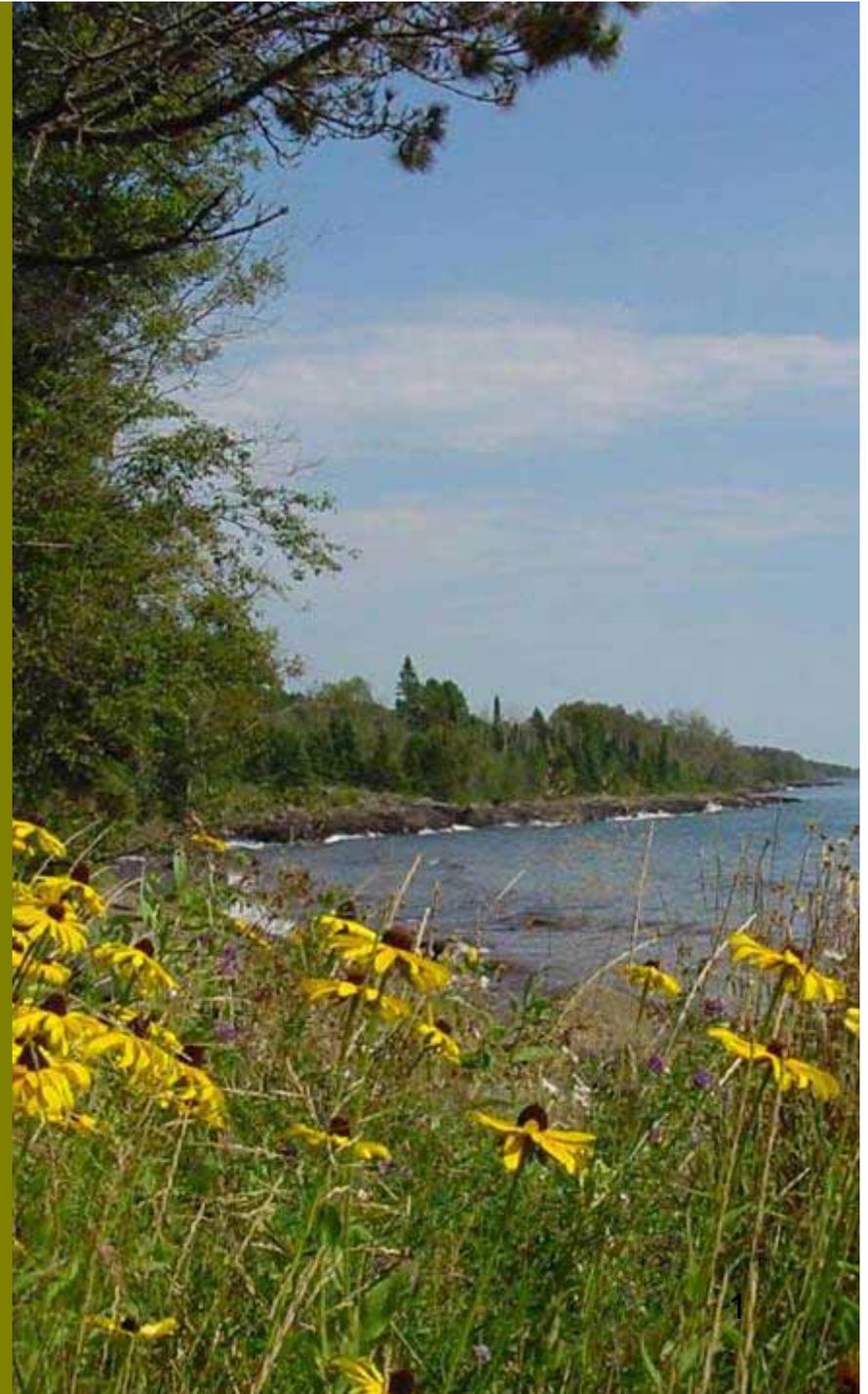


# Minnesota Statewide Conservation and Preservation Plan

INSTITUTE ON THE  
ENVIRONMENT



UNIVERSITY OF MINNESOTA



# Presenters

- Deb Swackhamer, Univ. of Minnesota
- Jerry Niemi, Univ. of Minnesota NRRI
- Anne Kapuscinski, Univ. of Minnesota
- John Shardlow, Bonestroo
- Les Everett, Univ. of Minnesota
- Dave Mulla, Univ. of Minnesota

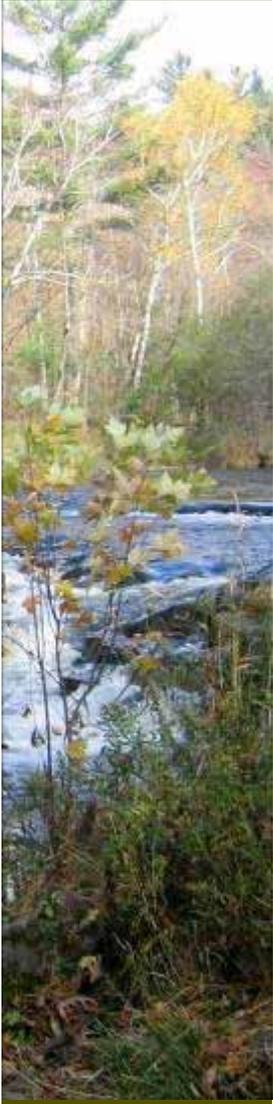


# Presentation Goals

- Describe the goals of the project
- Describe the process used to develop the recommendations
- Overview of the recommendations

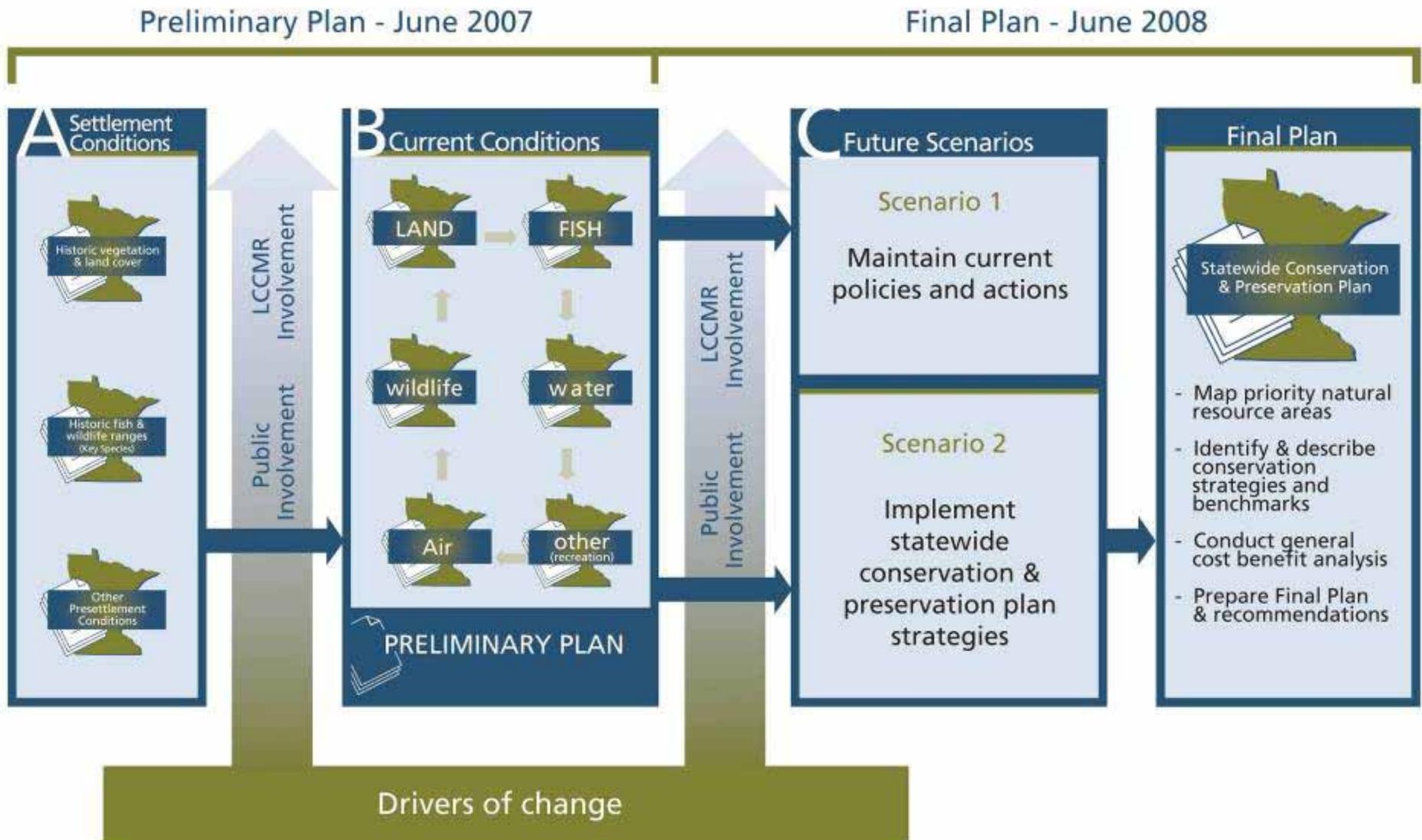


# Goals of the Project

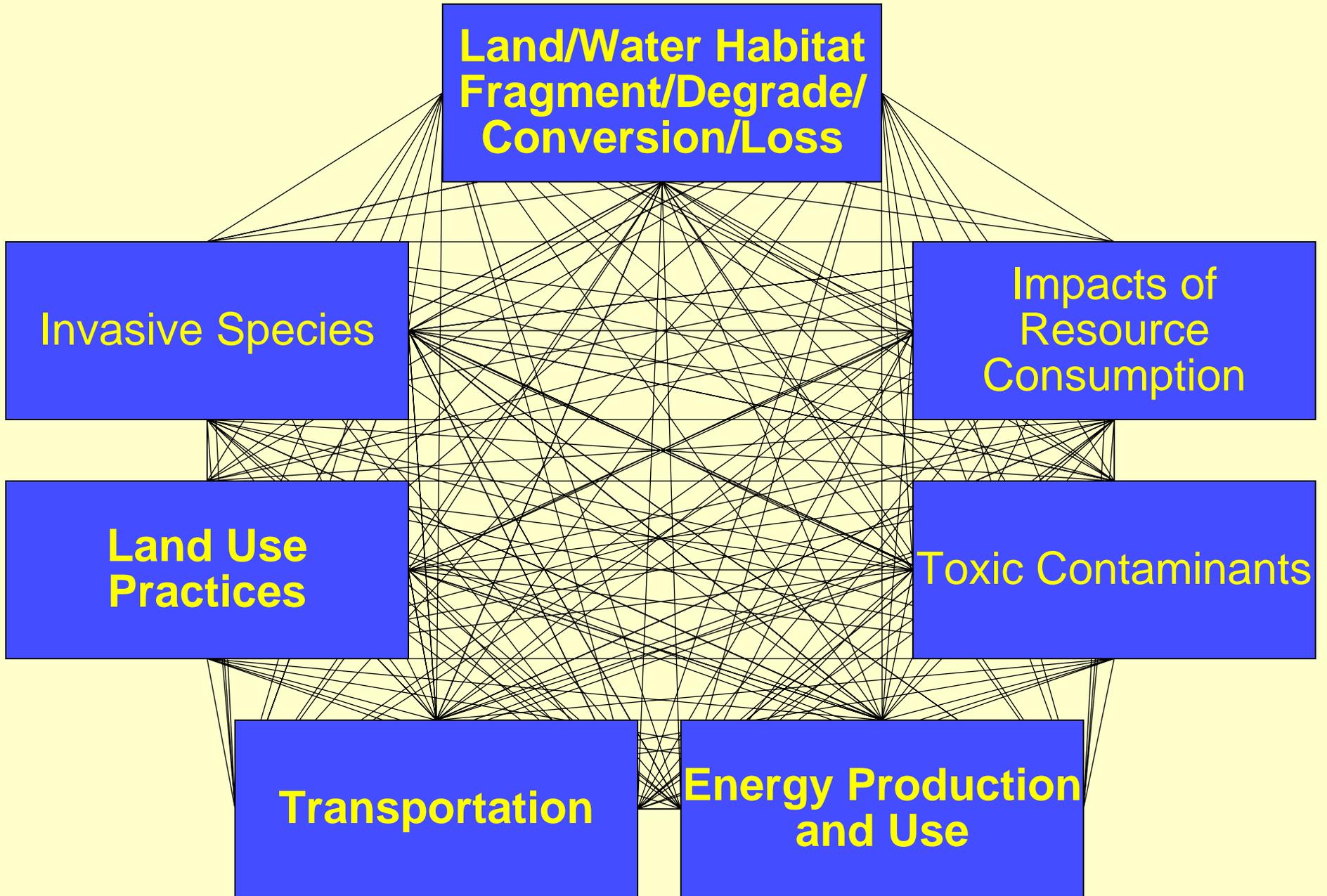


- Comprehensive inventory and assessment of Minnesota's environment and natural resources
- Review, analyze, integrate, & build upon existing information and plans pertaining to Minnesota's environment and natural resources
- Identify & prioritize important issues and trends affecting MN's environment and natural resources
- Develop and prioritize recommendations for strategies to best address issues and trends

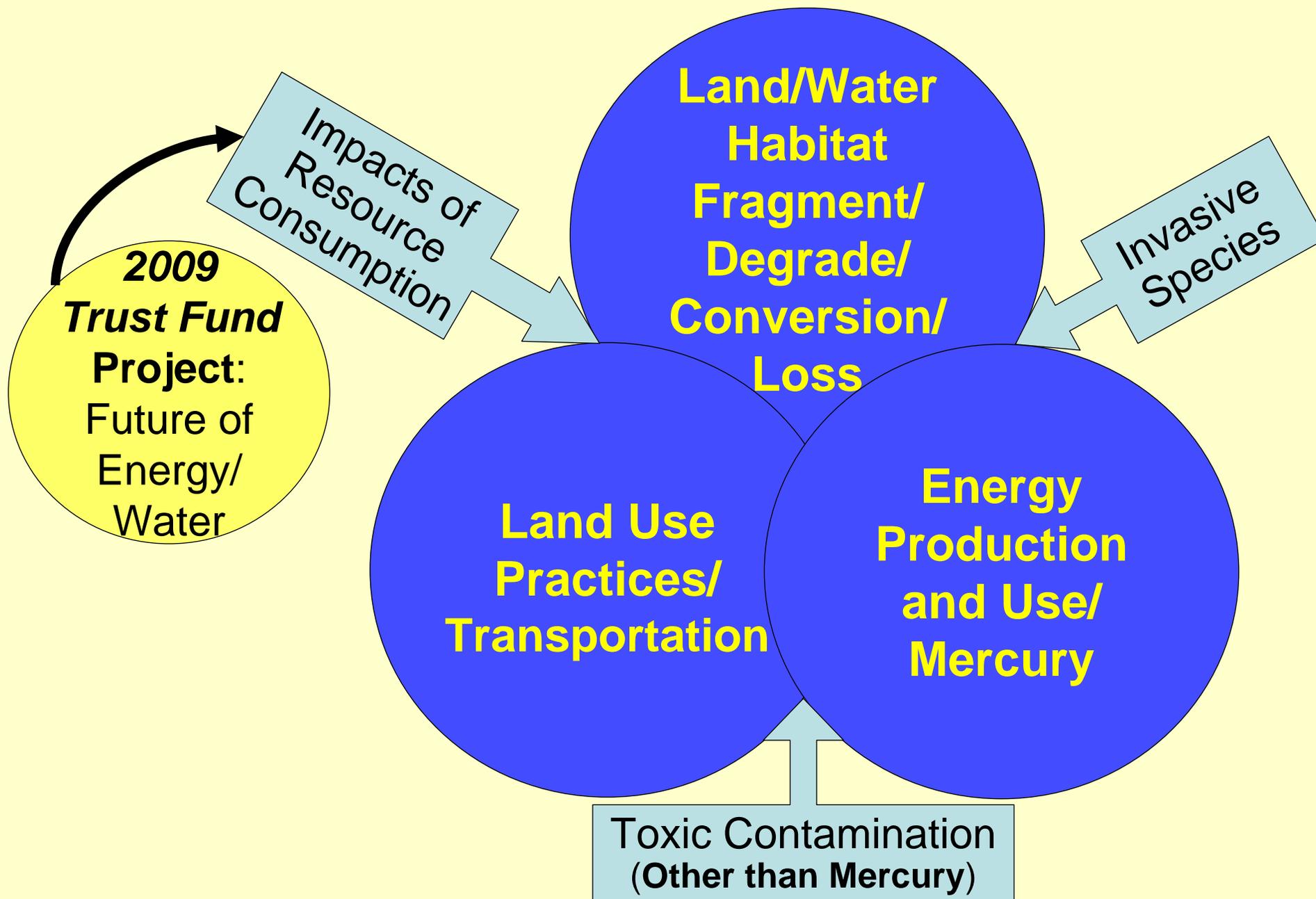
# Project phases and timeline



# Key issues identified in Phase I



# Issue integration: Phase II and beyond



# Interconnections



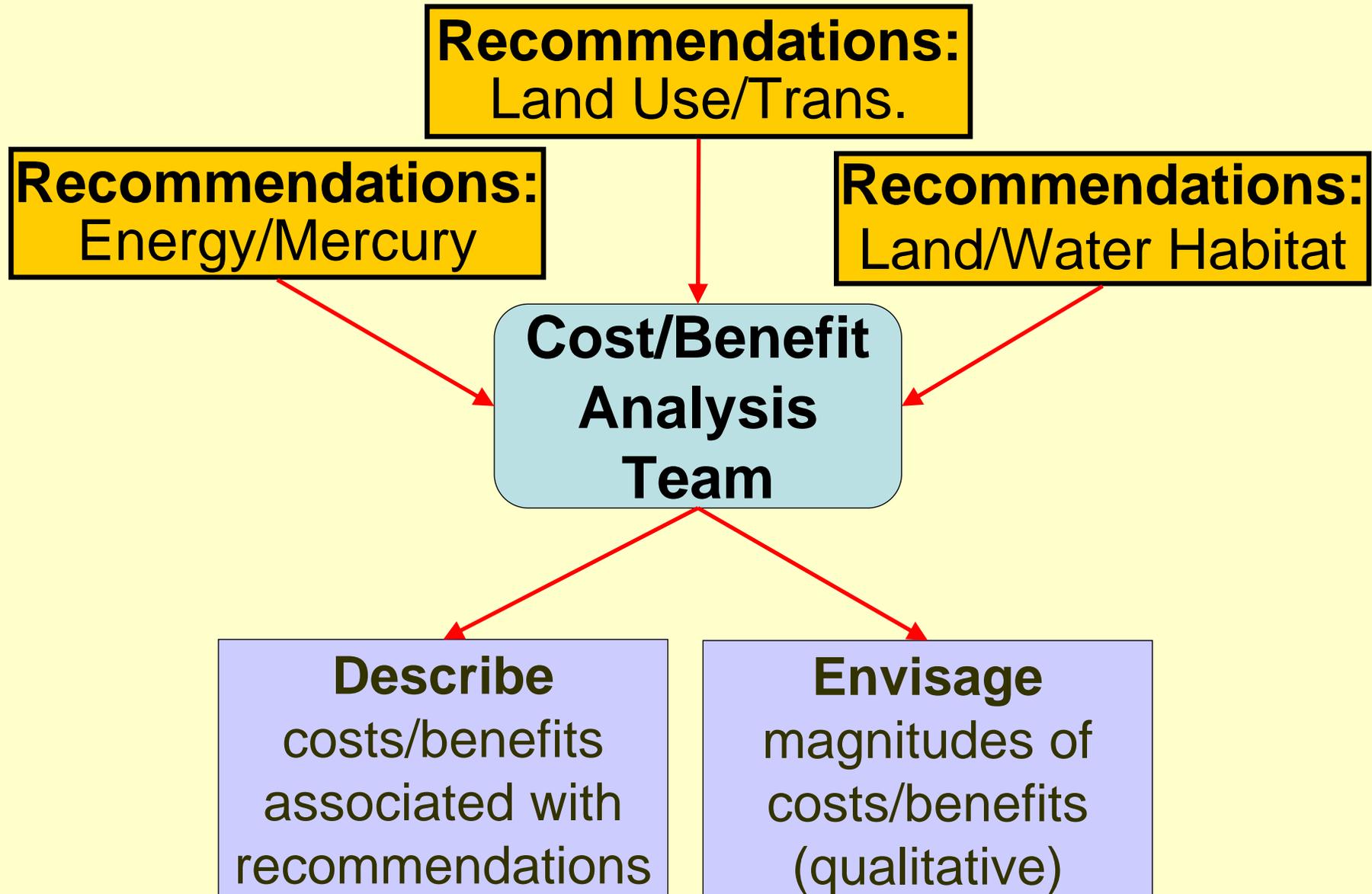
	Habitat	Land use	Energy	Consumption	Toxics	Transportation	Invasives
Air		✓	✓	✓	✓	✓	
Water	✓	✓	✓	✓	✓	✓	✓
Land	✓	✓	✓	✓	✓	✓	✓
Fish	✓	✓	✓	✓	✓	✓	✓
Wildlife	✓	✓	✓	✓	✓	✓	✓
Recreation	✓	✓	✓	✓	✓	✓	✓

# Phase II Products



- Priority area mapping
- Recommended conservation strategies
- Trend analysis supporting recommendations
- Evaluating conservation strategies

# Evaluating conservation strategies: Assessment of costs and benefits



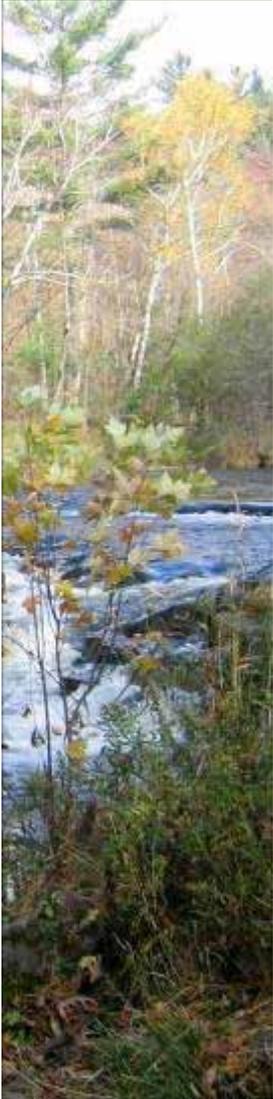
# Assessment of Costs and Benefits

- Objectives

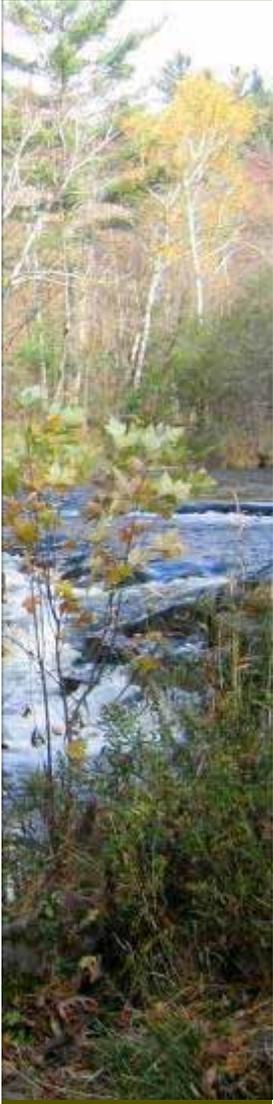
- Better understand potential costs and benefits of selected recommendations
- Estimate the order of magnitude of potential costs and benefits from the literature for selected recommendations

- Method

- *Brainstorming sessions*: Identification of key costs and benefit items
- *Survey*: Better understand various aspects of costs and benefits
- *Literature survey*: Identify relevant cost/benefit estimates from the literature



# Example: Wetland restoration



- Key benefits (total: \$7.6M – \$230.5M):
  - Mitigation of flooding: \$4.1M – \$148M per year
  - Improvement in water quality: \$2.5M – \$27.3M per year
  - Provision of critical habitat: \$1M - \$55.2M per year
- Key costs (total: \$20.3M – \$67.9M):
  - Restoration and management: \$2.8M - \$42M
  - Opportunity cost (avoided farm production): \$5M - \$12.7M
  - Land acquisition: \$11.8M
  - Easements: \$0.72M - \$1.4M
- Estimated cost effectiveness (benefit/cost): 0.38 – 3.38

# Stakeholder evaluation of recommendations

- Multiple avenues inviting people to comment
  - Advisors to the project teams
  - Website
  - Presentations
  - Outreach Forums
  - Final Forum on July 14<sup>th</sup> in Mankato
- Reached over 2,000 people at presentations
- Comments compiled in Appendix VII
- Comments reviewed by teams in writing final recommendations



# Phase II Project Organization

Project Coordinators

Core Management Team

## Research Teams

	Land & Aquatic Habitat Conservation	Land Use Practices/ Transportation	Energy Production and Use/Mercury
Team members			
Partners/ Advisors			

Information, Data, Geographic Information Systems

Outreach

Cost Benefit Analysis



# Phase I & II team members and project advisors

Over 100 scientists, professionals, agency staff, and citizen groups involved from the beginning of the project

	Land & Aquatic Habitat Conservation	Land Use Practices/ Transportation	Energy Production and Use/Mercury	Cost Benefit Analysis	GIS and Data Support
University of MN	25	15	15	5	15
Bonestroo/ CR Planning	5	3			4
Citizen groups	7	11	4		
Agency staff	7	5	3		



# Complementary efforts



- There are many complementary efforts such as:
  - Clean Water Council
  - Great Outdoors Minnesota/ Campaign for Conservation
  - MN Climate Change Advisory Group
  - Lake Pepin TMDL process
  - Regional Council of Mayors sustainability initiative
- Multiple State agency efforts
- We have reviewed and learned from their efforts

# Framework for Integrated Resource Conservation and Preservation



**Integrated  
Planning**

**Critical Land  
Protection**

**Land and Water  
Restoration**

**Sustainable  
Practice**

**Economic  
Incentives for  
Sustainable  
Society**

**Knowledge Infrastructure**

# Strategic Framework

## PHASE II:

### Strategic Areas

Integrated  
Planning

Critical Land  
Protection

Land & Water  
Restoration

Sustainability  
Practices

Economic  
Incentives for  
Sustainability

### mapped to Key Issues

Habitat Loss

Land Use  
Practice

Transportation

Energy Use,  
Mercury

## PHASE I:

### affecting Drivers of Change

Soil Erosion	Nutrient Loading	Solids Loading	Toxics Loading	Habitat Fragmentation	Consumptive Use	Hydrologic Modification	Invasive Species	GHG emissions
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### impacting Natural Resources

Air

Water

Land

Wildlife

Fish

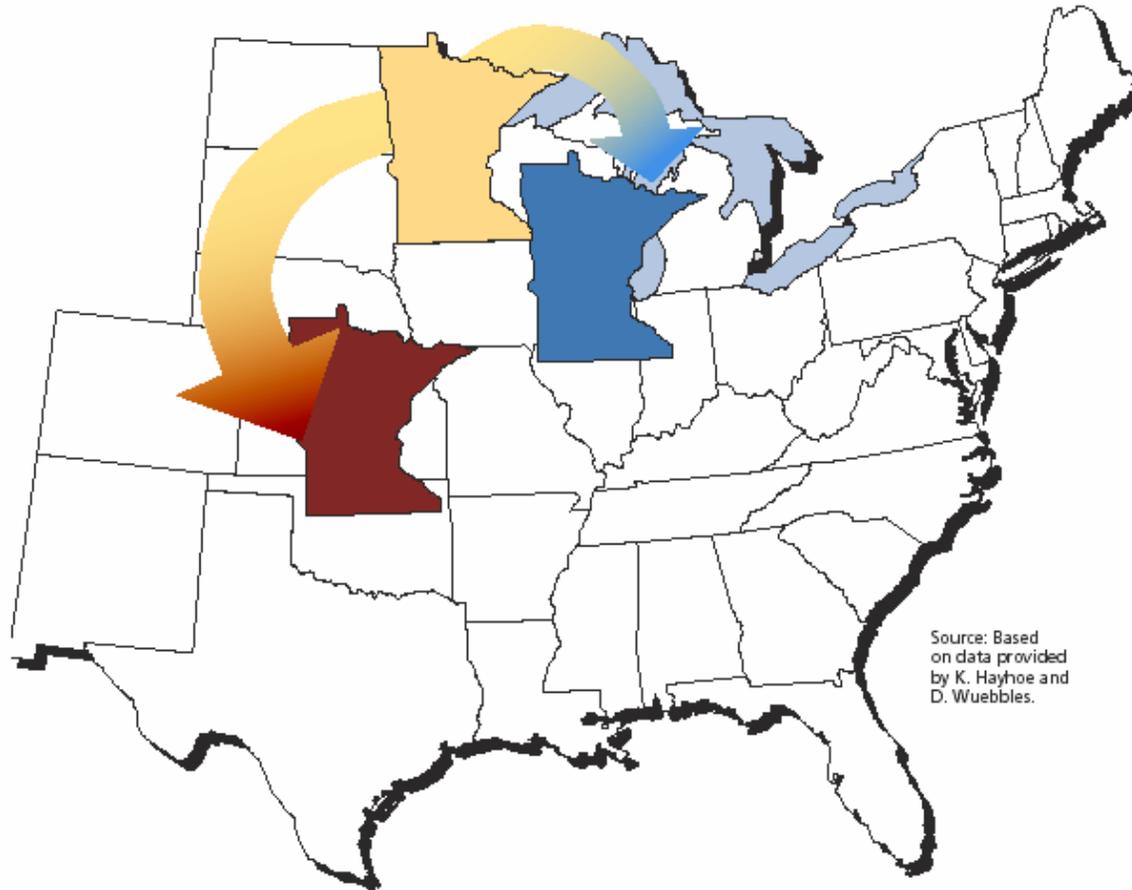
Recreation

# Natural Resource Values Assessment of Recommendations

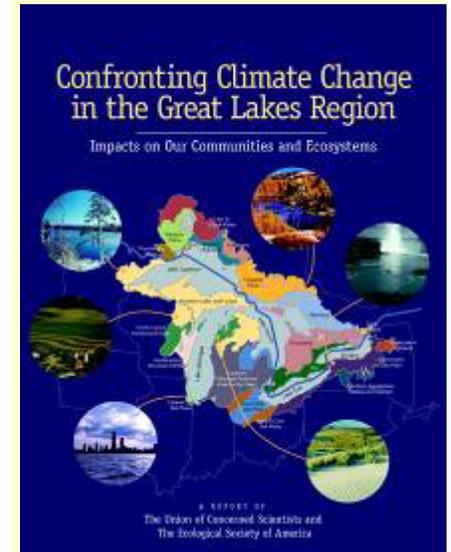
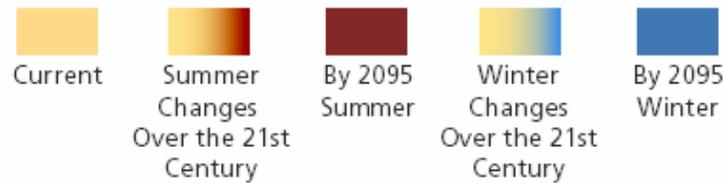
LEGEND: ● = Critical Impact ○ = Significant Impact ○ = Negligible Impact

		Air Quality	Water Quality/Quantity	Terrestrial Habitat Quality	Soil/Land Quality	Human Health	Biodiversity	Community Health	Aquatic	Economic Health	Recreational/Cultural/Spiritual/Aesthetic Value	Mitigation/Adaptation	Climate Change
HABITAT	Habitat 2	○	○	●	●	●	○	●	●	●	●	●	●
	Habitat 1	○	○	●	●	●	○	●	●	●	○	●	●
	Habitat 4	○	○	●	●	●	○	●	●	●	○	●	●
	Habitat 5	○	○	●	○	○	○	●	●	●	○	●	●
	Habitat 6	○	○	●	○	○	○	●	●	●	○	●	●
	Habitat 7	○	○	●	○	○	○	●	●	●	○	●	●
	Habitat 8	○	○	●	○	○	○	●	●	●	○	●	●
	Habitat 3	○	○	○	○	○	○	●	○	○	○	●	○
ENERGY	Energy 1	○	●	●	●	●	○	○	○	○	○	○	○
	Energy 13	○	○	●	●	●	○	○	○	○	○	○	○
	Energy 17	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 2	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 18	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 16	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 21	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 19	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 14	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 20	○	○	○	○	○	○	○	○	○	○	○	○
Energy 15	○	○	○	○	○	○	○	○	○	○	○	○	
LAND USE - AG	LU Ag 1/Energy 4	○	○	○	○	○	○	○	○	○	○	○	○
	LU Ag 2	○	○	○	○	○	○	○	○	○	○	○	○
	LU Ag 3	○	○	○	○	○	○	○	○	○	○	○	○
LAND USE - COMMUNITY	LU Comm 2	○	○	○	○	○	○	○	○	○	○	○	○
	LU Comm 3	○	○	○	○	○	○	○	○	○	○	○	○
TRANSPORTATION	Trans 1	●	○	○	○	○	○	○	○	○	○	○	○
	Trans 3	○	○	○	○	○	○	○	○	○	○	○	○
LAND USE - FORESTRY	LU Forest 1	○	○	○	○	○	○	○	○	○	○	○	○
	LU Forest 2	○	○	○	○	○	○	○	○	○	○	○	○

# Climate Change & Minnesota



Source: Based on data provided by K. Hayhoe and D. Wuebbles.



A REPORT OF  
The Union of Concerned Scientists and  
The Ecological Society of America

# Team Recommendations



- Land and Aquatic Habitat Team
- Land Use Team
  - Community
  - Agricultural
  - Forestry
- Transportation
- Energy Production and Use/ Mercury

# Land and Aquatic Habitat Conservation: Products



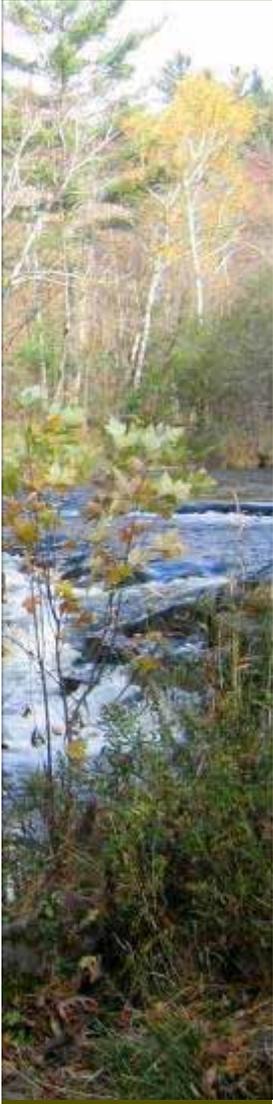
- **Identify/map critical land & aquatic areas** necessary to maintain/improve:
  - Water quality
  - Biodiversity
  - Sustainable outdoor recreation
  - Quality of Minnesota habitats
- **Identify strategies & policies** needed to maintain or restore critical land & water areas

# Mapping habitat quality: Methods and results



- Goal was to prioritize important areas for conservation
- Use existing information
- Integrate positive (resources) and negative (threats to resources) information

# What makes this study unique



- Collaboration with major natural resource management agencies provided access to most comprehensive and up-to-date data sets and expert knowledge
- Highly integrated data sets
- View across the spectrum of terrestrial and aquatic resources

Priorities  
analyzed for  
each  
Ecological  
Subsection

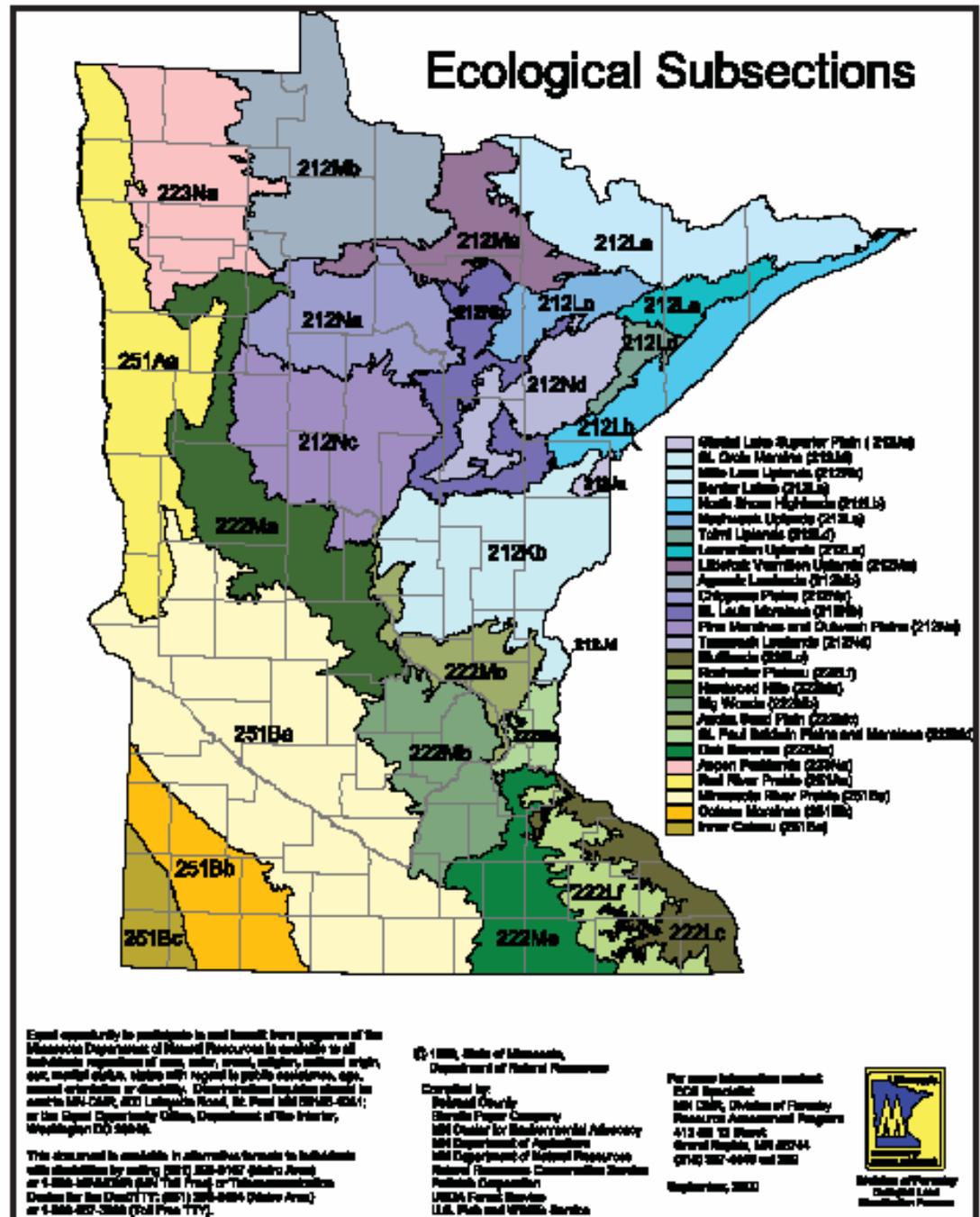


Figure H1. Minnesota Ecological Subsections. Credit: MnDNR.

# Integrated terrestrial value scores

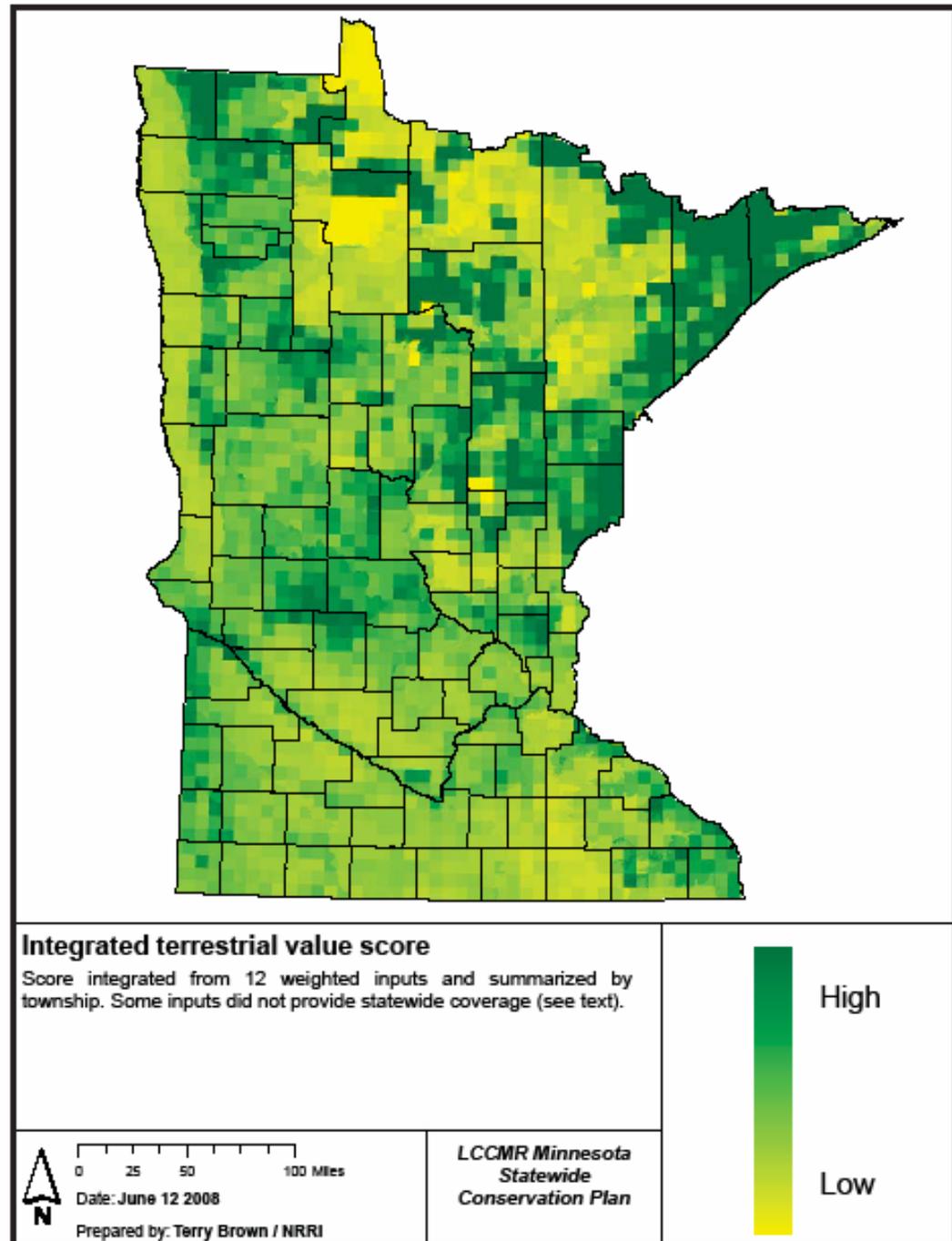


Figure H17. Integrated terrestrial value score. Credit: Terry Brown, Natural Resources Research Institute.

# Aquatic habitat quality vs. environmental stress

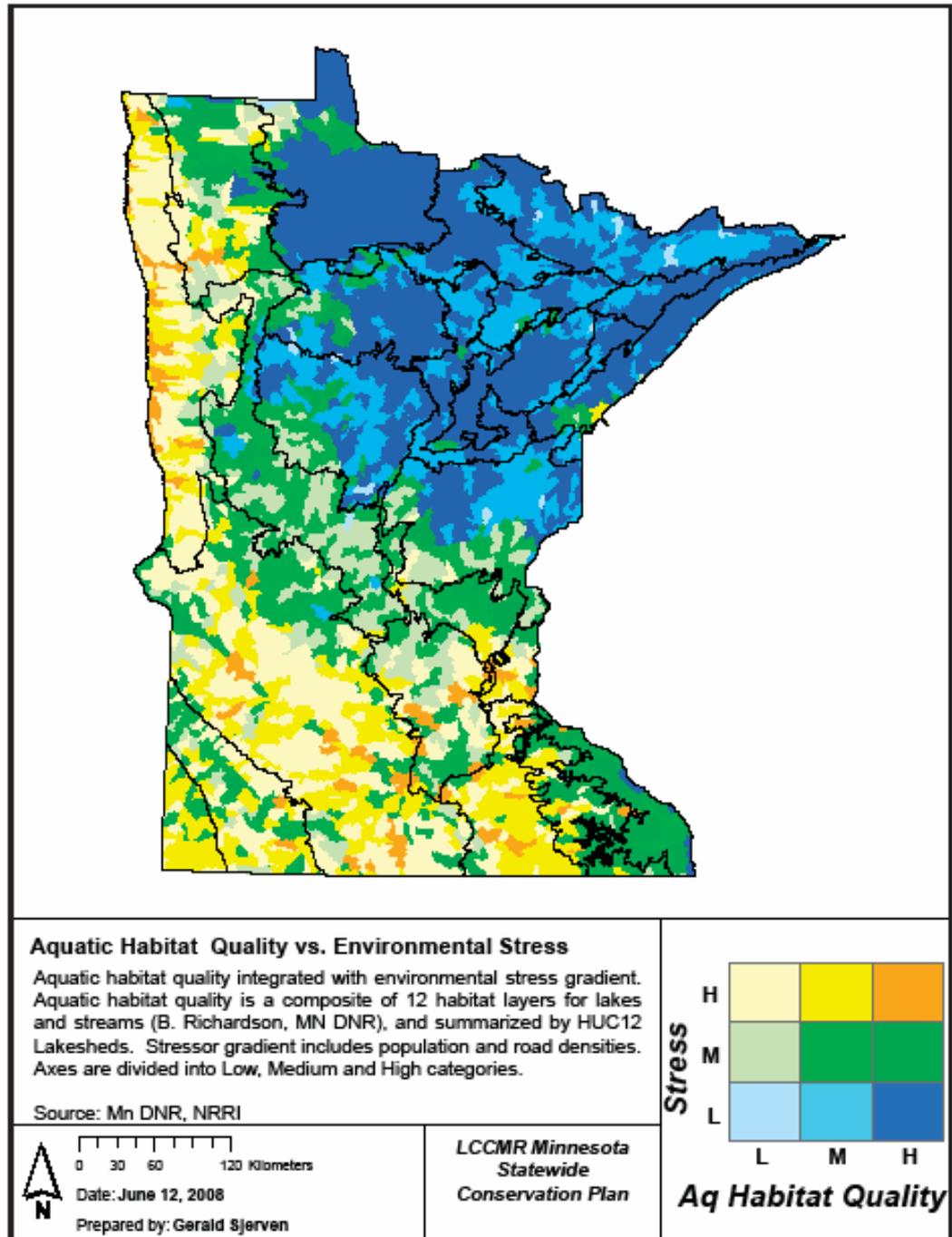


Figure H15. Aquatic habitat Quality vs. Environmental Stress. Credit: Gerald Sjerven, Natural Resources Research Institute.

Data shown at township level, however, high resolution data sets (30 meter cells) offer opportunity to conduct localized analysis

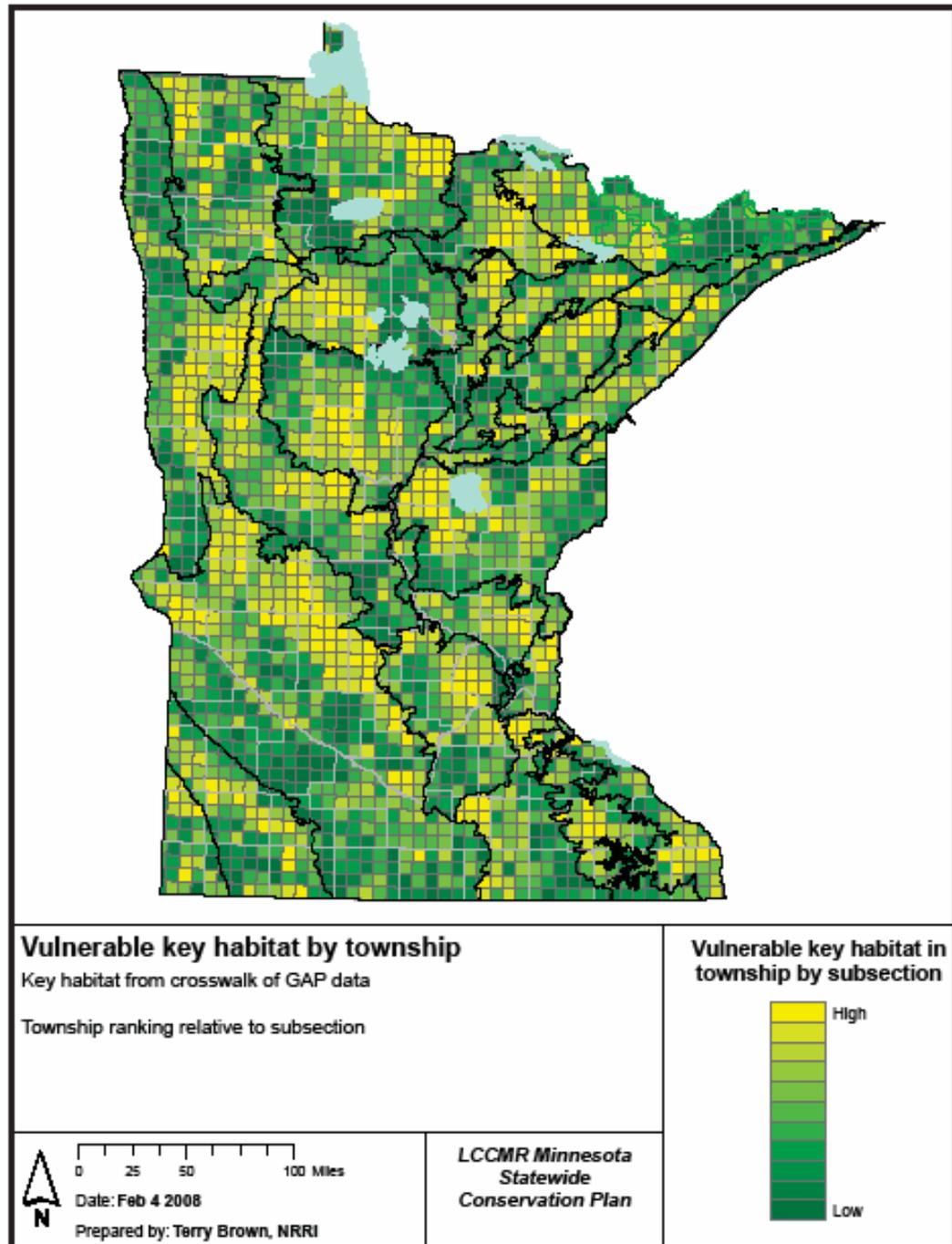
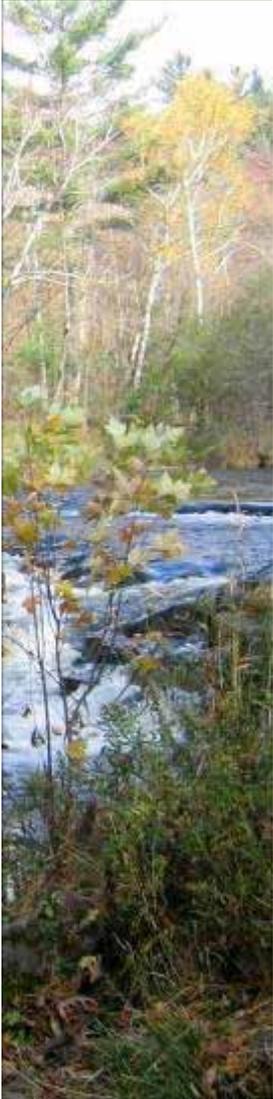


Figure H16. Vulnerable key habitat by township. Credit: Terry Brown, Natural Resources Research Institute.

# Land Protection



- *Habitat 1:* Protect priority land habitats
- *Habitat 2:* Protect critical shorelands of streams and lakes
  - 2A. Acquire high-priority shorelands
  - 2B. Protect private shoreland via economic incentives and other tools
- *Habitat 3:* Improve connectivity and access to outdoor recreation

# Land & Water Restoration



- *Habitat 4:* Restore and protect shallow lakes
- *Habitat 5:* Restore land, wetlands, and wetland-associated watersheds
- *Habitat 6:* Protect and restore critical in-water habitat of lakes and streams
  - 6A. Restore habitat structure within lakes
  - 6B. Protect and restore in-stream habitat
  - 6C. Protect deep-water lakes with exceptional water quality

# Sustainable Practice



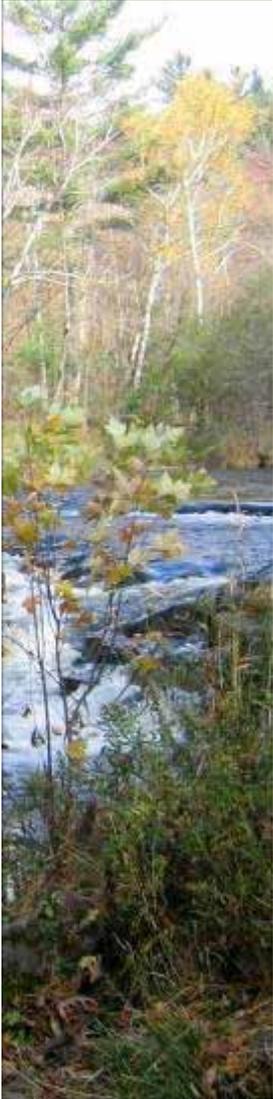
- *Habitat 7:* Keep water on the landscape
- *Habitat 8:* Review and analyze drainage policy

# Knowledge Infrastructure



- *Habitat 9:* Overall research on land and aquatic habitats
- *Habitat 10:* Research on near-shore habitat vulnerability
- *Habitat 11:* Improve understanding of ground water resources
- *Habitat 12:* Improve understanding of watersheds to multiple drivers of change
- *Habitat 13:* Habitat and landscape conservation education and training for all citizens

# Land Use Practices: Products



- Identify public/private land use choices needed to:
  - Improve environmental quality
  - Anticipate and adapt to environmental changes in Minnesota
- Identify land use practices & policies to best support these choices

# Land Use Practices Team



- Focus is on how land is used on a particular parcel or site
- Three major types of land uses in Minnesota
  - Urban/Community
  - Agriculture
  - Forest

# Land Use Trends: Population growth

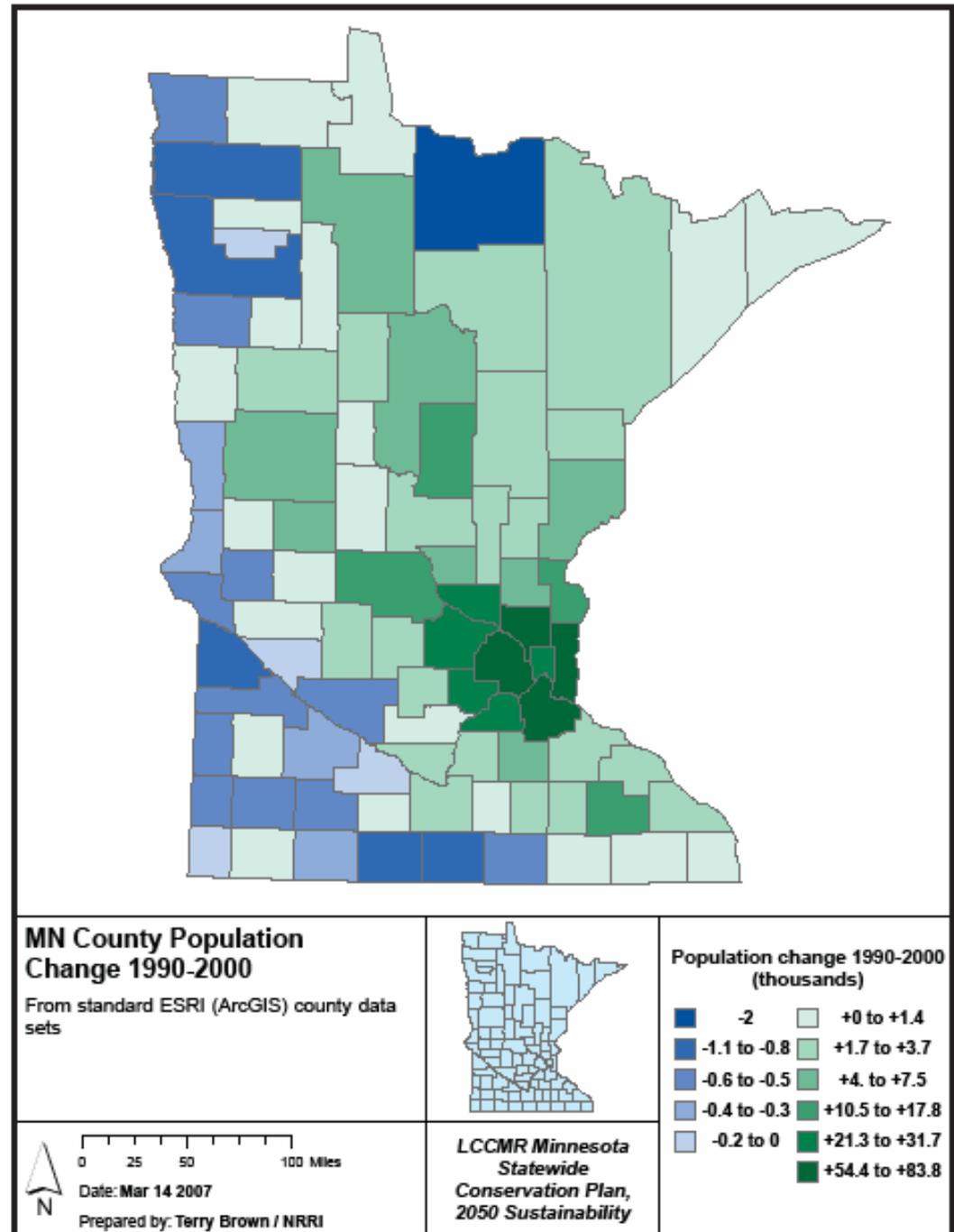


Figure L1. Minnesota County Population Change 1990-2000. Credit: Terry Brown, NRRI.

Tallgrass Aspen  
Parklands Province

Laurentian Mixed  
Forest Province

Eastern Broadleaf  
Forest Province

Prairie Parkland Province

- Province Outline
- Prairie
- Upland Shrub/woodland
- Upland deciduous (Hardwoods)
- Upland deciduous (Aspen-birch)
- Upland coniferous
- Lowland coniferous / shrubland
- Lowland deciduous
- Open Wetland
- Water
- Grassland
- Cropland
- Developed



0 20 40 80 Miles

Date: June 12, 2007

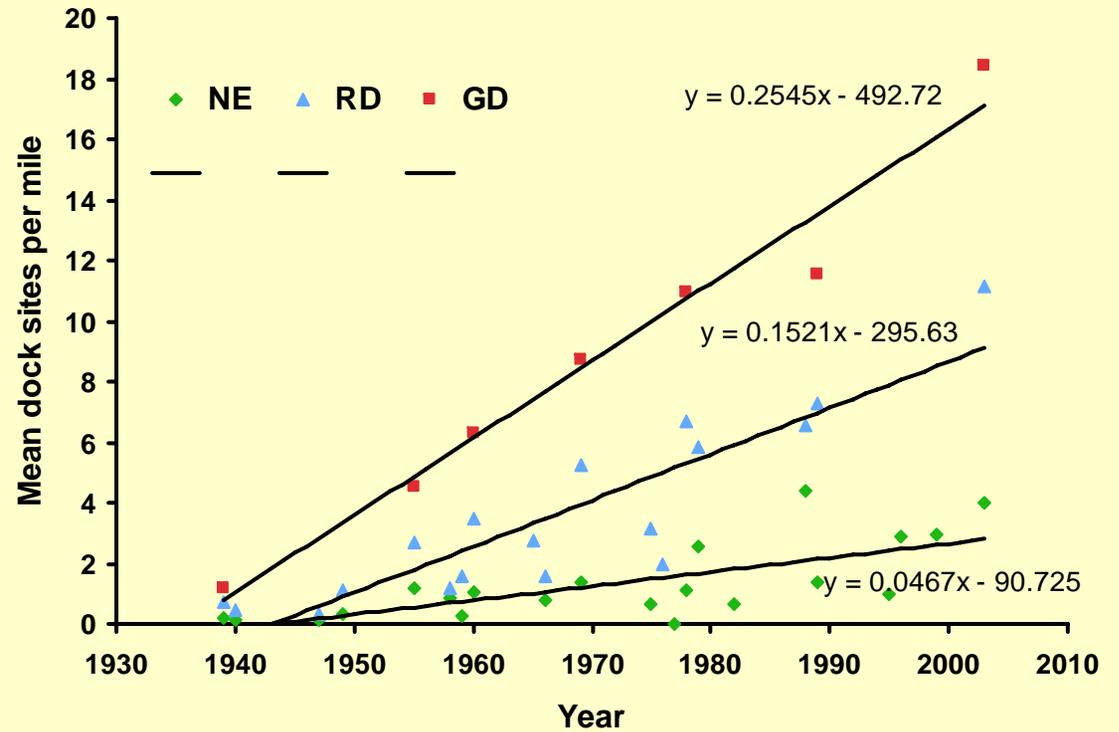
Prepared by: Daren Carlson / MNDNR

## Landcover Change, 1890 to 1990

1890 data from Marschner, 1990 data from USGS/GAP

*LCCMR Minnesota  
Statewide  
Conservation Plan*

# Increase in shoreline development



Increase in  
impervious surface:

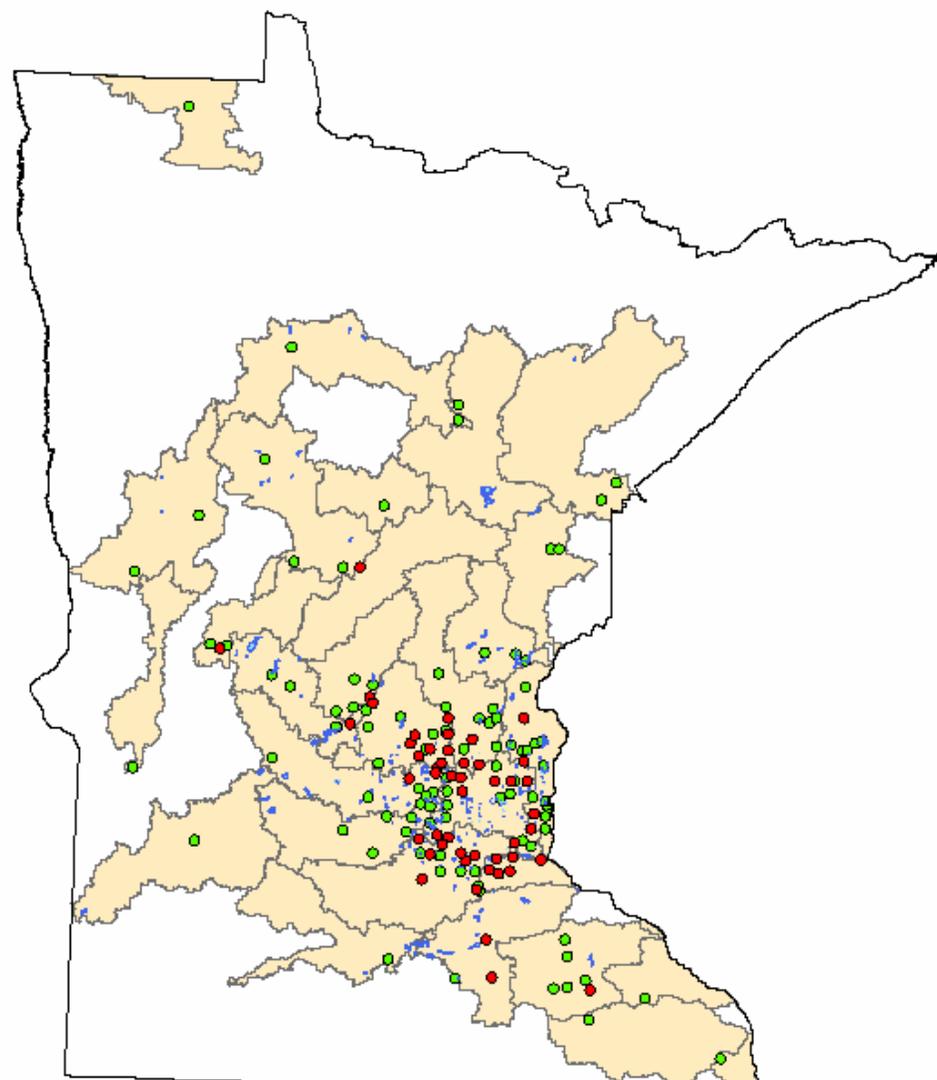
An additional  
893,506 acres by  
2020.

**1,396 square miles**

**93%** of these  
communities are  
located in just 9  
watersheds.

✓ Most are in the  
Mississippi Basin.

Communities with Substantial Growth



# Community Land Use



- *Community LU 1:* Fund and implement a state land use, development, and investment guide
- *Community LU 2:* Support local and regional conservation-based planning
  - 2A. Demonstration projects
  - 2B. Incentives
  - 2C. Tools and technical assistance
  - 2D. Investment in base data

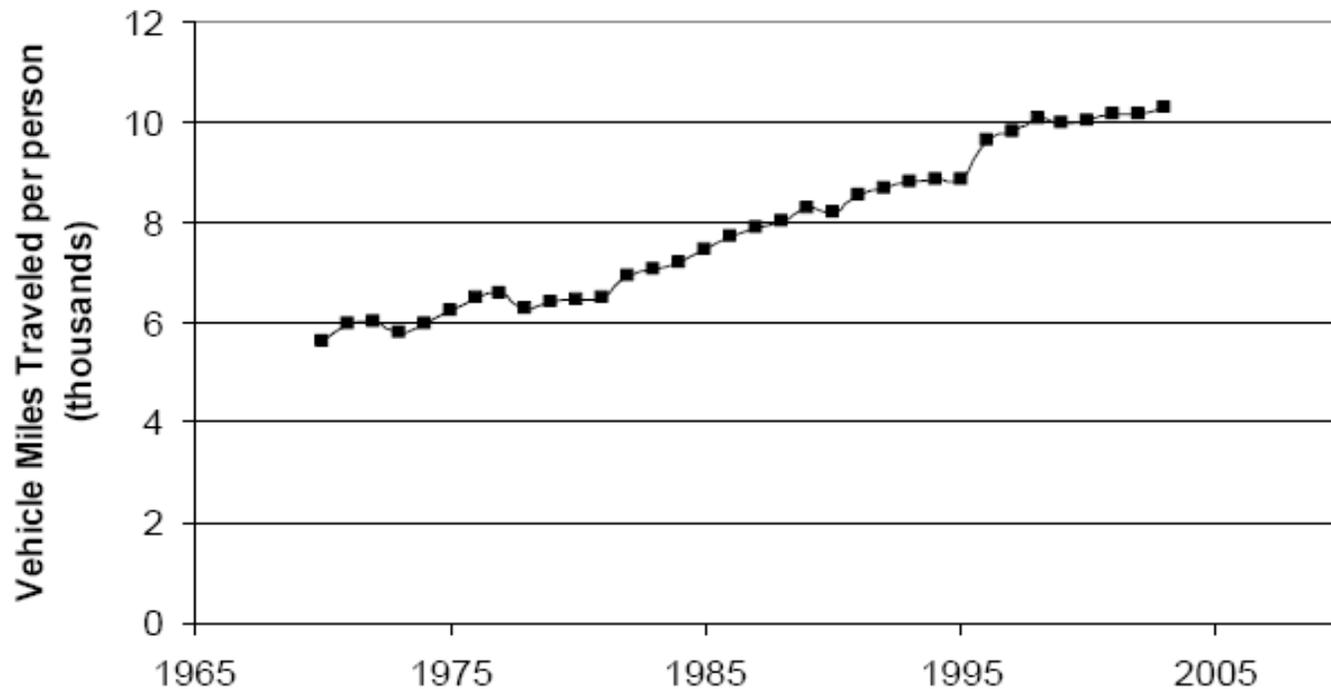
# Community Land Use

- *Community LU 3:* Ensure protection of water resources in urban areas by evaluating and improving current programs
  - 3A. Credit system for stormwater and low-impact development (LID) best management practices (BMPs)
  - 3B. Simple modeling for TMDL compliance
  - 3C. TMDL BMP implementation monitoring
  - 3D. Water quality media campaign



# Transportation trends: We are driving more miles

Annual Vehicle Miles Traveled per person in  
Minnesota, 1970-2004



Source: MPCA

# Transportation

- *Transportation 1*: Align transportation planning across state agencies and integrate transportation project development and review across state, regional, metropolitan and county/local transportation, land use and conservation programs
  - 1A. Institute interagency alignment of planning to coordinate transportation with other state planning cycles
  - 1B. Integrate streamlined statewide environmental transportation project review with other statewide and cross-jurisdictional planning



# Transportation

- *Transportation 2:*  
Reduce per capita vehicle miles of travel (VMT) through compact mixed-use development and multi-modal and intermodal transportation systems

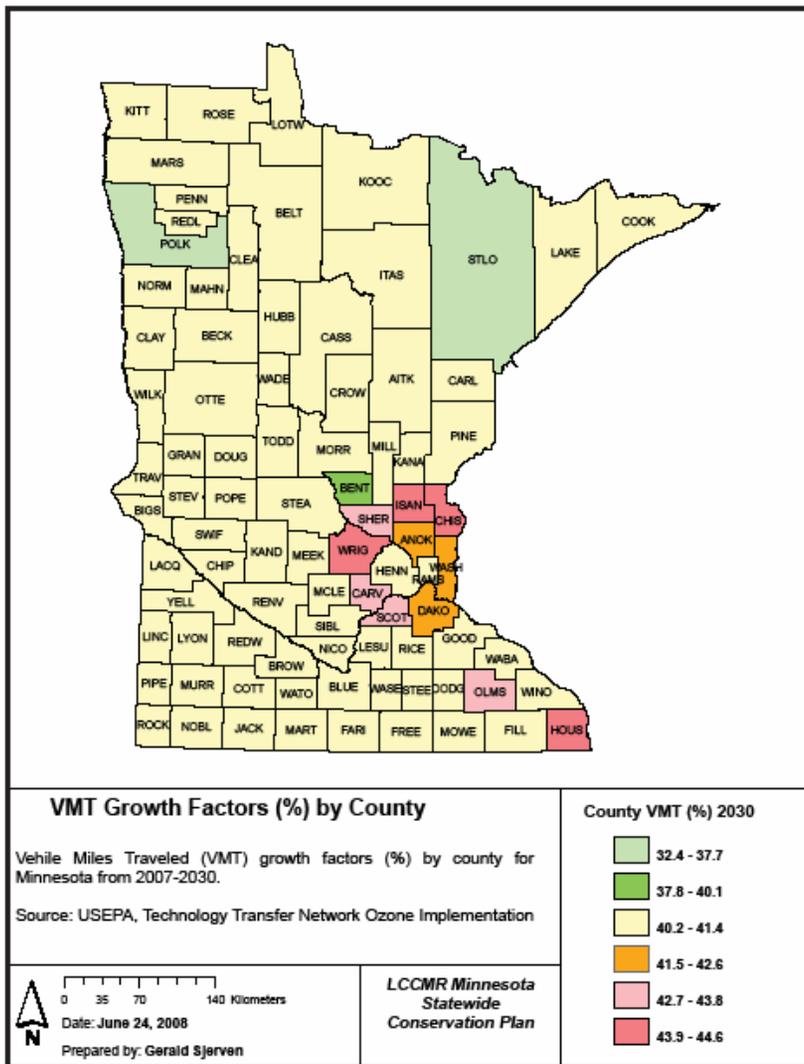


Figure T4. VMT Growth Factors (%) by County. Credit: Gerald Sjerven, Natural Resources Research Institute

# Transportation

- **Transportation 3:** Develop and implement sustainable transportation research, design, planning, construction practices, regulations,

and competitive incentive funding that minimizes impacts on natural resources, especially habitat fragmentation and non-point water pollution

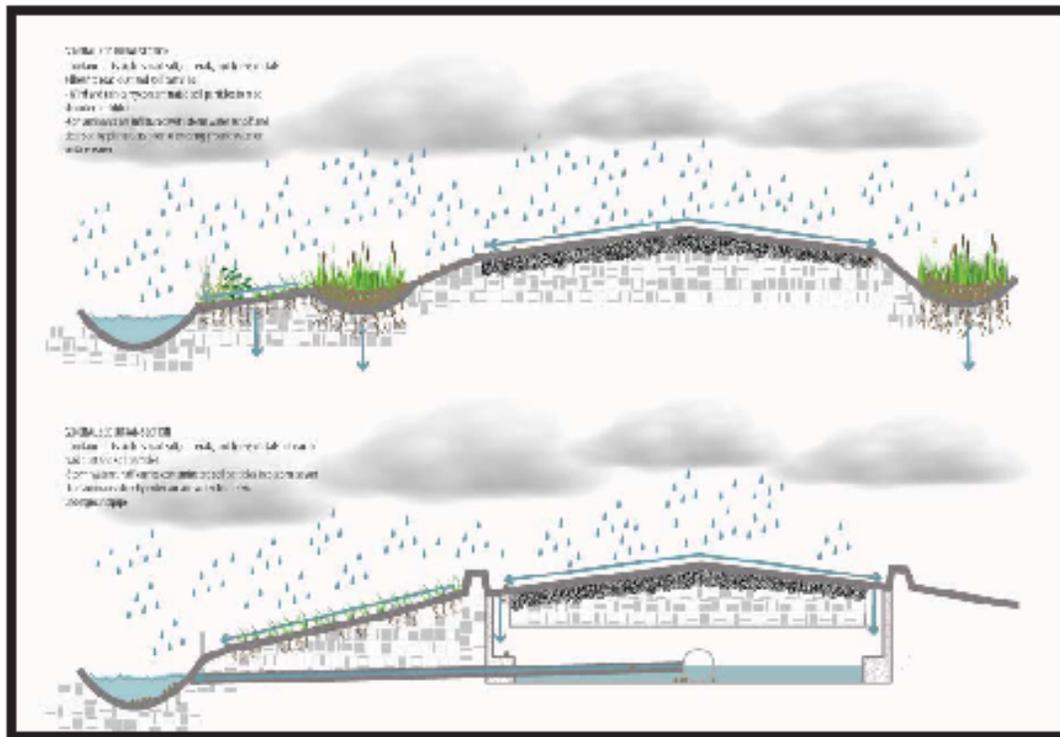
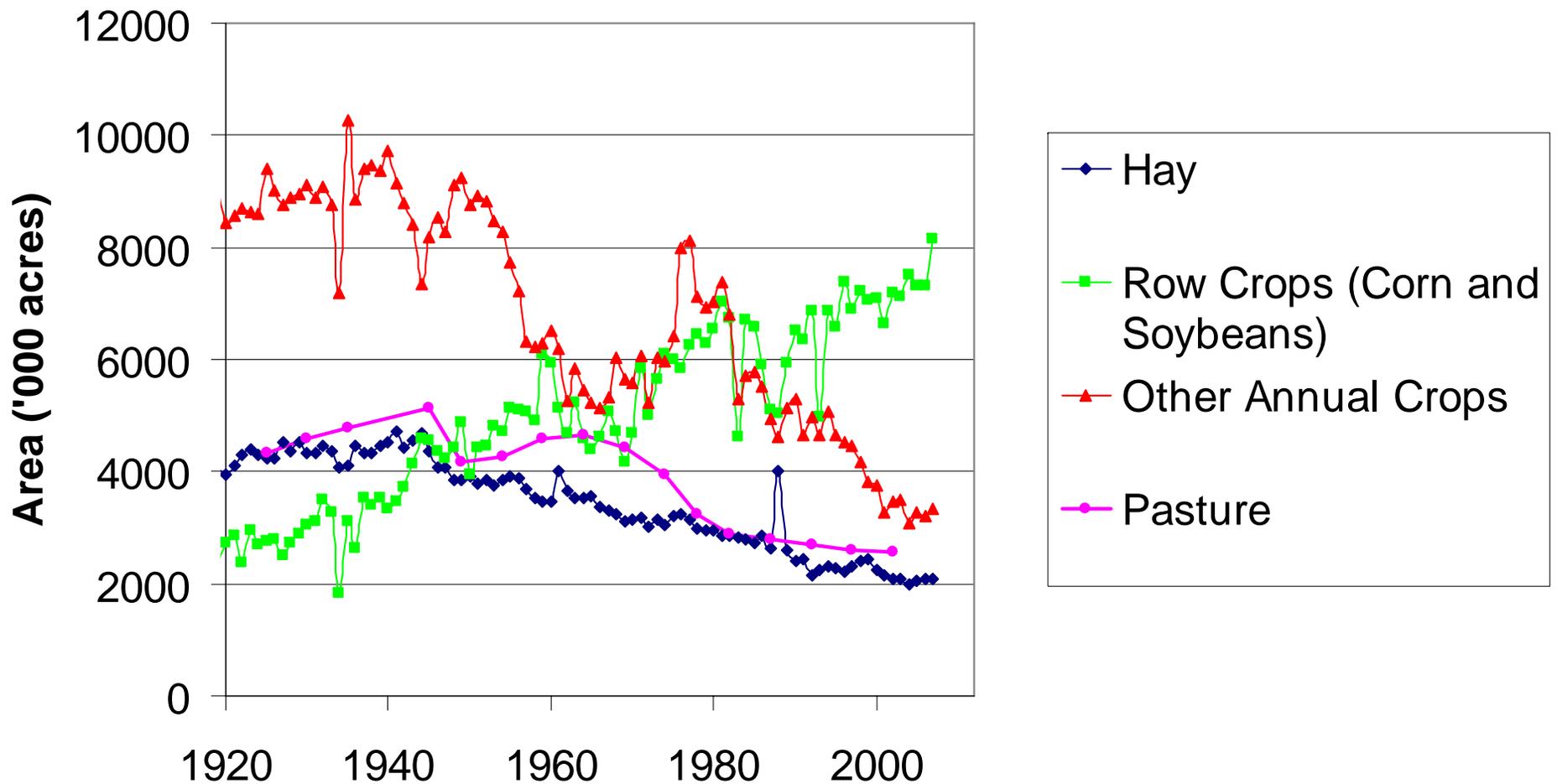
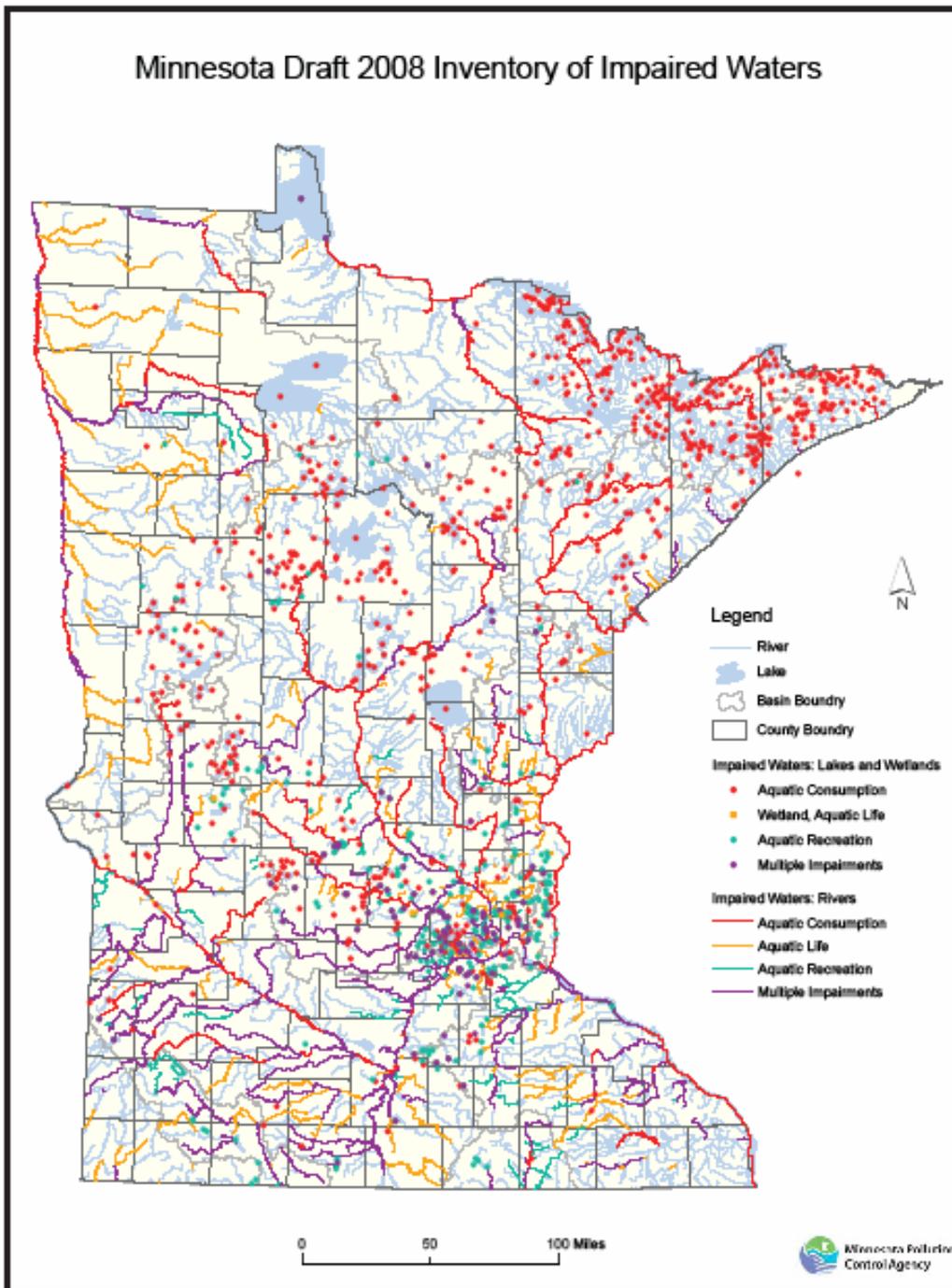


Figure 18. One current practice in road design is to provide vegetative infiltration areas in roadside swales to filter and slow runoff from paved surfaces. Curb and gutter additions to roads that accompany the changes in functional classification (e.g. to urban arterial) are especially detrimental near water bodies.. Credit: Katherin Thering, UM Metropolitan Design Center.

# Trend in agricultural land use

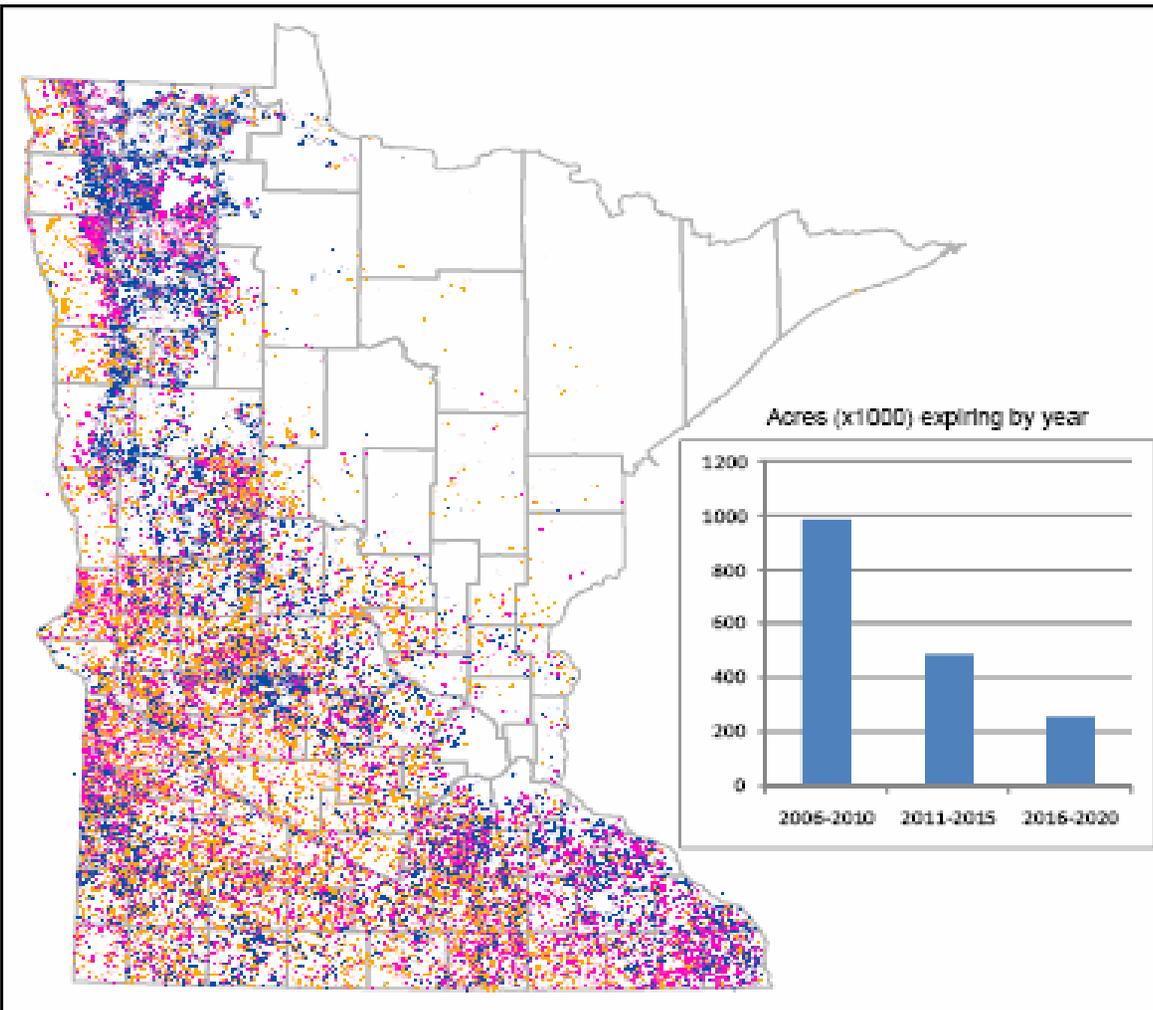




Impaired waters are being evaluated and identified.

Federal law requires action to protect and improve these waters.

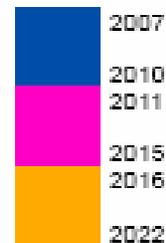
Figure L4. Minnesota Inventory of Impaired Waters. Credit: MPCA.



**CRP land expiration year**

USDA Farm Service Agency data

**CRP land expiration**



0 25 50 100 Miles  
 Date: Feb 6 2008  
 Prepared by: Terry Brown, NRRI

LCCMR Minnesota  
 Statewide  
 Conservation Plan

Conservation  
 Reserve Program  
 Year of expiration  
 of enrolled  
 acreage

# Agricultural Land Use

- **Agricultural LU Strategy 1:**

As much as possible, transition renewable fuel feedstocks to perennial crops

1A. Invest in research to determine ecoregion and site-specific suitability and management of perennial species for feedstock for biofuels and other products

1B. Investigate, analyze and adopt policy that will transition biofuel feedstocks to perennial crops

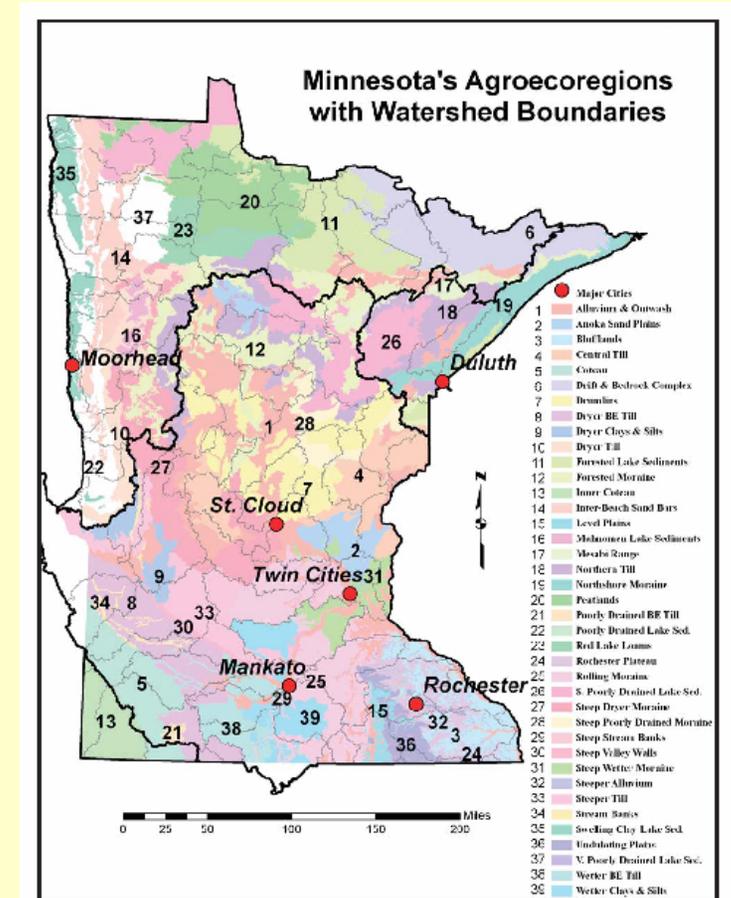
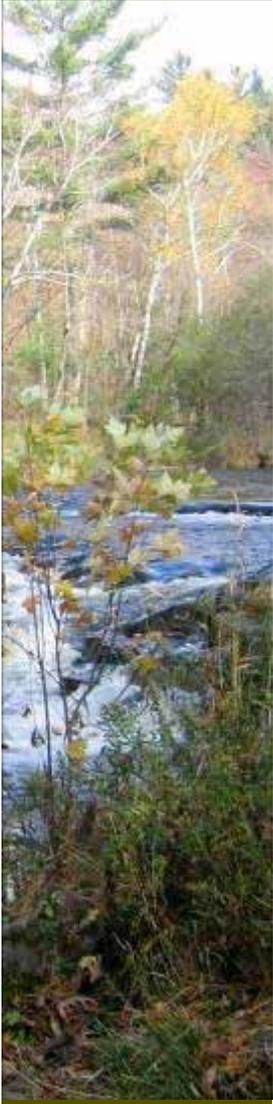


Figure L9. Minnesota agro-ecoregions differ significantly in suitability for perennial species that can serve as feedstocks for biofuels and other products. Growing season lengths and temperature, precipitation, and soil characteristics are important determinants of species suitability. Credit: David Mullis, University of Minnesota

# Agricultural Land Use



- *Agricultural LU Strategy 2*: Reduce streambank erosion through reductions in peak flows
  - 2A. Invest in research to determine the quantitative relationship among trends in precipitation, artificial drainage systems, and stream hydrology
  - 2B. Set research-based goals for peak flow reductions
  - 2C. Invest in strategically targeted programs for reduction of peak flows
  - 2D. Investigate, analyze, and adopt science-based policy that strengthens mitigation of peak flows from artificial drainage systems

# Agricultural Land Use

- *Agricultural LU Strategy 3*: Reduce upland and gully erosion through soil conservation practices
  - 3A. Invest in education and incentive programs that target landowners in critical sediment source areas
  - 3B. Investigate the feasibility of developing or amending policy to phase in outcome-driven, practice-flexible soil and water conservation plans for all farms with potential to deliver sediment and nutrients to water bodies



# Agricultural Land Use

- *Agricultural LU Strategy 4:* Enable improved design and targeting of conservation through improved and timely data collection and distribution
  - 4A. Invest in basic information to support soil and water protection
    - LIDAR
    - Statewide land cover
    - Maps of artificial drainage network
    - Annual crop residue survey

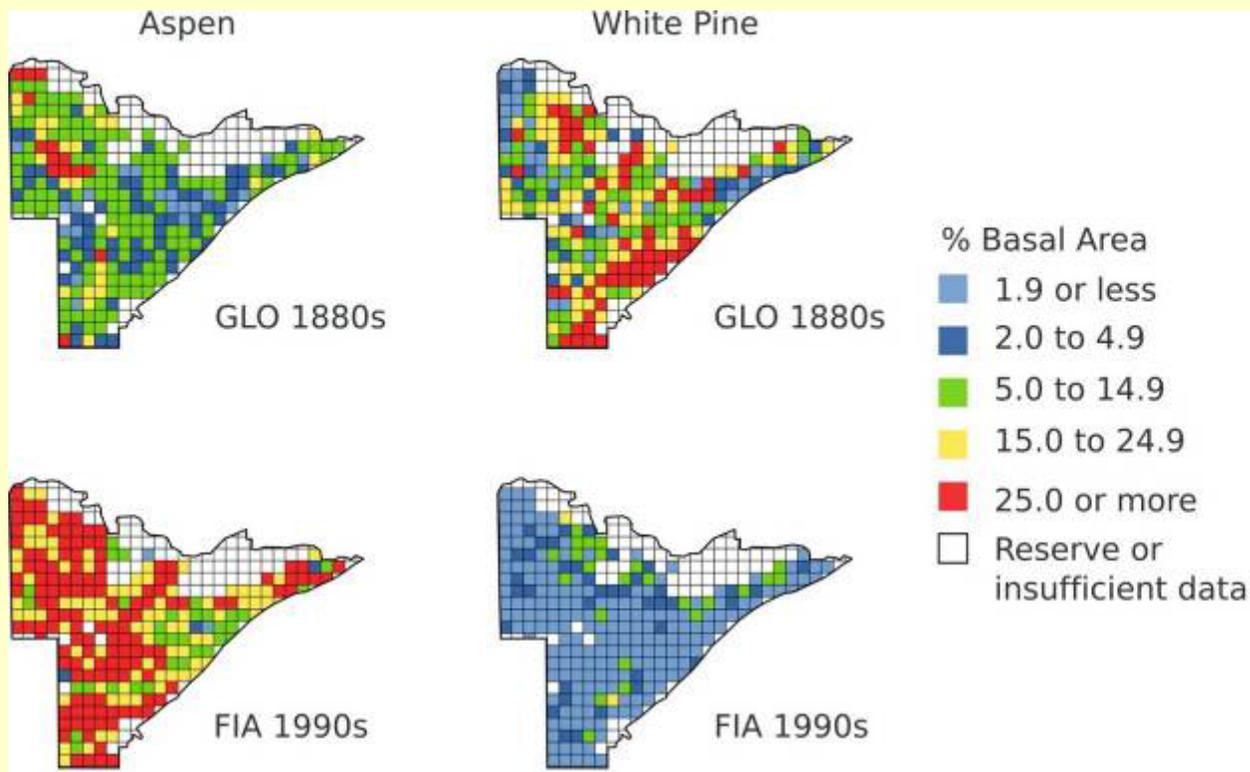


# Agricultural Land Use

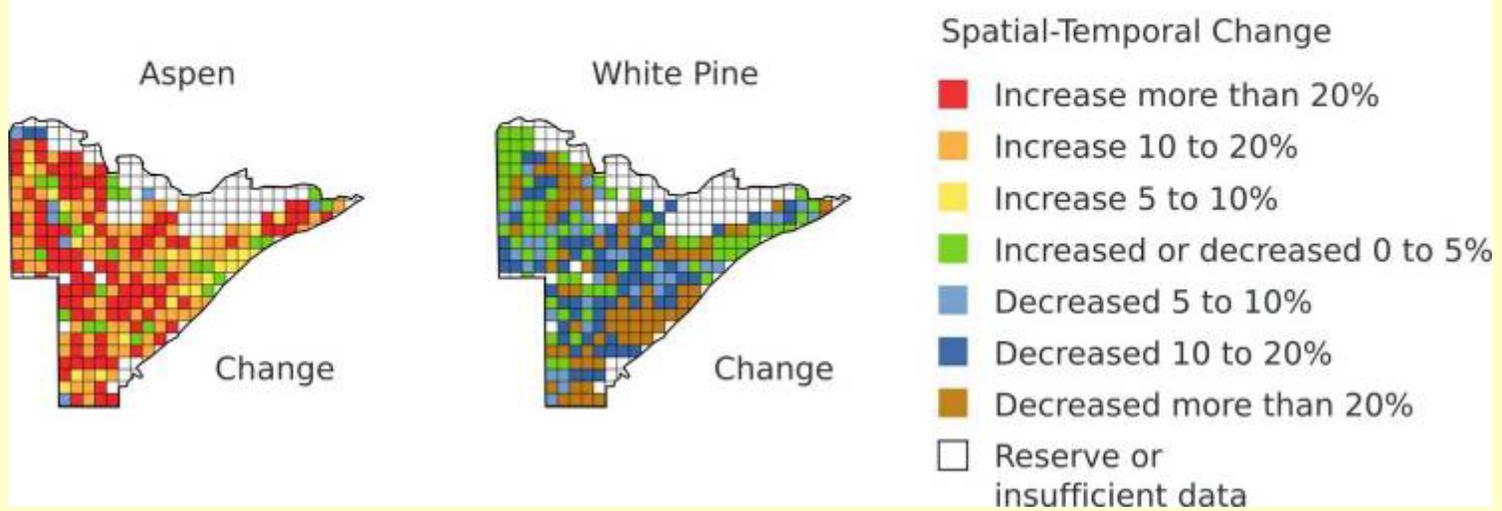
- *Agricultural LU Strategy 5:* Increase protection of important agricultural lands in local land use planning.

Integrated into state land use, natural resource, and investment guide and conservation-based planning recommendations





Forestry trends:  
 Change in native forest cover  
 White Pine nearly depleted allowing Aspen to thrive



# Forestry Land Use



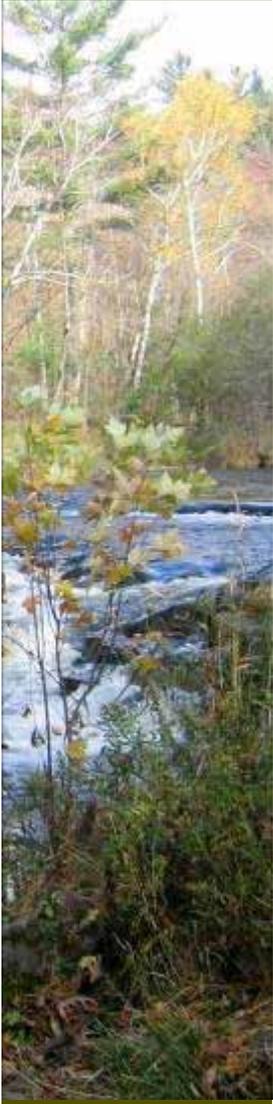
- *Forestry 1:* Protect large blocks of forested land
- *Forestry 2:* Assess tools for forest land protection
- *Forestry 3:* Support and expand sustainable practices on working forested lands

# Energy Production and Use: Products



- Identify energy trends/impacts, including the areas of:
  - Biofuels
  - Conservation of fossil fuels
- Identify/map priority natural resource areas likely to be affected
- Identify energy-related investment & policy choices that impact natural resources

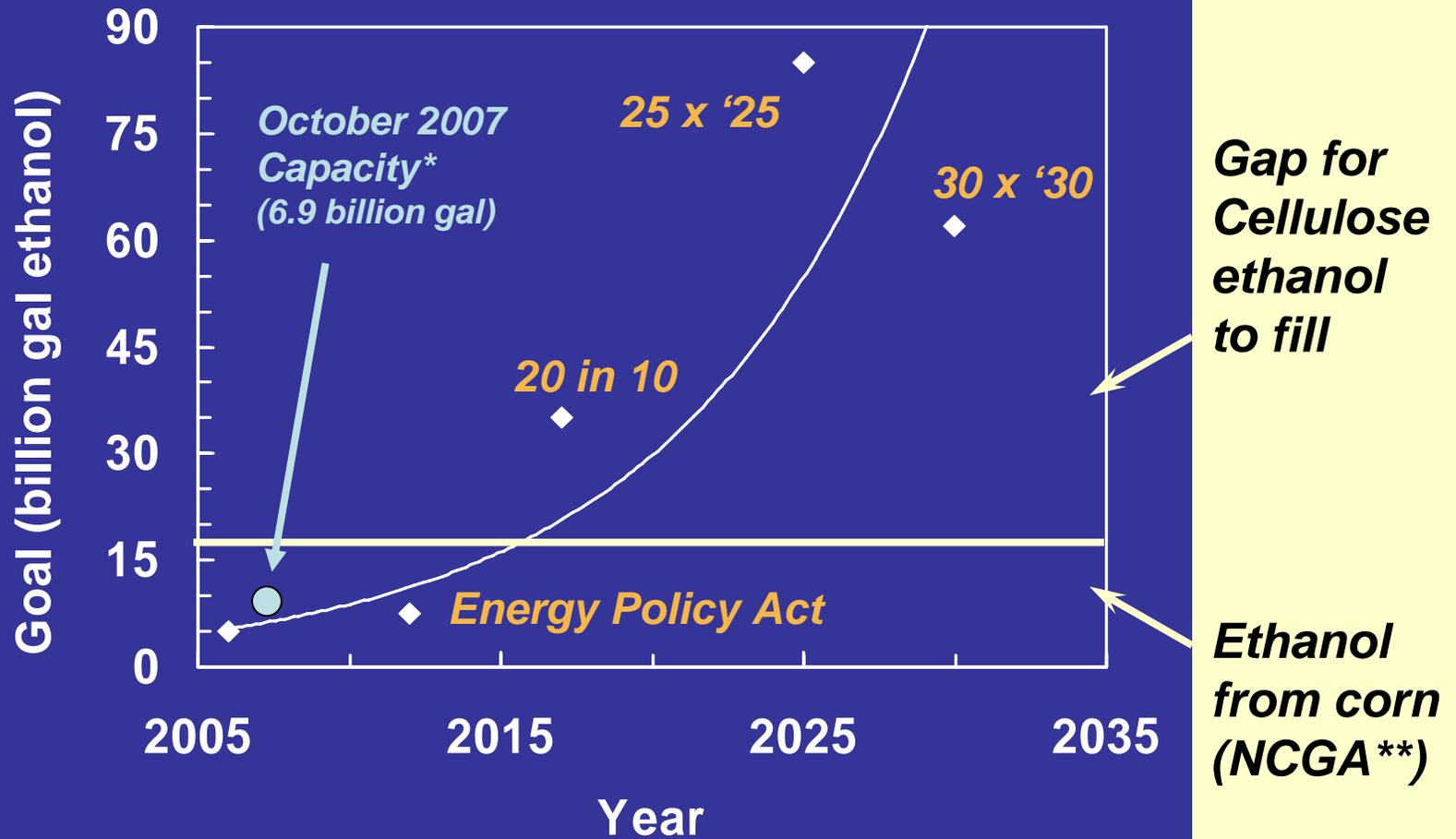
# Three Overarching Goals – Multiple Recommendations in Each



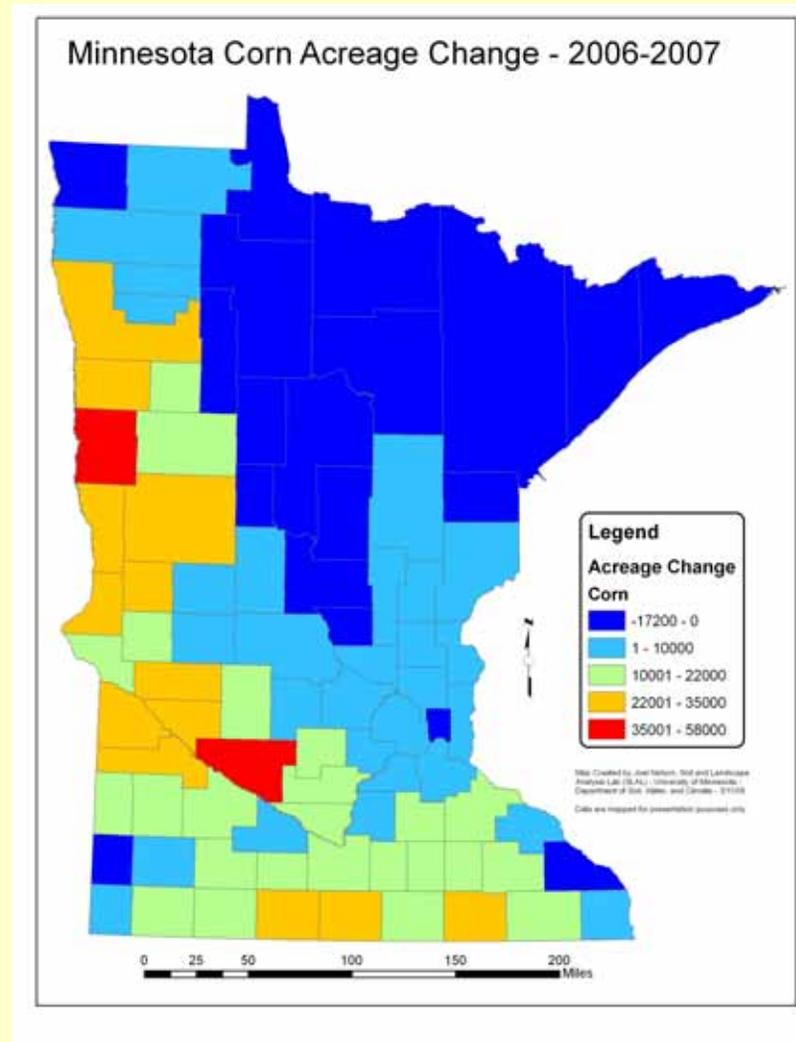
- A. Promote alternative energy production strategies** that balance or optimize production of food, feed, fiber, and fuel with protection or improvement of environmental quality
- B. Promote a healthy economy**, including strategies that promote local ownership of alternative energy production and processing infrastructure, where appropriate
- C. Promote energy conservation efforts** among individuals, businesses, communities and institutions

# Goal A: Promote Alternative Energy Production Strategies

Ethanol production will continue to grow, with most expected growth from cellulosic feedstocks

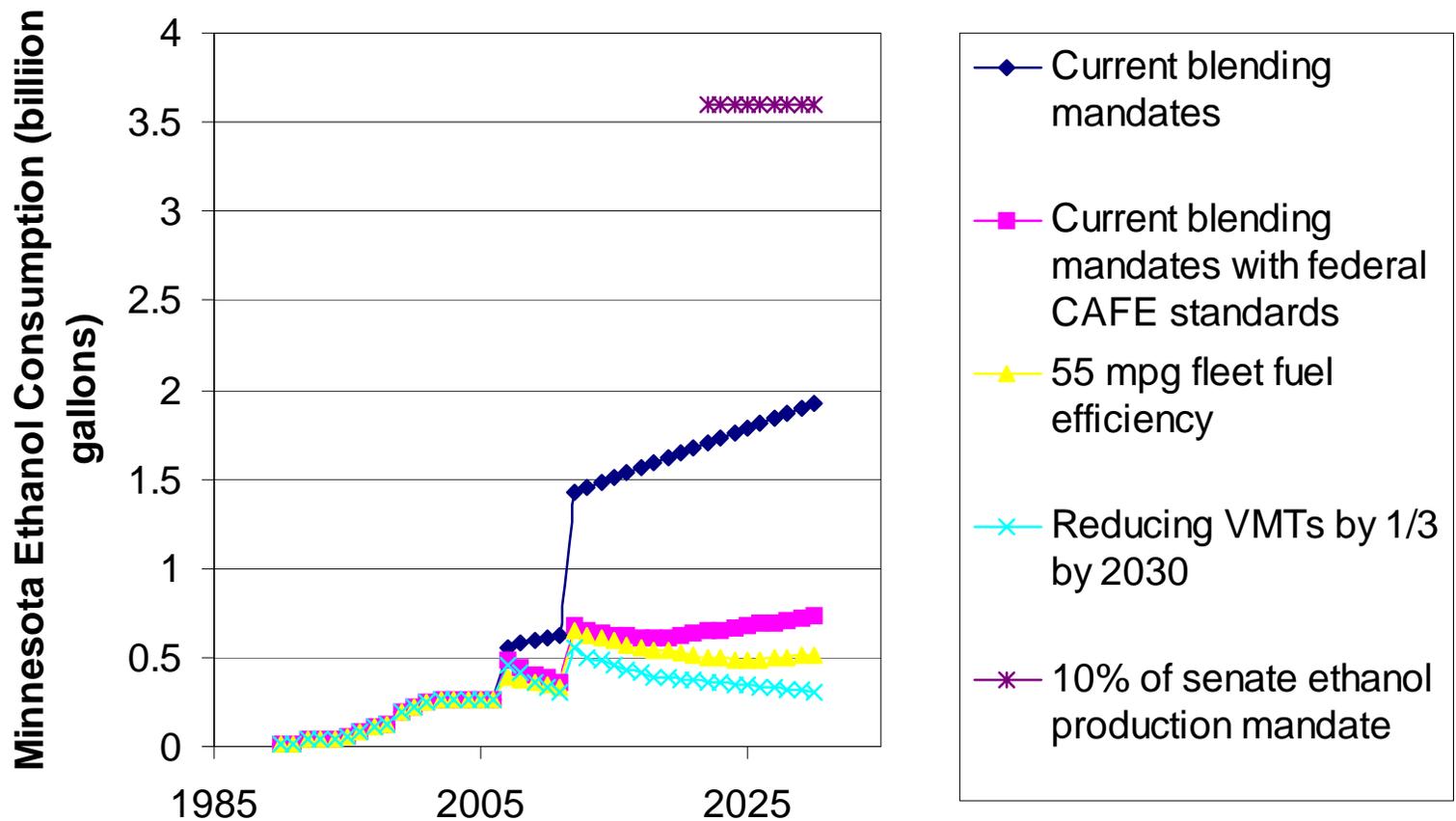
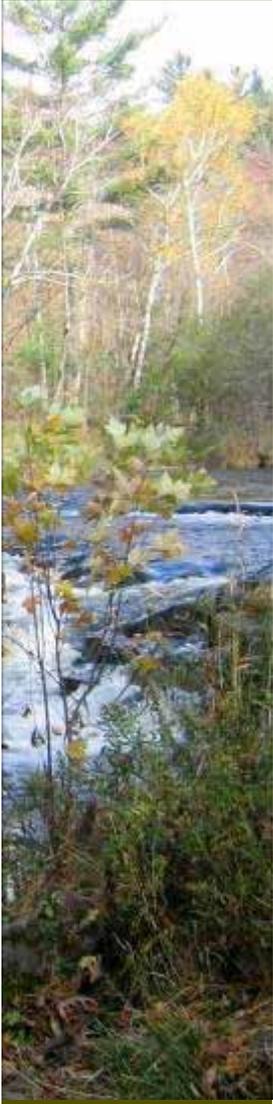


# Impacts of Biofuel Industry on Cropping System Change

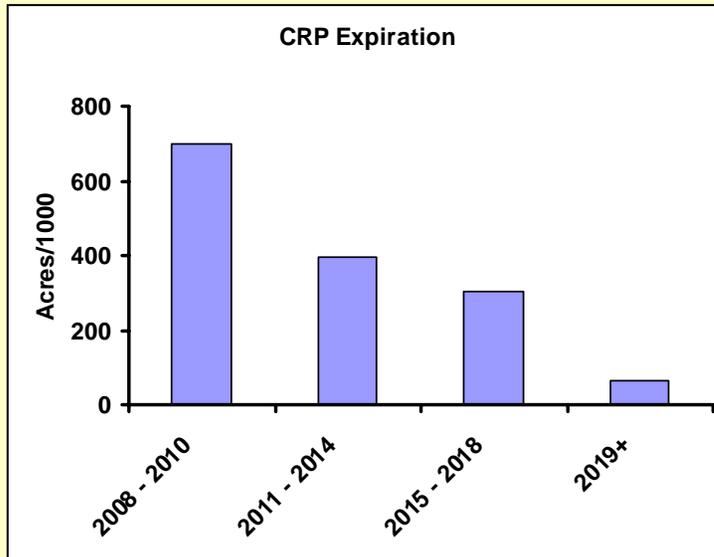


# Goal A: Promote Alternative Energy Production Strategies

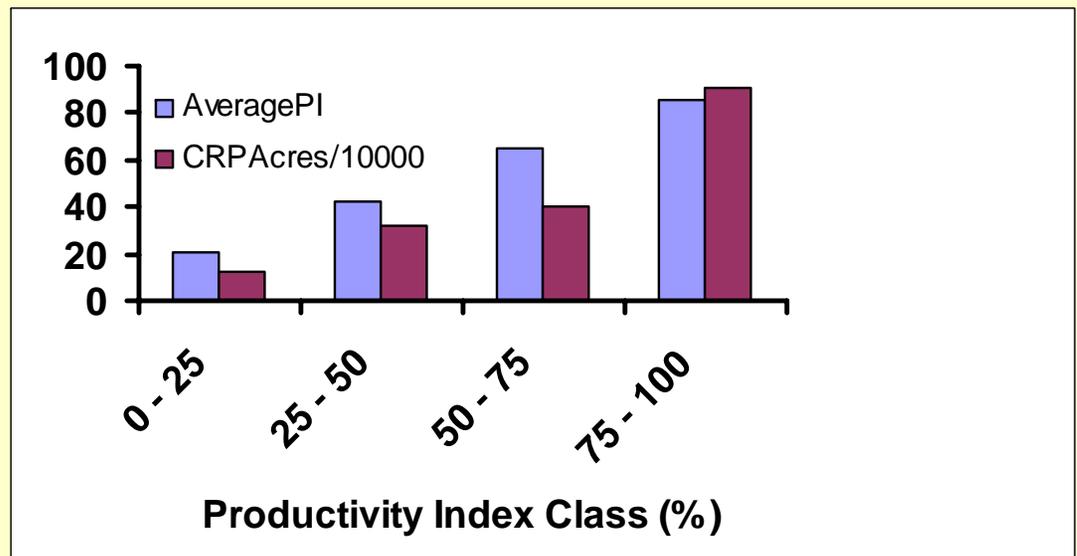
Ethanol demand in Minnesota will also continue to grow.



# Half of Minnesota's Expiring CRP Land Could be Lost



Potential Impacts:  
Loss of Wildlife Habitat  
Enhanced Erosion  
Increased Pesticide Leaching



# Goal A: Promote Alternative Energy Production Strategies



- *Energy 1:* Develop coordinated laws, policies, and procedures for governmental entities to assess renewable energy production impacts on the environment
- *Energy 2:* Invest in farm and forest preservation efforts to prevent fragmentation due to development, guided by productivity and environmental vulnerability research
- *Energy 3:* Invest in perennial biofuel and energy crop research and demonstration projects on a landscape scale

# Goal A: Promote Alternative Energy Production Strategies

- *Energy 4:* Develop policies and incentives to encourage perennial crop production for biofuels in critical environmental areas
- *Energy 5:* Invest in data collection to support the assessment process
- *Energy 6:* Invest in research to determine sustainable removal rates of corn stover and to establish incentives and BMPs

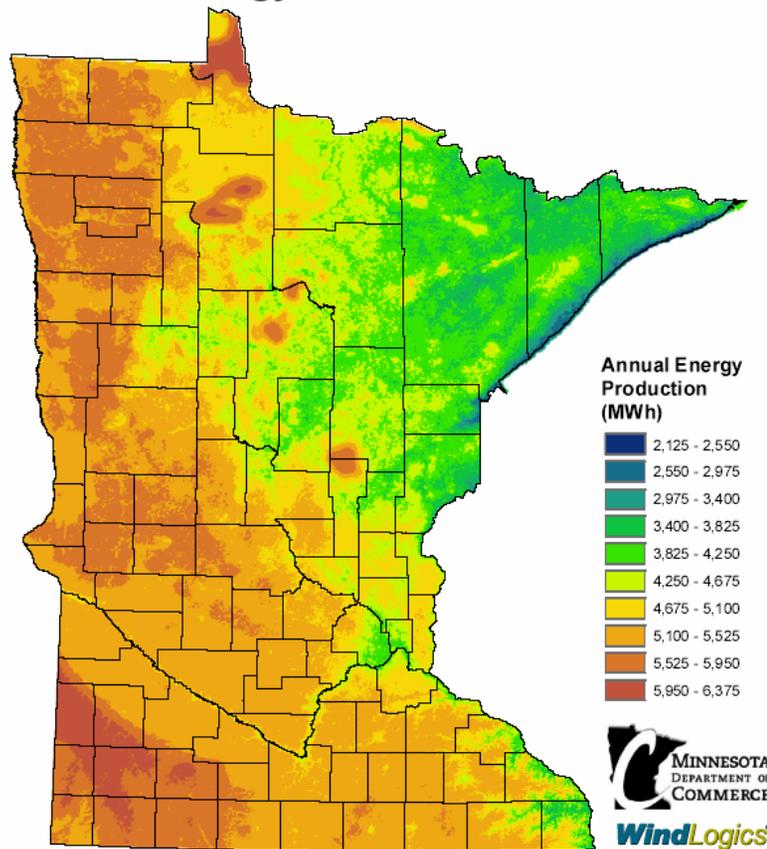


# Goal B: Promote a Healthy Economy

Community-owned wind power is posited to have a greater beneficial impact on the economy compared with corporate-owned wind power



Minnesota's Wind Resource by Estimated Annual Energy Production at 80 Meters



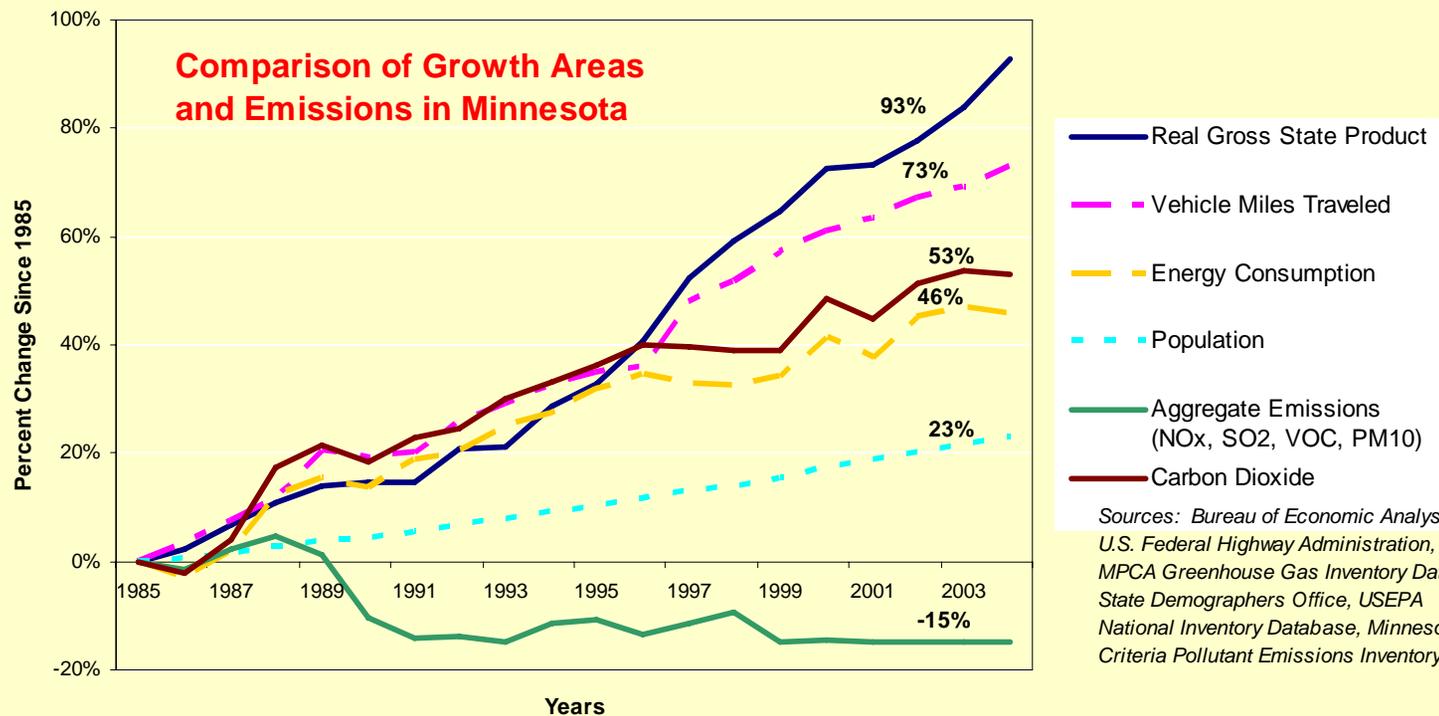
## Goal B: Promote a Healthy Economy



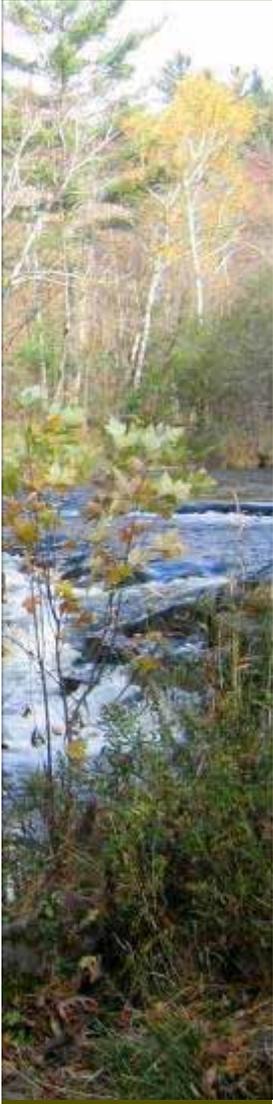
- *Energy 13:* Invest in research and policies on implementation strategies and optimal pricing schemes for ‘green payments.’ These ‘green payments’ may be applied to perennial energy crop production.
- *Energy 14:* Investigate opportunities to provide tax incentives for individual investors in renewable energy (e.g. for individuals who wish to install solar panels).
- *Energy 15:* Invest in efforts to develop, and research to support, community-based energy platforms for producing electricity, transportation fuels, fertilizer, etc. that are locally/ cooperatively owned.

# Goal C: Promote Energy Conservation Efforts

Energy consumption and CO<sub>2</sub> emissions are growing faster than population in Minnesota

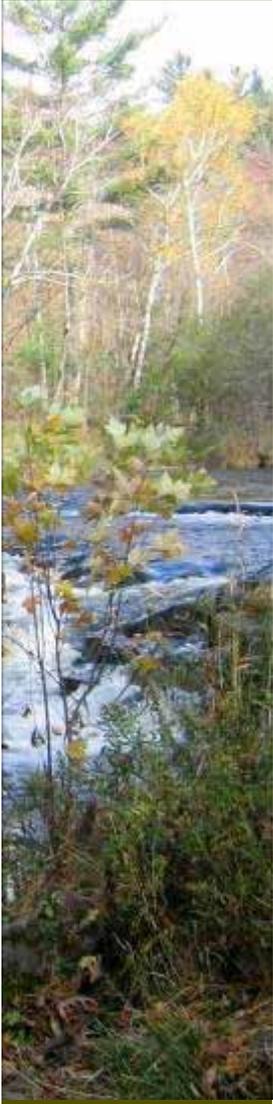


## Goal C: Promote Energy Conservation Efforts



- *Energy 16:* Provide incentives to transition a portion of Minnesota's vehicle fleet to electrical power, while simultaneously increasing renewable electricity production for transportation
- *Energy 17:* Promote policies and incentives that encourage carbon-neutral businesses, homes, communities
- *Energy 19:* Promote policies and strategies to implement smart meter and smart grid technology

# Energy Team Conclusions



- The recommendations made are a start for the state -- other actions likely will be important as we move into the future
- Many alternative energy scenarios exist – Biofuel energy production alone is not sufficient
- Policy changes are needed to ensure that perennial biofuels can be grown for renewable energy and environmental benefits, while maintaining production of other annual crops for food, feed and fiber

# Natural Resource Values Assessment of Recommendations

LEGEND: ● = Critical Impact ○ = Significant Impact ○ = Negligible Impact

		Air Quality	Water Quality/Quantity	Terrestrial Habitat Quality	Soil/Land Quality	Human Health	Biodiversity	Community Health	Aquatic	Economic Health	Recreational/Cultural/Spiritual/Aesthetic Value	Mitigation/Adaptation	Climate Change
HABITAT	Habitat 2	○	○	●	●	●	○	●	●	●	●	●	●
	Habitat 1	○	○	●	●	●	○	●	●	●	○	●	●
	Habitat 4	○	○	●	●	●	○	●	●	●	○	●	●
	Habitat 5	○	○	●	○	○	○	●	●	●	○	●	●
	Habitat 6	○	○	●	○	○	○	●	●	●	○	●	●
	Habitat 7	○	○	●	○	○	○	●	●	●	○	●	●
	Habitat 8	○	○	●	○	○	○	●	●	●	○	●	●
	Habitat 3	○	○	○	○	○	○	●	○	○	○	●	○
ENERGY	Energy 1	○	●	●	●	●	○	○	○	○	○	○	○
	Energy 13	○	○	●	●	●	○	○	○	○	○	○	○
	Energy 17	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 2	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 18	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 16	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 21	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 19	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 14	○	○	○	○	○	○	○	○	○	○	○	○
LAND USE - AG	LU Ag 1/Energy 4	○	○	○	○	○	○	○	○	○	○	○	○
	LU Ag 2	○	○	○	○	○	○	○	○	○	○	○	○
	LU Ag 3	○	○	○	○	○	○	○	○	○	○	○	○
	LU Ag 4	○	○	○	○	○	○	○	○	○	○	○	○
LAND USE - COMMUNITY	LU Comm 2	○	○	○	○	○	○	○	○	○	○	○	○
	LU Comm 3	○	○	○	○	○	○	○	○	○	○	○	○
TRANSPORTATION	Trans 1	●	○	○	○	○	○	○	○	○	○	○	○
	Trans 3	○	○	○	○	○	○	○	○	○	○	○	○
LAND USE - FORESTRY	LU Forest 1	○	○	○	○	○	○	○	○	○	○	○	○
	LU Forest 2	○	○	○	○	○	○	○	○	○	○	○	○

# Project Goal

To achieve a  
better future for  
Minnesota's  
natural resources



*Thank You!*

INSTITUTE ON THE  
ENVIRONMENT



UNIVERSITY OF MINNESOTA

