User Guide for the Provisional Flash Flood Risk Area Mapping Tool

Purpose

Flash flood risk area maps must identify flash flood-prone areas that may warrant outdoor warning sirens.

Contents

List of Tables

Disclaimer

The Provisional Flash Flood Risk Area Map is a screening-level assessment intended to identify areas that may be susceptible to flash flooding and where outdoor warning sirens may be warranted. It is based on a regional-scale analysis of physical watershed characteristics, available exposure data, and historical information, and does not predict the occurrence, timing, or severity of flash flooding during any specific storm event.

This product should not be used as a predictive or forecasting tool related to flooding. The mapped areas primarily reflect riverine and channel-adjacent flash flood susceptibility and may not capture all forms of localized or pluvial flooding, including flooding away from mapped streams or floodplains. Absence from the mapped areas should not be interpreted as absence of risk.

Results are dependent on the quality, resolution, and recency of available datasets, and are generalized at a 1-kilometer scale. Therefore, they are not intended for site-specific or parcel-level determinations. This product should not be used for regulatory determinations. Identification of areas that may warrant sirens does not ensure siren audibility or effectiveness under all conditions, nor does it replace the need for local knowledge, additional warning methods, or professional judgment. Final decisions regarding outdoor warning siren placement should incorporate local review, field verification, and community-specific considerations.

Data in the Provisional Flash Flood Risk Area Map represents the best information available to the TWDB at the time. The information is not represented in real-time and should not be considered as exact conditions in your area. The TWDB provides information via this website as a public service. Neither the State of Texas nor the TWDB assumes any legal liability or responsibility or makes any guarantees or warranties as to the accuracy, completeness, or suitability of the information for any particular purpose.

1) Introduction

In response to the devastating flash flooding that swept across parts of Texas in July 2025, the Texas Legislature enacted several bills to strengthen the state's preparedness for future flood events. Among them, Senate Bill 3 (SB 3) established requirements for outdoor warning sirens in designated flash flood-prone areas within the 30 counties included in the Governor's disaster declaration. SB 3 directs the Texas Water Development Board (TWDB) to identify the areas within these counties that have a history of consistent or severe flooding and may warrant the installation, maintenance, and operation of one or more outdoor warning siren systems. The legislature further supported this initiative through Senate Bill 5, which provides state-administered financial assistance to help local governments implement siren systems as required under SB 3.

While Texas has extensive flood hazard information, it does not typically indicate the risk of flash flooding. Additionally, conventional flood hazard studies for large regions, such as the 30 counties included in SB 3, would require substantial time and resources to complete. Given these constraints, the TWDB and its contractor developed a GIS-based approach to evaluate and estimate flash flood risk along the channels running through the counties included in SB 3, to produce timely and technically sound flash flood risk information. Multiple physical, geomorphic, hydrologic, land cover, and meteorologic factors were used to estimate the relative likelihood of flash flooding across more than 70,000 miles of channels in the SB 3 counties. This process produced a Flash Flood Hazard Index (FFHI), the results of which were validated against existing flood hazard models, maps, and historical flood data to ensure alignment with observed flooding patterns.

Identifying hazard areas alone is not sufficient to determine where outdoor warning sirens may be warranted; additional information about potential human exposure was also considered. The analysis incorporated population estimates, building footprints, historical flash flood records, and locations where people tend to spend time outdoors. These outdoor areas include camps, campgrounds, RV parks, and public parks along the channels within the SB 3 counties.

The combination of (1) elevated flash flood hazard risk and (2) the potential for human exposure resulted in the identification of Flash Flood Risk Areas (FFRA). These are the locations within the SB 3 counties where both flash flood susceptibility and potential exposure intersect. The provisional FFRA represents where it is estimated that flash flood hazards may pose the greatest risk to people outdoors and where outdoor warning sirens may ultimately be warranted.

The TWDB made the results of this analysis available through an online web map that displays the provisional FFRA. These provisional areas reflect sound analysis but require additional review and refinement based on local knowledge. This review process may include, but is not limited to, addressing data gaps or inconsistencies, or identification of alternative flood early warning systems that the county can demonstrate would be more effective than outdoor warning sirens. The counties included in SB 3, or their officially designated representatives, may submit revisions or supporting information to the TWDB for consideration as part of the process for finalizing the maps.

The purpose of this user guide is to help the 30 counties identified by SB 3 understand and use the Provisional Flash Flood Risk Area web map and associated ArcGIS Project Packages. The guide describes the data and methods used to develop the FFRAs, provides instructions for accessing and interpreting the mapping tool, and outlines the process for submitting feedback and requesting map changes. By combining provisional mapping data with the expertise of local officials, the final FFRA maps will support development of final flash flood risk area maps that identify where outdoor warning sirens are required under SB 3.

Mapping data is shared in the ArcGIS online map viewer (the FFRA online tool) and will be distributed to counties in a forthcoming map package. The map viewer can be found here:

https://arcg.is/1Xmvbe2

For more information, please refer to *Technical Memorandum: Identification of Flash Flood-Prone Areas that warrant Outdoor Warning Sirens*—specifically sections 6–7 and Appendix E that will be available on the TWDB Senate Bill 3 Implementation site.

2) Data Layers and Map Content

a) Data Layers

The table below provides a summary of layers included in the online map viewer as well as the map package. Included in the table below are the names of the layers as they appear in the map viewer/package, their symbols, and a brief description with map scales at which they are visible. It should be noted that not all layers will be visible at all scales. Using the zoom in/out feature, different layers can be viewed.

Layer Name	Symbol	Details
Youth Camps		Visible from 1:320,000 to ground Point features - Approximate address points for Youth Camps sourced from Texas Department of State Health Services, Texas Public Affairs, and external review
RV Parks		Visible from 1:320,000 to ground Point features - Approximate address points for RV Parks sourced from the Texas Association of Campground Owners and Kampgrounds of America.https://gis1.twdb.texas.gov/server/rest/services/WSC-FSCA-FM/Texas_Campgrounds/MapServer
NOAA Flood Records (2001-2025)		Visible from world to 1:40,000 Point features - NOAA Storm Events Database (SED) with recorded fatalities, injuries, or monetary building damages, downloaded February 2026
Building Footprints		Visible from 1:40,000 to ground Polygon features - Polygon shapefile of building footprints to determine exposed buildings/property as locations of known exposure and a proxy for transient populations - Sourced from 2025 Regional Flood Planning Group Building Footprints

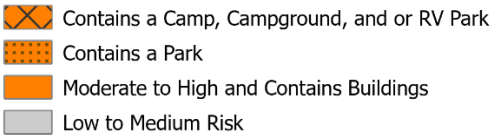
Parks		Visible from 1:320,000 to ground Polygon features - Park footprints - Sourced from Texas Parks and Wildlife Department (TPWD) Land and Water Resources Conservation and Recreation Plan (LWRCRP) Statewide 2012 Inventory Data; released October 2022, downloaded January 2026
USGS Stream Gages		Visible from 1:750,000 to ground Point layer - Stream gage observations of stage height and discharge contributed by the global GIS community - Sourced from ESRI Living Atlas
Meteorological Gaging Stations (Mesonet Stations)		Visible from 1:750,000 to ground Point layer - A comprehensive, state-wide network of automated weather stations - Sourced from TexMesonet
High Water Marks (2014)		Visible from 1:750,000 to ground Point layer - Post-storm high water marks and flood impacts from multiple sources - Sourced from TxGIO Texas High Water Marks
Flash Flood Risk Area Grid		Visible from 1:20,000 to ground Polygon features - 1-km grid displaying the number of buildings and population within 0.2 percent (500-year) annual chance floodplain
Flash Flood Risk Area		Visible from 1:320,000 to ground Polygon features - Sourced from 2024 Floodplain Quilt

Table 1. Data Layers

b) Using the Web Map

This section summarizes the functionality and tools within the web map that can be used for viewing Flash Flood Risk Area data as seen in Figure 1. The web map provides access to the Provisional Flash Flood Risk Areas Map without requiring any GIS software. Upon opening, the viewer displays the full study area. Users can zoom in to their areas of interest or use the search bar to locate an address of interest.

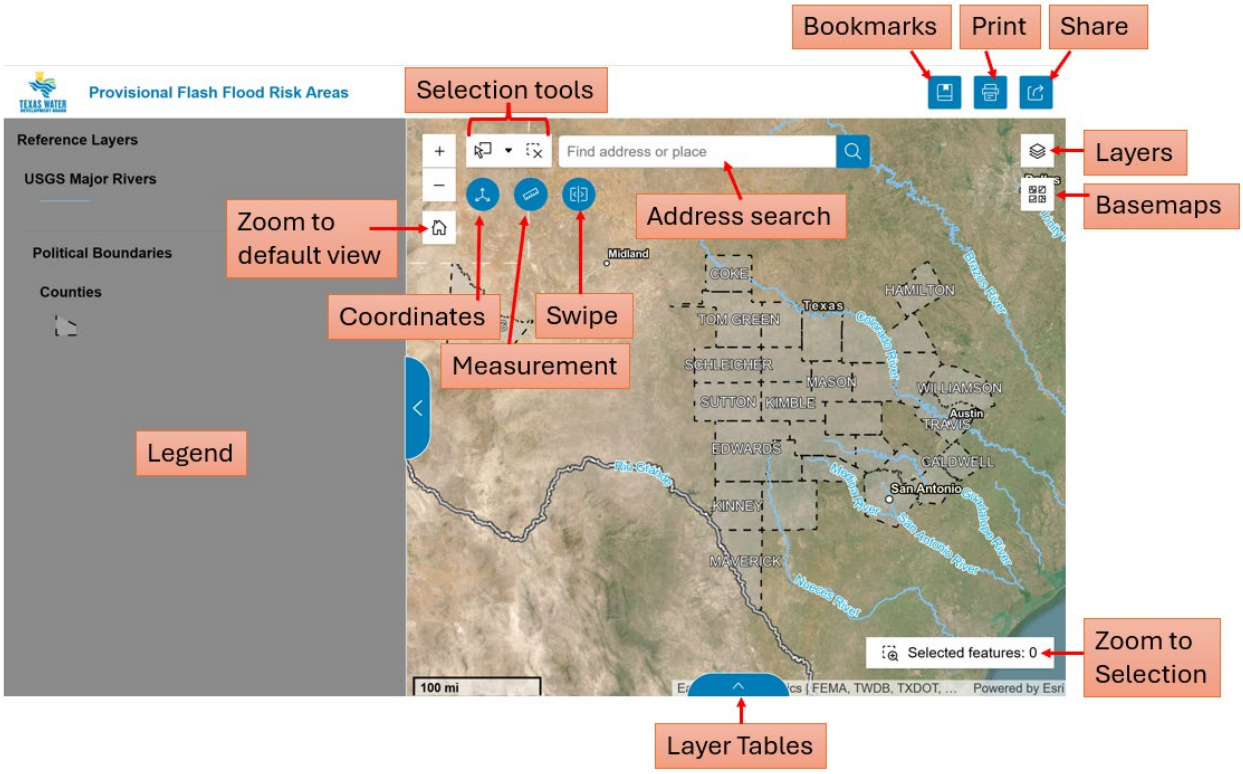


Figure 1. Overview of the web map widgets.

i) Web Map Widgets:

Bookmarks - A collection of spatial bookmarks created by the user. Can be used to easily return to locations of interest.

Print – Allows users to print web maps and includes options for previewing extents, selecting map layouts, and more.

Share - Allows users to share the app by posting it to a social media account, sending an email with a link, or embedding it in a website or blog. It also provides a URL and QR code of the app. It shares the entire app.

Legend - Displays labels and symbols for layers in a map.

Layer Tables - Displays interactive attribute tables for feature layers that users access from tabs. Users can use tools such as search, selection, sort tables by one or multiple fields and by ascending or descending order.

Selection Tools – Allows users to use various selection tools to select a single feature or multiple on the web map. Also includes a clear selection button.

Address Search – Allows users to input an address or location name and zooms to

Zoom to default view – Returns map to default map extent

Coordinates - Allows users to click a location on a map and get coordinates.

Measurement - Calculates distances, perimeters, and areas in the web map.

Swipe – Allows users to transition from one layer to another by moving, or swiping, a divider across the map. In this application it is only applied to the Provisional Flash Flood Risk Areas layer

Layers - Displays a list of map layers as well as a smaller legend.

Basemaps – Reference maps that users can select from to overlay the Provisional Flash Flood Risk Areas data.

Zoom to selection – Allows users to zoom to selected feature(s) in web map

ii) Viewing Floodplain Information

To view information for the underlying floodplain, make a selection by clicking on a Provisional Flash Flood Risk Area polygon. After making a selection, a pop-up window will appear with related tables that users can expand to view more information as shown in Figure *2*.

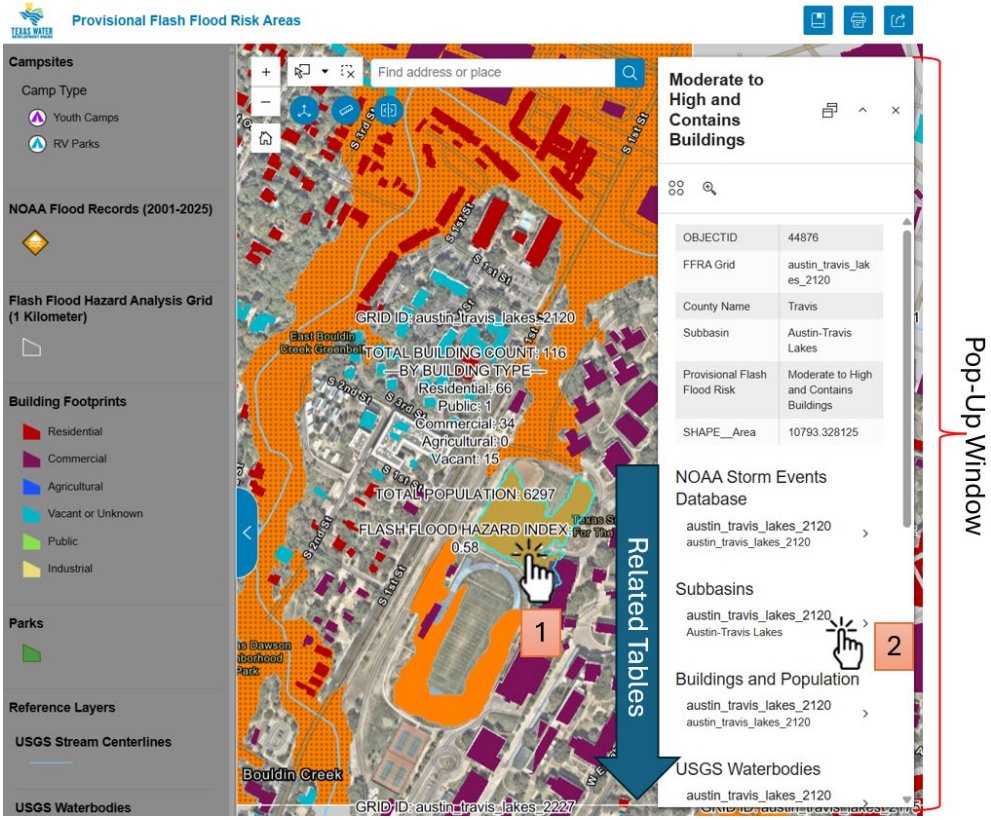


Figure 2. Related tables found in pop-up window.

iii) Grid Cell Labels

Zooming in on the grid at 1:2,000 ft will automatically enable the labels for each grid cell, which provides a quick glance of the grid cell ID, total building count, building type counts, and total population count within the 1-kilometer grid as well as the flash flood hazard index (scale of 0-1 with 1 being the highest hazard). This is shown in Figure 3.

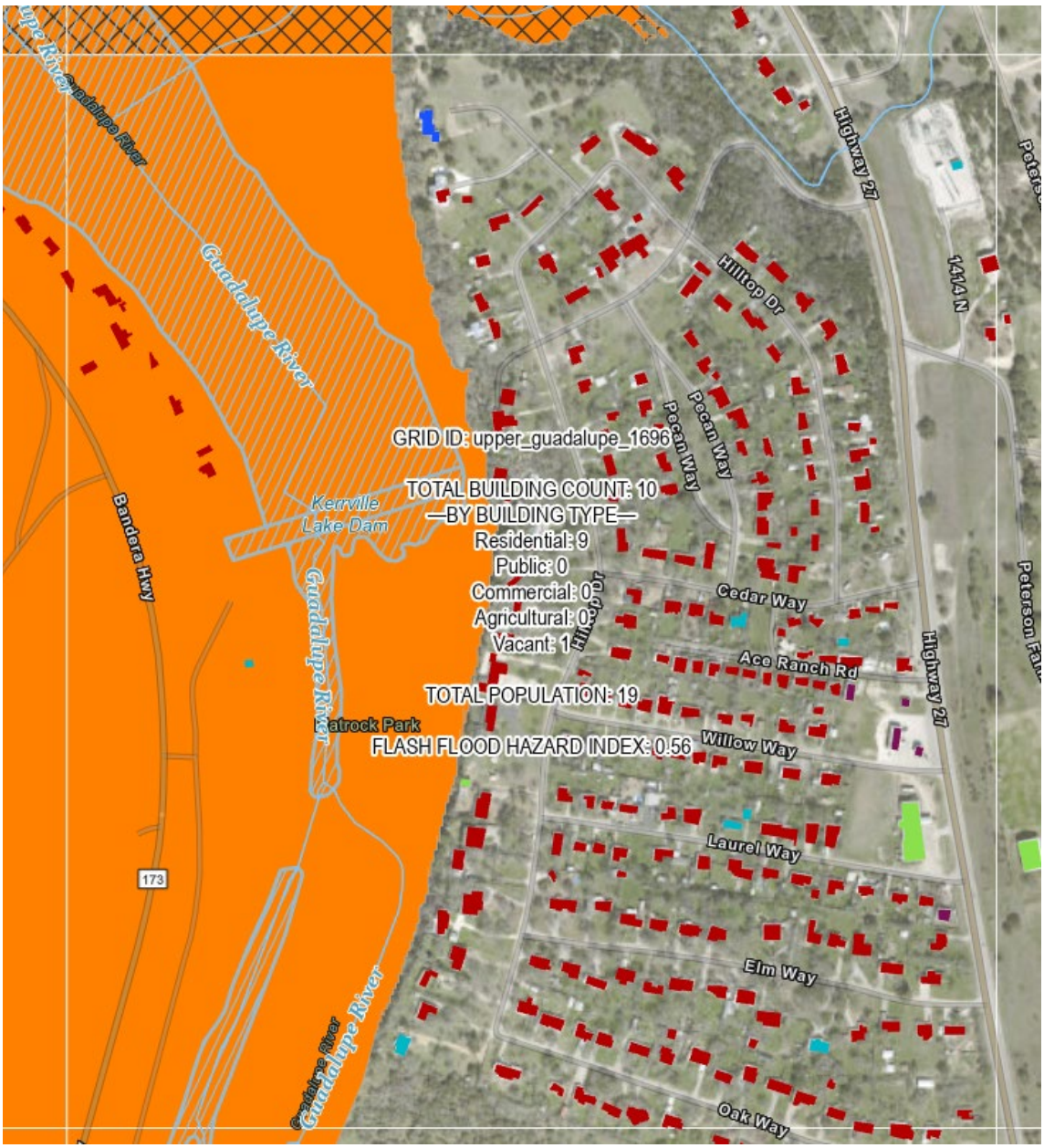


Figure 3. Example of the label for each 1- kilometer grid cell.

If only certain layers are needed for visualization purposes, toggle off any layer using the eye icon as shown in Figure 4.

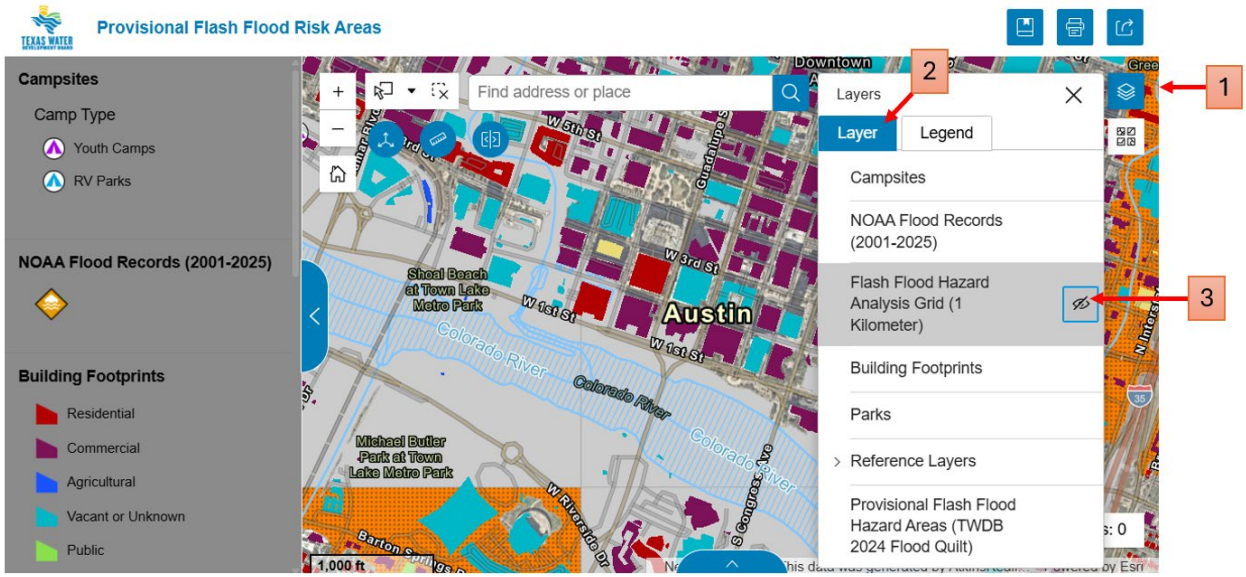


Figure 4. Steps to toggle off a layer in the web map.

3) How to request a map revision

The instructions from this point forward are for users who have experience with GIS software.

The Provisional Flash Flood Risk Area (PFFRA) maps represent an important first step in identifying locations within the SB 3 counties where flash-flood hazard and potential human exposure intersect. Local input is essential to ensure that the final maps accurately reflect on-the-ground conditions and community-specific considerations. The PFFRA maps were prepared using high-quality data available at the time the information was prepared. However, many of the datasets were developed for statewide use and may be missing detailed information available from local communities. Additionally, the PFFRA maps were developed by performing GIS analysis based on a 1-kilometer grid.

There are various reasons why a map revision may be requested:

1) Changed conditions.
2) Incorrect information.
3) Information that was not readily available during development of the flash flood risk area map.
4) Counties and/or their authorized representatives have proper justification showing that an outdoor warning siren is not warranted in a particular area based on local knowledge.

Items 1–3 listed above could include missing or inaccurate exposure data, incorrect or inconsistent hazard data, or changed conditions since the source datasets were created. Item 4 listed above could include justification that an outdoor warning siren is not warranted in a particular location because only storage facilities exist in that area, or because another means of alerting would be more successful. Counties included in SB 3 should work with local officials within their county boundaries to review the PFFRAs and **provide revisions to the TWDB to be considered in the final determination of FFRAs**.

a) Editing Steps for Revisions

The TWDB has provided an ArcGIS Project Package that mirrors the online web map to all SB3 counties. After opening the project package in ArcGIS Pro, locate the Provisional Flash Flood Hazard Areas (TWDB 2024 Flood Quilt) layer. From here on, this layer will be referred to as PFFRA.

To simplify the map, open the PFFRA layer properties and create a **Definition Query** using the **County Name** field to only display PFFRA polygons for the county of interest. Changes to the maps will need to be completed and submitted at the 1-kilometer grid level to the PFFRA feature class. Each grid cell has a unique ID, which appears in the cell's label and in the attribute tables of both the Grid layer and the PFFRA layer, as shown in Figure 5.

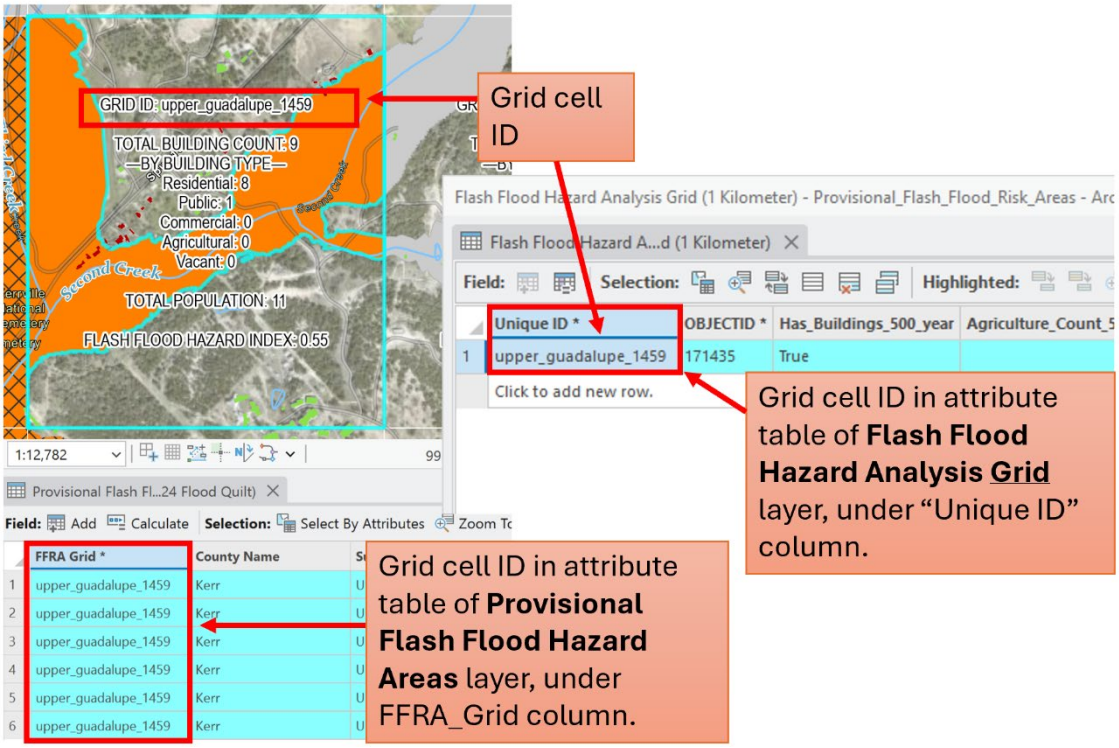


Figure 5. Key used to relate the PFFRA layer to the Flash Flood Hazard Analysis Grid

i) Append Selected Grid Features

Prior to performing revisions, identify both the PFFRA polygons that will be revised and the grid

1) Select the grid(s) containing the identified PFFRA polygons then perform a **Select by Location** using the Within Clementini relationship as seen in Figure 6 to capture all PFFRA features inside those grids.

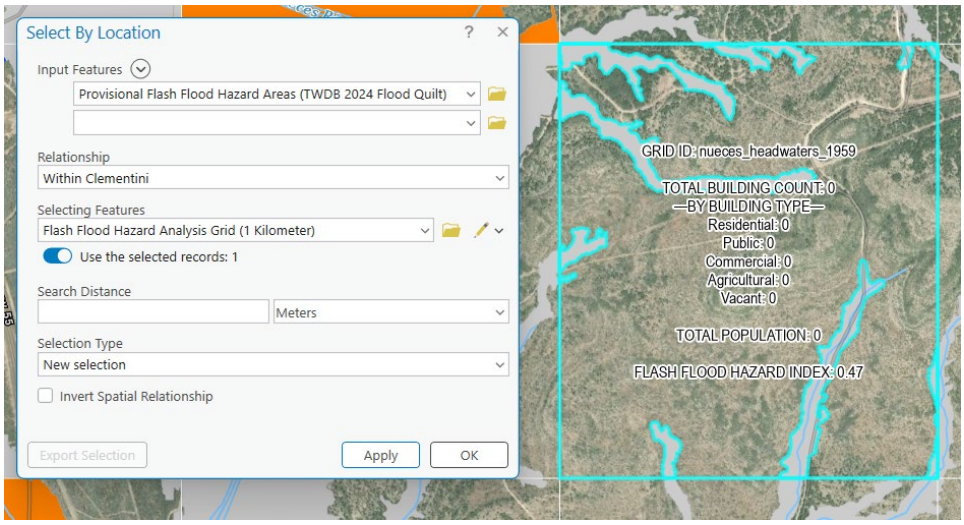


Figure 6. Demonstration of how to select all features by location within a grid using the within Clementini relationship.

2) **Append** the selected PFFRA features to the empty **PFFRA_500_Year_Revisions** polygon feature class in the provided File Geodatabase **PFFRA_Revisions.gdb**.
    - Set **Field Matching Type** to **"Use the field map to reconcile field differences"** as seen in Figure 7.

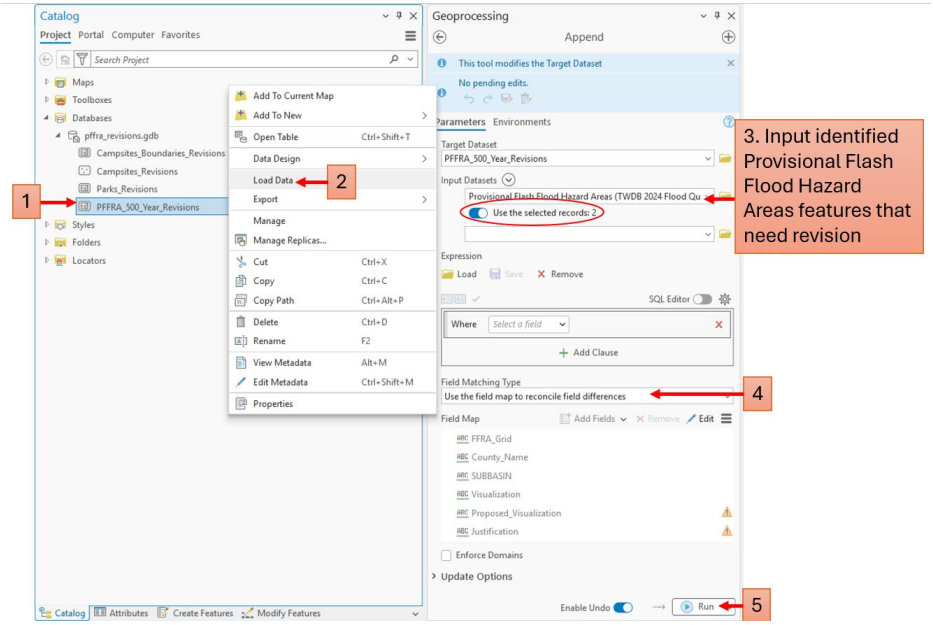


Figure 7. Steps to append identified PFFRA features to PFFRA_500_Year_Revisions layer

3) After appending, make any necessary **geometry edits** (i.e. Split).
4) Populate the **Proposed Visualization** and **Justification** fields using the provided domains.
   - **Nulls are not accepted.**

i) Youth Camps and RV Parks

At the time of map development, the TWDB did not have complete boundary information for Youth Camps.

If known, please append any CAD or parcel data that delineates the boundary for a Youth Camp to the Campsites_Boundaries_Revisions polygon feature class and populate fields.

If a Youth Camp boundary is unknown, please provide a point location for any Youth Camps and/or RV Parks not already identified by the TWDB in the Campsites_Revisions point feature class and populate fields.

ii) Parks

For any parks or recreation areas not mapped by the TWDB which counties feel are at flash flood risk, please append their extents to the Parks_Revisions polygon layer with the following fields populated:

- Park_Name
- Park_Type (i.e. city, county, state, etc.)

4) FAQ

- Why are all urban and rural areas with buildings at risk included in the PFFRA?
    - The intention of the provisional map provided is to be a conservative initial estimate of the FFRA. To expedite the delivery of FFRA maps, many factors—such as existing flood warning systems that comply with SB 3 or cell service availability—were not feasible to include in the initial study to determine FFRAs. It is important for communities to consider if outdoor warning sirens would meaningfully improve notification during a flash flood event. Input from local officials and emergency managers familiar with knowledge of the area is needed to accurately finalize the FFRA map, which will be used to determine where outdoor flood warning sirens need to be audible.
- Can additional RV parks, camps, and parks be added to the FFRA map?
    - Yes, local officials and emergency managers with knowledge of the area should work on identifying the locations of sites not included on the provisional map and request a revision so that they are included on the finalized map.
- Why are areas along waterbodies with an area larger than 1 square kilometer excluded?
    - Major waterbodies, such as lakes and ponds, with an area larger than 1 square kilometer, were identified for exclusion from the FFRA. In Texas, these areas are typically upstream of major dams or reservoirs. The volume of water required to drastically raise water level requires a widespread storm with a long event duration, such as a slow-moving tropical storm. These waterbody features were identified using the United States Geological Survey National Hydrography Dataset.
- Are flood siren systems only effective for outdoor use?
    - Flood sirens are most effective at warning people outdoors of a flash flood. People indoors may be alerted as well, but the sound will be muffled and less effective. Using multiple methods to warn the public is most effective, such as a combination of reverse 911 alerts, sirens, and TV/radio broadcasts. It is important that warnings only be issued when there is a reasonable risk, otherwise people may become fatigued and decide to opt out of reverse 911 alerts or ignore warnings.
- How was the FFHI threshold determined?
    - The FFHI was calculated using a combination of 13 weighted factors at a 1km-by-1km resolution which consisted of physical, hydrologic, geomorphic,

meteorologic, and land cover data. These factors were selected through a comprehensive literature review.

- After the FFHI was developed, its performance was validated using available Base Level Engineering (BLE) 2D hydraulic model outputs for 22 watersheds within the study area. BLE models provide depth and velocity estimates for the 100-year, 24-hour storm—conditions that are useful indicators of how severe flooding can be at a location. The BLE depth-velocity results were not used to build the index, but they were essential in confirming that higher FFHI values align with areas where modeled flooding is deeper, faster, and therefore more hazardous.

- Base Level Engineering depth and velocity data was compared to the FFHI values produced to create three categories of flash flood hazard: low (hazard < 0.525), medium (0.525 ≤ hazard < 0.55), and high (hazard ≥ 0.55). Section 3 of the Technical Memorandum on the Identification of Flash Flood-Prone Areas that Warrant Outdoor Warning Sirens provides additional details.

- What criteria were used to determine the Flash Flood Risk Area?
  1) Included moderate-to-high hazard campgrounds, camps and RV parks
     a. FFHI ≥ 0.525 and within 500-meter proximity of campground location
  2) Included moderate-to-high hazard parks
     a. FFHI ≥ 0.525 and overlaps park footprint
  3) Included moderate-to-high hazard buildings
     a. Where FFHI ≥ 0.525 and overlaps building footprint
     b. Or within 500-meter proximity of NOAA flash flood record and overlaps building footprint
  4) Excluded waterbody influence due to reduced risk from hydraulic dynamics

5) Contact Information

Please contact flood_sirens_program@twdb.texas.gov with any questions.