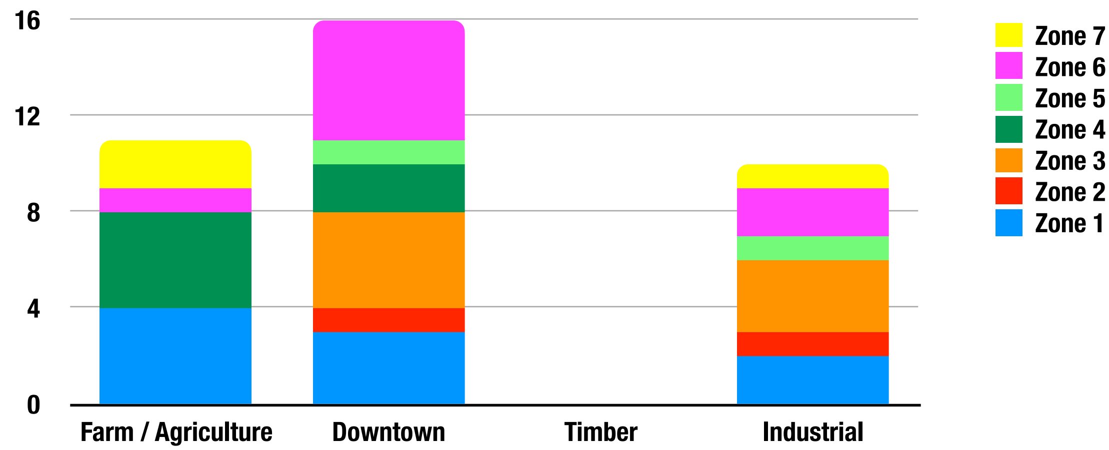


Figure 45 illustrates community preferences and priorities which commercial areas (by type and zone) should be prioritized for flood mitigation efforts, based on four key categories: Farm/ Agriculture, Downtown, Timber, and Industrial land uses.

The public's priorities for commercial flood mitigation clearly emphasize Downtown districts, followed by agricultural and industrial areas, with an emphasis on Zones 1, 3, and 6. This input will help guide future infrastructure planning to support economic resilience throughout the MPA.

Key Insights:

- Downtown areas received the highest attention indicating a strong public interest in protecting community cores and commercial districts from flooding, followed by Farm/ Agriculture and Industrial areas.
- Timber areas received no votes, suggesting they are not perceived as a priority for flood mitigation.

FIGURE 46: PREFERRED CRITICAL FACILITIES FLOOD MITIGATION BY ZONE

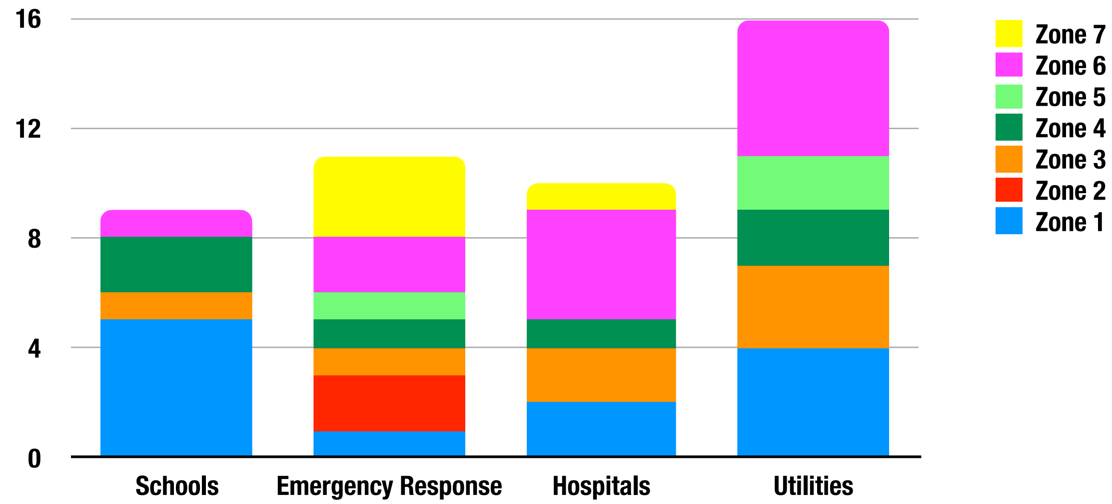


Figure 46 illustrates community preferences and priorities which critical facilities—such as schools, emergency services, hospitals, and utilities—should be prioritized for flood protection first.

Public feedback clearly indicates that Utilities, Emergency Services, and Hospitals should be the primary focus for flood mitigation planning. Zones 1 and 6 emerged as the most critical areas for investment, supported by a broad spread of votes across multiple facility types.

Key Insights:

- Utilities received the highest number of total votes (16), reflecting community concern for maintaining essential services during flood events.
- Emergency Response (11 votes) and Hospitals (10 votes) were close behind, emphasizing the need for operational continuity in emergencies.
- Schools received 9 votes, showing moderate public interest.

FIGURE 47: PREFERRED INFRASTRUCTURE MITIGATION FOCUS BY ZONE

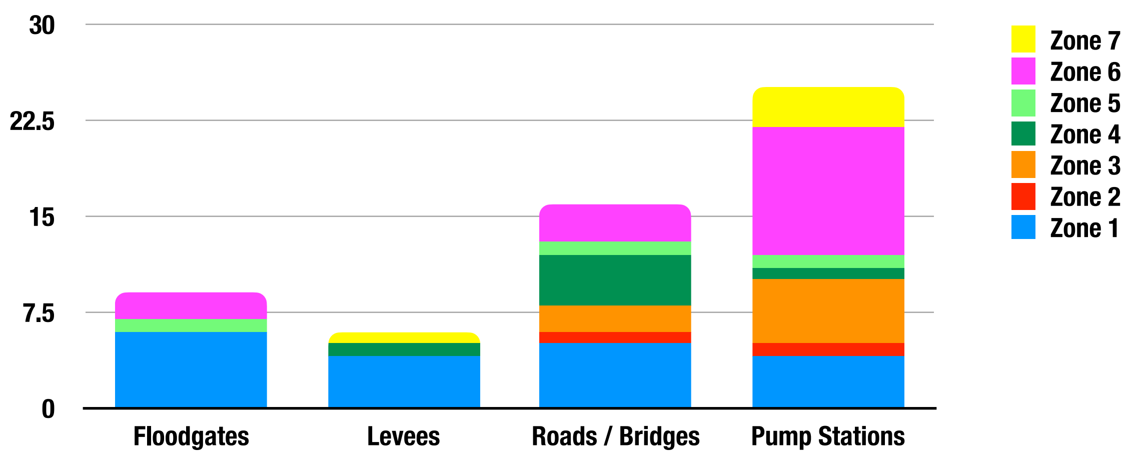


Figure 47 illustrates community preferences and priorities which types of infrastructure and which zones should be prioritized for stormwater-related mitigation efforts. The focus was on Floodgates, Levees, Roads & Bridges, and Pump Stations—key elements in protecting communities and maintaining access during flood events.

Public feedback strongly emphasized Pump Stations and transportation infrastructure (Roads & Bridges) as priorities for flood mitigation. Zones 1 and 6 stood out as the highest priority areas for infrastructure improvements, with consistent support across multiple mitigation strategies.

Key Insights:

- Pump Stations were the top priority, indicating strong public demand for investment in systems that can actively move water out of flood-prone areas.
- Roads & Bridges reflecting concern about accessibility during flood events.

FIGURE 48: PREFERRED NEIGHBORHOOD MITIGATION FOCUS BY ZONE

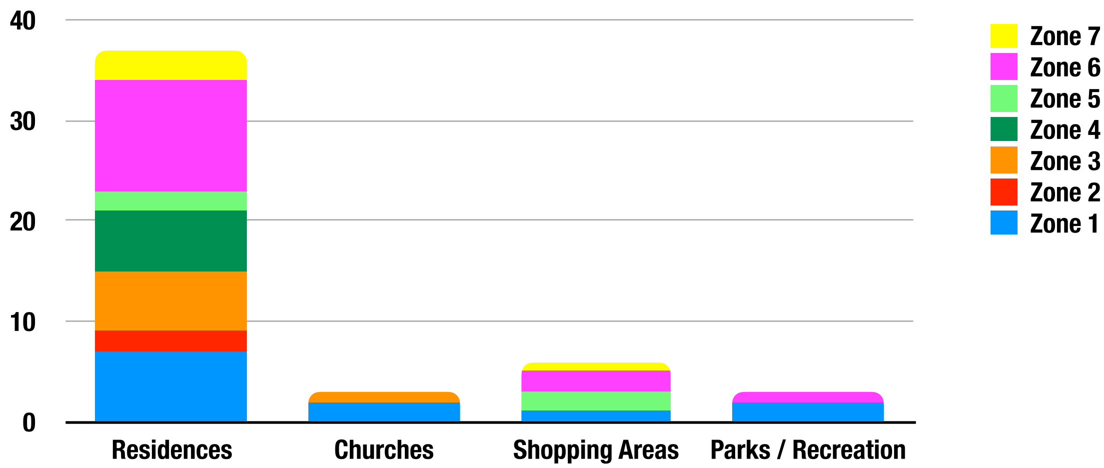


Figure 48 illustrates community preferences and priorities which types of neighborhood areas —Residential Buildings, Churches, Shopping Areas, and Parks & Recreation—should be prioritized for flood mitigation, and in which zones those improvements are most needed.

The feedback highlights Residential Buildings as the community's top concern for flood protection in neighborhood areas, especially in Zones 6 and 1. While secondary amenities like shopping and recreation received some attention, the results reinforce the public's desire to prioritize protection of homes above all.

Key Insights:

- Residential Buildings received overwhelming focus, clearly the top concern for participants.
- Shopping Areas and Parks & Recreation tied for second and third priority, followed by Churches with 3 votes.
- Support for non-residential neighborhood features (Churches, Shops, Parks) was spread more thinly, with no single zone dominating these categories.

FIGURE 49: PREFERRED DRAINAGE IMPROVEMENTS BY ZONE

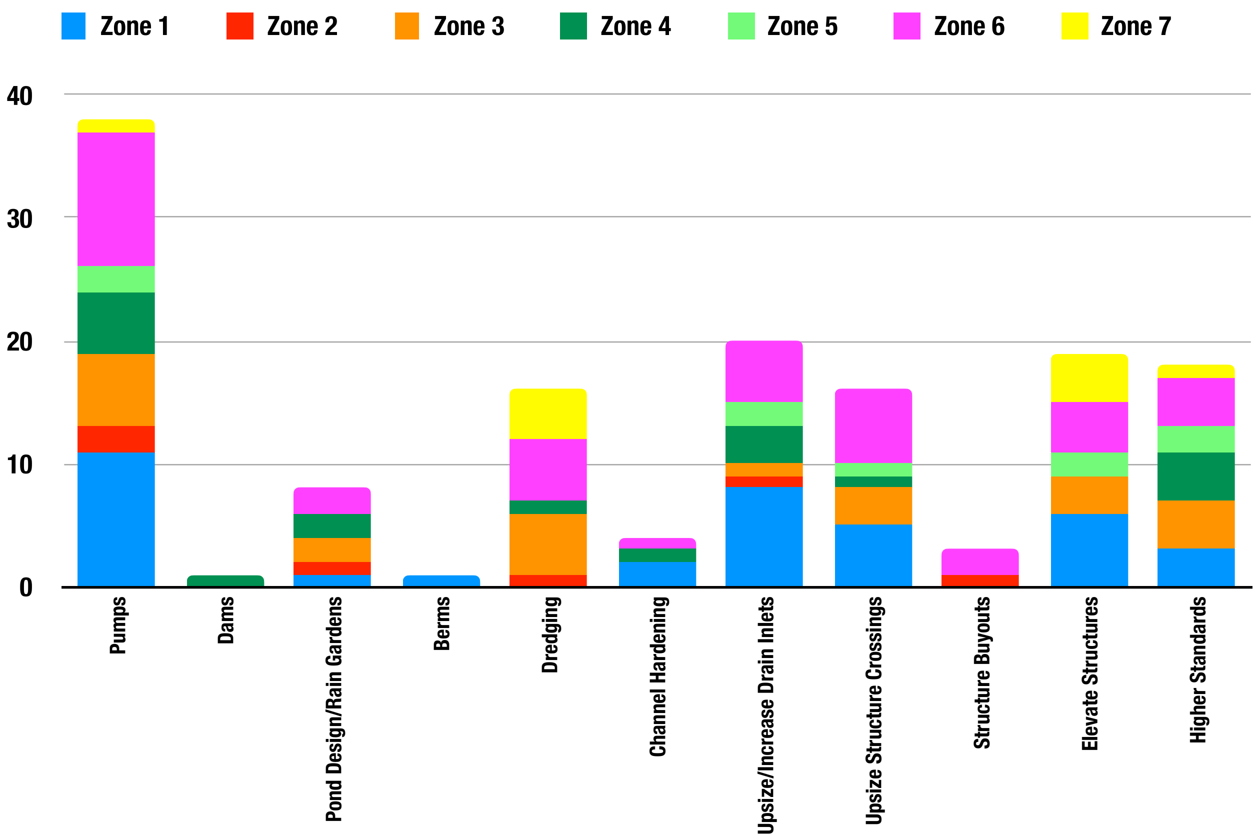


Figure 49 illustrates community drainage improvement strategies preferred by the community by RAPC Zone. Each option included pros and cons to help participants make informed decisions.

The public expressed clear preference for active infrastructure (pumps and inlets) and building-level protections (elevation). Less intrusive or long-term policies like buyouts and higher standards received minimal but notable support. These preferences reflect a community desire for proactive, visible flood management solutions, particularly in the most vulnerable areas like Zone 1.

Key Insights:

- Pumps - Most popular overall, seen as essential for moving water quickly in flood-prone areas
- Drain Inlets - Indicating a desire for improved street-level water capture
- Elevating Structures - Suggests public interest in long-term flood resilience for buildings
- Channel Hardening, Dredging, and Berms – Moderate support, depending on zone
- Structure Buyouts – Only 1 vote, suggesting limited public support

Flood Mitigation Preferences by Zone

Zone 1: Comprehensive Urban Resilience
Zone 1 reflects widespread flood vulnerability, necessitating multi-faceted, city-scale interventions. Zone 1 demonstrates a broad and intensive flood mitigation focus:

- Focus Areas: *Strong emphasis on protecting residential neighborhoods and critical facilities. Infrastructure is also noted, while commerce is a lesser concern.*
- Commercial Priorities: *Balanced concern across agriculture, downtown, and industrial sectors.*
- Critical Facilities: *Highest priority given to schools, with additional concern for utilities and hospitals.*
- Infrastructure: *Strong support for floodgates, levees, roads & bridges, and pump stations.*
- Neighborhoods: *Concern extends beyond homes to include churches and recreational spaces.*
- Mitigation Strategies: *Strongest support for pumps, drainage systems, elevating structures, and stormwater control.*

Zone 2: Targeted, Critical Protection
Zone 2 reflects localized risks, primarily focused on emergency functionality and home protection. Zone 2 displays a focused response:

- Focus Areas: *Prioritizes critical facilities only, with no identified needs for neighborhoods, commerce, or infrastructure.*
- Commercial Priorities: *Minor concern for downtown and industrial zones.*
- Critical Facilities: *Focused on emergency services.*
- Infrastructure: *Basic support for road access and pumps.*
- Neighborhoods: *Limited to residential buildings.*
- Mitigation Strategies: *Diverse yet minimal, including pond designation, dredging, structure buyouts, and pumping.*

Zone 3: Moderate Urban Adaptation
Zone 3 supports mid-level infrastructure upgrades aimed at maintaining urban function during floods. Zone 3 balances urban infrastructure with livability:

- Focus Areas: *Equal attention to neighborhoods and infrastructure, with some mention of critical facilities.*
- Commercial Priorities: *Focused on downtown and industrial sectors.*
- Critical Facilities: *Emphasis on utilities, followed by hospitals and schools.*
- Infrastructure: *Prioritizes pumping and roads/bridges.*
- Neighborhoods: *Strong preference for residential protection, with minor mention of churches.*
- Mitigation Strategies: *Emphasizes pumps, dredging, stormwater system upgrades, and elevation.*

Zone 4: Balanced, Multi-Sector Needs
Zone 4 exhibits zone-wide flood vulnerability across multiple sectors and land uses. Zone 4 presents a well-rounded profile:

- Focus Areas: *Equal focus on neighborhoods, infrastructure, and critical services.*
- Commercial Priorities: *Heaviest emphasis on agriculture, with moderate interest in downtown protection.*
- Critical Facilities: *Even distribution across schools, utilities, hospitals, and emergency services.*
- Infrastructure: *Road and bridge improvements are a top priority, with some levee and pump investment.*
- Neighborhoods: *Fully concentrated on residential protection.*
- Mitigation Strategies: *Mix of pumps, ponds, drainage upgrades, and structural controls.*

Zone 5: Localized Risk Management
Zone 5 requires strategic upgrades for specific assets, rather than broad infrastructure expansion. Zone 5 reflects a narrower, localized mitigation approach:

- Focus Areas: *Targeted at neighborhood flooding and infrastructure maintenance.*
- Commercial Priorities: *Even but modest concern for downtown and industrial zones.*
- Critical Facilities: *Minor interest in utilities and emergency services.*
- Infrastructure: *Balanced attention to pumps, roads, and floodgates.*
- Neighborhoods: *Focused equally on residences and local shopping areas.*
- Mitigation Strategies: *Smaller-scale solutions such as pumps, elevating buildings, and code upgrades.*

Zone 6: High-Risk, High-Response Zone
Zone 6 demands robust, layered flood protection for homes, utilities, and economic hubs. Zone 6 is the most mitigation-focused zone:

- Focus Areas: *Highest concern for neighborhood flooding, with mention of commerce and infrastructure.*
- Commercial Priorities: *Strongest support for downtown, with attention to agriculture and industrial sectors.*
- Critical Facilities: *Top-ranked for utilities and hospitals, reflecting infrastructure and healthcare vulnerability.*
- Infrastructure: *Most support for pumping stations, along with roads and floodgates.*
- Neighborhoods: *Leads in residential concern, plus interest in parks and shopping areas.*
- Mitigation Strategies: *Infrastructure-intensive focus—pumps, drain inlets, elevations, and stormwater control systems dominate.*

Zone 7: Strategic, Service-Focused Protection
Zone 7 is a service-resilience zone, supporting targeted investments to sustain emergency and rural systems. Zone 7 focuses on essential services:

- Focus Areas: *Emphasizes critical facilities—especially emergency response—with little concern for homes or businesses.*
- Commercial Priorities: *Agricultural protection leads, with minor industrial focus.*
- Critical Facilities: *Primarily concerned with emergency preparedness.*
- Infrastructure: *Focus on pump stations, with some mention of levees.*
- Neighborhoods: *Targeted concern for homes and local commerce.*
- Mitigation Strategies: *Favors dredging, structure elevation, and minimal pumping.*

Community-Driven Priorities for Flood Mitigation

Stakeholder and public feedback across the MPA highlights a clear preference for practical, high-impact, and visible drainage improvements. There is broad endorsement for targeted infrastructure investments, transparent funding, and sustainable strategies that reduce flood risks while building long-term resilience. Chief among these are investments in pump stations and drainage inlet upgrades, reflecting widespread concerns about stormwater accumulation and localized flooding.

Residents also expressed consistent support for protecting community assets, including:

- Residential neighborhoods (the most frequently cited concern),
- Critical facilities such as utilities, emergency services, and hospitals, and
- Transportation infrastructure, especially roads and bridges.

Top Priority Areas
- Residential Flooding: Universally prioritized across all zones (37 of 49 total mentions).
- Critical Services: Utilities were the highest-ranked, followed by emergency response and hospitals.
- Downtown Commercial Centers: Most commonly prioritized for commercial flood protection, especially in urban zones.
- Agriculture: A close second in commercial concern, particularly in rural and peri-urban zones.

Most Supported Mitigation Strategies
- Pump Stations: The top mitigation preference across all zones, indicating high community awareness of localized drainage issues.
- Drainage Inlets & Stormwater Structures: Strong secondary support, reflecting infrastructure-focused solutions.
- Elevation & Structural Improvements: Widely viewed as essential to flood-proof homes and key buildings.
- Natural Methods: Approaches like ponds and dredging were selectively supported, often based on geographic suitability.

Infrastructure & Access

- Road Access: Ranked high in Zones 1, 3, and 4, underlining concerns over mobility and emergency evacuation routes.
- Floodgates and Levees: Received moderate support, primarily in Zone 1, suggesting a more selective need for large-scale containment systems.

Key Takeaways

Community feedback provides a strong, unified foundation for shaping future stormwater investment and planning efforts. Across all zones, residents consistently prioritized the protection of neighborhoods and critical facilities, underscoring a shared concern for both public safety and daily livability.

The most widely supported mitigation strategies—pump stations, drainage system upgrades, and building elevation—reflect a dual need to manage stormwater volume and strengthen property-level resilience.

Zones such as 1 and 6 advocate for comprehensive, system-wide infrastructure improvements, while Zones 2, 5, and 7 show a preference for targeted, localized solutions tailored to specific vulnerabilities.

Overall, the public supports a thoughtful blend of physical infrastructure upgrades and strategic policy measures that not only reduce flood risk but also enhance long-term regional resilience in the face of increasingly severe weather events. This input offers a clear, community-driven path forward—ensuring flood mitigation strategies are both technically effective and publicly supported.

Section 3 |

Introduction

As communities across the Metropolitan Planning Area (MPA) increasingly face the impacts of extreme weather and chronic flooding, the resilience of transportation infrastructure has become a central focus of regional planning. This section presents a comprehensive framework of best practices that integrates traditional engineering methods with innovative, sustainable, and cost-effective approaches to stormwater management.

This section serves as a practical guide for local governments, planners, and public works teams to implement strategies that reduce roadway flooding, protect public safety, and extend the functional lifespan of vital transportation corridors. It highlights solutions tailored to a range of community sizes and capacities—from advanced smart systems in urban areas to scalable green infrastructure for rural and resource-limited jurisdictions.

By emphasizing prevention, adaptability, and coordination, the strategies outlined in this section support a more resilient and environmentally responsible infrastructure network. These practices also align with federal and state funding criteria, making them not only technically effective but also financially strategic for long-term implementation.

Alternatives and Flood Risk Solutions

Each HUC was evaluated separately due to potentially complex interactions between neighboring HUCs. The 100-year potential flood inundation results were used to identify problem areas that could benefit from mitigation alternatives. Considerations for conceptual alternatives include:

- Bypass (Diversion) systems
- Parallel systems
- Enlargement / replacement of existing systems
- New storm drain relief systems
- Detention
- Property Acquisitions
- Extension of hardened channels
- Rezoning
- Dredging / Regrading
- Berm height increase

Detailed analysis was conducted for the alternatives during this phase of the study.

Four alternatives were identified and modeled based on community outreach and model result investigation. These included Downs Lane and McKeithen Drive in Alexandria as well as Pineville Expressway and Main Street in Pineville. Existing infrastructure benefit assessment was also conducted for the I-49 downtown area. Additionally, a recently completed Louisiana Watershed Initiative (LWI) funded flood mitigation project was modeled in the Hynson watershed in Alexandria.

COMMUNITY OUTREACH ALTERNATIVES

In Phase I, vulnerable areas were identified using existing BLE information, structure inventory, and LADOTD road data. Projects were suggested to mitigate flooding at these sites. Impacted population and roadway corridors were two of several factors considered when determining overall project benefit.

The models produced in Phase II were further enhanced during Phase III with complex structures, significant underground conveyance, and calibration efforts. These enhancements allowed areas of risk to be more accurately identified. Prioritization of projects for these areas was based on factors such as roadway access, emergency access, project cost, and environmental impacts. A collaborative effort involving the Technical Advisory Committee (TAC), RAPC, and Halff was conducted to further refine potential study areas for this phase of the project to meet the goal of identifying areas for future mitigation projects.

Downs Lane

The longtime residents of Downs Lane complained that their yard now floods after new residential development was recently completed. A holistic approach was needed to provide flood protection for the entire neighborhood. The Downs Lane mitigation assessment consisted of testing multiple model updates to the surrounding terrain, including: widening of the Persimmon Bayou channel to the west of the neighborhood; raising the banks of the earthen channel to keep water out of the neighborhood; dredging or regrading the existing channels in the neighborhood to drain the runoff at a faster rate; creating a detention pond to the west to lower the outfall discharge; and creating a wetland delineated area between the two bayous that drain the neighborhood. The finalized alternative of this area consisted of raising the banks of the earthen channel as well as regrading the channels within the neighborhood. This presented significant reduction in flooding for the neighborhood overall.

In the existing conditions model, there is water overtopping the Heron Circle loop at Downs Lane as well as homes being inundated with over a foot of water during the 100-year storm event. With the alternative options modeled, the roadway was no longer overtopped, and the number of inundated homes was reduced. Some driveways or parts of properties that were inundated in the existing conditions and still shown to be inundated in the alternative had reduced depth of inundation.

McKeithen Drive

McKeithen Drive and the residential areas on Twin Bridges Road experience backwatering during a 100-year storm event. The resulting floodwater inundates properties and overtops neighborhood roads and driveways, making evacuation difficult. An unnamed waterway intersects McKeithen Drive in five different locations. Multiple alternatives were tested to reduce the amount of flooding, including: widening the two bridges along Twin Bridges Road; adding large cross culverts along McKeithen Drive to improve flow and decrease pooling; and dredging key areas to allow stormwater to flow away from the developed areas. The recommended mitigation measures consist of adding a detention pond north of Flats Bayou and a berm south of Flats Bayou, adding a roadside ditch, raising the road out of inundation, and installing additional culverts to move water from the area.

The detention pond would replace undeveloped land north of the neighborhood with a berm constructed just south of the pond to keep water from moving south into the neighborhood area. The addition of a detention pond and berm decreases the peak outfall of the bayou that crosses through the neighborhood area multiple times. As a result, residents would experience a reduction in backwatering.

Pineville Expressway

The model results for the 10-year and 100-year storm event show water overtopping the Pineville Expressway on-ramp and commercial roads. The flooding is caused by backwatering of the downstream channels. Based on initial model results, the roadway is inundated for roughly eight hours before dissipating. The proposed alternative for this area is to upsize seven culverts in the surrounding area and harden the channel to the south on both sides of the structure to move water south at a faster rate.

The decrease in flooding between the existing and proposed alternative model ranges from 0.25 feet to one foot. The spread of ponding is also greatly reduced in the proposed model.

Main Street

Main Street in Pineville is currently experiencing hydrological challenges due to backwater effects from downstream water bodies, resulting in the overtopping of residential roadways. The resultant floodwaters inundate properties and exceed the capacity of neighborhood roads and driveways. A hardened channel currently collects the neighborhood stormwater; however, the land use file did not accurately reflect this hardening, necessitating an update to the file. Furthermore, a terrain modification has been implemented to enhance the hydraulic capacity of the area, thereby increasing the volume of water conveyed through the neighborhood. In certain sections, these model improvements have resulted in elevated water depths, while in others, it has led to a reduction in depth.

ADVERSE IMPACTS

Along with the alternatives being examined to ensure reduction in flooding, adverse impacts downstream were also considered. This was done by comparing the WSEL from the existing conditions and the alternative conditions and those were then subtracted and showed either a no rise or a reduction in the downstream areas.

Section 3 |

Best Practices Stormwater Mitigation & Transportation Infrastructure

Effective stormwater management is crucial for maintaining the integrity and functionality of transportation infrastructure in the MPA. Recent advancements emphasize a holistic approach that integrates traditional engineering with sustainable, nature-based solutions. This strategy ensures that stormwater and transportation planning is forward-looking, inclusive, and built to reduce vulnerability in the face of climate-driven flooding risks.

KEY BEST PRACTICES IDENTIFIED FOR THE MPA:

Green Infrastructure for Roadside Drainage
Green infrastructure uses natural processes to manage stormwater. It reduces runoff volume, slows down water, and improves infiltration. These systems help absorb water before it reaches storm drains or floods roadways.

Key Methods:

- Bioswales and rain gardens along roadways
- Permeable pavements in parking lanes or low-traffic roads
- Vegetated buffer strips in medians and shoulders

Improved Road Design and Elevation
Design roads to handle 10–100 year flood events depending on location and risk level.

Engineering Approaches:

- Roadway elevation above known flood levels
- Sloping and grading to direct runoff toward collection systems
- Use of crown profiles to promote drainage from the center

Regular Maintenance of Drainage Systems
Many flood events result from clogged infrastructure, not capacity issues. Preventative maintenance is often the most cost-effective mitigation.

Maintenance Includes:

- Clearing culverts, storm drains, and ditches
- Jetting pipes and removing sediment buildup
- Inspecting for root intrusion or pipe collapse

Smart Stormwater Management Systems
These leverage sensors and automation for real-time control and alerts. Enable dynamic responses to storm events instead of passive systems.

Innovations:

- Smart valves to regulate flow during storms
- Flood sensors at low-water crossings
- Integrated stormwater data dashboards for public works

Natural Waterway Restoration
Reconnecting or daylighting buried streams and restoring wetlands near roadways helps absorb floodwaters before they hit infrastructure.

Co-benefits:
- Reduces erosion near roads
- Enhances biodiversity and aesthetics
- Expands stormwater storage naturally

Risk Mapping and Community Planning
Use hydrologic and hydraulic modeling to:
- Identify repetitive loss zones (like SRL properties)
- Prioritize drainage improvements in flood-prone neighborhoods
- Support transportation resiliency studies

Public Engagement and Interagency Coordination
- Educate residents on keeping drains clear
- Coordinate projects between public works, planning, and emergency management
- Integrate with FEMA's Community Rating System (CRS) for incentives

TABLE 14: SUMMARY OF BEST PRACTICES FOR STORMWATER MITIGATION FOR TRANSPORTATION INFRASTRUCTURE

Strategy	Purpose	Tools/Examples
Green Infrastructure	Absorb runoff at source	Bioswales, permeable paving
Road Design/Elevation	Keep roads above floodwaters	Grading, crowned profiles
Drainage Maintenance	Prevent clogs and backups	Jetting, sediment removal
Smart Systems	React in real-time	Flood sensors, automated valves
Natural Systems Restoration	Store water upstream	Wetlands, reconnected streams
Risk-Based Planning	Target investment	Flood maps, SRL data
Community Engagement	Improve public behavior	Drain clearing, emergency routes

Key Takeaways

- Incentivize nature-based solutions for eligible roads and intersections.
- Fund preventative maintenance programs as cost-effective alternatives to major retrofits.
- Adopt smart technologies for flood monitoring and operational coordination

Local Funding Mechanisms

This section summarizes local funding mechanisms that small towns and rural parishes—such as those in Rapides Parish—can use to fund drainage improvements, including both traditional and innovative approaches. These mechanisms are especially effective when paired with regional planning tools like the MPA Stormwater Study's H&H model and flood hotspot maps.

TABLE 15: LOCAL DRAINAGE IMPROVEMENT FUNDING MECHANISMS

Stormwater Utility Fee	Stormwater Impact Fees (One-Time)
• ***What it is:*** A monthly fee assessed on properties based on impervious surface area.	• ***What it is:*** A one-time fee on new development or redevelopment projects that increase runoff demand.
• ***Use it to:*** Fund culvert replacement, ditch regrading, green infrastructure, and system mapping.	• ***Use it to:*** Fund localized drainage upgrades in growing neighborhoods or to match FEMA grants.
Key Features: - Dedicated, recurring funding for drainage operations and capital improvements. - Equitable: Larger developments with more runoff pay more. - Legally upheld in Louisiana municipalities.	How It Works: - Collected during permitting or subdivision approval. - Fee supports system upgrades or maintenance in the impacted drainage basin.
Example Rate: - $4–$8/month for residential properties. - $0.05–$0.15/sq. ft. for commercial/ industrial impervious area.	Best Practice: - Tie impact fee directly to H&H model needs (e.g., "Model maintenance and culvert capacity studies").
Local Sales Tax Designation	**General Fund or Capital Improvement Program (CIP) Allocations**
• ***What it is**:* Dedicating a portion of existing or new sales tax revenues to stormwater infrastructure.	• ***What it is**:* Annual budget allocation from local government's general fund.
• ***Use it to*:** Fund larger capital projects like pump stations, levees, or detention basins.	• ***Use it to*:** Support smaller upgrades like ditch re-profiling or inlet expansion.
Implementation: - Requires voter approval (if new), or ordinance redirection (if reallocating). - Often bundled with other infrastructure improvements (roads, water, drainage).	Tips for Success: - Use flood hotspot maps and cost-benefit analysis to justify prioritization. - Bundle stormwater with road rehab projects to share construction mobilization costs.

Drainage Assessment Districts or Special Districts	In-Kind Contributions and Developer Agreements
• ***What it is:*** A district formed by property owners who pay a fee or tax specifically for local drainage improvements.	• ***What it is:*** Requiring developers to contribute drainage upgrades as part of project approval.
• ***Use it to:*** Fund independent ditch maintenance, culvert clearing, or retention ponds.	• ***Use it to:*** Stretch public dollars through public-private partnerships.
Advantages: - Allows hyperlocal funding and governance. - Can be voluntary or voter-approved.	Common Tools: - Drainage easement dedications - Off-site improvements (e.g., culvert upsizing downstream) - Cost-sharing for regional detention basins
Applications: - Rural subdivisions or unincorporated areas with repetitive flooding.	

Interlocal Agreements & Cost-Sharing
• ***What it is:*** Neighboring jurisdictions (e.g., parishes, municipalities, levee districts) pool resources for shared drainage systems.
• ***Use it to:*** Fund projects that cross boundaries (e.g., regional ditches or shared outfalls).
Benefits: - Shared funding reduces burden on smaller towns. - Supports regional watershed-scale planning.

Section 3 |

Grant Writing

Grant-ready writing for the alternatives that were developed into models is important for RAPC to be able to apply for grant funding. The benefit of finding grant funding for projects takes the burden of funding from the applying municipalities. Expedited grant writing can have a return on investment for municipalities and RAPC to have proposals at the ready when grants are open and accepting applications. This gives the applicants a head start in the grant process. Grant writing language for each alternative can be found in this section below. Potential grant opportunities to be pursued for each alternative can be found in APPENDIX J: POTENTIAL GRANT PURSUITS in tabular format.

ALEXANDRIA I-49 PUMPS

The flood management infrastructure in Alexandria, particularly around the I-49 underpasses, is critically outdated and insufficient to handle current and future storm events. Designed in 1988, the existing pumps are undersized and prone to frequent failures, leading to recurrent flooding and significant damage to both public and private properties. This outdated system is unable to cope with the increased runoff resulting from urban development and aging equipment, posing a substantial risk to the community.

Evidence of Need

The proposed project is in Census Tract 193, which is classified as a disadvantaged census tract by both the Climate and Economic Justice Screening Tool (CEJST) and the U.S. Department of Transportation (DOT). This designation indicates that the community is overburdened by environmental and economic challenges, including high levels of pollution, limited access to clean energy, and inadequate transportation infrastructure. In addition, the area is classified as an urban zone, characterized by high population density and significant economic activity.

The stretch of I-49 that will be addressed in this project is a highly utilized route, serving as a critical artery for daily commuters, commercial traffic, and emergency services. The heavy usage of this highway highlights the urgent need for improvements to reduce flooding impacts and enhance safety for residents and commuters. Recent storm events have highlighted the faults of the current flood management system. Historical data shows that these storms have caused severe flooding, lifting manhole covers and damaging roads and properties. The infrastructure, now over 35 years old, has not been upgraded to meet the increased demands brought about by urban expansion and development as well as increasing changes in climate and storm events. The inefficiency of this aging stormwater system disrupts daily life, poses safety risks, and incurs high repair costs for residents and the city. The community is significantly impacted by these frequent flood events, underscoring the urgent need for an upgraded and optimized flood management system.

Proposed Solution

This will be a comprehensive project to upgrade and optimize I-49's flood management infrastructure. This project will focus on the pump stations and drainage systems near the I-49 underpasses. By replacing outdated pumps with high-efficiency models, conducting detailed assessments using advanced modeling tools like ICM or StormCAD, and enhancing on-grade inlets and underground conveyance, we aim to significantly reduce the risk of flooding. Additionally, implementing measures to extend the service life of the infrastructure and adapt to future climate conditions will increase the resilience of the city's flood management system. This project will provide a sustainable and resilient solution to manage stormwater effectively, protecting the community and infrastructure from future flood events.

Objectives

1. Upgrade Pump Stations: Replace outdated pumps with high-efficiency models to handle increased water flow.
2. Conduct Detailed Assessments: Utilize advanced modeling tools to evaluate the current system's performance and identify areas for improvement.
3. Improve Drainage Systems: Enhance on-grade inlets and underground conveyance to prevent clogging and ensure efficient water flow.
4. Increase Resilience: Implement measures to extend the service life of the infrastructure and adapt to future climate conditions.

Activities

- Assessment and Planning: Conduct a comprehensive assessment of the existing pump stations and drainage systems.
- Equipment Upgrade: Procure and install new pumps and related infrastructure.
- Modeling and Simulation: Use advanced software to simulate various storm scenarios and optimize the system's performance.
- Community Engagement: Work with local stakeholders to ensure the project meets community needs and expectations.

By addressing these objectives and activities, this project will enhance Alexandria's flood management capabilities, ensuring a safer and more resilient community.

Census Data

- Census tract – 193; Rapides Parish
- Population – 2,289 (2020 Census)
- Urban designation (MPO and 2010 Census Urban Areas | HEPGIS)
- DOT disadvantage census tract (FHWA Office of Planning)
- CEJST YES disadvantage tract (Explore the map - Climate & Economic Justice Screening Tool)

DOWNS LANE

The Downs Lane residential area faces significant flooding risks due to inadequate flood management infrastructure. Currently, the road is unable to handle the backwatering from Persimmon Bayou and the overtopping of residential channels during significant storm events. This leads to repetitive flooding incidents, causing extensive property damage, road closures, and safety hazards. The existing earthen berm and drainage channels are insufficient to manage the volume of water during the increasing regular storms, highlighting the need for infrastructure improvements.

Evidence of Need

The Rapides Area Planning Commission (RAPC) plays a crucial role in transportation planning for the Downs Lane community by serving Alexandra-Pineville Metropolitan Planning Organization (APMPO) for the region. RAPC is responsible for developing comprehensive transportation plans that address the current and future needs of the community. APMPO, in coordination with regional stakeholders and the public, recognizes this project will address the severe and recurring flooding issues faced by the Downs Lane community, a small rural community near Alexandria. By facilitating public participation and incorporating community feedback, RAPC ensures that transportation solutions meet the needs of the residents.

The census tract where Downs Lane is located is considered disadvantaged by the Federal Highway Administration. When storm events cause severe flooding around Downs Lane, properties become inundated and roads and driveways are overtopped.

Section 3 |

Historical data indicates that these flooding incidents are becoming more frequent and severe, resulting in repetitive, significant property damage, road closures, and safety hazards for residents. The existing infrastructure, including the earthen berm and drainage channels, is outdated and unable to cope with the increased water flow during storm events. When flooding occurs, daily life, posed safety risks, and high repair costs are experienced for both residents and the city.

The rural community relies on Downs Lane as an access critical facilities and evacuation in emergency situations. The local community endures the impacts of these flooding events and needs a comprehensive and effective solution.

Repetitive severe storm and flooding issues are increasing in frequency at Downs Lane, a disadvantaged census tract according to the Federal Highway Administration. For this rural community, Downs Lane provides access to critical facilities and evacuation in emergencies. The existing stormwater infrastructure – including the earthen berm and drainage channels - is outdated and insufficient due to the increased volume of water even at the 10-year storm event level. As historical data show, flooding events are becoming more frequent and more severe, leading to costly repetitive significant property damages and losses, road closures, and safety hazards for residents. While the local community endures the impacts of these flooding events, they need a comprehensive, effective, and sustainable long-term solution.

Proposed Solution

To address these critical flooding issues, we propose to mitigate flooding on and around Downs Lane by increasing the height of the existing earthen berm and redefining the neighborhood's drainage channels. The identified solution will raise the height of the 5,900-foot earthen berm from approximately 75 feet to 78 feet to prevent backwatering of the downstream bayou into the neighborhood. Additionally, the definition and capacity of the drainage channels will be improved to efficiently collect and redirect stormwater. These measures are designed to reduce the frequency and severity of flooding events, protecting local infrastructure and enhancing the overall resilience of the community.

Objectives

1. **Increase Berm Height**: Raise the height of the existing earthen berm to prevent backwatering into the neighborhood.
2. **Redefine Drainage Channels**: Improve the definition and capacity of drainage channels to efficiently manage stormwater.
3. **Enhance Resilience**: Implement sustainable measures to ensure long-term effectiveness and resilience of the flood management system.

Activities

- **Assessment and Planning:** Conduct a comprehensive assessment of the existing berm and drainage channels.
- **Berm Enhancement:** Increase the height of the earthen berm to prevent backwatering.
- **Drainage Improvement:** Redefine and enhance the capacity of drainage channels within the residential area.
- **Community Engagement:** Work with local stakeholders to ensure the project meets community needs and expectations.

By implementing these objectives and activities, this project will provide a sustainable and resilient solution to manage stormwater effectively, protecting the Downs Lane community from future flood events.

The proposed improvements will safeguard the physical assets of the neighborhood and enhance the overall quality of life for its residents by reducing the stress and disruption caused by frequent flooding. This project represents a vital investment in the long-term safety and resilience of the Downs Lane community.

Census Data

- Census tract – 107.01; Rapides Parish
- Population – 3,453 (2020 Census)
- Rural designation (MPO and 2010 Census Urban Areas | HEPGIS)
- DOT disadvantage census tract (FHWA Office of Planning)
- CEJST NOT disadvantage tract (Explore the map - Climate & Economic Justice Screening Tool)

Sources

Frankson, R., Kunkel, K. E., Champion, S. M., & Nielsen-Gammon, J. (2022). *Louisiana State Climate Summary 2022*. NOAA Technical Report NESDIS 150-LA. NOAA/NESDIS, Silver Spring, MD. Retrieved from https://www.ncei.noaa.gov

MCKEITHEN DRIVE

McKeithen Drive and the residential areas on Twin Bridges Road experience backwatering during a 100-year storm event. The resulting floodwater inundates properties and overtops neighborhood roads and driveways, making evacuation difficult. An unnamed waterway intersects McKeithen Drive five times. The proposed solution would dredge the roadside ditch on the west side of the road to minimize the amount of water crossing back and forth under/over the road; culverts would be added to the southernmost crossing to move water to the east side of the road. Channel enlargement on this unnamed waterway would help the water move away more quickly. An earthen berm and a detention pond would be added along Flat Bayou to relieve some heavy flow coming from the west side of the road, and a section of McKeithen Drive would be raised to prevent overtopping and allow for the upsized culvert barrels. Initial feasibility assessment has confirmed no adverse impact downstream.

Project Description

Flooding is a statewide threat in Louisiana, especially as climate change continues to intensify and storms are increasingly abundant and more powerful. Within the contiguous United States, Louisiana has on average the second-highest annual number of thunderstorms, typically adding up to around 60 thunderstorms per year. The McKeithen Drive and Twin Bridges Road residential areas are highly susceptible to severe flooding during 100-year storm events. Significant inundation of properties and overtopping of neighborhood roads and driveways, posing substantial risks to residents and complicating evacuation efforts. In combination with the backwatering from regular storms, McKeithen Drive intersects frequently with the nearby unnamed waterway which exacerbates these flooding issues, as water crosses the road multiple times, contributing to the problem.

The Rapides Area Planning Commission (RAPC) is a regional organization that provides planning and technical assistance to their region. Two of the main areas of service RAPC works in are floodplain management and transportation. In order to address these critical issues, RAPC supports the proposed comprehensive flood mitigation project. This project includes dredging the roadside ditch on the west side of McKeithen Drive to reduce water crossing the road, installing culverts at the southernmost crossing to redirect water to the east side, and enlarging the channel of the unnamed waterway to expedite water flow.

Additionally, constructing an earthen berm and a detention pond along Flat Bayou will help manage heavy flow from the west side, and raising a section of McKeithen Drive will prevent road overtopping and accommodate upsized culvert barrels.

Initial feasibility assessments have confirmed that these interventions will not adversely impact downstream areas, ensuring that the proposed solutions are both effective and sustainable. This project is essential to protect the safety and property of residents, improve evacuation routes, and enhance overall community resilience to future storm events.
The measures being proposed have been carefully evaluated to uphold our effectiveness in addressing the immediate issues, sustainable long-term solutions, maintaining the health and stability of the entire watershed.

This project aims to protect the safety and property of residents by mitigating the risks associated with flooding and other storm-related hazards. By implementing these interventions, we can reduce the likelihood of damage to homes, businesses, and infrastructure, thereby safeguarding the community's assets. In addition, the project will improve access and usability of evacuation routes. In the event of a storm or other emergency, having clear and reliable evacuation routes is crucial for ensuring that residents can quickly and safely leave the affected areas. Enhancing these routes will help to prevent bottlenecks and delays, making the evacuation process more efficient and effective.

Overall community resilience will be increased when future storm events occur. By strengthening the community's ability to withstand and recover from storms, we can ensure that residents are better prepared for future challenges. This includes not only physical infrastructure improvements but also community education and preparedness initiatives that empower residents to take proactive steps in protecting themselves and their property.

Location Information
The McKeithen Drive and Twin Bridges Road project is situated within the jurisdiction of the Rapides Area Planning Commission (RAPC), a regional body responsible for coordinating planning and development efforts across multiple communities. This project is specifically located in census tract 107.01, an area characterized by its rural setting and home to a close-knit community of 3,453 residents. In a predominantly rural landscape, the residents and visitors who regularly utilize McKeithen Drive gain access to an evacuation route, a mix of agricultural lands, residential properties, and small local businesses. The area is known for its scenic beauty, with open fields, wooded areas, and waterways that contribute to its tranquil and picturesque environment.

The RAPC's involvement ensures that the project aligns with broader regional goals, such as improving infrastructure, enhancing safety, and promoting sustainable development. By focusing on this rural area, the project aims to address specific challenges faced by the local population, including limited access to essential services and the need for improved transportation routes. The McKeithen Drive and Twin Bridges Road project represents a significant investment in the future of this community, aiming to enhance the quality of life for its residents while preserving the unique character and natural beauty of the area.

Merit Criteria
Criterion #1: Program Alignment
Founded as a trading post in central Louisiana, Alexandria's growth and development has been integrally tied to water. With waterways such as the Red River meandering through this low-lying community, Alexandria benefited from its location along trading routes and as a military base for the confederate troops before the Union captured the city in 1863.

Now, having long since grown into a thriving community of 47,000 residents regionally, these waterways mean that Alexandria is increasingly vulnerable to the risk of flooding, a costly natural hazard that impacts residents and travelers alike. Regional transportation is critical to Alexandria, with a thriving agricultural economy on cotton, rice, and soybeans – critical national crops – and a nearby U.S. Army installation (Fort Johnson).

Importantly, flooding is a statewide threat in Louisiana, especially as storms continue to intensify and are increasingly abundant and more powerful. According to the NOAA National Centers for Environmental Information, Louisiana has had 104 confirmed weather/climate disaster events with losses over $1 billion each. More than 50% of these events fall into the "flooding" and "severe storm" categories. From 1980-2024 the annual average of billion-dollar events is 2.2. When taking a closer look at more recent years from 2019-2023, the average annual billion-dollar events increases to 5.8. Within the contiguous United States, Louisiana has on average the second-highest annual number of thunderstorms, typically adding up to around 60 thunderstorms per year (Frankson et al., 2022). While Alexandria tends not to take the brunt of most hurricanes, flooding from severe storms is a continuing issue, especially for the area's more rural communities that rely on two-lane roads for transportation.

Located off of State Road 488/Twin Bridges Road is a rural residential community highly susceptible to severe flooding. Significant inundation of properties and overtopping of neighborhood roads and driveways, posing substantial risks to residents and complicating evacuation efforts. In combination with the backwatering from regular storms, McKeithen Drive intersects frequently with the nearby unnamed waterway which exacerbates these flooding issues, as water crosses the road multiple times, further contributing to the problem.

The 2023 Louisiana Statewide Resilience Annual Report emphasizes the astounding impacts of extreme weather on local communities can have a ripple effect throughout the region. Louisiana's resilience goal is to build resilience and adapt continuously. Natural hazards, infrastructure and flooding were identified in the Annual Report as some of the most highlighted issues. Our project perfectly supports state goals of increasing resilience and addressing a system that is failing and is in need of renewal for citizens to properly access their regular and emergency route. In 2024, Alexandria experienced 4 "100-year" events that led to intense flooding all within 14 months of each other.

Census Data
- Census tract – 107.01; Rapides Parish
- Population – 3,453 (2020 Census)
- Rural designation (MPO and 2010 Census Urban Areas | HEPGIS)
- DOT disadvantage census tract (FHWA Office of Planning)
- CEJST NOT disadvantage tract (Explore the map - Climate & Economic Justice Screening Tool)

Sources
- Louisiana - State Climate Summaries 2022
- Climate Change Connections: Louisiana (Mississippi River Delta) | US EPA
- City experiences another '100-year' flood - Alexandria Times
- 2023 Louisiana Statewide Resilience Annual Report
- CAPExecutiveSummaryFinalWEB.pdf

Section 3 |

Other Required Forms:

PROTECT Merit Criteria (note: PROTECT is currently unavailable)

1. **Program Alignment:** The proposed project aligns with the PROTECT program's goals by addressing critical flood risks in the McKeithen Drive and Twin Bridges Road residential areas. By implementing flood mitigation measures such as dredging, culvert installation, channel enlargement, and the construction of an earthen berm and detention pond, the project aims to enhance community resilience, protect properties, and ensure safe evacuation routes during severe storm events.
2. **Planning Activity Approach**
3. **Schedule and Budget:** The project is planned to be completed over a two-year period, with detailed milestones for each phase, including planning, design, NEPA, permitting, construction, and final assessment. A comprehensive budget of roughly $10 million has been developed, covering all aspects of the project from initial feasibility studies to final construction and community outreach.
4. **Public Engagement, Partnerships and Collaboration:** The project will involve extensive public engagement, including community meetings and feedback sessions to ensure that residents' concerns and suggestions are incorporated. Partnerships with local government agencies, environmental organizations, and engineering firms will be crucial for the successful implementation of the project.
5. **Innovation:** The project incorporates innovative approaches such as the use of advanced flood modeling tools and the integration of green infrastructure elements like the detention pond and earthen berm. These solutions not only address immediate flood risks but also contribute to the long-term sustainability and environmental health of the area.

Census Data

- Census tract – 107.01; Rapides Parish
- Population – 3,453 (2020 Census)
- Rural designation (MPO and 2010 Census Urban Areas | HEPGIS)
- DOT disadvantage census tract (FHWA Office of Planning)
- CEJST NOT disadvantage tract (Explore the map - Climate & Economic Justice Screening Tool)

Sources

- Louisiana - State Climate Summaries 2022
- Climate Change Connections: Louisiana (Mississippi River Delta) | US EPA

MODEL UPKEEP

There is significant importance to maintaining these models throughout the development and growth of the RAPC area. Regular maintenance and updates to not only the area’s infrastructure but also the background data such as the LiDAR, precipitation from Atlas, and the NLCD data that is routinely published is pertinent to keeping the models accurate. As the area develops, it is also important to add these developments to the model. This could change the land use by increasing the square footage of impermeable areas, adding structures on streams, and more. One suggestion for keeping these models updated is having a fee included in the permitting timeframe that will help cover and supply the data to add the developments into the models.

STORING AND ACCESS

The master file of these models will be maintained by RAPC with regular updates to reflect the development, land use changes, etc. in the area. This file will be readily available for feasibility assessment through a request process with RAPC.

POTENTIAL STORM WATER UTILITY FEE

During Round 2 of the public outreach meetings and on the survey monkey that was sent to RAPC, there was a question posed to the public on if they would be willing to pay a stormwater utility fee in addition to their monthly bill to help reduce the flood insurance prices in their area. If they said yes, there was a sub question asking the amount that they would be willing to pay, i.e.$1-$3 for 10% discount. The results of this feedback can be found in both APPENDIX E: PUBLIC OUTREACH TOOLS ROUND 1 & 2 and APPENDIX F: SURVEYS.

COMMUNITY RATING SYSTEM (CRS)

FEMA's Community Rating System (CRS) program is a voluntary program for recognizing and encouraging community floodplain management activities that exceed the minimum National Flood Insurance Program (NFIP) standards. Under the CRS program, flood insurance premium rates are discounted based on community actions to reduce flood risk and accrued points that align with creditable activities of the CRS Class rating system.

A community receives a CRS classification based upon the total credit for its activities. The CRS Program classifies participating communities into ten classes, from Class 10 (no discount) to Class 1 (45% discount on flood insurance).

The CRS program is divided into 19 credited activities as outlined in the 2017 CRS Coordinators Manual and the 2021 Addendum. Credit is received under the following series: 300 (Public Information), 400 (Mapping and Regulation), 500 (Flood Damage Reduction Activities), 600 (Warning and Response).The CRS credit points, classes, and premium discounts are broken down in a table on the FEMA website, seen below in Table 16 (Community Rating System | FEMA.gov).

TABLE 16: CRS CREDIT POINTS, CLASSES, AND PREMIUM DISCOUNTS TABLE FROM FEMA

CRS Credit Points	CRS Class	CRS Discount (Premium Reduction)
4,500 (+)	1	45%
4,000 - 4,499	2	40%
3,500 - 3,999	3	35%
3,000 - 3,499	4	30%
2,500 - 2,999	5	25%
2,000 - 2,499	6	20%
1,500 - 1,999	7	15%
1,000 - 1,499	8	10%
500 - 999	9	5%
0 - 499	10	0

EXAMPLE PROJECT SUGGESTIONS IN LINE WITH CRS

Improvement suggestions can be those that reflect the efforts of a community to “reduce flood damage to existing buildings, manage development in areas not mapped by the NFIP, protect new buildings beyond the minimum NFIP protection level, preserve and/or restore natural functions of floodplains, help insurance agents obtain flood data, and help people obtain flood insurance” (CRS Coordinator Manual).

- ***Public Information***
  The public information accreditation includes activities that advise people about flood hazard, flood insurance, and flood protection measures. The activities can be directed toward floodplain residents, property owners, insurance agents, real estate agents, or other segments of the local populace. Activities relevant to the project that are eligible for points are public outreach projects, mapping information services, hazard disclosures, and more.

- ***Mapping and Regulation***
  CRS credits communities that enact and enforce regulations that exceed the National Flood Insurance Program’s (NFIP’s) minimum standards, so that more flood protection is provided for new and existing development. This includes mapping areas not included in the FIRM, preserving open space and protecting natural floodplains, along with enforcing higher standards. Activities relevant to the project that are eligible for points are flood hazard mapping, higher regulatory standards, stormwater management, and more.

- ***Flood Damage Reduction***
  Flood damage reduction focuses on existing development protection. This includes relocating or retrofitting flood prone structures and maintaining any drainage systems in the area.

- ***Warning and Response***
  Warning and response activities focus on linkages between a community’s emergency management mission/program and its voluntary CRS activities. Credit is awarded when public levees and high hazard dams are maintained.

- ***Detention***
  Before Low-Impact Development (LID) can be used to receive credit, the area must have SZ and DS credit. Once they do, LID can be used to receive credit if the stormwater management ordinance requires “soft” techniques to reduce runoff values before implementing detention. Detention is discouraged to control runoff because on-site infiltration is preferred. Detention methods can lose their effectiveness over time if the upstream land erodes and moves sediment into the detention pond with no maintenance performed. Storage Basin Maintenance (SBM) credit can be awarded, if Standard Operating Procedures (SOPs) is in place, for annual inspections and regular maintenance to be completed on storage basins, such as detention.

Section 4 |

Recommended Actions

The Alexandria-Pineville Metropolitan Planning Area (MPA) faces persistent road flooding challenges, driven by aging infrastructure, stormwater runoff, and increasing disaster frequency. This document outlines prioritized, actionable strategies to mitigate flood risks along transportation corridors based on the integrated recommendations from the MPA Stormwater Study. These strategies blend infrastructure investment, regulatory enhancements, nature-based solutions, and interagency coordination.

TABLE 17: TOP-PRIORITY STRATEGIES

1. Targeted Flood Hotspot Interventions
Objective: Mitigate chronic flooding in severe repetitive loss (SRL) areas with precision improvements.
Rational: Flood-prone zones such as Zone AE in Alexandria and clusters of Severe Repetitive Loss (SRL) properties represent chronic vulnerabilities within the MPA. These areas have experienced repeated flooding impacts and serve as critical indicators of underlying drainage system deficiencies. Implementing targeted hydrologic and hydraulic (H&H) modeling in these locations will provide precise insights into structural limitations and inform engineering solutions. Moreover, FEMA offers financial support for elevation and buyout programs, making intervention in SRL areas not only necessary but also highly fundable. By addressing these known hotspots, the region can drastically reduce future flood-related damages and enhance the overall resilience of the transportation network.
Action Steps: ○ Prioritize Zone AE in Alexandria for detailed hydrologic and hydraulic (H&H) modeling to identify drainage deficiencies. ○ Use TR-SWM modeling tools to visualize and simulate risk across hotspot corridors. ○ Pursue targeted elevation projects or property buyouts in SRL clusters, guided by FEMA eligibility and impact reduction potential. ○ Integrate SRL and flood declaration data into all planning models to predict future vulnerabilities.
2. Drainage Infrastructure Investment
Objective: Modernize culverts, ditches, and drainage networks to alleviate roadway flooding.
Rational: A central finding of the MPA study was that the majority of flood mitigation projects across 12 collaborating jurisdictions focused on culvert replacement and drainage enhancement. These infrastructure upgrades are critical to resolving localized road flooding issues caused by aging or undersized components. Many segments of the drainage network are no longer adequate to handle increasing runoff volumes, especially during extreme weather events. Upgrading these assets improves stormwater conveyance, reduces maintenance emergencies, and positions jurisdictions to access funding through FEMA's hazard mitigation and resilience programs. The direct impact of these physical improvements on road usability and public safety underscores their high priority.
Action Steps: ○ Focus on culvert replacement and drainage enhancement projects across jurisdictions. ○ Calibrate H&H models using local drainage datasets to refine capital improvement plans. ○ Use FEMA-related projects as leverage for additional funding and continuity in investment pipelines.

TABLE 18: SECONDARY STRATEGIES

3. Interjurisdictional Coordination and Ordinance Harmonization
Objective: Enhance collaborative governance for consistent flood mitigation.
Rational: The study highlighted significant inconsistencies in ordinance language and regulatory frameworks across the MPA. For instance, roles such as “compliance officer” and “director” are defined differently among jurisdictions, causing confusion in enforcement and planning efforts. Additionally, varying definitions of prohibited discharges and pollutant types undermine collaborative water quality and flood risk strategies. Harmonizing these ordinances will streamline enforcement, align policy with shared watershed boundaries, and enhance eligibility for region-wide federal funding applications. Standardization also lays the foundation for cohesive emergency response and long-term infrastructure management.
Action Steps: ○ Standardize ordinance terminology (e.g., “compliance officer,” “director”) across jurisdictions. ○ Harmonize definitions and enforcement language for prohibited discharges and pollutant sources. ○ Encourage inter-parish and municipal coordination for infrastructure design, project tracking, and emergency management.
4. Integration of Nature-Based Solutions (Green Infrastructure)
Objective: Use sustainable, low-impact development (LID) techniques to manage runoff near roadways.
Rational: Nature-based solutions offer an effective and sustainable approach to mitigating flood risks in vulnerable road segments. Practices such as bioswales, vegetated buffers, and permeable pavements manage runoff volume and reduce peak flow impacts without the need for extensive underground infrastructure. These solutions are especially suitable for intersections and corridors where minor, frequent flooding occurs. Furthermore, nature-based infrastructure contributes to environmental co-benefits such as improved water quality and habitat connectivity. By incorporating green infrastructure into flood-prone transportation areas, jurisdictions can meet FEMA’s resilience criteria while promoting sustainability and community aesthetics.
Action Steps: ○ Incentivize green infrastructure (e.g., bioswales, permeable pavements) at intersections and corridors where feasible. ○ Promote nature-based solutions through grant incentives and community workshops. ○ Align solutions with FEMA resilience goals for grant compatibility.

TABLE 19: SUPPORTING STRATEGIES

5. Preventative Maintenance Programming
Objective: Extend the lifespan of existing stormwater systems and delay costly retrofits.
Rational: Implementing preventative maintenance programs for stormwater systems provides a cost-effective strategy to mitigate flooding without large-scale capital projects. Regular cleaning and inspection of ditches, culverts, and inlets can significantly reduce the frequency of blockages that lead to road overflows. This approach not only extends the life of existing infrastructure but also reduces long-term operational costs. Many communities face deferred maintenance backlogs due to resource constraints; formalizing maintenance schedules ensures consistency and predictability. Furthermore, jurisdictions can earn FEMA Community Rating System (CRS) points for proactive maintenance activities, creating financial benefits for residents through insurance premium reductions.
Action Steps: o Establish preventative maintenance schedules for roadside drainage elements. o Use cost-benefit modeling to compare maintenance versus reconstruction costs. o Incorporate flood sensors and smart monitoring technologies for proactive response. o Periodically update the capital project inventory and resilience metrics.

6. Policy and Compliance Modernization
Objective: Enhance regulatory support for physical improvements and federal alignment.
Rational: Modernizing stormwater ordinances to reflect current EPA MS4 (Municipal Separate Storm Sewer System) and FEMA requirements is essential for regulatory compliance and funding eligibility. Many local codes remain outdated and do not address new best management practices (BMPs) or data integration requirements. Aligning ordinances with federal standards enables jurisdictions to participate in multi-agency planning efforts and ensures that local decisions regarding land use, permitting, and infrastructure development contribute to broader resilience goals. Incorporating updated BMPs also strengthens the technical foundation for capital planning and provides justification for grant requests tied to flood mitigation.
Action Steps: o Update local ordinances to incorporate EPA MS4 and FEMA-compliant BMPs. o Align zoning and permitting practices to enable faster response and integrate modeling updates via permitting fees. o Explore stormwater utility fee options for infrastructure funding and NFIP premium reductions.

TABLE 20: COMMUNITY ENGAGEMENT AND CAPACITY BUILDING

7. Smart Monitoring and Flood Alert Technologies

Objective: Empower local agencies and residents with tools to understand and reduce flood risk.

Rational: The adoption of smart technologies—such as flood sensors, real-time cameras, and automated alert systems—can drastically improve operational response to flooding events. These systems provide timely data that supports both emergency decision-making and long-term planning. By monitoring water levels at key points along road corridors, public works teams can identify trends, detect system failures early, and prioritize maintenance or capital improvements accordingly. Technological integration also supports H&H model calibration, ensuring that predictive models reflect actual on-the-ground conditions. The scalability and declining cost of these technologies make them increasingly viable for deployment in both urban and rural settings.

Action Steps:

- Identify priority monitoring sites (e.g., low-lying roadways, key culvert locations, or major intersections).
- Work with parish and municipal departments to identify optimal equipment placement locations and ensure safe, reliable power and connectivity.
- Create or coordinate a regional dashboard or data portal to collect, visualize, and store data from monitoring devices across the MPA.
- Build or maintain a regional GIS-based repository of flood risk data, mitigation projects, and public outreach efforts that can be used as supporting documentation for CRS applications.

8. Explore Stormwater Utility Fee Programs

Objective: Establish a sustainable, locally controlled funding mechanism dedicated to stormwater infrastructure improvements, maintenance, and flood mitigation initiatives.

Rational: A potential source of sustainable funding for stormwater infrastructure and modeling is the implementation of a stormwater utility fee. Public outreach conducted as part of the MPA study revealed that many residents would be willing to pay a small monthly fee in exchange for reductions in flood insurance premiums. This approach would generate a dedicated revenue stream for drainage improvements, model updates, and maintenance without relying solely on grants or local tax reallocations. Stormwater utility fees also support CRS participation by funding creditable activities that lower community risk scores and benefit individual property owners.

Action Steps:

- Facilitate Regional Dialogue and Stakeholder Engagement
- Commission a Regional Feasibility and Rate Study to determine total cost of stormwater infrastructure needs, appropriate fee structures, administrative options, legal analysis
- Create a template ordinance and implementation guide that can be adapted by individual jurisdictions.
- Lead a public education campaign across the MPA to explain the rationale, benefits, and proposed use of stormwater utility fees.

9. CRS Participation and Enhancement
Objective: Reduce flood insurance costs for residents by systematically engaging in FEMA's CRS program.
Rational: The FEMA Community Rating System (CRS) program offers tangible benefits to communities that go beyond minimum floodplain management standards. By engaging in CRS-eligible activities—such as education, infrastructure improvements, and regulatory enforcement—local governments can earn points that lead to discounted insurance rates for residents. Active participation in CRS not only rewards preparedness but also encourages jurisdictions to develop and maintain comprehensive flood mitigation strategies. The alignment of these activities with community development and financial goals makes CRS enhancement a strategic lever for reducing flood-related burdens on both public infrastructure and private property.
Action Steps: ○ Conduct a baseline inventory of which jurisdictions are currently CRS participants, what class they hold, and what activities earn them credit. ○ Identify communities that are not enrolled in CRS but have undertaken activities that could be creditable (e.g., updated floodplain ordinances, drainage projects, public outreach). ○ Evaluate barriers to participation, such as administrative capacity, technical gaps, or documentation deficiencies. ○ Establish a CRS coordination program within RAPC to: - *Guide jurisdictions through the CRS application and class improvement processes.* - *Offer training on FEMA's CRS Manual and scoring methodology.* - *Facilitate peer learning by connecting experienced CRS communities with newer participants.*

10. Deployment of the Rural Parish Stormwater Toolkit
Objective: Empower small jurisdictions to effectively identify, prioritize, and address transportation-related stormwater challenges—especially in under-resourced areas.
Rational: The Small Community and Rural Parish Toolkit provides a tailored framework for jurisdictions with limited technical or financial resources to address transportation-related flood challenges. By combining traditional engineering approaches with innovative green infrastructure practices, the toolkit offers a pragmatic roadmap for planning and implementation. It encourages local governments to assess their vulnerabilities, prioritize needs, and coordinate across agencies. The toolkit also promotes partnerships with academic institutions, enabling student-led modeling and mapping projects that augment local capacity. Distributing and implementing this toolkit across the MPA can accelerate resilience planning and ensure equitable access to solutions across rural and urban areas alike.
Action Steps: ○ Disseminate the Small Community & Rural Parish Toolkit focused on transportation resilience. ○ Distribute the Toolkit to all rural parishes and municipalities within the MPA, prioritizing those without dedicated stormwater management staff. ○ Host regional training workshops or virtual webinars to walk local agencies through the Toolkit. ○ Offer technical assistance to ensure jurisdictions can use the Toolkit for real-world planning and budgeting.

TABLE 21: SUMMARY OF RECOMMENDED ACTIONS BY PRIORITY

Tier	Strategy	Impact	Urgency
1	**SRL/Zone AE Infrastructure Modeling & Buyouts**	High	Immediate
	Culvert Replacement & Drainage Enhancements	High	Immediate
2	**Interjurisdictional Coordination & Ordinance Alignment**	Medium-High	Near-term
	Nature-Based Infrastructure for Roads	Medium	Near-term
3	**Smart Maintenance & Flood Monitoring Systems**	Medium	Medium-term
	Utility Fee Exploration & CRS Participation	Medium	Medium-term
4	**Public Toolkit Deployment & University Partnerships**	Indirect/Support	Ongoing

Conclusion

The objective of the stormwater analysis and modeling phase of the resiliency study was to confirm known flooding hazards, develop a comprehensive hydrologic and hydraulic approach for detailed modeling, identify flood risks within the project's study areas, and provide supporting data for upcoming conceptual improvement options. Approximately 493 miles of modeled streams and 215,000 acres of watershed areas were studied across the portion of the MPA studied in Phase II of the project.

Completed tasks for Phase III of the resiliency study included further enhancement of identified complex structures, incorporation of anticipated models covering other sections of the MPA, level of service analysis for the underground storm drain system, alternative mitigation improvement modeling, and stakeholder coordination throughout to guide prioritization of local needs. Four alternatives were identified and completed in the modeling efforts of Phase III. These alternatives included the Downs Lane and McKeithen Drive neighborhoods in the City of Alexandria as well as the Pineville Expressway on-ramp and Main Street in the City of Pineville.

This comprehensive, prioritized approach integrates both physical infrastructure upgrades and policy reform to address persistent roadway flooding in the Alexandria-Pineville MPA. Each recommendation is rooted in documented risks, modeled outcomes, and community feedback, creating a scalable roadmap for long-term resilience and fiscal sustainability.

APPENDIX A: DIGITAL DELIVERABLES

Digital Deliverables to support this document included the exported rasters, HEC-RAS models, and digital mapping. The exported water surface elevation and depth rasters for the minimum of the 2-, 10-, and 100-year events are available along with the HEC-RAS models for the entire MPA. Another useful tool added to the digital deliverables is the “one-button” run script to get the models to be ran all together without having to open each model individually to run and connect the results. Other digital mapping available includes the shapefiles used to represent the roads, railroads, channels, and more. The SDE will also be available for review.

APPENDIX B: EXAMPLE SURVEY FORM

Rapides Area Planning Commission
Survey Information Form

Project		Stream Name	
Location		Feature ID:	
Instrument Man		Feature Type	( ) BR ( ) CUL ( ) DAM ( ) XS
Rod Man		Coordinate System	

Bridge	Rail: __________ Deck: __________ Length: ___________ Piers: _______@_______ Skew: __________
Culvert	Inlets: __________ Type: __________ Length: ___________ Size: H______ W_______ Skew: __________
Dam	Width: _________ U Slope: __________ D Slope: ___________ Riser: ________ x _________ Skew: __________

Photo ID Number	DS Face		DSCH		OTXS		USCH		US Face	

Notes / Comments		Date of Survey	

Plan View

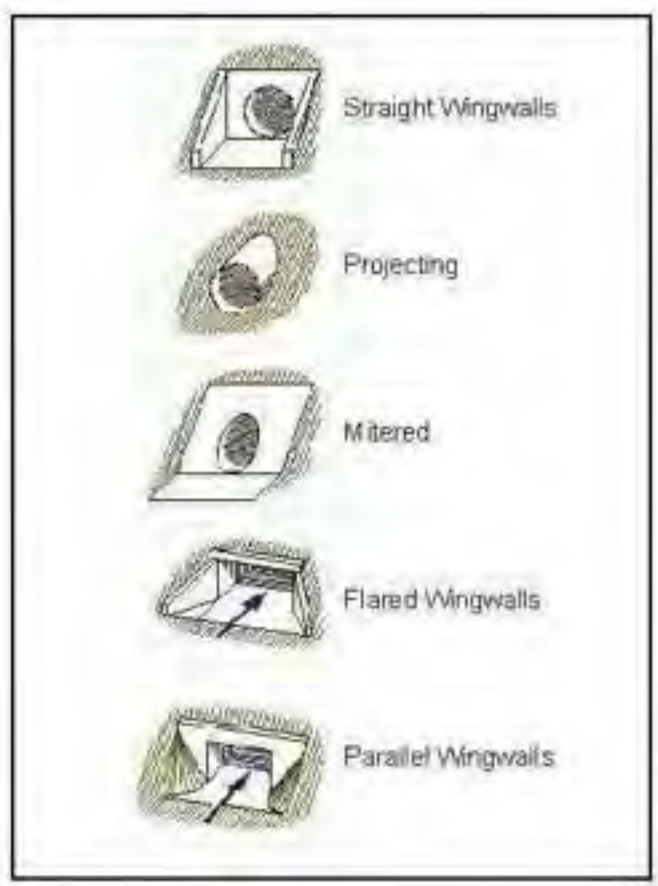
Profile View

Bridge Details:
- Rail – The height of the rail as measured from the top of the deck.
- Deck – The thickness of the deck.
- Length – The length of the bridge as measured along the channel.
- Skew – The angle between the stream and the bridge.
- Shape of Pier – The shape of the piers. Square, circular, oblong, other, or multiple are good entries. If other or multiple are used, please submit pictures of the piers that fully show all abnormalities.
- Piers (#@W) – The number and width of the piers. Two entry fields for this have been included for instances in which multiple pier shapes or sizes are identified.

Culvert Details:
This generally assumes that both ends of the culvert are the same. For culverts that change size or shape, please make note of the differences and provide a sketch for both ends.
- Openings – The number of openings for the culvert.
- Type – The type of culvert. RCB, RCP, CMP, Horseshoe, other, or multiple are good entries. If other or multiple are used, please submit pictures of the faces.
- Length – The length of the culvert.
- Size (H&W) – the height and width measurements of the culvert. For round culverts, please enter only one entry (in either slot) for the diameter. If multiple culvert types are present, please make note of the measurements for all types. It is acceptable to use multiple survey information forms if necessary, but make sure the original form indexes the other forms.
- Skew – The angle between the stream and the culvert. If the stream bends at all, the angle of the bend is the skew.
- Input / Output Type – The type of opening for the culvert. Use opening names as pictured below, or "other". If other is used, please submit pictures of the opening that fully show the special case.
- Material – The material the culvert is made of. This will be metal or concrete.
- %Obstructed – Percentage of Culvert opening blocked by debris or sediment

Dam Details:
- Width – The width across the channel that is affected by the dam.
- U/S Slope – The slope of the dam on the upstream side.
- D/S Slope – The slope of the dam on the downstream side.
- Skew – The angle between the stream and the dam.
- Number of Spillways – The number of spillways identified for the dam.
- Riser (#x#) – The width and length of a square riser (morning glory inlet). For round risers, please enter only one entry (in either slot) for the diameter.

***Note: Digital Records to be delivered in an excel spreadsheet with hyperlinks to the appropriate photographs. Individual point files should be organized in this database by object/structure classification (Bridge, Culvert, Dam, Other).**



APPENDIX C: PAIRWISE RANKING

Rapides Area Planning Commission
Project Screening and Prioritization - Technical Advisory Committee
Pairwise Evaluation Criteria Ranking for Transportation Flooding Resiliency Project
August 24, 2022

	Criteria	A	B	C	D	E	F	G	H	I	J
		Road Flooding and Mobility	Property/Infrastructure Flooding	Emergency Access	Public Acceptance	Social Vulnerability	Community Benefits	Project Cost	Economic Development Impacts	Funding Source (Grant Potential)	Environmental Impacts
1	Road Flooding and Mobility										
2	Property/Infrastructure Flooding										
3	Emergency Access										
4	Public Acceptance										
5	Social Vulnerability										
6	Community Benefits										
7	Project Cost										
8	Economic Development Impacts										
9	Funding Source (Grant Potential)										
10	Environmental Impacts										

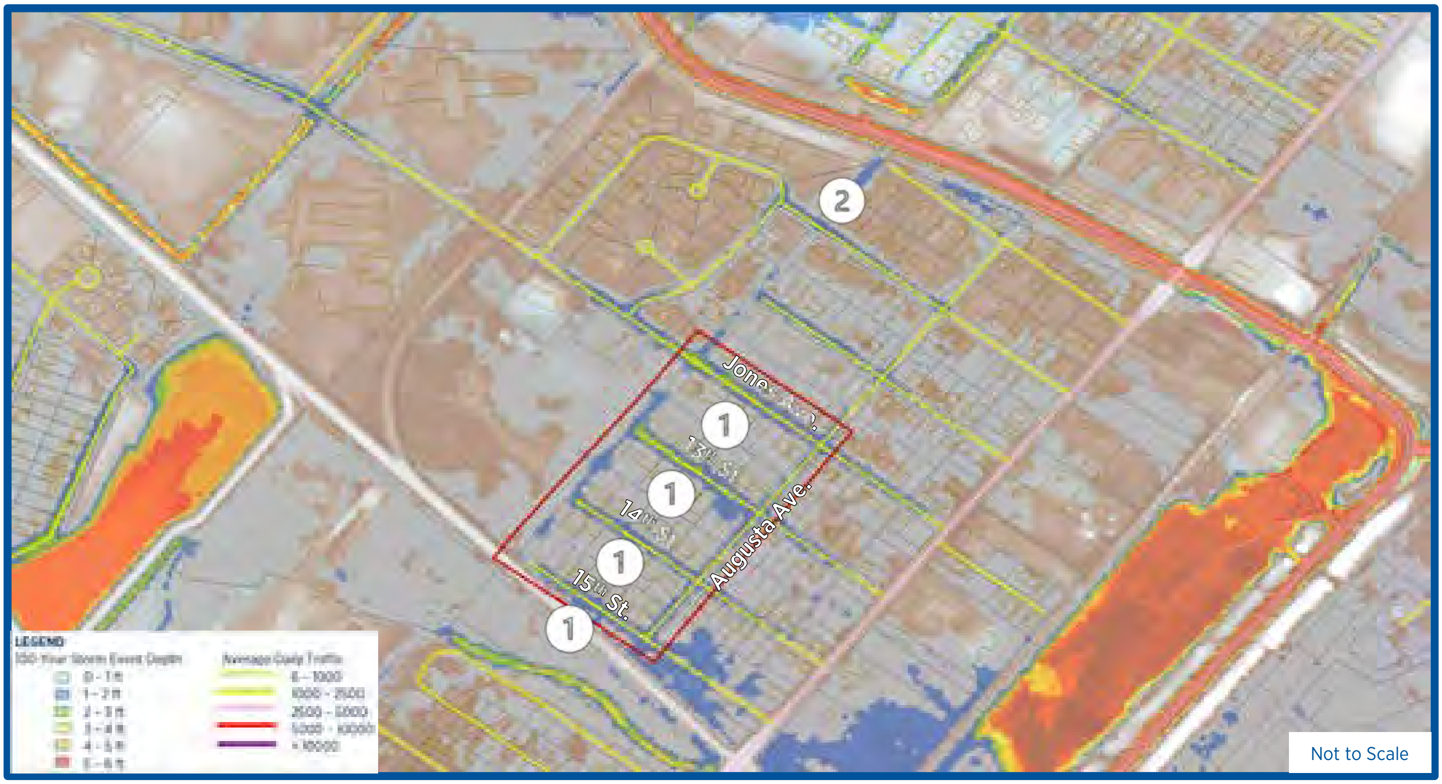
Compare each horizontal row against each vertical row. Assign each box a value based on the legend to the right. Please only fill out the white boxes to the right of the black shaded squares. Example: If you feel that Road Flooding/Mobility (Row 1) is more important than Property / Infrastructure Flooding (Column B), you would write a 3 in the corresponding box.

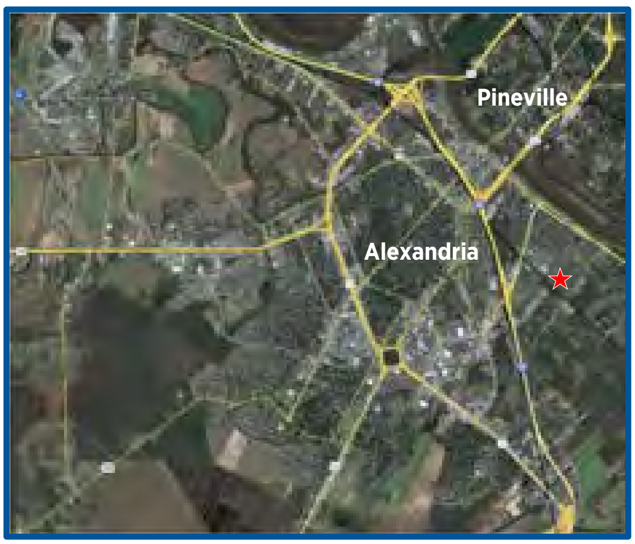
CATEGORY LEGEND:
- Public Safety
- Social Impact
- Economic Considerations
- Environmental Impact

RANKING LEGEND:
- 1 - less important
- 2 - equally important
- 3 - more important

APPENDIX D: ONE PAGE REPORTS

STUDY 3 - SANDY BAYOU





LOCATION

This specific area is in a moderately dense neighborhood in the southeast section of the City of Alexandria, east of I-49, south of Broadway Ave, and bordered by Sandy Bayou on the north and east sides of the subdivision. This area (enclosed in the dark red rectangle above) includes the western ends of Jones, 13th, 14th, and 15th Streets up to Augusta Avenue.

PROBLEM

The only visible drainage system are curb inlets and a shallow open channel ditch at the west end of each respective street. As a result, the street sections are inundated during a 100-year event, and stormwater spreads into residential yards. Additionally, the downstream open channel ditch directing stormwater runoff to Sandy Bayou does not have sufficient positive slope and contributes to the stormwater backup into the neighborhood. The identified problems are based on repetitive loss locations and available mapping products. Due to discrepancies between the effective mapping and BLE, further modeling efforts are needed to determine an accurate assessment of current risk.

KEY CONSIDERATIONS

40% of residences reported severe repetitive loss

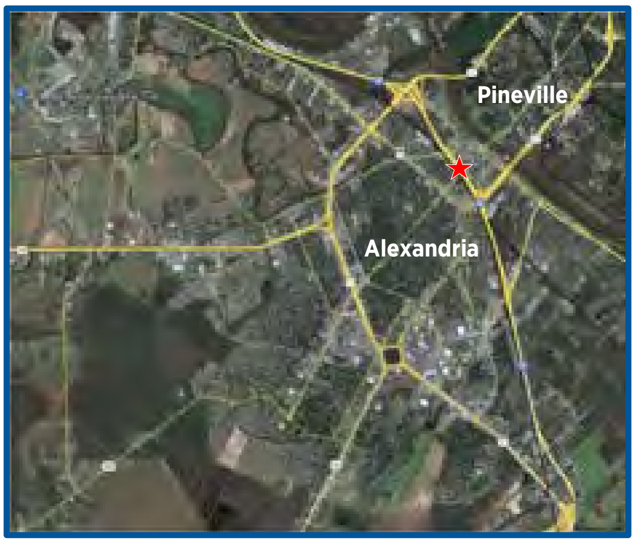
81% repetitive loss on 13th Street

PROPOSED SOLUTION

1. Add new on-grade inlets along Jones, 13th, 14th, and 15th Streets.
2. Regrade, reshape, and possibly harden open channel ditch leading to Sandy Bayou. Consider adding a low flow paved channel to ditch section.

The information shown is conceptual. Additional analysis including detailed watershed modeling and storm system design will be required for improvement.

STUDY 4 - I-49 UNDERPASSES



LOCATION

The Monroe St., Madison St, Elliot St., Jackson St., Washington St., Lee St., Winn St., and Casson St. underpasses are located along I-49, north of the I-49 and Pineville Expressway (Hwy 167). I-49 is the major hurricane evacuation route for the state of Louisiana.

PROBLEM

Storm drain systems with sag inlets are located at each underpass location. However, the current storm drain system and street section is inundated with stormwater from the 100-year storm event. These inundated streets block access from the central business district to the I-49 frontage roads and on ramps. The Rapides Regional Medical Center is located within this district.

KEY CONSIDERATIONS

More than **2** feet of floodwater on each underpass in a 10-year event

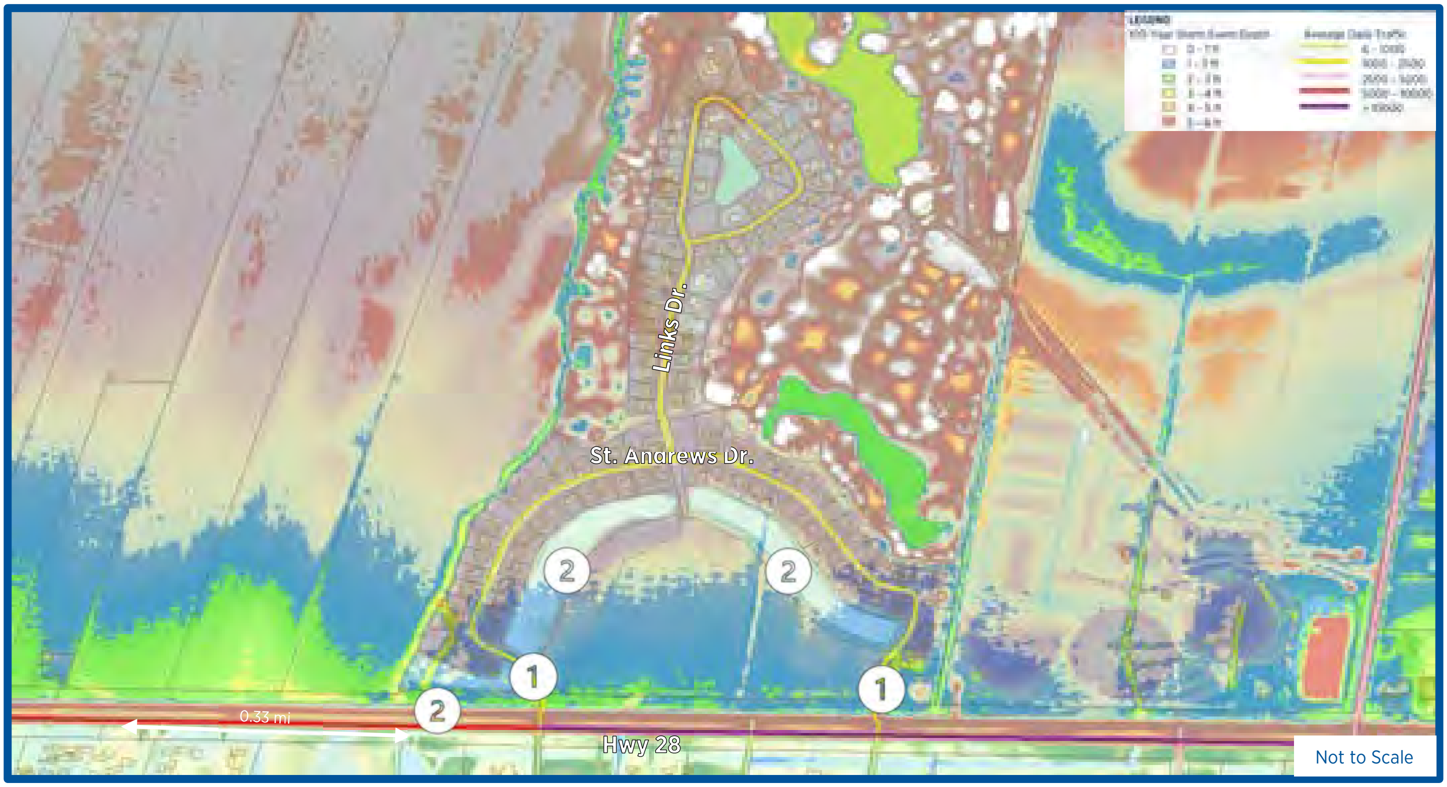
Flooding blocks **3** on-ramps

PROPOSED SOLUTION

1. Clean drains in debris-prone areas.
2. Increase storm sewer pipe sizes and add on-grade inlets at each underpass.
3. Resize sump inlets on either side of on ramp of Elliot St and along Thorn Rd west of Jackson St.
4. Upgrade and/or add pumps to direct stormwater to Red River.

The information shown is conceptual. Additional analysis including detailed watershed modeling and storm system design will be required for improvement.

STUDY 5 - ST ANDREWS DRIVE



LOCATION

This neighborhood is just north of Hwy 28, approximately 3.5 miles west of the intersection with Hwy 71 interchange. The subdivision abuts Middle Bayou to the west, the Johnny Down's Sports Complex to the east, and the Links on the Bayou golf course to the north.

PROBLEM

Both ingress/egress points of St. Andrews Drive are prone to flooding in a 100-year storm event at curb inlets located near the manmade ponds.

KEY CONSIDERATION

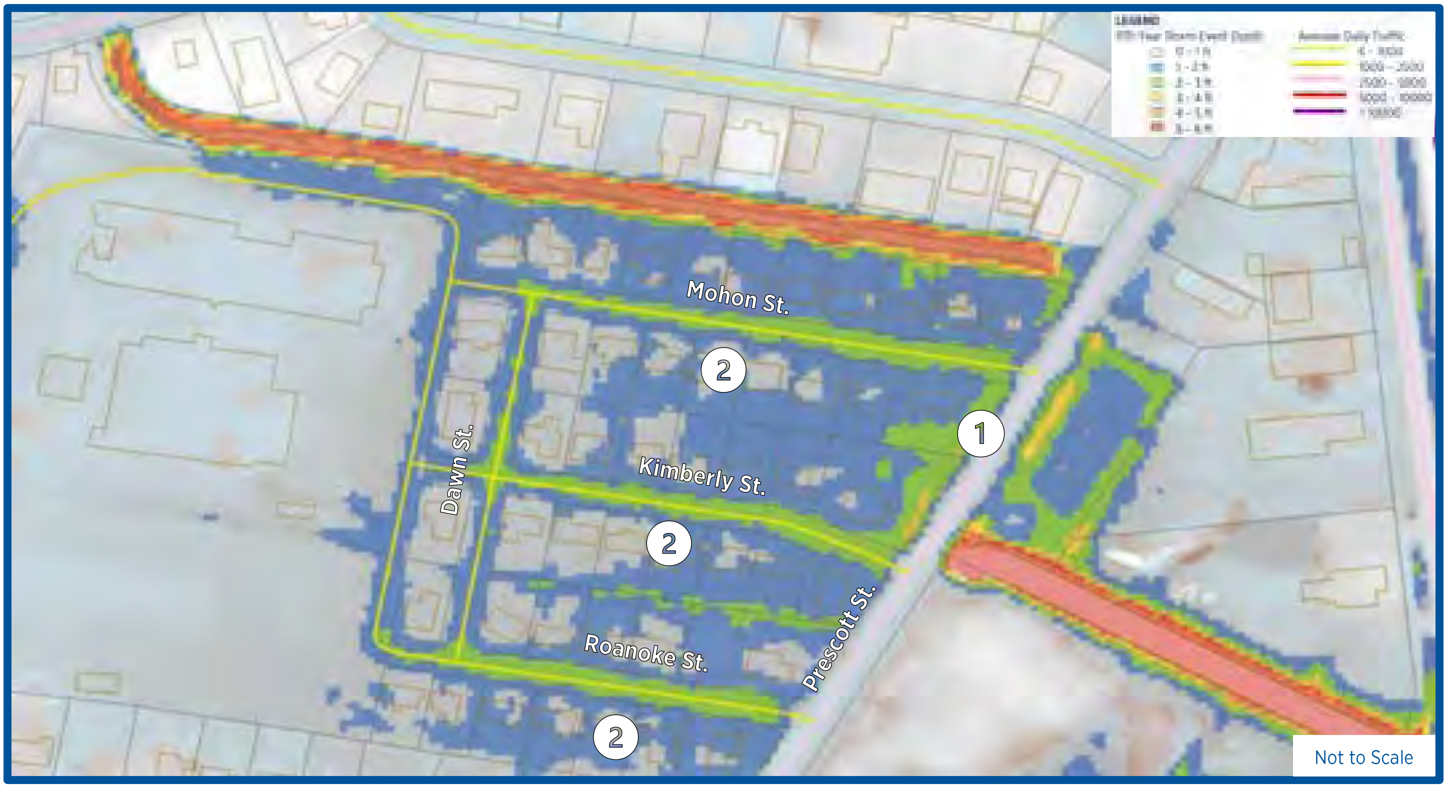
114 residences on or connected to this road

PROPOSED SOLUTION

1. Resize inlets to increase capture rate of storm runoff.
2. Consider lowering lower pond normal water surface elevation, to provide lower tailwater for street drainage system.

The information shown is conceptual. Additional analysis including detailed watershed modeling and storm system design will be required for improvement.

STUDY 1 - CAMELLIA PLACE



LOCATION

This neighborhood is located west of the South Traffic Circle in Alexandria, Louisiana. It is zoned for moderate-density single-family homes. The neighborhood is adjacent to the Horseshoe Drainage Canal.

PROBLEM

The entire area is at risk for flooding in a 100-year storm event. The current sump inlets along Mohon St., Kimberly St., and Roanoke St. are too small for the area and are in debris-prone areas. Most of the stormwater travels by overland flow in the street gutters to sump inlets at the eastern end of each respective street. The very slight street longitudinal grades create ponded water that spreads across the street sections.

KEY CONSIDERATIONS

50 impacted residences

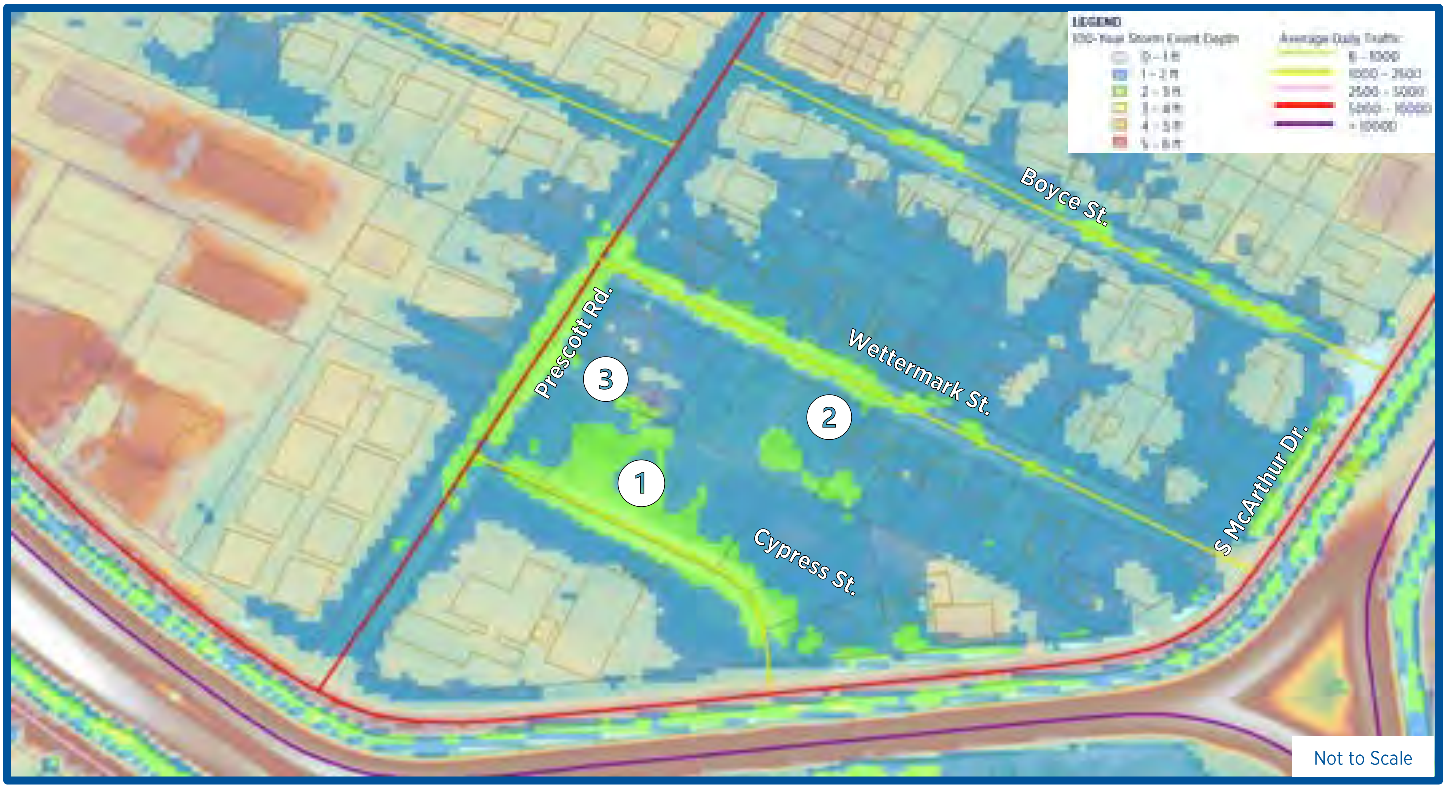
4 impacted streets

PROPOSED SOLUTION

1. Clear the debris from the inlets and resize the inlets and storm drain conveyance along the neighborhood on Prescott Road.
2. Add additional on-grade inlets on Mohon, Kimberly, and Roanoke Streets.

The information shown is conceptual. Additional analysis including detailed watershed modeling and storm system design will be required for improvement.

STUDY 2 - CYPRESS GARDEN



LOCATION

This area, located between Boyce Street and the north edge of the South Traffic Circle, includes a limited commercial district, a moderately-dense single-family district, and a community commercial district.

PROBLEM

1. Localized urban flooding occurs in the empty lot near the Cypress Lane—Prescott Road intersection.
2. The only drains on Wettermark Street are located at the east end. The very slight longitudinal grades create ponded water that spreads across the street section.
3. Inadequate grading has created a low point in the grassed drainage ditch on the west side of McArthur Drive.

PROPOSED SOLUTION

1. A bioretention cell (also known as a rain garden) on the empty lot of the north side of Cypress Lane would promote street drainage, filter contaminants, and beautify the area.
2. Add on-grade inlets at the mid-point of Wettermark Street.
3. Regrade and consider adding a hardened pilot channel to the drainage ditch west of McArthur Drive, and consider modifications to the inlet structure to allow stormwater to drain freely.

The information shown is conceptual. Additional analysis including detailed watershed modeling and storm system design will be required for improvement.

APPENDIX E: PUBLIC OUTREACH TOOLS ROUND

Critical Facilities

Schools

Emergency Response

Hospitals

Utilities

halff

RAPC
Rapides Area Planning Commission

Neighborhoods

Residential Buildings

Churches

Shopping Areas

Parks & Recreation

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RAPC
Rapides Area Planning Commission

Commerce

Farmland/Agriculture

Downtown

Timber

Industrial Facilities

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RAPC
Rapides Area Planning Commission

Infrastructure

Floodgates

Levees

Roads/Bridges

Pump Stations

RAPC
Rapides Area Planning Commission

Key Areas

Critical Facilities

Neighborhoods

Commerce

Infrastructure

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RAPC
Rapides Area Planning Commission

Pumps

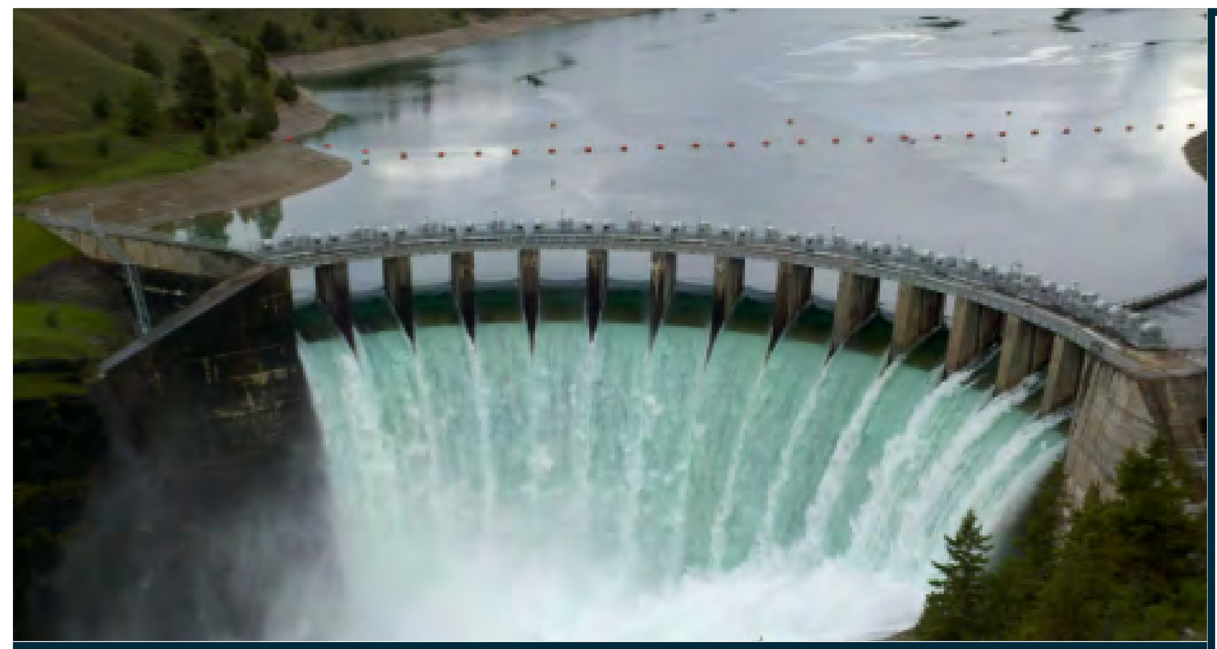
A water pump is used to transport water from one location to another.

Pros:
1. Alleviates low-lying flooded areas
2. Automated
3. Uses a small footprint

Cons:
1. Noisy/Unsightly
2. Expensive
3. Requires regular maintenace

Dams

A barrier constructed to hold back water that can be used to generate power or as a water supply

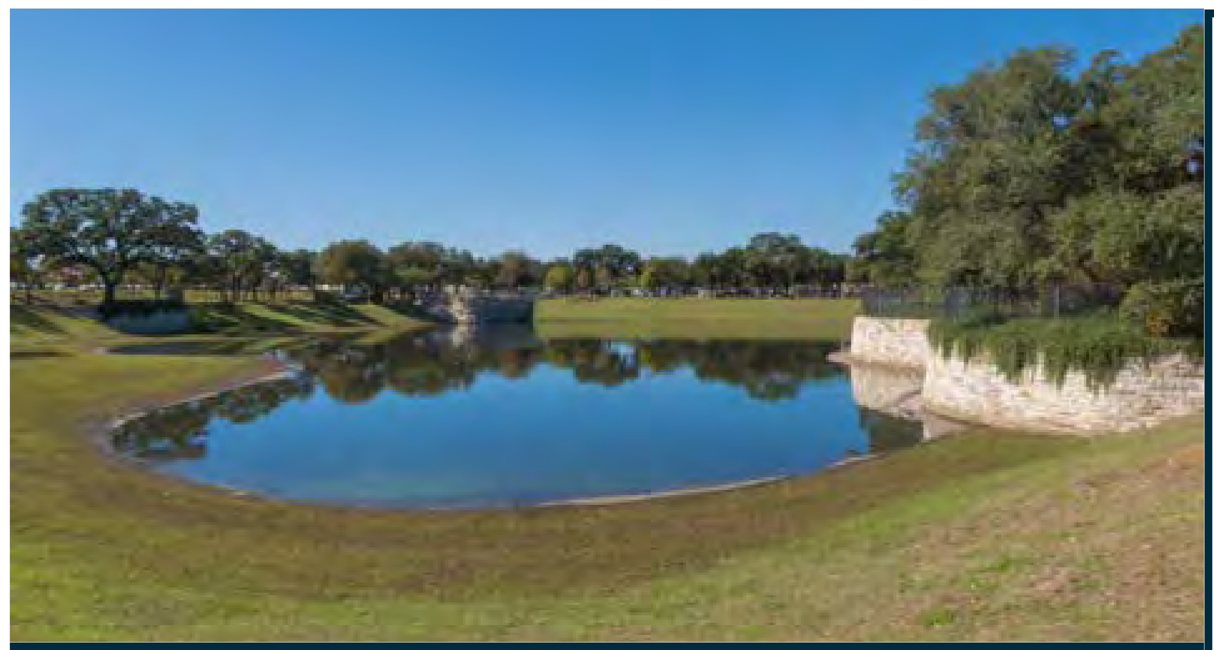


Pros:
1. Controlled outfall
2. Water storage for various uses
3. Potential power generation
4. Creates recreational area

Cons:
1. Expensive
2. Disrupts ecosystems
3. Impacts several jurisdictions
4. Dam breach is catastrophic

Pond Designs/Rain Gardens

A permanent or temporary pool of water used to contain stormwater



Pros:
1. Creates wildlife habitats
2. Can be use for recreation
3. Reduces peak runoff rates
4. Prevents erosion in downstream areas

Cons
1. Attracts mosquitos
2. Requires maintenance
3. Outfalls can become clogged with debris
4. Uses a large amount of space

Berms

A raised bank bordering a river or canal to control erosion and flooding

Pros:
1. Protects against WSEL
2. Provides land development opportunities
3. Works immediately
4. Maintains existing channel

Cons:
1. Requires maintenance
2. Expensive
3. Habitat disruption
4. Increases risk on unprotected side of berm

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Dredging

To clean out the bed of (a harbor, river, etc.) by scooping out mud, weeds, and garbage

Pros:
1. Returns streams to natural flow
2. Can remove polluted sediment
3. Project is mostly contained in existing streams

Cons:
1. Expensive
2. Not a permanent solution
3. Permit challenges can delay project

Channel Hardening

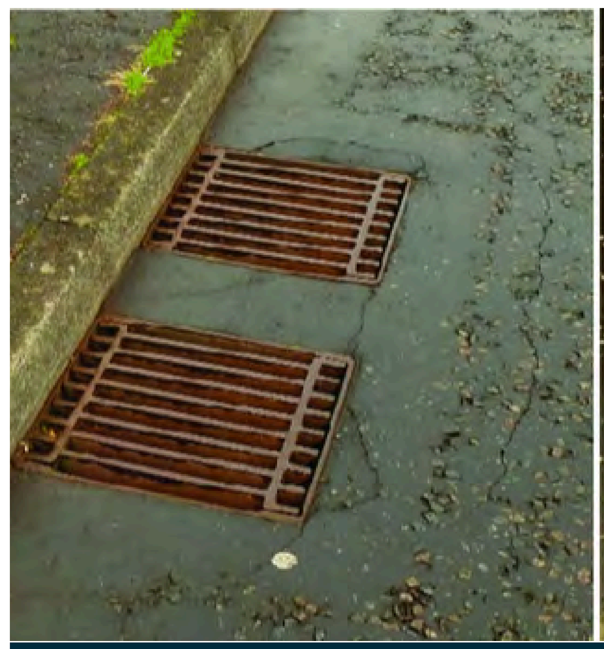
The act of adding materials such as concrete to harden the ditch to prevent erosion

Pros:
1. Contains large, swift flows
2. Limits channel erosion
3. Durable
4. Limited maintenance

Cons:
1. Very expensive
2. Long construction time
3. Disrupts environment
4. Increases downstream discharge
5. Increased future costs

Upsize/Increase Drain Inlets

A structure designed to collect excess water



Pros:
1. Quickly removes water
2. Reduces surface flooding
3. Visually appealing
4. Less regular maintenance

Cons:
1. Temporarily disruptive
2. Expensive
3. Often requires underground drainage upsizing
4. Can require roadway replacement

Upsizing Stream Structure Crossings

A bridge or culvert crossing a stream

Pros:
1. Maintained within existing footprint
2. Low maintenance
3. Can include raising roadways for safer travel
4. Inexpensive

Cons:
1. Disrupts traffic
2. Lengthy construction time

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RAPC
Rapides Area Planning Commission

Structure Buyouts

A transaction in which a controlling stake of a private company is acquired by the buyout fund

Pros:
1. Completely removes risk
2. Saves money long term
3. Can restore natural floodplain

Cons:
1. Expensive short term
2. Displaces citizens
3. Incomplete participation can lead to limited benefit

Elevating Buildings

A building elevated on columns or pilings to reduce the chance of flooding

Pros:
1. Reduces individual flood risk
2. Often lowers insurance premiums
3. Does not need property aquisition

Cons:
1. Temporarily disruptive
2. Provides no benefit outside the single structure
3. Evacuation recommended during flood events

Higher Standards

New regulation to dictate flood mitigation for new construction and land development

Pros:
1. More resilient new infrastructure
2. No adverse impact for existing infrastructure
3. Potential insurance savings

Cons:
1. Expensive
2. Limited benefit to existing infrastructure
3. Limited future development sites

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RAPC
Rapides Area Planning Commission

Flood Insurance Survey

Approximately how much do you pay monthly for flood insurance?

$0	$0-$50	$50-$100	$100-$150	$150-$200	$200+

A stormwater utility (SWU) fee is a $1-$5 charge on your monthly water bill that funds drainage improvements and maintenance. This money could also be used to support participation in FEMA's Community Rating System (CRS) which lowers flood insurance costs.

Please select an estimated SWU fee and corresponding flood insurance discount that you would support.

None	$1-$3 for a 10% discount	$4-$5 for a 15% or more discount

Martin Park

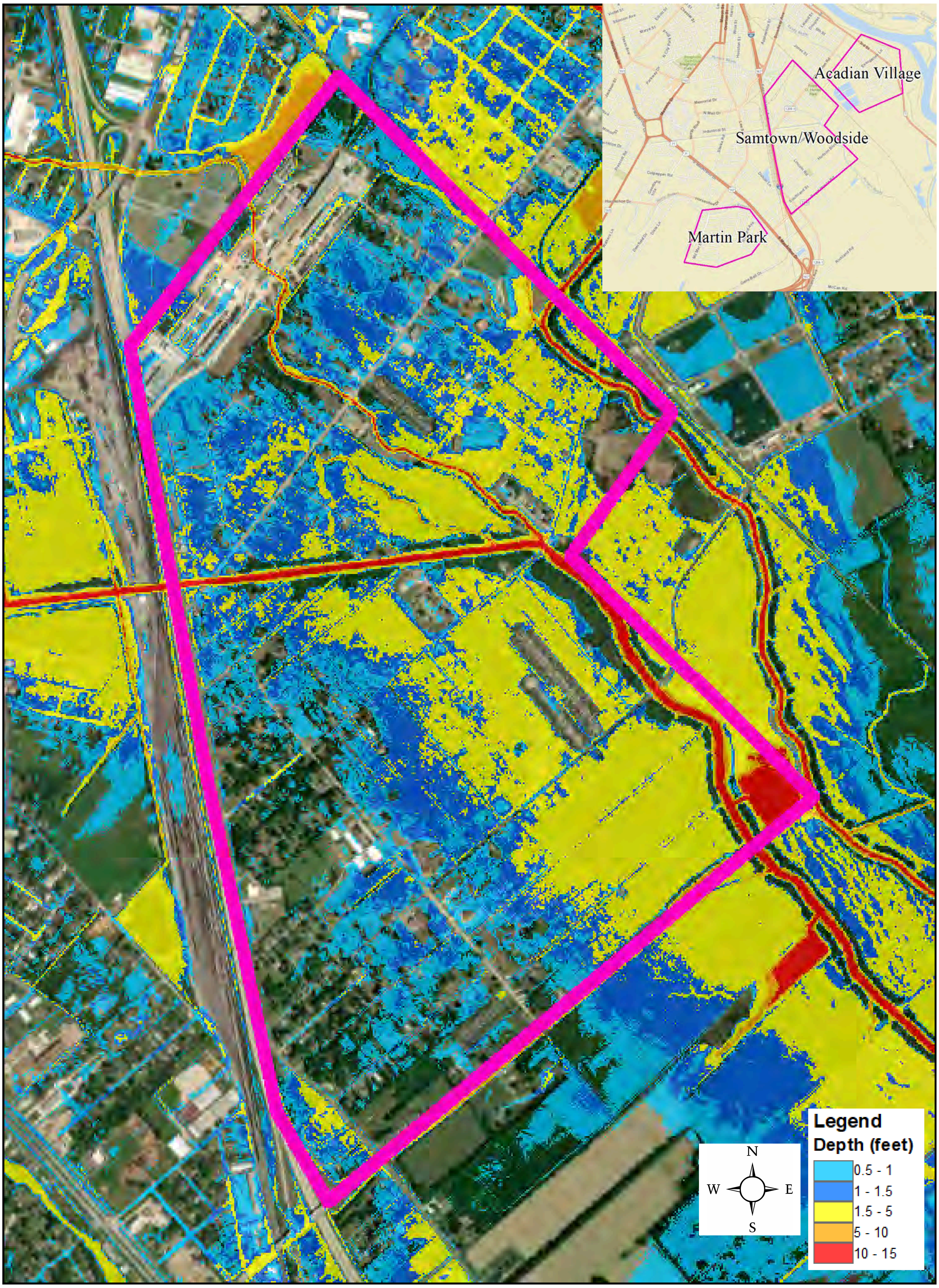
100-Year Weather Event

Acadian Village

100-Year Weather Event

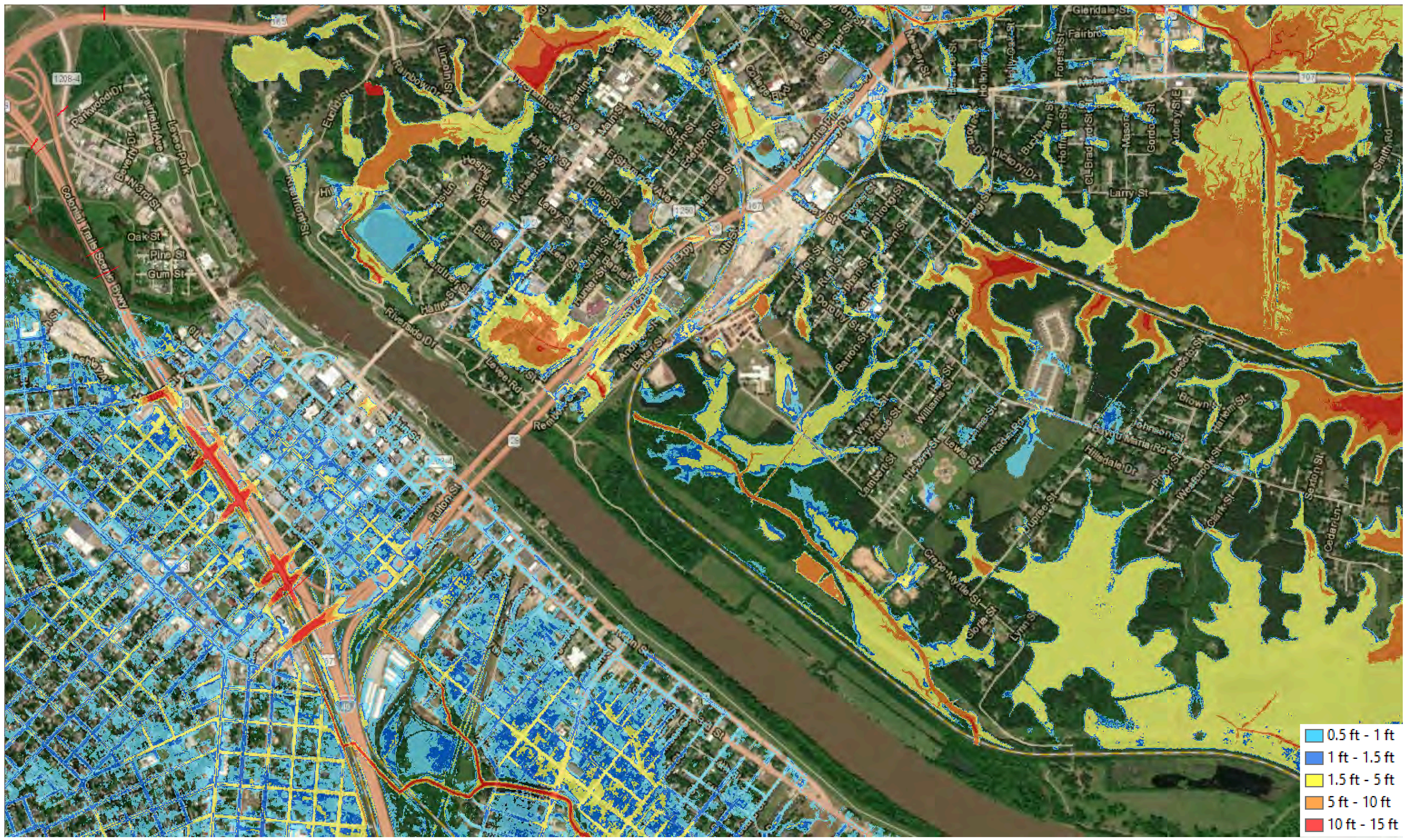
Samtown/Woodside

100-Year Weather Event



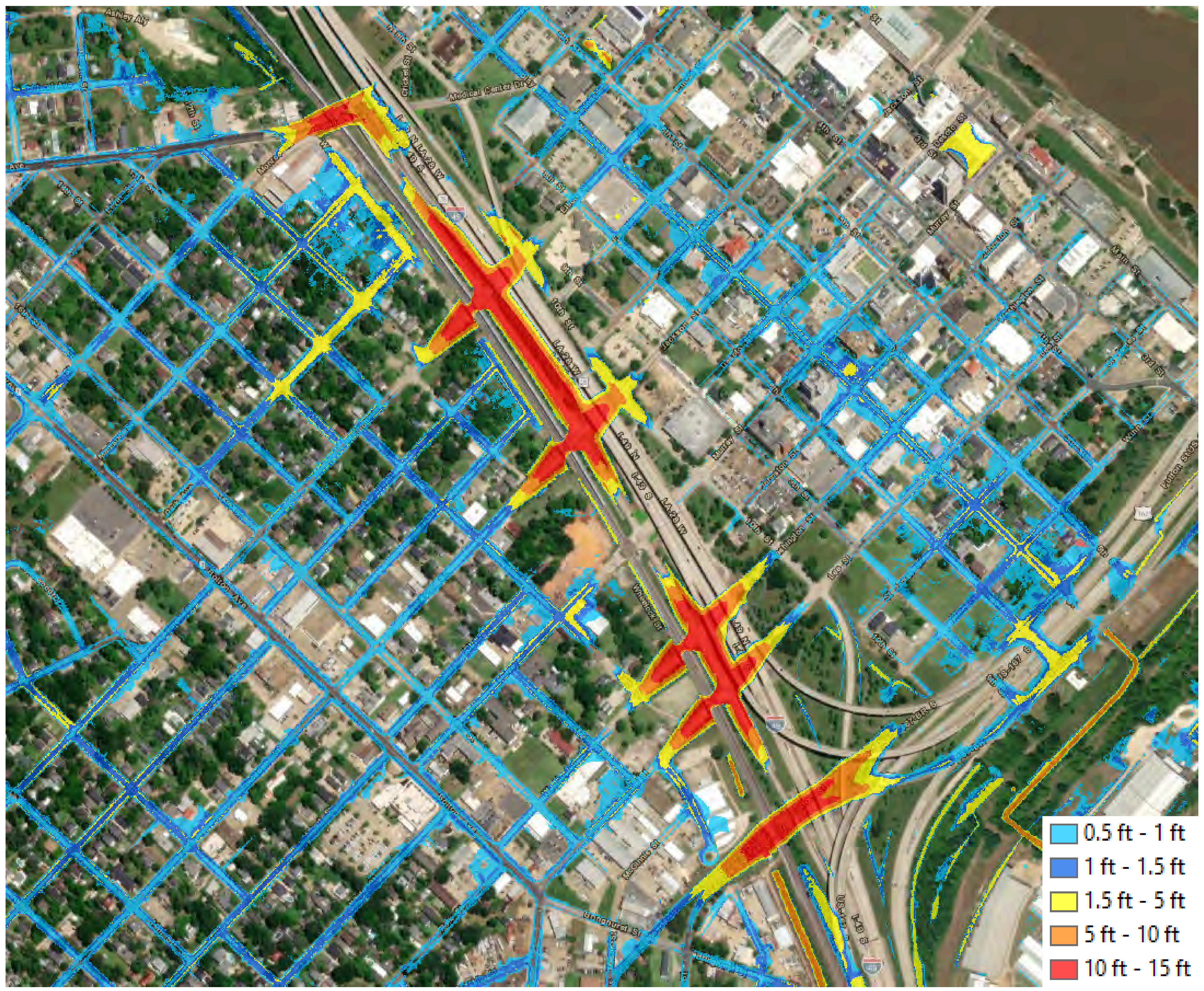
Pineville Expressway

The model can be used to support the need for transportation improvement along major evacuation routes. The model can demonstrate flooding along other roadways and exemplify the need for additional evacuation capacity along larger, less flood-prone roads like the Pineville Expressway. Route expansion can drive development and economic growth as well!



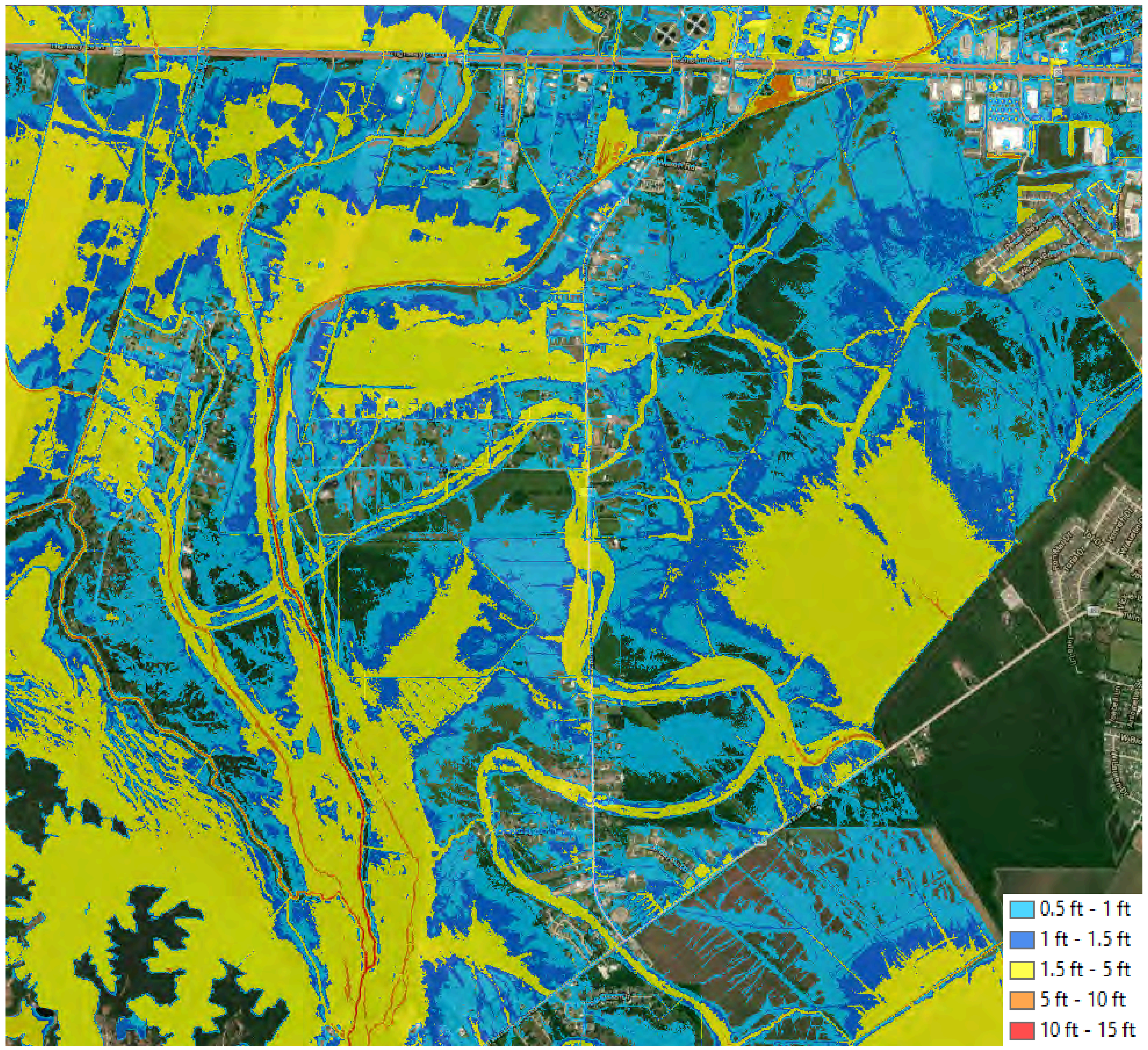
I-49 Pumps

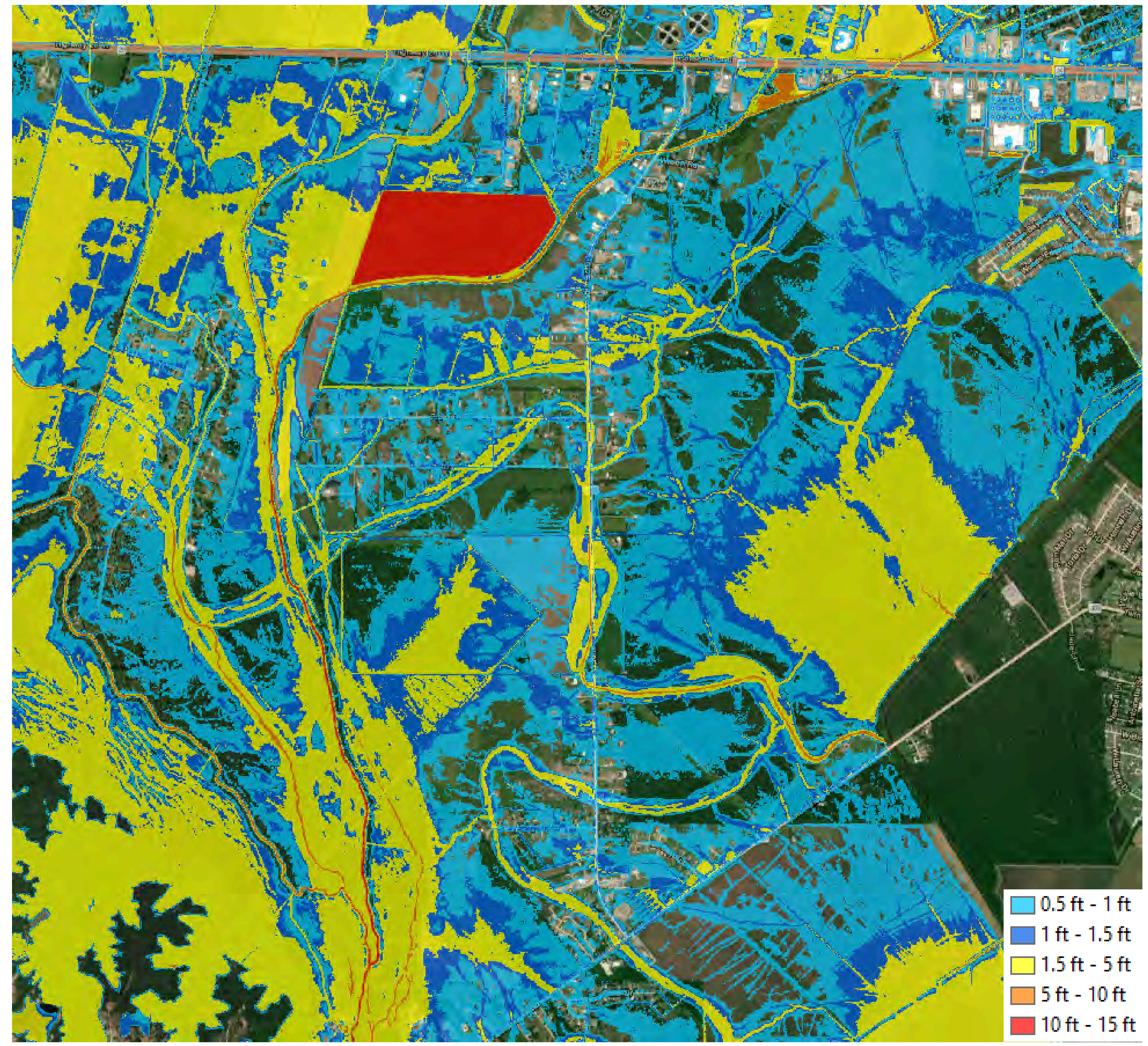
The I-49 area near downtown has two pressure pumps and two gravity pumps that are designed alleviate stormwater flooding up to a 10-year storm event. Their benefit can be seen in the reduction of water depth on the I-49 underpasses.



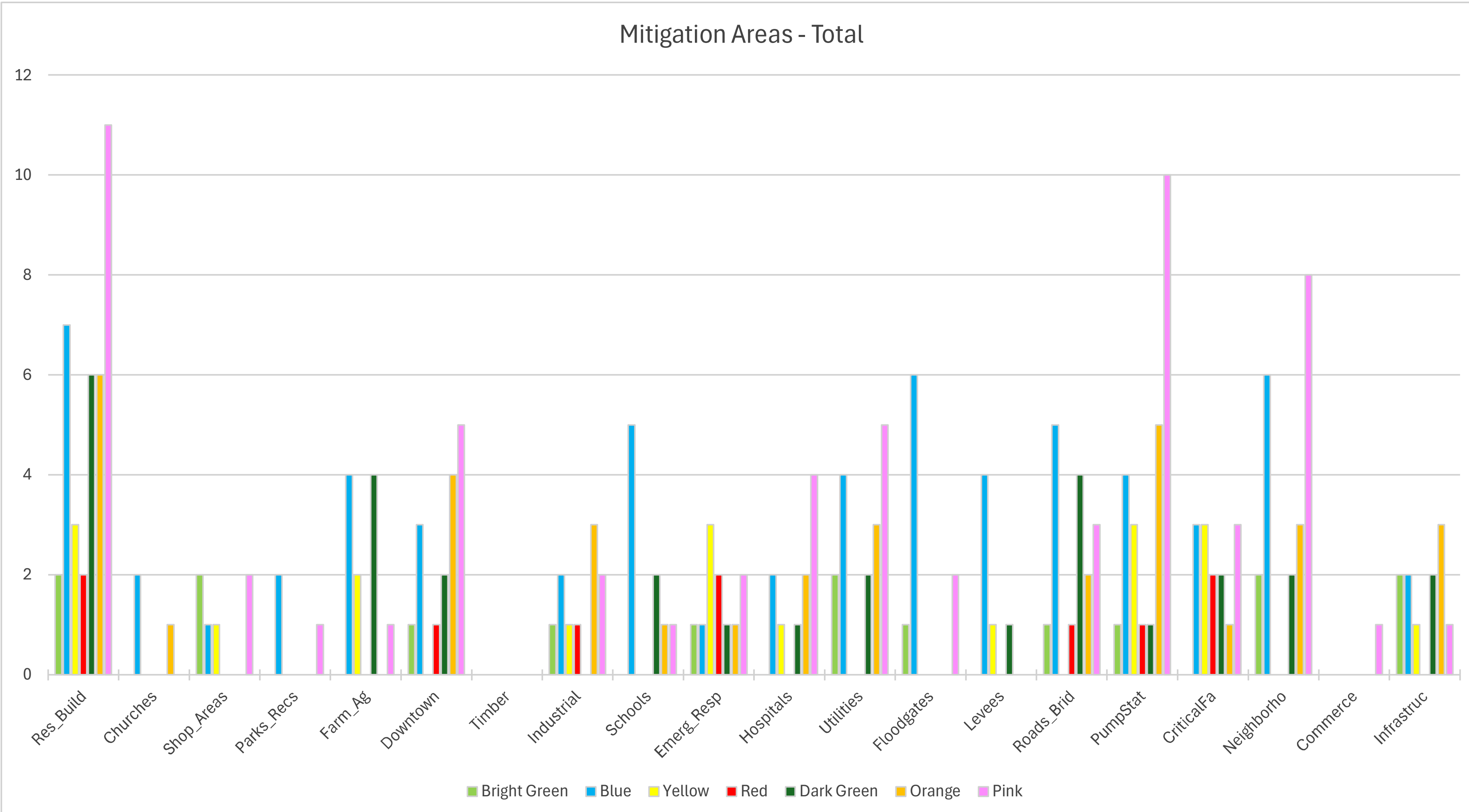
McKeithen Drive

Some strategies that were implemented in the model for the McKeithen Drive area were a levee with a detention pond to the north, small dredging effort along McKeithen Road, expansion of two bridges, and enlargement of culverts along the roadway.

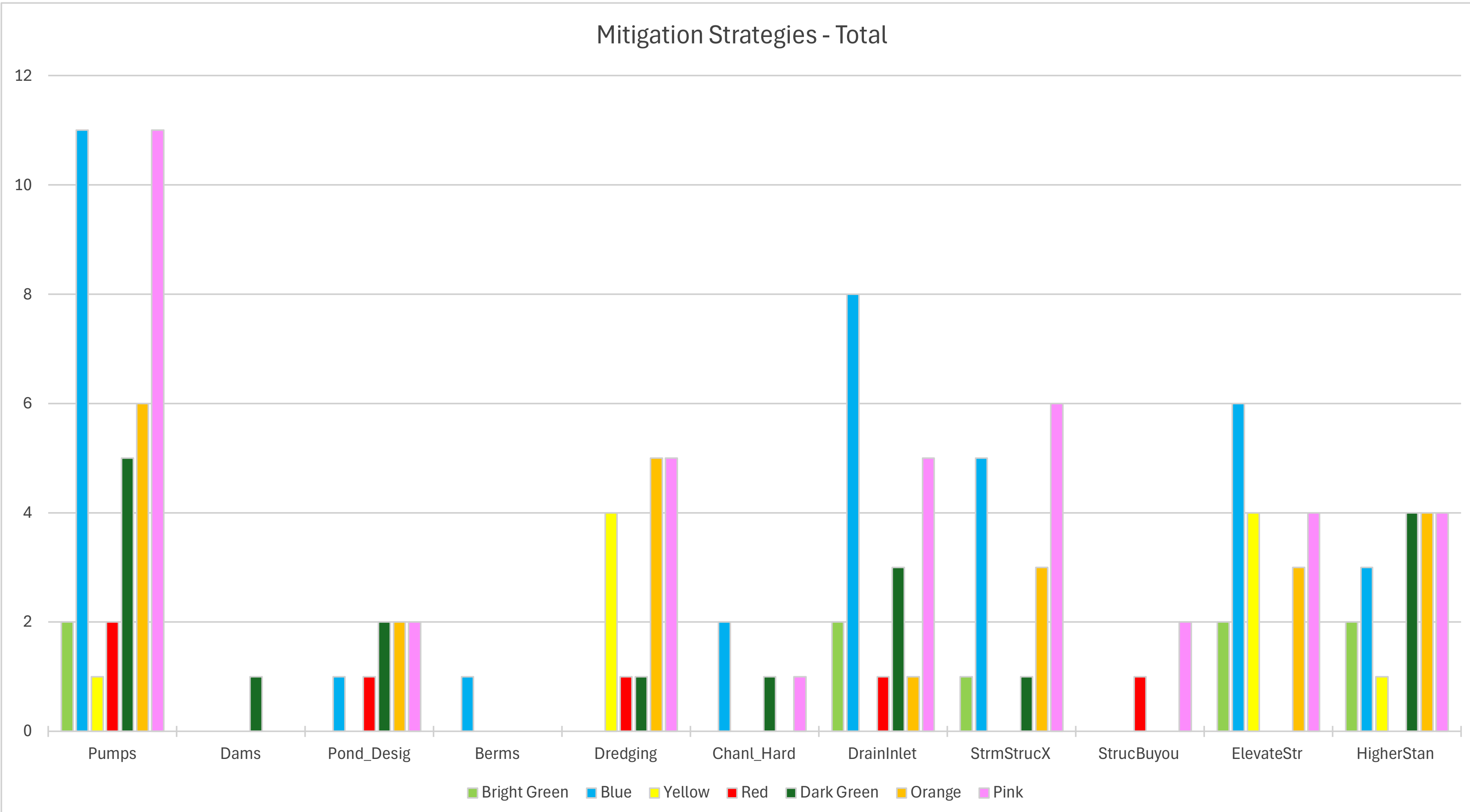


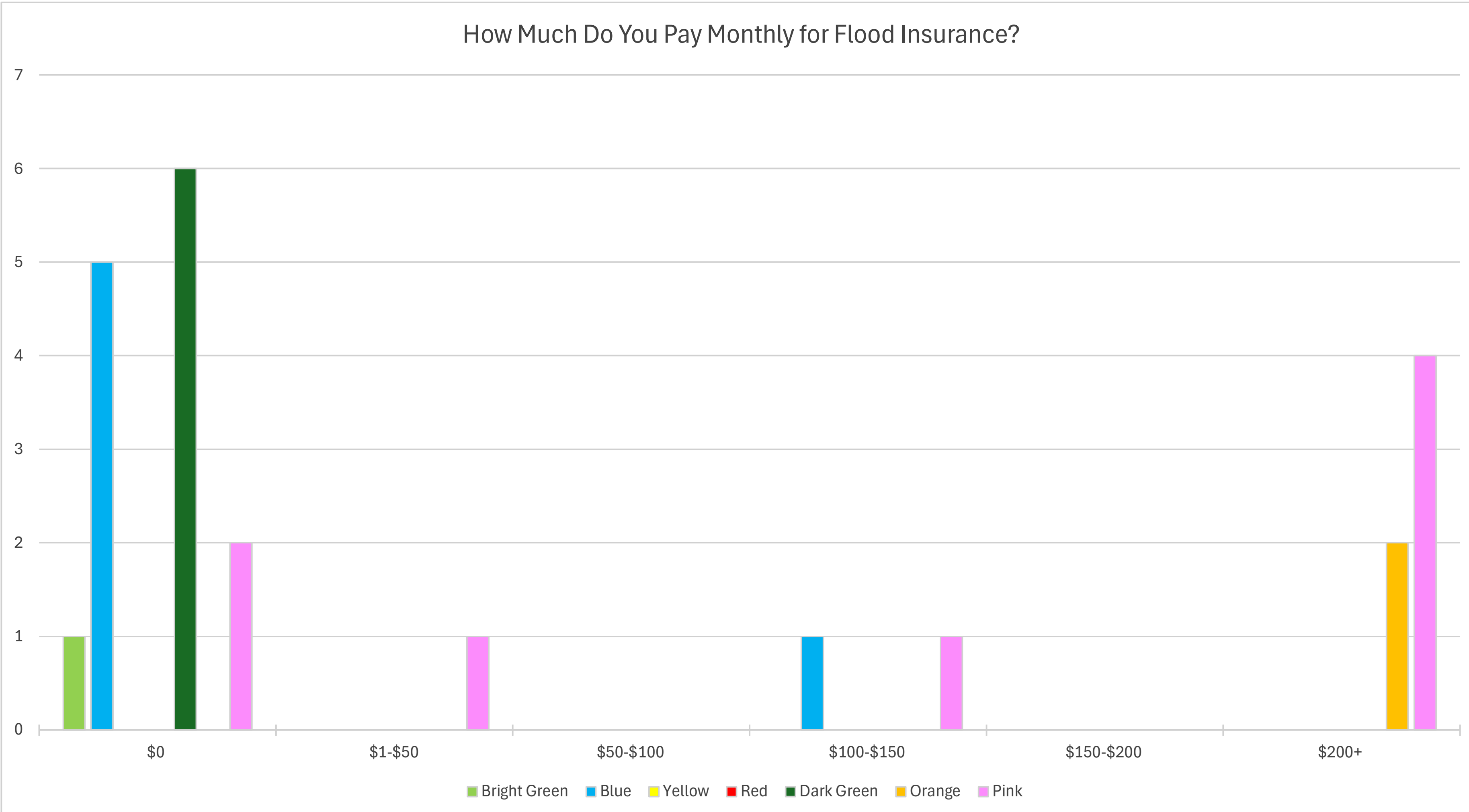


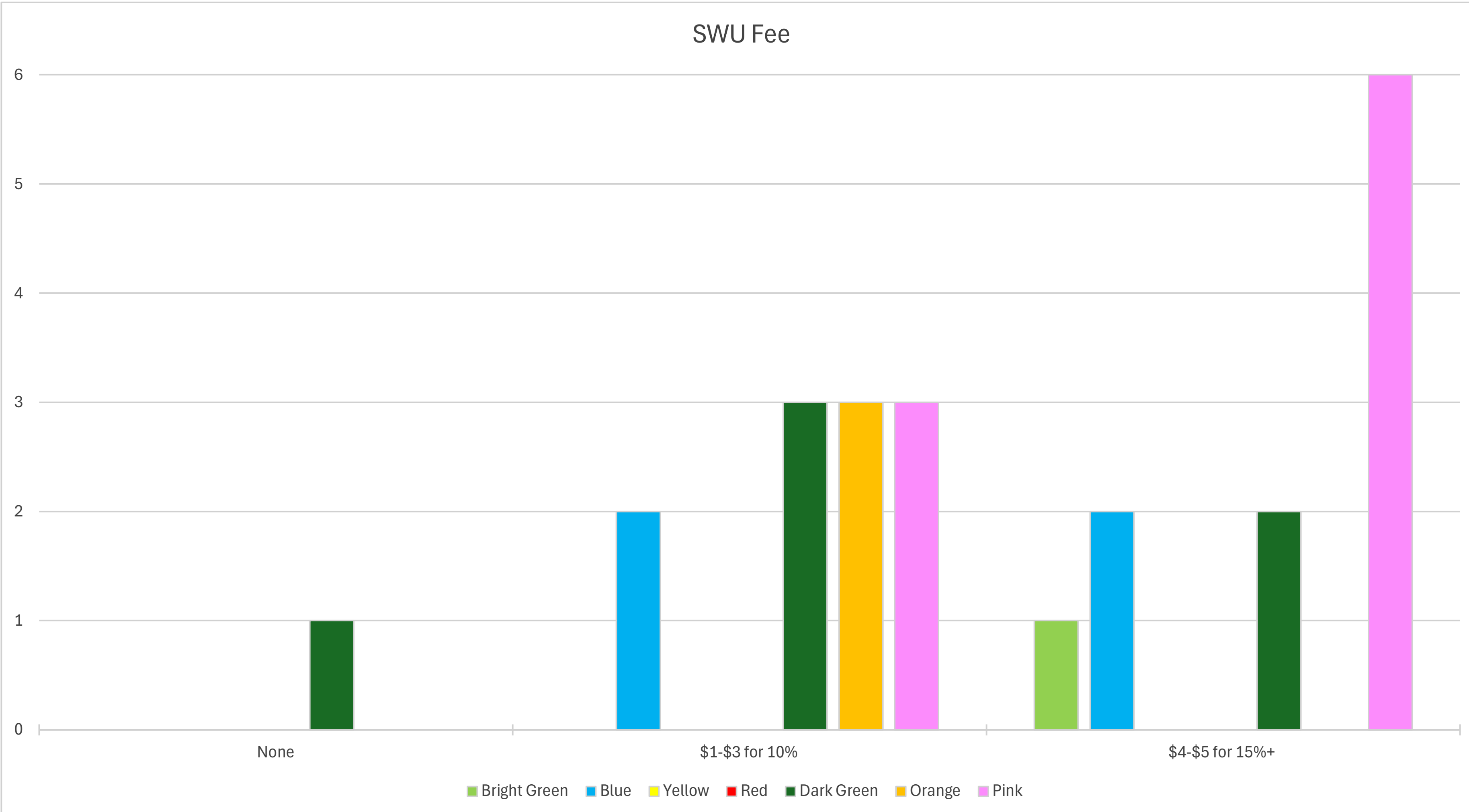
APPENDIX F: SURVEYS



Mitigation Areas - Total
12
10
8
6
4
2
0
Res_Build
Churches
Shop_Areas
Parks_Recs
Farm_Ag
Downtown
Timber
Industrial
Schools
Emerg_Resp
Hospitals
Utilities
Floodgates
Levees
Roads_Brid
PumpStat
CriticalFa
Neighborho
Commerce
Infrastruc
Bright Green
Blue
Yellow
Red
Dark Green
Orange
Pink


Mitigation Strategies - Total
12
10
8
6
4
2
0
Pumps
Dams
Pond_Desig
Berms
Dredging
Chanl_Hard
DrainInlet
StrmStrucX
StrucBuyou
ElevateStr
HigherStan
Bright Green
Blue
Yellow
Red
Dark Green
Orange
Pink

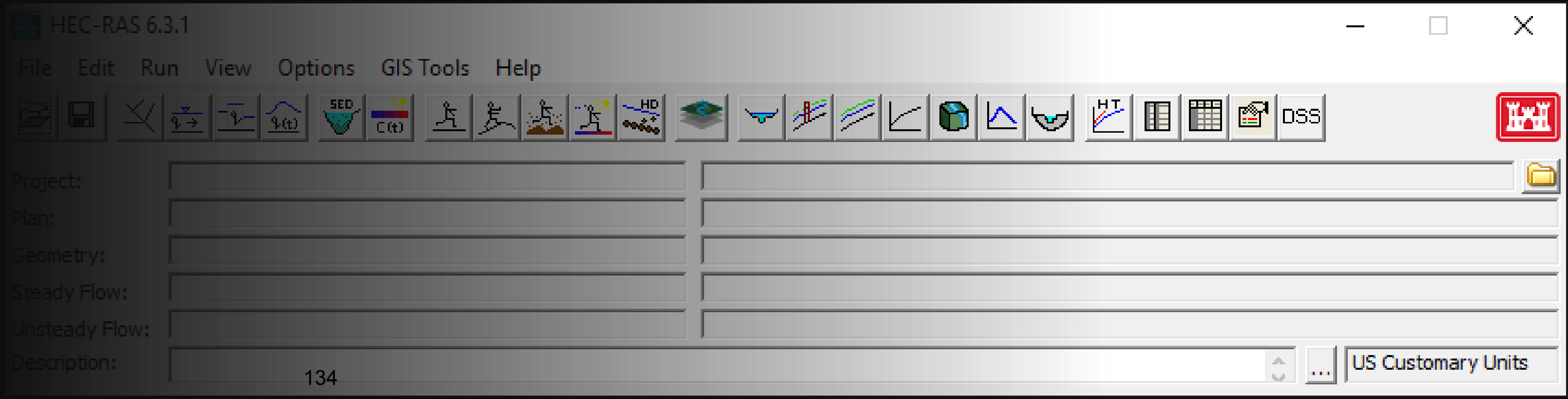

How Much Do You Pay Monthly for Flood Insurance?
0
1
2
3
4
5
6
7
$0
$1-$50
$50-$100
$100-$150
$150-$200
$200+
Bright Green
Blue
Yellow
Red
Dark Green
Orange
Pink



SWU Fee
6
5
4
3
2
1
0
None
$1-$3 for 10%
$4-$5 for 15%+
Bright Green
Blue
Yellow
Red
Dark Green
Orange
Pink

APPENDIX G: TECHNICAL TRAININGS

RAPC Technical Training



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Data Source Library

Navigating RAS Results

Interpreting RAS Results

Exporting Data for Other Software

Project Feasibility Assessment

136

DATA SOURCES

Terrain

- 2018 USGS Bayou Nezpique LiDAR
- 2019 USGS Sabine River LiDAR

Precipitation

- NOAA Atlas 14

Manning's n-Values

- Calibrated to match Red River CTP model

Land Use

- 2019 NLCD

Infiltration

- LADOTD Hydraulic Manual (2011)

Horizontal and Vertical Datum

- NAD_1983 State Plane Louisiana North FIPS1701 Feet
- NAVD88 GEOID18

Data Source Library

Navigating RAS Results

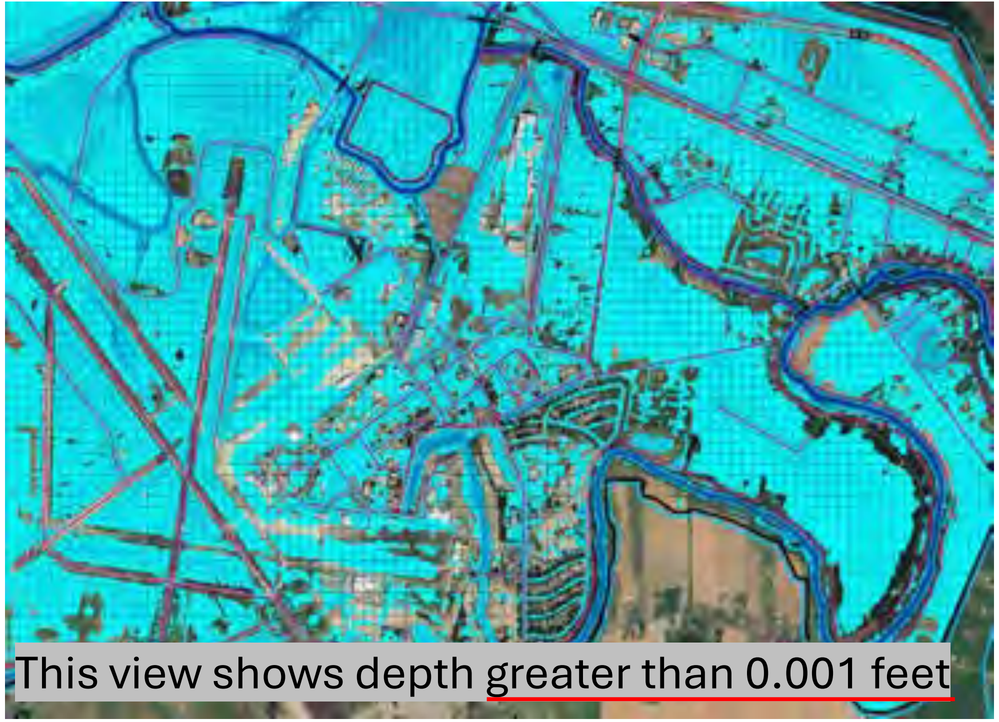
Interpreting RAS Results

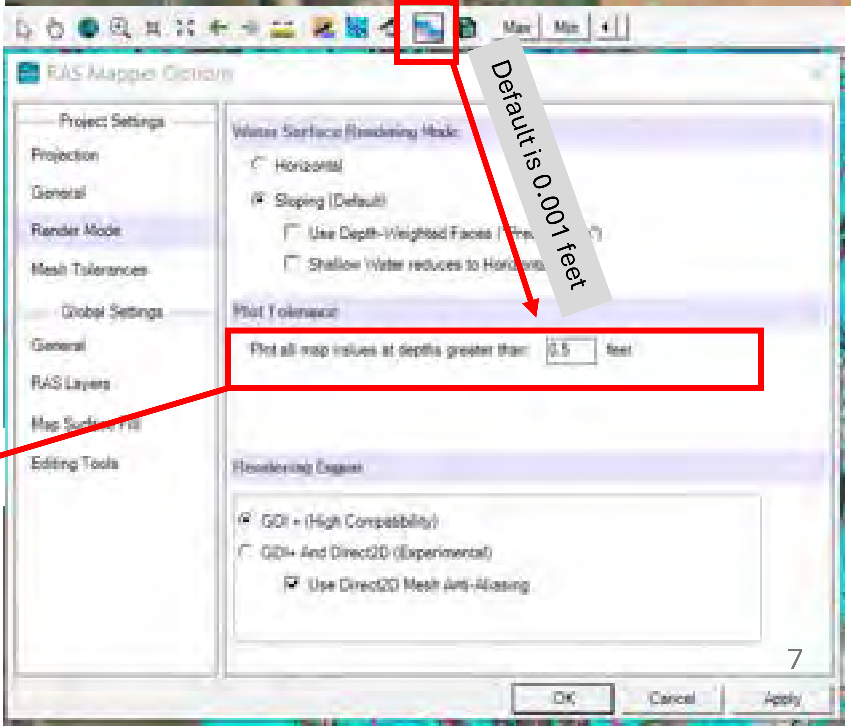
Exporting Data for Other Software

Project Feasibility Assessment

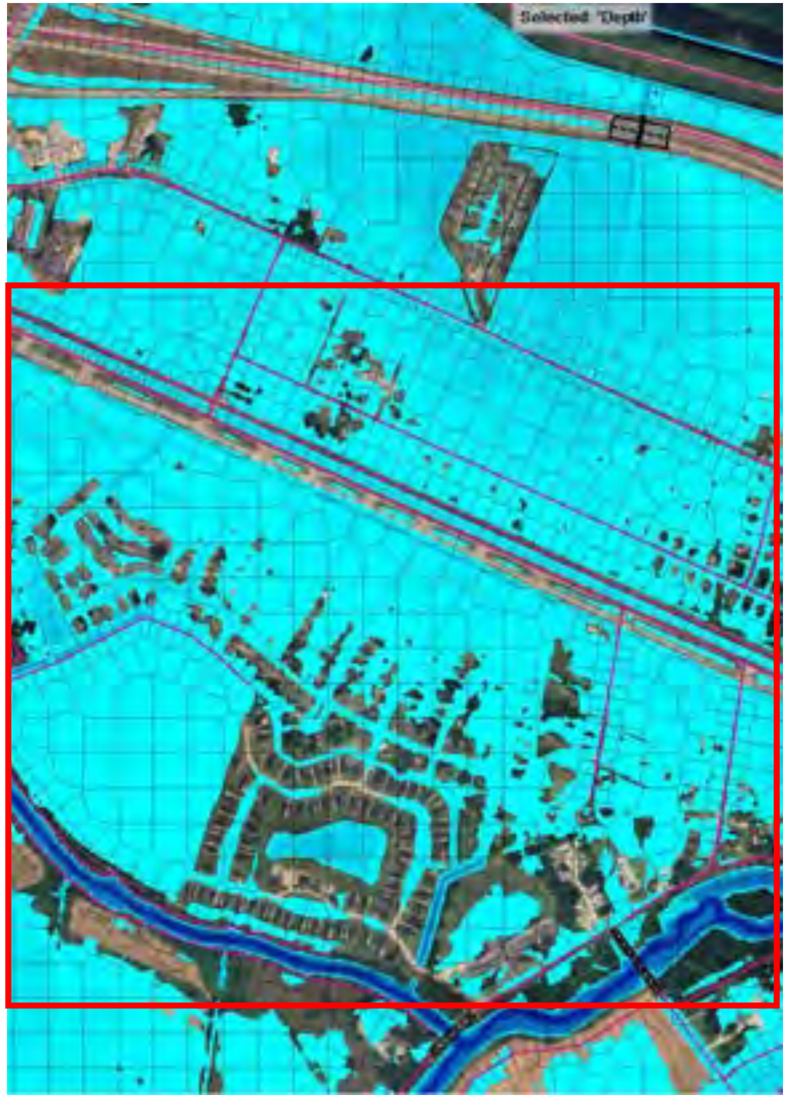
138

Viewing Results

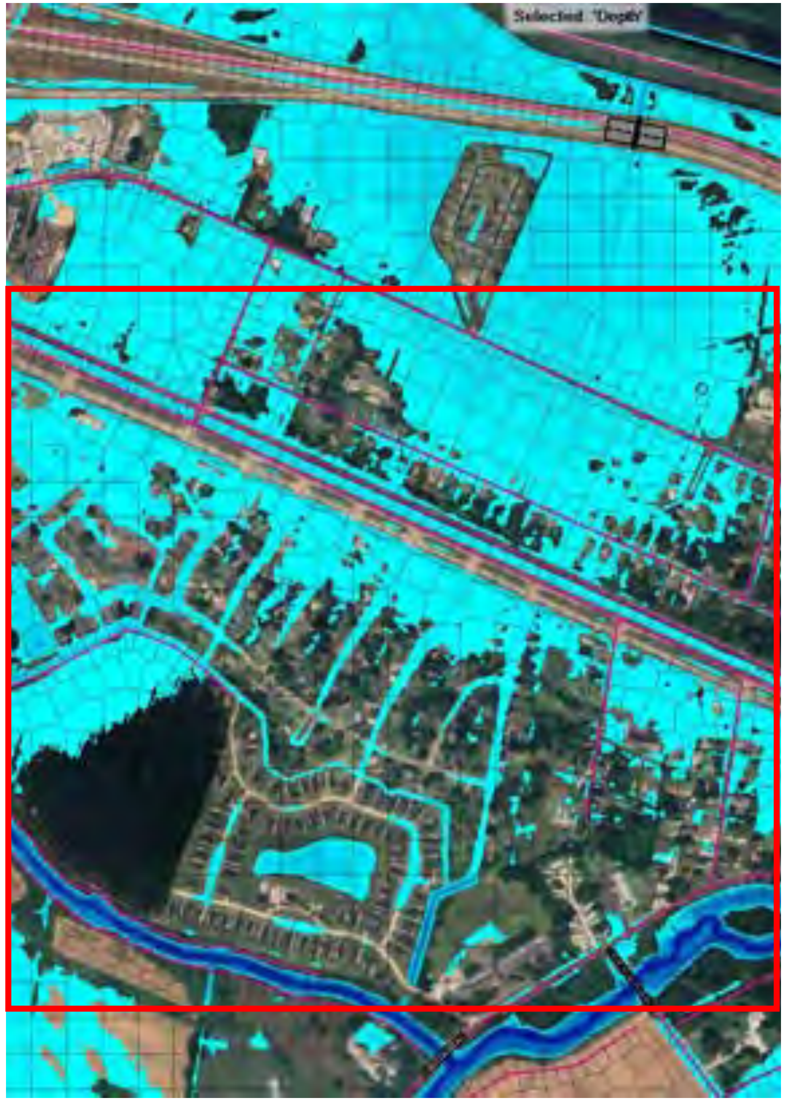




This view shows depths greater than 0.001 feet



This view shows depths greater than 0.5 feet

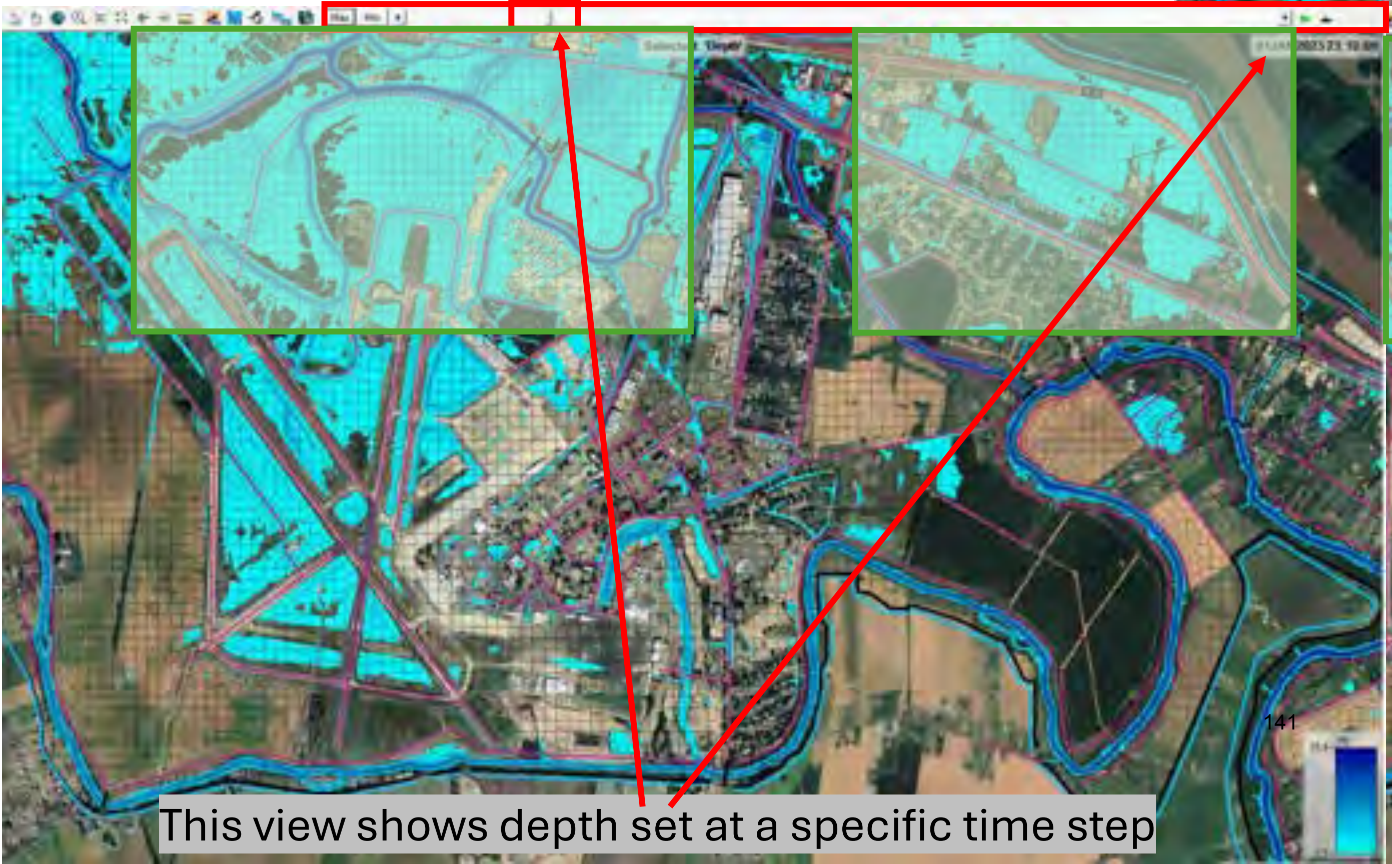


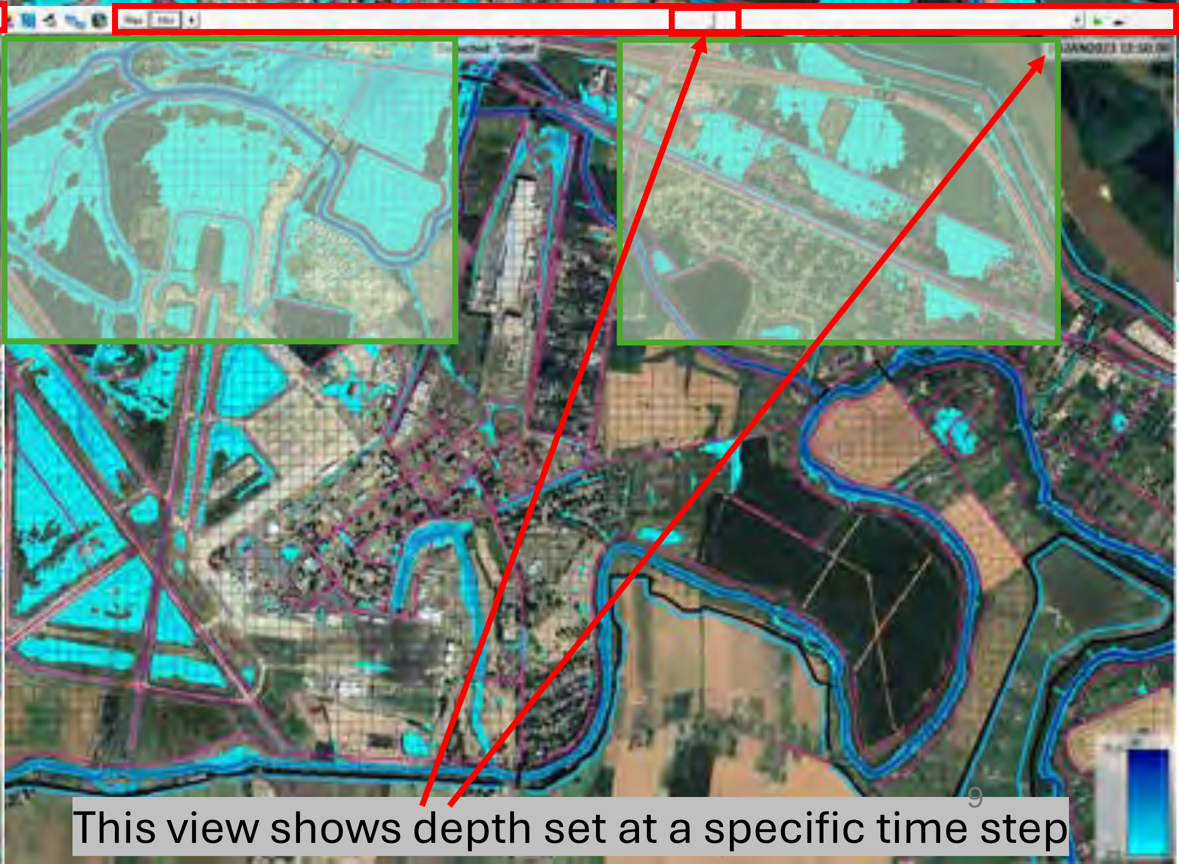
140

Changing the minimum depth shown can be important to help decide where sandbags are needed most for storm preparation.

Changing Time Steps

- Max will show the maximum amount of water that will be seen in an area
- Time steps can show the amount of water at a given time and can show how the water is receding, pooling, etc.

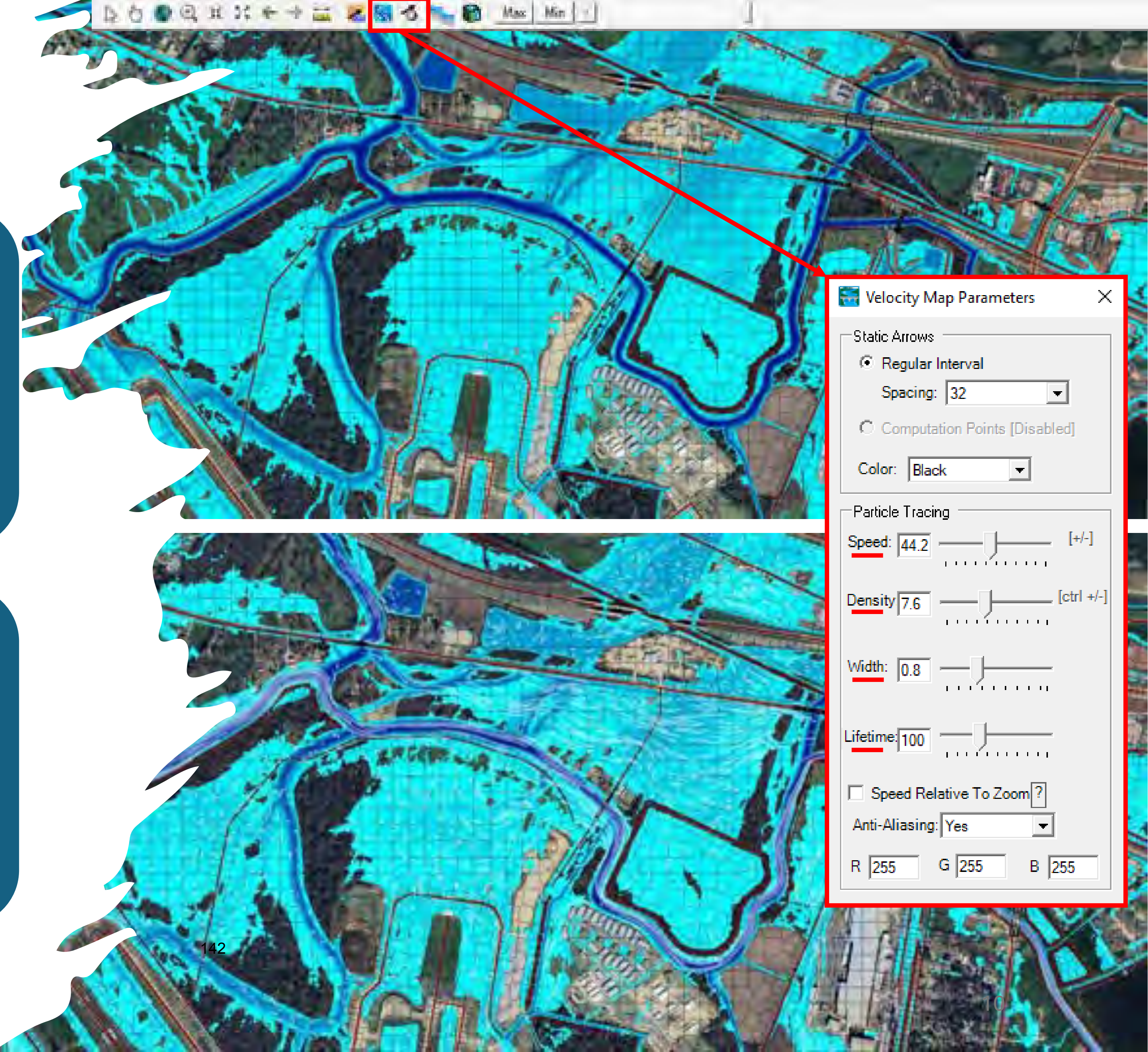


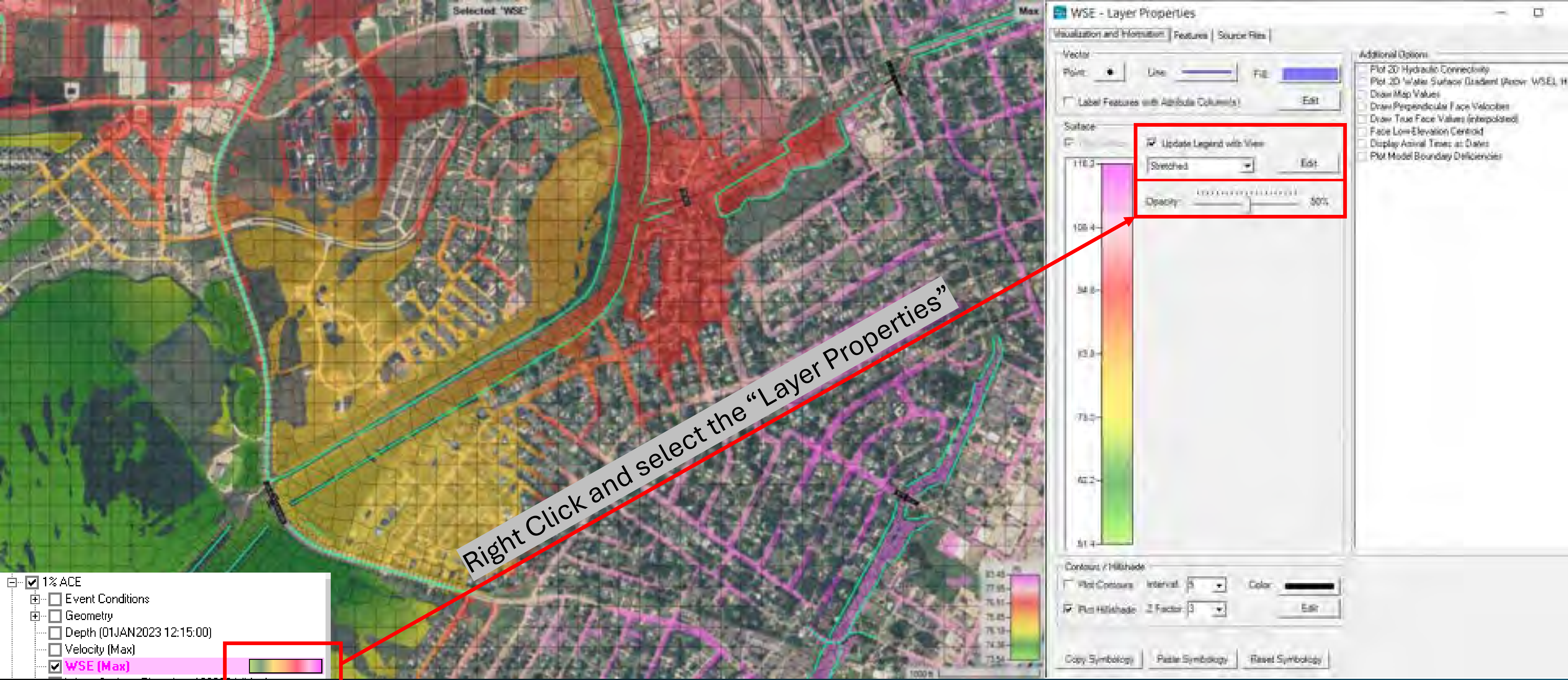


Particle Tracing

Particle Tracing can only be used when on a specific time, i.e. 01 JAN 2023 12:15:00.

The settings for particle tracing can determine the speed, density, width, and lifetime of the particles moving in the flow of water.

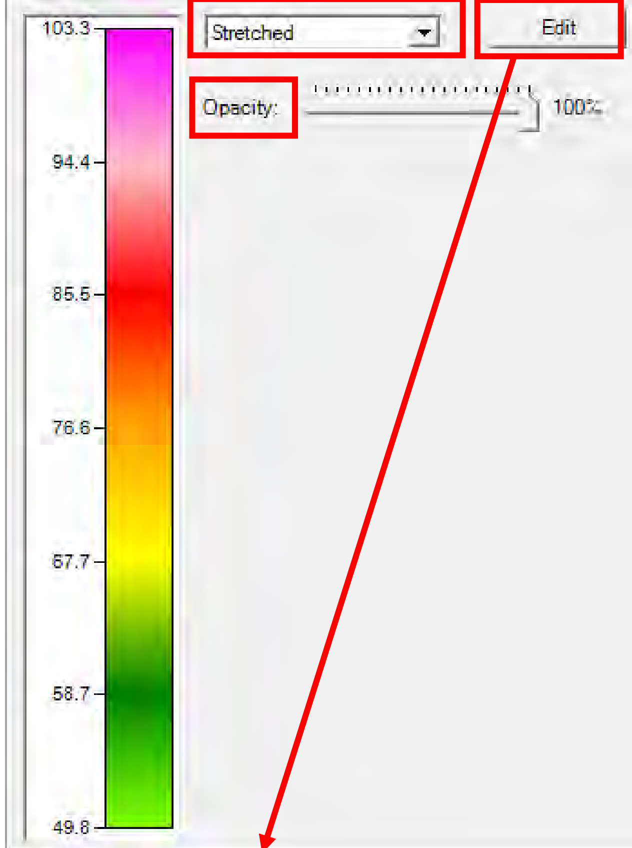


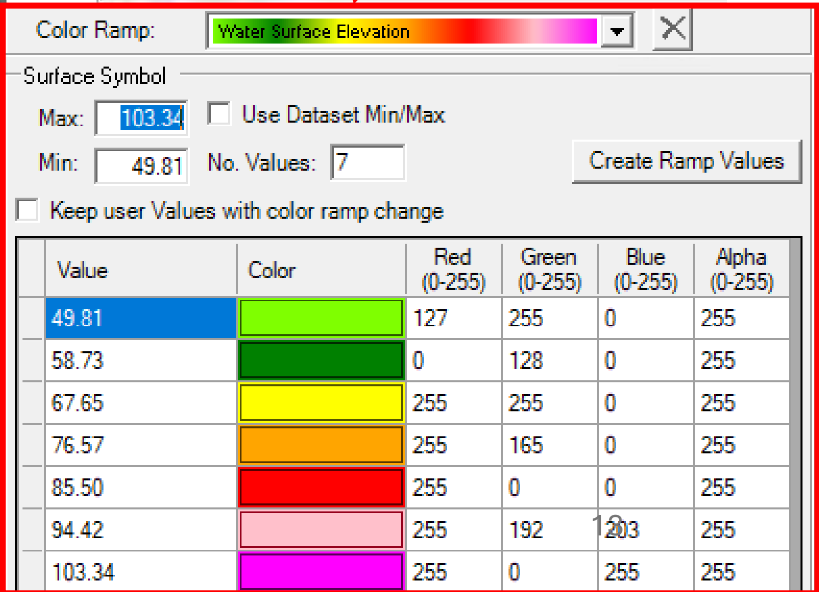


Layer Properties

Update Legend with View: This updates the result legend when you zoom into a certain area to be able to see accurately what is in the area.

Opacity: This helps make it possible to view results with the satellite mapping visible underneath them.

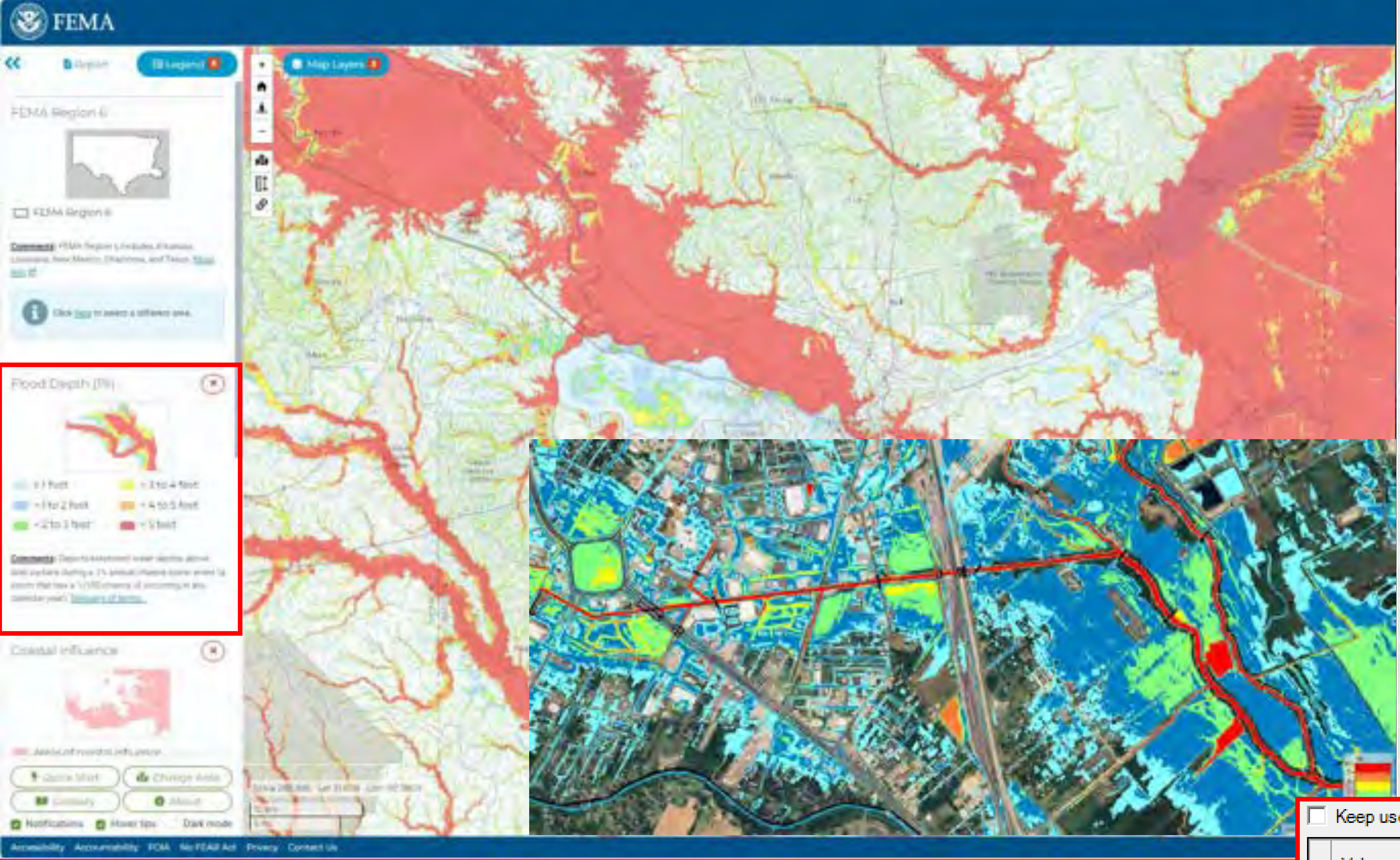


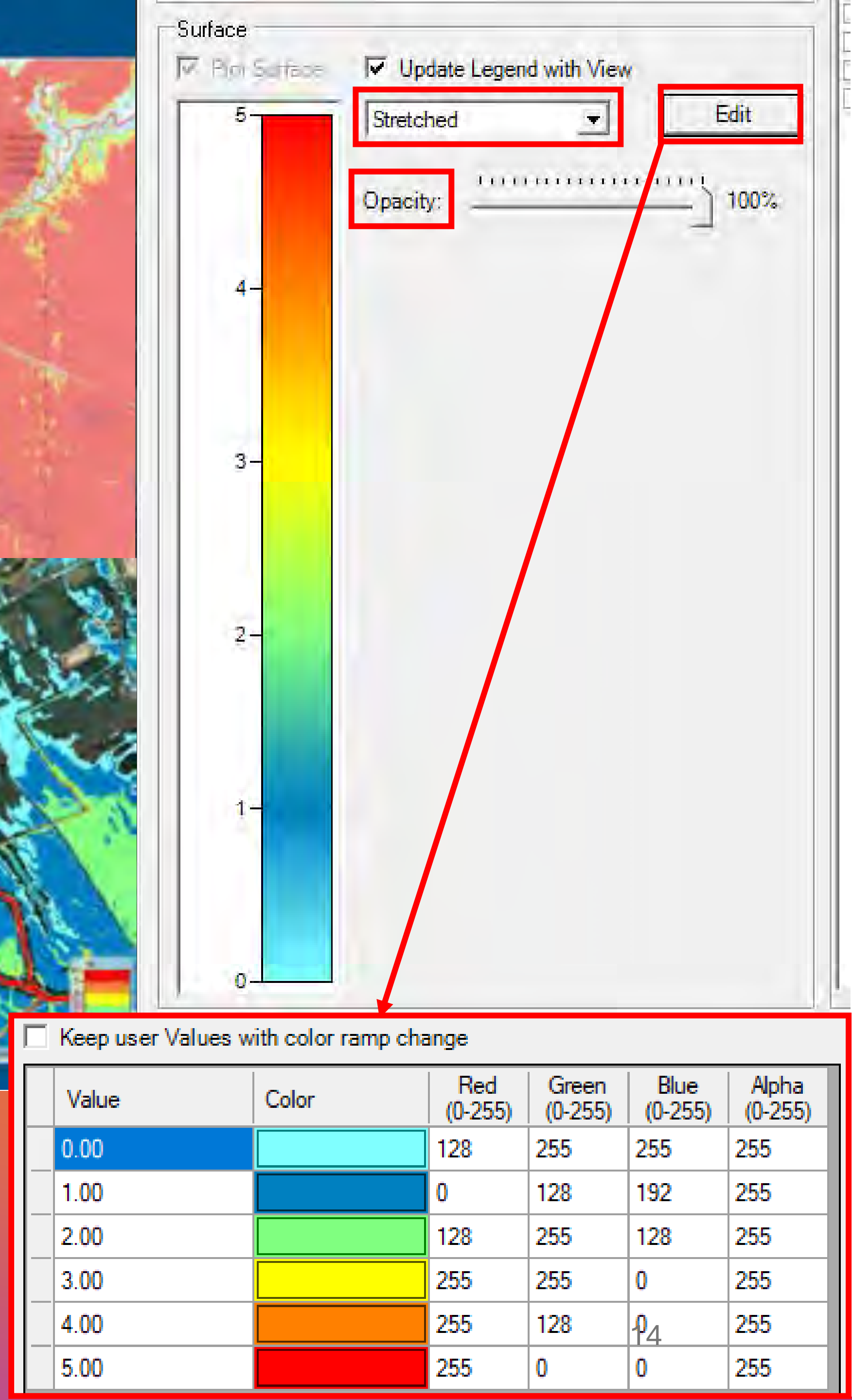


Value	Color	Red (0-255)	Green (0-255)	Blue (0-255)	Alpha (0-255)
49.81		127	255	0	255
58.73		0	128	0	255
67.65		255	255	0	255
76.57		255	165	0	255
85.50		255	0	0	255
94.42		255	192	203	255
103.34		255	0	255	255

Layer Properties

Surface Fill: The legend can be adjusted with the color and the scale depending on the preference of the viewer.





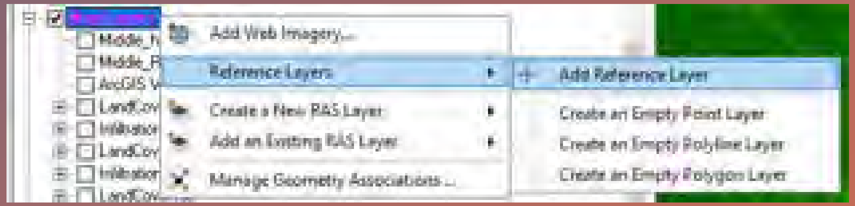
eBFE Viewer Legend Example

For those that are more familiar with the depth values on the eBFE viewer, the legend in RAS Mapper can be set to the same scale.

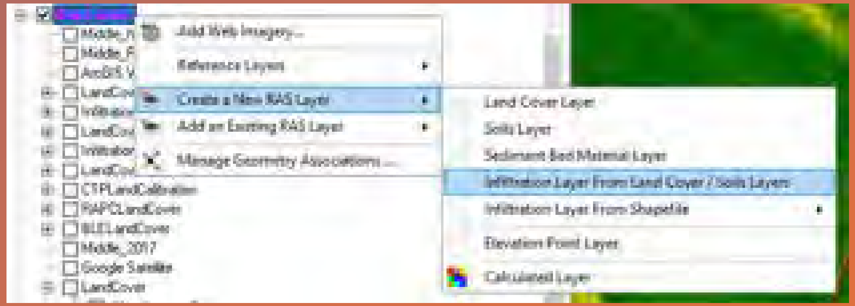
Map Layers

The Map Layers are where the Landuse or LandCover, Infiltration Layer, Basemaps, etc. are located.

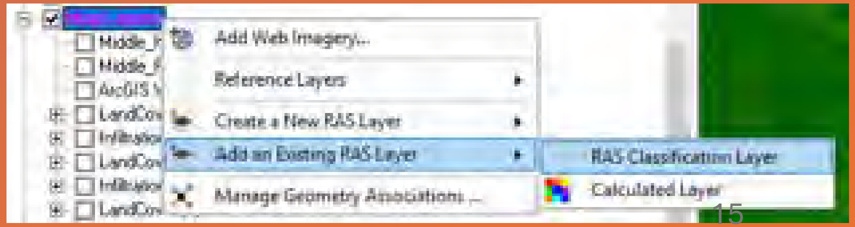
Reference Layers are used to import shapefiles.

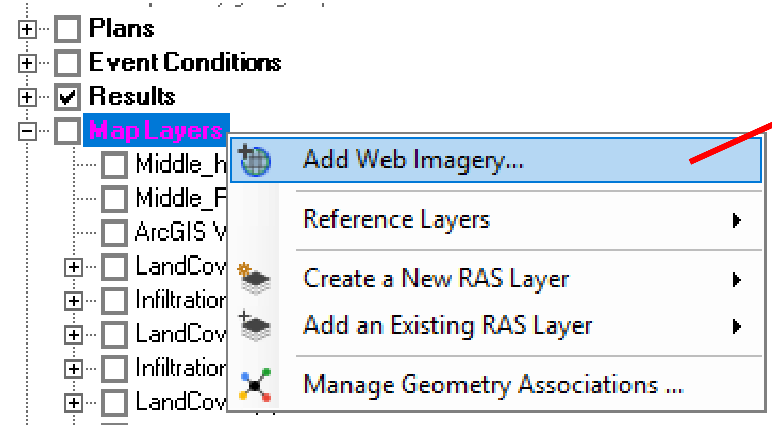


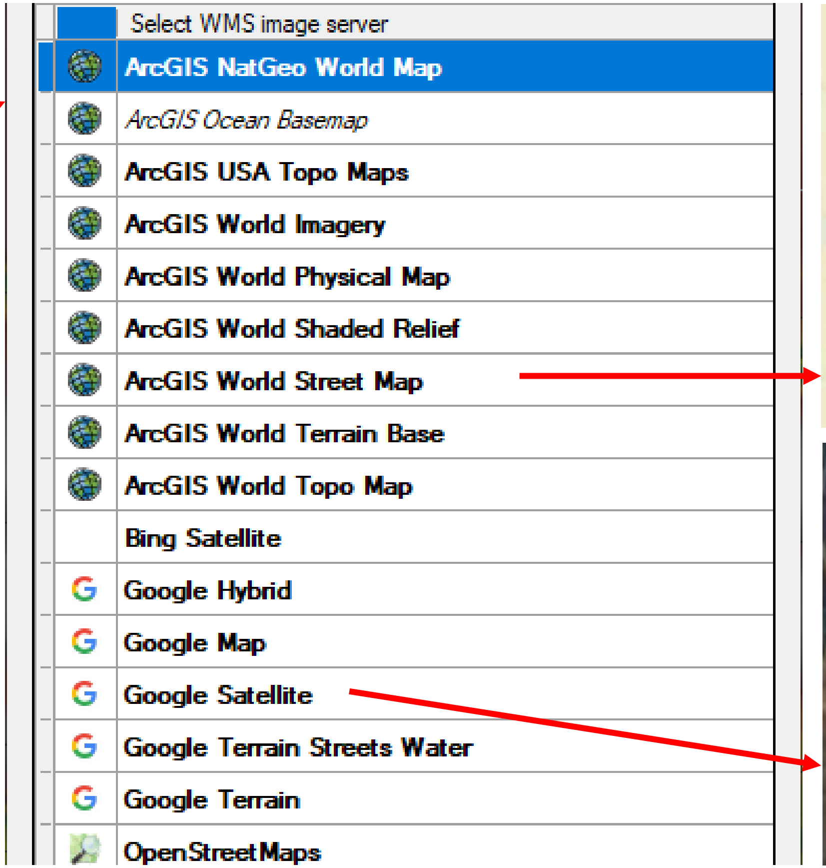
Infiltration layer can be imported from a shapefile or can be created from the landcover and soils data in RAS (previously uploaded by user).

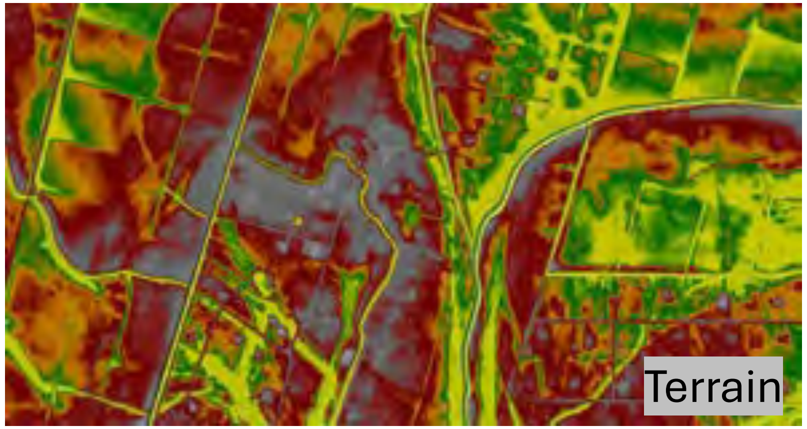


If the user has an existing layer from another RAS model, it can be imported and not have to be remade.





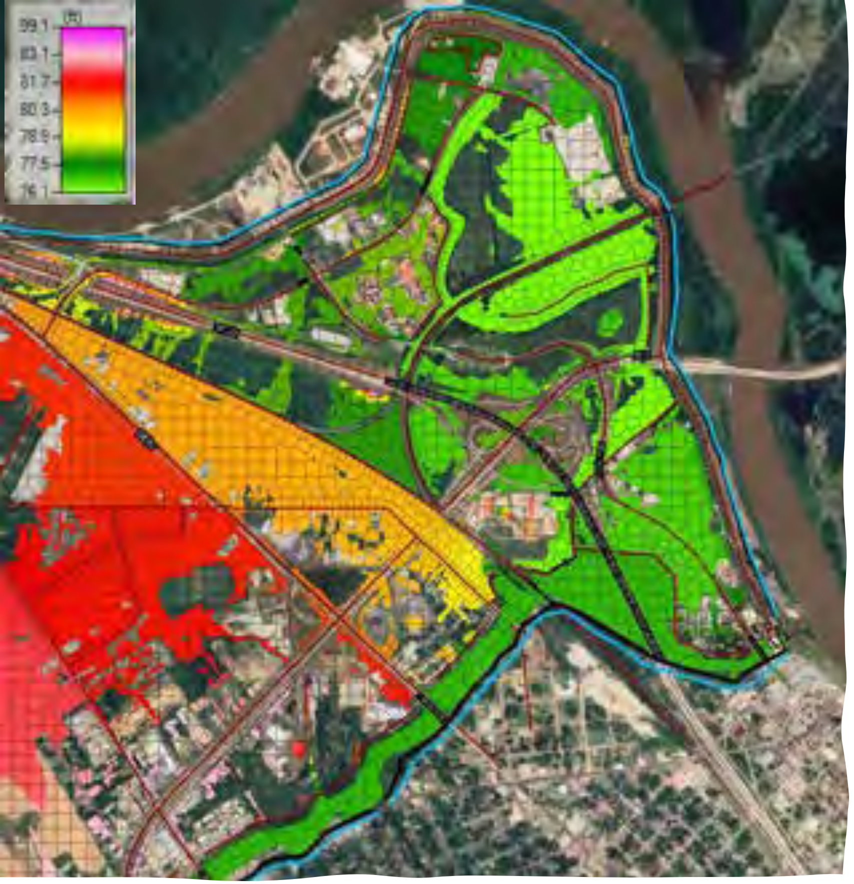




Adding Basemaps to RAS Mapper

Data Source Library
Navigating RAS Results
Interpreting RAS Results
Exporting Data for Other Software
Project Feasibility Assessment

148



How to Review Results

Water Surface Elevation (WSEL) shows the water's elevation on top of the terrain elevation, giving a total elevation.

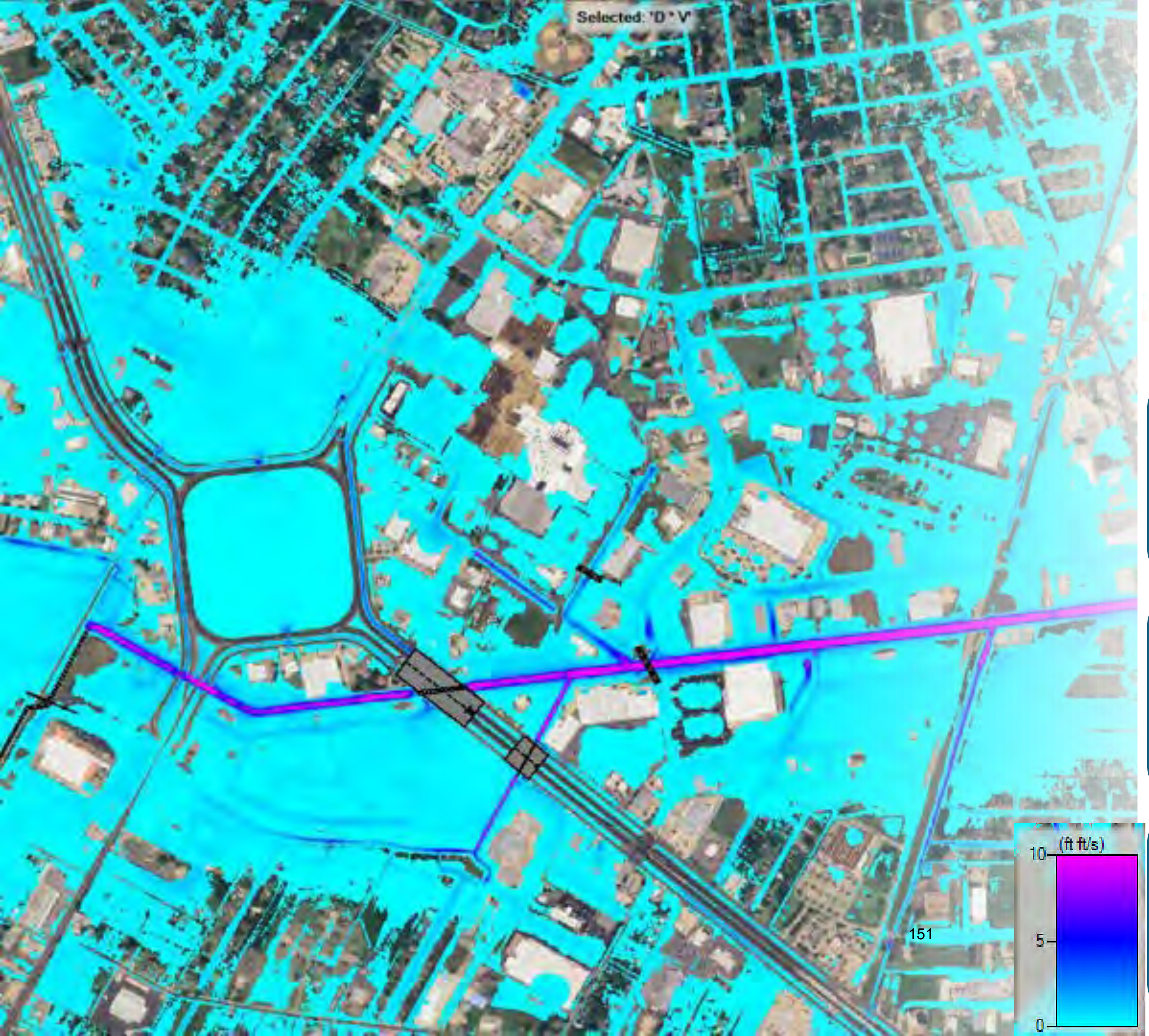
This raster can be used to understand, investigate, and determine projects based on the elevation changes.

How to Review Results

Depth rasters represent the difference between the WSEL and terrain to show the depth of the flood waters in the areas of the model.

The result rasters can:

- Identify channelization
- Inform on benefits to structure elevations
- Outline specific levels of inundation to be expected during specific storm events
- Help with community planning



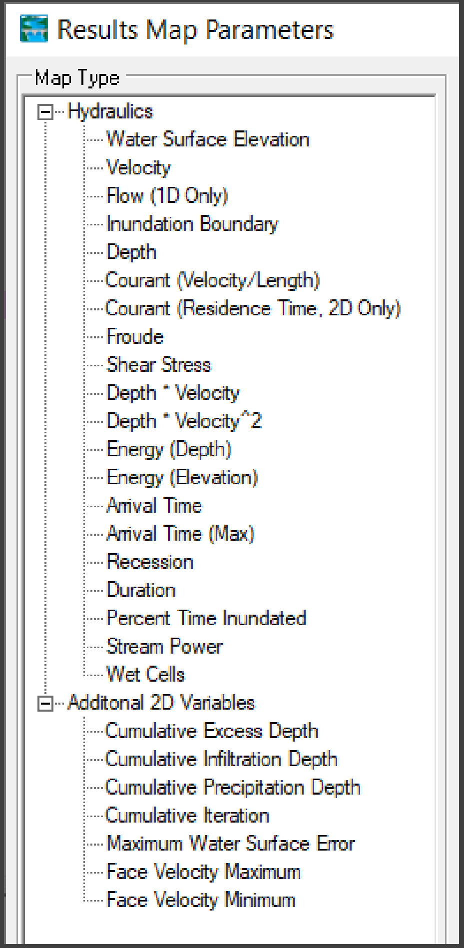
How to Review Results

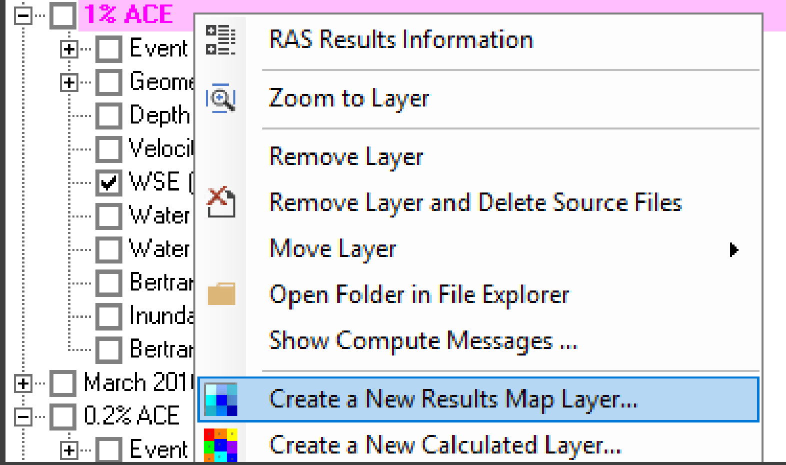
Depth multiplied by the velocity can present great benefits to the community planning decisions.

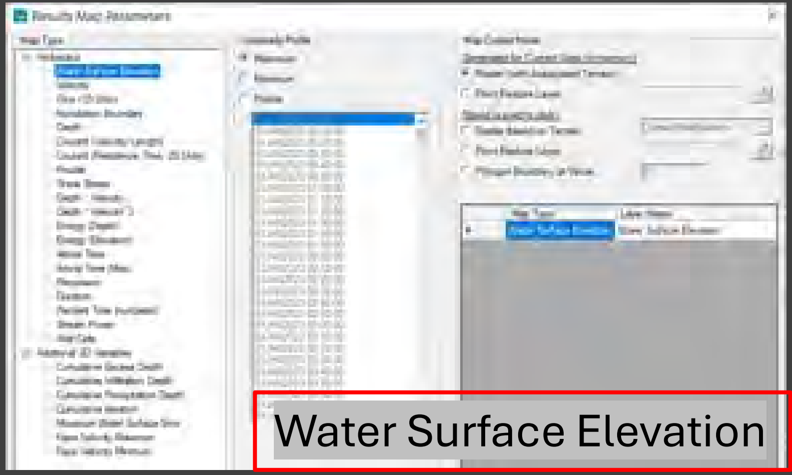
It can highlight areas of fast-moving water of significant depth which can move vehicles, create significant damage from erosion, and weaponize debris causing damage to vehicles, buildings, and personnel.

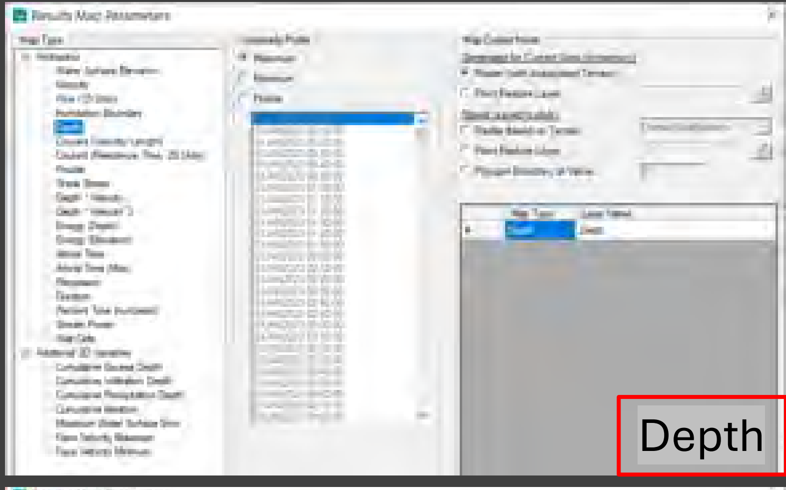
This could help the community plan before a storm hits to help those in the vulnerable areas to stay informed or evacuate before the storm hits.

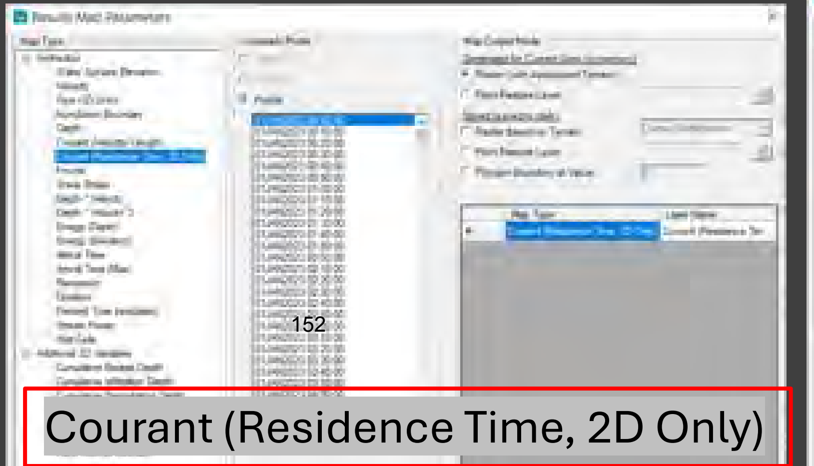
Other Common Rasters that can be Exported

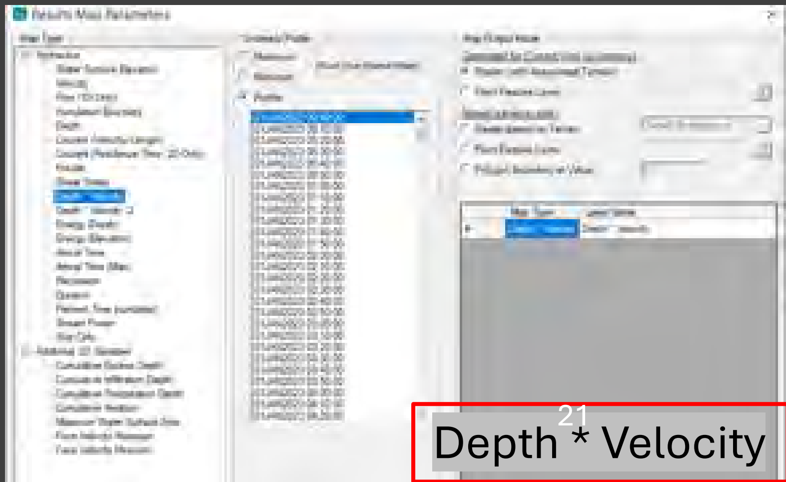


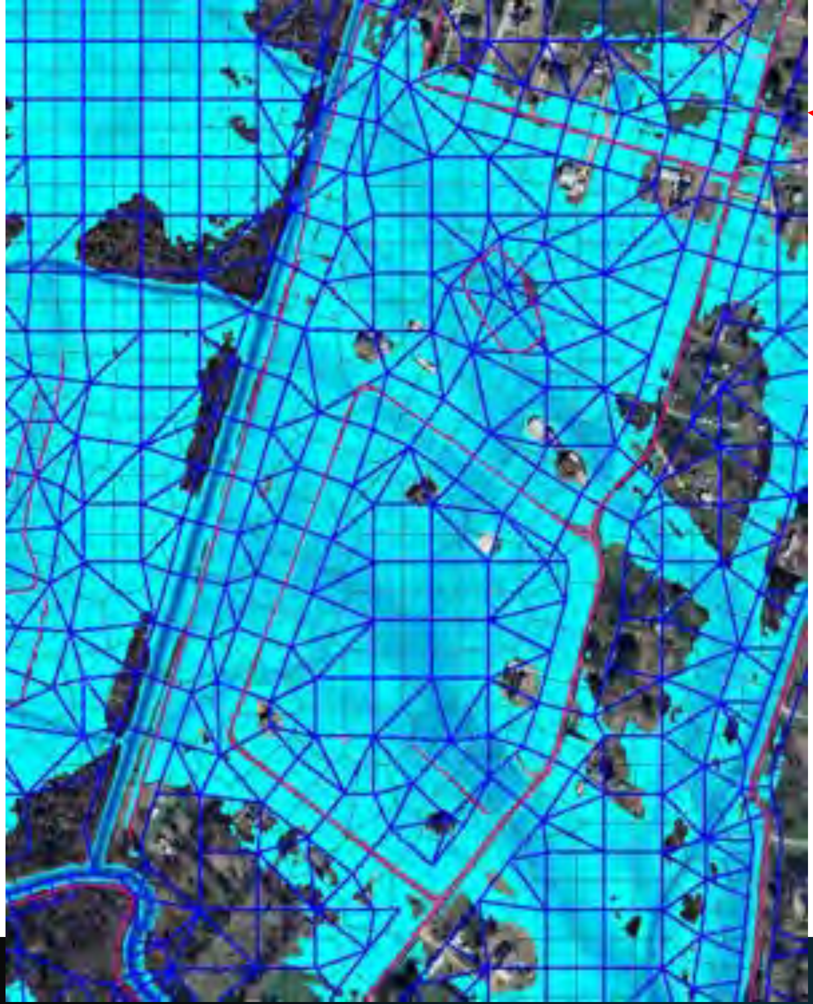


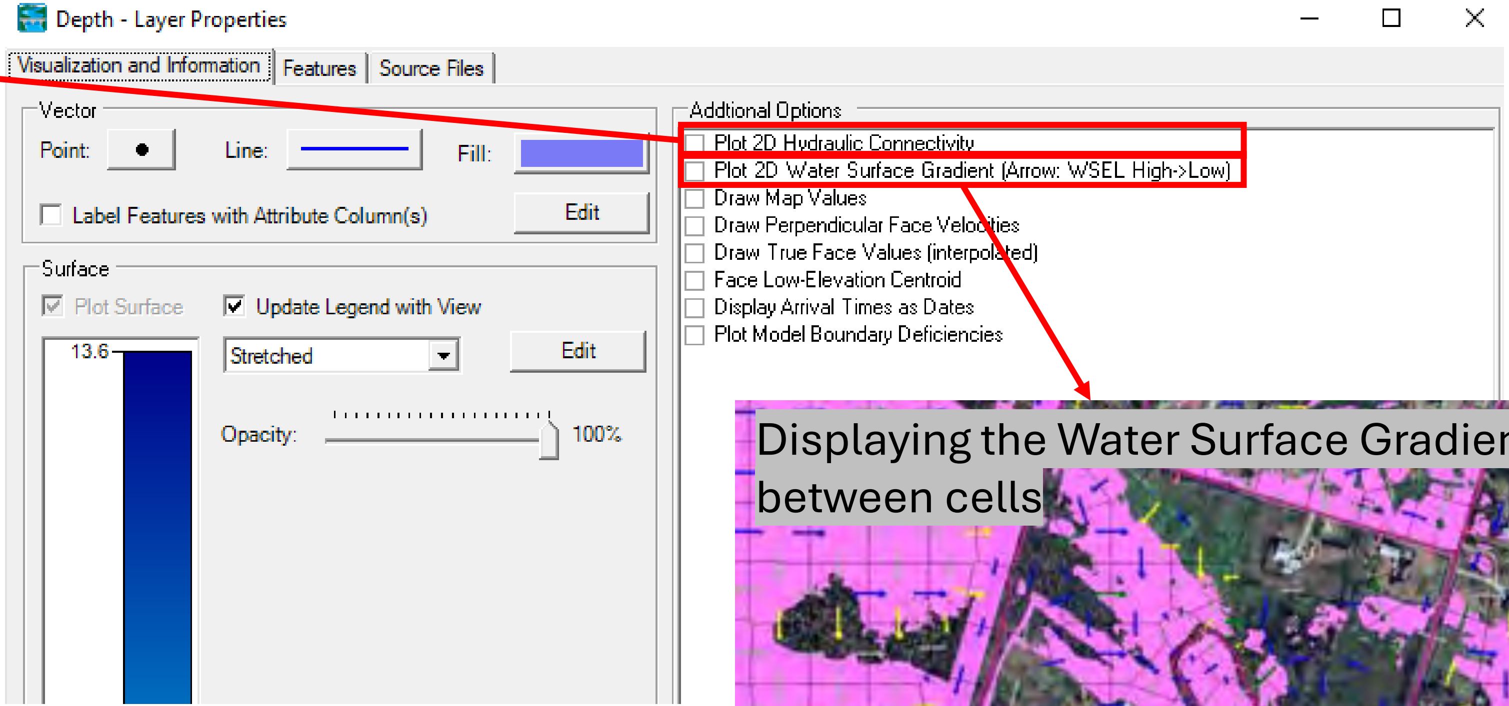


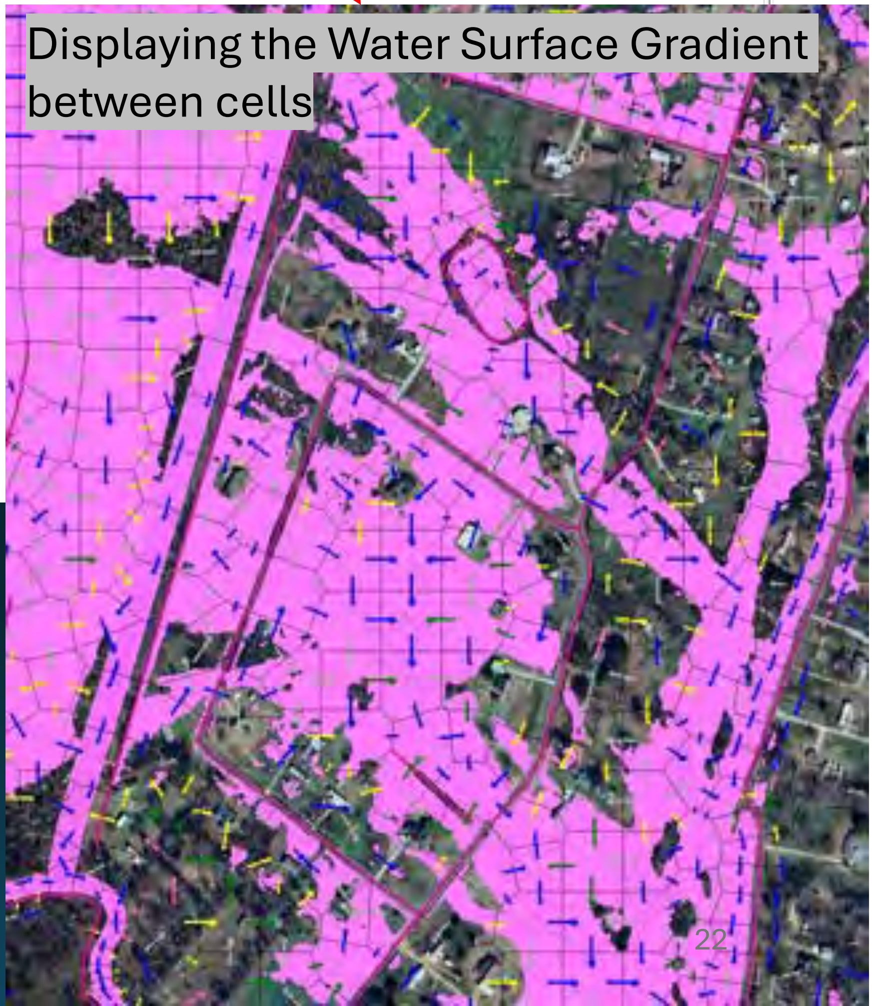


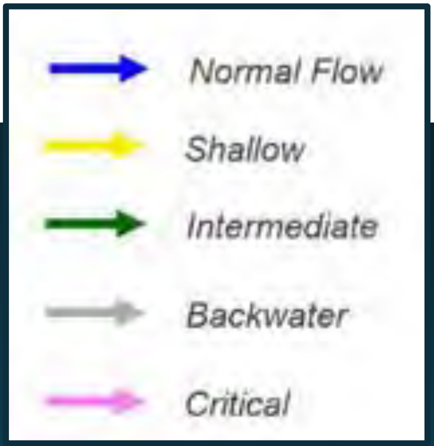










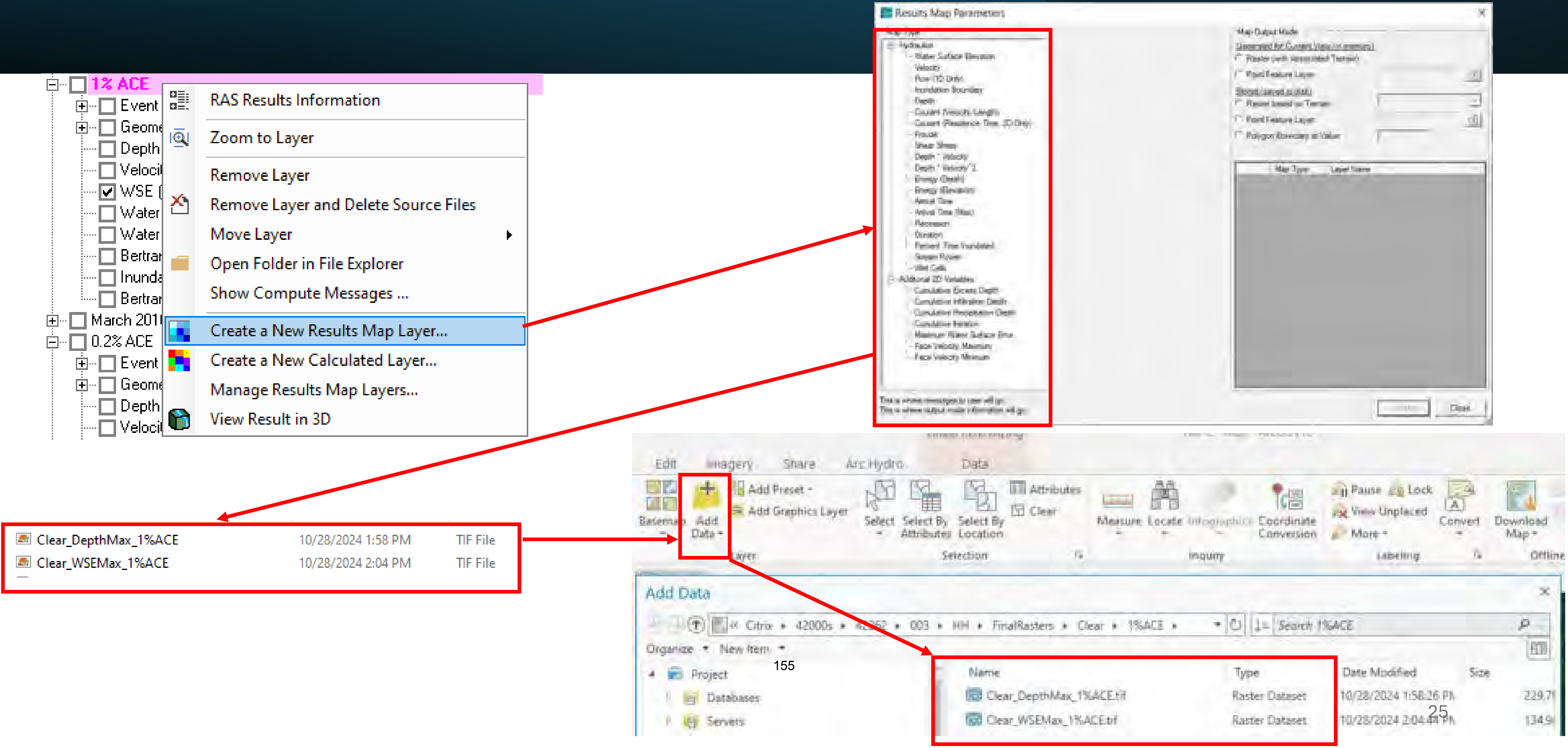


Displaying the Hydraulic Connectivity between cells

Directional Arrows

Data Source Library
Navigating RAS Results
Interpreting RAS Results
Exporting Data for Other Software
Project Feasibility Assessment

Export HEC-RAS Rasters to ArcPRO



KML Export

To create a KML, perform the following steps listed below:

1. Create and **Inundation Boundary** layer in RAS Mapper
2. Right-click on the Inundation Boundary layer and choose the **Export Layer | Save Features to KML** menu option.
3. Provide a filename and press **OK**.
4. The **KML** can then be added to a Google Earth instance (or likely you can double-click on the KML and it will launch and load Google Earth).

3D KML Export

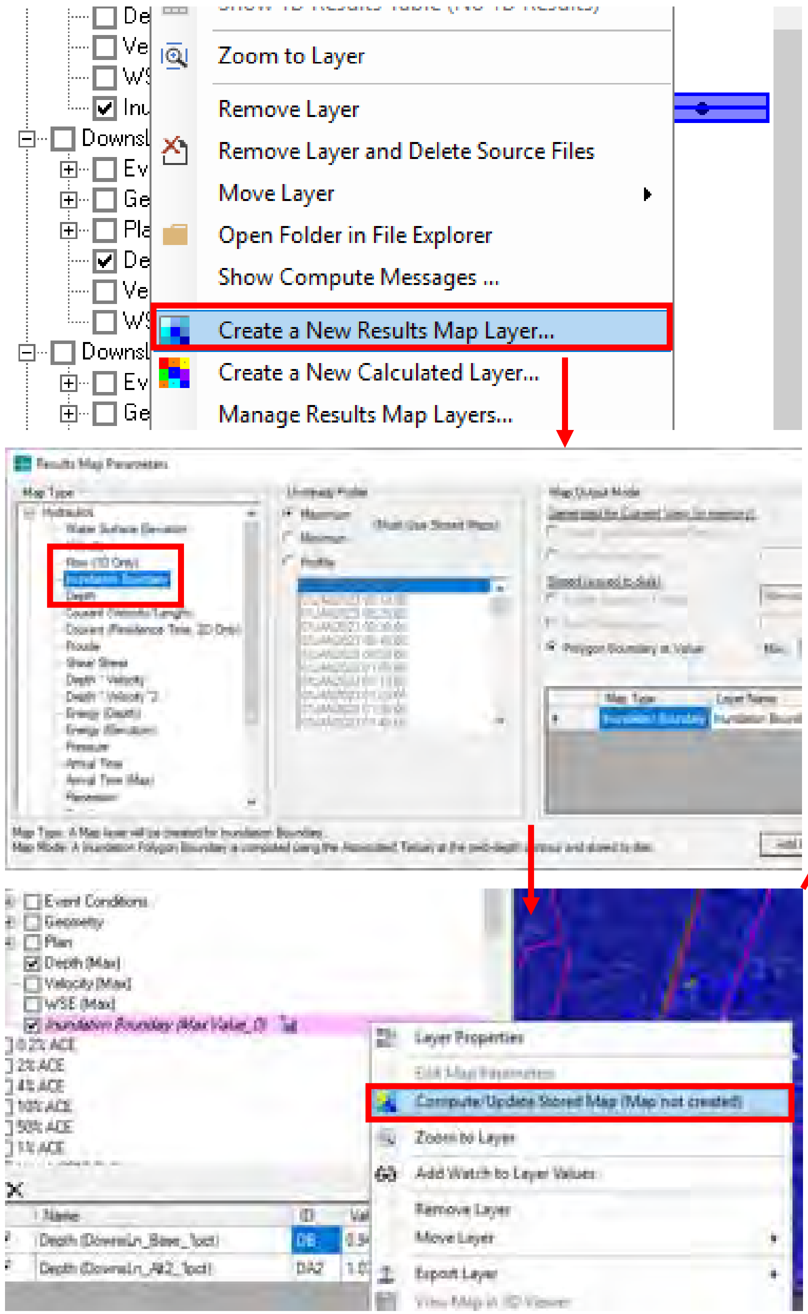
To create a 3D KML, perform the following steps listed below:

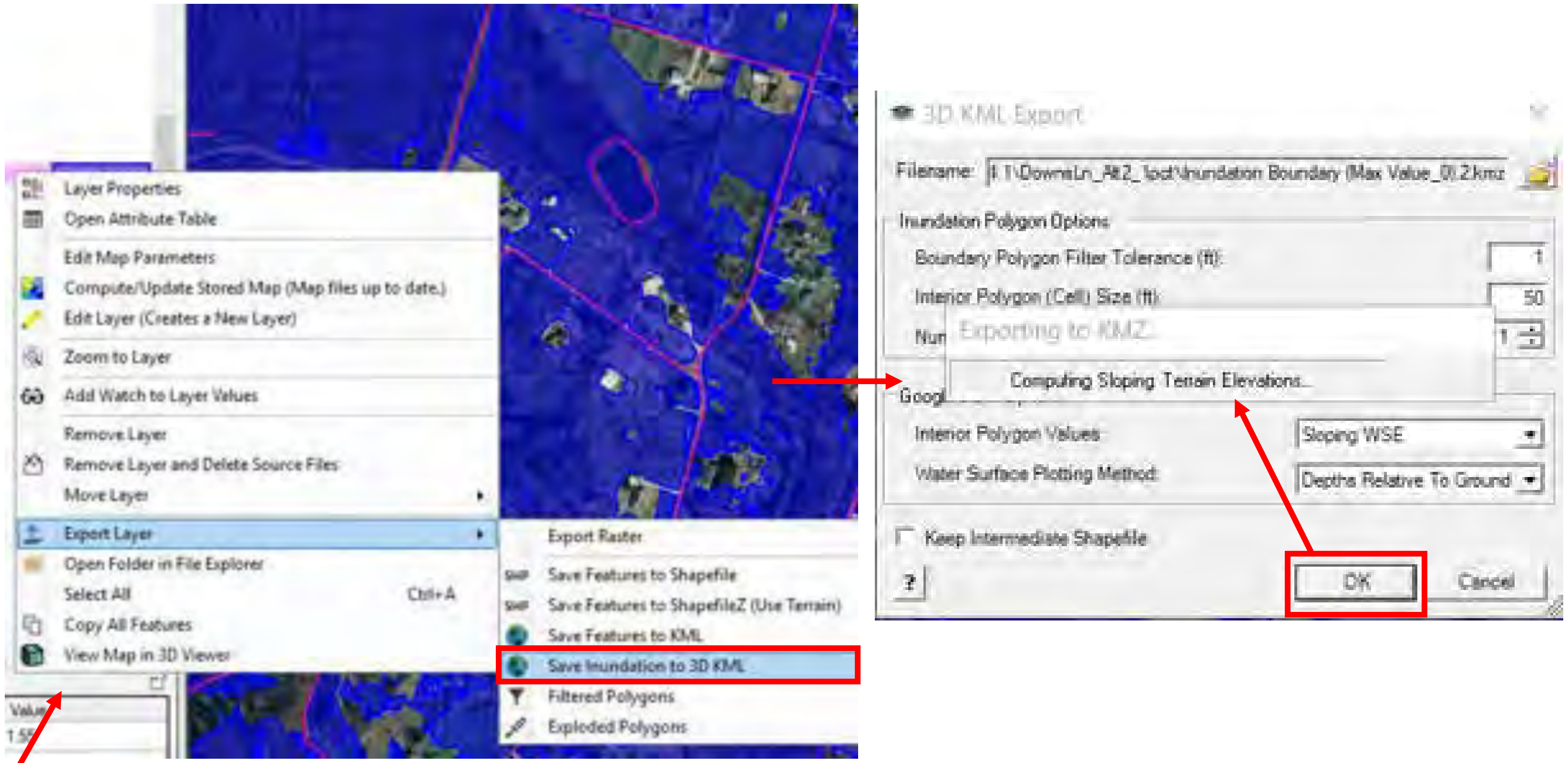
1. Create and **Inundation Boundary** layer in RAS Mapper
2. Set the **symbology** to the color and transparency (blue, 50% are good values).
3. Right-click on the Inundation Boundary layer and choose the **Export Layer | Save Inundation to 3D KML** menu option.
4. The 3D KML export dialog will be shown.
5. The default name and location of the KMZ file (zipped up KML) will be based on the Plan that produced the inundation boundary. You can change the name and file location using the Browse button.
6. The default values for the output options are good suggestions. They are discussed in detail below.
7. Press **OK** to generate a KMZ file to use in Google Earth.
8. As the file is generated, a status message will inform you of the progress. The number of polygons that are processed for the entire file extent is shown and the maximum count.
9. When finished, a message box will report the filename location and number of polygons in the KML file.
10. The KMZ can then be added to a Google Earth instance (or likely you can double-click on the KMZ and it will launch and load Google Earth).

Google Earth Exports

From HEC-RAS Mapper User's Manual

156





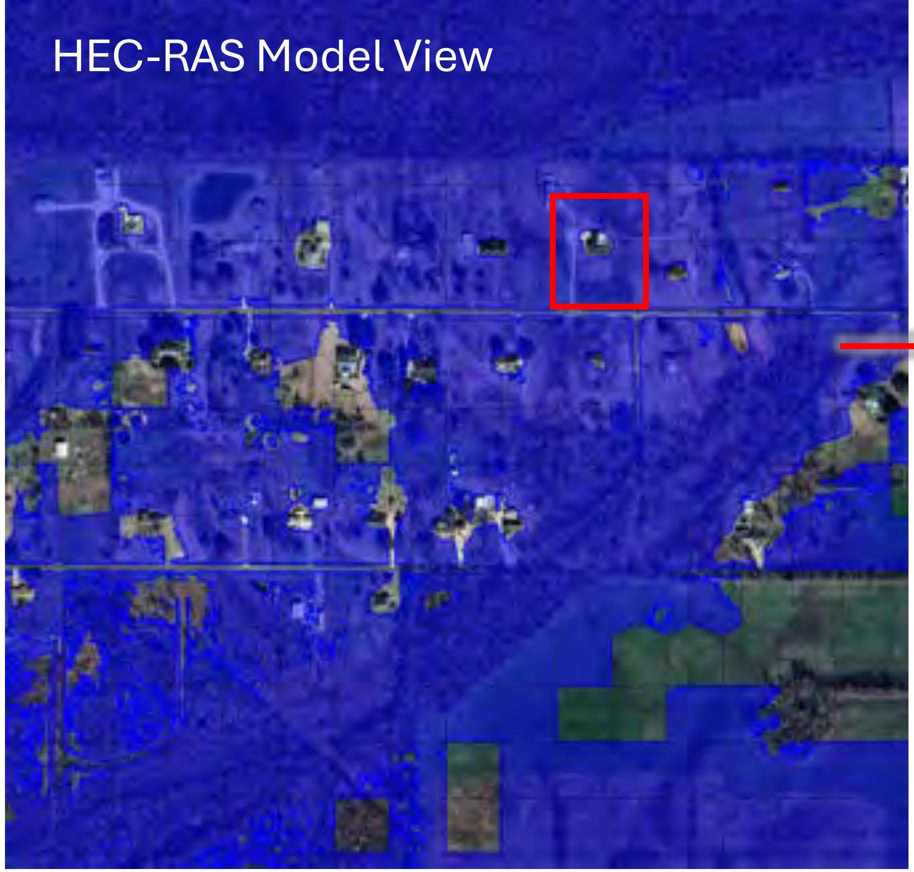
Google Earth Exports

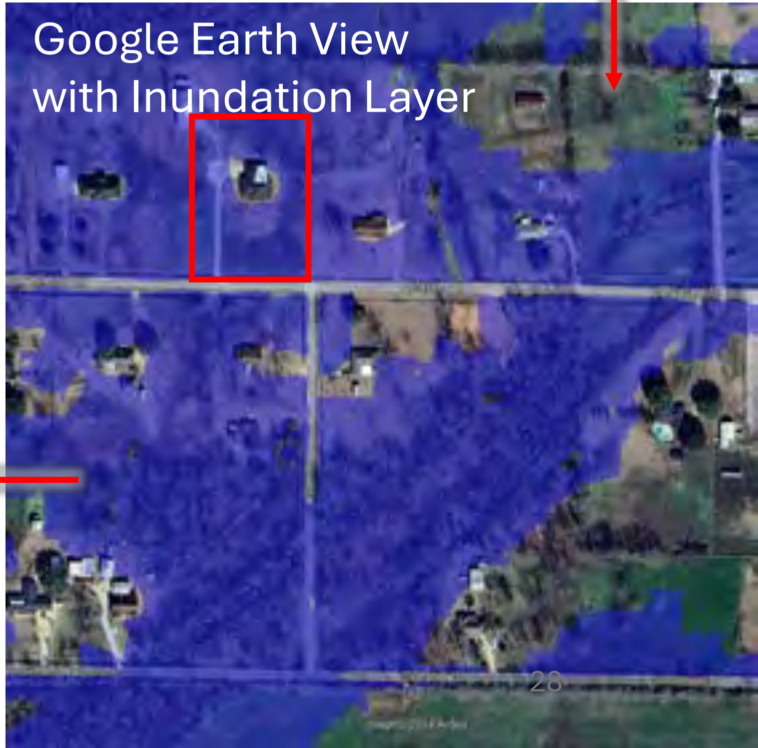
(Inundation Boundary)

157

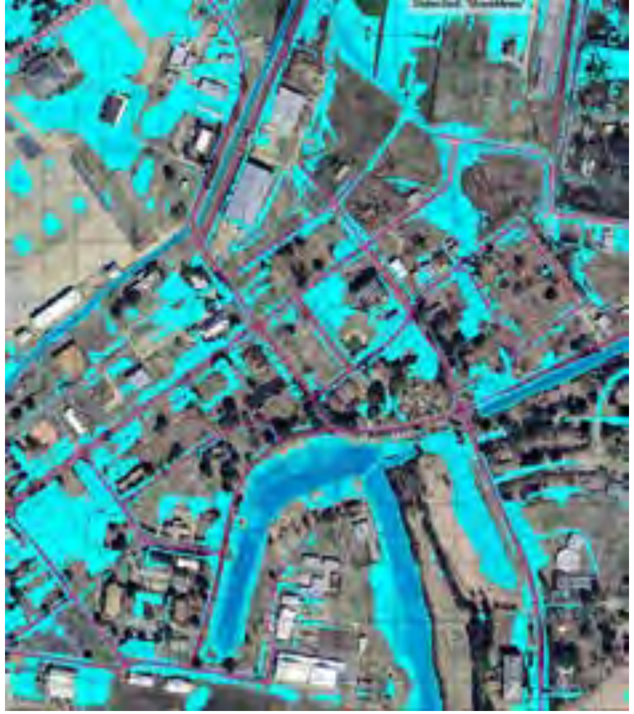
Using the Inundation 3D KML Layer

The inundation layer in Google Earth Street View is only accurate to a certain distance.





Data Source Library
Navigating RAS Results
Interpreting RAS Results
Exporting Data for Other Software
Project Feasibility Assessment



Importance of Breaklines

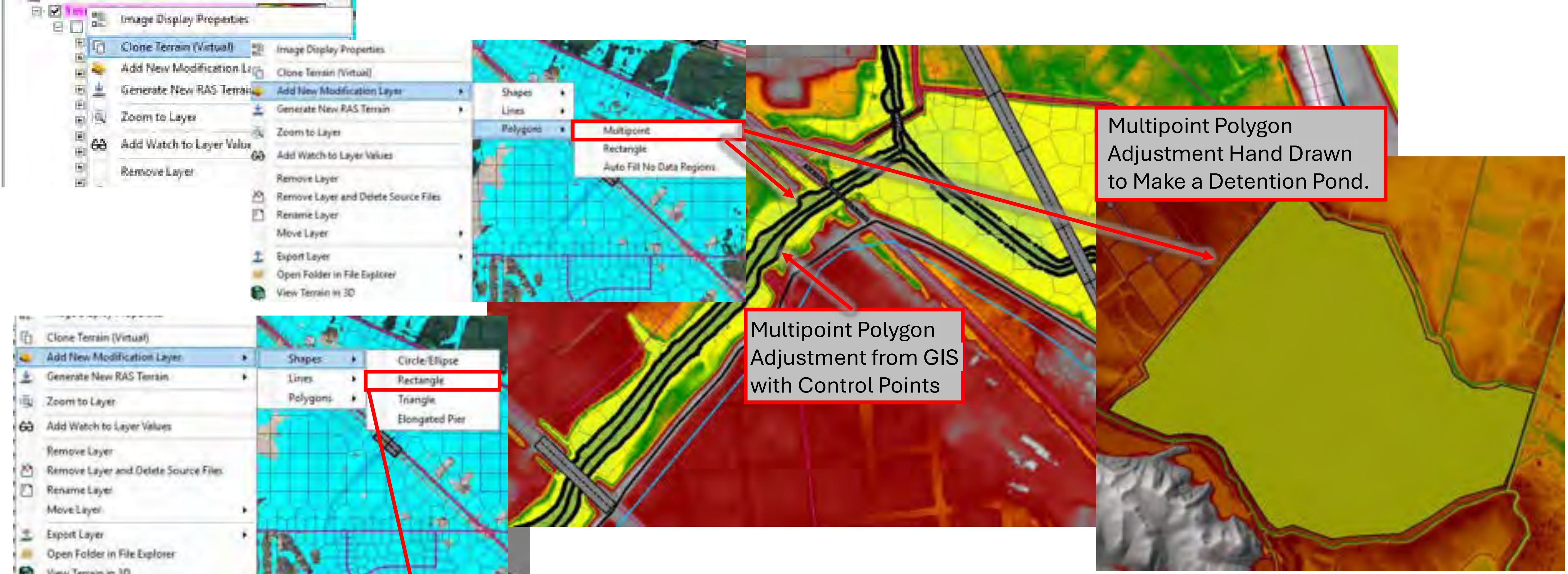
Used to Represent:

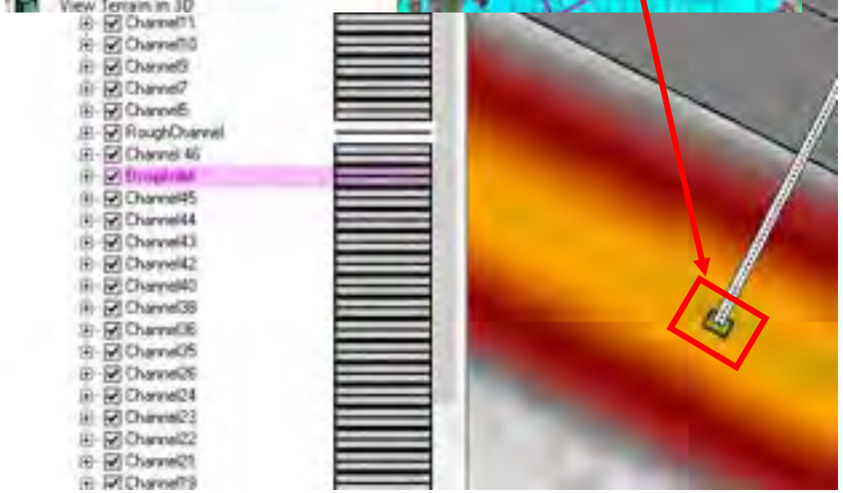
- Roads
- Railroads
- Levees

- Can help with cell alignment
- Can be imported from GIS as a shapefile
- Can be drawn by hand

Breaklines are typically drawn along the high ground to help the cells align correctly.

If the cells are not aligned along high ground, water in the model can “spill” over and show inaccurate representation of water in the area.



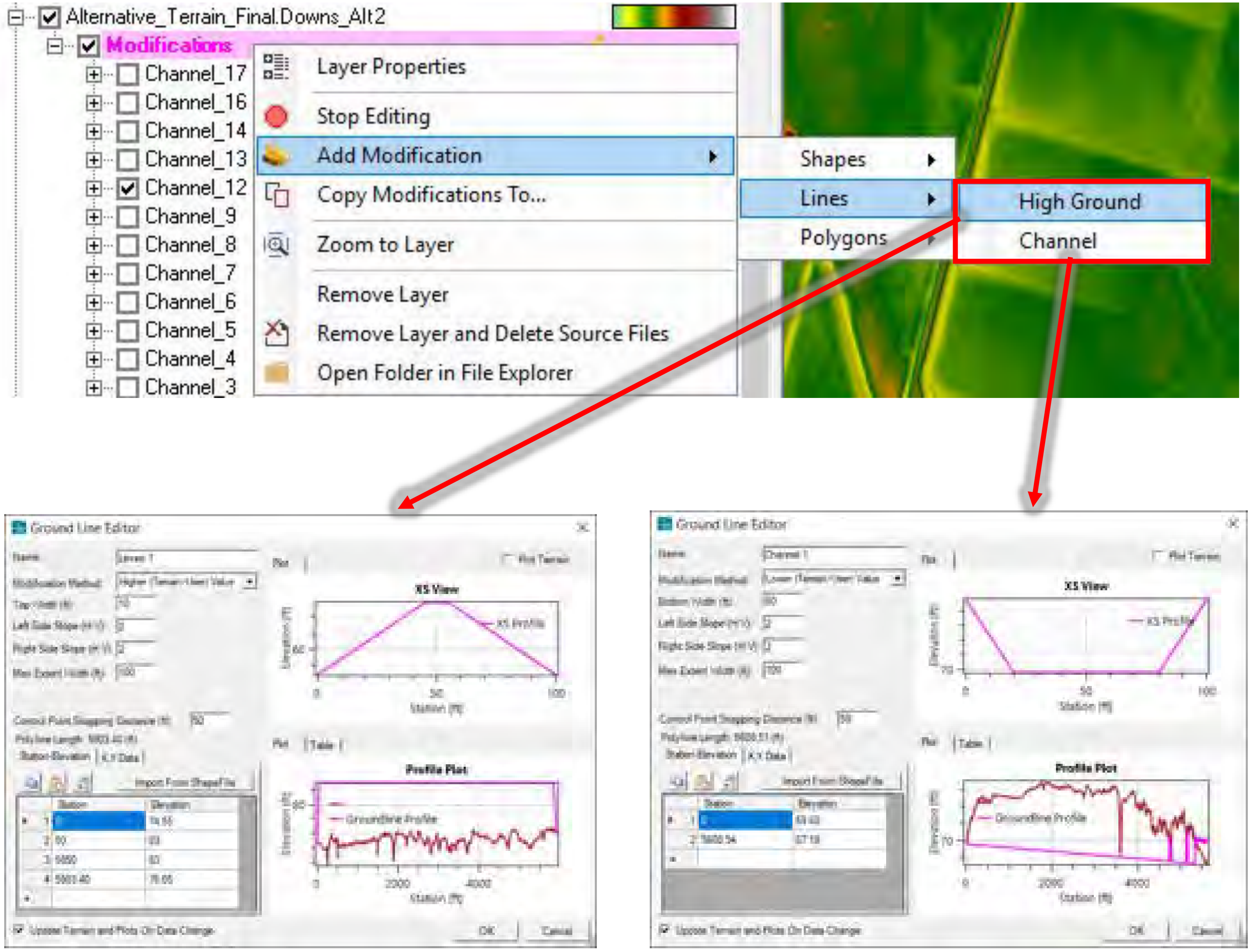


Terrain Modifications

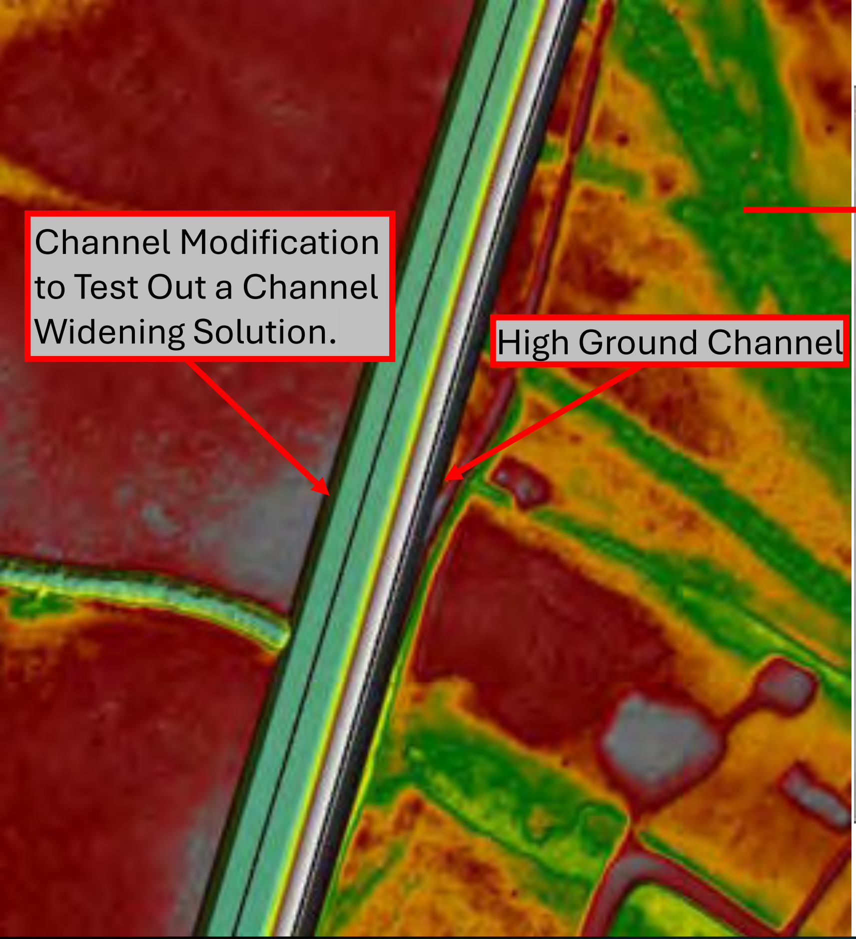
There are multiple types of modifications that can be added to an existing terrain. These modifications do not change the original terrain file, but the terrain can be exported with the modifications included.

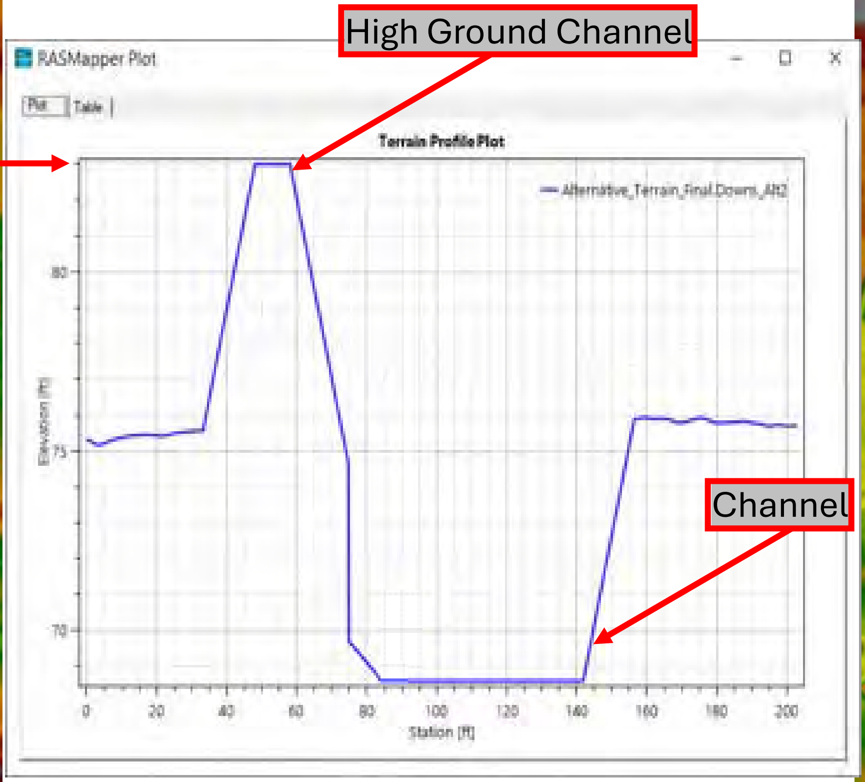
Terrain Modifications

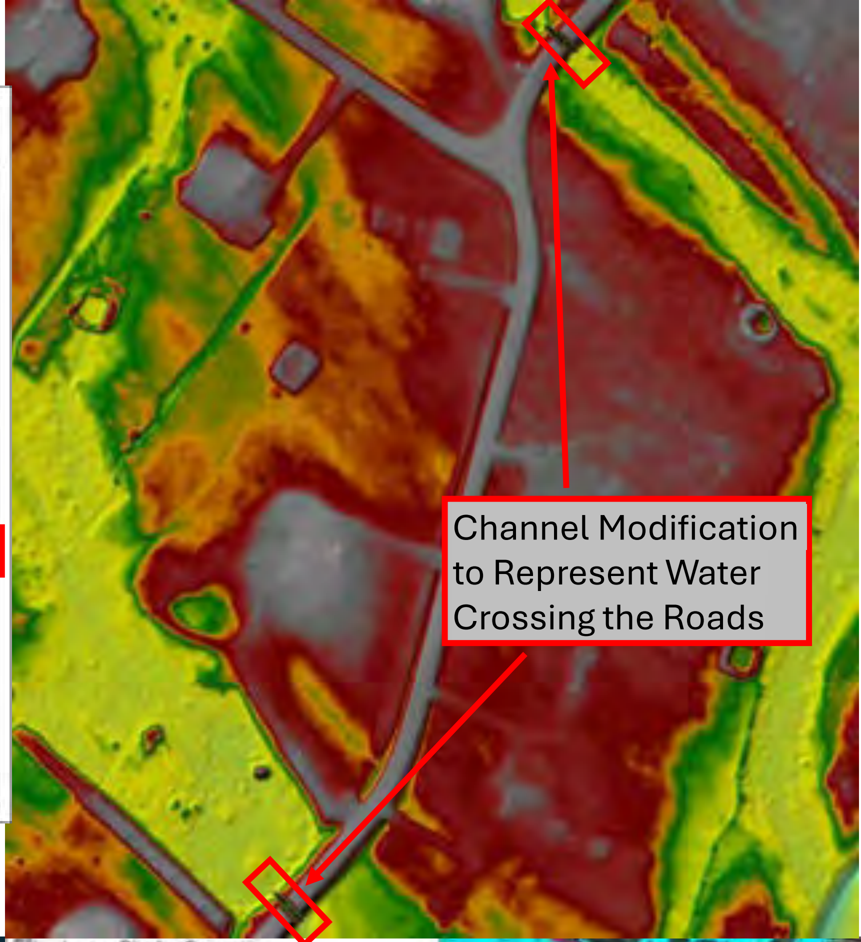
(Channel and Berm Modifications)

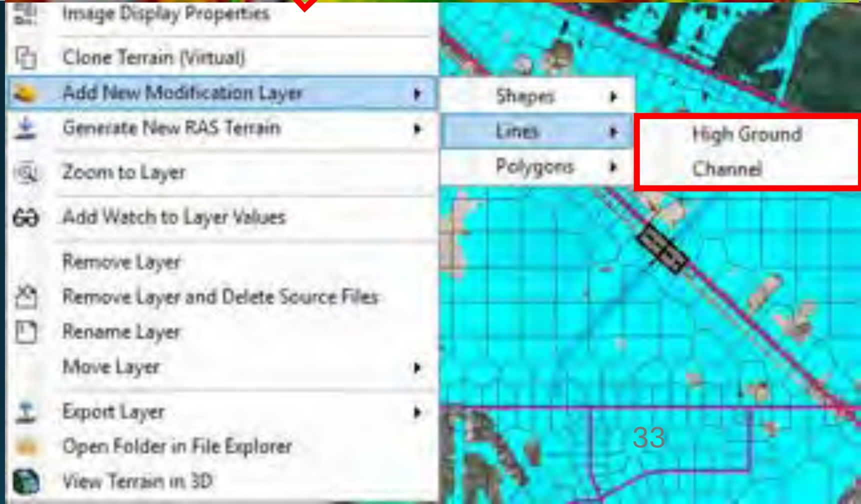


162





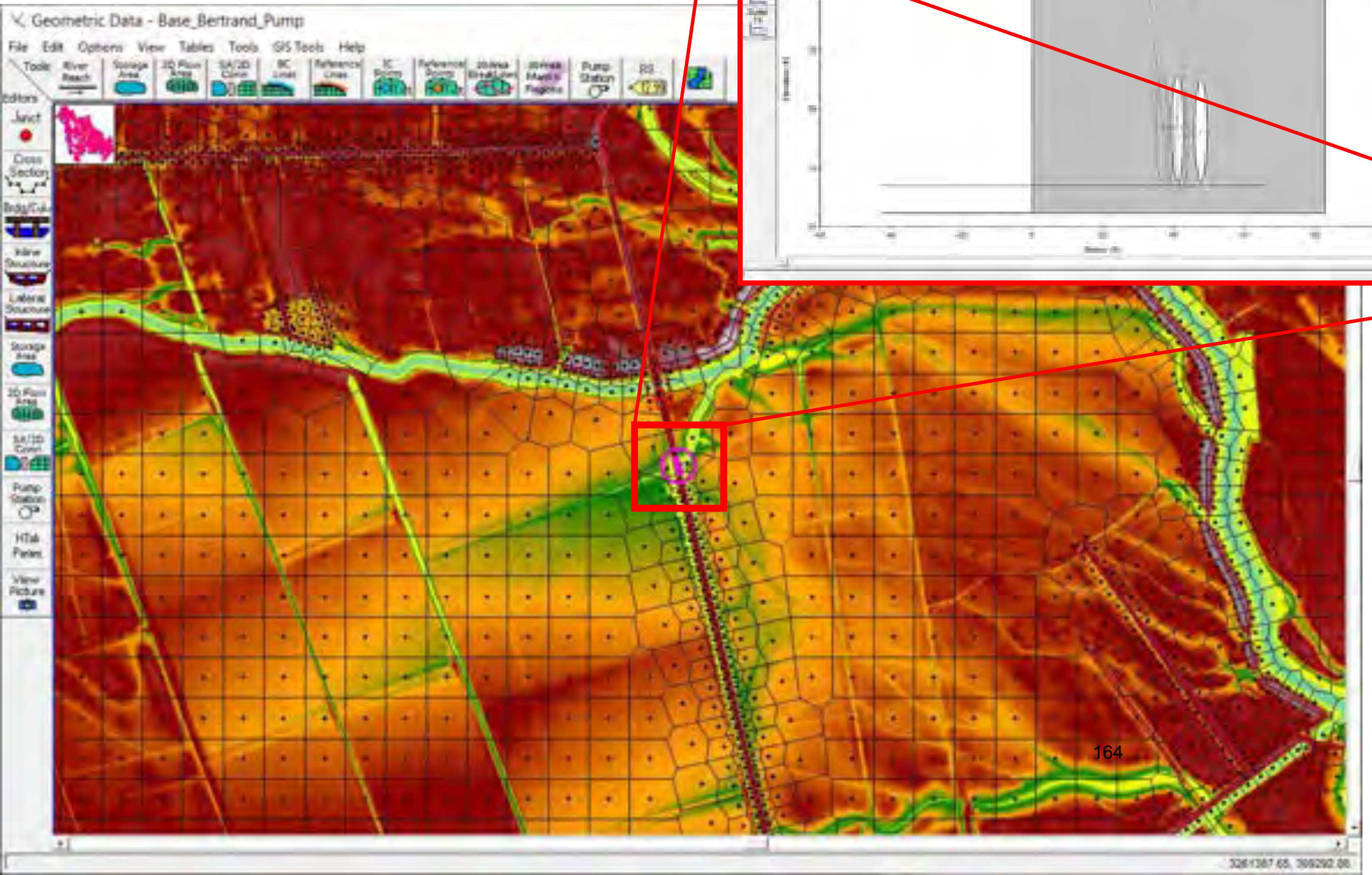


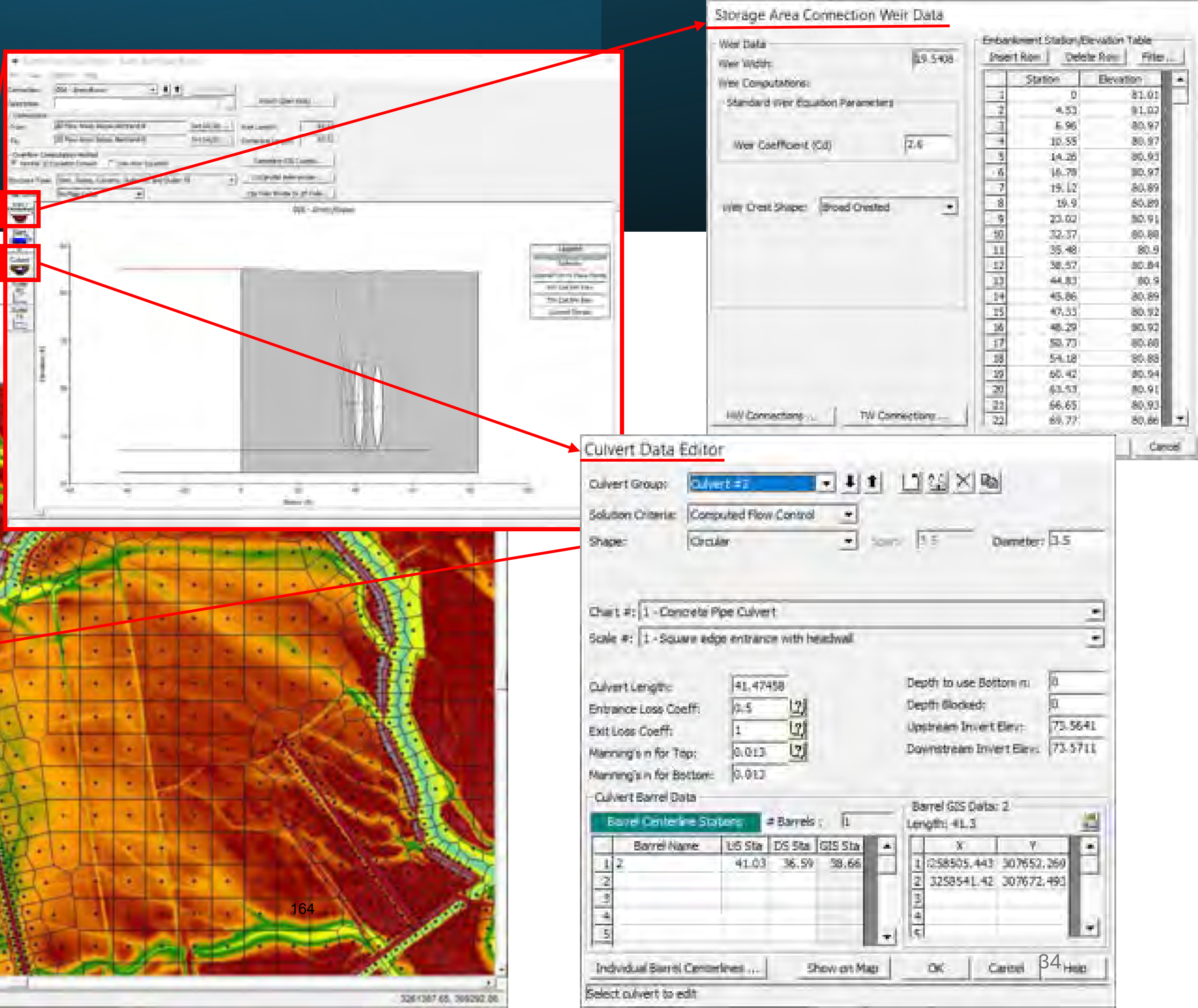


Terrain Modifications

- Can be imported from GIS using a shapefile
- Can be hand drawn
- Can be a simple polyline, or a polygon with control points

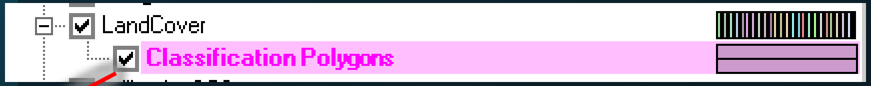
Structure Editing

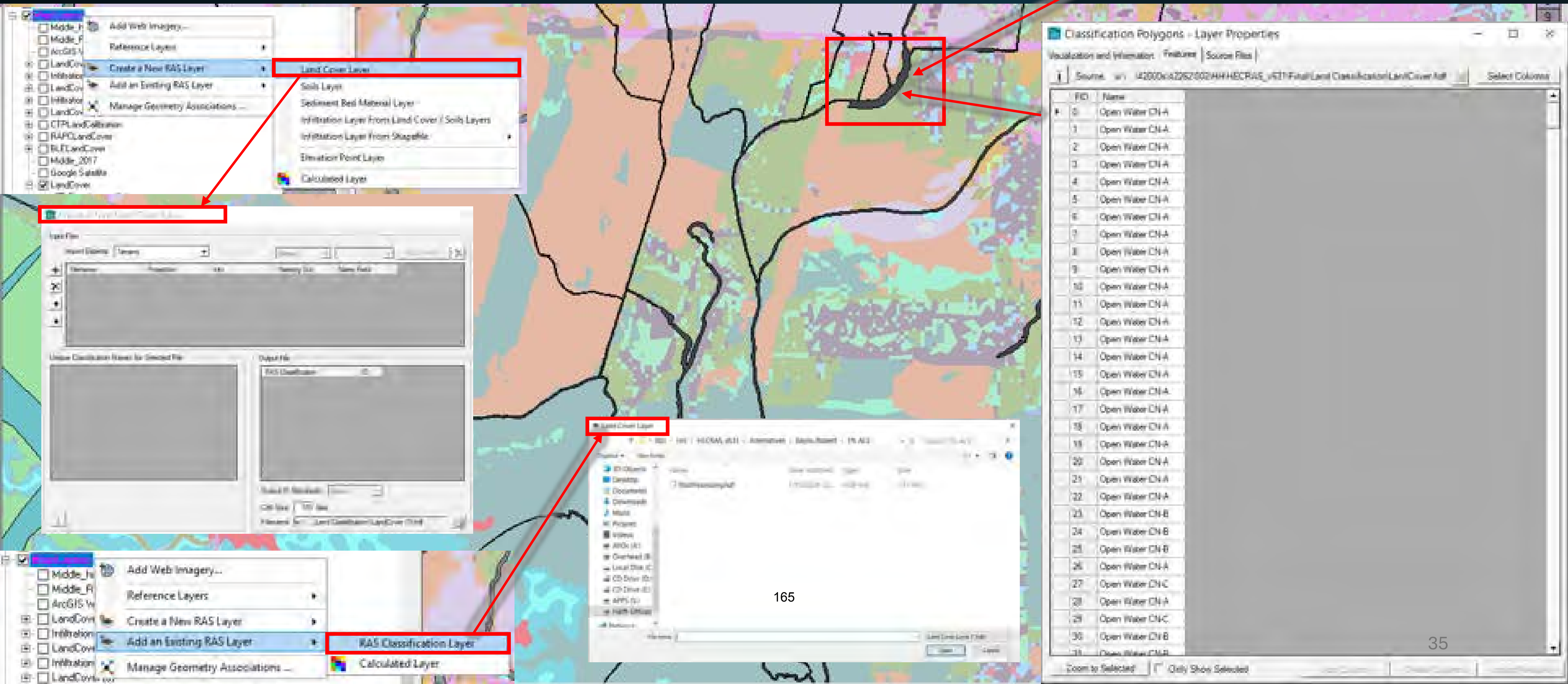




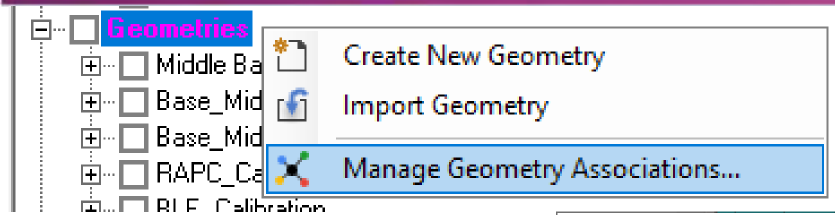
Adding New and Existing RAS Layers

(Landuse/LandCover as an example here)





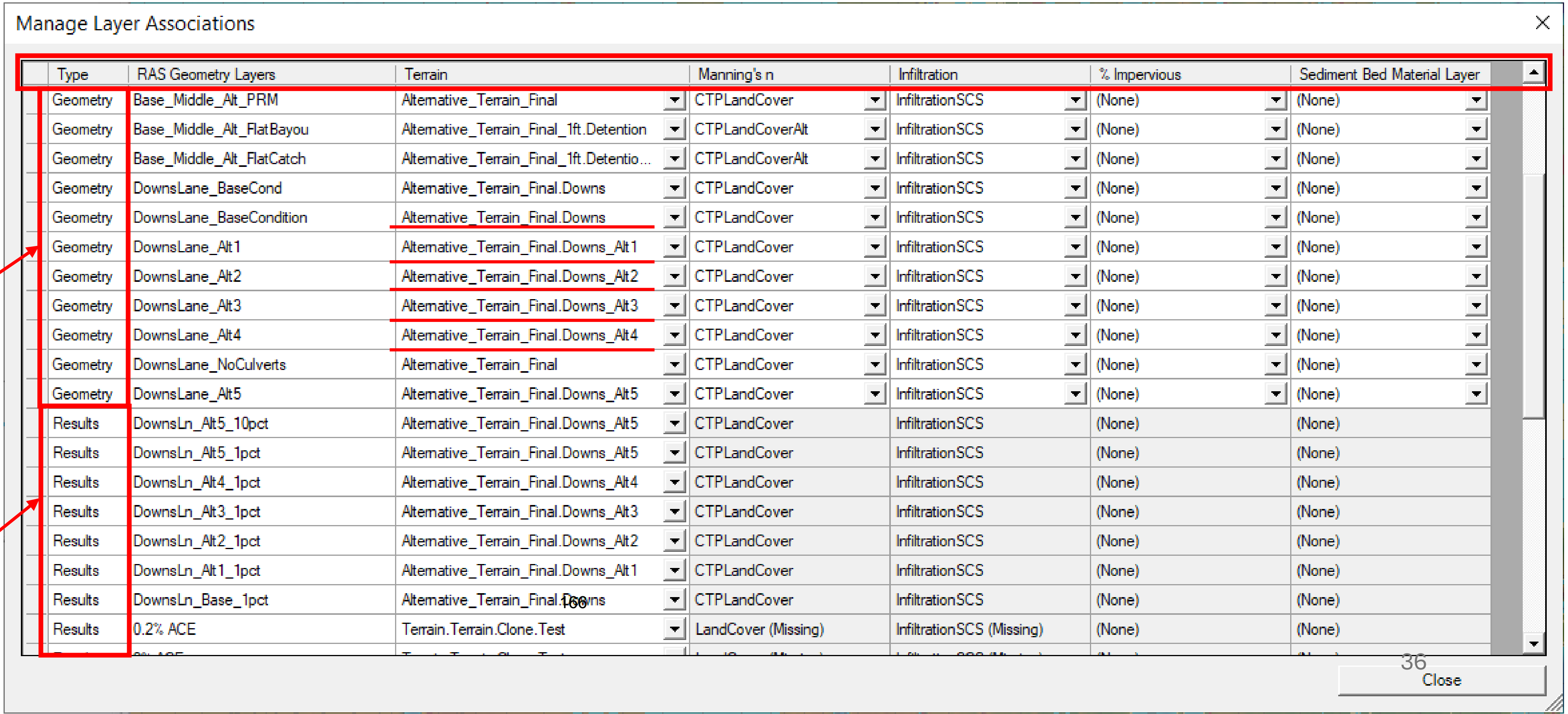
Geometry Associations



This feature is especially helpful when there are alternatives to be ran to test solutions (using terrain mods or updating manning's n values for calibration).

In this window, the user can change which terrain, manning's n, infiltration, etc. can be associated to each geometry.

This window also shows which associations are made with the results.



Manage Layer Associations

Type	RAS Geometry Layers	Terrain	Manning's n	Infiltration	% Impervious	Sediment Bed Material Layer
Geometry	Base_Middle_Alt_PRM	Alternative_Terrain_Final	CTPLandCover	InfiltrationSCS	(None)	(None)
Geometry	Base_Middle_Alt_FlatBayou	Alternative_Terrain_Final_1ft.Detention	CTPLandCoverAlt	InfiltrationSCS	(None)	(None)
Geometry	Base_Middle_Alt_FlatCatch	Alternative_Terrain_Final_1ft.Detentio...	CTPLandCoverAlt	InfiltrationSCS	(None)	(None)
Geometry	DownsLane_BaseCond	Alternative_Terrain_Final.Downs	CTPLandCover	InfiltrationSCS	(None)	(None)
Geometry	DownsLane_BaseCondition	Alternative_Terrain_Final.Downs	CTPLandCover	InfiltrationSCS	(None)	(None)
Geometry	DownsLane_Alt1	Alternative_Terrain_Final.Downs_Alt1	CTPLandCover	InfiltrationSCS	(None)	(None)
Geometry	DownsLane_Alt2	Alternative_Terrain_Final.Downs_Alt2	CTPLandCover	InfiltrationSCS	(None)	(None)
Geometry	DownsLane_Alt3	Alternative_Terrain_Final.Downs_Alt3	CTPLandCover	InfiltrationSCS	(None)	(None)
Geometry	DownsLane_Alt4	Alternative_Terrain_Final.Downs_Alt4	CTPLandCover	InfiltrationSCS	(None)	(None)
Geometry	DownsLane_NoCulverts	Alternative_Terrain_Final	CTPLandCover	InfiltrationSCS	(None)	(None)
Geometry	DownsLane_Alt5	Alternative_Terrain_Final.Downs_Alt5	CTPLandCover	InfiltrationSCS	(None)	(None)
Results	DownsLn_Alt5_10pct	Alternative_Terrain_Final.Downs_Alt5	CTPLandCover	InfiltrationSCS	(None)	(None)
Results	DownsLn_Alt5_1pct	Alternative_Terrain_Final.Downs_Alt5	CTPLandCover	InfiltrationSCS	(None)	(None)
Results	DownsLn_Alt4_1pct	Alternative_Terrain_Final.Downs_Alt4	CTPLandCover	InfiltrationSCS	(None)	(None)
Results	DownsLn_Alt3_1pct	Alternative_Terrain_Final.Downs_Alt3	CTPLandCover	InfiltrationSCS	(None)	(None)
Results	DownsLn_Alt2_1pct	Alternative_Terrain_Final.Downs_Alt2	CTPLandCover	InfiltrationSCS	(None)	(None)
Results	DownsLn_Alt1_1pct	Alternative_Terrain_Final.Downs_Alt1	CTPLandCover	InfiltrationSCS	(None)	(None)
Results	DownsLn_Base_1pct	Alternative_Terrain_Final.Downs	CTPLandCover	InfiltrationSCS	(None)	(None)
Results	0.2% ACE	Terrain.Terrain.Clone.Test	LandCover (Missing)	InfiltrationSCS (Missing)	(None)	(None)

160

Close

Calibration Update

- Calibration can be done by updating the Manning's N Values to better understand what the current land area is able to absorb or allow to runoff.

The higher the Manning's N Value, the faster the water moves.

- Classification Polygons are another way to calibrate the area by specifying where open channels are.

OR

- If an area is going to be developed, it can be updated to represent the new designation and its potential impacts.

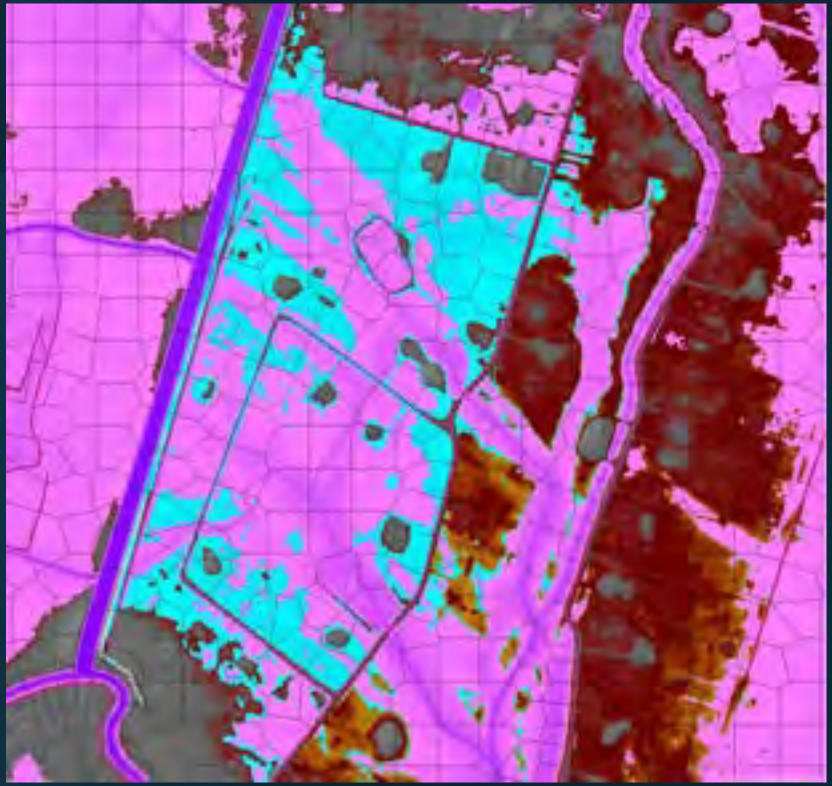
<u>Our Calibration Method:</u>

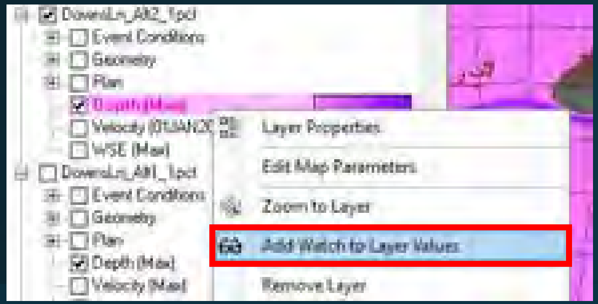
Compared our result data to the BLE elevations. Started with three sets of manning's n values. Ran all three sets and then we updated the manning's n values to whichever set results closely matched the BLE elevations.

8	Open Space - Good CN-C	0.055	
9	Residential - 1 Acre CN-D	0.1	20
10	Residential - 1 Acre CN-B	0.1	20
11	Residential - 1 Acre CN-A	0.1	20
12	Residential - 1 Acre CN-C	0.1	20
13	Residential - 0.33 Acre CN-D	0.1	30
14	Residential - 0.33 Acre CN-B	0.1	30
15	Residential - 0.33 Acre CN-A	0.1	30
16	Residential - 0.33 Acre CN-C	0.1	30
17	Industrial CN-D	0.12	72
18	Industrial CN-B	0.12	72
19	Industrial CN-C	0.12	72
20	Industrial CN-A	0.12	72
21	Gravel CN-D	0.03	

6	Barren Land	0.03
7	Deciduous Forest	0.12
8	Evergreen Forest	0.12
9	Mixed Forest	0.12
10	Shrub-Scrub	0.1
11	Herbaceous	0.04
12	Hay-Pasture	0.04
13	Cultivated Crops	0.04
14	Woody Wetlands	0.12
15	Emergent Herbaceous Wetlan...	0.06
16	Open Space	0.05
17	Woods	0.06
18	Residential	0.12

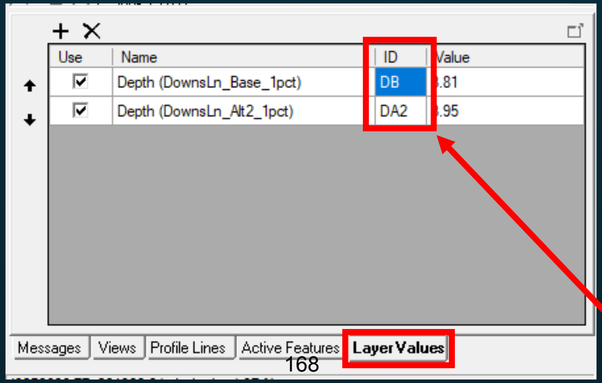
Comparing Results Between Base (Existing) and New (Improvements) Models:

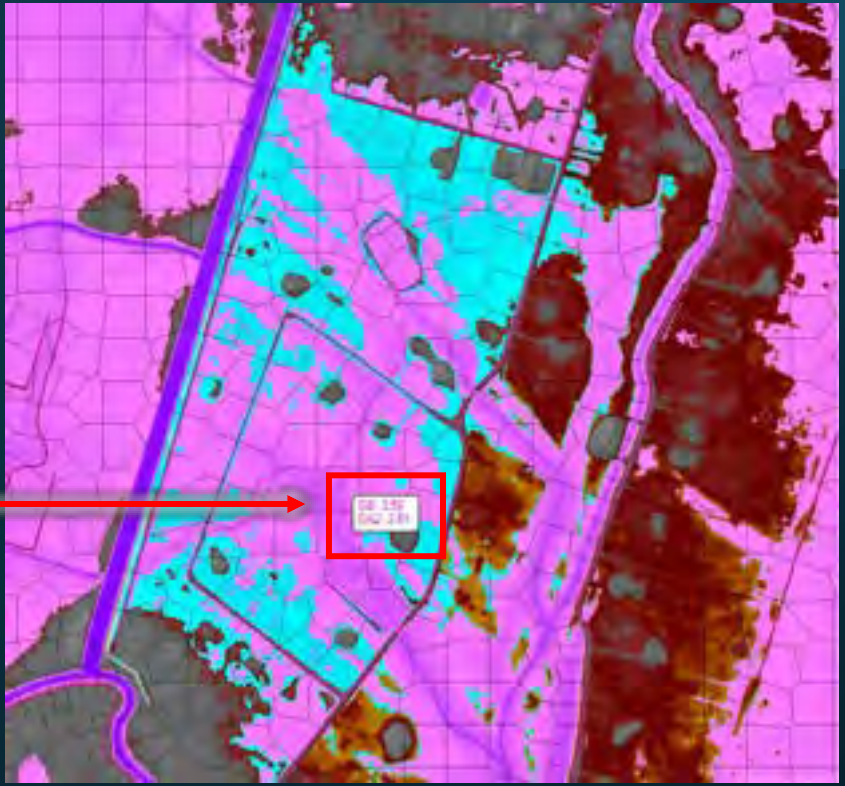




Right click on the results you want to see and select the "Add Watch to Layer Values".

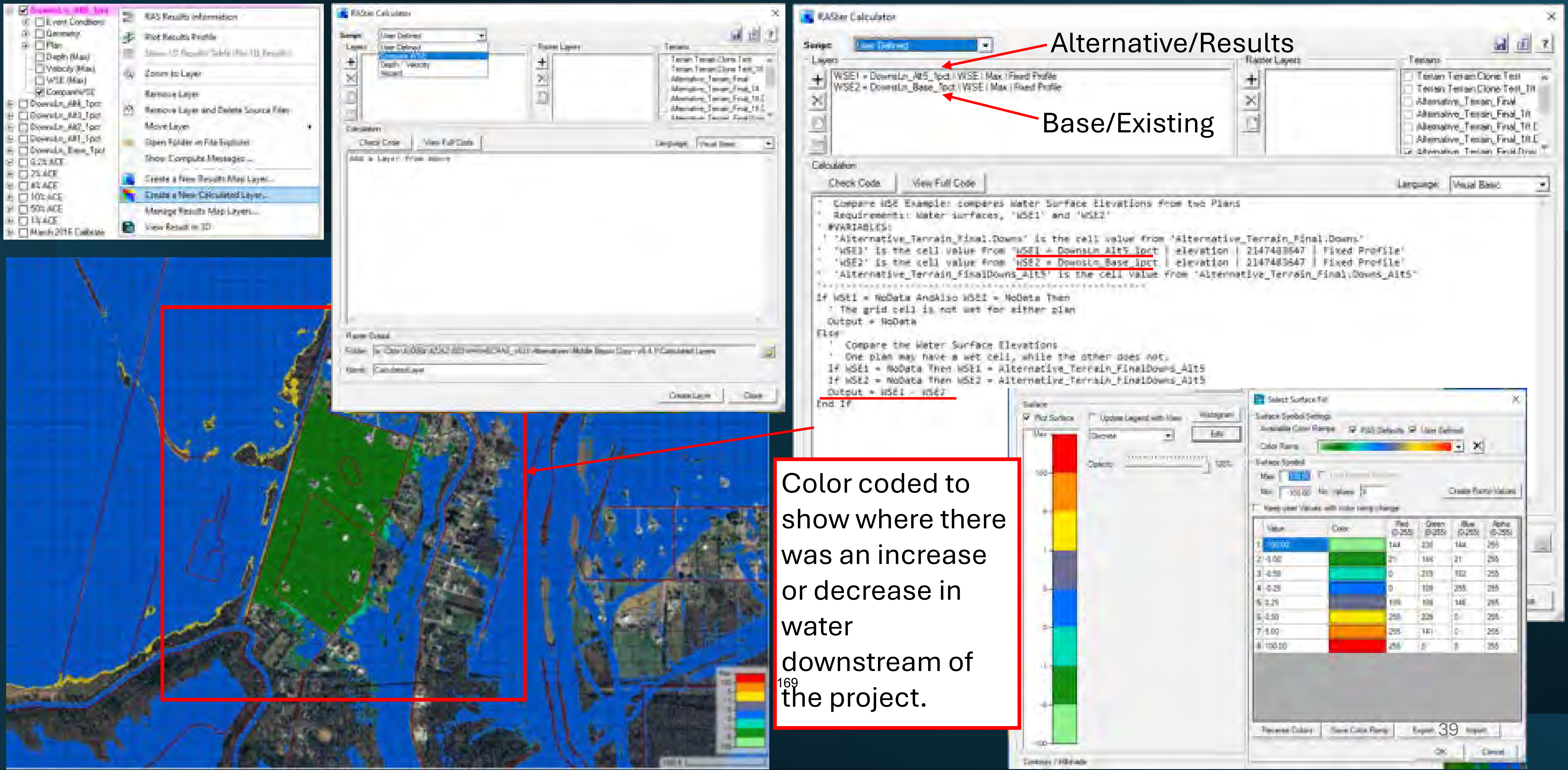
You can check and uncheck what you want to see when you hover or the results (to the right).





The "ID" can be edited to be what the viewer wishes to have represent the data results.

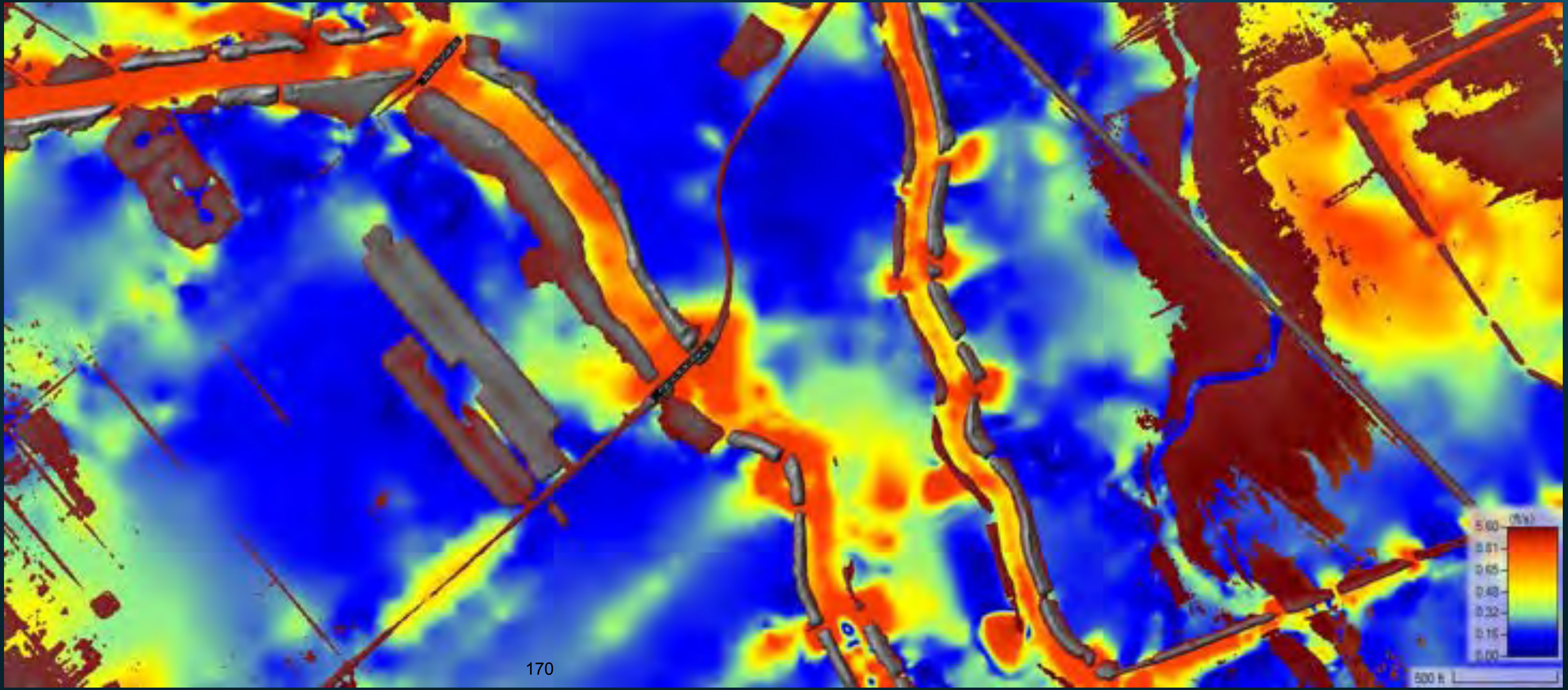
Confirming No Adverse Impacts Using “CompareWSE”:



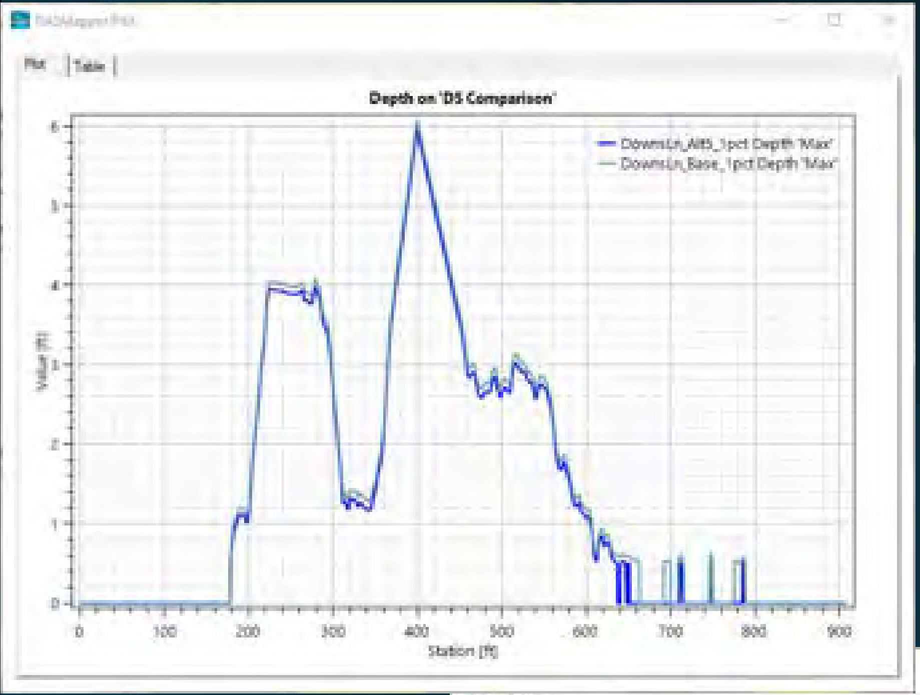
Velocity Check for Erosion Control:

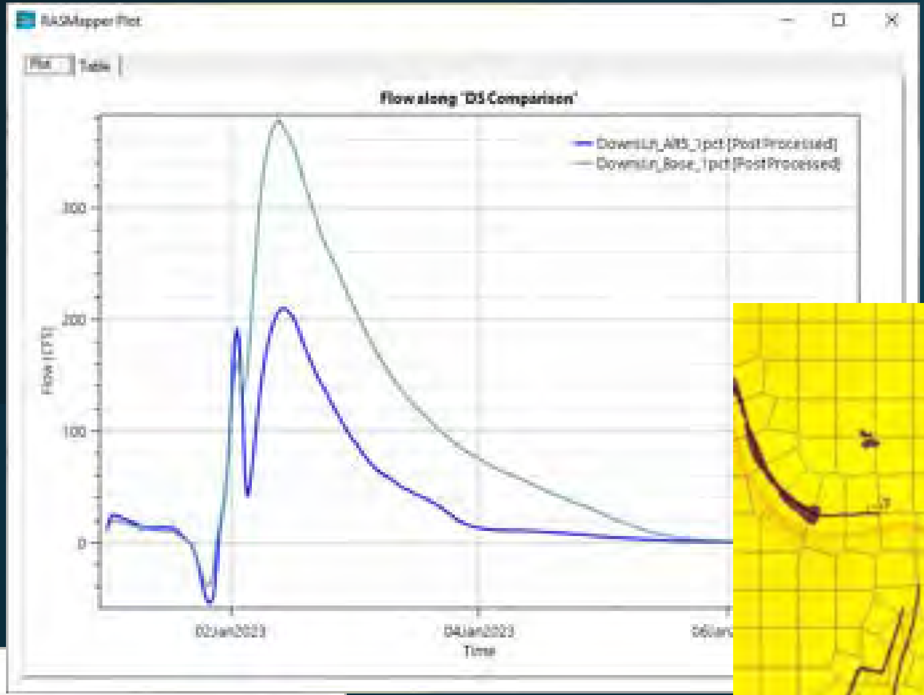
Velocities can be viewed on a set scale or a relative scale.

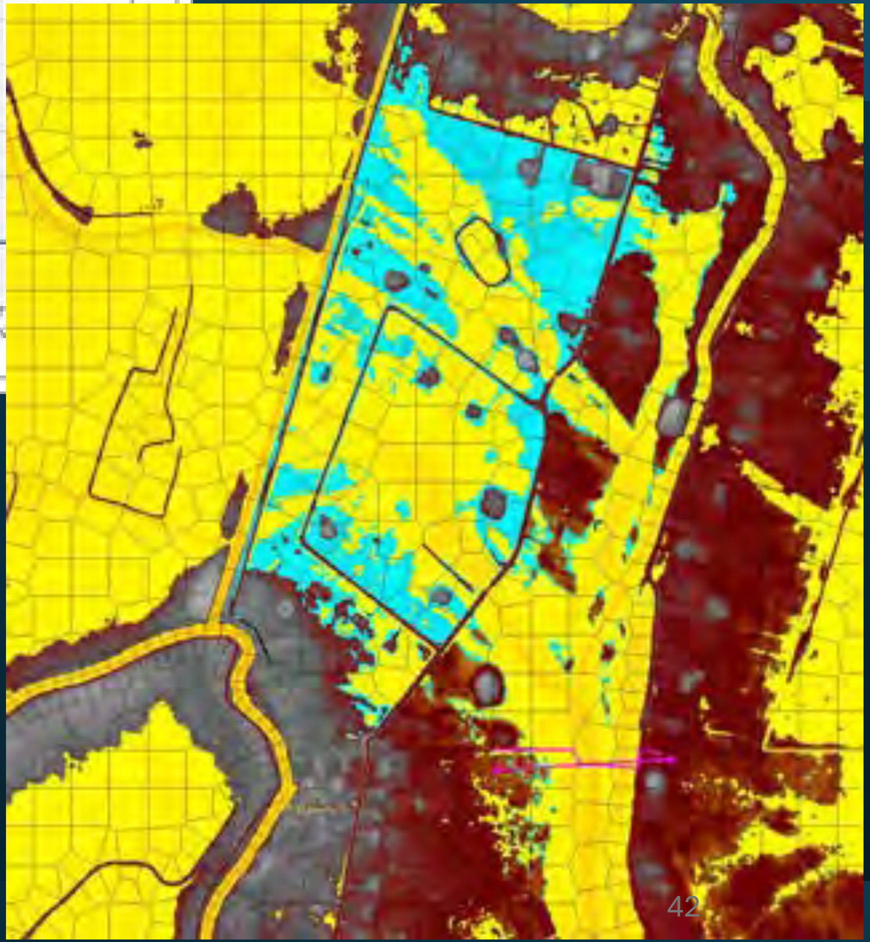
When analyzing results, the velocity rasters can be used to identify potential erosion concerns.



Flow and Depth Comparisons for End Results:

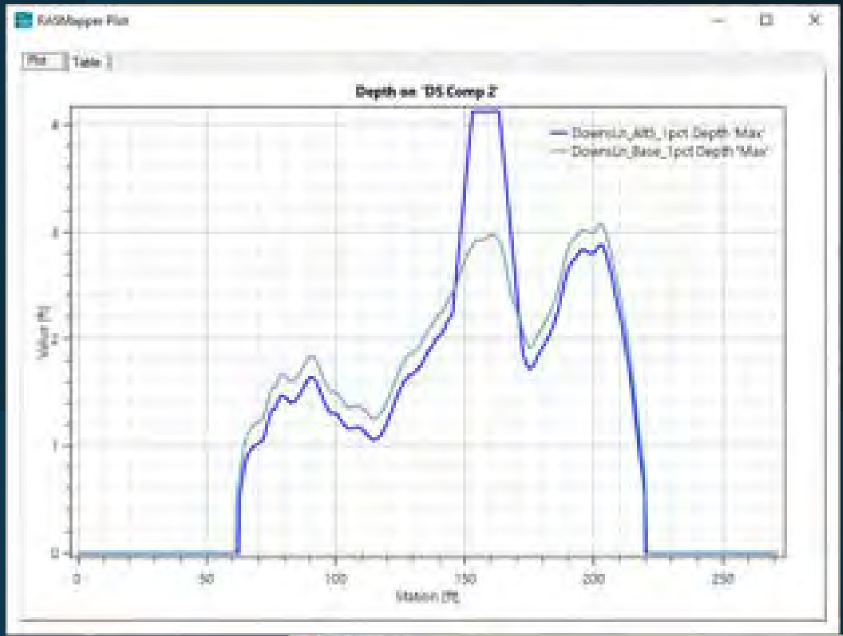


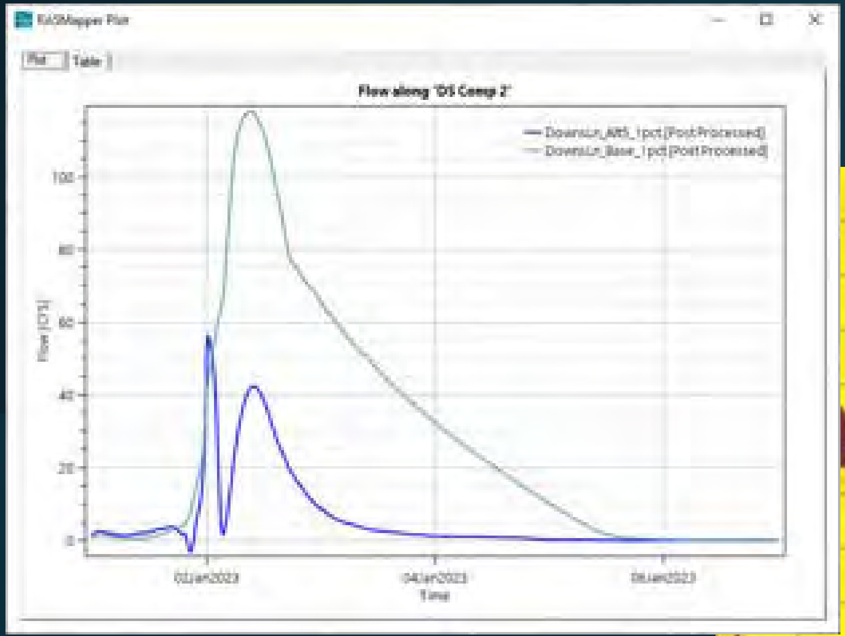


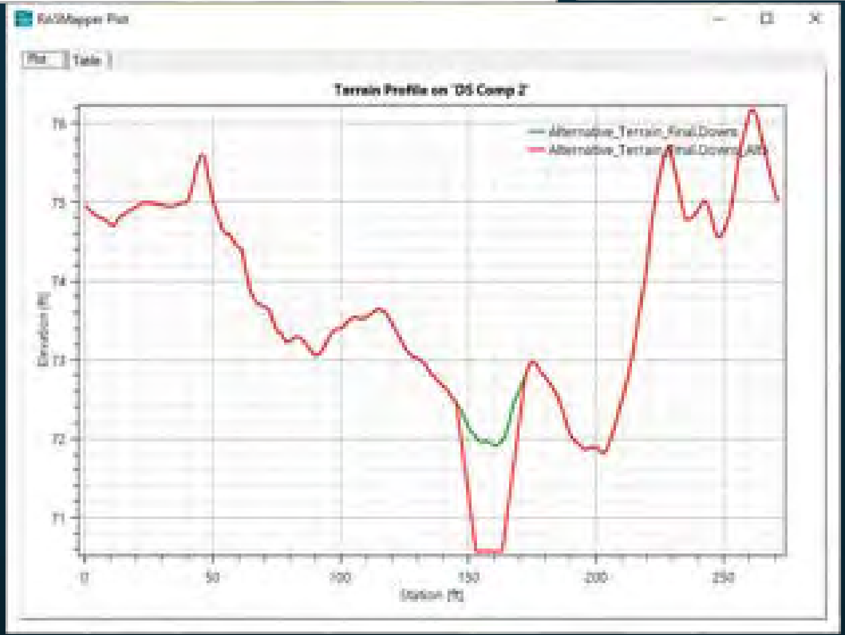


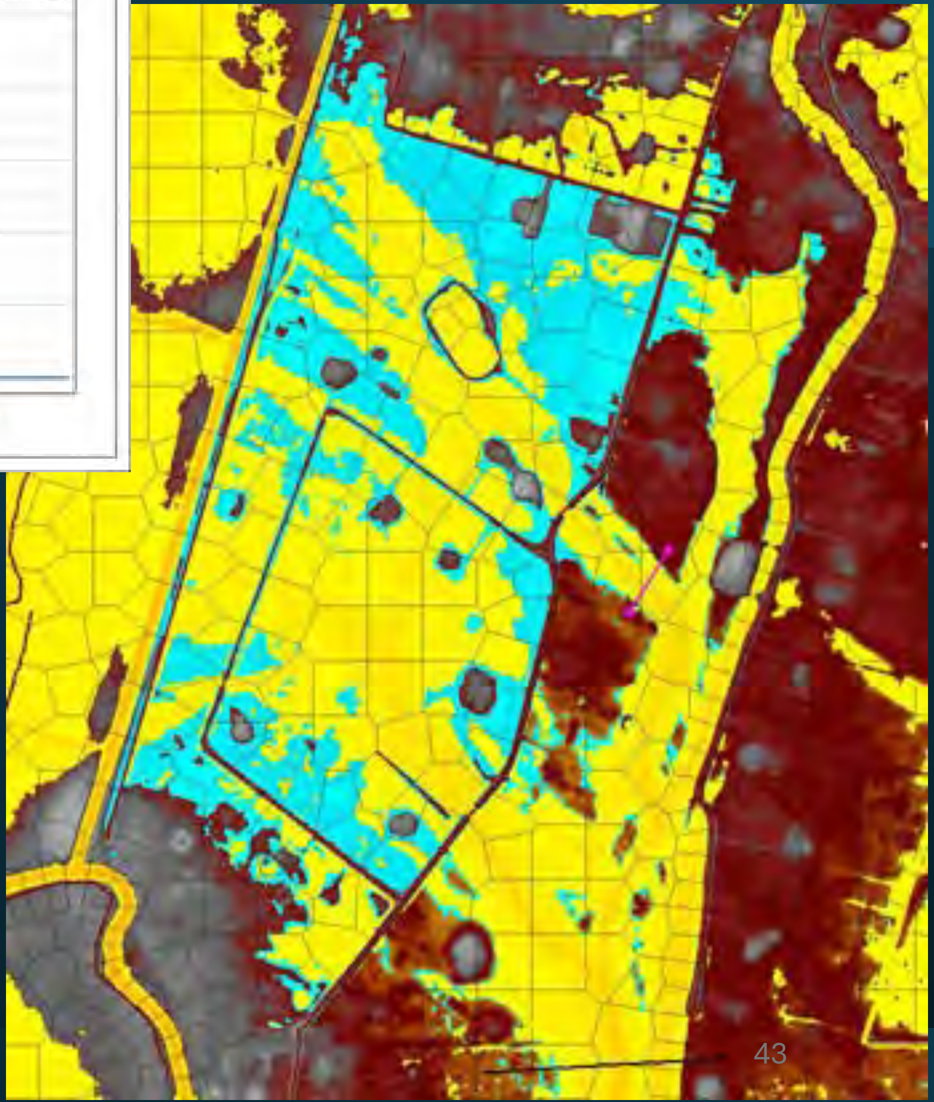
171

Flow and Depth Comparisons for End Results:









172

Q&A

GET IN TOUCH

Please reach out if you have any additional questions!

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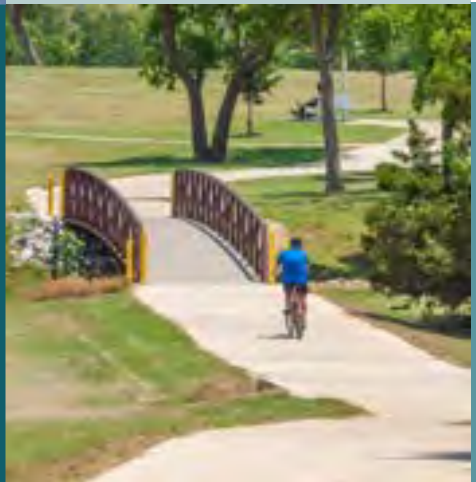
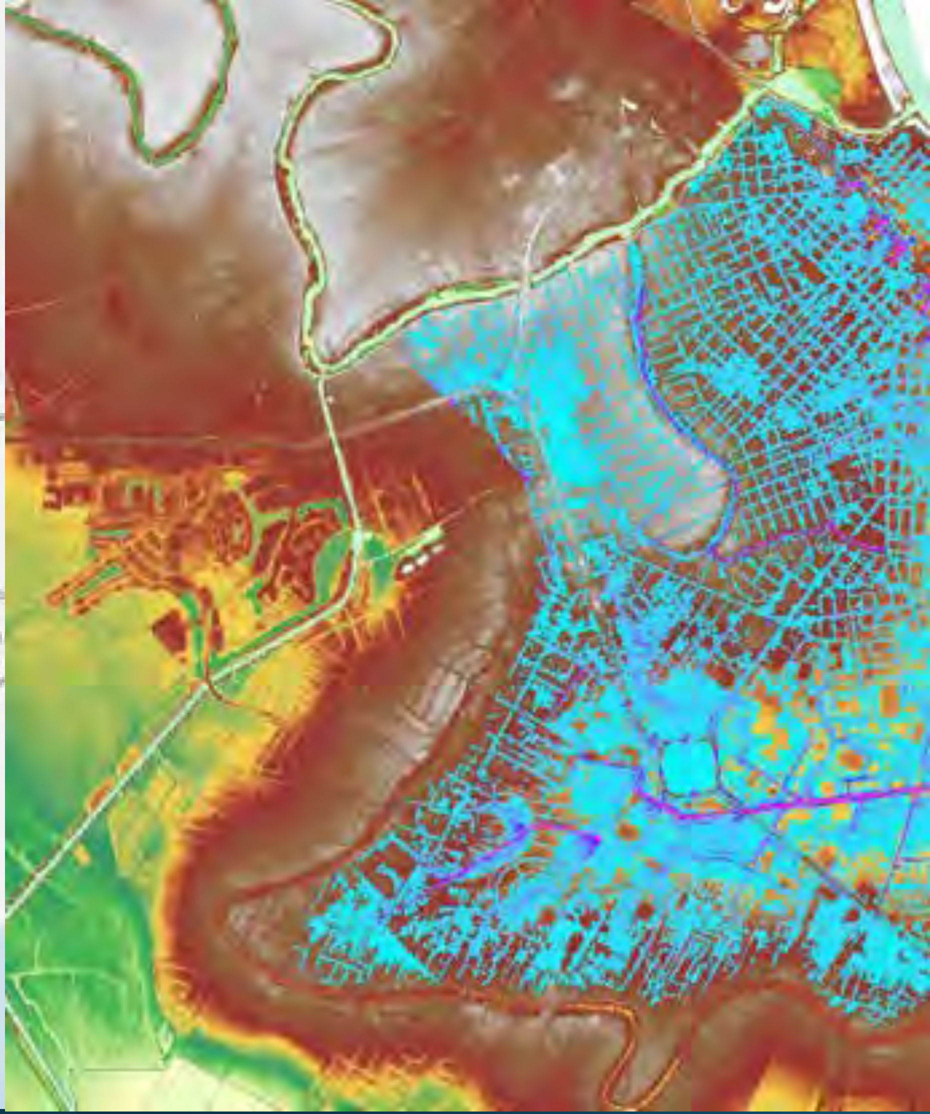
CONNECT WITH US. LIKE US. FOLLOW US.



halff



ArcGIS Pro Technical Training

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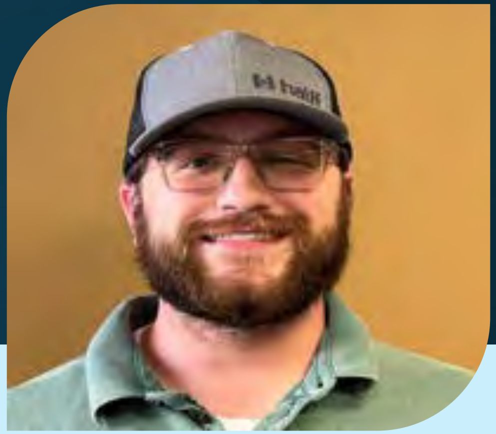

- Thomas Lejeune
- Lead Analyst

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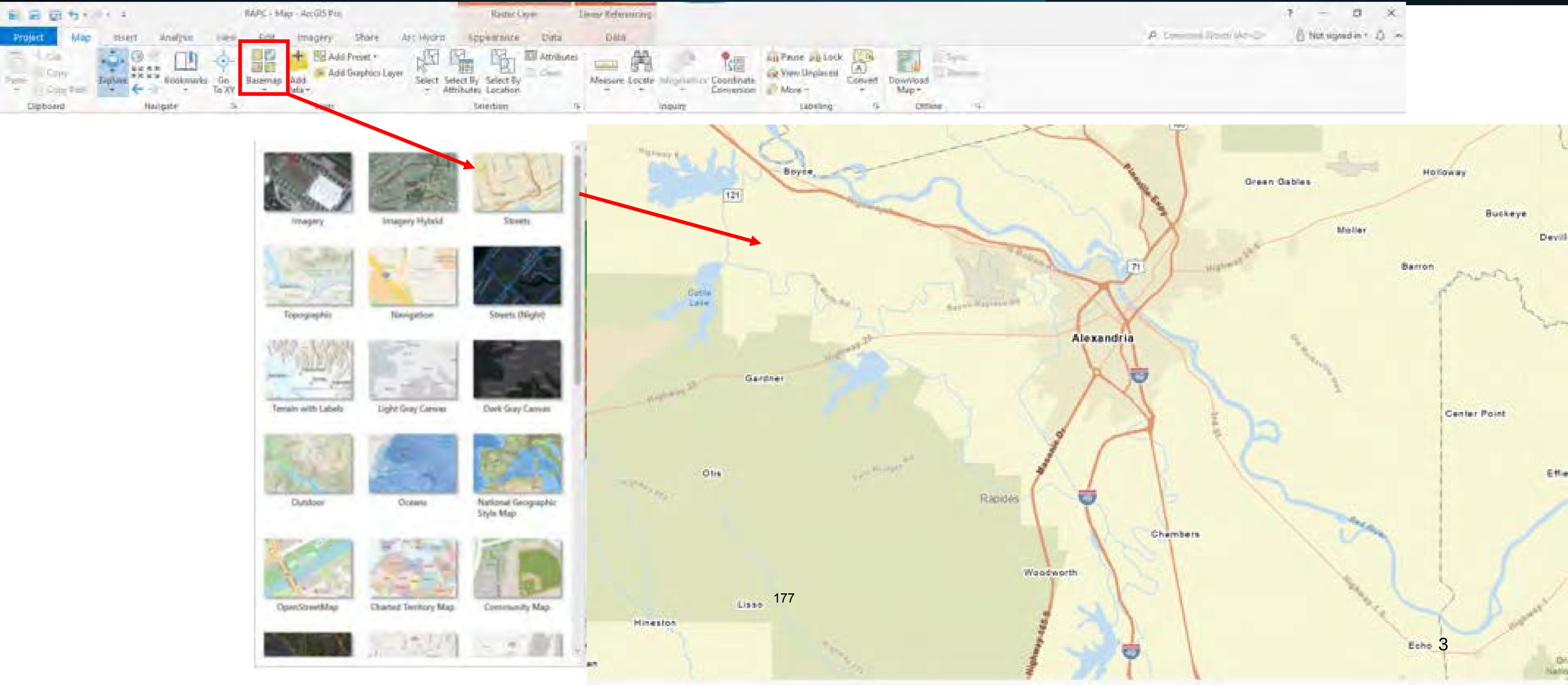
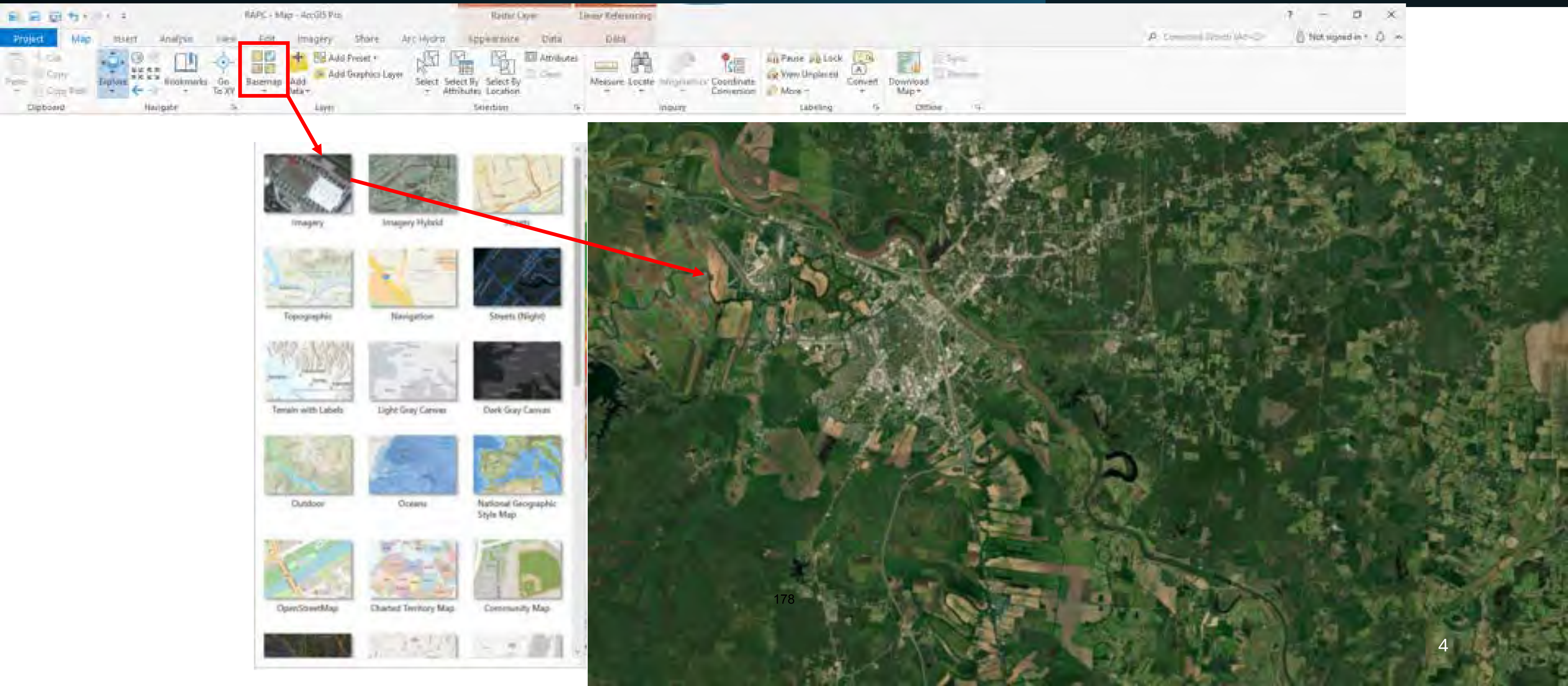
Basemap Layers



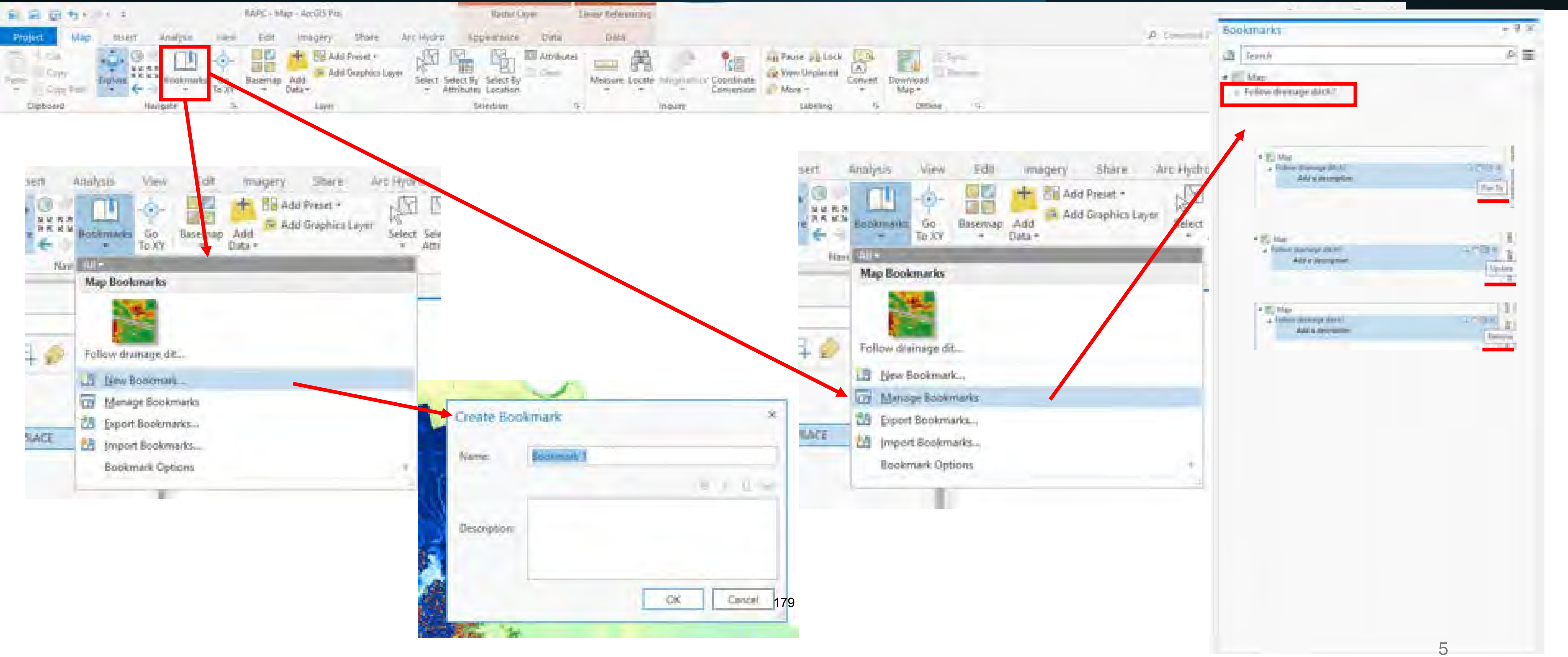
177

3

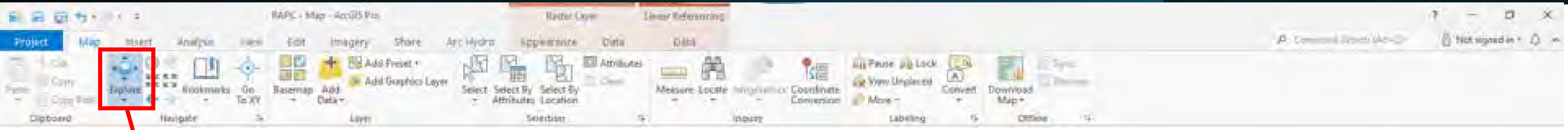
Basemap Layers

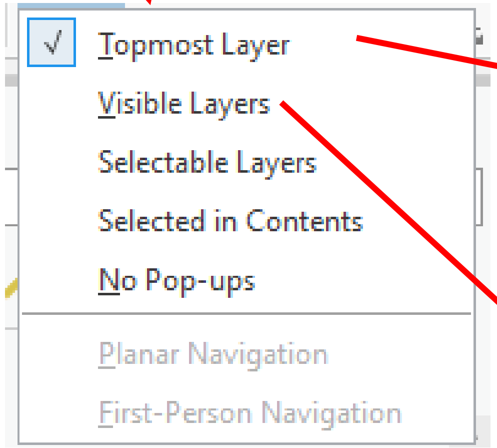


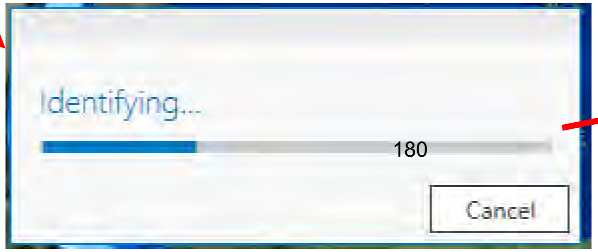
Bookmarks


Project
Map
Insert
Analysis
View
Edit
Imagery
Share
Bookmarks
Go To XY
Basemap
Add Data
Add Preset
Add Graphics Layer
Select
Select By Attributes
Select By Location
Measure
Locate
Coordinate Conversion
Convert
Download Map
Map Bookmarks
Follow drainage dit...
New Bookmark...
Manage Bookmarks
Export Bookmarks...
Import Bookmarks...
Bookmark Options
Create Bookmark
Name:
Bookmark 1
Description:
OK
Cancel
Bookmarks
Search
Map
Follow drainage ditch?
179

Explore Ribbon Tool

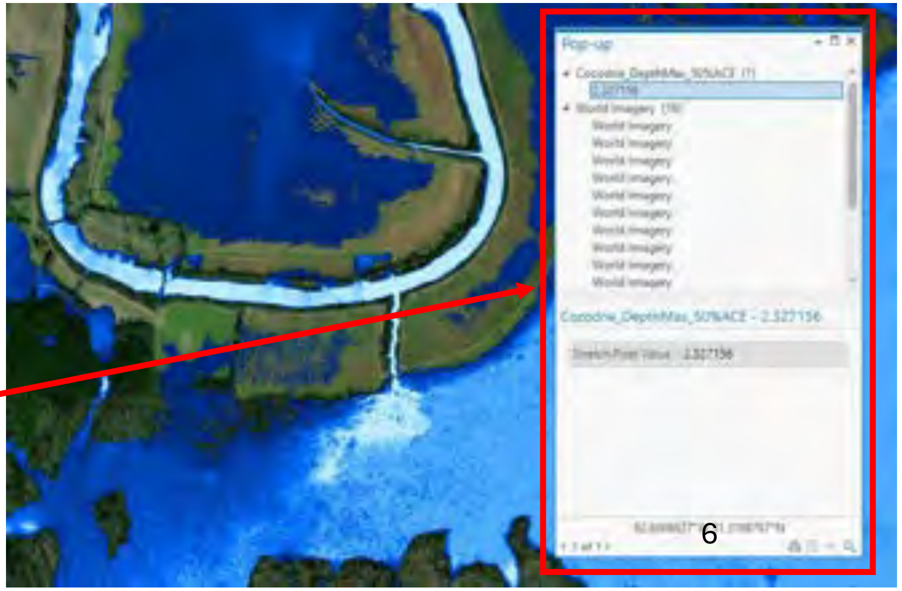




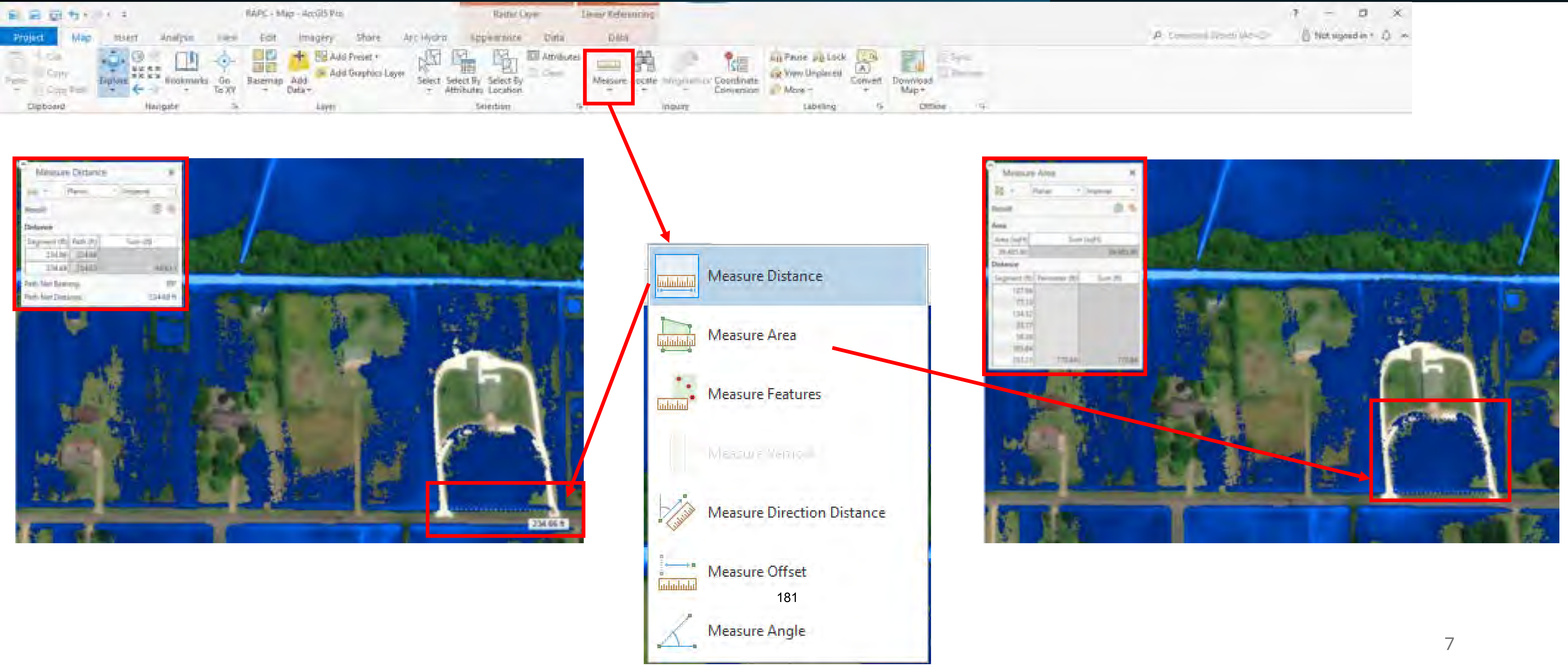


Topmost Layer will show information for only the top layer.

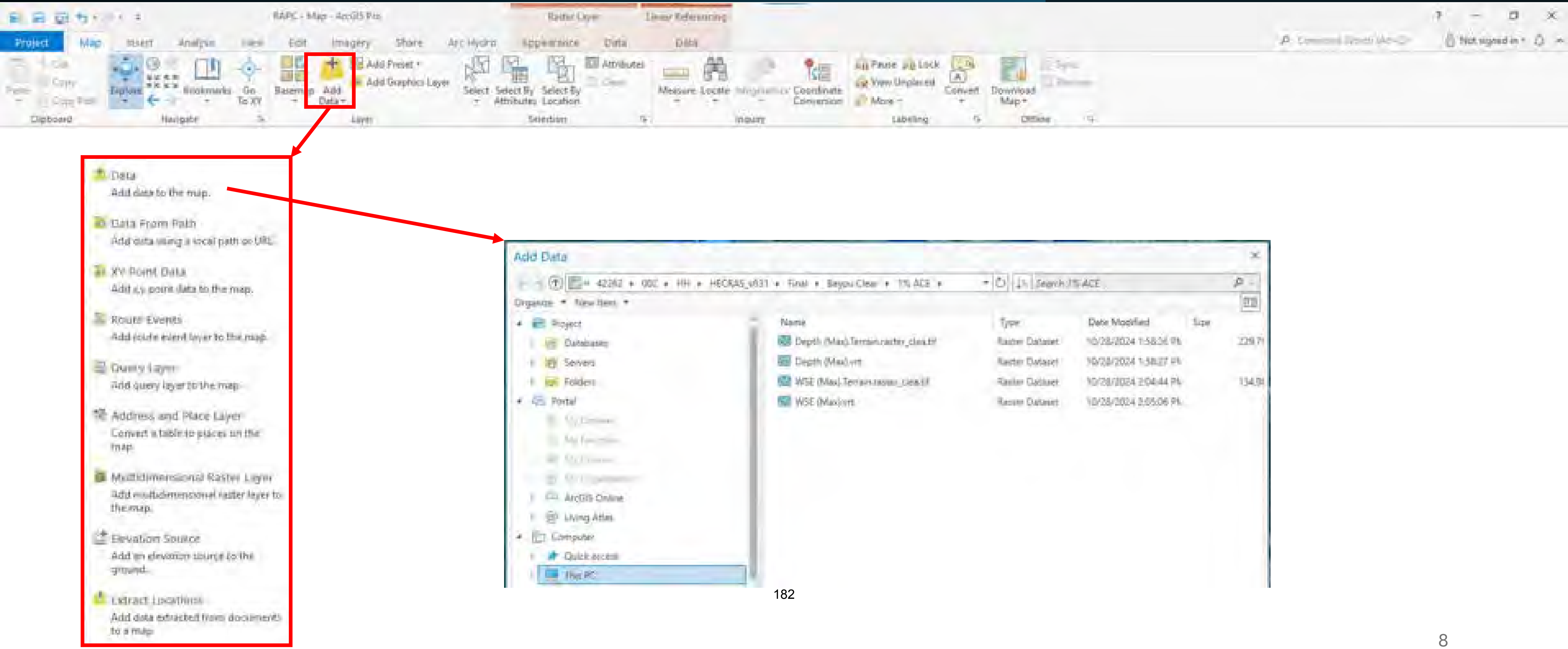
Visible Layers will show information for all layers visible in the current point of view.



Measure Ribbon Tool

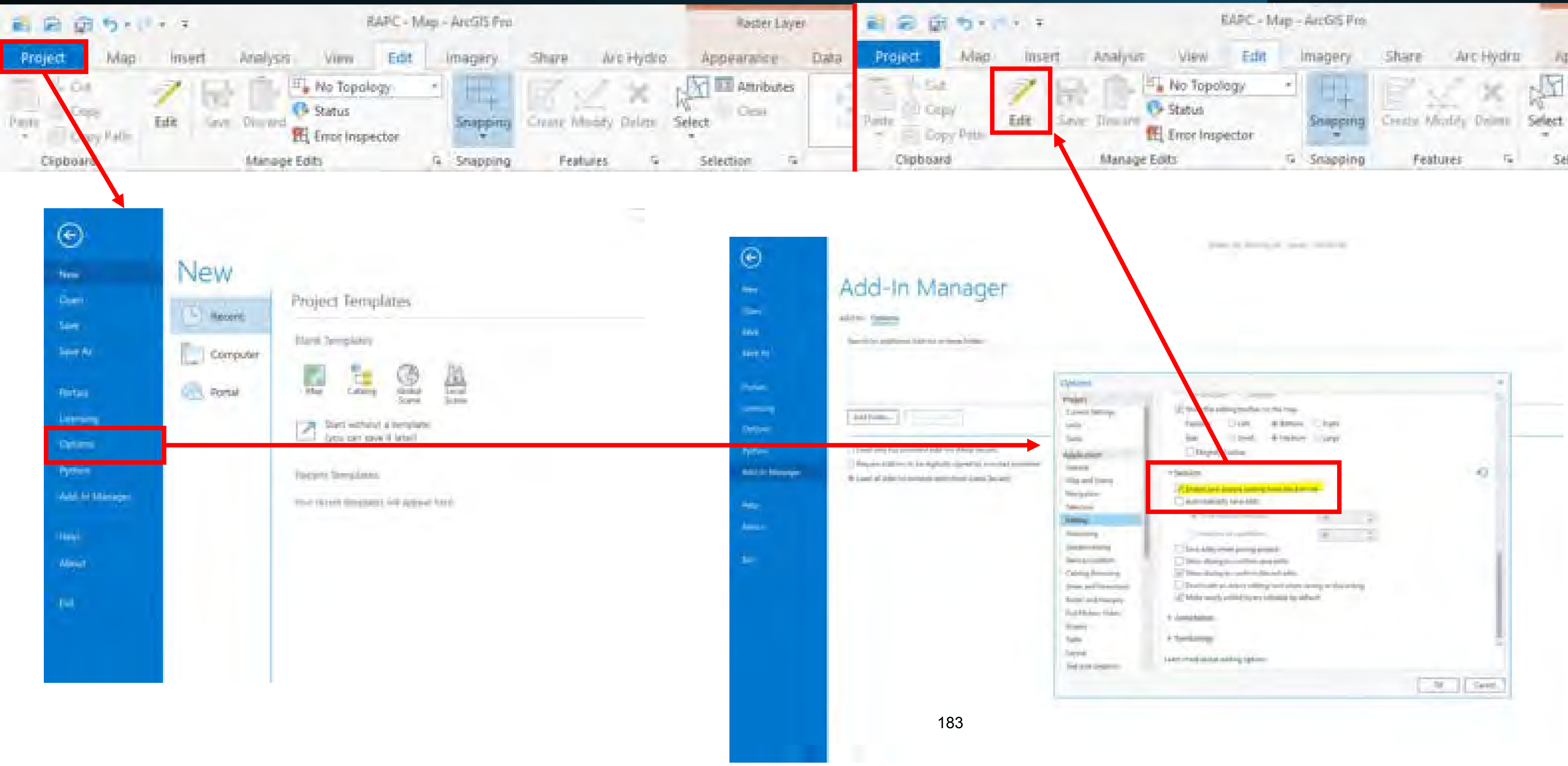


Add Data Ribbon Tool



182

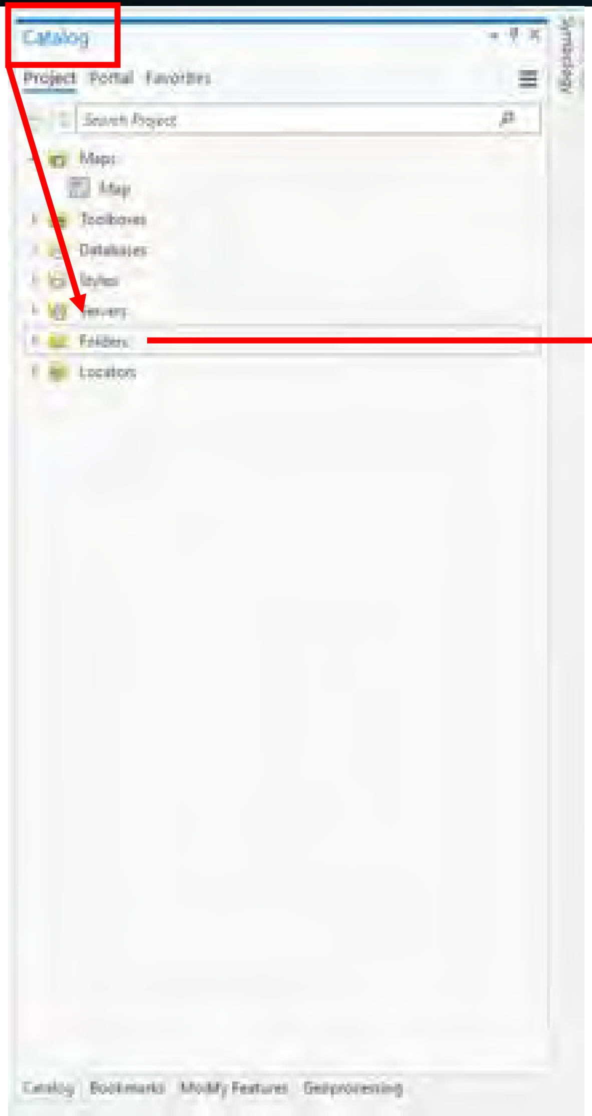
Editor Extension Ribbon Tool

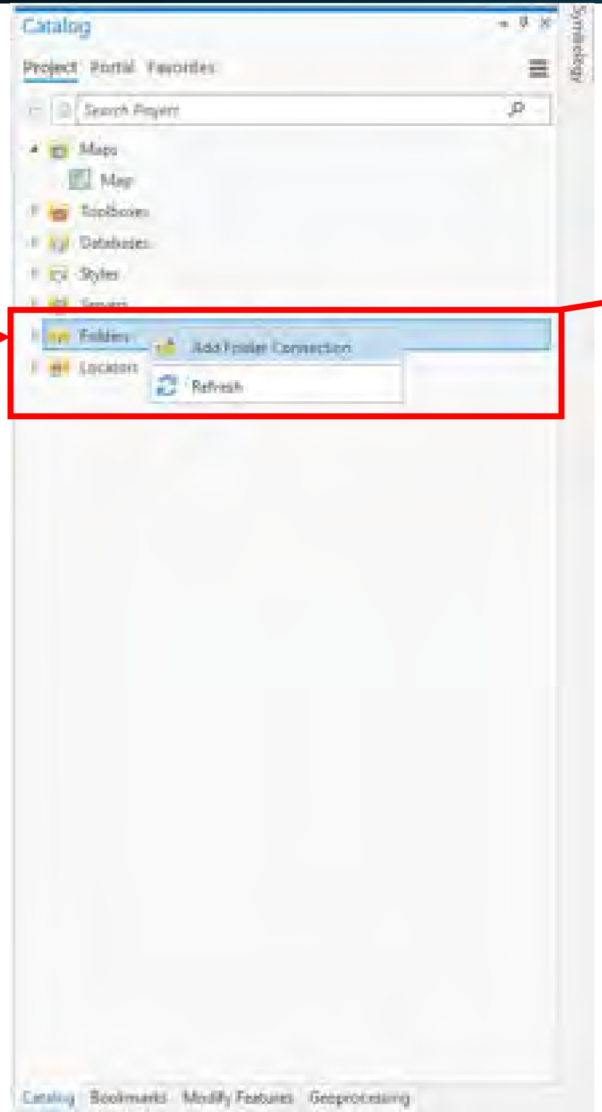


Adding an Editing Extension in ArcPro prevents any accidental edits by requiring to turn editing on.

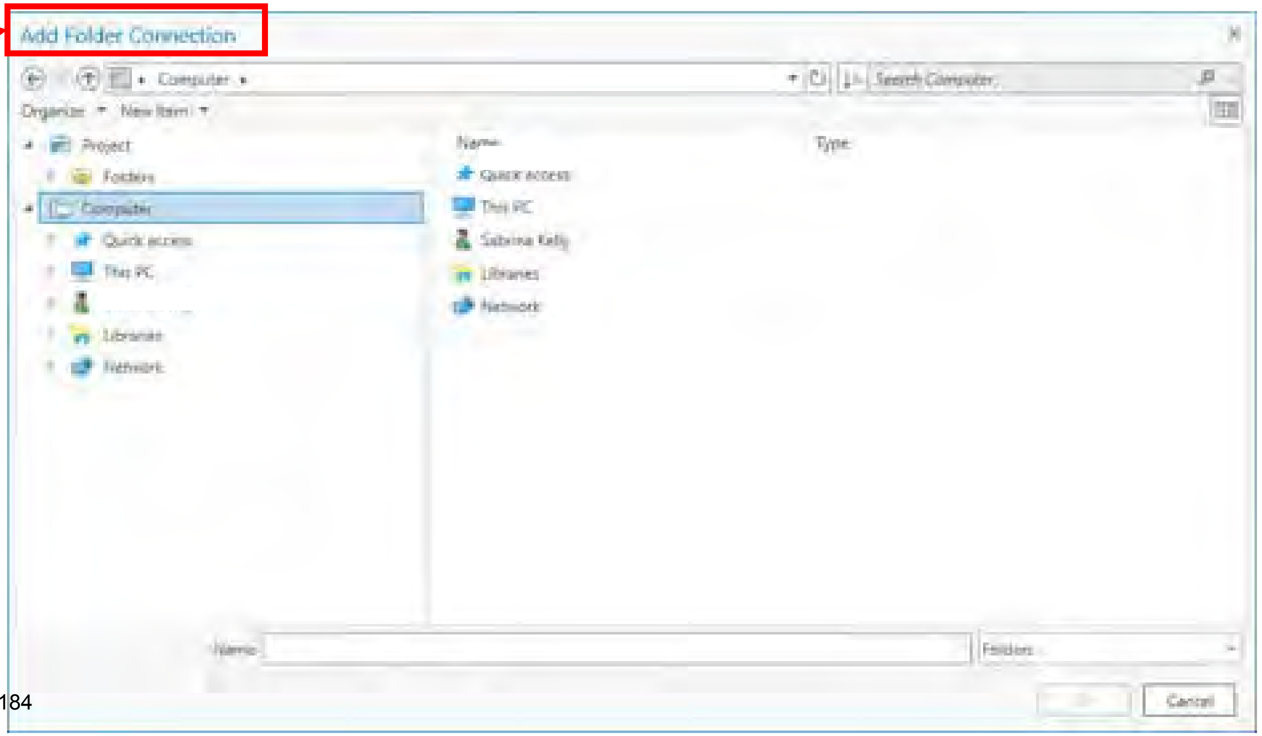
Note: The Options tab will not stay highlighted when you select it (as seen above).

Catalog Tool



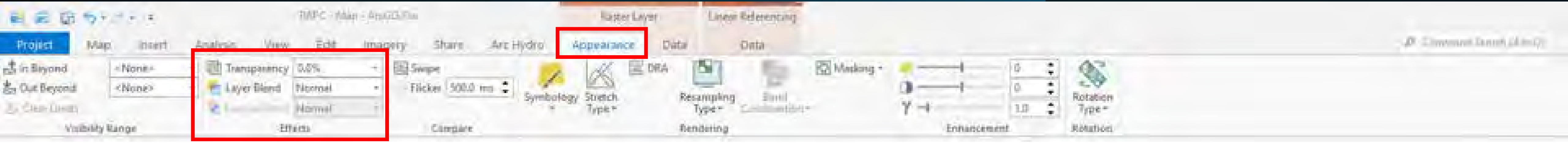


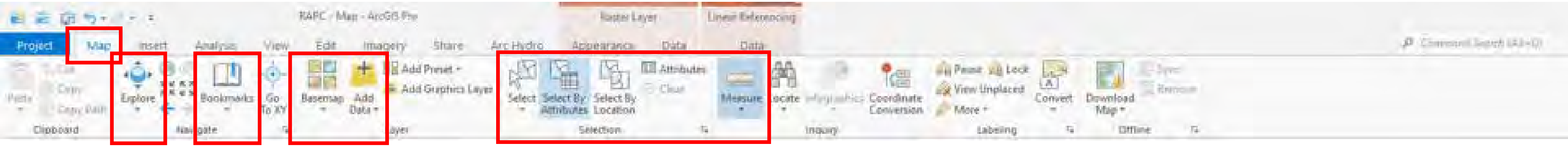
Adding folder connections can be useful when adding data from folders that are visited often. This can cut down the time of trying to locate the data.

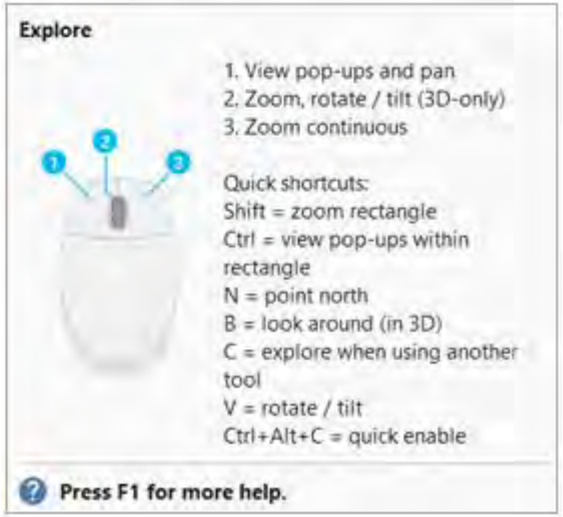


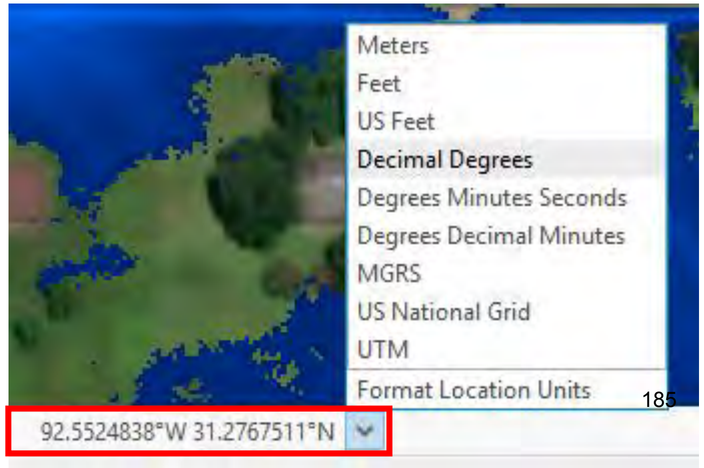
184

Common Ribbon Tools and Shortcuts

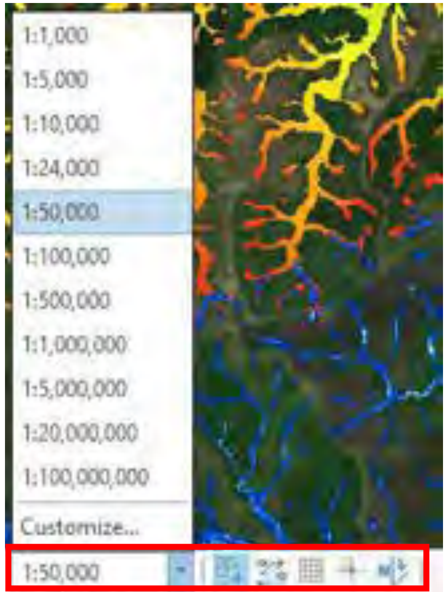






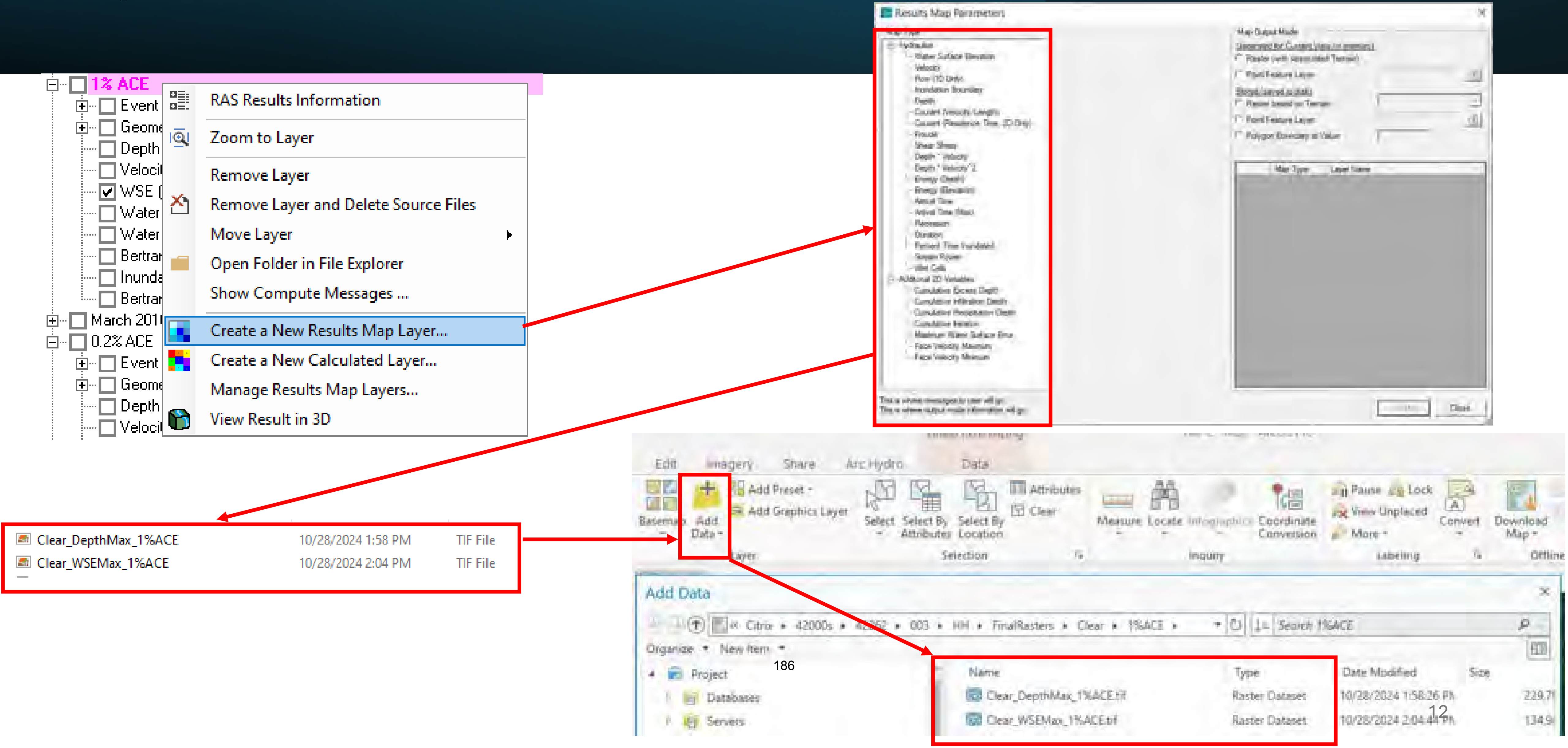


Default setting is "Decimal Degrees" but can be changed by selecting the down arrow and selecting one of the units displayed.



The view scale can be adjusted manually by scrolling with the mouse
Or
To the predetermined scale options at the bottom left of the window.

Export HEC-RAS Rasters to ArcPRO



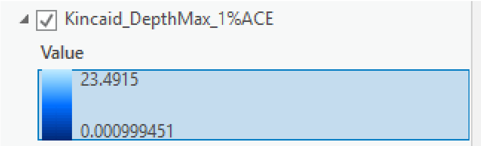
Clipping Rasters

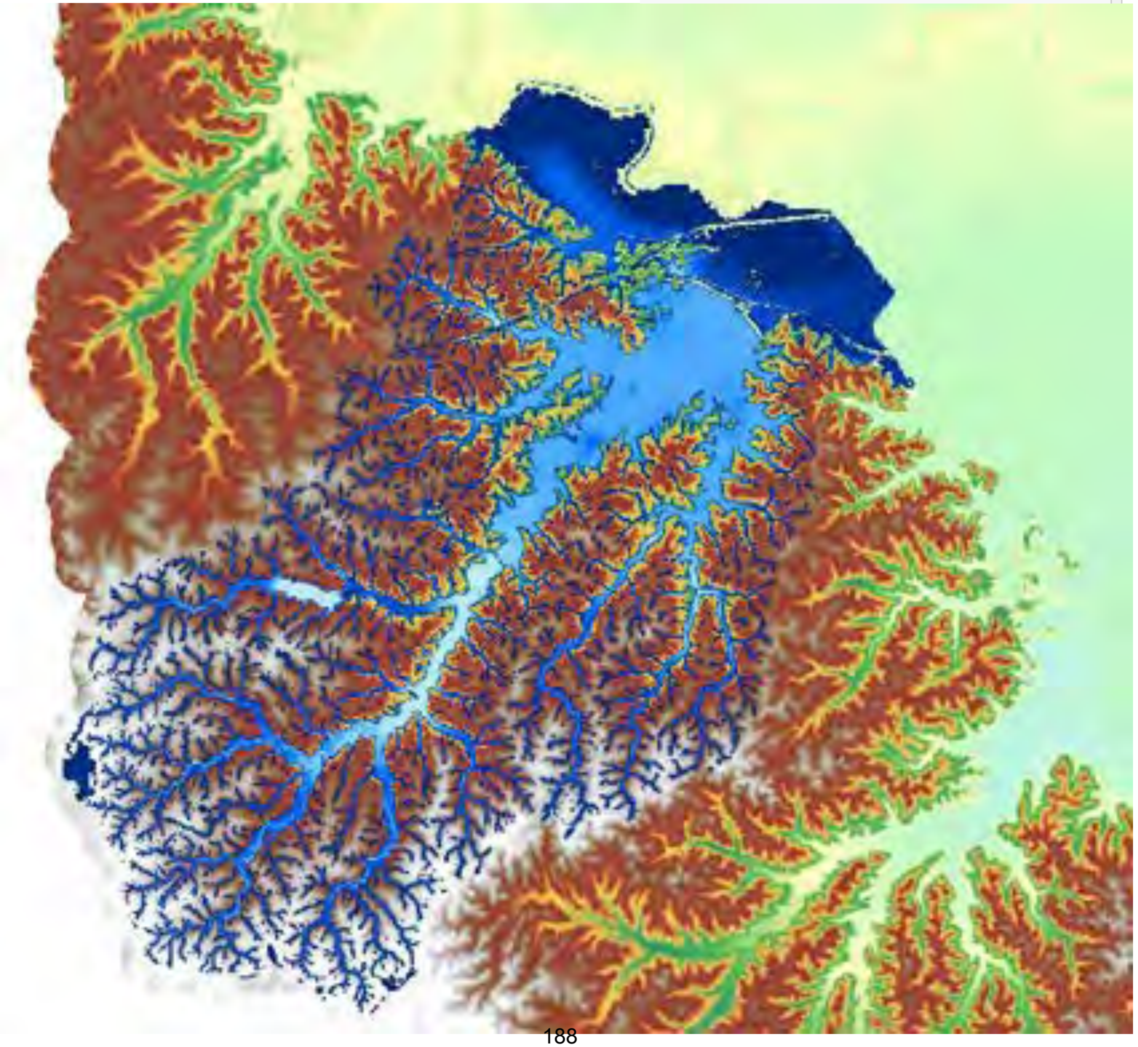
The most reliable way is to use the **Extract by Mask** tool. This requires a **Spatial Analyst License**.

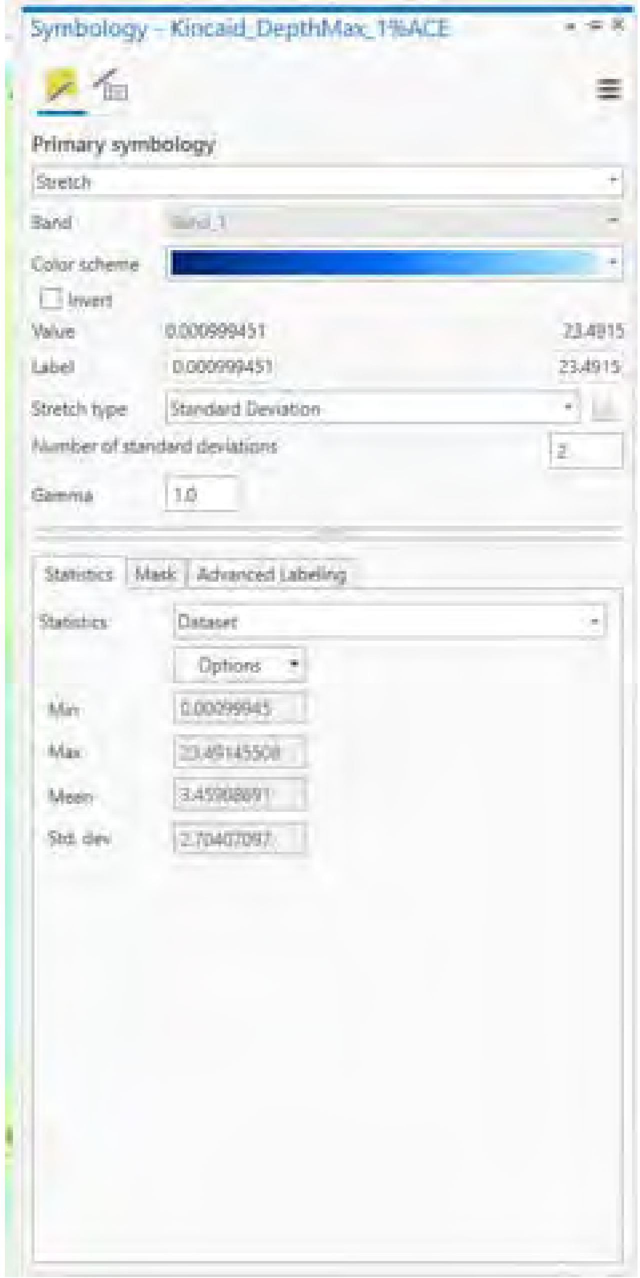
Step 1. In the Geoprocessing Pane select “Extract by Mask.”
Step 2. Select the input raster and feature mask data. Choose where to save your clipped raster.
Step 3. Click Run.

Viewing Rasters

- Depth rasters represent the difference between the WSEL and terrain to show the depth of the flood waters in the areas of the model.



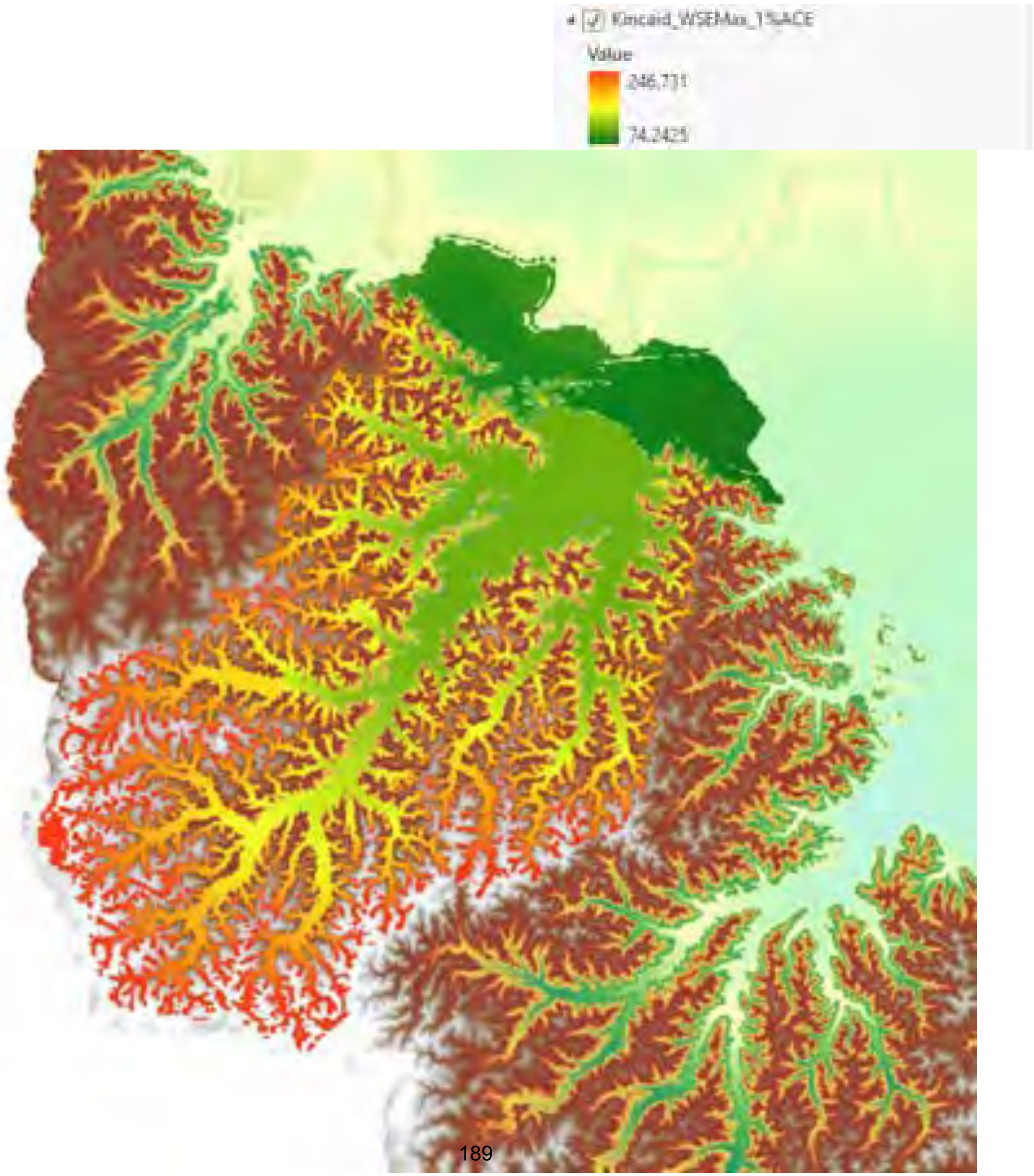




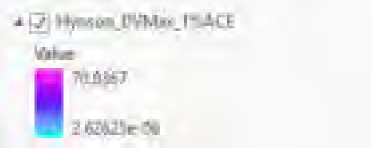
188

Viewing Rasters

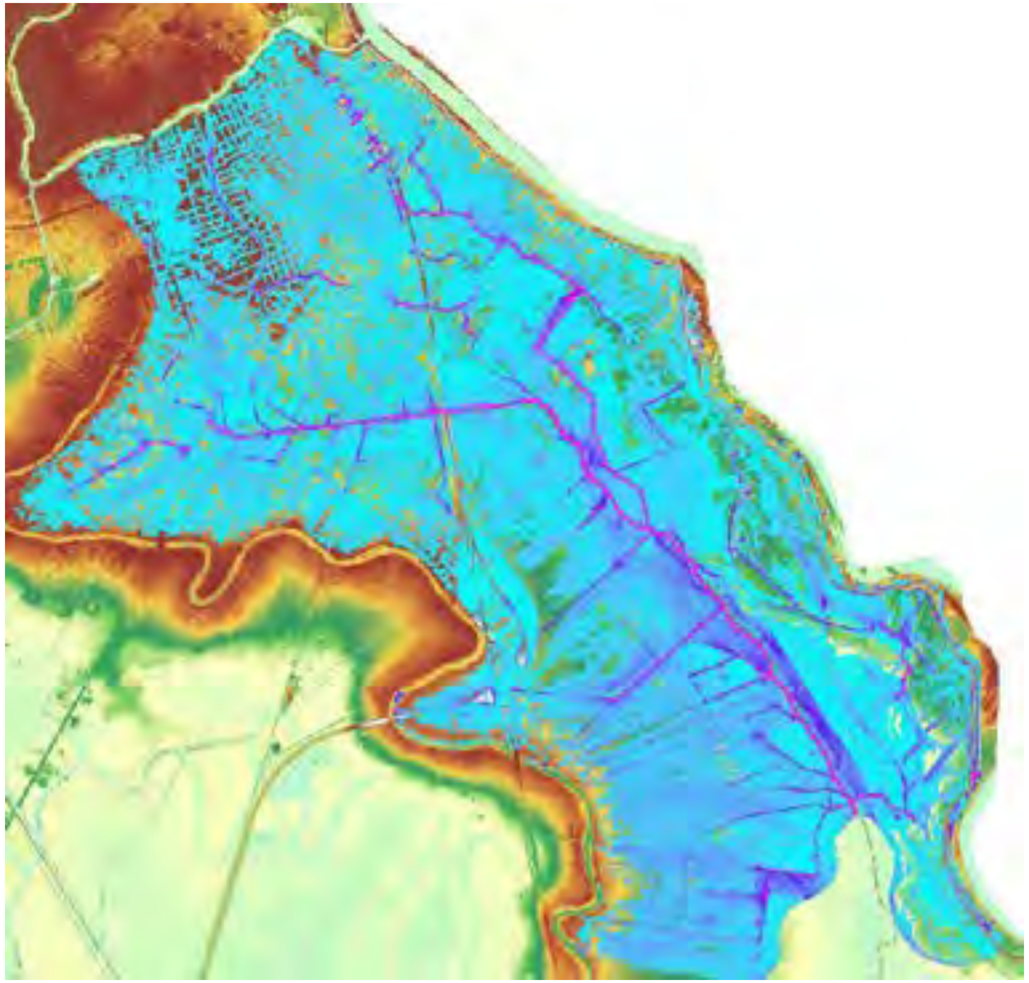
- Water surface elevation shows the water's elevation on top of the terrain elevation, giving a total elevation.

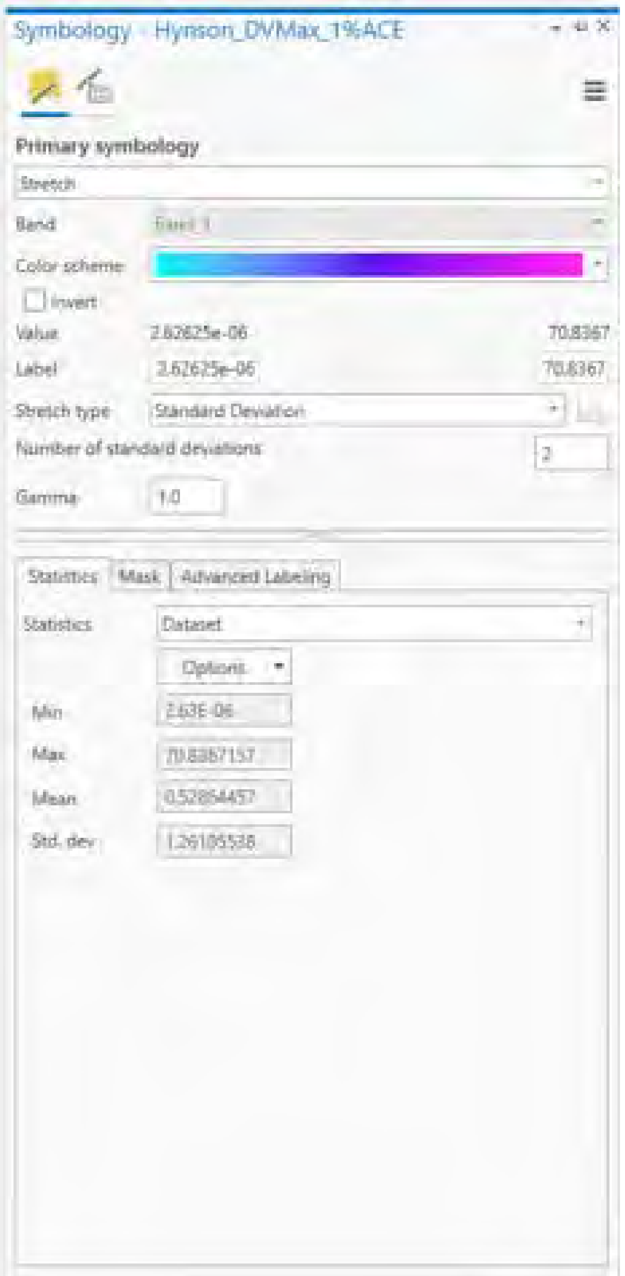


Viewing Rasters



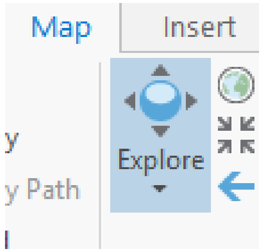
- Depth multiplied by the velocity can present great benefits to the community and planners of the community.

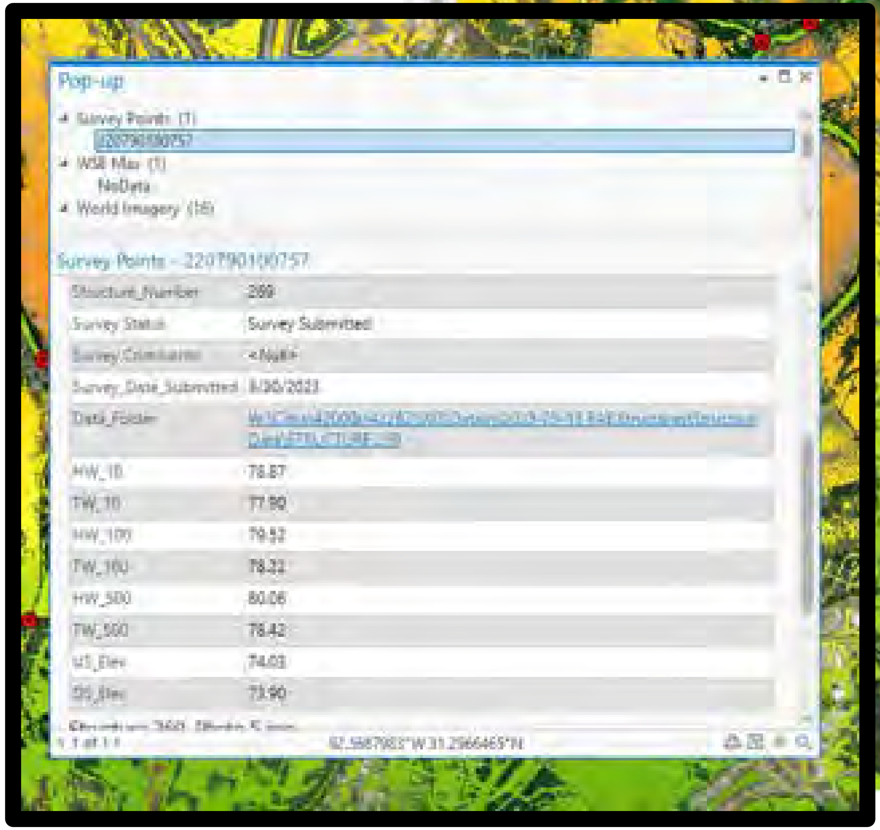




190

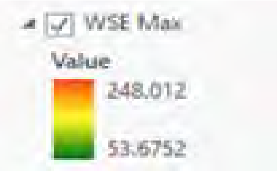
Viewing Surveyed Structures

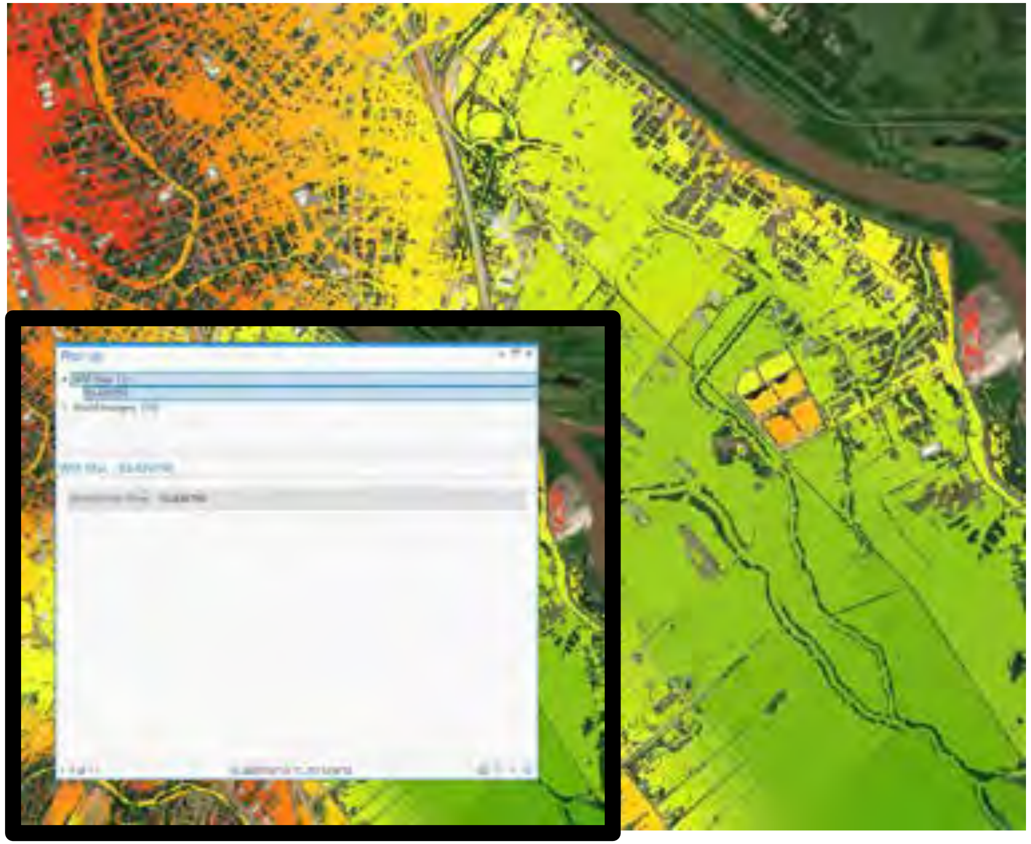


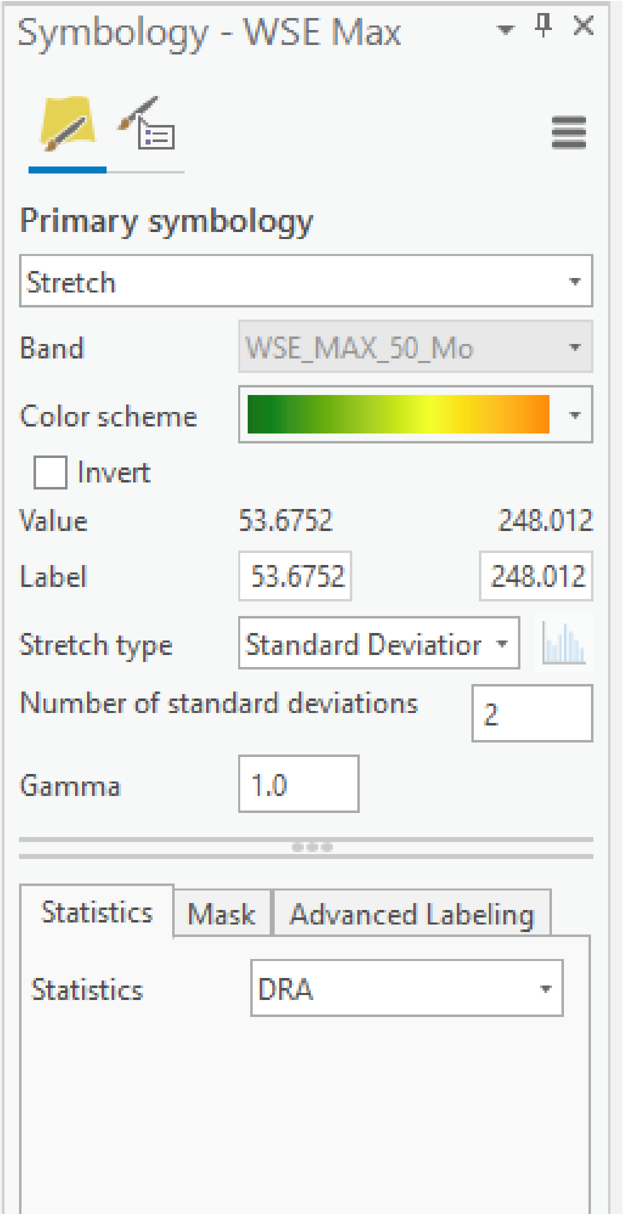


Viewing Water Surface Elevation Rasters

- Ensure the DRA(Dynamic Range Adjustment) is turned on. This adjusts the stretch of the raster to data contained in the view.
- Use the Explore tool to click on an area in the raster. This will generate a popup that contains the specific elevation of the area clicked.



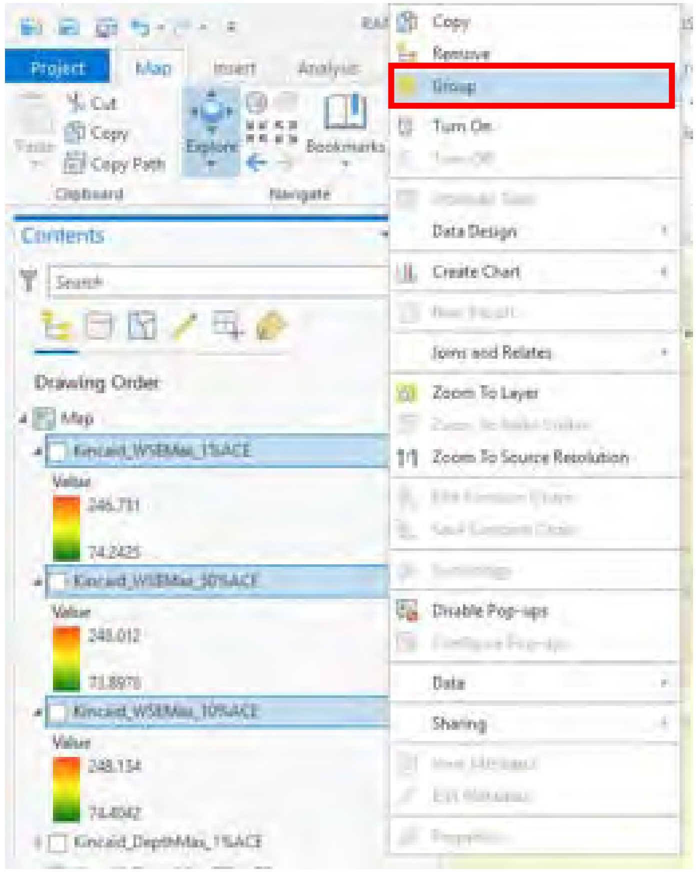




- Head loss can be approximated with the difference in water surface elevation across a structure

Contents Tools

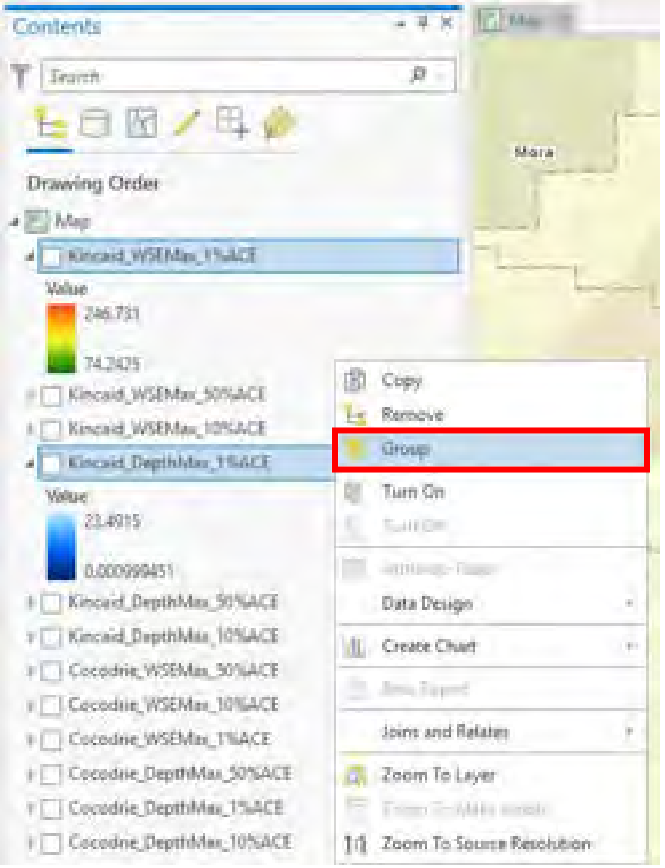
Group layers that are next to each other by holding “shift” and selecting the layers then right clicking on one file and selecting “Group”.



193

OR

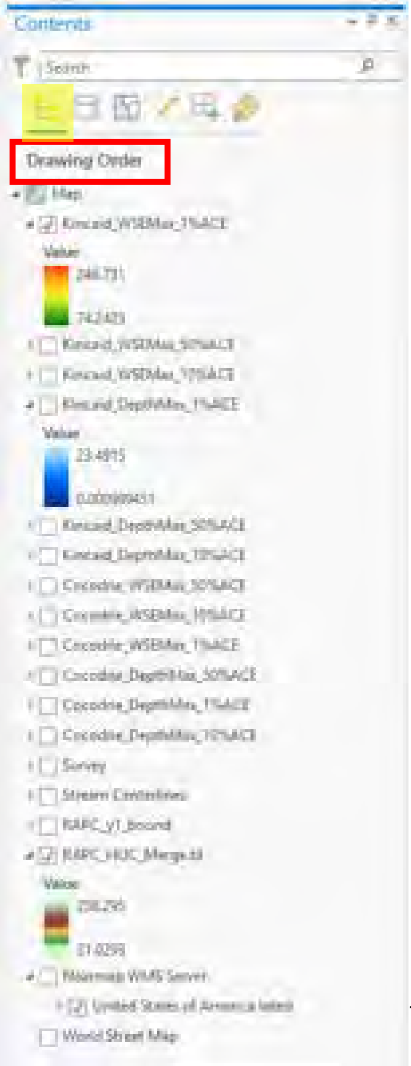
Group layers that are not in order by holding “ctrl” and selecting specific layers then right clicking on one file and selecting “Group”.



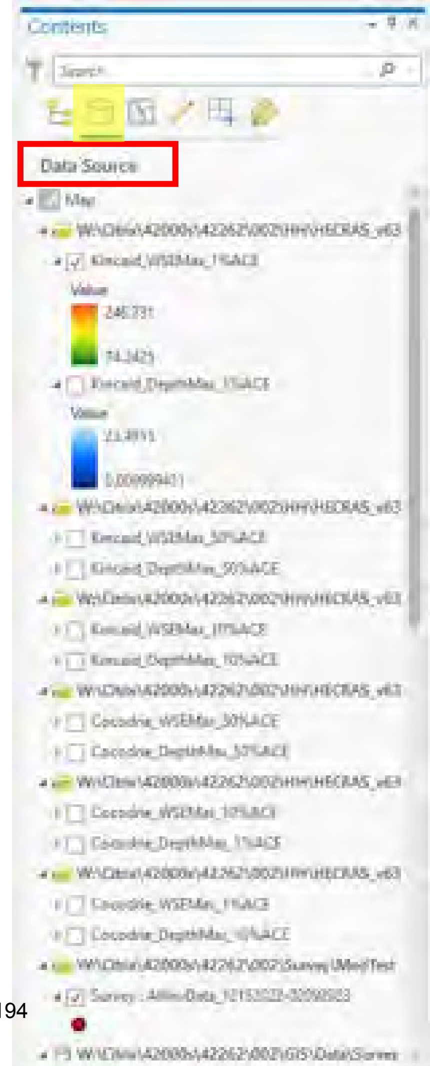
Contents Tools

In the Contents window, different views can be selected. Below are some of the main ones used:

Drawing Order



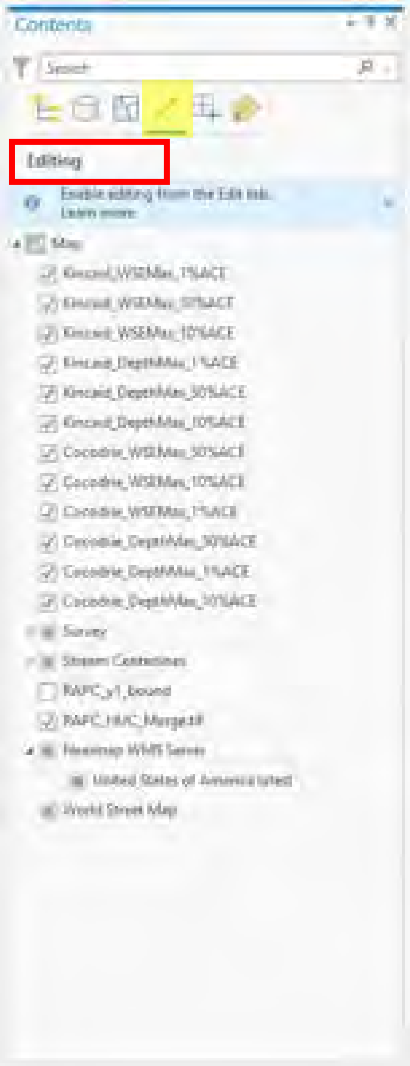
Data Source



194

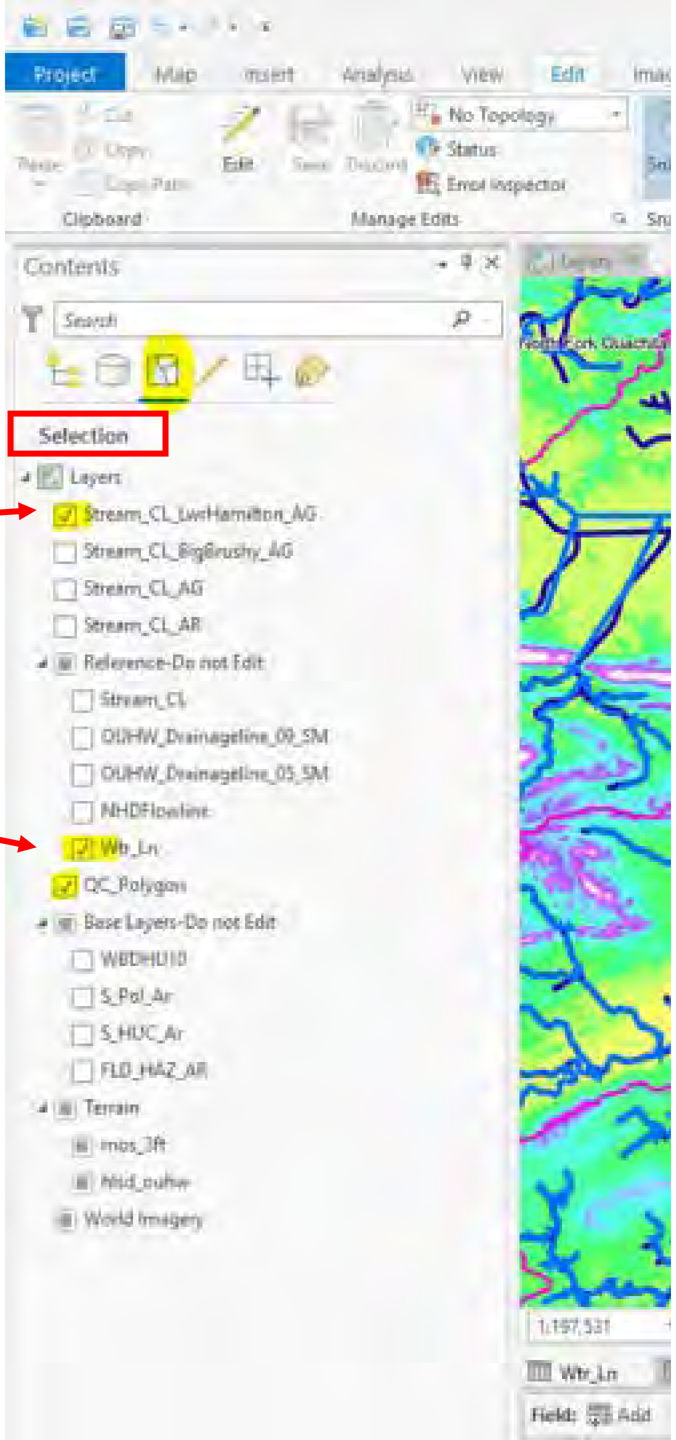
Selection

Editing



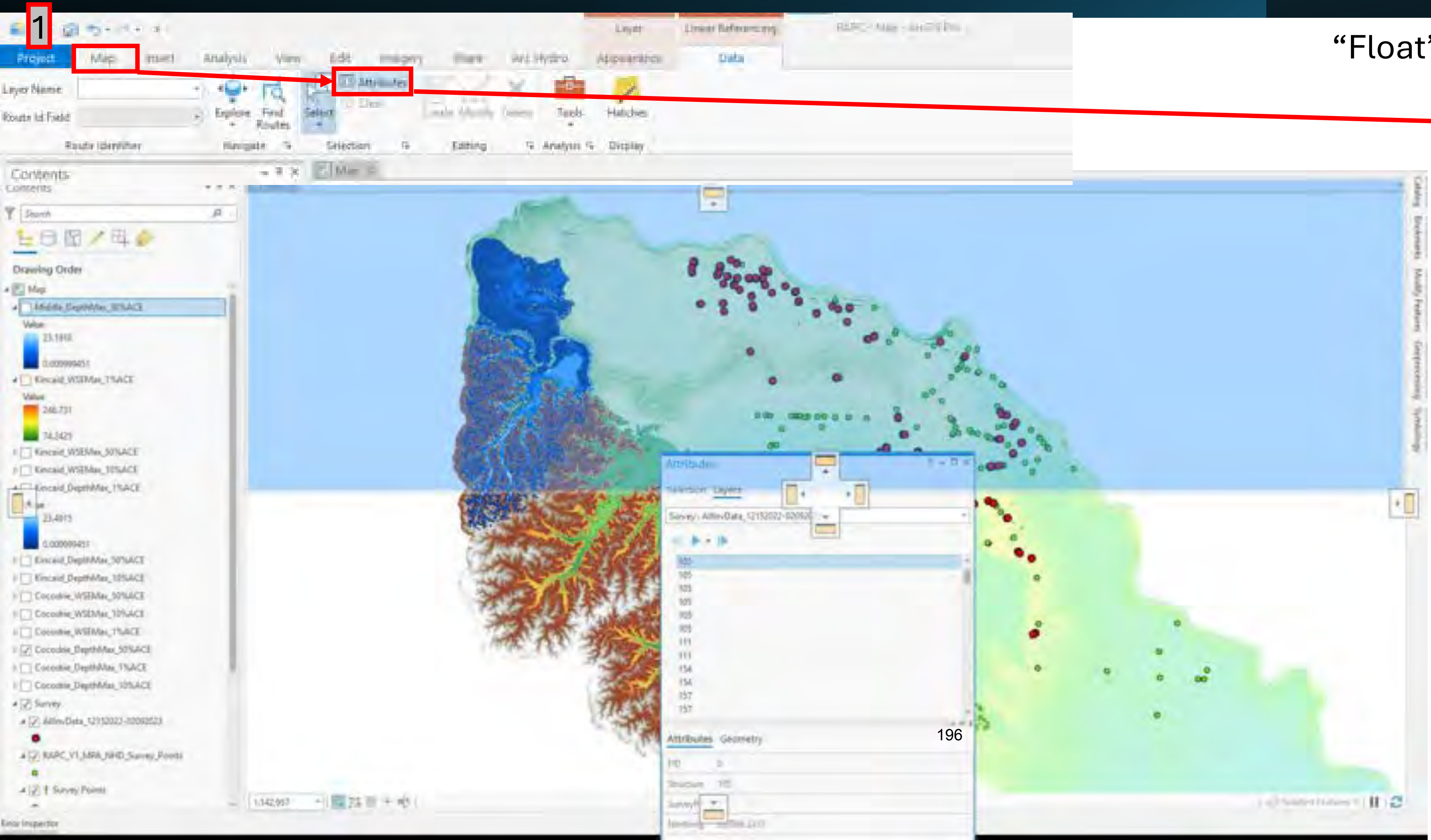
Contents Tools

Layers are listed by whether their features are selectable by the interactive selection and editing tools here:



Attribute Tool

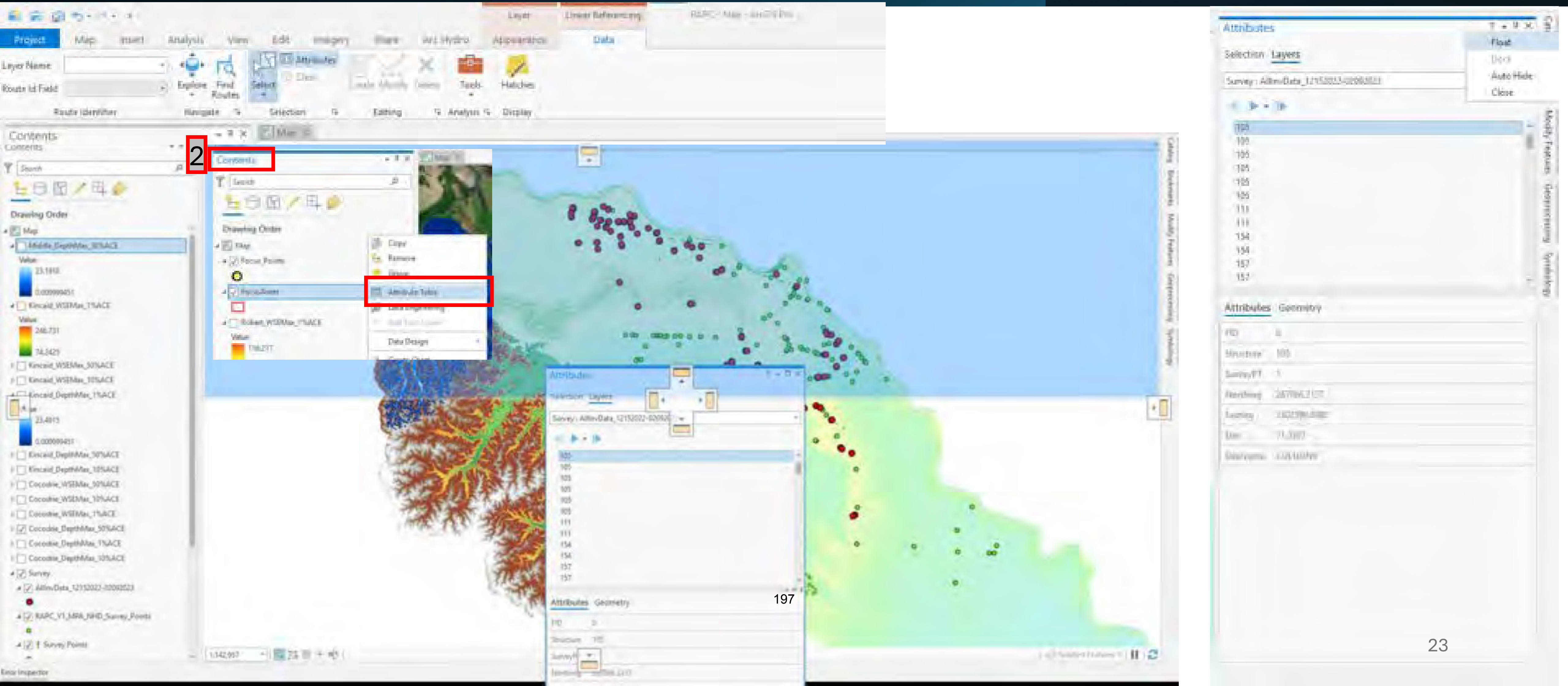
To view the Attributes Table, select from the “Map” tab and select “Attributes”.



“Float”:

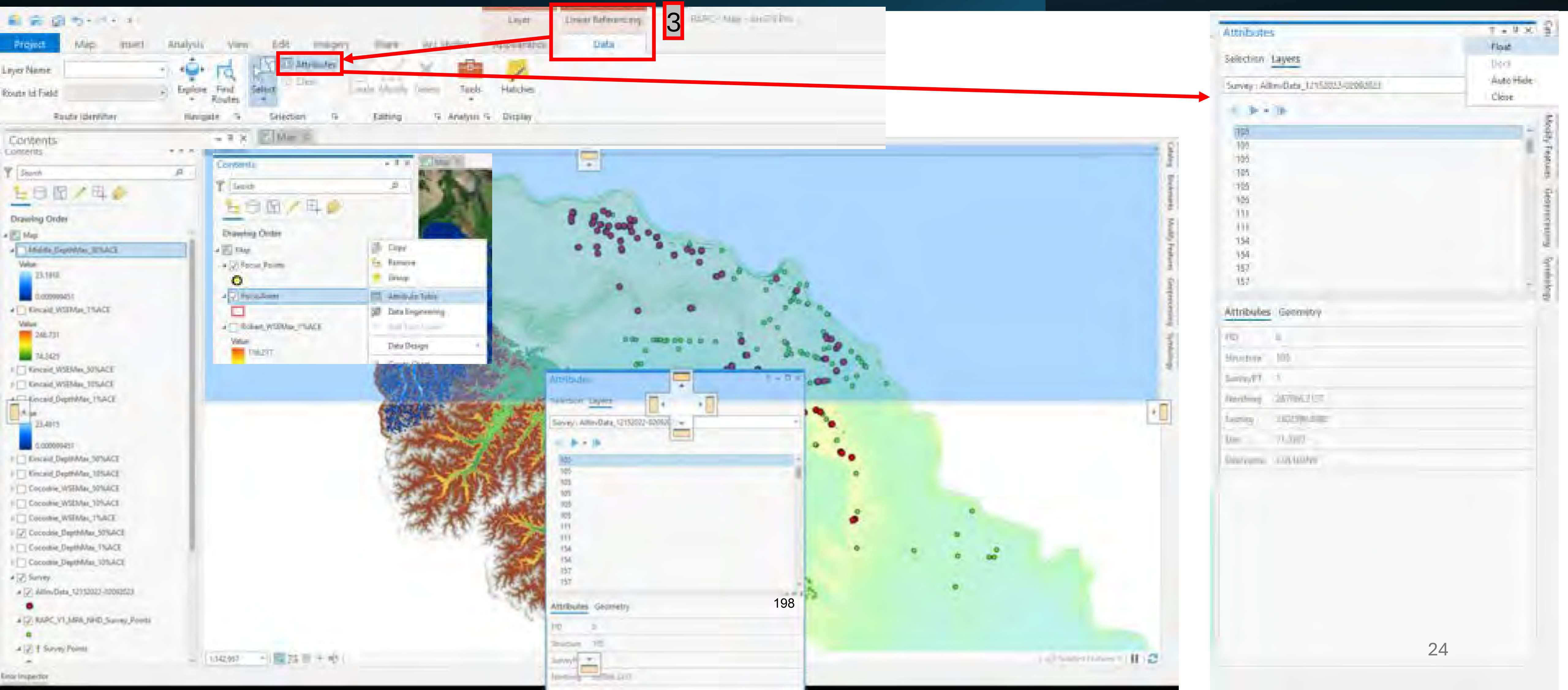
Attribute Tool

To view the Attributes Table, right click on the data in the Contents tab and select "Attribute Table".



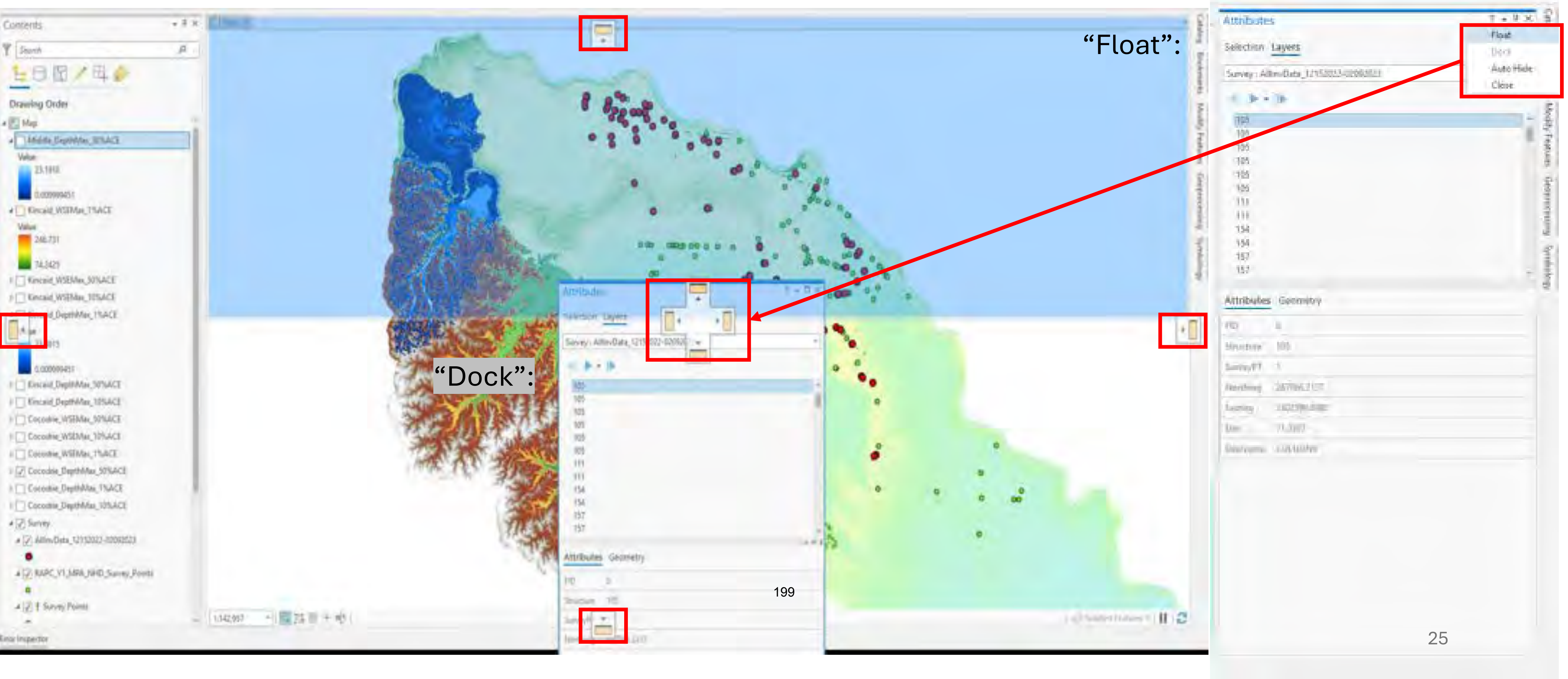
Attribute Tool

To view the Attributes Table, first select the data in mind and at the top of the ribbon, find “Data” and select “Attributes”.



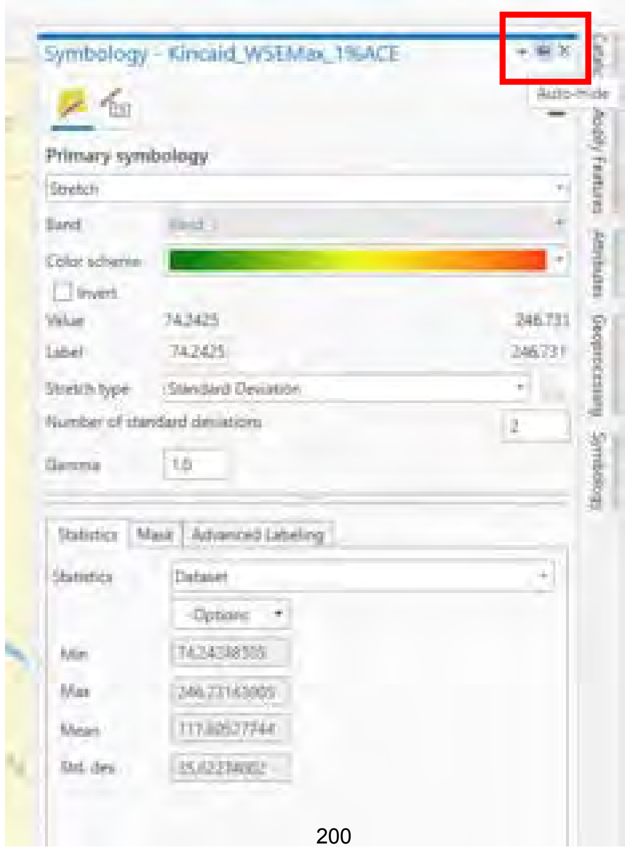
Attribute Tool

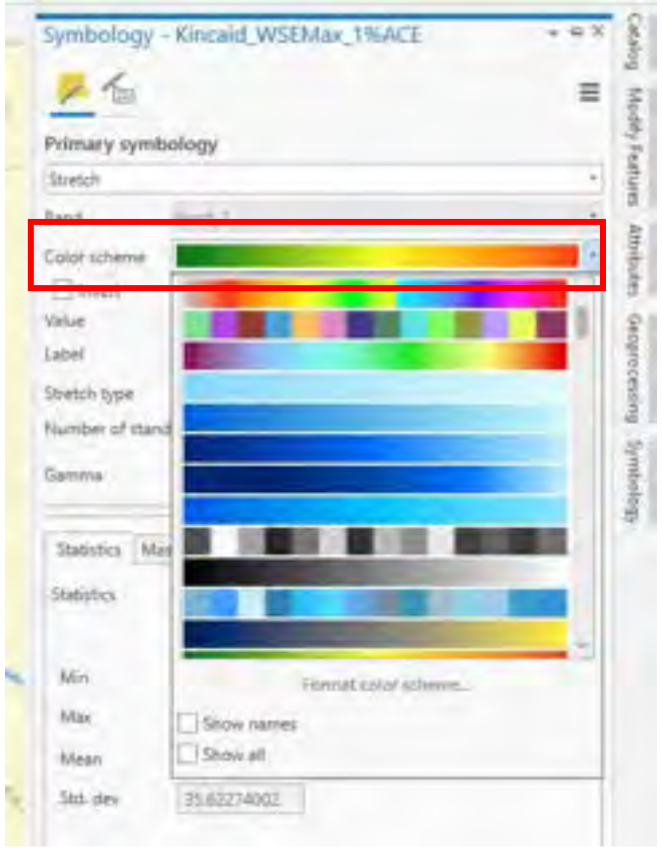
To move the window around, select “Float”, “Dock”, “Auto Hide”, or “Close”
There are four areas that the window can be docked to:

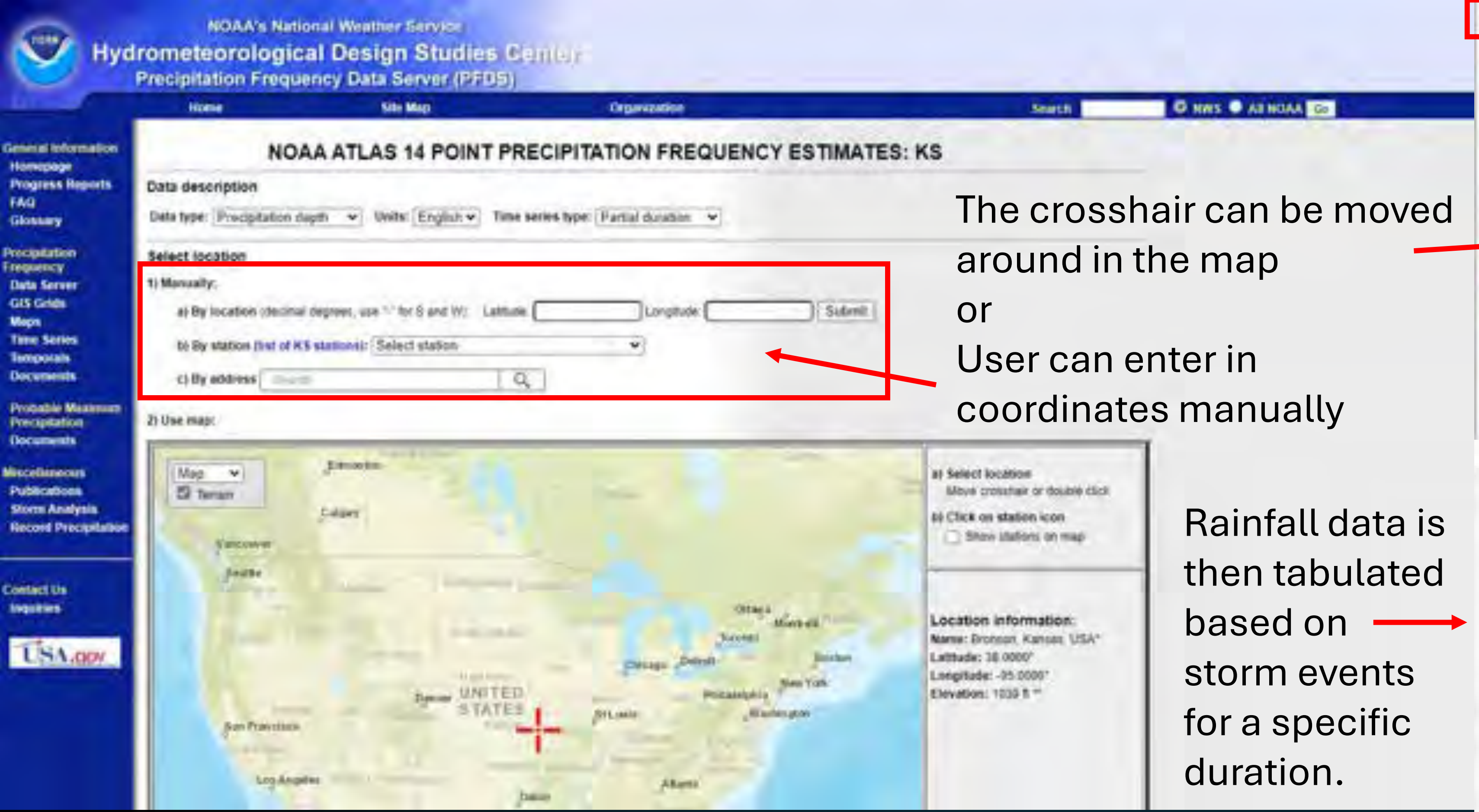


Symbology Tool

This Symbology window can be “pinned” in place or can “auto-hide”

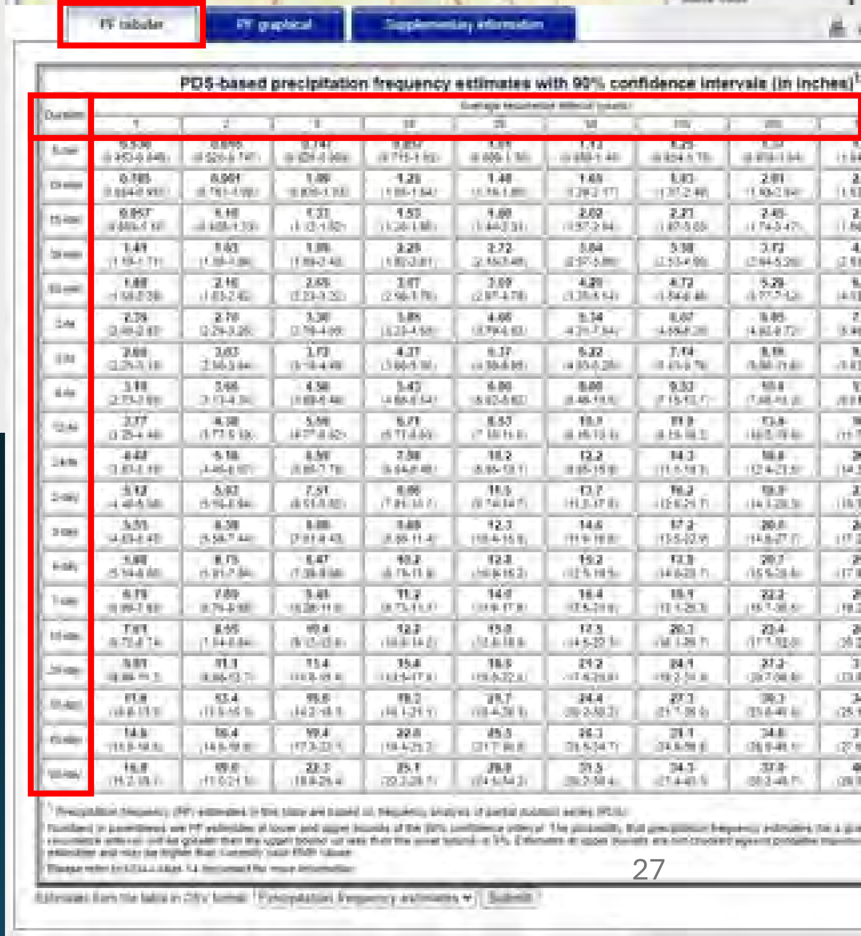






The crosshair can be moved around in the map
or
User can enter in coordinates manually

Rainfall data is then tabulated based on storm events for a specific duration.

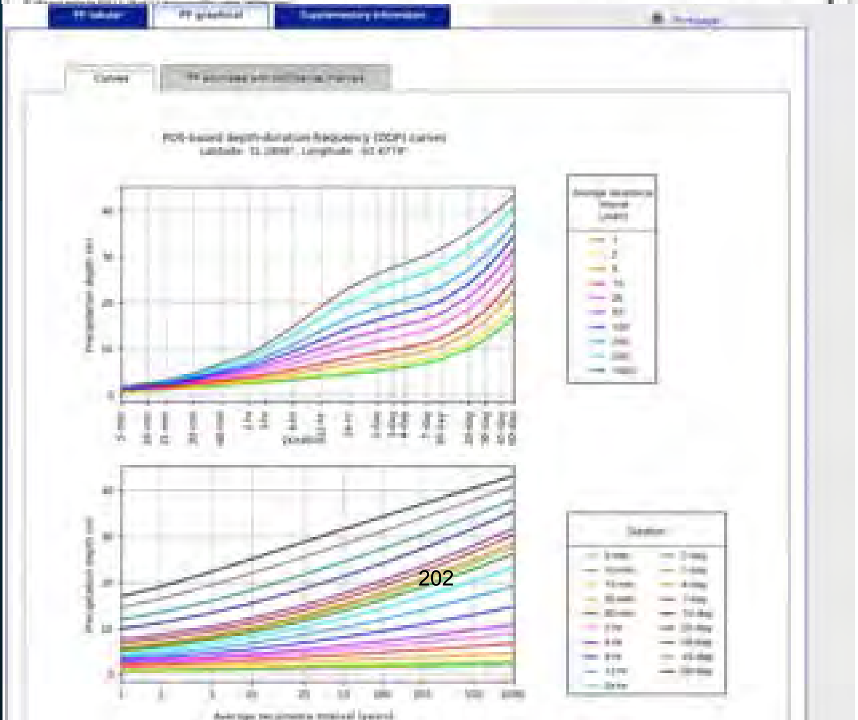


Flooding Identification Based on Storm Size Using Atlas 14

https://hdsc.nws.noaa.gov/pfds/pfds_map_cont.html

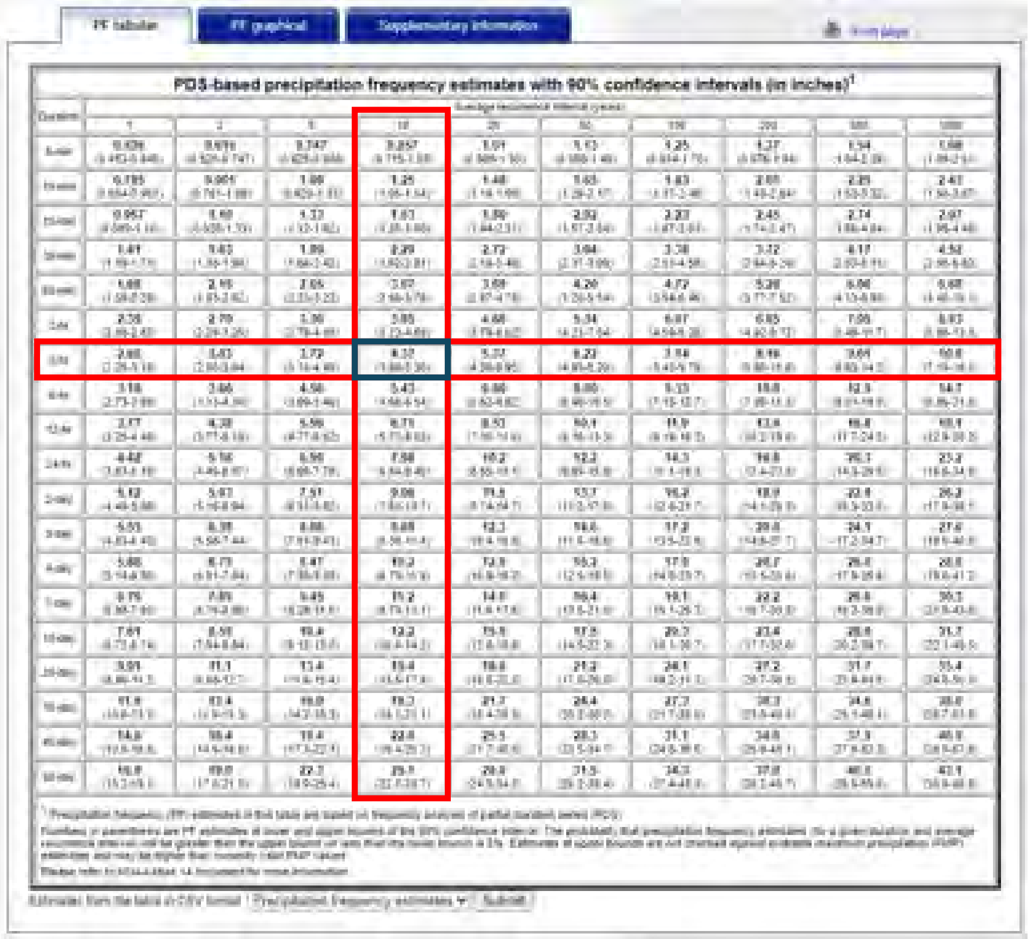
Flooding Identification Based on Storm Size Using Atlas 14

https://hdsc.nws.noaa.gov/pfds/pfds_map_cont.html



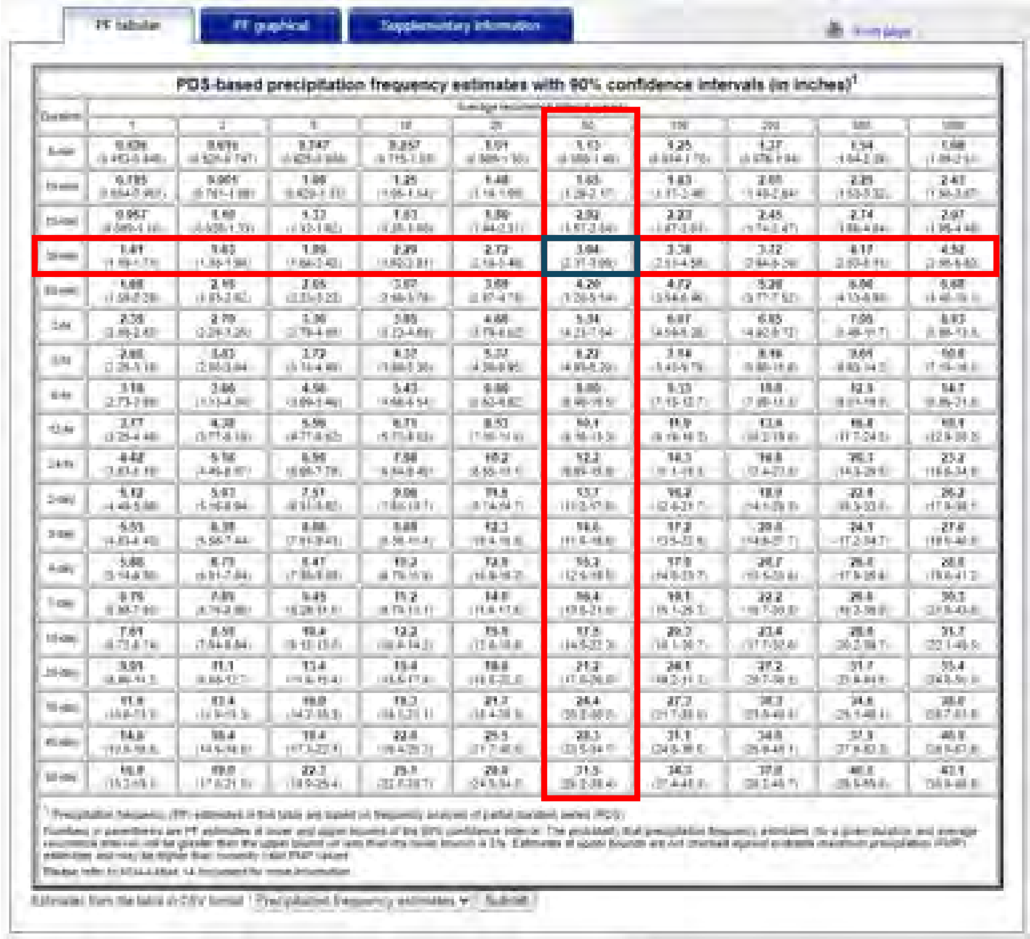
The Upper and Lower Confidence Limits are also known as the “plus” or “minus” storm events.
Typically seen with 100-year storm events.

Flooding Identification Based on Storm Size



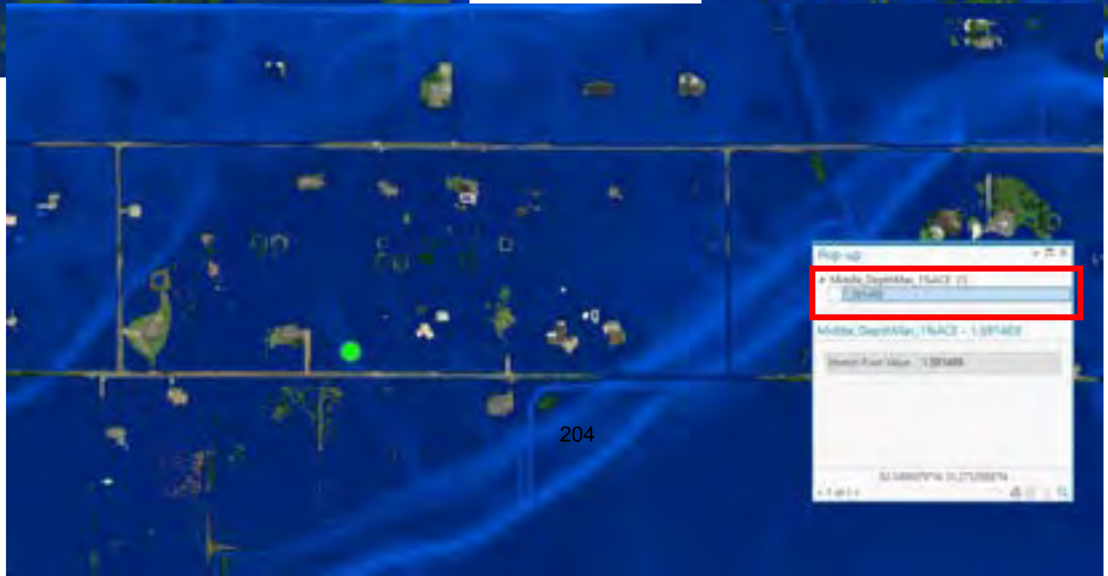
Example:
If a rainstorm is predicted for the area to last 3 hours and drop 4 inches of rain, the storm can be estimated to be a 10yr storm for the area. (Left)

Example:
If a rainstorm is predicted for the area to last 30 minutes and drop 3 inches of rain, the storm can be estimated to be a 50yr storm for the area. (Right)[203]



Flooding Identification Based on Storm Size

Where to Prioritize Resources for Different Levels of Storms



Typical Storm Event Naming Convention

2yr = 50% ACE

10yr = 10% ACE

25yr = 4% ACE

50yr = 2% ACE

100yr = 1% ACE

Q&A

GET IN TOUCH

Please reach out if you have any additional questions!

Victor Bivens, P.E., C.F.M.

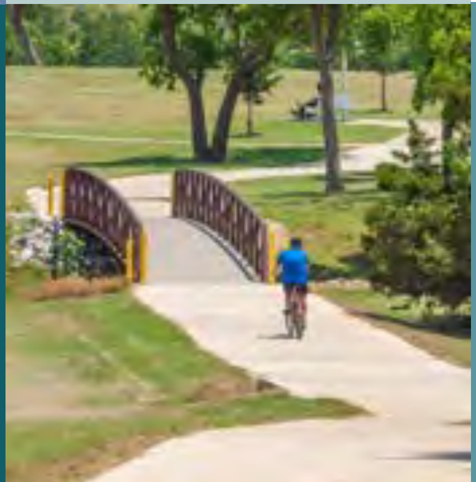
O: 318.716.6134

C: 318.537.0113

E: vbivens@halff.com

halff.com

CONNECT WITH US. LIKE US. FOLLOW US.



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APPENDIX H: AREAS OF MITIGATIONS (AOMIs)

Areas of Mitigation Interest

- Study 1 - Camellia Place*
- Study 2 - Cypress Garden*
- Study 3 - Sandy Bayou*
- Study 4 - I-49 Underpasses*
- Study 5 - St. Andrews Place*
- Study 6 - McAdams Ditch
- Study 7 - Greer Street
- Study 8 - Martin Park
- Study 9 - Pleasant Drive
- Study 10 - Donahue Ferry Rd.
- Study 11 - Singer Dr.
- Study 12 - Pineville Soccer Park
- Study 13 - Grandpa's Drive
- Study 14 - Ron Mar Drive

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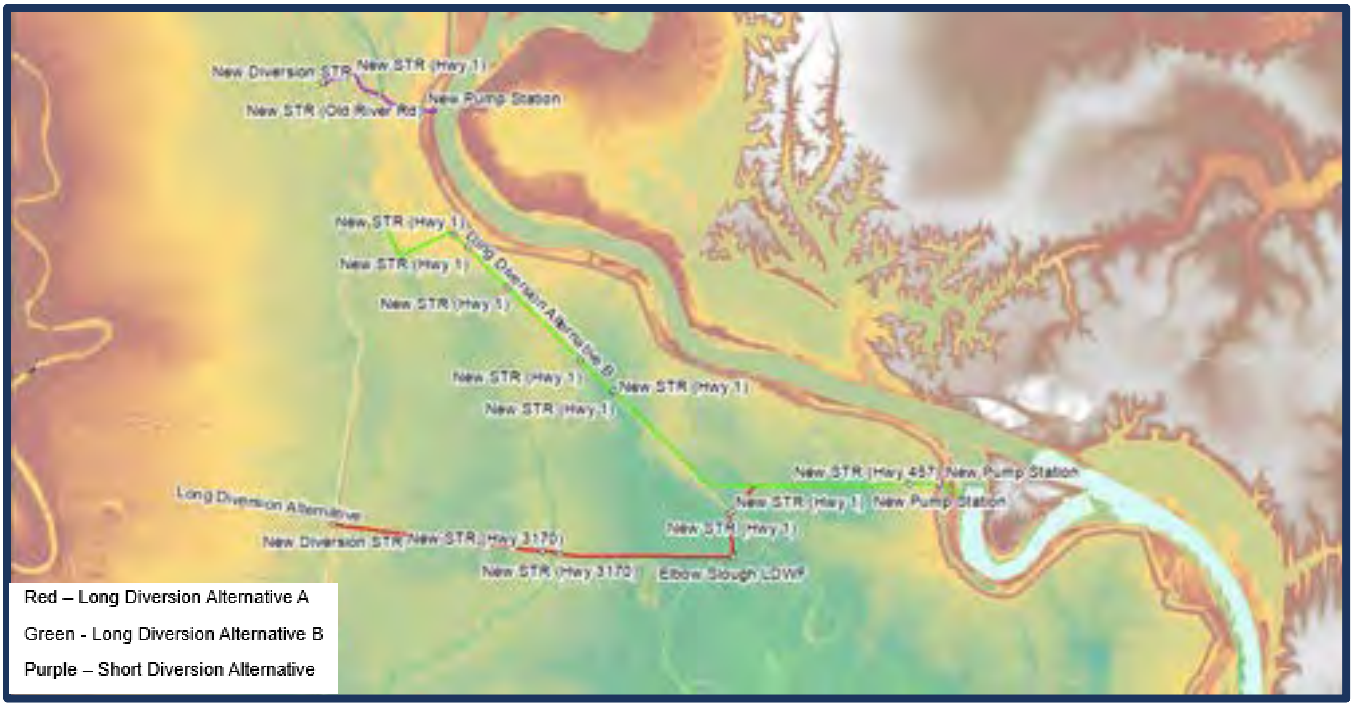
*Study Areas 1-5 have been identified as Critical AOMI's with preliminary project summary reports

CHATLIN LAKE CANAL



LOCATION

The alternatives follow the Chatlin Lake Canal and start west of Highway 1, parallel to Highway 3170, crosses Highway 1, then runs east to drain into Pool No. 1 below Lock & Dam No. 2.

PROBLEM

GDD (Gravity Drainage District) #1 - Alexandria, LA, was seeking resolution to flooding problem that would not require pump maintenance. Alternative would need to utilize gravity drainage to the Red River, however, conditions for gravity drainage appeared available only far downstream of the City.

Long Diversion was the preferred alternative.

Coincident-frequency analysis showed that gravity drainage would provide sufficient drainage for only 80% of events.

PROPOSED SOLUTIONS

- Long Diversion was developed to include improvements to Chatlin Lake Canal along diversion canal, control structure on Chatlin Lake Canal at the diversion canal, gated pump station through levee, and a detention pond (so pumps could be sized for non-peak conditions), stretching 5+ miles.
  - Since pumps would be required - opened possibility of a shorter diversion canal upstream that is functionally equivalent.
- Short Diversion includes improvements to Chatlin Lake Canal above diversion canal, control structure on Chatlin Lake Canal at the diversion canal, possible detention ponds, and a pump station that would outfall to the Red River during high-flow events.
  - Short Diversion (approx. 1 mile) from Chatlin Lake Canal to the Red River where Chatlin Lake Canal comes close to the river.

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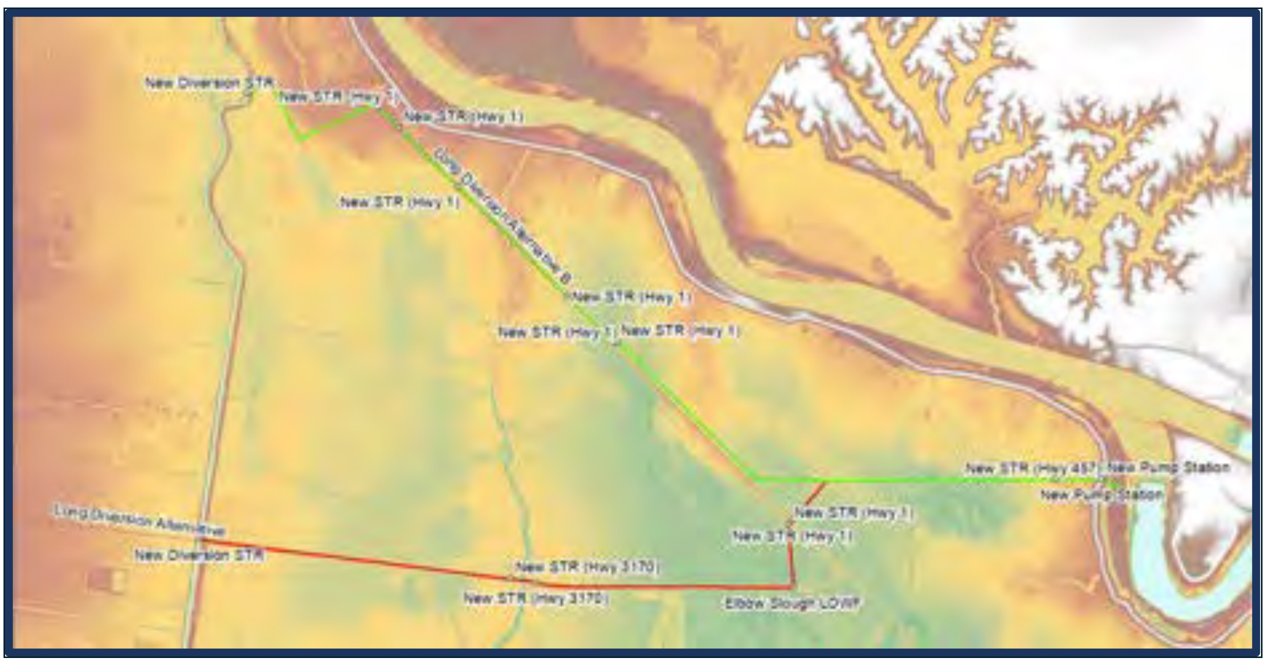
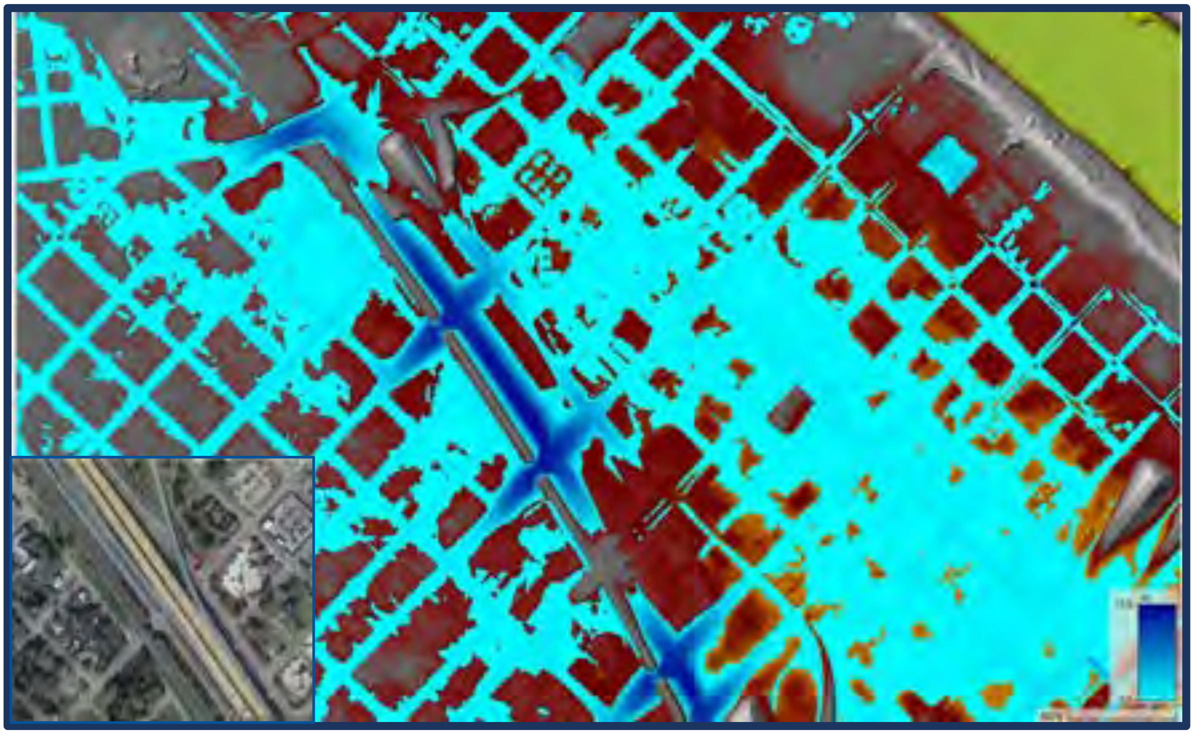
Zoomed in view of the Short Diversion Alternative.



View of the Long Diversion Alternatives A and B.

I-49 UNDERPASSES



LOCATION

This drainage issue is located on the intersection of 10th Street and Elliot Street near the I-49 North on-ramp. Stormwater flows under I-49 where it ponds before street inlets can relieve flooding.

PROBLEM

The photograph below, taken August 24, 2022, shows stormwater lifting a manhole cover on Elliot Street just before the elevation drop under the overpass. There are on-grade and sag inlets that appear undersized for the flow.

PROPOSED SOLUTIONS

- Fund a pump project to remove water from the area.
- Overlay the current roadway under I-49 to increase the crown of the road to direct runoff to inlets faster.
  - Upsize the drainage system to accommodate for the increase in road runoff capture.
  - Create underground detention to accommodate for road runoff.

Google earth view of the clearance and grade under the bridge.

Photographs from site visit at Elliot Street during a rainstorm event in the area, taken August 24, 2022.

McKEITHEN DRIVE AREA

LOCATION

This area is encompassed within Middle Bayou. The primary roadway to the east is McKeithen Drive. Neighborhoods include Pleasant Drive and Sunshine Drive.

PROBLEM

Neighborhoods in the area are reporting frequent flooding.

According to an investigative effort, there appear be multiple factors:

- Due to the flatness of the area, pluvial flooding is occurring in the northern neighborhoods.
- To the south, there appear to be backwater issues that are overpowering the current drainage structures and flooding houses in the area.

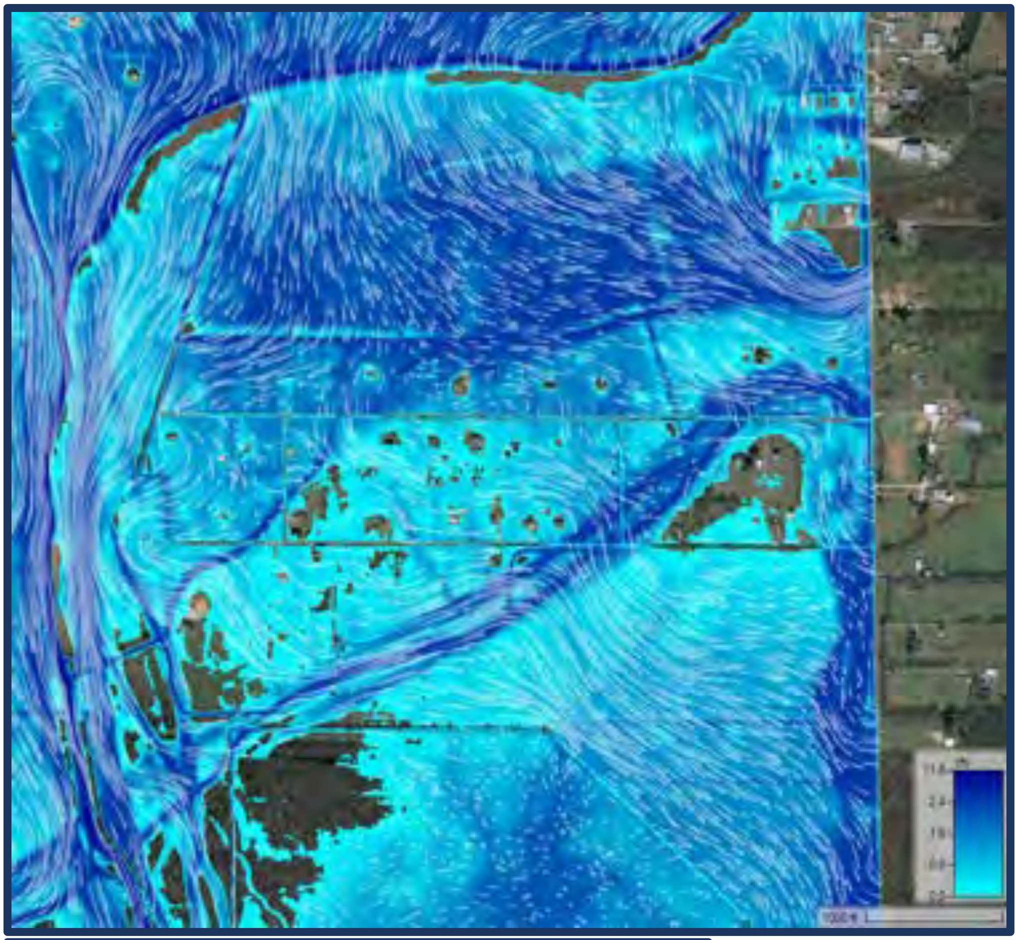
PROPOSED SOLUTIONS

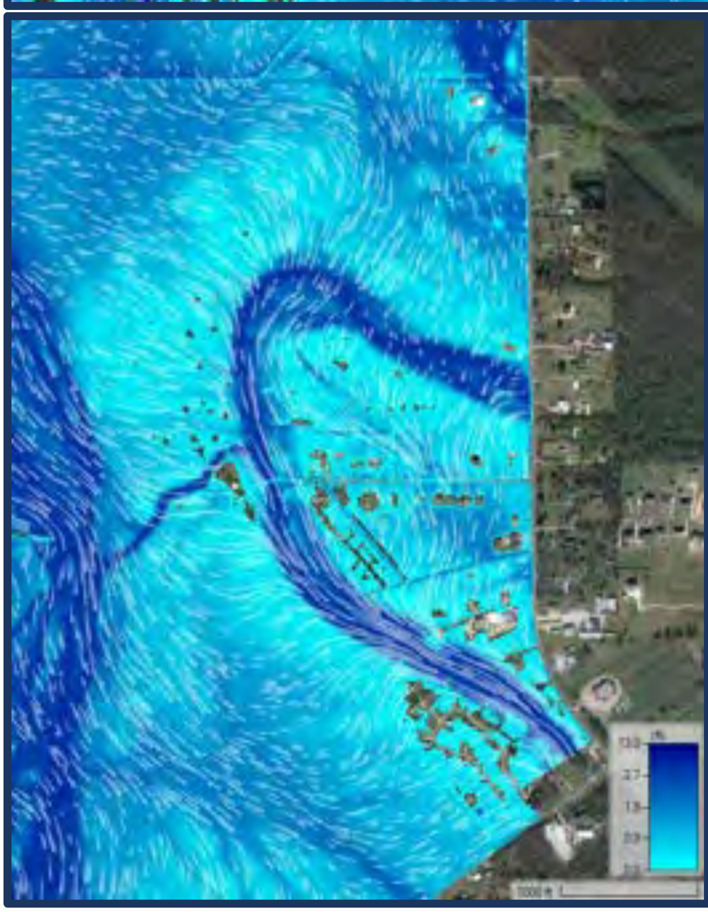
For the pluvial flooding:

- Sloping the roadside ditches to help move water out of the neighborhoods.
- Upsizing undersized or missing culverts on Pleasant Drive, Sunshine Drive, and McKeithen Drive.

For the backwater effect:

- Consider widening bridge opening on Twin Bridges Rd. to the southwest of the area.
- Consider upsizing culverts along McKeithen Drive to the east.





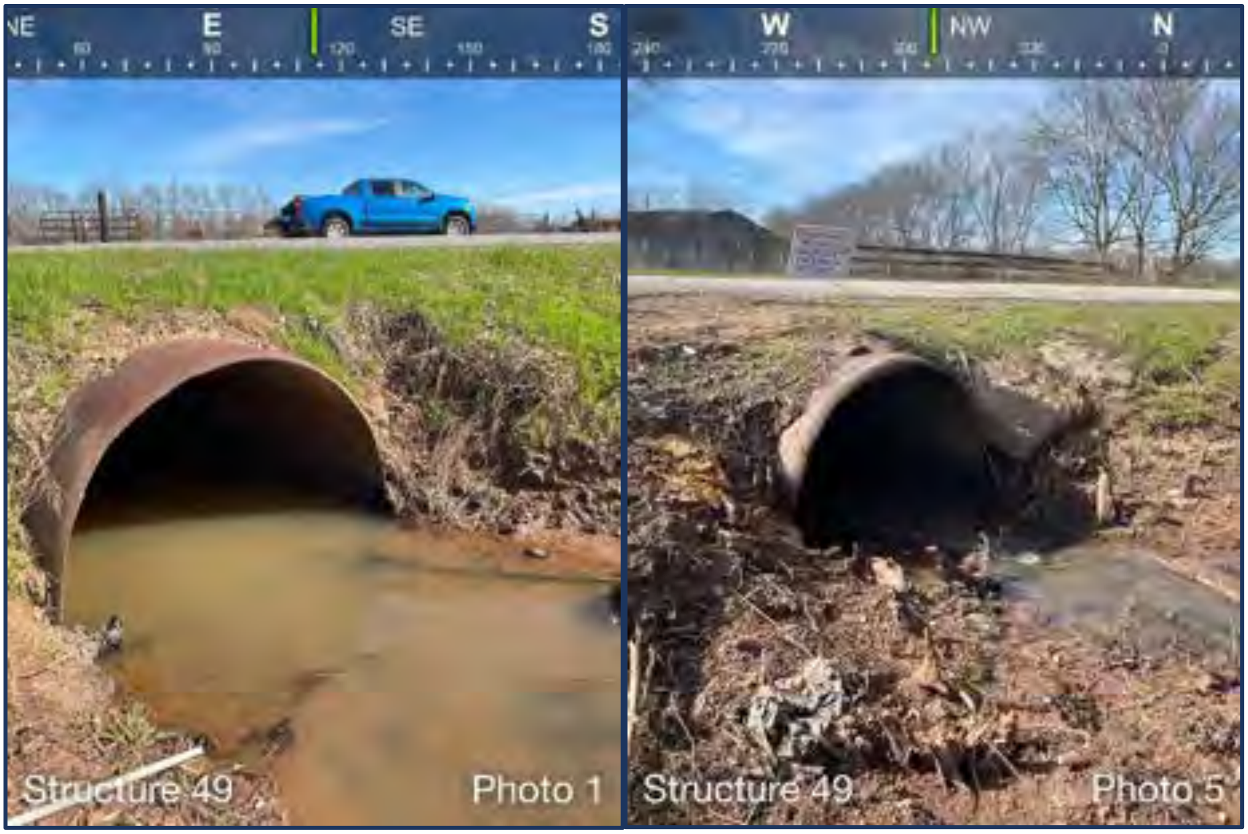
Above show the pluvial flooding of the area with depths and particle tracing to represent flow of the water.

Aerial location of the McKeithen Drive area with culverts and bridges marked for discussion.

Zoomed in view of the bridge on the west end of the Twin Bridges Road.

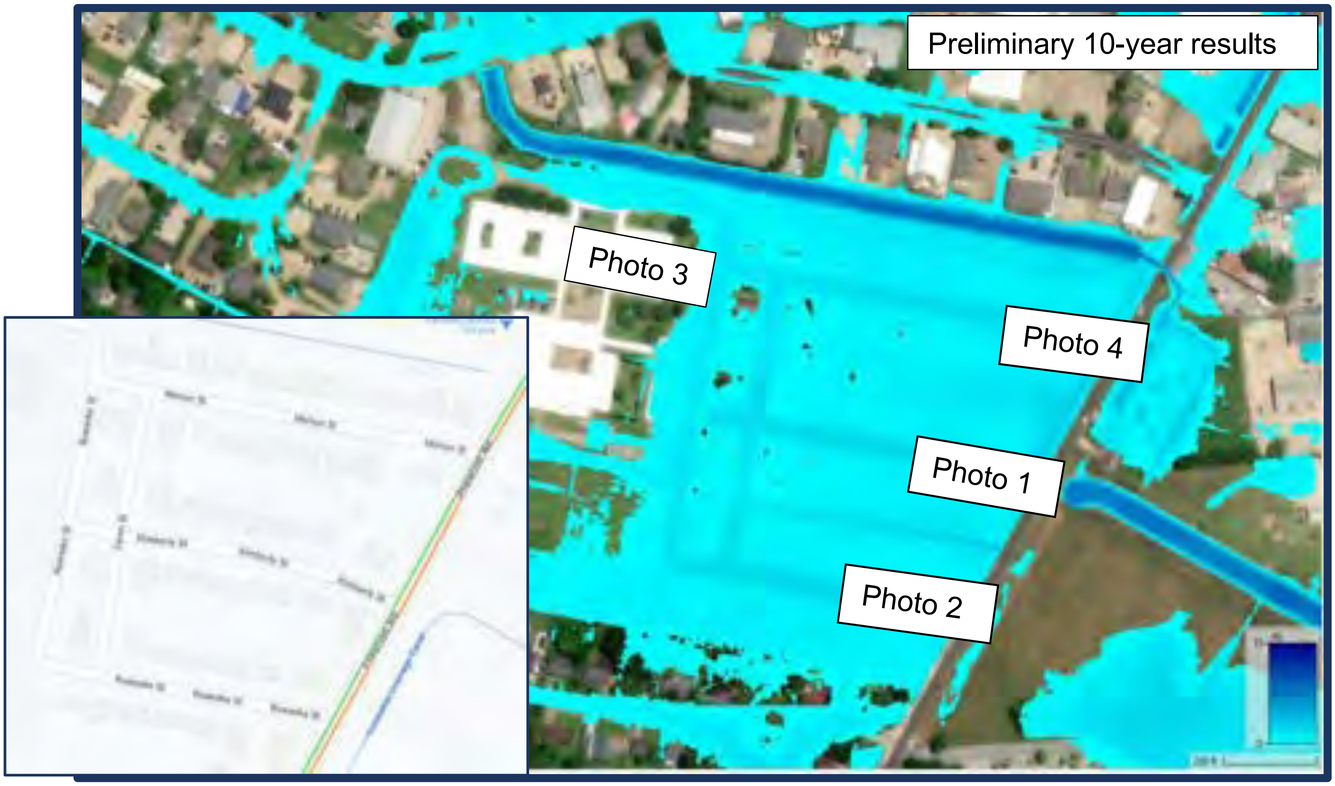
Survey photo of the bridge on the west end of the Twin Bridges Road.

Zoomed in view of the culvert on the east end of the Twin Bridges Road.



Survey photos of the culvert on the east end of the Twin Bridges Road.

sCAMELLIA PLACE



LOCATION

Camellia Place is a subdivision located west of Masonic Circle in Alexandria, Louisiana. It is zoned for moderate-density single-family homes. The neighborhood is adjacent to the Horseshoe Drainage Canal.

PROBLEM

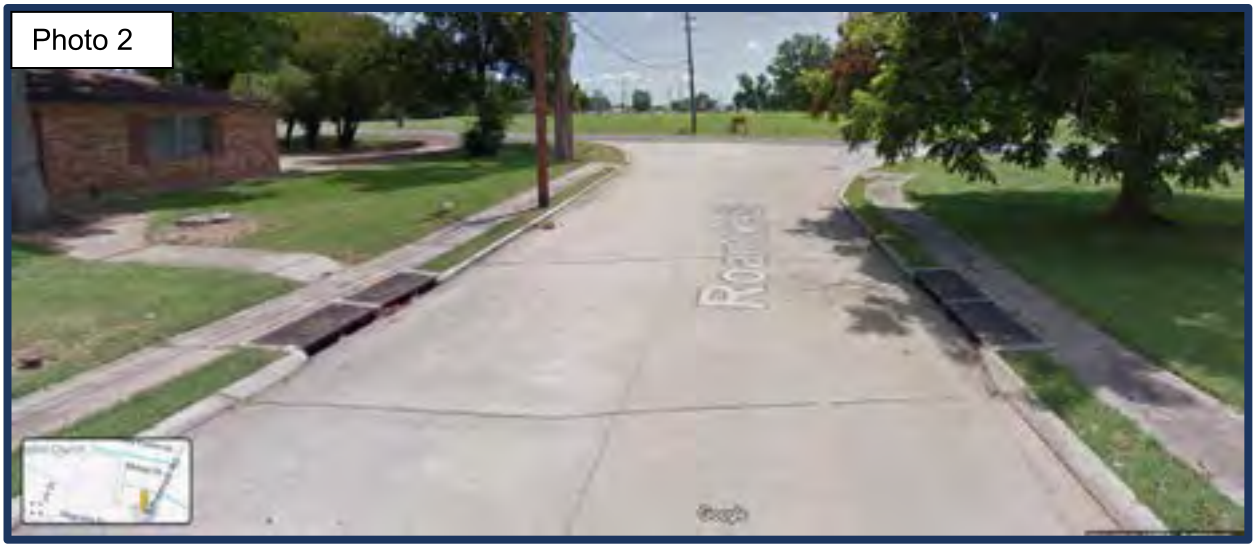
Area is at risk for flooding in a 10-year storm event. The current sag inlets along Mohon, Kimberly, and Roanoke are too small for the area and are in debris-prone areas. Most of the floodwater is overland and is struggling to flow to the sag inlets at the eastern end of each respective street due to the roads' almost-level grades.

Street view of drainage in the area - Kimberly Street.

PROPOSED SOLUTION

Resize and clear debris from the current inlets along Prescott Road and add on-grade inlets on Mohon, Kimberly, and Roanoke Streets. Level of service analysis may indicate a need for storm drain improvements. LWI Horseshoe Canal drainage improvement under Masonic Drive can be included for full risk assessment to understand potential tailwater effects. Detailed risk can be determined through storm drain modeling.

Photo 2



Street view of the roadway drainage in the area - Roanoke Street.

Photo 3

Street view of the roadway drainage in the area – Mohon Street.

Photo 4

Street view of the roadway drainage in the area – Mohon Street.

HORSESHOE DRAINAGE CANAL

LOCATION

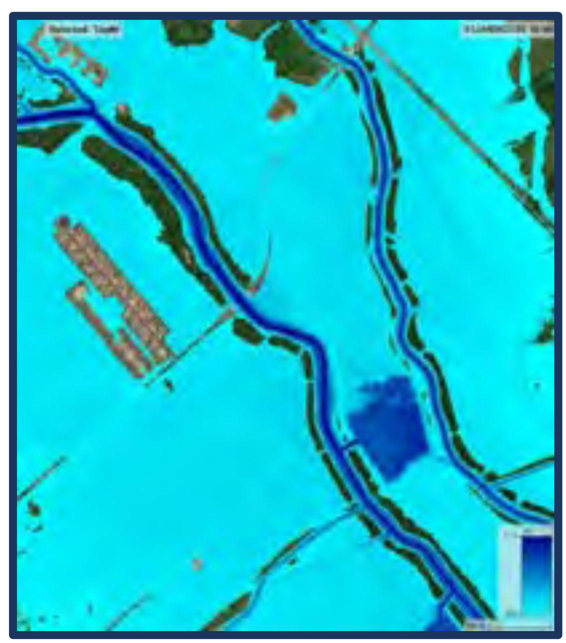
This channel is located east of the Masonic Circle. The specific section of the Horseshoe Channel needing to be transitioned from earthen to hardened channel is between Tulane Avenue and Hudson Boulevard.

PROBLEM

Large amounts of water move quickly through the hardened channel into a natural channel. The change in channel lining slows the flow of water leaving the city and erodes the natural channel.

PROPOSED SOLUTION

- Develop and extend the channel hardening starting at the Tulane Avenue Bridge and down past the Hudson Boulevard Bridge to convey water more quickly and prevent erosion.



Screenshot from model showing approximate 100-year peak depth.

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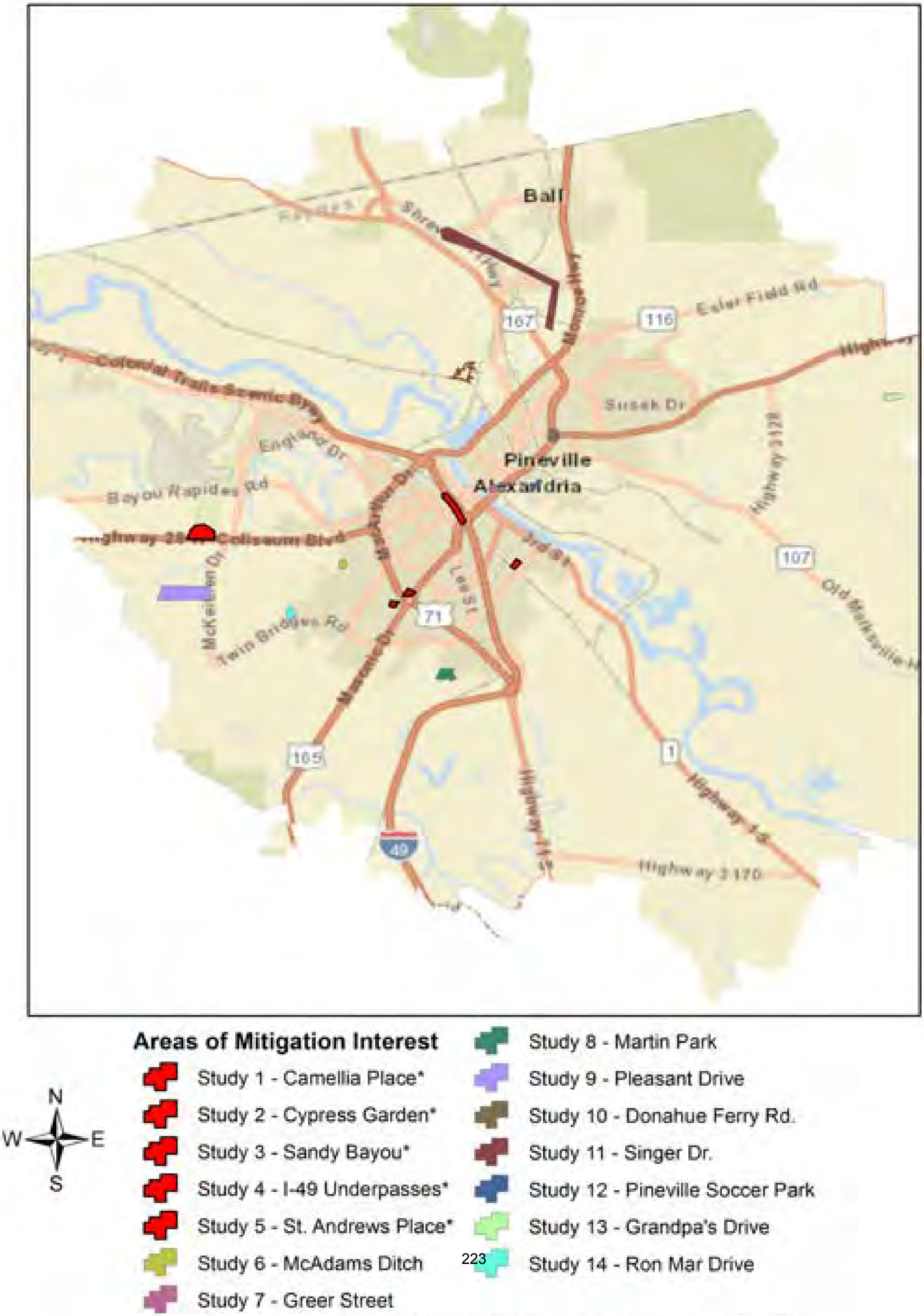
Aerial view of the Horseshoe Drainage Canal into Hynson Bayou.

Northwest street view of the hardened portion of the Horseshoe Drainage Canal from Tulane Avenue.

Southeast street view of the earthen portion of the Horseshoe Drainage Canal from Tulane Avenue.



*Areas in red denote Critical AOMI's with Preliminary Project Summary Reports

Areas of Mitigation Interest

- Study 1 - Camellia Place*
- Study 2 - Cypress Garden*
- Study 3 - Sandy Bayou*
- Study 4 - I-49 Underpasses*
- Study 5 - St. Andrews Place*
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APPENDIX I: MOSAIC FREQUENCIES FOR FULL MPA

APPENDIX J: POTENTIAL GRANT PURSUITS

ALEXANDRIA I-49

Grant Program *Agency*	Deadline	Funding	Description & Eligible Projects
Building Resilient Infrastructure and Communities (BRIC) *FEMA – administered through Governor's Office of Homeland Security & Emergency Preparedness (NOTE: still referred to as Pre-Disaster Mitigation on website)*	Annual Program Anticipated deadline January-February 2025	Award: Varies Cost share is 75% Federal and 25% non-Federal 10% match required for impoverished communities	The Building Resilient Infrastructure and Communities (BRIC) grant program provides proactive investment in resilience for communities so they are better prepared and remain resilient prior to a natural disaster. BRIC provides funds annually for hazard mitigation planning and projects to reduce risk of damage before a disaster. Funding supports capability and capacity building and mitigation projects, as well as management costs. Eligible Activities: • Planning; • Engineering design; • Levees, floodwalls, or related infrastructure; • Local or regional detention and/or retention basins; • Local drainage improvements; • Local channel conveyance improvements • Roadway bridges, culverts, and pipes • Codes, standards, policies • Property buyouts or relocations • Property elevations • Flood-proofing and/or flood retrofits • Flood awareness training and/or education • Flood warning system
Hazard Mitigation Grant Program (HMGP) *FEMA – administered through Governor's Office of Homeland Security & Emergency Preparedness*	Disaster Recovery Funding Determined by disaster declaration	Award: Varies Cost share is 75% Federal and 25% non-Federal	Planning and enforcement including hazard mitigation plans, acquisition of hazard-prone homes and businesses, flood protection (elevating, reconstructing, drainage improvement projects), retrofitting - safe rooms, slope stabilization. Eligible Activities: • Planning • Levees, floodwalls, or related infrastructure • Local or regional detention and/or retention basins • Local drainage improvements • Local channel conveyance improvements • Roadway bridges, culverts and pipes • Codes, standards, policies • Property buyouts or relocations • Flood-proofing and/or flood retrofits • Flood awareness training and/or education • Flood warning system
Clean Water State Revolving Fund *Louisiana Department of Environmental Quality*	Annual Program Annually on May 1	Low-interest loan	The Clean Water State Revolving Fund, authorized by the Clean Water Act, provides low-cost financial assistance for planning, acquisition, design, and construction of wastewater, reuse, and stormwater infrastructure. Wastewater treatment facilities, collection systems, wastewater recycling and reuse, stormwater mitigation, nonpoint source pollution control, estuary management, eligible green project reserve components, and disaster recovery.

Flood Mitigation Assistance (FMA) Grant Program *FEMA – administered through Governor's Office of Homeland Security & Emergency Preparedness*	Annual Program Anticipated deadline February-April 2025	Award: Varies Cost share is 75% Federal and 25% non-Federal 10% match required for repetitive loss properties No match required for severe repetitive loss properties	Provides funding to support sustained natural hazard mitigation activities to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on federal funding from future disaster. Eligible activities: • Planning • Engineering design • Local or regional detention and/or retention basins • Local drainage improvements • Local channel conveyance improvements • Roadway bridges, culverts, and pipes • Property elevations • Flood-proofing and/or flood retrofits • Flood awareness training and/or education
Statewide Flood Control Program *Louisiana Department of Transportation & Development*	Annual Program Pre-application due May 1 annually Application is due October 1 annually	Cost share is a 10% local match based on construction cost	The purpose of this program is to reduce existing flood damage by providing public funds to build flood control infrastructure that reduces flood damage to areas that are experiencing structural damages and agricultural losses. Local project sponsors who represent a population of less than 50,000 may request engineering services from DOTD for participation in the program.
PROTECT (Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation) Program (currently unavailable) *U.S. Department of Transportation*	Annual Program February 24, 2025	Planning grants have a minimum award of $100,000 and do not require cost share. All others have a minimum request of $500,000 and require 80% Federal and 20% non-Federal match	The Bipartisan Infrastructure Law (BIL) established the Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Program to help make surface transportation more resilient to natural hazards, including climate change, sea level rise, flooding, extreme weather events, and other natural disasters through the support of planning activities, resilience improvements, community resilience and evacuation routes, and at-risk coastal infrastructure. **Note**: *This program would work for the planning of drainage issues relating to transportation facilities and infrastructure.*
Community Development Block Grant - Disaster Recovery (CDBG-DR) *HUD – administered through Louisiana Division of Administration*	Disaster Recovery Funding Determined by disaster declaration	Award: Varies Cost share varies but 75% Federal and 25% non-Federal is typical	In response to presidentially declared disaster, CDBG-DR grants work to rebuild affected areas and provide crucial seed money to start the recovery process, with a large emphasis on low-to-moderate income areas. Eligible activities: • Planning • Engineering design • Local or regional detention and/or retention basins • Local drainage improvements • Local channel conveyance improvements • Roadway bridges, culverts, and pipes • Property buyouts or relocations • Property elevations • Flood-proofing and/or flood retrofits • Flood awareness training and/or education
Community Development Block	Mitigation Funding	Award: Varies	The Community Development Block Grant Mitigation (CDBG-MIT) Program funds a unique opportunity for eligible grantees to use this assistance in areas impacted by recent disasters to carry out

Grant - Mitigation (CDBG-MIT) *HUD – administered through Louisiana Office of Community Development*	Determined by disaster declaration	Cost share varies but 75% Federal and 25% non-Federal is typical	strategic and high-impact activities to mitigate disaster risks and reduce future losses. Eligible activities: • Planning • Engineering design • Levees, floodwalls, or related infrastructure • Local or regional detention and/or retention basins • Local drainage improvements • Local channel conveyance improvements • Roadway bridges, culverts and pipes • Codes, standards, policies • Property buyouts or relocations • Property elevations • Flood-proofing and/or flood retrofits • Flood awareness training and/or education • Flood warning system
Local and Regional Projects Louisiana Watershed Initiative - *Funded as part of the CDBG-MIT*	Round 3: Jan 2025 pre-applications	$15 million	This program provides funding and technical support to local and regional agencies to implement projects that reduce flood risk and enhance community resilience. • Restoration, enhancement or preservation of floodplains and wetlands • Flood mitigation of critical infrastructure and stormwater management projects • Buyout or elevation projects for flood-prone residential areas • Voluntary relocation projects to move residents out of high flood risk areas • Acquisition of floodplain easements in flood abatement areas or developments in repetitive loss areas • Major capital projects that improve flood resilience or provide regional stormwater detention • Implementation of resilient development standards and floodplain management regulations • Housing developments using resilient construction practices • Projects developed through LWI's watershed modeling, statewide planning, and regional planning efforts

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<table>
<tr><th>Grant Program
Agency</th><th>Deadline</th><th>Funding</th><th>Description & Eligible Projects</th></tr>
<tr><td>Building Resilient Infrastructure and Communities (BRIC)
FEMA – administered through Governor's Office of Homeland Security & Emergency Preparedness (NOTE: still referred to as Pre-Disaster Mitigation on website)</td><td>Annual Program

Anticipated deadline January-February 2025</td><td>Award: Varies

Cost share is 75% Federal and 25% non-Federal

10% match required for impoverished communities</td><td>The Building Resilient Infrastructure and Communities (BRIC) grant program provides proactive investment in resilience for communities so they are better prepared and remain resilient prior to a natural disaster. BRIC provides funds annually for hazard mitigation planning and projects to reduce risk of damage before a disaster.

Funding supports capability and capacity building and mitigation projects, as well as management costs.

Eligible Activities:
• Planning;
• Engineering design;
• Levees, floodwalls, or related infrastructure;
• Local or regional detention and/or retention basins;
• Local drainage improvements;
• Local channel conveyance improvements
• Roadway bridges, culverts, and pipes
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• Flood awareness training and/or education
• Flood warning system</td></tr>
<tr><td>Hazard Mitigation Grant Program (HMGP)
FEMA – administered through Governor's Office of Homeland Security & Emergency Preparedness</td><td>Disaster Recovery Funding

Determined by disaster declaration</td><td>Award: Varies

Cost share is 75% Federal and 25% non-Federal</td><td>Planning and enforcement including hazard mitigation plans, acquisition of hazard-prone homes and businesses, flood protection (elevating, reconstructing, drainage improvement projects), retrofitting - safe rooms, slope stabilization.

Eligible Activities:
• Planning
• Levees, floodwalls, or related infrastructure
• Local or regional detention and/or retention basins
• Local drainage improvements
• Local channel conveyance improvements
• Roadway bridges, culverts and pipes
• Codes, standards, policies
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• Flood warning system</td></tr>
<tr><td>Clean Water State Revolving Fund
Louisiana Department of Environmental Quality</td><td>Annual Program

Annually on May 1</td><td>Low-interest loan</td><td>The Clean Water State Revolving Fund, authorized by the Clean Water Act, provides low-cost financial assistance for planning, acquisition, design, and construction of wastewater, reuse, and stormwater infrastructure. Wastewater treatment facilities, collection systems, wastewater recycling and reuse, stormwater mitigation, nonpoint source pollution control, estuary management, eligible green project reserve components, and disaster recovery.</td></tr>
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Grant Program *Agency*	Deadline	Funding	Description & Eligible Projects
Flood Mitigation Assistance (FMA) Grant Program *FEMA – administered through Governor's Office of Homeland Security & Emergency Preparedness*	Annual Program Anticipated deadline February-April 2025	Award: Varies Cost share is 75% Federal and 25% non-Federal 10% match required for repetitive loss properties No match required for severe repetitive loss properties	Provides funding to support sustained natural hazard mitigation activities to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on federal funding from future disaster. Eligible activities: • Planning • Engineering design • Local or regional detention and/or retention basins • Local drainage improvements • Local channel conveyance improvements • Roadway bridges, culverts, and pipes • Property elevations • Flood-proofing and/or flood retrofits • Flood awareness training and/or education
Statewide Flood Control Program *Louisiana Department of Transportation & Development*	Annual Program Pre-application due May 1 annually Application is due October 1 annually	Cost share is a 10% local match based on construction cost	The purpose of this program is to reduce existing flood damage by providing public funds to build flood control infrastructure that reduces flood damage to areas that are experiencing structural damages and agricultural losses. Local project sponsors who represent a population of less than 50,000 may request engineering services from DOTD for participation in the program.
PROTECT (Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation) Program *U.S. Department of Transportation*	Annual Program February 24, 2025	Planning grants have a minimum award of $100,000 and do not require cost share. All others have a minimum request of $500,000 and require 80% Federal and 20% non-Federal match	The Bipartisan Infrastructure Law (BIL) established the Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Program to help make surface transportation more resilient to natural hazards, including climate change, sea level rise, flooding, extreme weather events, and other natural disasters through the support of planning activities, resilience improvements, community resilience and evacuation routes, and at-risk coastal infrastructure. **Note**: *This program would work for the flood mitigation relating to transportation facilities and infrastructure.*
Community Development Block Grant - Disaster Recovery (CDBG-DR) *HUD – administered through Louisiana Division of Administration*	Disaster Recovery Funding Determined by disaster declaration	Award: Varies Cost share varies but 75% Federal and 25% non-Federal is typical	In response to presidentially declared disaster, CDBG-DR grants work to rebuild affected areas and provide crucial seed money to start the recovery process, with a large emphasis on low-to-moderate income areas. Eligible activities: • Planning • Engineering design • Local or regional detention and/or retention basins • Local drainage improvements • Local channel conveyance improvements • Roadway bridges, culverts, and pipes • Property buyouts or relocations • Property elevations • Flood-proofing and/or flood retrofits • Flood awareness training and/or education

Grant Program *Agency*	Deadline	Funding	Description & Eligible Projects
Community Development Block Grant - Mitigation (CDBG-MIT) *HUD – administered through Louisiana Office of Community Development*	Disaster Recovery Funding Determined by disaster declaration	Award: Varies Cost share varies but 75% Federal and 25% non-Federal is typical	The Community Development Block Grant Mitigation (CDBG-MIT) Program funds a unique opportunity for eligible grantees to use this assistance in areas impacted by recent disasters to carry out strategic and high-impact activities to mitigate disaster risks and reduce future losses. Eligible activities: • Planning • Engineering design • Levees, floodwalls, or related infrastructure • Local or regional detention and/or retention basins • Local drainage improvements • Local channel conveyance improvements • Roadway bridges, culverts and pipes • Codes, standards, policies • Property buyouts or relocations • Property elevations • Flood-proofing and/or flood retrofits • Flood awareness training and/or education • Flood warning system
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Hazard Mitigation Grant Program (HMGP) *FEMA – administered through Governor's Office of Homeland Security & Emergency Preparedness*	Disaster Recovery Funding Determined by disaster declaration	Award: Varies Cost share is 75% Federal and 25% non-Federal	Planning and enforcement including hazard mitigation plans, acquisition of hazard-prone homes and businesses, flood protection (elevating, reconstructing, drainage improvement projects), retrofitting - safe rooms, slope stabilization. Eligible Activities: • Planning • Levees, floodwalls, or related infrastructure • Local or regional detention and/or retention basins • Local drainage improvements • Local channel conveyance improvements • Roadway bridges, culverts and pipes • Codes, standards, policies • Property buyouts or relocations • Flood-proofing and/or flood retrofits • Flood awareness training and/or education • Flood warning system
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HUD – administered through Louisiana Office of Community Development	Determined by disaster declaration	and 25% non-Federal is typical	strategic and high-impact activities to mitigate disaster risks and reduce future losses. Eligible activities: • Planning • Engineering design • Levees, floodwalls, or related infrastructure • Local or regional detention and/or retention basins • Local drainage improvements • Local channel conveyance improvements • Roadway bridges, culverts and pipes • Codes, standards, policies • Property buyouts or relocations • Property elevations • Flood-proofing and/or flood retrofits • Flood awareness training and/or education • Flood warning system
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APPENDIX K: ADDITIONAL RESOURCES

THE RRABB LEVEE DISTRICT BOUNDARY

[BOUNDARY MAP | RRABB]

[HOME | RRABB]

APPENDIX L: ACRONYMS AND DEFINITIONS

Acronyms and Definitions

The following list of acronyms and definitions is for frequently and generally used terms in the RAPC Transportation Resiliency Through Storm Water Mitigation in A/P MPO UZA study reports. Not every term listed is used in this report.

BFE – Base Flood Elevation: FEMA term for the elevation that defines the level of flooding resulting from the one percent chance (100-year flood) storm event.

CFS – Cubic Feet per Second: Rate of flow.

Channel: Any river, stream, creek, brook, branch, natural or artificial depression, ponded area, lake, flowage, slough, ditch, conduit, culvert, gully, ravine, swale, wash, or natural or man-made drainageway, in or into which surface or groundwater flows, either perennially or intermittently.

CRS – Community Rating System: A voluntary incentive program that recognizes and encourages community floodplain management practices that exceed the minimum requirements of the National Flood Insurance Program (NFIP).

Critical Facility: A facility that is critical to the community's public health and safety, is essential to the orderly functioning of a community, stores or produces highly volatile, toxic or water-reactive materials, or houses occupants that may be insufficiently mobile to avoid loss of life or injury. Examples of critical facilities include jails, hospitals, schools, fire stations, nursing homes, wastewater treatment facilities, water plants, and gas/oil/propane storage facilities.

CN - Curve Number: Empirical parameter used in hydrology for predicting direct runoff from rainfall.

Design Storm: A selected storm event, described in terms of the probability of occurring once within a given number of years, for which stormwater or flood control improvements are designed and built.

Detention Facility: A man-made structure for the temporary storage of stormwater runoff with controlled release during or immediately following a storm.

Drainage Area: The land area upstream of a given point that contributes stormwater to that point.

FEMA: Federal Emergency Management Agency and its regulations promulgated at 44 C.F.R. 59-79 effective as of October 1, 1986.

Flood Frequency: A period of years, based on a statistical analysis, during which a flood of a stated magnitude may be expected to be equaled or exceeded.

GIS - Geographic Information Systems: System designed to capture, store, manipulate, analyze, manage, and present spatial or geographic data.

GPS - Global Positioning System: Navigation system to determine exact location.

HEC-HMS – Hydrologic Engineering Center – Hydrologic Modeling System: Software from the US Army Corps of Engineers designed to simulate the complete hydrologic processes of watershed systems.

HSG - Hydrologic Soil Group: An indicator of infiltration that is predetermined for each soil type. HSG is organized into 4 groups (A, B, C, and D). The letter A indicates rapid infiltration, and the letter D indicates that rainwater generally runs off the surface.

LF - Linear Feet: Length measurement.

LID - Low Impact Development: Managing stormwater for less impact on the natural environment.

LiDAR - Light Detection and Ranging: Remote sensing method used to digitally examine the surface of the earth.

Mitigation: Measures taken to minimize flood risk and damage from stormwater overflows.

NRCS - Natural Resources Conservation Service: Federal agency that provides technical assistance to farmers, private landowners and managers for the environment (formerly known as the Soil Conservation Service or SCS).

Overflow: Excessive stormwater in the street because of underground stormwater systems that cannot accommodate design flood event flows.

Ponding: Ponding is when stormwater pools/accumulates in a low area.

RAPC - Rapides Area Planning Commission: A regional organization providing land use planning, development review, technical assistance, geographical information, and other planning and enforcement services.

RCBC - Reinforced Concrete Box Culvert: Rectangular or square shaped concrete conduit used to convey or store water.

RCP - Reinforced Concrete Pipe: Circular shaped concrete conduit used to convey or store water.

Record Drawings: Upon completion of the land disturbance, a professional engineer licensed in the State of Louisiana or land surveyor shall certify construction drawings as to actual construction, documented in a set of record drawings.

Rain on Grid: Modeling that combines hydrologic and hydraulic modeling by applying rainfall directly to a 2D mesh.

ROW - Right-Of-Way: Publicly owned land for transportation, drainage, and/or utility use.

Runoff: Stormwater generated from rainfall that flows over the ground surface.

SCS - Soil Conservation Service: See NRCS.

Spill: Stormwater runoff that flows from one system into another area that was not intended to receive the flow.

SSURGO - Soil Survey Geographic Database: Digital soil data produced and distributed by NRCS.

Stormwater System: Combination of features that convey stormwater (pipe, box culvert, open channel, inlets, outfall, manholes, etc.).

Storm Drainage System: See stormwater system.

Structures Flooded: Structures where the flood level is higher than the lowest floor elevation of the structure.

Structures Potentially Flooded: Structures where the lowest floor elevation is less than 0.5 feet above a specified flood level, usually that of the 100-year flood.

Swale: A vegetated channel, ditch, or low-lying or depressional tract of land that is periodically inundated by conveying stormwater from one point to another.

TC - Time of Concentration: The longest time required for a drop of water falling at the upper limit of a drainage area to travel to the point under consideration.

TIN - Triangular Irregular Network: Digital data structure used in GIS for the representation of a land surface.

TR-55 - Technical Release 55 (Urban Hydrology for Small Watersheds): An NRCS publication that presents simplified procedures to calculate storm runoff volume, peak rate of discharge, hydrographs, and storage volumes required for floodwater reservoirs.

USDA - United States Department of Agriculture: Federal organization that manages programs related to food, agriculture, natural resources, rural development, and nutrition.

WSEL - Water Surface Elevation: Water's elevation on top of the terrain elevation, giving a total elevation.

100-year Storm Event: Refers to rainfall or flood event that has one percent (1%) probability of occurring in any given year.

HUC-8: A Hydrologic Unit Code (HUC) is part of a hierarchical system that divides the country into nested drainage areas — from the largest river basins down to small sub-watersheds – HUC 8 represents medium-sized watersheds draining into a major river or basin

DEM: A digital, 3D representation of the Earth's surface that shows ground elevation (height above sea level) at regularly spaced points, essential in hydrology, stormwater modeling, transportation planning, and flood risk analysis because they illustrate how water flows across the landscape.

HEC-RAS: Hydrologic Engineering Center – River Analysis System, a powerful software tool developed and maintained by the U.S. Army Corps of Engineers (USACE) for modeling the movement of water through natural rivers, streams, and engineered drainage systems.

Mesh Boundaries: Defined boundaries of the simulation area and control how the model divides the land surface into a grid (or mesh) of smaller computational cells. These cells are where the software calculates water flow, depth, and velocity during a storm or flood event.

NOAA Atlas 14: A comprehensive, nationwide dataset developed by the National Oceanic and Atmospheric Administration (NOAA)that provides precipitation frequency estimates — commonly known as design rainfall depths and intensities — used in flood modeling, stormwater design, and infrastructure planning.

HEC-HMS: Stands for Hydrologic Engineering Center – Hydrologic Modeling System, a software application developed by the U.S. Army Corps of Engineers (USACE) to simulate how rainfall becomes runoff and flows through a watershed.

FEMA Flood Zones: Geographic areas defined by the Federal Emergency Management Agency (FEMA) that indicate the level of flood risk for a particular location based on statistical analysis of storm events and historical flooding.

Zone	Risk Level	Annual Chance of Flooding	Description & Use
Zone A	High	≥ 1% (100-year flood)	Areas with a 1% annual chance of flooding. No base flood elevations (BFEs) determined. Common in rural areas.
Zone AE	High	≥ 1%	Similar to Zone A but with BFEs established. Most common in detailed flood studies.
Zone AH	High	≥ 1%	Areas with shallow flooding (ponding) typically 1–3 feet deep. BFEs provided.
Zone X (Shaded)	Moderate	0.2% – 1% (500-year flood)	Areas between the 100-year and 500-year flood limits. Flood risk exists but is lower.

APPENDIX M:

COMMUNITY FLOOD SURVEY TOOL

APPENDIX M:

Welcome:
Welcome to the RAPC Community Flooding Survey!

Thanks for taking the time to fill out this survey regarding the impact of floods on homes, businesses, and property in the Alexandria-Pineville metropolitan planning area. Your response will help determine strategies and recommendations for addressing flooding problems in the watershed.

If you have any questions or problems with the site, you can send a message to the RAPC project team by calling 318-487-5401, ext.12 or emailing jbolen@rapc.info.

Numbered steps shown along the top right of the page guide you through the survey process. Your response is greatly appreciated. **Addresses will be kept confidential.**

Instructions:
Step 1. Scroll / zoom to your address (residential or business) or by using the search bar.
Step 2. Select “POINTS”
Step 3. Choose property type and then place on map
Step 4. Complete questions, add a photo of flooding if you like, click submit

1. What type of property is this?
Property Types:
- Residential, lot smaller than 5 acres
- Residential, lot larger than 5 acres
- Business / Commercial
- Agricultural
- Industrial
- Civic / Institutional / Non-profit

2. Has this property been flooded in the last 10 years?
- Yes (If YES, please specify extend and number of times)

	Number of times flooded over the last 10 years				
Extent/Type of Flood Damage	1-3	4-6	7-9	10 - 49 (1-4.9/year)	50 or more (at least 5/ year)
Yard/Open green space was flooded, with little/no damage					
Yard/Green space was flooded, with damage to lawn, trees, and shrubs					
Crops were damaged					
Fences, auxiliary buildings (sheds, etc.), or other structures were damaged					
Primary home/business was damaged					

- No (If NO, skip to Question #6)

3. What was the cause of the flooding that affected this property? *(Select all that apply)*
- Heavy rainstorm
- Flooding from nearby river, stream, lake, ditch, or pond
- Obstruction in nearby river, stream, lake, ditch, or pond
- Pipe (not sewer), culvert, or ditch that was blocked or needs maintenance.
- Lack of drainage facilities (swales, ditches, storm sewers, etc.) to drain water from the property
- Sewer backup
- I don't know
- Other, (please explain)

4. Did you report flooding to anyone? *(Select all that apply)*
- My local or parish government
- My insurance company
- I did not report my flooding to anyone
- Other, (please explain)

5. How have you been affected by flooding on this property? *(Select all that apply)*
- Monetary loss due to repair of flood damage
- Monetary loss due to lost valuables or equipment
- Partial loss of access to property
- Lost business income (business closed, lost productivity)
- Loss of crops
- No significant effect

6. Have any of your nearby neighbors experienced flooding at their home, business, or property in the last 10 years? *(Choose one)*
NOTE: If you have neighbors who experienced flooding, please let them know about this survey.
- YES. One or two neighboring properties.
- YES. Three to five neighboring properties.
- YES. Six or more neighboring properties.
- NO. I don't know of any neighbors who have experienced flooding on their home or property. (If NO, Skip to question 8)

7. If you answered YES above, what was the severity of your neighbors' flooding? *(Choose one)*
- Less severe than my flooding problems.
- Similarly severe to my flooding problems.
- More severe than my flooding problems.
- I don't know the severity of my neighbors' flooding.

8. Is the property at this address covered by a flood insurance policy?
NOTE: Flood insurance is typically not included in a standard home insurance policy.
- Yes
- No
- I don't know

9. Have you ever made a flood insurance claim?
- Yes
- No
- I don't know

APPENDIX M:

10. Have you made any improvements to your property to help reduce stormwater or flood impacts? *(Select all that apply)*

- Installed a rain garden.
- Created or enlarged a pond, detention/retention basin, ditch, or swale.
- Raised one or more buildings.
- Created a levee around the property.
- Installed permeable paving.
- Planted native vegetation, buffer strips, or other conservation measures.

APPENDIX N:

SMALL COMMUNITY & RURAL PARISH FLOOD MITIGATION TOOLKIT

APPENDIX N:

Small Community & Rural Parish Flood Mitigation Toolkit

Flooding remains one of the most disruptive natural hazards facing local transportation networks—especially in small towns and rural communities with aging infrastructure or limited resources. This toolkit empowers under-resourced municipalities to participate in data-driven mitigation and leverage available state and federal funding for infrastructure improvements.

To support effective mitigation planning, this toolkit outlines a set of adaptable, cost-conscious best practices to enhance local stormwater management for transportation resilience. The primary goals of the toolkit are to:

- Identify flood-prone areas and transportation vulnerabilities
- Provide low-cost, scalable solutions for managing stormwater
- Support long-term planning with funding, mapping, and maintenance tools
- Foster interagency coordination and community engagement

Key Components:

Assessment and Planning
Local jurisdictions are encouraged to begin with a flood vulnerability assessment using FEMA flood maps, Severe Repetitive Loss (SRL) data, and local incident records. An inventory of existing stormwater assets (culverts, ditches, inlets) should be created and maintained. Overlaying flood zones with transportation corridors helps prioritize high-risk areas such as:

- School bus routes
- Emergency response access roads
- Economic connectors (e.g., routes to markets or freight facilities)

Action Steps:
STEP 1 **Conduct Flood Vulnerability Assessment**
Overlay known flood zones with critical roads, schools, hospitals, etc. Use Tools:

  - FEMA Flood Insurance Rate Maps (FIRMs)
  - Repetitive Loss / Severe Repetitive Loss (RL/SRL) datasets
  - Local knowledge: history of flooded intersections or washouts

STEP 2 **Prioritize Hotspot Areas**
Rank based on:

  - Frequency of flooding
  - Impact on emergency access or school transport
  - Economic disruption (e.g., blocked commerce routes)

APPENDIX N:

<u>STEP 3</u> **Create a Stormwater Infrastructure Inventory**
Use the inventory to identify capacity limitations or clogged assets. Include:

- Culverts (size, material, condition)
- Ditches and swales
- Outfalls and inlets
- Maintenance logs

Design and Engineering Strategies
The toolkit promotes a combination of green infrastructure and conventional engineering methods that are adaptable and scalable depending on road classification and available funding:

Green Infrastructure:
- Rain Gardens: Capture runoff in residential or park zones
- Bioswales: Treat and slow runoff along roadways
- Permeable Pavements: Allow infiltration in parking areas or low-traffic roads
- Cost-effective and visually appealing for small communities.

GREEN INFRASTRUCTURE OPTIONS

Practice	Where to Use	Benefits
Rain gardens	Near intersections or parks	Filters runoff, adds green space
Bioswales	Along collector streets	Slows & filters stormwater
Permeable pavement	Low-volume roads, parking areas	Reduces runoff volume

Conventional Solutions:
- Upsizing or replacing undersized culverts
- Road elevation or shoulder grading for segments prone to overtopping
- Ditch re-profiling, regrade and stabilization for better slope and flow

Funding and Partnerships
Collaboration with regional MPOs or local universities can enhance technical capacity, especially for mapping or hydrologic modeling. Partner with regional MPOs or councils of governments for technical assistance. Partner with local universities for student capstone projects and engage for mapping, modeling, and low-cost design prototypes.

FEDERAL & STATE FUNDING FOR TRANSPORTATION STORMWATER IMPROVEMENTS

Program	Use Case
FEMA BRIC / HMGP	Infrastructure resilience and buyouts
DOT RAISE or PROTECT grants	Rural road elevation or drainage upgrades
EPA CWSRF (State Revolving Fund)	Stormwater retrofits and treatment systems

APPENDIX N:

Maintenance and Operations
A proactive maintenance approach is critical. The toolkit includes a suggested Stormwater Maintenance Schedule, illustrated in Table 6.

Small crews can dramatically reduce flood risk with proactive checks. Local training and laminated field checklists can assist small public works teams in carrying out these tasks efficiently.

- Create laminated inspection cards
- Provide basic training on BMPs and how to spot erosion signs
- Document inspections for liability protection

SUGGESTED STORMWATER MAINTENANCE SCHEDULE

Frequency	Activity
Monthly	Check inlets, clear debris
Quarterly	Inspect ditches and culvert joints
After Storms	Check for washouts, clogged grates, backups, and erosion.

Public Engagement and Emergency Readiness
Residents play a vital role in maintaining roadside infrastructure. Suggested community outreach includes:

- “Adopt-a-Drain” cleanup/volunteer programs
- Awareness / Educational signage in flood-prone areas
- Storm prep flyers for residents

Emergency coordination should include flood detour routes and communication protocols with first responders and schools. Suggested emergency coordination includes:

- SMS alerts or social media updates for road closures
- Create detour maps for flooded roads
- Coordinate with schools and first responders

Toolkit Deliverables (Optional to Create)

The toolkit includes formats for the following:
- ArcGIS/QGIS base maps with flood overlays and asset inventories
- Standard Operating Procedures (SOPs) for stormwater inspections
- Public education flyers and signs
- Culvert inventory templates (Excel or app-based)
- Flood Vulnerability Map (RL/SRL overlays + critical roads)

APPENDIX N:

EXAMPLE STORMWATER PILOT PROJECTS

Location	Project Type	Estimated Cost	Example Use
School zone	Rain Garden at School & Signage	$5,000–$10,000	Detains and filters runoff
Rural road	Culvert upsizing & guardrails	$25,000–$75,000	Eliminates overtopping at low points
Main Street park	Permeable Parking Lot with Bioswales	$20,000–$60,000	Enhances downtown or trailhead areas

Recommendations

This toolkit offers small communities a practical roadmap to identify, prioritize, and address stormwater flooding challenges that impact transportation infrastructure. By blending traditional methods with innovative green practices—and leveraging available funding—localities can build more resilient, functional, and sustainable road systems.

- Distribute toolkit to local agencies and public works teams
- Encourage interagency coordination and data sharing
- Engage universities for mapping/modeling support through capstone projects

APPENDIX O:

COMMUNITY STORMWATER ACTION PLAN

APPENDIX O:

Purpose

Community Stormwater Action Plans (CSAPs) are strategic frameworks developed by local governments, environmental agencies, or community coalitions to address stormwater management comprehensively. While large urban areas often receive more attention, stormwater maintenance is equally, if not more, critical for small towns and rural communities.

TABLE 1: PURPOSE OF COMMUNITY STORMWATER ACTION PLANS

Mitigate Flooding Risks	Stormwater, if unmanaged, can cause flooding that damages infrastructure, homes, and ecosystems. CSAPs identify vulnerable areas and prioritize interventions.
Improve Water Quality	Runoff carries pollutants like oil, pesticides, sediments, and heavy metals into local waterways. Action plans aim to reduce this through best practices in stormwater treatment and filtration.
Ensure Regulatory Compliance	Many regions, including under U.S. EPA's Clean Water Act, require municipalities to meet certain stormwater management standards. A CSAP helps organize efforts to remain compliant with federal and state mandates.
Support Sustainable Development	By planning for green infrastructure (like bioswales, rain gardens, permeable pavement), communities can manage runoff in ways that also beautify neighborhoods and provide co-benefits like cooling urban heat.
Enhance Community Resilience	Climate change is increasing the frequency and intensity of rainfall events. CSAPs help towns prepare for these risks in a structured and proactive manner.

TABLE 2: BENEFITS OF COMMUNITY STORMWATER ACTION PLANS

Protecting Local Infrastructure	Unmaintained ditches, culverts, and drainage systems can lead to road washouts, culvert failures, and costly emergency repairs. Regular maintenance extends the life of infrastructure and saves money long-term.
Preventing Property Damage	Rural flooding can damage homes, farmland, and businesses. Maintaining stormwater systems reduces the risk of flooding and protects property values.
Safeguarding Public Health	Stormwater can carry contaminants into drinking water supplies. Rural areas with private wells or small utilities are particularly vulnerable. Maintenance prevents contamination and protects public health.
Economic Stability	Agricultural economies depend on stable land and water conditions. Erosion and sedimentation caused by unmanaged stormwater can reduce land productivity and clog irrigation or drainage systems.
Avoiding Legal and Regulatory Fines	Even smaller jurisdictions are subject to environmental regulations. Poor stormwater control can result in penalties or grant disqualifications from agencies like FEMA or the EPA.
Supporting Emergency Preparedness	In areas prone to hurricanes or flash floods, functional stormwater systems are essential for emergency response. Proactive maintenance reduces recovery time and supports disaster resilience.

APPENDIX O:

Strategic Value of Investing in CSAPs and Maintenance

Small towns and rural parishes often operate with limited budgets, so **investing wisely** in stormwater planning and maintenance provides:

- **Access to Grants & Technical Assistance**: Many state and federal programs favor jurisdictions with documented action plans. [12]
- **Community Engagement**: Developing a CSAP involves public input, which raises awareness and can spark volunteer maintenance programs or funding initiatives. [13, 14]
- **Partnership Opportunities**: Regional collaboration can amplify resources and support through watershed coalitions or parish partnerships. [15]

Community Stormwater Action Plan Development

This section outlines a recommended local action planning steps that small towns and rural parishes—particularly within Rapides Parish and the MPA—can take to address flood hotspots, based on FEMA, EPA, and MPA Stormwater Study guidance.

TABLE 3: COMMUNITY STORMWATER ACTION PLANNING STEPS

STEP 1. Conduct Site-Specific Drainage Assessments	STEP 2. Implement Targeted Infrastructure Upgrades
Why: Understanding micro-level drainage behavior is key to effective mitigation.	**Why**: Many floods are caused by undersized or blocked culverts.
Actions: • Perform field inspections of culverts, ditches, and outfalls near known flood hotspots. • Use H&H modeling to assess system capacity under different rainfall scenarios. • Prioritize areas with Severe Repetitive Loss (SRL) properties for study.	Actions: • Upsize culverts and storm drains near flood-prone roads and intersections. • Elevate road segments in low-lying areas (especially emergency routes and school bus paths). • Regrade roadside ditches and shoulders to improve flow.
Tools: Use flood overlays and inventory data (like SRL points) from your GIS system to identify priority areas.	*Strategy*: Use project typologies from the RAPC database (culvert replacement, road elevation, etc.) to inform capital planning.

APPENDIX O:

STEP 3. Apply Nature-Based Solutions (OPTIONAL)	**STEP 4. Launch a Proactive Maintenance Program**
Why: Green infrastructure helps reduce runoff at the source.	**Why**: Clogged or damaged infrastructure is a leading cause of flash flooding.
Actions: • Install **rain gardens** or **bioswales** near hotspots and downstream bottlenecks. • Use **permeable pavement** in parking lots or low-volume roads to reduce flow into the drainage system. • Restore or reconnect wetlands and stream buffers in flood-prone corridors.	Actions: • Establish a routine inspection and cleaning schedule for all drainage assets. • Maintain a digital log of maintenance history tied to GIS culvert IDs. • Train public works staff in BMPs for erosion and sediment control.
Example: Use rain gardens near parks or public buildings; implement vegetated swales in subdivision entrances.	*Checklist*: Use laminated field inspection forms and the maintenance schedule from the RAPC rural toolkit.

STEP 5. Engage Residents and Neighborhood Watch Programs	**STEP 6. Seek Funding for Mitigation Projects**
Why: Community awareness reduces localized issues and improves emergency coordination.	**Why**: Many mitigation improvements are eligible for state and federal cost-sharing.
Actions: • Start an "Adopt-a-Drain" program to keep neighborhood inlets clear. • Distribute flood readiness flyers and display signage in hotspots. • Use social media or SMS alerts to notify residents of road closures or detours during storms.	Actions: • Bundle hotspot improvements into **FEMA BRIC or HMGP** applications. • Apply for **DOT PROTECT** grants for road-related drainage upgrades. • Use **EPA CWSRF** for green infrastructure and stormwater treatment retrofits.
Bonus: Engage local schools or civic groups to assist with stormwater education campaigns.	*Tip*: Include updated H&H model outputs and SRL hotspot maps in funding proposals to strengthen justification.

APPENDIX O:

Proactive Stormwater Maintenance Program

Target Goal: Prevent localized flooding by improving culvert, ditch, and storm drain functionality through routine, trackable maintenance.

Objectives:

- Identify and catalog all existing stormwater assets (culverts, ditches, inlets) within flood-prone areas.
- Implement a quarterly maintenance cycle for high-risk zones.
- Train local public works staff and volunteers to conduct inspections.
- Reduce maintenance backlog and prevent flooding during seasonal storm events.

TABLE 4: STORMWATER MAINTENANCE PROGRAM ACTION STEPS

Step	Description	Timeline	Responsible Party
1	Inventory assets using GIS & field verification	Month 1	Public Works + RAPC support
2	Prioritize flood hotspots from SRL data	Month 1	Planning Dept
3	Develop laminated field inspection checklists	Month 2	Public Works
4	Implement quarterly maintenance rotation	Month 2+	Field Crews
5	Train crews on erosion signs, clog detection	Month 2	Engineering or University Partner
6	Log all inspections in central spreadsheet or mobile app	Ongoing	Stormwater Coordinator
7	Review and update program annually	Annually	Parish Engineer / RAPC

TABLE 5: SAMPLE BUDGET: 12-MONTH PROGRAM (STARTUP + OPERATIONS)

Item	Description	Estimated Cost
Field Equipment	Safety vests, flags, gloves, buckets, tools	$1,500
Laminated Checklists	Field-ready inspection guides (20 copies)	$250
Mobile GIS App or Spreadsheet Setup	Template or app subscription (e.g., Fulcrum, ArcGIS Field Maps)	$1,200
Staff Training	1-day BMP training for 10 crew members	$1,500
Labor (Part-time Seasonal)	2 part-time workers @ $15/hr, 10 hrs/week for 26 weeks	$7,800
Drainage Inventory Update	One-time consulting/GIS update	$3,000
Miscellaneous Supplies	Flags, signage, replacement tools	$750
	Total Estimated	**$16,000**

APPENDIX O:

Program Funding

Table 6 and Table 7 lists local and external stormwater maintenance program funding sources tailored for small cities, rural communities, and parishes. These options cover a mix of federal, state, and local resources, including grants, technical assistance, and utility-based revenue models. By blending local innovation with state and federal opportunities, small towns and rural parishes can fund robust, sustainable stormwater action plans that reduce flooding, improve water quality, and build community resilience.

TABLE 6: LOCAL, STATE, REGIONAL PROGRAM FUNDING SOURCES

Local Funding Sources	
Stormwater Utility Fees	**Definition**: A dedicated local fee charged to property owners based on impervious surface area. Provides sustainable, predictable funding for operations, maintenance, and capital improvements.
General Fund Allocations	**Definition**: Annual budget appropriations from the municipal or parish general fund. Often used to initiate programs in the absence of a utility fee.
Local Sales or Property Tax Levies	**Definition**: Voter-approved tax measures can create dedicated revenue for infrastructure and maintenance. Often implemented through ballot initiatives or local ordinances.
In-Kind Contributions or Volunteer Labor	**Definition**: Local support through public works staff, volunteer corps, or civic groups for maintenance tasks and inspections.
State & Regional Funding Sources	
Louisiana Community Development Block Grants (LCDBG)	**Definition**: Administered by the Louisiana Office of Community Development. Supports infrastructure improvements including stormwater drainage and flood mitigation.
Louisiana Watershed Initiative (LWI)	**Definition**: A major source of flood mitigation funding in parishes within Louisiana. Supports project planning, implementation, and data collection for stormwater improvements.
RAPC and Metropolitan Planning Organization (MPO) Support	**Definition**: Regional planning commissions may offer matching funds, technical assistance, or grants for infrastructure planning and environmental improvements.

APPENDIX O:

TABLE 7: FEDERAL PROGRAM FUNDING SOURCES

Federal Funding Sources	
FEMA Hazard Mitigation Grant Program (HMGP)	**Definition**: Funds projects that reduce long-term flood risk. Eligible uses include culvert upgrades, ditch regrading, and other mitigation activities.
EPA Clean Water State Revolving Fund (CWSRF)	**Definition**: Provides low-interest loans to municipalities for stormwater infrastructure. Managed by state agencies (e.g., Louisiana Department of Environmental Quality).
EPA Section 319 Nonpoint Source Pollution Grants	**Definition**: Supports implementation of nonpoint source pollution control programs, including stormwater runoff solutions.
USDA Rural Development – Water & Waste Disposal Program	**Definition**: Provides funding for stormwater and drainage improvements in rural communities with populations under 10,000.
Community Development Block Grant (CDBG) – HUD	**Definition**: Available nationwide to eligible communities for critical infrastructure, including stormwater system upgrades.
Infrastructure Investment and Jobs Act (IIJA) / Bipartisan Infrastructure Law	**Definition**: Provides billions in funding for climate resilience, green infrastructure, and water quality improvements—including stormwater maintenance.

APPENDIX O:

Program Performance

Small cities and rural communities can strategically leverage any combination of performance metrics for proactive stormwater maintenance programs in a number of impactful ways. These metrics serve as practical tools for improving services, justifying budgets, complying with regulations, and building resilient communities.

Table 8 illustrates various types of performance metrics used to track and monitor success of their CSAP.

TABLE 8: STORMWATER MAINTENANCE PROGRAM PERFORMANCE METRICS

Performance Metric	Definition	Why	Target
Asset Inventory Completion Rate	**Definition**: Percentage of stormwater assets (culverts, ditches, drains) identified, mapped, and cataloged in a geospatial system or asset register.	**Why it matters**: A complete asset inventory is foundational for planning maintenance cycles and emergency response.	**Target**: 90–100% inventory completion within 12–18 months of program launch.
Maintenance Frequency Adherence	**Definition**: Percentage of planned maintenance activities (e.g., ditch cleaning, culvert flushing) completed on schedule, typically quarterly or biannually.	**Why it matters**: Regular maintenance prevents clogging, improves hydraulic performance, and extends system lifespan.	**Target**: ≥ 90% adherence to scheduled maintenance across priority zones.
Reduction in Service Calls or Emergency Repairs	**Definition**: Year-over-year change in the number of citizen-reported drainage issues or emergency public works interventions related to stormwater.	**Why it matters**: A decrease indicates improved system performance and fewer disruptions.	**Target**: 25–50% reduction in stormwater-related service calls over 2 years.
Flood Event Severity or Incidence Tracking	**Definition**: Number of flood events in previously identified hotspots before and after implementation of proactive maintenance.	**Why it matters**: Helps assess the effectiveness of interventions in reducing localized flooding.	**Target**: ≥ 50% reduction in frequency or severity of flooding in target areas.
Inspection Completion Rate	**Definition**: Percentage of required visual or physical inspections completed per maintenance cycle.	**Why it matters**: Timely inspections help detect and resolve issues before they become costly failures.	**Target**: ≥ 95% completion per cycle.

APPENDIX O:

Performance Metric	Definition	Why	Target
Training Participation and Certification Rates	**Definition**: Number or percentage of local public works staff and volunteers who complete stormwater maintenance training and receive certification.	**Why it matters**: A trained workforce ensures consistent, safe, and informed operations.	**Target**: 100% of stormwater personnel certified within the first year.
Backlog Reduction Rate	**Definition**: Reduction in the number of deferred maintenance work orders or unresolved stormwater issues over time.	**Why it matters**: Indicates how efficiently the community is catching up on maintenance delays.	**Target**: 50–75% backlog reduction within 2–3 years.
Cost per Asset Maintained	**Definition**: Total maintenance costs divided by number of stormwater assets serviced in a given period.	**Why it matters**: Useful for budgeting and measuring cost-effectiveness over time.	**arget**: Establish baseline in Year 1, then seek efficiency improvements of 10–15%.
Public Satisfaction or Awareness Survey Results	**Definition**: Community feedback on perceived flood risk, stormwater responsiveness, or visibility of maintenance efforts.	**Why it matters**: Builds community trust and can guide outreach or funding support.	**Target**: ≥ 80% satisfaction in annual surveys.

By integrating performance metrics into everyday planning, small cities and rural communities can professionalize their stormwater programs, reduce risks, and create a compelling case for long-term investment.

To maximize success, small communities should:

- Bundle multiple sources (e.g., use local utility fees to match federal grants).
- Leverage planning documents like CSAPs to strengthen applications.
- Use regional partnerships (via MPOs or watershed coalitions) for shared access to funds.
- Track metrics to demonstrate impact and readiness for future funding.

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APPENDIX P:

PUBLIC HEARING, FINAL PUBLIC REVIEW & COMMENT PERIOD, & ADOPTION

August 8, 2025 **PUBLIC NOTICE**

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Metropolitan Planning Organization

Public Hearing – Findings of the MPA Stormwater Study

The Alexandria–Pineville Metropolitan Planning Organization's (MPO) Transportation Policy Committee will conduct a public hearing on Wednesday, September 3rd at 10:00 am, at RAPC and online via Zoom to review findings of the Metropolitan Planning Area (MPA) Stormwater Study and receive additional public input prior to considering formal adoption.

The MPA Stormwater Study evaluates regional drainage challenges and recommends strategies for transportation-related stormwater infrastructure improvements throughout the MPO planning area. The goal of the MPA Stormwater Study is to improve the transportation resiliency of the metropolitan region's transportation system through stormwater mitigation.

Public Hearing Details:

Date: Wednesday, September 3, 2025

Time: 10:00 a.m.

Location: Rapides Area Planning Commission, 803 Johnston Street, Alexandria, LA 71301 / Online (Zoom)

Virtual Access: Link and call-in details available at www.rapc.info/transportation.

The draft MPA Stormwater Study and its findings are available for public review at:

- **Online:** www.rapc.info/transportation
- **In-Person:** Rapides Area Planning Commission, 803 Johnston Street, Alexandria, LA 71301 (Monday–Friday, 8:00 a.m.–4:00 p.m.)
- Scan the QR code to view the document.

Written comments may be submitted in any of the following ways:

- **Online**: Use the public comment form at www.rapc.info/transportation or scan the QR code below to use the online public comment form.
- **By Mail**: Rapides Area Planning Commission
  ATTN: MPA Stormwater Study
  803 Johnston Street
  Alexandria, LA 71301
- **By Email**: jbolen@rapc.info

All comments must be received by September 12, 2025 to be considered in the final document.

ADA Notice:
The Rapides Area Planning Commission does not discriminate based on race, color, national origin, sex, age, disability, or income status in its programs or activities. Language assistance services and special accommodations are available at no cost. Please contact Heidi at (318) 487-5401 or heidi@rapc.info at least 48 hours before the hearing.

View the Study Document

Scan the code to view the draft document today — your input matters.

Share Your Feedback

Scan the code to share you feedback using the online public comment form.

For More Information:
Jonathan Bolen, Chief Transportation Officer
(318) 487-5401
jbolen@rapc.info
www.rapc.info/transportation

Your participation helps shape the future of stormwater management and community resilience in our region.

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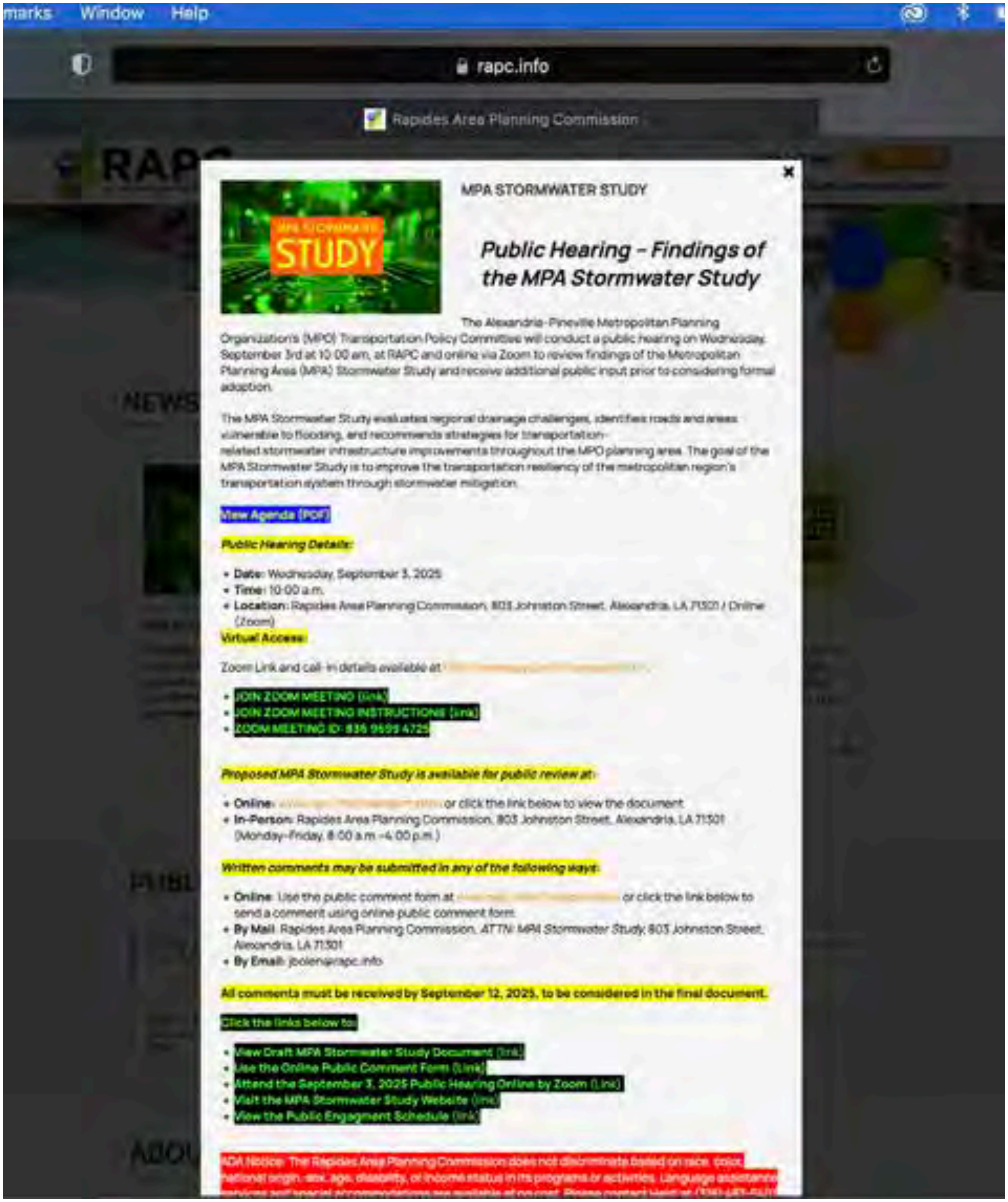
MPA STORMWATER STUDY

Public Hearing – Findings of the MPA Stormwater Study

The Alexandria-Pineville Metropolitan Planning Organization's (MPO) Transportation Policy Committee will conduct a public hearing on Wednesday, September 3rd at 10:00 am, at RAPC and online via Zoom to review findings of the Metropolitan Planning Area (MPA) Stormwater Study and receive additional public input prior to considering formal adoption.

The MPA Stormwater Study evaluates regional drainage challenges, identifies roads and areas vulnerable to flooding, and recommends strategies for transportation-related stormwater infrastructure improvements throughout the MPO planning area. The goal of the MPA Stormwater Study is to improve the transportation resiliency of the metropolitan region's transportation system through stormwater mitigation.

View Agenda (PDF)

Public Hearing Details:

- **Date:** Wednesday, September 3, 2025
- **Time:** 10:00 a.m.
- **Location:** Rapides Area Planning Commission, 803 Johnston Street, Alexandria, LA 71301 / Online (Zoom)

Virtual Access:

Zoom Link and call-in details available at

- JOIN ZOOM MEETING (link)
- JOIN ZOOM MEETING INSTRUCTIONS (link)
- ZOOM MEETING ID: 835 9599 4725

Proposed MPA Stormwater Study is available for public review at:

- **Online:** or click the link below to view the document.
- **In-Person:** Rapides Area Planning Commission, 803 Johnston Street, Alexandria, LA 71301 (Monday–Friday, 8:00 a.m.–4:00 p.m.)

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- **By Email:** jbolen@rapc.info

All comments must be received by September 12, 2025, to be considered in the final document.

Click the links below to:

- View Draft MPA Stormwater Study Document (link)
- Use the Online Public Comment Form (Link)
- Attend the September 3, 2025 Public Hearing Online by Zoom (Link)
- Visit the MPA Stormwater Study Website (link)
- View the Public Engagment Schedule (link)

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The Alexandria-Pineville Metropolitan Planning Organization's (MPO) Transportation Policy Committee will conduct a public hearing on Wednesday, September 3rd at 10:00 am, at RAPC and online via Zoom to review findings of the Metropolitan Planning Area (MPA) Stormwater Study and receive additional public input prior to considering formal adoption.

The draft study is available for review online at www.rapc.info/transportation and at the RAPC office, 803 Johnston Street, Alexandria, LA, Monday-Friday, 8:00 a.m.-4:00 p.m. Comments may be submitted at the hearing, by online using RAPC's online public comment form, or by mail to APMPO, Attn: Stormwater Study Comments, 803 Johnston Street, Alexandria, LA 71301, by September 12, 2025.

RAPC complies with Title VI of the Civil Rights Act, ADA, and related laws. For accommodations or language assistance, contact (318) 487-5401 or heidi@rapc.info at least 48 hours before the hearing.

August 17, 31 2025
LLOU0349664

Outlook

PUBLIC NOTICE: MPO Hosts Public Hearing – Findings of the MPA Stormwater Study

From Jonathan Bolen <jbolen@rapc.info>

Date Fri 8/8/2025 10:37 AM

Bcc Candice Cheney <candicecheney@yahoo.com>; Melissa Becker <mbecker@rapc.info>; Matt Johns <matt@rapc.info>; Kimberly Boyd <kimberly@rapc.info>; Victor Bivens <vbivens@halff.com>; metro@thetowntalk.com <metro@thetowntalk.com>; contact@cenlafocus.com <contact@cenlafocus.com>; Matt Johns <matt@rapc.info>; news@klax-tv.com <news@klax-tv.com>; Nick Blackstone <nick@rapc.info>; news@kalb.com <news@kalb.com>; news@thetowntalk.com <news@thetowntalk.com>; pat@cenlabroadcasting.com <pat@cenlabroadcasting.com>; dave@cenlabroadcasting.com <dave@cenlabroadcasting.com>; jay@cenlabroadcasting.com <jay@cenlabroadcasting.com>; eyesopentbrown@yahoo.com <eyesopentbrown@yahoo.com>; downtownnickbrown@gmail.com <downtownnickbrown@gmail.com>; graphics@cenlafocus.com <graphics@cenlafocus.com>; melissa@cenlabroadcasting.com <melissa@cenlabroadcasting.com>; achauvin@fox48tv.com <achauvin@fox48tv.com>

2 attachments (370 KB)

MPA Stormwater Public Hearing Notice.pdf; MPA Stormwater Executive Summary.pdf;

Public Hearing – Findings of the MPA Stormwater Study

The Alexandria–Pineville Metropolitan Planning Organization's (MPO) Transportation Policy Committee will conduct a public hearing on Wednesday, September 3rd at 10:00 am, at RAPC and online via Zoom to review findings of the Metropolitan Planning Area (MPA) Stormwater Study and receive additional public input prior to considering formal adoption.

The MPA Stormwater Study evaluates regional drainage challenges and recommends strategies for transportation-related stormwater infrastructure improvements throughout the MPO planning area. The goal of the MPA Stormwater Study is to improve the transportation resiliency of the metropolitan region's transportation system through stormwater mitigation.

Public Hearing Details:

- **Date:** Wednesday, September 3, 2025
- **Time:** 10:00 a.m.
- **Location:** Rapides Area Planning Commission, 803 Johnston Street,

Alexandria, LA 71301 / Online (Zoom)

- **Virtual Access:** Link and call-in details available at www.rapc.info/transportation.

The draft MPA Stormwater Study and its findings are available for public review at:

- **Online:** www.rapc.info/transportation
- **In-Person:** Rapides Area Planning Commission, 803 Johnston Street, Alexandria, LA 71301 (Monday–Friday, 8:00 a.m.–4:00 p.m.)
- Scan the QR code below to view the document.

Written comments may be submitted in any of the following ways:

- **Online**: Use the public comment form at www.rapc.info/transportation or scan the QR code below to use the online public comment form.
- **By Mail**: Rapides Area Planning Commission
  ATTN: MPA Stormwater Study
  803 Johnston Street
  Alexandria, LA 71301
- **By Email**: jbolen@rapc.info

All comments must be received by September 12, 2025 to be considered in the final document.

View the Study Document

Scan the code to view the draft document today — your input matters.

Share Your Feedback

Scan the code to share you feedback using the online public comment form.

ADA Notice:
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For More Information:
Jonathan Bolen, Chief Transportation Officer
(318) 487-5401
jbolen@rapc.info
www.rapc.info/transportation

Your participation helps shape the future of stormwater management and community resilience in our region.

Transportation Policy Committee

Alexandria / Pineville Metropolitan Planning Organization

AGENDA

Date: Wednesday, September 3, 2025
Time: 10:00 am - 11:00 am
Where: RAPC Conference Room, 803 Johnston Street, Alexandria, LA
& Online (Zoom Conferencing)

Join Zoom Meeting: https://us02web.zoom.us/j/83696994725

Meeting ID: 836 9699 4725

Join Instructions: https://us02web.zoom.us/meetings/83696994725/invitations?signature=U6e0KVbgSBGDTdAan4-zPze2A0hLDfLEDSciLtxoZUk

1. **Call to Order & Roll Call**

2. **Approval of Minutes** P_F_T_
   Motion to approve Minutes for TPC meeting held June 11, 2025.

3. **MPA Stormwater Study Public Hearing**

   a. **Motion to close TPC meeting and open public hearing for MPA Stormwater Study** P_F_T_

   b. **Call to Order & Welcome**
   Opening remarks made by TPC Chair; statement of purpose to review findings of the MPA Stormwater Study and receive public comment before adoption.

   c. **Introduction to the Study**
   Why was this study initiated? How does it align with regional goals and federal/state transportation planning requirements.

   d. **Presentation of Study Findings**
   Staff review of the study's purpose & methodology, key findings, and recommendations.

   e. **Public Comment Session**
   Explanation of comment process, followed by public comments. NOTE: Each speaker limited to 3-5 minutes. All comments entered into the official record.

   f. **Next Steps**
   Timeline for next steps. Ongoing opportunities for public engagement.

   g. **Motion to close public hearing for MPA Stormwater Study.** P_F_T_

4. **Other Business**

5. **Adjournment**

ADA NOTICE:
For special meeting accommodations, contact our ADA Coordinator via phone (318) 487-5401 at least 72 hours in advance of the meeting.

MPA Stormwater Study

Why We're Here

Flooded roads, washed-out culverts, and clogged ditches can make it hard to get around.

That's why we launched the MPA Stormwater Study: to figure out where the problem spots are and how to make our transportation system tougher, safer, and smarter when the water rises.

How We Did It

- **Mapped + Modeled:** Used high-tech flood models (think HEC-RAS + HEC-HMS) and LiDAR maps.
- **Counted + Measured:** Surveyed 219 culverts and 77 bridges across the region.
- **Listened + Learned:** Held open houses, sent out community surveys, and worked with local experts.

What We Found

- Flood-prone corridors: Downs Lane, McKeithen Drive, Horseshoe Canal
- Aging, undersized drainage systems in urban & rural areas.
- Alexandria has clusters of "repeat flood" (Severe Repetitive Loss) properties.
- Public priorities: 1) Better maintenance, 2) Steady funding.

What We're Recommending

1. **Bake flood fixes into all future transportation project decisions.**
2. **Target high-risk corridors (Augusta Ave, Roanoke St) for drainage upgrades.**
3. **Standardize stormwater ordinances across jurisdictions.**
4. **Expand public education on resilience, mitigation, and insurance.**

How You Can Join In

- **Speak today:** You've got 3 minutes — make 'em count!
- **Write it down:** Send us comments by **September 12, 2025**.
  - **RAPC Online Comment Form**: rapc.info/transportation,
  - **Email:** jbolen@rapc.info, or
  - **Mail:** RAPC, *ATTN: MPA Stormwater Study*, 803 Johnston St., Alexandria, LA 71301.

What's Next

- **Comment window closes: Sept 22, 2025.**
- We'll update the draft with your input.
- The MPO Policy Committee will vote on adoption at the next TPC meeting.

View the Study Document

Scan the code to view the draft document today—your input matters.

Share Your Feedback

Scan the code to share you feedback using the online public comment form.

"Your participation helps shape a safer, more resilient transportation system for our region."

Outlook

Fw: PUBLIC NOTICE: Final 14-Day Public Review & Comment Period: MPA Stormwater Study

From Jonathan Bolen <jbolen@rapc.info>
Date Tue 9/9/2025 12:53 PM
To steven@cenlabroadcasting.com <steven@cenlabroadcasting.com>

1 attachment (231 KB)
MPA Stormwater Final Public Comment Period_090925.pdf;

From: Jonathan Bolen <jbolen@rapc.info>
Sent: Tuesday, September 9, 2025 11:20 AM
Subject: PUBLIC NOTICE: Final 14-Day Public Review & Comment Period: MPA Stormwater Study

AP-MPO
ALEXANDRIA • PINEVILLE
Metropolitan Planning Organization

Final 14-Day Public Review & Comment Period:
MPA Stormwater Study

The Rapides Area Planning Commission (RAPC) invites the public to review and comment on the MPA Stormwater Study during a final 14-day public comment period beginning September 9, 2025 and ending September 23, 2025, prior to final adoption by the Transportation Policy Committee.

The draft MPA Stormwater Study and its findings are available for public review at:

- **Online:** www.rapc.info/transportation
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  803 Johnston Street
  Alexandria, LA 71301

- **By Email**: jbolen@rapc.info

All comments must be received by September 23, 2025 to be considered in the final document.

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For More Information:

Jonathan Bolen
Chief Transportation Officer
Desk: 318.487.5401 x12 I Email: jbolen@rapc.info
803 Johnston St. Alexandria, LA 71301 / www.rapc.info

September 9, 2025 **PUBLIC NOTICE**

AP-MPO
ALEXANDRIA • PINEVILLE
Metropolitan Planning Organization

Final 14-Day Public Review & Comment Period: MPA Stormwater Study

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September 9, 2025 **PUBLIC NOTICE**

For More Information:
Jonathan Bolen, Chief Transportation Officer
(318) 487-5401
jbolen@rapc.info
www.rapc.info/transportation

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No.	COMMENT RECEIVED & MPO ACTION	SOURCE
1	The Susek drive area has some issues, especially around Huntington Ridge. Raising Susek years ago actually created a dam - previously excess water could flow OVER Susek but now it must go through drainage structures, which are not adequate.	Online Public Comment Form
	While the study did not identify this area as an Area of Mitigation Interest (AMOI), staff will advance this as a possible TIP project to consider for the FFY2027-2030 Transportation Improvement Program and will investigate as part of the long-range transportation plan (MTP 2050).	MPO Action
2	Stormwater and runoff has been redirected to flow into residential properties and private lakes causing major trash and unwanted oils and other runoff into this area. The area is specifically College Park in Zone 2 on your map. The city changed this pattern of drainage approximately ten years ago.	Online Public Comment Form
	The project team identifed this area around Greer Street and Pineville Expressway as an Area of Mitigation Interest (AMOI) in the study and model. The MPO was actively developing a PROTECT grant application using the model data to develop the solution, however the grant program is no longer available.	MPO Action
3	Define or spell out acronyms when first used.	FHWA
	Staff updated Appendix L: Acronyms and Definitions to include missing abbreviations.	MPO Action
4	Explain/describe NOAA Atlas 14. Is it a set of data and/or an analysis tool? What kind of information does it provide? What is its purpose?	FHWA
	Staff updated Appendix L: Acronyms and Definitions to include definitiion of Atlas 14	MPO Action
5	In this report, do you identify the owners of the the pertinent infrastructure or property at these sites? Identifying owners would be a useful piece of information. Owners are the ones most likely to pursue improvements, or would at least need to provide support if another agency pursues improvements.	FHWA
	Individual property addresses and owner were not included in the text as required by FEMA.	MPO Action
6	Which tense is appropriate: "would provide" or "provides?" Clarify if the toolkit is already developed or yet to be developed.	FHWA
	Staff updated language in this section to clarify that the toolkit was developed and is ready for distribution/publication/use.	MPO Action

ALEXANDRIA/PINEVILLE METROPOLITAN PLANNING ORGANIZATION
TRANSPORTATION POLICY COMMITTEE

RESOLUTION #RAPC-250903-01

(ADOPTION OF THE MPA STORMWATER STUDY)

I, Mayor Jacques M. Roy, Chairman of the Metropolitan Planning Organization's Transportation Policy Committee, do hereby certify that at a duly convened meeting of the Transportation Policy Committee held in Alexandria, Louisiana, at 10:00 a.m. on September 3, 2025, the following Resolution was adopted:

WHEREAS, the Rapides Area Planning Commission, as the designated Metropolitan Planning Organization (MPO), is responsible for developing and maintaining a continuing, cooperative, and comprehensive transportation planning process for the Alexandria-Pineville Metropolitan Planning Area (MPA), and for the effective use of Federal transportation funds in the region; and

WHEREAS, the MPA Stormwater Study Document, entitled "*Improving Transportation Through Stormwater Mitigation Study*"(May 2025), was prepared in cooperation with the Louisiana Department of Transportation and Development, the MPO Technical Advisory Committee, local jurisdictions, and regional stakeholders; and

WHEREAS, the MPA Stormwater Study provides a comprehensive technical assessment of stormwater and flood-related risks to the regional transportation system, identifies vulnerable roadways and infrastructure, and develops data-driven, community-informed strategies to mitigate flooding and enhance system resiliency; and

WHEREAS, the study was developed with broad-based public participation, including public open houses, surveys, GIS-based feedback tools, and workshops, ensuring that the document reflects both scientific analysis and community priorities; and

WHEREAS, notice of public availability of the draft MPA Stormwater Study was published and made available for public review and comment, public hearing was conducted, and the Technical Advisory Committee has reviewed the document and recommended its adoption by the Transportation Policy Committee; and

WHEREAS, the Transportation Policy Committee has reviewed the MPA Stormwater Study Document and concurs with the recommendations of the Technical Advisory Committee.

NOW, THEREFORE, BE IT RESOLVED, that the Transportation Policy Committee of the Alexandria-Pineville Metropolitan Planning Organization does hereby approve and adopt the MPA Stormwater Study Document as the official stormwater mitigation study for the Metropolitan Planning Area, and directs that its findings and recommendations be incorporated into future transportation planning, project development, and policy decisions.

Signed and executed this 25 day of September, 2025.

Mayor Jacques M. Roy,
Chairman, Transportation Policy Committee
Alexandria/Pineville MPO

ATTEST: Jonathan W. Bolen

Jonathan Bolen
Alexandria/Pineville MPO