Transportation Resilience

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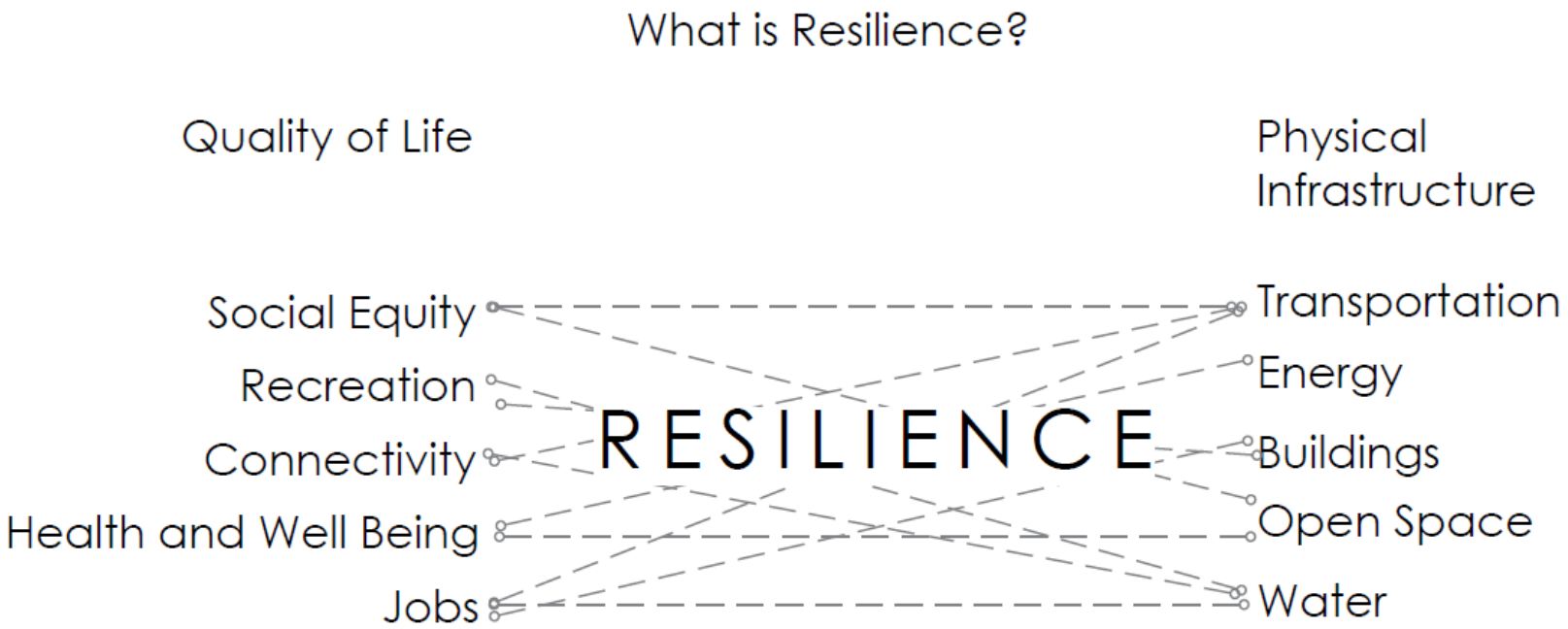
Overview

- How we think about climate's impact and building resilience
- Current MnDOT practices that build climate resilience
- Ongoing MnDOT Efforts
  - Vulnerability Assessment
  - Integration of Climate Vulnerability
  - Collaborative Projects

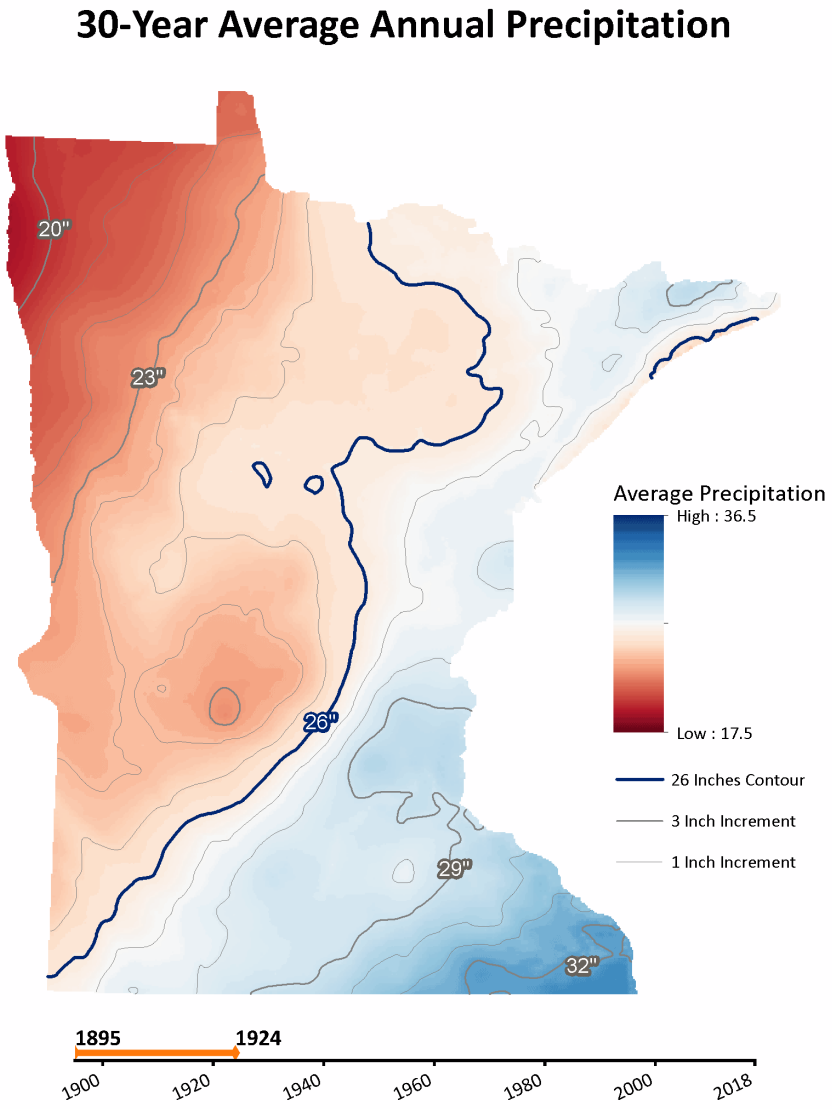
Climate Resilience



Resilience

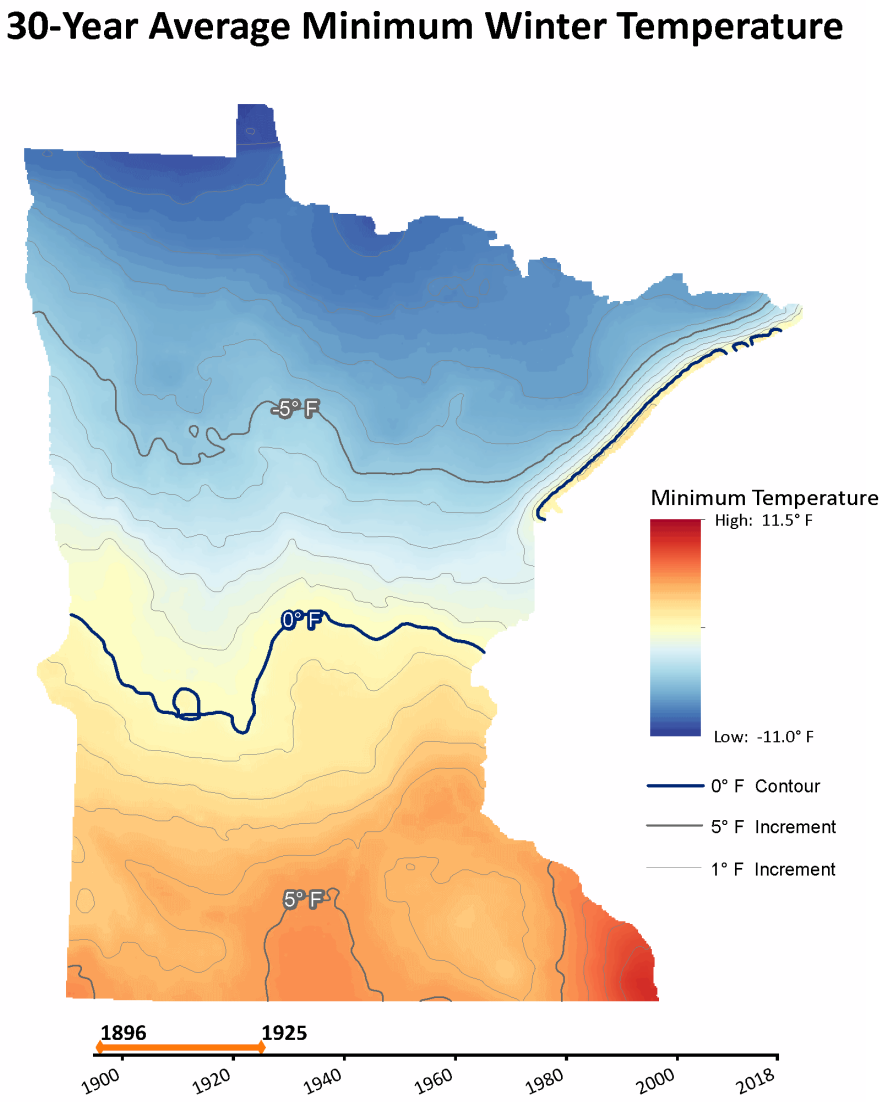
Resilience can be seen as the ability of the physical environment to respond to forces; we as the people can equip the physical environment to respond to forces in a positive way. Therefore, the questions we need to ask are: is the physical environment increasing the quality of life? Is the physical environment aiding natural systems? We can implement green infrastructure that not only aids in the combat of climate change but also increases the quality of life for neighborhoods, communities, and all of Providence.

Shift in Average Annual Precipitation



https://www.dnr.state.mn.us/climate/historical/annual.html

Shift in Average Annual Winter Low



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Climate Change Impacts on Transportation

Climate Impacts	Likelihood this will change in MN over the next 20 years	Potential Negative Implications for the Transportation System
Heavy Precipitation / Flooding	**Very High**	▪ Slope failures and erosion (More mudslides, sink holes, road bed failure) ▪ **Increased large-scale river flooding and localized flooding** (bridge scour, roadway erosion, inundation, construction disruption, etc.) ▪ More frequent and extensive inundation of low-lying areas (both temporary and permanent)
Warmer Winters	**Very High**	▪ Increase in overnight icing and in freeze/thaw cycles, leading to reduced pavement conditions and life cycles length ▪ **Increase in average winter precipitation** and more extreme precipitation
New Species Ranges (mainly due to warmer winters)	High	▪ Soil erosion from vegetation loss ▪ Increase in invasive species populations ▪ Wetland site failure
Drought	Medium	▪ Roadside vegetation stress and increases soil erosion ▪ Low stream and ground water flow
High Heat	Medium-low	▪ Pavement and rail buckling ▪ Increase in vehicles overheating and electrical system malfunctions ▪ Limitations on construction hours
Wildfires	Low	▪ Immediate and significant threat to human safety ▪ Increased risk of future flooding and slope failure
Severe Wind	Low	▪ Severe wind-related road closures, blown-down trees, signs

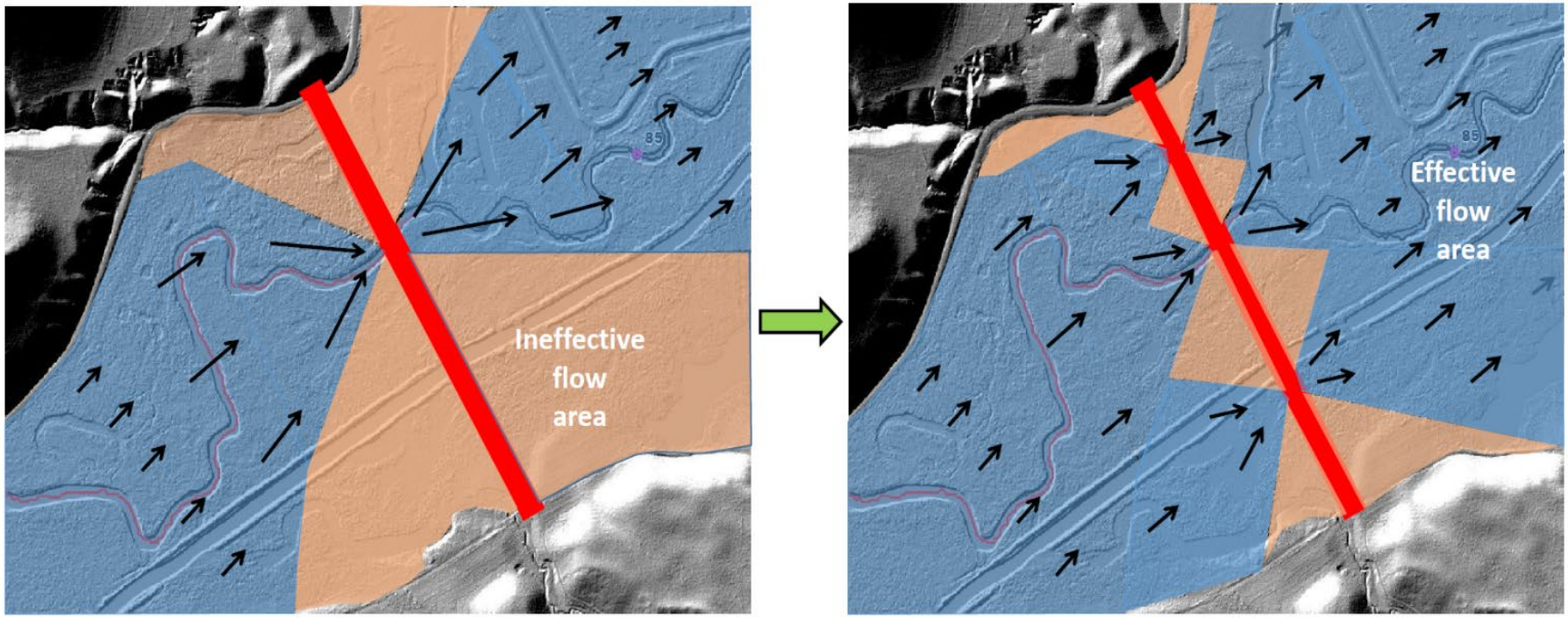
MnDOT Resilience Practices

Program Area	Current Practices
Planning	• Flash Flood VA and Extreme Flood VA • Slope Stabilization Guide and Slope VA (multi-phased)
Design and Environmental Review	• Bridge Manual (draft language) • MN AOP Guide • Geomorphic Design
Construction	• Stormwater Erosion Control • State Flood Mitigation Program • Sustainable Pavements
Maintenance & Operations	• Living Snow Fences • Salt Management • Native and Resilient Plants • On-site Solar Energy • Asset Management
Emergency Response	• State Aid Betterment • Emergency Management and Response
Overarching Initiatives	• Advancing Transportation Equity • Active Transportation and Complete Streets • EV and EV Infrastructure

Example of Practice with Resilience Co-benefits

Overview of Traditional VS Geomorphic Design Approach

Basic Approach



Traditional Approach

Geomorphic Approach

https://www.dnr.state.mn.us/climate/historical/annual.html

Example of Practice with Resilience Co-benefits

- New Aquatic Organism Passage guidance
- “What’s good for the fish is good for the climate”

Peter Leete (2013)

Natural substrate on the bottom of the stream and adequate water depth demonstrate that this culvert provides AOP by connecting the upstream and downstream reaches of this stream.

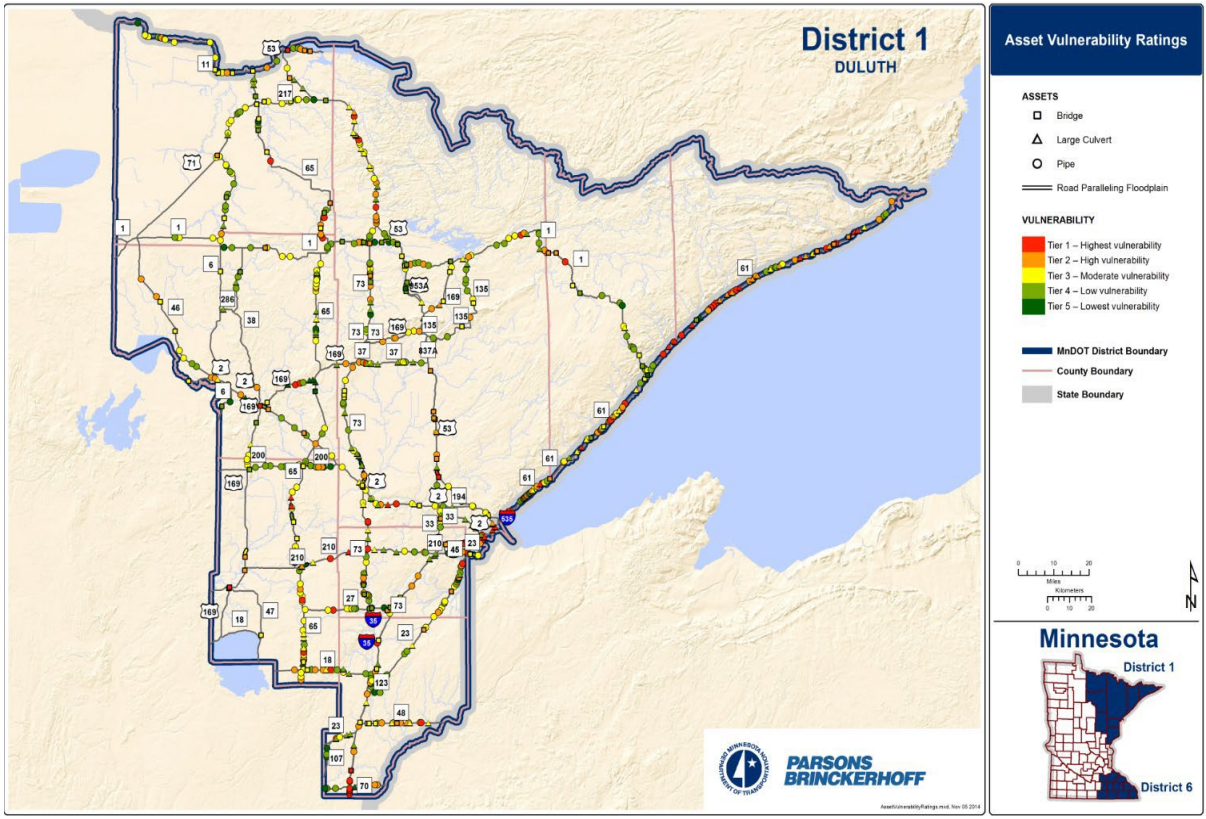
Ongoing Efforts

Adaptation Action	Status	Action Description
Complete System-wide Climate Vulnerability Assessment	In Progress	Develop a set of climate projections and use assess infrastructure vulnerability using them.
Incorporate findings into Asset Management	Planned	Integrate findings of the vulnerability assessments into asset management (BRIM and TAMS)
Update Design Guidelines	Planned	Review design guidelines using climate projections and incorporate changes to maintain performance into the future
Protect Environmental Justice and Vulnerable Populations	In Progress	Improve metrics for vulnerable population to incorporate it into decision-making
Downscaled Climate Data	Not started	Allows for more detailed and region-specific climate forecasting. MnDOT play a support role
Actions with Adaptation Co-benefits	In Progress	Identify, support, and pilot projects with potential to increase resilience
Resilience Research	In Progress	Continue to develop state specific research to address data and information gaps

Ongoing Projects

Climate change increases infrastructure vulnerability

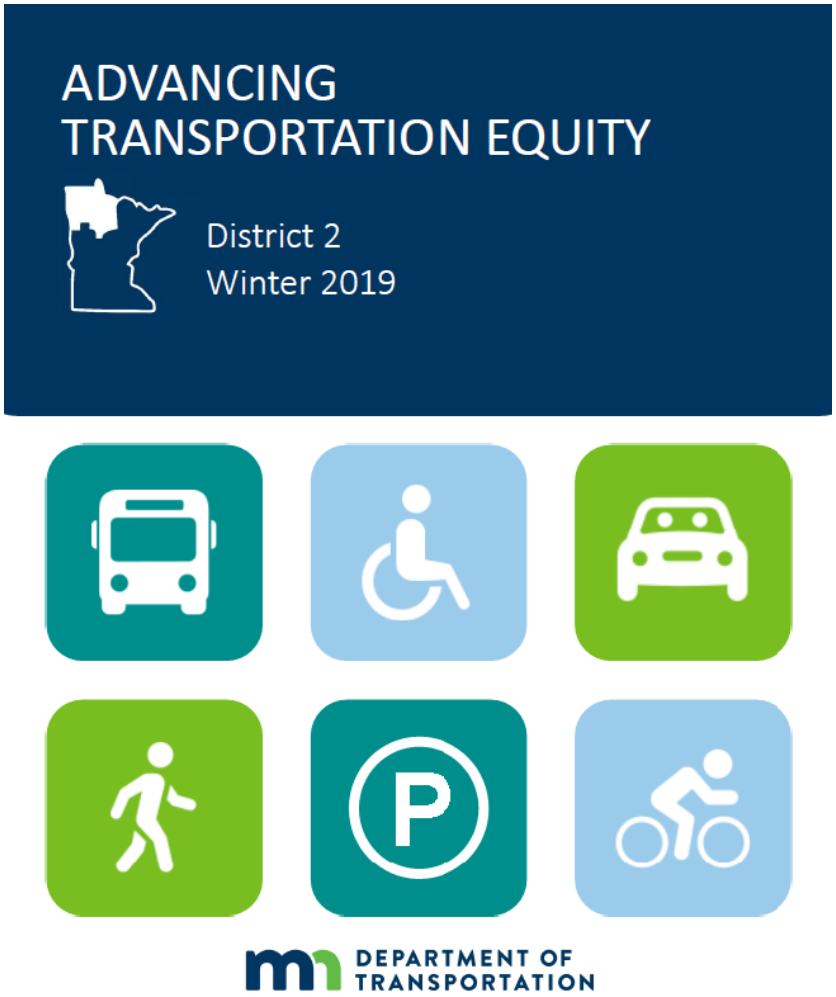
- Ongoing Extreme Flood VA will result in climate projections and a formula for analyzing asset vulnerability
- Incorporate findings into BRIM and TAMS
- Use findings to update design guidance



Betterment Example

Resilience Co-Benefits

- Social Vulnerability – climate adaptation benefits of reducing vulnerability (health, equity, access, etc.)
- More resilient transportation system supports healthy community (ex: mode redundancy)
- Compost as stormwater mitigation, and sequester carbon
- Better understand the impacts of changes in freeze/thaw cycles



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Thank you

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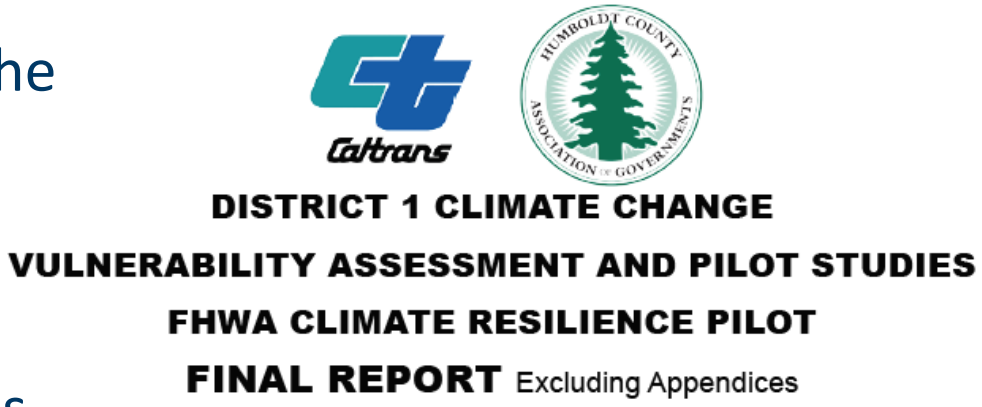
Extra Slides

Resilience at the Federal Level

- Senate Bill, America's Transportation Infrastructure Act
- AASHTO is aware of the need – MnDOT is part of the Steering committee
- MN FHWA has Identified resilience as a risk to MnDOT
  - Corridor Resilience Assessment on TH52 (built from work in CO and UT)
  - Peer Exchange with other state DOTs

Review of Other State DOTs

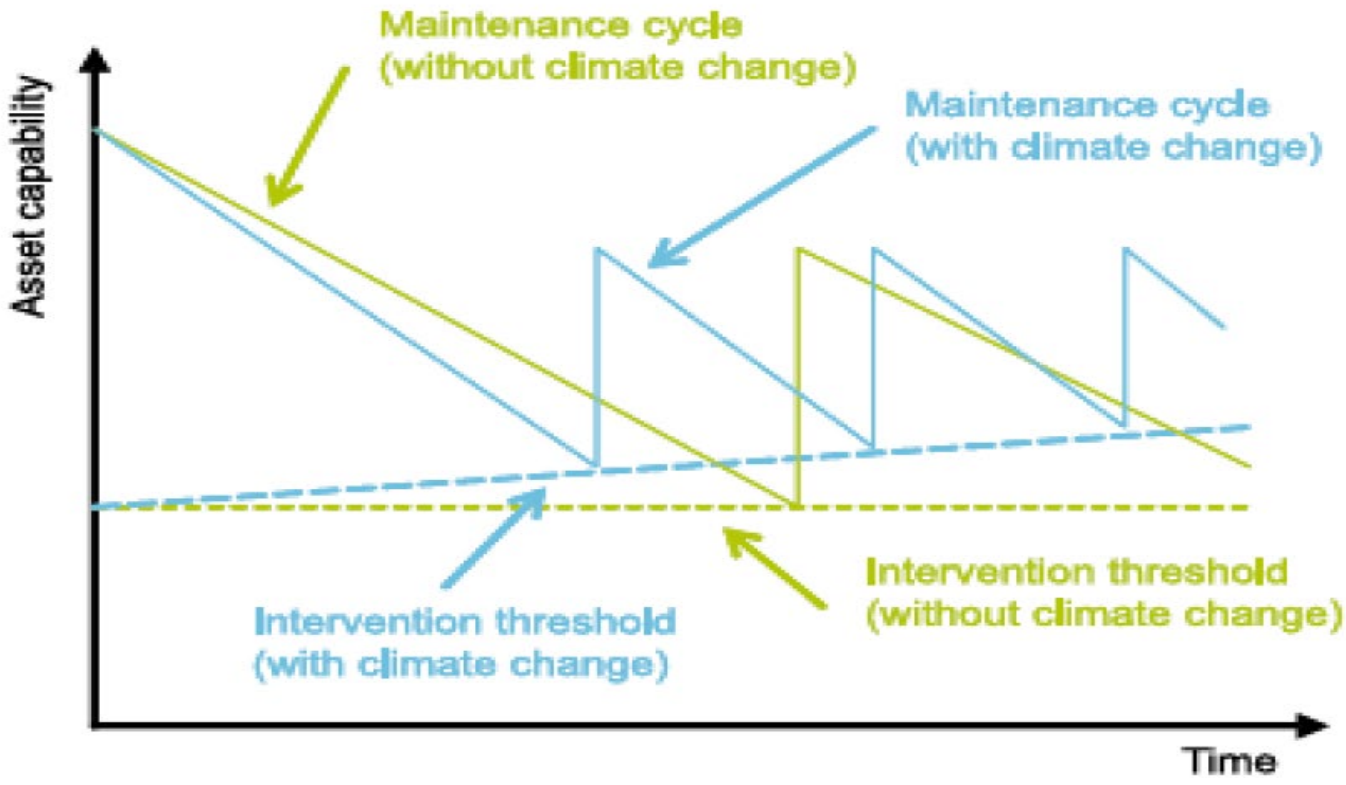
- Vulnerability Assessment is the critical first step
- Select climate projections
- District-level adaptation plans (Caltrans)



- State Adaptation Plan has helped other DOTs advance efforts
- Resilience Hub – having centralized location for all related info advances work more quickly and accelerates collaboration (ex: resilientma.org)

Example of How Climate Change Shifts Practices

U.S. Department of Transportation
Federal Highway Administration



UK Highways Agency, Climate Change Adaptation Strategy and Framework.

Potential Resilience Collaborations

Projects with Resilience Co-benefits

- Compost as stormwater mitigation, and sequester carbon
- Increase/improve use of vegetation to stabilize slopes

Research Projects

- Better downscaled climate data
- Change in Freeze/Thaw cycles
- Others?

Summary of Next Steps

- Extreme Flood Vulnerability Assessment and develop set of climate projections
  - Incorporate the findings into BRIM and TAMS
  - Update Design Guidelines: review current design guidelines and identify where climate projections can be incorporated
- Improve the use of social vulnerability in decision making
  - Gather feedback on the district reports
  - Establish EJ and Social Vulnerability metrics that are consistent and inclusive, and incorporate into decision-making processes
- Pilot Corridor Resilience Assessment