Climate Change/Extreme Weather Vulnerability Risk Assessment:

Federal Highway Administration (FHWA) Pilot Study for the Dallas-Fort Worth Region

June 4, 2014 2014 TxDOT Transportation Planning Conference Corpus Christi, TX
Dallas-Fort Worth Regional Characteristics
“The Big Picture”

- Population and employment in the Dallas-Fort Worth (DFW) region expected to grow nearly 50% between now and 2035.
- Vehicle miles of travel and annual cost of congestion projected to increase at greater rates.
- Metropolitan Transportation Plan (Mobility 2035 – 2013 Update) identifies just 1/4th of funding necessary to eliminate the worst congestion by 2035.
- Burdens on existing infrastructure:
  - Increasing age and wear
  - Damage from accidents
  - Changes in environmental conditions
  - Impacts to reliability/level of service
Capital/Operations Asset Management System

Data-Driven Project Solutions and Prioritization

PROGRAM AREA
- Congestion Management
- Sustainable Development
- Asset Management

Revenue Enhancement Options
- Mobility Options
- Urban Design
- Economic Development
- Demographics
- Climate/Weather Resiliency
- Right of Way Constraints
- Current Configuration Details
- Life-Cycle Costs
- Pavement Conditions
- Traffic Control Device Conditions
- Bridge Conditions
- Critical Infrastructure
- Recurring Congestion
- Non-Recurring Congestion

Project Prioritization & INVEST

Value Engineering Studies

Project Identification & Scoping
Climate Change/Extreme Weather Effects
Challenges to Mobility and Functionality

Frisco
Fort Worth
Palo Pinto County
Euless
Recent Conditions and Issues

- Eight of the DFW top-ten warmest years have occurred after 1998 (regional records kept since 1899)
  - #1 – 2006
  - #2 – 2012
  - #3 – 2008/2011

- Through May 24th, DFW recorded the 4th least year-to-date rainfall total in 2014

- Since 2010, period-to-date rainfall deficits in DFW exceeded 40 inches at many locations
NCTCOG Vulnerability Assessment Pilot Study

Project Overview

- Conduct multi-modal risk assessment of critical transportation facilities in the North Central Texas region
- Determine potential mobility, economic, and quality of life effects of impacted facilities
- Identify methods to incorporate vulnerability parameters into the traditional planning process
- Relate conclusions to performance data affecting project prioritization
City of Dallas (Streets, Emergency Management, & Police Departments)
- Provide jurisdictional performance data and reference historical weather-related reports at vulnerable roadway locations

Fort Worth Transportation Authority (“The T”)
- Provide maintenance data/reports for the Trinity Railway Express

University of Texas at Arlington (Colleges of Engineering, Science, & Urban and Public Affairs)
- Retrieve and analyze regional climate and hydrologic data
- Examine regional heat island effects and integration possibilities

Texas Department of Transportation (TxDOT)
- Provide asset sufficiency reports/research and maintenance data
- Identify/define potential exposure magnitudes and ranges of facility effects
CLIMATE CHANGE AND EXTREME WEATHER VULNERABILITY ASSESSMENT FRAMEWORK

1. DEFINE SCOPE

- Identify Key Climate Variables
  - Climate impacts of concern
  - Sensitive assets & thresholds for impacts

- Articulate Objectives
  - Actions motivated by assessment
  - Target Audience
  - Products needed
  - Level of detail required

- Select & Characterize Relevant Assets
  - Asset type
  - Existing v. Planned
  - Data availability
  - Further delineate

2. ASSESS VULNERABILITY

- Collect & Integrate Data on Assets
- Develop Climate Inputs
- Assess Asset Criticality (Optional)
- Identify & Rate Vulnerabilities
- Incorporate Likelihood & Risk (Optional)
- Develop Information on Asset Sensitivity to Climate

3. INTEGRATE INTO DECISION MAKING

- Incorporate into Asset Management
- Integrate into Emergency & Risk Management
- Contribute to Long Range Transportation Plan
- Assist in Project Prioritization
- Identify Opportunities for Improving Data Collection, Operations or Designs
- Build Public Support for Adaptation Investment
- Educate & Engage Staff & Decision Makers

1. DEFINE SCOPE

**IDENTIFY KEY CLIMATE VARIABLES**
- Climate impacts of concern
- Sensitive assets & thresholds for impacts

**ARTICULATE OBJECTIVES**
- Actions motivated by assessment
- Target Audience
- Products needed
- Level of detail required

**SELECT & CHARACTERIZE RELEVANT ASSETS**
- Asset type
- Existing v. Planned
- Data availability
- Further delineate
Define Vulnerability Assessment Parameters

- Parameters determined through initial Partner Coordination meetings (Summer 2013)
- Geographic Area:
  - Dallas and Tarrant Counties
- Transportation Assets:
  - Limited-access roadway facilities
  - Select major thoroughfares
  - Rail lines (transit and freight)
- Climate Stressors:
  - Periods of extreme heat
  - Heavy rain/flooding events
  - Drought conditions
2. **ASSESS VULNERABILITY**

- **Collect & Integrate Data on Assets**
- **Develop Climate Inputs**
- **Develop Information on Asset Sensitivity to Climate**
- **Assess Asset Criticality**
- **Identify & Rate Vulnerabilities**
- **Incorporate Likelihood & Risk**
NCTCOG Vulnerability Assessment Pilot Study (cont.)

Criticality of Transportation Assets

- Develop a comprehensive index of regional criticality based on:
  - Functional Classification
  - Project Prioritization (MTP/TIP)
  - Congestion Management Process (CMP)
    - System demand/reliability
    - Availability of alternative roadway and/or modal options
  - Safety/Security Criteria
    - Hazmat/Evacuation Routing
    - Urban Area Security Initiative (UASI)
  - Other Performance Measures
    - Factors from other FHWA Pilot Studies
    - Recurring repair/incident reports (TxDOT)
NCTCOG Vulnerability Assessment Pilot Study (cont.)

Coarse GIS Screening Tool

- 1-mile² grid system for the 12-county Metropolitan Planning Area (MPA)
- Based on USDA soil data and FEMA floodplain mapping
- Identifies locations of greater risk factors for additional study
- Ranking based on regional averages:
  - Flooding – Length/Area of streams, lakes, floodplains, & hydric soils
  - Heat/Drought – Range of Soil Linear Expansivity (LEP)
  - Composite Vulnerability
NCTCOG Vulnerability Assessment Pilot Study (cont.)

Regional Climate/Extreme Weather Data

- **Climate**
  - Historical frequency of events (1899-2013)
  - Three scenarios of GCM projections (2041-2060 and 2081-2100 timeframes)

- **Urban Heat Island**
  - Added effects on heat, precipitation, and soil moisture/permeability
  - Local zones/areas of influence

- **Hydrologic Model**
  - Changes to infiltration capacity and runoff volume/characteristics
  - Spatial effects on drainage basins
Determine Asset Sensitivity to Climate

- Thresholds establish the relationship between asset categories, stressors, and sensitivity to potential impacts

- Threshold variances:
  - Exceedance severity and/or duration
  - Materials and design
  - Geographical issues

- Particular attention to be focused on soil moisture content
  - Regional differences in types and effects
  - Provides bridge between drought and flash flooding
NCTCOG Vulnerability Assessment Pilot Study (cont.)

Identify Risk and Potential Impacts

- **Risk Assessment Matrix**
  - Identifies most vulnerable assets
  - Tool for project prioritization

- **Asset-Specific Risk Analysis**
  - Outlines climate stressors
  - Nature of potential impacts

- **Maximizing Asset Life-Cycle**
  - Potential concepts for focused future studies
  - Mitigation vs. Replacement
NCTCOG Vulnerability Assessment Pilot Study (cont.)

Upcoming Schedule

- **June 2014**
  - Initiate University Partnership Program effort to retrieve/analyze climate and hydrologic model data
  - Conduct regional workshop with providers to define asset thresholds and survey maintenance needs

- **July 2014**
  - Finalize criticality index and GIS screening tools

- **August 2014**
  - Prepare risk matrix and profile fact sheets for selected assets

- **October 2014**
  - Complete Final Report
Vulnerability Assessment Outcomes

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- List of Vulnerable Assets
- Repeateable Methodology

- Partnerships
  - UTA Center of Excellence
  - Regional Asset Management Working Group
Capital/Operations Asset Management System
Data-Driven Mitigation and Adaptation Efforts

PROGRAM AREA
- Congestion Management
- Sustainable Development
- Asset Management

Revenue Enhancement Options

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CAPITAL/OPERATIONS ASSET MANAGEMENT SYSTEM
Climate Change/Extreme Weather Implications
Anticipated Future Needs/Actions

- Incorporate research, results, and lessons learned into the upcoming Mobility 2040 Plan development process
- Develop partnerships with providers to update design manuals with improved focus on infrastructure resiliency
- Provide linkages for preparation of future State Preparedness Reports (NCTCOG Emergency Preparedness)
- Perform a post-evaluation of resiliency strategies through the INVEST project
- Identify and/or improve best practices/measures in the monitoring and evaluation of vulnerability factors
- Investigate climate change and weather-related impacts among various transportation system investment strategies
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