



TxDOT Project 0-6992: Traffic Safety Improvements at Low Water Crossings—Summary Webinar

Product 0-6992-P1

Cooperative Research Program

TEXAS A&M TRANSPORTATION INSTITUTE
COLLEGE STATION, TEXAS

in cooperation with the
Federal Highway Administration and the
Texas Department of Transportation [https://
tti.tamu.edu/documents/0-6992b-P1.pdf](https://tti.tamu.edu/documents/0-6992b-P1.pdf)

TxDOT Project 0-6992: Traffic Safety Improvements at Low Water Crossings



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Summary Webinar
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Acknowledgments

Chris Glancy (TxDOT), PM

Project Panel: Abderrahmane Maamar-Tayeb, Adam Jack, Adam Kaliszewski, Arturo Perez, Chris Cowen, Jiaming Ma, John Bassett, John Gianotti, Joseph Muck, Kenneth Mora, RoseMarie Klee, Steve Chiu

TTI

Kevin Balke (co-PI), Adam Pike, David Florence, Hassan Charara, Nadeem Chaudhary, Stefan Hurlebaus, Subasish Das, Roger Bligh, Dick Zimmer
Geza Pesti, Timothy Barrette

Southwest Research Institute

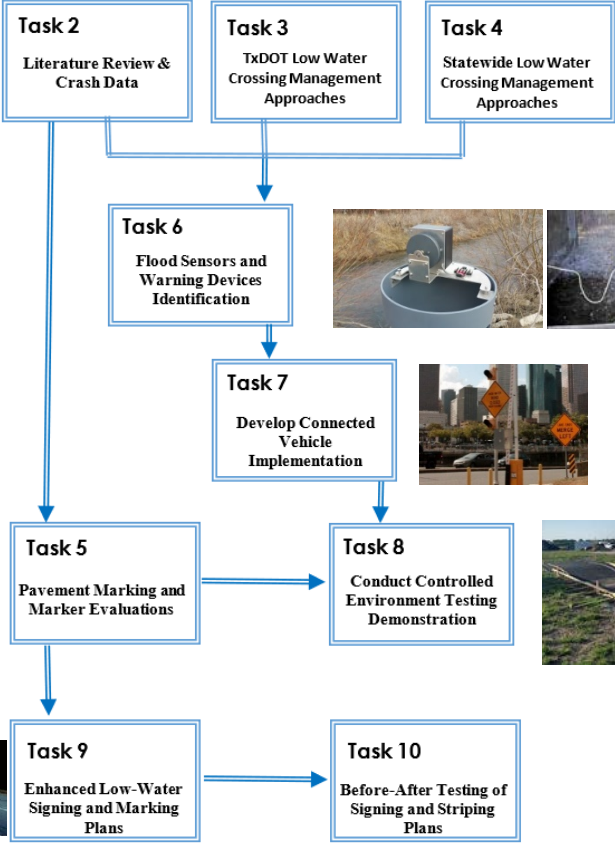
Cameron Mott
John Esposito
Darin Parish
Purser Sturgeon, II

Synopsis

- Texas leads Nation in flood-related deaths
- Majority of deaths caused by motorists driving through moving water (Low Water Crossing, Nighttime)
- 18-24 inches of moving water sweep away truck, 6 inches for small car
- Impractical to raise /remove all low water crossings
- Low-cost means to better alert driving public to these risks



Task 1 Project Management and Research Coordination



Low Water Crossing Management Approaches – State of the Practice Review

Chiara S. Dobrovolny

Texas A&M Transportation Institute

Literature Review

- Developed a synthesis of relevant information by reviewing the research literature and state policy documents regarding low water crossing related issues.
- Review was further divided into following **categories**:
 - Safety Issues
 - Countermeasures and Design Alternatives
 - Behavioral Issues
 - Consequences

Developed Databases

P3 Product

Dataset 1: TNRIS LWC Crash Database

- Spatial match
- 70,616 Crashes in 5 years (2013-2017)

Dataset 2: HCRS LWC Crash Database

- Spatial-temporal match
- 6072 events
- 209 crashes in 5 years (2013-2017)

Dataset 3: CRIS Data with 'Standing Water' as Surface Condition

- Filter: Surface condition as Standing water
- 14,426 crashes in 5 years (2013-2017)

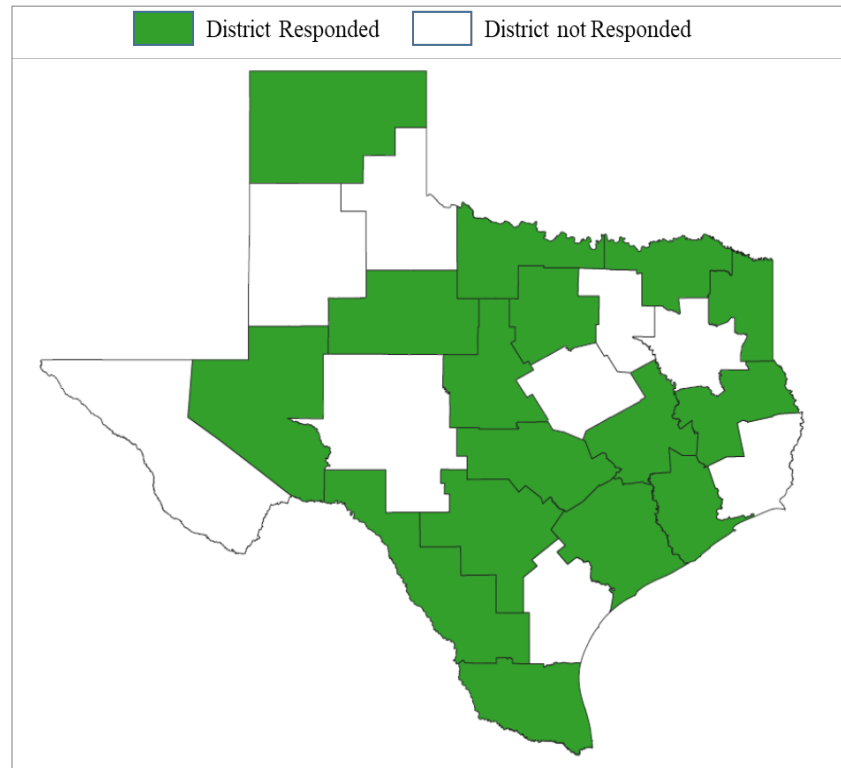
Receiving Agency Low Water Crossing Management Approach

A survey was completed by TxDOT agency offices with knowledge of current Low-Water Crossing (LWC) inventory and DOT's management approach and practices, including:

- LWC design and countermeasure implementation protocol
- Criteria and methods for diagnosing problems and choosing advanced alternatives, and
- LWC inventory and management approaches.

Receiving Agency Low Water Crossing Management Approach

- A survey with 13 relevant question was developed and distributed among TxDOT area offices.



Receiving Agency Low Water Crossing Management Approach

Additional breakdown

- **88% respondents** indicated that the area offices **do not have** LWC inventories
- **44% respondents** indicate that the area offices **have developed** LWC design and countermeasure implementation protocols
- Majority of the area offices (**around 64%**) **have not developed** any specific criteria or methods.
- Similar negative responses were found from the responses regarding consideration to locations /scenarios characteristics for LWC implementation.

Pavement Marking/Marker Evaluations for Low Water Crossings

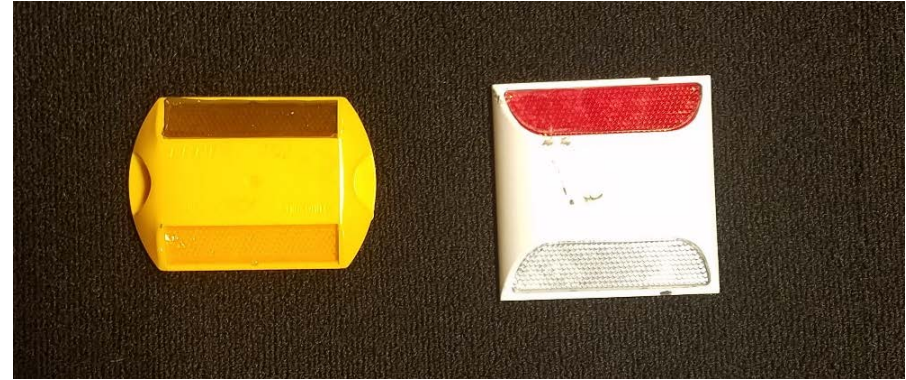
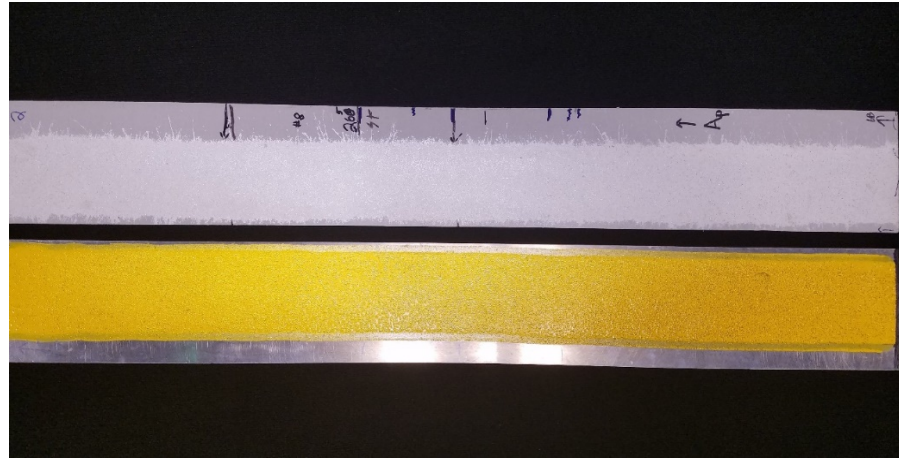
Adam Pike

Texas A&M Transportation Institute

Task Objectives

- 1) Evaluate visibility of markings and markers in dry and flooded conditions to determine if they provide adequate visibility to indicate the flooded condition
- 2) Evaluate impact of various factors on the treatment visibility
 - 1) Day vs night
 - 2) Water depth
 - 3) Water clarity
 - 4) Treatment type (standard markings, wet-weather markings, RRPMS, IIRPMS)

Types of Markings and Markers Evaluated



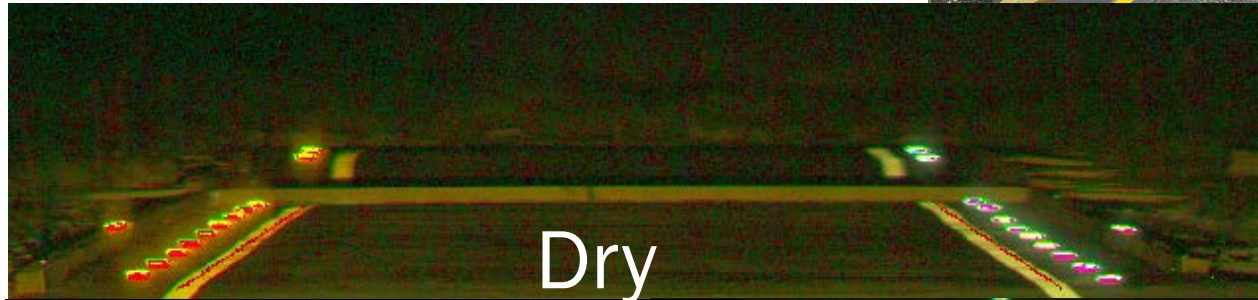
Initial Small Scale Testing



Full Scale Testing

Marking and Marker Evaluations

- Wet, Dry
- Day, Night



Connected Vehicle Applications to Low-Water Crossing

Cameron Mott

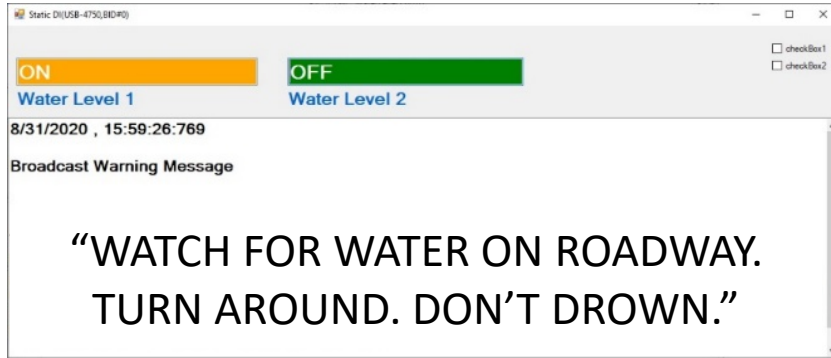
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Application of CV Technologies to Low-Water Crossings

- Explore the use of Connected Vehicle technology
- Links infrastructure and vehicles through dedicated short-range communications
- Allows alerts and messages to be broadcast directly to vehicles
- Two deployment options
 - Standalone deployment
 - Integrated with the Lonestar software through a TMC



LEVEL 1: ALERT MESSAGE



Static D:\(USB-4750,BID#0)

ON Water Level 1 **OFF** Water Level 2

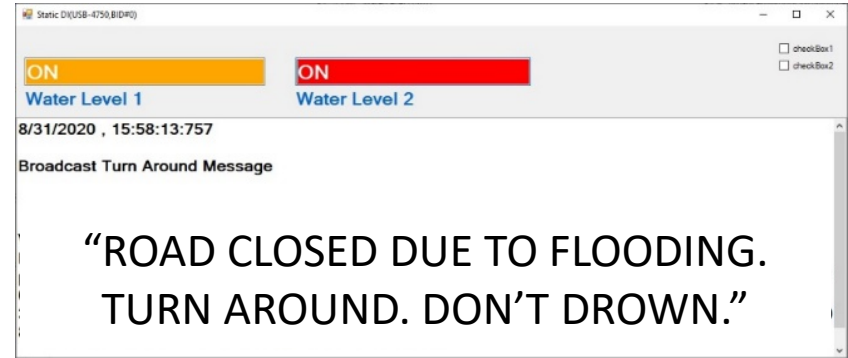
checkBox1
 checkBox2

8/31/2020 , 15:59:26:769

Broadcast Warning Message

**“WATCH FOR WATER ON ROADWAY.
TURN AROUND. DON’T DROWN.”**

LEVEL 2: WARNING MESSAGE



Static D:\(USB-4750,BID#0)

ON Water Level 1 **ON** Water Level 2

checkBox1
 checkBox2

8/31/2020 , 15:58:13:757

Broadcast Turn Around Message

**“ROAD CLOSED DUE TO FLOODING.
TURN AROUND. DON’T DROWN.”**

DIVERSION MESSAGE



Static D:\(USB-4750,BID#0)

ON Water Level 1 **ON** Water Level 2

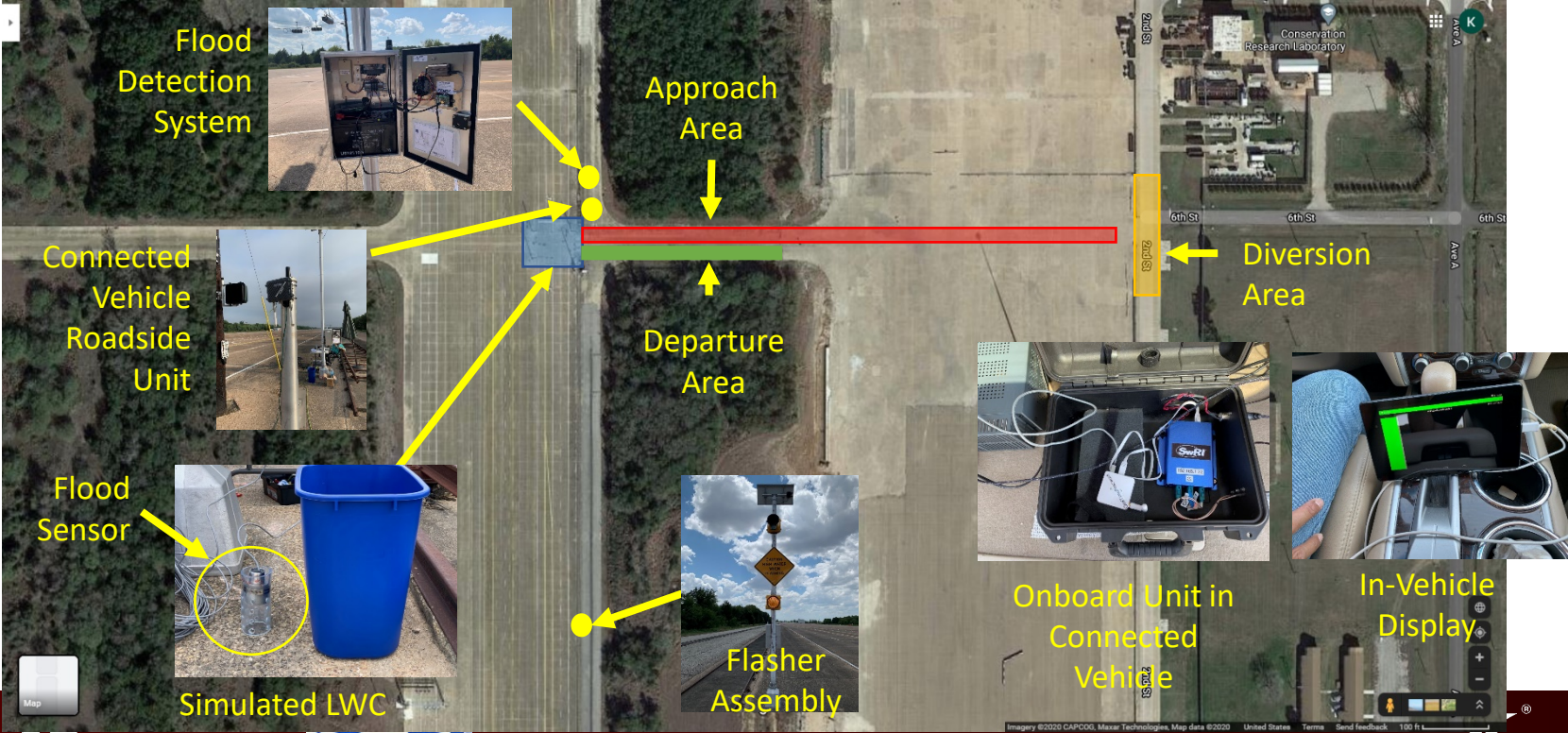
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Broadcast Turn Around Message

**“NEARBY ROAD CLOSED DUE TO
FLOODING. RIGHT TURN CLOSED.”**

Connected Vehicle Testbed Deployment



Connected Vehicle Demonstration Finding



- Successfully showed the application of Connected Vehicle technologies
- Message can be generated by standalone system or by TxDOT's Lonestar traffic management system
- Human factors testing needed for design of in-vehicle displays

Implementation Recommendations

Kevin Balke

Texas A&M Transportation Institute

Develop and Deploy Enhanced Low-Water Signing and Marking

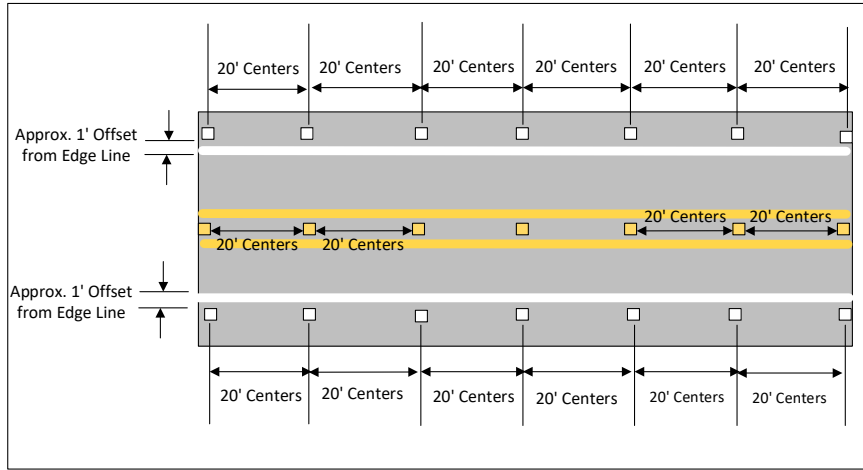
- Use the results from investigation of marking conspicuity
- Identify potential sites where probability of flooding likely
- Design enhances marking improvements



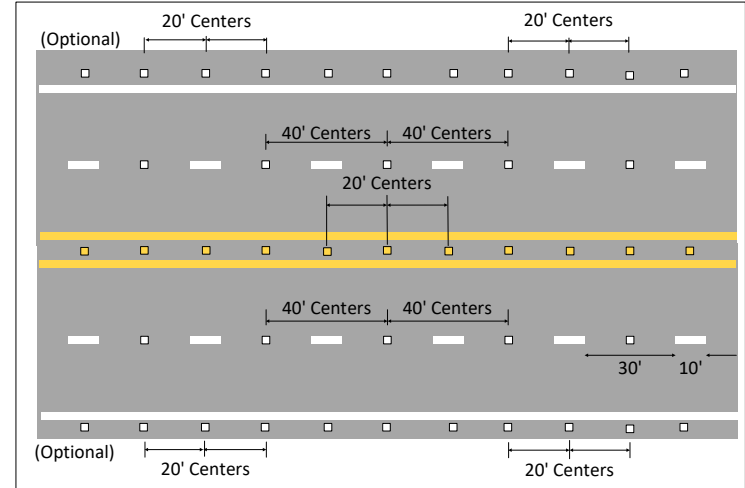
Candidate LWC Delineation Enhancements

- Ensure standard marking through crossing are well maintained.
- Supplement with RRPM
 - Install offset white RRPMs on edge line (if possible)
 - Decrease spacing of yellow RRPMs
 - Extend through flood area
- Rationale: Driver will notice “gap” in marking when flooded
- Consider using Internally Illuminated Raised Pavement Markers (IIRPMs) at problematic locations
 - Activated during flood conditions
 - Longitudinal – yellow to delineate center line
 - Lateral – red to indicate stop and turn around condition
 - Requires request for experimentation

Proposed Delineation Details

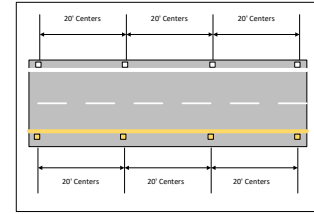
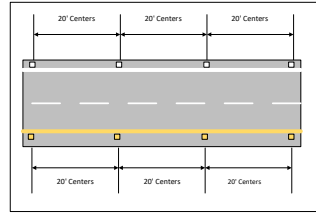


Two-Lane, Undivided



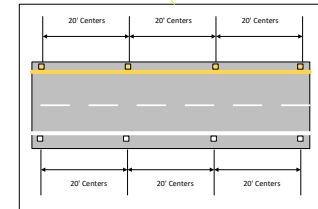
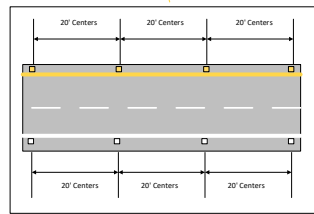
Four-Lane, Undivided

Developed Proposed LWC Enhancement



REPLACE

WITH



Conclusions and Wrap-Up

Chiara S. Dobrovolny

Texas A&M Transportation Institute

Conclusions

- The research explored strategies and techniques designed to discourage motorists from entering flooded grade crossings resulting in lives saved.
- Increased the level of knowledge of TxDOT personnel related to the issues and potential solutions for improving safety at LWCs on TxDOT highways.
- The research has the potential to improve the quality of life for Texas motor vehicle operators. The public benefits from more precise and accurate information about the status of the hazards associated with flooded crossings.
- The project also demonstrated how TxDOT could integrate advanced technologies for disseminating warnings and alerts to drivers directly in their vehicle.

Deliverables

Product P1. Webinar Presentation

Product P2. Guidelines for Enhancing Delineation at TxDOT LWCs

Product P3. Cross Reference Database to identify suitable locations for the implementation of LWC countermeasures

R1A. Research Report (Including VoR)

PSR. Project Summary Report

R1B. Research Report



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