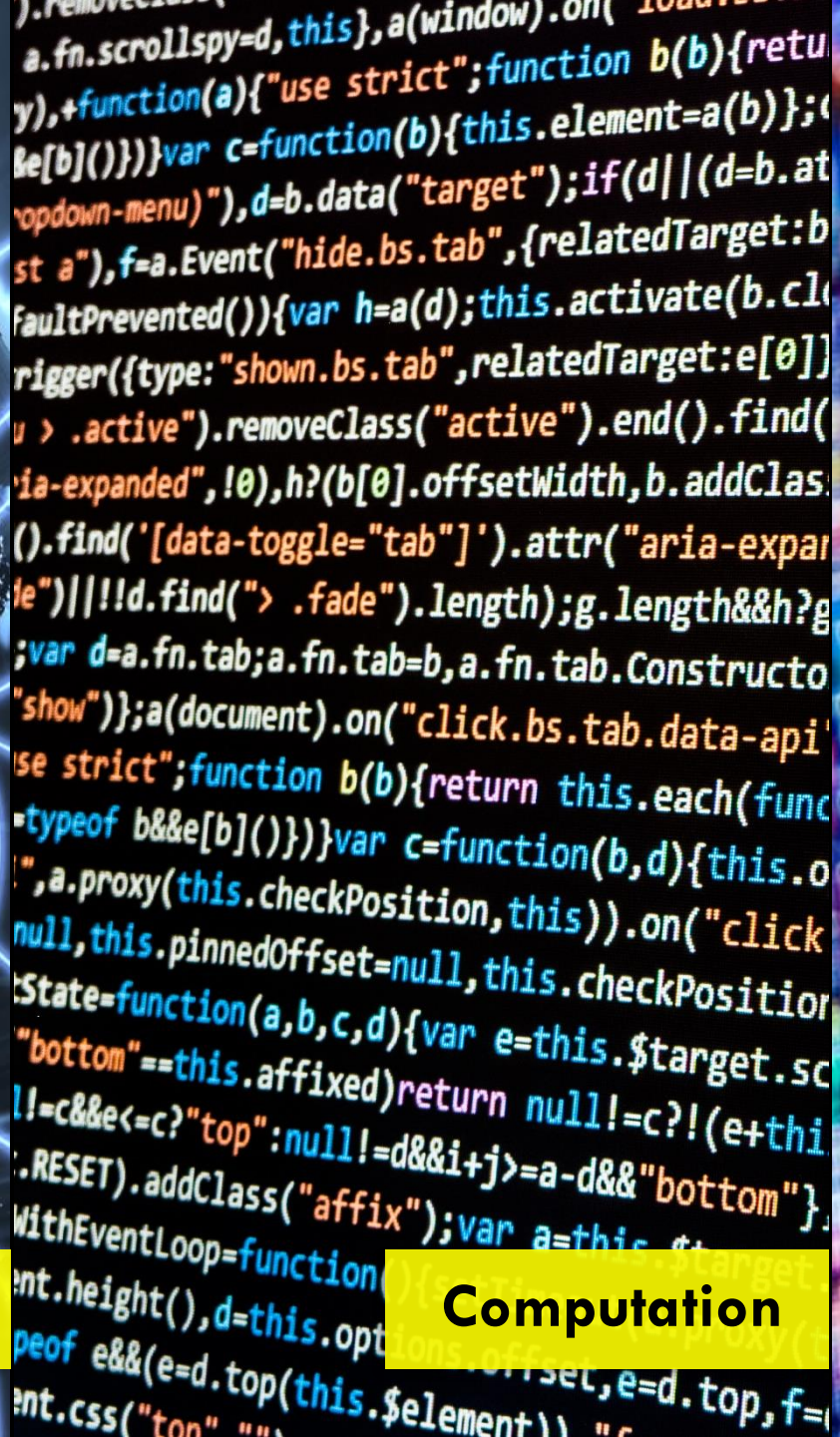
Intelligent Data Analytics and Communication Systems for Disasters

Ibrahim Demir

Iowa Flood Center
IIHR
The University of Iowa

Integration


Computation

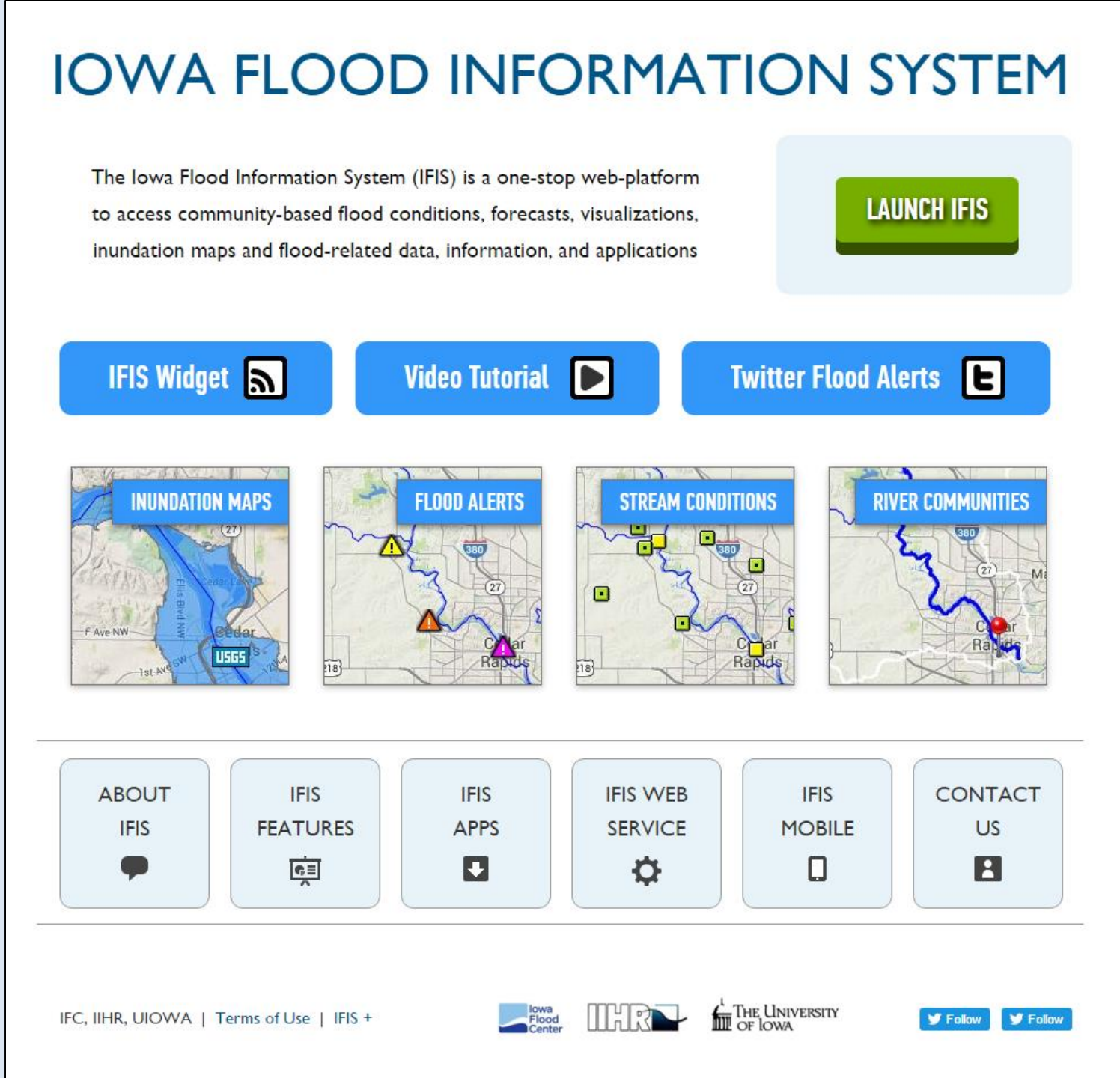
Intelligence

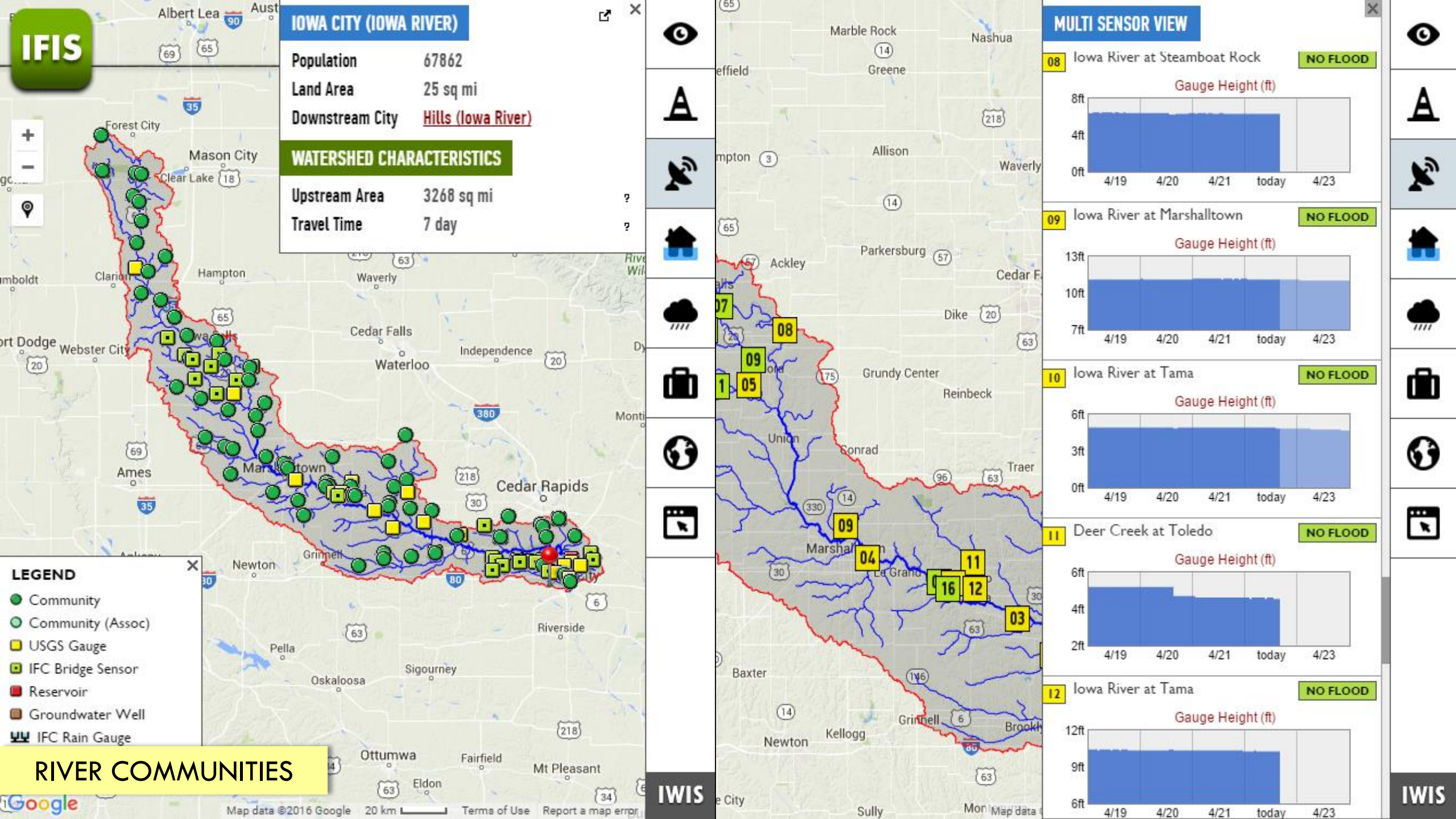
IFIS

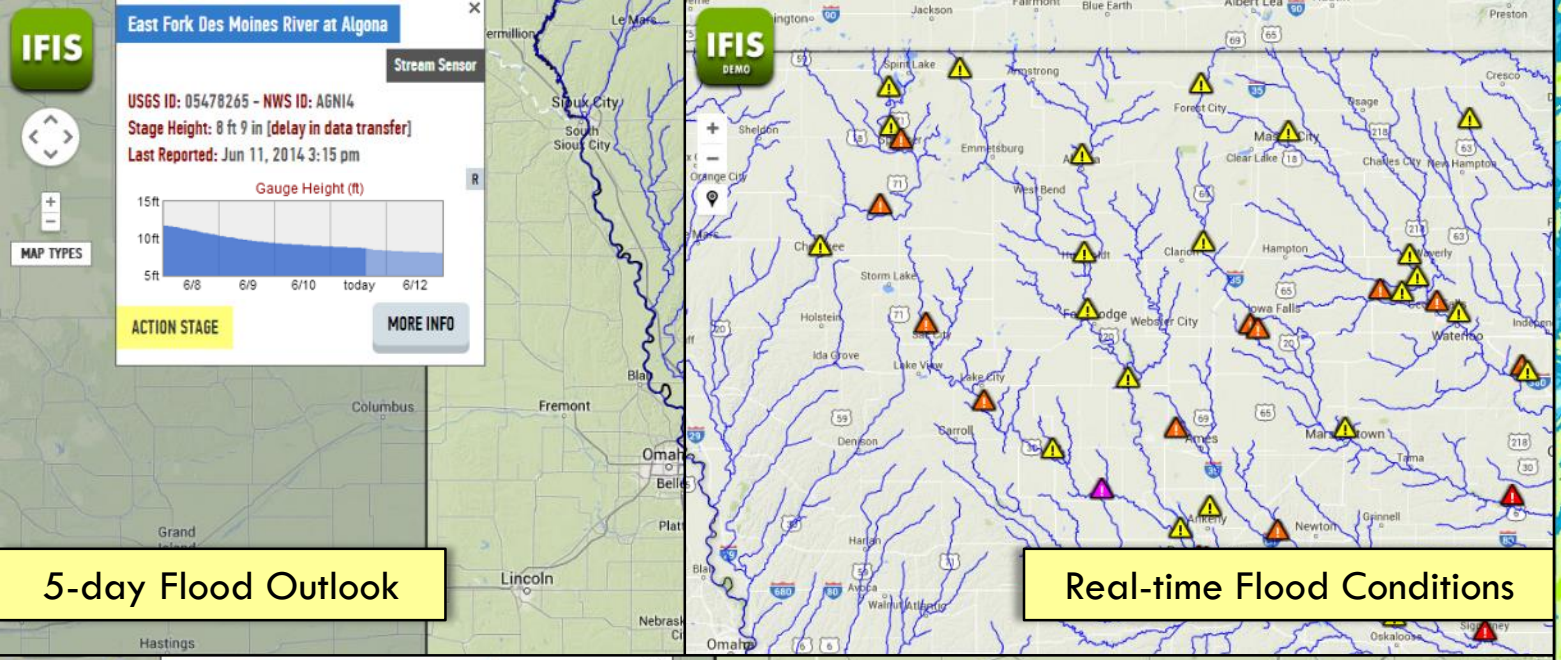
Information System

- ✓ Disaster Communication
- ✓ Decision Making

- ✓ Large Userbase - 300K users
- ✓ Big Data (50GB/day)
- ✓ Optimized User Experience
- ✓ Generalized Infrastructure

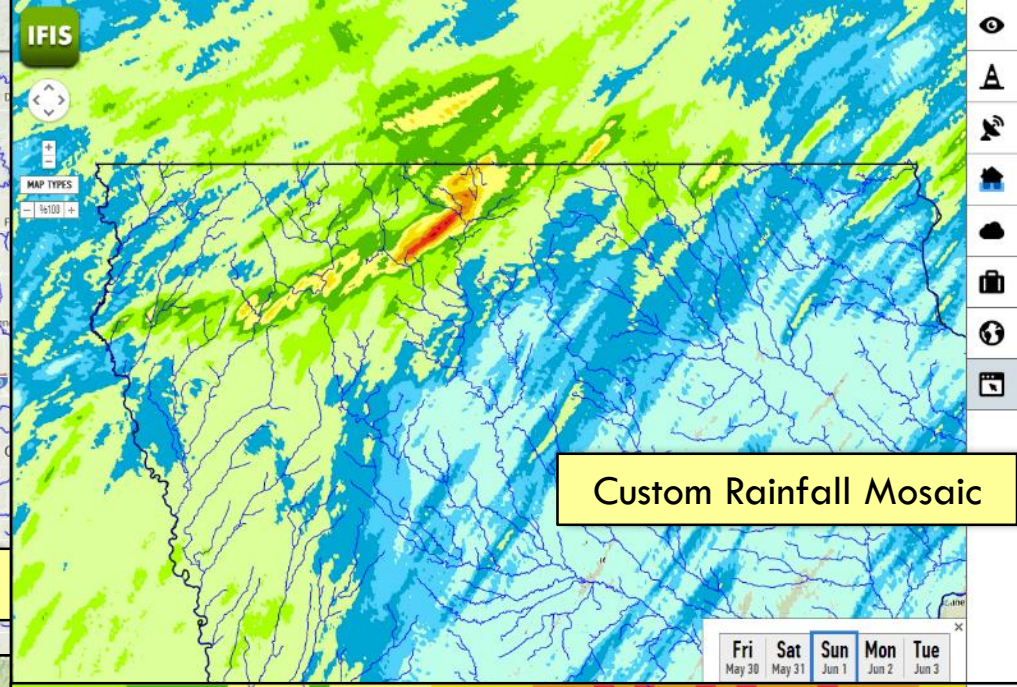



IFIS
IOWA CITY (IOWA RIVER)
Population 67862
Land Area 25 sq mi
Downstream City Hills (Iowa River)
WATERSHED CHARACTERISTICS
Upstream Area 3268 sq mi
Travel Time 7 day
LEGEND
Community
Community (Assoc)
USGS Gauge
IFC Bridge Sensor
Reservoir
Groundwater Well
IFC Rain Gauge
MULTI SENSOR VIEW
08 Iowa River at Steamboat Rock NO FLOOD
Gauge Height (ft)
8ft 4ft 0ft
4/19 4/20 4/21 today 4/23
09 Iowa River at Marshalltown NO FLOOD
Gauge Height (ft)
13ft 10ft 7ft
4/19 4/20 4/21 today 4/23
10 Iowa River at Tama NO FLOOD
Gauge Height (ft)
6ft 3ft 0ft
4/19 4/20 4/21 today 4/23
11 Deer Creek at Toledo NO FLOOD
Gauge Height (ft)
6ft 4ft 2ft
4/19 4/20 4/21 today 4/23
12 Iowa River at Tama NO FLOOD
Gauge Height (ft)
12ft 9ft 6ft
4/19 4/20 4/21 today 4/23
IWIS
IWIS
RIVER COMMUNITIES
Google
Map data ©2016 Google 20 km Terms of Use Report a map error

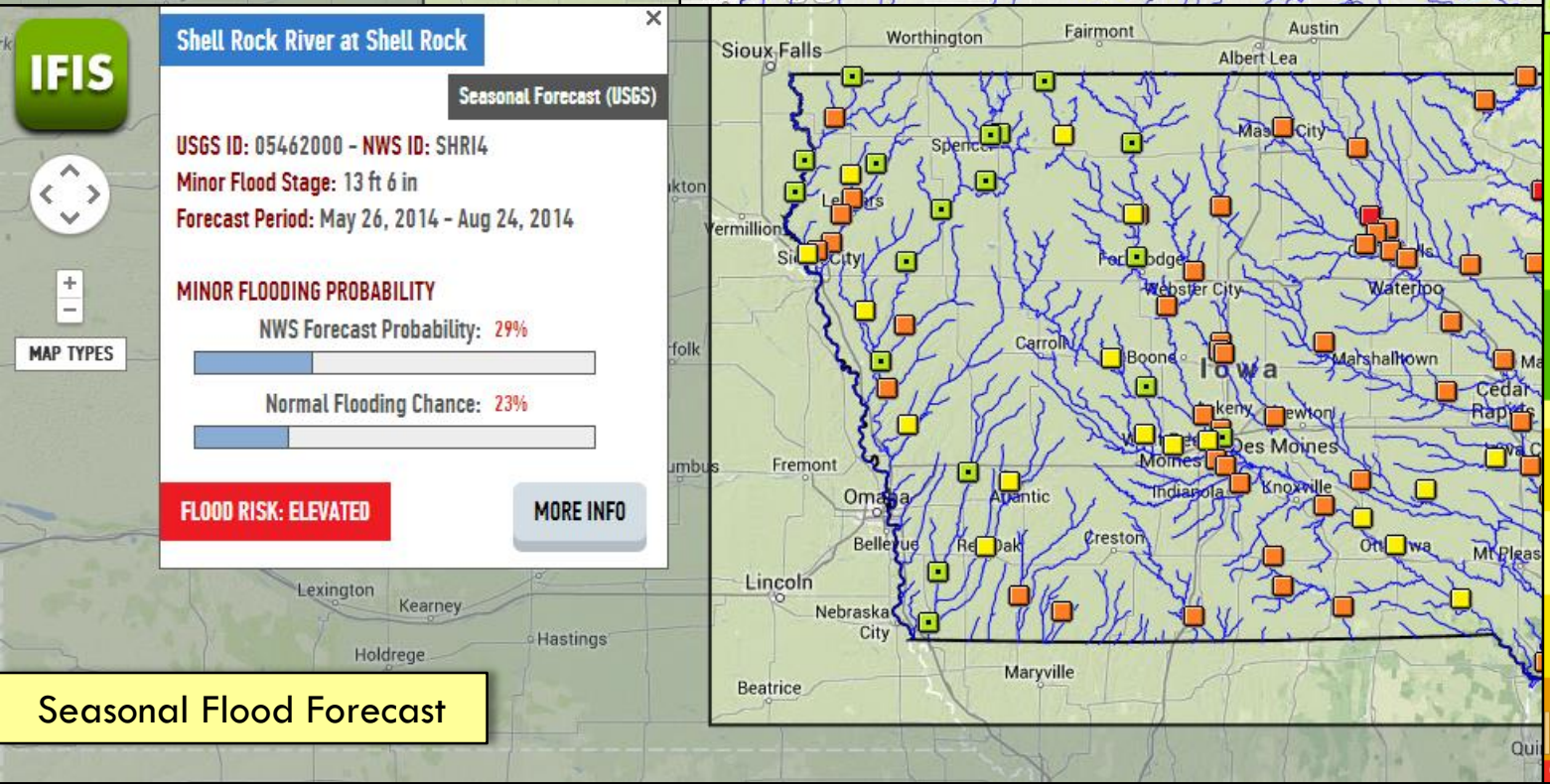


5-day Flood Outlook

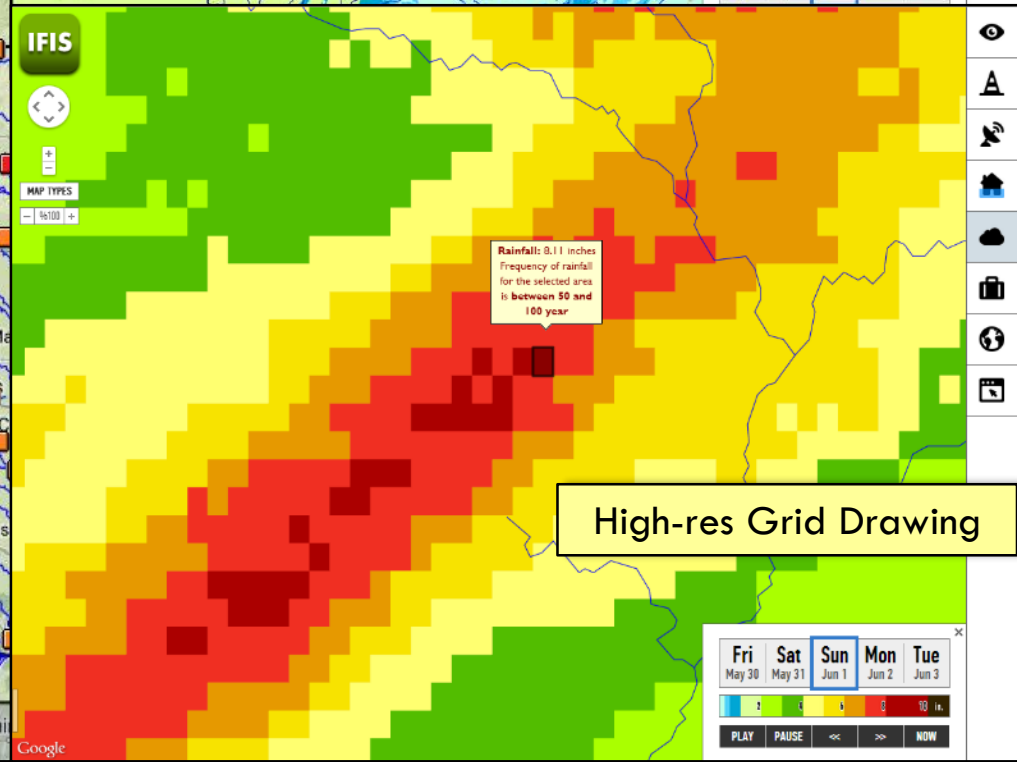
Real-time Flood Conditions



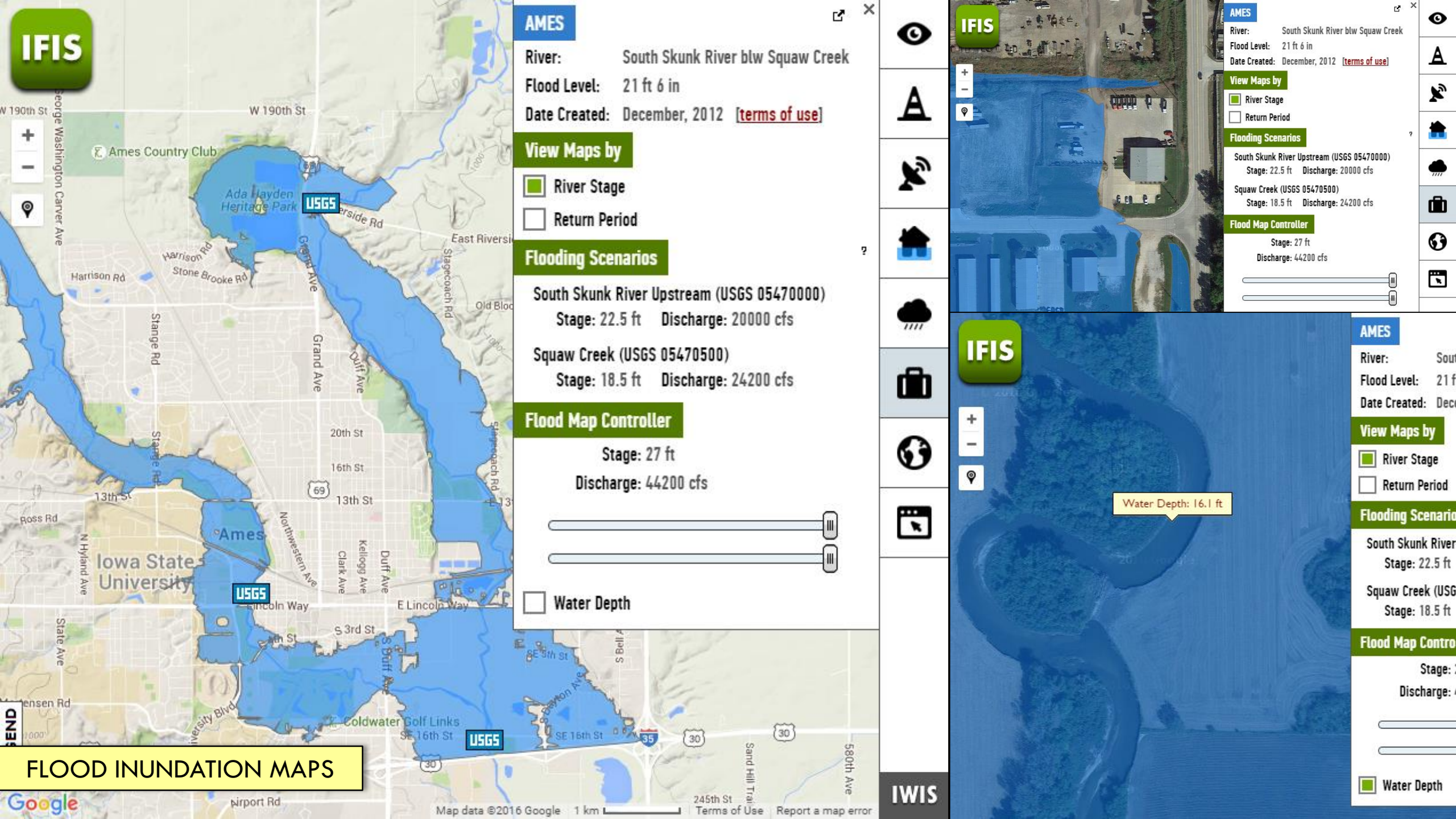
Custom Rainfall Mosaic



Seasonal Flood Forecast



High-res Grid Drawing



FLOOD INUNDATION MAPS

IWIS

IFLOODS
Iowa Flood Studies

IFloodS is a field experiment being conducted in northeast Iowa by NASA in collaboration with Iowa Flood Center during the spring of 2013

About IFLOODS | Campaign Portal | IFLOODS Information System | Iowa Flood Information System

Planning Platform | Rainfall Browser | WSR-88D Browser

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IOWA WATER QUALITY
INFORMATION SYSTEM

Welcome to the Iowa Water Quality Information System. The IWQIS allows access to real-time water-quality data and information such as **nitrate**, **pH**, and **dissolved oxygen concentrations**, discharge rates, and **temperature**.

LAUNCH IWQIS

ABOUT IWQIS | TOOLS & FEATURES | HELP & TUTORIALS | DATA REQUEST | EMBED WIDGET | CONTACT US

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IIHR | The University of Iowa

Iowa Watershed Approach
Information System

HOME / ABOUT / IWA / FEATURES / CONTACT

IWA Watersheds | LAUNCH

The Iowa Watershed Approach Information System (IWAIS) is an interactive data visualization tool designed to support and inform decisions related to strategic best management practice (BMP) implementation and the development of community flood resilience[read more]

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Iowa Flood Center | IIHR | The University of Iowa

IWFoS
Iowa Well Forecasting System

HOME ABOUT

The IWFoS is a web-platform to access information on well geology and water quality information in Iowa

LAUNCH IWFoS

Was your private well affected by recent flooding? Click here to learn more about what you should do when your well floods.

Did you know that you can get your private well water tested each year for nitrate, bacteria and arsenic at no cost to you through the Grants to Counties Program? Click here to learn more about this important program and how to get your water tested free of charge.

IOWA FLOOD INFORMATION SYSTEM

The Iowa Flood Information System (IFIS) is a one-stop web-platform to access community-based flood conditions, forecasts, visualizations, inundation maps and flood-related data, information, and applications

LAUNCH IFIS

IFIS Widget | Video Tutorial | Twitter Flood Alerts

ABOUT IFIS | IFIS FEATURES | IFIS APPS | IFIS WEB SERVICE | IFIS MOBILE | CONTACT US

UMIS

Home | About | Partners | Resources | Workshop | Contact

Upper Mississippi Information System

Launch UMIS

The UMRB has over
20,361,000

Become Data Partner

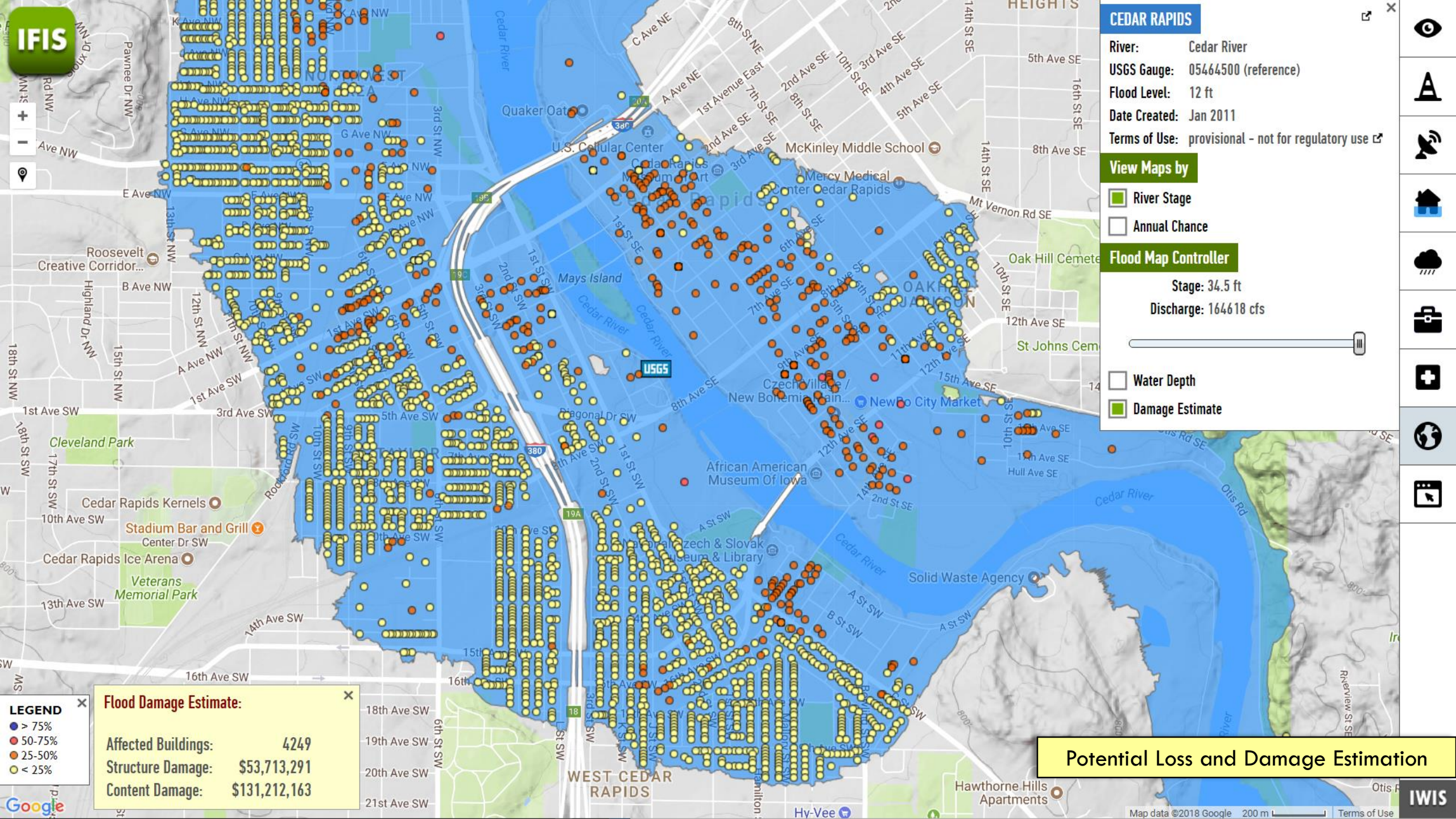
Click the following button for a data partner sharing

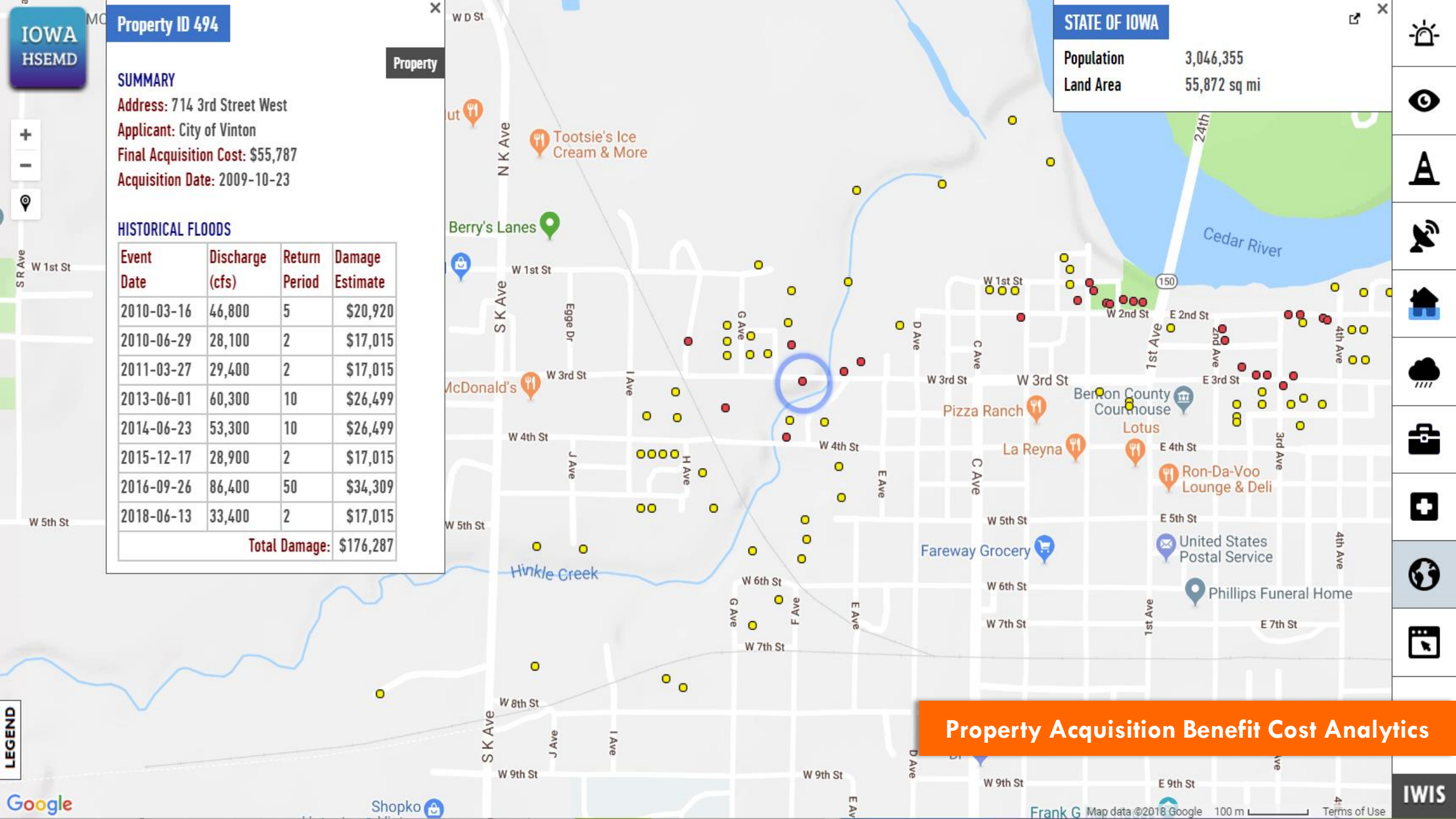
Become Beta User

Click the following button to become a UMIS beta user. Gain early access to the

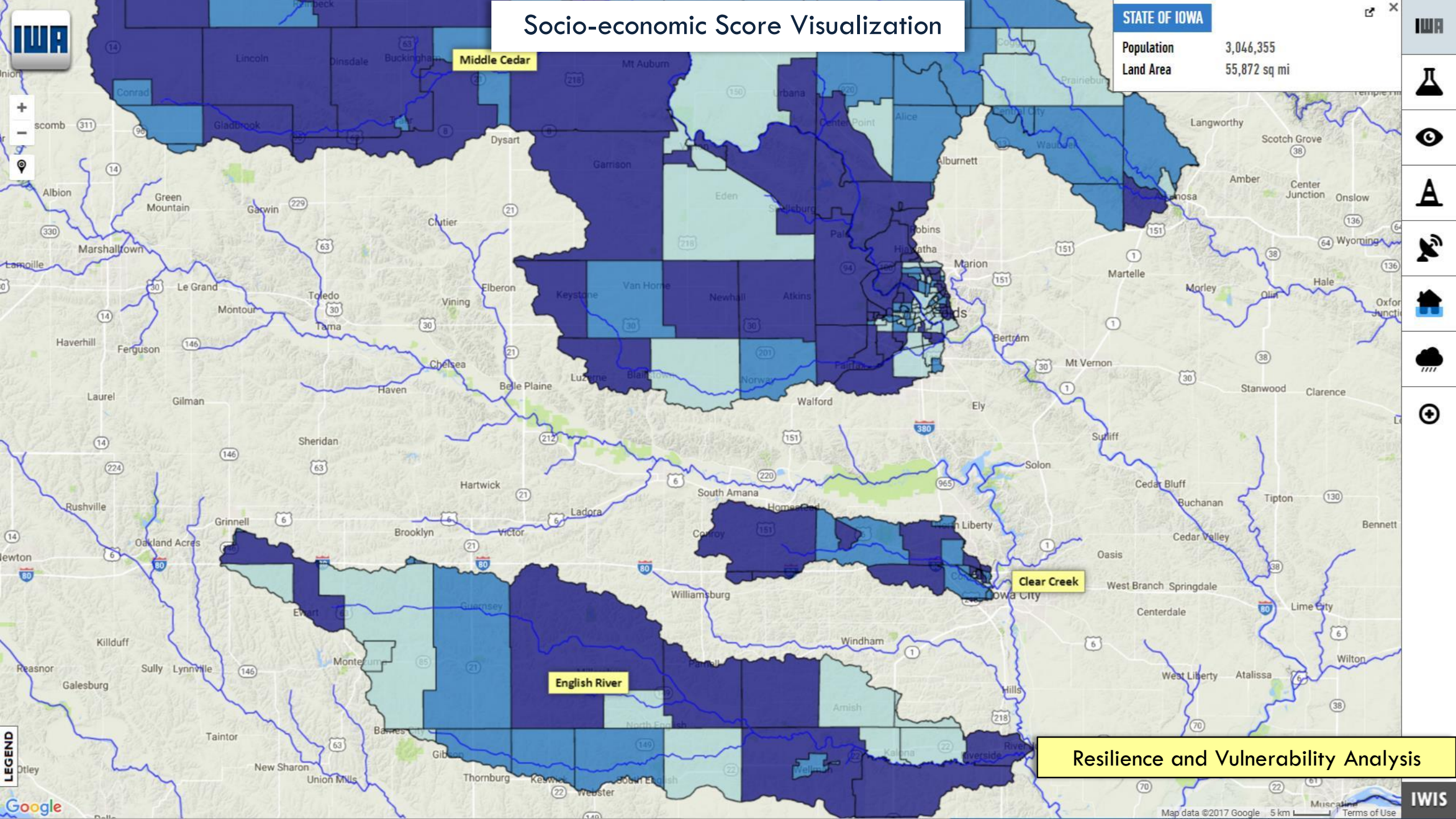
Visual Data Analytics

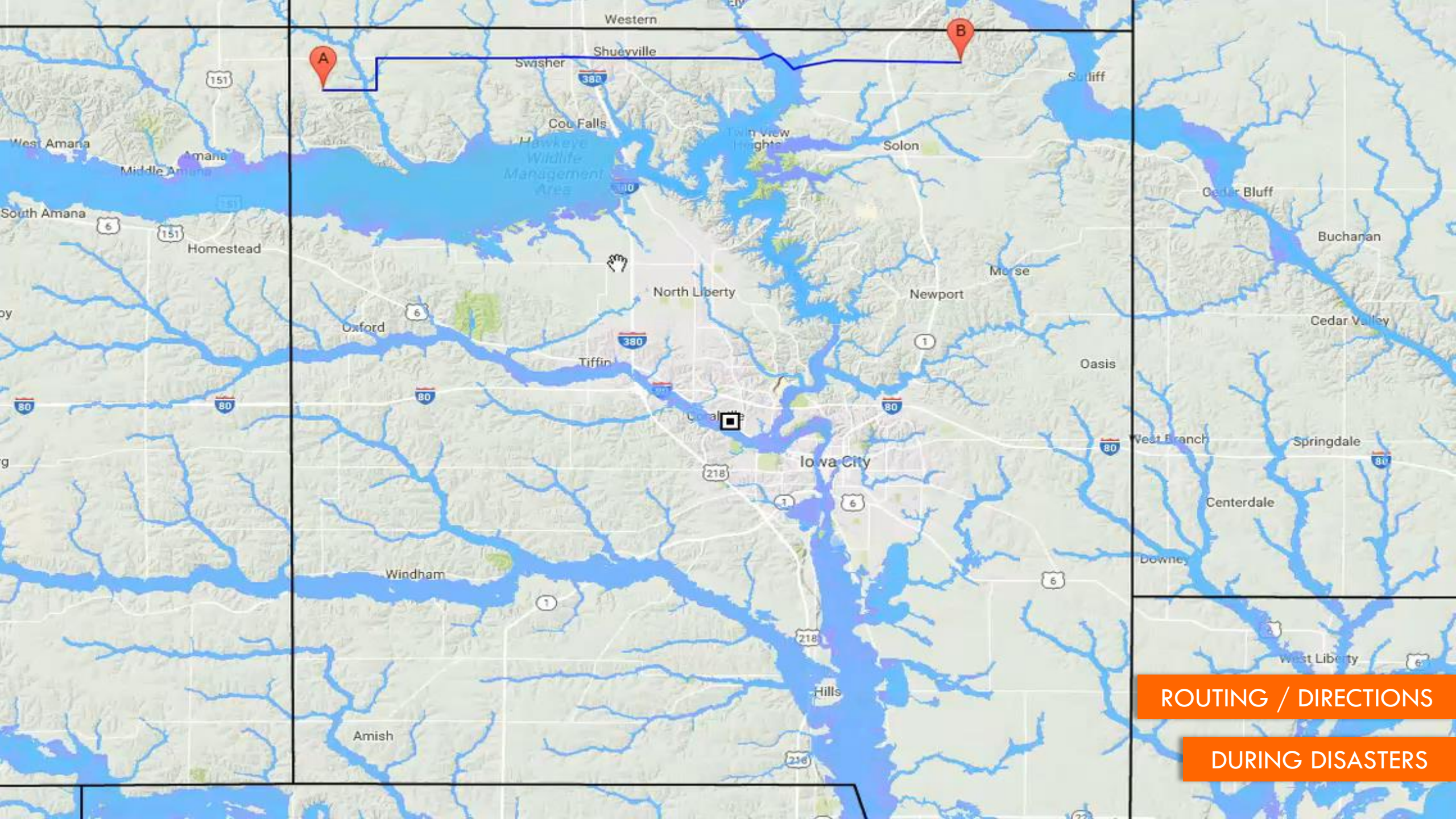
Decision Support Systems


IFIS
CEDAR RAPIDS
River: Cedar River
USGS Gauge: 05464500 (reference)
Flood Level: 12 ft
Date Created: Jan 2011
Terms of Use: provisional - not for regulatory use
View Maps by
River Stage
Annual Chance
Flood Map Controller
Stage: 34.5 ft
Discharge: 164618 cfs
Water Depth
Damage Estimate
LEGEND
> 75%
50-75%
25-50%
< 25%
Flood Damage Estimate:
Affected Buildings: 4249
Structure Damage: $53,713,291
Content Damage: $131,212,163
Potential Loss and Damage Estimation
IWIS
Google
Map data ©2018 Google
Terms of Use


IOWA HSEMD
Property ID 494
Property
SUMMARY
Address: 714 3rd Street West
Applicant: City of Vinton
Final Acquisition Cost: $55,787
Acquisition Date: 2009-10-23
HISTORICAL FLOODS
Event Date | Discharge (cfs) | Return Period | Damage Estimate
2010-03-16 | 46,800 | 5 | $20,920
2010-06-29 | 28,100 | 2 | $17,015
2011-03-27 | 29,400 | 2 | $17,015
2013-06-01 | 60,300 | 10 | $26,499
2014-06-23 | 53,300 | 10 | $26,499
2015-12-17 | 28,900 | 2 | $17,015
2016-09-26 | 86,400 | 50 | $34,309
2018-06-13 | 33,400 | 2 | $17,015
Total Damage: $176,287
STATE OF IOWA
Population 3,046,355
Land Area 55,872 sq mi
Tootsie's Ice Cream & More
Berry's Lanes
McDonald's
Pizza Ranch
Benton County Courthouse
Lotus
La Reyna
Ron-Da-Voo Lounge & Deli
Fareway Grocery
United States Postal Service
Phillips Funeral Home
Cedar River
Hinkle Creek
Shopko
W 1st St
W 2nd St
E 2nd St
W 3rd St
E 3rd St
W 4th St
E 4th St
W 5th St
E 5th St
W 6th St
W 7th St
E 7th St
W 8th St
W 9th St
E 9th St
N K Ave
S K Ave
S R Ave
Egge Dr
G Ave
I Ave
J Ave
H Ave
D Ave
C Ave
E Ave
F Ave
1st Ave
2nd Ave
3rd Ave
4th Ave
24th
150
LEGEND
Google
Map data ©2018 Google
100 m
Terms of Use
Property Acquisition Benefit Cost Analytics
IWIS

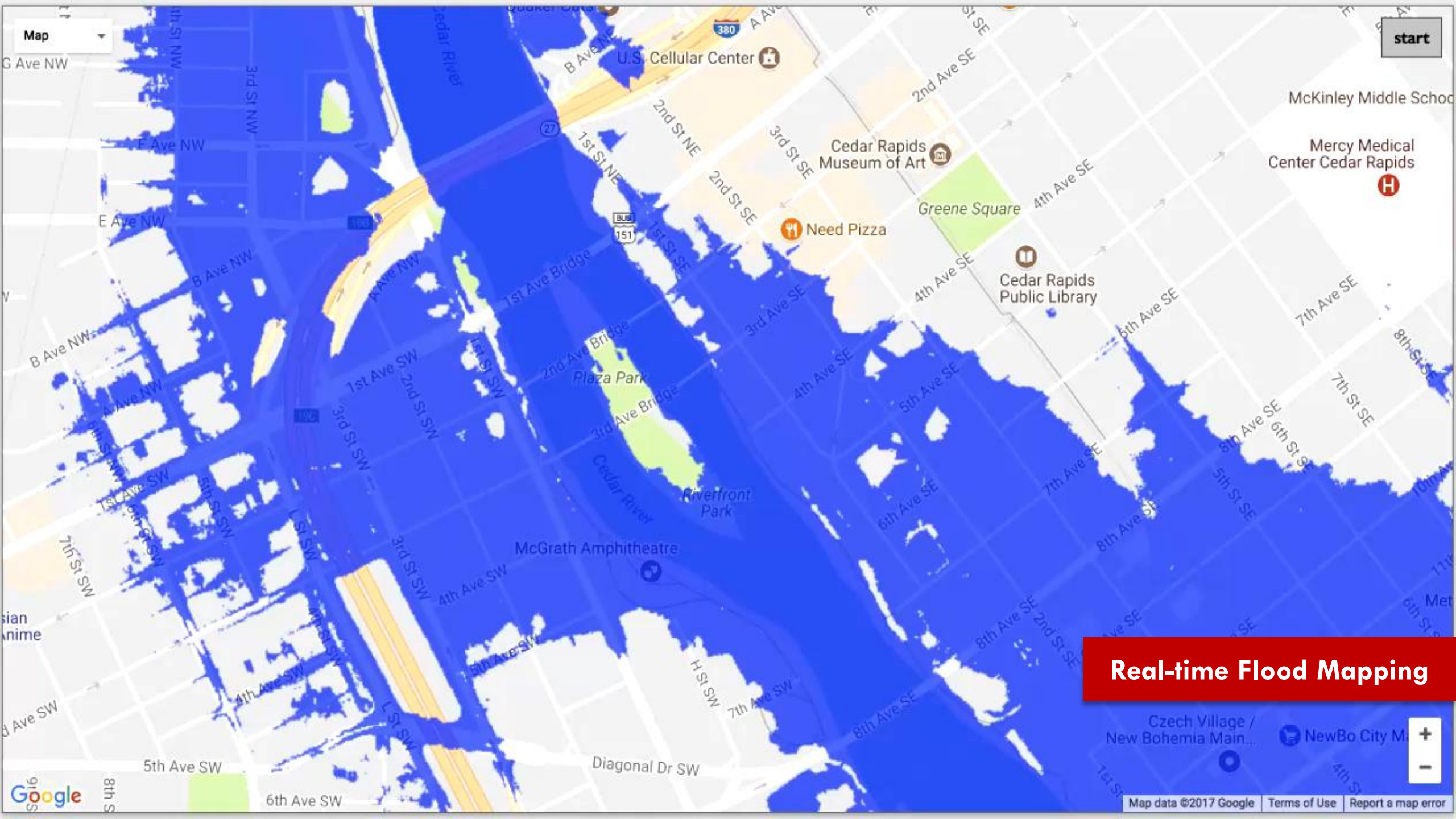
Socio-economic Score Visualization

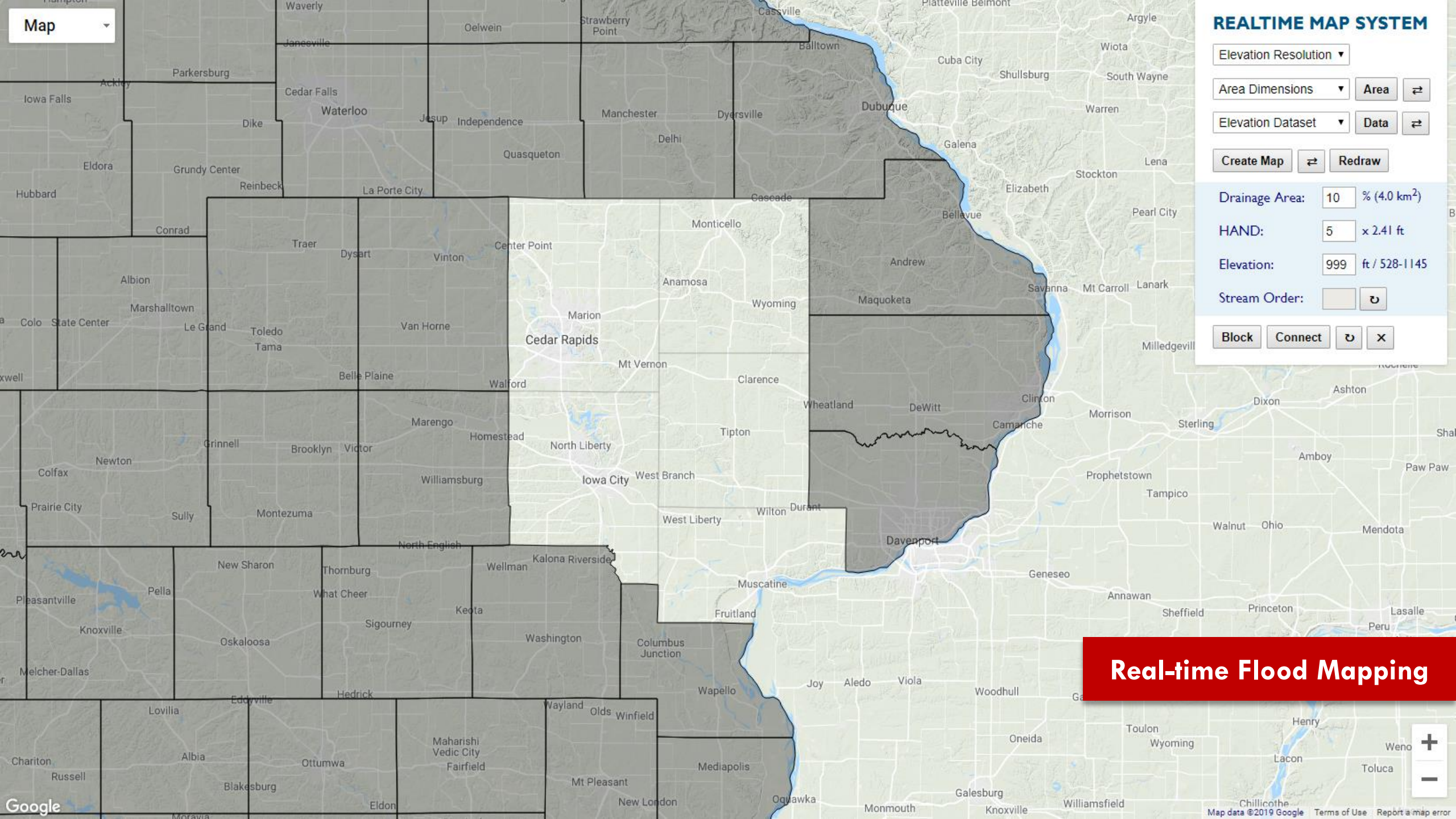


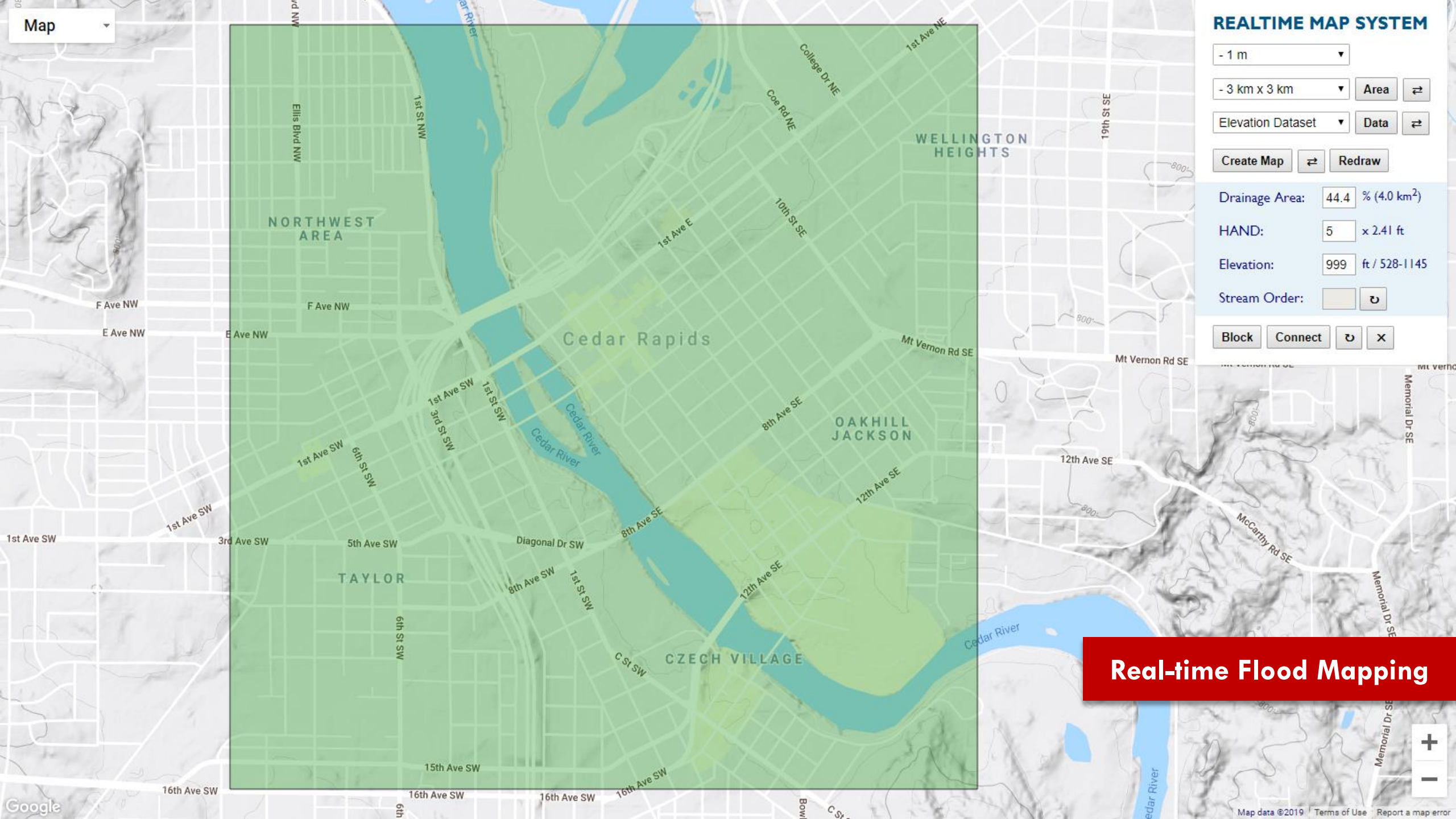


ROUTING / DIRECTIONS

DURING DISASTERS


Map
start
U.S. Cellular Center
Cedar Rapids Museum of Art
Need Pizza
Greene Square
Cedar Rapids Public Library
Mercy Medical Center Cedar Rapids
McKinley Middle Schoo
Plaza Park
Riverfront Park
McGrath Amphitheatre
Cedar River
1st Ave Bridge
2nd Ave Bridge
3rd Ave Bridge
2nd St NE
1st St NE
2nd St SE
3rd St SE
4th Ave SE
5th Ave SE
6th Ave SE
7th Ave SE
8th Ave SE
1st Ave SW
2nd St SW
3rd St SW
4th Ave SW
5th Ave SW
6th Ave SW
7th St SW
Diagonal Dr SW
Czech Village / New Bohemia Main...
NewBo City M
Real-time Flood Mapping
Google
Map data ©2017 Google
Terms of Use
Report a map error


Map
REALTIME MAP SYSTEM
Elevation Resolution
Area Dimensions
Area
Elevation Dataset
Data
Create Map
Redraw
Drainage Area:
10
% (4.0 km²)
HAND:
5
x 2.41 ft
Elevation:
999
ft / 528-1145
Stream Order:
Block
Connect
Real-time Flood Mapping
Google
Map data ©2019 Google
Terms of Use
Report a map error


Map
REALTIME MAP SYSTEM
- 1 m
- 3 km x 3 km
Area
Elevation Dataset
Data
Create Map
Redraw
Drainage Area: 44.4 % (4.0 km²)
HAND: 5 x 2.41 ft
Elevation: 999 ft / 528-1145
Stream Order:
Block
Connect
Real-time Flood Mapping
Cedar Rapids
NORTHWEST AREA
WELLINGTON HEIGHTS
OAKHILL JACKSON
TAYLOR
CZECH VILLAGE
Cedar River
1st Ave NE
College Dr NE
Coe Rd NE
19th St SE
Ellis Blvd NW
1st St NW
1st Ave E
10th St SE
F Ave NW
E Ave NW
Mt Vernon Rd SE
1st Ave SW
3rd St SW
1st St SW
8th Ave SE
12th Ave SE
6th St SW
5th Ave SW
Diagonal Dr SW
8th Ave SW
C St SW
15th Ave SW
16th Ave SW
McCarthy Rd SE
Memorial Dr SE
Google
Map data ©2019
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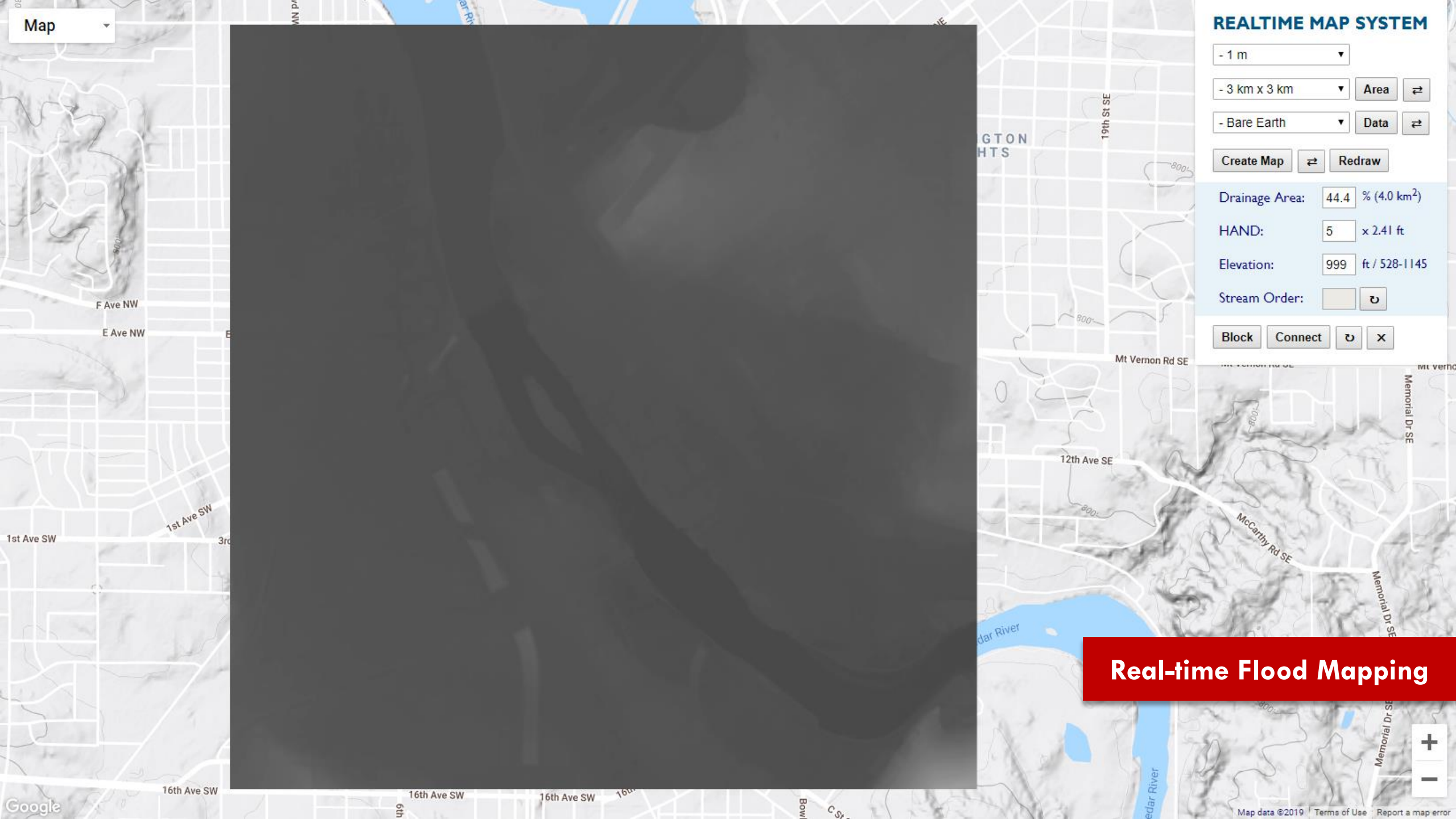
Report a map error


Map
REALTIME MAP SYSTEM
- 1 m
- 3 km x 3 km
Area
- Bare Earth
Data
Create Map
Redraw
Drainage Area:
44.4
% (4.0 km2)
HAND:
5
x 2.41 ft
Elevation:
999
ft / 528-1145
Stream Order:
Block
Connect
Real-time Flood Mapping
F Ave NW
E Ave NW
1st Ave SW
16th Ave SW
Mt Vernon Rd SE
12th Ave SE
McCarthy Rd SE
Memorial Dr SE
19th St SE
Google
Map data ©2019
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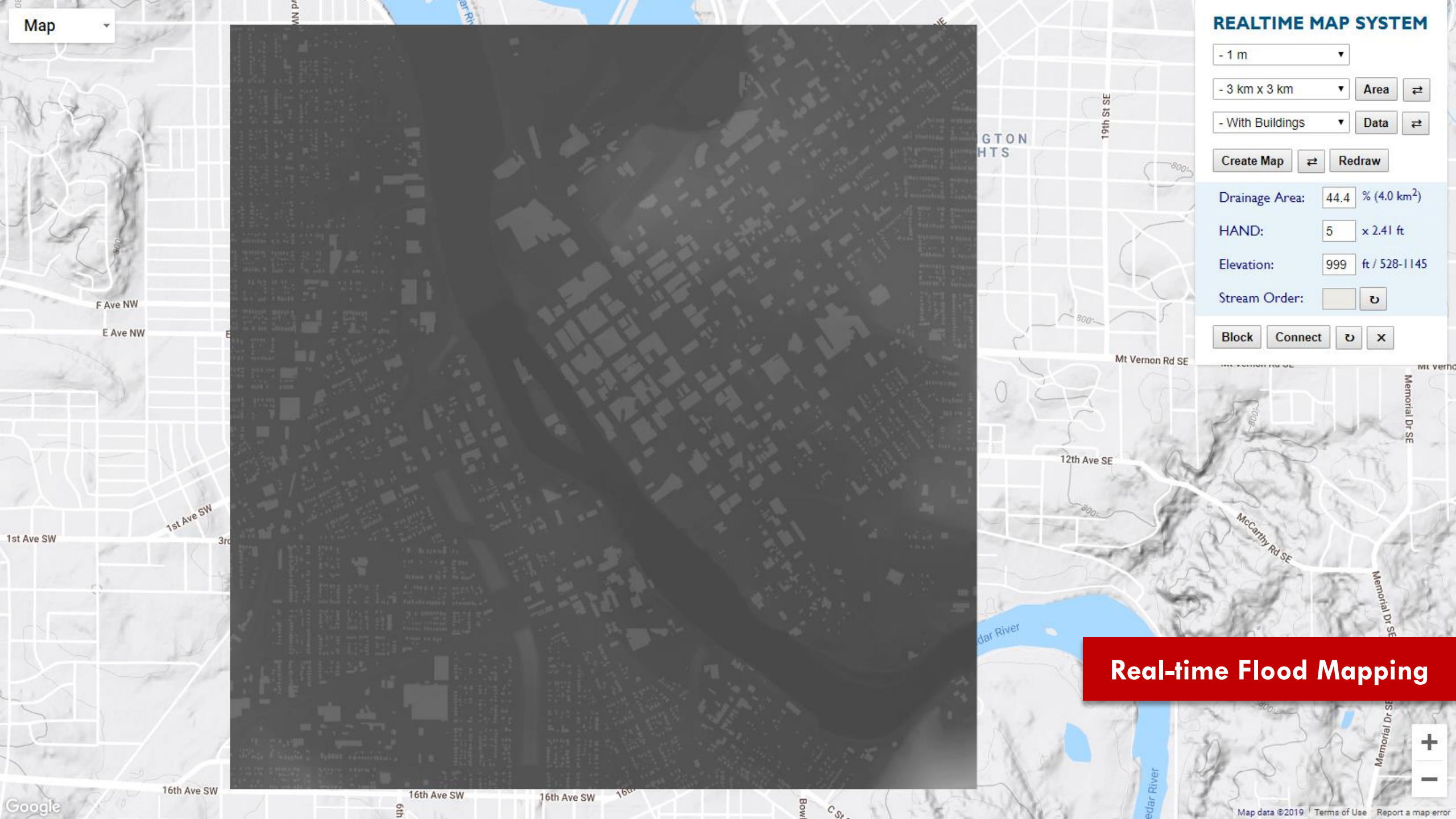
Report a map error


Map
REALTIME MAP SYSTEM
- 1 m
- 3 km x 3 km
Area
- With Buildings
Data
Create Map
Redraw
Drainage Area:
44.4
% (4.0 km2)
HAND:
5
x 2.41 ft
Elevation:
999
ft / 528-1145
Stream Order:
Block
Connect
F Ave NW
E Ave NW
1st Ave SW
16th Ave SW
Mt Vernon Rd SE
12th Ave SE
McCarthy Rd SE
Memorial Dr SE
19th St SE
Google
Map data ©2019
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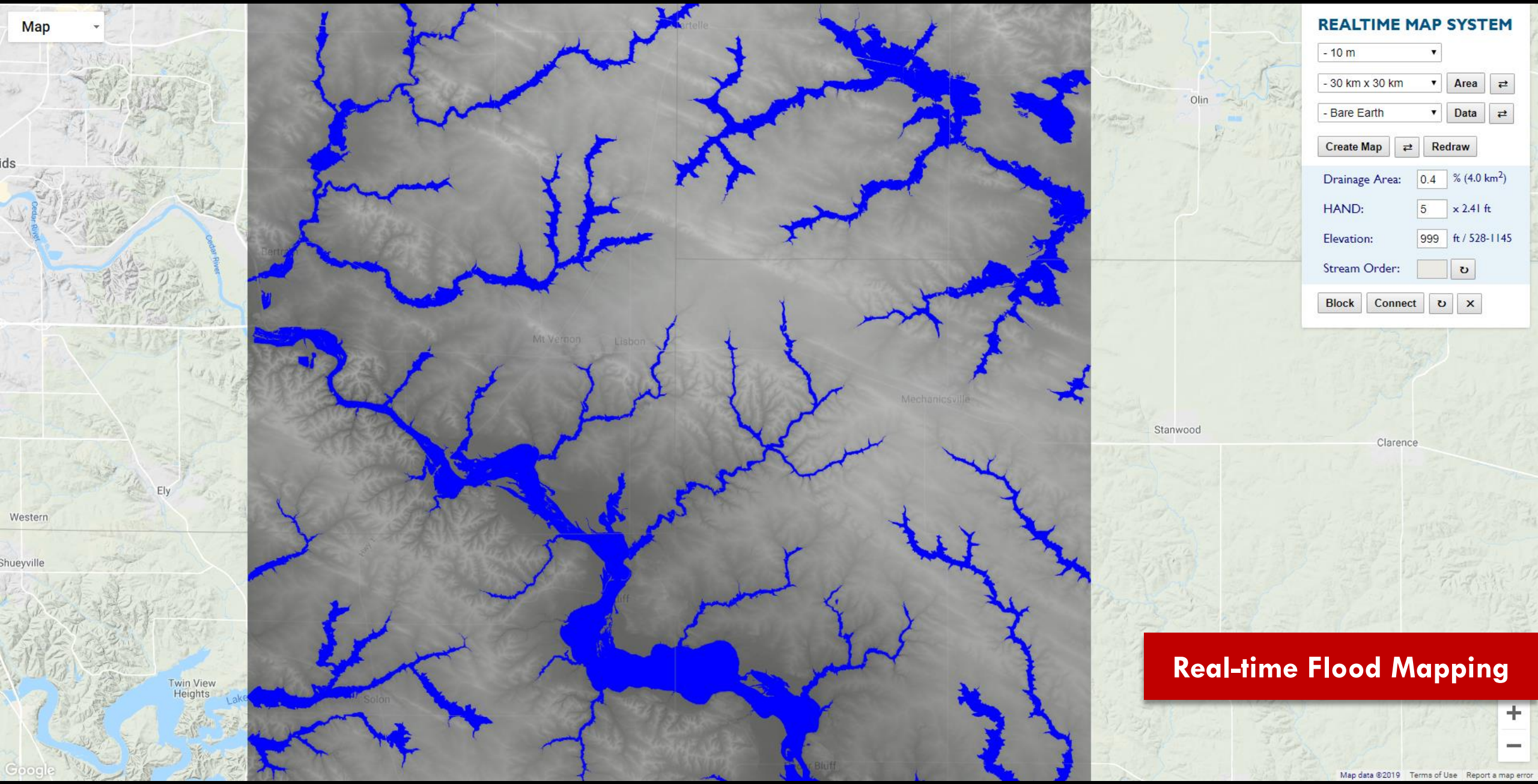
Report a map error
Real-time Flood Mapping


Map
REALTIME MAP SYSTEM
- 10 m
- 30 km x 30 km
Area
- Bare Earth
Data
Create Map
Redraw
Drainage Area:
0.4
% (4.0 km2)
HAND:
5
x 2.41 ft
Elevation:
999
ft / 528-1145
Stream Order:
Block
Connect
Olin
Stanwood
Clarence
Mt Vernon
Lisbon
Mechanicsville
Ely
Western
Shueyville
Twin View Heights
Solon
Google
Map data ©2019
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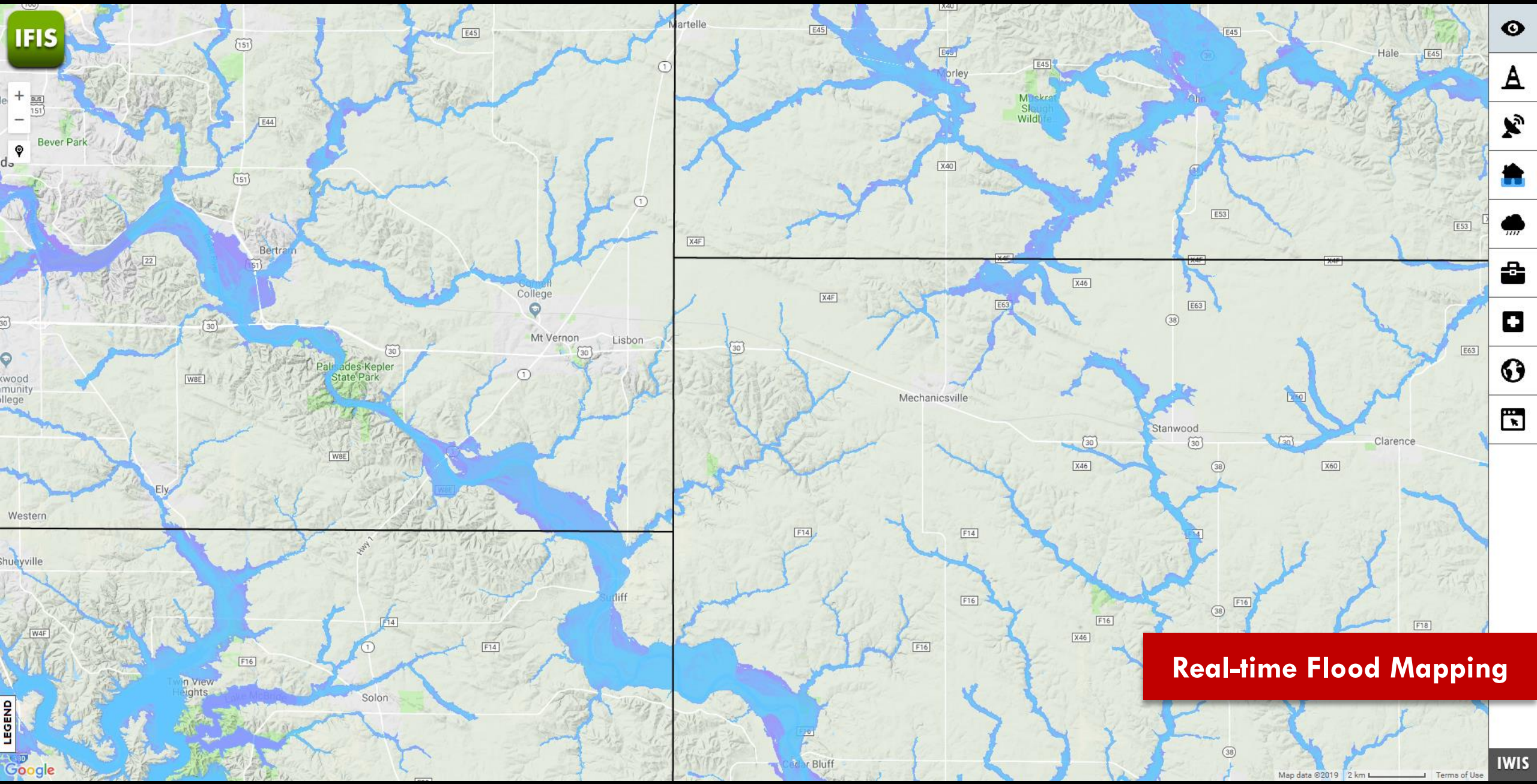
Report a map error
Real-time Flood Mapping


IFIS
Martelle
Morley
Hale
Bever Park
Bertram
Cornell College
Mt Vernon
Lisbon
Palisades-Kepler State Park
Mechanicsville
Stanwood
Clarence
Ely
Western
Shueyville
Sutliff
Twin View Heights
Solon
Cedar Bluff
LEGEND
Google
Map data ©2019
2 km
Terms of Use
IWIS
Real-time Flood Mapping

Map
REALTIME MAP SYSTEM
- 1 m
- 3 km x 3 km
Area
- With Buildings
Data
Create Map
Redraw
Drainage Area:
10
% (0.9 km2)
HAND:
5
x 2.41 ft
Elevation:
999
ft / 528-1145
Stream Order:
Block
Connect
Real-time Flood Mapping
E Ave NW
3rd St NW
1st St SW
8th Ave SE
12th Ave SE
3rd Ave SW
C St SW
Google
Map data ©2019
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Report a map error

Map
REALTIME MAP SYSTEM
- 1 m
- 3 km x 3 km
Area
- With Buildings
Data
Create Map
Redraw
Drainage Area:
10
% (0.9 km2)
HAND:
5
x 2.41 ft
Elevation:
999
ft / 528-1145
Stream Order:
Block
Connect
Real-time Flood Mapping
Google
Map data ©2019
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Report a map error

Map
REALTIME MAP SYSTEM
- 1 m
- 3 km x 3 km
Area
- With Buildings
Data
Create Map
Redraw
Drainage Area:
10
% (0.9 km2)
HAND:
5
x 2.41 ft
Elevation:
999
ft / 528-1145
Stream Order:
Block
Connect
Real-time Flood Mapping
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Scientific Visualization

Serious Gaming

Iowa Watershed DSS

MULTI HAZARD TOURNAMENT

Search Watershed
Overview
Data Resources
Planning
Support

Middle Cedar

Log Out

Turn 1

Historic Climate Record

Turn Actions

Assess Alternative

Budget

Total:
$0 / $1,600,000,000

Localized Actions:
$0 / $800,000,000

Watershed Actions:
$0 / $800,000,000

O&M Localized Actions:
$0 / $31,000,000

Plan Progress

1 Objective — 2 Resources — 3 Alternative — 4 Assessment — 5 Selection — 6 Implementation — 7 Evaluation

Choose Strategy - Localized Actions

Protect Municipal Water Supply

- ☐ Raise Well Intakes
- ☐ Install New Deep Water Well (IMGD)
- ☐ Install Nitrate Removal Equipment

Structural Action

- ☐ Levees

Non-Structural Action

Elevate Structures

- ◉ None
- ○ Low Number of Structures Elevated
- ○ Moderate Number of Structures Elevated
- ○ High Number of Structures Elevated

Relocate Structures

- ◉ None
- ○ Low Number of Structures Relocated
- ○ Moderate Number of Structures Relocated
- ○ High Number of Structures Relocated

Choose Strategy - Watershed Actions

Land Cover Changes

Grass-Based

Riparian Buffer

- ◉ None

Full Extent | Reset App | Basemaps

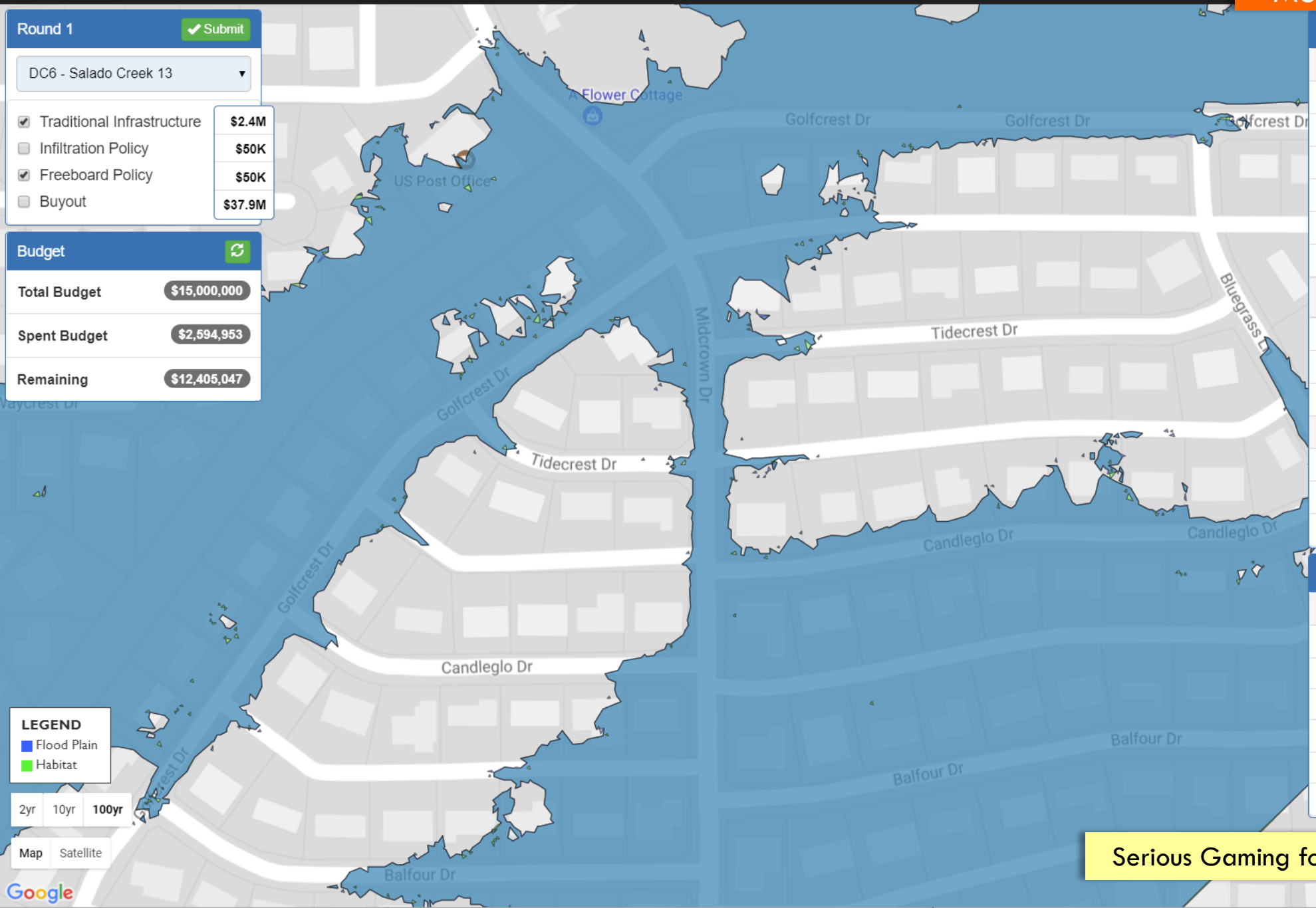
Legend
- POI drainage area
- POI Selected

Serious Gaming for Participatory Decision Making

Leaflet | Map data ©2016 Google | Terms of Use | Report a map error

San Antonio Multi-Hazard Tournament: Bexar County (Upper)

MULTI HAZARD TOURNAMENT



Round 1 — Submit

DC6 - Salado Creek 13

☑ Traditional Infrastructure	$2.4M
☐ Infiltration Policy	$50K
☑ Freeboard Policy	$50K
☐ Buyout	$37.9M

Budget

Total Budget	$15,000,000
Spent Budget	$2,594,953
Remaining	$12,405,047

LEGEND
- Flood Plain
- Habitat

2yr | 10yr | 100yr

Map | Satellite

Plan Benefits — DC Info

Description	DC6	All DCs
Recreation Created	$0	$0
WQ - TSS Removed	105 lbs	9,348 lbs
WQ - E.coli Removed	36T MPN	300T MPN
GW Recharge	4,137 m^3	94,196 m^3
Habitat Created - Forest	$478.7	$131.7K
Habitat Created - Wetland	$2.6K	$142.3K
Flood Damages		
2 year flood	$119.1K	$771.4K
10 year flood	$153.7K	$1.4M
100 year flood	$213.3K	$173.3M
Vulnerable Population (cost)		
2 year flood	$24.4K	$83.8K
10 year flood	$31.4K	$127.6K
100 year flood	$43.6K	$7.5M

Round 1 Summary

DC Name	Trad	Infil	Free	Buyout	Add-On
DC1 - MC		✓			✓
DC2 - LC17					
DC3 - LC07					
DC4 - SA02		✓	✓		
DC5 - SC03					
DC6 - SC13	✓		✓		

Serious Gaming for Participatory Decision Making

Google
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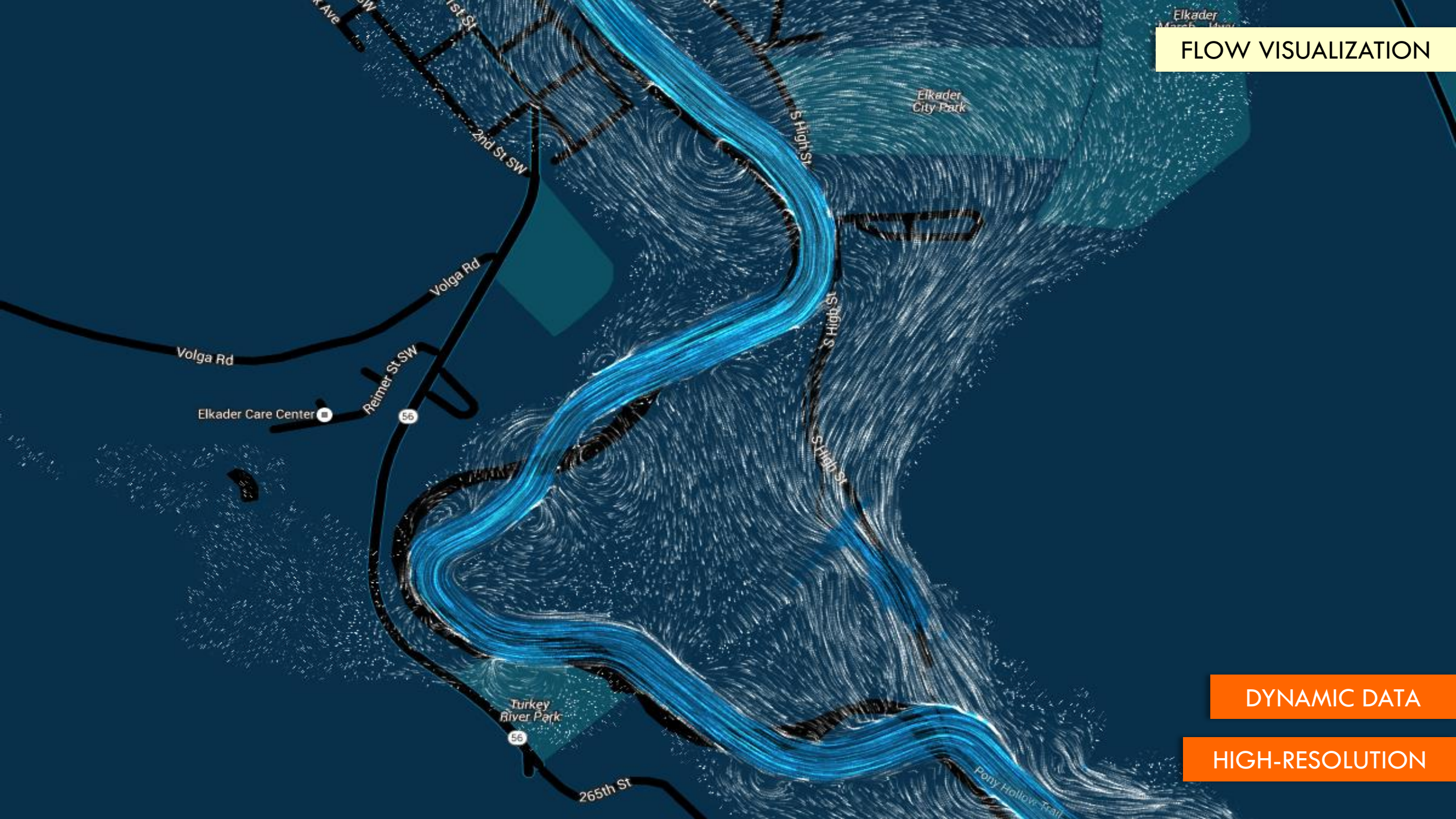

FLOW VISUALIZATION
Elkader City Park
S High St
Volga Rd
Reimer St SW
Elkader Care Center
56
Turkey River Park
265th St
DYNAMIC DATA
HIGH-RESOLUTION

FLOW VISUALIZATION

IFIS RESEARCH PLATFORM

- [ ] Multi-Sensor Box View
- [ ] Iowa Flood Visualizer
- [ ] Iowa Video Stream
- [ ] Iowa 3D City Visualizer
- [ ] Smart Assistant

Rainfall

- [ ] Current Rainfall (demo - 1m)
- [ ] IFIS & MRMS Rainfall Comparison
- [ ] Rainfall Drainage

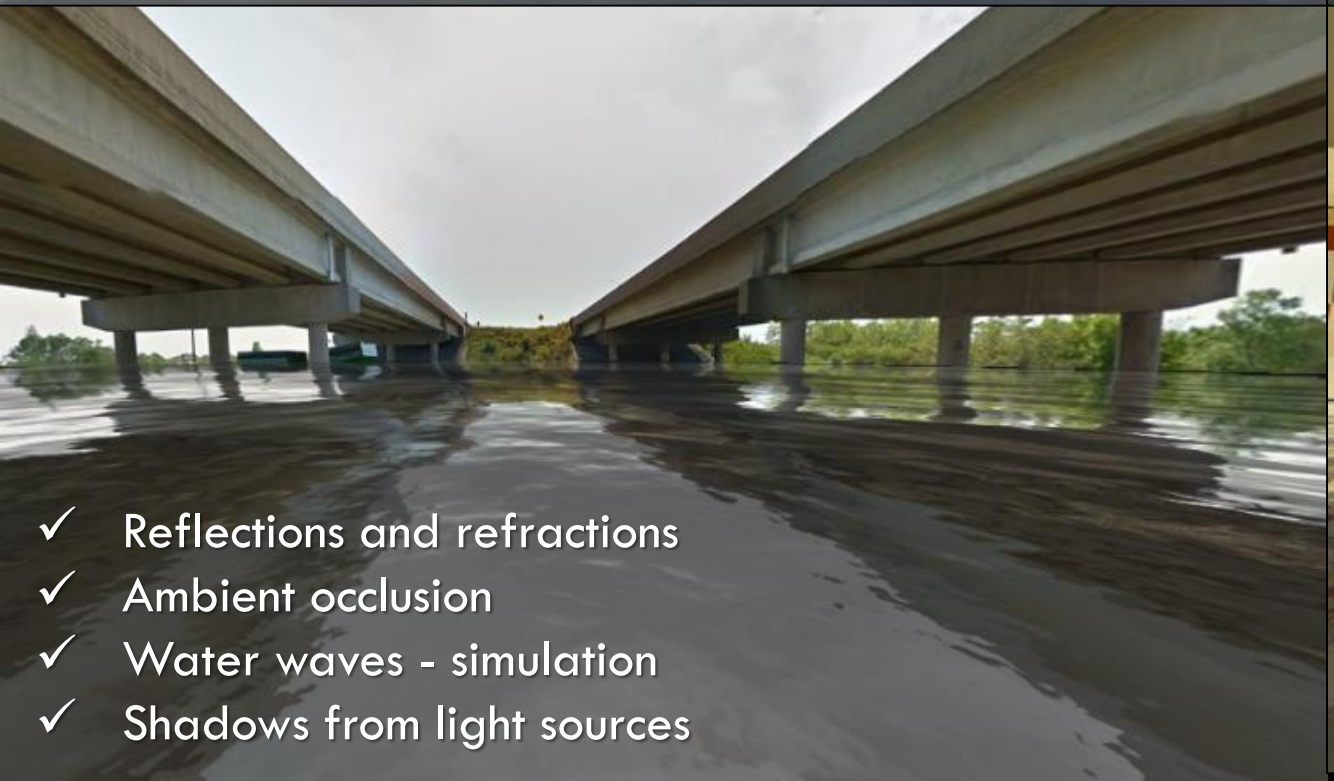
Water Animation

- [ ] Streamflow Forecast
- [ ] Rainfall (daily)
- [ ] Water Quality (stream)
- [ ] Water Quality (model)
- [x] Flood Inundation M

Canvas / WebGL

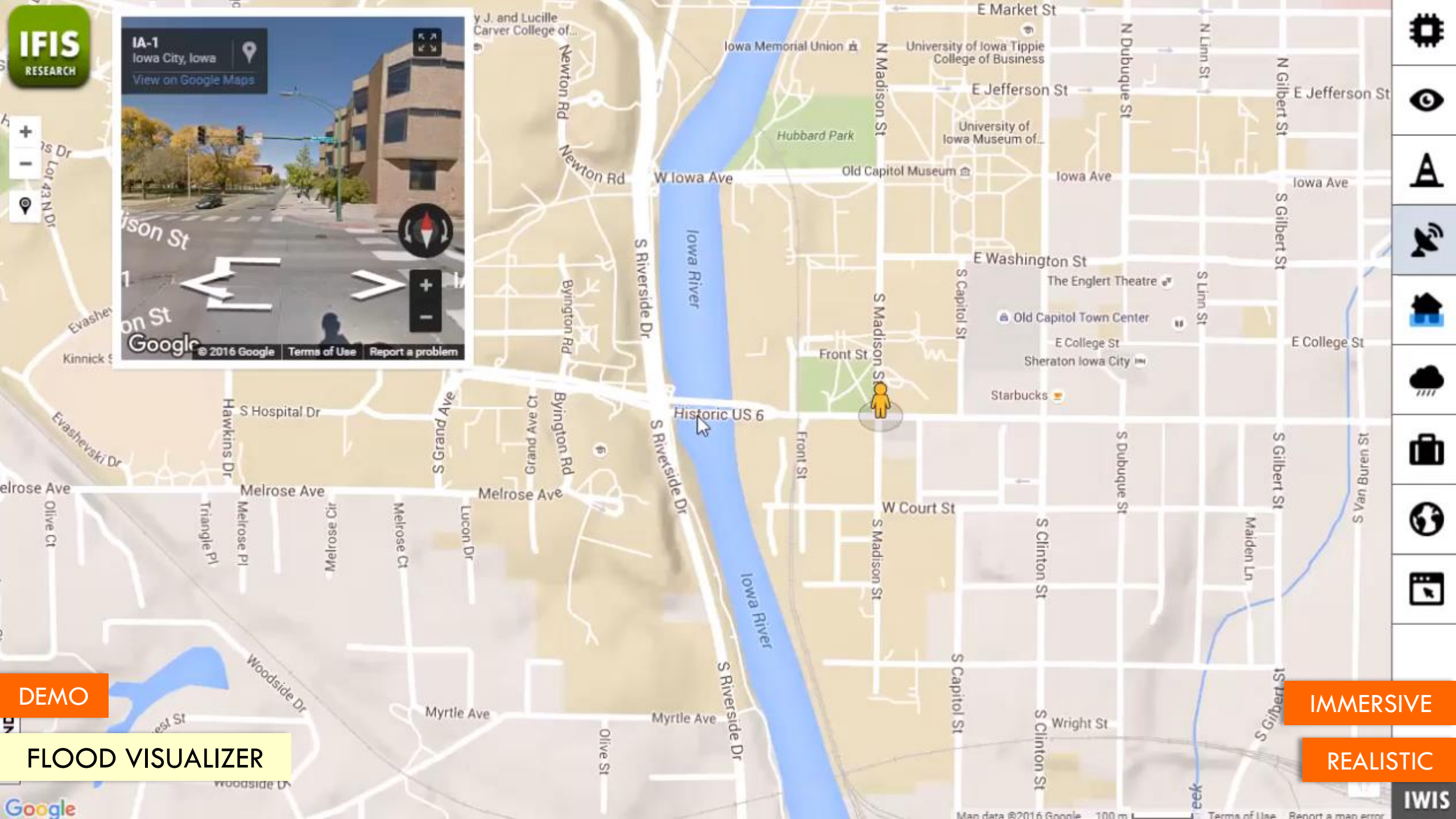
Client-Side Processing

IWIS



- ✓ Reflections and refractions
- ✓ Ambient occlusion
- ✓ Water waves - simulation
- ✓ Shadows from light sources

FLOOD SCENE GENERATOR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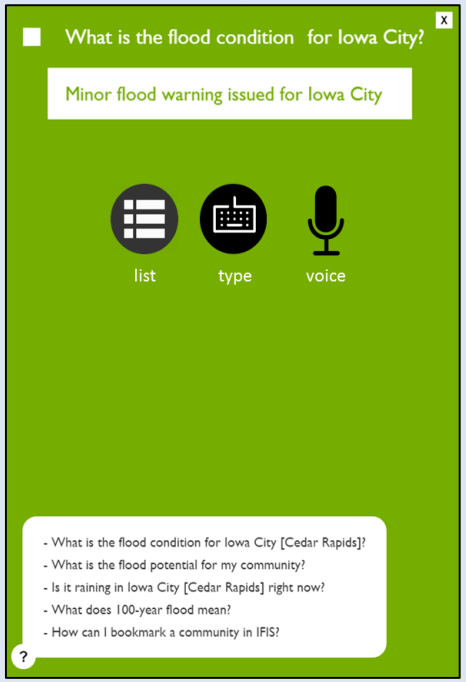
Intelligent Systems

ML and AI

Flood AI: Artificial Intelligence System for Disasters

Supported by Microsoft 'AI for Earth' award

Received "2018 Outreach Award" by ASFPM



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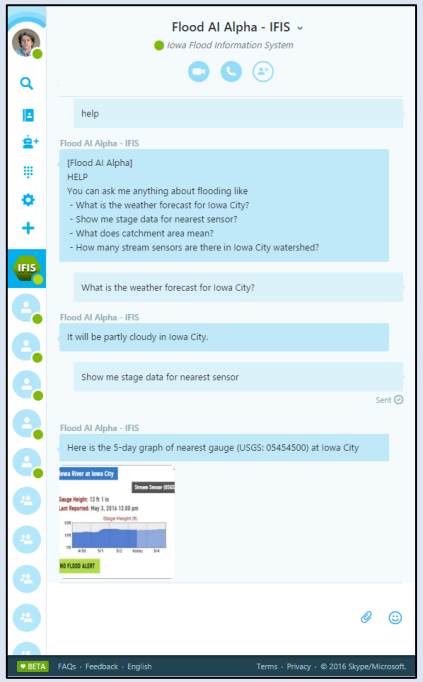

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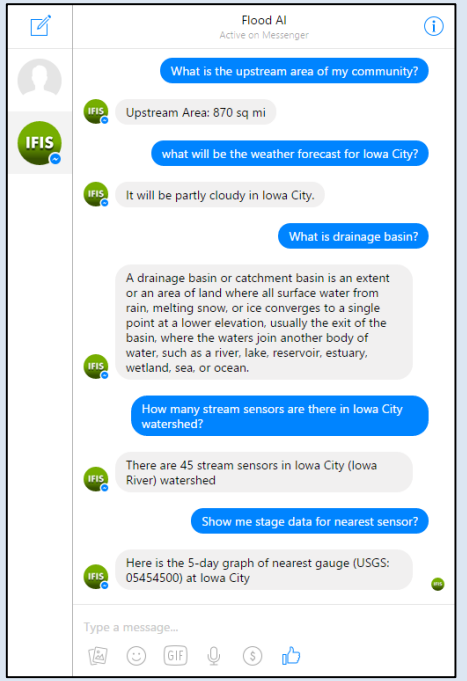
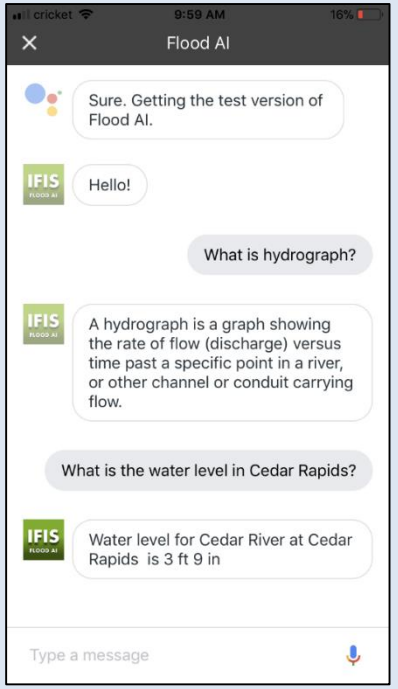


facebook

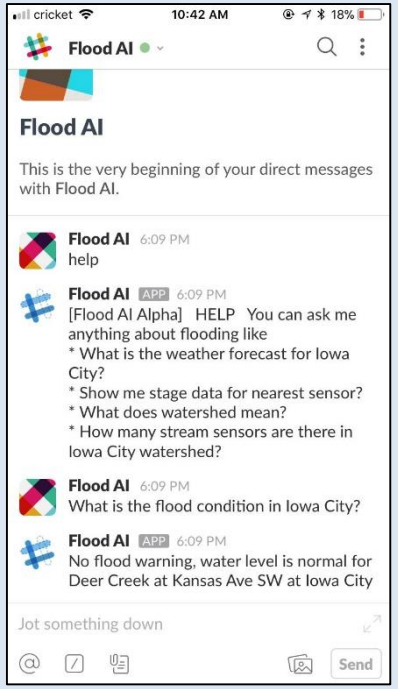
Chat Bots

Flood AI: Artificial Intelligence System for Disasters

Cortana



Google Assistant



slack

Smart Assistants

Amazon Echo

Alexa **ask Flood AI** …

Google Home

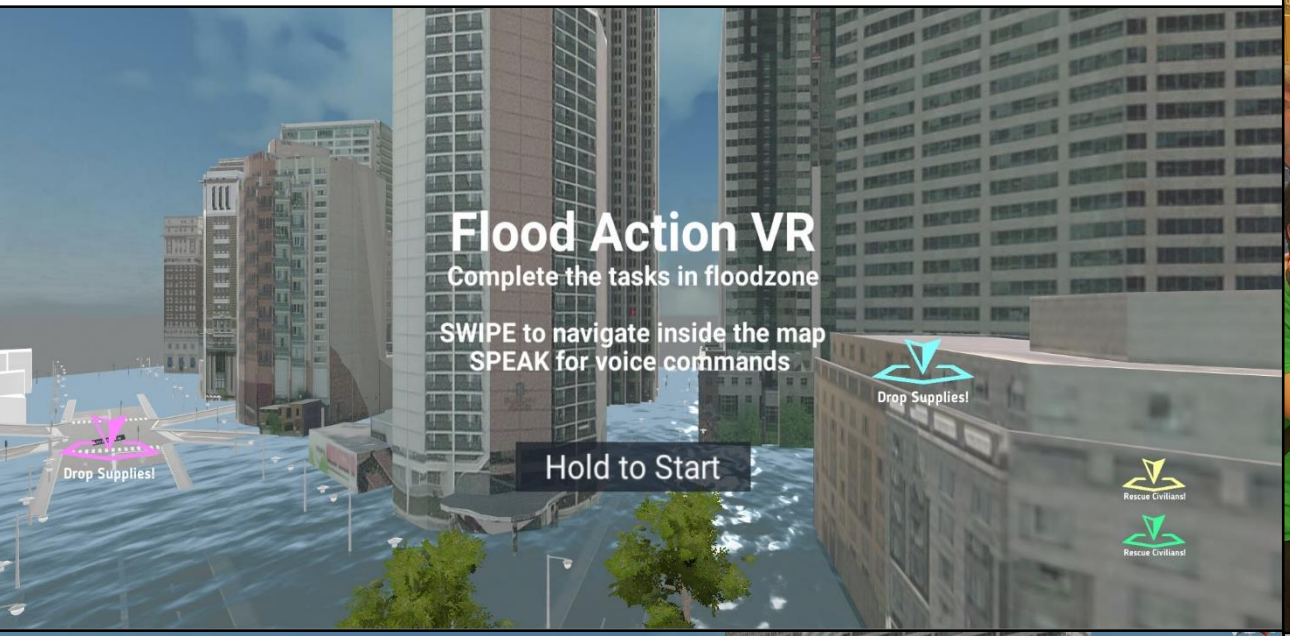
Ok Google **talk to Flood AI**

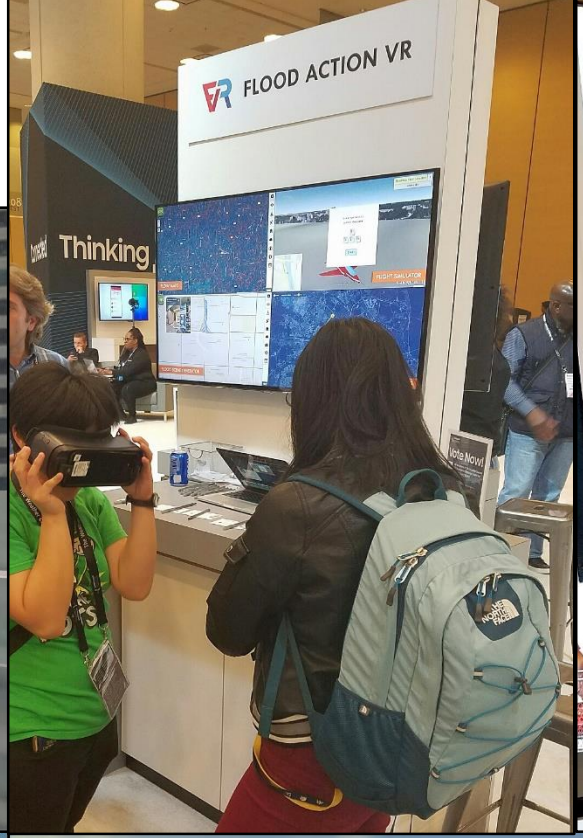
Smart Devices

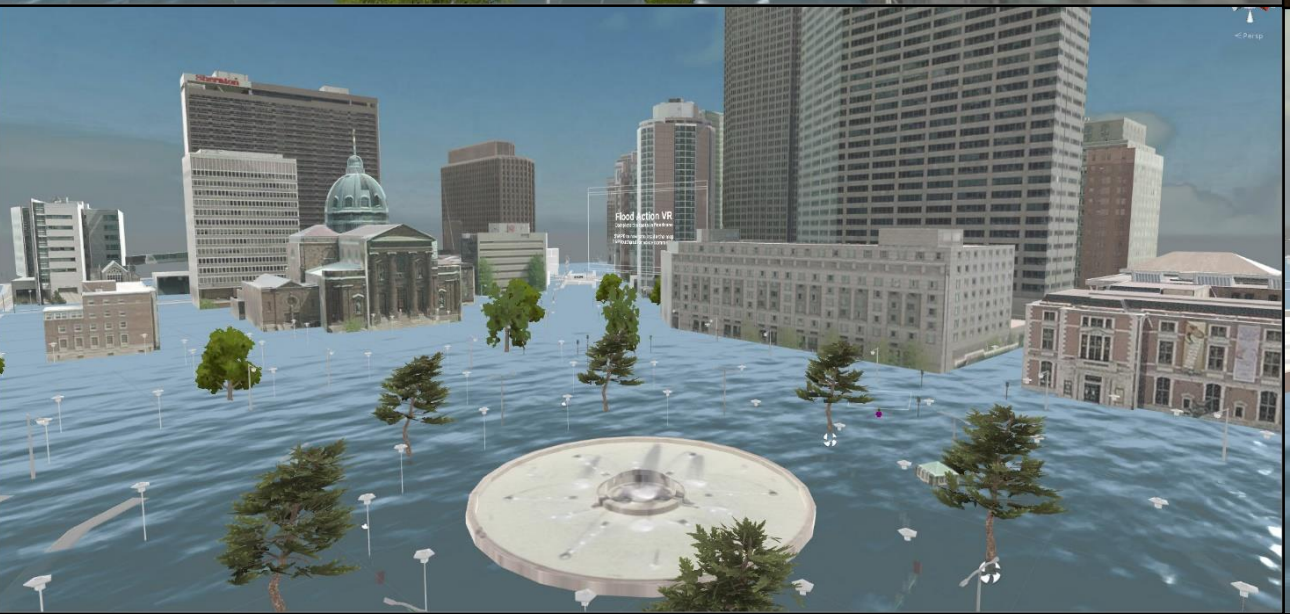
Next Generation Communication

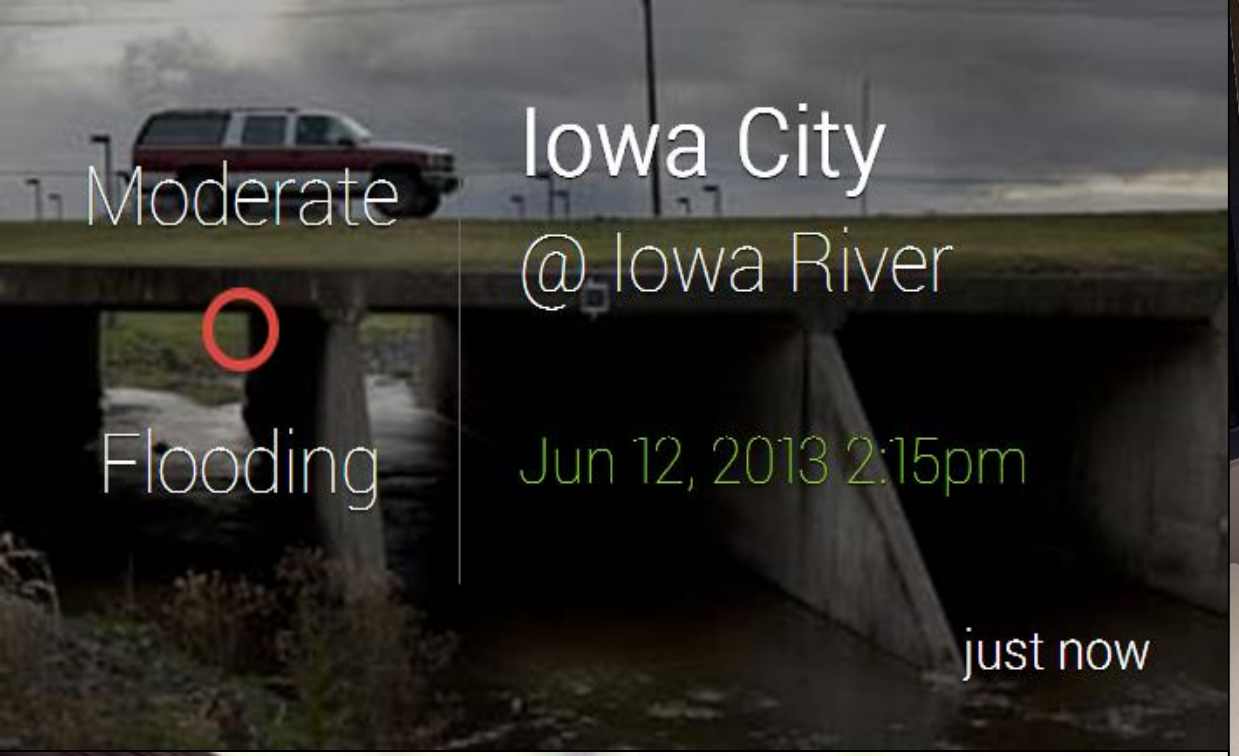
Holography

FLOOD ACTION VR

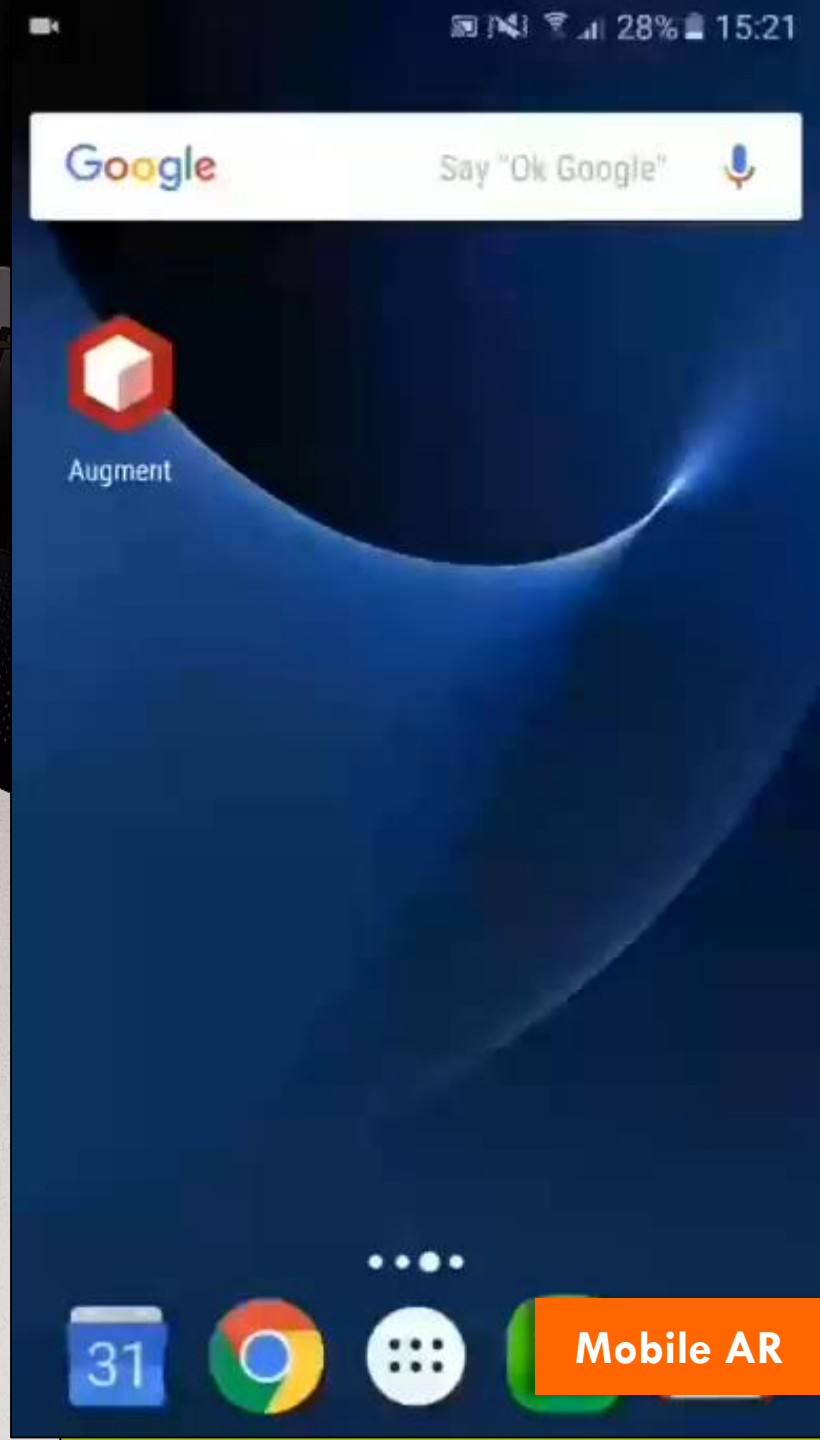








Google Glass



Mobile AR

Holographic Experience

Immersive Analytics

LG

What's Next?

What is next for Flood AI?

Brain Computer Interface

Many devices available ($80-$300)

e.g. Emotiv Epoc+

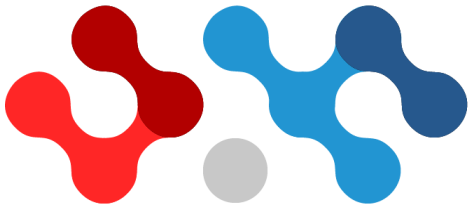
Bone Conduction Headphones

MindFlood

Flood Knowledge by Thought

Ibrahim Demir

ibrahim-demir @ uiowa.edu

https://hydroinformatics.uiowa.edu

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