MESHEK & ASSOCIATES, LLC

GIS for Hazard Mitigation Planning

David Littlejohn, GISP

Our Purpose

Communities need trusted partners
to safeguard today
and build a stronger tomorrow
— it's why we exist.

What We Do

- Land Acquisition
- Civil & Roadway Design
- Hydrologic & Hydraulic Engineering
- LiDAR
- Land Surveying
- GIS
- Planning

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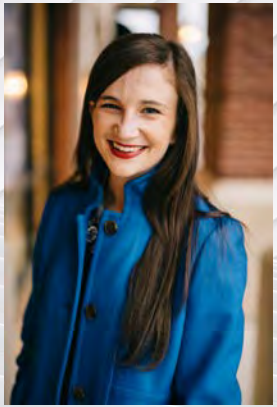
Planning Department



Kim Jenson

Planner

Annie Vest

Planning Manager

Philip Berry

Planner

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On average,

$1 spent on **HAZARD MITIGATION**

provides the **NATION** approximately **$6 IN FUTURE BENEFITS**

Source: National Institute of Building Sciences, 2017 Mitigation Saves Interim Report

Current Planning Projects

CITY OF
Tulsa
A New Kind of *Energy*™

MAYES
COUNTY

The City of
Claremore
OKLAHOMA

The City of
Stillwater
OKLAHOMA

Parts of a plan

Chapter 1	• Introduction	Why make this plan?
Chapter 2	• The Planning Process	Steps 1 – 10
Chapter 3	• Capability Assessment	What resources do we have?
Chapter 4	• Risk Assessment	Identify Hazards + Vulnerability
Chapter 5	• Mitigation Strategy and Action Plan	Actions!
Chapter 6	• Implementation and Maintenance	Meet FEMA standards

The Planning Process

1. Organize to prepare the plan
2. **Involve the public**
3. Coordinate with other agencies and organizations
4. **Assess the hazard**
5. Assess the problem
6. Set Goals
7. Review Possible Activities
8. Draft the action plan
9. Adopt the plan
10. Implement, evaluate, and revise

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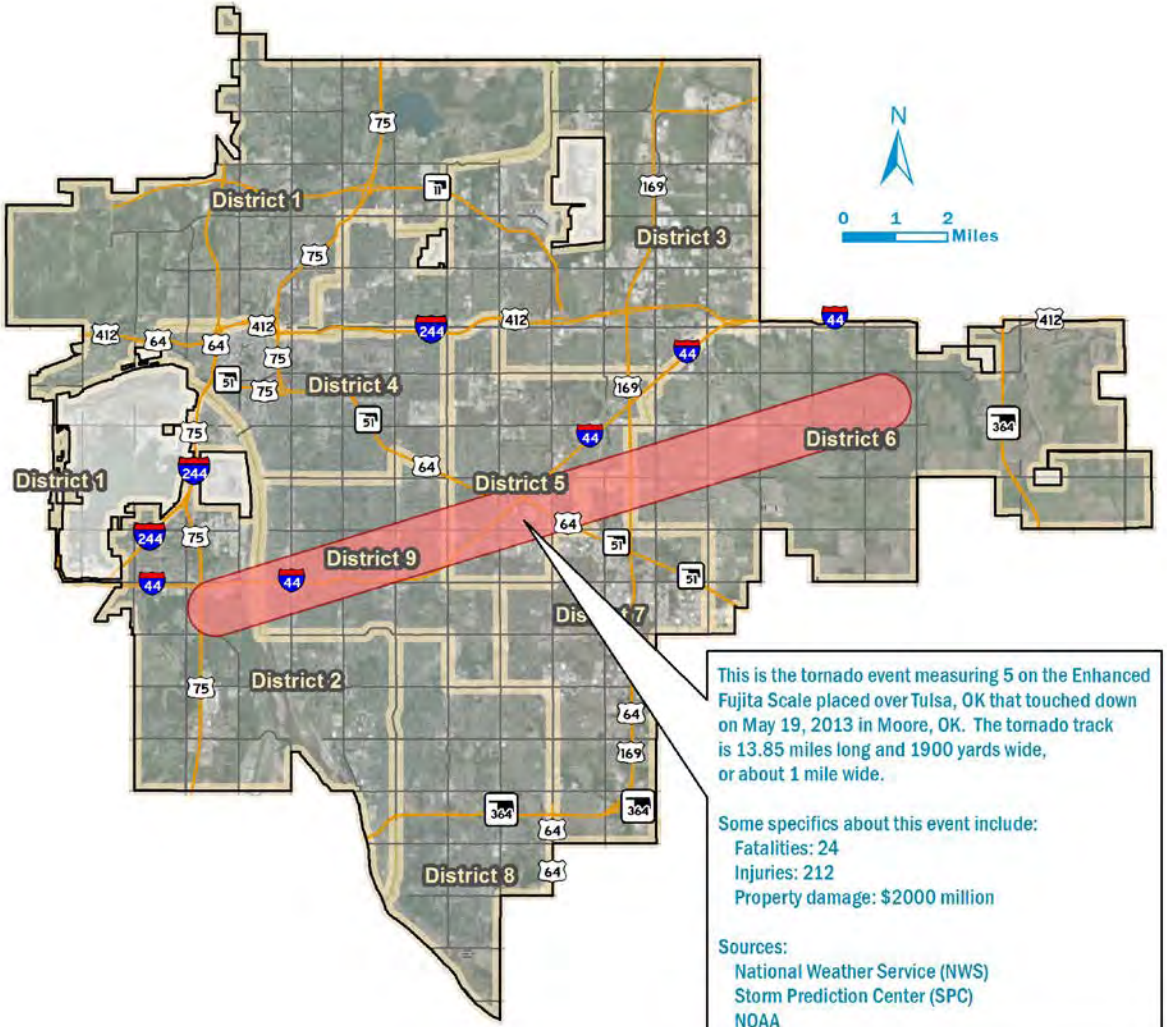
Geological Hazards
✓ Earthquakes
✓ Landslides
✓ Volcanic eruptions
✓ Expansive Soils

Meteorological Hazards

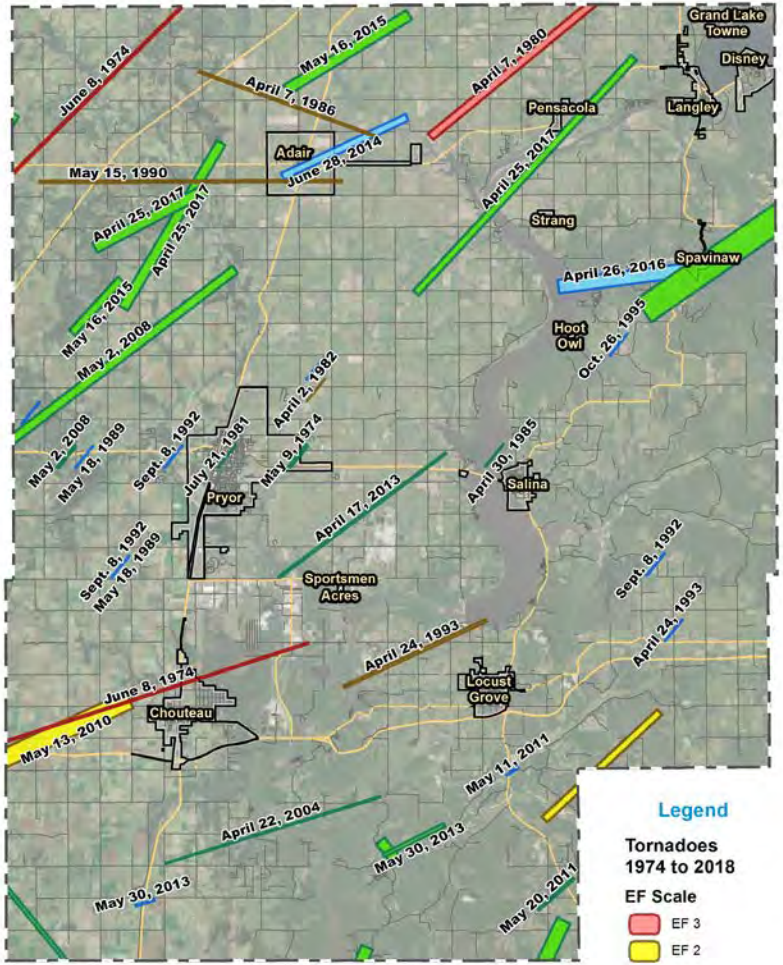
- ✓ Tornado
- ✓ Hail
- ✓ Extreme Heat
- ✓ Drought
- ✓ Severe Winter Storm
- ✓ Lightning

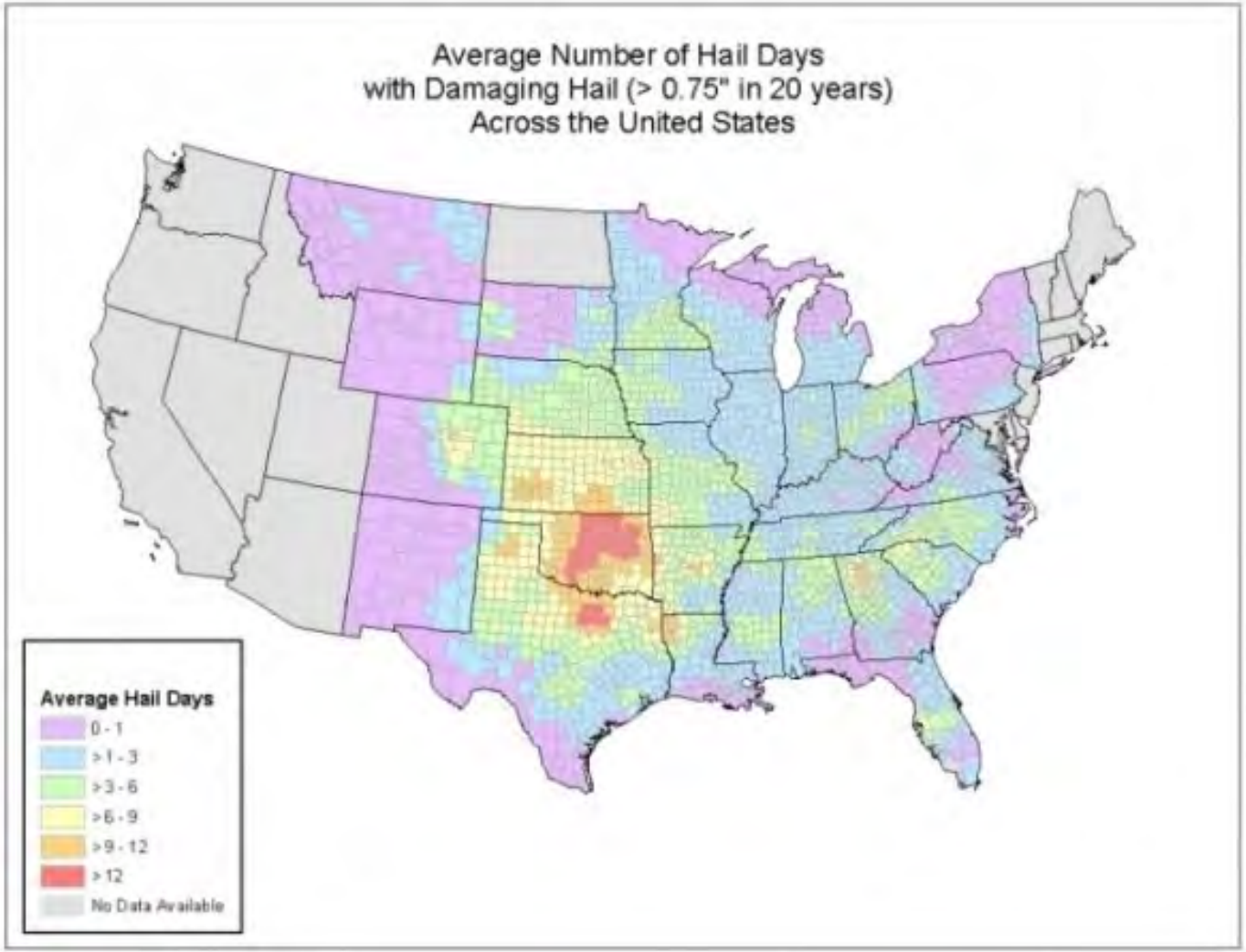


This is the tornado event measuring 5 on the Enhanced Fujita Scale placed over Tulsa, OK that touched down on May 19, 2013 in Moore, OK. The tornado track is 13.85 miles long and 1900 yards wide, or about 1 mile wide.

Some specifics about this event include:
- Fatalities: 24
- Injuries: 212
- Property damage: $2000 million

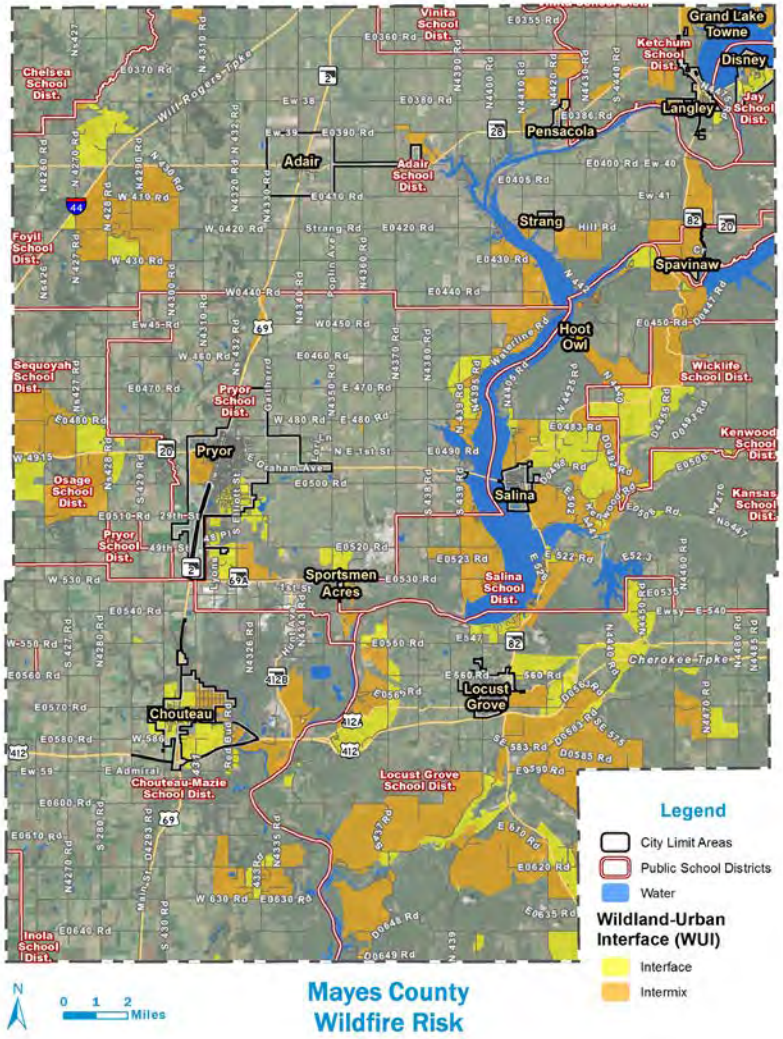
Sources:
- National Weather Service (NWS)
- Storm Prediction Center (SPC)
- NOAA


Grand Lake Towne
Disney
Langley
Pensacola
Adair
Strang
Spavinaw
Hoot Owl
Salina
Pryor
Sportsmen Acres
Locust Grove
Chouteau
June 8, 1974
May 16, 2015
April 7, 1986
April 7, 1980
May 15, 1990
June 28, 2014
April 25, 2017
April 26, 2016
Oct. 26, 1995
May 2, 2008
April 2, 1982
May 18, 1989
Sept. 8, 1992
July 21, 1981
May 9, 1974
April 30, 1985
April 17, 2013
May 13, 2010
April 24, 1993
May 11, 2011
April 22, 2004
May 30, 2013
May 20, 2011
N
0 1 2 Miles
Mayes County Tornado Events
Legend
Tornadoes 1974 to 2018
EF Scale
EF 3
EF 2
EF 1
EF 0


Average Number of Hail Days
with Damaging Hail (> 0.75" in 20 years)
Across the United States
Average Hail Days
0 - 1
> 1 - 3
> 3 - 6
> 6 - 9
> 9 - 12
> 12
No Data Available

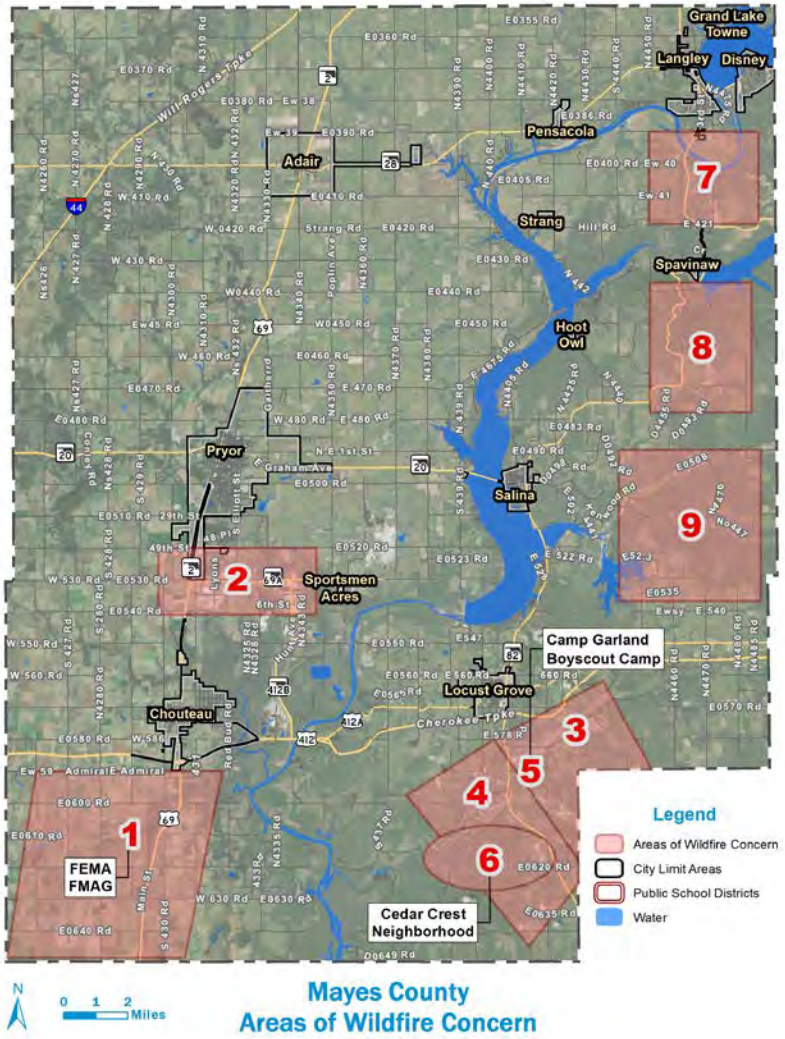
Wildfires

Wildland-Urban Interface (WUI)



Wildfires

Where are you concerned about wildfires?



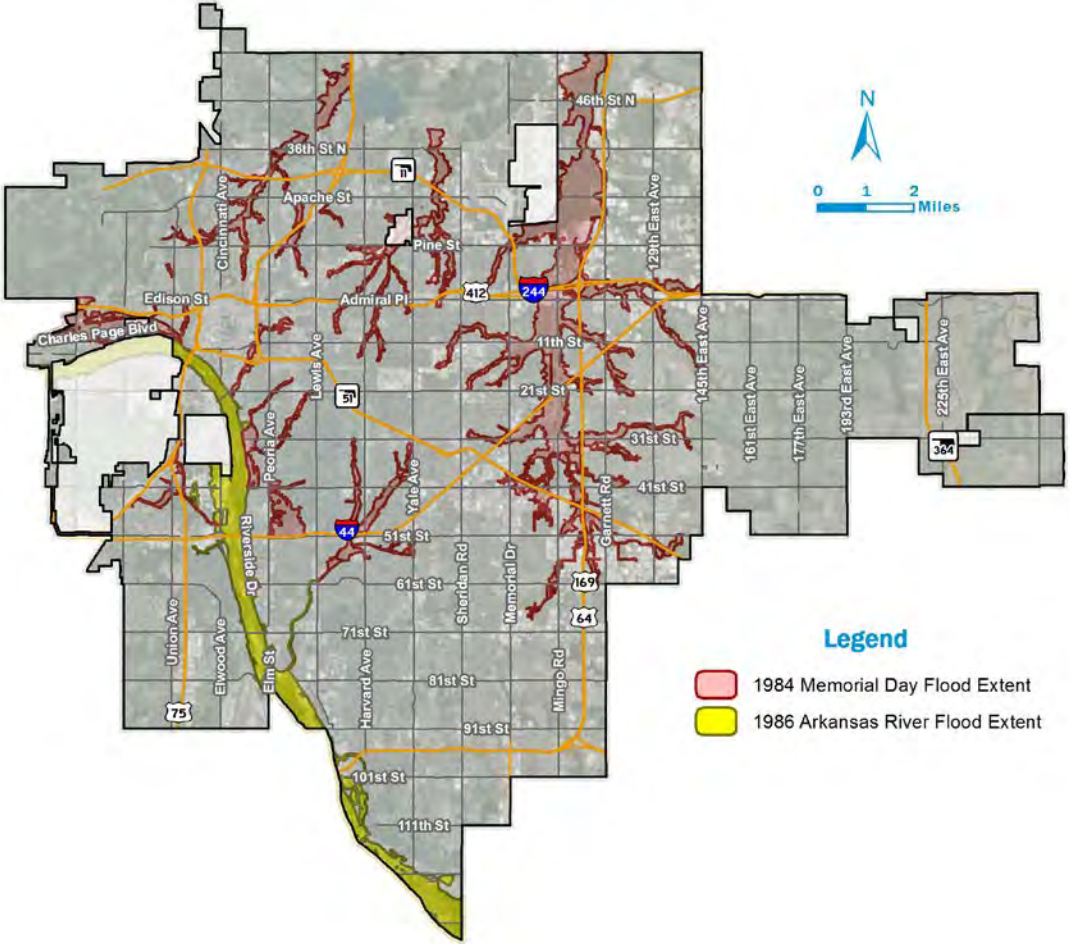
Space Disasters

“Astronomical Hazards”

- ✓ Solar flares
- ✓ Asteroids
- ✓ ET?

Hydrological

- ✓ Floods
- ✓ Tsunamis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36th St N
Apache St
Pine St
Edison St
Admiral Pl
Charles Page Blvd
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21st St
31st St
41st St
51st St
61st St
71st St
81st St
91st St
101st St
111th St
Cincinnati Ave
Lewis Ave
Peoria Ave
Riverside Dr
Yale Ave
Union Ave
Elwood Ave
Elm St
Harvard Ave
Sheridan Rd
Memorial Dr
Garnett Rd
Mingo Rd
129th East Ave
145th East Ave
161st East Ave
177th East Ave
193rd East Ave
225th East Ave
412
244
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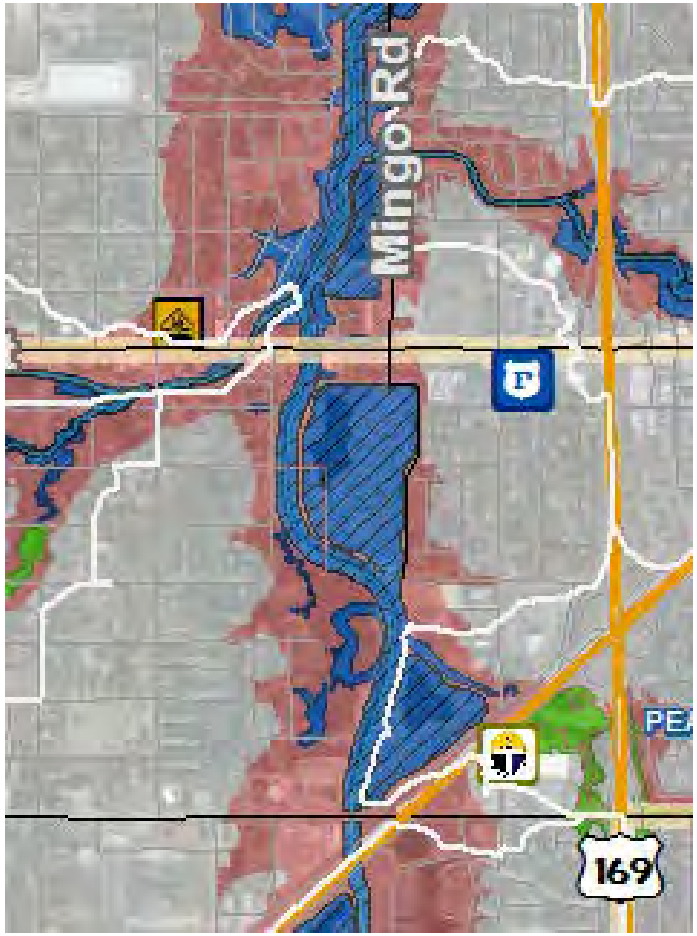
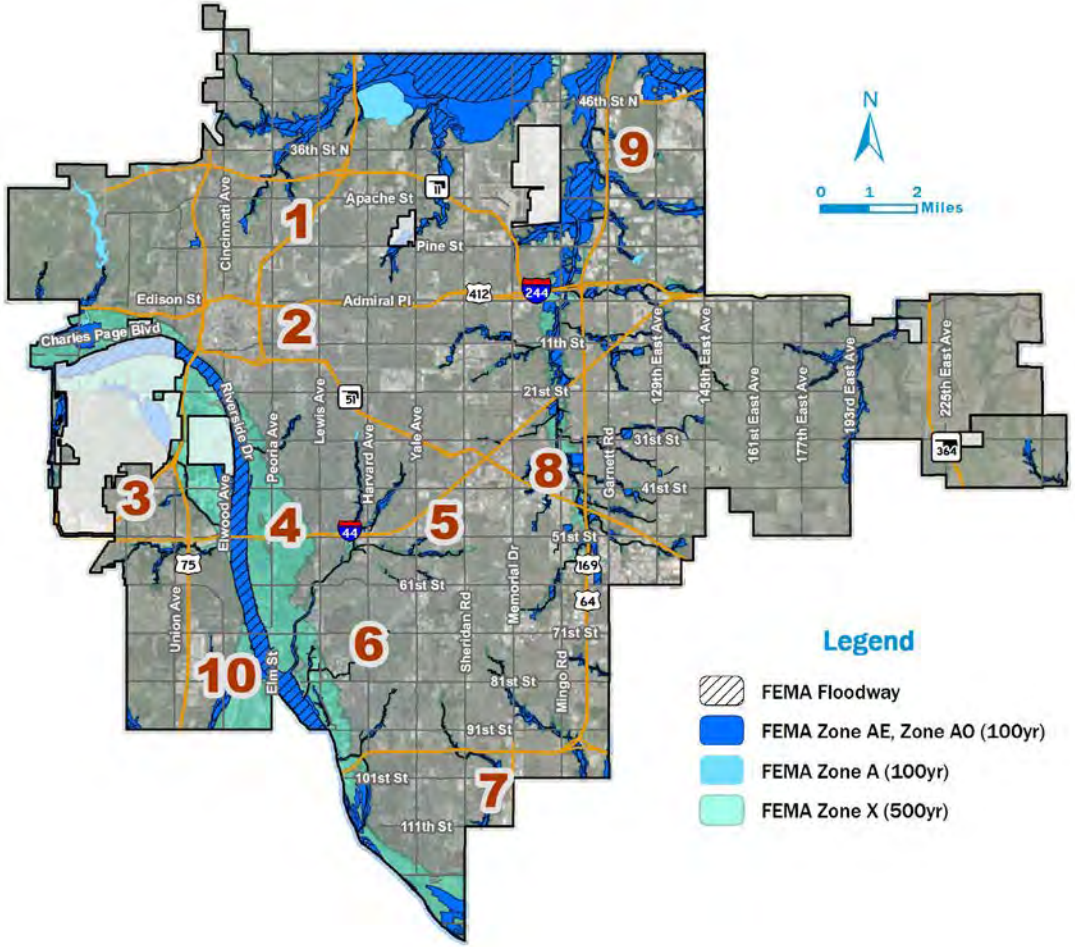
44
169
64
75
384
Legend
1984 Memorial Day Flood Extent
1986 Arkansas River Flood Extent


Mingo Rd
169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145th East Ave
161st East Ave
177th East Ave
193rd East Ave
225th East Ave
1
2
3
4
5
6
7
8
9
10
Legend
FEMA Floodway
FEMA Zone AE, Zone AO (100yr)
FEMA Zone A (100yr)
FEMA Zone X (500yr)

What Hazards are your biggest concern?

- ✓ Earthquakes
- ✓ Landslides
- ✓ Volcanic eruptions
- ✓ Tornadoes
- ✓ Hail
- ✓ Extreme Heat
- ✓ Drought
- ✓ Lightning
- ✓ Flood
- ✓ Dam/Levee Breach
- ✓ Tsunami
- ✓ Asteroids
- ✓ Solar flares
- ✓ Expansive Soils
- ✓ Severe Winter Storms
- ✓ Hazardous Materials

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Risk Assessment Section

→ Where Hazards and Vulnerability Intersect
→ Where GIS is key

Impact vs. Probability vs. Capability

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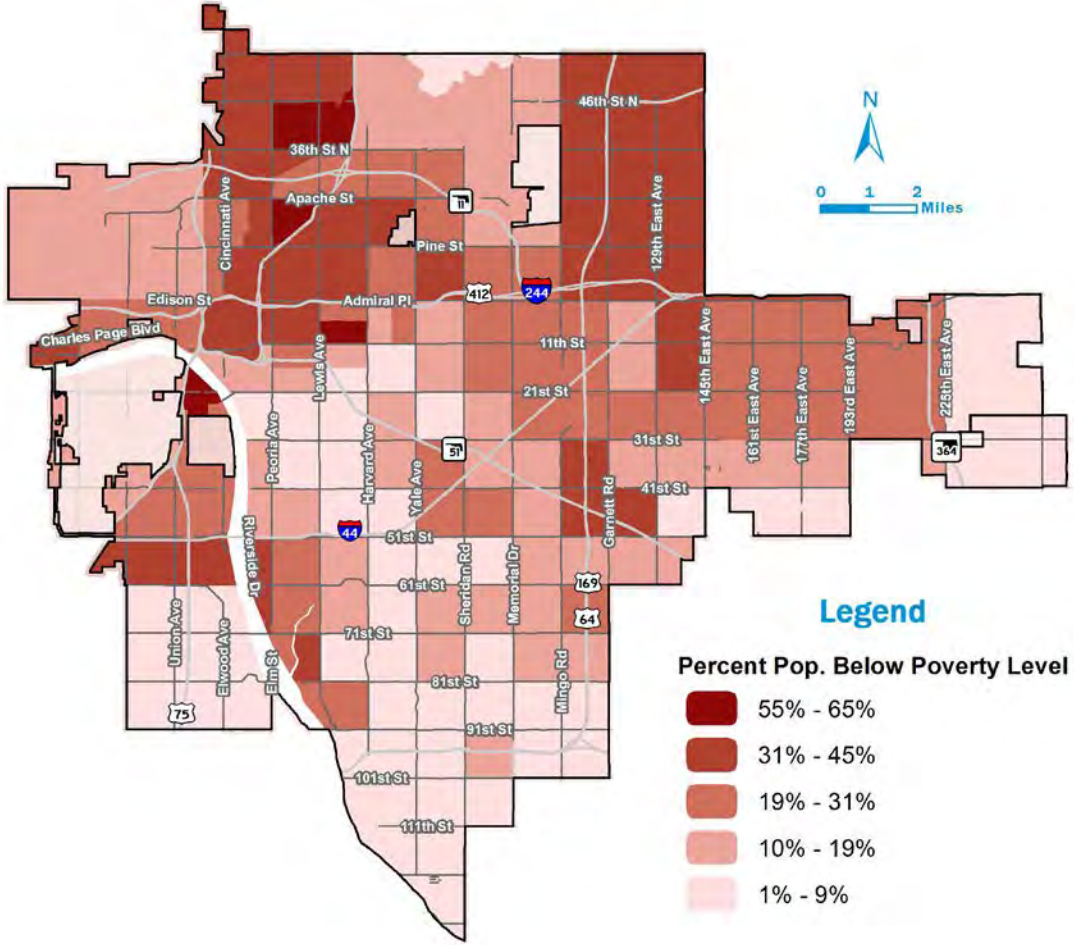
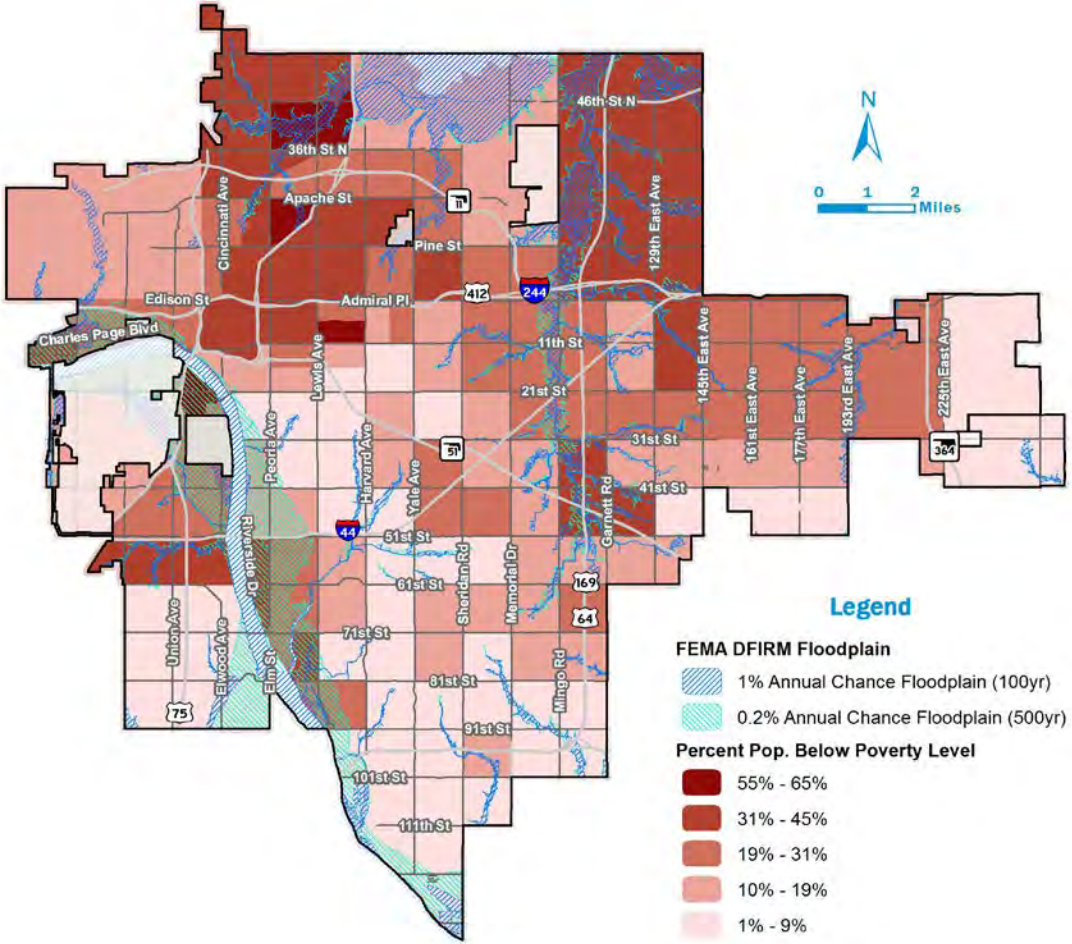
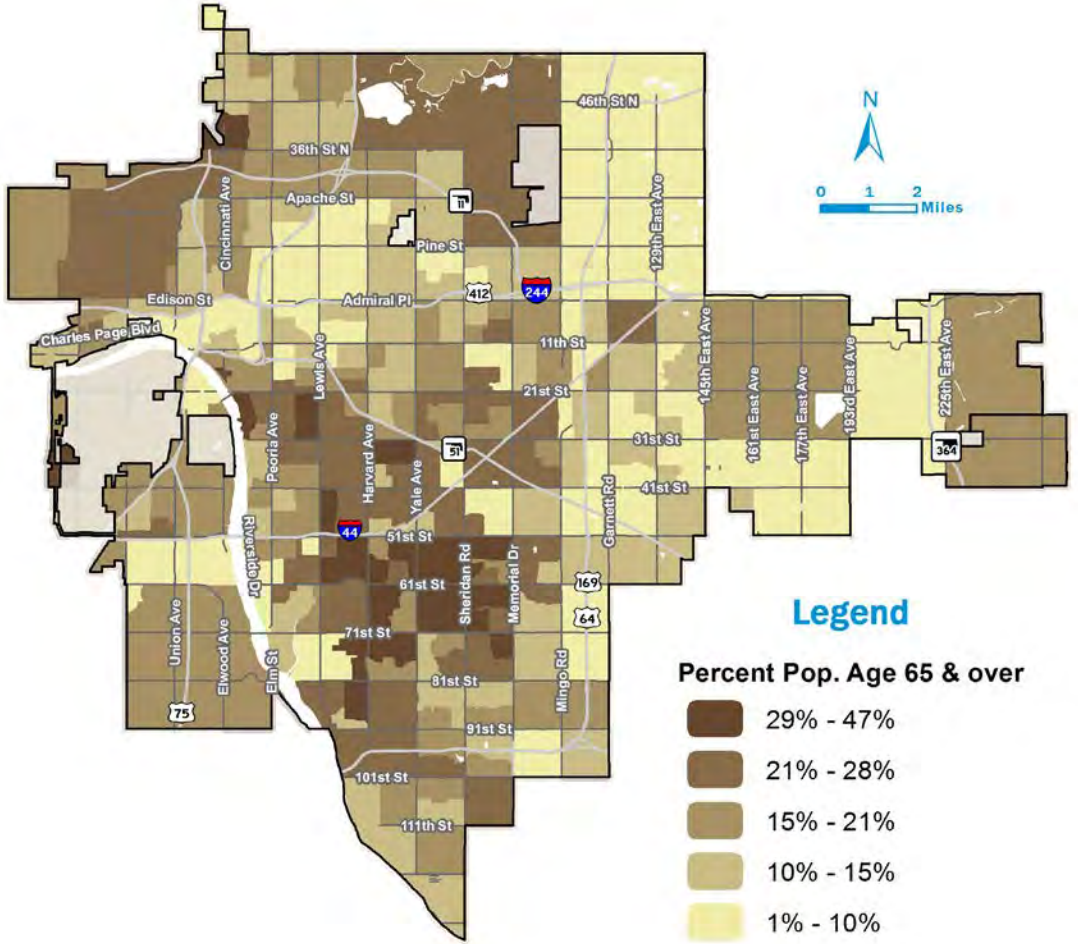
Vulnerable Populations



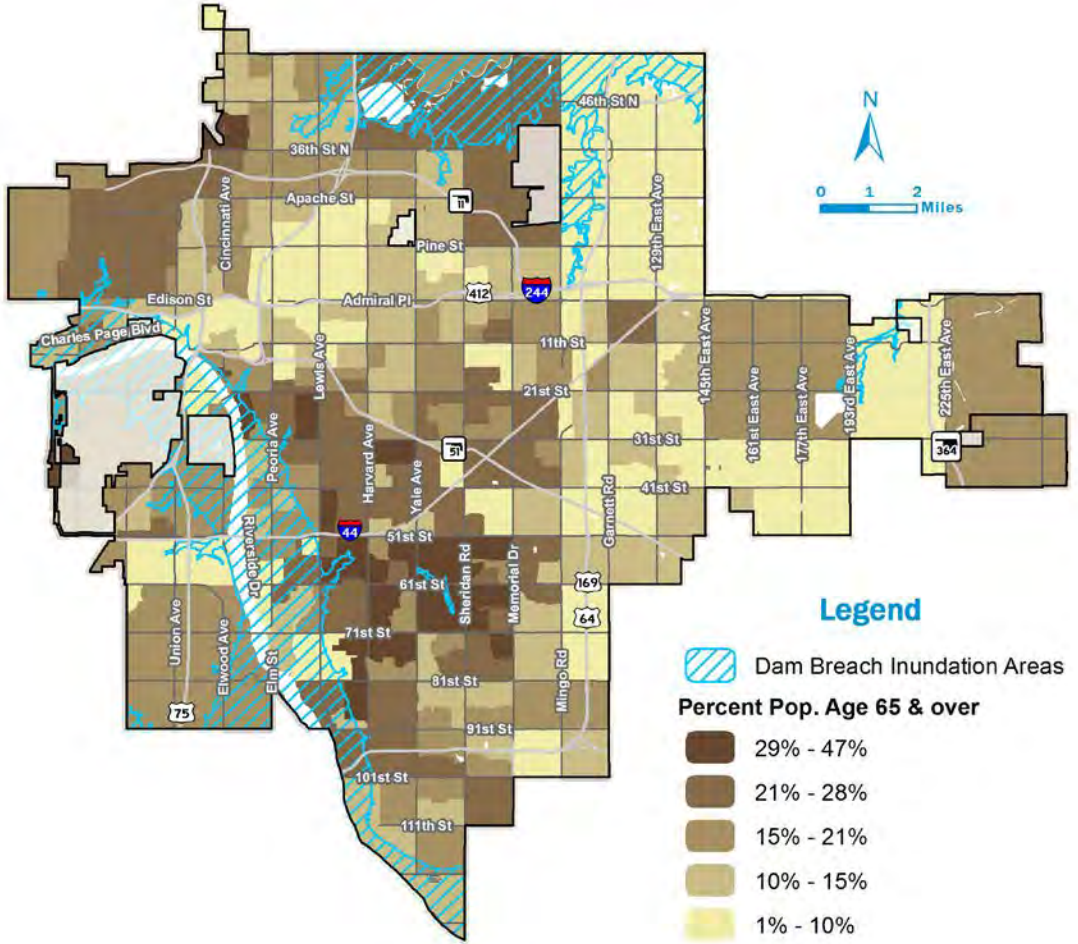
Vulnerable Populations + Flood Risk

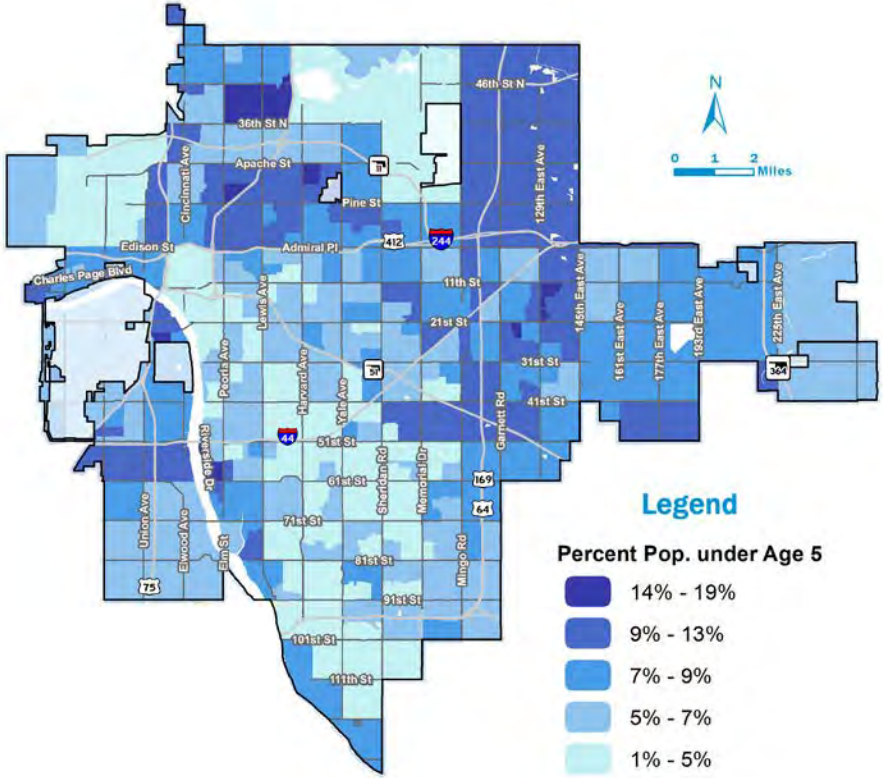


Vulnerable Populations



Vulnerable Populations + Dam Breach

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36th St N
Apache St
Pine St
Edison St
Admiral Pl
Charles Page Blvd
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21st St
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41st St
51st St
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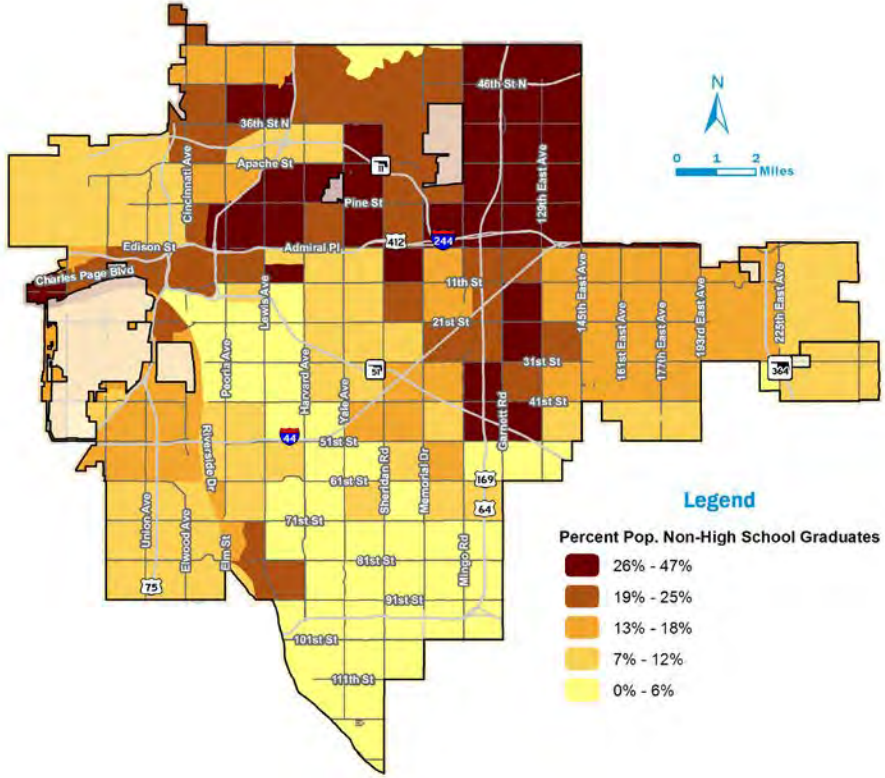
Memorial Dr
Mingo Rd
129th East Ave
145th East Ave
161st East Ave
177th East Ave
193rd East Ave
225th East Ave
412
244
75
44
169
64
51
364
Legend
Percent Pop. under Age 5
14% - 19%
9% - 13%
7% - 9%
5% - 7%
1% - 5%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161st East Ave
177th East Ave
193rd East Ave
225th East Ave
412
244
75
44
169
64
51
364
Legend
Percent Pop. Non-High School Graduates
26% - 47%
19% - 25%
13% - 18%
7% - 12%
0% - 6%

Floodplain

Floodplain

+

Parcels

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Floodplain

+

Parcels

+

Building Footprints

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https://github.com/Microsoft/USBuildingFootprints

Table 4-46 2018 Structures and Parcels Touched by SFHA[6]

	2018 Building Footprints		2018 Parcel Boundaries	
Improvement Type	Number	Est. Market Value	Number	Est. Market Value
Residential Single-Family	1,863	$176,218,014	3,784	$482,331,838
Residential Multi-Family	200	$106,694,500	641	$383,972,907
Commercial	347	$179,152,543	949	$948,327,891
Other	196	$2,144,345	1,852	$23,513,381
Total	*2,506*	*$464,209,402*	*7,226*	*$1,838,146,018*

City of Tulsa's
Top Hazards

Hazard	Probability	Overall Significance
Flooding	Highly Likely	High
Severe Winter Storm	Likely	High
Tornado	Likely	High
Dam & Levee Failure	Occasional	High
Extreme Heat	Highly Likely	Medium
Fire	Highly Likely	Medium
Hail	Highly Likely	Medium
Hazardous Materials	Likely	Medium
Drought	Highly Likely	Low
Expansive Soils	Highly Likely	Low
Lightning	Highly Likely	Low
Earthquake	Unlikely	Low

City of Tulsa's Mitigation Actions

- Develop and fund hazard preparedness, education, information, and awareness programs.
- Develop a city-wide disaster recovery and reconstruction plan.
- Inventory and maintain an active list of disaster resources available in Tulsa.
- **Develop an emergency preparedness and mitigation website.**
- Evaluate, upgrade and maintain outdoor warning systems.
- Purchase and distribute NOAA weather radios.
- Maintain debris management plan and update as required/needed.
- Initiate an individual safe room rebate program
- **Maintain safe room inventory and GIS database.**
- Provide safe rooms at critical facilities
- Educate the public on benefits of disaster resistant construction.
- Train/Educate on techniques of disaster-resistant homebuilding.
- Retrofit critical facilities to with stand hazard events.
- Install generators at critical facilities.
- Purchase and install lightning warning systems.
- Construct lightning rods or air terminals for protection of critical facilities.
- Educate the public on the importance of flood insurance.
- Update Master Drainage Plans when conditions warrant.
- Acquire properties in the FEMA Floodplain, Tulsa Regulatory Floodplain and Repetitive Loss/Severe Repetitive Loss properties.
- Develop emergency plan for the Arkansas River Corridor.
- Implement recommendations of the City of Tulsa Master Drainage Plans.
- Repair the levees based on recommendations from USACE.
- **Notify the general public of their risk living within the floodplain, levee, or dam inundation area.**
- Construct additional fire stations in outlying areas.
- Replace inadequately sized water lines with lines of sufficient size to provide proper fire protection to annexed and existing areas.
- Implement mitigation actions to reduce fire access issues.
- Implement Water Sense Program.
- Replace broken pipes in areas of high soil expansion, with piping more resistant to breakage.
- Create community resilience hubs.
- Develop and implement an air conditioner loan program.

MESHEK & ASSOCIATES, LLC

Thank you

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