TH101 & TH41
Flood Mitigation Study

Presented by
Mark Benson, PE
Rachel Pichelmann, EIT, CFM
Study Purpose

• Identify lower cost improvements to Hwy 41 and 101 to minimize transportation disruption caused by seasonal flooding of the Minnesota River

• Also, identify measures to ease congestion at Hwy 169 to mitigate the impacts of detoured traffic resulting from flood-related closures at Hwy 41 and 101

• Results will aid Mn/DOT in pursuing flood mitigation funding
Study Elements

- Traffic forecasting and analysis
- Analysis of historical flooding
- Development of alternatives
- River modeling
  - Subconsultant for 2-D modeling - Baird
- Evaluation of alternatives
- Public and Agency involvement
# River Bridge Traffic Volumes

<table>
<thead>
<tr>
<th>Roadway</th>
<th>Existing Traffic</th>
<th>2030 ADT</th>
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</thead>
<tbody>
<tr>
<td>TH 169</td>
<td>63,000</td>
<td>88,600</td>
</tr>
<tr>
<td>TH 101</td>
<td>20,400</td>
<td>25,700</td>
</tr>
<tr>
<td>TH 41</td>
<td>12,500</td>
<td>20,200</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>95,900</strong></td>
<td><strong>134,500</strong></td>
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Flooding History – TH101

TH 101 Crossing Historical River Elevations

Current Closure Elevation (709.4')

Elevation, ft

Date


Cost of Closures

- Cost of TH 101 and TH 41 Closure (travel time and additional miles)*:
  - $670,000 per day (2009)
  - $1,675,000 per day (2030)

* Costs developed using Metropolitan Council’s 2030 Regional Model.
Spring 2011 Flood – TH41
Looking North Towards Chaska
Spring 2011 Flood – TH101
Looking North Towards Chanhassen
Why Not Just Raise The Road

• Raising the road would act as a dike and back up the river causing impacts up stream

• The regulations do not allow fill in the floodplain that will cause the river to raise
Hydraulic Modeling Objectives

• Assess WSE for Existing Conditions
  – Existing Conditions Model
  – Approx. 35 Miles of MN River
  – From Carver to Confluence with Mississippi River
  – HEC-RAS 4.1.0

• Assess Impact of Design Alternatives
  – Reduce Road Closure Frequency & Duration

• Develop a Calibrated 2-D Model
  – Finite-Element Surface-Water Modeling System (FESWMS)
  – Done by Baird
Hydraulic Models

• HEC-RAS vs. FESWMS
  – HEC-RAS
    • Basic model used to evaluate alternatives
    • Regulatory model
  – FESWMS
    • Detailed data set (river cross sections, USACE hydrographic survey, LiDAR data, and USDA/NRCS National Elevation Data)
    • More accurately evaluates velocities, allowing for better bank stabilization design
  – D/S boundary condition: USGS Gage at Ft. Snelling
  – Flow values: USGS Gage near Jordan
Finite Element Grid Near TH101
2-D Model Calibration

- Hydrodynamic Modeling using FESWMS
  - Calibrated Using Field Data
  - Approximately 30-Year Flood Event
  - March 28, 2011 Event (Approx. 30-yr Event)
  - Compared Flooded Area from Model to Flood Photos
  - Measured Flow, WSE, and Velocity
  - Adjusted Manning’s ‘n’ Values to Calibrate
2011 Flood Event – TH101
Design Alternatives

• Filling to Raise Road Profile
  – Modeling Showed Surcharge in 100-Yr Floodway WSE
  – Culverts Could Not Mitigate Surcharge

• Use of Upstream Storage
  – Not Feasible Due to Flat River Profile

• LOMR to Allow for Some Stage Increase
  – Not Practical Due to Length of Upstream Impact (30+miles)

• Land Bridge
Land Bridge Design

- Iterative Process which Involved Varying:
  - Road Elevation
  - Bridge Length
  - Pier Width
  - Pier Spacing
  - Bridge Deck Depth
TH41 Preferred Concept

- Minimum Road Centerline Elevation = 722.5’
- Bridge Length = 1,350’
- Bridge Deck Depth* = 86”
- Pier Spacing = 100’
- Pier Width = 1.5’
- No Change in 100-Year WSE (722.5’)
- Closure Elevation Increased from 714.6’ to 719.6’

*Depth includes road cross-section, structural elements of bridge and railing/barrier.
TH41 Preferred Concept

Legend:
- Proposed Bridges
- Proposed Roadway
- Proposed Culverts
- Existing Bridges
- Existing Roadway
- Existing Culverts
- Existing Lift Ogee
- Existing Coyote
- Existing Bicycle Bridge

Concept Subject to Change

Proposed Bridge Typical

Proposed Roadway Typical

Remove Existing Bridge 70041

Existing Bridge 70041

130' Land Bridge

Excavation

Fill

Bridge 10012

Proposed Roadway/Bridge Low Elevation = 722.5'

Existing Closure Elevation = 714.6'

100' = 222.5 feet
50' = 200.3 feet
10' = 714.2 feet
TH 41 Crossing Historical River Elevations

- Proposed Closure Elevation (719.6')
- Current Closure Elevation (714.6')

Dates and Elevations:
- 1951: 670.0 ft
- 1952: 670.0 ft
- 1965: 720.0 ft
- 1969: 720.0 ft
- 1993: 720.0 ft
- 1997: 720.0 ft
- 2001: 720.0 ft
- 2010: 720.0 ft
- 2011: 720.0 ft

Dates:
- 11/7/1932
- 7/17/1946
- 3/25/1960
- 12/2/1973
- 8/11/1987
- 4/19/2001
- 12/7/2014
Road Closure Duration – TH41

TH 41 Crossing, Summer 1993

- Proposed Closure Elevation (719.6')
- Current Closure Elevation (714.6')

- 4 Days
- 11 Days
TH101 Preferred Concept

- Minimum Road Centerline Elevation = 724.0’
- Bridge Length = 3,080 ft
- Bridge Deck Depth* = 84 inches
- Pier Spacing = 100 ft
- Pier Width = 1.5 ft
- 100-Year WSE Decreased From 720.7’ to 720.6’
- Closure Elevation Increased from 709.4’ to 722.0’

*Depth includes road cross-section, structural elements of bridge and railing/barrier.
TH 101 Crossing Historical River Elevations

- Proposed Closure Elevation (722.0')
- Current Closure Elevation (709.4')

Dates of Closure:
- 1951
- 1952
- 1965
- 1969
- 1993
- 1997
- 2001
- 2010
- 2011

Dates:
- 11/7/1932
- 7/17/1946
- 3/25/1960
- 12/2/1973
- 8/11/1987
- 4/19/2001
- 12/27/2014
TH 101 Crossing, Summer 1993

Proposed Closure Elevation (722.0')

Current Closure Elevation (709.4')

23 Days

Date

Modeling Results

- Increased conveyance for all events
- No increase in stage
- TH 41 Velocity
  - Decreased for 10-Year event (~4 ft/s)
  - Increased (~4-5 ft/s) for larger events, yet less than existing for 10-year (~6 ft/s)
- TH 101 Velocity
  - Decreased for all events
• Construction Cost
• Benefit Cost
• Property Impacts and Costs
• Constructability
• Environmental Impacts/Opportunities
• Community Input
Cost Effectiveness

- **TH41 Preferred Concept**
  - $22.4 Million to Construct & Design
  - Benefit/Cost = 3.06

- **TH101 Preferred Concept**
  - $33.3 Million to Construct & Design
  - Benefit/Cost = 3.81
TH 101 Selected for Flood Mitigation

- Carries more traffic
- Able to achieve higher crossing
  - Results in more significant reduction in closure frequency and closure duration
- Granted $20 million in Flood Mitigation funding
  - Seeking remaining funds from State Legislature
- Project development underway