

A stylized illustration of a park scene. On the left, there is a red park bench with blue legs. Behind the bench is a green tree and a white cloud. To the right of the bench is another green tree. The background is a light blue sky with a white cloud. The ground is a solid green color.

Welcome to Beatrice, Nebraska

Avoiding Flood Losses in the American Heartland

A tale of successful risk management and acquisition in Beatrice, Nebraska



A decorative header featuring a light blue sky with white clouds, a green ground line, two green trees on the left, and a blue bicycle with red wheels on the right.

A Snapshot of Savings: The 2015 Flood

- ▶ On May 7, 2015, the Big Blue River rose to its third highest crest
- ▶ The damage that occurred was significantly less due to a flood prone property acquisition program that the city began in the 1970s
- ▶ Flood levels that had been devastating in the 1970s, 1980s, and 1990s were significantly reduced in 2015
- ▶ Over more than 45 years, the City invested \$4.9 Million (2017 adjusted) to purchase 120 properties (95 structures)
- ▶ According to the study results, nearly \$13 million dollars in flood damage was avoided in the 2015 flood

$$\begin{array}{rcccl} \$12.9 & - & \$4.9 & = & \$8 \text{ MILLION} \\ \text{MILLION} & & \text{MILLION} & & \text{SAVINGS IN 2015} \\ \text{(FLOOD LOSS AVOIDED)} & & \text{(INVESTED)} & & \end{array}$$

A 263% RETURN ON INVESTMENT

An online interactive [Story Map](#) has been developed to allow readers to take a virtual journey through the history of flooding turned to mitigation success in Beatrice.

Welcome To Beatrice, Nebraska

Scroll down to see our story!

Image By: Tim Vrtiska

The header features a light blue sky with white clouds. On the left, there are two green trees of different sizes. On the right, there is a blue bicycle with red wheels. The title 'Story Map Mitigation Effectiveness Project' is centered in the sky area.

Story Map Mitigation Effectiveness Project

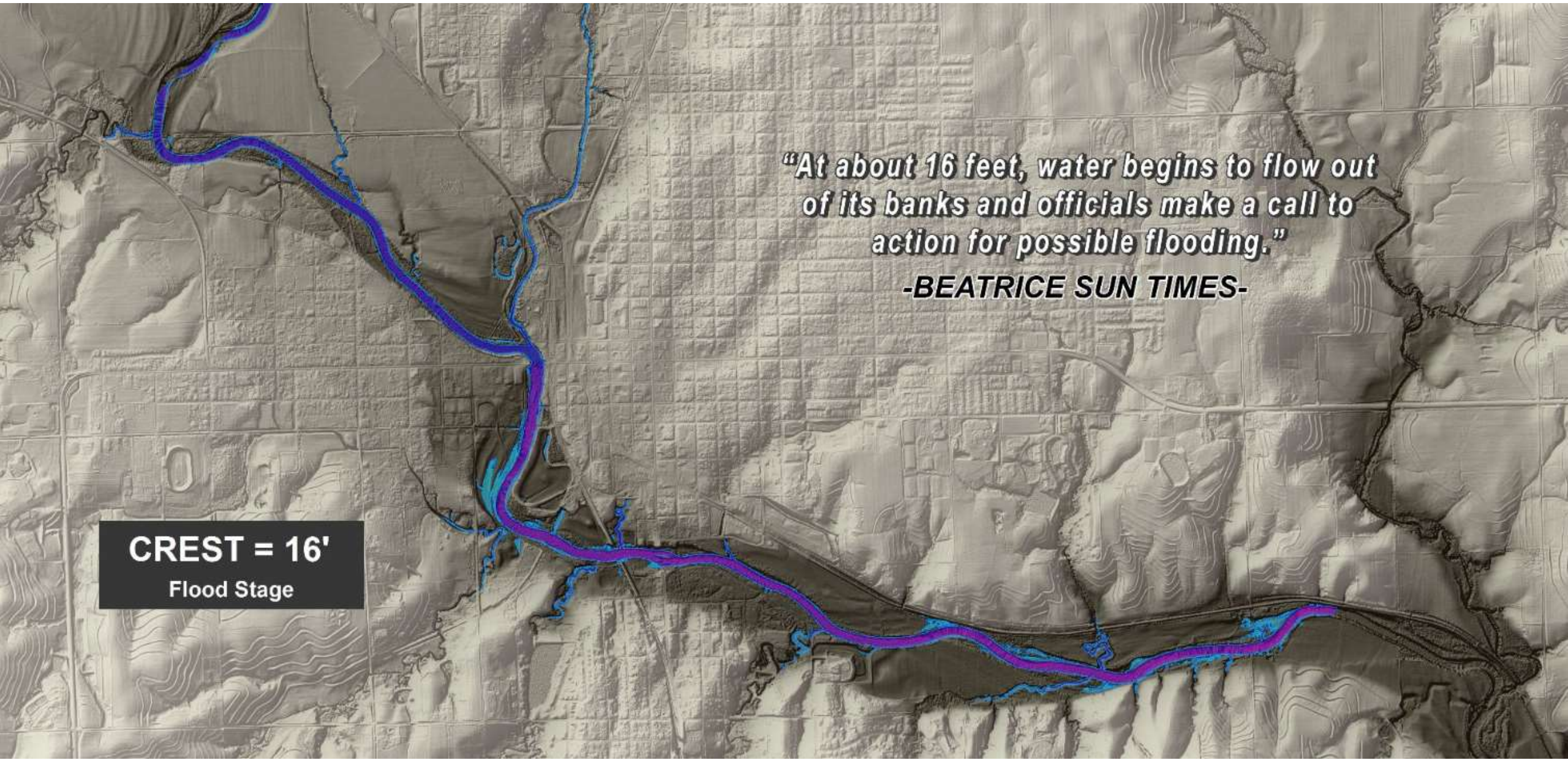
The story map presents Beatrice's acquisition success story from the aftermath of its highest flood event on record in 1973 through two major flood events that followed in 1984 and 1993 and culminating with the 2015 flood event that demonstrated the benefits of the flood prone property acquisition program.

The goal is to show how this type of investment can have significant long-term economic and flood risk benefits for a community, as well as quantify the return on investment over time.

To provide an understanding of the flood history in Beatrice, we go back before the City's flood prone property acquisition program began to the fall of 1973 as rains began to fall and the Big Blue River Began to leave its banks...



1973 – Largest Flood of Record



"At about 16 feet, water begins to flow out of its banks and officials make a call to action for possible flooding."

-BEATRICE SUN TIMES-

CREST = 16'
Flood Stage

1973 – Largest Flood of Record



1973 – Largest Flood of Record



***"The river hit 20 feet before West Court Street
bridge was closed"***
-BEATRICE SUN TIMES-

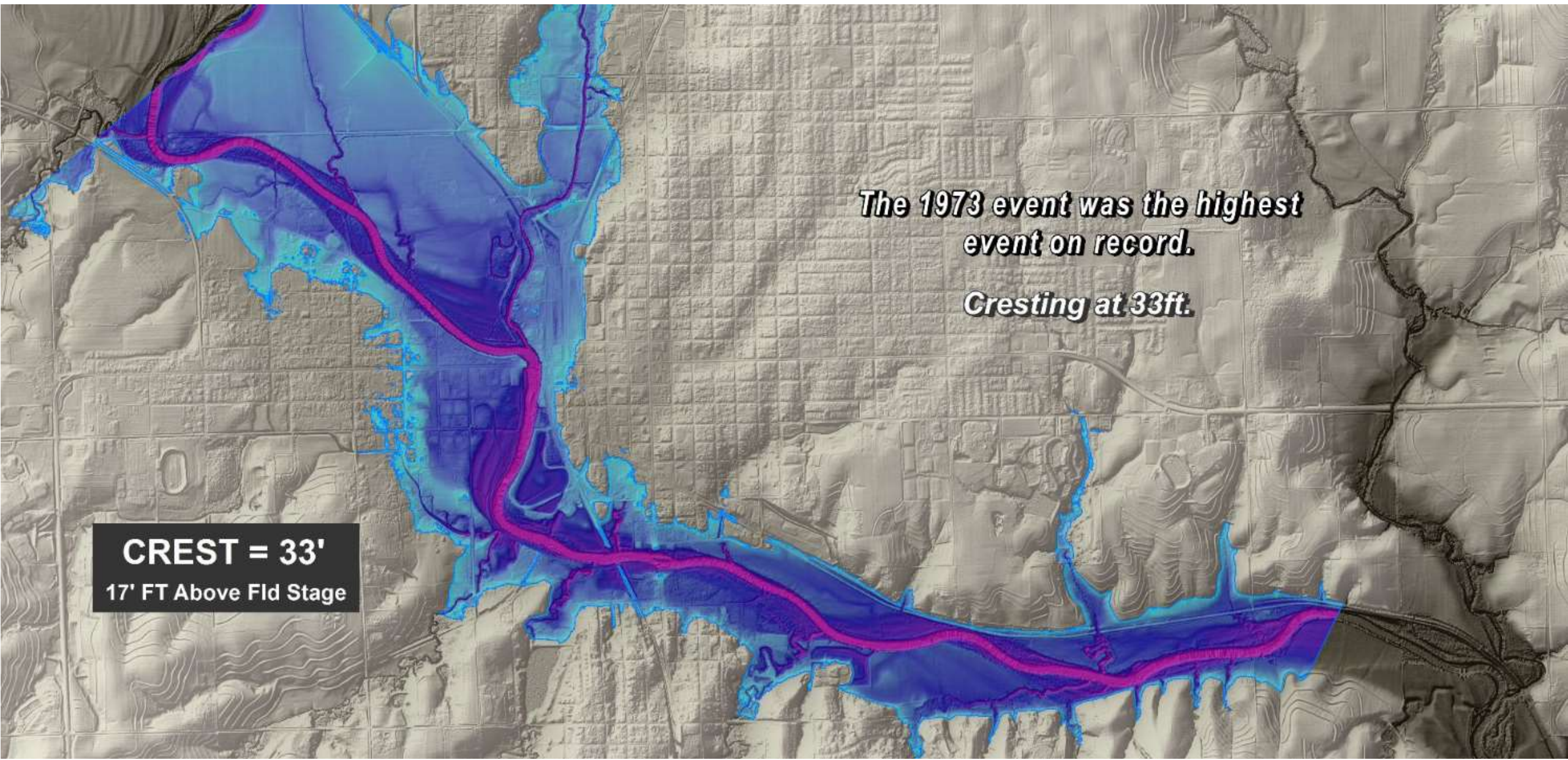


CREST = 20'
4' FT Above Fld Stage

1973 – Largest Flood of Record



1973 – Largest Flood of Record



***The 1973 event was the highest
event on record.***

Cresting at 33ft.

CREST = 33'
17' FT Above Fld Stage

"...old man river is going to do it ultimately if we don't."

- Doug Probst, Beatrice City Councilman (1975)

Learning From The Past

"...the emptied floodplain would cut the dollar loss from floods and would lessen the chances of people being killed or injured in a flood"

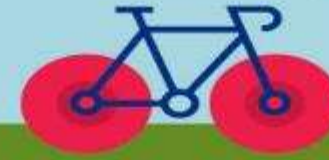
- Terry Doyle, City Clerk-Treasurer (1975)

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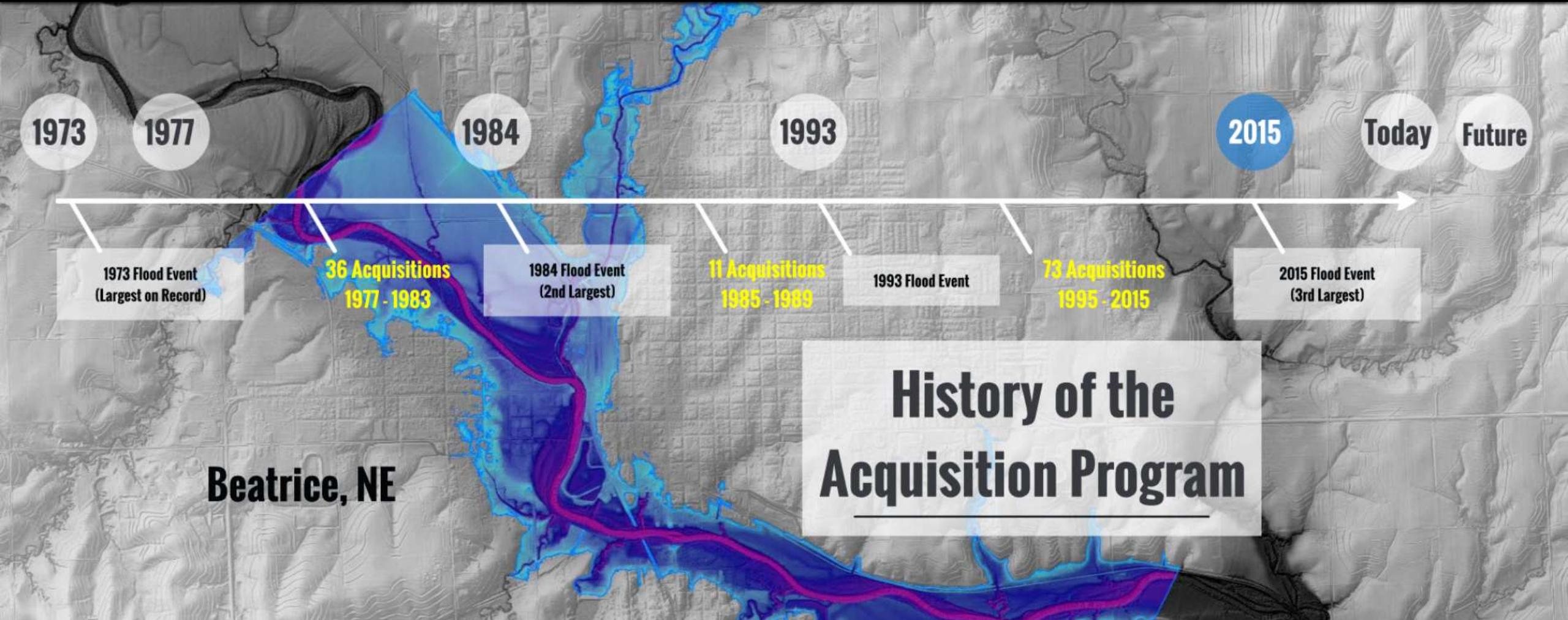
The Acquisition Program is Born

- **In 1973, flooding throughout the region was devastating**
- **The City of Beatrice's response was to approach recovery through hazard mitigation planning**
- **The goal was to avoid the same level of devastation with future floods**
- **Spanning over 45 years, community leaders have utilized several funding sources to support the program**
 - City funds
 - Private contributions
 - Gifts
 - HUD Community Development Block Grants
 - FEMA Hazard Mitigation Grant Program,
 - FEMA Flood Mitigation Assistance Program
 - FEMA Project Impact Grant

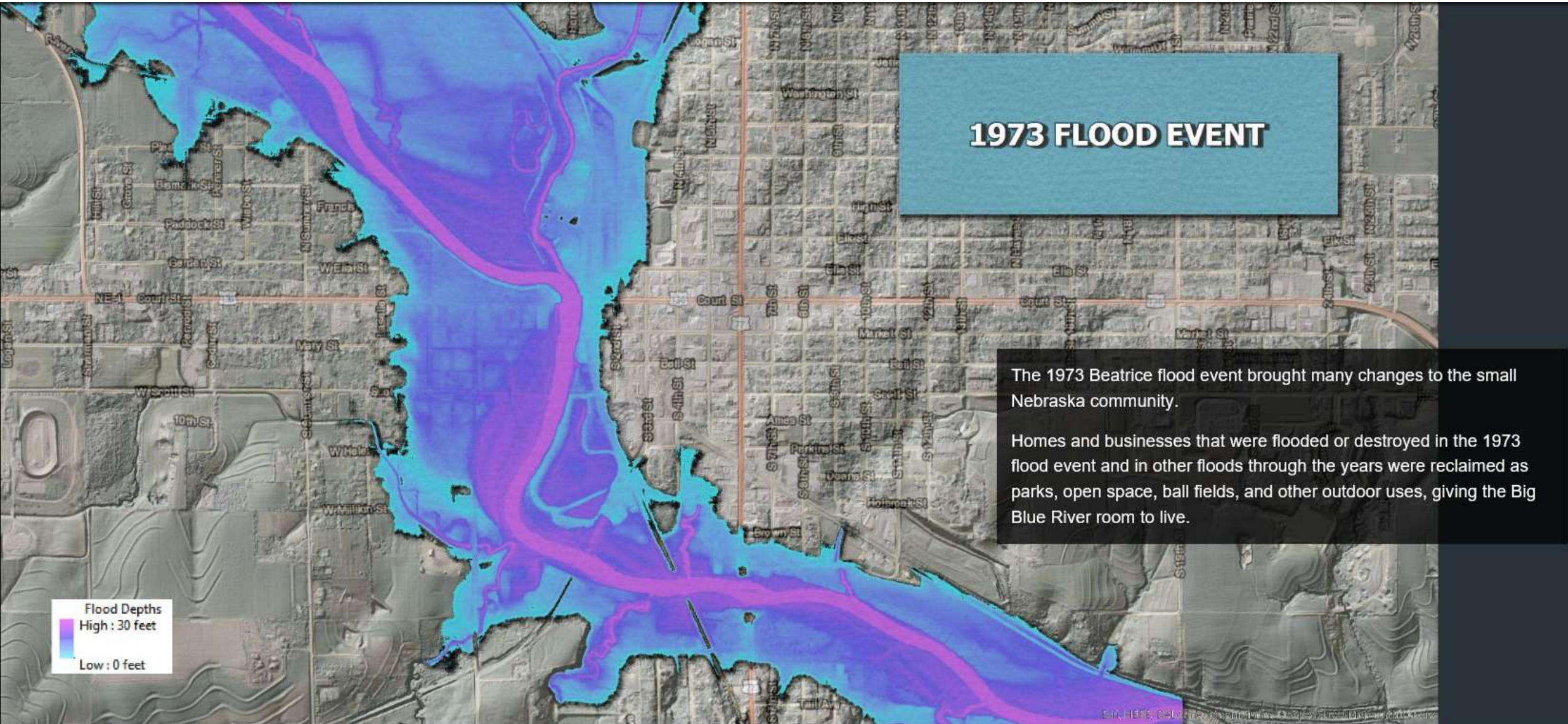
Timeline of Events



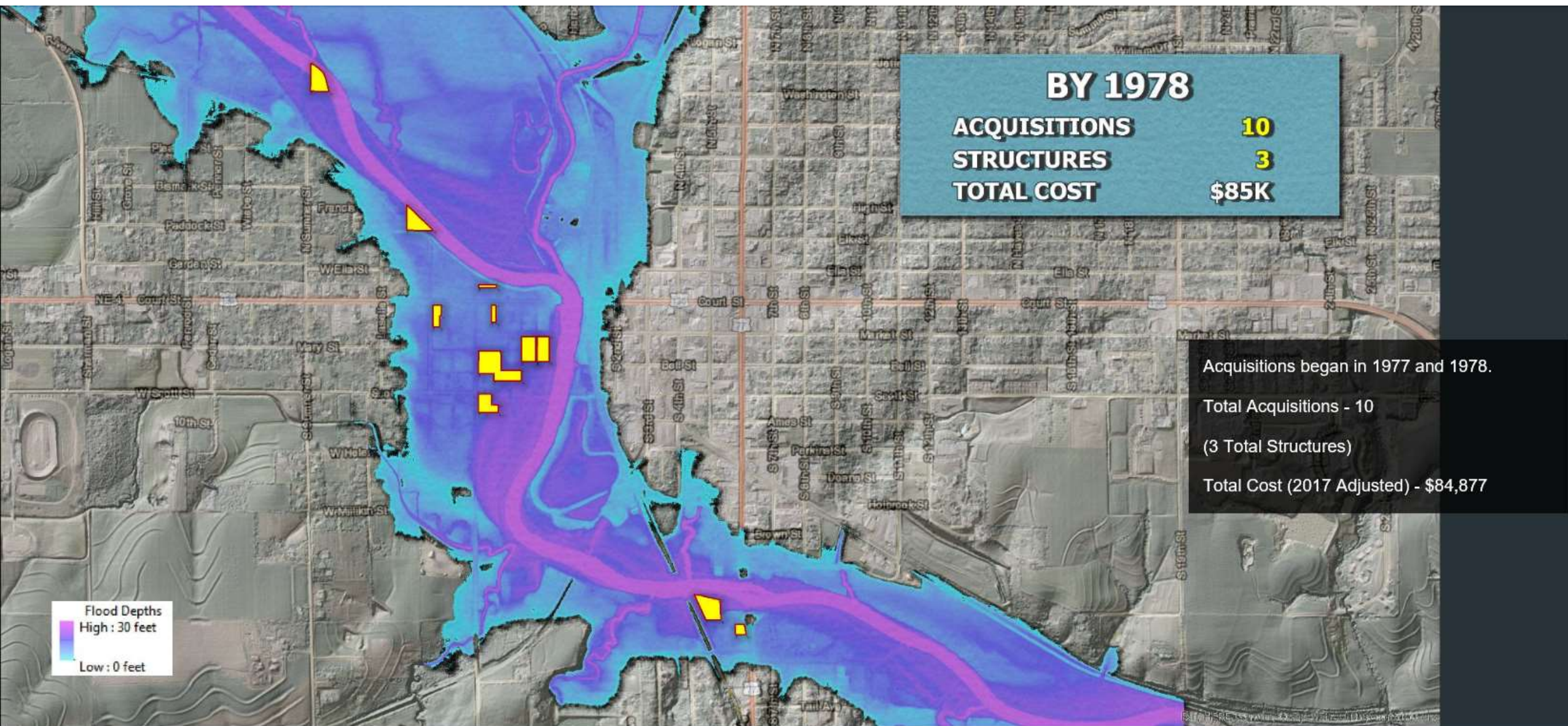
Learning From The Past



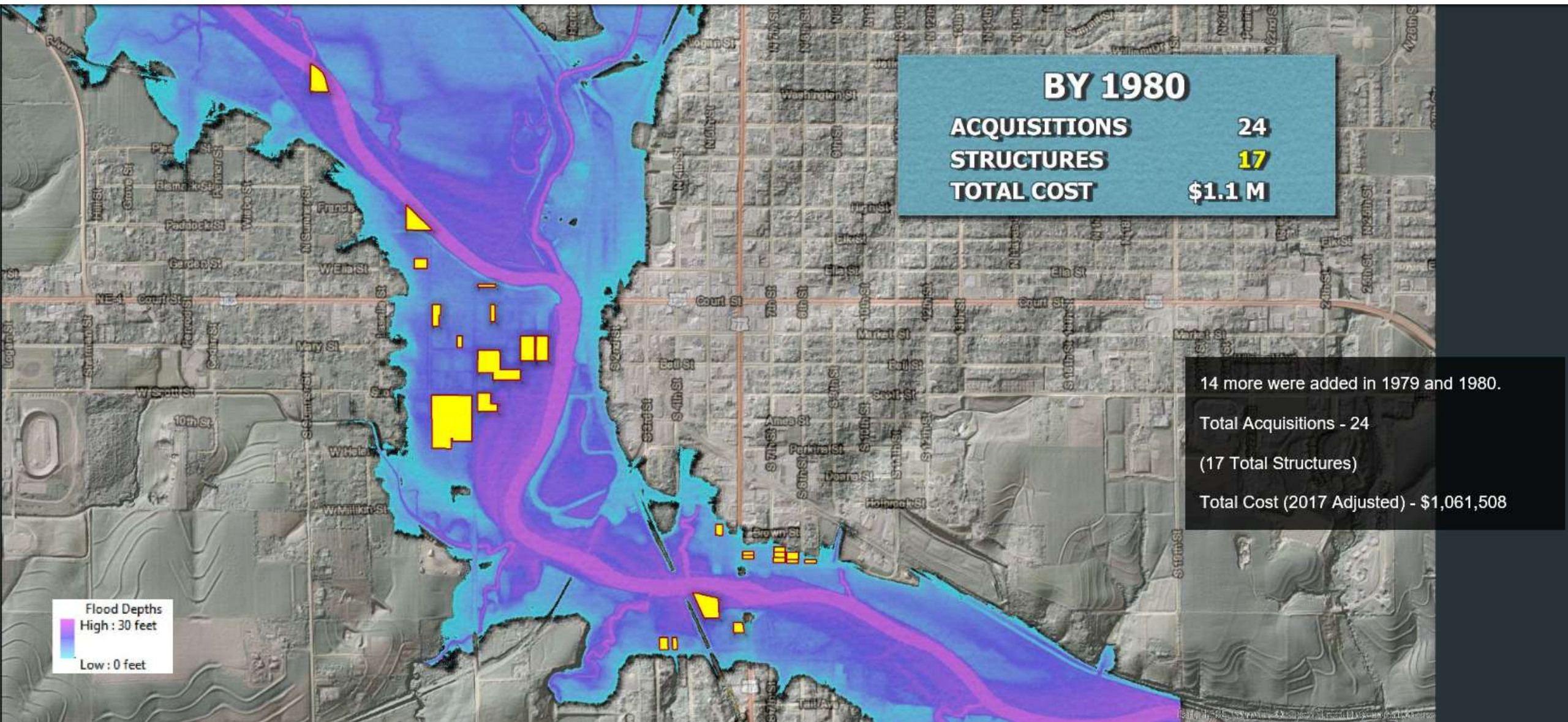
History of the Acquisition Program



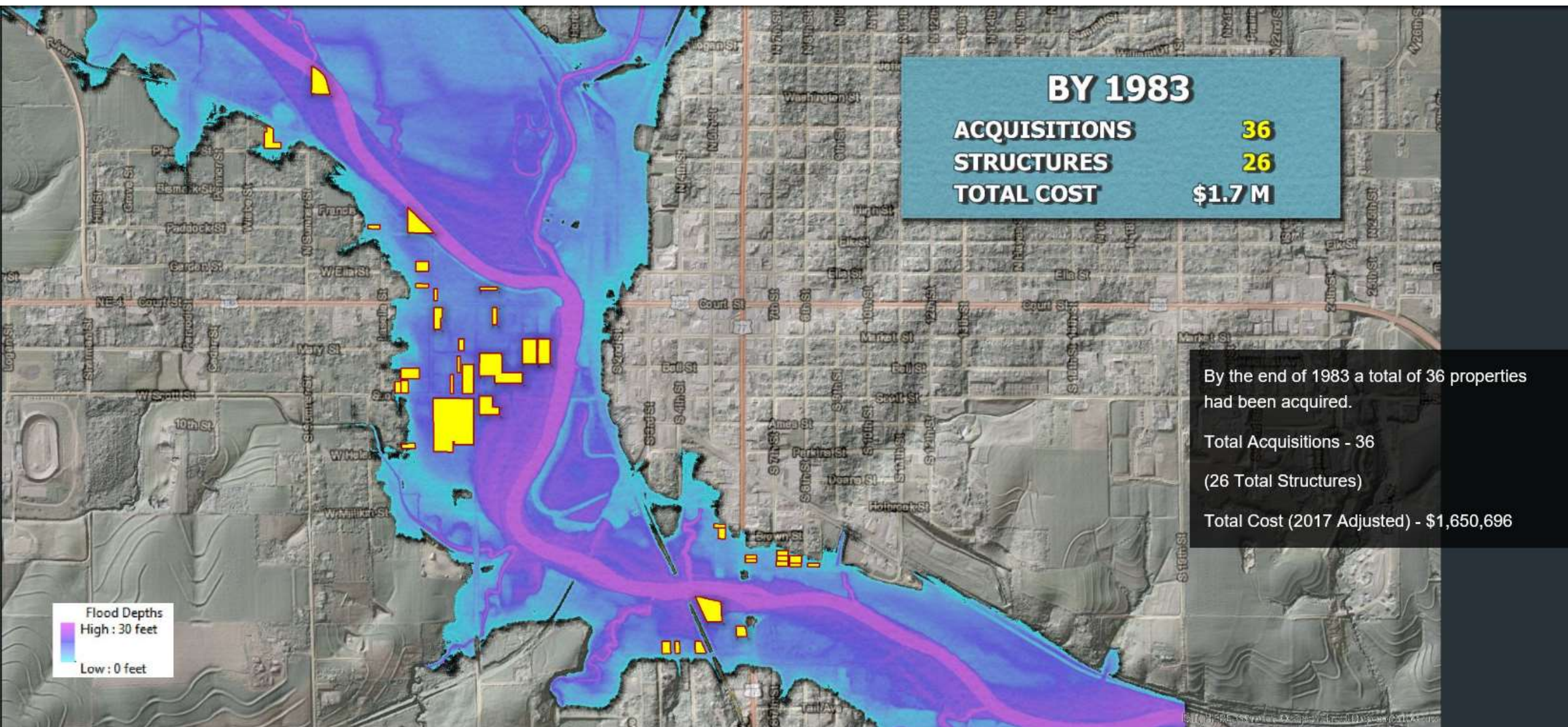
History of the Acquisition Program



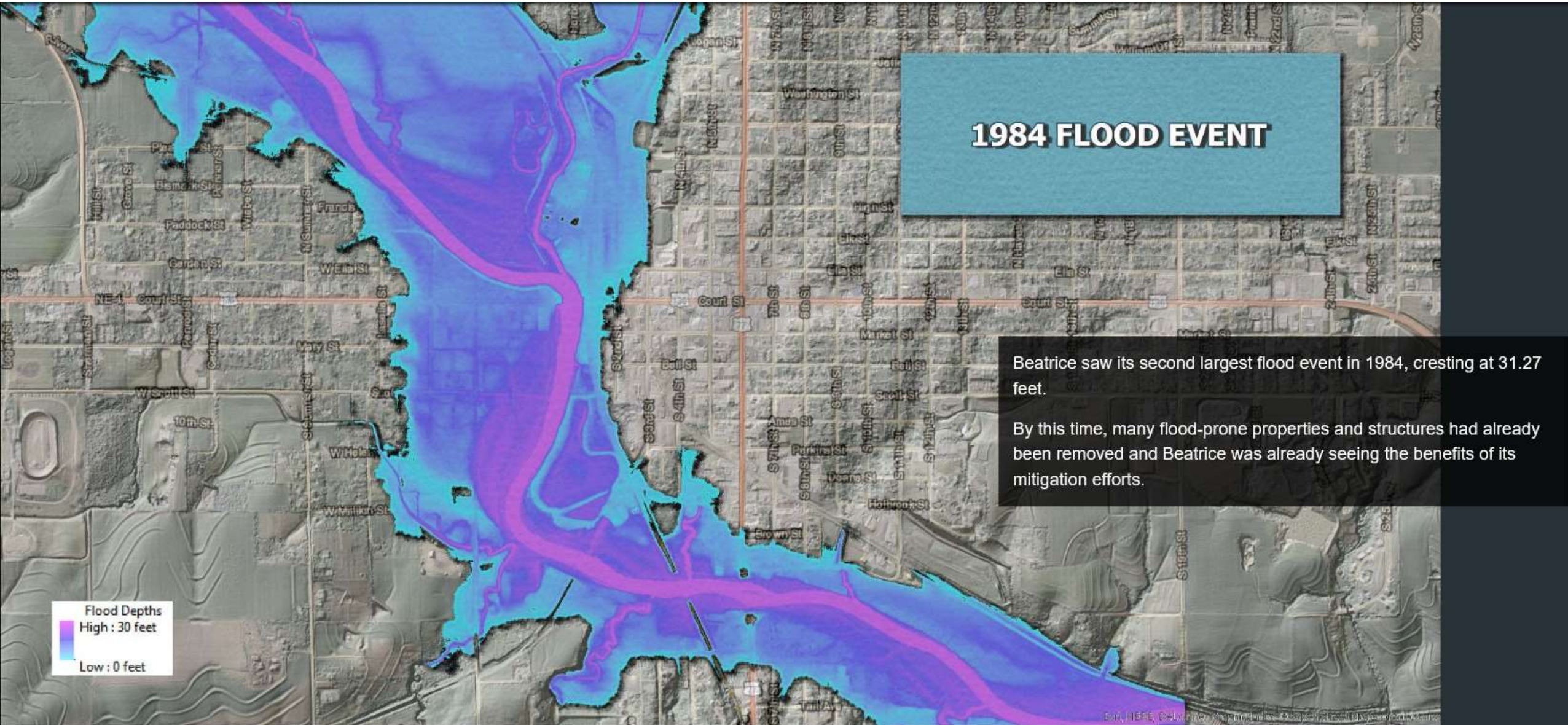
History of the Acquisition Program



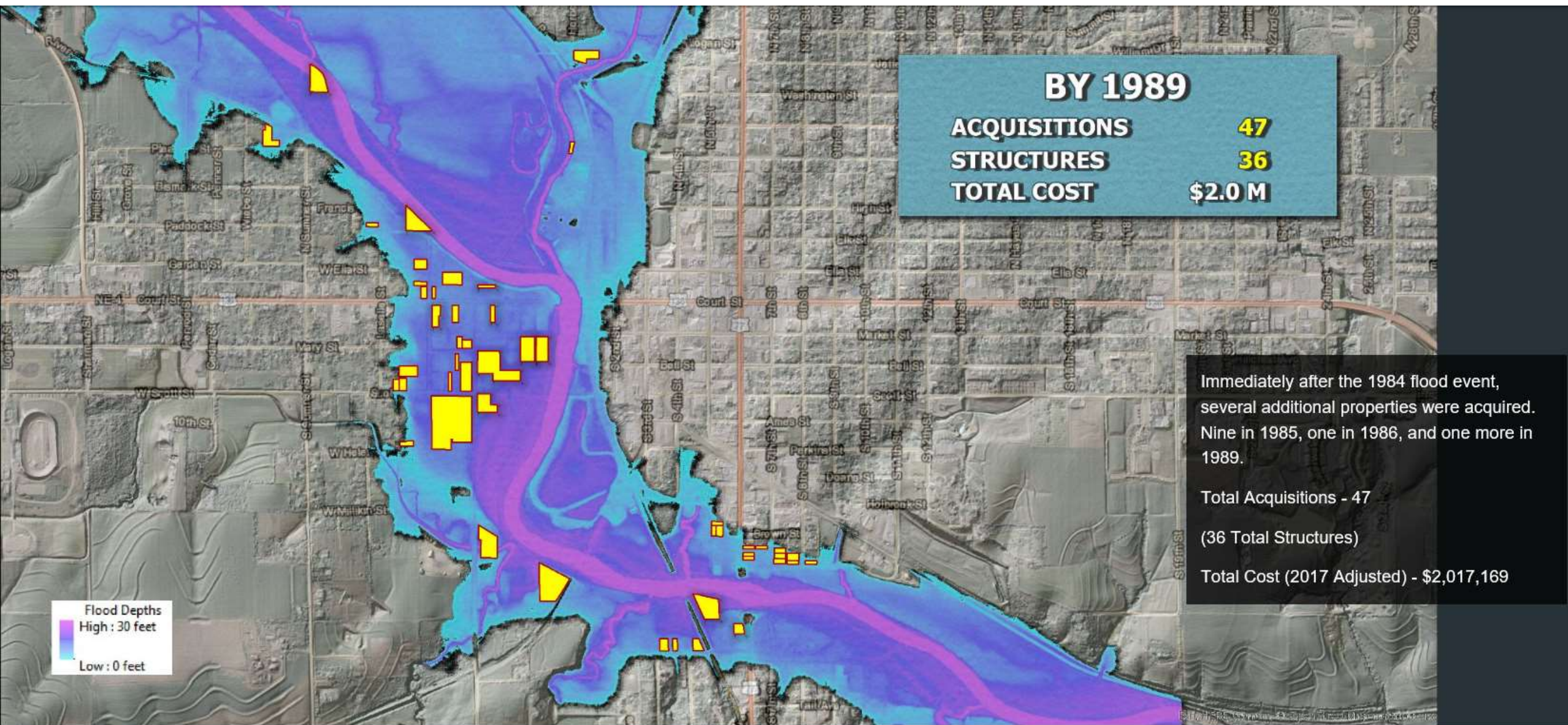
History of the Acquisition Program



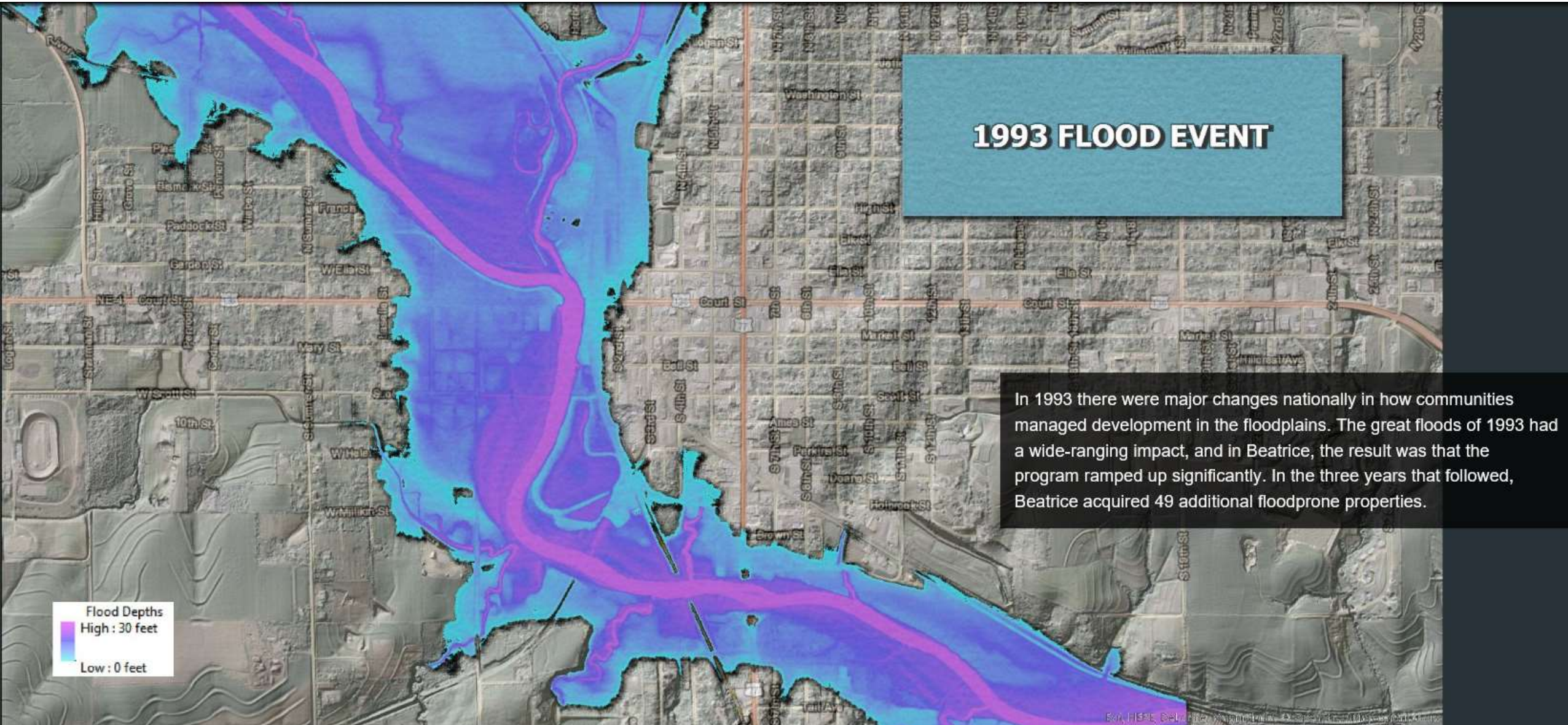
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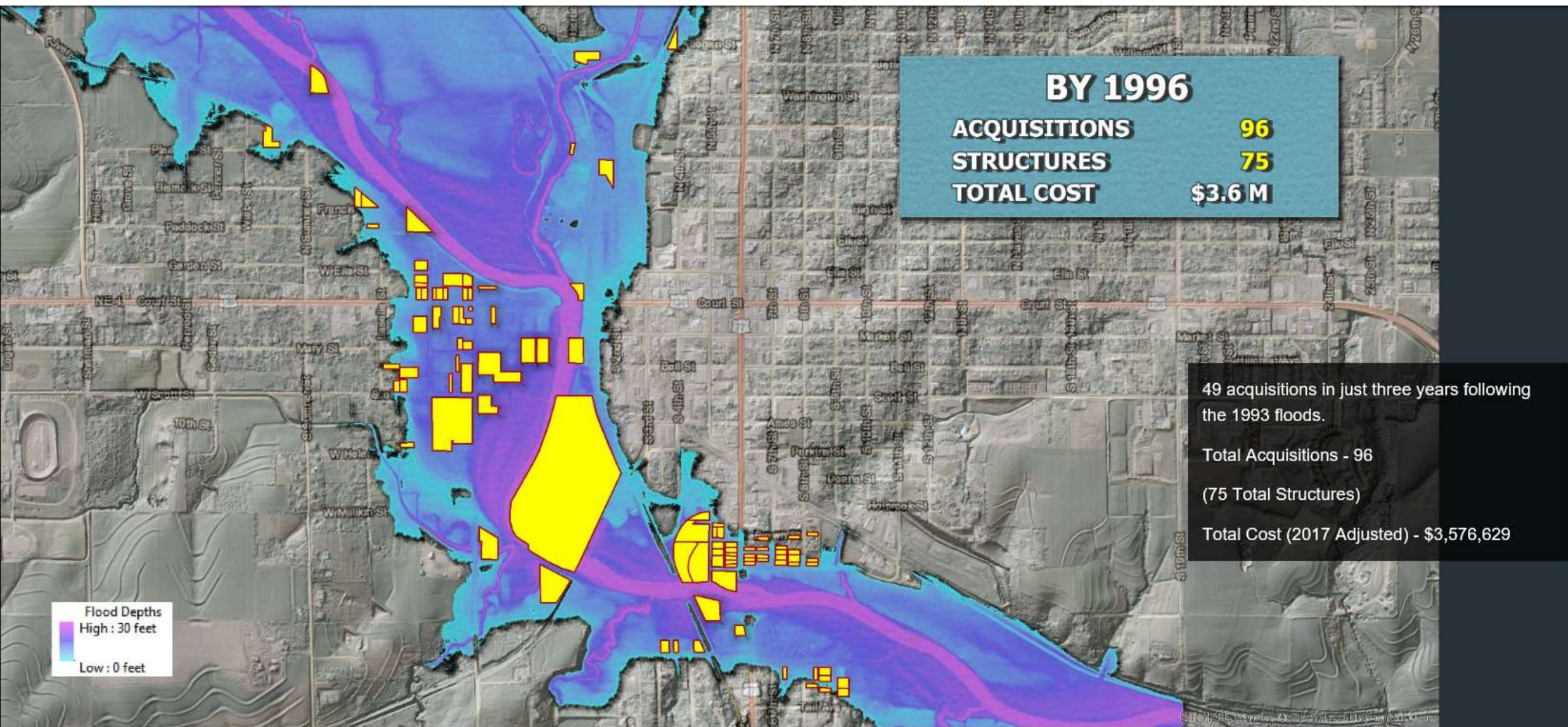
History of the Acquisition Program



History of the Acquisition Program



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History of the Acquisition Program

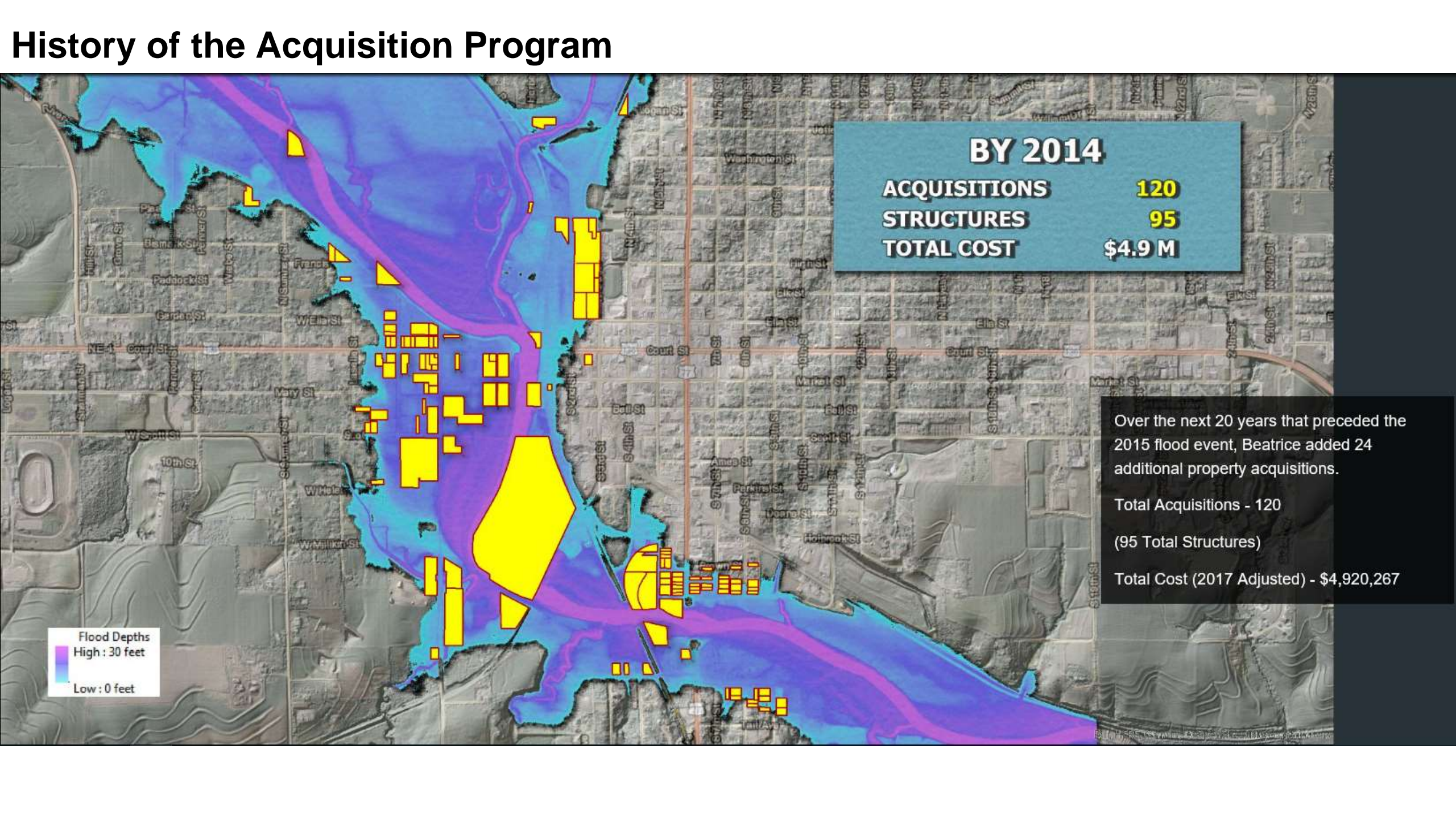
BY 2014

ACQUISITIONS	120
STRUCTURES	95
TOTAL COST	\$4.9 M

Flood Depths
High : 30 feet
Low : 0 feet

Over the next 20 years that preceded the 2015 flood event, Beatrice added 24 additional property acquisitions.

Total Acquisitions - 120
(95 Total Structures)
Total Cost (2017 Adjusted) - \$4,920,267

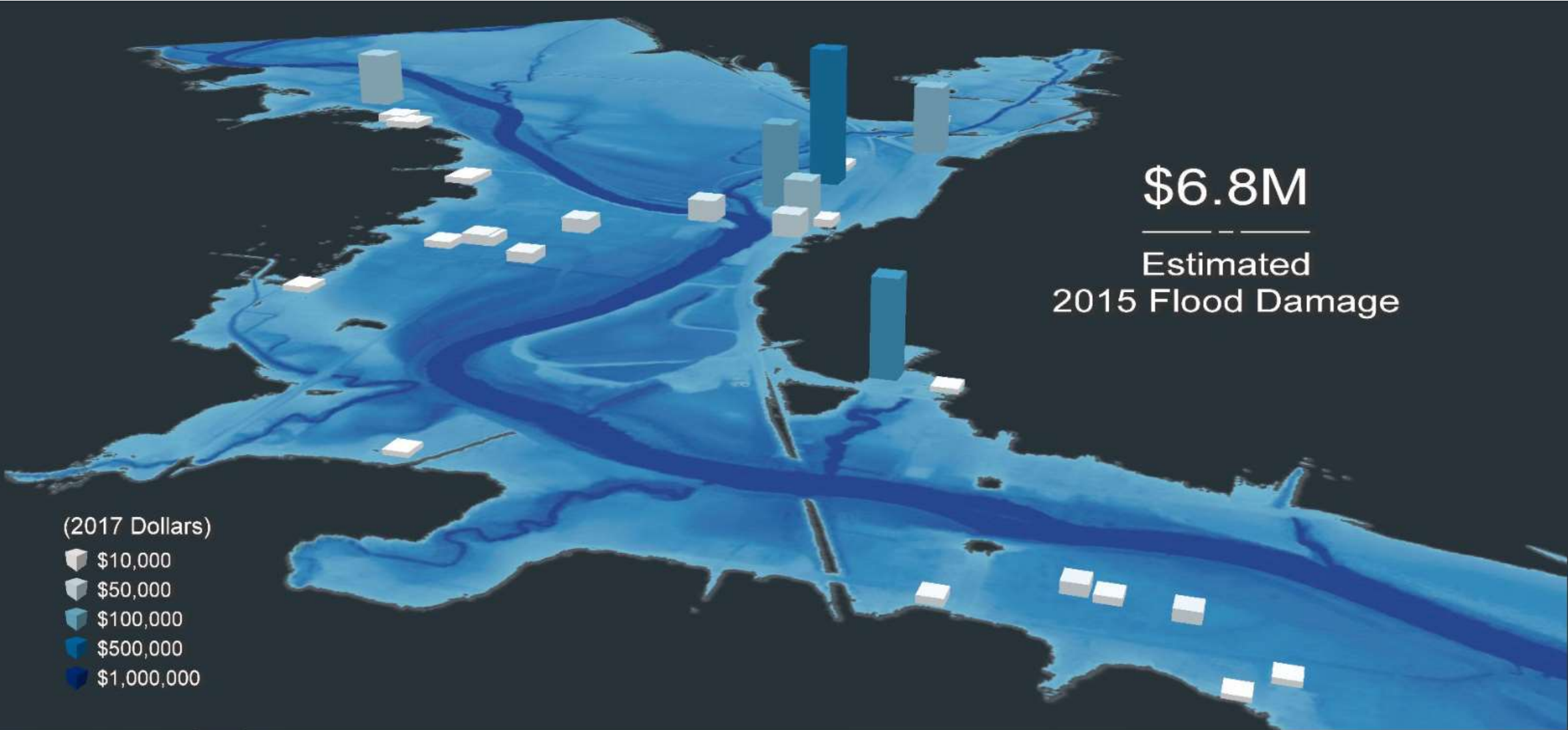


A stylized map background featuring a blue river winding through green land with various tree icons and red picnic tables. A road with a '77' shield is visible on the right. The title 'A Mitigation Success Story' is centered over the map.

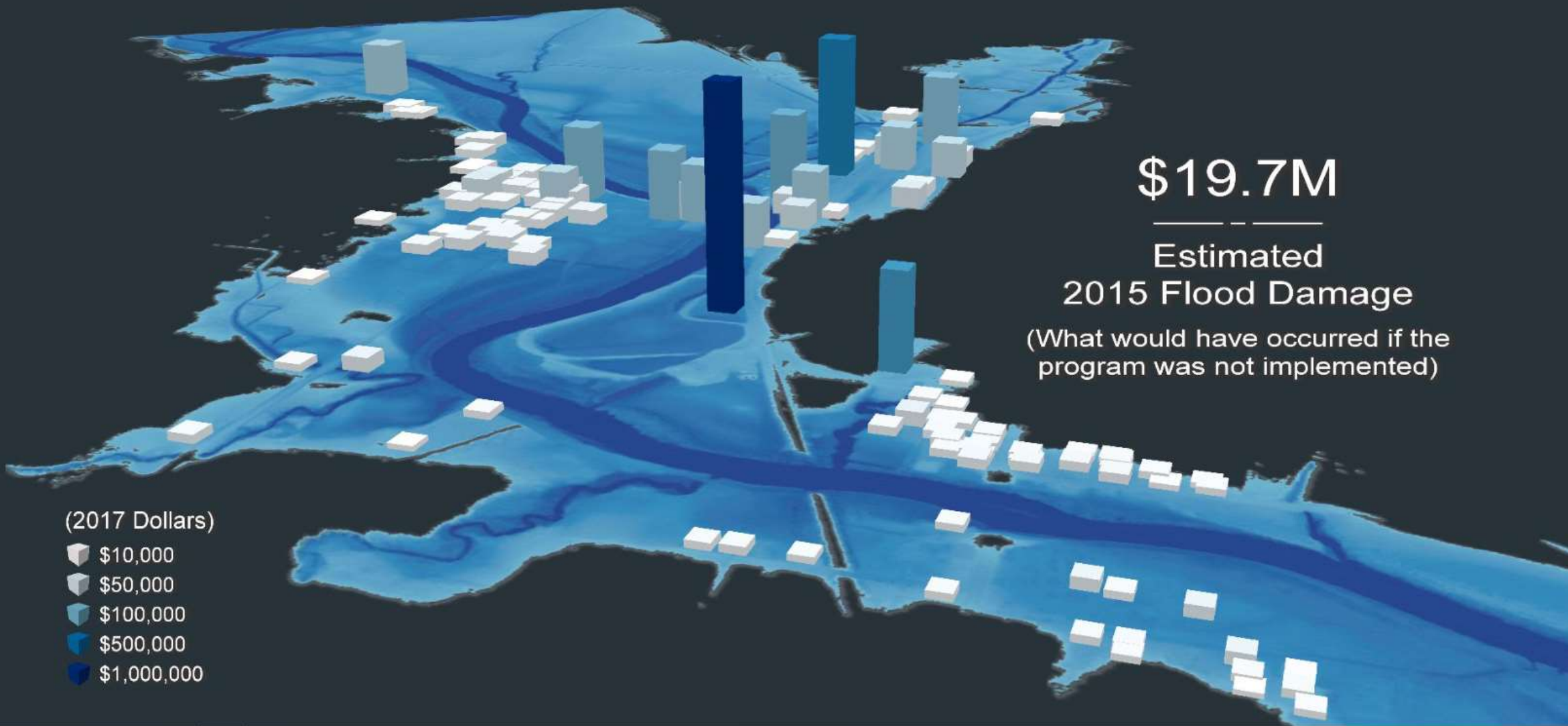
A Mitigation Success Story

"We were better aware of what could happen this time around if river waters did rise quickly" - Jason Moore, Beatrice Street Superintendent

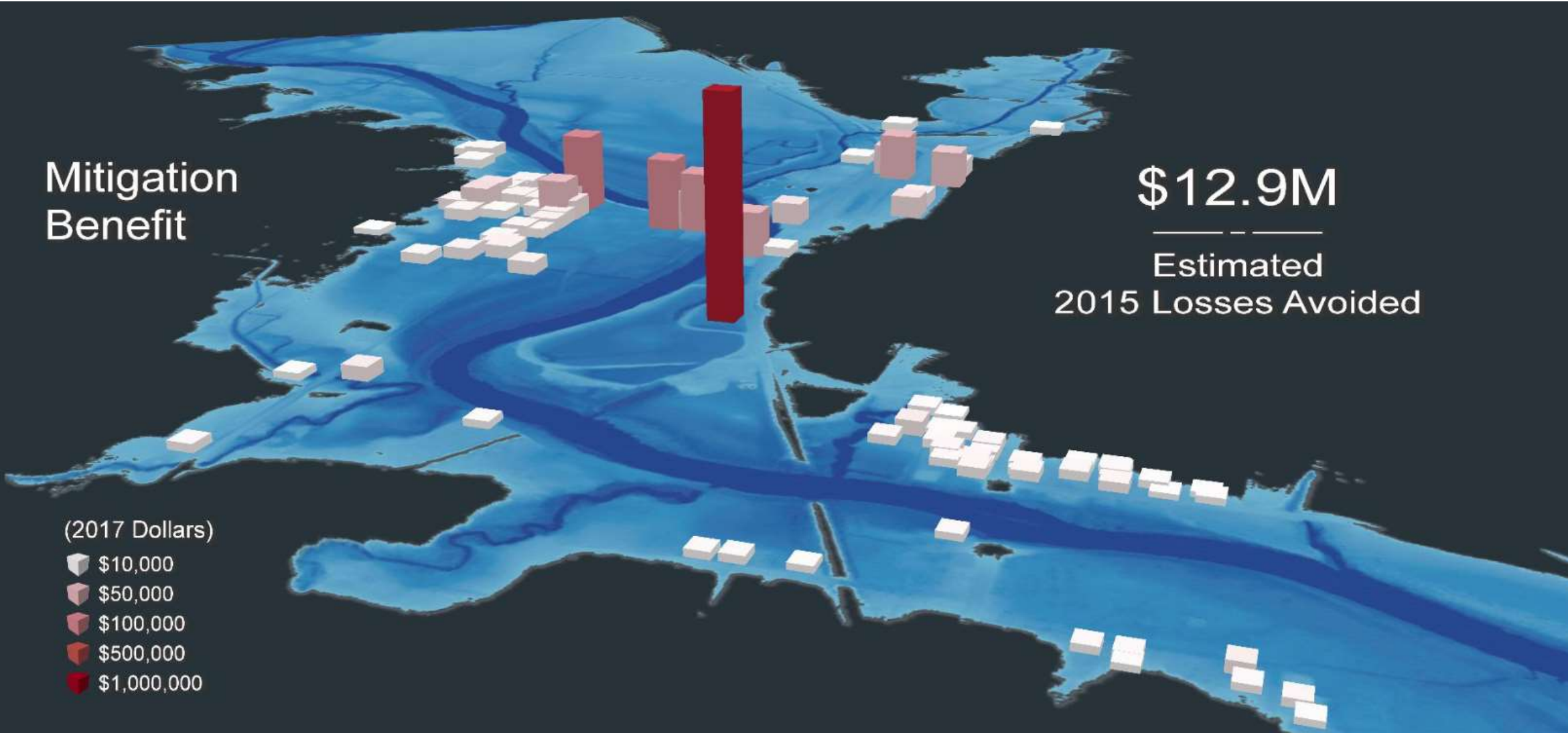
A Mitigation Success Story



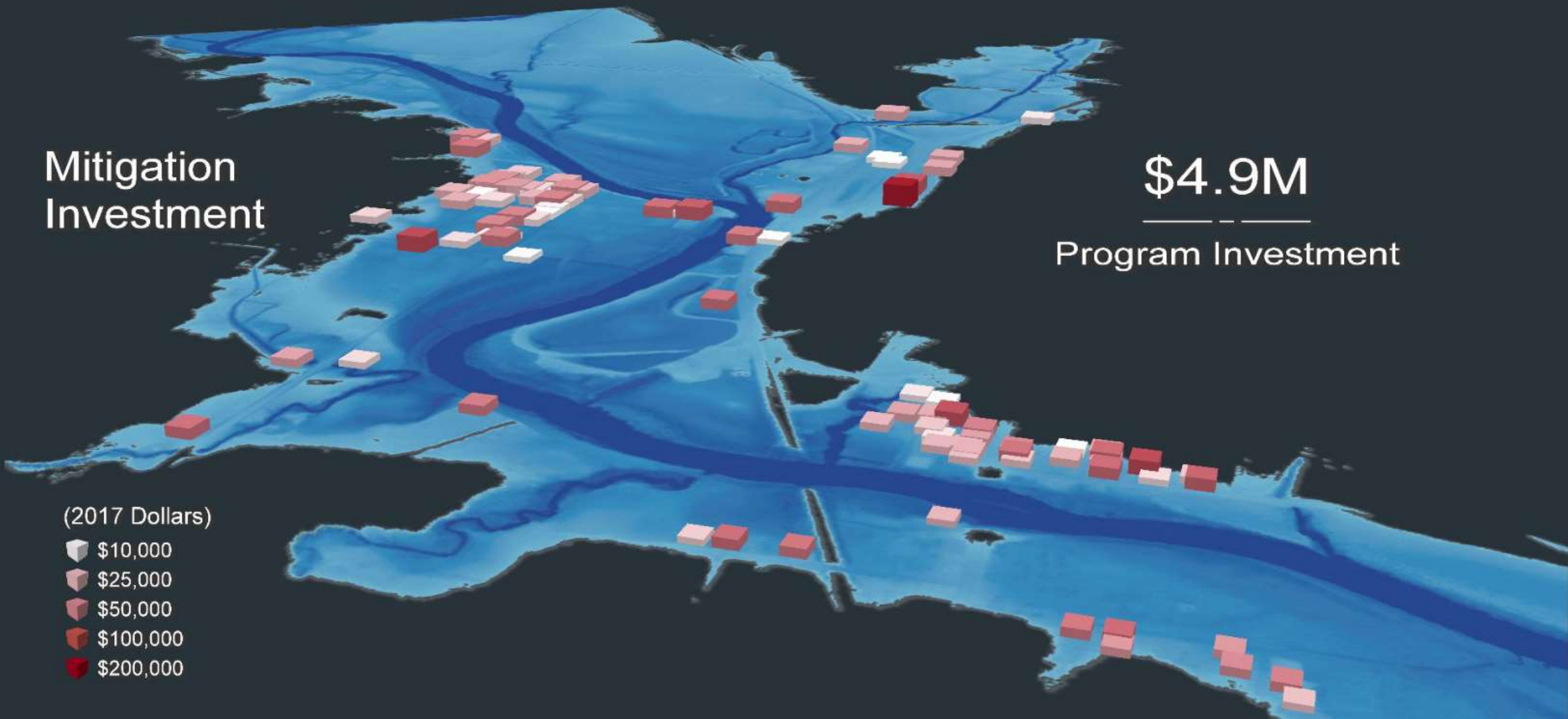
A Mitigation Success Story



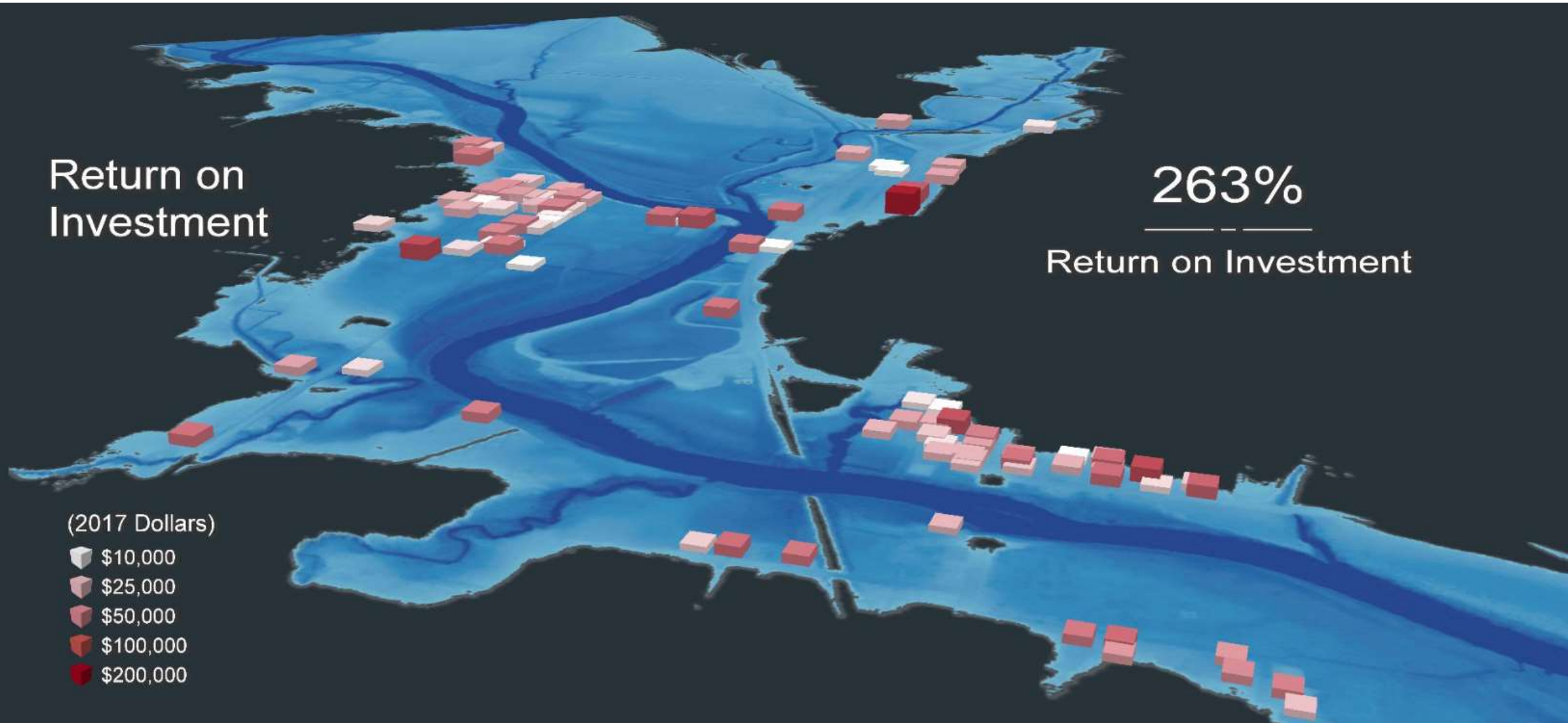
A Mitigation Success Story



A Mitigation Success Story



A Mitigation Success Story



Mitigation Effectiveness Summary Results

		Millions of Dollars (2017 Adjusted)			
	Structures	Losses	Losses Avoided	Estimated Program Cost	Savings (ROI%)
Structure Acquisitions (1973 - 2014)	95	\$12.9M	\$12.9M	\$4.9M	\$8.0M (263%)
Structures (Remaining)	32	\$6.8M	-	-	-
Total	127	\$19.7M	-	-	-

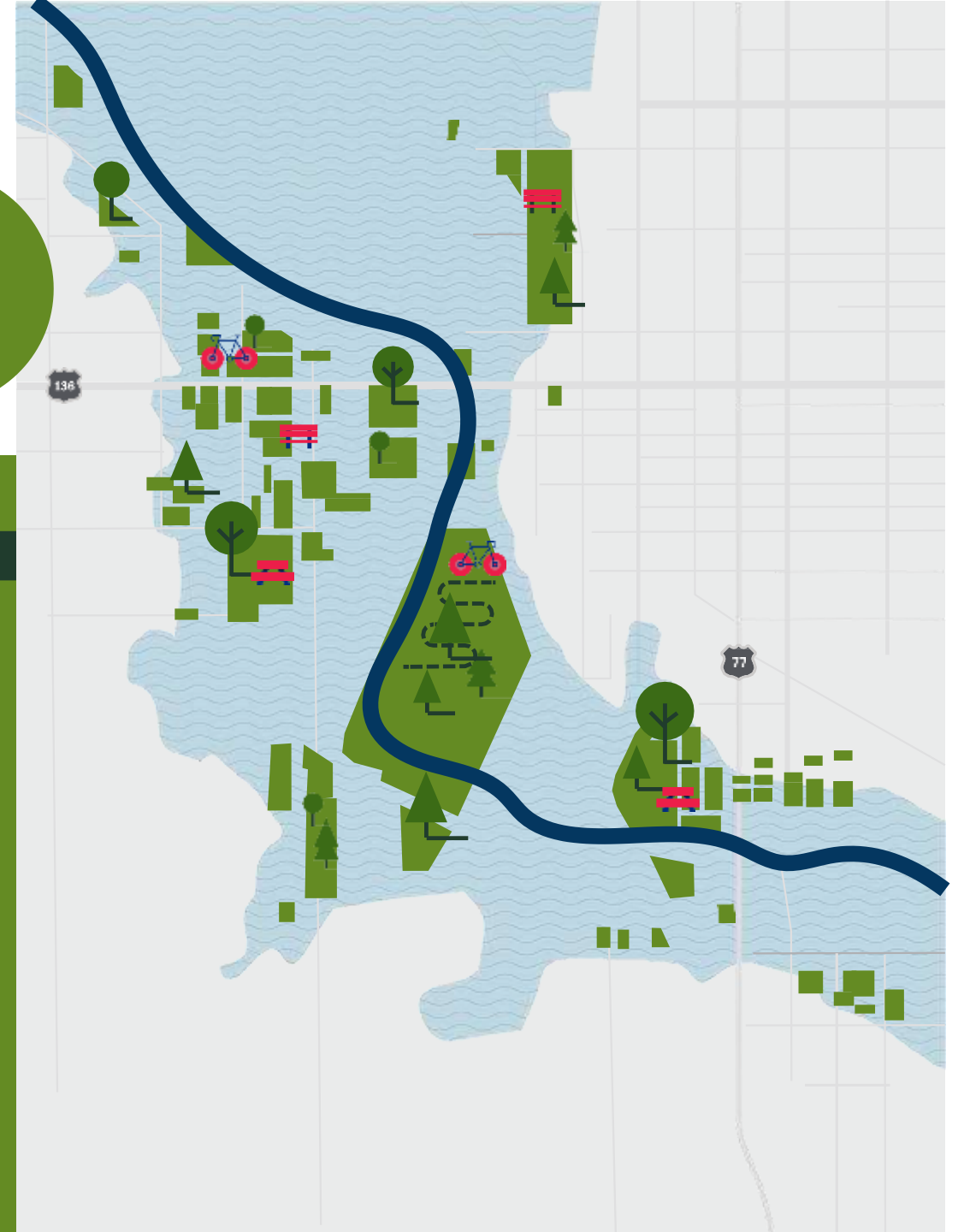


EFFECTIVE MITIGATION IN BEATRICE, NE:

A SNAPSHOT OF SAVINGS

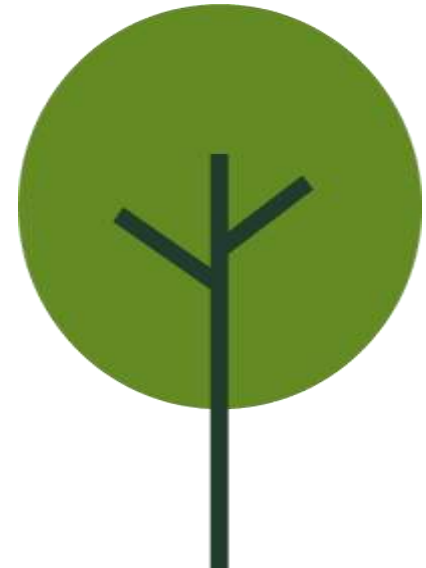
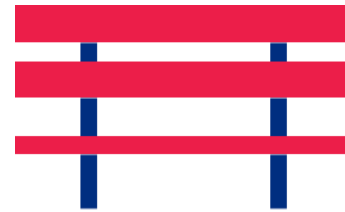
“The mitigation efforts in Beatrice and the cost-savings evidenced by this study are the result of a long-term strategy and a commitment on the part of community leaders spanning over 40 years. This is an example of responsible community mitigation planning, dedication, and the ability to make use of multiple programs and available resources to achieve a common goal.”

- David I. Maurstad, Deputy Associate Administrator for the Federal Insurance and Mitigation Administration;
Mayor of Beatrice (1991-1994)



Added Benefits

- ▶ Increase in natural greenspace, wetland acreage, natural habitat for wildlife, and riparian buffers, which all increase water quality
- ▶ Increase in parks, open space, hiking and biking trails, ballfields, and other venues
- ▶ Reduction in fire department/law enforcement costs for flood duty and rescue
- ▶ Avoidance of future disruption of the community – business, education, health and social services
- ▶ Increased public safety
- ▶ And more...





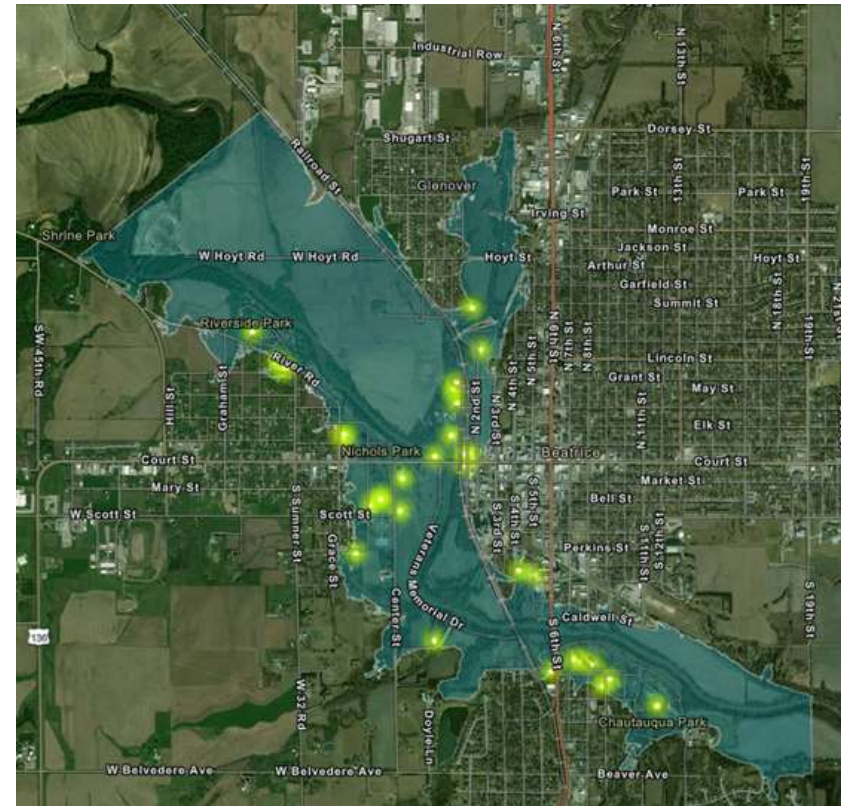
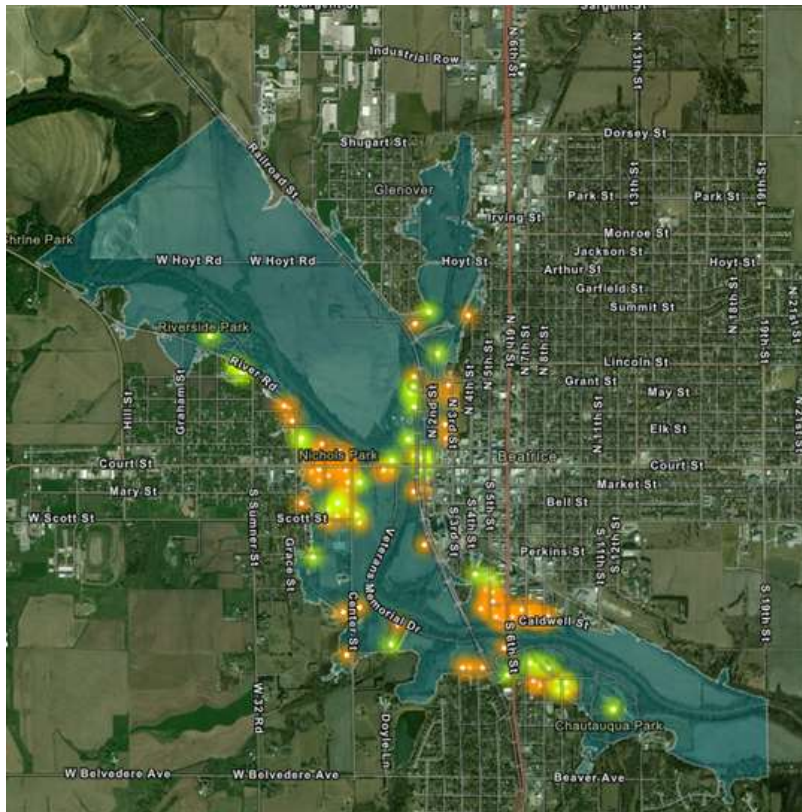
How Success Was Measured

Analysis Used To Measure The Success Of The Program

Use of Hazus to Model Mitigation Effectiveness



- ▶ **Damages modeled for 127 structures based on the 2015 flood inundation area**
 - 95 Structures Removed – orange points
 - 32 Structures Remaining - green points





Hazus Run

► Hazus 4.0 Enhanced Flood Analysis

- Hazard data replaced with 2015 Flood User Defined Depth Grid
- Structure data replaced with User Defined Facility (UDF) Data

► Modeled loss estimates based on

- Depth of flooding
- Property-specific attribute information
- Location-specific depth-damage curves in Hazus

Hazus UDF Requirements

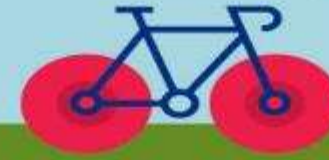
- Building Value
- Content Value
- Building Type
- Occupancy Class
- #Stories
- Foundation Type
- Year Built
- Square Footage
- First Floor Height
- Design Level
- Latitude and Longitude

Data Collection

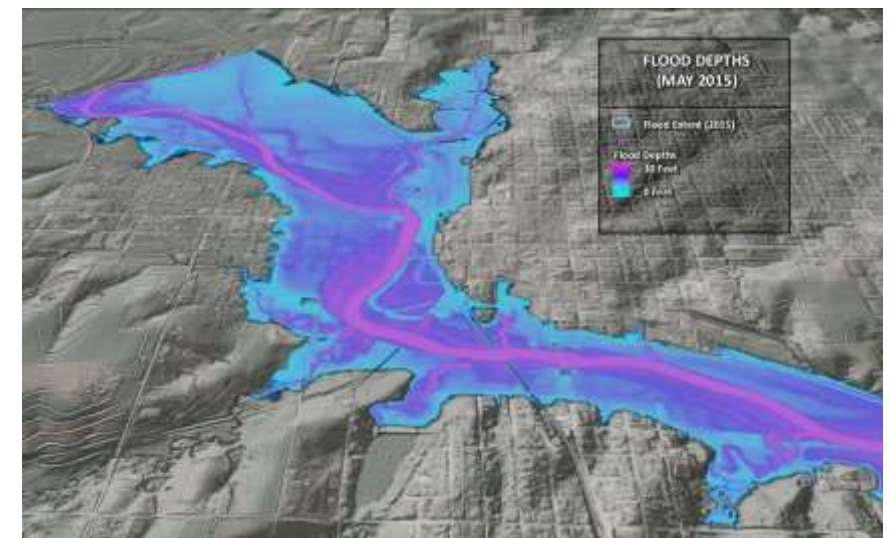
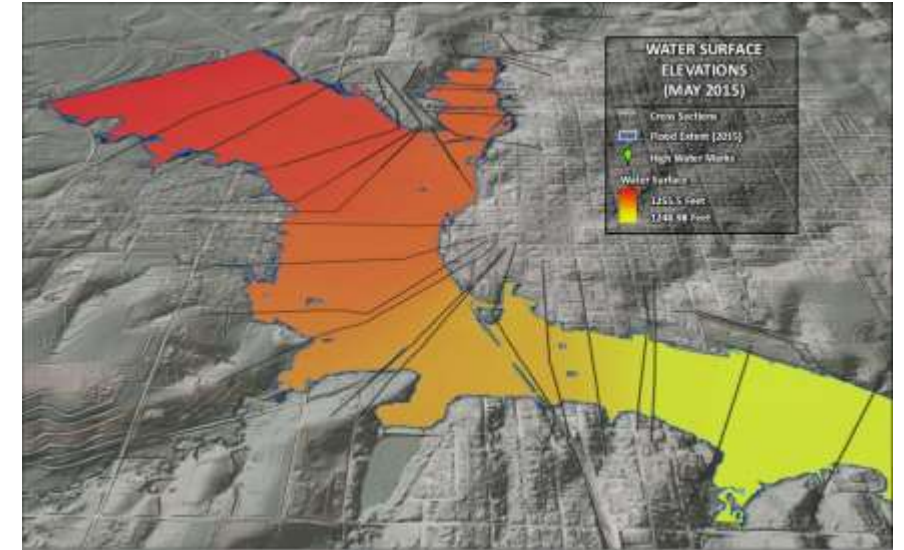


- **Parcel data**
- **Assessor data**
- **Historical aerial imagery**
- **Gauge data**
- **LiDAR topography**
- **High water marks**
- **Property acquisition records back to 1973**
- **Other local media such as photos and video footage**

Depth Grid Development



- ▶ **Developed Triangular Irregular Network (TIN) to represent surface morphology using**
 - High Water Mark data from 2015 flood event from NeDNR
 - High Water Mark data-points from photos and video footage
- ▶ **Developed 2015 Event Depth Grid**
 - Difference from existing ground surface from LiDAR and event water surface



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Developing Values/Costs and Assumptions

▸ Remaining Structures

- Gage County assessor parcel data
- Defined assumptions to fill any gaps

▸ Acquired Structures

- Acquisition records
- Defined assumptions to fill any gaps

▸ Acquisition Program Costs

- Acquisition records converted to 2017 dollars
- Inflation Calculator from Bureau of Labor Statistics
- Conversion rate based on date of acquisition (ranged from 1.06 in 2014 to 4.02 in 1977)
- \$4.9 Million total adjusted acquisition program cost



Determining Mitigation Effectiveness: A Snapshot of Savings from the 2015 Flood

► Results

- \$19.7 M losses to all structures (32 Remaining + 95 Acquired)
- Minus \$6.8 M losses to Remaining Structures
- Equals \$12.9 Million in Avoided Losses 2015 Flood

$$\begin{array}{rcccl} \$12.9 & - & \$4.9 & = & \$8 \text{ MILLION} \\ \text{MILLION} & & \text{MILLION} & & \text{SAVINGS IN 2015} \\ \text{(FLOOD LOSS AVOIDED)} & & \text{(INVESTED)} & & \\ & & & & \text{A 263\% RETURN ON INVESTMENT} \end{array}$$

Beatrice has taken a **holistic approach** to flood risk identification, assessment, planning and floodplain management that underscores the “MAP” of Risk MAP – Mapping, Assessment, & Planning

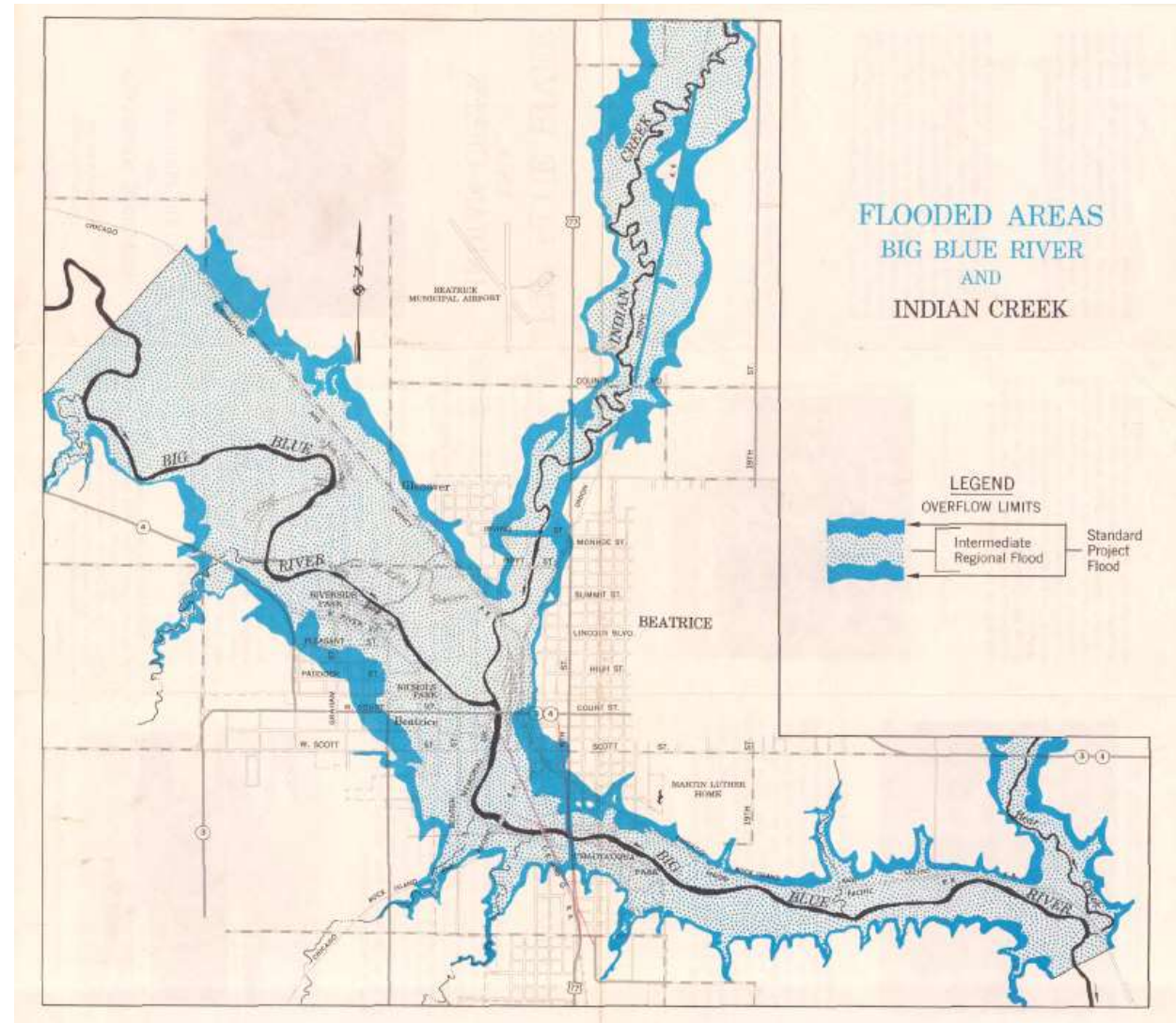
Risk Mapping, Assessment and Planning at Work



Early Flood Risk Mapping in Beatrice



- ▶ In June 1968, the City of Beatrice Requests a Flood Risk Study to aid in identification of local flood problems and to promote the best utilization of lands subject to overflow
- ▶ This was prior to the 1973 flood of record



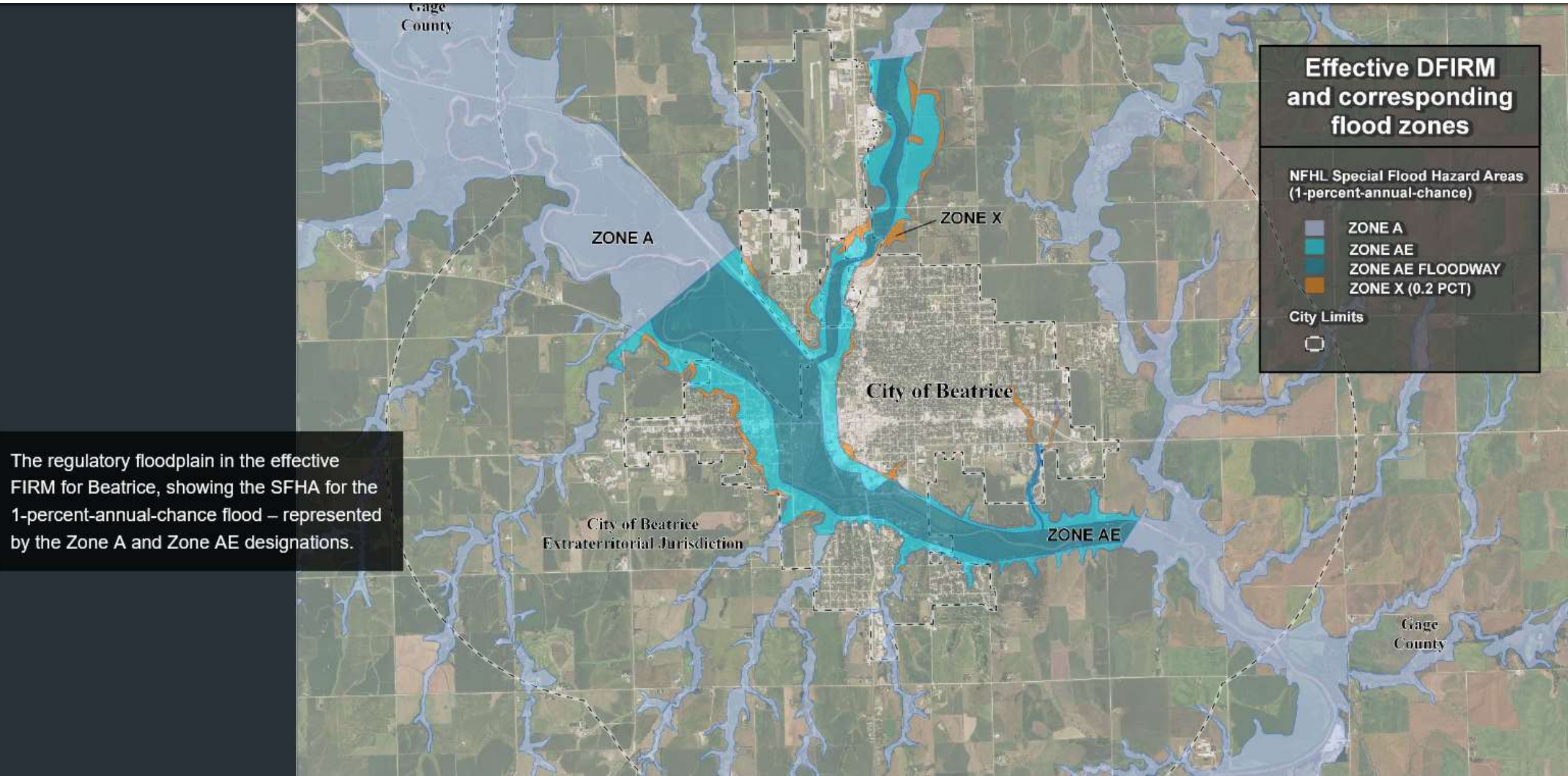
As shown in the 1970 study, the "Intermediate Regional Flood" identified the 1-percent-annual-chance floodplain.

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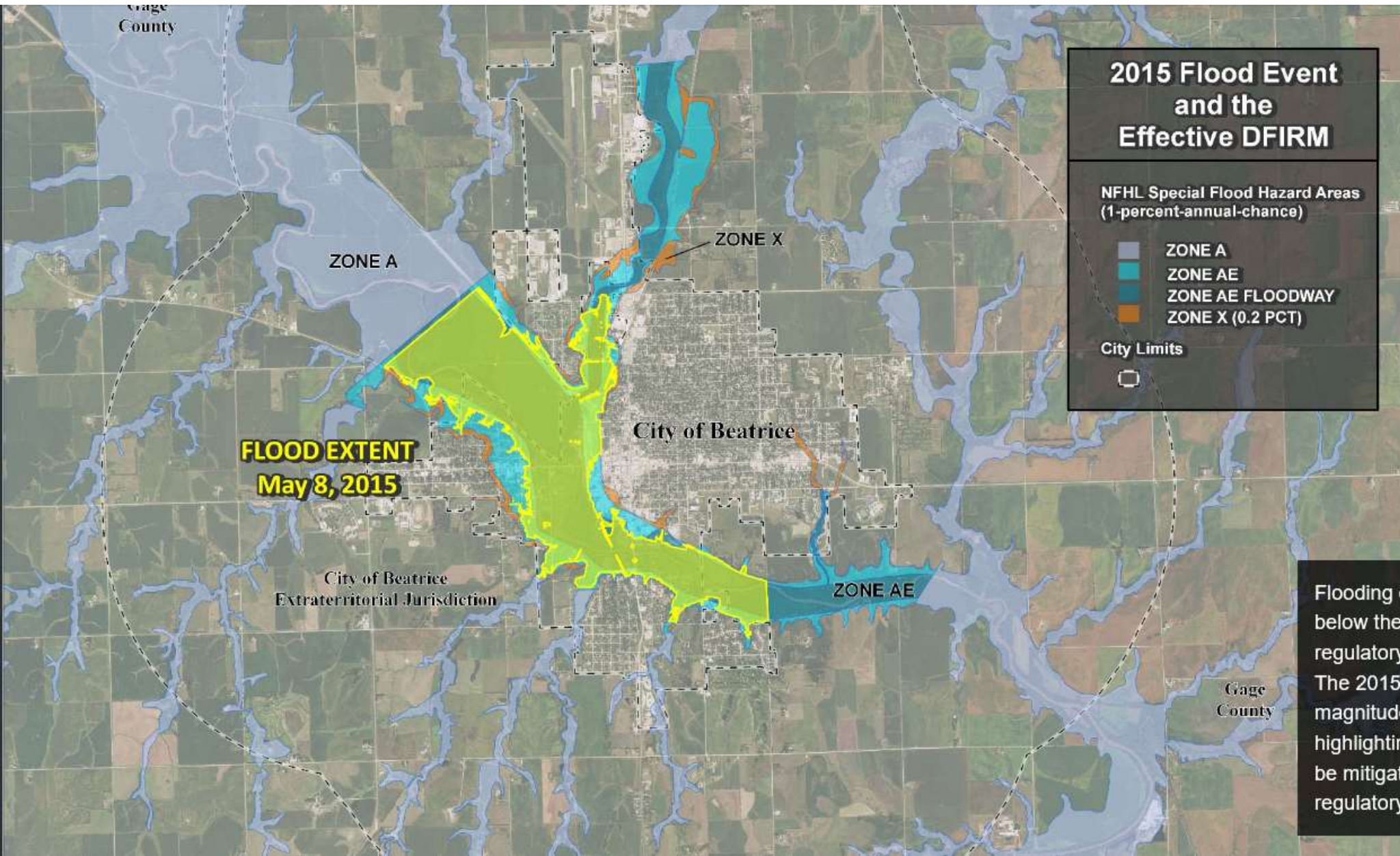
Responsible Floodplain Management in Beatrice

- ▶ **Since 1968, Beatrice has been building a strong foundation in floodplain management and risk reduction, including:**
 - Asked for the flood risk to be mapped in 1968, the USACE created the first flood maps in 1970
 - Passing first floodplain zoning ordinance in 1974 restricting development in identified flood risk areas
 - Included Standards above Federal minimum requirements, as required by the State of Nebraska
 - One foot of freeboard for all new and substantially improved structures built in the floodplain
 - No new or substantially improved residential structures in the floodway
 - Practicing effective floodplain management to reduce flood risk for future development
 - Joining the National Flood Insurance Program (NFIP) emergency program in 1974, and regular program in 1977
 - Adopting their first Flood Insurance Rate Map (FIRM), effective on September 30, 1977
 - Revised floodplain ordinance regulating development in Special Flood Hazard Areas (SFHA)
 - FIRM updated in 1985
 - Digital FIRM Updated in 2010

Risk Assessment in Beatrice

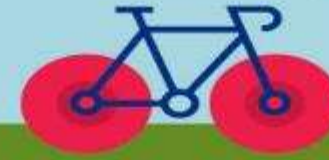


2010 Digital Flood Insurance Rate Map and 2015 Flood Extent



Flooding during the 2015 event was just below the modeled extents of FEMA's regulatory floodplain in the effective FIRM. The 2015 event was the third flood of this magnitude or higher in the span of 42 years, highlighting the value for all communities to be mitigating and preparing for floods at the regulatory level and beyond.

Risk Planning in Beatrice



- ▶ **Mitigation Planning has been underway in Beatrice since the 1970s**
- ▶ **1970 pamphlet captures early mitigation planning efforts**

Now that the elevations and areas that future floods could be expected to reach are known, a realistic program of flood damage reduction can be accomplished.

- ▶ **1997 – Beatrice formalized flood mitigation planning efforts with one of the nation’s first Flood Mitigation Plans to secure funds for FEMA’s Flood Mitigation Assistance Program to continue acquisition program**
- ▶ **2008 – Beatrice expanded the Flood Mitigation Plan to an All-hazards Mitigation Plan in accordance with the Disaster Mitigation Act of 2000**
- ▶ **2014 – All Hazard Mitigation Plan Updated**
- ▶ **2018 – Plans underway for 2019 All Hazard Mitigation Plan Update**

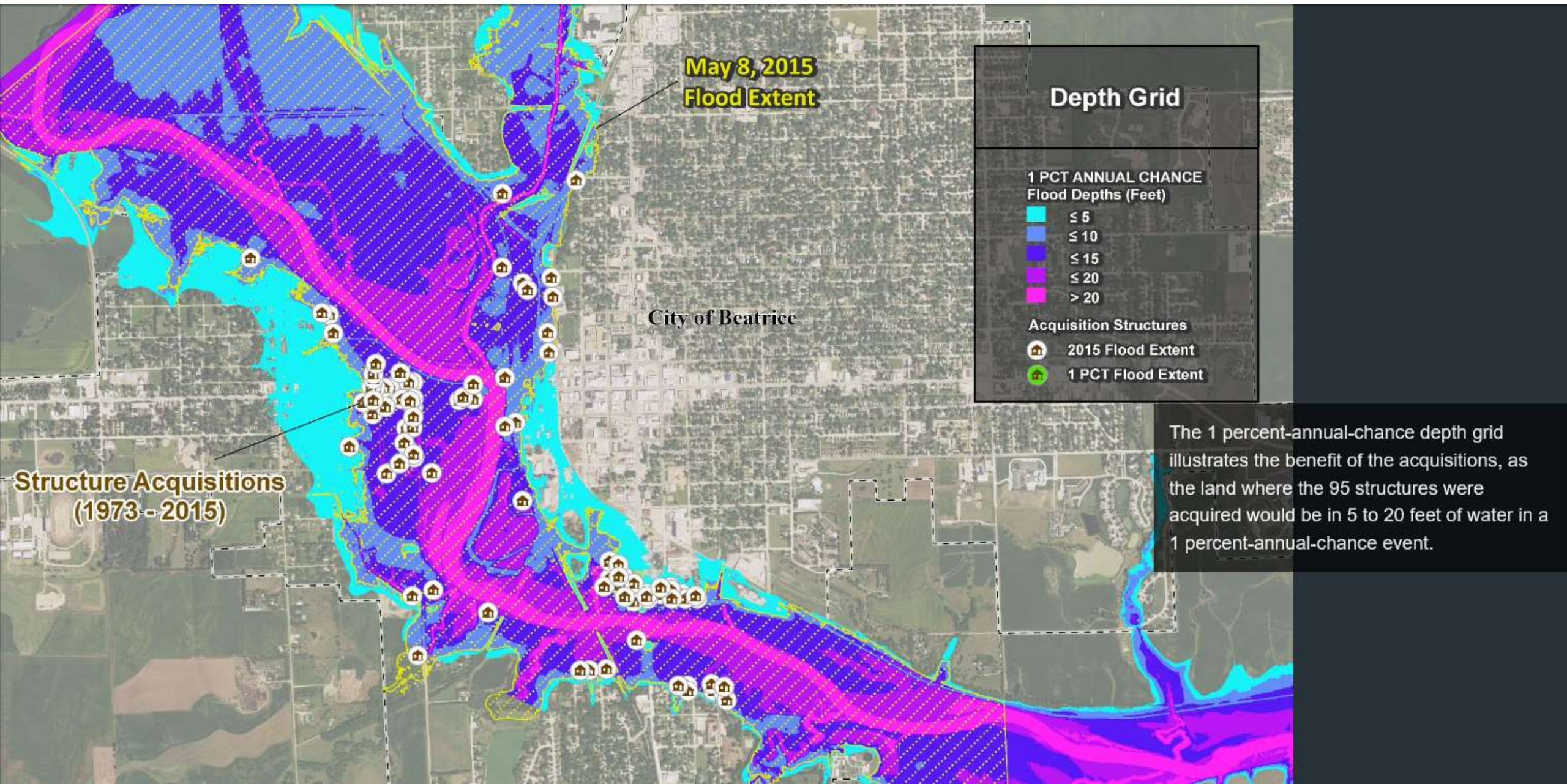
WHAT CAN BE DONE

Now that the elevations and areas that future floods could be expected to reach are known, a realistic program of flood damage reduction can be accomplished. Such a program is vitally important because, as development continues to increase, there will be an even greater demand for building sites in the flood plain. Unless properly planned, some of these sites could be vulnerable to serious flood damages. A further danger is that new developments in the flood plain could be so constructed as to restrict the flow of water and thus increase flood heights and damage upstream.

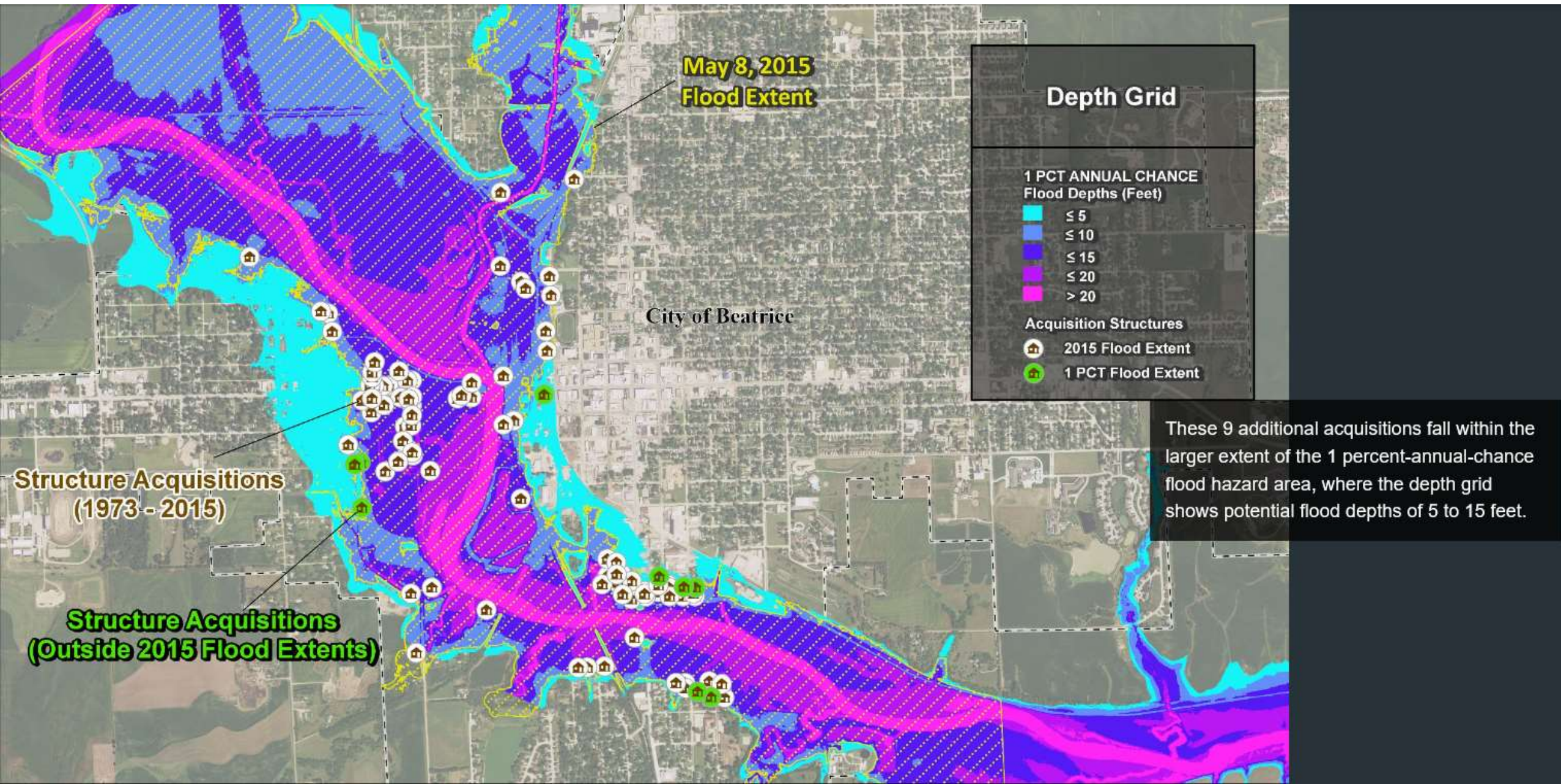


UNION PACIFIC RAILROAD DEPOT, BEATRICE, NEBRASKA.

Beatrice Acquisitions and the 1-Percent-Annual-Chance Flood



Beatrice Acquisitions and the 1-Percent-Annual-Chance Flood



Modeling Losses/Savings for the 1-Percent Annual Chance Flood Event



- Continued Risk Assessment
- As a point of comparison, losses and associated acquisition program savings were modeled for the 1-percent annual chance flood event
- Included 9 additional structures acquired prior to 2015 but not in 2015 inundation area
- Included 3 additional structures acquired after the 2015 event
- The snapshot of savings increases dramatically

$$\begin{array}{ccc} \$26 & - & \$5 & = & \$21 \\ \text{MILLION} & & \text{MILLION} & & \text{MILLION} \\ \text{(FLOOD LOSS)} & & \text{(INVESTED)} & & \\ \text{SAVINGS)} & & & & \end{array}$$

SNAPSHOT OF SAVINGS FROM THE
1 PERCENT-ANNUAL-CHANCE ANALYSIS



Thank you!

- ▶ **Final tab of Story Map is “Get Started in Your Community”**
 - Information on Initiating a flood prone property acquisition program
 - Includes links to additional resources
- ▶ **Story Map link - <http://arcg.is/1LXin5>**
 - Also on handout

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