

# Enhancing Camden's Flood Mitigation and Resilience: A Community-Focused Approach

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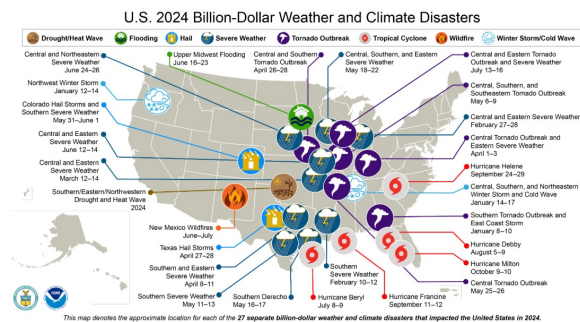
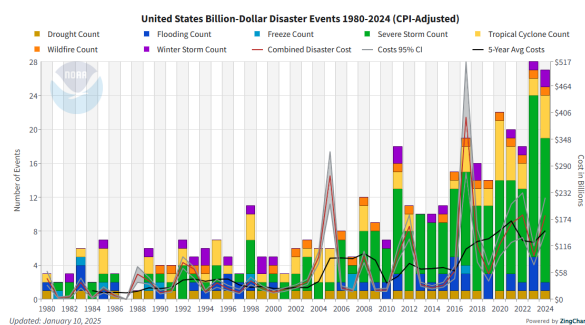
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## In Numbers...



- From 2018-2024, the total cost of billion-dollar disasters in the United States was \$600 billion
- The U.S. has sustained 387 weather and climate disasters since 1980



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# Diving Deeper

## The Unequal Impacts of Flood Risk

**STEP 1. Filter counties by flood risk** Click label to filter map

Low
  Medium
  High
  Very High

**STEP 2. Apply demographic filters** \*High\* means county values > U.S. median

Families in poverty (%)	High	Households with no car (%)	(All)
People with disabilities (%)	High	Mobile homes (%)	(All)
People with language barriers (%)	(All)	Rental homes (%)	(All)
People of Color and Hispanics (%)	High	Community capacity	(All)

**STEP 3. Learn about counties where people could be disproportionately impacted by floods**

Counties displayed on the map include:

38,720,512 Total people	1,307,041 Families in poverty	5,771,369 People with disabilities	1,661,997 People with language barriers
22,933,781 People of Color or Hispanics	5,878,573 Households that rent	1,641,383 Households with no car	1,067,307 Mobile homes

- Climate-driven threats - rural communities with very limited capacity face high risks:
  - 3,626 (46%) have high flood risk
  - 3,035 (38%) have high wildfire risk
  - 1,534 (19%) have both high flood risk and high wildfire risk

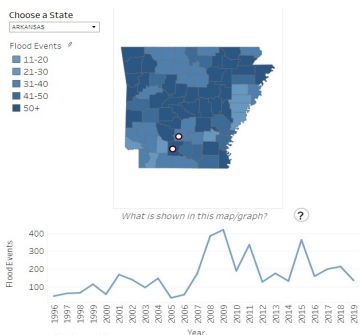
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# Historical Flood Risks and Costs

Since 1996...

- Ouachita County – 88 Flooding Events
- Dallas County – 33 flooding Events




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# Community Voices...

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*Standing water on road, Road Underwater, Standing water in unpaved areas, Creek out of its banks.*

*No permanent damage, Erosion, Erosion and damage to buildings*

*Road washes out after a rain. The creek overflows and cannot cross.*

*Yeah, I lost my car to water before so went to get my truck - Reverend Kemp*

Source: <https://www.fox16.com/news/ouachita-river-flooding-dozens-of-roads/>

*Ouachita County Judge Robert McAdoo says this flood so far has impacted around 75 to 100 people - whether it be water around their homes or navigating around the dozens of closed county roads.*

Source: <https://www.fox16.com/news/ouachita-river-flooding-dozens-of-roads/>

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# NRCS Watershed Program?

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- Natural Resources Conservation Service (NRCS) – a federal agency within United States Federal Agency (USDA)
- Watershed and Flood Prevention Operations (WFPO) Program

Helps units of federal, state, local and federally recognized tribal governments (project sponsors) protect and restore watersheds for the purpose of:

- Flood Prevention (flood damage reduction)
- Watershed Protection
- Public Recreation
- Public Fish and Wildlife
- Agricultural Water Management
- Municipal and Industrial Water Supply
- Water Quality Management



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# CASE STUDY

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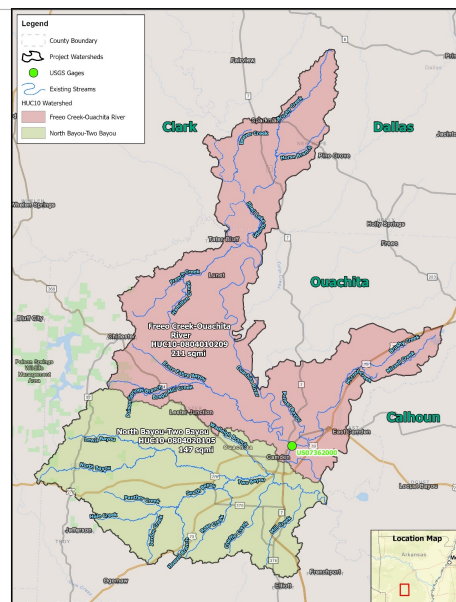
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## Camden Watershed

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- Two HUC10 watershed:
  - North Bayou-Two Bayou (0804020105),
  - Ecore Fabre Bayou-Ouachita River (0804010209)
- Total scoped area: **372 sq. miles**
- Total drainage area: **5360 sq. miles**
- Population of **20,711**
- **22 communities** – City of Camden is the largest
- Mainly **two counties**: Ouachita and Dallas
- One USGS gage (07362000)
- **Each Census block group contains at least one EPA - IRA disadvantaged community**

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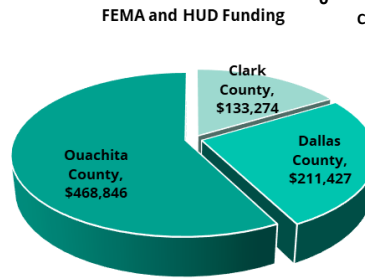
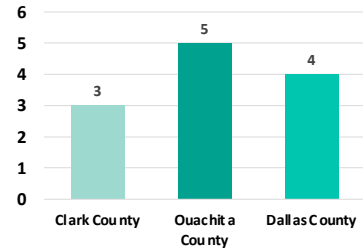


# Flooding History

- United States Geological Survey (USGS) gage 07362000 has 100+ yrs of data record
- Ouachita County has the highest flooding issues
- The amount of funding provided is not significant

Date	Crest (feet)
May 12, 1882	46.00
April 3, 1945	44.82
May 5, 1958	43.87
May 17, 1968	43.08
December 29, 1987	42.50
<b>February 26, 2018</b>	<b>41.29</b>
<b>December 28, 2009</b>	<b>41.16</b>
June 12, 1974	39.59
March 12, 1990	39.40
February 3, 1969	39.15
March 12, 1990	39.40
February 3, 1969	39.15

Number of Disasters Recorded between 2011 and 2021



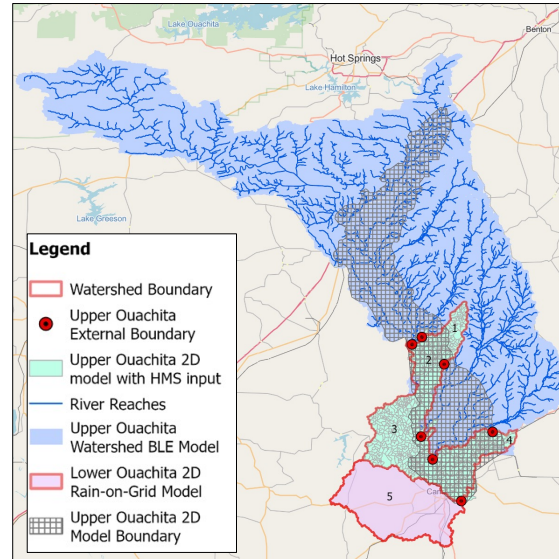
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## BLE to Enhanced BLE

# BLE Model

- Current model is updated from the existing Base Level Engineering (BLE) model(s)
  - Area 1 – HMS and 1D model available
  - Area 2 - 2D HEC-RAS hydraulic model available (v6.3.1)
  - Areas 3 and 4 – HMS and 1D model available
  - Area 5 – HMS and 2D rain on grid BLE model available (v5.0.7)
- One combined domain

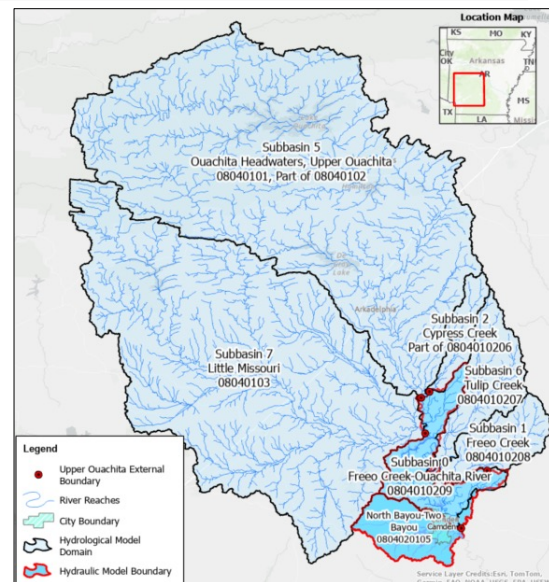


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# Hydrologic Model

- HEC-HMS v4.11
- Sub catchment area of 5,360 sq. miles
- Part of three HUC8 areas
- Loss method: SCS curve, following existing BLE model
- Transformation method: SCS unit hydrograph, following existing BLE model
- 50-, 20-, 10-, 4-, 2-, 1-, and 0.2-percent- AEP - NOAA Atlas14

	2yr	5yr	10yr	25yr	50yr	100yr	500yr
Avg. Rain (in)	4.45	5.48	6.33	7.70	8.78	9.92	12.78

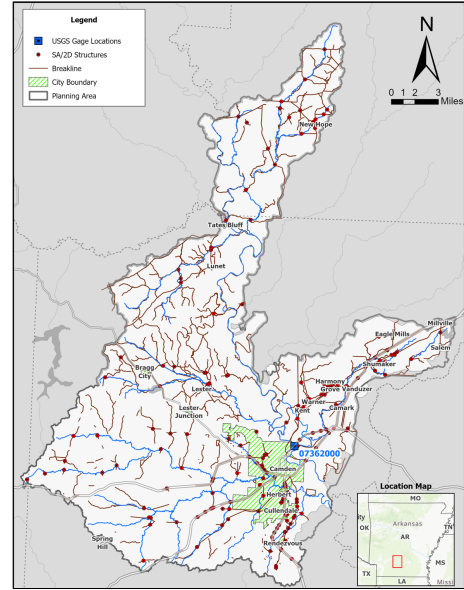


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# Hydraulic Model

- HEC-RAS v6.5
- Breaklines added
  - All major roads & Railroads
  - 571 miles
- SA-2D structures added
  - 182 major bridges and culverts
  - ArDOT as-built data
  - In-house automation
- Mesh size refinements
- Refinement based on local information

Land use type	Channel or tributary width (ft)	Refinement mesh size (ft)	Minimum number of cells
Channel/stream	500 or more	200 X 200	2
Channel/stream	200-500	100 X 100	2
Channel/stream	100-200	50 X 50	2
Channel/stream	100 or below	50 X 50	1
Urban area		100 X 100	1
Lake or large waterbody		500 X 500	1

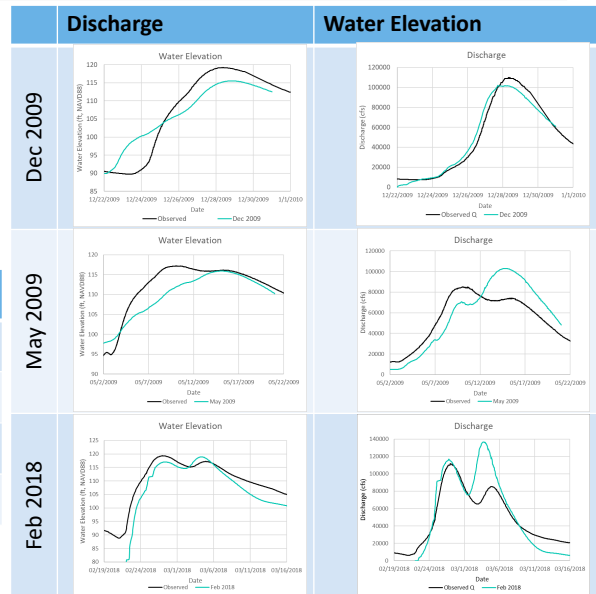


# Model Calibration

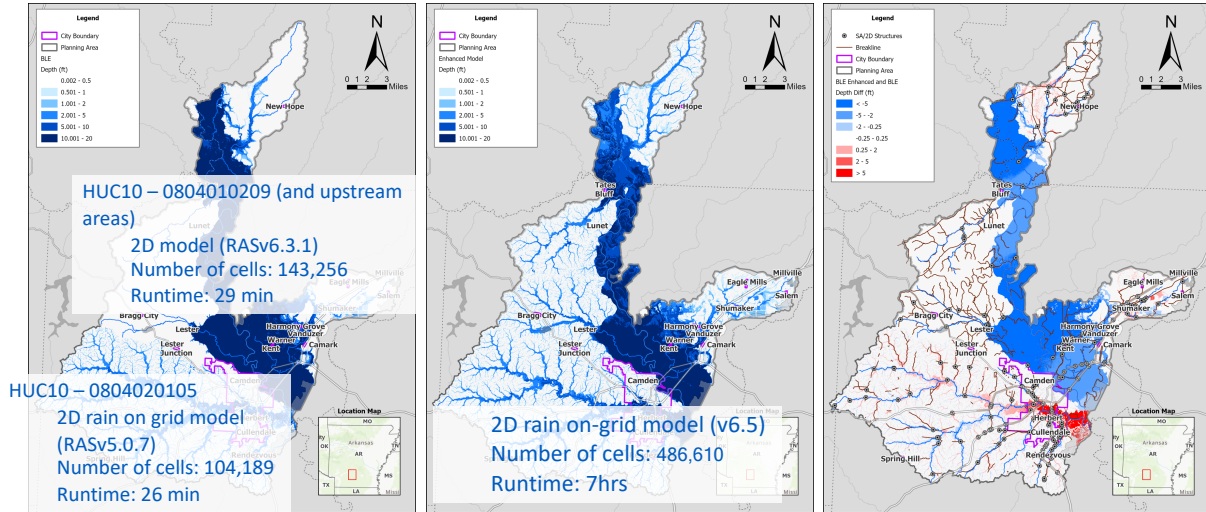
- Recent major events
- Gage location: USGS 07362000 at Ouachita River
- HEC-HMS model calibrated for discharge
- HEC-RAS model calibrated for water elevation and discharge

		Dec 2009 Calibration	May 2009 Validation 1	Feb 2018 Validation 2
Water Elevation (ft)	BIAS	-0.03 (-0.1%)	-1.95 (-8%)	-3.30 (-12%)
	RMSE	5.00 (17%)	3.61 (15%)	4.67 (17%)
Discharge (cfs)	BIAS	525 (0.5%)	2,562 (3%)	3,191 (3%)
	RMSE	6,749 (6%)	17,461 (21%)	20,510 (18%)

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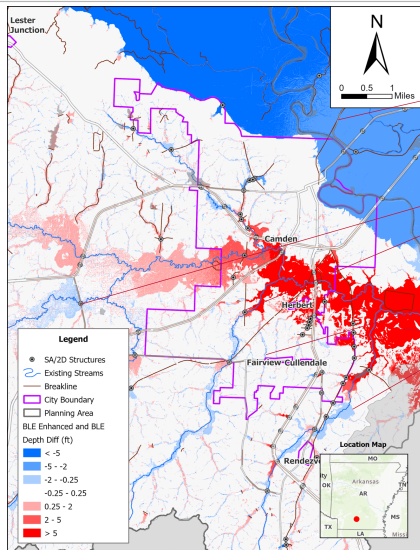
# BLE vs BLE - Enhanced



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# BLE vs BLE - Enhanced



Higher upstream flow in BLE

Due to SA-2D structures

Due to breaklines

Due to backwater flow

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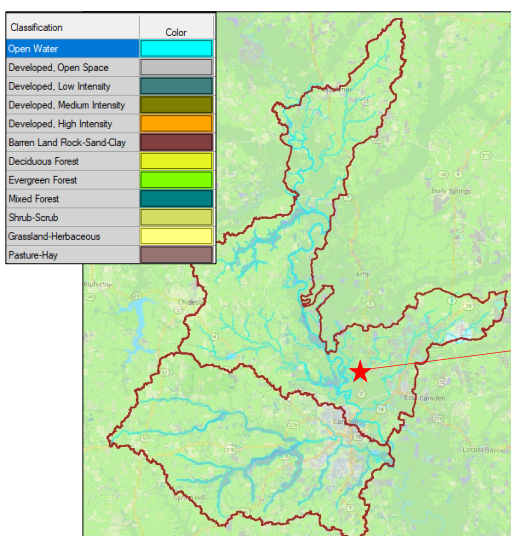
# Flooding Issues

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## Problem Identification

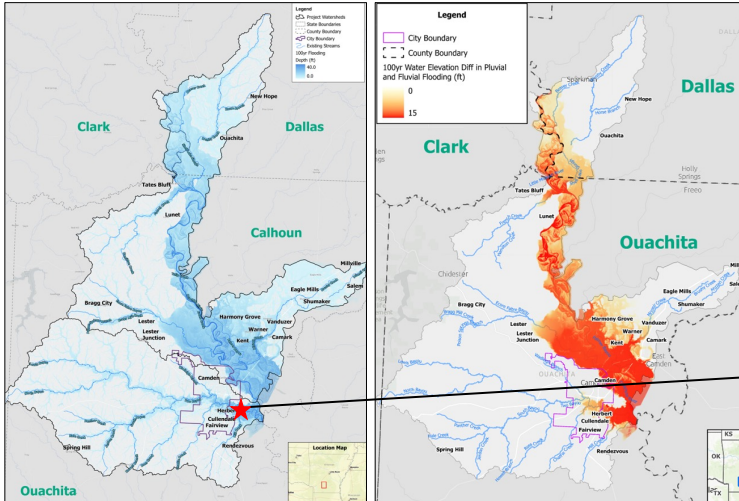
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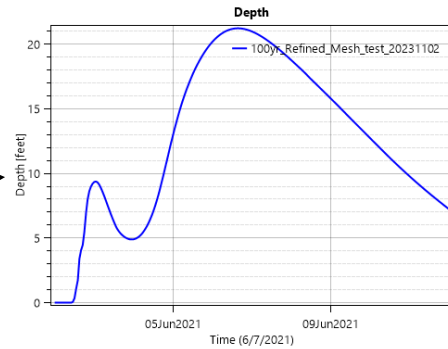
- Channel capacity
  - The channels within the watershed have too much vegetation, making the capacity low



# Problem Identification



- Upstream flow
  - The 1% AEP flow from Ouachita River upstream creates backwater flow in Two Bayou channel and floods the city of Camden



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# Problem Identification



- Other areas
  - Some areas have flooding sources from Ouachita River over bank flow
- Different levels of flooding were identified
  - 171.5 sq. miles area are flooded under 100-yr flood

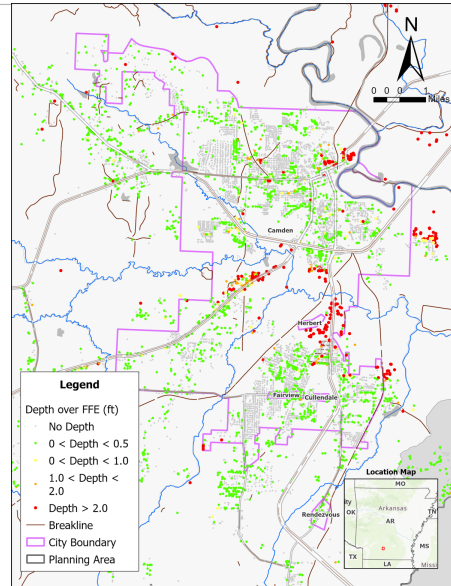
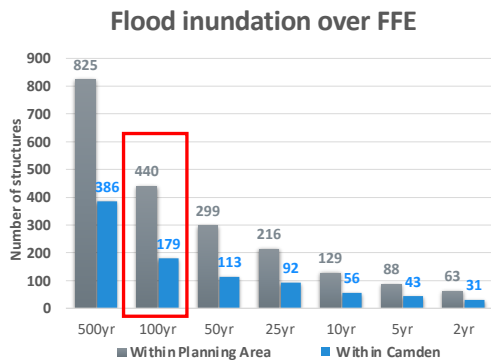
Atlas 14 Design Storm Event	Floodplain area (sq. mile)			
	0 < Depth <= 0.5'	0.5' < Depth <= 1.5'	Depth > 1.5'	TOTAL
50% AEP	8.604	56.787	49.768	115.159
20% AEP	7.041	57.473	73.516	138.031
10% AEP	5.850	52.147	91.961	149.957
4% AEP	4.898	46.942	108.591	160.431
2% AEP	4.386	43.923	118.261	166.570
<b>1% AEP</b>	<b>4.030</b>	<b>42.186</b>	<b>125.327</b>	<b>171.543</b>
0.2% AEP	3.436	39.514	137.704	180.654

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# Problem Identification

- Affected structures
  - In 1% AEP event
    - 440 structures have flooding over FFE
    - 179 structures are within Camden



# Risk and Vulnerability

- Prepared a risk map based on 100-yr and 500-yr flood

**Risk = Flood Impact Probability x SVI**

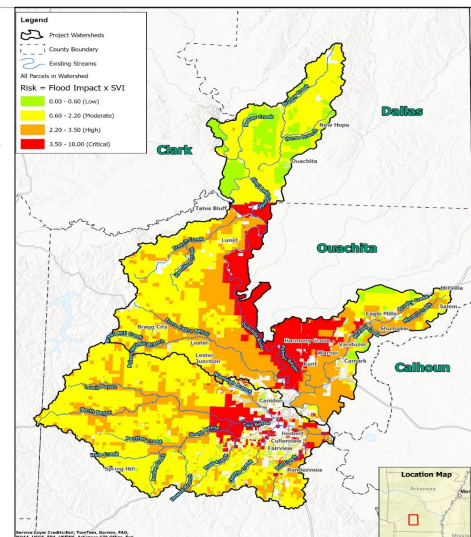
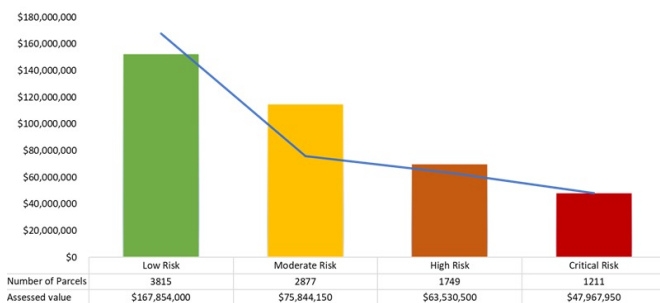
**Flood Impact Probability = Flood Impact x Probability x Depth Multiplier**

**Flood Impact = Parameter considering the type of parcels**

High value for residential parcels (150)

Low value for agricultural parcels (100)

**Depth Multiplier = 1 for 0.5 < Depth ≤ 1 ; 5 for Depth > 5**



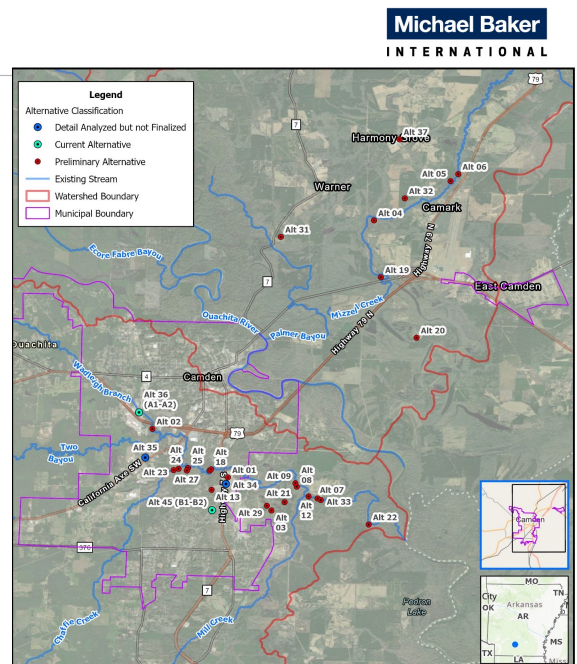
# Alternative Solutions

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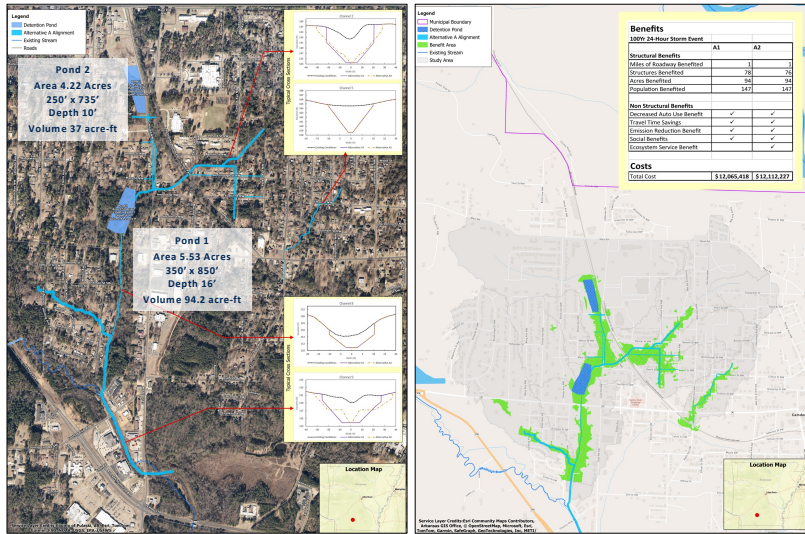
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## Alternatives Proposed

- NRCS PR&G guideline:
  - Maximizing public benefits relative to cost
  - Without prioritizing economic, social, or environmental goals
- Mix of structural, non-structural, and nature-based solutions
- Main challenge
  - Backwater flow
  - Project cost limit – \$25M
- Mitigation
  - Implementation of larger storage ponds
  - Improved drainage capacity



# Alternative A1 – A2



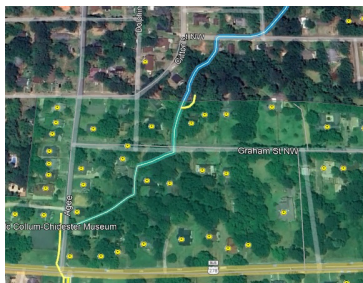
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- Dredging and widening approximately 2.0 miles of existing channels
- Lining one existing stream (0.3 miles) within with concrete and connecting to a new channel
- Widening and creating approximately 1.2 miles of roadside ditches
- Two detention ponds: approximately 131 acre-feet of maximum flood volume

# Alternative A1-A2 Main Constraints

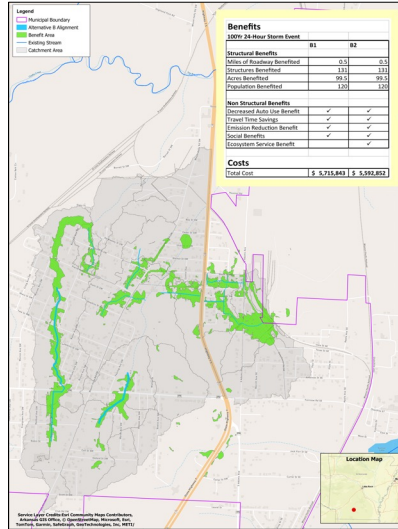
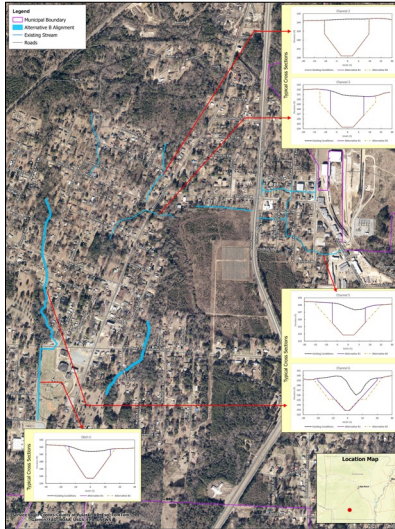
- Historic properties within the project area
- Proposed channel improvement near Camden SDA Church historical site
- Pond 2 is located on a privately owned land



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# Alternative B1 – B2



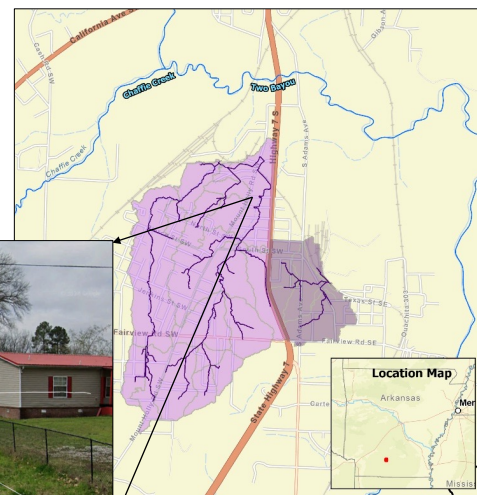
- Widening of drainage ditches
- Dredging an existing swale through Macon St, Rich St, and S Adams Ave
- One new grass-lined ditch to construct
- Two new concrete-lined channels to construct
- Installation of a series of box culverts

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# Alternative B1-B2 Main Constraints

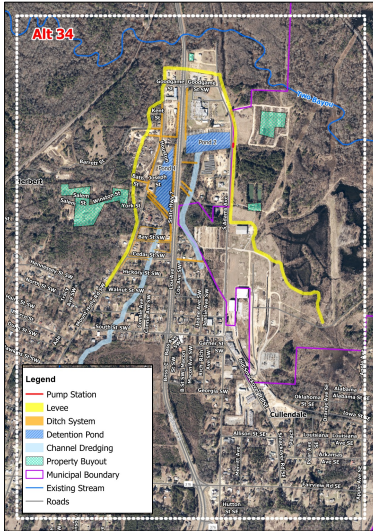
- Construction constraints
  - Channel widening locations
- Conservation of flow path
  - Committed to preserving the original meandering patterns
  - Pre-existing drainage flow connectivity to avoid adverse impacts



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## Other Alternatives

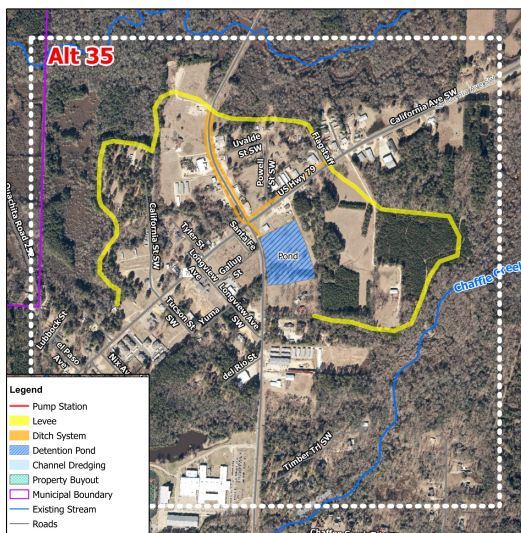


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- Alternative 34
- Construction of a 2-mile levee around the core developed area
- Two detention ponds: 310-acre feet of flood storage volume
- Deepening and widening of 2.4 miles of roadside ditches
- Dredging nearby channels by 10 feet below existing channel depth.
- Digging a new 5-foot-deep channel
- Estimated cost: **\$58.9M**



## Other Alternatives



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- Alternative 35
- Construction of a 2.3-mile levee
- Construction of a 119 acre-ft detention pond
- Dredging of the existing ditch system
- Replacement of a culvert with a 3-foot culvert
- Estimated cost: **\$56.5M**



# Proposed Alternative: Alternative C

- Combining both Alternative A1 and B1
- Based on NRCS suggestions and public opinion
- Maximizing public benefit within budget
- Benefit calculated for 100-yr only

	Present Value Benefit	Annual Average Benefit
Structures	\$1,230,646	\$45,584
Roads	\$160,591	\$5,948
Social Benefit	\$4,536,191	\$168,025
Residual Value (land)	\$211,081	\$7,819
Decreased Auto Use Benefit	\$2,802	\$104
Travel Time Savings	\$3,521	\$130
Emissions Reduction Benefit	\$394	\$15
<b>Total</b>	<b>\$6,145,226</b>	<b>\$227,625</b>

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# Proposed Alternative: Alternative C



## FLOOD RISK AWARENESS

**34%**  
of RiskMAP Communities  
are aware<sup>1</sup> of their flood risk



**23%**  
of non-Risk MAP Communities  
are aware of their flood risk

**12%**  
of RiskMAP Communities  
are aware<sup>2</sup> of flood risk to  
their residence



**8%**  
of non-Risk MAP Communities  
are aware of flood risk to their  
residence

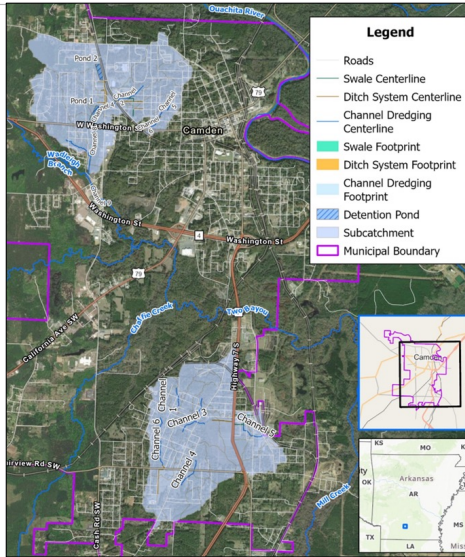
## Non-structural measures

- Increase preparedness – educating residents about flood risks.
- Bridge information gaps for underserved communities
- Improve disaster readiness and response time

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# Proposed Alternative: Alternative C



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- Cost basis 2023 ArDOT
- Estimated discount rate 2.75%
- Inflation rate 2.0% (Federal Government target rate)
- 50-yr service life considered

Estimated Capital Costs	\$17,781,260
50-year total O&M Costs @ 2.75 discount rate	\$7,416,937
Present day value of total Costs @ 2.75 discount rate	\$25,198,198
Present day value of total 50-year benefit @ 2.75% discount rate	\$6,145,226
Estimated Benefit – Cost Ratio	0.24



# Community Engagement



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- Community Engagement is a major integral part of NRCS projects
- From risk identification to alternative selection - the local community was involved in all steps



# Conclusion

- This work promotes flood mitigation for a historically under-served community
- Provides a data-driven decision-making, combining community inputs and H&H modeling
- Improving Focusing long term resilience
- Creating flood awareness about flood risk management
- The proposed alternatives comply with NRCS guidelines

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Thank you

USDA NRCS  
United States Department of Agriculture  
National Resources Conservation Service

CAMDEN  
CLARK COUNTY  
STARBUCK

FINAL | OCTOBER 2024

**CAMDEN WATERSHED PLAN-EA**  
FREEO CREEK-OUACHITA RIVER AND  
NORTH BAYOU-TWO BAYOU WATERSHEDS  
NRCS WATERSHED PROGRAM  
CLARK, DALLAS AND OUACHITA COUNTIES, ARKANSAS

PREPARED BY  
USDA NATURAL RESOURCES  
CONSERVATION SERVICE

IN COOPERATION WITH  
CITY OF CAMDEN  
CAMDEN, ARKANSAS