Flood Mitigation for Nebraska Rural Communities

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Nebraska Association-County Officials
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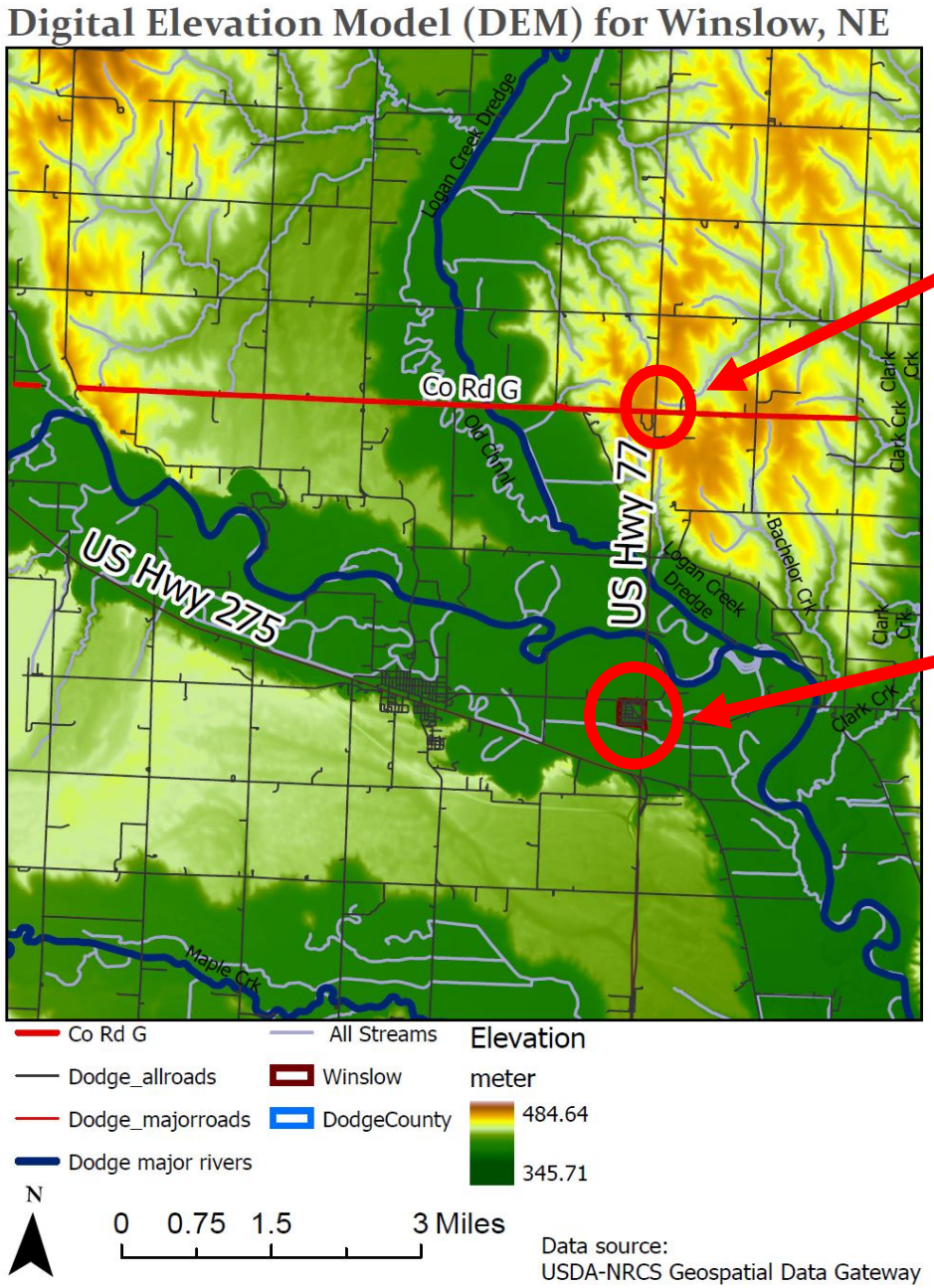
UNL Students Helped Winslow Relocation Plan







An Example of Flood Recovery : Progress, Challenge, Complexity



Potential new site

Damaged house burned (NPR, 2023)

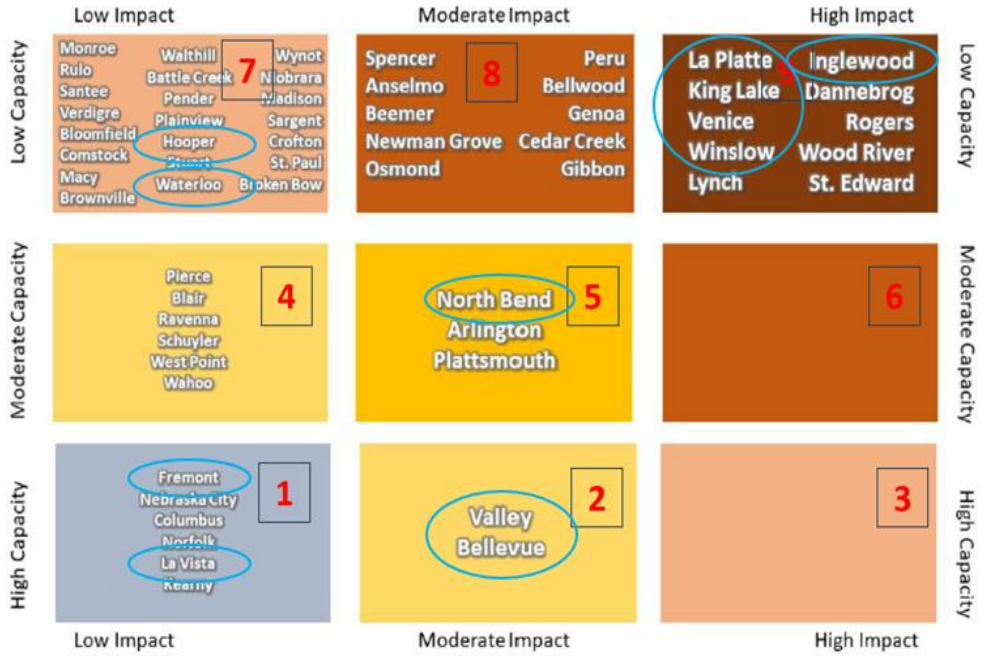
Flood site cleaned

Update after 6 years:

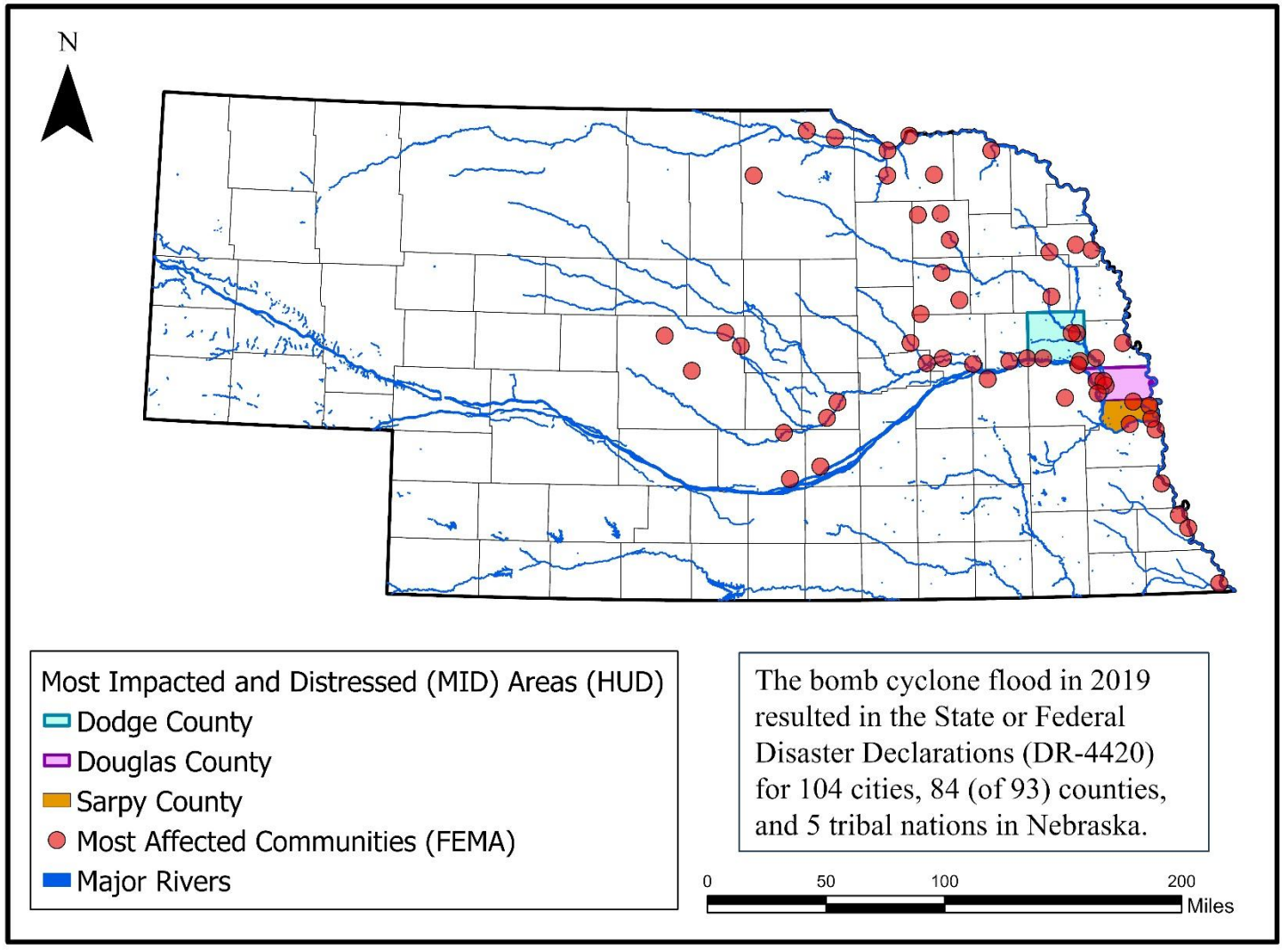
Winslow is still working on completing the FEMA projects, which include the **property acquisition** and **levee repairs** from the 2019 flooding.

Winslow is still **considering the relocation of the village** **if** funding is available.

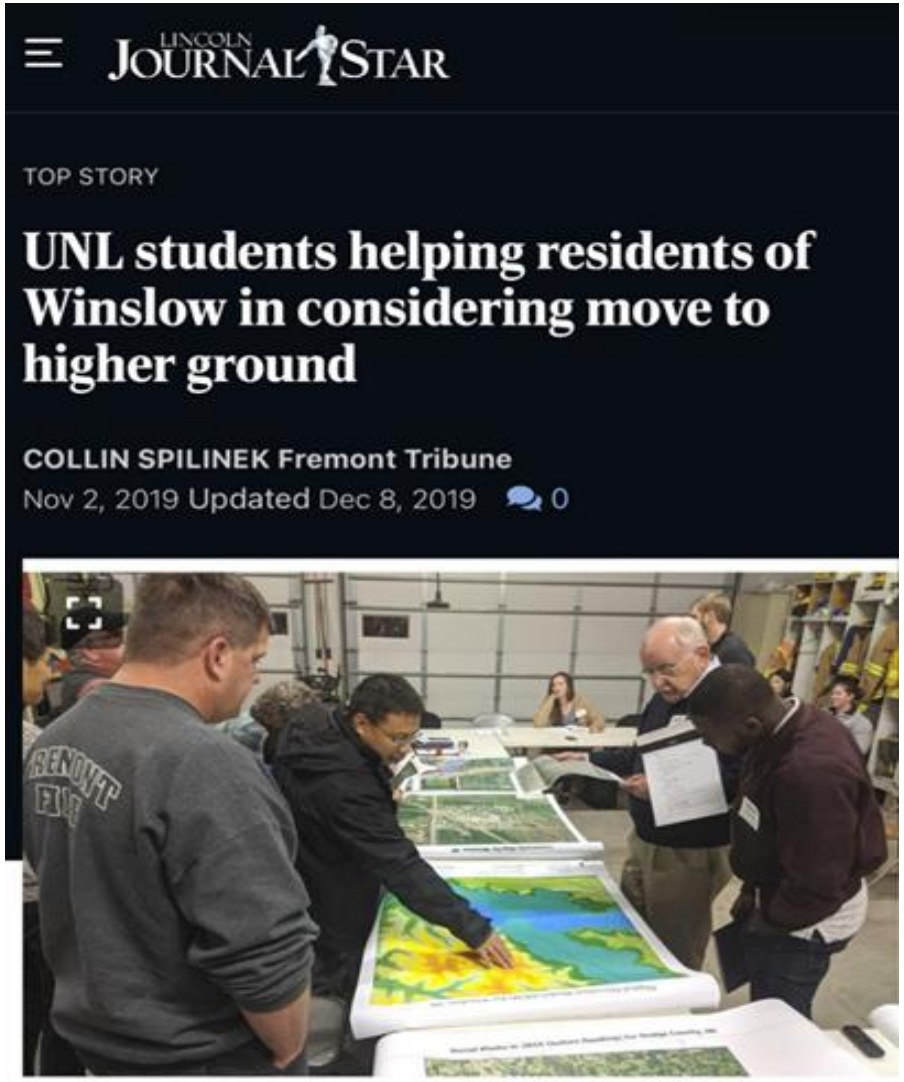
2019's Flood: FEMA's Assessment & Nebraska's Reality as "High Impact & Low Capacity"

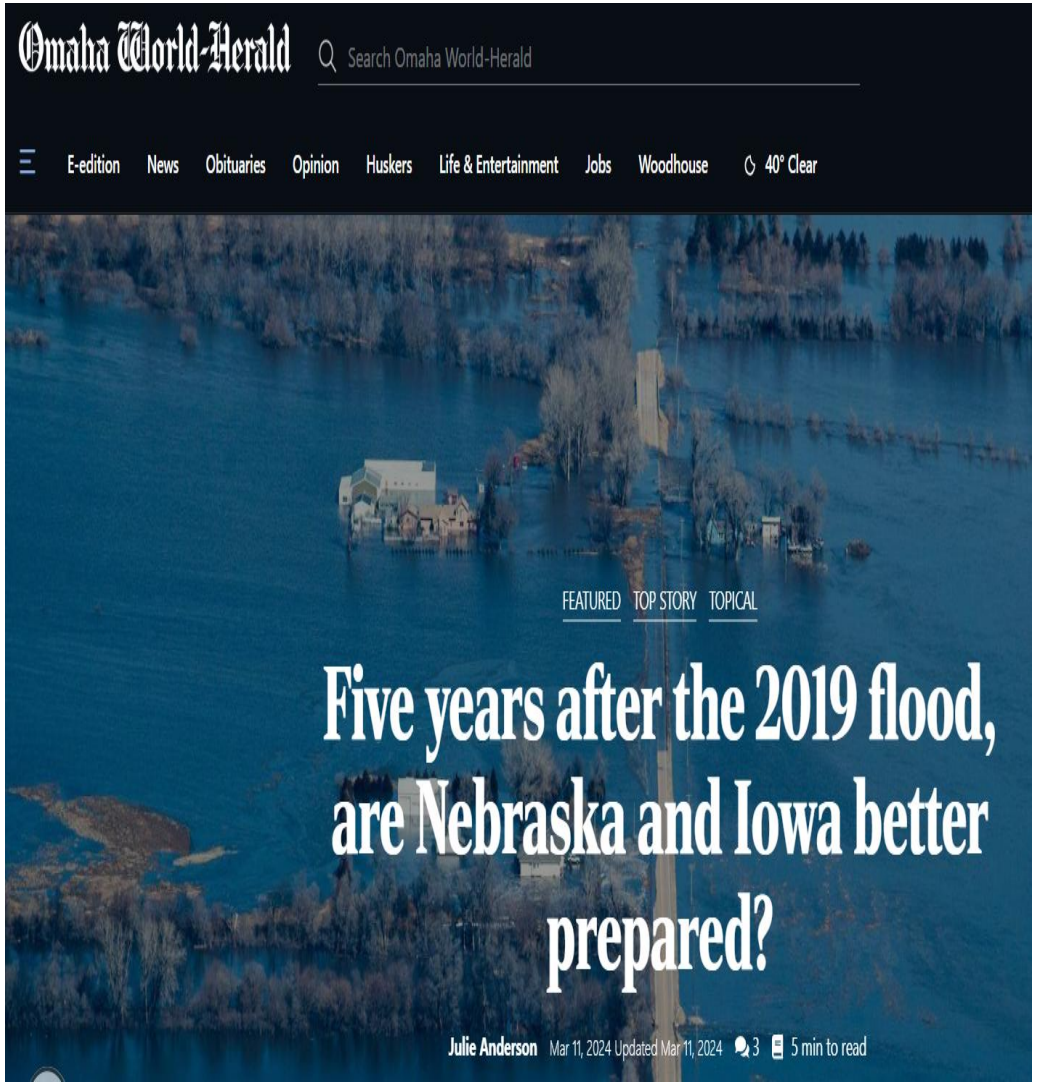


DR-4420-NE Community Conditions Assessment (CCA) / Mission Scoping Process Summary* (FEMA, July 2019)



2019 Nebraska Flood: Lessons Learned or Already Forgotten?





Are We Well Prepared for the Next Flood?

1. Local Comprehensive Plans

3. New Residential Development

5. Nature-based Solutions

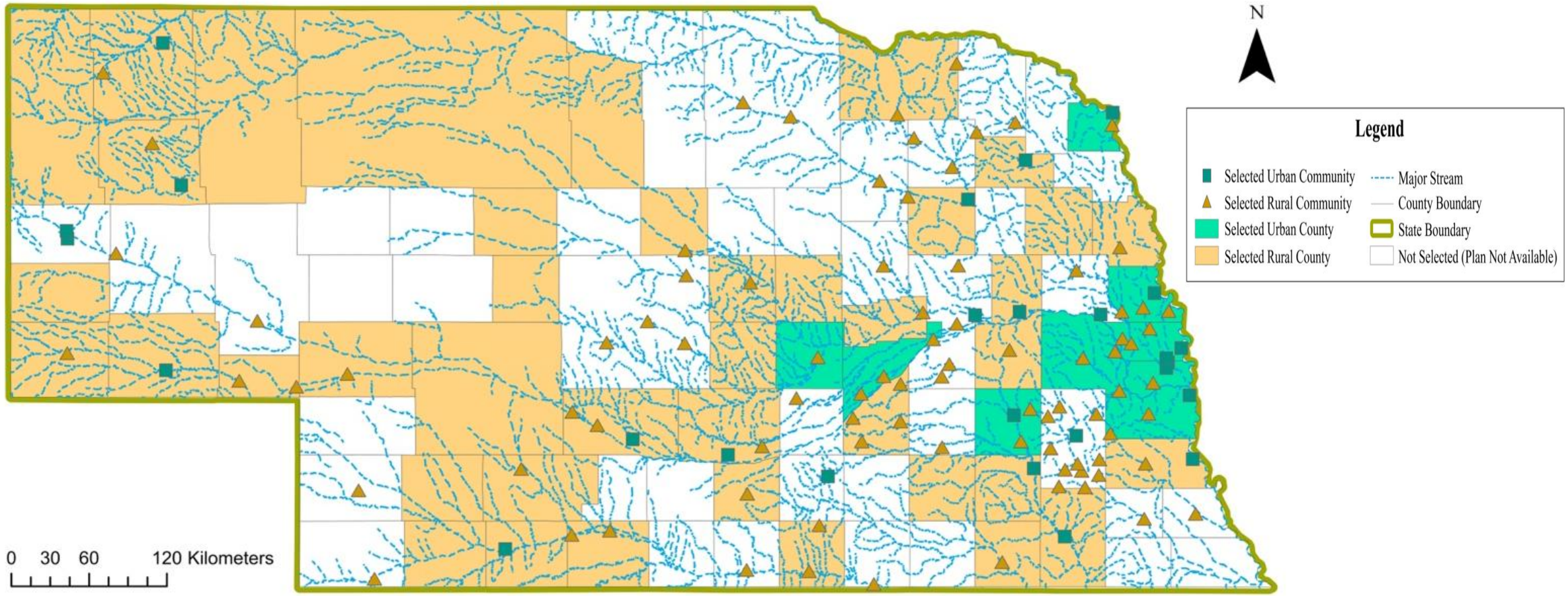
2. Local Zoning Ordinances

4. Mobile Home Parks

6. Awareness, Partnership, Engagement

Data Collection: Comprehensive Plans

This study selected a total of **162** comprehensive plans, covering **50 counties and 112 communities** in Nebraska. These plans were made during 2000-2023.



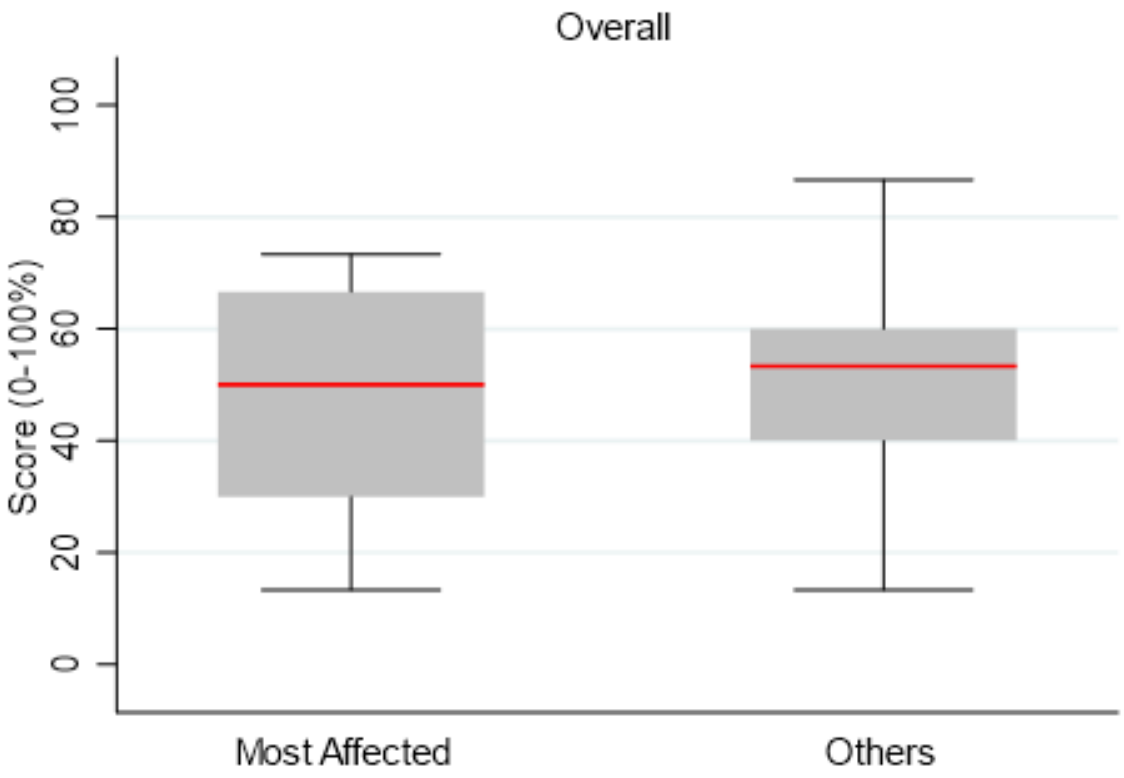
Results

Overall, local comprehensive plans **have been prepared** but still have **significant room for improvement** in flood risk reduction.

Rural/Urban		Sample	Max.	Min.	Mean	Median	Std. Dev.
Rural	Community	86	86.67	13.33	**49.77**	53.33	17.04
	County	41	80.00	20.00	**49.11**	46.67	15.40
Urban	Community	26	86.67	26.67	**61.79**	60.00	16.28
	County	9	80.00	40.00	**62.96**	66.67	12.52
Overall		162	86.67	13.33	**52.26**	53.33	16.98

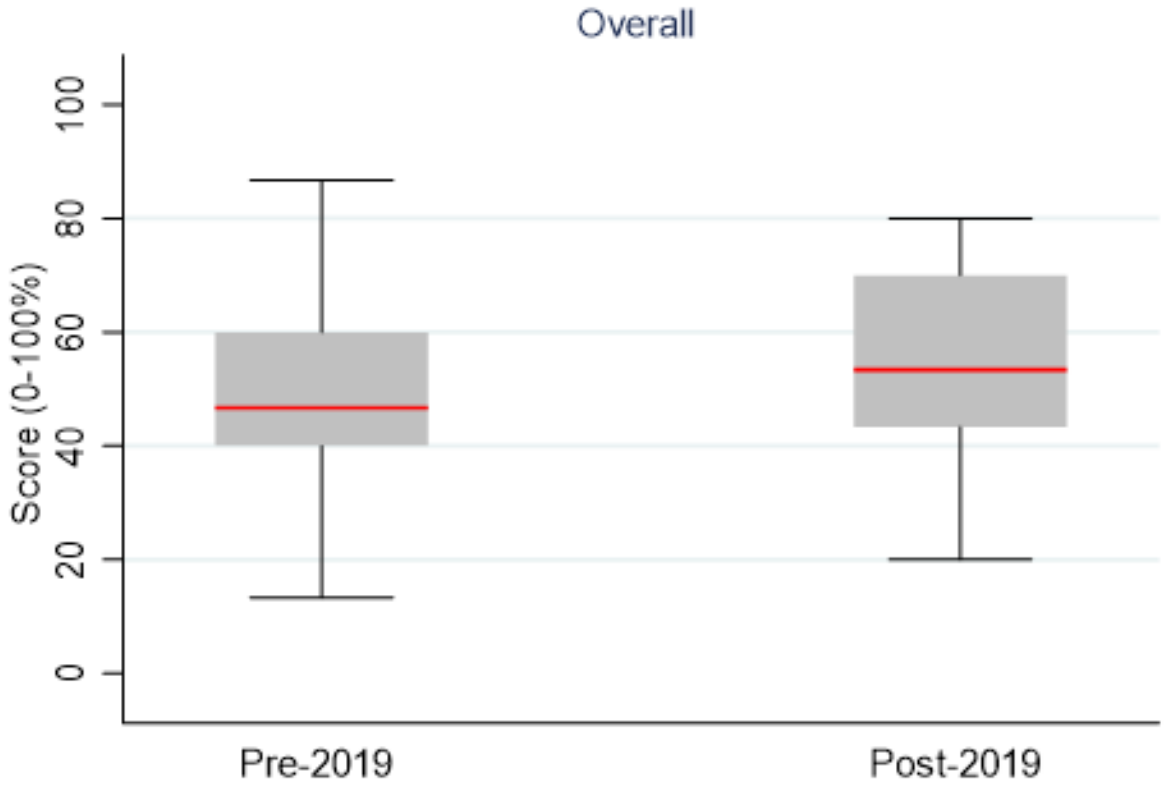
Note: The values for Max., Min., Mean, Median indicate scores on the scale of 0-100%.

Results for Most-affected Rural Communities vs. Other Rural Communities



No statistical difference between the comprehensive plans in the most-affected rural communities and other rural communities.

Results for Most-affected Rural Communities Before vs. After 2019 Floods



The most-affected rural communities have better plan quality after 2019's flood.

Results For Indicator Performance

Indicators		Rural	Urban	Overall
1.	Regulatory flood maps (NFHL, FIRM)	61.5	75.4	68.5
2.	Localized information for flood, flooding, floodplain and flood history	48.8	64.1	51.9
3.	Physical vulnerability assessment for critical infrastructure and high-risk areas	7.1	22.6	10.5
4.	Social vulnerability assessment for most affected population group	0.6	0.0	0.6
5.	Extreme weather and climate event situation analysis for future flood risk	0.0	5.8	1.9
6.	Land use regulations and policies/ hazard avoidance/ incentive programs	85.8	92.3	85.8
7.	Floodplain insurance programs	20.3	39.3	21.6
8.	Retrofitting or protecting existing critical public infrastructure	100	100	100
9.	Flood related new infrastructure development programs	30.7	67.9	42
10.	Natural systems protection/ management	82.3	98.1	84
11.	Flood education, awareness programs/ best practices	13.0	21.2	18.5
12.	Community-driven planning decision making for hazard mitigation and resiliency	55.5	67.9	56.8
13.	Horizontal across-sector or stakeholder coordination	100.0	100.0	100.0
14.	Vertical inter-governmental coordination	68.8	90.4	67.9
15.	Planning integrations with other type of plans	67.1	90.6	74.1

Note: The values indicate (mean) scores on the scale of 0-100%.

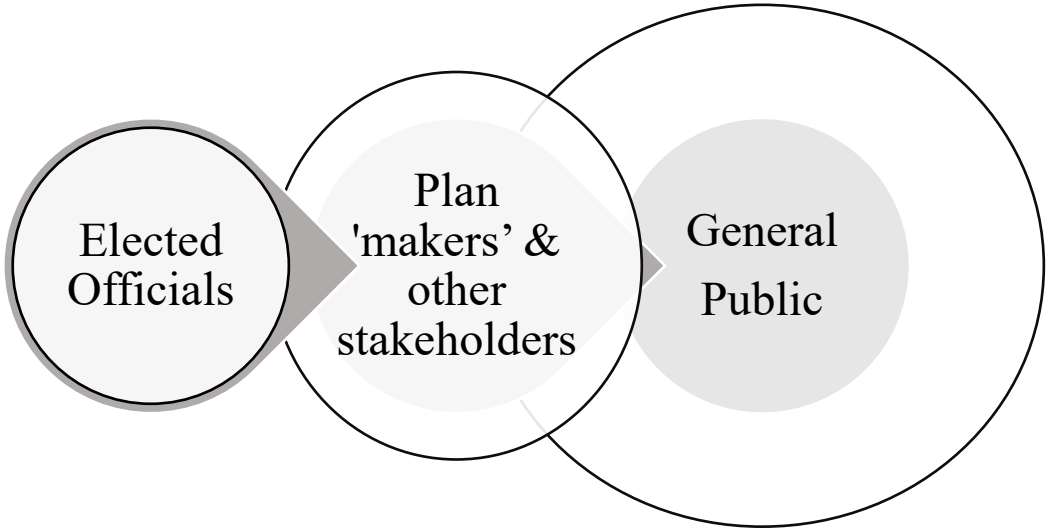
Recommendations For Local Comprehensive Plans

1. Promoting **a regional planning approach** to leverage rural technical capacity in flood mitigation

2. Promoting **continuous education, outreach, and public engagement** to improve flood awareness

3. Expanding **policy toolkits through multi-objective projects** to align flood mitigation with community priorities

4. Enhancing **natural systems protection** to leverage the strengths of rural contexts



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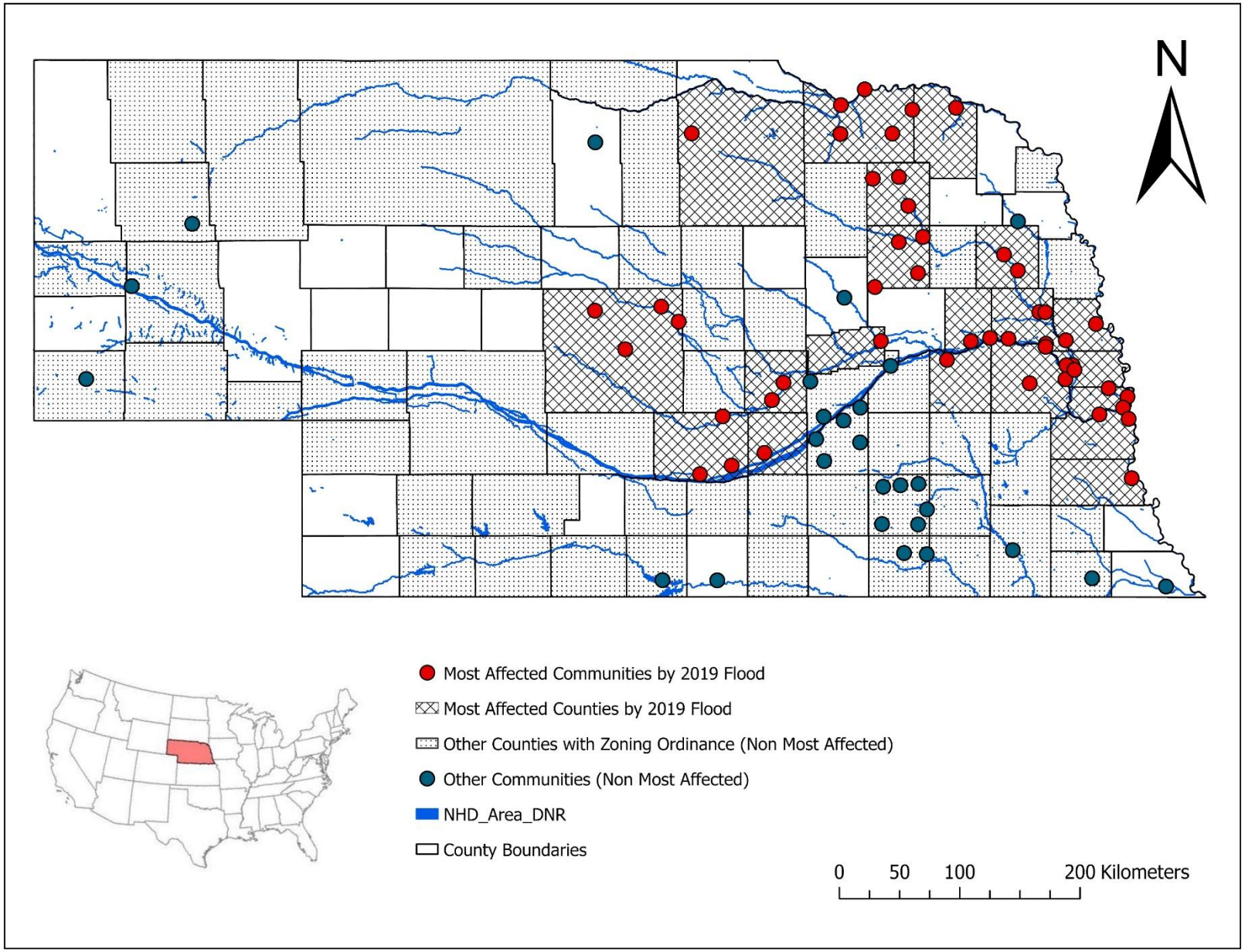
Study Area

- Total Jurisdictions = 169
- 68 Most affected communities and counties by 2019 flood.
- 101 other (Non most affected) communities and counties by 2019 flood

Data source: County's Official website, 2024



Categories and Indicators

Category	Indicator
1. Regulatory and permitting policies	1.1 Floodplain Construction Restrictions
	1.2 Base Flood Elevation (BFE)
	1.3 Floodproofing Requirements
	1.4 Development Restrictions in High-Risk Flood Areas
	1.5 Floodway & Flood fringe Overlay District (FW & FF)
	1.6 Limitations on Impervious Surface
	1.7 Flood Emergency Evacuation Routes
	1.8 Floodplains development Permit
	1.9 Other Regulations
2. Voluntary and Incentive Policies	2.1 Incentives for Flood-Resilient Construction
	2.2 Public-Private Partnership for Joint Development
	2.3 National Flood Insurance Program (NFIP) Compliance
	2.4 Community Rating System (CRS)
	2.5 Flood Resiliency in Land Use
	2.6 Low Impact-Development (LID)
	2.7 Other Policies
3. Nature Based Solutions	3.1 Floodplain and Floodway Protection
	3.2 Floodplain Acquisition and Relocation
	3.3 Open Space Protection and Conservation
	3.4 Stormwater Retention/Detention
	3.5 Wetland and Watercourse Preservation
	3.6 Natural Buffer Zones
	3.7 Natural Drainage and Erosion Control
	3.8 Other Practices

Results

Rural/Urban		Sample	Max.	Min.	Mean	Median	Std. Dev.
Rural	Community	10	68.32	20.5	**51.78**	56.29	17.48
	County	13	69	23.67	**47.70**	53	15.75
Urban	Community	5	61.64	28.97	**47.94**	48.41	11.94
	County	7	78	40	**57.09**	59.99	13.74
Overall		35	78	20.5	**50.80**	52.71	15.23

Results

1. Regulatory and permitting policies

2. Voluntary and Incentive Policies

3. Nature Based Solutions

S. No.	Indicators	Mean Score (Most affected areas)	Mean Score (Other non affected areas)
1.1	Floodplain Construction Restrictions	100.00	65.85
1.2	Base Flood Elevation (BFE)	79.17	52.44
1.3	Floodproofing Requirements	72.92	35.37
1.4	Floodway & Flood fringe Overlay District (FW & FF)	81.25	59.76
1.5	Development Restrictions in High-Risk Flood Areas	64.58	51.22
1.6	Limitations on Impervious Surface	18.75	15.85
1.7	Flood Emergency Evacuation Routes	2.08	0.00
1.8	Floodplains development Permit	93.75	63.41
2.1	Incentives for Flood-Resilient Construction	16.67	0.00
2.2	Public-Private Partnership for Joint Development	8.33	0.00
2.3	National Flood Insurance Program (NFIP) Compliance	79.17	40.24
2.4	Low Impact-Development (LID)	12.50	0.00
2.5	Flood Resiliency in Land Use	22.92	0.00
2.6	Community Rating System (CRS)	0.00	0.00
3.1	Floodplain and Floodway Protection	70.83	60.98
3.2	Floodplain Acquisition and Relocation	12.50	0.00
3.3	Open Space Protection and Conservation	37.50	45.12
3.4	Stormwater Retention/Detention	35.42	29.27
3.5	Wetland and Watercourse Preservation	58.33	37.80
3.6	Natural Buffer Zones	39.58	14.63
3.7	Natural Drainage and Erosion Control	64.58	46.34

Are We Well Prepared for the Next Flood?

Local Comprehensive Plans

New Residential Development

Nature-based Solutions

Local Zoning Ordinances

Mobile Home Parks

Awareness, partnership, and engagement

3. Analyzing Flood Zone Residential Development Trends

Nebraska needs more affordable housing while also building resilient communities to mitigate future flood risks.

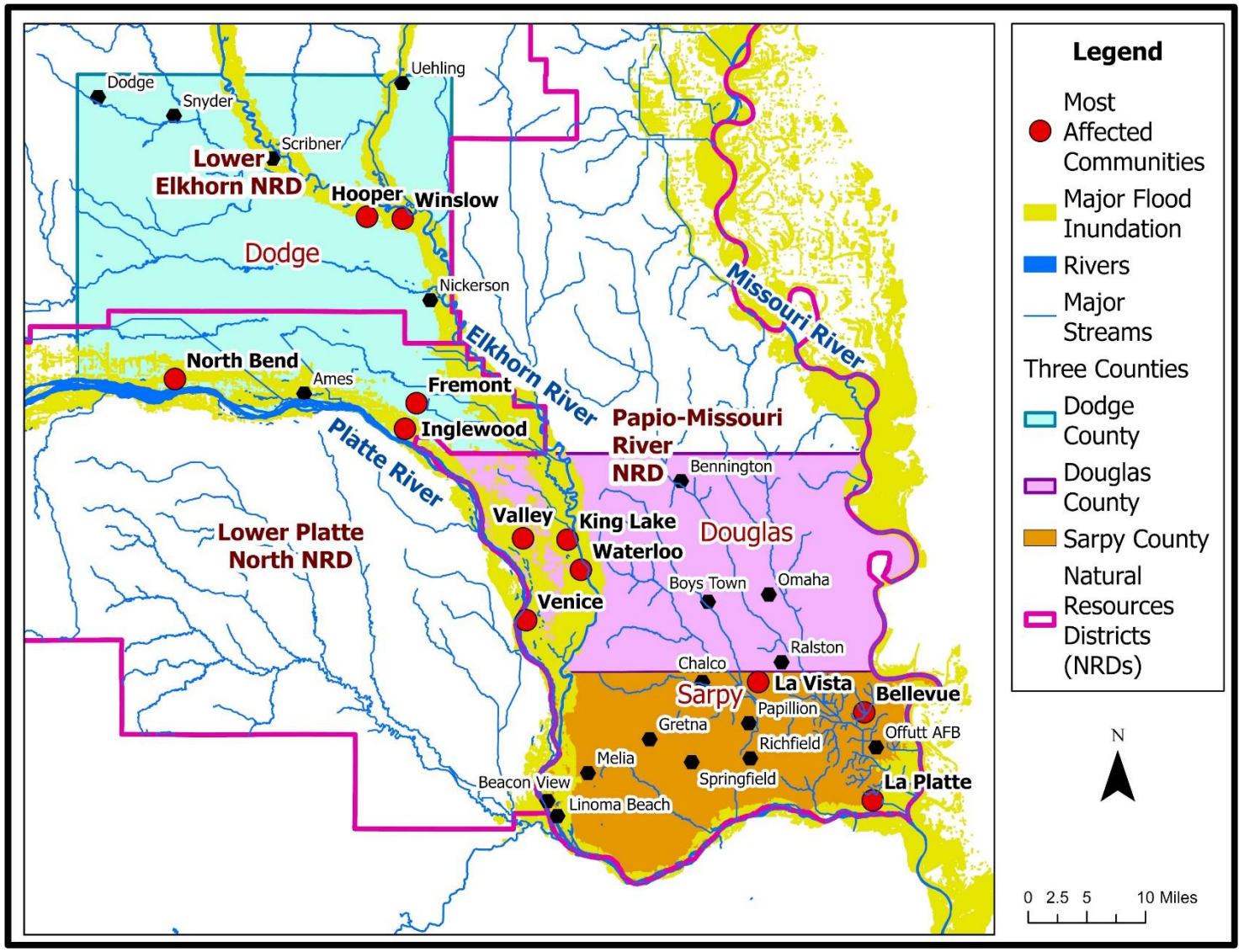
1% Chance Annual Flood Zone
740 W 8th ST, North Bend, NE (*Taken on October 17, 2024*)

1% Chance Annual Flood Zone
1650 Woods Dr, Fremont, NE (*Taken on October 17, 2024*)

Study Area

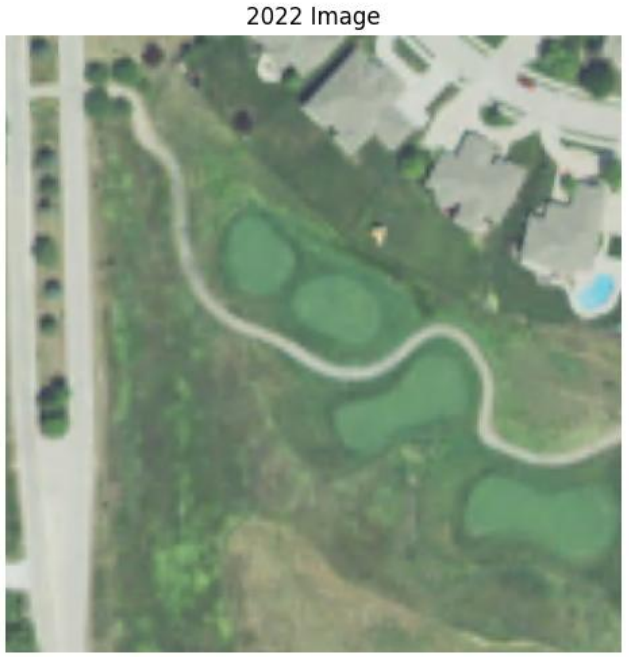
This study focuses on the **twelve most affected communities** by the 2019 flood.

- **Dodge County (5 communities)**
  - Fremont, Hooper, Inglewood, North Bend, and Winslow
- **Douglas (4 communities)**
  - King Lake, Valley, Venice, and Waterloo
- **Sarpy County (3 communities)**
  - La Vista, La Platte, and Bellevue



Methodology

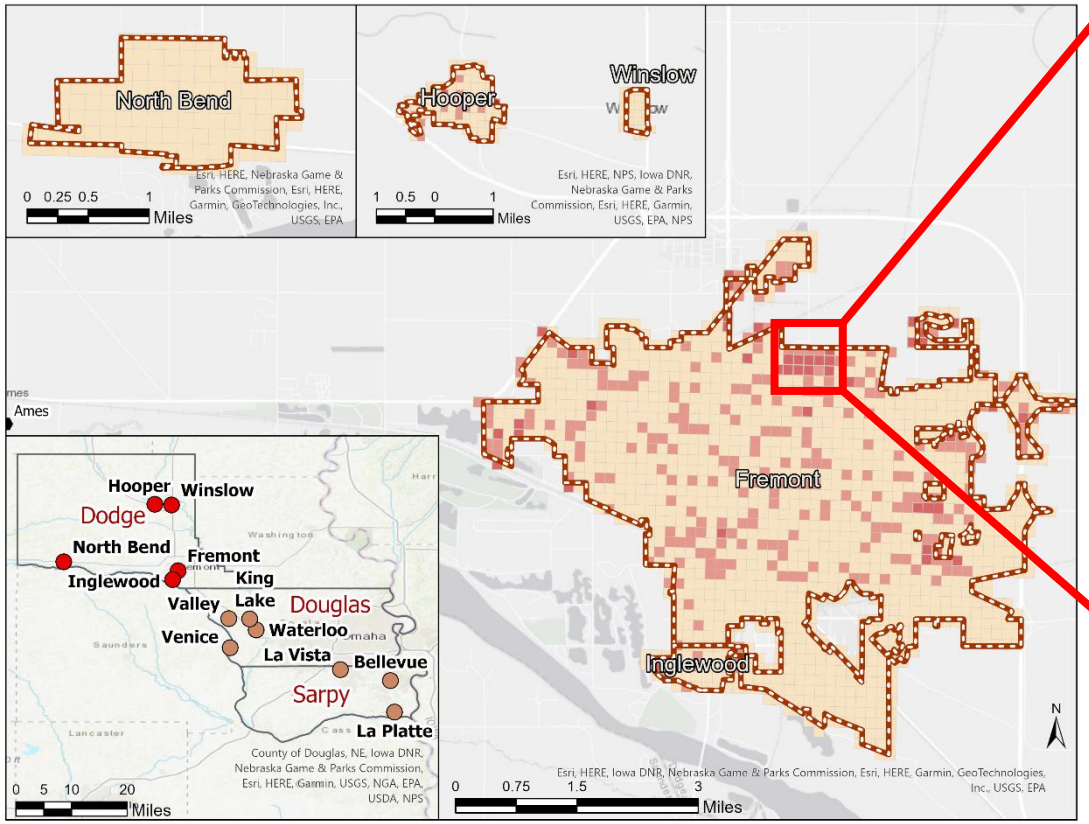
A machine learning methodology was used to **detect changes** between two images taken at **different times** by **analyzing and comparing specific regions** within the images to identify differences.



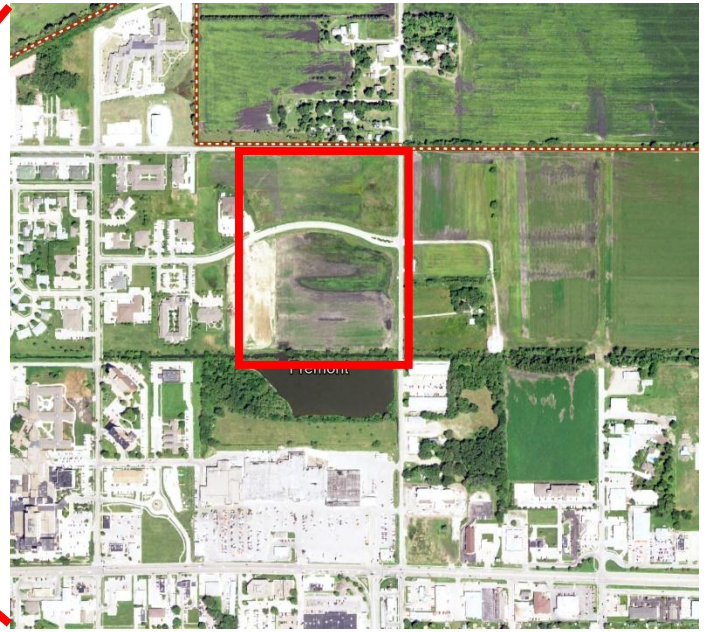
12449 Read St, Omaha, NE 68142
(Mixed flood zone)

Results for Dodge County, NE

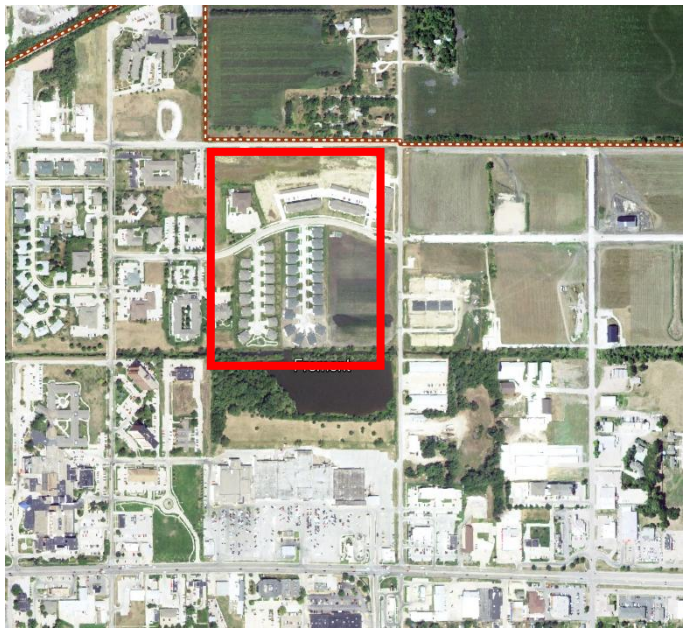
Dodge County



2016



2022



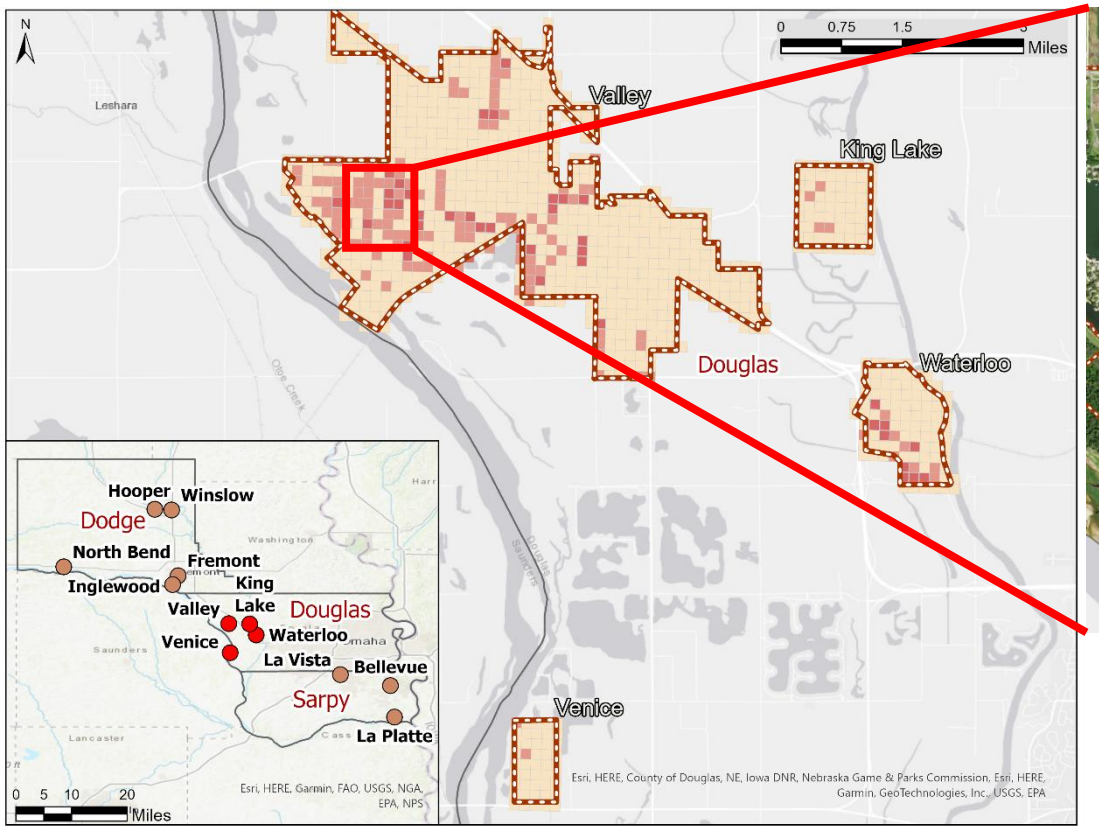
- **Flood Zone**
  - 0.2% Chance of Annual Flood (500-Year Floodplain)
- **Percentage of Low- and Moderate Income (LMI) resident**
  - High

Number of Residential Development

0-1 2-4 5-10 11-19 20-30

Results for Douglas County, NE

Douglas County



2016

2022

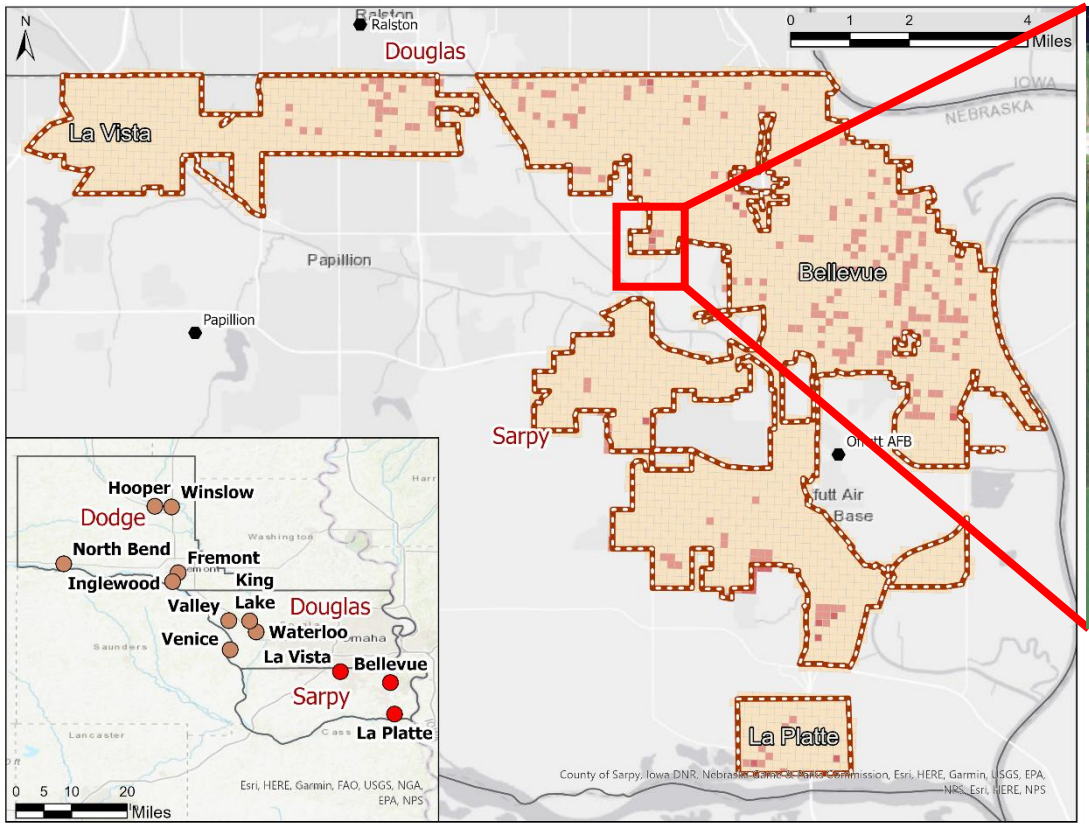
- **Flood Zone**
  - 1% Chance of Annual Flood (100-Year Floodplain)
- **Percentage of Low- and Moderate Income (LMI) resident**
  - Medium High

Number of Residential Development

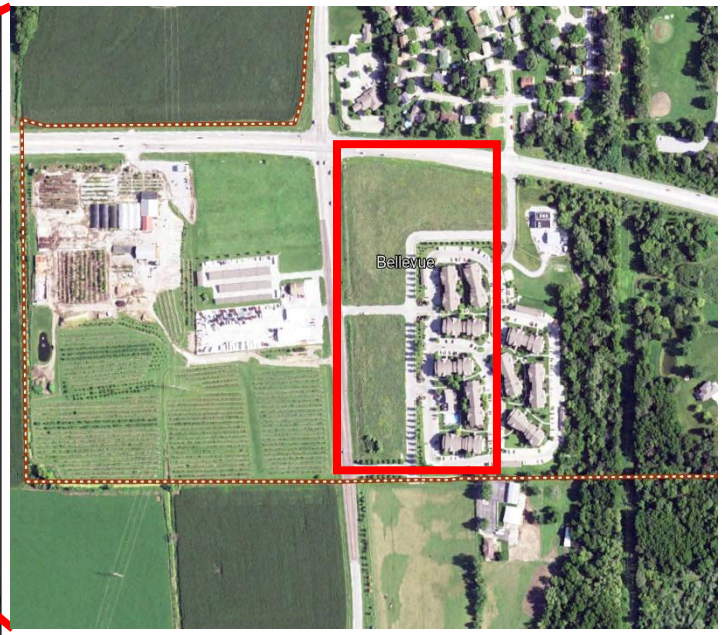
0-1 2-4 5-10 11-19 20-30

Results for Sarpy County, NE

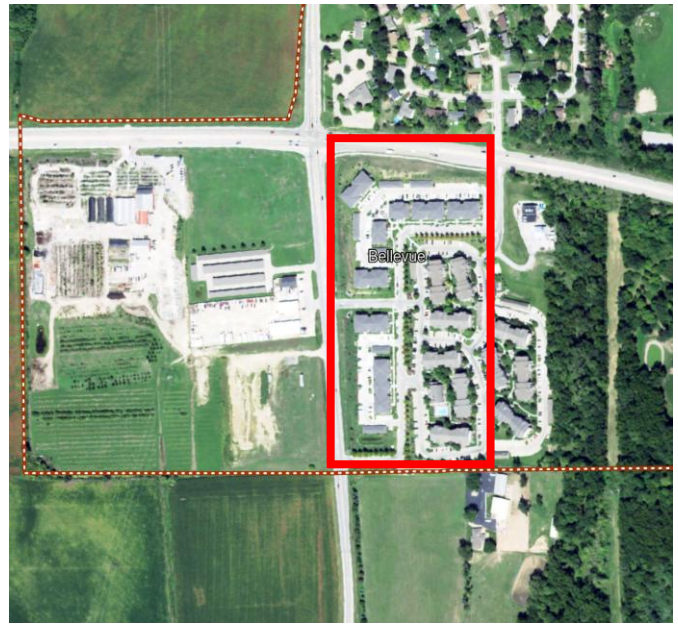
Sarpy County



2016



2022

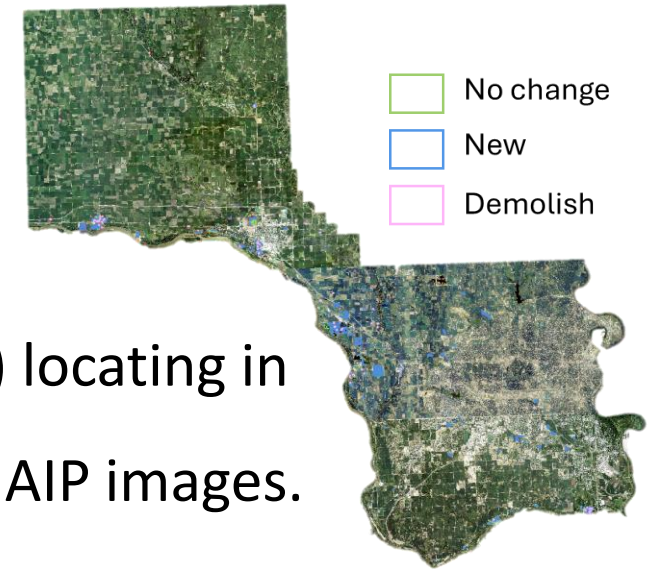


- **Flood Zone**
  - Mixed flood zones
- **Percentage of Low- and Moderate Income (LMI) resident**
  - High

Number of Residential Development

0-1 2-4 5-10 11-19 20-30

Results



4,341 residential buildings (including 2,250 new residential buildings) locating in the 1% chance of flood zone based on changes in the 2003 and 2022 NAIP images.

County	No Change	New	Demolish	Total Buildings
Dodge	1,362	**514**	58	1,934
Douglas	358	**1,193**	28	1,579
Sarpy	265	**543**	20	828
Total Buildings	1,985	**2,250**	106	4,341

Recommendations For New Residential Development

1. Safe growth and resilient development of residential areas

2. Innovative tools to support adaptive regional planning in high-risk river corridor landscape

More buildings continuing in flood-risky areas

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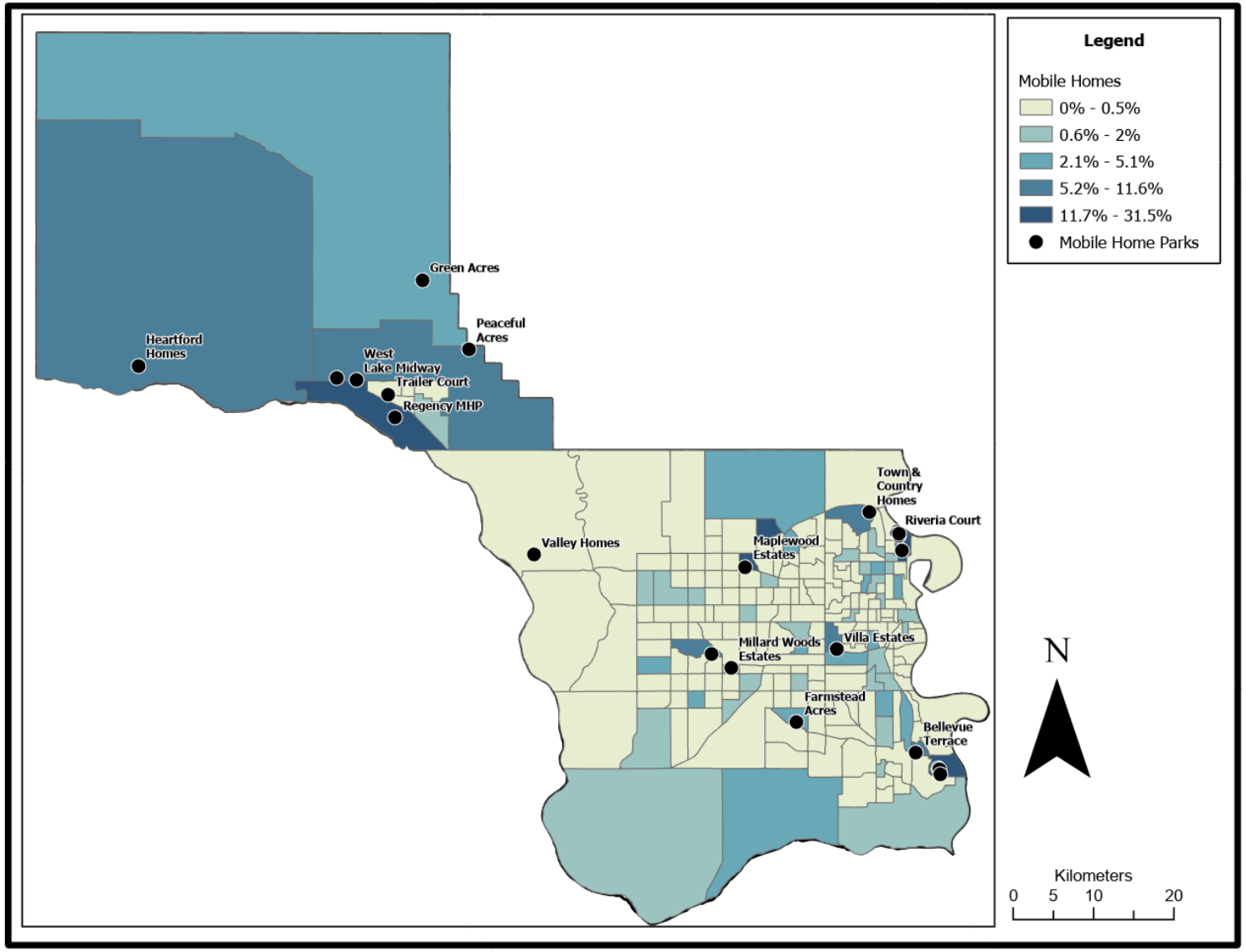
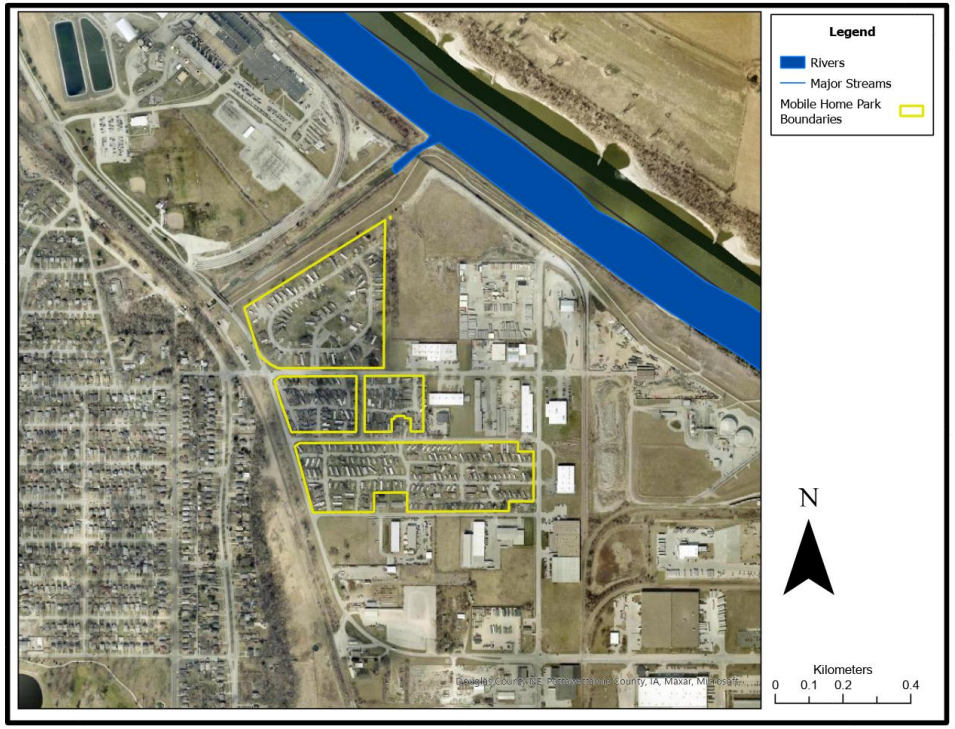
Methods: Identifying MHP

Mobile Home Percentages with MHP Locations





MHPs located in Northeast Omaha

- 23 MHPs identified using parcel and satellite data
  - 11 in Douglas
  - 7 in Dodge
  - 5 in Sarpy
- All zoned as commercial MHPs
- Two concentrations of MHPs
  - Northeast Omaha
  - Bellevue near Offutt Airfield

Data & Methods

Geospatial Data

Building Footprints – Microsoft building footprints data to count structures. **Regulatory Risk** – FIRM maps to determine level of regulatory risk
2019 Inundation – Imagery to determine buildings in inundated area

Field Data

Infrastructure Level

- **Low**- Unpaved streets and no apparent drainage
- **Intermediate** - Rough paving and evidence of rudimentary drainage infrastructure
- **High** – Roads have hard surfaces and drainage infrastructure

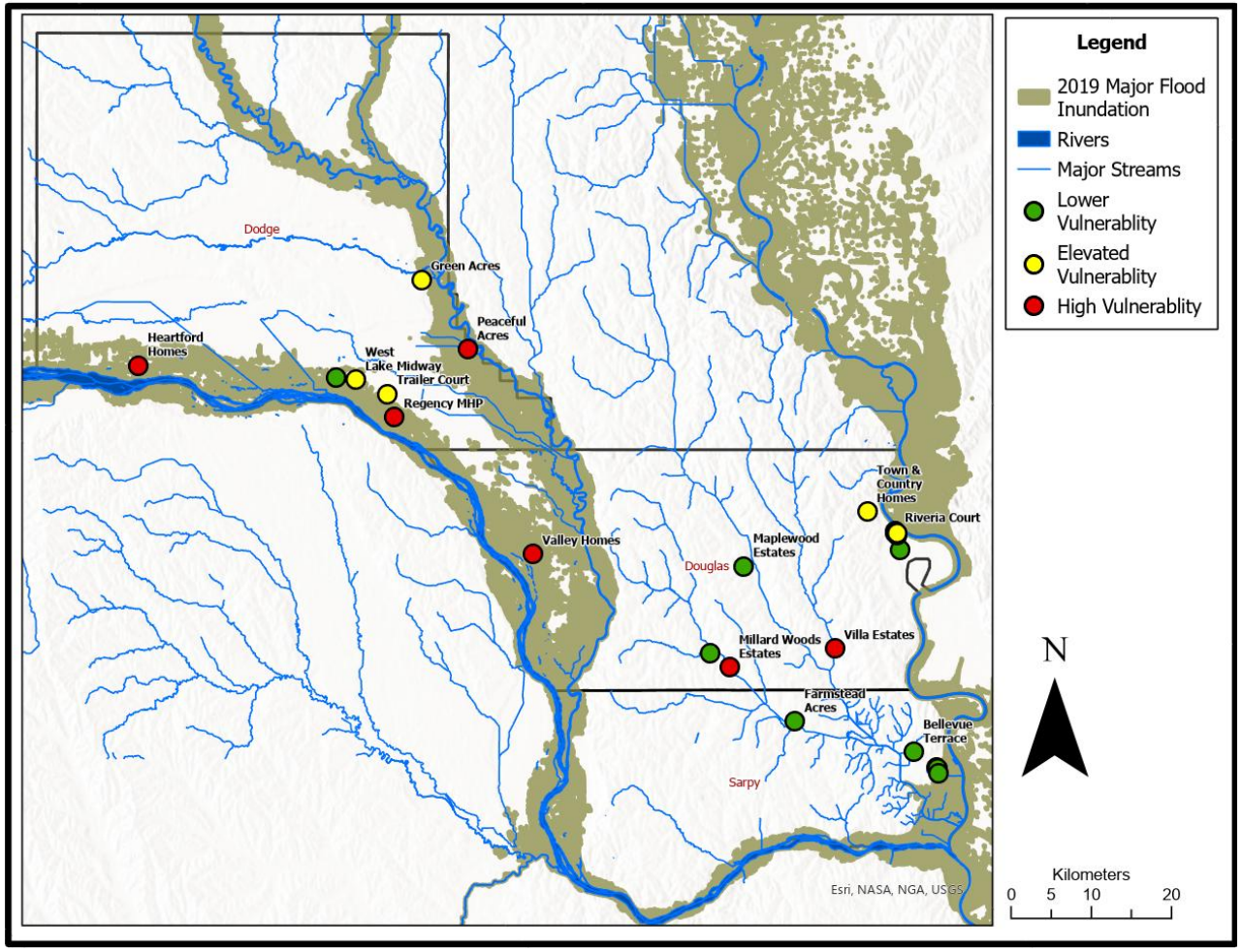
Low Infrastructure

Intermediate Infrastructure

High Infrastructure

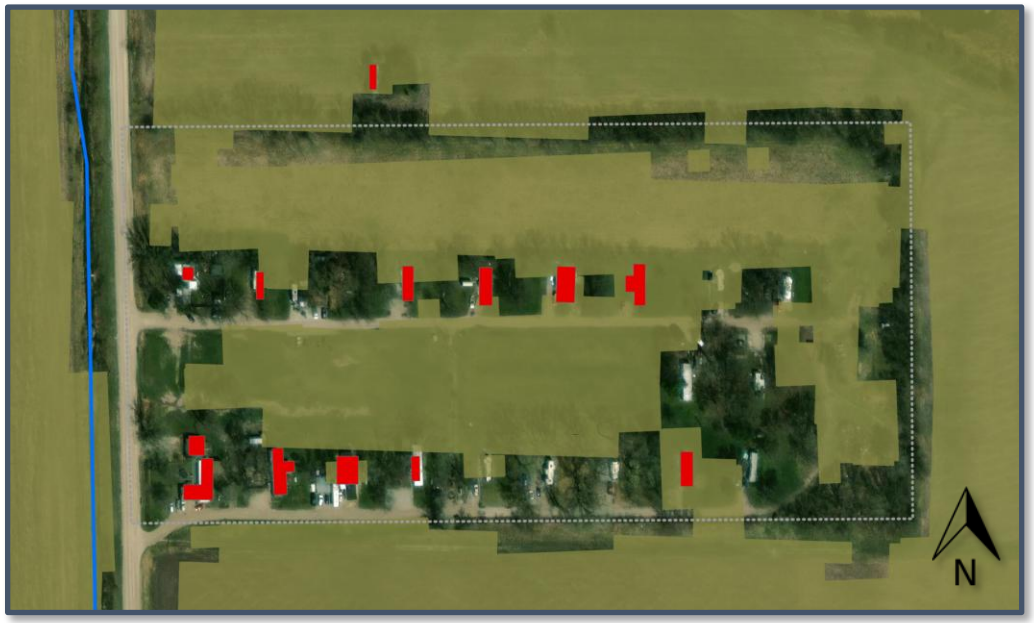
Results

Which MHPs exhibit elevated physical vulnerability to flooding?



Mobile home parks in the study area by vulnerability cluster

- 3 MHPs in Douglas & Dodge cluster High Vulnerability
- Dodge has higher overall vulnerability.
- Lower scores on infrastructure and MHPs have a higher percentage in the flood plain & 2019 inundation area
- Most High Vulnerability parks are small
- Peaceful Acres exhibits highest vulnerable
- Regency MHP in Fremont largest park by buildings in the High Vulnerability cluster
- Millard Estates and Villa Estates in Douglas County in High Vulnerability cluster due to lower infrastructure quality & high percentage of buildings in the flood plain



Peaceful Acres Mobile Home Park

4924 N County Rd 26
Fremont, NE

Risk Level: High

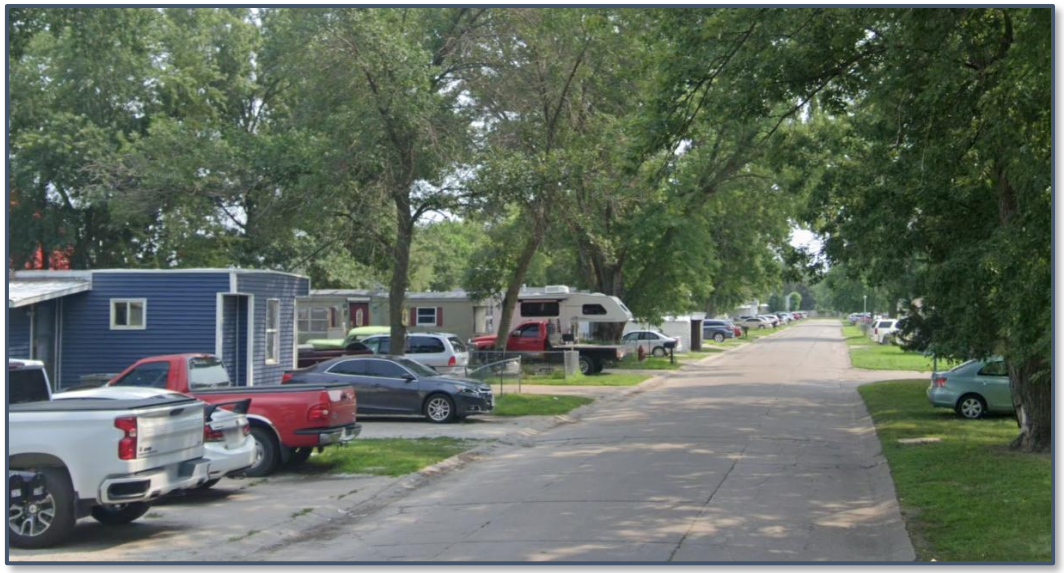
Flood Risk

- All buildings within the park are in the AE Zone
- Over half the area of the park is within 2019 inundation area

Vulnerability Factors:

- Presence of immobilized campers and RVs
- Single unpaved access road with standing water during the 2019 event

Physical Vulnerability Rating: High
Flood Zone Risk: High (100% in AE Zone)
Infrastructure: Low
Connectivity: Low
2019 Water Level: High (54% of Area Inundated)
Buildings: 21



Regency Mobile Home Park

809 S Broad St

Fremont, NE

Risk Level: High

Flood Risk

- All buildings in area of low regulatory risk
- Areas on the fringes of the parks and some streets within park were within the 2019 inundation area

Vulnerability Factors:

- 350 Meters from a Levee
- Limited access to the park, all access points had standing water in 2019

Physical Vulnerability Rating: High
Regulatory Risk: Low (100% in X Zone)
Infrastructure: Intermediate
Connectivity: Low
2019 Inundation: None
Buildings: 255

Home Trailer Park

6902 N 16th St
Omaha, NE

Risk Level: Elevated

Flood Risk

- All buildings within low-risk X zone
- Not directly effected by 2019 flooding
- Entire area of the park designated as ‘Protected By Levee’

Vulnerability Factors:

- Presence of immobile campers and RVs
- Road is sandy material, some road access points are blocked

Physical Vulnerability Rating: High
Regulatory Risk: Low (100% in X Zone)
Infrastructure: Intermediate
Connectivity: Low
2019 Inundation: None
Buildings: 109

Discussion: MHPs & Levees

Beyond Regulatory Risk

- Levee failure: Approximately 5% total buildings in the study area located in areas of lower regulatory risk due to levee protection were within 2019 inundation area

- MHPs are disproportionately located near flood protection infrastructure

- MHs are particularly physically vulnerable to levee breaches
- Important to consider elevated sensitivity of MHs to these events

Recommendations

Dodge County

- Explore **buyout options for Peaceful Acres**
- Stricter **siting and infrastructure requirements** for MHPs

Douglas County

- Suggest anchoring in X zone subtype, '**Protect by Levee**'
- Disallow long-term habituation of RVs & campers in regulatory flood plain or areas near levees
- Work with landowners to improve infrastructure & connectivity within parks

Sarpy County

- Update code to require multiple points of paved vehicle access for MHPs

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6. Nature-based Solutions for Flood Mitigation

Wetlands in Omaha, NE
(*Taken on September 10, 2024*)

Wetlands near Valley, NE
(*Taken on October 17, 2024*)

Correlation Matrix for Land Use/Land Cover on Flood Damage Components (2004–2023) for Major Affected Communities In Nebraska

Land Use/Land Cover Classification	Rainfall-Related Flood Damages	Rainfall & Stream-Related Flood Damages
Open Water	0.06	0.20
Developed, Open Space	0.38	0.15
Developed, Low Intensity	0.51	0.12
Developed, Medium Intensity	0.64	0.15
Developed, High Intensity	0.47	0.22
Barren Land	0.06	-0.02
Deciduous Forest	-0.15	0.15
Evergreen Forest	-0.12	-0.14
Mixed Forest	-0.11	0.10
Shrub/Scrub	-0.05	-0.11
Grassland/Herbaceous	0.34	0.09
Pasture/Hay	0.20	0.15
Cultivated Crops	-0.47	-0.16
Wetlands	0.08	-0.07

Pluvial Factors: **Flood Damage Due To Accumulation Of Rainfall**
Combine Factors: **Flood Damage Due To** Stream, River, Or Lake Overflow And Alluvial Fan Overflow and **Accumulation of Rainfall**

Results

1. **Significant loss of natural capacity**: Cultivated crops lands (by areas) and wooded wetlands (by percentage) experienced the largest reductions between 2004 and 2023.

2. **Continuous increase in flood risk areas, particularly for low- and moderate-income populations:** High-intensity development **in areas inundated in 2019** increased by 93% between 2004 and 2023, significantly raising flood risks for vulnerable communities.

3. The combination of **dramatic loss of natural assets** and the **continuous increase of high-density development** in flood-risk areas will bring amplified challenges for people, particularly **low- and moderate-income populations**, concerning future flood risks.

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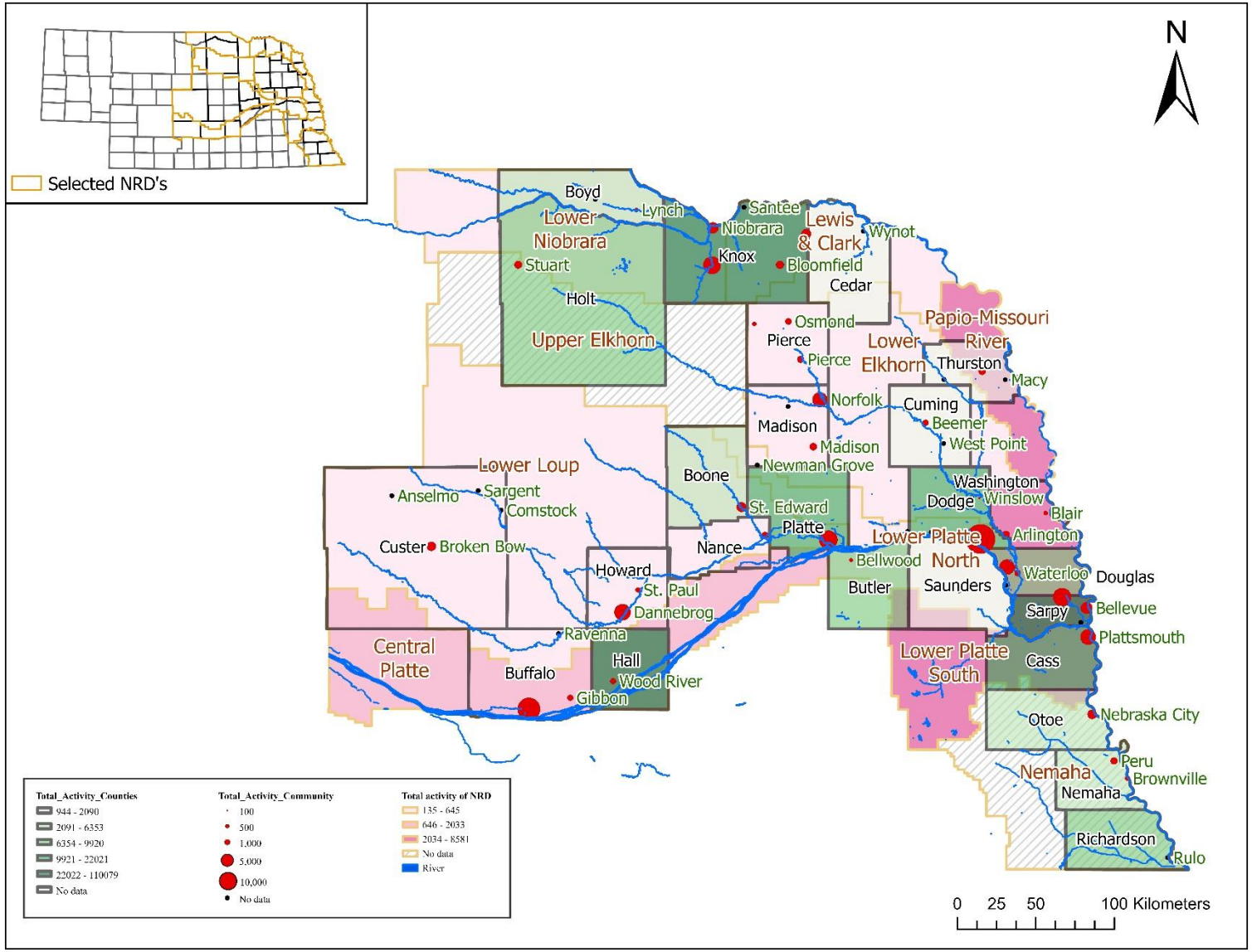
Social Meida Communications for Flood Mitigation



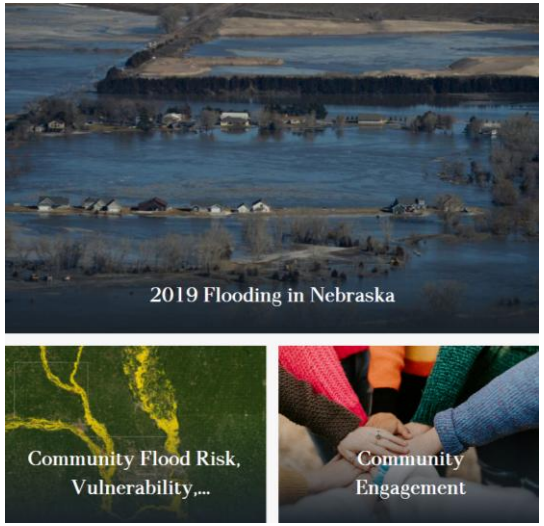
- Eastern Nebraska has the highest social media activity.
- NRDs with the most engagement: Papio-Missouri River and Lower Platte South.
- Major active communities on social media are Waterloo, Arlington, Dodge.

- Central & Northeast counties show moderate social media engagement.
- NRDs with moderate activity: Central Platte, Lower Platte North, and Lower Elkhorn.
- Notable communities actively posting about flood including St. Paul, St. Edward, Gibbon.

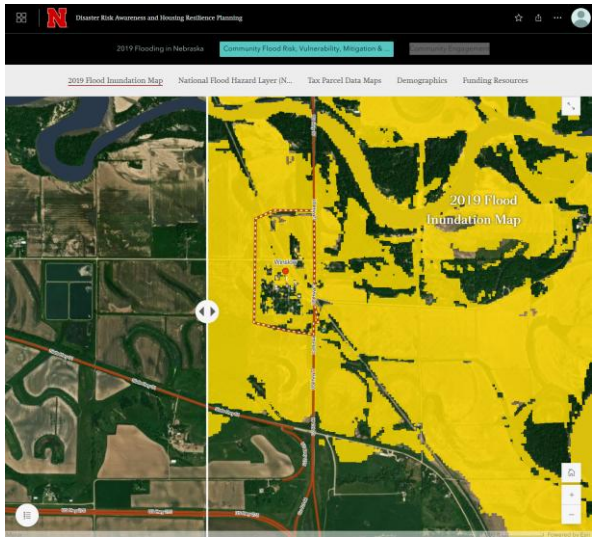
- Western and North-Central Nebraska show less flood-related social media activity.

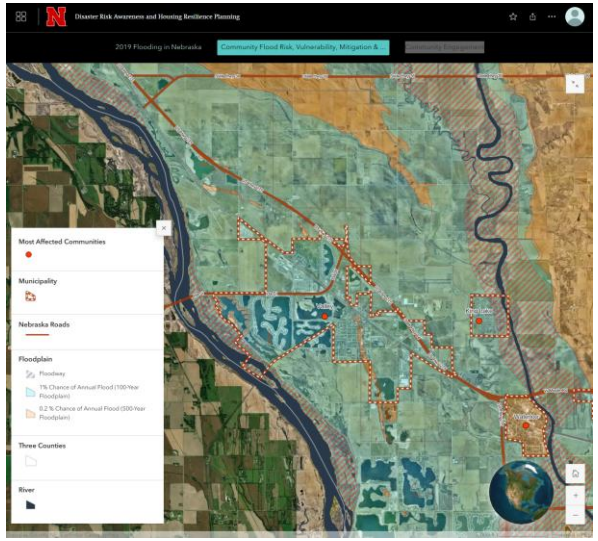
ArcGIS StoryMaps For Nebraska Flood Mitigation

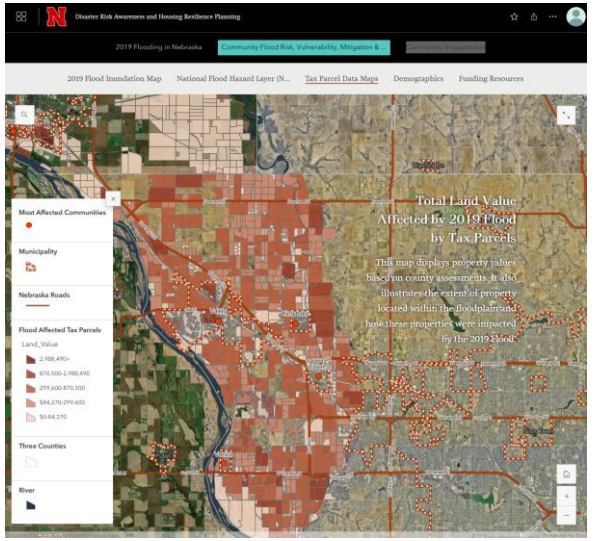
English Version

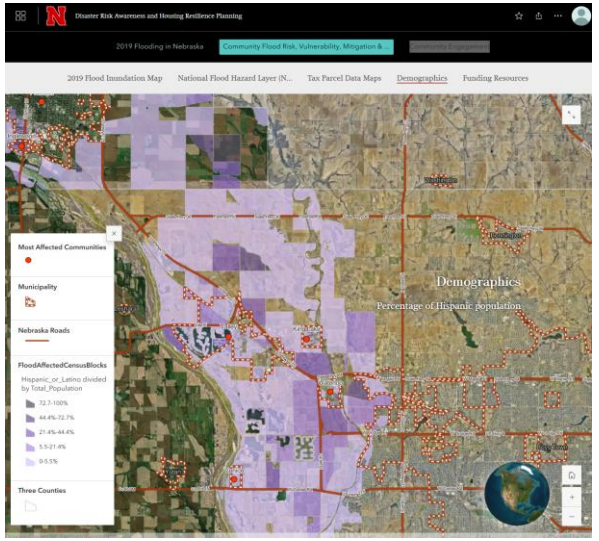


Versión en Español









Flyers For Flood Awareness

Collaboration With Media

FALL

Students and faculty in the Community and Regional Planning Program held a public meeting in April to discuss flood risks and mitigation measures for Fremont, Nebraska. The group included Matt Bolander, left, a master's student in community and regio

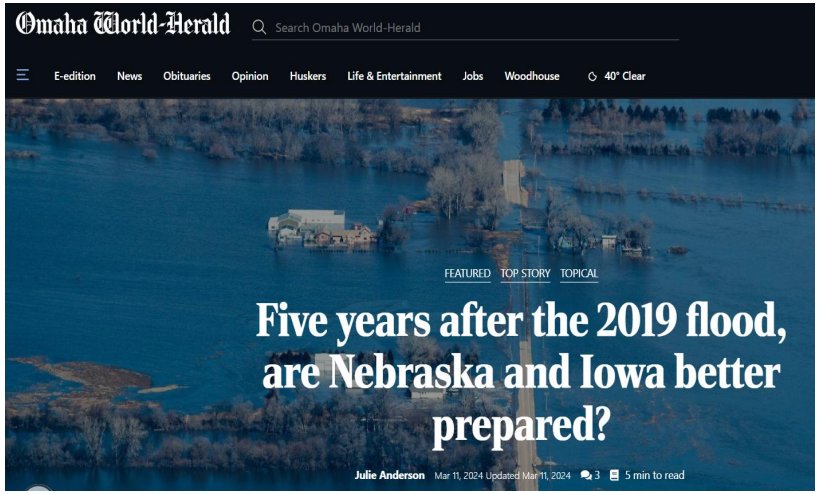
ARCHITECTURE

Helping Hands

TEAM ASSISTING HARD-HIT COMMUNITIES PREPARE FOR FUTURE FLOODS

and three graduate students, led by faculty members Zhenghong Tang and Yunwoo Nam.

Focused on 31 communities in Douglas, Sarpy and Dodge counties, primary goals are to thoroughly evaluate flood risk; provide risk mitigation education and outreach to residents; and propose new planning, zoning and land-use approaches to government leaders. The anticipated outcome is better risk awareness and housing resiliency plans at both local and regional levels.



NEBRASKA TEAM HELPING HARD-HIT COMMUNITIES PREPARE FOR FUTURE FLOODS

BY: LESLIE REED; MAY 7, 2024; REPRINTED FROM NEBRASKA TODAY

Supported with $1 million in federal funds awarded via Nebraska's Department of Economic Development, Husker community and regional planning experts are developing long-term recovery and resilience strategies for communities hardest-hit by historic 2019 flooding.

The multifaceted effort was launched at the start of 2024 by a team of two postdoctoral researchers and three graduate students, led by University of Nebraska-Lincoln faculty members Zhenghong Tang and Yunwoo Nam.

Focused on 31 communities in Douglas, Sarpy and Dodge counties, primary goals are to thoroughly evaluate flood risk; provide risk mitigation education and outreach to residents; and propose new planning, zoning and land-use approaches to government leaders. The anticipated outcome is better risk awareness and housing resiliency plans at both local and regional levels.

"The project is designed to address flood vulnerabilities in counties

Zhenghong Tang (center), professor and director of the Community and Regional Planning Program at Nebraska, discusses a flood resilience plan with the advisory committee on Jan. 26. Jenny B. Mason, community development and disaster recovery director with the Nebraska Department of Economic Development and project manager, is at left; and Yunwoo Nam,

UNL TEAM'S ARCGIS STORYMAP EMPOWERS COMMUNITIES TO BUILD FLOOD RESILIENCE

BY: ZHENGHONG TANG & KERRY MCCULLOUGH-VONDRAK, UNL COLLEGE OF ARCHITECTURE

A persistent challenge during flood recovery and prevention has been the lack of accurate and timely disaster information, especially for vulnerable populations. Non-English speakers and individuals with limited digital access often face significant barriers to obtaining critical, life-saving information. These challenges are further exacerbated by inefficient spatial data systems, undermining community resilience.

To address these issues, the research team from the Community and Regional Planning program at the University of Nebraska-Lincoln (UNL) has developed the "Nebraska Flood Resilience" through ArcGIS StoryMap Collection, a multilingual and user-friendly platform designed to improve flood information accessibility. The ArcGIS StoryMap Collection is a visual and interactive tool available in English and Spanish. It focuses on improving information delivery for multicultural audiences, particularly Spanish-speaking users, enabling them to better understand and act on disaster-related data. It aims to enhance public awareness and build capacity in communities severely affected by the 2019 floods, preparing them for future flood events.

In addition to its multilingual capabilities, ArcGIS StoryMap empowers communities with an intuitive interface to explore flood risk data, visualize past flood events, and identify high-risk areas. By integrating maps, images, and narratives, it bridges the gap between complex geospatial information and actionable insights for local decision-makers and residents. The platform also supports collaborative planning by allowing stakeholders to share information, build scenarios, and engage in informed discussions about flood mitigation strategies.

The StoryMap Collection also supports the creation of a digital twin of Nebraska, an advanced technology that integrates geospatial data to produce a virtual replica of the real world.

This innovation is vital for disaster prediction, infrastructure design, and urban planning. By leveraging ArcGIS StoryMap's powerful visual storytelling and data visualization features, communities can better anticipate, prepare for, and respond to flooding events, ultimately strengthening resilience and saving lives.

"This innovative tool will serve as an essential information platform to serve economic development and climate resilience as a demonstration model for planners and policy makers at the local, state and national levels" said Dean of College of Architecture, Kevin Van Den Wymelenberg.

"The StoryMap Collection provides developers, urban planners and researchers with critical data for informed decision-making, laying the groundwork for Nebraska's future disaster management and sustainable urban development," said Community and Regional Planning Program Director and Professor Zhenghong Tang.

UNL Community and Regional Planning Team Helps Hard-Hit Communities Prepare for Future Floods

Thursday, December 19, 2024

Share |

Supported with $1 million in federal funds awarded via Nebraska's Department of Economic Development and a grant from the U.S. Department of Housing and Urban Development, Husker community and planning experts are developing long-term recovery and resilience strategies for communities hardest-hit by Nebraska's historic 2019 flooding.

Take-Home Messages

1. **Flood recovery is complex, costly, and prolonged**.

2. **Floods are inevitable**—another major flood will come as part of the natural cycle.

3. **Development in flood-prone areas continues to increase**—long-term flood risks remain significant.

4. **Pre-disaster mitigation with more integrated and proactive approaches are essential** to foster long-term flood resilience, such as regulatory policies, voluntary and incentive-based programs, nature-based solutions, and public awareness,.

Acknowledgements

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