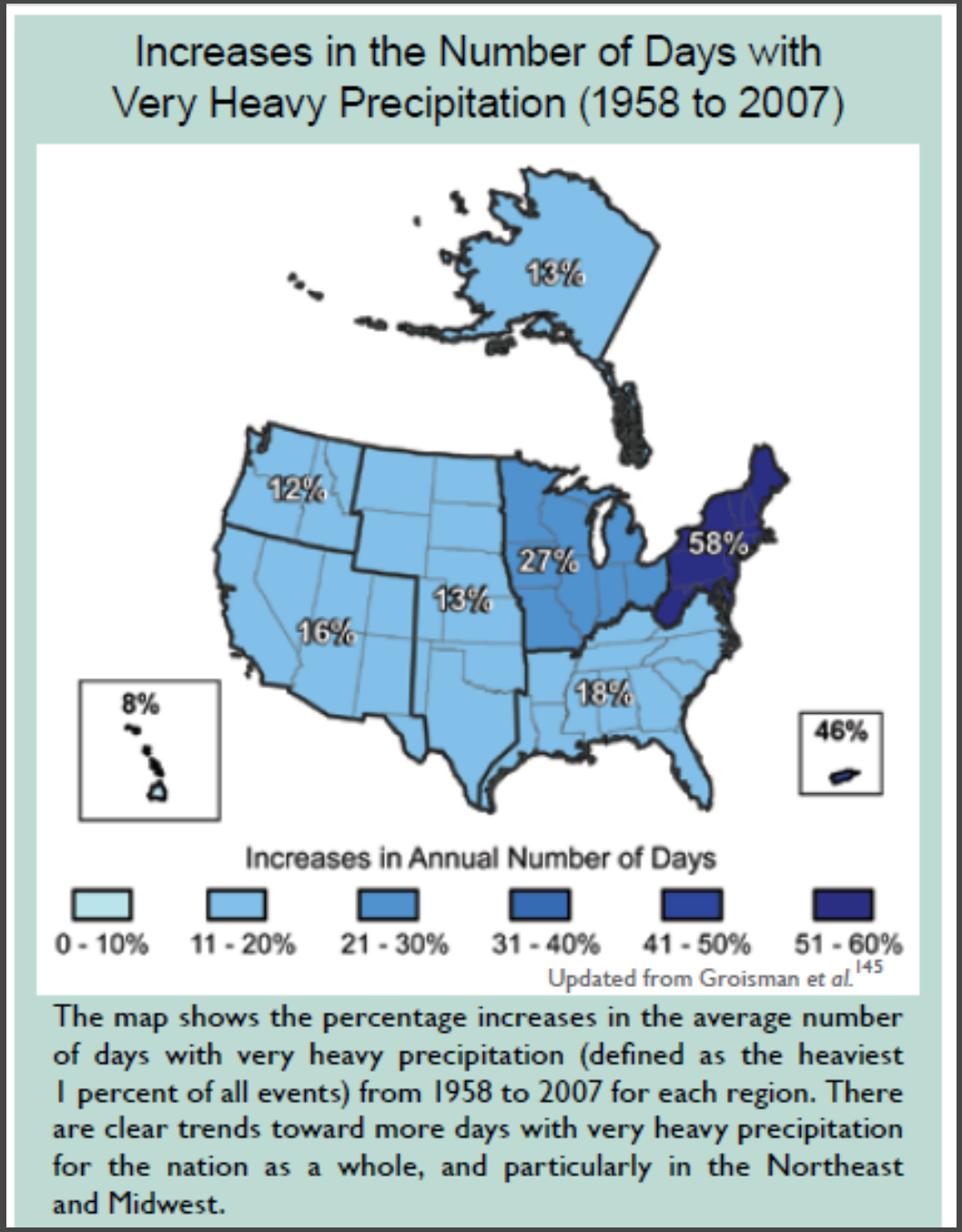
It is 2050!

Siavash Beik and Robert Barr

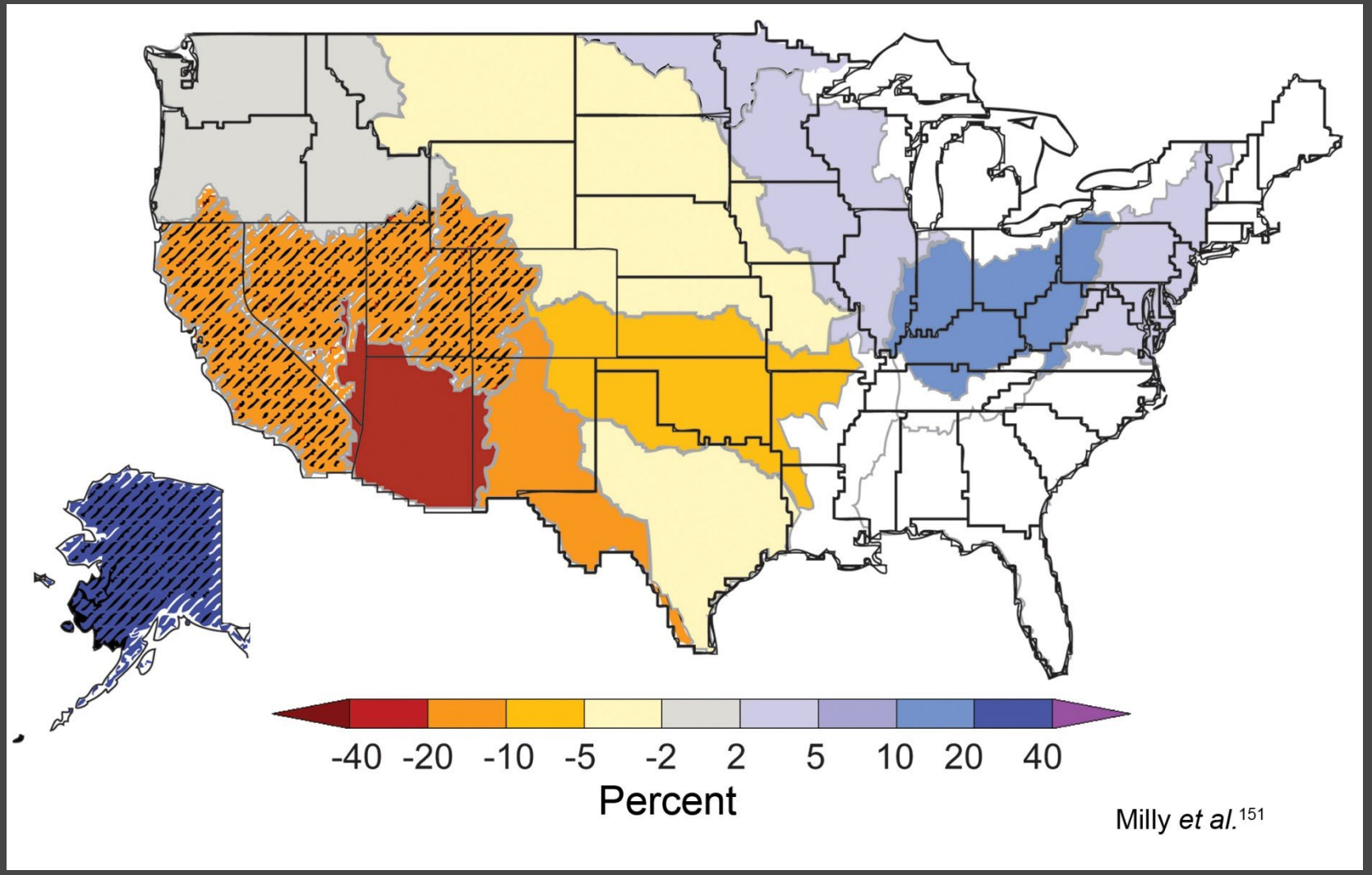
INAFSM Annual Conference 2022
South Bend, IN
September 16, 2022

BURKE

CEES



Global Climate Change Impacts in the United States, 2009.

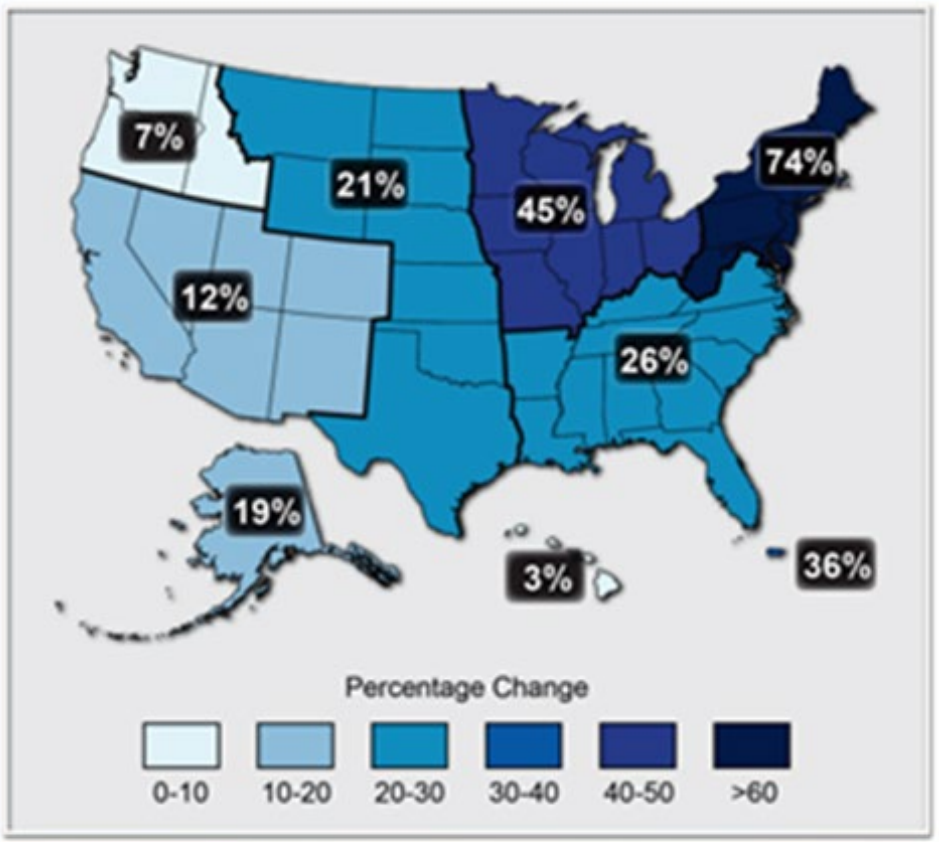


Projected changes in median runoff for 2041-2060, relative to a 1901-1970 baseline, are mapped by water-resource region. Colors indicate percentage changes in runoff.

Observed Change in Very Heavy Precipitation

- 1958 to 2011
- "Very Heavy Events" = Heaviest 1% of all daily events
- Clear trends toward a greater amount of very heavy precipitation for the nation as a whole
  - Particularly in the Northeast and Midwest

Melillo et al. 2013 National Climate Assessment Draft for Public Comment



Whitewater River near Brookville, IN

2006

2008

Distance in 2006 = 1846 feet
Distance in 2008 = 1812 feet
34 foot change/ 2 years

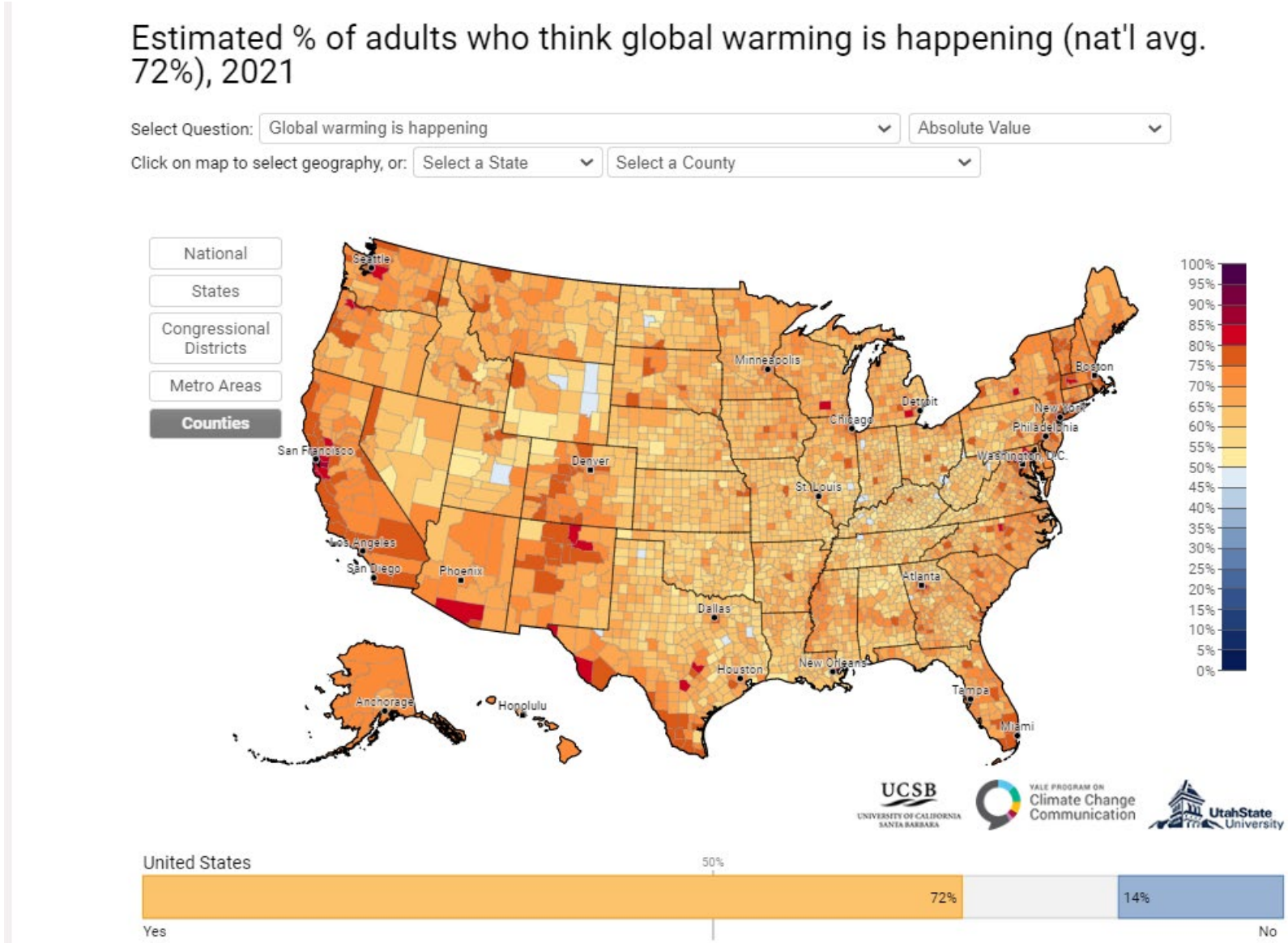
[INAFSM, 2011]

MODULE 1 - Heads Up!

INAFSM, 2013

Streams Move!

Robinson, USGS, 2012



Map · Feb 23, 2022 Yale Climate Opinion Maps 2021

By Jennifer Marlon, Liz Neyens, Martial Jefferson, Peter Howe, Matto Mildenberger and Anthony Leiserowitz

65% of Hoosiers believe global warming is happening. 50% of Hoosiers believe it is caused mostly by human activities. 57% of Hoosiers are worried about global warming. 65% of Hoosiers believe it will harm plants and animals, 64% believe it will harm future generations and only 40% believe it will harm them personally.

72% of Hoosiers believe schools should teach about global warming. However, only 30% say they discuss global warming. One of the last questions asked in the survey was, “Who should do more about global warming?”. 65% of Hoosiers feel corporations should do more, and 60% believe citizens should do more. 53% believe the Governor should do more about global warming.

Yale Climate Opinion Maps 2021

Indian-Kentuck Creek near Manville, Jefferson County, IN

Indian-Kentuck Creek near Manville, Jefferson County, IN

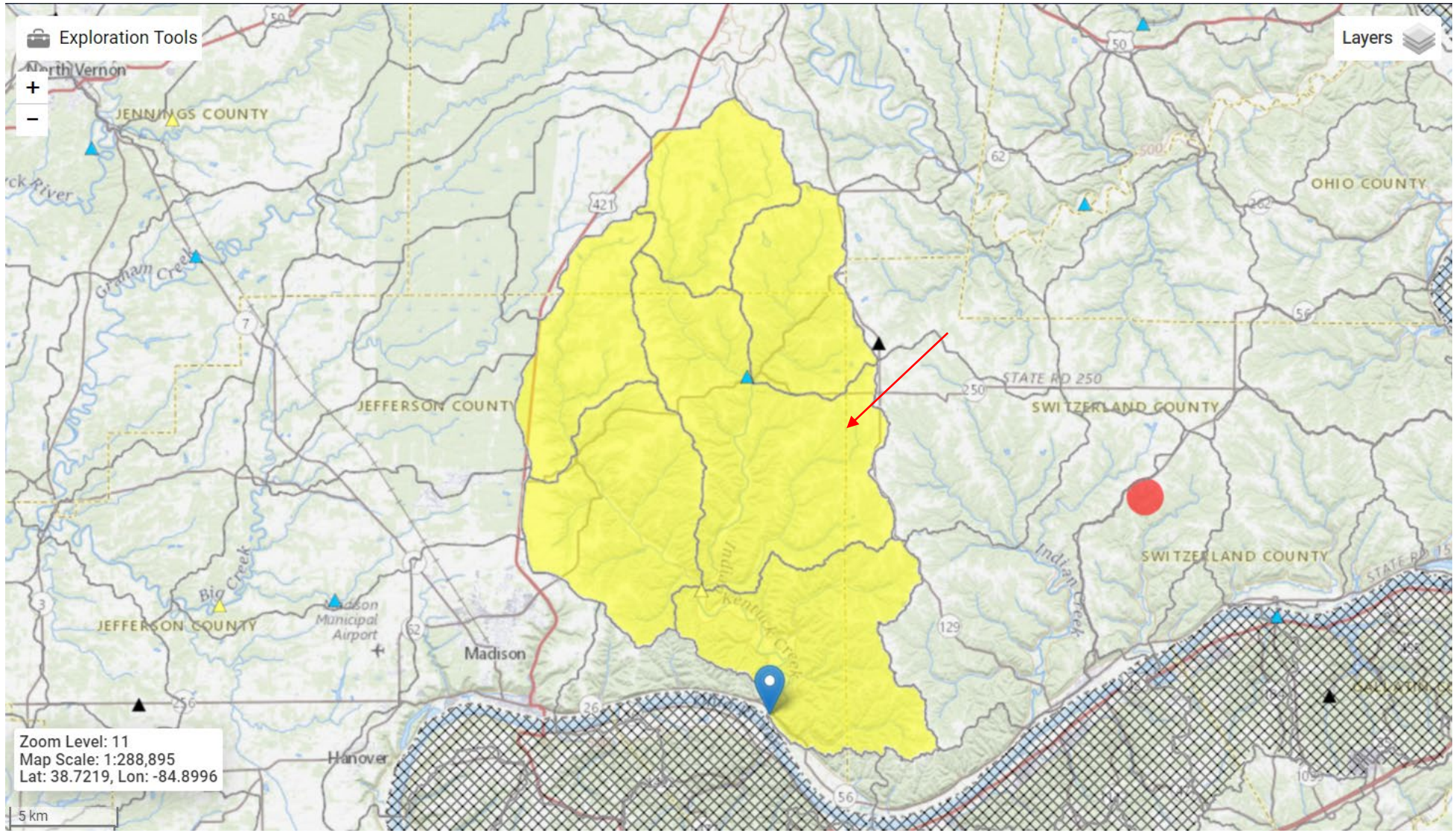
Indian-Kentuck Creek near Manville, Jefferson County, IN

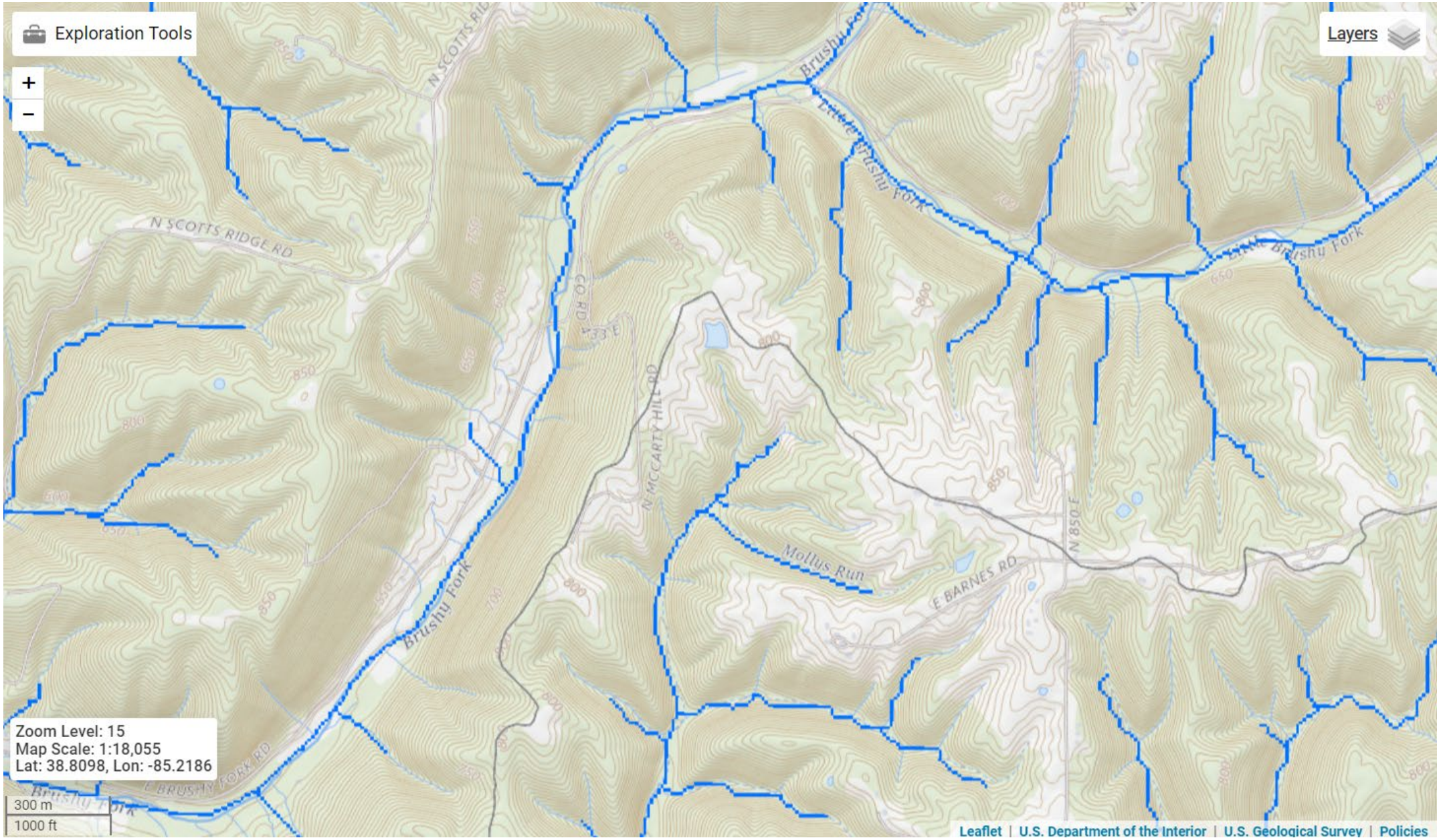
Brushy Fork, Switzerland County, IN

Toby Adams IDNR

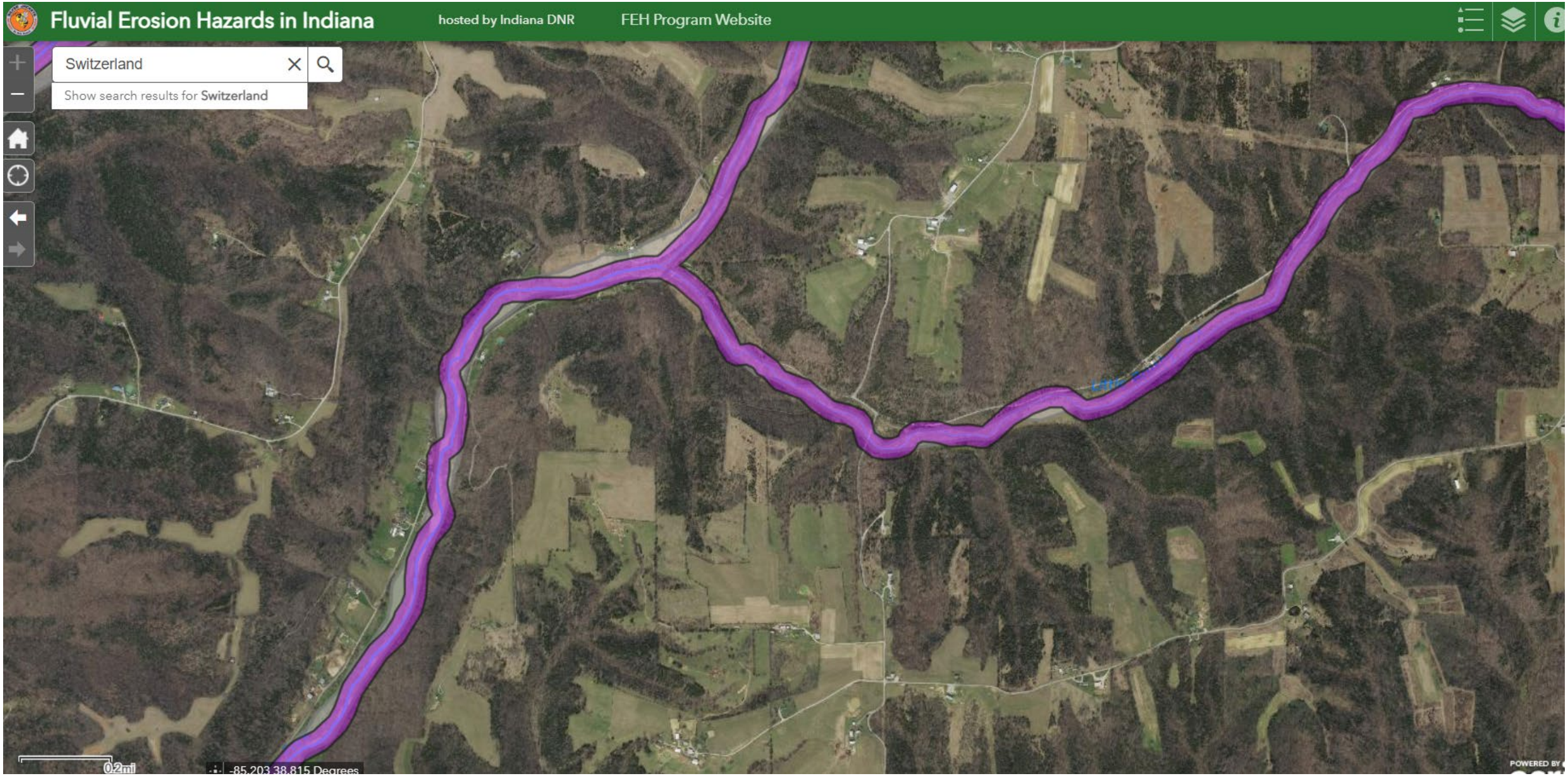
Indian Creek, Switzerland County, IN

Toby Adams IDNR

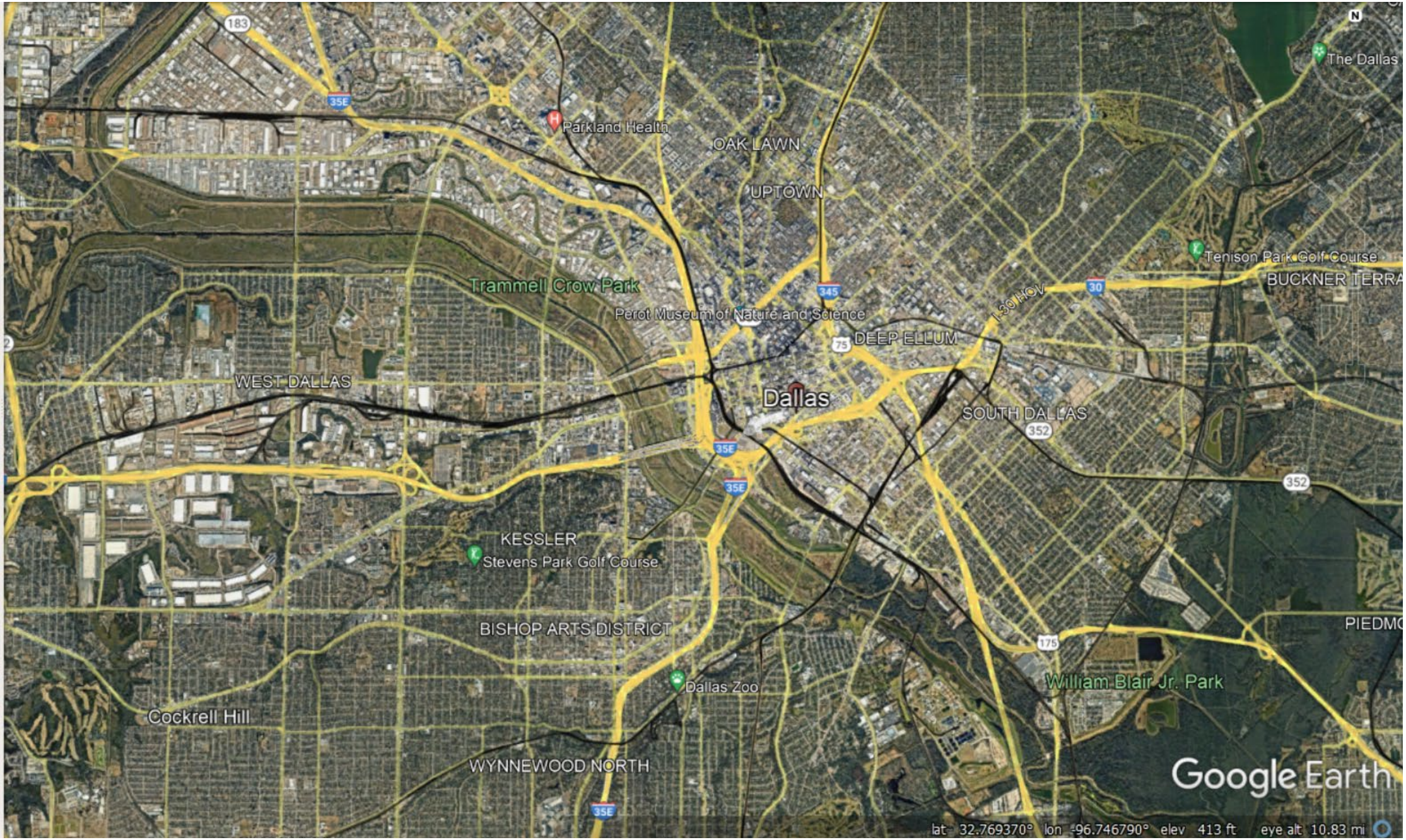

Exploration Tools
Layers
JENNINGS COUNTY
OHIO COUNTY
JEFFERSON COUNTY
SWITZERLAND COUNTY
STATE RD 250
Madison
Hanover
Big Creek
Graham Creek
Indian Kentucky Creek
Indian Creek
Madison Municipal Airport
Zoom Level: 11
Map Scale: 1:288,895
Lat: 38.7219, Lon: -84.8996
5 km



Brushy Fork, Switzerland County

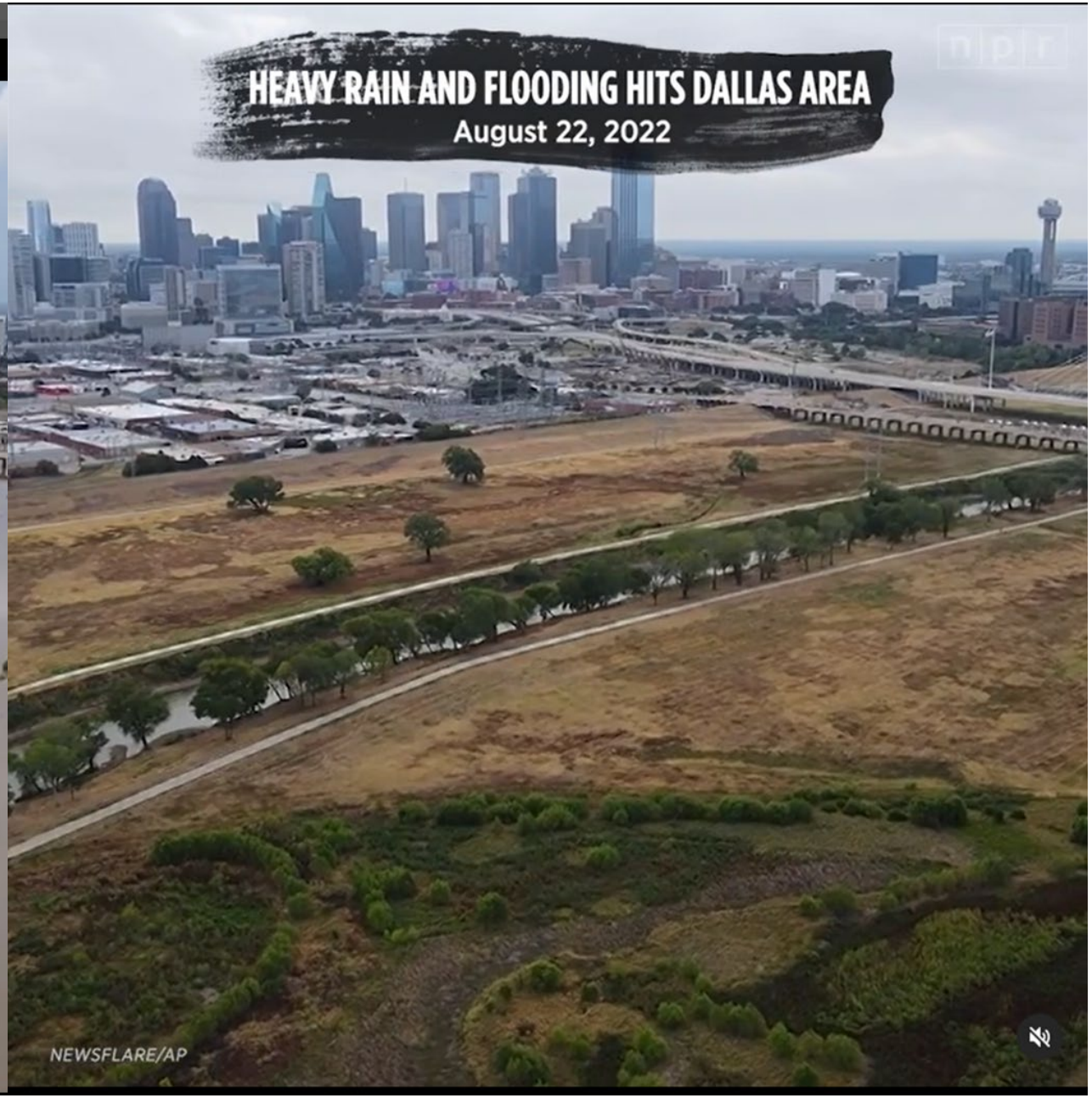

Fluvial Erosion Hazards in Indiana
hosted by Indiana DNR
FEH Program Website
Switzerland
Show search results for Switzerland
0.2mi
-85.203 38.815 Degrees

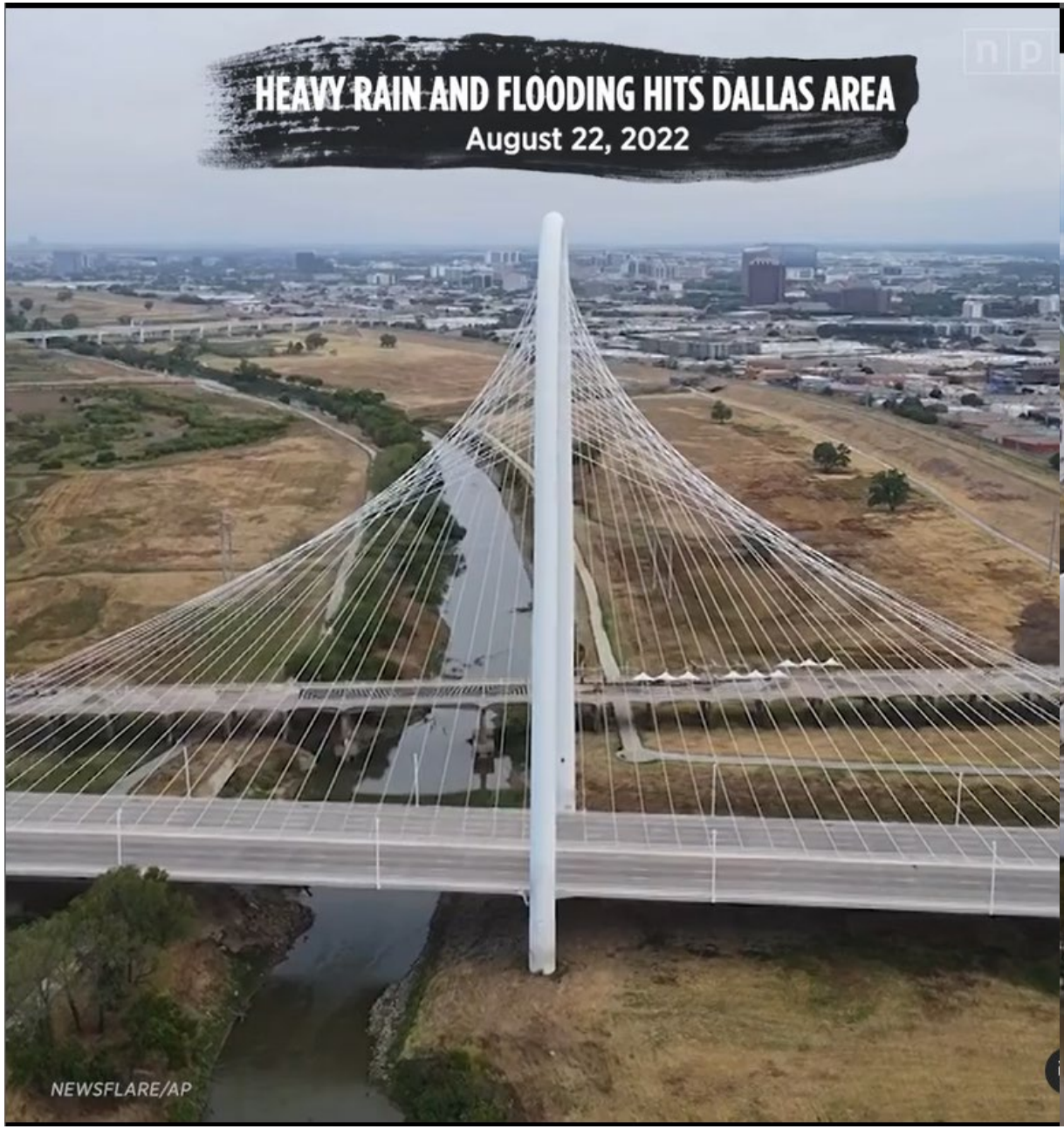
There is a better way!


183
35E
Parkland Health
OAK LAWN
UPTOWN
The Dallas
Tenison Park Golf Course
BUCKNER TERRA
Trammell Crow Park
345
Perot Museum of Nature and Science
30
I-30 HOV
DEEP ELLUM
75
WEST DALLAS
Dallas
SOUTH DALLAS
352
35E
352
KESSLER
Stevens Park Golf Course
BISHOP ARTS DISTRICT
PIEDMO
175
William Blair Jr. Park
Dallas Zoo
Cockrell Hill
WYNNEWOOD NORTH
35E
Google Earth
lat 32.769370° lon -96.746790° elev 413 ft eye alt 10.83 mi

Trinity River Greenway rendering courtesy of MVVA


HEAVY RAIN AND FLOODING HITS DALLAS AREA
August 22, 2022
NEWSFLARE/AP


HEAVY RAIN AND FLOODING HITS DALLAS AREA
August 22, 2022
NEWSFLARE/AP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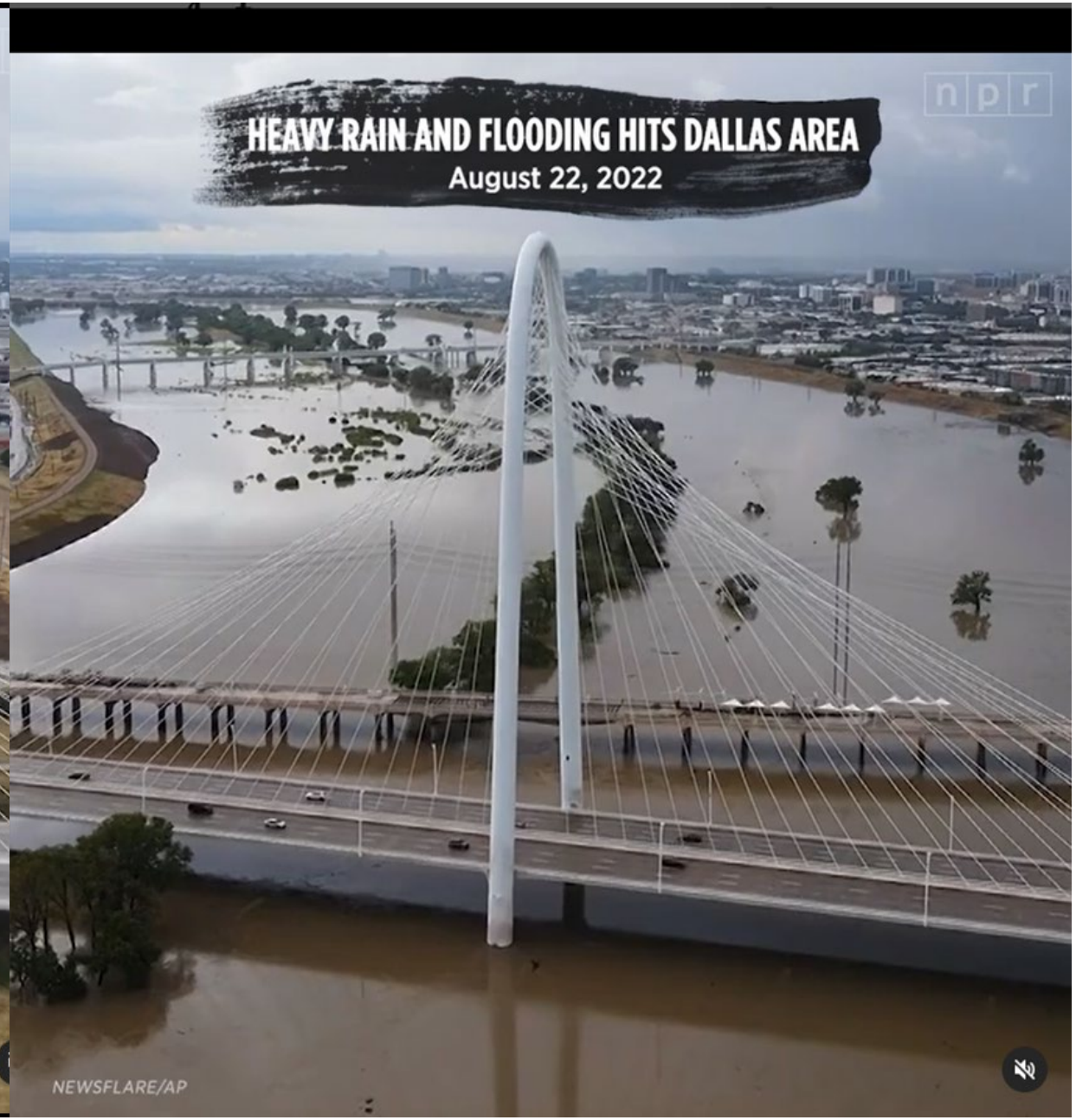
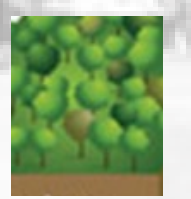
NEWSFLARE/AP

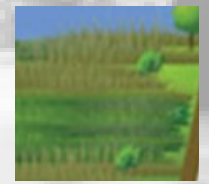

HEAVY RAIN AND FLOODING HITS DALLAS AREA
August 22, 2022
NEWSFLARE/AP

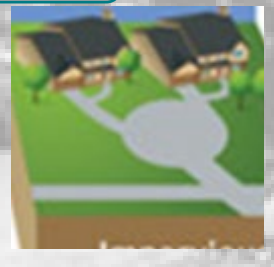
FACTORS THAT IMPACT FLOODING

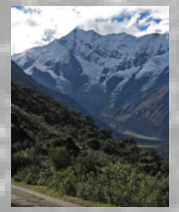
1) Rainfall

2) Watershed (Land Use, soil & slope)









3) Flow Path

Best Case Scenario

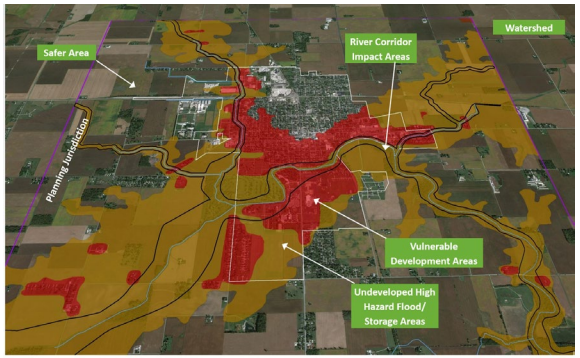
Worst Case Scenario

AVAILABLE CHOICES IN ADDRESSING SYSTEMIC FLOODING AND EROSION IN THE FACE OF A CHANGING CLIMATE

1. **Mitigate/Modify the Flooding Source** (major federal structural solutions)

2. **Adapt and Become Resilient** (locally initiated policies and projects)

3. **Do Nothing/Status Quo, Suffer the Consequences**



BEST PATH FORWARD: ADAPTATION AND RESILIENCE

"Three-Prong Approach"

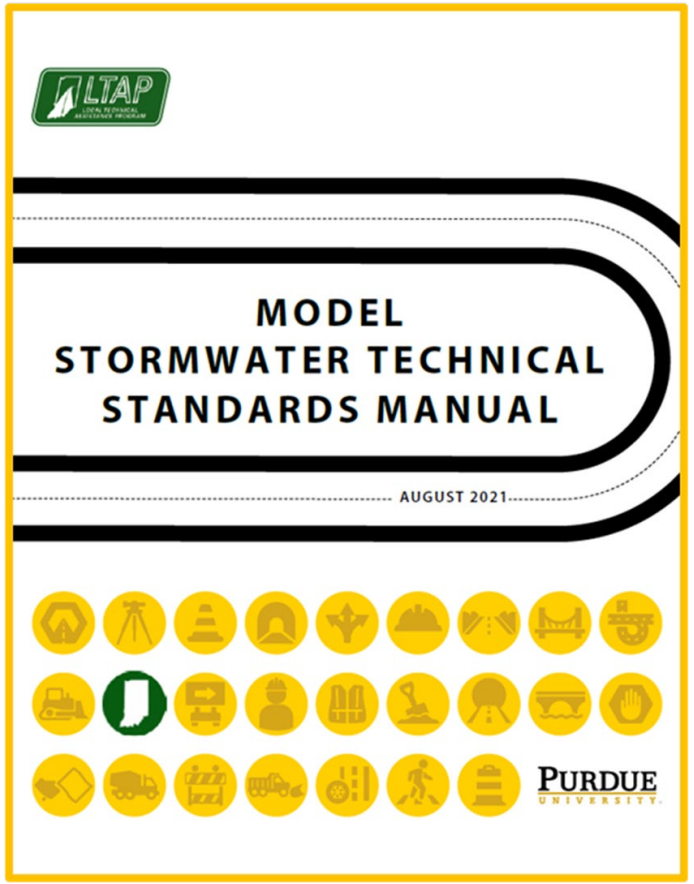
1. Prevent Things from Getting Worse

2. Protect/Relocate Existing Buildings in the Harm's Way & Plan for Flood Response

3. Create Room for the River

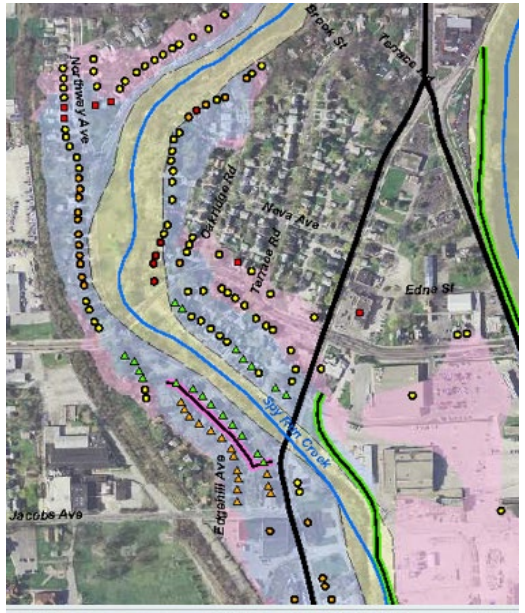
WHAT ARE THE MOST IMPORTANT AND IMMIDIATE THINGS WE CAN DO TO PREVENT THINGS FROM GETTING WORSE?

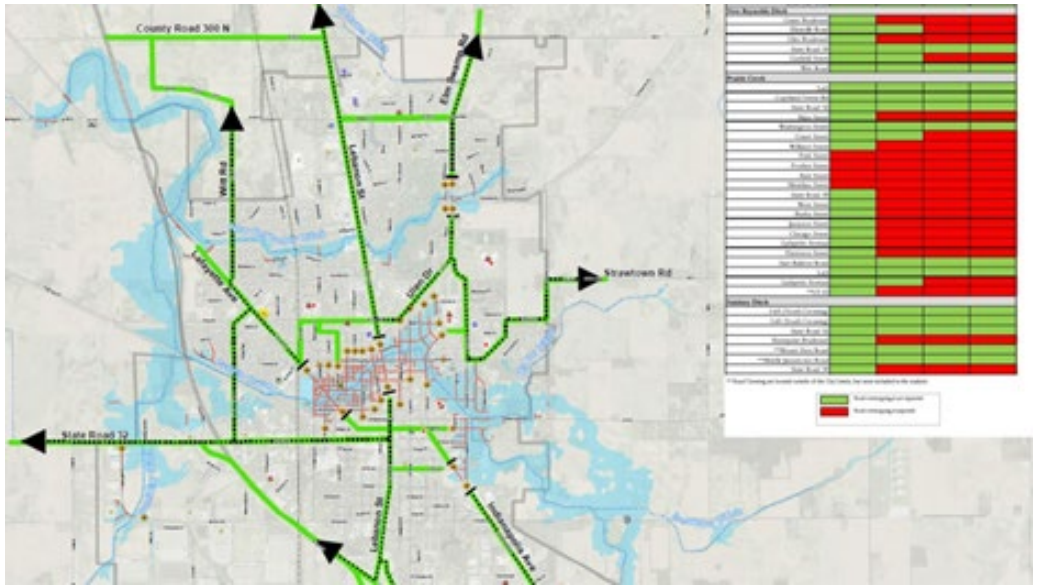
- Preserve Existing Wetlands and Upland Depressional Areas
- Preserve the Remaining Undeveloped Floodplains
- Do Not Disturb Floodway and FEH Corridors (keep morphological floodplains attached)
- Do Not Allow Adverse Impacts as a Result of New Urban or Agricultural Development
  - Adopt No-Adverse-Impact Development Standards
  - Require/Provide Agricultural Drainage Impact Compensation
  - Consider Potential Climate Change Impacts When Permitting New Development
- ❖ The LTAP Model Standards Manual Contains Language to Achieve Most of the Above



WHAT ARE THINGS WE CAN DO TO RELOCATE/PROTECT EXISTING BUILDINGS IN THE HARM'S WAY ?

- **Accurately Determine the Extent of Flood Risk Areas**
- **Identify, Categorize, and Set Buyout or Floodproofing Strategies Appropriate for Each Category**
- **Set Priorities and Secure Local Funding to Cost-Share with Federal Grants and Other Funding Sources**
- **Prepare a Flood Response Plan**



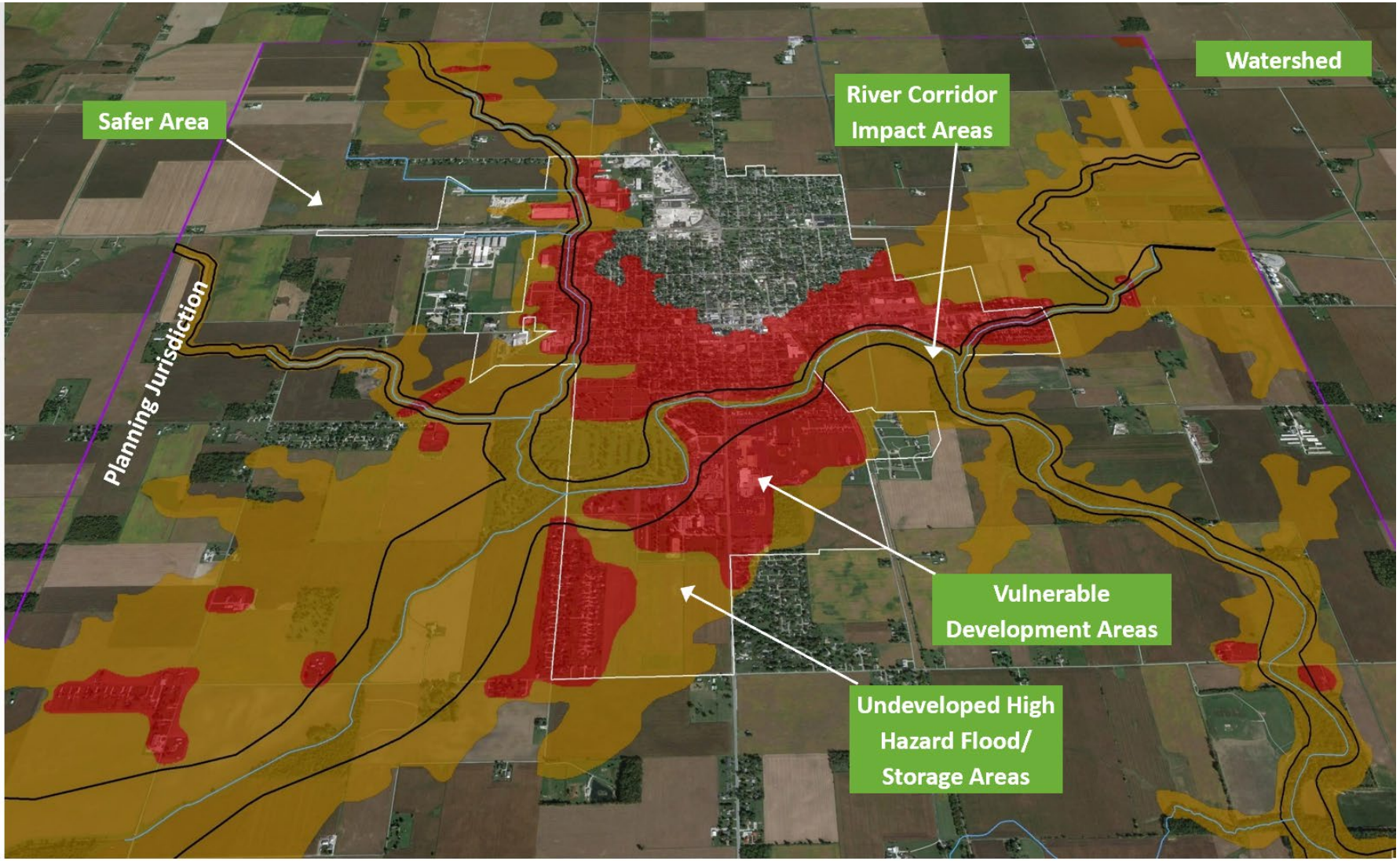


HOW DO WE CREATE ROOM FOR THE RIVER ?

- **Create 2-Stage Ditches**
- **Connect the Disconnected Geomorphic Floodplains**

ZONE-SPECIFIC SMART GROWTH RESILIENCE STRATEGIES

- Develop Strategies for Distinct Geographical Areas within Each Jurisdiction's Planning Boundary:
  - River Corridor Impact Area
  - Undeveloped High Flood Hazard/Flood Storage Area
  - Vulnerable Developed Area
  - Moderate Flood Hazard Area
  - Safer Area
  - Watershed

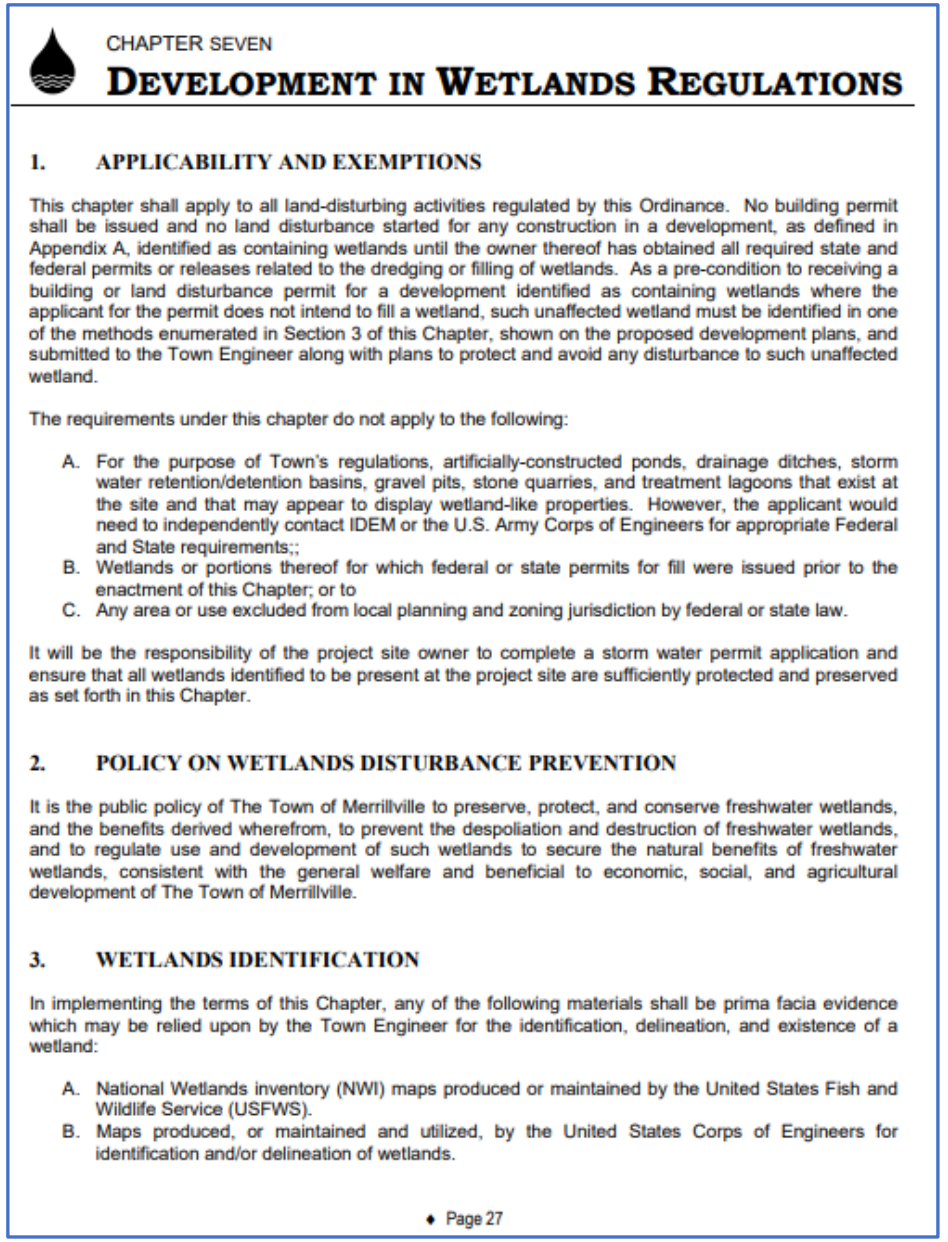


One Local Example of Wetland Protection Regulation

Town of Merrillville has added a chapter in their Stormwater Ordinance to regulate and discourage loss of wetlands.

Hint:

- Ask Matt Lake why he felt it was important to have such a provision and how he did it.



CHAPTER SEVEN

DEVELOPMENT IN WETLANDS REGULATIONS

1. APPLICABILITY AND EXEMPTIONS

This chapter shall apply to all land-disturbing activities regulated by this Ordinance. No building permit shall be issued and no land disturbance started for any construction in a development, as defined in Appendix A, identified as containing wetlands until the owner thereof has obtained all required state and federal permits or releases related to the dredging or filling of wetlands. As a pre-condition to receiving a building or land disturbance permit for a development identified as containing wetlands where the applicant for the permit does not intend to fill a wetland, such unaffected wetland must be identified in one of the methods enumerated in Section 3 of this Chapter, shown on the proposed development plans, and submitted to the Town Engineer along with plans to protect and avoid any disturbance to such unaffected wetland.

The requirements under this chapter do not apply to the following:

A. For the purpose of Town's regulations, artificially-constructed ponds, drainage ditches, storm water retention/detention basins, gravel pits, stone quarries, and treatment lagoons that exist at the site and that may appear to display wetland-like properties. However, the applicant would need to independently contact IDEM or the U.S. Army Corps of Engineers for appropriate Federal and State requirements;;
B. Wetlands or portions thereof for which federal or state permits for fill were issued prior to the enactment of this Chapter; or to
C. Any area or use excluded from local planning and zoning jurisdiction by federal or state law.

It will be the responsibility of the project site owner to complete a storm water permit application and ensure that all wetlands identified to be present at the project site are sufficiently protected and preserved as set forth in this Chapter.

2. POLICY ON WETLANDS DISTURBANCE PREVENTION

It is the public policy of The Town of Merrillville to preserve, protect, and conserve freshwater wetlands, and the benefits derived wherefrom, to prevent the despoliation and destruction of freshwater wetlands, and to regulate use and development of such wetlands to secure the natural benefits of freshwater wetlands, consistent with the general welfare and beneficial to economic, social, and agricultural development of The Town of Merrillville.

3. WETLANDS IDENTIFICATION

In implementing the terms of this Chapter, any of the following materials shall be prima facia evidence which may be relied upon by the Town Engineer for the identification, delineation, and existence of a wetland:

A. National Wetlands inventory (NWI) maps produced or maintained by the United States Fish and Wildlife Service (USFWS).
B. Maps produced, or maintained and utilized, by the United States Corps of Engineers for identification and/or delineation of wetlands.

One Local Example of Floodplain Avoidance Regulation

As part of its Stormwater Technical Standards, Hamilton County prohibits floodplain fill along any water course that has a defined channel and a contributing drainage area of 25 acres or more. On occasions, they allow a variance but only after requiring a 3:1 to 10:1 compensatory flood storage

Hint:

- Ask Kent Ward why he felt it was important to have such a provision and how he did it.

105.01 Floodplain Management	Floodplain management shall be in accordance with Hamilton County's adopted floodplain regulations. In addition to these regulations, the following floodplain policy is adopted by Hamilton County. The intent of Floodplain management is to protect against loss of property, protect human life, and maintain natural beneficial functions of floodplains in helping mitigate flooding and providing habitat and water quality benefits. Therefore, filling of the land in the floodplain of a regulated drain or any natural stream or watercourse, that has a defined channel and a contributing drainage area of 25 acres or more, located within the land under the jurisdiction of the Hamilton County government is prohibited. The use of the floodplain area for detention/retention ponds or lakes is also prohibited. Floodplain boundaries are to be determined by using the 100-year Base Flood

One Local Example of Compensatory Flood Storage Regulation

As part of its Stormwater Technical Standards, Boone County requires a minimum of 3:1 compensatory flood storage along any water course that has a defined channel and a contributing drainage area of 25 acres or more.

Hint:

- Ask Ken Hedge why he felt it was important to have such a provision and how he did it.

D. NO NET LOSS FLOODPLAIN STORAGE REQUIREMENTS (Updated 06/15/2021)

Floodplains exist adjacent to all natural and man-made streams, regardless of contributing drainage area or whether they have been previously identified or mapped. Due to potential impacts of floodplain loss on peak flows in streams, on streambank erosion, and on the environment, disturbance to floodplains must be avoided. In rare circumstances when the avoidance of floodplain disturbance is not practical, the natural functions of the floodplain should be preserved to the extent possible.

Due to proven negative impacts of loss of floodplains, it is the Boone County's policy to strongly discourage and disincentivize floodplain development. When disturbance within floodplain cannot be avoided, compensatory excavation at least three times the floodplain storage lost shall be required for all activities within floodplain of streams located in the County where drainage area of the stream is equal to or larger than 25 acres. For watersheds where the drainage area of the stream is at least 25 acres but less than 640 acres (one square mile) the project applicant of designer must contact the Boone County Surveyor's Office for guidance on compensatory storage requirements. The Boone County Drainage Board and/or Boone County Surveyor may increase the compensation ratio, based on extenuating circumstances, for a specific project. Note that the provision of this section applies to all unincorporated areas within the jurisdiction of Boone County as well as areas within incorporated towns and cities that are located in the watershed of a Boone County regulated drain.

General Requirements

Note that by definition, compensatory storage is the replacement of the existing floodplain and, in rare exceptions, the floodway storage lost due to fill. Compensatory storage is required when a portion of the floodplain is filled, occupied by a structure, or when as a result of a project a change in the channel hydraulics occurs that reduces the existing available floodplain storage. Compensatory storage must:

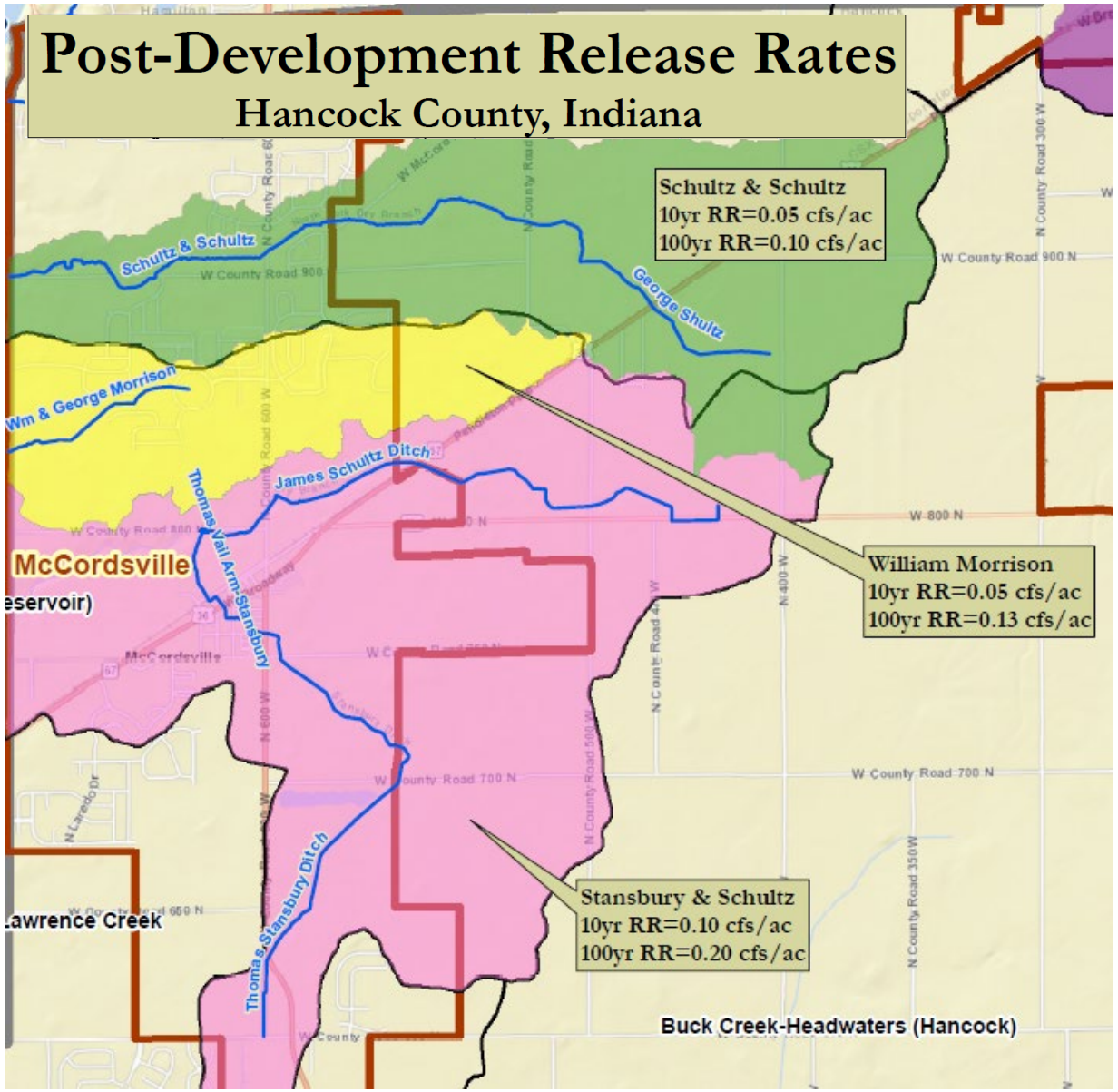
- Be provided regardless of whether the flooding source is mapped or whether flood elevations are published or not. When flood elevations are not available for a flooding source that has a drainage area equal to or larger than 25 acres but less than 640 acres, the applicant is to determine the 10-year and 100-year flood elevations at the site and get them approved by Boone County Surveyors Office prior to use for floodplain compensation calculations. For drainage areas larger than 640 acres, the calculated flood elevations shall require approval by IDNR.
- Equal at least 3 times (unless increased by the County due to extenuating circumstances on a case by case basis) the volume of flood storage lost below the 10-year and 100-year flood elevations;

One Local Example of No-Adverse-Impact Development Regulation

As part of its Stormwater Technical Standards, Hancock County requires 100-year flood detention with watershed-specific release rates, Channel Protection Volume, FEH Corridor avoidance, comp flood storage, and much more!

Hint:

- Ask Susan Bodkin why she felt it was important to have such provisions and how she did it.

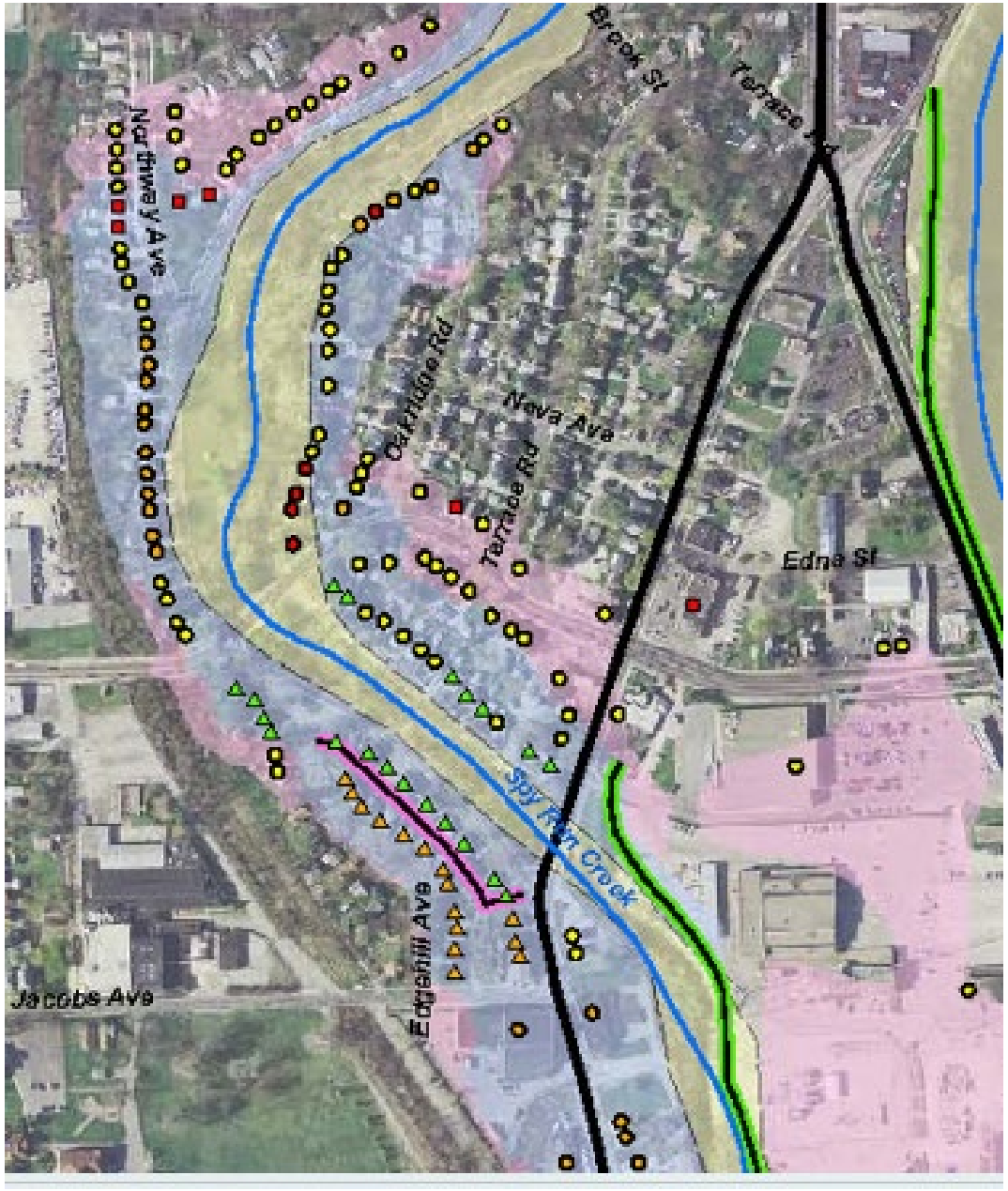


One Local Example of Buyout Cost-Share Assistance Program

Maumee River Basin Commission has a Voluntary Buyout Cost-share Program through which has acquired and removed hundreds of buildings out of harms way

Hint:

- Ask Rodney Renkenberger why he felt it was important to have such a program and how he did it.



One Local Example of Critical Facility Flood Protection

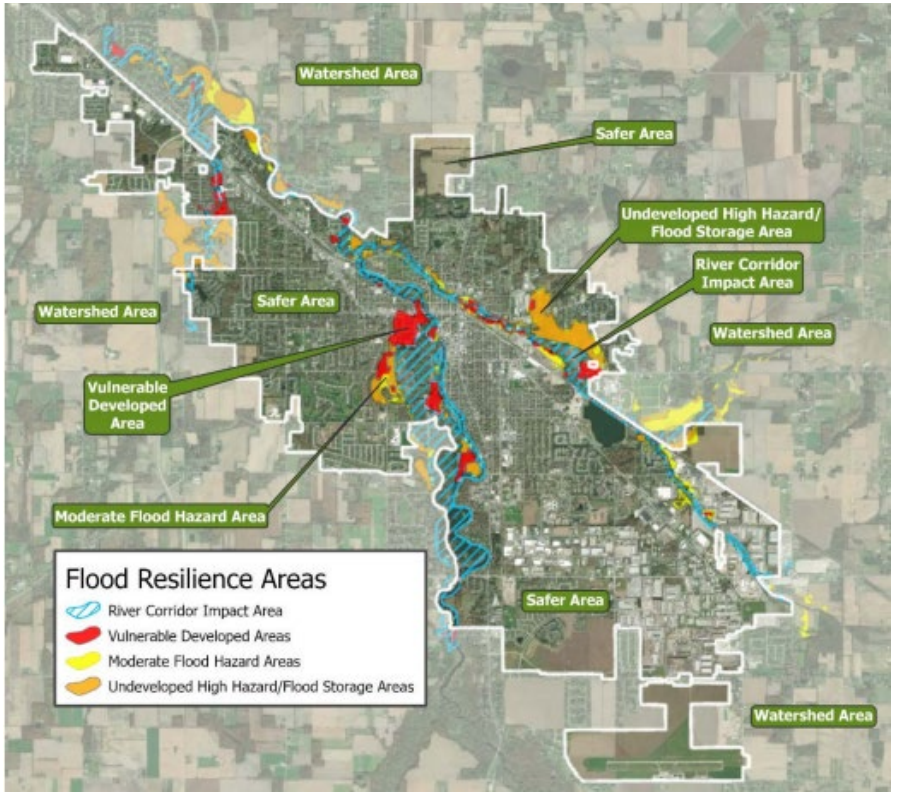
Following the devastating 2008 record flood along Haw Creek in Columbus, The Columbus Regional Hospital as well as Cummins, Inc. constructed perimeter floodwall protection along with automated flood gates.

One Local Example of Room for River Creation

Following the 2018 flooding in Tipton, Burke developed a comprehensive flood risk management plan for the Big Cicero Joint Drainage Board, which called for creating a 2-stage ditch along Big Cicero Creek through Tipton to give the river the room it needs to reduce bank erosion and flooding. The construction just completed this month.

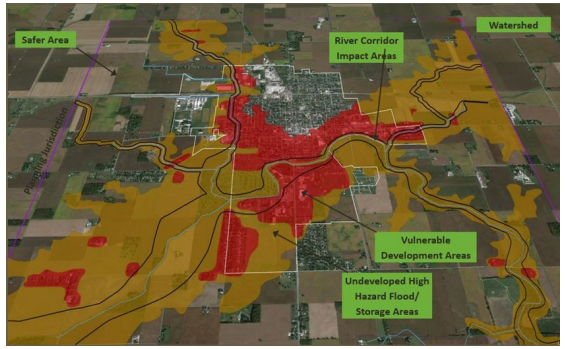
One Local Example of Flood Resilience Planning

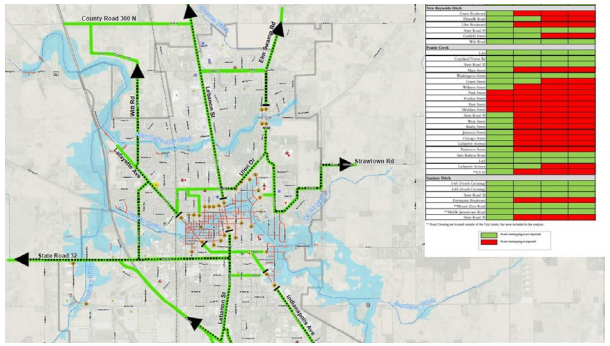
The City of Goshen recently adopted a comprehensive flood resilience plan that includes several Citywide and geographical area specific strategies to reduce flooding and bank erosion. The implementation plan contained in the plan will help a smoother path to adoption of higher standards and the needed capital projects!

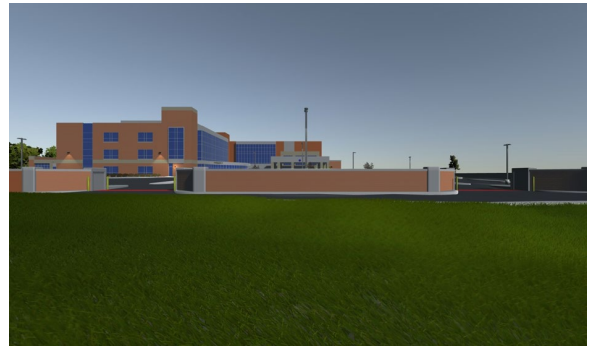


BOTTOM LINE – TAKE ACTION BEFORE IT IS TOO LATE!

1. Prevent any increase in flood vulnerability (Smart Growth: steer new development to safer areas, NAI regulations in the watershed, no more wetland and floodplain fill)
2. Protect buildings and Infrastructure (relocate or floodproof) and Plan for Next Flood
3. Create Room for the River (2-Stage Ditches, Floodplain Recollection)







❖ REMEMBER: COMMUNITIES MAY BE FOUND LIABLE FOR ALLOWING ADVERSE IMPACTS AND/OR INACTION!

QUESTIONS?

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