Addressing Climate Change Vulnerabilities to Transportation Infrastructure

Lessons from Michigan and the Austin, TX region

presented to

Transport Chicago 2014

presented by

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Climate Change Context

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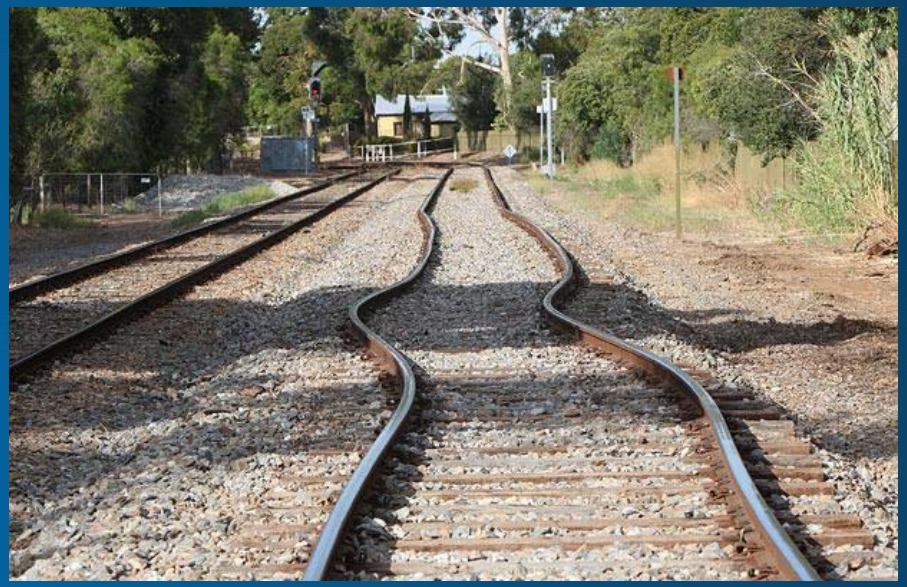
What is Climate Change Vulnerability?

Climate change and extreme weather vulnerability in the transportation context a function of a transportation asset or system's **sensitivity** to climate effects, **exposure** to climate effects, and **adaptive capacity**



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Objective of Climate Vulnerability Assessments

- Assess vulnerability of transportation infrastructure to climate change
- Develop adaptation strategies and update asset management process to address these vulnerabilities

Vulnerability Assessment

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Adaptation

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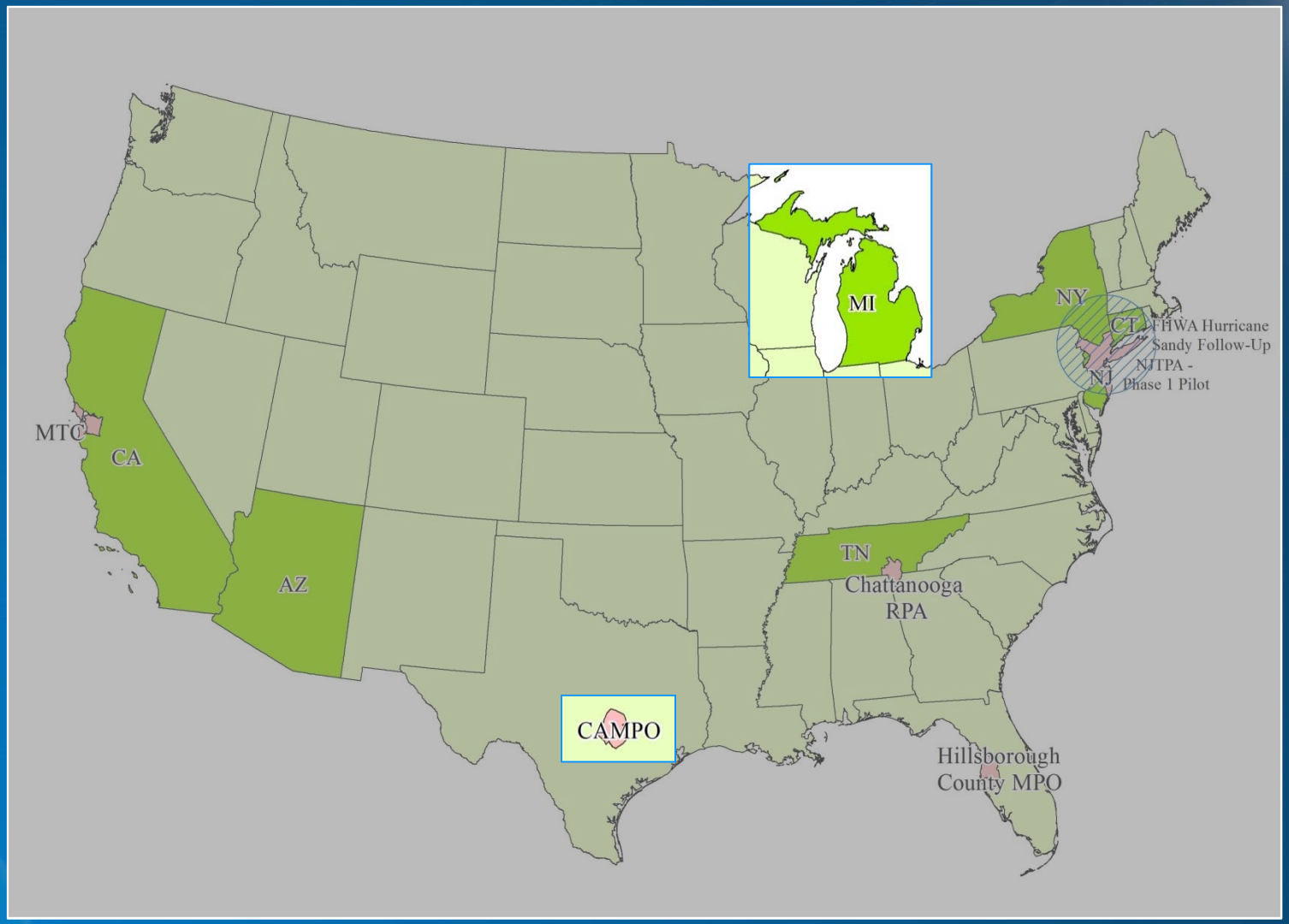
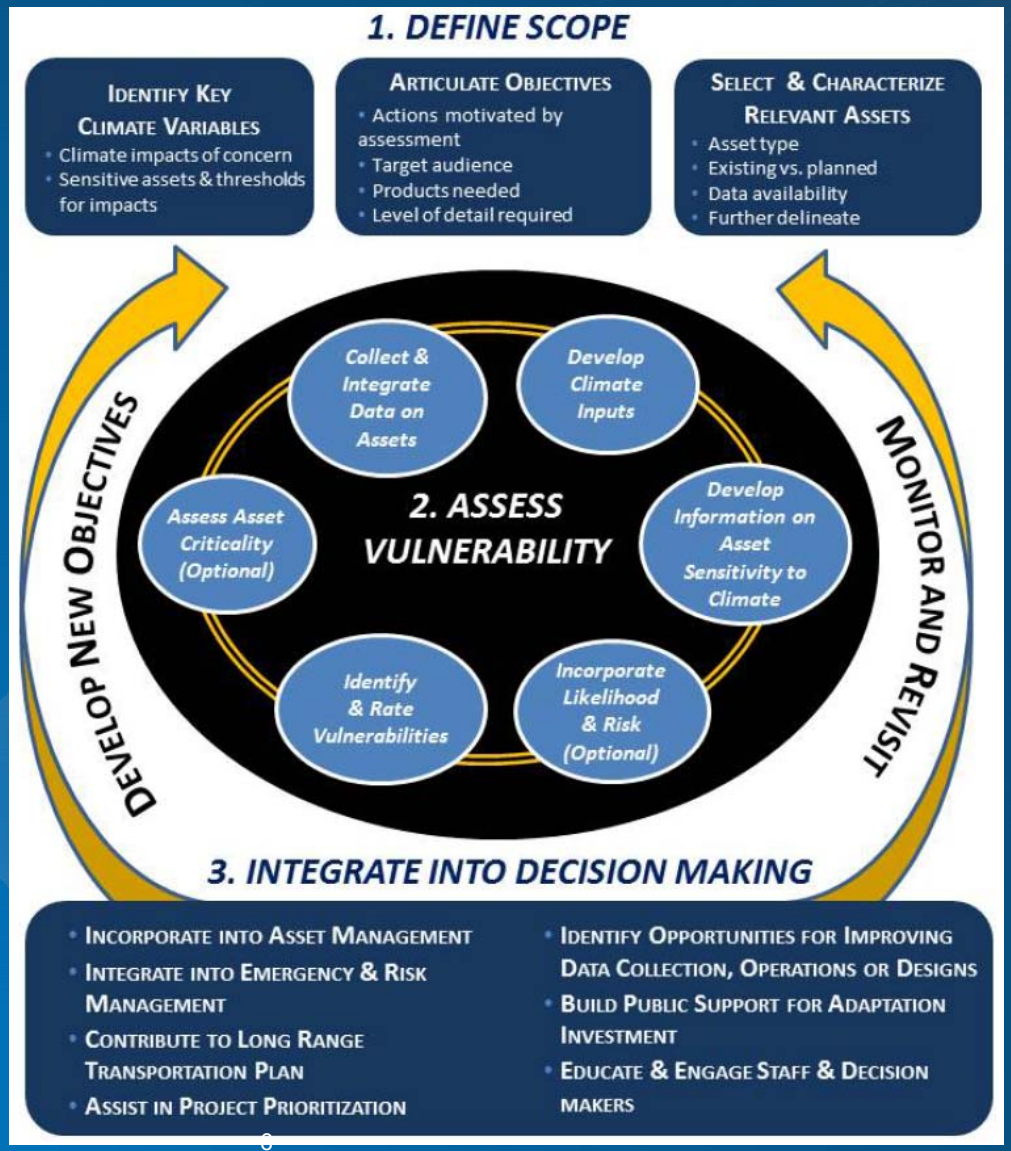
FHWA-Sponsored Climate Vulnerability Assessment Locations

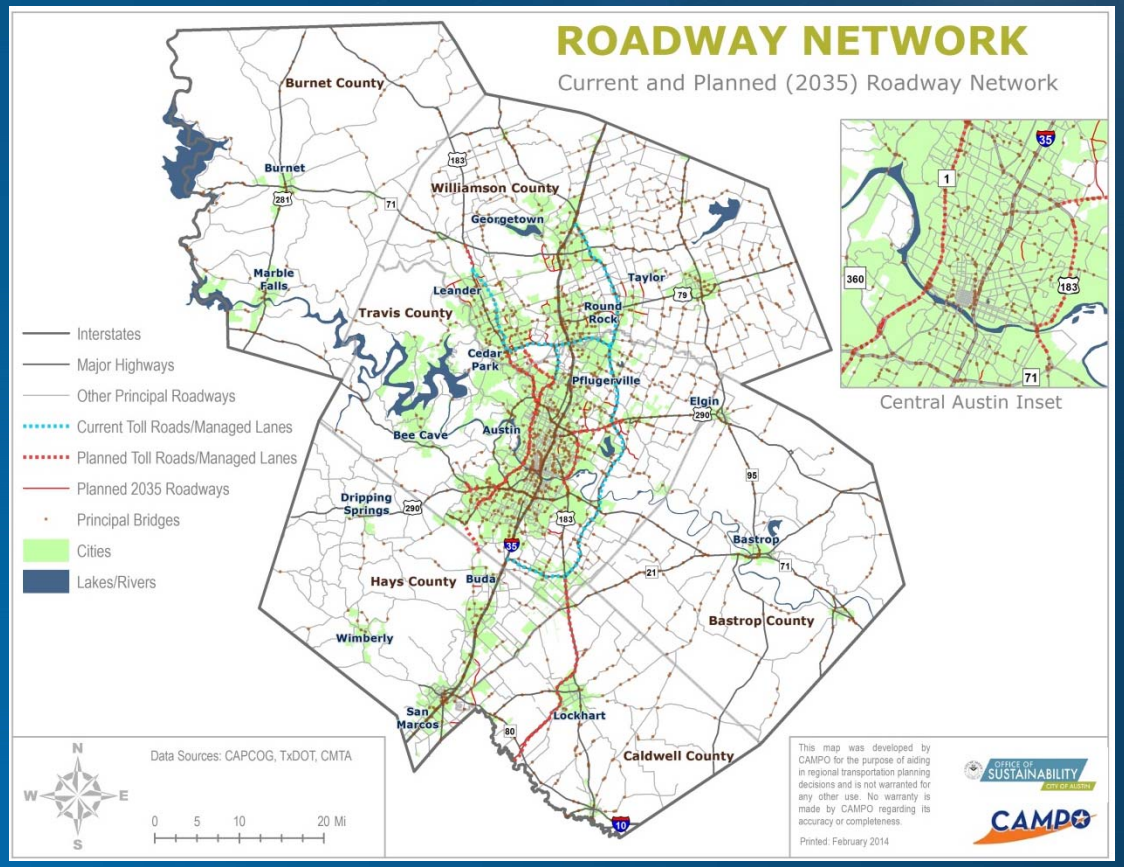


FHWA Vulnerability Assessment Framework



Asset Inventory

- A meaningful vulnerability assessment requires robust, accurate transportation system data
- Obtaining the best available spatial and attribute data in Geographic Information System (GIS) format a critical first step



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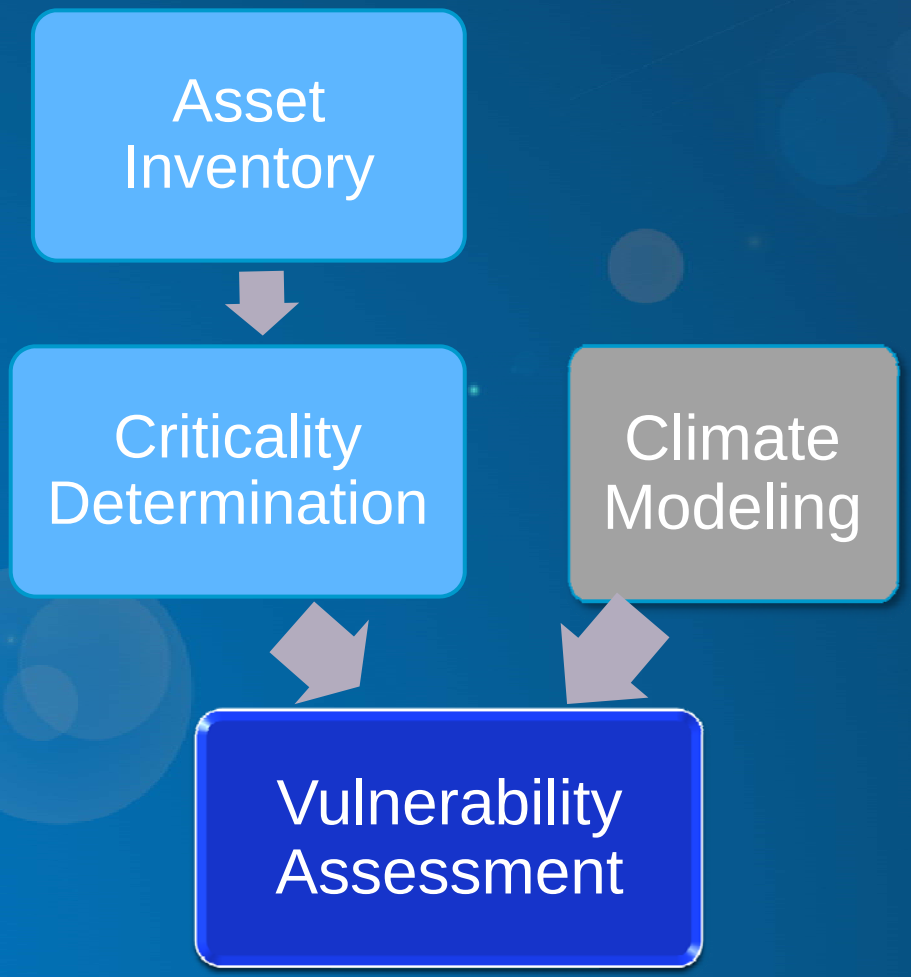

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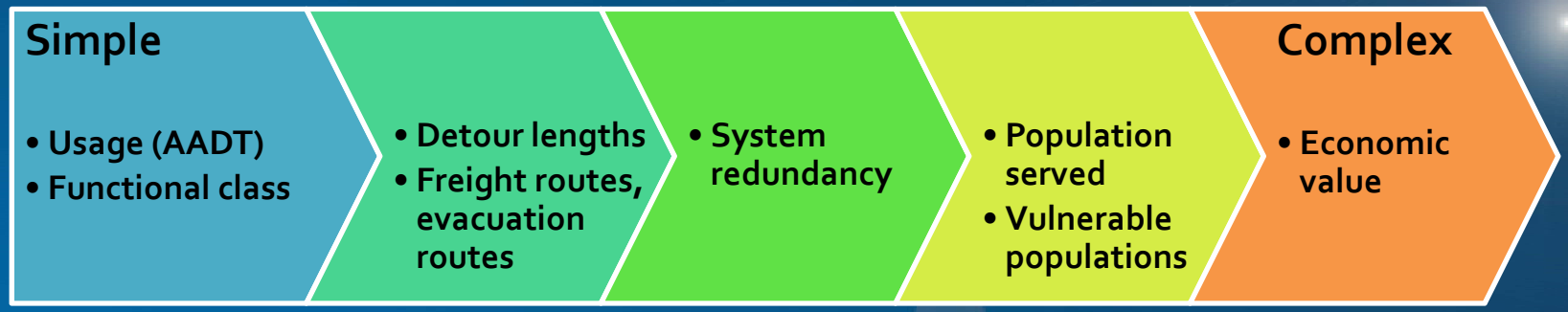
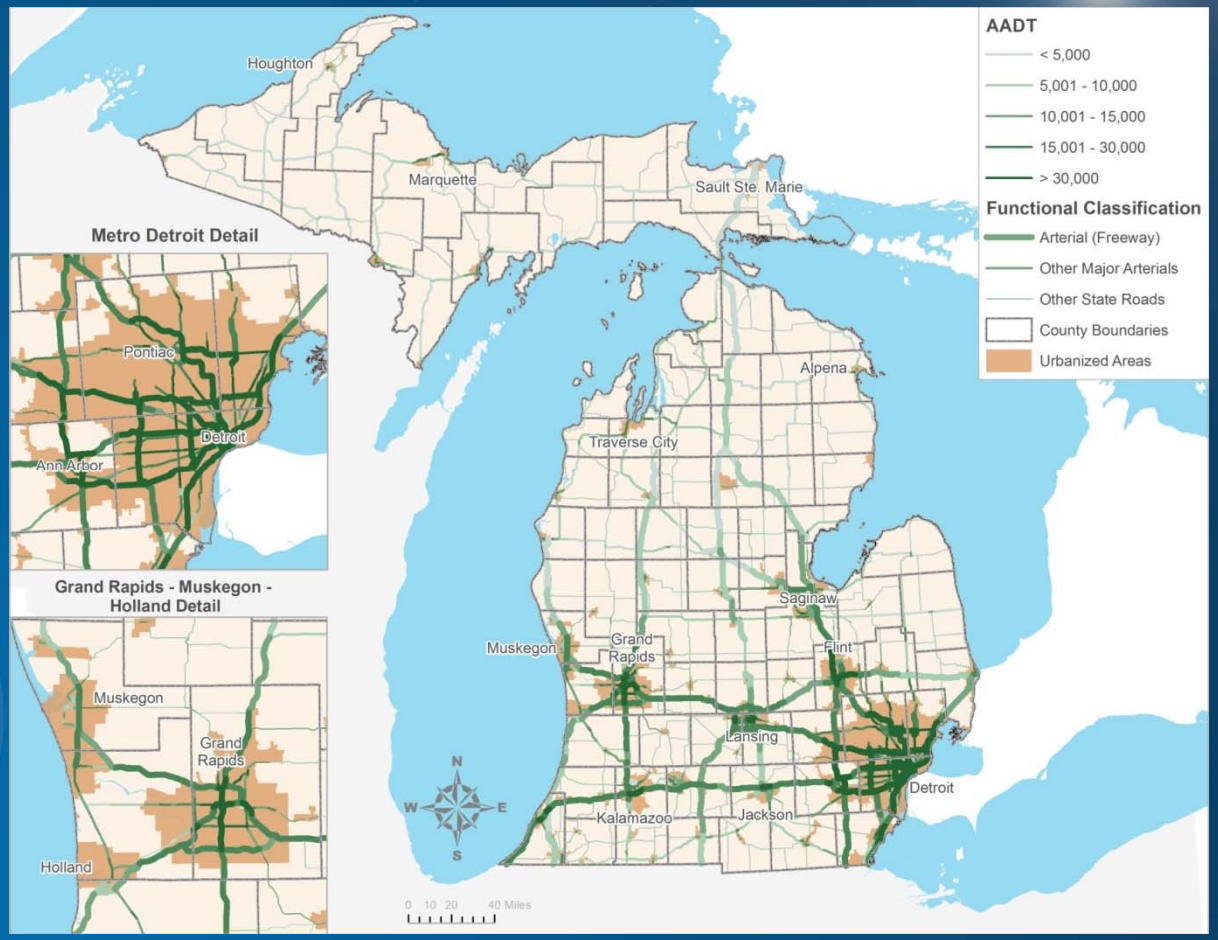
Range of Approaches for Defining Criticality



- Approaches for assessing asset criticality can range from simple to complex
- Criticality assessment attempts to define the consequence of asset unavailability
- Used to screen down number of assets for vulnerability assessment

Determining Asset Criticality - Michigan

- Using “desk review” approach
- Incorporating some stakeholder input
- Ranking assets based on “low, medium, high” criticality



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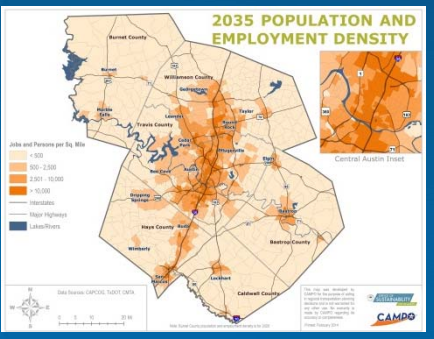
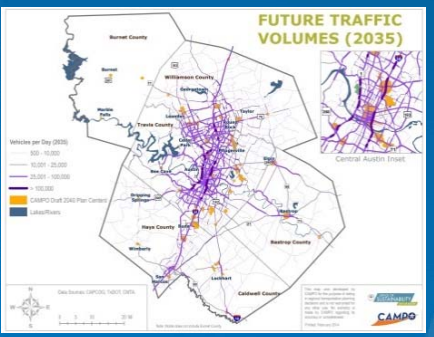
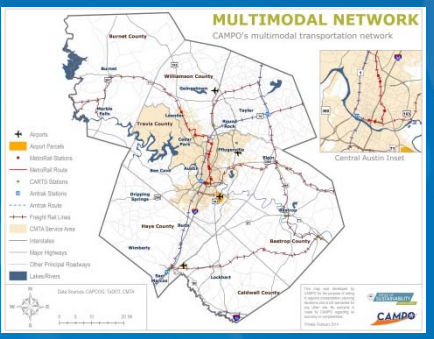
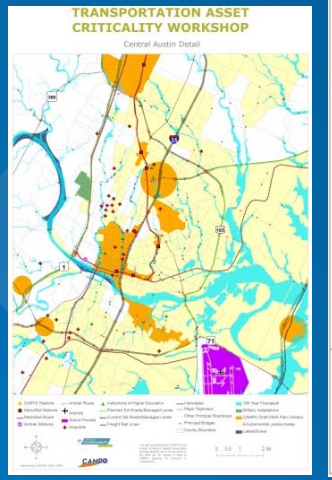
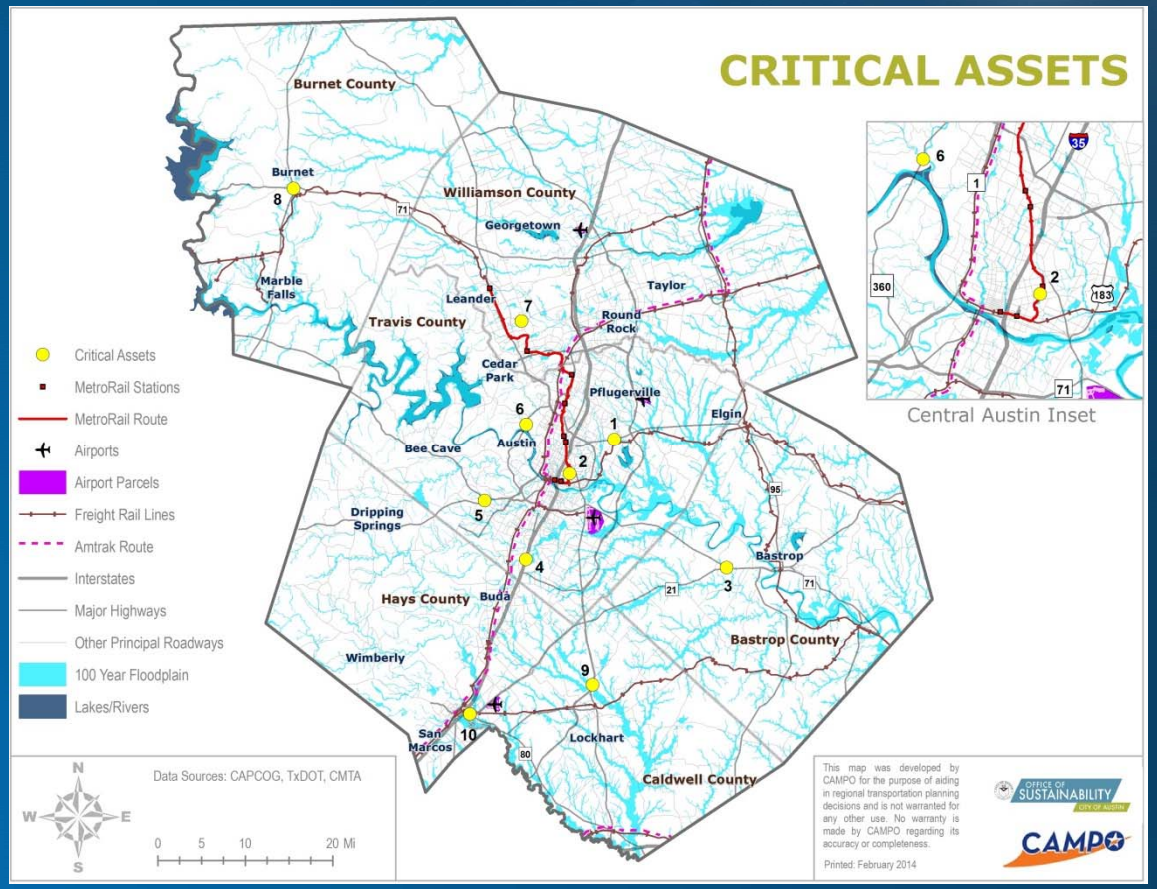
Determining Asset Criticality – CAMPO











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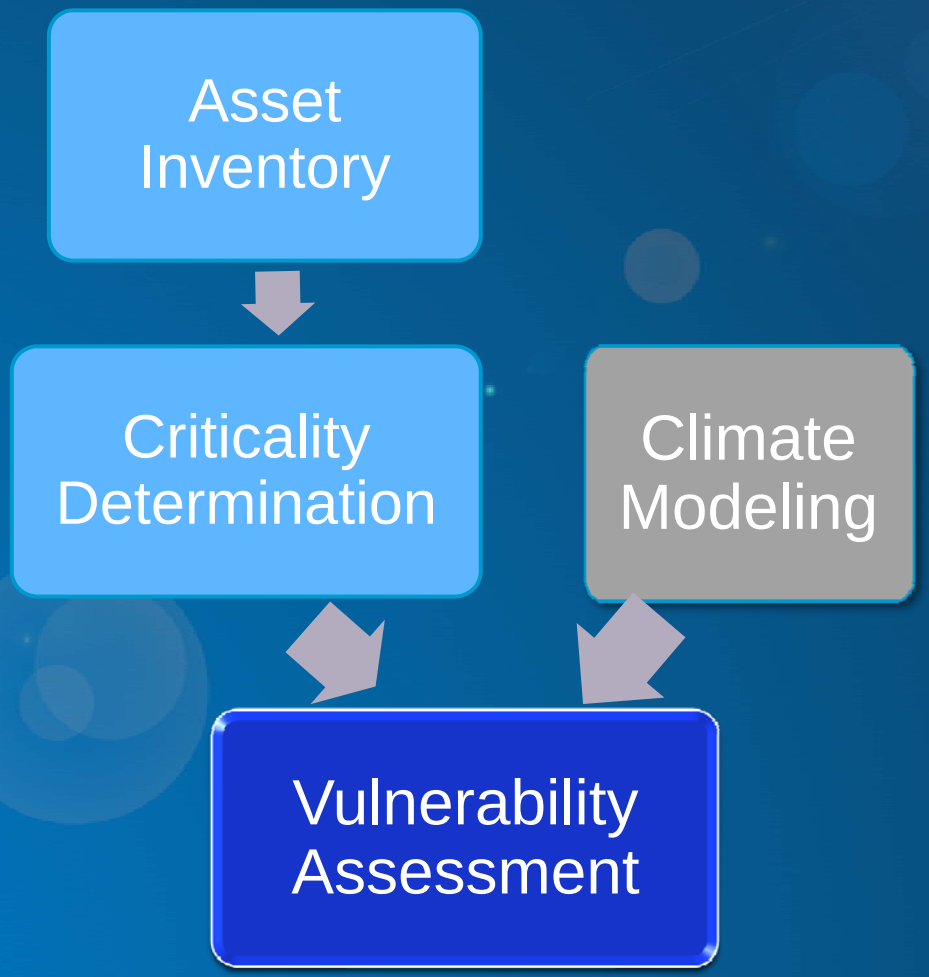

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Climate Stressors: CAMPO

- Extreme weather: Precipitation (both heavy rainfall events and ice storms), temperatures, wildfire, drought

Aftermath of wildfire - 2011

Drought: Disrupted Water - 2011

Buckling roads - 2009

Flooding: Tropical Storm Hermine - 2010

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Extreme Weather Sensitivities in Central Texas

Asset Type	Flooding	Drought	Extreme Heat	Cold/Ice	Wildfire
Roads	Major impact, especially on rural roads (disruption, washout)	Cracking, failures on edge of pavement; soil destabilization if roadside vegetation affected	Some cracking and degradation, especially on edge of pavement	Hazardous roadway conditions; cracking on longitudinal joints	Disruption; Low short-term impact on pavements; destruction of guardrail and sign posts
Bridges	Minimal impact, except where heavy debris and sediment loads	Minimal impact	Minimal impact	Hazardous driving conditions, icing	Operational disruptions
Rail	Service interruptions	Minimal impact	Speed restrictions, delays during extreme heat; risk of thermal misalignment	Damage to switches	Major impact, if exposed
Transit (bus)	Routes disrupted, but may have ability to detour	Damage to routes, but may have ability to detour	A/C issues in high heat	Risks to passenger health at stops	Operational disruptions

Major Impact	Moderate Impact	Lesser or long-term impact	Minimal or no impact

Legend

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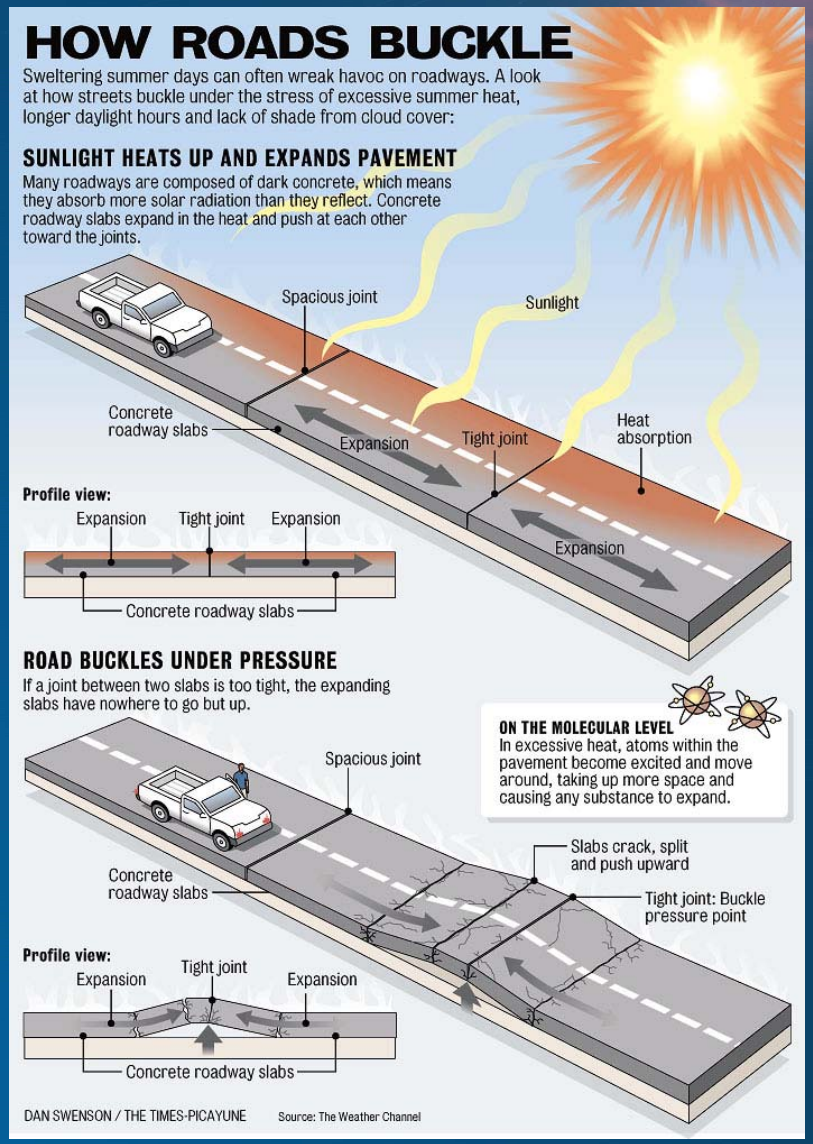
CAMPO Sensitivity Example: Extreme Heat & Drought

- **Drought:** Cracking, failures on edge of pavement; soil destabilization if roadside vegetation affected
- **Extreme Heat:** Some cracking and degradation, especially on edge of pavement



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Extreme Weather Sensitivity Thresholds in Central Texas – Pavement Deterioration

Thresholds in CAMPO region for pavement cracking/deterioration:

- » Extended temperature > **100°F** (empirical)
- » Average 7-day maximum temperature > **108°F** (design)
- » Drought lasting longer than **14 days**
- » Alternating wet and dry weather patterns, cycling between a few days or weeks
- » Extremely wet conditions for > **1 month**
- » Temperatures < **50°F**

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Climate Stressors: Michigan

Issues of concern:

- » Increased erosion from intense precipitation, decreased snow/increased rain
- » Bridge scour
- » Freeze/thaw cycle
- » Great Lakes ice cover and impact on lake effect snow; lake levels
- » Road buckling

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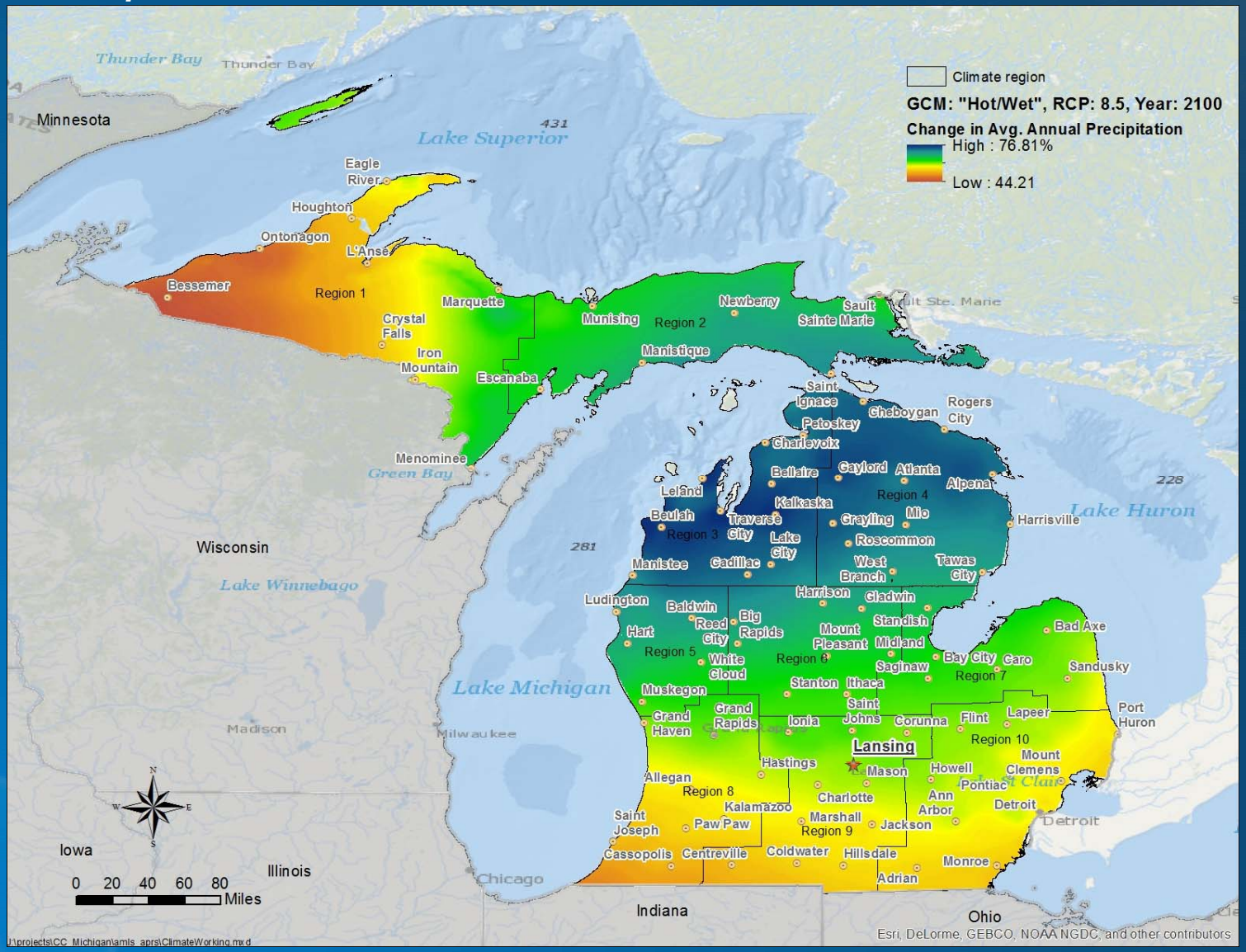
Climate Stressors: Michigan

Issue(s) of Concern	Climate Variable for Analysis	Operationalized Climate Variables
Increased erosion and flooding from intense precipitation (particularly extreme precipitation events in a 3-6 hour time period)	Extreme precipitation	• Change in 25, 50, and 100-year rain events • Change in precipitation as snow vs. rain

Sample of Climate Projections: Michigan

"Worst Case" Scenario: 44 – 77% increase in Average Annual Precipitation



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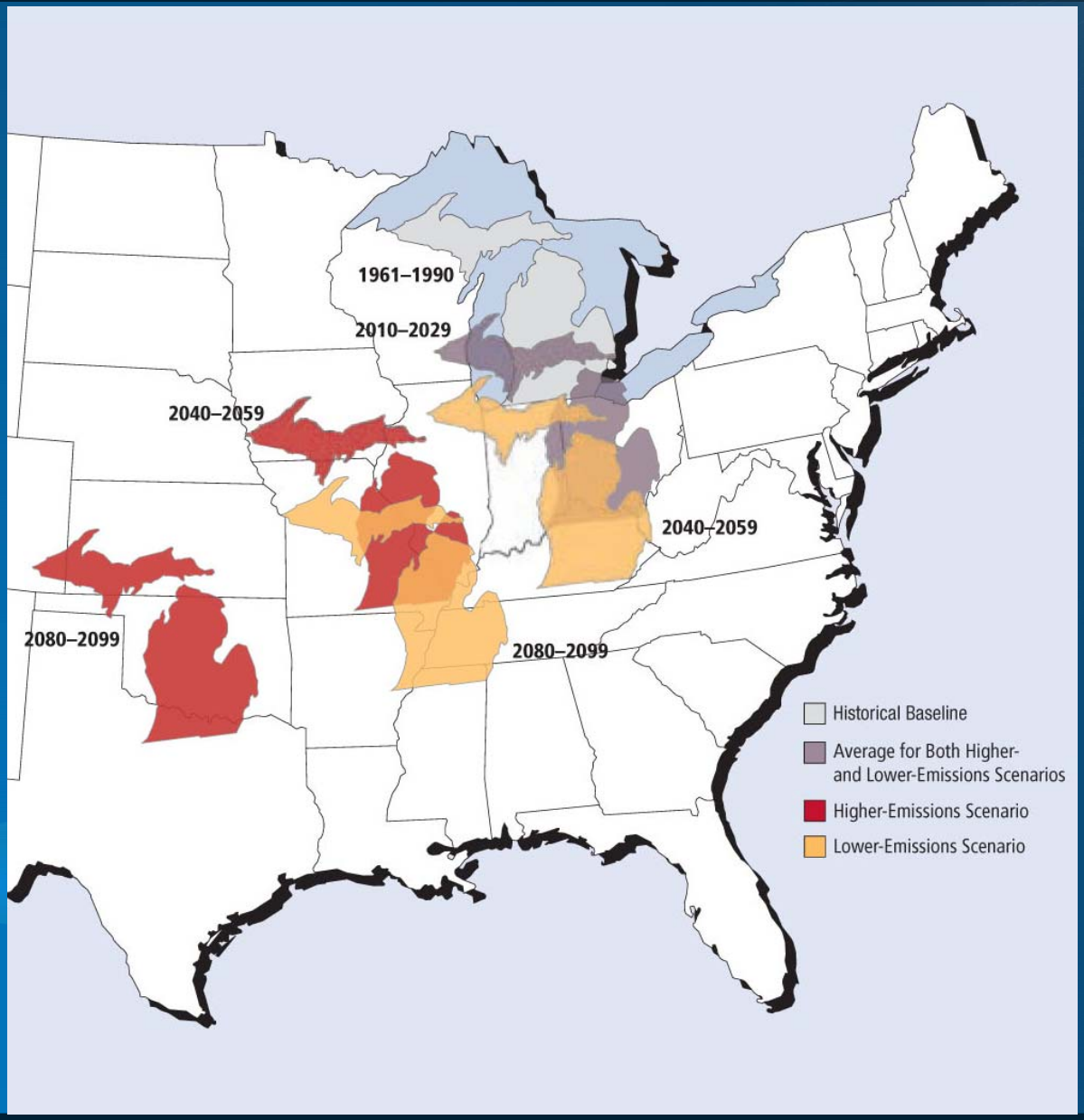
Michigan's Shifting Climate



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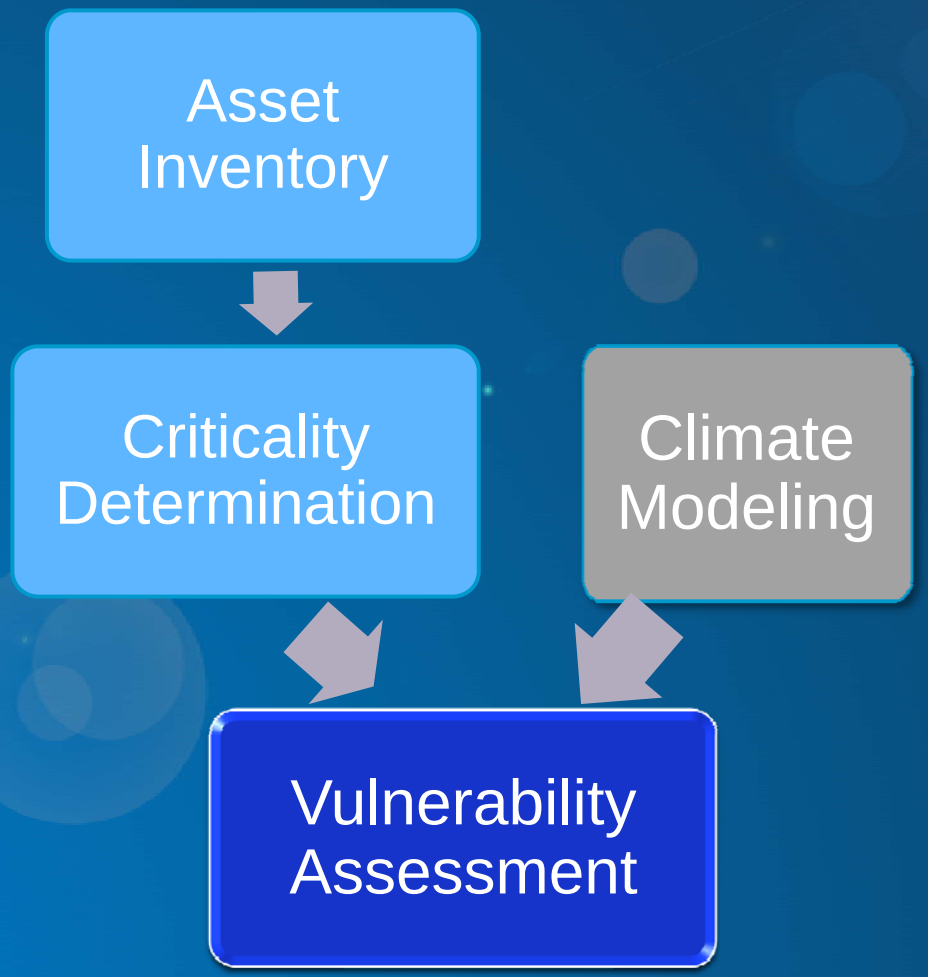

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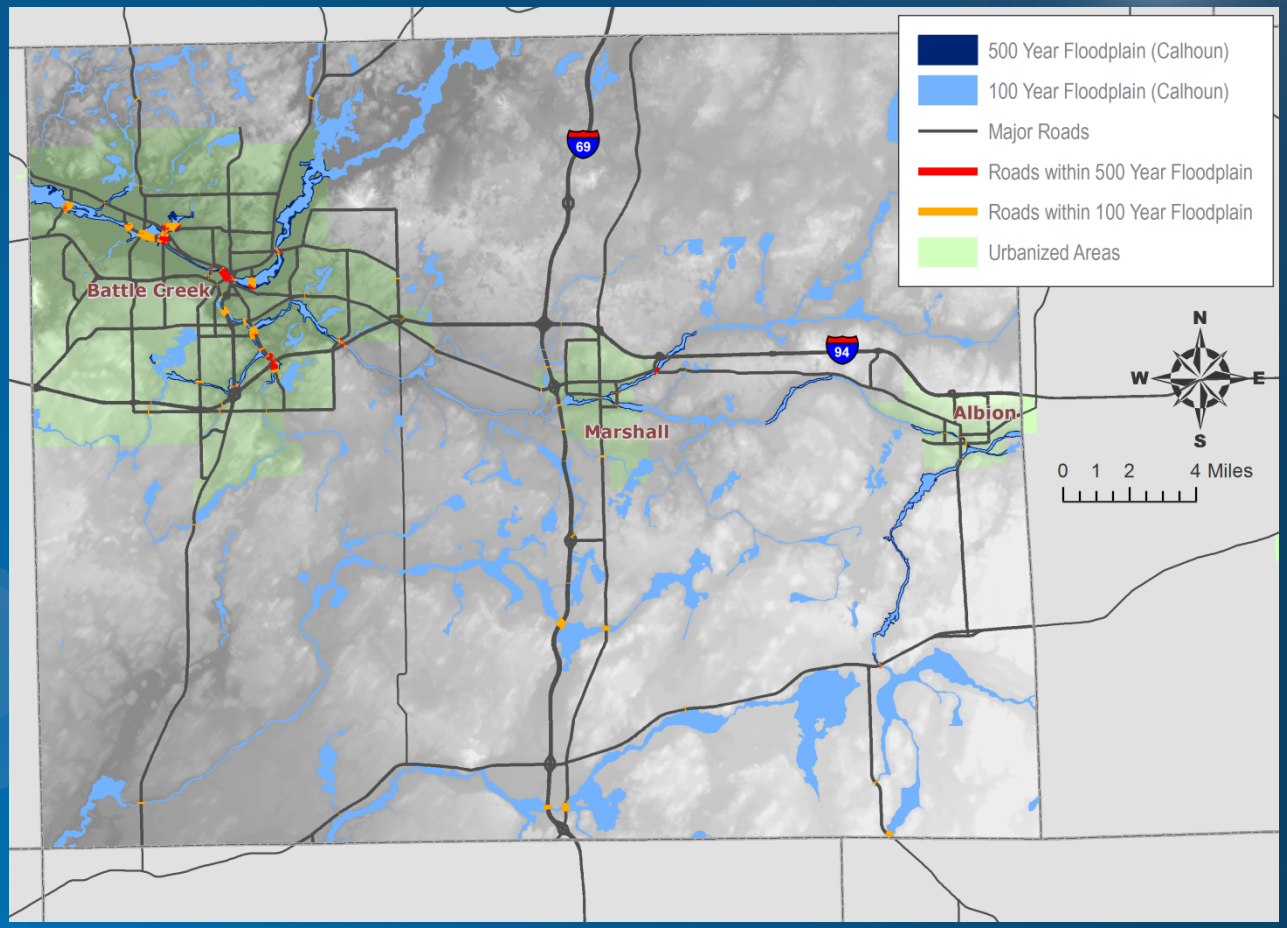
Michigan Vulnerability Example: Flooding

	Major Roadways
Total in County	383 Miles
Number in 100 Year Floodplain	8.5 Miles
% in 100 Year Floodplain	2.2%
Number in 500 Year Floodplain	10 Miles
% in 500 Year Floodplain	2.6%



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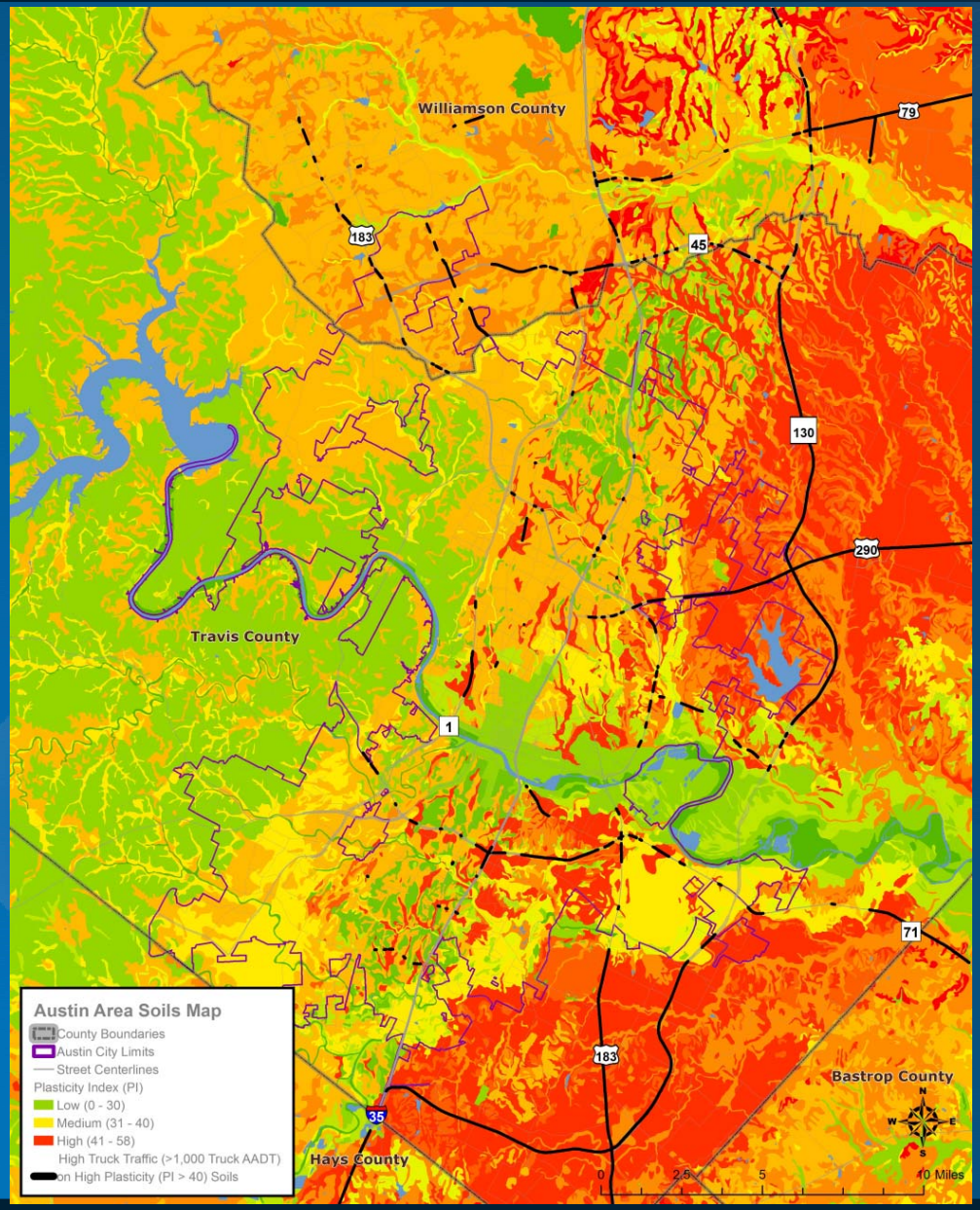
CAMPO Vulnerability Example: Extreme Heat & Drought



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Final Step: Integrate Findings into Decision-making Processes

- Educate staff regarding overall climate risks to the agency's transportation system
- Inform the development of adaptation strategies, such as updated design standards
- Site new assets in areas less vulnerable to climate change

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THANK YOU!