#### Signing Treatments for Flood-Prone Roadways TxDOT Research Project 0-6262

TexITE Annual Meeting September 16, 2011

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### State of the Practice









# Focus Groups

- Visual cues important
  - How dangerous does the water look?
  - How much of the road can they see?
  - Where do they think the road surface is?
- Sign preferences
  - Directive messages
  - Active signs/lights
  - Flood gauges: color-coding?
  - Placed to avoid last-minute turnarounds

#### **Driver Comprehension Studies**





## Static Signs and Gauges



#### Active Signs (at Flood-Prone Site)





#### Active Signs (at Flood-Prone Site)







#### Roadways – Advance Sign Location





### Flood-Prone Site: Dry Road





### Low Water – 6" on gauge





### High Water – 18" on gauge





# Advance Signs – Road Entrance



# Advance Signs – Road Entrance







#### Would you continue driving on this road?







From the information shown, how risky do you think it would be to continue driving on this road?



If five other drivers saw this scenario, how many of them do you think would continue on this road?





# Results – Passive Signs and Gauges

- Visual cues (water, roadway) biggest influence at passive crossings
- Water level on flood gauges influenced decisions; static warning signs did not
- Color-coded gauges
  - No difference in responses for color-coded vs. standard gauge for high water (18")
  - Drivers slightly more likely to continue through low water (6") with color-coded gauge

### Color-Coded Gauge – Low Water

- White gauge: 73% would continue
- R/W gauge: 81% would continue



### Effects of Active Signs – High Water

- When ON, 96% would not continue on road
- When OFF, 82% would not continue





### Effects of Active Signs – Low Water

- Signs OFF: 25% would not continue
- Signs ON: 61% would not continue
- Beacon color did not matter



# Active Signs on Dry Roads

- Only showed signs ON
- Average of 53% would not continue
- Range depending on sign messages:
  - Road Flooded When Flashing
    34% would not proceed
  - Do Not Enter (LED) 75% would not proceed





# **Results: Sign Messages**

- Advance signs
  - "Road May Flood" preferred
  - No difference in response
- Static signs at crossing
  - No strong preference
  - No difference in response
- Active signs at crossing
  - "Do Not Enter" messages influenced more drivers to turn back at low water levels

# Recommendations: Passive Crossings

- Yellow Flood Gauge
  - At deepest point of crossing
  - Potentially add a second gauge on other side of road

#### • "Road May Flood" as advance sign

- Preferred by participants
- Consistent with new MUTCD
- "Do Not Cross When Flooded" as sign at crossing (optional)
  - Helpful where sight lines are restricted
  - Place 25 to 50 feet ahead of crossing to allow turnaround space

#### TxDOT Roadway Design Guide Sight Distances

	Stopping	Decision
Design	Sight	Sight
Speed	Distance	Distance
(mph)	(ft)	(ft)
50	425	465
55	495	535
60	570	610
65	645	695
70	730	780
75	820	875
80	910	970



#### TxDOT Advance Placement Distance

Posted or	
85th	Condition B:
Percentile	Stop
Speed	Condition
(mph)	(ft)
40	125
45	175
50	250
55	325
60	400
65	475
70	550
75	650
80	725

# Recommendations: Active Warning Devices

#### For higher-risk crossings

- Inadequate sight distance
- Difficult to judge speed and depth of water
- High exposure crossings
- History of fatalities due to flooding

#### • Couple with flood detection system

- Activate at approx. 12 inches (18 inches max)
- Yellow flashers on "HIGH WATER DO NOT ENTER" static sign
  - Message provides strong action statement
  - Yellow beacons consistent with other "flasher" applications

#### • Possible alternative: LED "DO NOT ENTER"

• Test in controlled field study



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Recommendation: Roads with Multiple Crossings

- At major decision point (intersection), use "HIGH WATER ROAD CLOSED TO THRU TRAFFIC WHEN FLASHING"
  - Provides strong action message to drivers
  - Require use of active devices at crossing
  - Need to establish communication linkages between closures
  - Must test communication linkages routinely





### Questions

