Highlands County Adaptation Action Areas

Task 3: Identification and Prioritization of Adaptation Action Areas

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Summary of Methodology and Dataset Updates

- Polygon assets were removed from the critical asset dataset, resulting in a methodology based exclusively on point- and line-based asset inputs.
- Natural, Cultural, and Historical Resource assets were excluded from the dataset, modifying both the distribution and total count of asset category points.
    - This asset category was removed from the Asset Categories total scoring, and the score for Transportation and Evacuation Route assets was adjusted from 3 points to 4 points to reflect the revised structure.
- Buffer overlapping considerations are no longer applicable due to changes in the buffering and raster-conversion methodology.
    - Once all vector layers are converted to raster format, any area falling within a buffer is assigned the corresponding value, regardless of overlapping vector geometries. Overlaps do not compound or conflict because all cells representing the same factor receive a uniform score.

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Executive Summary

This document presents the 2-phase process to identify and prioritize Adaptation Action Areas (AAAs) in Highlands County. The methodology includes (1) identification of AAAs through weighted matrix of spatial criteria and (2) prioritization of those AAAs based on additional evaluation factors.

Phase 1 – AAA Scoring Methodology

In Phase I, each matrix category was assigned a weight (see Figure 1), with higher weights reflecting the County's priorities as expressed during project meetings and in the project Scope of Work. Each category corresponds to a Geographic Information System (GIS) dataset, and these layers were combined to map cumulative areas of highest priority. Assets with the highest cumulative scores represent locations where critical assets face the greatest risk of flooding.

Subdivision and neighborhood boundaries were used to ensure proposed AAA boundaries remained consistent with community geography. County staff provided additional refinements based on local knowledge and observed flood patterns. These adjustments helped refine boundaries, for example, by making polygons more contiguous or removing areas without a known flooding history.

Phase 2 – AAA Prioritization

Per the project Scope of Work, public input and quantity of critical assets were used to prioritize the AAAs identified in Phase I. The public input score reflects the number of community comments received during public engagement events about flooding "hot spots" throughout the County. The asset quantity score reflects the number of critical assets included located within each AAA boundary. Together, these two factors provide a community-informed method for prioritizing the areas most in need of adaptation planning and funding.

Introduction

Highlands County is developing Adaptation Action Area (AAA) Plans in parallel with the Highlands County Vulnerability Assessment (VA) to identify geographic areas and critical assets that exhibit elevated exposure and sensitivity under future flood conditions. The AAA Plans will help the County to prioritize capital improvement projects and strategically target grant funding opportunities.

This document outlines the methodology used to identify AAAs, including datasets, processing steps, scenario criteria, and the scoring framework applied to evaluate vulnerability across the County. The methodology is designed to ensure a consistent, data-driven approach for identifying areas where coordinated adaptation and mitigation strategies are needed most. Figure 1 shows the seven data categories incorporated into the AAA scoring framework, along with their associated weighting factors. Table 1 details the weighting scheme, scoring structure, and category-specific criteria applied in Phase 1 of the AAA scoring methodology.

Data sources for this scoring methodology include the Central Florida Regional Planning Council (CFRPC), Highlands County, and findings from the ongoing Highlands County VA. The VA data sources and methodology are provided in Appendix I.

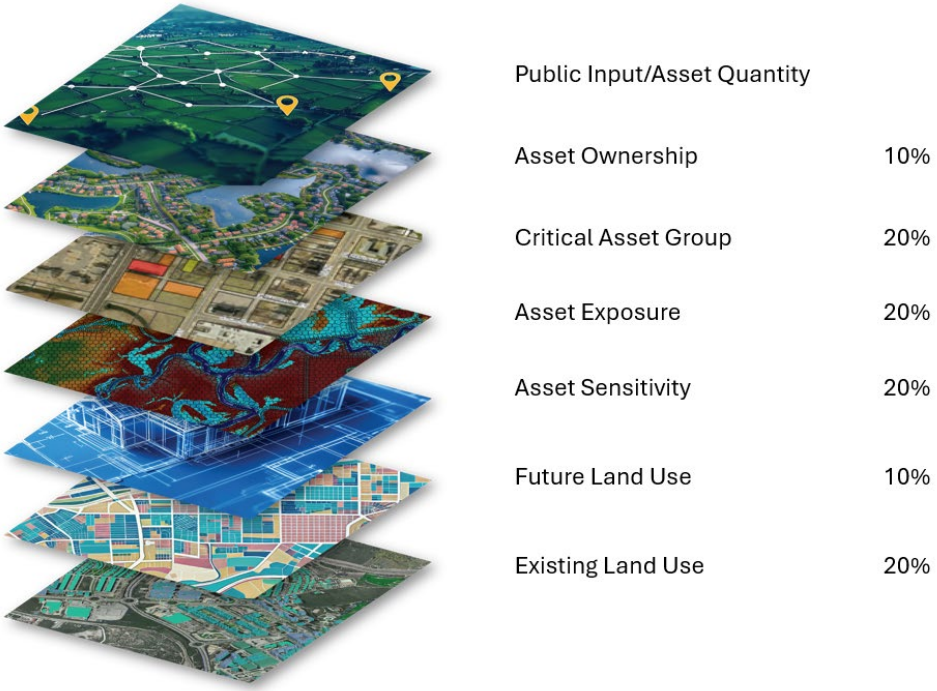

Figure 1: Category Weight

Table 1: Assigned Weights for Each Category of Data Used in Scoring Methodology

Weight	Points Total	Category	Subcategory	Score	% out of 100 Points
20%	20	**Critical Asset Group**	Critical Community and Emergency Facilities	10	10%
			Critical Infrastructure	6	6%
			Transportation and Evacuation Routes	4	4%
			Natural, Cultural and Historical Resources	N/A	N/A
			No Information	0	0%
20%	20	**Existing Land Use**	Existing High Density Residential	10	10%
			Existing Commercial/Industrial	6	6%
			Existing Single Family Residential	3	3%
			Existing Open Space and Agricultural	1	1%
			No Information	0	0%
10%	10	**Future Land Use**	Future High Density Residential	4	4%
			Future Commercial/Industrial	3	3%
			Future Single Family Residential	2	2%
			Future Open Space and Agricultural	1	1%
			No Information	0	0%
20%	20	**Asset Exposure**	100-year 2040 inundation	12	12%
			500-year 2040 inundation	8	8%
			Not inundated	0	0%
20%	20	**Asset Sensitivity**	Flood depth exceeds FFE	10	10%
			Flood depth 6 inches or less below FFE	8	8%
			Flood depth more than 6 inches below FFE	2	2%
			No Information	0	0%
10%	10	**Asset Owner**	Public	8	8%
			Private	2	2%
			No Information	0	0%
100%	**100**				**100%**

Phase 1: AAA Scoring Methodology

1. Critical Asset Group

As part of this analysis, critical assets were categorized according to the four statutory subcategories defined in Section 380.093, Florida Statutes (F.S.)[i], under the Resilient Florida Program. These subcategories, Critical Community and Emergency Facilities, Critical Infrastructure, Transportation and Evacuation Route Assets, and Natural, Cultural, and Historical Resources, are summarized in Table 2 and were adopted directly for the Highlands County AAA methodology.

The initial dataset provided by CFRPC included assets across all four categories. However, the refined dataset no longer includes any natural, cultural, or historical resource assets. To maintain transparency and consistency with statutory categories, this asset category has been retained in the table for contextual reference only, but they are now assigned 'N/A' to reflect their absence from the updated dataset and their exclusion from scoring and spatial analysis.

Each critical asset subcategory was originally assigned a score ranging from 0 to 10 based on its importance to emergency response and alignment with Highlands County priorities. Critical community and emergency facilities were identified as the highest priority and assigned a maximum score of 10. Other categories received lower weights consistent with their relative importance.

Given that natural, cultural, and historical resource assets are no longer included in the dataset, the scoring distribution for the remaining categories has been adjusted to ensure proportionality across the existing assets. As a result, transportation and evacuation route assets, which were previously assigned a weight of 3 when all four categories were present, are now assigned 4 points to maintain relative balance within the updated dataset. The subcategories were scored as follows: critical community and emergency facilities receive a score of 10, critical infrastructure receive a score of 6, transportation and evacuation routes receive a score of 4, and natural, cultural, and historical resources do not receive a score.

Table 2: Critical Asset Categories per Resilient Florida Statute and Scoring

Asset Group	Previous Score	Updated Score	Asset Types
Critical Community and Emergency Facilities	10	10	Affordable public housing, colleges and universities, community centers, correctional facilities, disaster recovery centers, emergency medical service facilities, emergency operation centers, fire stations, health care facilities, hospitals, law enforcement facilities, local government facilities, logistical staging areas, risk shelter inventory, schools, state government facilities
Critical Infrastructure	6	6	Communications facilities, disaster debris management sites, drinking water facilities, electric production and supply facilities, military installations, solid and hazardous waste facilities, stormwater treatment and pump stations, wastewater treatment and lift stations, water utility conveyance systems
Transportation and Evacuation Routes	3	4	Airports, bridges, bus terminals, major roadways, marinas, ports, rail facilities, railroad bridges
Natural, Cultural and Historical Resources	1	N/A	Historical and cultural assets, parks, shorelines, surface waters, wetlands

1.1 Asset Buffering

Point and polyline assets do not inherently contain measurable area, which limits their ability to be compared directly with polygon features or incorporated into spatial scoring. To ensure that all asset types could be evaluated consistently, buffers were applied to point and linear features to account for a spatial area of influence around each asset. These buffers establish the extent within which an asset contributes to flood-related vulnerability or community importance. Once buffered, all assets can be incorporated uniformly into subsequent spatial analysis.

The full GIS workflow used to prepare and process data for analysis is provided in Appendix II, and all buffer distances applied in the analysis are summarized in Tables 3 and 4.

1.1.1 Critical Asset Points

Only three critical asset subcategories contained point-based features: critical community and emergency facilities, critical infrastructure, and transportation and evacuation routes. The natural, cultural, and historical resources category did not include any point features and therefore did not require buffering.

To incorporate point-based assets into an area-based evaluation framework, each point was assigned a category-specific buffer distance to create a polygon representing its general spatial influence. This buffering step allows point features, originally without measurable area, to be evaluated consistently alongside polyline and polygon assets within the composite vulnerability analysis.

The buffer distances were not intended to reflect precise service areas. Instead, they represent generalized assumptions about each asset type's potential area of influence, used solely to support consistent spatial comparison across different geometry types. All buffer distances used for point assets are summarized in Table 3. Figure 2 shows the critical asset points with buffers.

Table 3: Asset Subcategory Point Buffer Distances

Asset Group	Point Buffer (radius)
Critical Community and Emergency Facilities	5,280 feet
Critical Infrastructure	4,000 feet
Transportation and Evacuation Routes	2,000 feet

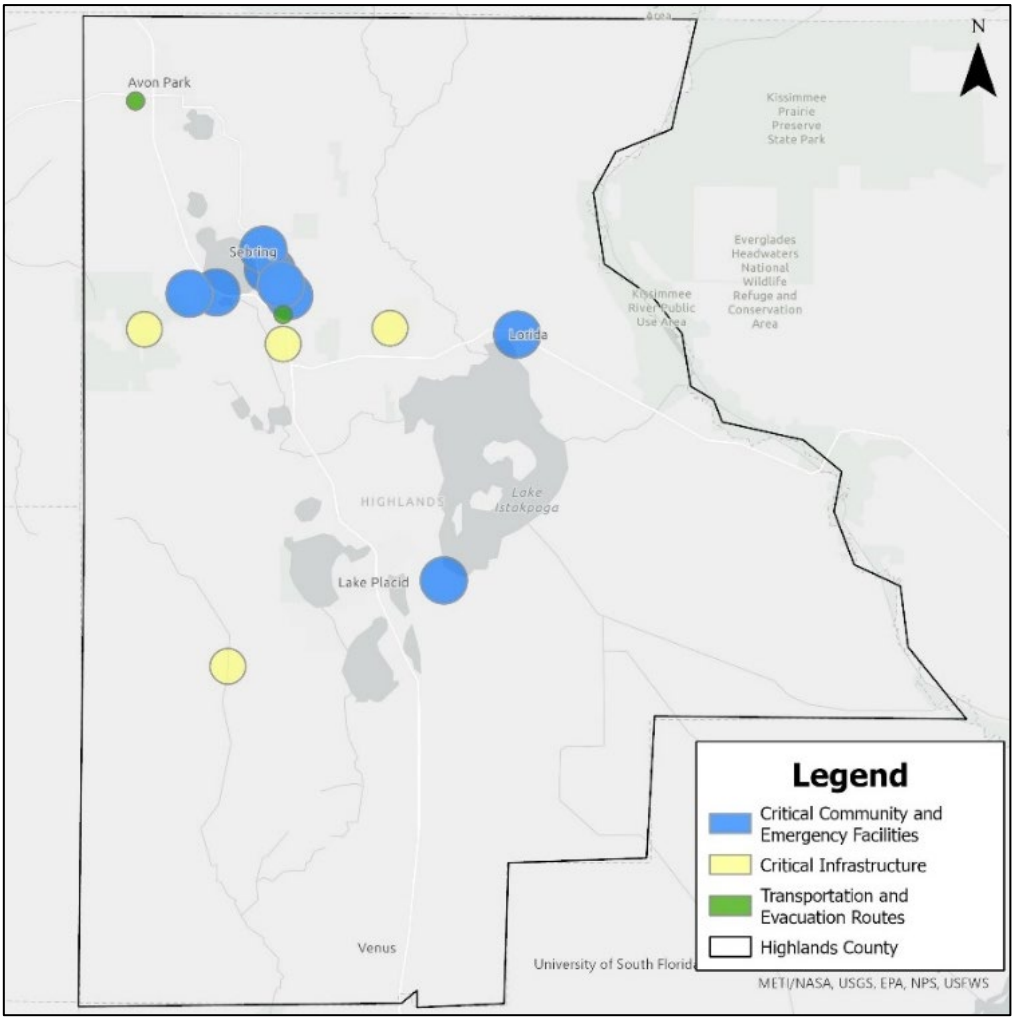

Figure 2: Highlands County Critical Assets - Buffered Points

1.1.2 Critical Asset Polylines

Polyline features were present in two asset subcategories: critical infrastructure and transportation and evacuation routes. The critical community and emergency facilities category did not include any polyline features.

To ensure consistency with area-based scoring framework, each polyline was assigned a category-specific buffer distance. These buffers were selected to approximate the general width or physical extent of each asset type and to ensure comparability with point and polygon features. Buffer distances were informed by typical design standards, commonly observed dimensions, and measurements derived from aerial imagery, providing a consistent representation of each asset's spatial influence. This step enabled linear assets to be evaluated uniformly within the GIS environment and integrated into the composite scoring alongside point and polygon assets. All buffer distances used for polyline assets are summarized in Table 4. For visualization purposes, Figure 3 does not display buffer distances.

Table 4: Asset Subcategory polyline buffer distances

Asset Group	Polyline Buffer (total width)
Critical Community and Emergency Facilities	N/A
Critical Infrastructure	N/A
Transportation and Evacuation Routes The assigned width reflects a generalized two-lane roadway profile, assuming a minimum lane width of approximately 8 feet, with an additional 4-foot shoulder on each side. An extra buffer distance was added to account for variability in roadway design and surrounding right-of-way conditions.	30 feet

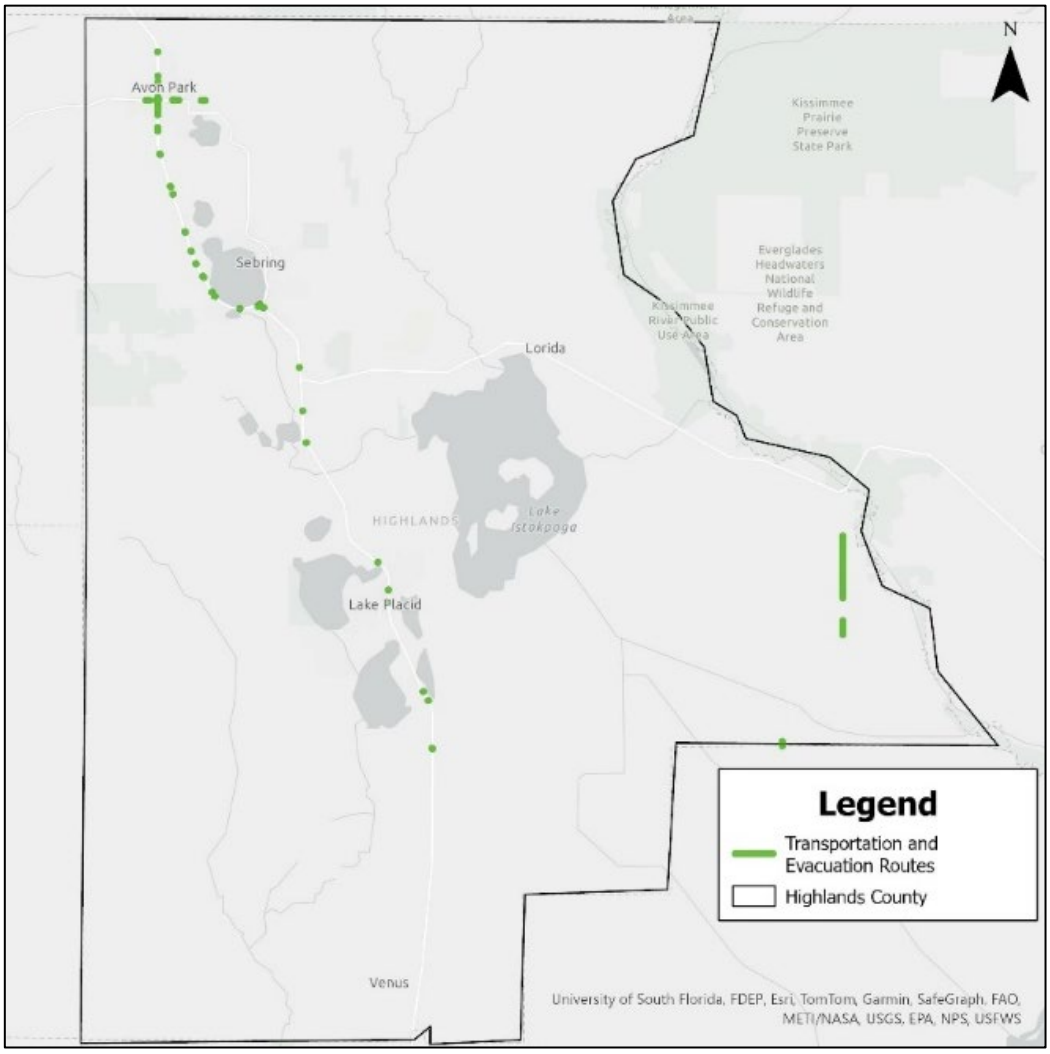

Figure 3: Highlands County Critical Asset – Nonbuffered Polylines

2. Asset Exposure

Flood exposure under current and future flooding conditions was evaluated as part of the Exposure Analysis in the Highlands County VA. The predictive modeling incorporates historical flooding and precipitation data, combined with change factors, to project future flood conditions. For the AAA methodology, the 100- and 500-year flood scenarios for the year 2040 were used to assess how each asset (point, polyline, polygon) would be exposed to flooding under these modeled conditions.

The asset exposure score represents the degree to which an asset is projected to experience flooding under these scenarios. Assets inundated under the 100-year 2040 scenario receive a score of 12, while assets inundated only under the 500-year 2040 scenario receive a score of 8, as shown in Table 5.

Table 5: Asset Exposure Scoring

Flood Exposure	Score
100-year 2040 flood inundation	12
500-year 2040 flood inundation	8
Not Inundated	0

3. Asset Sensitivity

Asset Sensitivity in the Highlands County VA was evaluated by comparing projected flood depths from the exposure analysis to each asset's (point, polyline, polygon) Finished Floor Elevation (FFE). Flood depths were derived from the 100-year 2040 flood scenario, allowing the analysis to identify which assets are most at risk of inundation under future conditions.

Assets were scored based on the relationship between projected flood depth and FFE. Flood depths that exceed an asset's FFE receive a score of 10; depths within 6-inches or less below FFE receive a score of 8; depths more than 6-inches below the FFE receive a score of 2; and assets with no FFE data are assigned a score of 0. These scoring criteria are summarized in Table 6.

Table 6: Asset Sensitivity Description, and Scoring

Type	Score
Flood depth exceeds the Finished Floor Elevation (FFE)	10
Flood depth is within 6-inches or less below FFE	8
Flood depth is more than 6-inches lower than FFE	2
No Information	0

4. Existing and Future Land Use

Highlands County's existing and future land use types were evaluated to understand the potential consequences to people residents, property, and community function if an asset or area were to be impacted by any hazard. Existing land use categories are weighed more heavily than future land use because it reflects current development patterns, population

distribution, and the immediate importance of these areas to residents and the local economy.

4.1 Existing Land Use

Existing land use categories are assigned scores from 0 to 10 based on the relative severity of consequences associated with impacts to each land use type (see Table 7). Higher scores correspond to land uses where disruption would have greater effects on population, essential services, or community operations. High density residential areas receive the highest score (10) due to the large number of residents and the potential for substantial displacement. Commercial/industrial areas follow (6), as impacts to businesses and employment centers can significantly affect economic activity and recovery. Other categories, including single-family residential (3), open space and agriculture (1), are scored according to their relative importance and the scale of potential impacts.

Table 7: Existing Land Use Categories, Description, and Scoring

Land Use	Score	Zoning Category
High Density Residential – residential with multiple families on a single plot of land or manufactured home communities. This category assumes a very high displacement of people during an event with a very difficult ability to recover after an event.	10	• R-2 - Two-family dwelling district • R-3 - Multiple-family dwelling including motel and hotel district • R-3 - NC non-commercial multiple-family dwelling • M-1 - Manufactured home subdivision district • M-1-S - Manufactured home and residential subdivisions district • M-2 - Manufactured home parks district • RV - Park (FUD) district
Commercial/Industrial – businesses and industry important to the community's economic recovery and prosperity and people's livelihoods. This category assumes a high displacement of goods, services, jobs, and livelihoods with a difficult ability to recover after an event. This category also includes airports and public water supplies.	6	• B-1 - Neighborhood business district • B-2 - Limited business district • B-3 - Business district • B-4 - Business district • O - Office district • BC-1 - Business campus, research, and light manufacturing park district • BC-2 -B campus, research, and light manufacturing park district • I-1 -I district • I-2 - Industrial district • PW - Public water supply district • A-1 - Airport district • P - Public and quasi-public lands district

Land Use	Score	Zoning Category
Single-Family Residential – residential lot owned by one family with one family residing within the home. This category assumes a moderate to low displacement of individual families with a moderately difficult ability to recover after an event.	3	• R-1 A - Residential district • R-1 - Residential district • EU - Estate District • TND - Traditional neighborhood development district
Open Space and Agriculture – green space and fields. Includes parks, undeveloped land, and croplands. This category assumes a low displacement of people and goods and services for the community with an easier ability to recovery after an event.	1	• AU - Agricultural district • CG-1 - Campground district • CG-2 - Campground district • CG-3 - Campground district • CM - Conservation/management lands district
No Information	0	

4.2 Future Land Use

Future land use scores, ranging from 0 to 4, represent the potential consequences of future development in areas that may be exposed to flooding (see Table 8). These scores are based on the County's Future Land Use Map, as outlined in the Comprehensive Plan[ii], and reflect how land is anticipated to develop under planned future conditions.

To avoid overstating the influence of uncertain long-term development patterns, scores assigned to future land use are intentionally lower than those used for existing land use. The scoring framework is as follows: high density residential (4), commercial/industrial (3), single-family residential (2), open space (1).

Table 8: Future Land Use Categories, Description, and Scoring

Land Use	Score	Zoning Category
High Density Residential – residential land of multiple families on a single plot of land or manufactured home communities This category assumes a very high displacement of people during an event with a very difficult ability to recover after an event	4	• RH - High Density Residential
Commercial/Industrial – businesses and industry important to the community's economic recovery and prosperity and people's livelihoods	3	• C – Commercial • CI - Commercial/Industrial Mixed Use • BPC - Business Park Center • I – Industrial

This category assumes a high displacement of goods, services, jobs, and livelihoods with a difficult ability to recover after an event This category also includes airports and public water supplies		• MUC - Multi-Use Center • PW - Public Water Supply • P - Public/Quasi-Public Facility and Institutional Lands
Single-Family Residential – residential lot owned by one family with one family residing within the home This category assumes a moderate to low displacement of individual families with a moderately difficult ability to recovery after an event	2	• RL - Low Density Residential • RM - Medium Density Residential • MU - Mixed Use
Open Space and Agriculture – green space and fields. Includes parks, undeveloped land, and croplands This category assumes a low displacement of people and goods and services for the community with an easier ability to recovery after an event	1	• AG – Agriculture • CM - Conservation/Management Lands • E - Existing Designation Category (Grandfathered zoned parcels)
No Information	0	

5. Asset Owner

Asset ownership was incorporated into the Highlands County VA as part of the asset dataset collection, distinguishing between public and privately owned assets. Public assets were assigned a score of 8, reflecting their importance to community function and their eligibility for future implementation funding. This distinction is particularly relevant because, should the County pursue grant funding for infrastructure improvements within AAAs, funding is typically restricted to publicly owned facilities. Private assets were assigned a lower score of 2, while assets with unidentified ownership receive a score of 0 (see Table 9).

It is important to note that most private assets identified in the Countywide VA were excluded from this project's analysis, with only a few exceptions. As a result, the number of private assets considered in this assessment is substantially reduced.

Table 9: Asset Ownership Scoring

Asset Ownership	Score
Public	8
Private	2
No Information	0

6. AAA Identification Results

6.1 Preliminary AAA Results

The six scoring categories were integrated into ArcGIS Pro to generate a comprehensive score for each critical asset included in the Highlands County asset dataset. Subdivision and neighborhood boundaries were then applied to ensure that all proposed AAA polygons-maintained neighborhood cohesion and logical geographic grouping. Minor boundary adjustments were made with input from Highlands County, based on their on-the-ground experience, thereby improving the accuracy and relevance of the AAAs.

Results from the Phase I methodology are presented in Figure 4. The identified AAAs are listed in Table 10, where the "Number" column corresponds to the labels shown on the map in Figure 5.

Table 10: Highlands County Adaptation Action Areas Matrix Results

No.	Adaptation Action Area
1.	Avon Park Executive Airport
2.	Country Club of Sebring
3.	Little Lake Jackson
4.	Downtown Sebring
5.	Sebring Parkway
6.	DeSoto City
7.	Sebring Regional Airport
8.	Lorida
9.	Highlands Park Estates
10.	Fisheating Creek

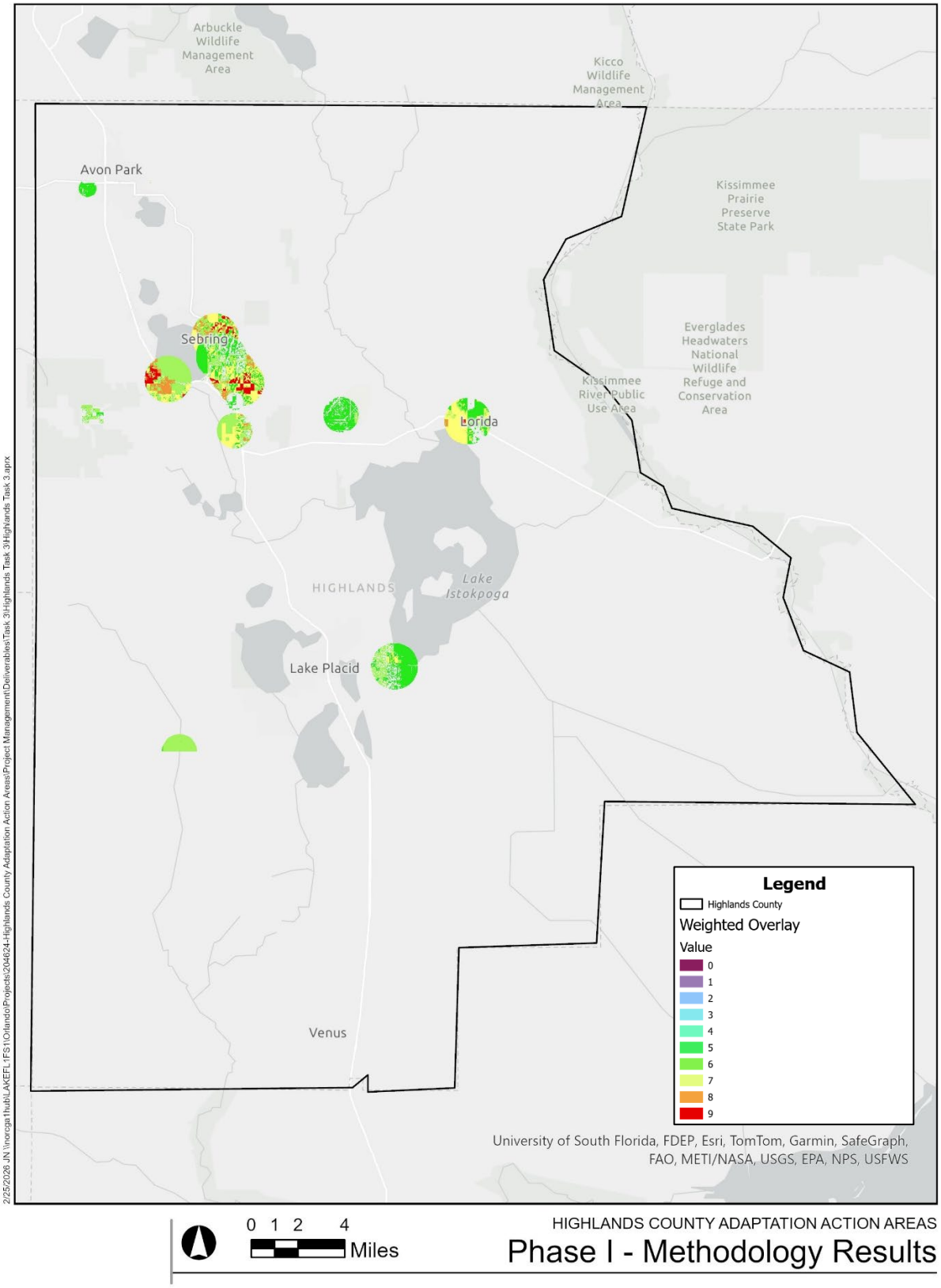

Figure 4: Phase I Methodology Results

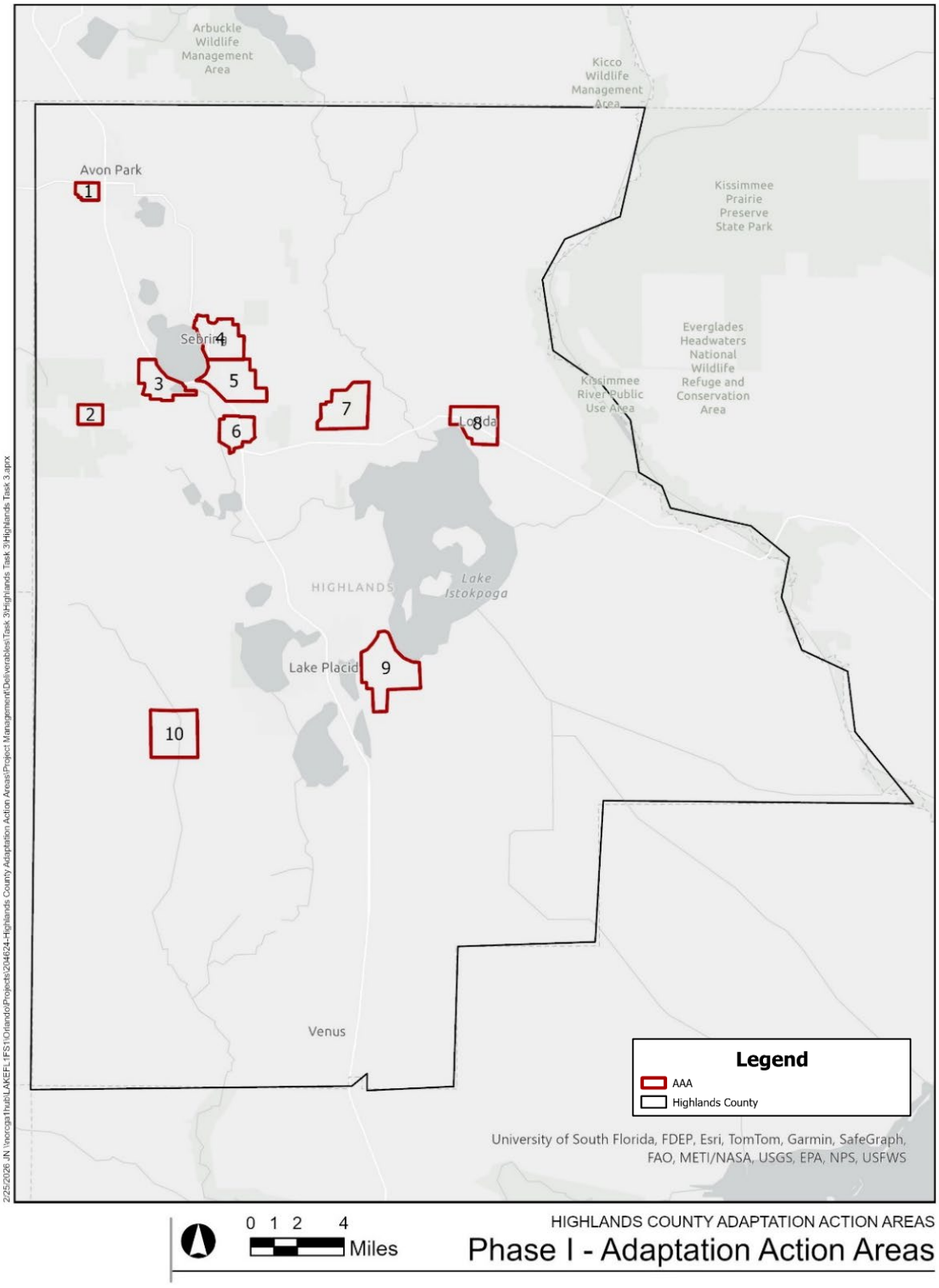

Figure 5: Phase I Adaptation Action Area Boundaries

Appendix I. CFRPC Vulnerability Assessment Data Sources and Methodology

Adaptation Action Areas Project

Supplement to the **Highlands County** Comprehensive Vulnerability Assessment

TASK 3: IDENTIFICATION AND PRIORITIZATION OF ADAPTATION ACTION AREAS

Methodology Exposure and Sensitivity Analyses

AND

Refinement of Critical Assets

February 19, 2026

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I. Task 3 Overview: Identification and Prioritization of Adaptation Action Areas

Task 3 Description: Adaptation Action Areas (AAAs) will be identified and prioritized based on critical assets, exposure and sensitivity analysis and on each flood scenario from the Highlands County Comprehensive Vulnerability Assessment (CVA) flood modeling, as well as input from community workshops, and local government feedback including from Highlands County, and the municipalities of Avon Park, Sebring, Town of Lake Placid within the county. This task also includes identifying, mapping (GIS shapefile layer) and PDF of a GIS map, and prioritizing the AAAs in order of highest priority where the most critical assets are most severely impacted to least priority where the least amount of critical assets are clustered and impacted.

Deliverable: The deliverable for Task 3 is an AAAs Technical Memorandum summarizing:

- Detailed description of the methodology for identifying AAAs as well as the methodology prioritizing AAAs justification for choosing each AAA.
- Map illustrates where the AAAs are located within the County; illustrating the location of each adaptation area compared to the locate of all critical assets within the geographic extent of the study.
- Tables listing each AAA with any critical assets that are contained therein.
- GIS files and associated metadata used in completing this task, including GIS shapefile boundaries of the identified adaptation areas and the critical assets therein.

II. Highlands County Exposure and Sensitivity Methodology

A.) Overall Approach

This section presents a combined Exposure and Sensitivity Analysis Methodology applied consistently to all critical assets in Highlands County, Florida. The intent is to provide a single, technical reference describing how rainfall-driven flood exposure and regional sensitivity were evaluated and integrated into planning, prioritization, and decision-making. Together, these analyses ensure that the critical assets included are evaluated for physical exposure to rainfall-driven flooding as well as the social, environmental (hydrological), and hazard sensitivity context. This approach is foundational for the baseline components for the Adaptation Action Areas (AAA) project. Discussion regarding the refinement of critical assets needed for the AAA project is provided in Section III.

Exposure Analysis:

The exposure analysis quantifies modeled flood depths and the spatial extent of inundation at the asset level using depth, ponding, and drain flow rasters for multiple rainfall return periods and planning horizons.

Sensitivity Analysis:
The sensitivity analysis characterizes relative regional sensitivity using a framework incorporating social vulnerability (SOVI), population distribution, FEMA flood hazard extent, and natural environmental (hydrological - canals, ditches, stormwater facilities, lakes, rivers, and streams) features, and exposure inundation.

B.) Critical Assets

GIS data containing critical assets as defined in 380.093, F.S. was downloaded from the Florida Department of Environmental Protection Geospatial Open Data portal. Highlands County, Avon Park, Sebring, Town of Lake Placid provided additional data used to verify and update the statewide dataset. This data includes four asset groups and their associated subtypes.

1. **Transportation Assets and Evacuation Routes Asset Group**
    - **Subtypes:** Airports, bridges, bus terminals, ports (not applicable in Highlands County which is an inland county), major roadways, marinas, rail facilities, and railroad bridges.

2. **Critical Infrastructure Asset Group**
    - **Subtypes:** Wastewater treatment facilities, lift stations, stormwater treatment facilities, pump stations, drinking water facilities, water utility conveyance systems, electric production and supply facilities, solid and hazardous waste facilities, military installations, communications facilities, and disaster debris management sites.

3. **Critical Community and Emergency Facilities Asset Group**
    - **Subtypes:** Schools, colleges, universities, community centers, correctional facilities, disaster recovery centers, emergency medical service facilities, emergency operation centers, fire stations, health care facilities, hospitals, law enforcement facilities, local government facilities, logistical staging areas, affordable public housing, risk shelter inventory, and state government facilities.

4. **Natural, Cultural, and Historical Resources Asset Group**
    - **Subtypes:** Conservation lands, parks, shorelines, surface waters, wetlands, and historical and cultural assets.

C.) Data Inputs

1. Critical Asset Datasets

   All asset classes share a common unique identifier: CFRPC_ID. This is a unique number for each critical asset and is the primary tool used for all joins, summaries, and cross-dataset relationships. Critical assets are organized into the following feature classes:

   a. Point Assets which are identified as:
   CFRPC_PT: critical assets: points. Point assets include: critical infrastructure -

Wastewater treatment facilities; lift stations; stormwater treatment facilities; pump stations; drinking water facilities; water utility conveyance systems; electric production and supply facilities; solid and hazardous waste facilities; military installations (none in Highlands County); communications facilities; disaster debris management sites; critical community and emergency facilities - schools, colleges, universities, community centers, correctional facilities, disaster recovery centers, emergency medical service facilities, emergency operation centers, fire stations, health care facilities, hospitals, law enforcement facilities, local government facilities, logistical staging areas, affordable public housing, risk shelter inventory, and state government facilities; and Natural, Cultural, and Historical Resources - Conservation lands, parks, shorelines, surface waters, wetlands, and historical and cultural assets.

b. Polyline Assets which are identified as:

CFRPC_PL- critical assets: general linear assets. Polylines include: electric production and supply facilities; stormwater treatment facilities and pump stations; historical and cultural assets; shorelines; and surface waters.

c. Transportation Polyline Assets which are identified as:

CFRPC_PL_TRANS_critical assets: transportation linear assets. These assets include: bridges; major roadways; and rail facilities.

d. Polygon Assets which are identified as:

CFRPC_PG: critical assets: polygon areas. Polygons include: stormwater treatment facilities and pump stations; conservation lands; historical and cultural assets; parks; surface waters; and wetlands.

2. Rainfall Induced Flooding Rasters

These rasters represent rainfall-driven flooding based on modeling exclusively created for the 100-, 200-, and 500-year events for the current year, 2040, and 2070 forecast year's exposure analysis by HighTide (subcontractor for the CFRPC).

All raster datasets were synced to a common coordinate system, resolution, and vertical unit (feet, Foot_US) prior to analysis.

- **100-Year Rainfall Events (Current, 2040, 2070):** For the 100-year rainfall event, the analysis relies on the modeling completed by HighTide developed for the 100-year rainfall event surfaces for:
    - Current-year conditions
    - 2040 forecast conditions
    - 2070 forecast conditions

- **200-Year Rainfall Events (Current, 2040, 2070):** For the 200-year rainfall event, the analysis relies on the modeling completed by HighTide developed for the 200-year rainfall event surfaces for:

- Current-year conditions
- 2040 forecast conditions
- 2070 forecast conditions

- **500-Year Rainfall Events (Current, 2040, 2070):** For the 500-year rainfall event, the analysis relies on the modeling completed by HighTide developed for the 500-year rainfall event surfaces for:
    - Current-year conditions
    - 2040 forecast conditions
    - 2070 forecast conditions

D.) Exposure Analysis

Critical assets exposure analysis within Highlands County uses four primary geometry types (Points, Polylines, Transportation Polylines, and Polygons) to quantify modeled flood depths and spatial extent of inundation at the asset level using depth, ponding, and drain flow rasters for multiple rainfall return periods and planning horizons. Each geometry type was handled in a consistent and intentional manner to support the exposure analysis.

- **Point Assets**

  Point features represent assets with a discrete geographic location (e.g. facilities or site-specific infrastructure). These point locations were used directly for both exposure analysis. Flood exposure values were extracted at the point location.

  Exposure Analysis Specific Fields include:

  - 100-Year
    - RF_100YR_2025 (Rain flow 100-Year 2025 Scenario)
    - RF_100YR_2040 (Rain flow 100-Year 2040 Scenario)
    - RF_100YR_2070 (Rain flow 100-Year 2070 Scenario)

  - 200-Year
    - RF_200YR_2025 (Rain flow 200-Year 2025 Scenario)
    - RF_200YR_2040 (Rain flow 200-Year 2040 Scenario)
    - RF_200YR_2070 (Rain flow 200-Year 2070 Scenario)
    -

  - 500-Year
    - RF_500YR_2025 (Rain flow 500-Year 2025 Scenario)
    - RF_500YR_2040 (Rain flow 500-Year 2040 Scenario)
    - RF_500YR_2070 (Rain flow 500-Year 2070 Scenario)

- **Polyline Assets**

General polyline features represent linear assets such as utilities, irrigation canals, ditches, trails, etc. For exposure purposes, a single representative point was generated at the midpoint of each polyline feature. This midpoint was used to obtain the modeled flood exposure values.

Exposure Analysis Specific Fields include:

- 100-Year
  - RF_100YR_2025 (Rain flow 100-Year 2025 Scenario)
  - RF_100YR_2040 (Rain flow 100-Year 2040 Scenario)
  - RF_100YR_2070 (Rain flow 100-Year 2070 Scenario)

- 200-Year
  - RF_200YR_2025 (Rain flow 200-Year 2025 Scenario)
  - RF_200YR_2040 (Rain flow 200-Year 2040 Scenario)
  - RF_200YR_2070 (Rain flow 200-Year 2070 Scenario)
  -

- 500-Year
  - RF_500YR_2025 (Rain flow 500-Year 2025 Scenario)
  - RF_500YR_2040 (Rain flow 500-Year 2040 Scenario)
  - RF_500YR_2070 (Rain flow 500-Year 2070 Scenario)

- **Transportation Polyline Assets**

  Transportation features were treated consistently with other linear assets. A midpoint was generated for each transportation polyline, and that midpoint served as the representative location for flood exposure extraction values. This approach ensures uniform treatment across linear asset classes while maintaining a clear spatial reference.

  Exposure Analysis Specific Fields include:

  - 100-Year
    - RF_100YR_2025 (Rain flow 100-Year 2025 Scenario)
    - RF_100YR_2040 (Rain flow 100-Year 2040 Scenario)
    - RF_100YR_2070 (Rain flow 100-Year 2070 Scenario)

  - 200-Year
    - RF_200YR_2025 (Rain flow 200-Year 2025 Scenario)
    - RF_200YR_2040 (Rain flow 200-Year 2040 Scenario)
    - RF_200YR_2070 (Rain flow 200-Year 2070 Scenario)
    -

  - 500-Year
    - RF_500YR_2025 (Rain flow 500-Year 2025 Scenario)
    - RF_500YR_2040 (Rain flow 500-Year 2040 Scenario)

- RF_500YR_2070 (Rain flow 500-Year 2070 Scenario)

- **Polygon Assets**

  Polygon features represent areal assets such as facilities, campuses, or other spatially extensive features. For exposure analysis, a centroid was calculated for each polygon. The centroid location was used to extract flood exposure values.

  Exposure Analysis Specific Fields include:

  - 100-Year
    - RF_100YR_2025 (Rain flow 100-Year 2025 Scenario)
    - RF_100YR_2040 (Rain flow 100-Year 2040 Scenario)
    - RF_100YR_2070 (Rain flow 100-Year 2070 Scenario)

  - 200-Year
    - RF_200YR_2025 (Rain flow 200-Year 2025 Scenario)
    - RF_200YR_2040 (Rain flow 200-Year 2040 Scenario)
    - RF_200YR_2070 (Rain flow 200-Year 2070 Scenario)
    -
  - 500-Year
    - RF_500YR_2025 (Rain flow 500-Year 2025 Scenario)
    - RF_500YR_2040 (Rain flow 500-Year 2040 Scenario)
    - RF_500YR_2070 (Rain flow 500-Year 2070 Scenario)

  Single Point Rationale: Using a single representative point for each asset ensures methodological consistency across asset types, simplifies exposure results, and supports clear interpretation at the planning scale. This approach allows every asset, regardless of geometry, to be evaluated uniformly within the flood exposure modeling framework.

E.) Sensitivity Analysis

The sensitivity analysis provides a context for interpreting exposure results by identifying areas of social vulnerability (SOVI), population distribution, FEMA flood hazard extent, natural environmental features (hydrological – canals, ditches, stormwater facilities, lakes, rivers, and streams), and exposure inundation. The methodology was applied across Highlands County and results are applicable to all critical assets that were evaluated.

The sensitivity analysis applies to a standardized framework where the inputs are used to derive a relative sensitivity index representing baseline conditions for each exposure rainfall event and forecast year. The inputs needed to determine the Sensitivity Analysis include the following inputs:

1. Social Vulnerability (SOVI)
2. Population Distribution

3. FEMA Flood Hazard Extent
4. Natural Environmental features (hydrological – canals, ditches, stormwater facilities, lakes, rivers, and streams)
5. Exposure Inundation

Inputs 1 through 4 used hexagon grid frameworks to ensure uniform comparison across the County. Hexagons intersecting the regional boundary were retained while open-water areas (lakes, reservoirs) were removed. Wetlands were also retained. Each hexagon serves as a container for aggregated scores derived from multiple assets. Input 5 was developed by computing inundation exposure percentages.

1. Social Vulnerability (SOVI)

   SOVI data at the Census tract level were spatially joined to a hexagon grid. Each hexagon was assigned a SOVI score based on a five-class system from low to high.

Table 1: SOVI Scoring

SOVI Class	Score
Low	1
Medium Low	2
Medium	3
Medium High	4
High	5

2. Population Distribution

   Population was estimated using Census block data and redistributed into hexagons through a weighted point-based approach. Hexagon population totals were then classified into a five-tier score reflecting relative population concentration.

Table 2: Population Scoring

Score	Population
1	0 to 100
2	101 - 400
3	401 - 700
4	701 – 1,000
5	1,001 – 4,100

3. FEMA Flood Hazard Extent

   FEMA 100-year and 500-year flood zones were combined and summarized within each hexagon after removing open-water areas. The percentage of each hexagon intersecting

flood hazard zones was calculated and translated into five-class flood sensitivity scores. The scores are reflected in Table 3.

Table 3: FEMA Scoring

Score	Percentage Flood Zone
1	0 - 1%
2	1.01 25%
3	25.01 – 49.99%
4	50 – 74.99%
5	75 – 100%

4. Natural Environmental (Hydrology) Factors

   Environmental sensitivity was captured by incremental scoring hexagons intersecting natural environmental hydrological features including wetlands, lakes, and rivers. Coastal boundaries and coastal erosion/critical erosion zones are not applicable as Highlands County is an inland county.

Table 4: Intersecting Natural Hydrology Scoring

Boundary Touching	Score	*Coastal*
Every Hexagon	1	-
Lakes and Wetlands	2	-
River	3	-
Ocean and Lagoons	4	*Not applicable*
Coastline	5	*Not applicable*

5. Exposure Inundation

   Inundation Hazard Inputs (Rainfall-Based Surfaces Only)

   Flood exposure is derived from modeled rainfall depth rasters as discussed earlier representing storm intensity and projected climate conditions. Surfaces were generated for the following:

   Storm Recurrence Intervals (provided for each planning horizon)

   - 100-year
   - 200-year
   - 500-year

   Planning Horizons

   - Current
   - 2040
   - 2070

The rasters represent expected rainfall depth and intensity under present and future climate scenarios. They serve as the foundation hazard layer for inundation analysis.

a. Percent Inundation Computation (Raster-to-Polygon Method)

To compute inundation percentages, rainfall depth rasters were first converted into area polygon surfaces. This provides for area-based spatial intersection with critical asset geometries. The process is described as follows. The asset polygons are separated from various area polygon surfaces used for analysis. Different analyses were run on the four asset groups utilizing various geoprocesses, scripts, tools, temporary features, and tables. Ultimately, the analyses and results are always ascribed and populated back to the primary four asset features. Any working and temporary tables or asset features (like the area polygon surfaces) used during analysis processes are temporary and simply are referenced to clarify the process used. The geometries refer to the Point Assets (PT), Polyline Assets (PL), Transportation Polyline (PLT), and Polygon Assets (PG).

Process Overview

- Rainfall depth rasters were converted to polygon flood extent layers.
- Each asset geometry was spatially intersected with the inundation polygons.
- The area of inundated portions was calculated.
- Percent inundation was computed as:

$$Percent\ Inundated = \frac{Area\ of\ Asset\ Intersecting\ Flood\ Polygon}{Total\ Asset\ Area} \times 100$$

Advantages to this Approach

This method produces proportional inundation, avoiding sampling bias and ensuring percentage exposure values which are important for large polygons and complex asset footprints.

Scenario-Specific Fields include:

- 100-Year
  - PCT_100_C (Percent 100-Year Current Scenario)
  - PCT_100_40 (Percent 100-Year 2040 Scenario)
  - PCT_100_70 (Percent 100-Year 2070 Scenario)
- 200-Year
  - PCT_200_C (Percent 200-Year Current Scenario)
  - PCT_100_40 (Percent 200-Year 2040 Scenario)
  - PCT_100_70 (Percent 200-Year 2070 Scenario)
- 500-Year
  - PCT_500_C (Percent 500-Year Current Scenario)

- PCT_100_40 (Percent 500-Year 2040 Scenario)
- PCT_100_70 (Percent 500-Year 2070 Scenario)

b. Risk-Sensitive Exposure Scoring (0-5 Scale)

Percent inundation values are translated into a non-linear risk-sensitive exposure score, indicating that higher flood coverage increases risk at an accelerated rate. The scale in Table 5 ensures partial flooding does not over inflate risk, while near-total inundation is prioritized.

Table 5: Percent Inundated Exposure Score Interpretation

Percentage %	Score	Level of Exposure
0%	0	None
>0 – 10%	1	Minimal
>10 – 30%	2	Low
>30 – 60%	3	Moderate
>60 – 90%	4	High
>90 – 100%	5	Severe

c. Sensitivity Calculation

The final sensitivity score integrates: Social Vulnerability (1-5), Population Distribution (1-5), FEMA Flood Hazard Extent (1-5), Natural Environmental (Hydrology) features (1-5), and exposure Inundation (0-5).

Formula

Sensitivity = Social Vulnerability (1-5) + Population Distribution (1-5) + FEMA Flood Hazard Extent (1-5) + Natural Environmental (Hydrology) features (1-5) + and exposure Inundation (0-5).

Table 6: Sensitivity Scoring

Factor	Scoring
SOVI	1-5
Population Distribution	1-5
FEMA Flood Hazard Extent	1-5
Natural Environmental (Hydrology) Features	1-5
Exposure Inundation	0-5
Total Possible Sensitivity Score	***Up to 25***

Scenario-specific total score fields include:

- 100-Year
  - STOT_100_C (Sensitivity Total 100-Year Current Scenario)
  - STOT_100_40 (Sensitivity Total 100-Year 2040 Scenario)
  - STOT_100_70 (Sensitivity Total 100-Year 2070 Scenario)
- 200-Year
  - STOT_200_C (Sensitivity Total 200-Year Current Scenario)

        - STOT_100_40 (Sensitivity Total 200-Year 2040 Scenario)
        - STOT_100_70 (Sensitivity Total 200-Year 2070 Scenario)
    - 500-Year
        - STOT_500_C (Sensitivity Total 500-Year Current Scenario)
        - STOT_100_40 (Sensitivity Total 500-Year 2040 Scenario)
        - STOT_100_70 (Sensitivity Total 500-Year 2070 Scenario)

This provides that:

- Highly sensitive assets escalate in priority.
- Moderate flood exposure can yield high overall risk.
- Final rankings reflect both hazard magnitude and asset consequences.

F.) Exposure-Sensitivity Summary

Table 7 summaries how exposure metrics and sensitivity are used together. Assets inherit the sensitivity score of the hexagon in which they are located, allowing asset-level exposure to be interpreted within a broader regional context.

Table 7: Exposure-Sensitivity Crosswalk Table

Component	Spatial Unit	Primary Metrics	Purpose
Exposure Analysis	Asset (point, line, polygon)	Depth (MIN / MEAN / MAX), % Exposed	Quantifies physical flood impact
Sensitivity Analysis	Hexagon	Composite sensitivity score (1–5)	Provides regional vulnerability context
Integrated Review	Asset + Hexagon	Exposure metrics + Sensitivity score	Supports prioritization and decision-making

1. <u>Consultant Attribution and Data Sources</u>

   All datasets were reviewed, standardized, and integrated by CFRPC staff using ArcGIS Pro-based workflows.

2. <u>Considerations and Appropriate Use</u>

   This methodology is subject to the following considerations.

   - Modeled flood depths represent scenario-based conditions, not observed events.
   - Sensitivity scores are relative, dependent on classification thresholds and input data resolution.
   - SOVI represents baseline social conditions and does not reflect future demographic change.
   - Results should be interpreted as planning-level indicators, not site-specific engineering determinations.

   The sensitivity analysis produces a relative index. This is designed to support comparative planning, prioritization, and contextual interpretation. When paired with asset-level exposure

results, the sensitivity analysis provides where exposure intersects with social, environmental, and hazard-related vulnerabilities, supporting more informed mitigation and investment strategies.

3. Integrating Exposure and Sensitivity Analyses for Planning Decisions

   Exposure and Sensitivity serve distinct, but complimentary roles within the modeling framework.

   Exposure analysis identifies how much flooding a critical asset could potentially experience under a given rainfall scenario.

   Sensitivity analysis identifies how sensitive the surrounding area is to flooding impacts based on social vulnerability (SOVI), population distribution, FEMA flood hazard extent, natural environmental features (hydrological – canals, ditches, stormwater facilities, lakes, rivers, and streams), and exposure inundation.

   By evaluating exposure and sensitivity together, critical assets may be prioritized not solely on modeled depth, but on contextual importance and potential impacts. Example applications include:

   - Prioritizing mitigation for assets with high exposure located within high-sensitivity hexagons.
   - Identifying critical assets with moderate exposure but elevated social or environmental (hydrological) sensitivity.
   - Supporting funding, phasing, and project justification decision.

III. Asset Refinement Methodology

A. Background

Section II outlined the overall methodology for exposure and sensitivity analyses, which included information regarding all critical assets. This section addresses the refinement of assets by asset features. The refinement of assets was completed due to the following:

- Mindful of budget for project design plan development with cost estimates, it is likely that only priority assets will be included in the design plans which are those critical to protect public health and safety, for example water quality components because bacteria in the water can impact public health and safety.

- It was determined that it is better to narrow down to priority critical flooded assets that are important for the community at this stage and create a refined dataset rather than try to separate this out later in the project.

Appendices A and B provide the **detailed spreadsheets** outlining all critical assets by asset features including Asset Points, Asset Polylines, Asset Transportation Polylines, and Asset Polygons. This refinement has been completed through an iterative process to help identify and prioritize the Adaptation Action Areas (AAAs). For the methodology to yield the best results, there is a need to refine critical asset data gathered for the vulnerability assessment (which casts a broad net to gather all information available) down to a subset that will meet the project objectives for the AAAs.

Appendix A provides the master Excel workbook containing asset feature spreadsheets with colors indicating levels of refinement. There is also a "NOTES" column in the spreadsheet indicating determinations made by the local government or CFRPC for inclusion or removal to the final AAA assets.

Appendix B provides the refined asset Excel workbook containing asset feature spreadsheets. These spreadsheets are the remaining critical assets following the refinement process.

AAA boundaries may be drawn based on the critical assets remaining based on this refinement.

The Baseline Critical Asset dataset, which was identified in Section II of this methodology include four asset groups and their associated subtypes.

1. **Transportation Assets and Evacuation Routes Asset Group**
    - **Subtypes:** Airports, bridges, bus terminals, ports (not applicable in Highlands County which is an inland county), major roadways, marinas, rail facilities, and railroad bridges.

2. **Critical Infrastructure Asset Group**
    - **Subtypes:** Wastewater treatment facilities, lift stations, stormwater treatment facilities, pump stations, drinking water facilities, water utility conveyance systems, electric production and supply facilities, solid and hazardous waste facilities, military installations, communications facilities, and disaster debris management sites.

3. **Critical Community and Emergency Facilities Asset Group**
    - **Subtypes:** Schools, colleges, universities, community centers, correctional facilities, disaster recovery centers, emergency medical service facilities, emergency operation centers, fire stations, health care facilities, hospitals, law enforcement facilities, local government facilities, logistical staging areas, affordable public housing, risk shelter inventory, and state government facilities.

4. **Natural, Cultural, and Historical Resources Asset Group**
    - **Subtypes:** Conservation lands, parks, shorelines, surface waters, wetlands, and historical and cultural assets.

B. Refining Critical Assets

An overview of the list for refining critical asset data (points, polylines, transportation polylines, and polygons) is provided after this section. Details by asset features are provided after this section.

1. Remove non-flooded assets. Keep if Exposure is greater than zero (>0), remove all assets where Exposure = 0. This was determined for the 500-year 2040 scenario.

2. Ground truth remaining assets on a case-by-case basis to identify what should be grouped or removed based on decisions and expertise and local knowledge from Highlands County, its municipalities, and the CFRPC.

3. The following actions were taken to refine the critical assets.
    a. If the asset is a private well which only serves one business, then remove.

    b. If there are multiple components of the same asset, they are grouped into one asset.

    c. Remove assets where the County does not have authority to make improvements, so assets don't artificially weigh areas with projects that are not appropriate to be included in Task 4 (i.e., regional rail, private communication towers).

    d. Removal of natural, cultural, and historic sites apply on a case-by-case judgement. Consultation with the County and its municipalities was conducted to decide if this is an asset where they would be likely to develop a project to protect assets from flooding.

Asset Features

Refinement by asset feature is provided below. Asset features are: 1) Point Assets; 2) Polyline Assets; 3) Transportation Polylines Assets and 4) Polygon Assets. Each are described below along with the methodology for refinement for each.

1. **Point Assets** which are identified as: CFRPC_PT: critical assets: points. Point assets include: critical infrastructure - Wastewater treatment facilities; lift stations; stormwater treatment facilities; pump stations; drinking water facilities; water utility conveyance systems; electric production and supply facilities; solid and hazardous waste facilities; military installations (none in Highlands County); communications facilities; disaster debris management sites; critical community and emergency facilities - schools, colleges, universities, community centers, correctional facilities, disaster recovery centers, emergency medical service facilities, emergency operation centers, fire stations, health care facilities, hospitals, law enforcement facilities, local government facilities, logistical staging areas, affordable public housing, risk shelter inventory, and state government

facilities; and Natural, Cultural, and Historical Resources - Conservation lands, parks, shorelines, surface waters, wetlands, and historical and cultural assets.

POINT ASSET REFINEMENT:

Appendix A provides the master Excel workbook containing asset feature spreadsheets with colors indicating levels of refinement. There is also a "NOTES" column in the spreadsheet indicating determinations made by the local government or CFRPC for inclusion or removal to the final AAA assets.

Appendix B provides the refined asset Excel workbook containing asset feature spreadsheets. These spreadsheets are the remaining critical assets following the refinement process.

The guide for color coding for Appendix A is provided below.

Yellow Highlighting:

All assets that have no exposure in the scenario of the 500 year flood in the year 2040. Remove non-flooded assets. Keep if Exposure is greater than zero (>0), remove all assets where Exposure = 0. This was determined for the 500-year 2040 scenario. This is reflected in the "RF_500YR_2040" field in Appendix A.

Pink Highlighting:

Private flooded assets including: private wells that serve RV parks, single businesses, mobile home parks, private business, private communication towers, residences, and other assets. Removal of rail facilities that are not county-owned.

Blue Highlighting:

Private flooded assets that remain due to their significance and community benefit were removed.

Purple Highlighting:

Public assets removed because of minimal impact to public safety and health at time of flood. These assets include communication towers (where design solutions exists), private residences (now owned by public entities), community centers, dams, drainage assets, hotel/motel, law enforcement, library, local govt facility, post office, public school, public water system (PWS + Plant), state govt facility, tank (PWS), wastewater facility, and well (PWS), debris staging areas, small quantity generator disposal sites, and boat ramps.

Green Highlighting:

Removed public wells that have plans to prevent flooding, wastewater facility, public water system (PWS-Plant), small quantity generators, community center, shelter, law enforcement, power plant, substation, and fire station. This also includes assets owned by the State or other government entities that are not county or municipal.

2. **Polyline Assets** which are identified as: CFRPC_PL- critical assets: general linear assets. Polylines include: electric production and supply facilities; stormwater treatment facilities and pump stations; historical and cultural assets; shorelines; and surface waters.

POLYLINE ASSET REFINEMENT:

Appendix A provides the master Excel workbook containing asset feature spreadsheets with colors indicating levels of refinement. There is also a "NOTES" column in the spreadsheet indicating determinations made by the local government or CFRPC for inclusion or removal to the final AAA assets.
Appendix B provides the refined asset Excel workbook containing asset feature spreadsheets. These spreadsheets are the remaining critical assets following the refinement process.

The guide for color coding for Appendix A is provided below.

Yellow Highlighting:

All assets that have no exposure in the scenario of the 500 year flood in the year 2040. Remove non-flooded assets. Keep if Exposure is greater than zero (> 0), remove all assets where Exposure = 0. This was determined for the 500-year 2040 scenario. This is reflected in the "RF_500YR_2040" field in Appendix A.

Purple Highlighting:

Public/Private assets removed because of impacts to assets the County cannot control. These include: electric production and supply facilities; stormwater facilities; historical and cultural assets including bridges; shorelines; and surface waters.

3. **Transportation Polyline Assets which are identified as:** CFRPC_PL_TRANS_critical assets: transportation linear assets. These assets include: bridges; major roadways; and rail facilities.

TRANSPORTATION POLYLINE ASSET REFINEMENT:

Appendix A provides the master Excel workbook containing asset feature spreadsheets with colors indicating levels of refinement. There is also a "NOTES" column in the spreadsheet indicating determinations made by the local government or CFRPC for inclusion or removal to the final AAA assets.
Appendix B provides the refined asset Excel workbook containing asset feature spreadsheets. These spreadsheets are the remaining critical assets following the refinement process.

The guide for color coding for Appendix A is provided below.

Yellow Highlighting:

All assets that have no exposure in the scenario of the 500 year flood in the year 2040. Remove non-flooded assets. Keep if Exposure is greater than zero (> 0), remove all assets where Exposure = 0. This was determined for the 500-year 2040 scenario. This is reflected in the "RF_500YR_2040" field in Appendix A.

Purple Highlighting:

Roadways owned by FDOT have been removed as the local governments have no control over these roads.

Green Highlighting:

Public roadways that are flooded but are not as identified as EVAC or EVAC SIS.

Red Highlighting:

Private roadways that are flooded and identified as EVAC or EVAC SIS

4. **Polygon Assets which are identified as:** CFRPC_PG: critical assets: polygon areas. Polygons include: stormwater treatment facilities and pump stations; conservation lands; historical and cultural assets; parks; surface waters; and wetlands.

POLYGON ASSET REFINEMENT:

Appendix A provides the master Excel workbook containing asset feature spreadsheets with colors indicating levels of refinement. There is also a "NOTES" column in the spreadsheet indicating determinations made by the local government or CFRPC for inclusion or removal to the final AAA assets.

Appendix B provides the refined asset Excel workbook containing asset feature spreadsheets. These spreadsheets are the remaining critical assets following the refinement process.

The guide for color coding for Appendix A is provided below.

Yellow Highlighting:

All assets that have no exposure in the scenario of the 500 year flood in the year 2040. Remove non-flooded assets. Keep if Exposure is greater than zero (> 0), remove all assets where Exposure = 0. This was determined for the 500-year 2040 scenario. This is reflected in the "RF_500YR_2040" field in Appendix A.

In the case of polygons, all polygons are being removed. They consist of biological stations, canals/ditches, stormwater ponds; cemeteries; conservation lands; historical and cultural assets; parks; surface waters; wetlands, and linear resources such as roads, railroads, levees, ditches, and canals.

Appendix II. GIS-based Methodology

Highland County AAA GIS-based Methodology

The following sections present a comprehensive, GIS-based methodology that expands upon the Highlands County Adaptation Action Area (AAA) report. It provides a detailed, step-by-step guide documenting the spatial analyses, data processing procedures, and criteria used to initially identify the preliminary AAA boundaries. The intent of this document is to ensure transparency, repeatability, and consistency in the boundary development processes, allowing future users to fully understand and replicate the analytical workflow. Table 1 details the weighting scheme, scoring structure, and category-specific criteria applied in the AAA scoring methodology.

Table 1: Assigned weights for each category of data used in scoring methodology

Weight	Points Total	Category	Subcategory	Score	% out of 100 Points
20%	20	**Asset Group**	Critical Community and Emergency Facilities	10	10%
			Critical Infrastructure	6	6%
			Transportation and Evacuation Routes	4	4%
			Natural, Cultural and Historical Resources	N/A	N/A
			No Information	0	0%
20%	20	**Existing Land Use**	Existing High Density Residential	10	10%
			Existing Commercial/Industrial	6	6%
			Existing Single Family Residential	3	3%
			Existing Open Space and Agricultural	1	1%
			No Information	0	0%
10%	10	**Future Land Use**	Future High Density Residential	4	4%
			Future Commercial/Industrial	3	3%
			Future Single Family Residential	2	2%
			Future Open Space and Agricultural	1	1%
			No Information	0	0%
20%	20	**Asset Exposure**	100-year 2040 inundation	12	12%
			500-year 2040 inundation	8	8%
			Not inundated	0	0%
20%	20	**Asset Sensitivity**	Flood depth exceeds FFE	10	10%
			Flood depth 6 inches or less below FFE	8	8%
			Flood depth more than 6 inches below FFE	2	2%
			No Information	0	0%
10%	10	**Asset Owner**	Public	8	8%
			Private	2	2%
			No Information	0	0%
100%	**100**				**100%**

Phase 1: AAA Scoring Methodology

Step 1.Preparing Data

After all required datasets were collected, they were imported into the GIS environment (ArcGIS Pro) for initial review and preprocessing. The input data included both vector and raster formats:

- **Vector data** (points, polylines, and polygons) representing discrete geographic features such as facilities and infrastructure.
- **Raster data** representing continuous surfaces composed of cells, typically used for environmental or physical variables such as elevation or land cover.

Since the final analysis relies on a raster-based suitability model, all input datasets must be standardized prior to processing. This requires converting vector layers to raster format, establishing a uniform cell size, and assigning appropriate value classifications or weights that align with the analytical framework. Standardizing spatial resolution and value structure ensures that all layers integrate properly and contribute consistently during subsequent analytical steps.

Step 2. Buffer Generation

Buffer distances were assigned based on the scoring structure defined in Table 1. The buffer establishes standardized proximity thresholds for each critical asset category. Three primary asset groups were used as inputs for buffer creation, derived from the following datasets:

- Highlands-Assets_PT_02202026 – 14 locally identified point-based critical assets
- Highlands-Assets_PLT_02202026– roadway segments

Table 2: Asset Subcategory Buffer Distances

Asset Group	Point Buffer (radius)	Polyline Buffer (total width)
Critical Community and Emergency Facilities	5,280 feet	N/A
Critical Infrastructure	4,000 feet	N/A
Transportation and Evacuation Routes	2,000 feet	30 feet

Figure 1 illustrates the distribution of point-based assets, while Figure 2 displays the polyline assets used in buffer generation (buffers not shown for visualization purposes). The asset-specific buffers were generated using the buffer parameters shown in Table 2.

Once all indivudal buffer layers were created, they were combined using the '*Merge*' geoprocessing tool in ArcGIS Pro to produce a single, unified Merged Asset Buffer Layer. This consolidated layer represented the complete set of proximity based influence zones for all critical assets. Figure 3 shows the 'Merge' tool configuration, and Figure 4 presents the final merged buffer output used in later stages of the methodology.

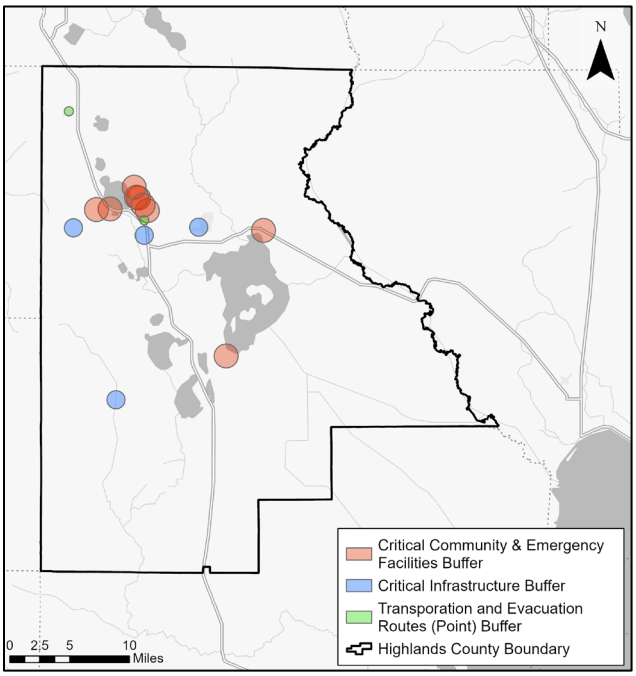

Figure 1: Highlands County Critical Asset – Buffered Points

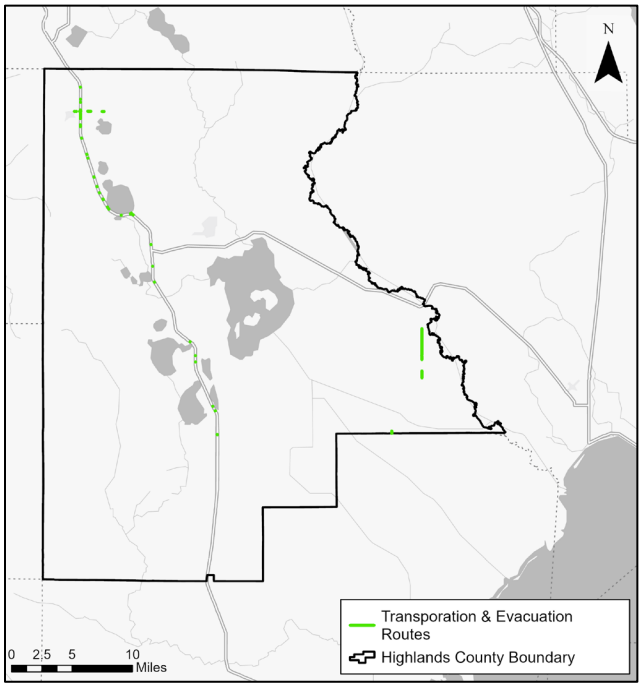

Figure 2: Highlands County Critical Asset Polylines

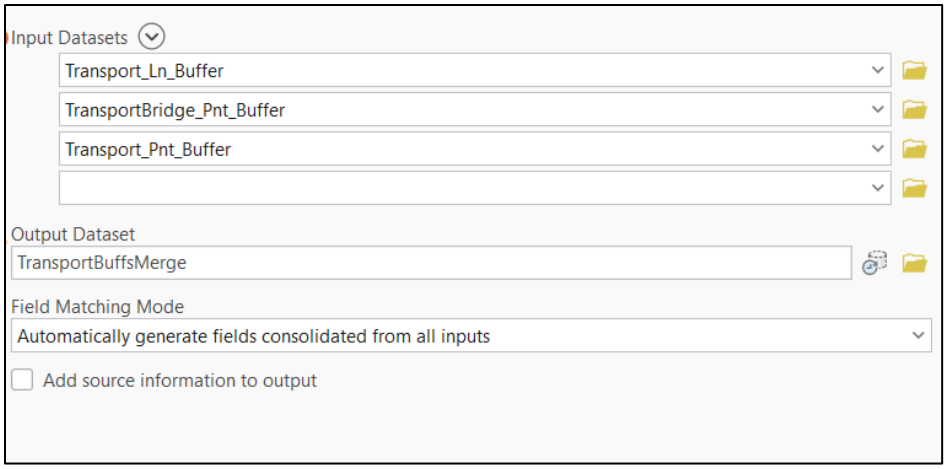

Figure 3: 'Merge' Geoprocessing Tool in ArcGIS Pro

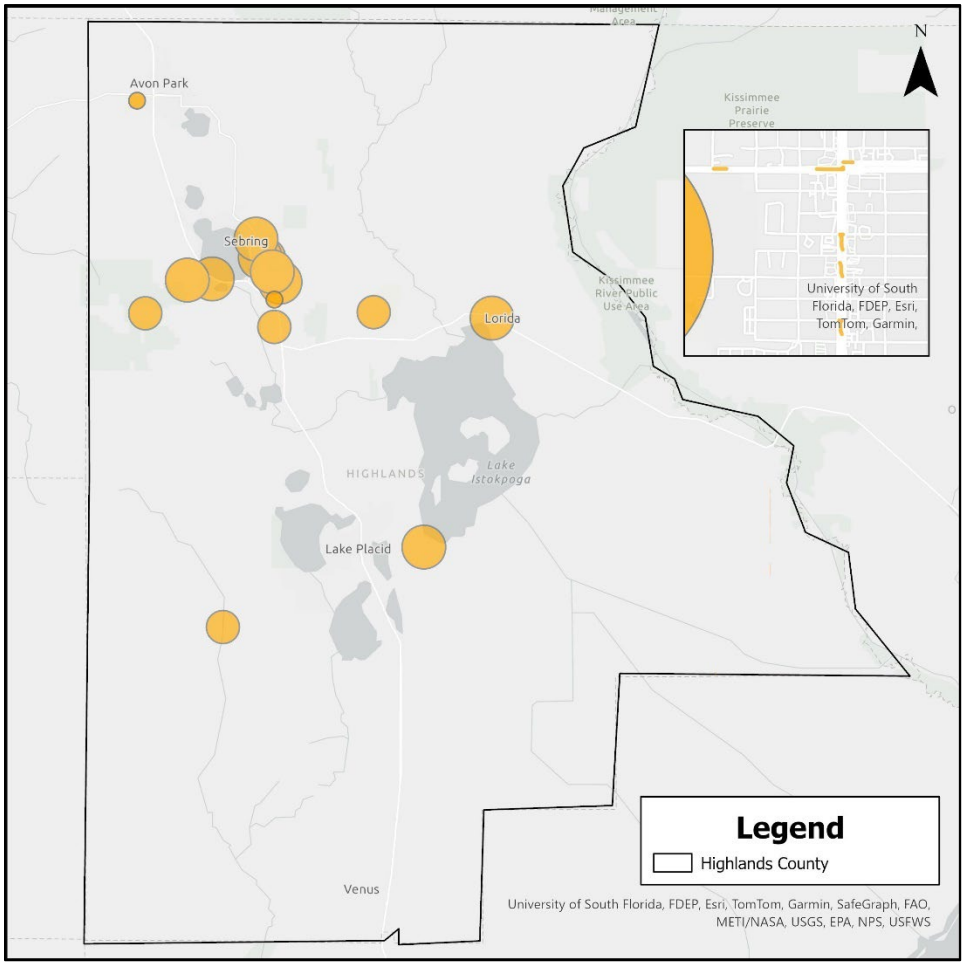

Figure 4: All Highlands County Critical Assets With Buffers; Merged Into a Single Layer

Step 3. Polygon to Raster Conversion

To prepare all spatial inputs for use in the raster-based model, polygon feature layers were converted to raster format using the '*Feature to Raster'* geoprocessing tool in ArcGIS Pro. The following datasets were included in this conversion step:

- Merged Highlands County Assets with buffer
- 2040 100-year Flood Inundation
- 2040 500-year Flood Inundation

To ensure consistency across all outputs, the following raster settings were applied during conversion:

- **Cell Size**: 30 meters (selected as an appropriate resolution for countywide analysis)
- **Processing Extent**: Highland County boundary (to maintain a uniform spatial footprint across all layers)

These settings ensured that each raster dataset shared the same resolution, alignment, and spatial extent, allowing them to overlay seamlessly and contribute comparably to subsequent analysis. Figure 5 shows the '*Feature to Raster'* tool configuration.

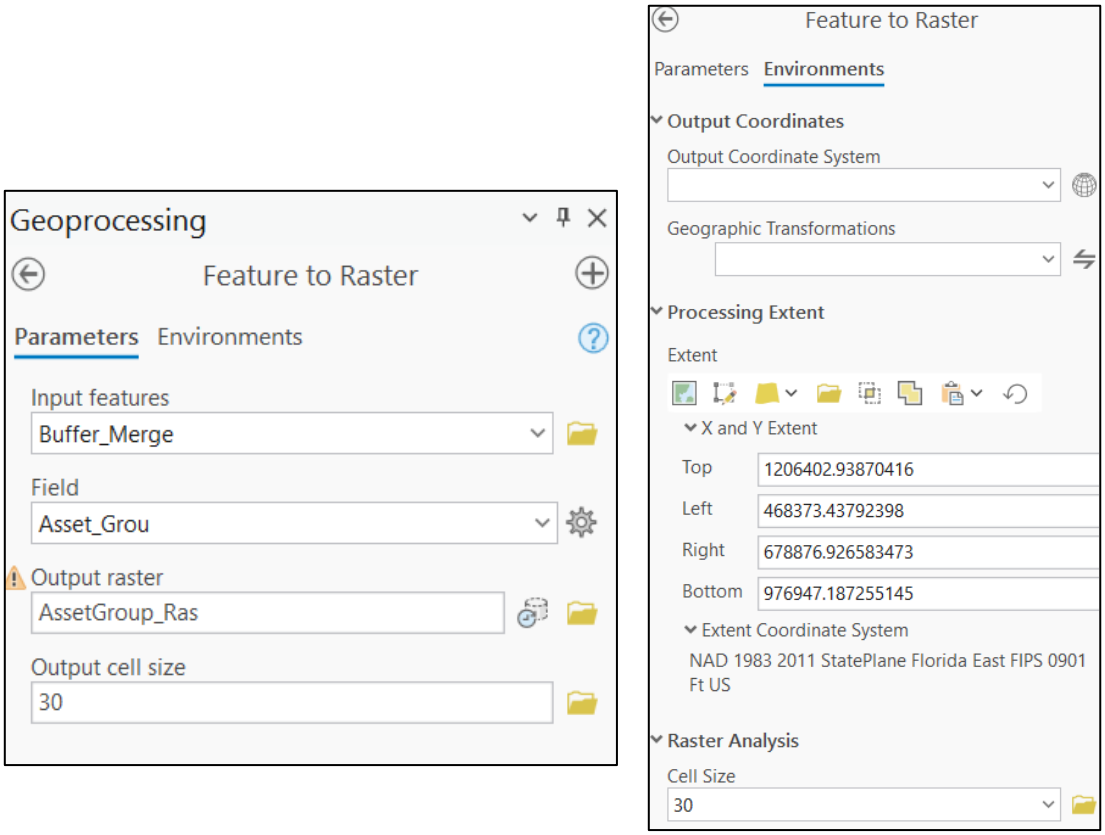

Figure 5: 'Feature to Raster' Tool in ArcGIS Pro

In addition to asset buffer data, several polygon-based categorical datasets were also converted to raster format for inclusion in the analysis. These include:

- Asset Category
- Asset Owner
- Asset Sensitivity
- Existing Land Use
- Future Land Use

The 100-year and 500-year 2040 flood inundation layers were likewise converted to raster format and incorporated into the dataset (Figures 9 and 10).

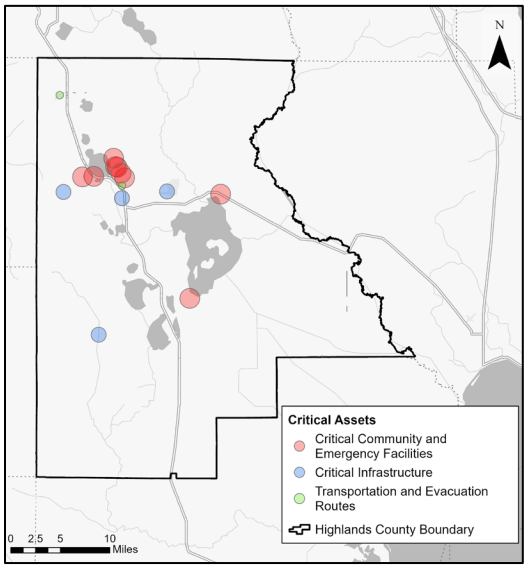

Figure 6: Asset Category

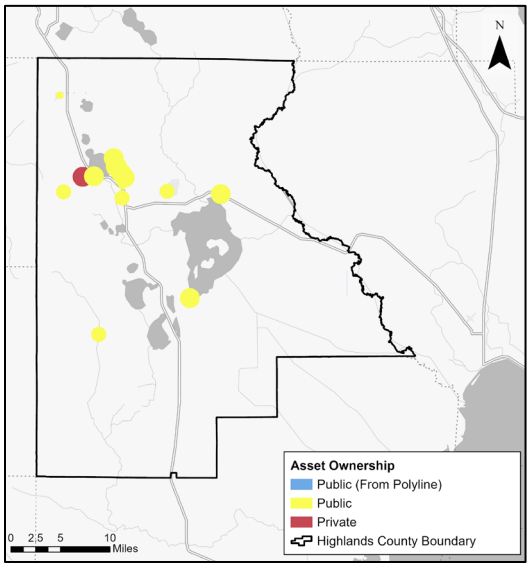

Figure 7: Asset Owner

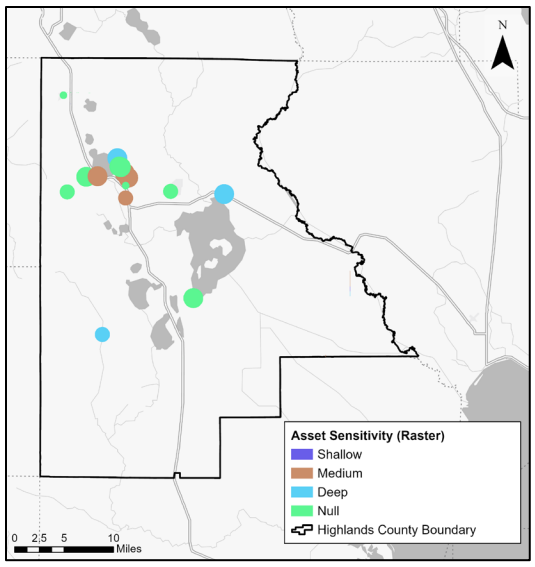

Figure 8: Asset Sensitivity

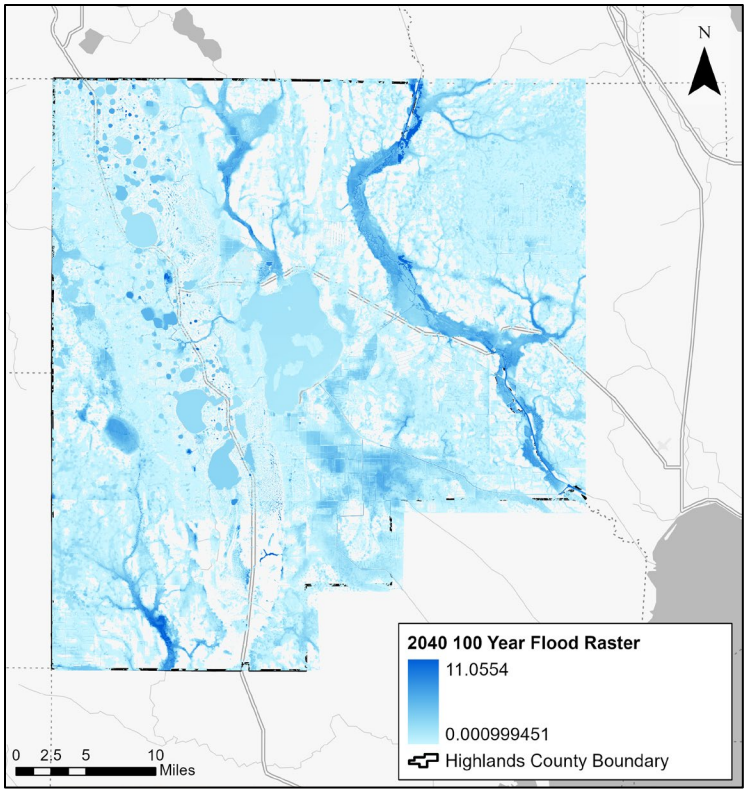

Figure 9: 100-year 2040 flood inundation raster map

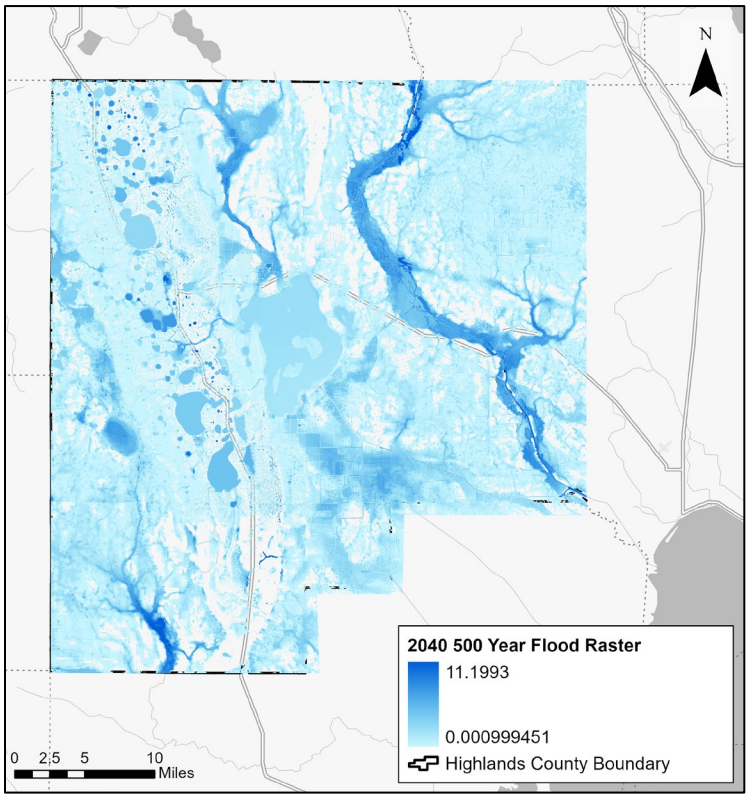

Figure 10: 500-year 2040 flood inundation raster map

Step 4. Reclassify Rasters

Following raster conversion, each dataset was reclassified to match the standardized scoring system defined in Table 1. Reclassification ensures that all raster inputs share a common value structure that can be integrated seamlessly during the weighted overlay stage. During reclassification:

- All valid cells were assigned new values based on the designated suitability scores associated with each category or condition.
- Cells containing 'No Information' or falling outside defined categories were explicitly reassigned a value of 0. This prevents gaps in data coverage and avoids propagation of null values during subsequent operations.

The following raster datasets were reclassified as part of this step:

- Asset Owner
- Asset Sensitivity
- Critical Assets (Merged Asset Buffer Layer)
- 2040 100-year Flood Inundation
- 2040 500-year Flood Inundation
- Existing Land Use
- Future Land Use

The reclassification process was implemented using the '*Reclassify*' geoprocessing tool in ArcGIS Pro (Figure 11). Figures 12 through 18 illustrate individual reclassification outputs for each dataset, depicting how original categorical or numeric values were translated into standardized scores:

- Asset Owner Reclassification (Figure X)
- Asset Sensitivity Reclassification (Figure X)
- Critical Assets (Merged Asset Buffer Layer) Reclassification (Figure X)
- 2040 100-year Flood Inundation Reclassification (Figure X)
- 2040 500-year Flood Inundation Reclassification (Figure X)
- Existing Land Use Reclassification (Figure X)
- Future Land Use Reclassification (Figure X)

Through this process, all raster layers were transformed into consistent, comparable formats, allowing them to be combined accurately in the following step.

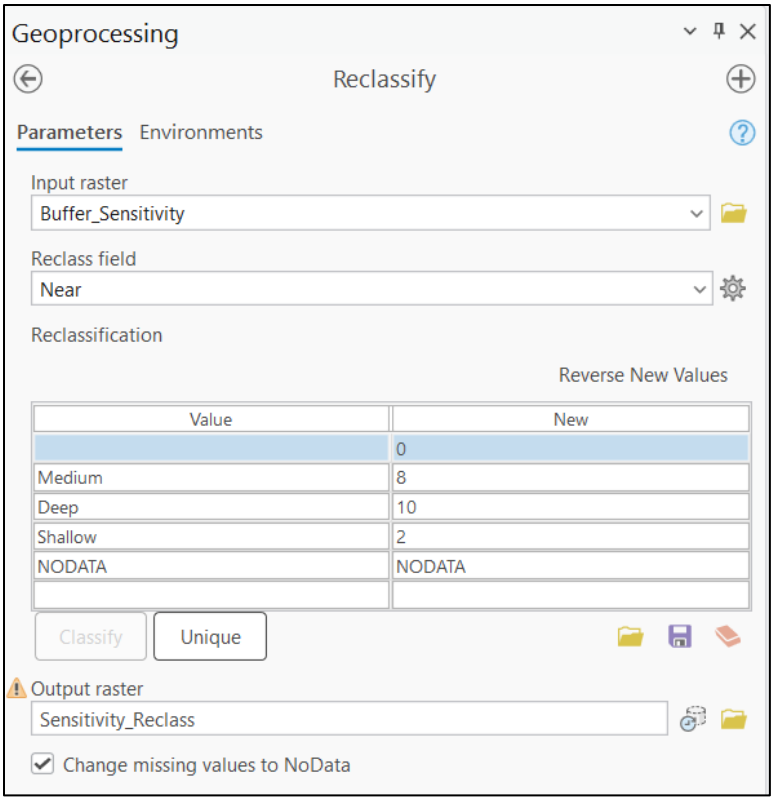

Figure 11: 'Reclassify' Geoprocessing Tool in ArcGIS Pro

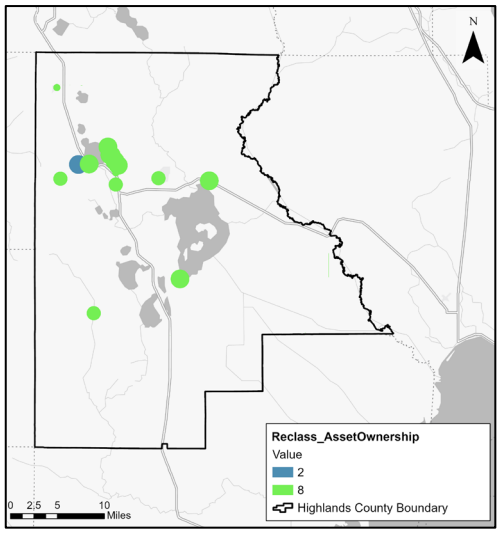

Figure 12: Asset Owner Reclassification

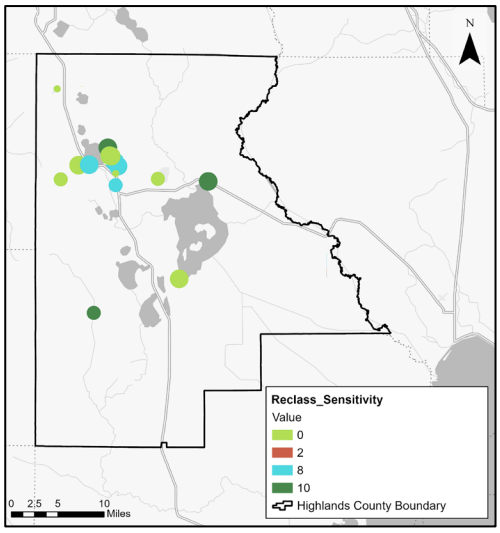

Figure 13: Asset Sensitivity Reclassification

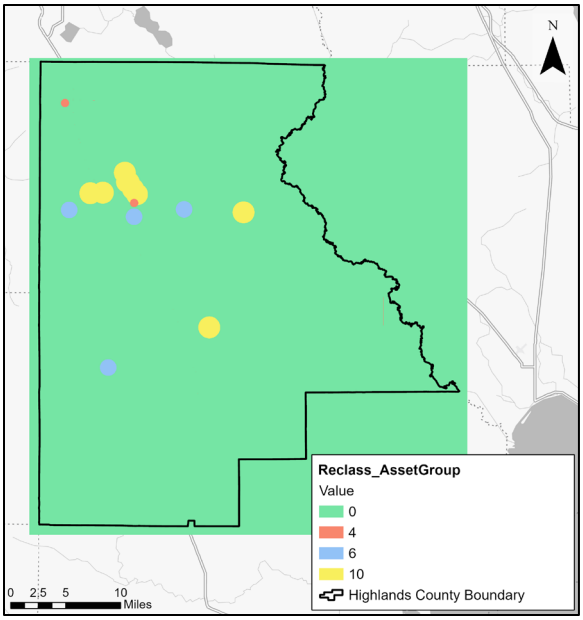

Figure 14: Asset Category

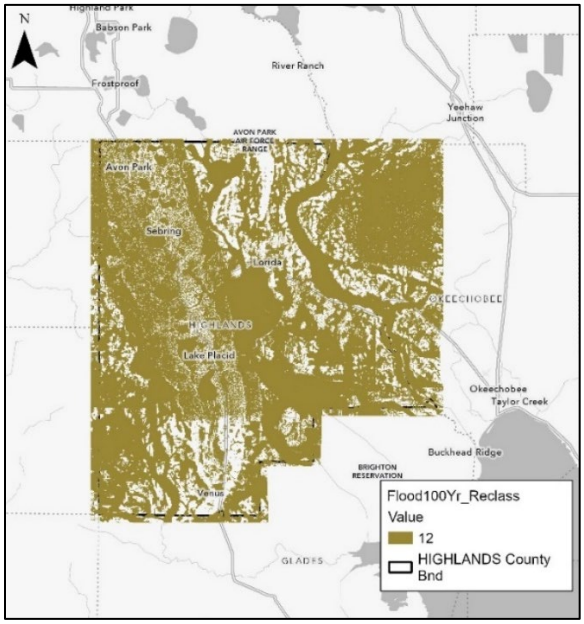

Figure 15: 100-Year 2040 Inundation Reclassification

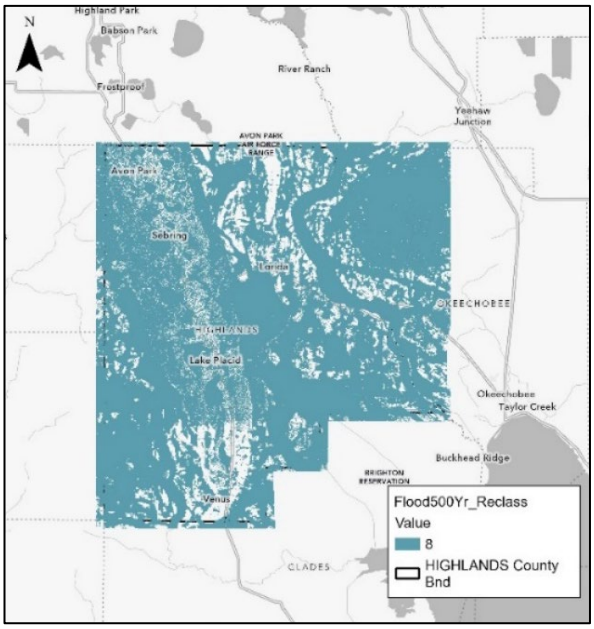

Figure 16: 500-Year 2040 Inundation Reclassification

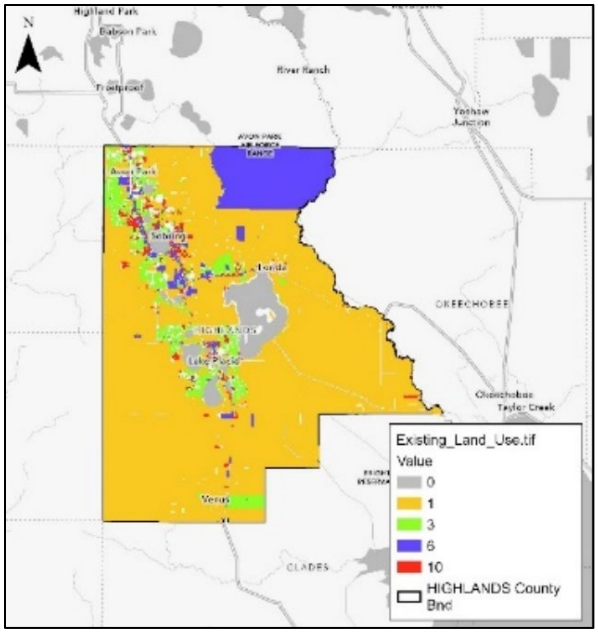

Figure 17: Existing Land Use Reclassification

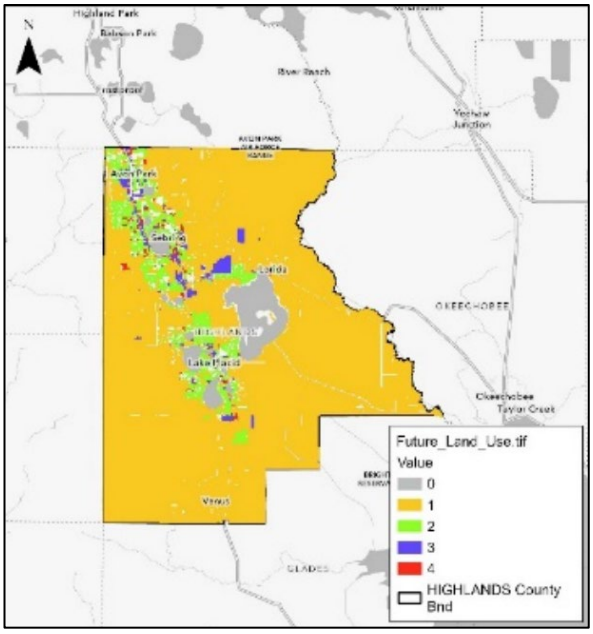

Figure 18: Future Land Use Reclassification

Step 5. Weighted Overlay

The final assessment was completed using the '*Weighted Overlay*' geoprocessing tool in ArcGIS Pro. This tool integrates multiple reclassified raster inputs, each representing a different factor of sensitivity or vulnerability, and evaluates them on a standardized scale. Factor weights, derived from Table 1, determine the influence of each input on the final output.

Key Weighted Overlay Settings:

- **Scale**: 0-12
    - Allows inclusion of zero-value categories
    - Supports maximum flood-related vulnerability scores
- **Processing Extent**: Highlands County boundary
- **Mask**: Highlands County boundary

Setting the processing extent and mask to the Highlands County boundary ensures that (1) only pixels within the study area are included in the final output and (2) all input raster align spatially, eliminating edge artifacts and ensuring consistent coverage across layers. Figure 19 displays the '*Weighted Overlay*' tool parameters.

In addition to the primary settings, several configurations in the Environments tab were required to maintain spatial consistency. Both the Processing Extent and Mask were set to a layer representing the full Highlands County boundary to ensure the final raster:

- Contains output values only within the study area, and
- Retains full coverage for all raster inputs included in the overlay

This configuration supports clean, interpretable results and prevents the generation of unnecessary No Data regions. Figure 20 shows the Environments tab settings used for this step.

Output – The final weighted overlay raster provides:

- A spatially continuous index representing the represented factors
- Identification of locations where multiple contributing factors overlap to create elevated risk conditions

This raster serves as the final product of the suitability analysis and forms the basis for subsequent interpretation and decision support mapping.

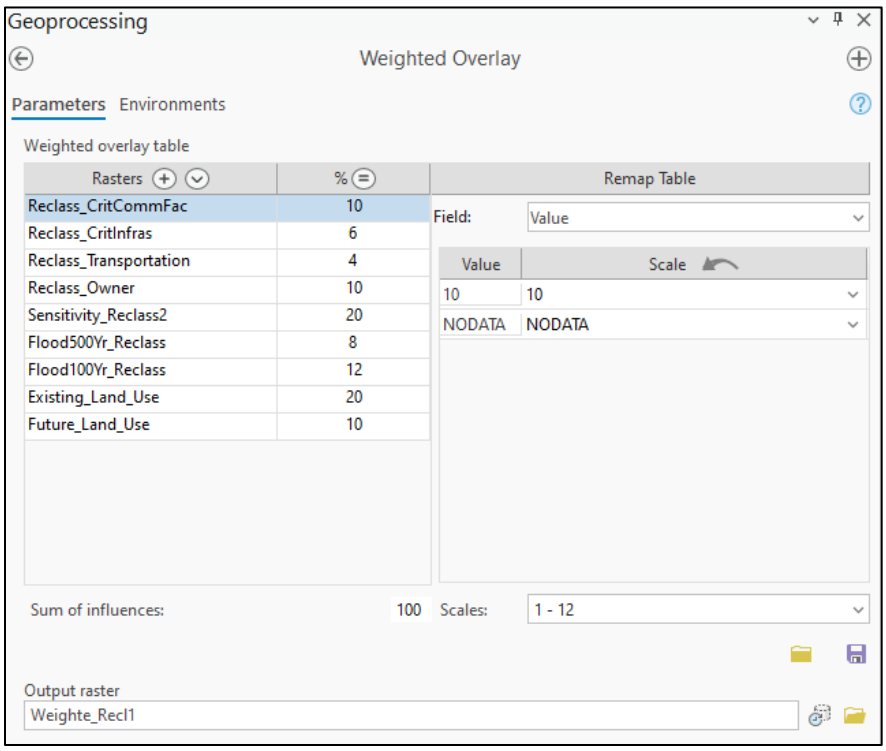

Figure 19: 'Weighted Overlay' Geoprocessing Tool in ArcGIS Pro

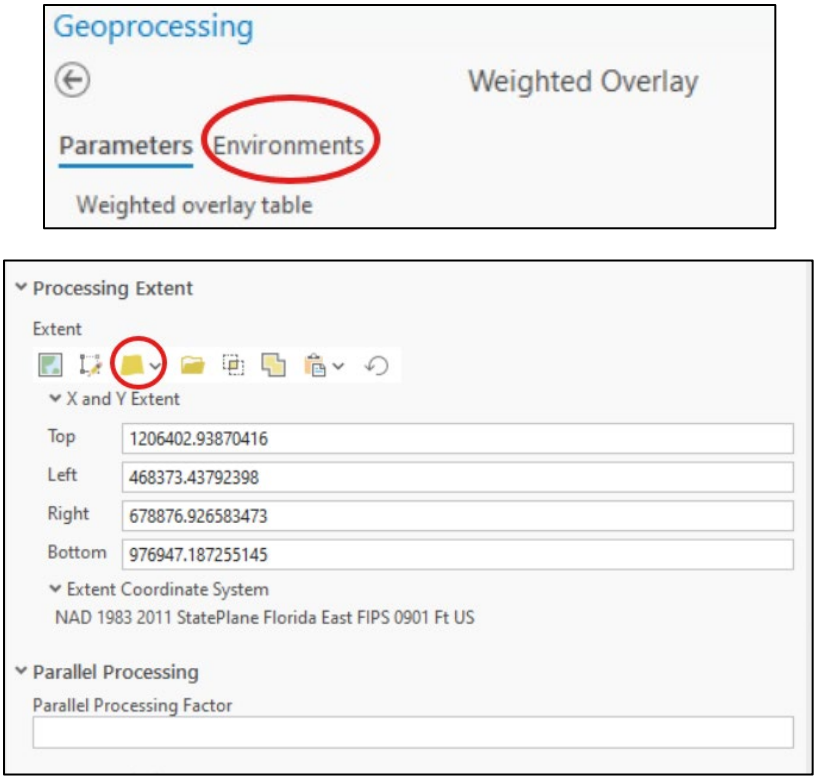

Figure 20: 'Weighted Overlay' Environments Inputs in ArcGIS Pro

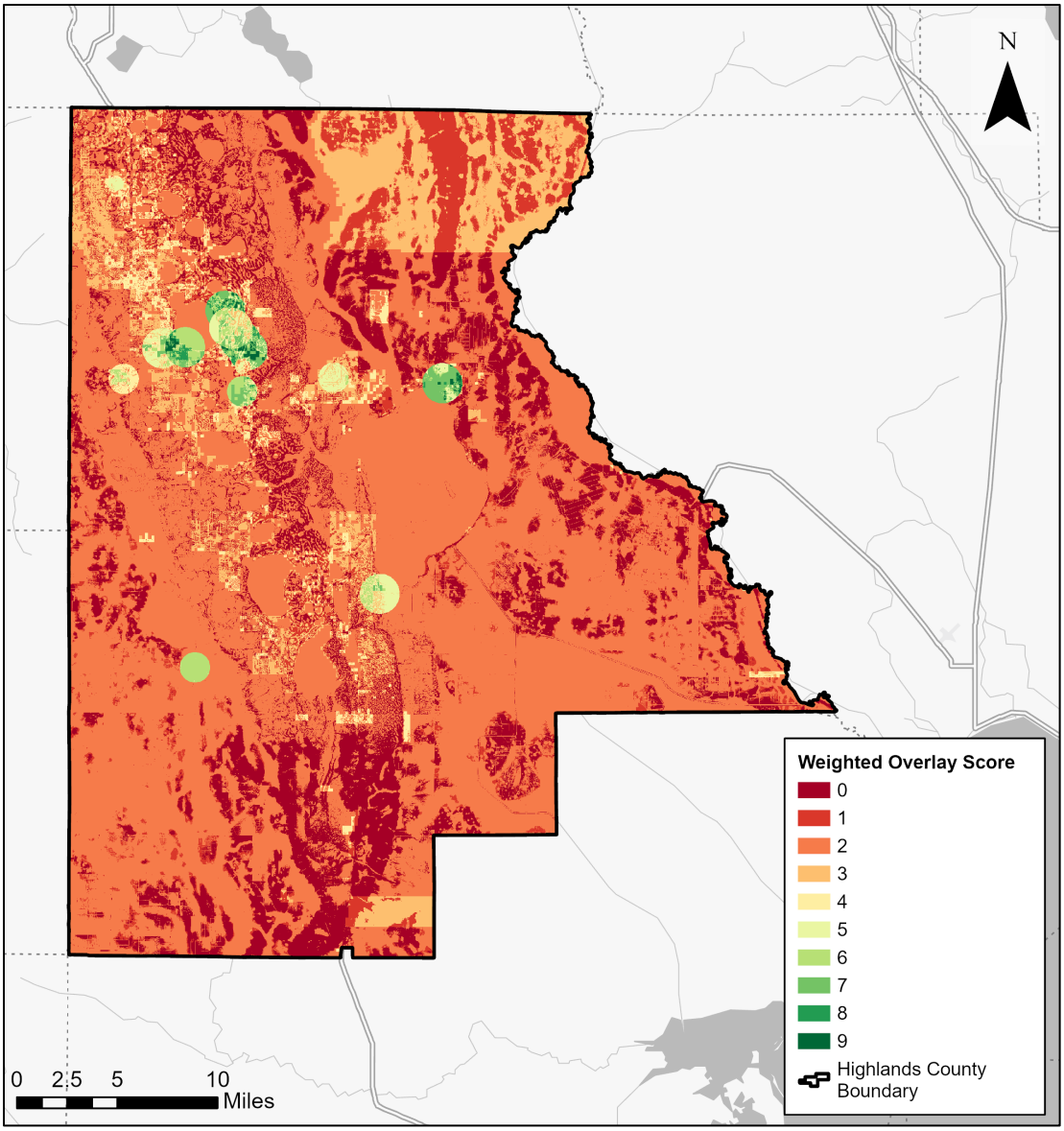

Figure 21: Weighted Overlay AAA Methodology Results

References

[i] Florida Legislature. (2024). Section 380.093 Florida Statutes. Retrieved from: http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&Search_String=&URL=0300-0399/0380/Sections/0380.093.html.

[ii] Highlands County. (2011). Highlands County 2030 Comprehensive Plan. Retrieved from: https://cms2.revize.com/revize/highlandscountyfl/departments/development_services/planning/Highlands_County_2030_Comprehensive_Plan_updated_11.7.2024.pdf?t=202506161129290&t=202506161129290.