Metropolitan Council

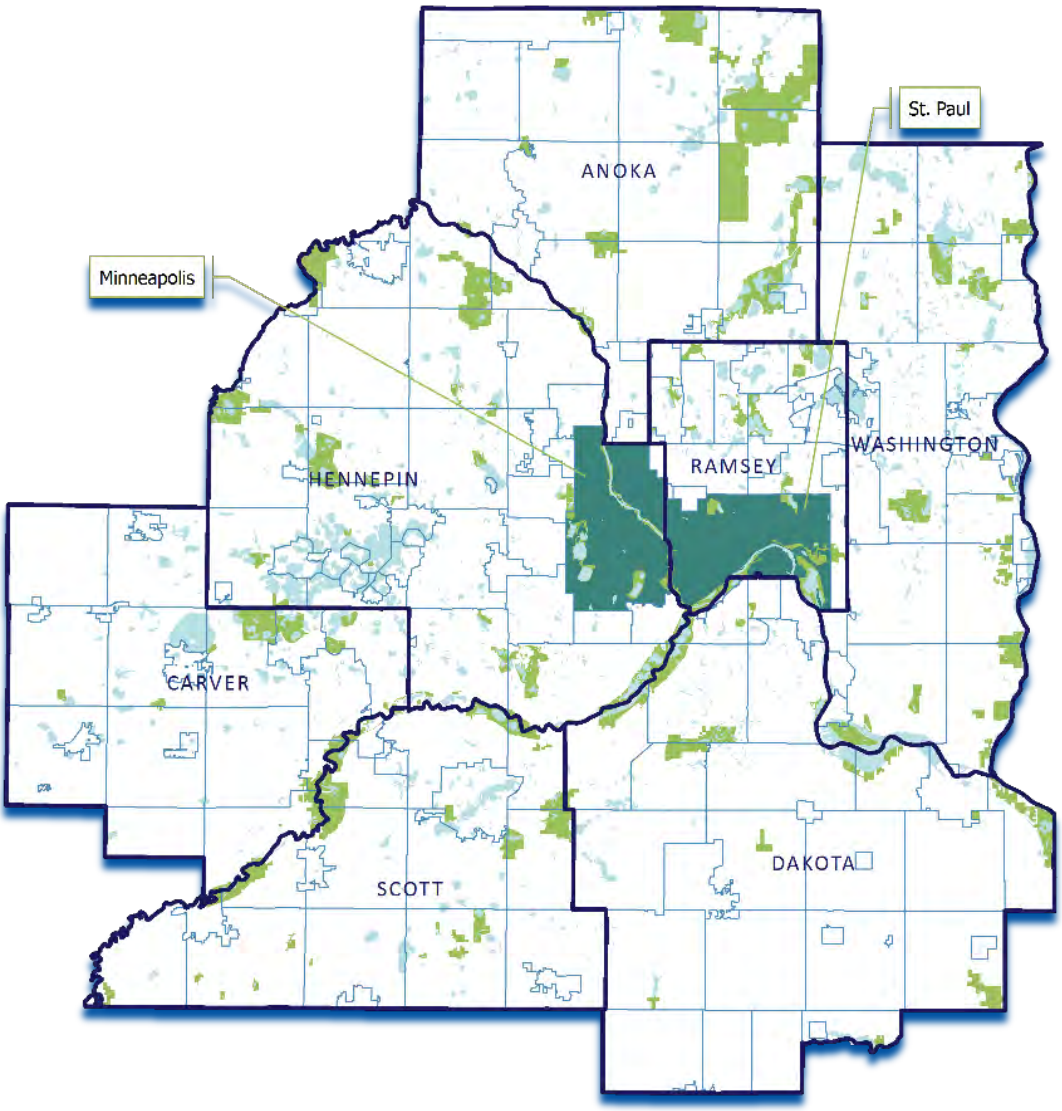
Climate Resilience through Community Planning

Eric Wojchik – Senior Planner

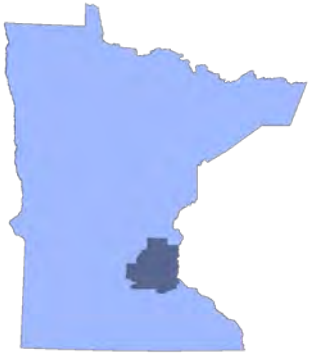
September 26, 2017

METROPOLITAN COUNCIL

Twin Cities Metropolitan Region



- 7 counties
- 181 cities and townships
- 3 major rivers
- Nearly 3 million people today
- Projected growth of 783,000 people by 2040



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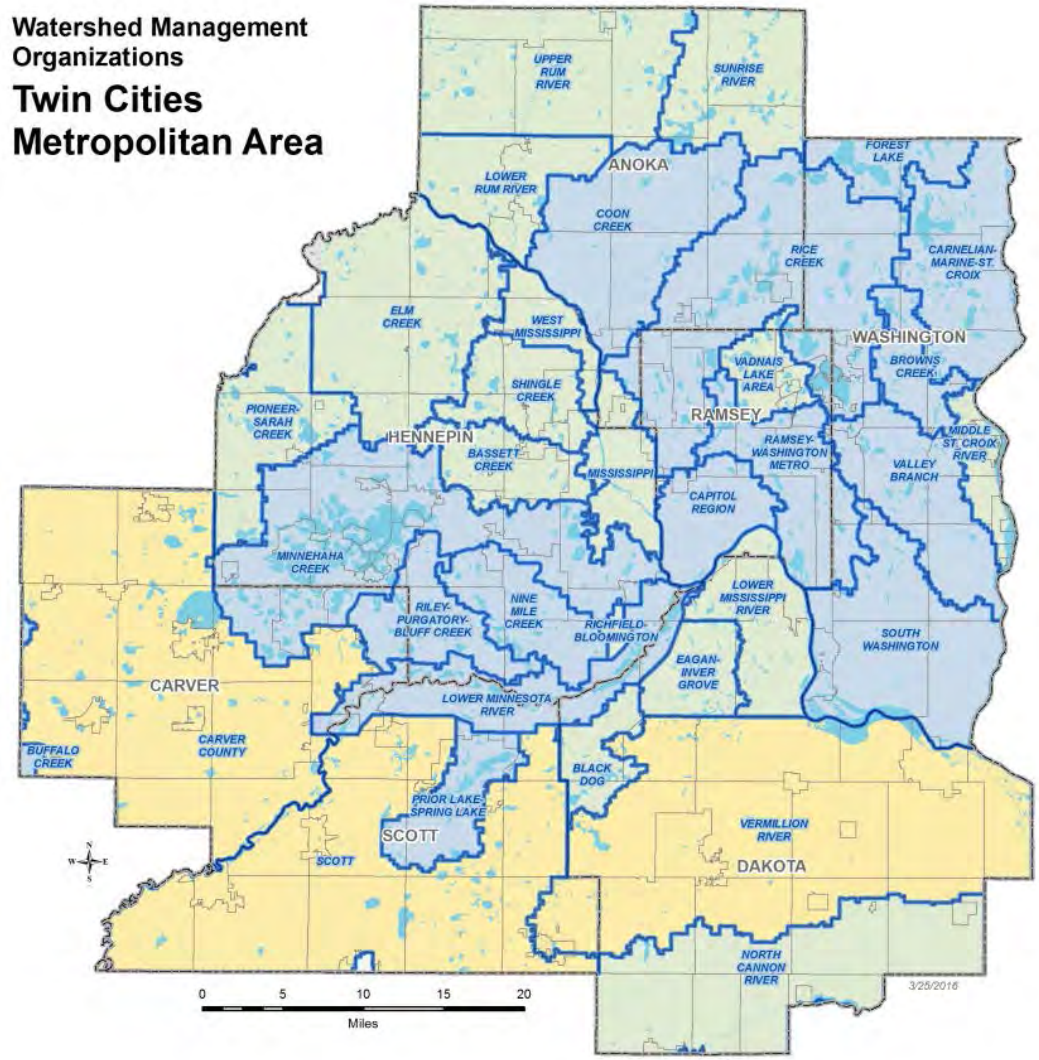

- 33 WDs & WMOs
- ~900 lakes
- 3 major rivers
- 100s of miles of streams
- Groundwater reserves & aquifers
- 75k SSTS
- 120 Public Water Suppliers
- 8 treatment plants, serving 2.5 million people & 108 communities
- 250 million gallons p/d
- 600 miles of interceptors

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REGIONAL 10-YEAR PLANNING CYCLE

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Local Plan Implementation and Plan Amendments

United States Census 2010

2013 - 2014
Regional Development Guide

2040 Thrive MSP

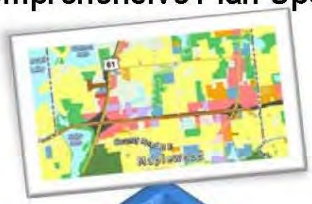
2014 - 2015
Regional System and Policy Plans:

Regional Parks
Water Resources
Transportation
Housing

Fall 2015
System Statements

Fall 2015
LOCAL PLANNING HANDBOOK

December 31, 2018
Comprehensive Plan Updates



Land Use Policy - Building in Resilience

Building in Resilience

COMMUNITY ROLE

- Address climate change mitigation and adaptation in locally meaningful ways in the local comprehensive plan.
- Identify local measures that would result in reductions in water use, energy consumption, and emission of greenhouse gases.
- Ensure that local comprehensive plans and ordinances protect and enable the development of solar resources, as required by the Metropolitan Land Planning Act, and consider the use of other alternative energy sources as part of the planning process.
- Consider the development or use of community solar gardens (CSGs) by public and private entities to enable fuller and more economic use of the community's solar resource, including participating as subscribers, assisting in marketing community solar garden opportunities for economic development, and providing sites for gardens to be developed.
- Identify local measures to address impacts to local economies, local resources, and infrastructure systems as a result of more frequent or severe weather events.
- Identify local initiatives as cost-saving measures that may, as a result, lower energy consumption, reduce the generation of greenhouse gas emissions, preserve water supply, reduce municipal waste, or increase participation in recycling programs.
- Participate in programs that evaluate and share city practices and provide technical support, such as the GreenStep Cities program and the Regional Indicators Initiative.

retrofits throughout the city, adopting a new recycling program, and exploring solar power, all implemented or to be implemented as cost saving measures. Another resource focusing on the built environment for communities is Minnesota's B3 Sustainable Building 2030 (SB 2030) Energy Standard, which is a conservation program designed to significantly reduce energy use in commercial, institutional, and industrial buildings.

Effective land use planning provides a community with the tools needed to better address climate change locally. Encouraging land use policies that create a more compact land use pattern can reduce energy consumption, protect public investments in infrastructure, lessen development pressures on habitat and open space, provide benefits to public health, and create more sustainable communities. Innovative land use policies can create a more compact region resulting in more efficient use of our infrastructure investments, cost-effective extension of urban services, and preservation of natural and agricultural areas within the region.

Building in Resilience

COUNCIL ROLE

- Provide technical assistance and toolkit resources to communities in integrating climate change mitigation and adaptation strategies as part of local comprehensive plans.
- Develop and strengthen partnerships with experts in climate change to better assist and inform local communities on how best to evaluate and develop local climate changes strategies.
- Encourage communities to participate in regional programs which support efforts to inform, plan for, mitigate, adapt, and respond to climate change issues of local significance such as water conservation, stormwater infrastructure adaptation, greenhouse gas reduction, use of alternative energy sources, infrastructure planning, and hazard mitigation planning.
- Provide technical references and resources for communities seeking to mitigate and adapt to climate change in their own facilities and their communities. Examples of these resources include stormwater, wastewater, and water supply management practices, and transit and land use planning.
- Provide, or collaborate with partners to provide, technical references, and resources for communities seeking to mitigate and adapt to climate change, in their own facilities and in their communities, including, but not limited to, stormwater, wastewater, and water supply management practices, and transit, and land-use planning.

Vulnerabilities
Social –Environmental – Infrastructure

Mitigation

Resilience

Adaptation

Reduce impacts/
Maintain current conditions

Forward-looking/
Promote change

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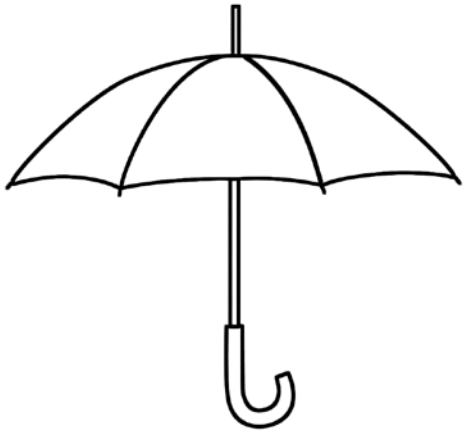
What is the Role of the Comprehensive Plan?

Comprehensive Plan

- Official Controls
  - Zoning Ordinances
  - Subdivision Ordinances
  - Capital Improvement Plan



- Implementation Actions
  - Small Area Studies
  - Feasibility Studies
  - New Programs
  - Update Ordinances

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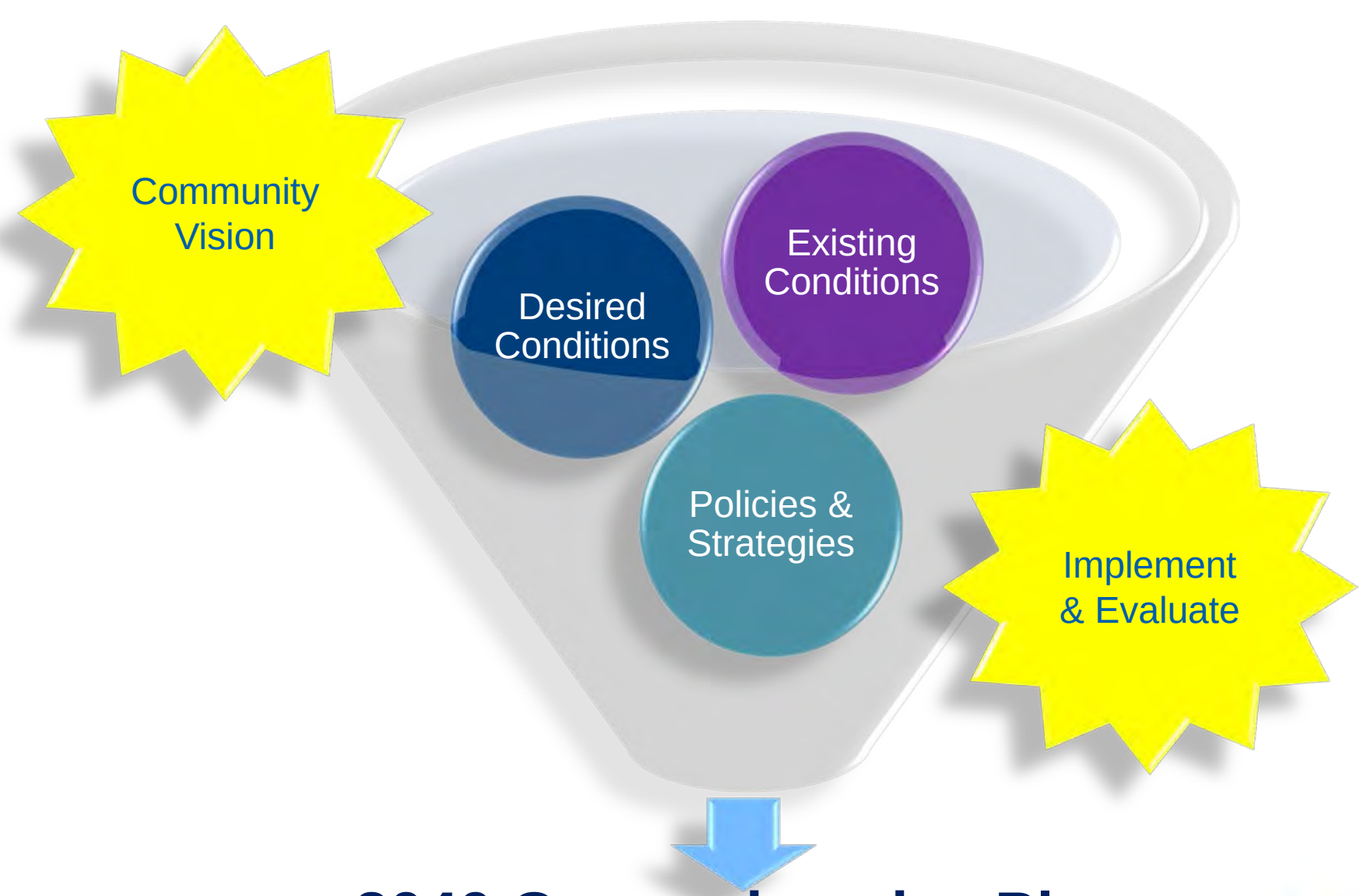

2040 Comprehensive Plan

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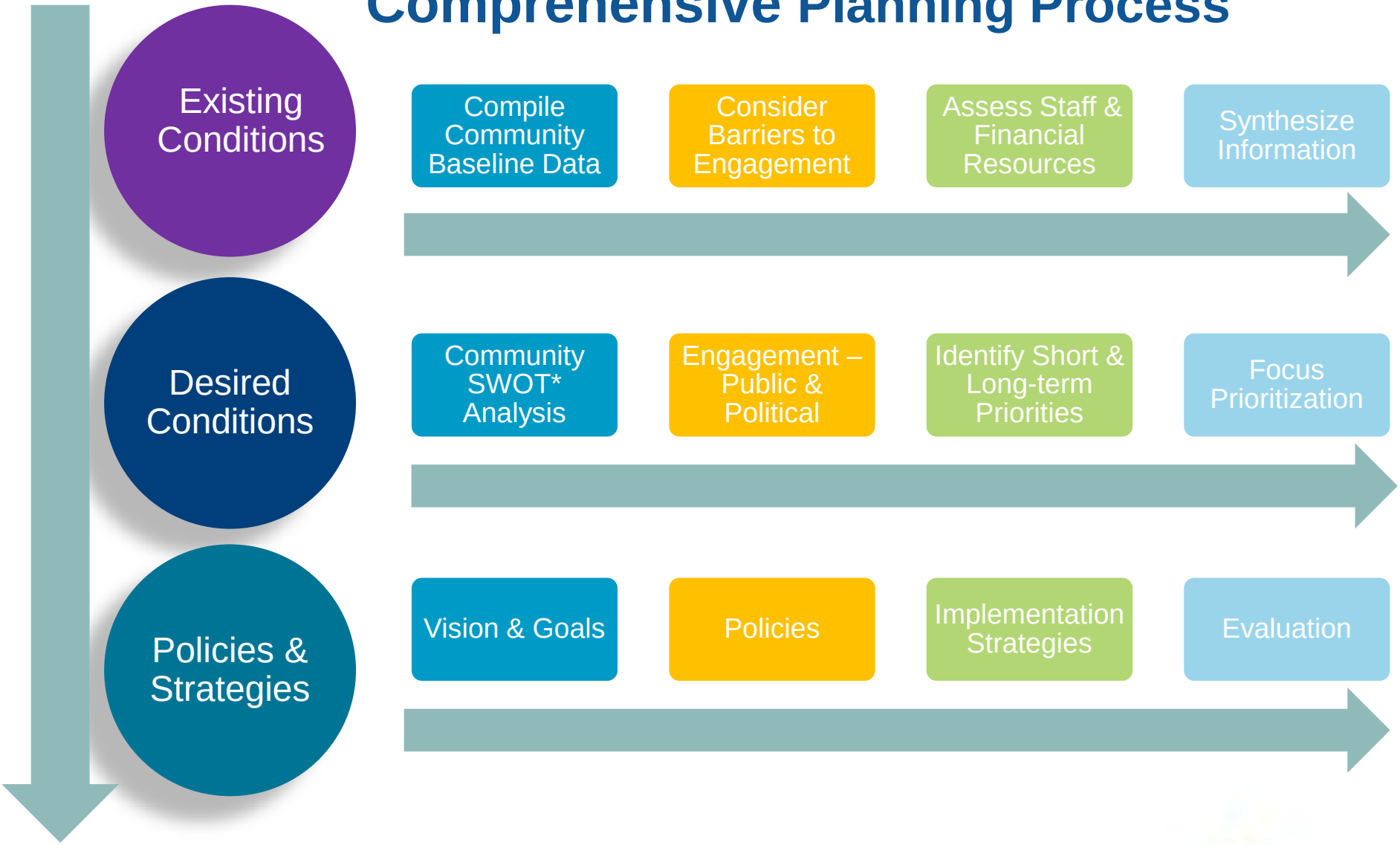
Comprehensive Planning Process



*Strengths, weaknesses, opportunities, & threats

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Diversify Your Implementation

Do not plan all of your resources for one possible outcome

Plan Elements

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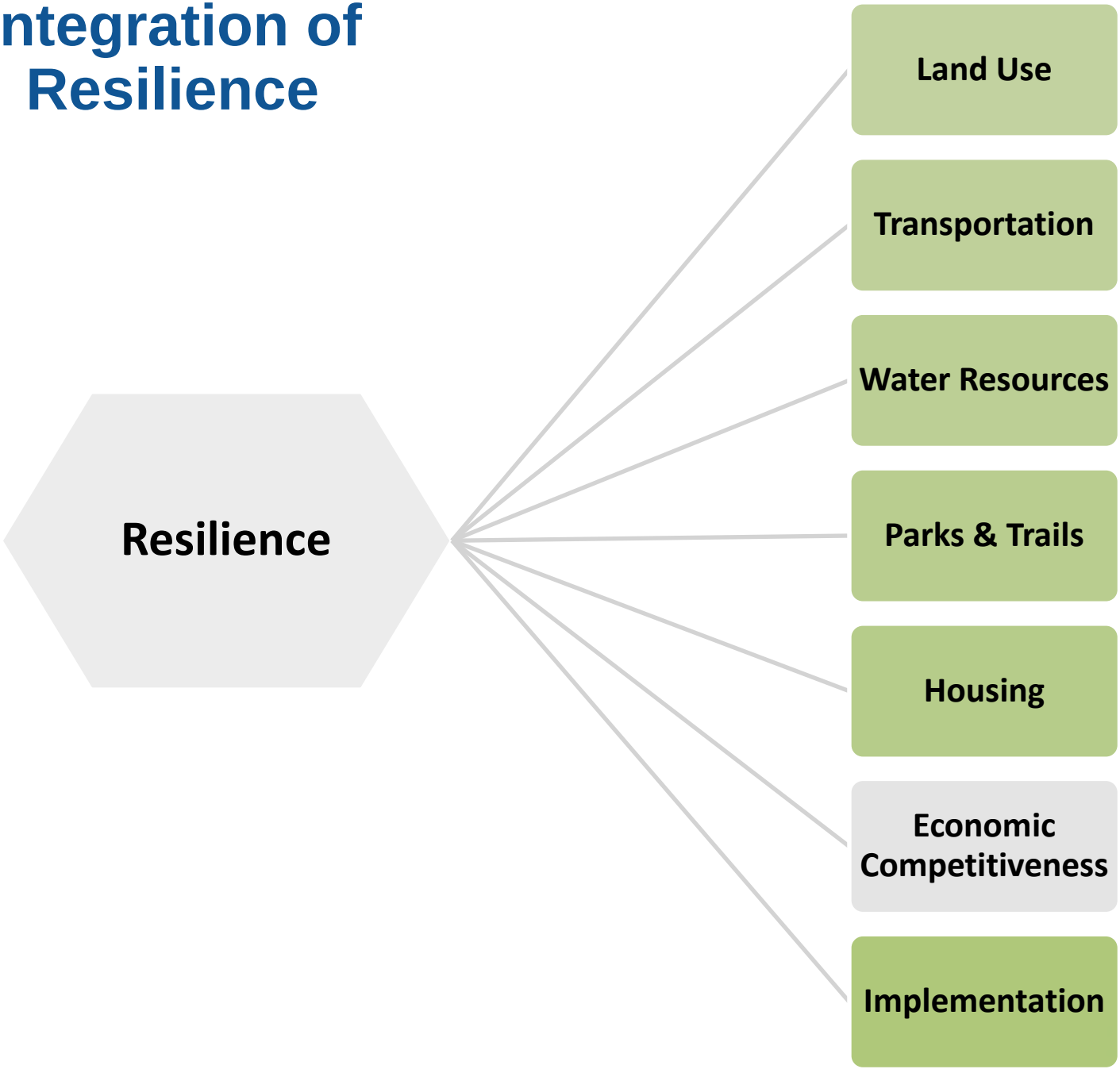
Integration of Resilience



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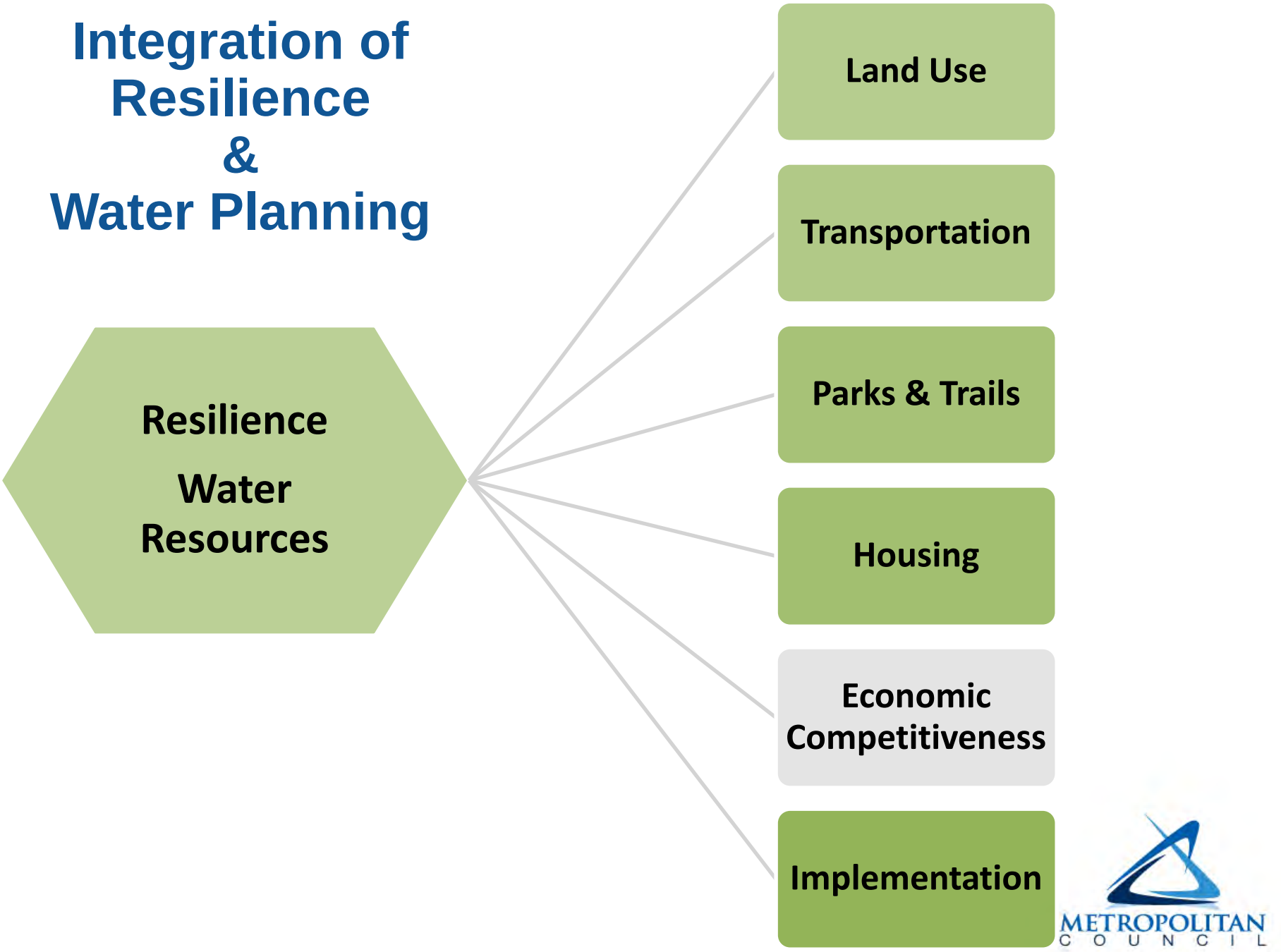
Integration of Resilience & Water Planning



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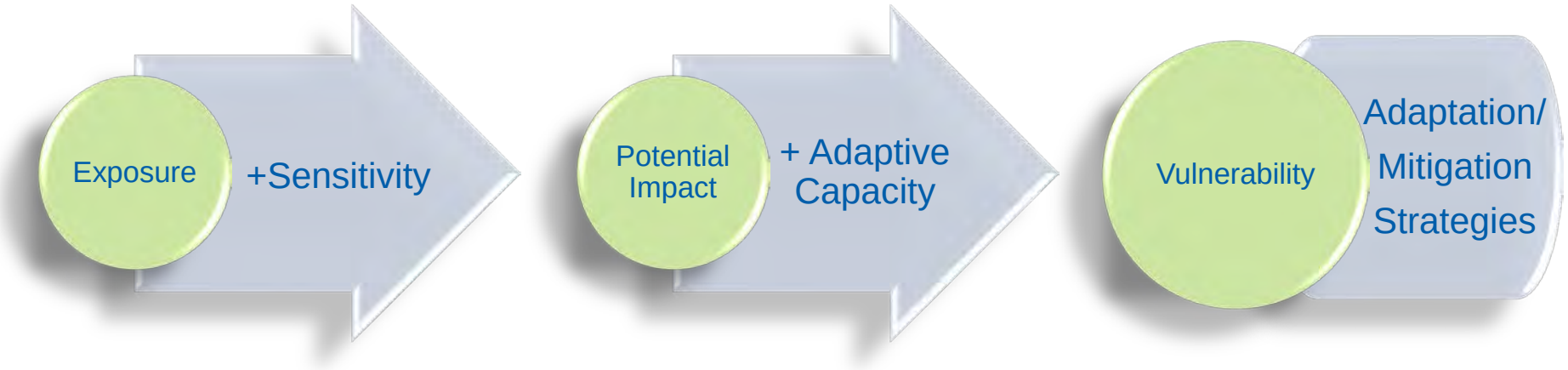
Community Resilience is a Measure of Community Vulnerability



Climate Impacts on Community Indicators:

- Social
- Environment
- Infrastructure

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Local Planning Handbook

Community Resilience Workshops

Minnesota Pollution Control Agency

RILEY PURGATORY BLUFF CREEK WATERSHED DISTRICT

9 MILE CREEK WATERSHED DISTRICT

FRESHWATER SOCIETY

BARR

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IMAGE SOURCE: Freshwater Society

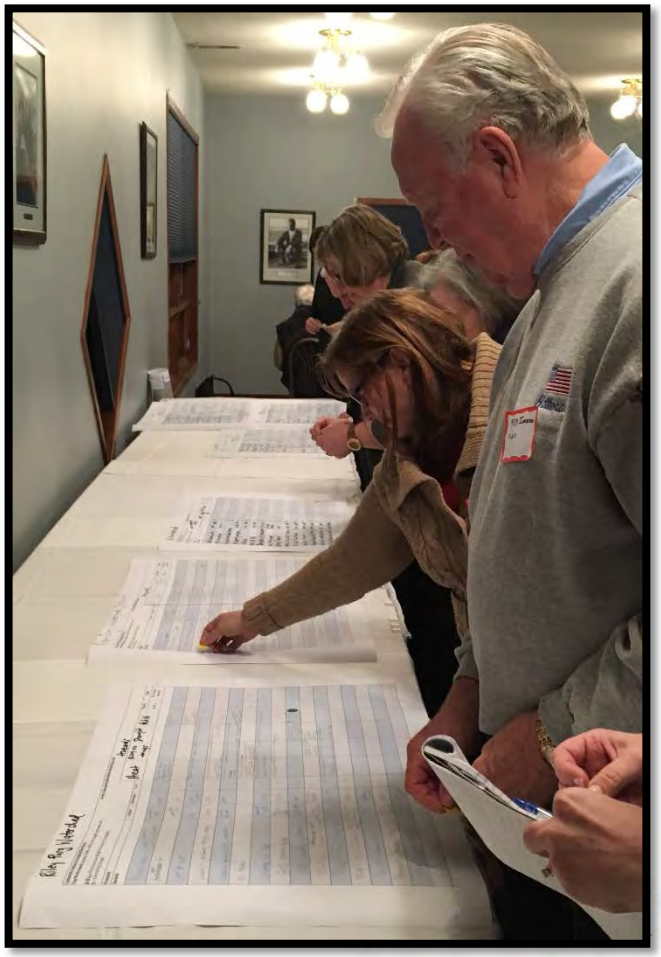

IMAGE SOURCE: Freshwater Society

Resources

LOCAL PLANNING HANDBOOK

http://metrocouncil.org/Handbook

PlanIt

http://www.metrocouncil.org/Handbook/PlanIt.aspx

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Upcoming Events

PlanIt Workshop

How to Address Climate Vulnerability in Your Community

Thursday, October 26, 2017

PlanIt

Registration Now Open!

9AM – Noon
at the Mississippi Watershed Management Organization
2522 Marshall St NE, Minneapolis

PlanIt

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DEPARTMENT OF NATURAL RESOURCES

Keys to Understanding Minnesota's Changing Climate

Dr. Kenneth (“Kenny”) Blumenfeld | Sr. Climatologist
DNR State Climatology Office

Minnesota's most pronounced trends

1. Minnesota is becoming warmer and wetter
    - **Major shift observed, projected to continue**
2. Cold temperatures are increasing fastest
    - **Rapid loss in cold extremes, projected to continue**
3. Extreme rainfall increasing
    - **More and larger "big" events, projected to continue**

Important weather/climate phenomena showing NO trends

1. Hot days, warm nights, heat waves
   - **Not yet observed, projected as likely**
2. Drought
   - **Not yet observed, projected as possible**
3. Tornadoes, severe convective storms
   - **Not observed, projections unclear**

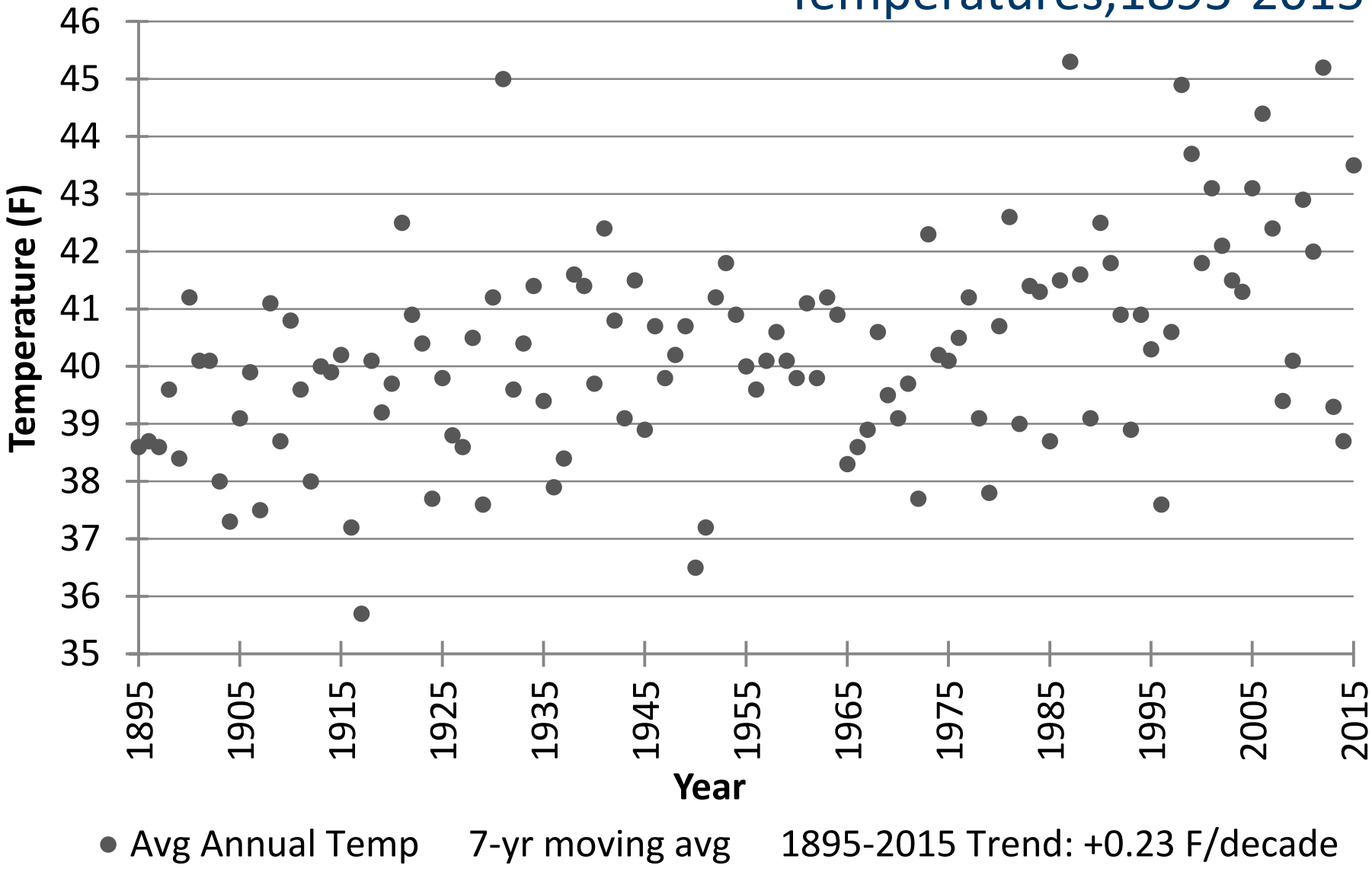
Items to bear in mind

1. Climate news elsewhere may not apply here
    - Important because decisions made and resources managed **here**
2. *Observations* & *Projections* are different
    - Past data vs modeled future

Items to bear in mind

3. ***Variability*** and ***Trends*** do not prove or disprove each other
    - Leading source of confusion
4. Seek more info and refresh frequently!

Example: Minnesota Average Annual Temperatures,1895-2015



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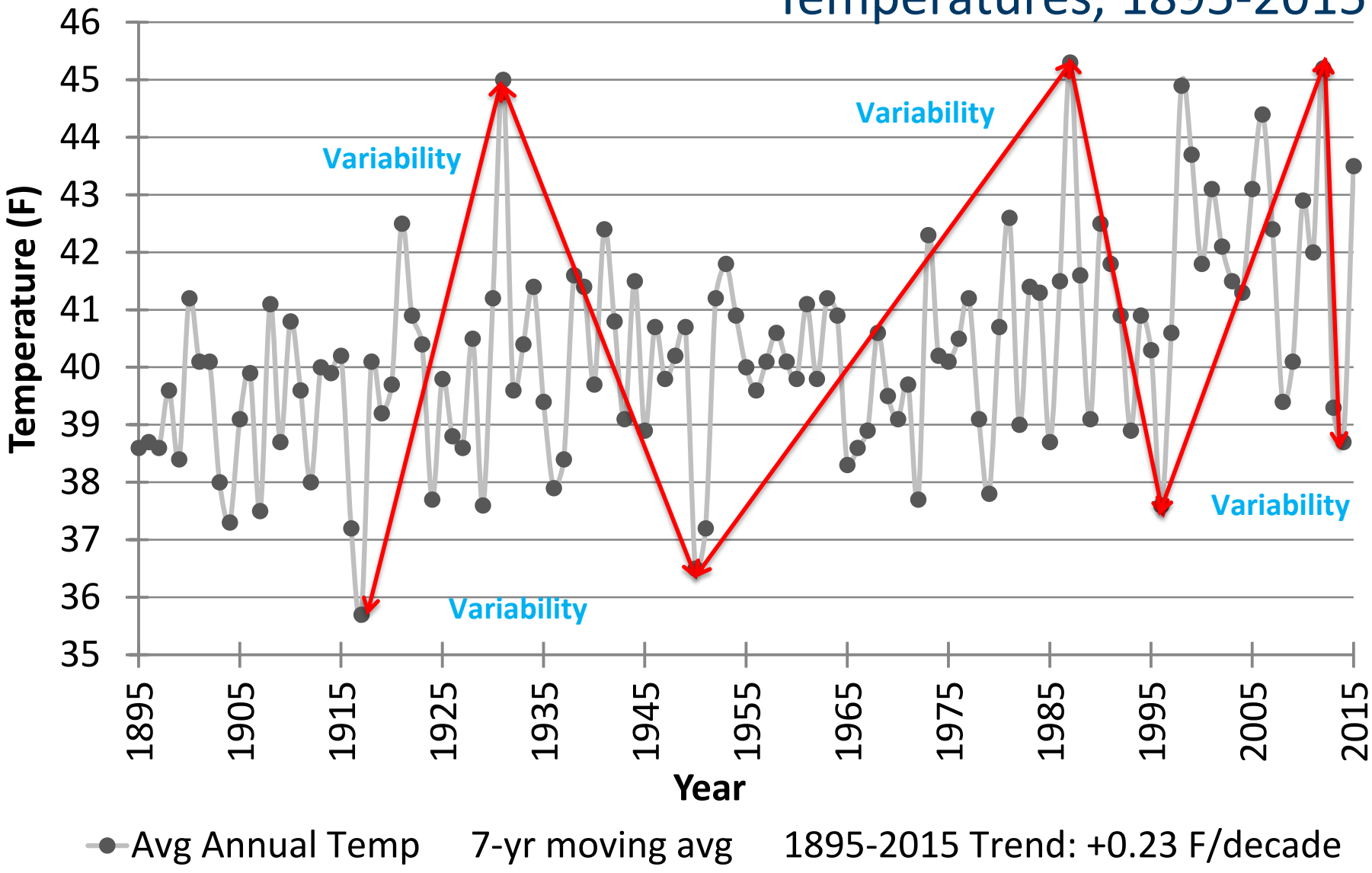
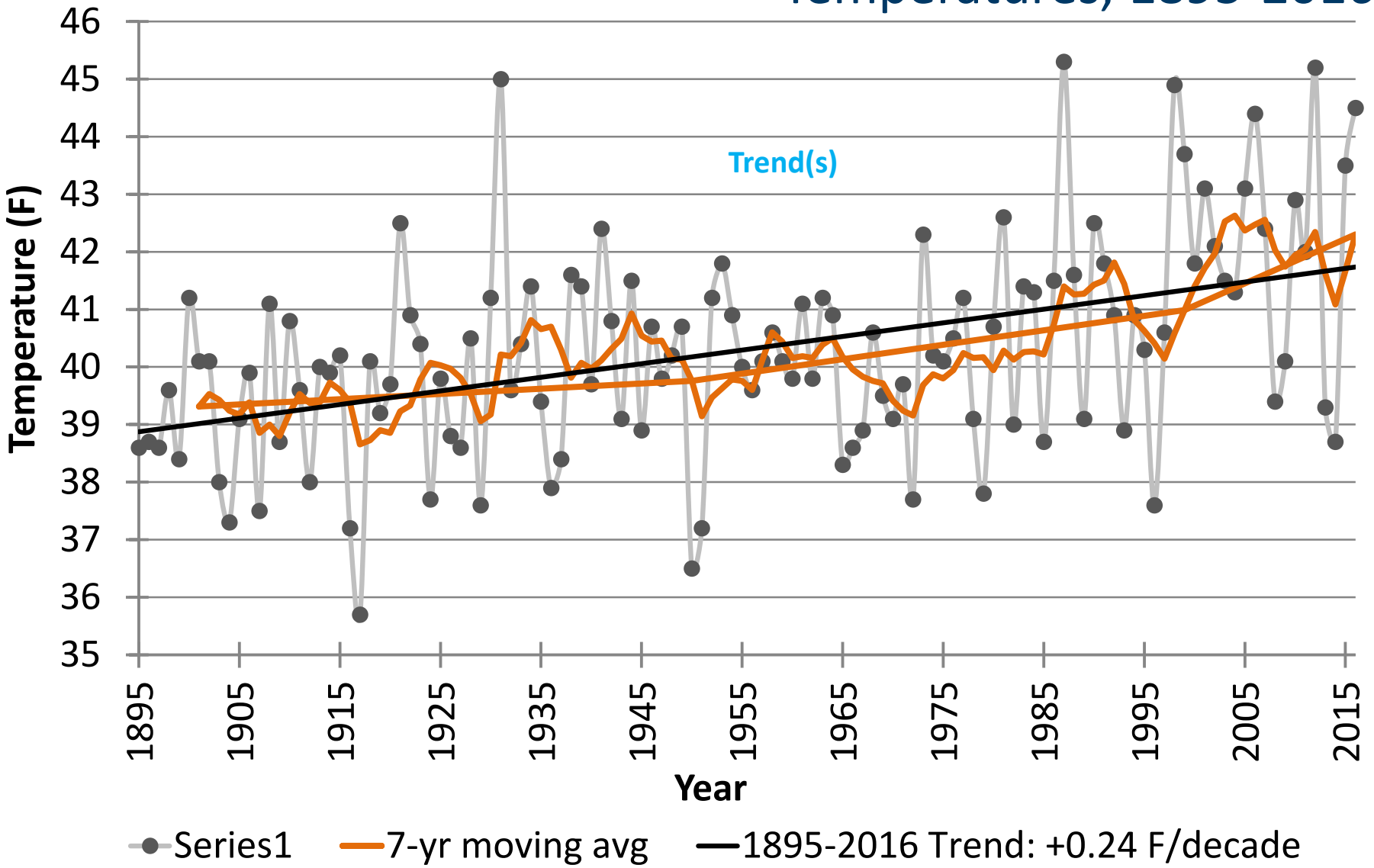


Example: Minnesota Average Annual Temperatures, 1895-2016



Confidence that climate change has *already* impacted common Minnesota weather/climate hazards

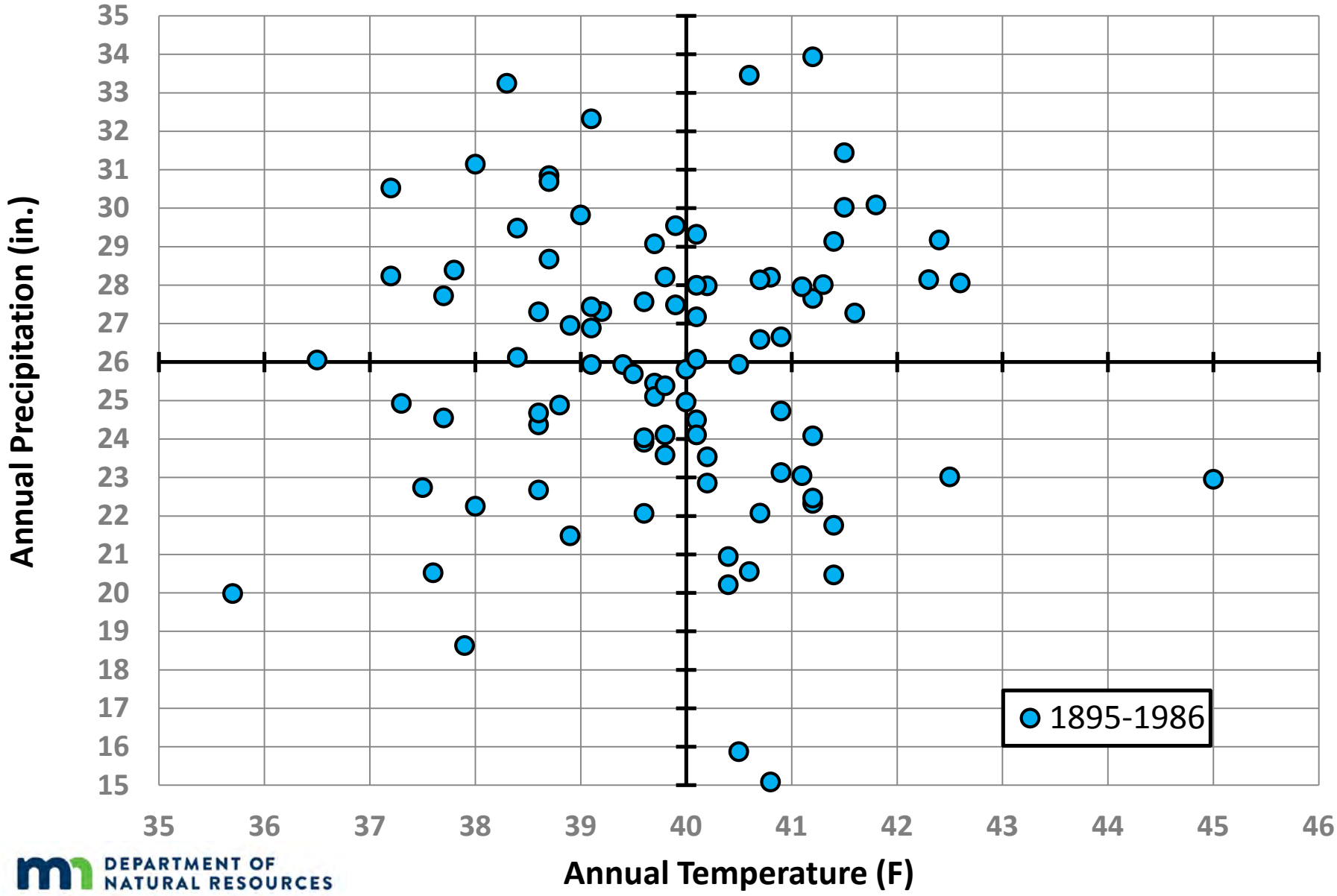
Confidence	Hazard	Recent & Current Observations
Highest	**Extreme cold**	Rapid decline in severity, frequency
	Extreme rainfall	Becoming larger and more frequent
Moderately High	**Heavy snowfall**	Large events more frequent
Moderately Low	**Severe thunderstorms & tornadoes**	Historical comparisons difficult; Few major tornadoes in MN since late 2010
Lowest	**Heat waves**	No recent increases or worsening
	Drought	

Confidence that climate change will impact common Minnesota weather/climate hazards beyond 2025

Confidence	Hazard	Expectations beyond 2025
Highest	**Extreme cold**	Continued rapid decline
	Extreme rainfall	Unprecedented events expected
High	**Heat waves**	Increases in severity, coverage, and duration expected
Moderately High	**Drought**	Increases in severity, coverage, and duration possible
Moderately Low	**Heavy snowfall**	Large events less frequent as winter warms
Moderately Low	**Severe thunderstorms & tornadoes**	More “super events” possible, even if frequency decreases

Trends: 1. MN Getting Warmer and Wetter

Minnesota Average Temperature and Precipitation



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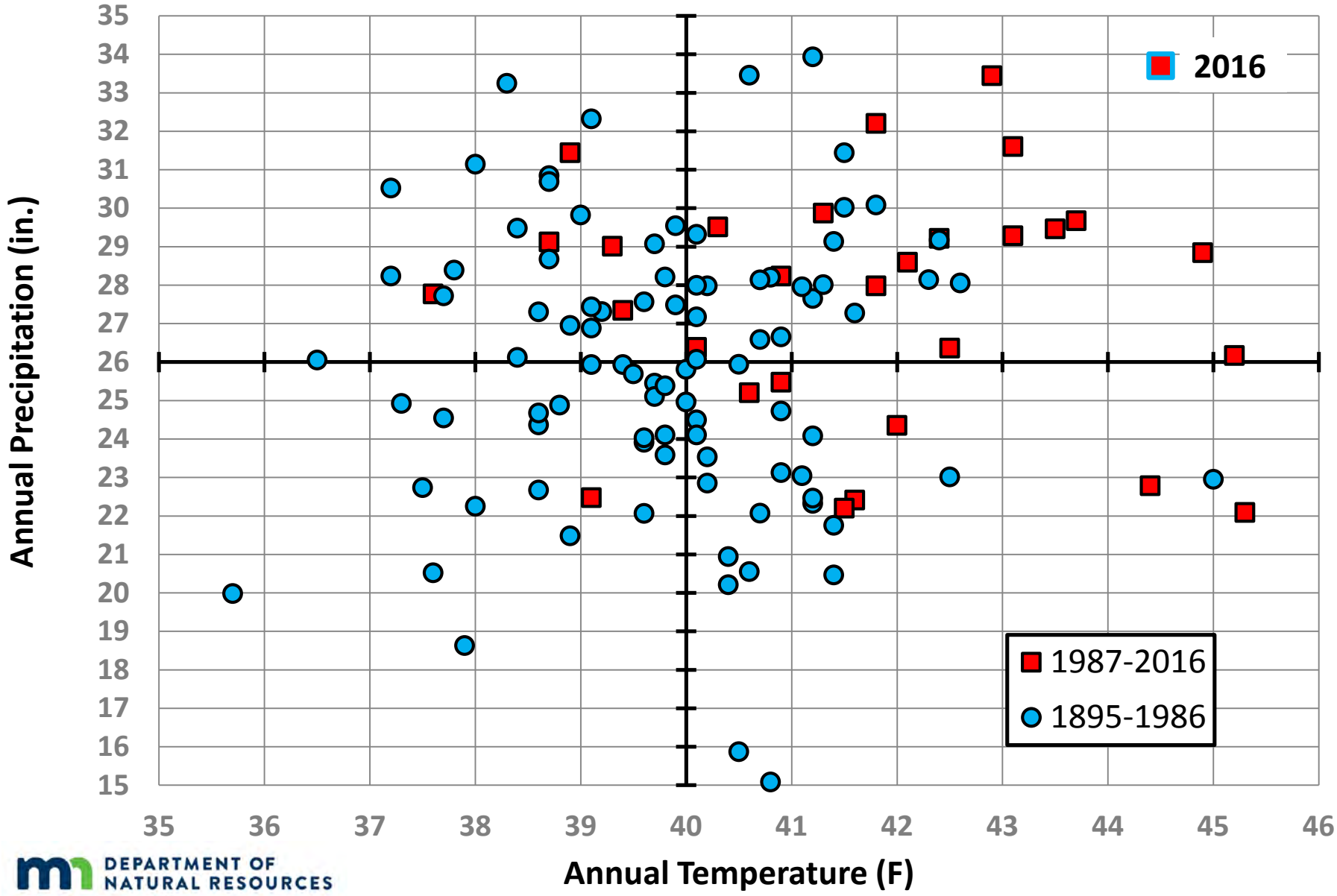
State Climatology Office

Minnesota Average Temperature and Precipitation



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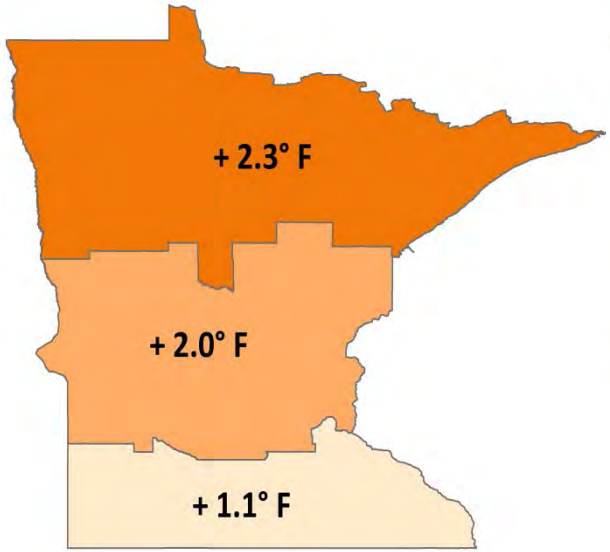
State Climatology Office

All seasons getting wetter

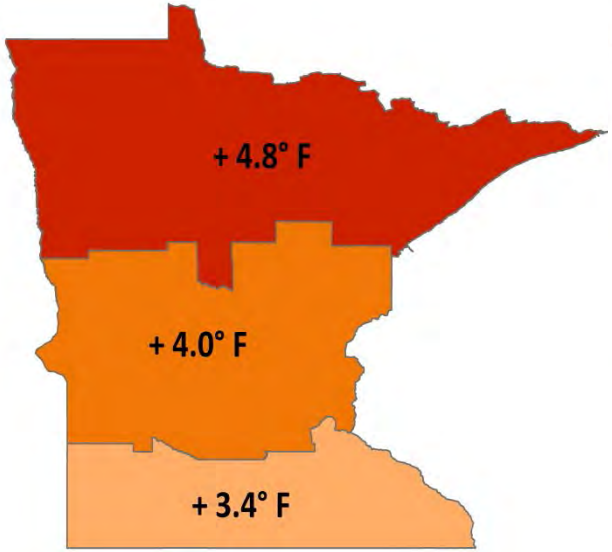
Season	Total precipitation change, 1895-2016
Winter (Dec - Feb)	+ 6% (0.13”)
Spring (Mar – May)	+15% (0.93”)
Summer (Jun - Aug)	+11% (1.21”)
Fall (Sep – Nov)	+11% (0.66”)
Growing Season (May – Sep)	+ 9% (1.55”)
Annual	+12% (2.98”)

Temperature changes vary across regions, *seasons,* and times of day

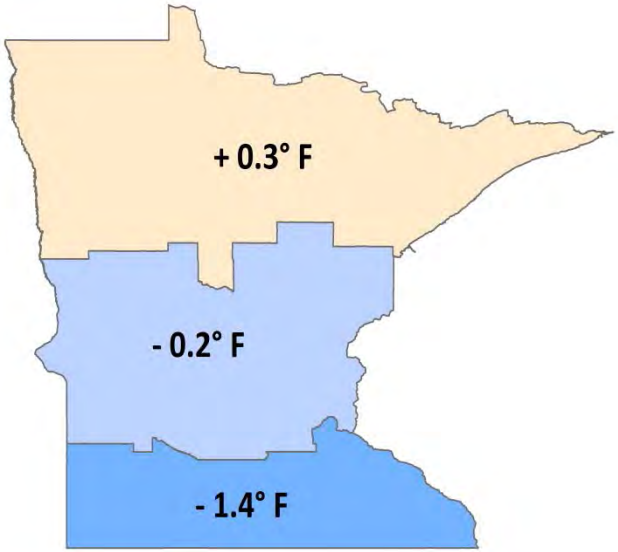
Total temperature change, 1895-2015



Annual Average



Winter Lows



Summer Highs

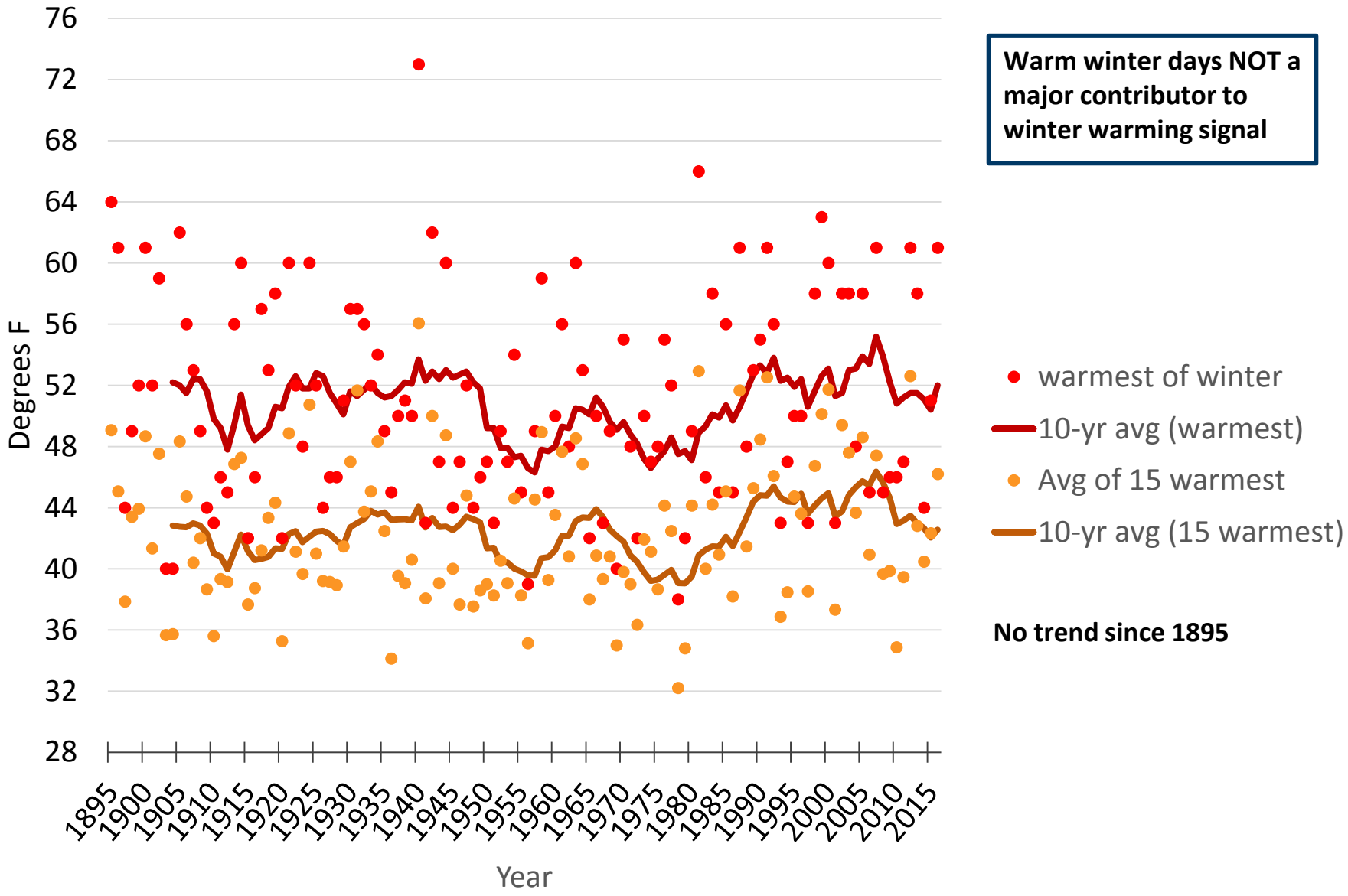
Trends: 2. Cold Temperatures Rising Fastest

- Rapid winter warming
- Loss of cold weather (more so than gain in warm weather)
- Fewer cold extremes

Winter warming 13x faster than summer

Season	Temperature Metric	Avg. change per decade since 1895	Avg. change per decade since 1970
Winter (Dec - Feb)	Seasonal Avg.	**+ 0.40°F**	**+ 1.2°F**
Summer (Jun - Aug)	Seasonal Avg.	**+ 0.13°F**	**+ 0.09°F**

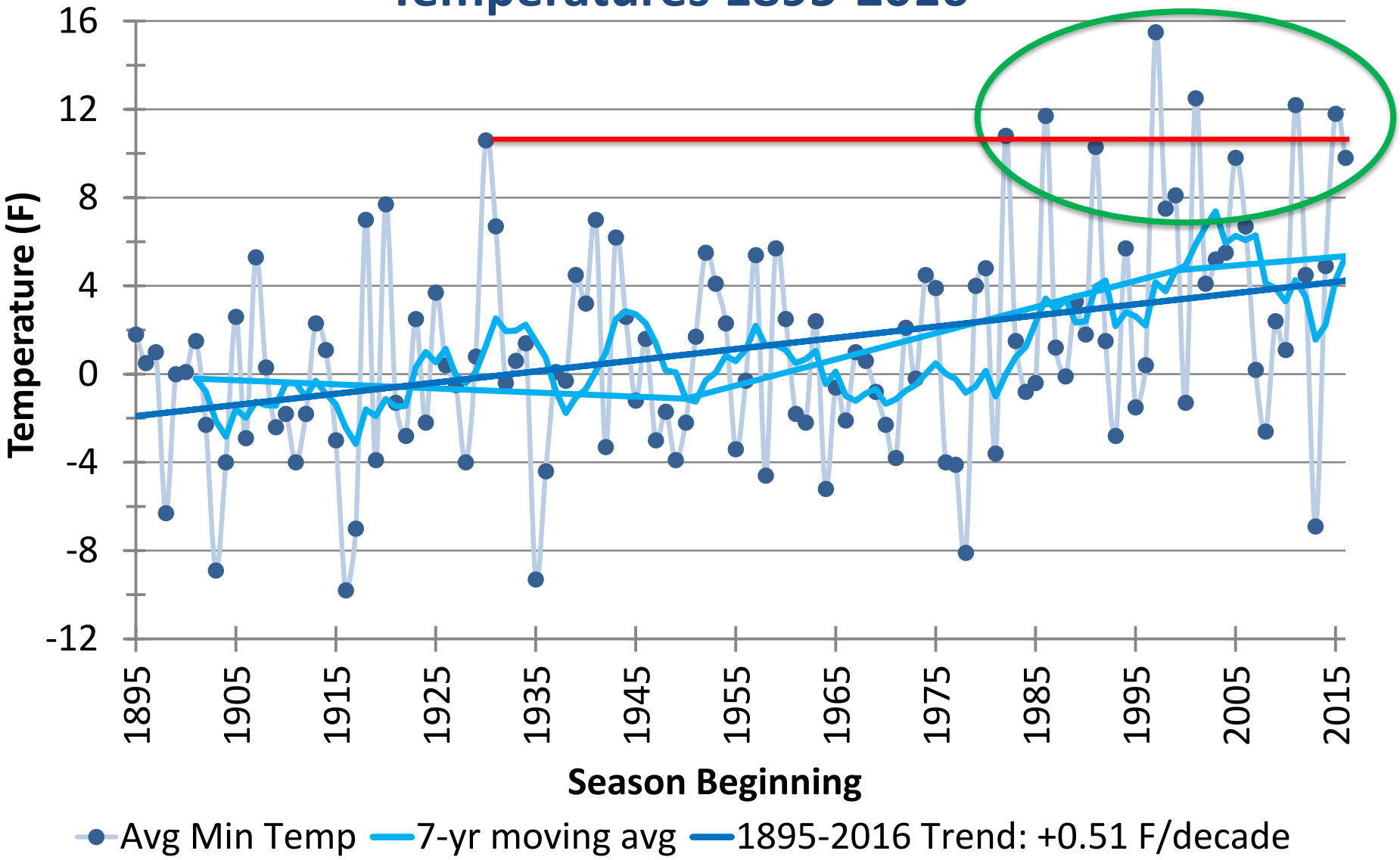
Highest Highs of Winter, Milan (MN), 1895-2016



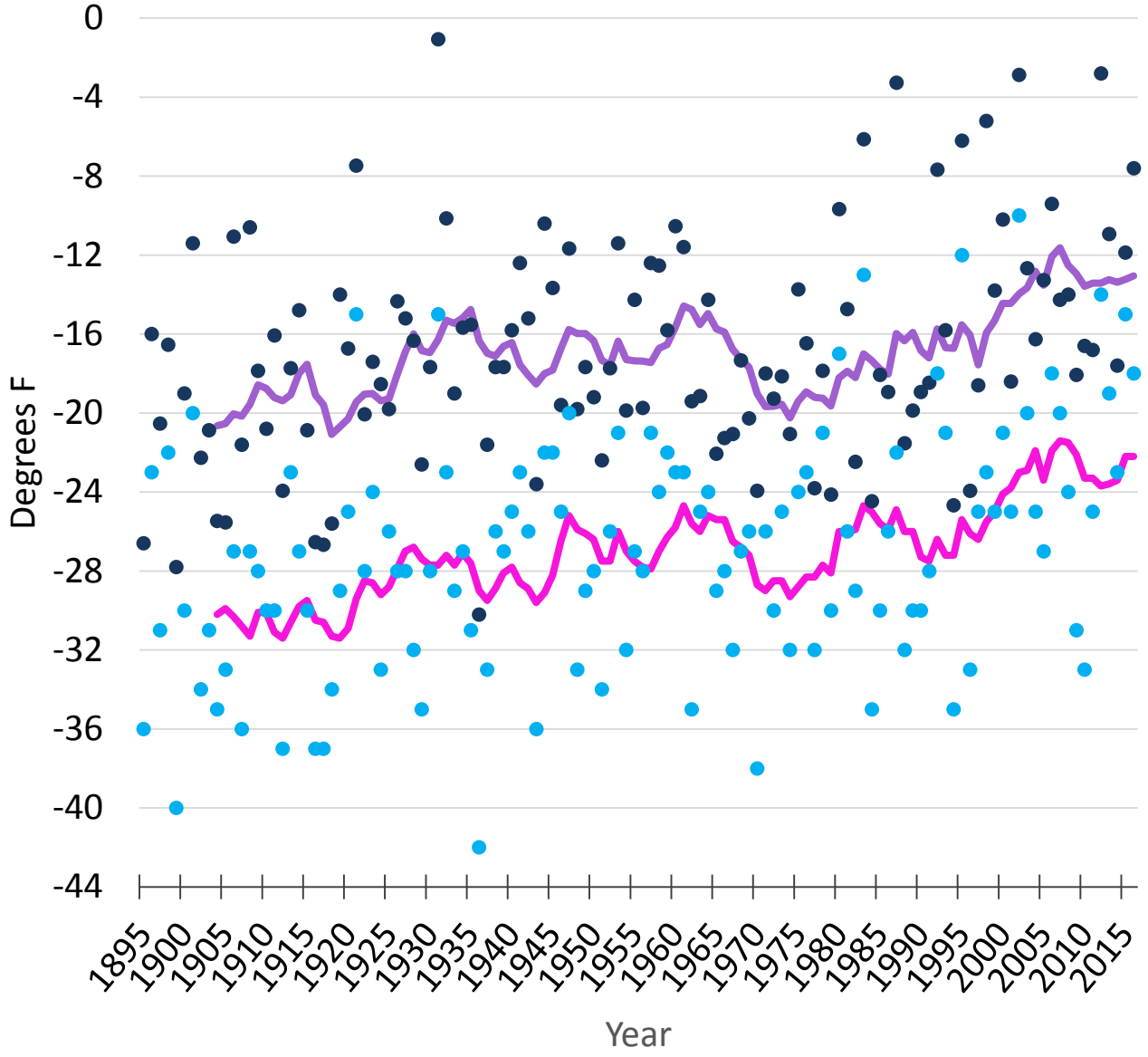
Warm winter days NOT a major contributor to winter warming signal

No trend since 1895

Minnesota Average Winter Minimum Temperatures 1895-2016



Lowest Lows of Winter, Milan (MN), 1895-2016



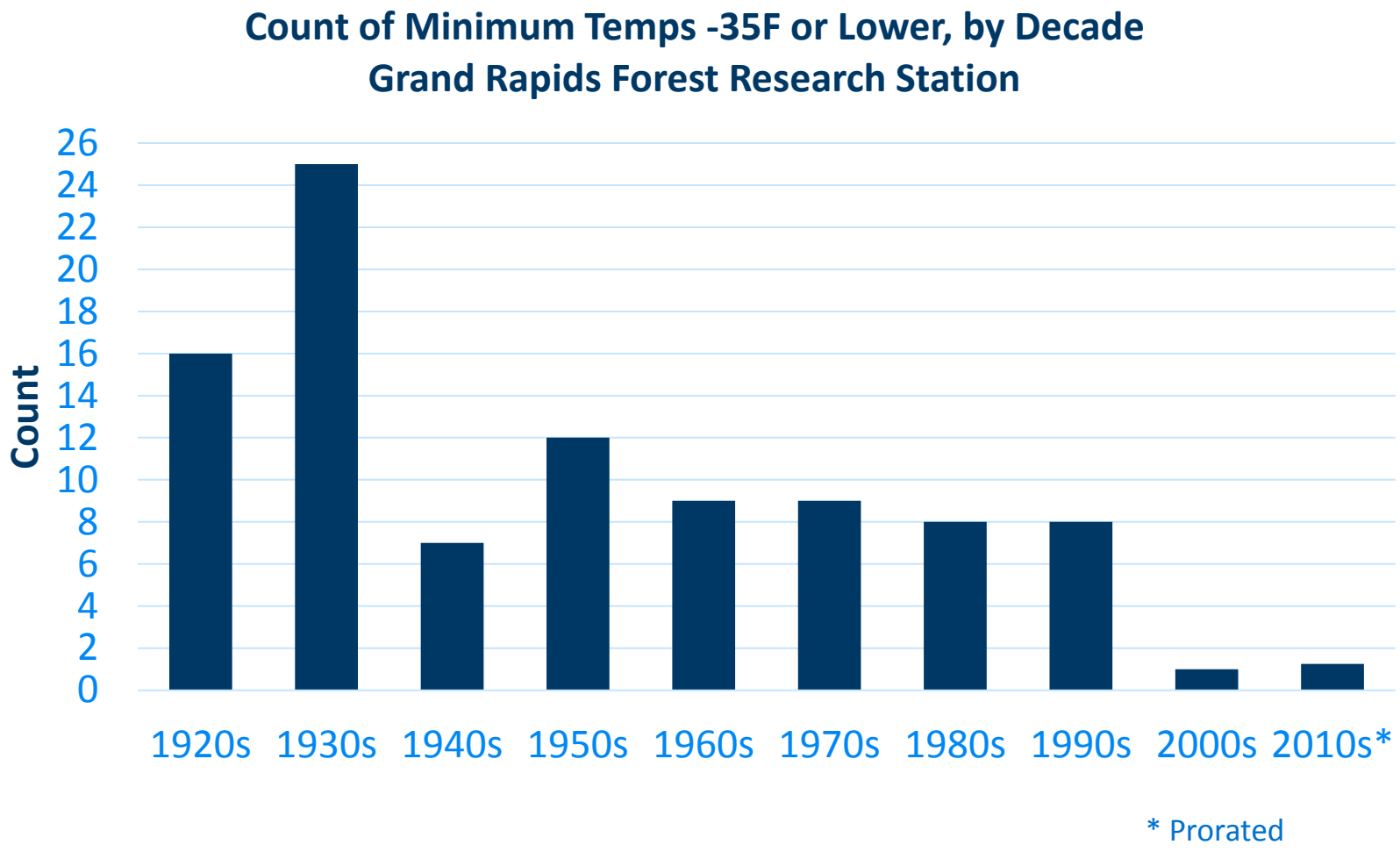
The loss of cold winter days IS a major contributor to winter warming signal

- Avg of 15 coldest
- 10-yr avg (15 coldest)
- Coldest of winter
- 10-yr avg (coldest)

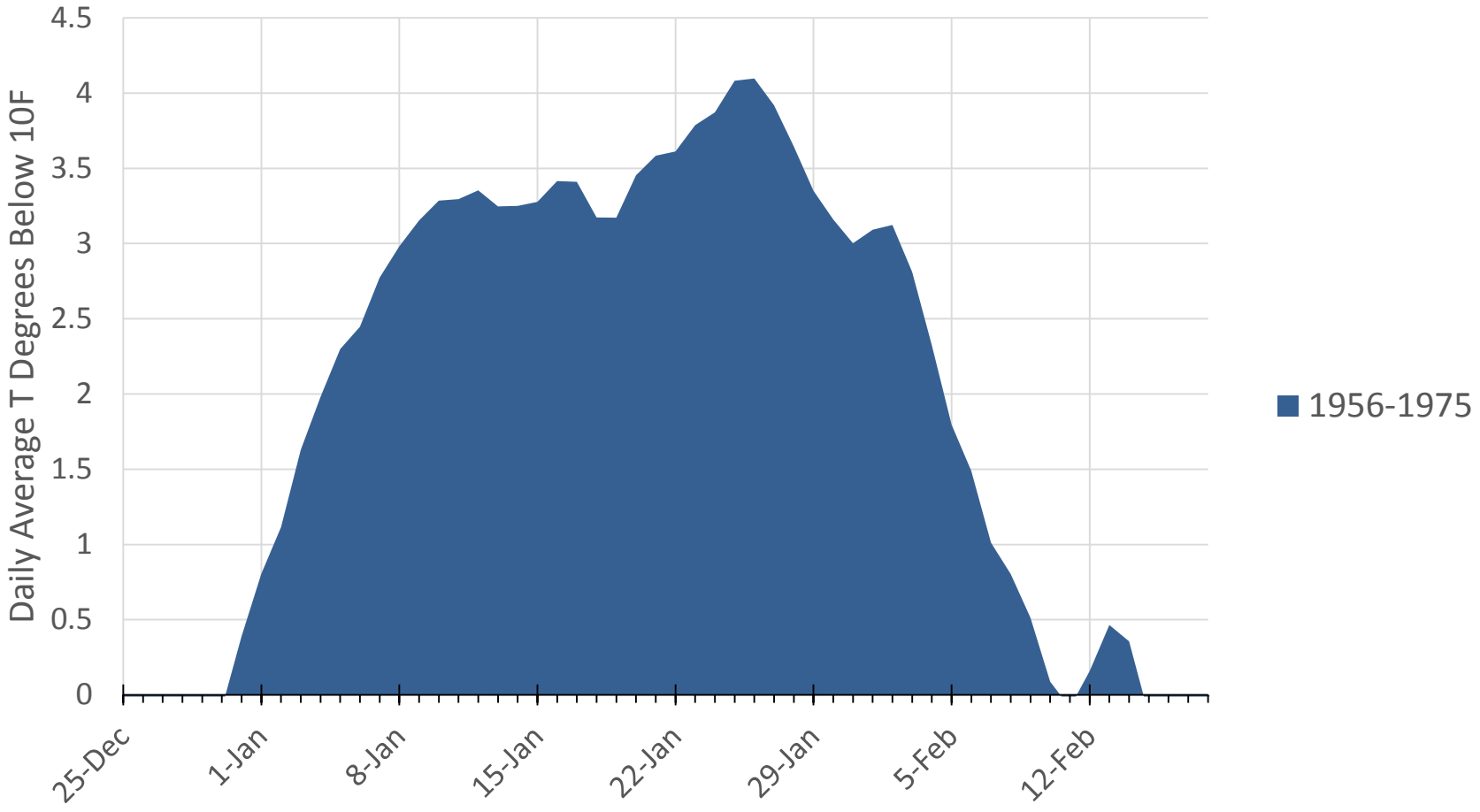
+ 6.6 F per century since 1895

+ 17.7 F per century since 1970 (sig. at 0.99)

Dramatic Loss of -35 F Lows in Grand Rapids



Length and Magnitude of 10 F Temperature Season, Duluth MN



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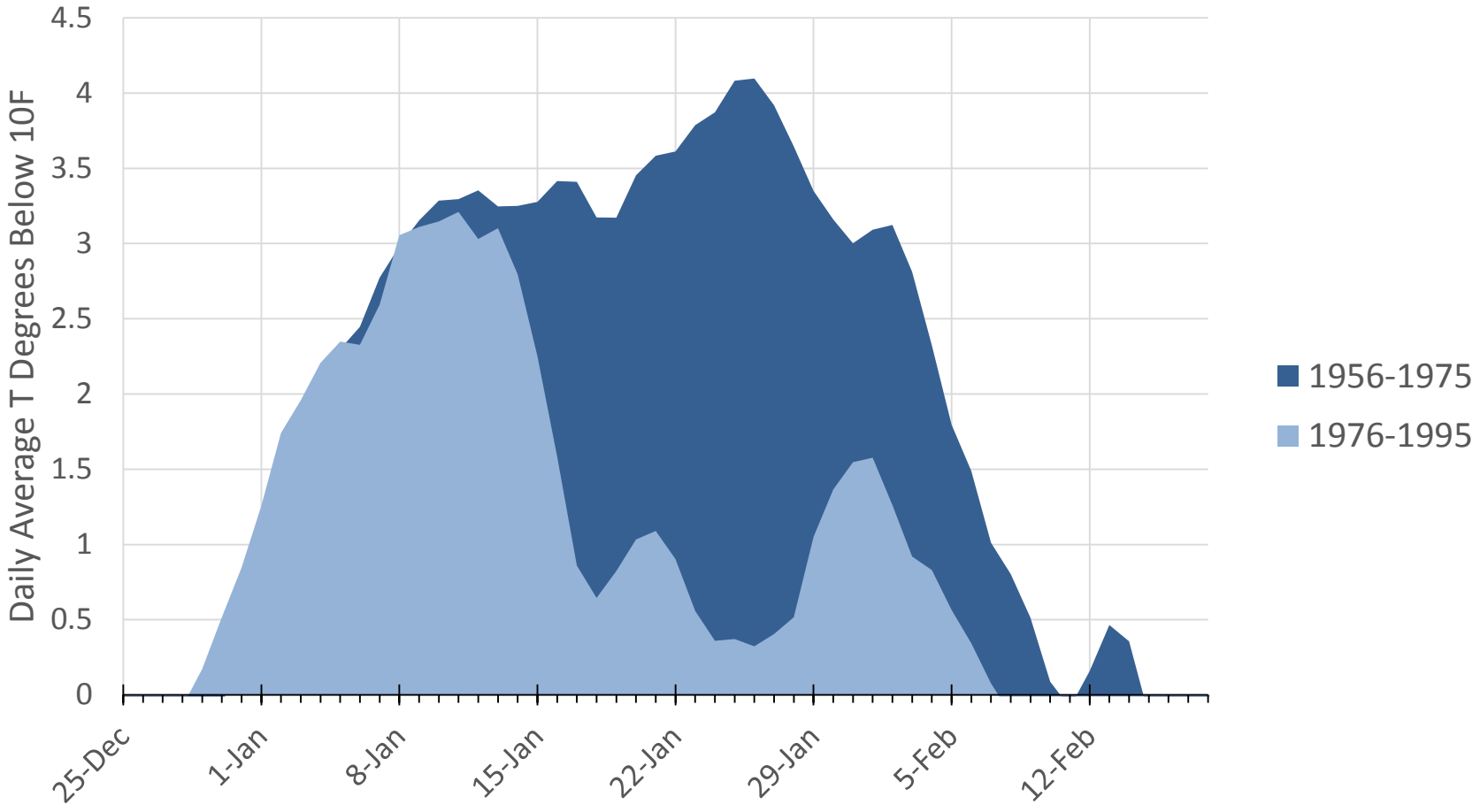

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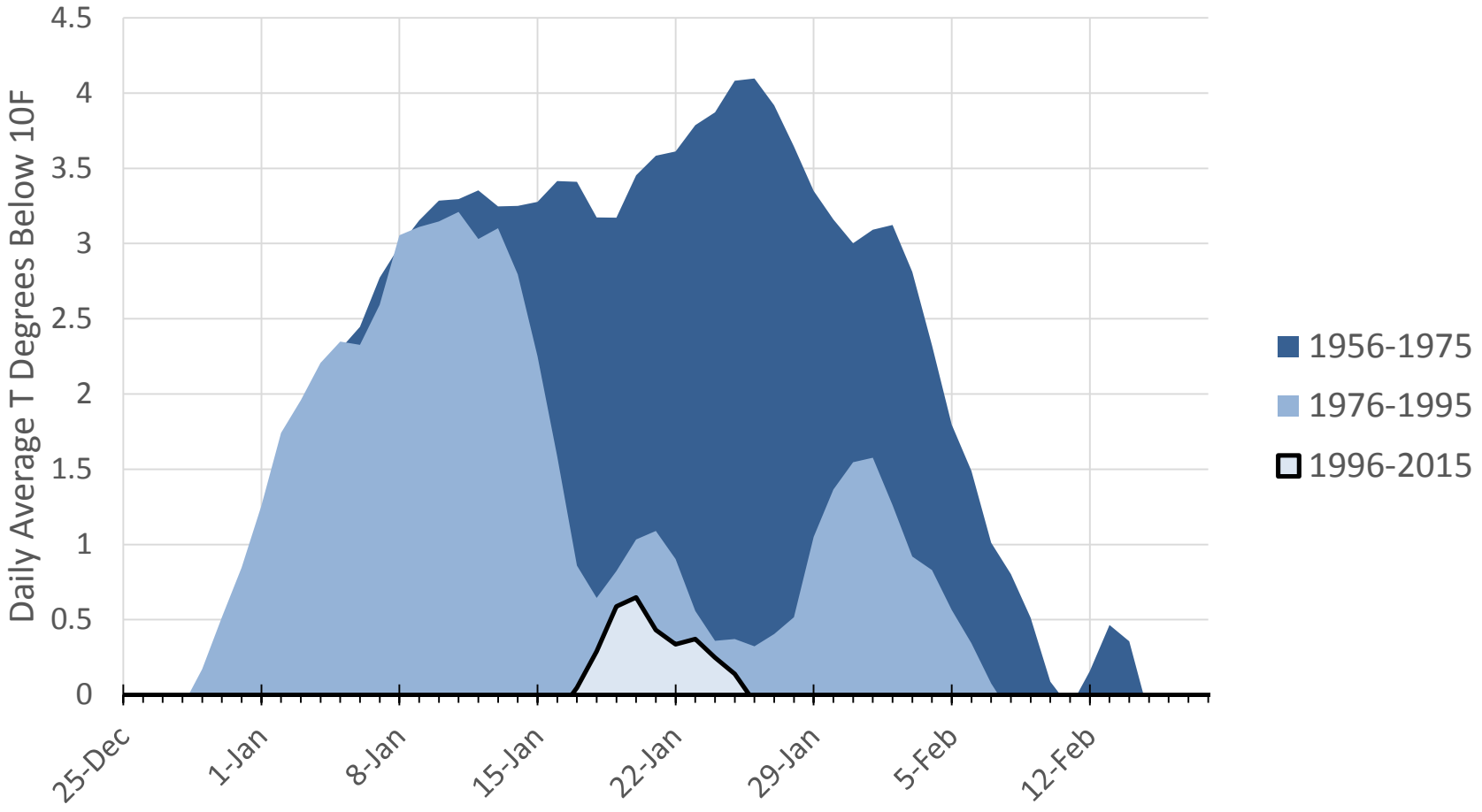

Trends: 3. Extreme Rainfall Increasing

- Increases in frequency of heavy rainfall
- Increases in magnitude of heaviest rainfall
- Increased occurrence of large areal coverage extreme rainfall events

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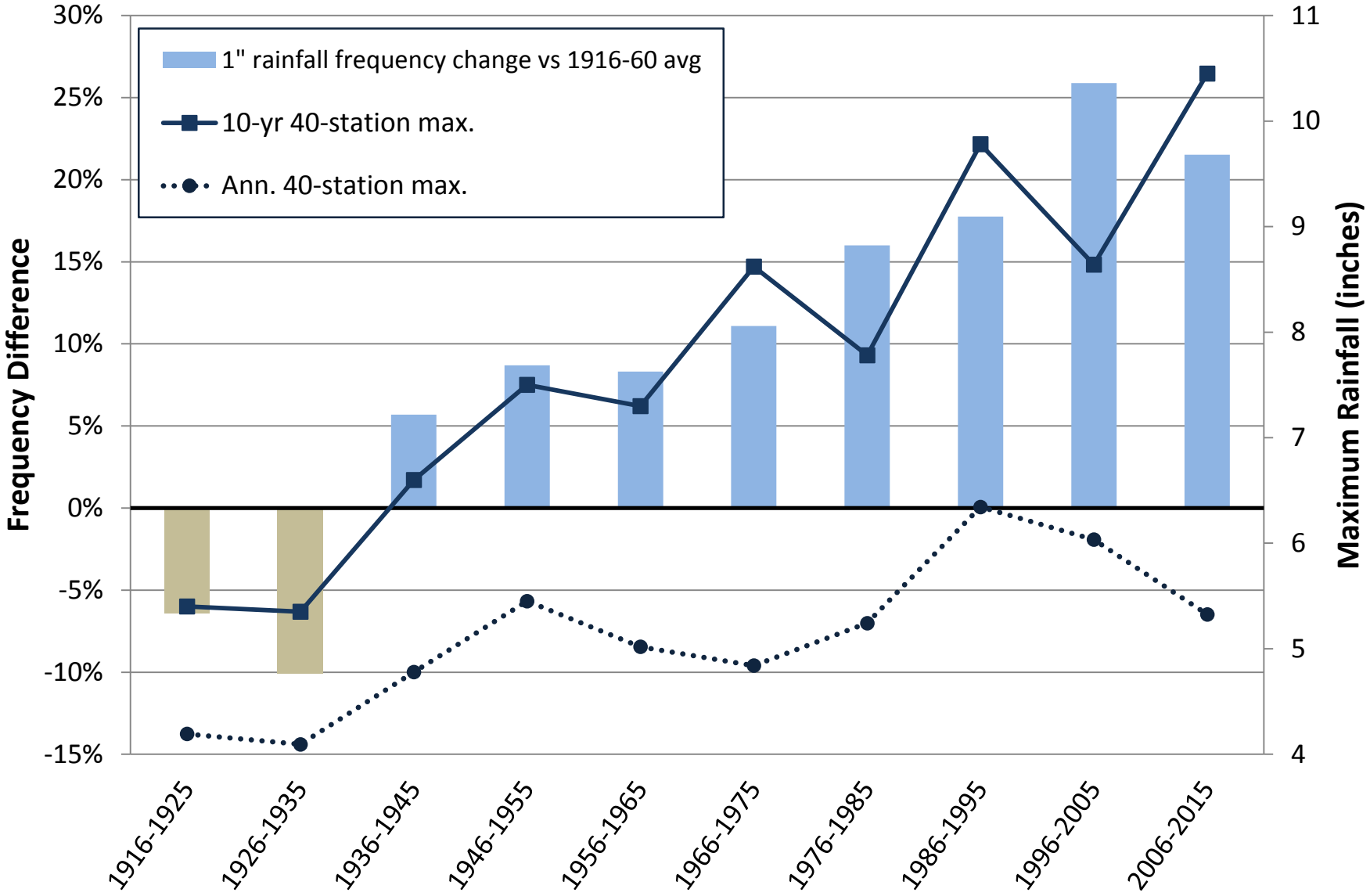
Changes in Heavy Precipitation Frequency and Intensity from 40 Long-Term Minnesota Stations, 1916-2015



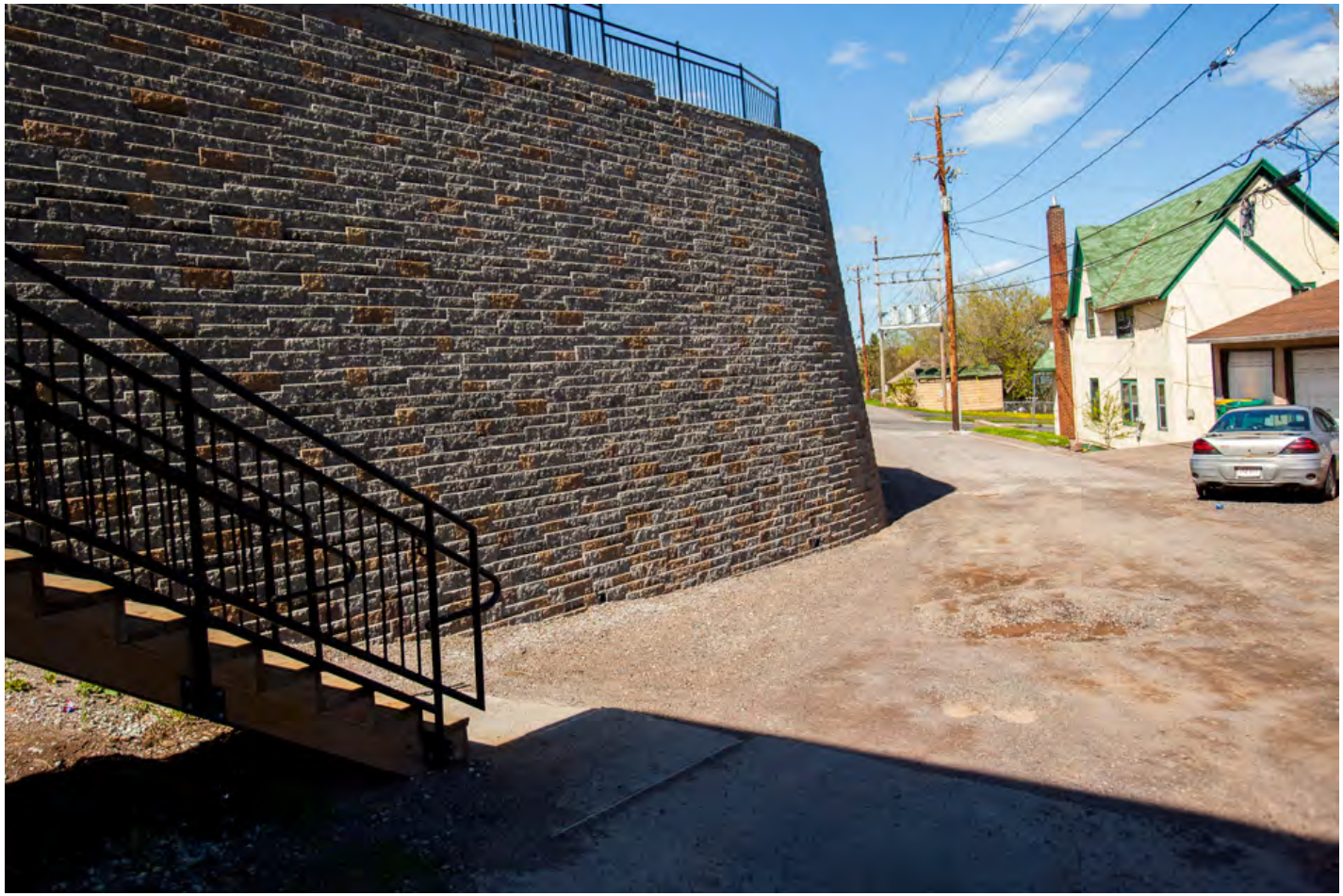
Before

Source MPR

After

Source MPR

Before



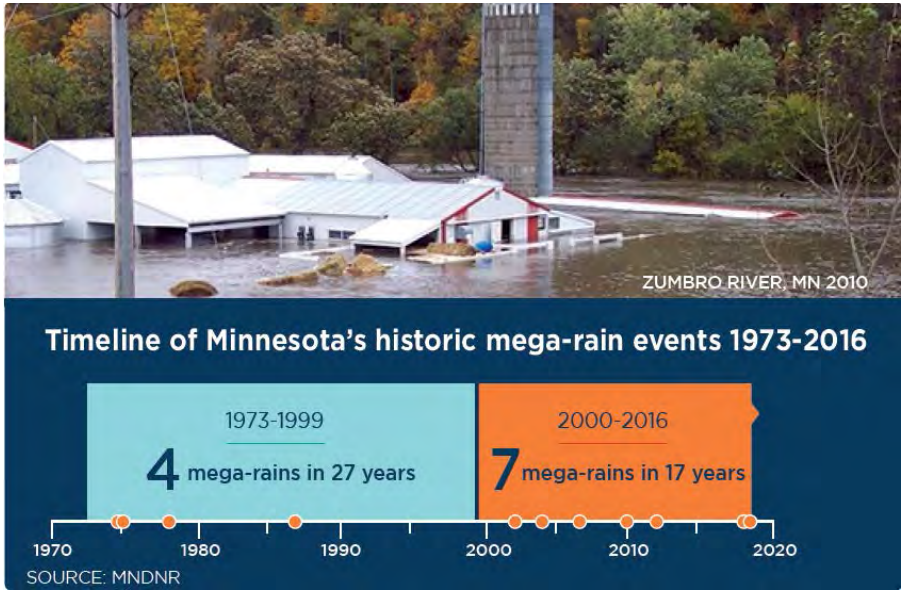
Source MPR

After

Source MPR

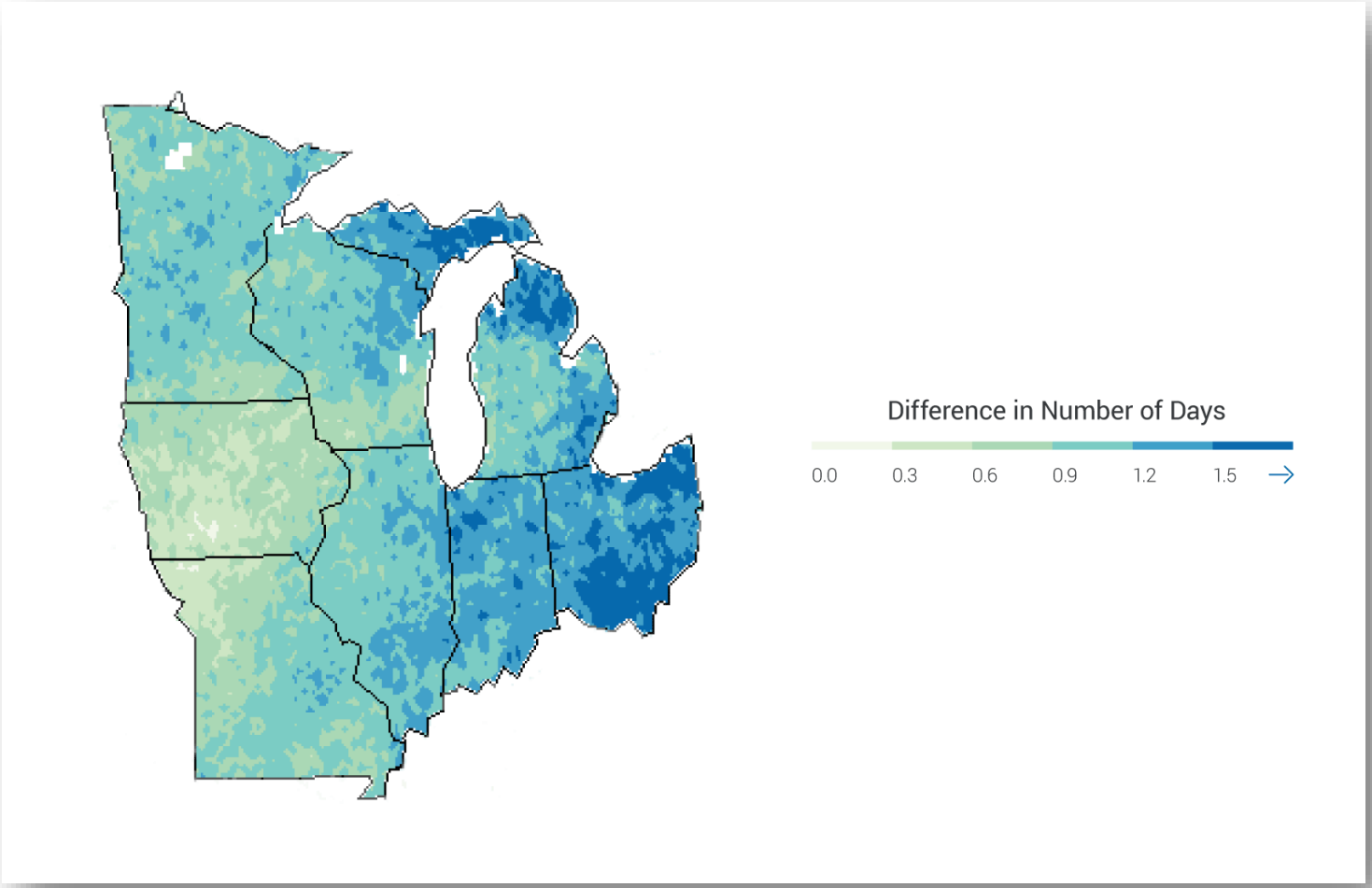
Extreme rainfall: “Mega” rain events (6” + over 1000 sq mi) are increasing

- June 28-29, 1975, Northwest MN
- June 30-July 2, 1978, Southeast MN
- July 23-24, 1987, Twin Cities Superstorm
- June 9-10, 2002, Northern MN
- September 14-15, 2004 Southern MN
- August 18-20, 2007, Southern MN
- September 22-23, 2010 Southern MN
- June 19-20, 2012, Northeast MN
- July 11-12, 2016, East-central MN
- August 10-11, 2016, Central and Southeast MN



Source: 2017 MN EQB Environment and Energy Report Card (via DNR)

Continued increase in “upper 2 percentile” rainfall events projected by mid-century



Source: 2014 National Climate Assessment, Midwest Chapter

No Trends: 1. Hot Weather, Warm Nights, Heat Waves

- Seems counterintuitive, but observed throughout region
- No trend observed in summer highs or hot extremes

  →***Important!*** This is true in MN and neighboring states, but not all of US or world

- Projections do indicate heat extremes more likely in decades ahead, right here in MN

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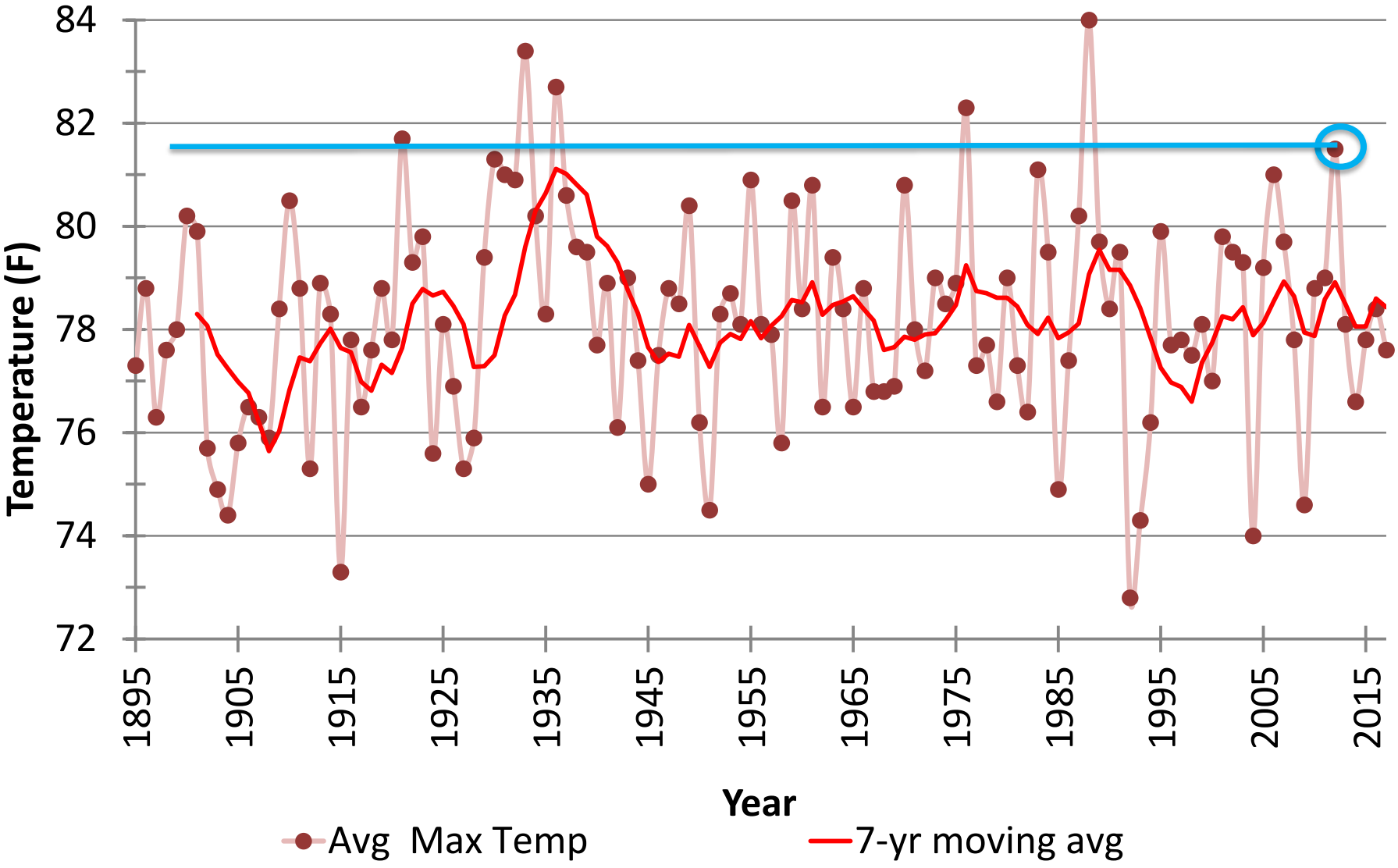
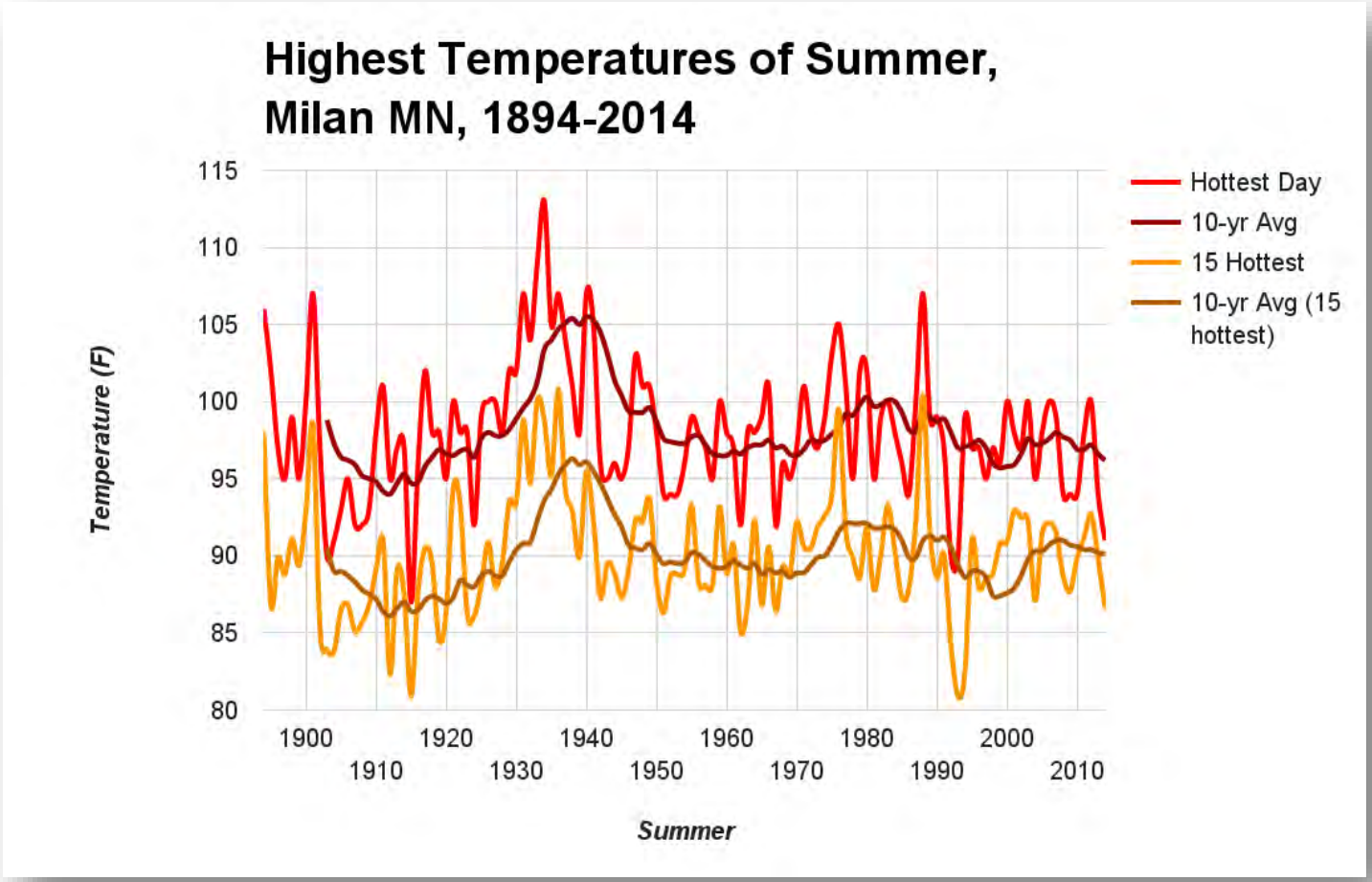
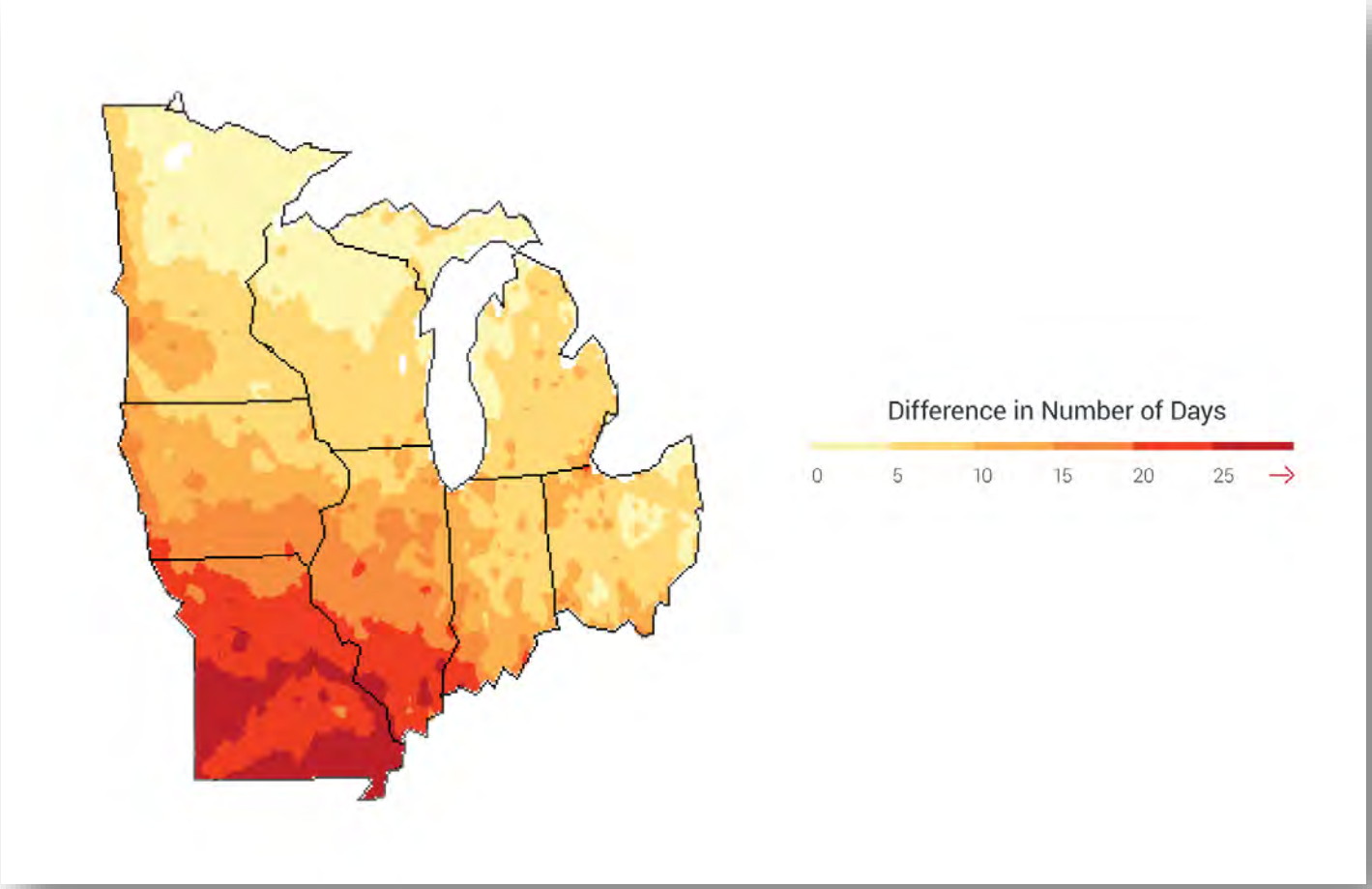
Minnesota Average Summer Maximum Temperatures 1895–2017



Extreme heat not increasing--yet



However, additional days above 95 F projected by mid-century

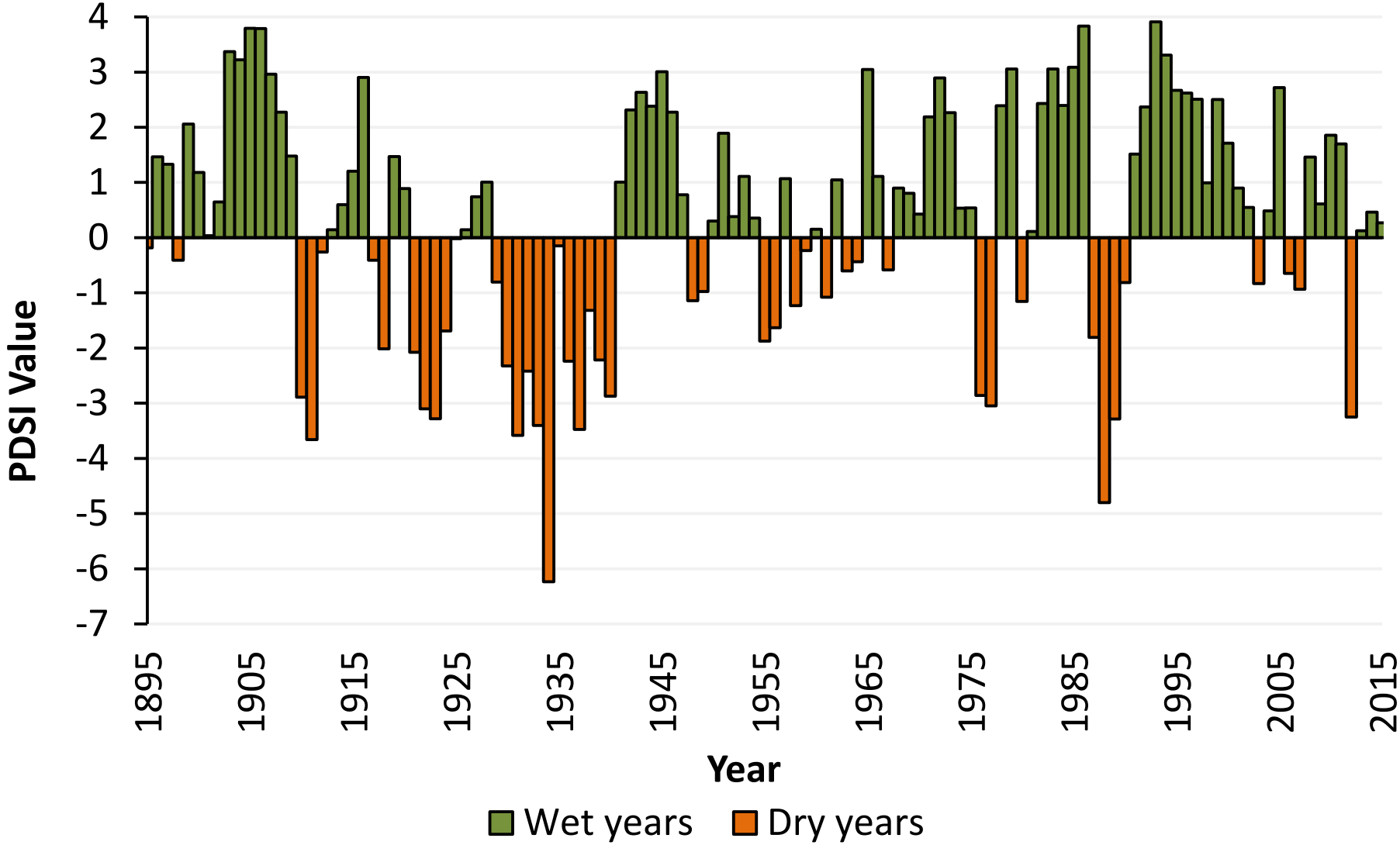


Source: 2014 National Climate Assessment, Midwest Chapter

No Trends: 2. Drought

- Drought a “normal” part of Minnesota’s climate
- No trends towards increased severity, duration, or coverage
  - Some NE MN forests stressed nevertheless
- Projections indicate more days between precipitation events, leading to more “intermediate” dry periods

Minnesota Palmer Drought Severity Index, 1895-2015: no drought increase



However, “hydrothermal deficit” and stress noted in northeast MN forests

Box 1 Forest droughts have increased in recent decades.

What changes in drought are in progress now?

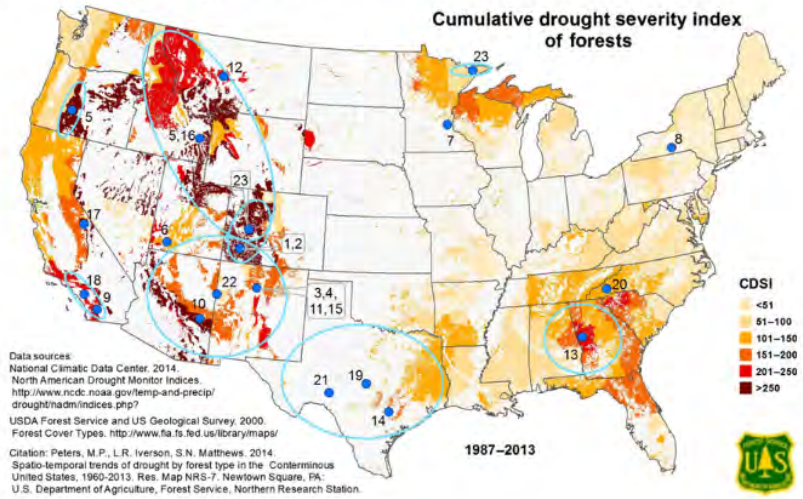
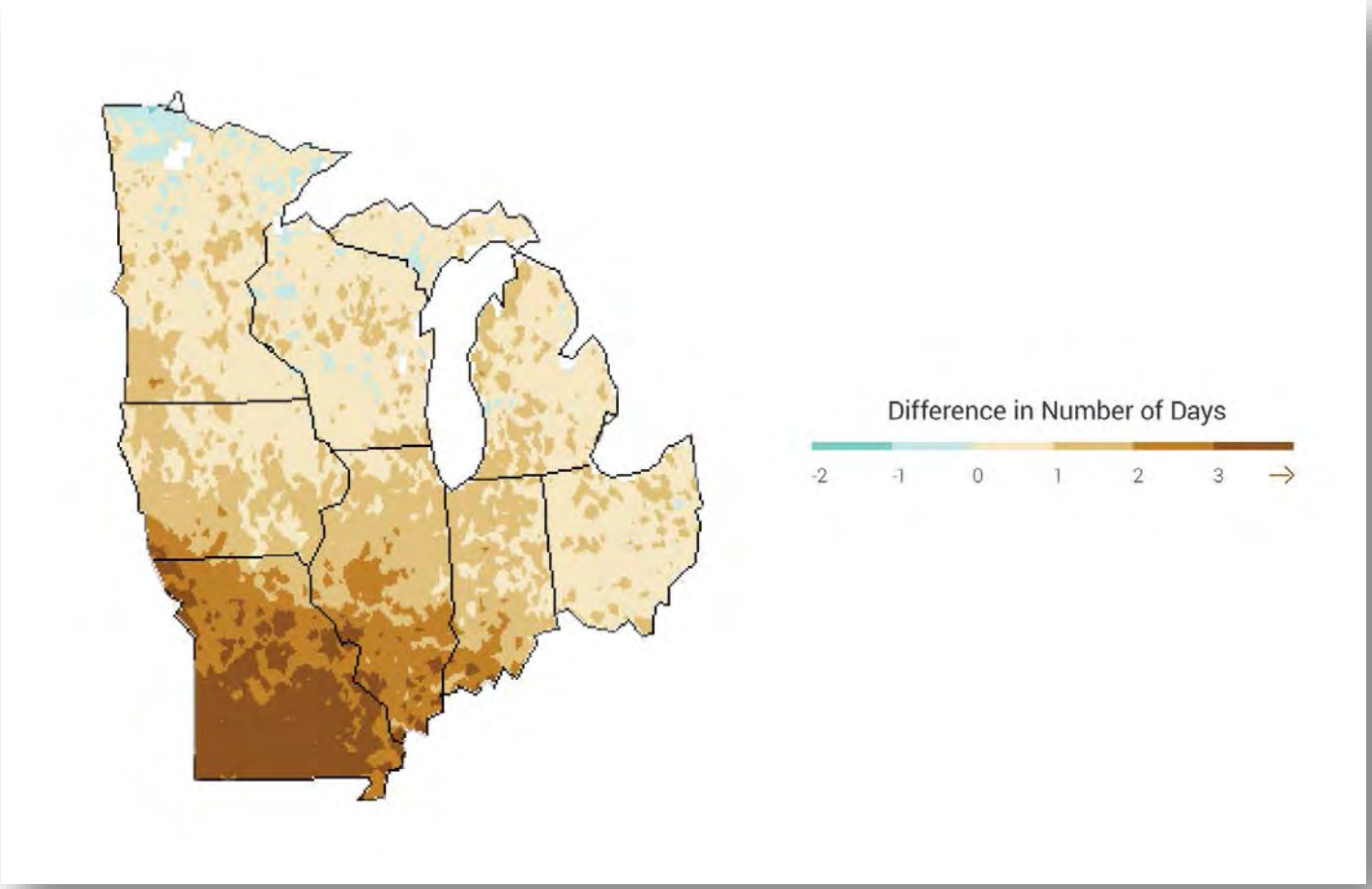


Fig. B1.1. Cumulative drought severity index (CDSI) for forested lands from 1987 to 2013, (modified from Peters *et al.*, 2014), with selected locations of drought- and heat-induced tree mortality indicated by blue circles (modified from Allen *et al.*, 2010 and Figure 4–7 in IPCC, 2014). Numbers correspond to supporting references. (modified from Peters *et al.*, 2014) (1) Anderegg *et al.* (2012) (2) Anderegg *et al.*, (2013b) (3) Breshears *et al.*, (2005) (4) Breshears *et al.*, (2009) (5) Creeden *et al.* (2014) (6) DeRose and Long (2012) (7) Faber-Langendoen and Tester (1993) (8) Fahey (1998) (9) Fellows & Goulden, (2012) (10) Ganey & Vojta, (2011) (11) Garrity *et al.* (2013) (12) Kaiser *et al.* (2012) (13) Klos *et al.*, (2009) (14) Kukowski *et al.* (2012) (15) Macalady and Bugmann (2014) (16) Meddens *et al.* (2012) (17) Millar *et al.*, (2012) (18) Minnich, (2007) (19) Moore *et al.* (2013) (20) Olano and Palmer (2003) (21) Twidwell *et al.* (2013) (22) Williams *et al.*, (2013) (23) Worrall *et al.*, (2013).

Clark, James S., et al. "The impacts of increasing drought on forest dynamics, structure, and biodiversity in the United States." *Global change biology* (2016).

And, additional consecutive dry days projected by mid-century

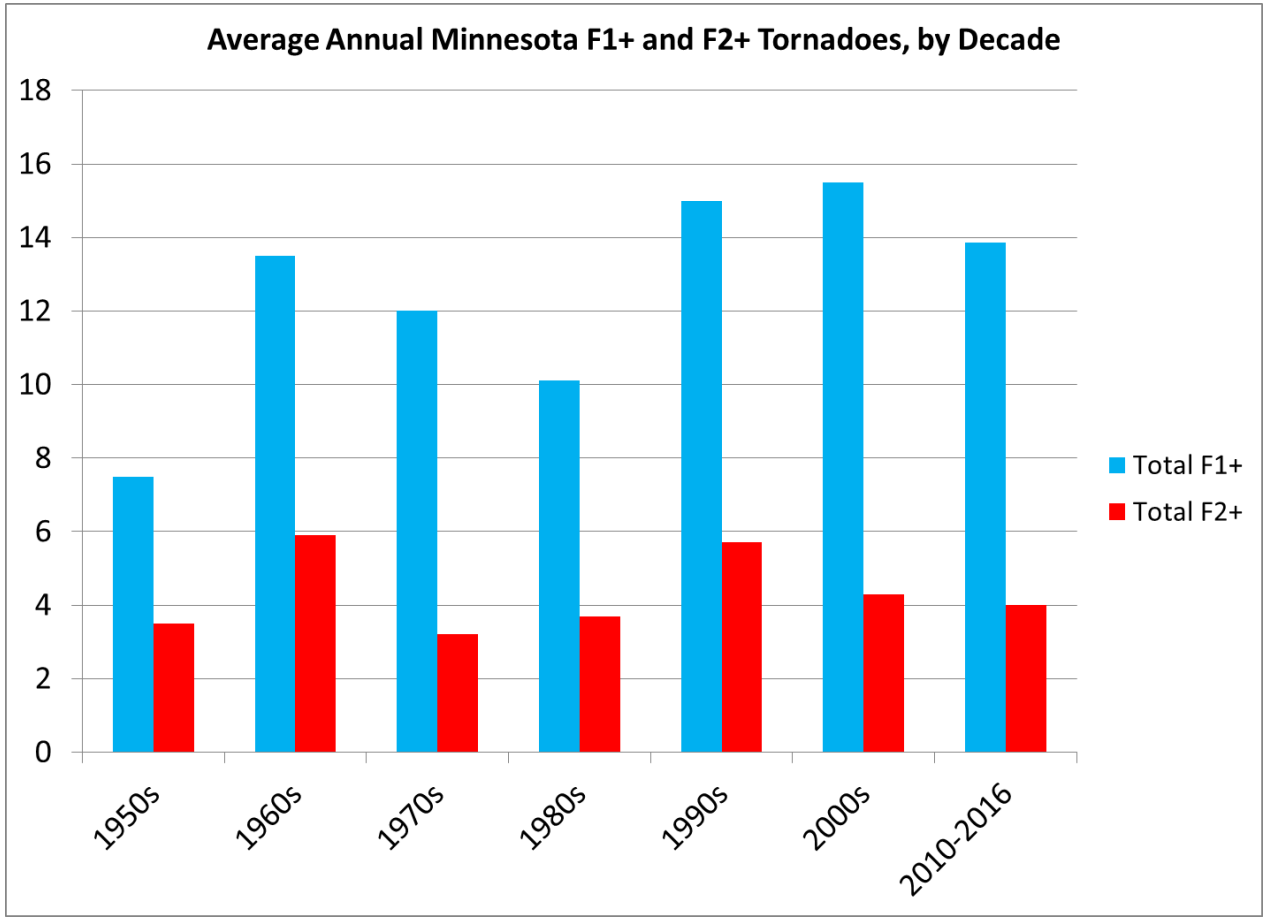


Source: 2014 National Climate Assessment, Midwest Chapter

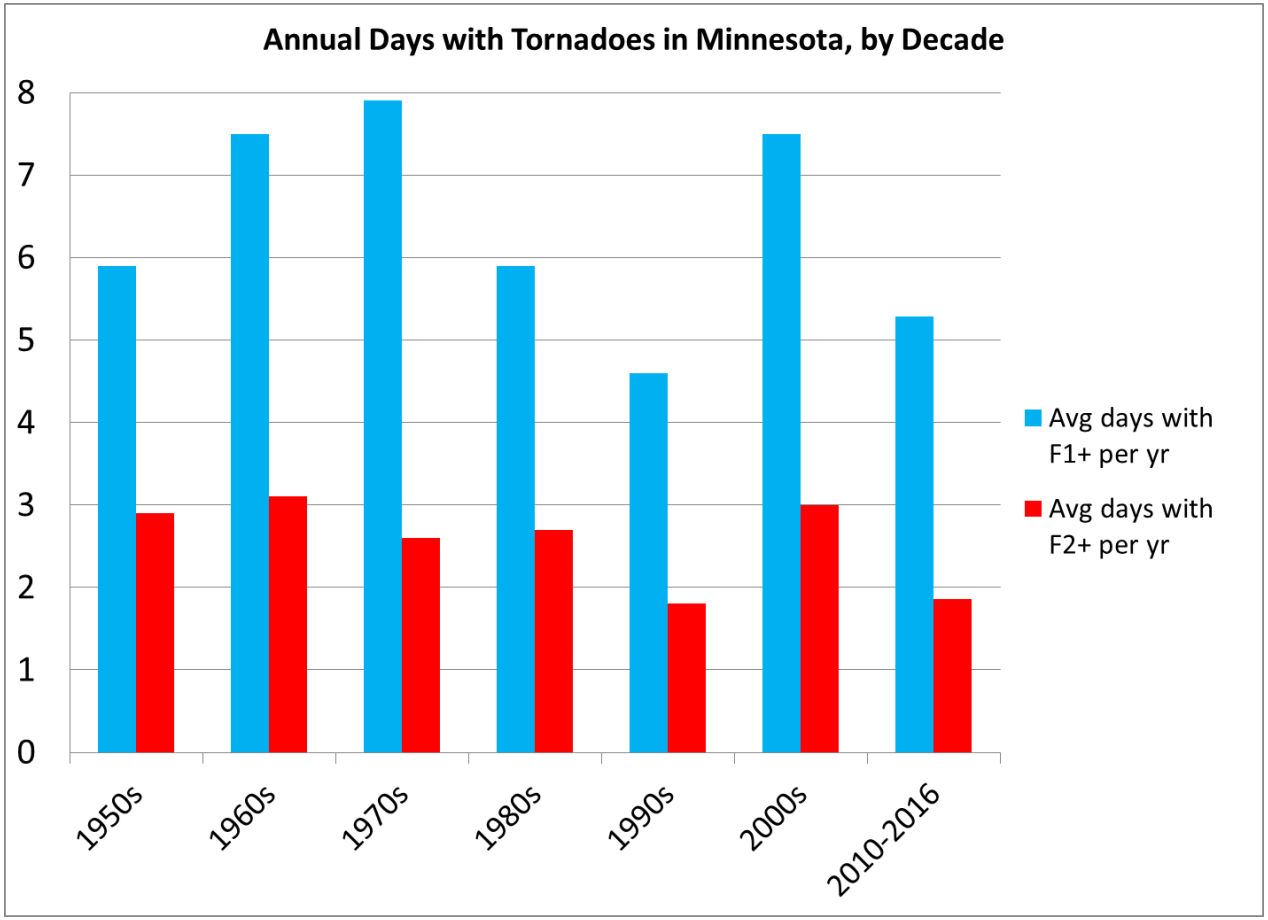
No Trends: 3. Tornadoes and Severe Convective Storms

- Tornadoes, damaging wind, and hail, all have reporting/observing biases towards more detection recently
- Statewide and national trends show no increase in *damaging* tornadoes.
- Projections unclear, with some possibility of fewer days but more "outbreaks." Robust consensus still lacking.

Damaging Tornadoes



Damaging Tornadoes *Days*



In Summary

1. Minnesota becoming warmer and wetter, projected to continue
2. Cold conditions warming fastest, projected to continue
3. Extreme rainfall events increasing, projected to continue
4. Hot weather not yet increasing, projected in decades ahead
5. Drought not increasing, future increases possible
6. Tornadoes/hail/damaging winds not increasing, projections unclear

DEPARTMENT OF NATURAL RESOURCES

Thank You!

Kenny Blumenfeld

Kenneth.Blumenfeld@state.mn.us

651-296-4214

Current and Expected Impacts of Climate Change in Washington County

Photo credit: SWWD

South Washington Watershed District

Ramsey-Washington Metro Watershed District

Freshwater Society

Barr

The good news…

….there is much we can do to prepare and even reduce the impacts of climate change.

Thanks for being here!

Preparing for our Changing Climate

BARR

Situation Today
changes are occurring

Engage Stakeholders

Possible Future Scenarios

- High Wind
- Extreme Storm Events
- Extreme Heat Event
- Extended Drought

→ Catastrophic Flooding?
→ Water Shortage?
→ Failed Infrastructure?
→ Industrial Challenges?
→ Health Impacts?
→ What Else?

Strategy
(Informed Decisions)
Community Engagement

Conclusions: A B C D E F

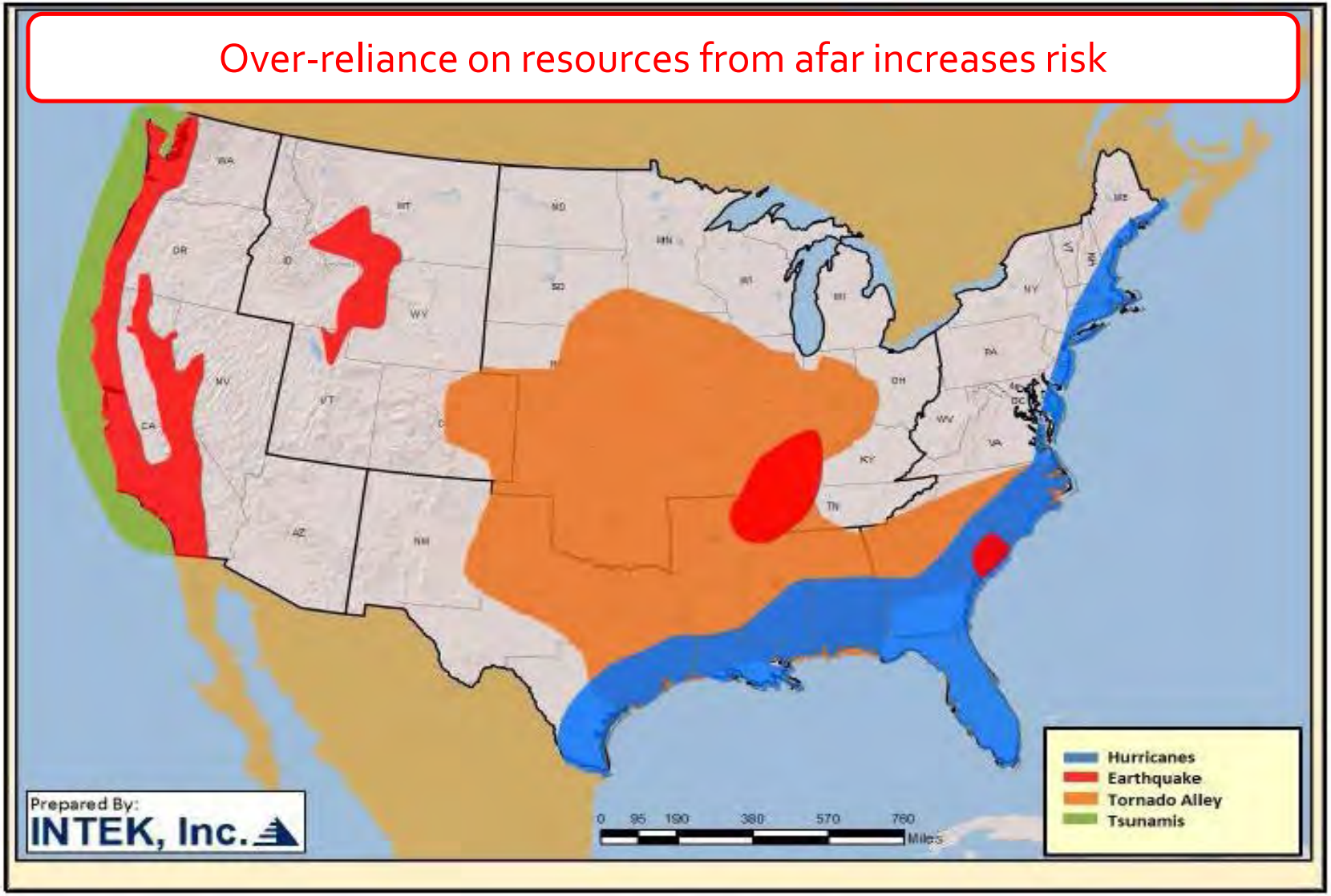
Operate Strategically for a Resilient Tomorrow

WHAT ARE WE NOTICING NOW? → WHAT COULD HAPPEN? → HOW VULNERABLE ARE WE? → CREATE A PLAN! → WHAT WE WILL DO?... → FOR A RESILIENT TOMORROW

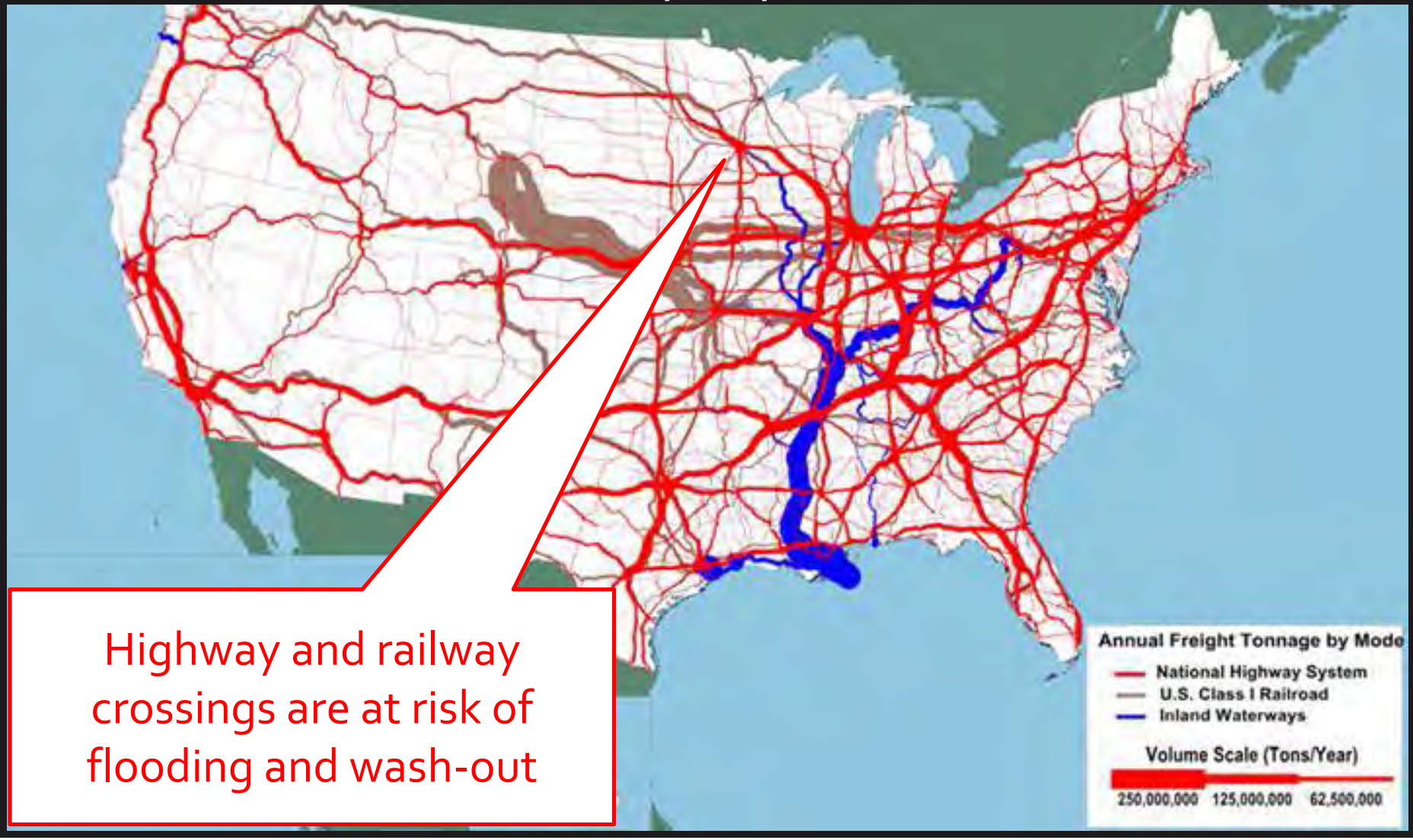
Climate Hazards

- Extreme precipitation & flooding
- Urban heat island & heat waves
- Drought
- Extreme wind (tornado, straight-line winds, etc.)
- Winter minimum temperature increase (including ice storms)

Climate risk exists across our entire supply chain network



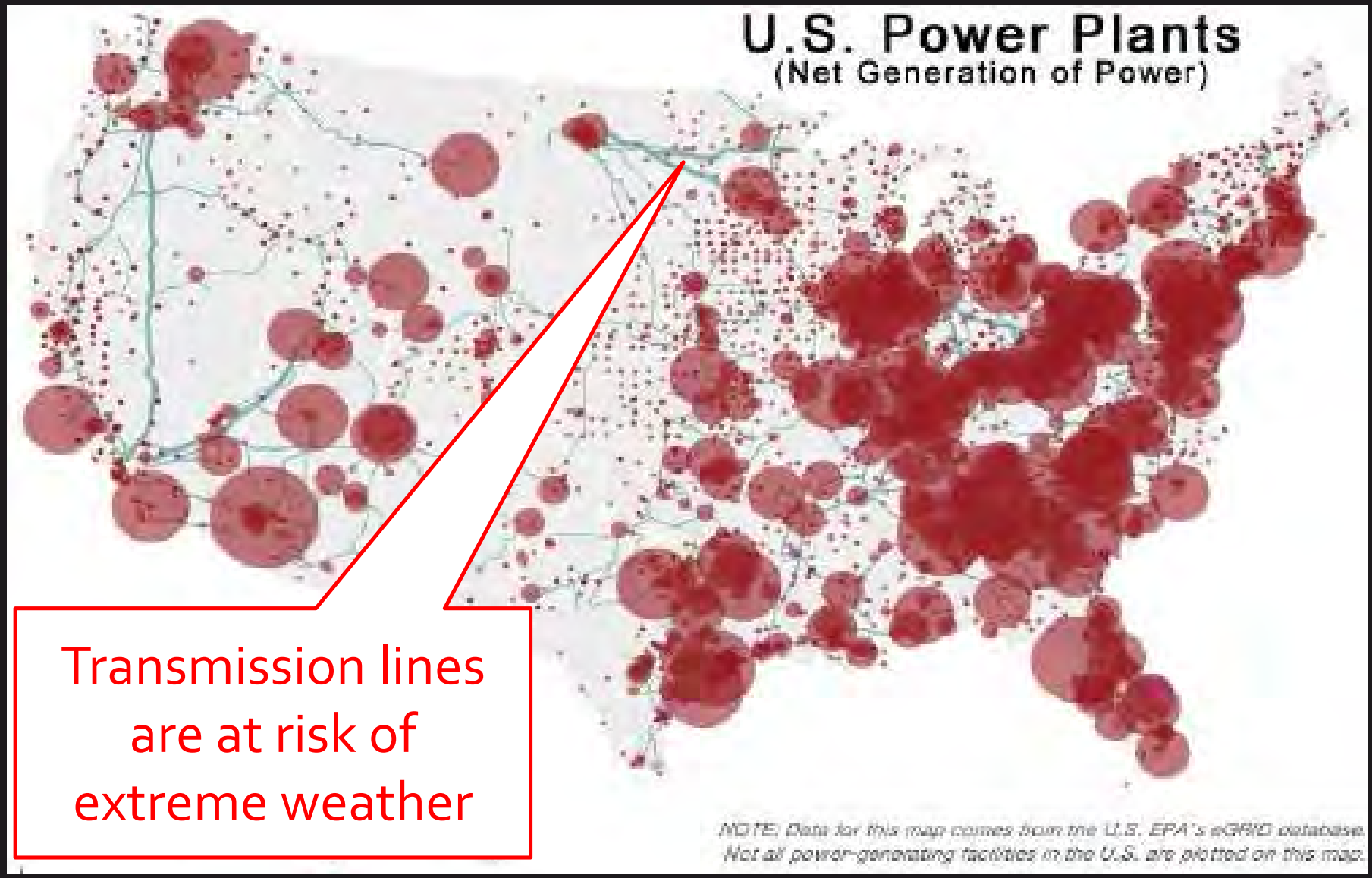
Affordability and reliability of electricity, fuel, and food are affected by impacts elsewhere



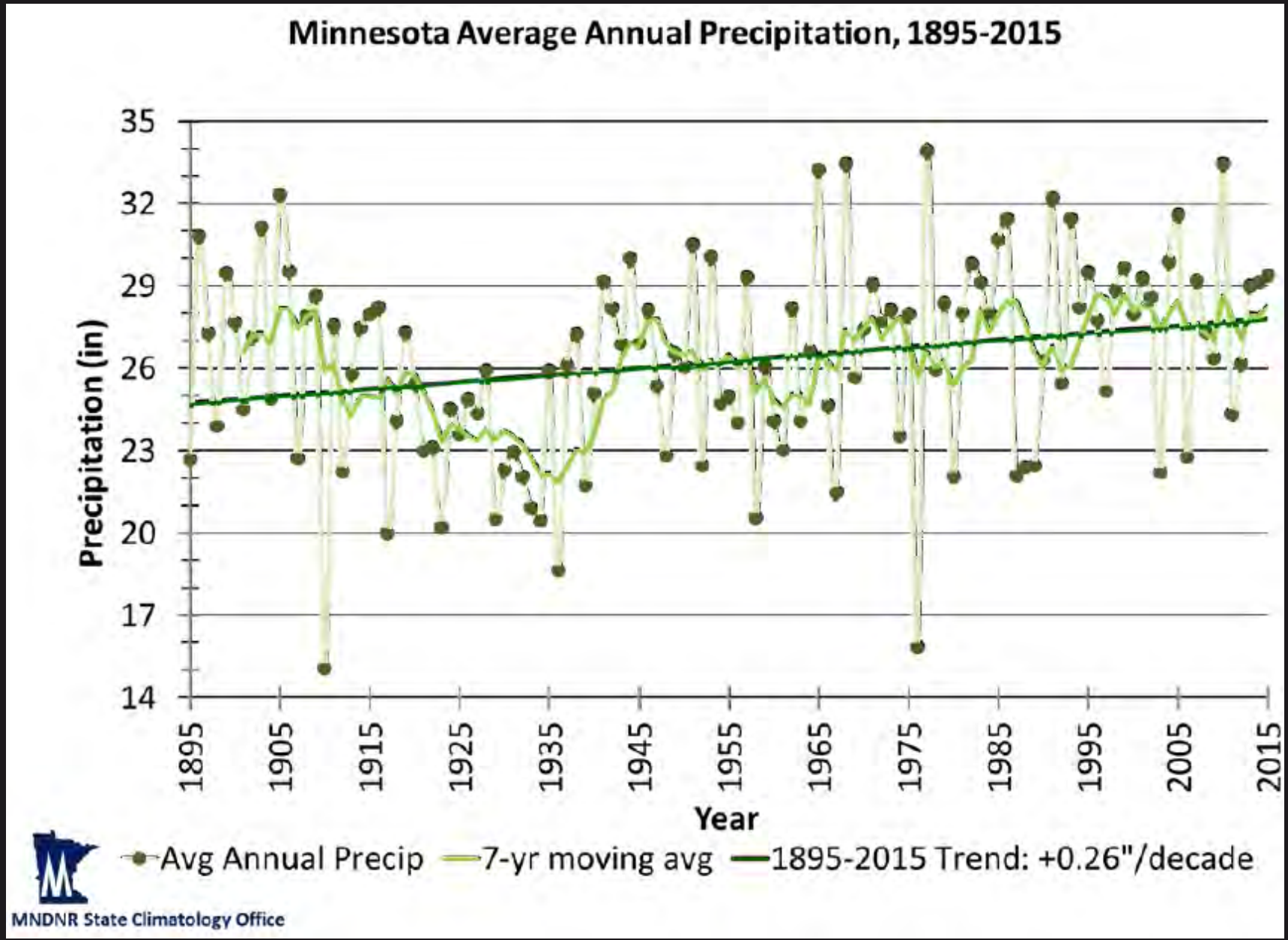
Highway and railway crossings are at risk of flooding and wash-out

Sources: Highways: U.S. Department of Transportation, Federal Highway Administration, Freight Analysis Framework, Version 2.2, 2007. Rail: Based on Surface Transportation Board, Annual Carload Waybill Sample and rail freight flow assignments done by Oak Ridge National Laboratory. Inland Waterways: U.S. Army Corps of Engineers (USACE), Annual Vessel Operating Activity and Lock Performance Monitoring System data, as processed for USACE by the Tennessee Valley Authority; and USACE, Institute for Water Resources, Waterborne Foreign Trade Data, Water flow asssignments done by Oak Ridge National Laboratory.

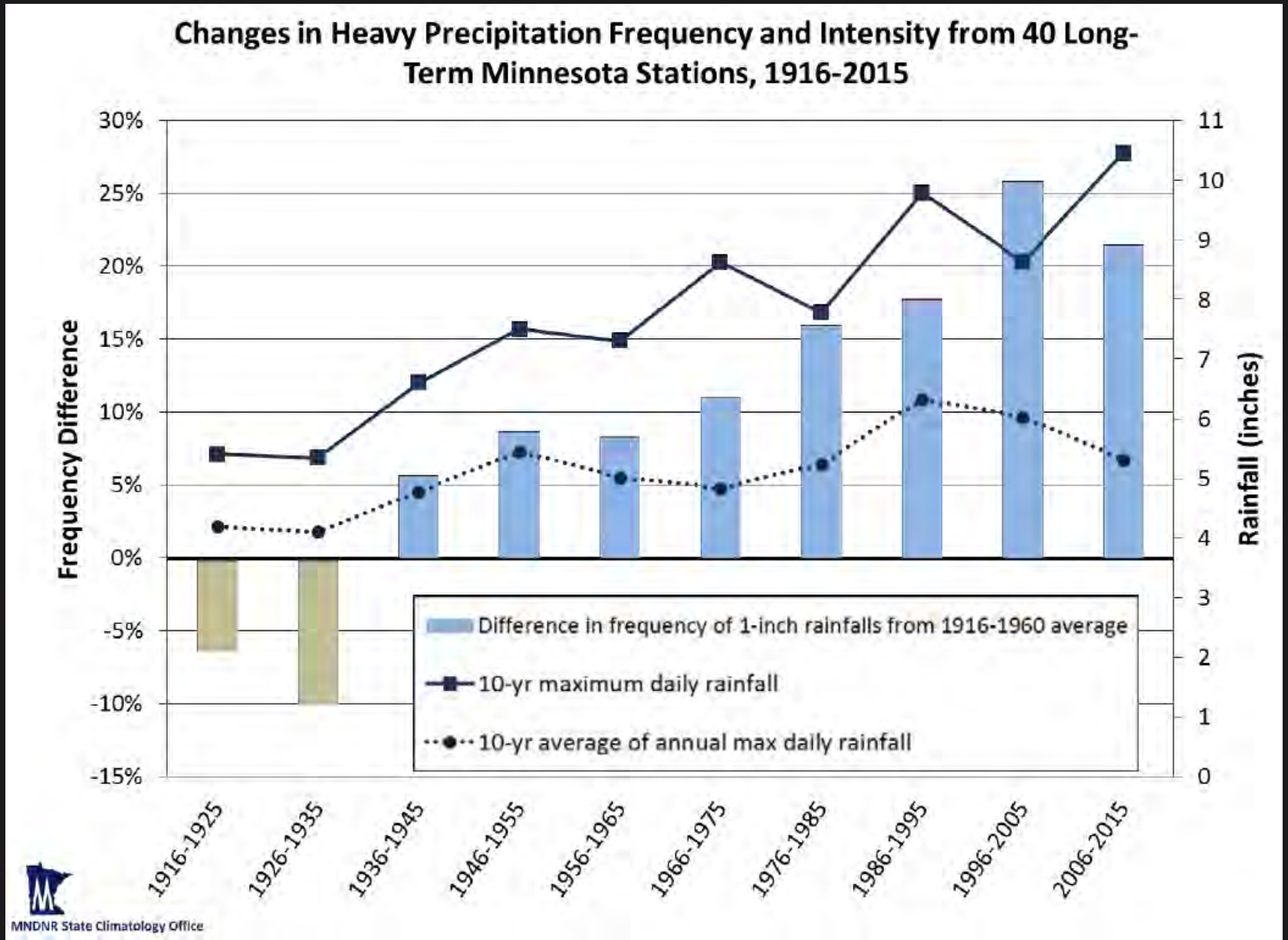
Affordability and reliability of electricity, fuel, and food are affected by impacts elsewhere



Precipitation is increasing



Extreme events are happening more frequently




Timeline of Minnesota's historic mega-rain events 1866-2014
1860
1880
1900
1920
1940
1960
1980
2000
2020
ROAD
CLOSED
Photo credit: Barr

Bloomington, MN

Extreme Storm Event – Duluth 2012

The Lester River flows through a gash it created in Jean Duluth Road north of Duluth, Minn., Thursday morning, June 21, 2012. City, county and state officials spent Thursday assessing damage, while areas farther south continued to fight rising floodwaters. The town of Moose Lake was being described as "an island." (AP Photo/The News-Tribune, Bob King)

Extreme Storm Event – Duluth 2012

Source: The Duluth News-Tribune, Bob King

2014 Landslide at West River Parkway

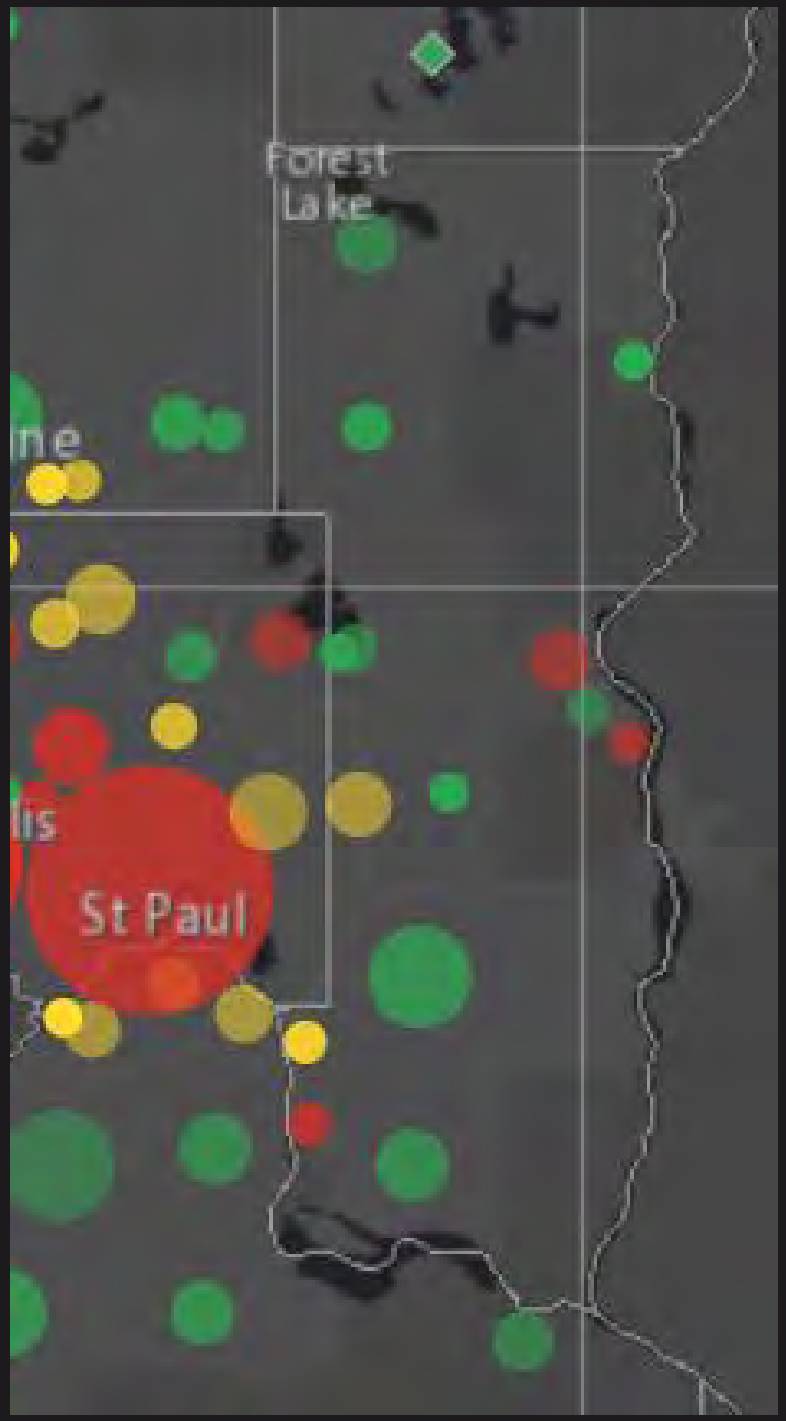
Minneapolis

Photo Credit: Barr Engineering Co.

Historical Landslide Inventory for the Twin Cities Metropolitan Area.
MN DNR, 2016 Report.

Many slopes are vulnerable to extreme precipitation & slope failures

Newer infrastructure is a community strength



Age Category with Highest % of Sewer Collection System

Sewer Age Category

- < 30 years old
- 30-50 years old
- > 50 years old

Minnesota State Auditor

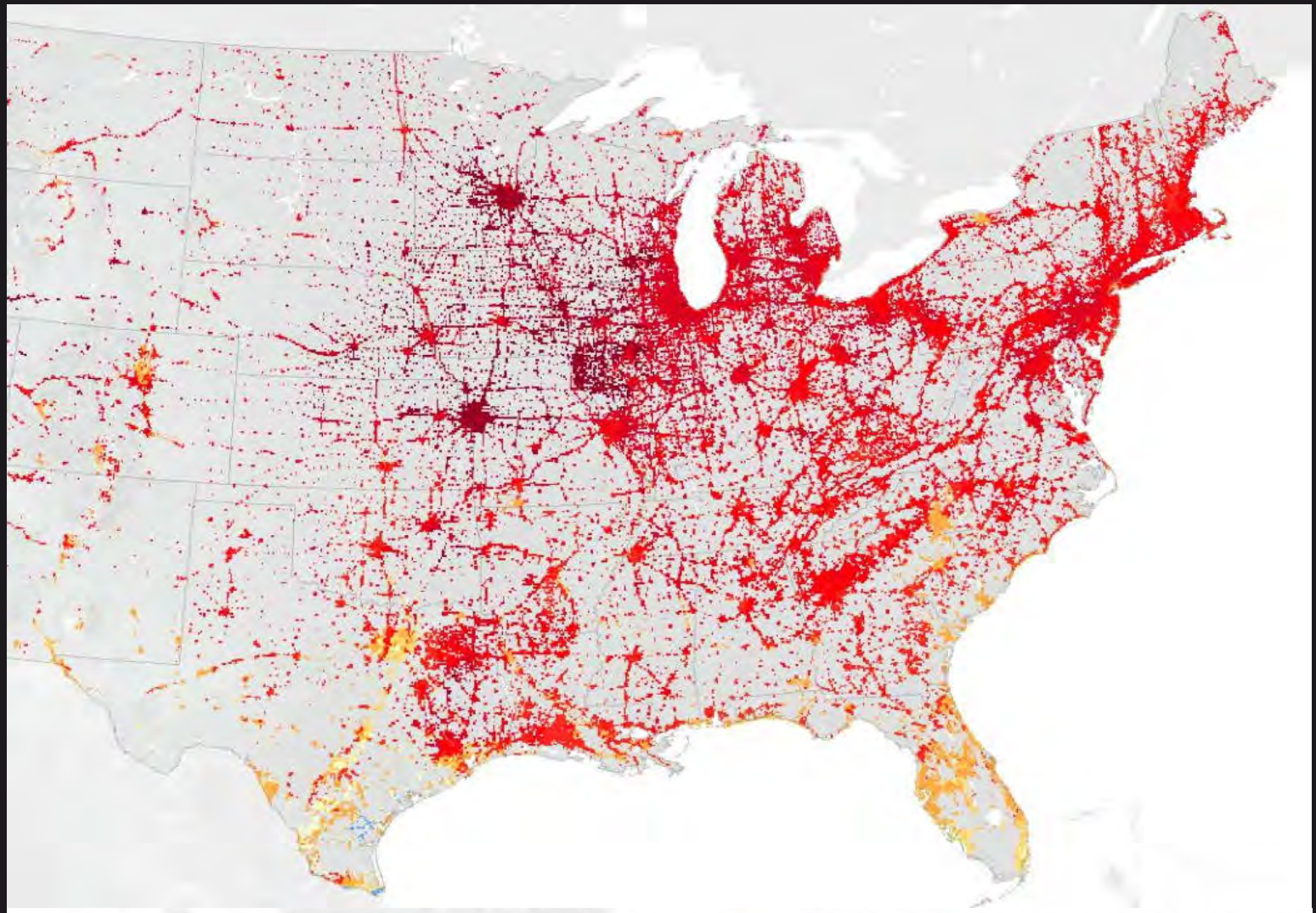
Audience Story Telling:

Extreme Precipitation and Flooding

Climate Hazards

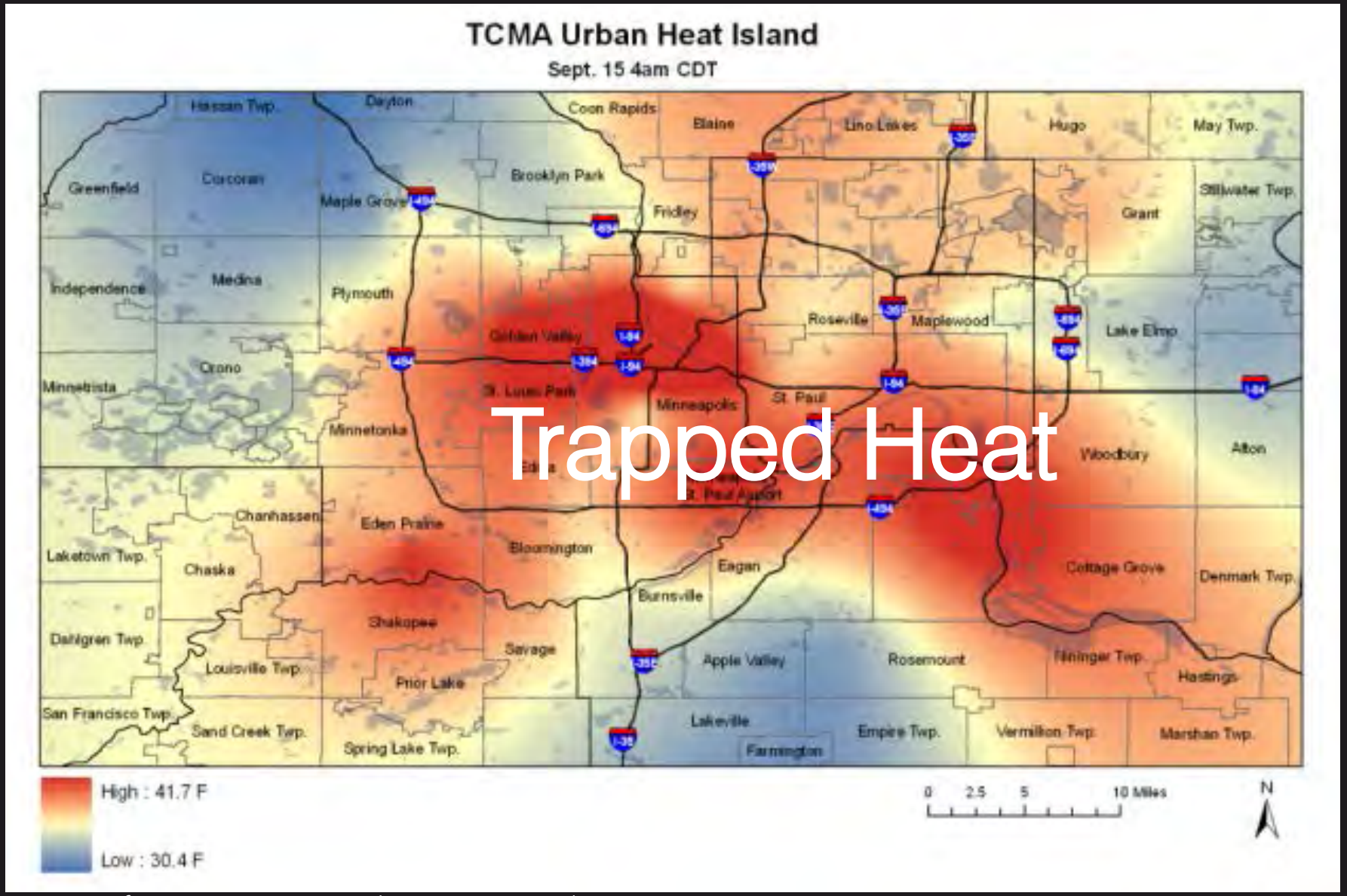
- Extreme precipitation & flooding
- Urban heat island & heat waves
- Drought
- Extreme wind (tornado, straight-line winds, etc.)
- Winter minimum temperature increase (including ice storms)

Urbanization creates heat island



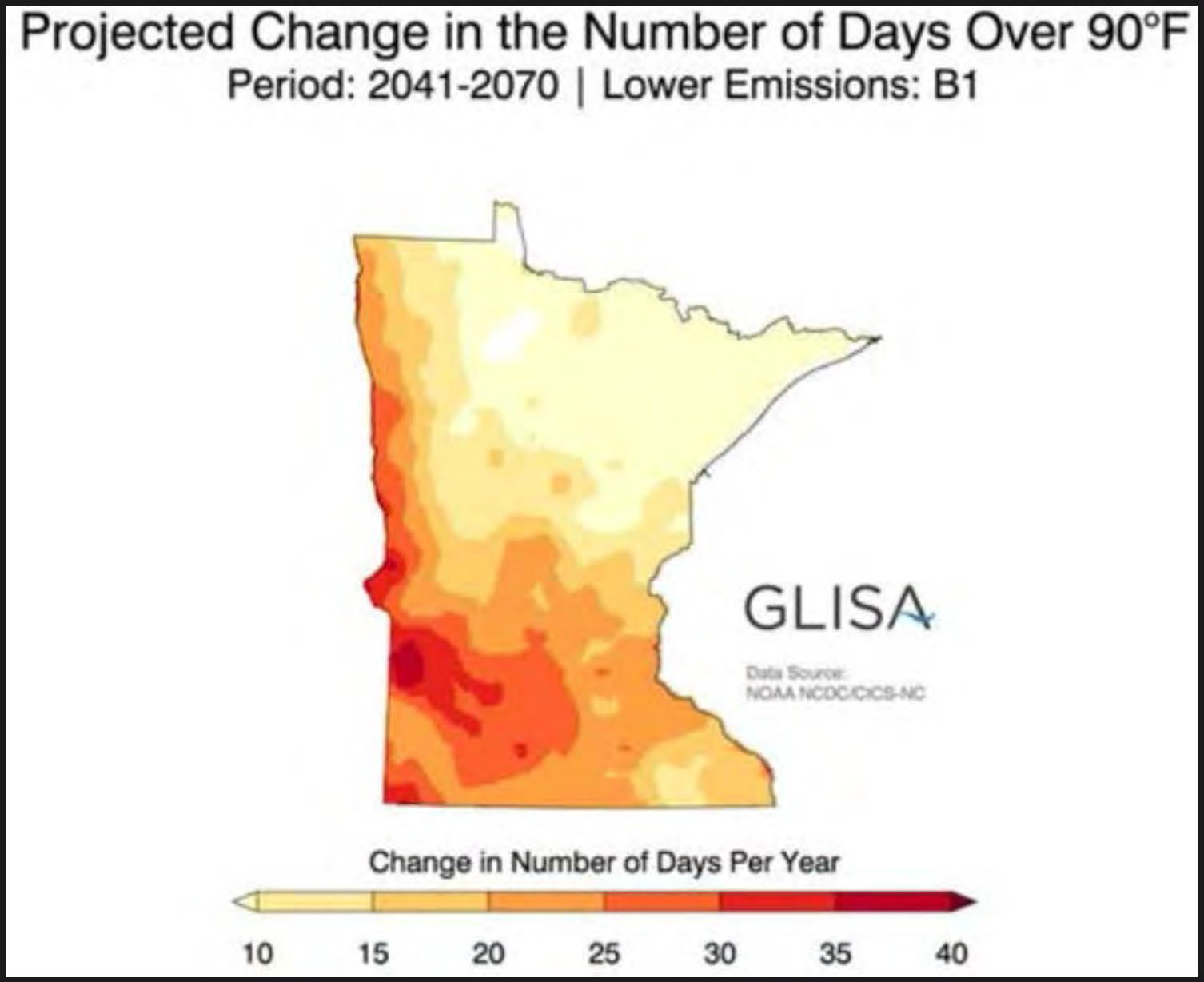
The temperature difference between urban areas and surrounding vegetated land due to the presence of impervious surfaces across the continental United States. Credits: NASA's Earth Observatory

Urban heat island in So. Washington County



University of Minnesota, 2011, Peter Snyder & Tracy Twine, et al.
http://www.startribune.com/twin-cities-heat-islands/134412178/

More heat predicted



Extreme heat creates safety and budgetary concerns

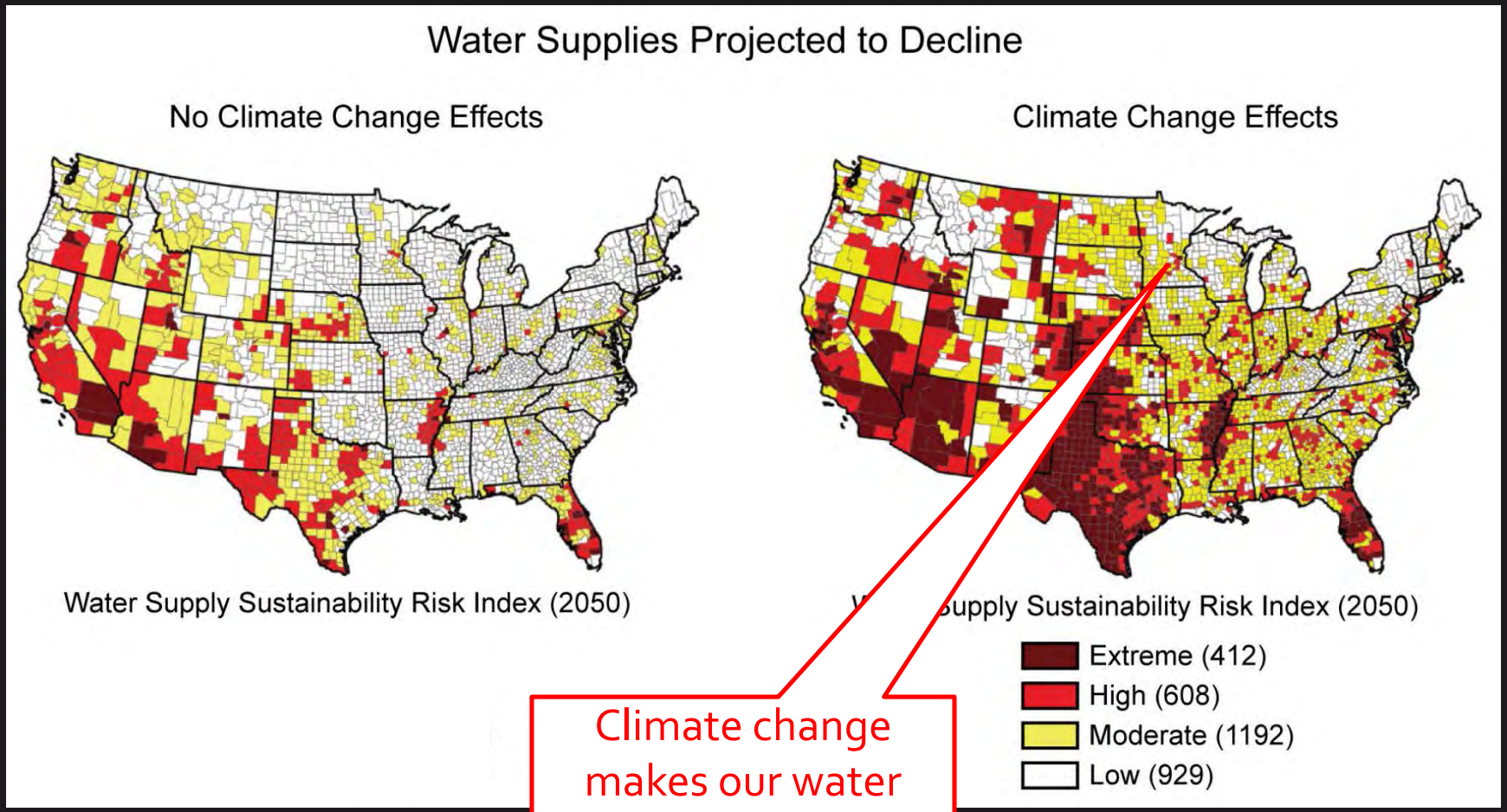
Source: Spielel On Line

https://www.youtube.com/watch?v=vmB3BrwTHBs

Climate Hazards

- Extreme precipitation & flooding
- Urban heat island & heat waves
- Drought
- Extreme wind (tornado, straight-line winds, etc.)
- Winter minimum temperature increase (including ice storms)

Our water footprint is large and keeps growing

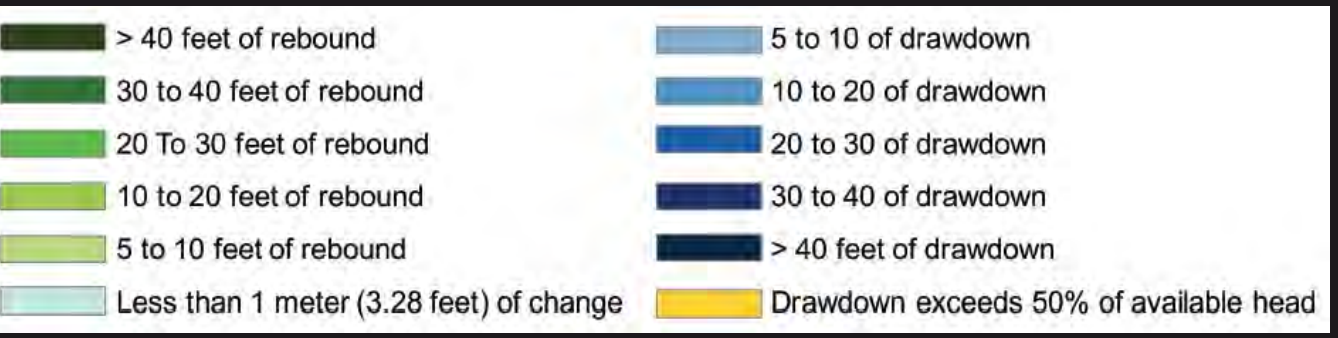


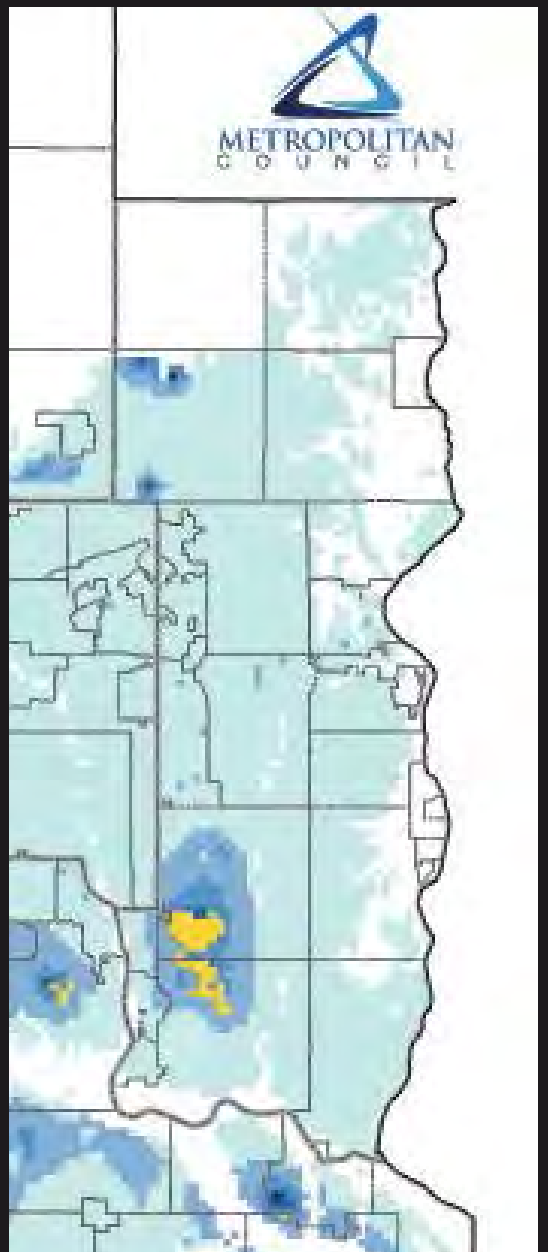
U.S. Climate Resilience Toolkit, 2014 National Climate Assessment. U.S. Global Change Research Program
https://toolkit.climate.gov/topics/water

Our water footprint is large and keeps growing

Climate change increases uncertainty with our local aquifers

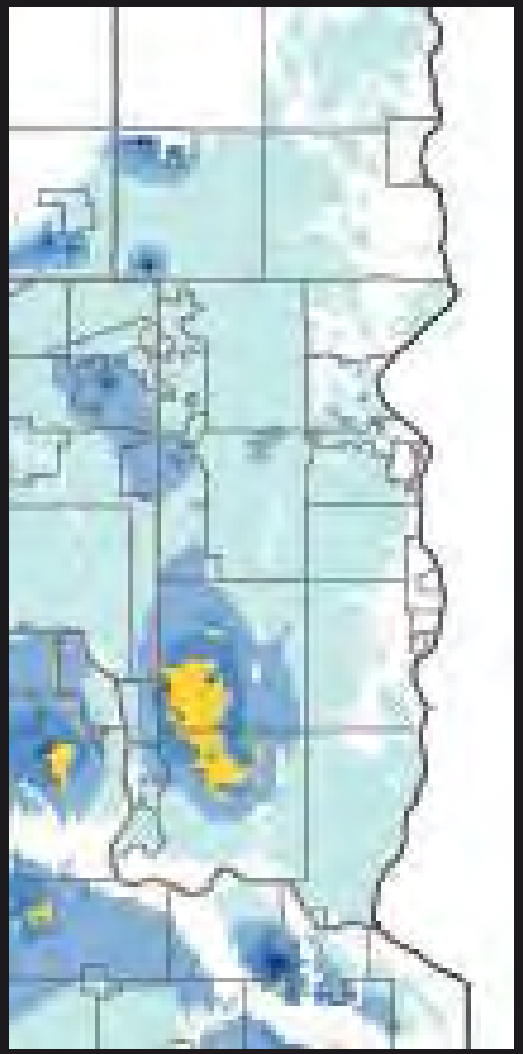
Drawdown by 2040 in the Prairie du Chien-Jordan aquifer under average pumping





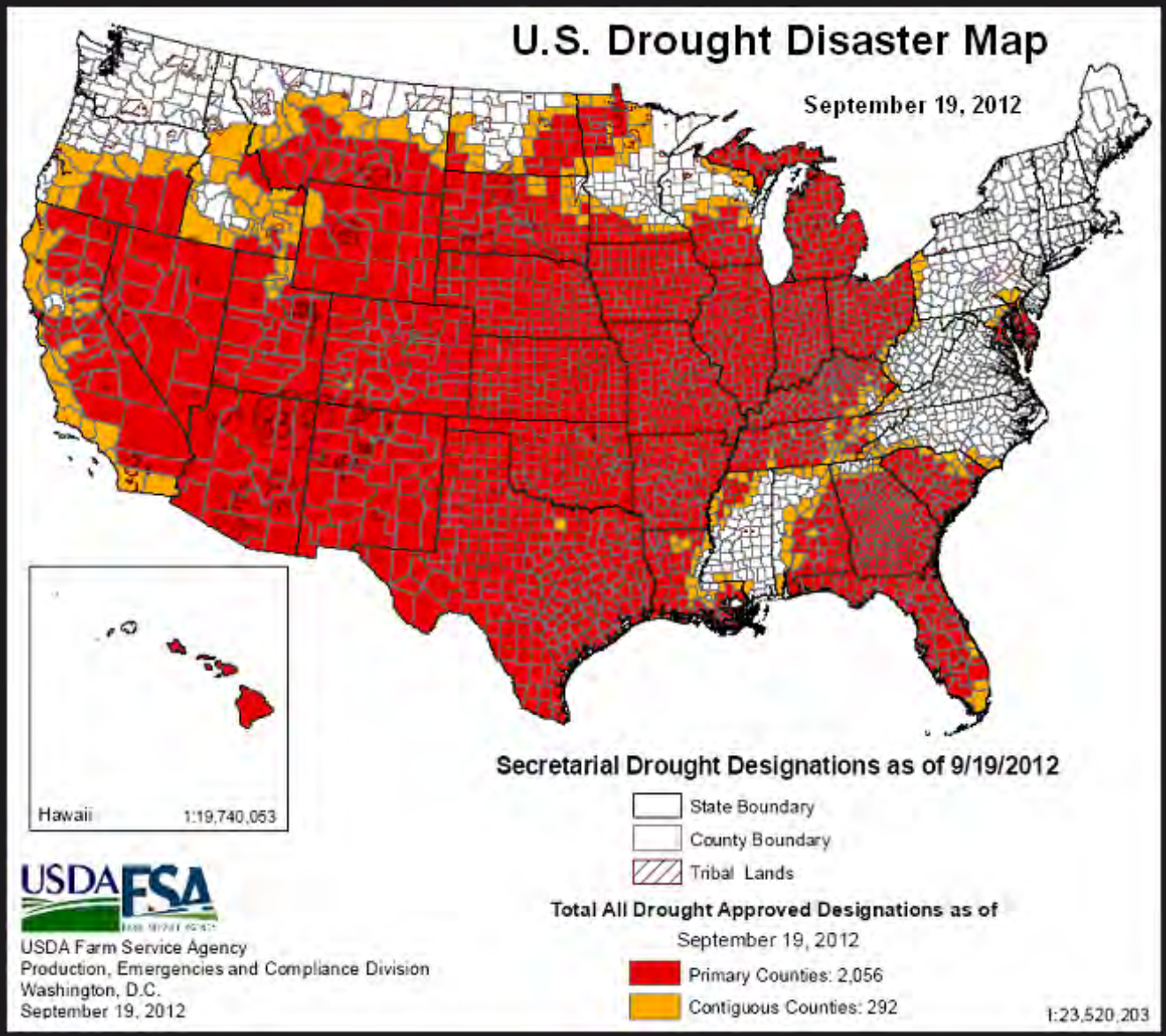
Aquifer drawdown should average projected pumping be reduced by 20%

Aquifer drawdown should average projected pumping be increased by 20%

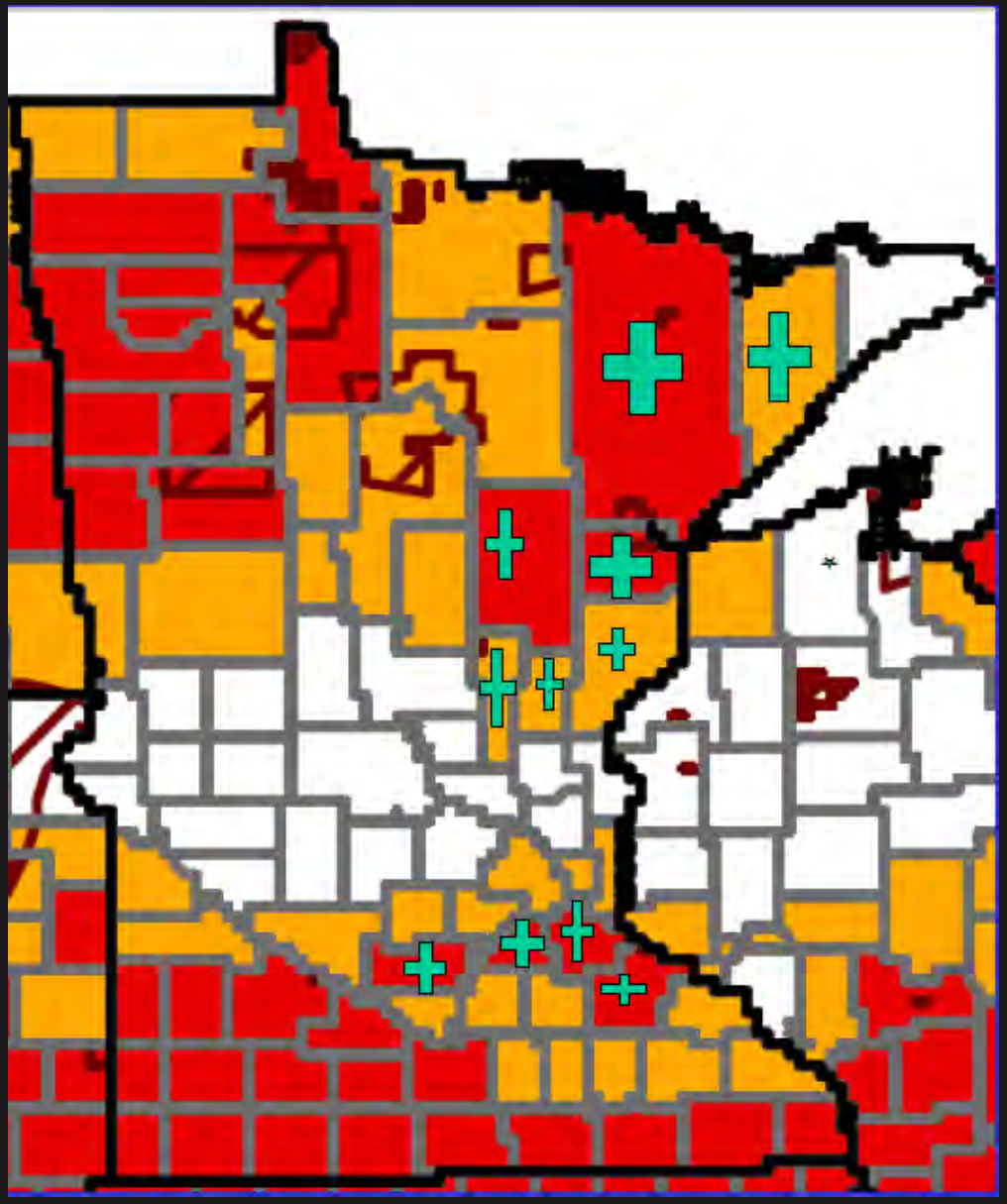


Source: Met Council

2012 – Most ever drought-specific disaster declarations by county



Minnesota observed drought and floods in 2012



Counties receiving disaster assistance for drought, except counties with :

Counties receiving disaster assistance for flooding

Image used with permission from Mark Seeley, University of Minnesota, Drought Trends and the Climate Outlook for 2013,
Institute of Ag Professionals, Proceedings of the 2012 Crop Pest Management Shortcourse & Minnesota Crop Production Retailers Association Trade Show, 13 Dec. 2012

Climate Hazards

- Extreme precipitation & flooding
- Urban heat island & heat waves
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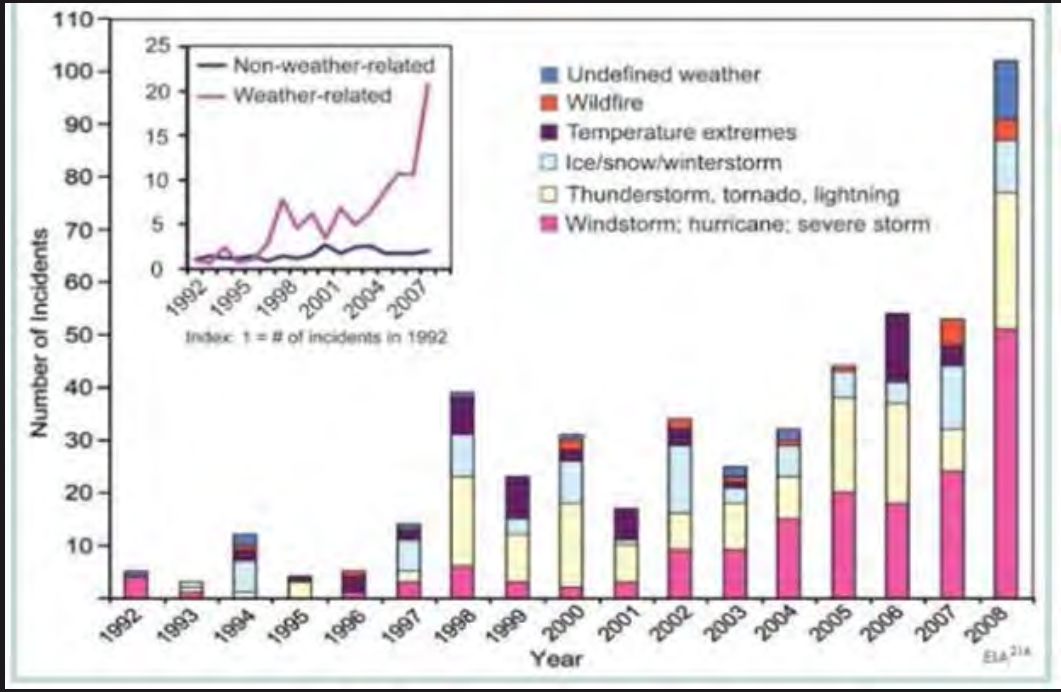
- Extreme wind (tornado, straight-line winds, etc.)
- Winter minimum temperature increase (including ice storms)

Significant weather-related U.S. electric grid disturbances increasing

1992-2008



Source: Energy Information Administration, U.S. Global Change Research Program

Source: Agweek

Source: FEMA

Tornado alley may shift north

North Minneapolis 2011
Source: Tony Webster

St. Nazianz, Wisconsin
2000 Super Storm
Source: Wikimedia


Photo credit: Barr

Climate Hazards

- Extreme precipitation & flooding
- Urban heat island & heat waves
- Drought
- Extreme wind (tornado, straight-line winds, etc.)
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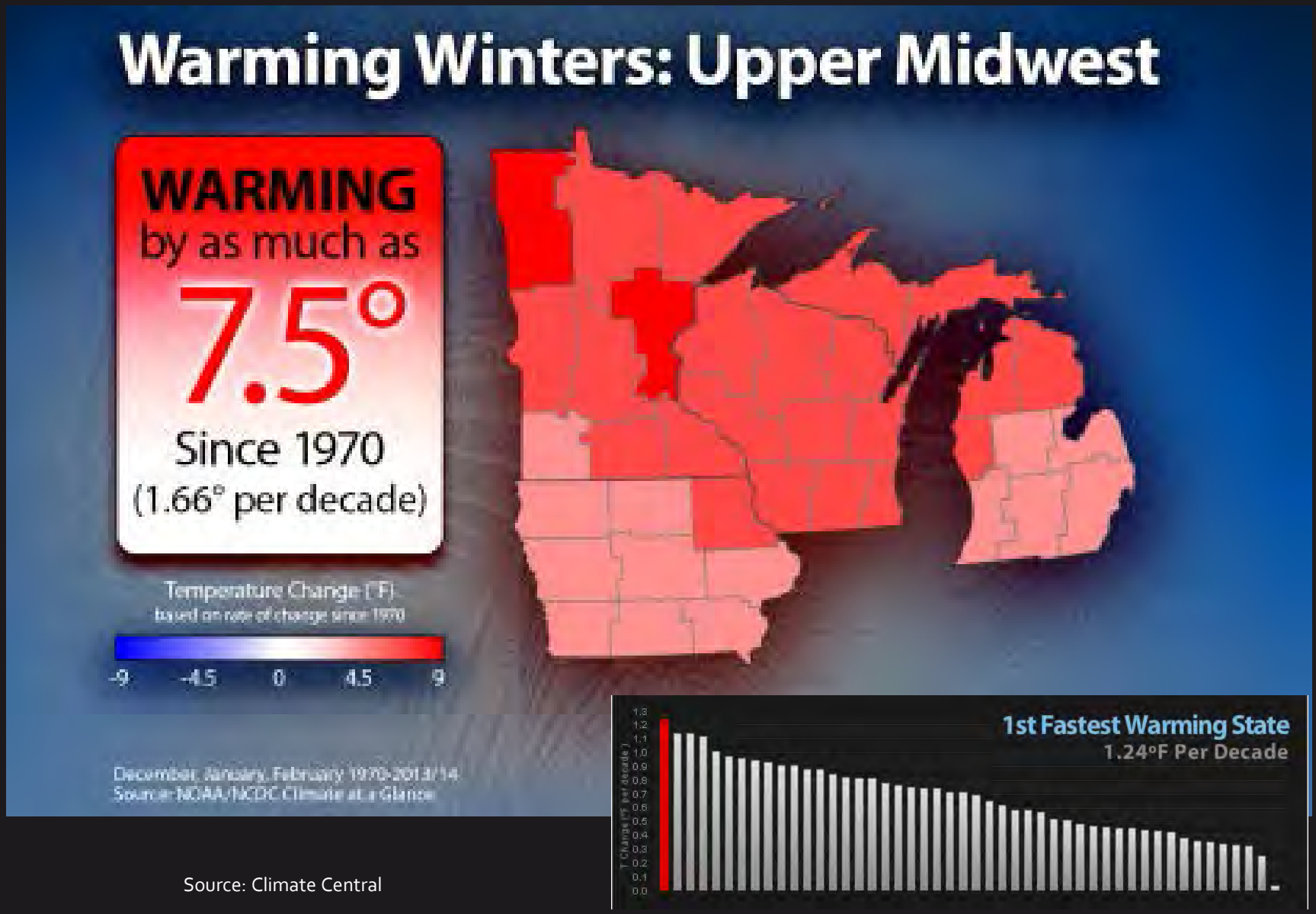
Minnesota is the fastest warming state



Source: Climate Central

Warming winters increase frequency of freeze-thaw cycles, ice storms

urce: www.polhole.info

Source: Kevin Van Paassen, The Glove and Mail

More maintenance dollars and city staff time/effort

More vehicle wear and tear

Audience Story Telling:

- Urban heat island & heat waves
- Drought
- Extreme wind
- Winter minimum temperature increase

Current and Expected Impacts of Climate Change in Washington County

Photo credit: SWWD

South Washington Watershed District

Ramsey-Washington Metro Watershed District

Freshwater Society

Barr

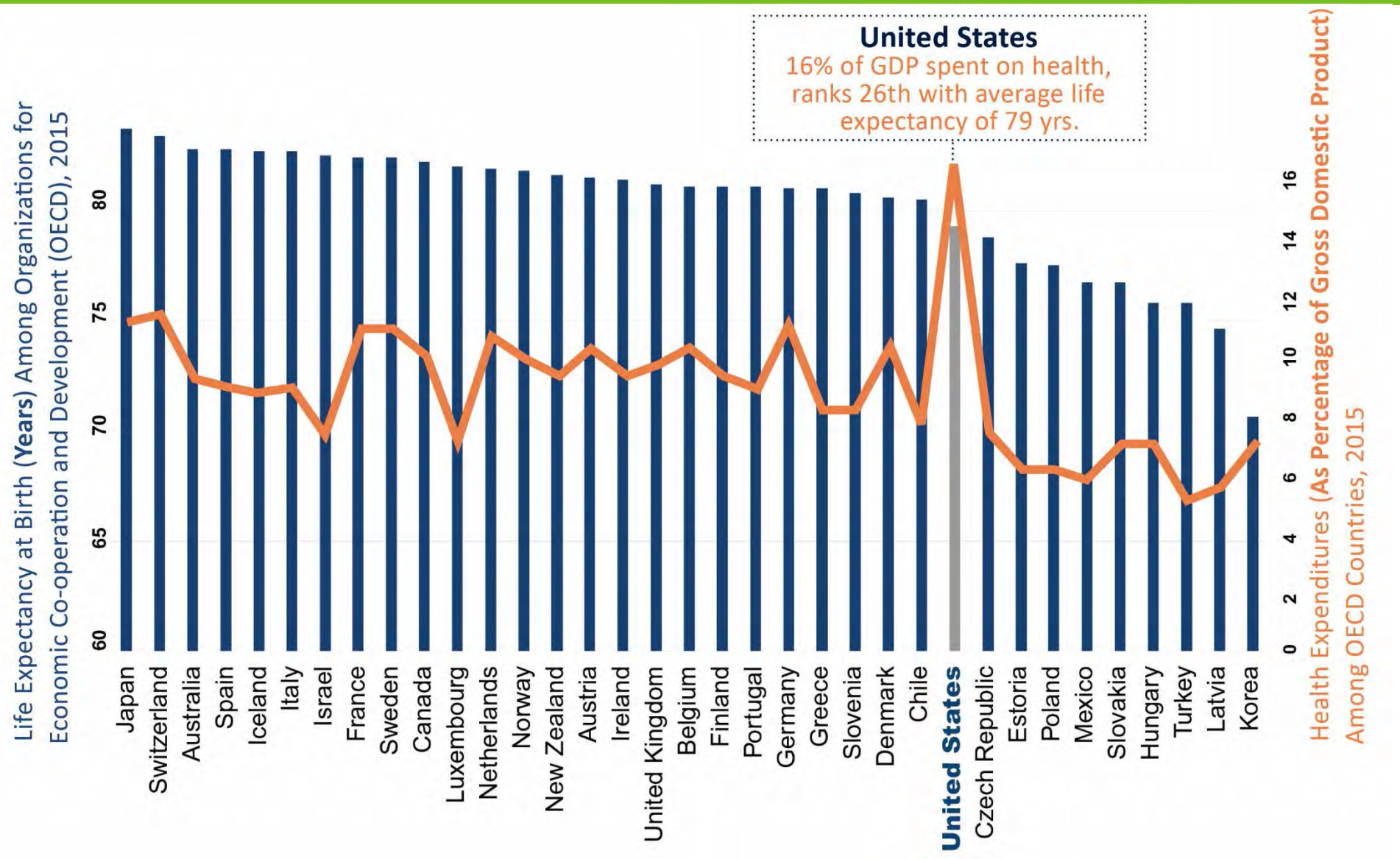
CLIMATE & HEALTH IN MINNESOTA
SOCIETAL IMPLICATIONS FOR ADAPTATION

Nissa Tupper, Program Planner, Environmental Health, MN Department of Health

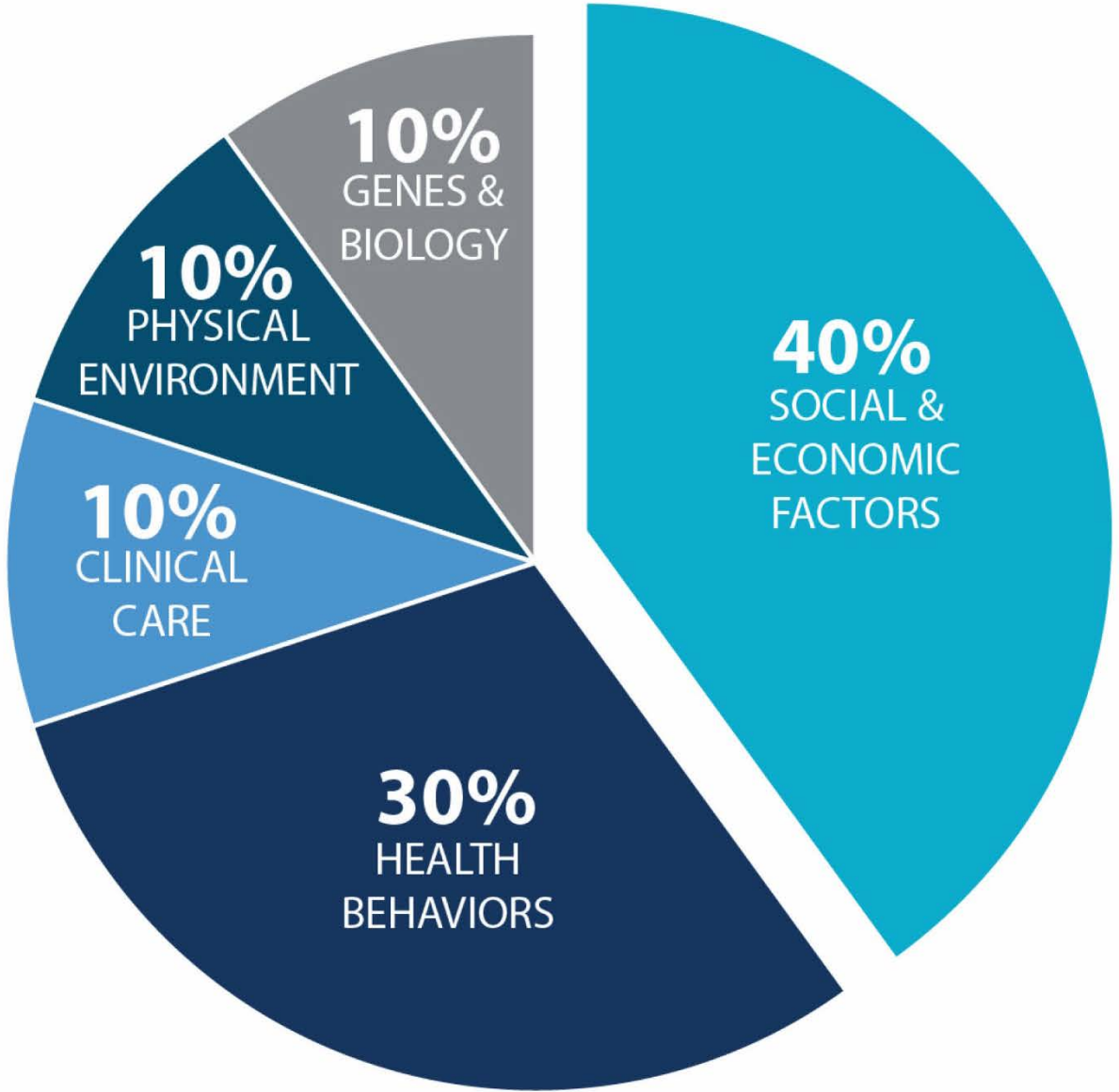
OVERVIEW

- The Climate & Health Connection
- Societal Implications – People Focused Planning
- Guidance & Resources

WHAT IMPACTS OUR HEALTH?



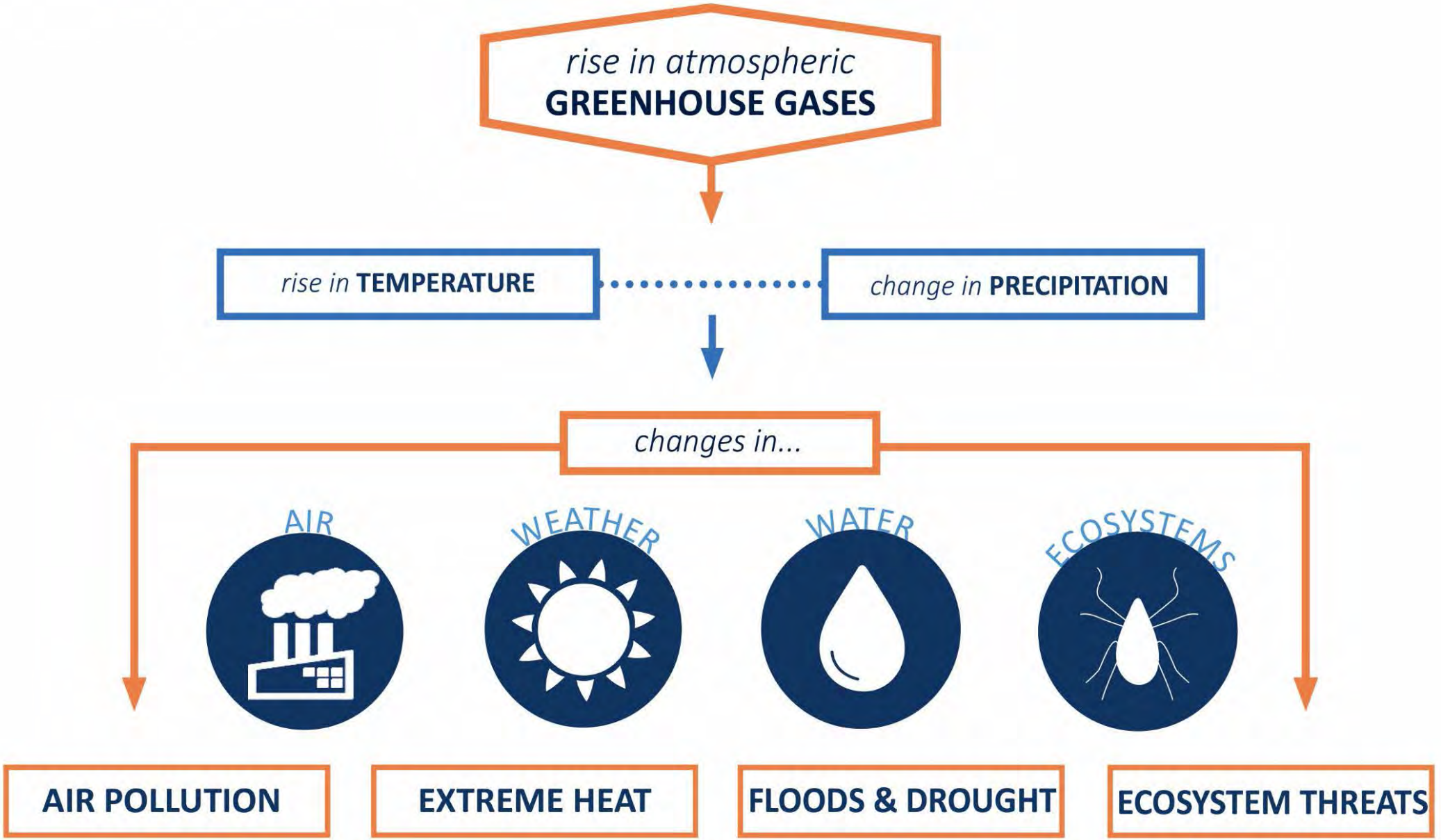
WHAT IMPACTS OUR HEALTH?



Good health starts long before the doctor's office. Health is created where we live, learn, work, and play. **Healthy communities make healthy people.**

IMAGE SOURCE: Kalyan Chakravarthy, Flickr, 2011

CLIMATE CHANGES LEAD TO HEALTH EFFECTS



CLIMATE CHANGES LEAD TO HEALTH IMPACTS

changes in...

AIR POLLUTION

Direct effects
- » Initiate or worsen respiratory, cardiovascular and other diseases

Indirect effects
- » Reduced visibility
- » Reduced productivity at work or school
- » Degradation of crops and water bodies

EXTREME HEAT

Direct effects
- » Heat stress and illness
- » Worsening of pre-existing conditions
- » Heat-related mortality

Indirect effects
- » Infrastructure failures
- » Strain on essential services
- » Disruption to key social networks

FLOODS & DROUGHT

Direct effects
- » Mental stress
- » Waterborne disease
- » Drowning and injuries

Indirect effects
- » Respiratory ailments
- » Disruption to economic and social networks
- » Strain on essential services
- » Wildfires

ECOSYSTEM THREATS

Direct effects
- » West Nile virus
- » Lyme disease
- » Liver, respiratory, nervous, skin disorders (from harmful algal blooms)

Indirect effects
- » Threats to livelihood
- » Financial strains

AIR POLLUTION

OZONE
POLLEN
PARTICULATE MATTER

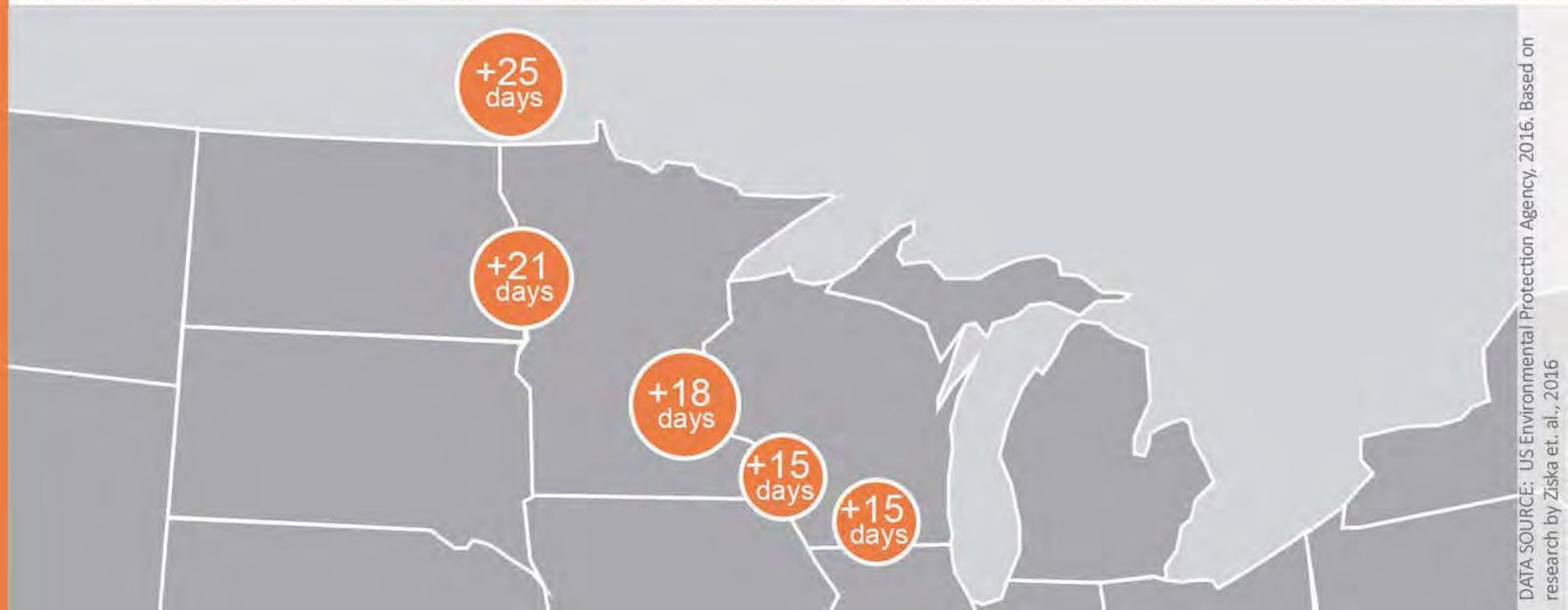
DIRECT EFFECTS

» Cause or aggravate chronic pulmonary disease, lung cancer, cardiovascular diseases, allergies or asthma

INDIRECT EFFECTS

» Reduced visibility
» Reduced productivity at work or school
» Degradation of crops and water bodies

CHANGE IN RAGWEED POLLEN SEASON (1995-2015)



EXTREME HEAT

DIRECT EFFECTS

» Heat stress, heat exhaustion or heat stroke
» Worsening of existing disease or death

INDIRECT EFFECTS

» Infrastructure failures
» Strain on essential services
» Disruption to social and economic networks

2011 SUMMER EXTREME HEAT

IN THE
SUMMER OF 2011
WE DOCUMENTED

1,255 EMERGENCY DEPARTMENT VISITS

AND

3 DEATHS

DUE TO HEAT IN MINNESOTA

FLOOD & DROUGHT

DIRECT EFFECTS (FLOOD)

» Mental stress
» Decrease safety and availability of drinking water
» Injury or drowning

INDIRECT EFFECTS (FLOOD)

» Worsen respiratory ailments
» Disruption to social and economic networks
» Strain on essential services
» Loss of safe & secure housing

INDIRECT EFFECTS (DROUGHT)

» Reduce water supply
» Cause fiscal strain
» Threaten community cohesion
» Increase risk of wildfires

2016 WASECA FLOOD - IMPACTS TO INFRASTRUCTURE, SERVICES & SOCIAL COHESION

ECOSYSTEM THREATS

DIRECT EFFECTS

» Lyme disease, West Nile virus, and other vector-borne diseases
» Disorders from harmful algal blooms

INDIRECT EFFECTS

» Financial strains
» Livelihood threats

ALGAL BLOOMS

IMAGE SOURCE: Minnesota Pollution Control Agency, 2010

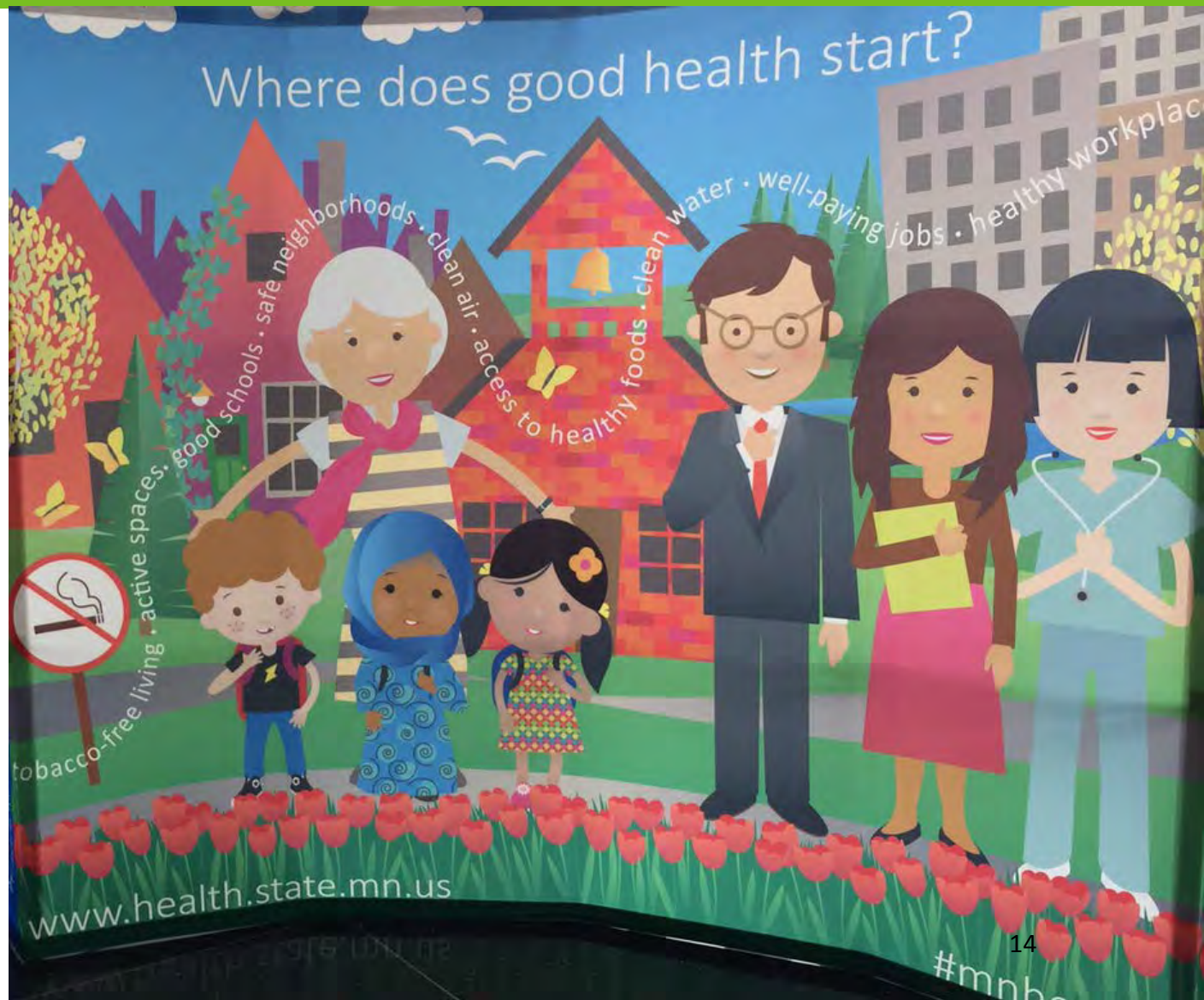
IMAGE SOURCE: Minnesota Pollution Control Agency, 2007

IMAGE SOURCE: Kalyan Chakravarthy, Flickr, 2011

PEOPLE-FOCUSED PLANNING: HEALTH EQUITY

- Climate change is a powerful risk amplifier, particularly in regard to health impacts.

- To reduce climate and health inequities, focus on the conditions in which people are born, live, learn, work, and age (social determinants of health) to create communities where everyone has what they need to be healthy.



PEOPLE-FOCUSED PLANNING: HEALTH EQUITY

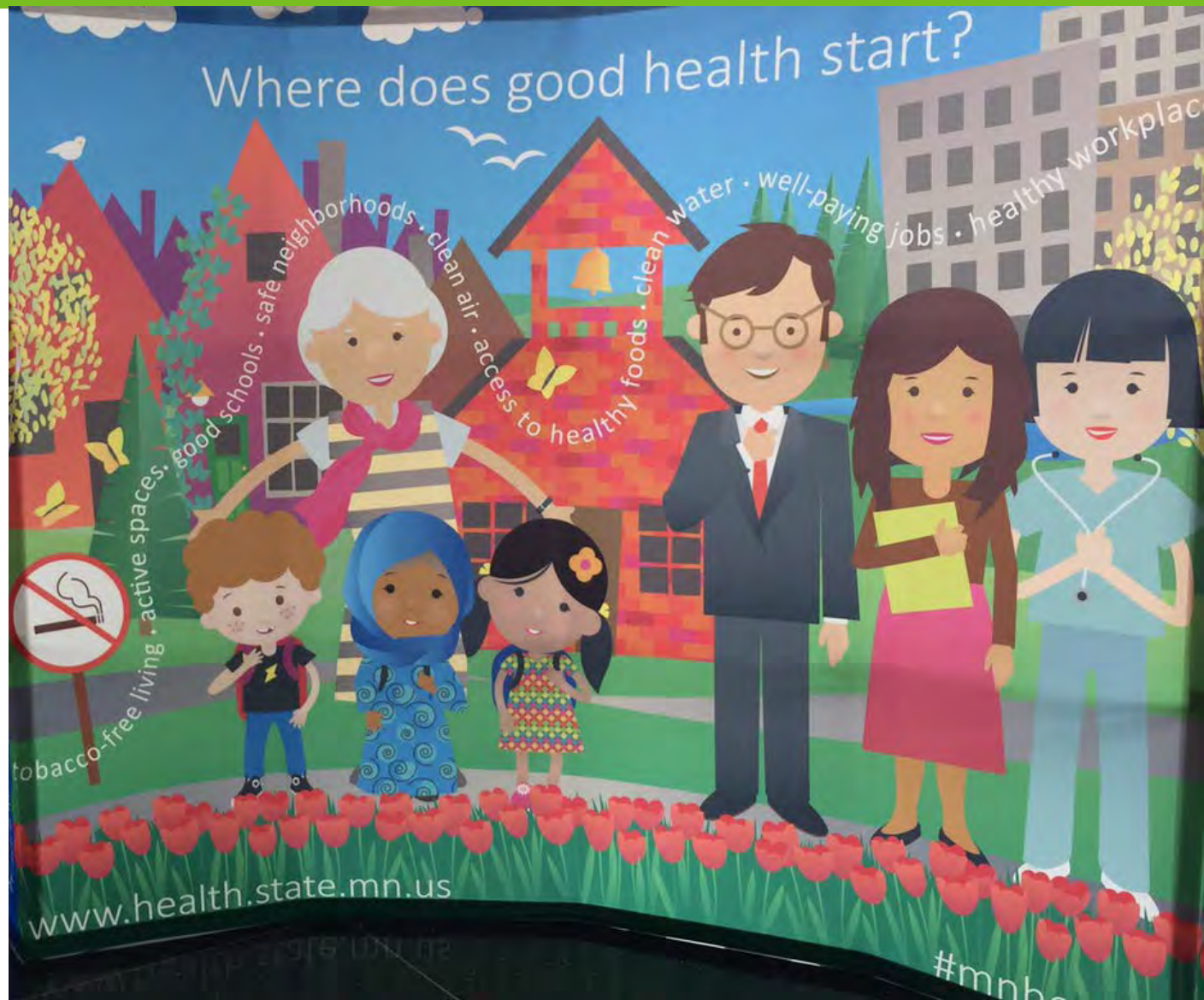
Asking the right questions, early and often, can help advance health equity and build climate-resilient communities.

- What values underlie the decision-making process? What assumptions are being made?
- What are the health, equity, and climate implications of the policy/program being considered?
- Who's benefiting and who is left out?
- Who's at the decision-making table and who is not? Who should be?
- Who's being held accountable and to whom? How is this influencing the strategy, process, and potential outcomes?

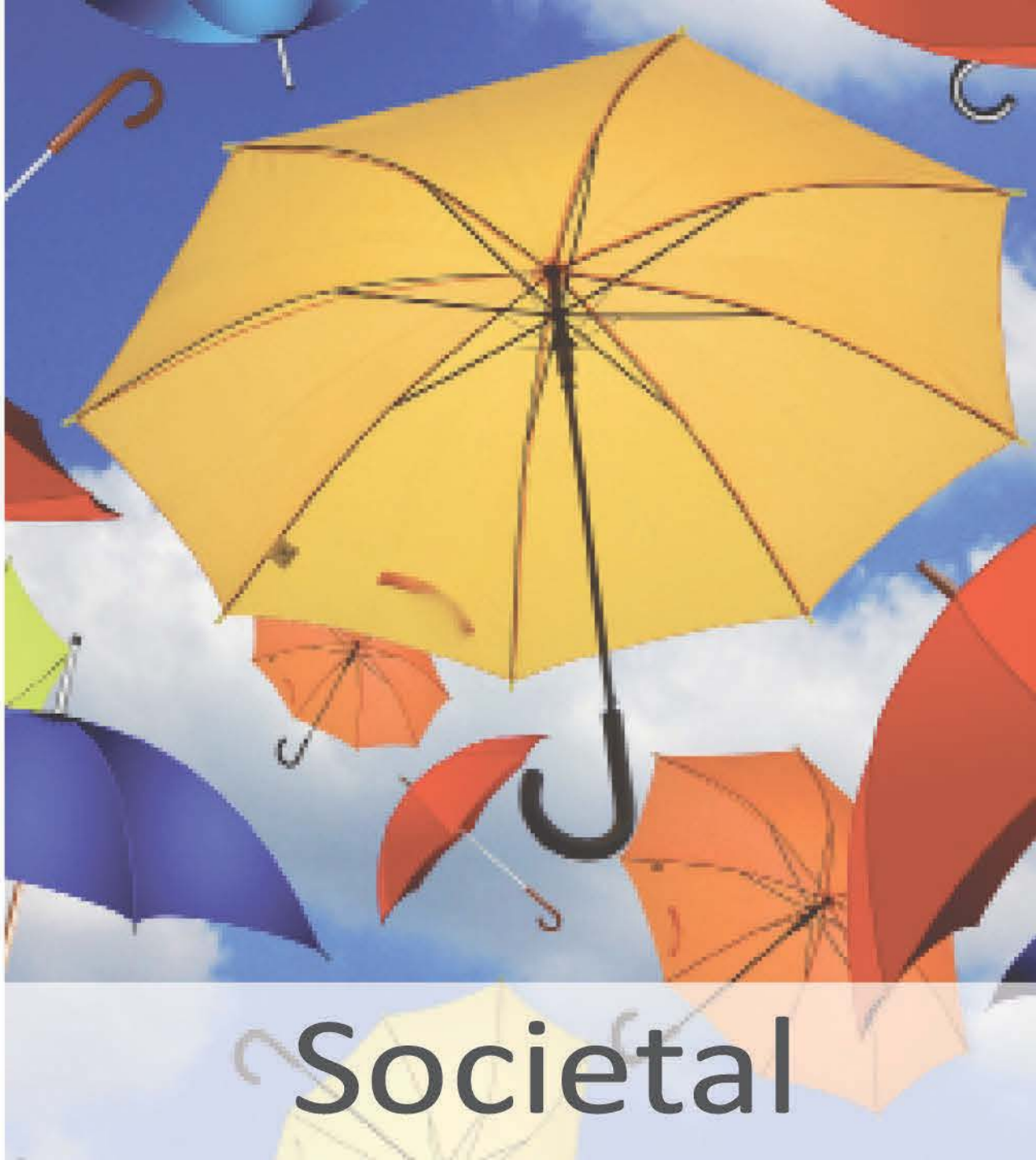
PEOPLE-FOCUSED PLANNING: HEALTH EQUITY

If you ask but one question…

What would it look like if health equity was the starting point for *[this]* decision?




Individual

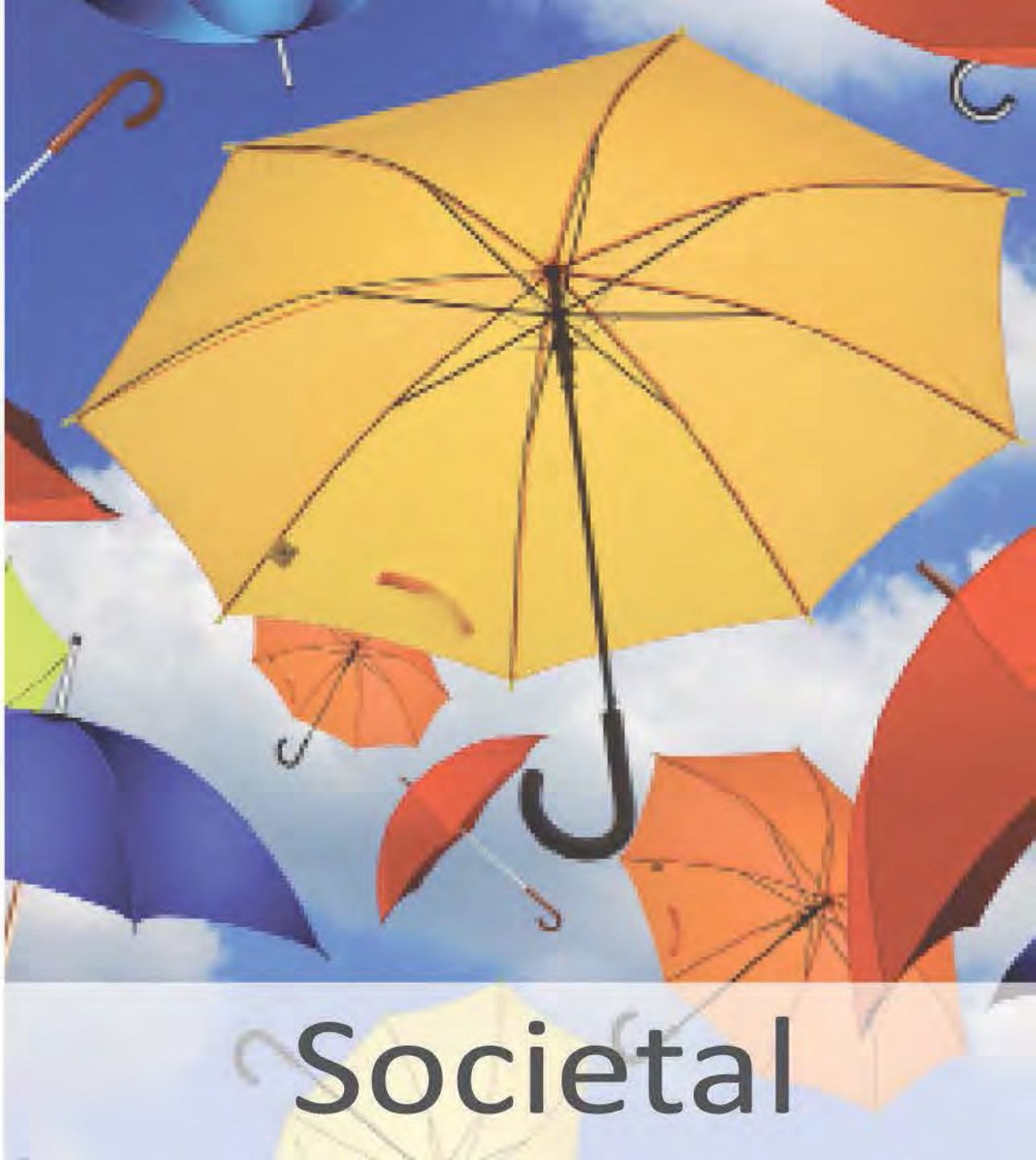

Societal

RISK FACTORS

- People older than 65
- Children under 5
- People with an existing illness or disease
- People with a disability
- Race/ethnicity
- Gender

RISK FACTORS

- »Elderly living alone
- »Diverse populations with limited English proficiency
- »People living in poverty
- »Workers employed in outdoor occupations
- »People experiencing homelessness
- »People who rent
- »People with lack of air conditioning
- »Communities geographically located in a disaster-prone areas
- »Economic dependence on climate and the environment
- »Outdated emergency plans that don't address mental or behavioral health



- How will you help alert at-risk populations when unhealthy air quality arrives?
- How is your community managing green infrastructure to lessen allergy impacts?
- What policies can help lessen community contribution and exposure to particulate matter and ground-level ozone (reduce backyard fires & wood stoves, swap gas-fueled lawn equipment for electric, increase mass transit)?

- Does your community have a heat response plan/is it updated to include cross-sector partners?
- Is community infrastructure ready to support at-risk citizens during a heat event (i.e. cooling centers are available, youth sports associations are involved)?
- How will you educate your community about heat-related illnesses, their risk, and available resources?

- How are you managing precipitation extremes to lessen impacts for those most at-risk (green & grey infrastructure solutions)?
- What opportunities exist to better support long-term recovery from floods (mental and behavioral health interventions)?

- Is there a common understanding about the health of your community's water bodies and the connection to human health?
- How is the community working to prevent exposure to vector-borne diseases, such as Lyme and West Nile?

How can these planning and policy efforts also build community cohesion?

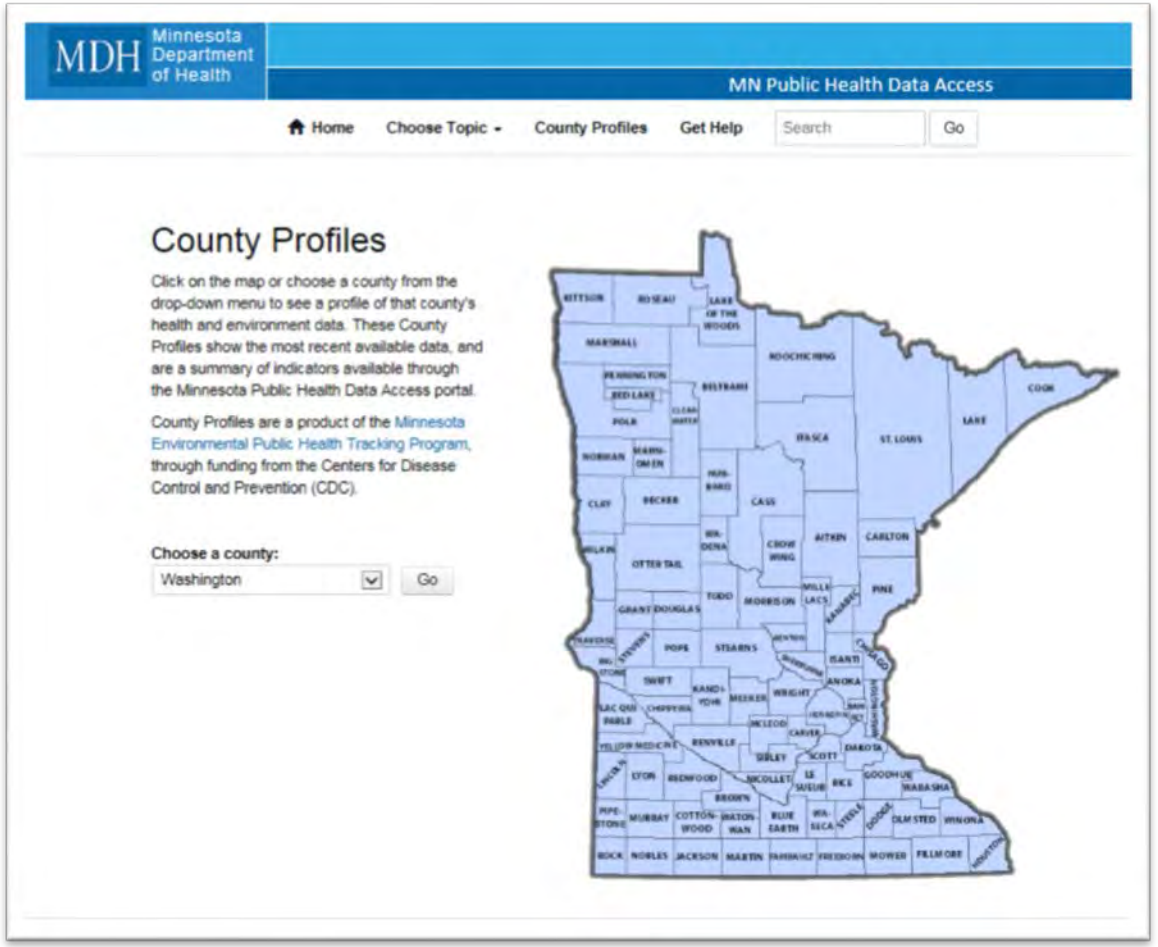
RESOURCES

www.health.mn.gov/climatechange

RESOURCES

www.health.mn.gov/climatechange

RESOURCES



www.health.mn.gov.mndata / health.dataportal@state.mn.us

DEPARTMENT OF HEALTH

Questions?

Nissa Tupper, Program Planner

Minnesota Climate and Health Program

Nissa.Tupper@state.mn.us

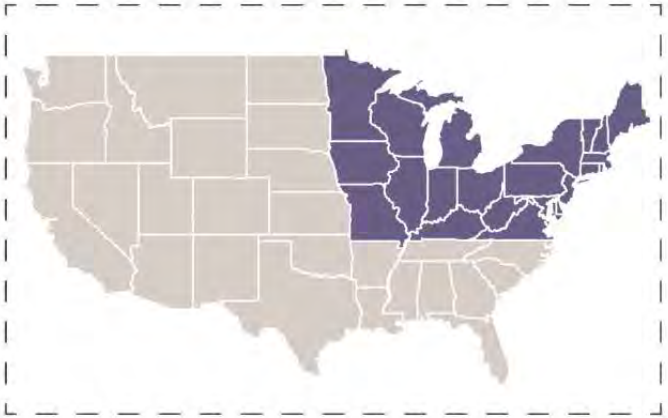
651-201-5995

health.mn.gov/climatechange

ECOLOGICAL CONSEQUENCES OF CLIMATE CHANGE

South Washington Watershed District Community Resilience Workshop
9/28/2017

NORTHEAST CLIMATE SCIENCE CENTER & CONSORTIUM MEMBERS



University of Minnesota

College of Menominee Nation

Iowa State University

University of Wisconsin - Madison

University of Massachusetts Amherst

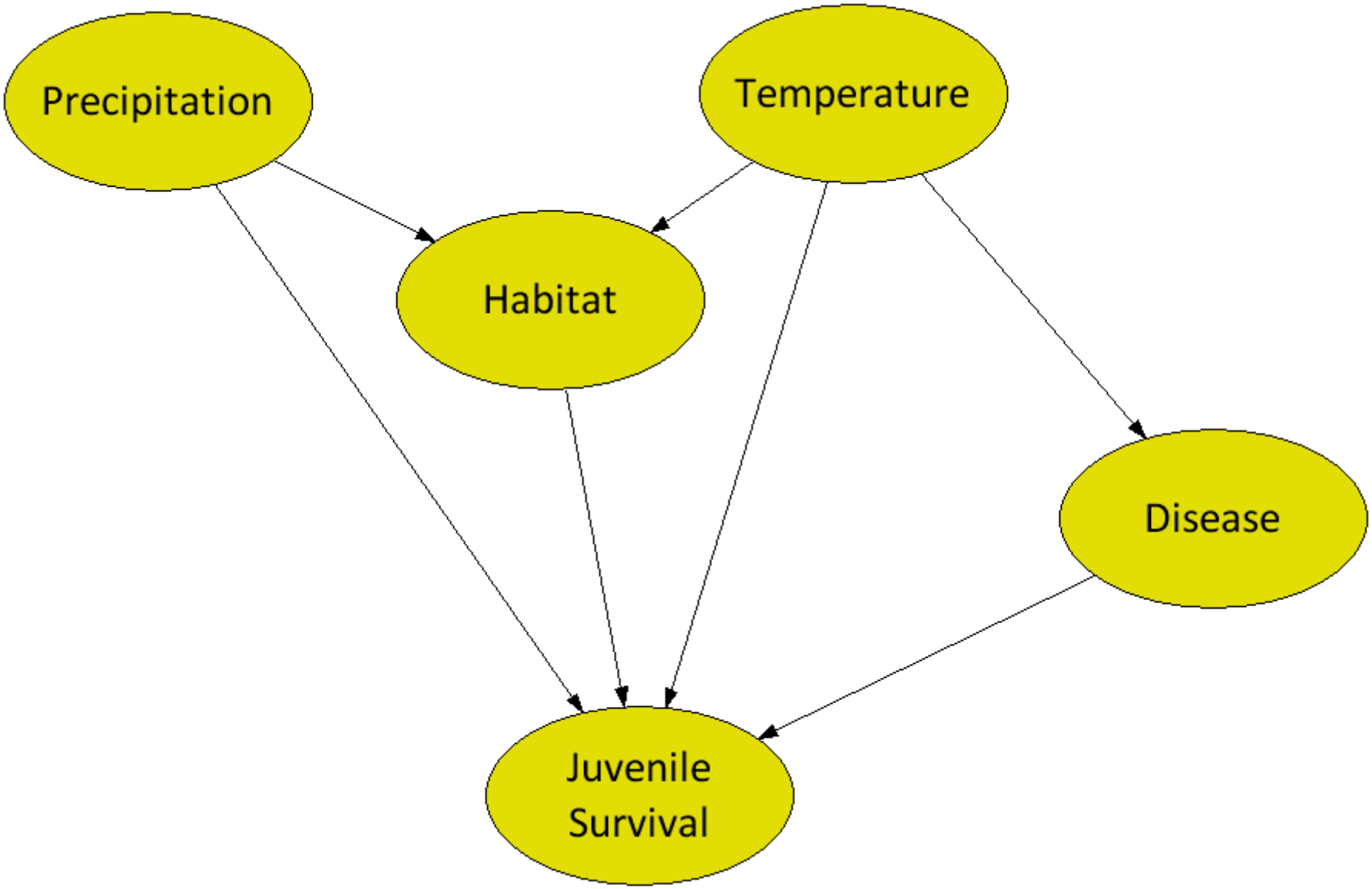
Columbia University

Marine Biological Laboratory

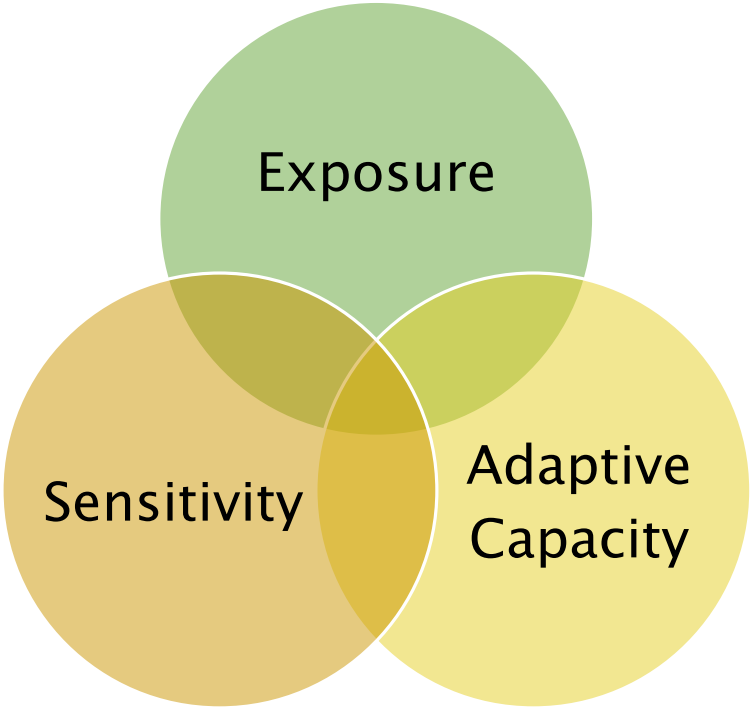
University of Missouri Columbia

CLIMATE SCIENCE TO INFORM RESOURCE MANAGEMENT

The Northeast Climate Science Center provides scientific information, tools, and techniques that managers and other parties interested in land, water, wildlife and cultural resources can use to anticipate, monitor, and adapt to climate change in the Northeast region.


Precipitation
Temperature
Habitat
Disease
Juvenile
Survival

VULNERABILITY



TYPES OF ASSESSMENT

	Trait-based	Correlative	Mechanistic
Description	Use characteristics as predictors of extinction risk	Use past distribution to predict future range	Use detailed biological understanding to model change
Method	Select and score traits/characteristics	Spatially-explicit, correlative model	Quantitative abundance and distribution model
Data	Experts or literature	Past climate and distribution records	Lab/field data-physiology, demography, behavior

Pacifici et al. 2015

FORESTS

Boreal species will face increasing stress from climate change. Projected decline for northern species such as balsam fir, black spruce, tamarack, quaking aspen, and white spruce. Smaller productivity gains.

Southern species will be favored by climate change. Projected increase for American basswood, black cherry, bur oak, eastern white pine, green ash, red maple, white oak, and a variety of minor southern species. Potential for large productivity gain.

Forest communities will change across the landscape. Native Plant Community Systems and Classes may rearrange into novel communities. Potential increase in nonnative species.

Forest productivity will increase across the assessment area.

Handler et al. 2014

Warmer temperatures are expected to speed nutrient

SUGAR MAPLE

Availability of trees to tap
Suitable habitat for the sugar maple tree has been predicted to decline in most of its U.S. range by 2100.

Tree health
Reduced snow pack during the winter can cause root die-back and reduced shoot growth, and more frequent spring frost can negatively impact trees that respond to warmer temperatures by breaking bud earlier. Growth declines in mature trees in recent decades may be related to rising temperatures.

Tapping season characteristics
Maple syrup producers are already reporting that the tapping season is starting earlier with a shorter duration and becoming more variable.

Climate change effects on sap quality
Sap quality is determined by its sugar content, mineral profile, and secondary metabolite chemicals that create the distinct taste of maple syrup and impart its health attributes. Climate change is likely to influence these aspects of sugar maple

Stinson et al.

Preparing Urban Forests in the Twin Cities for Climate Change

Contact Leslie Brandt
Northern Institute of Applied Climate Science &
U.S. Forest Service
651-649-5016
lbrandt@fs.fed.us

Additional info:
www.forestadaptation.org

GRASSLANDS

Changes in phenology.
Shifts in the timing and duration of reproductive events; earlier spring flowering.

Altered competition.
C3 (forbs, woody plants, legumes) and C4 plants (grasses, sedges) sensitive to July conditions. C3 more responsive to increased carbon dioxide (i.e., higher productivity).

Increase in the abundance of native woody species.
Attributed to changes in climate, increased atmospheric carbon dioxide, nitrogen deposition, grazing pressure, and altered disturbance regimes.

Altered community composition.
Diversity may increase in tallgrass prairie. Novel communities.

Altered carbon cycling.
Water stress alters net photosynthesis, aboveground productivity, and soil CO_2 flux.

Loehman et al. 2013

TREE OF HEAVEN

Nationwide distribution is right on the edge of plant hardiness zone 4, and it is likely to become better able to thrive and spread in MN as the climate warms.

MN Dept. of Agriculture.

Invasive Plant Control Database

MIPN.org
Midwest Invasive Plant Network

Welcome to the Invasive Plant Control Database

This website contains information on how to control many invasive plants common to the Midwestern United States. Information was collected from both scientific literature and expert opinions and summarized by the Midwest Invasive Plant Network (MIPN), in partnership with the Mark Renz lab from the University of Wisconsin-Madison. Methods that are uncommon, do not provide sufficient control, or lack information for determining effectiveness on target species are omitted. For each species, information was reviewed by four individuals, including two identified as experts on control of that species. Information is searchable by several fields to improve the user's ability to find pertinent information. To view the search feature, you must first select an invasive plant. Additionally, users have the option of entering personal experiences with managing specific species (see "add new case studies" under search results). These case studies will be visible to all users once verified by MIPN staff.

WATER RESOURCES

Increase in duration of thermal stratification.
Seasonal mixing may be eliminated in shallow lakes, decreasing dissolved oxygen and leading to excess concentrations of nutrients and toxins.

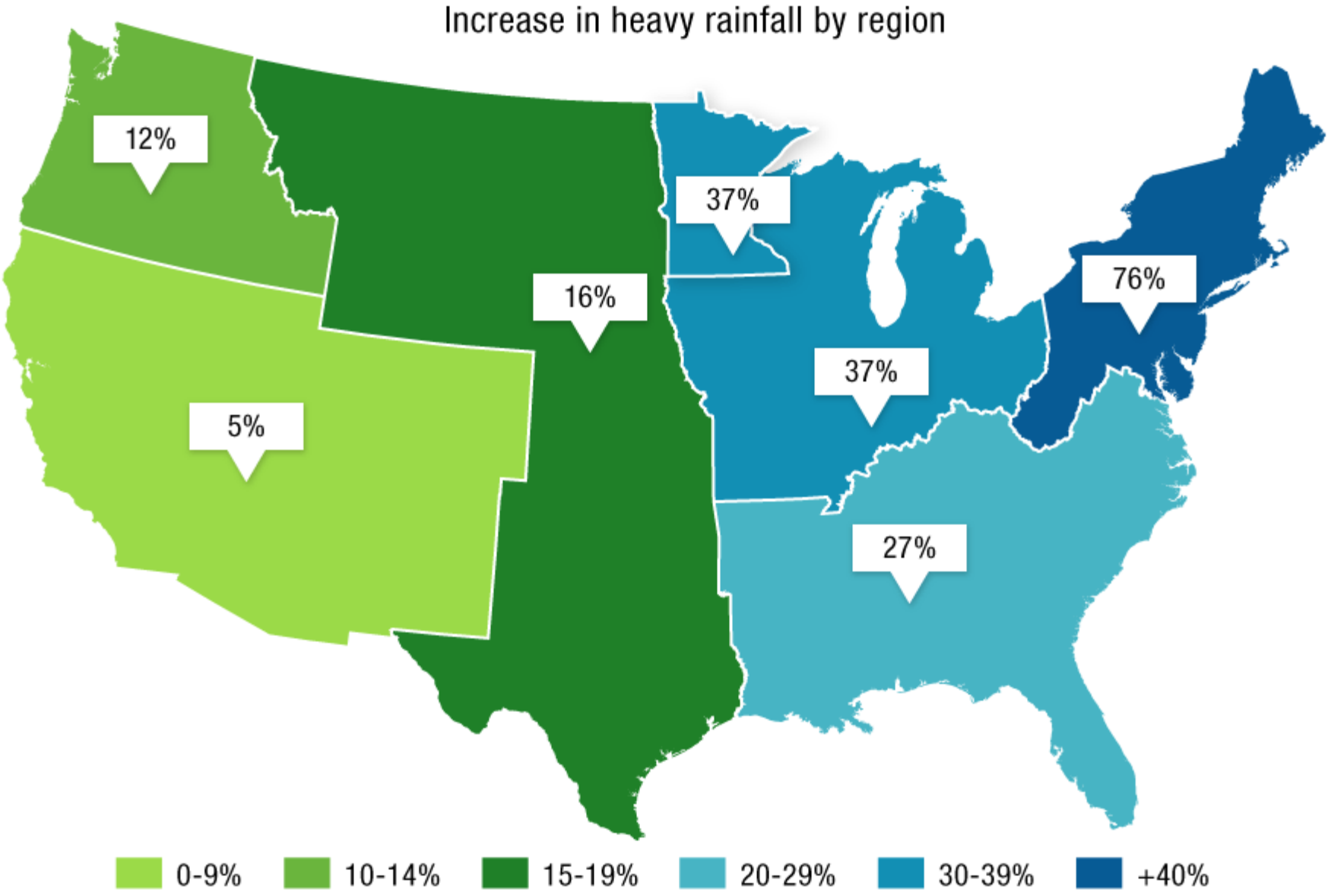
Altered flow (low and high).
Increasing sediment, nutrient, minerals, and contaminant loads.

Low water levels.
Increased nutrient concentrations and residence times in streams, potentially increasing the likelihood of harmful algal blooms and low oxygen conditions.

Reduced surface and groundwater supplies.
Reduced supply in many areas (due to changes in precipitation, runoff, consumption and withdrawal)

Increased flood risk.
Vulnerable people infrastructure ecosystems

National Climate Assessment 2014



Source: National Climate Assessment, National Climatic Data Center

YAHARA RIVER WATERSHED

Evaluating the ability to detain water in natural depressions upstream from Madison.

Improving monitoring of rainfall and stream flows.

Updating Lake Mendota water level management scenarios to increase downstream discharges prior to heavy rainfall.

Budgeting for more sandbags and emergency response capacity.

Identifying infrastructure at greater risk of flooding.

Discussing new controls on stormwater runoff from urbanized areas

https://toolkit.climate.gov/case-studies/using-demonstration-storms-prepare-extreme-rainfall

Potter et al.

The MDH Climate & Health Program will present a **Health, Climate Change, & Water Training Webinar on Wednesday, October 11, 2017 from Noon-1:00p.m. (CST).**

The training webinar and module will provide an overview of the observed climate changes in Minnesota, the public health issues related to climate change and water, and public health strategies to mitigate and adapt to climate change to reduce the health impacts.

SWC Bulletin

FISH AND WILDLIFE

Advance of spring conditions.
Migration, breeding, recruitment

Spatial shift in climate niche.
Expand, contract, or shift in suitable environment

High temperature extremes.
Relative to organism's upper thresholds

Altered ice/snow cover and cold exposure.
Lost thermal protection and access to forage, reduced winter kill

Drought.
Moisture stress, habitat loss

Heavy rainfall/flooding.
Habitat loss, reduced reproductive success, contaminants, sedimentation

Habitat.
Change in type, amount, and quality

Interspecific interactions.
Predator-prey, pollination, disease/pathogens

Other stressors.
Invasives, land change, pollution, water use

LeDee et al. 2013

FishTail: A Decision Support Mapper for Conserving Stream Fish Habitats for the NE CSC Region

Craig Paukert, Dana M. Infante, Jana Stewart, Joanna Whittier, Wesley Daniel, Nick Sievert, Kyle Herreman

The broad goal of this project was to

1) Characterize current condition of stream fish habitat; develop three spatially-explicit indices reflecting target fish species' response

   a) Human land use

   b) Stream fragmentation from dams and road crossings

   c) Water quality impairments based on EPA 303d listings in waterbodies

2) Identify stream reaches that may change with climate based on potential changes to distributions of target fish species; develop a spatially-explicit index reflecting likelihood of habitat change with climate

3) Distribute the results through a decision support web based mapper.

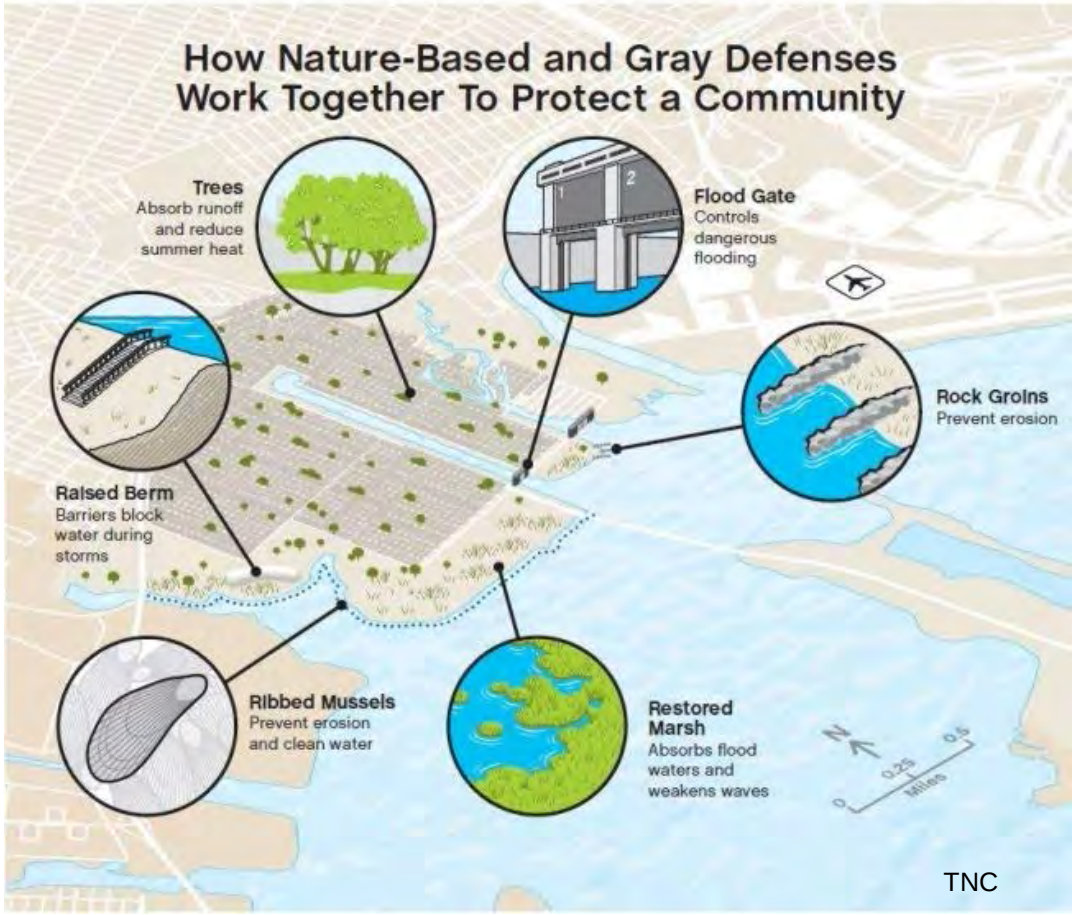
https://ccviewer.wim.usgs.gov/Fishtail/#

SUMMARY

- Changes in water availability and timing is altering systems
- Indirect effects may be most influential
- Invasive species have new advantages
- Population changes (survival and reproduction), not just distribution
- Some resources are more vulnerable than others
- Species-level responses lead to community changes

ADAPTATION

Limit harm or exploit beneficial opportunities



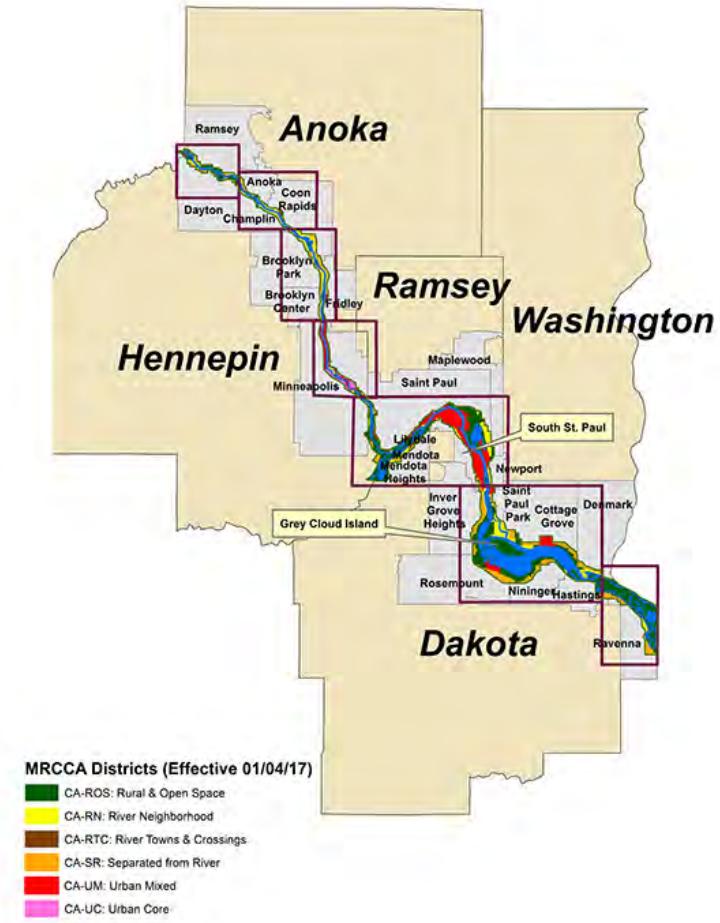
NATIONAL *fish, wildlife & plants*
CLIMATE ADAPTATION STRATEGY

National Fish, Wildlife and Plants Climate Adaptation Strategy

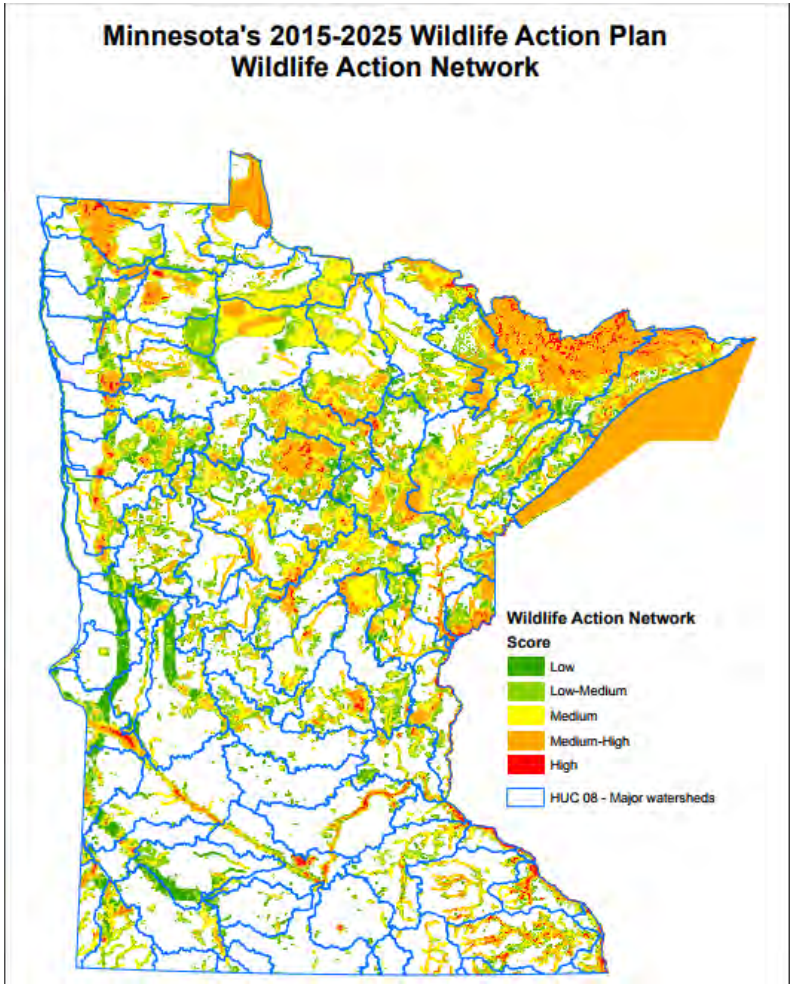
A framework for coordinated action by multiple partners to reduce risks and impacts of climate change on U.S. natural resources and the people that depend on them.

https://www.wildlifeadaptationstrategy.gov/

GOAL 1. CONSERVE AND CONNECT HABITAT



GOAL 2. MANAGE SPECIES AND HABITATS



GOAL 3. ENHANCE MANAGEMENT CAPACITY

Climate Adaptation Conference: Transforming Awareness into Action

January 28, 2016
DoubleTree by Hilton
Minneapolis North
2200 Freeway Boulevard
Minneapolis, MN 55430

Welcome and opening remarks: Mark Seeley, Professor, Soil, Water and Climate, University of Minnesota

Business Panel A panel of corporate leaders will discuss the need for sustainability as an underlying principle when it comes to considerations of climate change and how it will affect our natural resources, our societal infrastructure, and the future of products and services from the highly competitive corporate world. Specifically, we will hear perspectives on supply chain challenges, facilities management, product development, and marketing.

Moderator: Paul Douglas, President, Aeris Weather

Panelists:

Jerry Lynch, Chief Sustainability Officer, General Mills

Chris Nelson, 3M

Laura Bishop, Best Buy VP for Public Affairs and Sustainability

A. Climate impacts and adaptation for water resources: An exploration of water quantity and access in Minnesota Minnesota and the Great Lakes Region are experiencing significant impacts to our water resources as a result of climate change. These impacts include changing water temperatures, wind speeds, ice cover, water levels, and water quality issues, which can have negative effects on aquatic ecosystems and communities. In this session we will hear from two

Main menu

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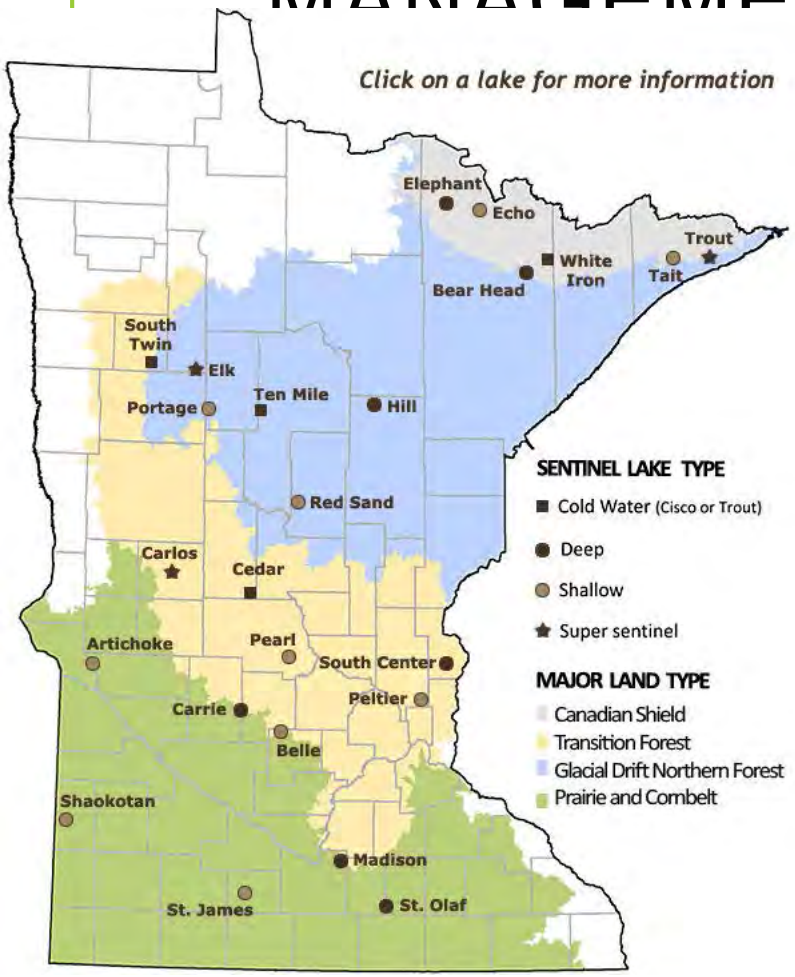
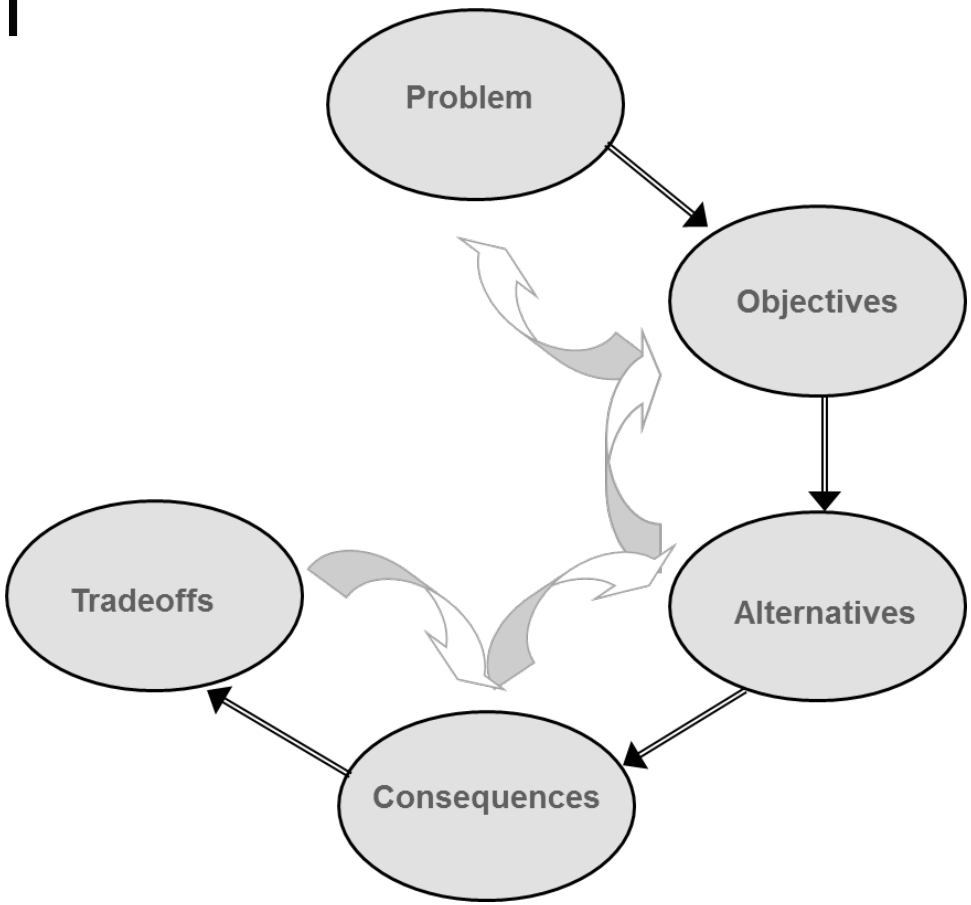
- Publications
- Extension Water Resources
- WRS Graduate Program
- Water Topics

GOAL 4. SUPPORT ADAPTIVE MANAGEMENT

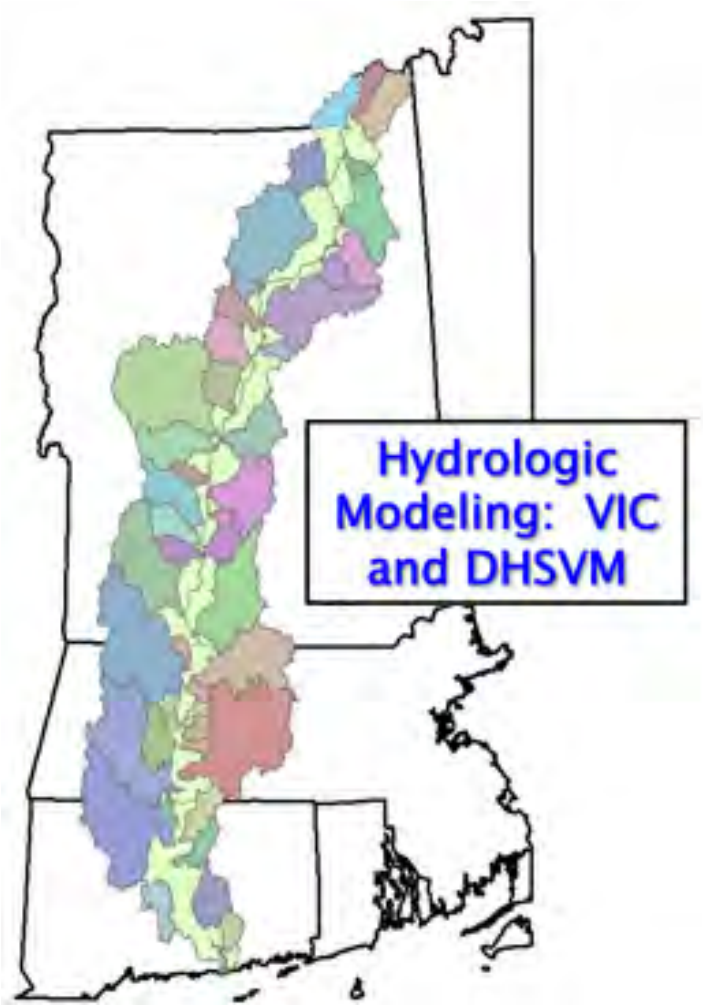


Sustaining Lakes in a Changing Environment



Structured Decision Making

GOAL 5. INCREASE KNOWLEDGE/ INFORMATION



GOAL 6. INCREASE AWARENESS/MOTIVATE ACTION

PRIOR LAKE - SPRING LAKE WATERSHED DISTRICT

info@plslwd.org

952-447-4166

HOME | ABOUT | WATERBODIES | OUTLET CHANNEL | PROJECTS AND PROGRAMS | NEWS & EVENTS | GET INVOLVED! | CONTACT

Harvey Is What Climate Change Looks Like

Posted by PLSLWD Staff - September 1, 2017 - News

Hurricane Harvey just dropped unprecedented amounts of rain in Texas. The huge amount of rain dropped by Harvey was partially a result of the effects of climate change. Human produced emissions of greenhouse gases (like carbon dioxide and methane) have caused a small but significant rise in global temperatures. This, in turn, resulted in warmer than normal water temperatures in the Gulf of Mexico which fueled Harvey, feeding the storm more energy and precipitation and brought greater devastation to Houston.

But- this isn't just a Houston problem. Here in Minnesota, we are also experiencing increasing frequency and intensity of rainstorms (Source: MPCA). We should take this opportunity to look at how prepared our own local communities are. Are we building our communities to be resilient to climate change ? If not, we'd better get started. We have a choice to make, so let's choose success.

News & Events

Ongoing Projects

- Fish Point Park Retrofits
- Highway 13 Ferric Chloride
- Monitoring
- CR 12/17 Wetland Restoration
- Carp Management
- Flood Study
- Indian Ridge Park Water Quality Project
- Spring Lake Shoreline Restoration

Completed Projects

- Arctic Lake Subwatershed Analysis
- Lower Prior Diagnostic Study

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GOAL 7. REDUCE NON-CLIMATE STRESSORS

Garlic Mustard

Queen Anne's Lace

MORE INFORMATION

National Fish, Wildlife, and Plants Climate Adaptation Strategy

Northeast Climate Science Center

National Climate Assessment

CAKE–Climate Adaptation Knowledge Exchange