Incorporating Resiliency into Iowa DOT Infrastructure
Webster’s Definition of Risk & Resiliency

- **Risk/Vulnerability** – Possibility of LOSS or Exposure to Hazard
- **Resiliency** - An ability to RECOVER from or ADJUST easily to MISFORTUNE or CHANGE..
- **Transportation Resilience** can be reflected as a measure of annualized monetary loss of service or mobility from weather related threats based on asset design, characteristics and vulnerability.
Design for Resiliency
I-35 over South Skunk River
I-35 over South Skunk River - 2010
Flood Event

• South Skunk River - Over 500 Yr. Flood in 2010
  • Previous Peak = 26,000 cfs
  • 2010 Flood = 36,000 cfs (38% increase above Record Flood)
• Gage has 63 years of record
2D Hydraulic Modeling

• Conventional 1D Modeling is Difficult – Due to Levees/Dikes & Skewed Highway to Flood Plain

• 2D Hydraulic Model more Accurate
  • Modeling Surface vs. Cross Sections

• Model was Correlated with 2010 Flood
Design for Resiliency – I-35 over South Skunk River
TRANSPORTATION RESILIENCY
Gage Record – Historic Floods

USGS 05451500 Iowa River at Marshalltown, IA

Annual Peak Streamflow, in cubic feet per second

25 yr. Flood = 23,000 cfs
U.S. 30 over Iowa River near Le Grand, IA
U.S. 30 Flood Resiliency/Adaptation
I-35 over Raccoon River in West Des Moines
Resilient Mobility w/Implementation of Real-Time Monitoring of Highway Overtopping:

1. Integrating IFC technologies into the IDOT Operational Framework for Roadway Flooding

2. Proactively notifying Garage Supervisors of Highway Overtopping
### 22 Most Susceptible Overtopping Sites

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<thead>
<tr>
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<th>CURRENT STAGE</th>
<th>FUTURE STAGE</th>
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<tbody>
<tr>
<td><strong>11 Sensor Sites</strong></td>
<td>Ultrasonic Bridge Mounted Sensor <strong>High Accuracy</strong></td>
<td>Hydrological Model + Rating Curve <strong>Limited but Higher Accuracy</strong></td>
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(*2 USGS Gauge*)
The Iowa Flood Center

Since its creation in 2009 the IFC has been developing technologies for monitoring, predicting and anticipating the effect of floods and flash-floods in Iowa.
Sonic Stage Sensors
Flood Forecasting Model
Integration with BridgeWatch™

Garage Supervisors will receive information from actual observations by sonic-sensors or from model predicted states. In addition, roadway overtopping locations with rating curves will receive model forecast.
Resiliency is Proactive – Not Reactive

Monitoring will Accomplish:

Consistency - to develop a statewide framework which enhances public safety by proactively responding to overtopping alerts as opposed to responding to situations where overtopping has already occurred.

Quality - the degree to which the forecast corresponds to what actually happened.

Value - the economic benefits of the real-time forecast by properly allocating time and resources for monitoring and closing the road.
“Bomb Cyclone”
Rainfall from Bomb Cyclone

Forecast Rainfall

WHAT
Locally heavy rainfall with possible flooding. Flood watch in effect.

WHEN
Tuesday March 12 through Thursday, March 14. Flood watch in effect Wednesday.

WHERE
All of eastern Nebraska and southwest Iowa.

Weather Hazards
HEAVY RAIN  FLOODING  ICE JAMS

Published on: 03/11/2019 at 4:54AM
Levee Breach
Infrastructure Impacts
I-680 Damage - 2011
I-680 – Restored In-Kind – 34 Working Days
I-680 Damage – March 2019
Incorporating Resiliency - Flexamat
Sufficient Anchorage
I-680 Asphalt Connection – June Event
I-680 June 2019 Flood Event

I-29 South @ I-680 I/C (CBTV36) 06/26/2019 12:03:01
I-680 Flexamat – June Event
Minor Repairs – More Resilient
Corps Levee System
Recovery Status
May 23, 2019
L-611-614 – U.S. 34 & Pacific Junction
Pacific Junction - Before
Pacific Junction - After

Hundreds of homes and an entire neighborhood underwater

Railway and highway submerged
U.S. 34 – March Event
U.S. 34 Damage – March 2019 Event
U.S. 34 – June Event – Revetment Countermeasure

North US 34 EB near St. Mary’s Wildlife Mgmt Area (IWZ 3705) 2019-06-10 07:44:11
Corps Repair of L-611 – 614 Levee
L-601 Cell - Bartlett
Wabonsie Creek - Before
Wabonsie Creek Flank Levee Breach
Corps Levee Repair L-601
2D Modeling for Resiliency along I-29 and Bartlett Interchange – Most Vulnerable Cell

• Modeling will Determine Level of Service
• Analyze Resiliency by Constructing Earthen Dike in Lieu of Raising I-29
• Provide Interior Drainage Design at Bartlett Interchange
• Determine Potential Use of AquaDam
L-575 Cell – IA 2 and Hamburg
Repair of L-575

- Dredge Iowa re-mobilized and began pumping on 6/3
- Target breach closure is ~June 17th
L-575 Levee Repair
Temporary Mobility
Temporary Mobility
RISK: Flooding 2.0
RISK: Additional Damages
IA 2 Grade Raise w/Overflow Bridges
Incorporating Resiliency for DOT Infrastructure

• Raise Road Grade
• Add More Conveyance under Highway
  • Bridges/Culverts
• Provide Real-Time Monitoring to Enhance Safety/Mobility
• Incorporate Cost Effective Strategies
  • Dikes
  • Paved Shoulders
  • Flexamat
• Design Anticipating Higher Design Storms/Flows
HYDRAULIC DESIGN for RESILIENCY

Continue to Design Based on the Past
or
Based on Potential Future Impacts?

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