



Minnesota Board of Water and Soil Resources.
Minutes.

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**BOARD OF WATER AND SOIL RESOURCES
ONE WEST WATER STREET, CONFERENCE ROOM
ST. PAUL, MINNESOTA 55107
MARCH 22, 2000**

BOARD MEMBERS PRESENT:

Jim Dahlvang, Darrell Bruggman, Dwain Otte, Lee Coe, Paul Krabbenhoft, Char Kahler, Jack Frost, Mark Dittrich-MDA, Jim Anderson-MES, Ginny Imholte, Dan Wilson-MDH, Rod Massey-MPCA, Wayne Edgerton-DNR, Clair Nelson, Jerome Deal

BOARD MEMBERS ABSENT:

Allan Oehlke, Kathleen Roer

STAFF PRESENT:

Ron Harnack, Marybeth Block, Jim Birkholz, Doug Thomas, Mary Jo Anderson, Kamal Alsharif, John Jaschke, Doug Snyder

OTHERS PRESENT:

Scott Hoese, MASWCD
John Steinworth, Preserve Camp Coldwater Coalition

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Vice-Chair Jim Dahlvang called the meeting to order at 9:00 a.m.

**
00-21 Adopt Agenda - Moved by Lee Coe, seconded by Jack Frost, to adopt the agenda as presented. Motion passed on a voice vote.

**
00-22 Minutes of February 23, 2000 - Moved by Clair Nelson, seconded by Paul Krabbenhoft, to approve the minutes of February 23, 2000 as circulated. Motion passed on a voice vote.

Introduction of New Board Members - Vice-Chair Dahlvang welcomed and introduced Char Kahler and Jack Frost. Board members introduced themselves. Vice-Chair Dahlvang congratulated Dwain Otte on his reappointment to the Board.

Reports

Executive Director - Ron Harnack stated it's been five years since the Board reviewed the Strategic Plan and feels that we should revisit it in the near future and provide some focus for the next five years. Ron proposed that board members utilize the July BWSR meeting to review the strategic plan. Ron reported that Jim Birkholz will take the lead in facilitating meetings with LGUs, state agencies, and the Dairy Industry to discuss issues that need to be resolved.

Ron updated the Board on legislation. Ron reported that the legislative initiative with the Board of Government Innovation regarding Special Purpose Districts Pilot Project Senate File #3369/House File #3596 passed in the Senate, is now in the House General Orders. Ron reported that the drainage bill, which allows drainage authorities to accept funds for water quality, wetland restoration and flood control, passed in the Senate, and is now part of House omnibus funding bill. SF #83 will be up next week; Ron expects passage. Issues relating to soil science licensure seem to be resolved. Ron reported on the 2000 capital budget in the House and Senate as it pertains to BWSR's budget. Board members have copies of the House and Senate positions to date.

Dispute Resolution Committee (DRC) - Jim Haertel reported that there are two WCA appeals pending. One is in the City of Sartell which involves a violation and restoration order. No action has been taken yet on the appeal and no pre-hearing has been set. The other pending appeal involves Cub Foods and Chisago County. The appeal is in abeyance until the City of Forest Lake makes a decision.

Jim gave an update on the Hugo lawsuit. This is a suit filed by the City of Hugo and some landowners against the Rice Creek Watershed District, DNR, and BWSR. It

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involves issues relating to ditch repair and culverts which allegedly impact wetlands, protected waters and wildlife management areas. The state and the watershed district had requested the judge to dismiss the suit since administrative routes were still available. However, the judge did not dismiss the suit and furthermore decided that it would be a trial by jury. Presently the trial date is set for October.

Wetlands Committee - Darrell Bruggman reported that the Wetlands Committee will meet on April 7 at 9:30 a.m. in St. Paul, to review wetlands plans, legislative update and rulemaking plans.

Cost-Share/Soil Conservation Committee - Dwain Otte reported that the Cost-Share/Soil Conservation Committee met on February 23 and discussed feedlot issues, non-point engineering assistance was reviewed, many issues on the table, a lengthy meeting will be held in the near future.

Education/Public Relations Committee - Paul Krabbenhoft reported that the Education/Public Relations Committee met this morning, education reports were given by staff. Paul presented two publications "The RIM Program" and "Wetland Regulation in Minnesota" for board members information. Paul thanked Jim Birkholz for attending the MASWCD area meeting last week.

Agency Reports

Mark Dittrich, Department of Agriculture (MDA), reported that a memorandum of understanding will be signed tomorrow between Iowa and Minnesota. A "Manure Management for Energy" farm tour will be held April 6-8 at the Haubenschild Farms near Princeton. A drainage conference "Better Drainage Without the Legal Challenges" will be March 31 at the Minnesota West Technical & Community College in Granite Falls and on April 5 at the South Central Technical College in Mankato.

Dan Wilson, Department of Health (MDH), reported that session produced no bills that directly effect drinking wells, private well testing. The amendments to the 1996 Safe Drinking Waters Act will affect public waters regarding radon, arsenic, and microbiological waters. Dan will give updates to this as they happen.

Wayne Edgerton, Department of Natural Resources (DNR), reported that the wolf bill is moving forward; it looks as though it may pass. Funding package is moving forward, watching the process to see what comes out of this. Wayne announced that the Greenways initiative has been renamed to "Minnesota Conservation Connections" - the initiative does not change, just the name.

Jim Anderson, Minnesota Extension Service (MES), distributed the "Minnesota Water 2000" conference brochure, sponsored by MES, which will be held at the Minneapolis Convention Center, April 25-26, he encouraged board members to attend. Jim distributed the publication, "Minnesota Rivers a Primer" for board members information. Jim stated that MES will be working closely with BWSR, NRCS, and DNR to put a publication together on wetlands. Jim reported that he met with Ron Harnack and all the MES district directors to discuss facilitation needs for the Red River mediation.

Rod Massey, Pollution Control Agency (PCA), reported that waste water infrastructure funding and feedlots are entering the home. ^{1 1/2 stretch} Rod suggested that we need to put more effort into communications with SWCDs and counties on the feedlot MOU between Agriculture and PCA. Dwain Otte stated that SWCDs are willing to work together, however it appears that the SWCDs and counties have been left out of the communications loop. Mark Dittrich stated that the dairy inspectors roles and responsibilities are spelled out, and agreed that there is more interaction needed. Dwain stated we don't need to duplicate or complicate the process for the producer. We need to have cooperation and coordination. Scott Hoese stated that a dairy inspector attending the MASWCD area meeting didn't know what SWCDs were or what the district's role could be. Jim Birkholz will work with PCA, Ag, SWCDs and counties to facilitate meetings, with everyone involved and willing to discuss issues this will get resolved. Rod Massey supported this approach.

Consent Agenda

City of Eden Prairie Comprehensive Wetland Protection and Management Plan - Doug Snyder introduced Leslie Stoving from the City of Eden Prairie who briefly discussed the plan. Ron Harnack asked why the duplication in the city/watershed district process? he encouraged the City of Eden Prairie to review this with the WMO to achieve even greater process efficiency. Ron commended the City of Eden Prairie for their efforts in looking at the buffer issue, this sets a good template for others to follow. Doug reported that the BWSR Metro Subcommittee reviewed the Comprehensive Wetland Protection and Management Plan and recommends approval. Moved by Jack Frost, seconded by Jerome Deal to approve the City of Eden Prairie's Comprehensive Wetland Protection and Management Plan. Motion passed on a voice vote.

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00-23

Red Lake County Request to Change Effective Date of Red Lake County's Local Water Plan - Doug Thomas gave a brief overview and explained that the effective date, December 31, 2000, of Red Lake County's comprehensive local water plan is inconsistent with M.S. 103B, subdivision 4, (A), (5). BWSR staff have reviewed the request and recommend that the date be changed from December 31, 2000, to December 31, 2002, which is consistent with the five-year length of the plan.

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00-24 Moved by Ginny Imholte, seconded by Lee Coe, to approve the request to change the date of the Red Lake County Comprehensive Local Water Plan from December 31, 2000, to December 31, 2002. Motion passed on a voice vote.

Vice-Chair Dahlvang called for a break in the meeting at 10:10 a.m. The meeting reconvened at 10:25 a.m.

Committee Recommendations

Metro Subcommittee:

Minnehaha Creek Watershed District Boundary Change Petition - Jim Haertel reported that the Metro Water Planning Subcommittee met on March 7. The draft order distributed earlier has been revised to order a boundary change hearing that would include a possible Lower Minnesota River Watershed District petition. Jim stated that the U.S. Department of the Army, the U.S. Air Force, the U.S. Department of the Navy, and the Metropolitan Airports Commission have requested to be included in the Lower Minnesota River Watershed District. Jim explained that the Metro Water Planning Subcommittee recommends approval of a hearing for the boundary change. Ron Harnack stated that the key element is to make this more efficient for the Board, address the issues at one time, with the Board to take action at the May meeting.

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00-25 Moved by Clair Nelson, seconded by Dwain Otte, that the Board orders the hearing on the Petition for Boundary Changes for the Minnehaha Creek Watershed District to be heard by the Metro Water Planning Subcommittee on April 27, 2000 and to hear the Lower Minnesota River Watershed District petition for boundary change at the same time if the petition is filed before the hearing. Motion passed on a voice vote.

Comfort Lake-Forest Lake Watershed District Hearing - Jim Haertel explained that Columbus Township in Anoka County and Anoka County were not notified when the Board held the establishment hearing for the Comfort Lake-Forest Lake Watershed District. The procedural deficiency occurred since the establishment petition did not include any land in Anoka County. However, after the establishment hearing the Metro Water Planning Subcommittee included a portion of Anoka County in the watershed district since the area was within the hydrologic boundary of the Comfort Lake-Forest Lake watershed. Staff recommend a public hearing be ordered to receive comments on inclusion in the Comfort Lake-Forest Lake Watershed District of the area of

- **
00-26 Columbus Township in Anoka County. Moved by Dwain Otte, seconded by Jerome Deal to order a hearing on the inclusion in the Comfort Lake-Forest Lake Watershed District of an area in eastern Columbus Township in Anoka County be heard by the Metro Water Planning Subcommittee at a time and place to be scheduled by the executive director, no later than May 1, 2000. Motion passed on a voice vote.

DNR Project WET Facilitator of the Year Award - Kent Lokkesmoe, Director, DNR Division of Waters, presented this award to Kamal Alsharif for his outstanding contributions as Minnesota Facilitator of the Year. Kamal stated that he's honored to receive this award and expressed his appreciation. He appreciated the assistance from the northern region staff and Kristina Smitten. Kamal commended the DNR for the resource handbook "Project WET".

National Resource Inventory (NRI) Program Update – Ron Harnack stated that as mandated by Congress, every five years the NRCS conducts a natural resources inventory of America's non-federal lands. Ron introduced Susan Ploetz, NRCS Resources Inventory Specialist, she explained that the NRI is a statistically based survey that has been designed and implemented using scientific principles to assess conditions and trends of soil, water, and related resources on non-federal lands in the United States. The NRI is the largest natural resource database in the world. Susan gave a brief overview of the NRI background, highlights, design and data collection results of 1997. Discussion followed. Ron Harnack requested that Susan work with Greg Larson to assist with the state cost-share program.

Demonstration on Minnesota Shoreland Management Guidebook Project - Marybeth Block explained that the 1998 legislature appropriated \$100,000 passed through BWSR to Minnesota Sea Grant Extension. The purpose was to review, update and consolidate existing shoreland and lake related guidebooks, manuals, fact sheets, and publications into a single comprehensive document. Marybeth introduced Cindy Hagley and Janell Miersch, Minnesota Sea Grant; and Barb Liukkonen, Water Resources Center. Cindy explained how the Minnesota Shoreland Management Resource Guide will improve the implementation of effective and sustainable shoreland management practices in Minnesota. Through fact sheets, technical and scientific information, selections from existing publications, and an extensive bibliography, individuals will be empowered to adopt practices to protect Minnesota's shorelands and waters. Cindy presented how the resource guide is easily accessible on the website. The information will also be compiled and summarized on CD. Vice-Chair Dahlvang thanked them for their informational presentation.

Year Two Staffing Grant Agreements with SWCDs for CREP Implementation - Ron Harnack explained that if new appropriations are made, the grant allocations for CREP implementation will be revised. Greg Larson stated that these grants were made last year. Staff recommend base grant allocations again this year to implement CREP. Moved by Jack Frost, seconded by Darrell Bruggman, to approve the grant allocations for \$424,853. Motion passed on a voice vote.

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Update on Grazing Land Activities - Howard Moechnig gave a brief overview of the activities he's been working on since the CRP-RIM Pilot Project was completed. Ron Harnack reported that he represents BWSR on the steering committee for the National Grazing Land Initiative. Howard stated that there's terrific interagency cooperation on the grazing land effort. Wayne Edgerton reported that DNR is sponsoring an agency tour on June 23 at the Big Woods State Park, demonstrating rotational grazing.

Revisiting Reform Project - Ron Harnack explained the BWSR initiative regarding the Revisiting Reform. Jim Birkholz and Ron Harnack are the BWSR team working on this. Ron asked for Board endorsement so this document can be submitted to Minnesota Planning by the April 1st deadline date. Moved by Lee Coe, seconded by Darrel Bruggman, to endorse the BWSR initiative on the Revisiting Reform Project, submit to Minnesota Planning by April 1st. Motion passed on a voice vote.

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00-28

Advisory Comments

MASWCD - Scott Hoese reported that the MASWCD Legislative Day on March 5-6 was well attended. Scott stated that he looks forward to working with Jim Birkholz and agency heads on the dairy issues. He thanked Jim for attending the MASWCD area meeting on Monday.

Natural Resources Conservation Service (NRCS) - Howard Moechnig reported that Bill Hunt is in Washington, D.C., discussing the budget shortfall. Howard reported that the Services Support Bureau (comprised of Rural Development, FSA and NRCS) has been terminated, however, the staff will continue to work together. Howard reported that EQIP sign-up is open until April 14. The CRP notification of sign-up should be completed by the end of April. Howard stated that NRCS has increased incentives for continued CRP sign-up. There are two vacancies in NRCS, one in Caledonia and an assistant NRI position in Perham.

Minnesota Association of Watershed Districts (MAWD) - Ginny Imholte reported that the MAWD annual tour will be held June 22-24, at the Pelican River Watershed District in Detroit Lakes.

Jerome Deal reported that the second annual meeting of the Red River mediation was held and well attended. Jerome stated that there's a considerable amount of things happening in the Red River Valley. He will go to Washington, D.C., in the next few weeks to testify.

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The next BWSR meeting will be April 26, 2000.

Respectfully submitted,



Jim Dahlvang
Vice-Chair

2000 House Capital Investment Recommendations
HF 4078 Author Rep. Jim Knoblach

Project	Agency Request	Governor's Rec's 2000	Fund	Comm Priority	Capital Inv Rec
Perpich Center for Arts Education					
Delta Dormitory Upgrades	\$214	\$214	GO	K10	\$214
Delta Dormitory Upgrades	\$82	\$82	GF	K10	\$82
Asset Preservation	\$918	\$918	GO	K11	\$0
Repair and Maintenance Building	\$123	\$0	GO	K34	\$0
Air Condition East Building	\$31	\$0	GO	K31	\$0
Air Condition GAIA Building	\$81	\$0	GO	K31	\$0
Perpich Center for Arts Ed Total	\$1,449	\$1,214	Total		\$298
	\$1,367	\$1,132	GO		\$214
	\$82	\$82	GF		\$82
DCFL					
Metropolitan Magnets	\$20,700	\$17,700	GO	K1	\$15,936
Library for the Blind Expansion	\$750	\$0	GO	K25	\$0
Library for the Blind Shelving	\$600	\$600	GF	K9	\$600
Early Childhood Learning Facilities Grants	\$5,000	\$0	GO	F1	\$500
Grand Meadow K12 Dome School	\$2,500	\$0	GO	K14	\$1,500
Maximum Effort Loan Program	\$15,800	\$15,800	GO		
Caledonia Max Effort			GO	K2	\$13,982
La Porte Max Effort			GO	K3	\$7,200
Red Lake Max Effort			GO	K4	\$4,300
Cass Lake Max Effort			GO	K5	\$7,505
Library Access Grants	\$1,500	\$0	GO	K16	\$0
School Access Grants	\$1,000	\$0	GO	K24	\$0
St Paul Achievement Plus	\$5,200	\$0	GO	K6	\$0
West Metro Fine Arts Resource School	\$500	\$0	GO	K12	\$0
West Metro Integration Magnet School Planning	\$3,000	\$0	GO	K13	\$0
Library Facility Grants	\$10,000	\$0	GO	K15	\$0
Ulen-Hitterdal Maximum Effort School	\$4,025	\$0	GO	K22	\$0
School Safety Improvements	\$2,500	\$0	GO	K30	\$0
DCFL Totals	\$47,850	\$34,100	Total		\$51,521
	\$47,250	\$33,500	GO		\$50,923
	\$600	\$600	GF		\$600
Minnesota State Academies					
Asset Preservation	\$1,750	\$1,750	GO	K7	\$2,000
West Wing Noyes Hall Phase I	\$2,066	\$2,066	GO	K8	\$2,066
Minnesota State Academies	\$3,816	\$3,816	GO		\$4,066
Commerce					
Energy Investment Loans	\$8,000	\$2,500	UF	ED13	\$0
Commerce	\$8,000	\$2,500	UF		\$0
DNR					
Statewide Asset Preservation	\$2,000	\$2,000	GO	E6	\$2,000
Office Facilities Development	\$5,048	\$5,048	GO	E11	\$750
Field Office Renovations and Improvement	\$1,497	\$1,497	GO	E36	\$0
ADA Compliance	\$3,000	\$3,000	GO	E26	\$2,000
State Park & Rec Area Building Rehab	\$1,900	\$1,900	GO	E18	\$1,900
State Park and Rec Building Development	\$500	\$500	GO	NR	\$0
Dam Repair/Reconstruction/Removal	\$1,700	\$1,700	GO	E30	\$1,200
State Park & Rec Betterment Rehab	\$1,600	\$1,600	GO	E37	\$1,500
Flood Hazard Mitigation Grants	\$8,000	\$8,000	GO	E14	\$10,600

2000 House Capital Investment Recommendations
HF 4078 Author Rep. Jim Knoblach

Project	Agency Request	Governor's Rec's 2000	Fund	Comm Priority	Capital Inv Rec
114 Trust Fund Lands	\$1,000	\$500	GO	NR	\$0
115 Forest Roads and Bridges	\$1,300	\$1,300	GO	E33	\$1,300
116 Fisheries Acquisition	\$500	\$500	GO	E13	\$200
117 RIM Fisheries Improvement	\$200	\$200	GO	E4	\$200
118 SNA's and Prairie Bank	\$700	\$700	GO	NR	\$0
119 Prairie Bank	\$900	\$900	GO	E10	\$0
120 Stream Protection and Restoration	\$1,000	\$1,000	GO	E8	\$500
121 Reforestation	\$700	\$0	GO	E27	\$0
122 RIM Critical Habitat Match	\$1,000	\$1,000	GO	E3	\$1,000
123 Metro Greenways and Natural Areas	\$1,500	\$1,500	GO	E19	\$500
124 RIM Wildlife Development/Habitat Improvement	\$2,000	\$2,000	GO	E4	\$2,000
125 State Forest Land Acquisition	\$1,000	\$0	GO	E41	\$0
126 State Park and Rec Area Acquisition	\$1,000	\$700	GO	NR	\$700
127 Forest Recreation Facility Rehab	\$500	\$500	GO	NR	\$0
128 Water Access Acq. Betterment and Fishing Piers	\$1,000	\$0	GO	E32	\$0
129 Trail Acq. and Development - Paul Bunyan Trail	\$1,400	\$1,400	GO	E40	\$1,400
130 Lake Superior Safe Harbors Two Harbors	\$0	\$0	GO	E16	\$0
131 Lake Superior Safe Harbors McQuade	\$4,000	\$0	GO	E16	\$0
132 Metro Regional Parks Capital Improvement	\$5,000	\$5,000	GO	E2	\$6,000
133 State Trail Connections	\$1,000	\$1,000	GO	E38	\$1,750
134 Moose Lake Rock and Gem Museum	\$0	\$0	GO	NR	\$1,300
135 Red River State Recreation Area	\$0	\$0	GO	E7	\$0
136 RIM Shoreland Pilot Project	\$0	\$0	GO	E12	\$0
137 Lake Minnetonka Public Water Access	\$0	\$0	GO	E17	\$500
138					
139					
140 DNR Totals	\$50,845	\$43,445	Total		\$37,300
141			GO		\$37,300
142					
143 Office of Environmental Assistance					
144 Capital Assistance Program	\$3,000	\$3,000	GO	NR	\$3,000
145					
146 Environmental Assistance Total	\$3,000	\$3,000	GO		\$3,000
147					
148 BOWSR					
149 RIM Reserve-Habitat, Soil Conserv, Water Quality	\$45,000	\$25,000	GO	E1	\$20,000
150	\$7,600	\$4,990	GF	E1	\$0
151 Local Gov't Roads Wetland Banking	\$1,000	\$0	GO	E42	\$2,400
152 Rim Reserve Non-Crep	\$5,500	\$5,585	GO	E21	\$0
153					
154 BOWSR Total	\$58,100	\$35,575	Total		\$22,400
155	\$50,500	\$30,685	GO		\$22,400
156	\$7,600	\$4,990	GF		\$0
157					
158 Agriculture					
159 Laboratory Building	\$2,500	\$0	GO	A1	\$0
160 Rural Finance Authority	\$50,000	\$20,000	UF	A2	\$20,000
161					
162 Agriculture Total	\$52,500	\$20,000	Total		\$20,000
163	\$2,500	\$0	GO		\$0
164	\$50,000	\$20,000	UF		\$20,000
165					
166 MN Zoological Gardens					
167 Heating Supply Line/Chiller Replacement	\$1,100	\$1,100	GO	E29	\$1,100
168 Roads and Pathways	\$4,000	\$4,000	GO	NR	\$0
169					
170 MN Zoo Total	\$5,100	\$5,100	GO		\$1,100

2000 House Capital Investment Recommendations
HF 4078 Author Rep. Jim Knobloch

Project	Agency Request	Governor's Rec's 2000	Fund	Comm Priority	Capital Inv Rec
Corrections					
Faribault Sewer Repair	\$10,636	\$10,636	GO	J1	\$7,500
Oak Park Heights Administrative Control Unit	\$855	\$855	GO	J3	\$855
Lino Lakes H-Building Remodeling Phase III	\$3,923	\$3,923	GO	J6	\$3,398
Red Wing Mental Health Support and Living Unit	\$801	\$801	GO	J2	\$801
Red Wing Vocational Building	\$4,689	\$0	GO	NR	\$0
Stillwater Conversion to Health Services	\$1,829	\$1,829	GO	NR	\$0
Stillwater Wall, Towers, Catwalk, and Security	\$1,476	\$1,476	GO	J5	\$1,476
Willow River Activities Building	\$1,397	\$0	GO	NR	\$0
Bayport Storm Sewer Project	\$3,800	\$0	GO	J4	\$2,680
Corrections Totals	\$29,406	\$19,520	GO		\$16,710
Public Safety					
Covered Walkway-State Patrol Training Facility	\$247	\$0	THF	NR	\$0
Weather Radio Expansion	\$0	\$0	GF	NR	\$844
Public Safety Totals	\$247	\$0	THF GF		\$0 \$844
DTED					
MPFA State Matching Funds	\$12,893	\$12,893	GO	E14/ED1	\$12,893
MPFA Wastewater Infrastructure Funds	\$8,017	\$0	GO	ED5	\$14,216
Clean Water Partnership	\$2,000	\$2,000	GO	E31/ED4	\$2,000
Redevelopment Grant Funding	\$3,000	\$0	GO	ED13	\$7,000
Little Falls Paper Mill Cleanup	\$0	\$0	GO	NR	\$0
DRI Water and Sewer Extension	\$4,000	\$0	GO	NR	\$3,500
West Mille Lacs Sanitary Sewer Grant	\$0	\$0	GO	E34	\$0
Landfall HRA Retaining Walls	\$750	\$0	GO	NR	\$100
Urban League HQ Building	\$0	\$0	GO	NR	\$1,000
Farmamerica	\$0	\$0	GF	NR	\$470
DTED Total	\$30,860	\$14,893	Total GO GF		\$41,179 \$40,708 \$470
GRANTS					
Bagely Storm Sewer	\$0	\$0	GF	NR	\$0
Becker County Tourism Facility	\$0	\$0	GF	NR	\$0
Bemidji Headwaters Science Center Operating	\$61	\$0	GF	NR	\$0
Brooklyn Center Boiler and Chiller	\$0	\$0	GF	K32	\$0
Camp Heartland Renovation and Expansion	\$650	\$0	GF	NR	\$0
Camp Knutson Improvements	\$0	\$0	GF	NR	\$0
Farmamerica Safety and Access Improvements	\$472	\$0	GF	NR	\$0
Greenway Area Schools Communications 2000	\$357	\$0	GF	K23	\$0
Guthrie Theater Improvements	\$25,000	\$0	GF	NR	\$0
St Paul Achievement Plus Frogtown	\$0	\$0	GF	K27	\$0
Staples Park Academy	\$193	\$0	GF	K28	\$0
St. Cloud Central MN Parks and Trails	\$100	\$0	GF	E43	\$0
Virginia Silver Lake Storm Sewer	\$0	\$0	GF	NR	\$0
Ada Outdoor Recreation Complex	\$69	\$0	GO	NR	\$0
Ag Innovation Center	\$1,000	\$0	GO	ED7	\$0
Agassiz Environmental Learning Center	\$0	\$0	GO	NR	\$0
Anoka County Courthouse Repair	\$394	\$0	GO	NR	\$0
Austin Area Activity Center	\$919	\$0	GO	NR	\$0
Austin Paramount Theater	\$550	\$0	GO	NR	\$0

2000 CAPITAL BUDGET (\$thousands)

ENVIRONMENT, NAT RES AND AGRICULTURE
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Page # or Bill #	Agency/ Project Description	Agency Priority	Strat Score	Fund If not GO	AGENCY Request 2000	GOVERNOR Budget 2000	SENATE Bills 2000	DIVISION Bill 2000	DIVISION (B) 2000	DIVISION (C) 2000
	Dept of Agriculture									
D-5	Laboratory Building	1	385							
D-9	Rural Finance Authority Loan Participation	2	350	UF	2,500	0				
Legacy (L)	Ag Land Conservation Easements				50,000	20,000		20,000		
SF 2607	Ag BMP Loans -feedlots			GF			10,000			10,000
SF3402	Agroforestry Loan Program			GF			100,000	3,000		
	MDA Total						1,000	1,000		
	Bond Fund portion				52,500	20,000	111,000	24,000	0	10,000
	General Fund portion				2,500	0	10,000	0	0	10,000
	User funding portion				50,000	20,000	101,000	4,000	0	0
							0	20,000	0	0
	Natural Resources									
D-19/L	Statewide Asset Preservation	B-1	395							
D-23	Office Facilities Development (Fergus Falls)	B-2	310		2,000	2,000	2,000	2,000		
D-23/G-47	Office Facilities (St. Cloud collocate w/DOT)				5,048	5,048		5,048		
SF 2488	District Office at Pelican Rapids				2,530				2,530	
D-27	Field Office Renovation & Improvement	B-3	250		1,497	1,497	1,000			
D-31	ADA Compliance	B-4	370		3,000	3,000		1,497		
D-35/L	State Park & Rec Bldg Rehab	B-5	470		1,900	1,900		3,000		
D-41/SF 2356	State Park & Rec Bldg Devel (Lac qui Parle)	B-6	250		500	500	5,500	2,000		3,500
SF 2738	Rock&Gem Ctr at Moose Lk St Pk						750	500		
D-45/L	Dam Repair/Reconstr/Remove (incl.Mazeppa)	NB-1	465		1,700	1,700	1,500		1,500	
D-51/L	State Park & Rec Btmt Rehab	NB-2	445		1,600	1,600	1,000	1,700	80	
D-55/SF 3573	Flood Mitig Grants	NB-3	435		8,000	8,000	1,500	1,500		
SF 2476	Ring Dikes			GF			13,300	13,300		
SF 2308	Lewis & Clark rural water project						2,025	400		1,625
D-61/L	Trust Fund Lands	NB-4	115		1,000	500	610	610		
D-65	State Forest Roads & Bridges	NB-5	370		1,300	1,300	1,000	500		500
D-69/L	Fisheries Acquisition	NB-6	290		500	500		1,300		
D-73/L	RIM Fisheries Improvement	NB-7	255		200	200	2,000	500		1,500
D-77/L	SNA Acquisition & Development	NB-8	355		700	700	3,000	1,000	2,000	
D-77/SF 3546	Prairie Bank Easements	NB-8	355		900	900	2,000	2,000		
D-85/L	Stream Protec/Restor	NB-9	245		1,000	1,000	2,000	2,000		
D-91/L	Reforestation	NB-10	225		700	0	2,000	2,000		
D-95/L	RIM Critical Habitat Match	NB-11	400		1,000	1,000	700		700	
D-99/SF 2706	Metro Greenways & Natural Areas	NB-12	245		1,500	1,500	3,000	2,000	1,000	
							10,000	10,000		

2000 CAPITAL BUDGET (\$thousands)

ENVIRONMENT, NAT RES AND AGRICULTURE
AS PASSED BY DIVISIONpage 2 of 4
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Page # or Bill #	Agency/ Project Description	Agency Priority	Strat Score	Fund If not GO	AGENCY Request 2000	GOVERNOR Budget 2000	SENATE Bills 2000	DIVISION Bill 2000	DIVISION (B) 2000	DIVISION (C) 2000
L	Metro Trout Streams						2,000			2,000
L	Statewide Greenways						2,000			2,000
D-103/L	RIM Wildlife Dev/Hab Imp	NB-13	270		2,000	2,000	4,000	2,000	2,000	
L	WMA Acquisition & Devel						3,000		3,000	
D-109/L	State Forest Land Acqu	NB-14	250		1,000	0	1,000	1,000		
D-113/L	State Park & Rec Acqu	NB-15	345		1,000	700	2,500	1,800		1,500
SF 2425	Red River State Rec Area						4,000	2,400	1,600	
SF 2876	Big Bog State Rec Area						4,045	3,000	1,045	
D-117/L	State Forest Rec Facility Rehab	NB-16	240		500	500	500	500		
D-121/L	Wat Access Acqu/Betmt/Plans	NB-17	330		1,000	0	1,000		1,000	
D-127/L	Trail Acqu/Devel -Paul Bunyan Trail	NB-18	300		1,400	1,400	1,400	1,400		
L	Gitchi Gami Trail						1,600	1,600		
SF 3392	Blazing Star State Trail bridge						800	800		
SF 2745	Shooting Star Trail						517	517		
SF 2745	Blufflands State Trail						636		636	
D-131/SF 3287	Lk Superior Harbor-McQuade Rd	NB-19	285		4,000	0	4,000	4,000		
SF 2778	Two Harbors Marina						2,100	2,100		
D-137/SF 2696	Metro Parks Capital Improv	G-1	265		5,000	5,000	11,200	11,200		
SF 3469	Metro Regional Trails						7,000	4,000	3,000	
D-145/L	State Trail Connection Grants	G-2	185		1,000	1,000	2,000	1,000	1,000	
L	Natural & Scenic Area Grants						8,000		8,000	
L	Outdoor Recreation Grants						2,000		2,000	
L	Regional Trail Grants						2,000	2,000		
SF 2621	Mississippi Whitewater Trail						7,000	7,000		
SF 2747	Lk Minnetonka Public Access						6,500	6,500		
	DNR Total				53,475	43,445	135,683	105,672	31,091	12,625
	Bond Fund portion				53,475	43,445	133,658	105,272	31,091	11,000
	General Fund portion						2,025	400	0	1,625
	Pollution Control Agency									
L	ISTS Grants			GF			1,000	1,000		
	PCA Total				0	0	1,000	1,000	0	0
	Bond Fund portion				0	0	0	0	0	0
	General Fund portion				0	0	1,000	1,000	0	0

2000 CAPITAL BUDGET (\$thousands)

Senate
 ENVIRONMENT, NAT RES AND AGRICULTURE
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Page # or Bill #	Agency/ Project Description	Agency Priority	Strat Score	Fund if not GO	AGENCY Request 2000	GOVERNOR Budget 2000	SENATE Bills 2000	DIVISION Bill 2000	DIVISION (B) 2000	DIVISION (C) 2000
D-157 SF 2396	Office of Environmental Assistance Capital Assistance Program Pope/Douglas & Olmsted projects OEA Total Bond Fund portion General Fund portion	1	425	GF	3,000 3,000 3,000 3,000	3,000 3,000 3,000 3,000	4,900 4,900 0 4,900	3,000 3,000 3,000 0	4,900 4,900 0 4,900	0 0 0 0
	Public Facilities Authority									
D-169/SF 2607	WW/DW Revolving Fund (SRF)	1	504		12,893	12,893	197,000	12,893		
D-175/SF 2607	Wastewater Infrastr Fund (WIF)	2	386		8,017	0	100,000	40,000		
D-179/L SF 2088	Clean Water Partnership Bagley stormwater project PFA Total Bond Fund portion General Fund portion	3	190	GF	2,000 2,000 22,910 22,910	2,000 2,000 14,893 14,893	2,000 79 299,079 299,000 79	2,000 79 54,893 54,893 0	79 79 79 0 79	0 0 0 0 0
	Bd of Water & Soil Resources									
D-193/SF 2389	Conservation Reserve Enhancement Program (CREP GF portion)	1	405	GF	45,000 7,600	25,000 4,990	60,000	45,000 7,600		
D-193/L	RIM Reserve Easements	1	405		5,500	5,585	10,000	5,500	4,500	
D-199/SF 2867	Local Gov't Roads Wetland Banking	2	275		1,000	0	4,700	2,300		
SF 2695	Feedlot Cost-Share Grants			GF			10,000	3,000		
SF 134	Lazarus Creek						1,500	1,500		
SF 1837 & L	Shoreland Conservation Pilot Project BWSR Total Bond Fund portion General Fund portion				59,100 51,500 7,600	35,575 30,585 4,990	91,200 81,200 10,000	67,900 57,300 10,600	6,500 6,500 0	0 0 0
	Minnesota Zoo									
D-211	Heating Supply Line/Chiller Replacement	1	400		1,100	1,100		1,100		
D-215	Roadways & Pathways Zoo Total	2	405		4,000 5,100	4,000 5,100		4,000 5,100		
	Local Grants									
SF 2639	St Cloud parks & trails			GF			9,870	1,000	8,870	
SF 2639	St Cloud parks & trails						130		130	

2000 CAPITAL BUDGET (\$thousands)

ENVIRONMENT, NAT RES AND AGRICULTURE
AS PASSED BY DIVISION

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Page # or Bill #	Agency/ Project Description	Agency Priority	Strat Score	Fund If not GO	AGENCY Request 2000	GENERAL Budget 2000	SENATE Bills 2000	DIVISION Bill 2000	DIVISION (B) 2000	DIVISION (C) 2000
SF 962	Como Park Zoo						21,000	21,000		
SF 2719	St. Paul Trails, Upper Landing, Rasp Island						9,397	1,100	8,297	
SF 2429	Lk of the Isles Flood Mitigation						6,000	6,000		
SF 3312	Raptor Center						100	100		
SF 2664	Headwaters Science Center (Bemidji)						7,929		7,929	
SF 2416	Taconite Trailhead building (Itasca Co)						150	150		
SF 276	Bear Center at Northome						5,760			5,760
SF 3013	Bear Center at Orr/Ely						6,186			6,186
SF 2353	Agassiz Environmental Learning Center						1,750		1,750	
SF 2300L	Mill Towns Trail						350		350	
SF 3137	Farmamerica						472		472	
SF 2731	Ag Innovation Center (Olivia)						1,078	500	500	
SF 2982	Rock County trails						88		88	
	Grants Total				0	0	70,260	29,850	28,386	11,946
	Bond Fund portion						70,130	29,850	28,256	11,946
	General Fund portion						130	0	130	0
Environment & Agriculture Totals										
	All Funds			all	196,085	122,013	713,122	291,415	70,956	34,571
	Bond Fund			GO	138,485	97,023	593,988	255,415	65,847	32,946
	General Fund			GF	7,600	4,990	119,134	16,000	5,109	1,625
	User Financed			UF	50,000	20,000	0	20,000	0	0

Minnesota Board of Water and Soil Resources
One West Water Street
Suite 200
St. Paul, Minnesota 55107

In the matter of Modifying the Effective Date of
the Comprehensive Water Plan for **Red Lake**
County (Minnesota Statutes 103B.311, Subd. 4, (1997)
Specifying the Effective Date of Plans.

**ORDER
MODIFYING
EFFECTIVE DATE**

Whereas, Red Lake County has a state approved Comprehensive Local Water Plan (Plan) that is effective until December 31, 2000 pursuant to Minn. Stat. 1990, Section 103B.301, and

Whereas, the Red Lake County Board of Commissioners has requested a modification of the effective date of the Plan, and

Whereas, the Board of Water and Soil Resources (Board) has authorization to establish the effective date of a Plan consistent with requirements of Minn. Statutes 103B.311, Subd. 4, Paragraph (5).

Now Therefore, the Board hereby makes the following Findings of Fact, Conclusions and Order:

FINDINGS OF FACT

1. On February 25, 2000 the Board received a resolution from Red Lake County requesting that the effective date of the Plan be changed from December 31, 2000 to December 31, 2002.
2. Minn. Statutes 103B.311, Subd. 4, Paragraph (5) states that a Plan must specify the period of time covered by the Plan and that it must extend a least five years but no more than ten years from the date the board approves the Plan.
3. The Red Lake County Plan states the effective date of the Plan as December 31, 2000 which is less than the minimum five year requirement.
4. On March 15, 2000 BWSR Board Conservationist Bill Best recommended that the Board approve a modification of the effective date of the Red Lake County Plan to December 31, 2002.

CONCLUSIONS

1. All relevant requirements of law have been fulfilled. The Board has proper jurisdiction in the matter of modifying the effective date of the Comprehensive Local Water Plan of Red Lake County pursuant to Minn. Statutes 103B.311, Subd. 4, Paragraph (5).

ORDER

The Board hereby approves the modification of the effective date of the Red Lake County Comprehensive Local Water Plan until December 31, 2002. Dated at St. Paul, Minnesota this 22nd day of March 2000.

MINNESOTA BOARD OF WATER AND SOIL RESOURCES

BY: Kathleen Roer, Board Chair

METROPOLITAN AIRPORTS COMMISSION

Minneapolis-Saint Paul International Airport

6040 - 28th Avenue South • Minneapolis, MN 55450-2799

Phone (612) 726-8100 • Fax (612) 726-5296



March 21, 2000

Mr. Ronald Harnack
Executive Director
Minnesota Board of Water and Soil Resources
One Water Street, suite 200
St. Paul, MN 55107

Re: Petition for Boundary Change
Minnehaha Creek Watershed District

Dear Mr. Harnack:

The Metropolitan Airports Commission (MAC) is aware that the Board of Soil and Water Resources (BWSR) will be considering at its March 22nd meeting, a petition for boundary change from the Minnehaha Creek Watershed District (MCWD). The petition as we understand it, seeks to expand the MCWD boundary by 710 acres into land that is owned by the federal government contiguous to the north side of the Minneapolis-St. Paul International Airport (MSP).

The petition boundary appears to have been carefully drawn to avoid MAC property however the federal property is occupied by the Air Force Reserve, the Army Reserve, the Naval Reserve, and the Department of Veterans Administration with whom we interact with routinely as airport tenants. As such, we have had recent discussions with representatives of these agencies as they attempt to evaluate this petition. As you know, the federal properties possess a unique challenge in that they likely are not compelled to comply with state law and watershed district jurisdiction.

Coincident with this petition and at the urging of BWSR staff, we have engaged the Lower Minnesota River Watershed District (LMRWD) Board of Managers in recent conversation concerning incorporation of MSP into the management area of the LMRWD as almost all drainage from MSP flows to the Minnesota River. It is our desire to work with BWSR, MCWD, the LMRWD and our contiguous federal agencies to establish a comprehensive jurisdiction taking into account hydrologic boundaries and the unique challenges of the adjoining federal properties.

We look forward to discussing this matter with you in detail in the coming weeks. Recognizing the inter-relationship of the current MCWD petition to the MSP/LMRWD affiliation discussion we request that the current petition be expanded to more comprehensively deal with the MSP property and our contiguous tenants.

Thank you for your consideration of this matter. Should you have any questions, please call me at 612/726-8131.

Sincerely,

Gary G. Warren, P.E.
Director-Airside Development

cc: Mr. Larry Samstad, LMRWD
Mr. Terry Schwalbe, LMRWD
Mr. Dave Swanberg, AFR/MANG

Mr. Mark Buck, Army Reserve
Mr. Eric Evenson, MCWD
Mr. John Bocek, VA



DEPARTMENT OF THE ARMY
HEADQUARTERS, 88TH REGIONAL SUPPORT COMMAND
506 ROEDER CIRCLE
FORT SNELLING, MINNESOTA 55111-4009

March 21, 2000

Mr. Ronald Harnack
Executive Director
Minnesota Board of Water and Soil Resources
One Water Street, Suite 200
St. Paul, MN 55107

Dear Mr. Harnack,

The 88th Regional Support Command (88th RSC) recently became aware of the Minnehaha Creek Watershed District (MCWD) Board of Managers' petition to incorporate the 710-acre area contiguous to the southeastern boundary of the MCWD that is currently not under jurisdiction of any watershed district or joint powers watershed management organization. The 88th RSC currently owns 2 parcels of property within the proposed boundary area including a 68-acre parcel with 6 buildings and another 3-acre parcel with 1 building.

The 88th RSC met with the Metropolitan Airports Commission (MAC), the US Air Force Reserve (USAFR) and the Lower Minnesota River Watershed District on Tuesday, March 21, 2000 to discuss what impacts, if any, the proposed watershed boundary realignment may have. The 88th RSC currently is coordinating with the MAC, the USAFR and the Minnesota Department of Transportation on a variety of issues that may impact 88th RSC property in the near future. Since any impact would have a greater influence on the MAC and the USAFR, the 88th RSC's initial position would be to defer to the opinions of the MAC and the USAFR.

The 88th RSC is requesting additional time to review the MCWD's petition for watershed boundary realignment prior to any action taken by the Minnesota Board of Water and Soil Resources on the petition. In addition, the 88th RSC would like to be included for distribution on all relevant or pertinent correspondence regarding this action.

If you have any questions or would like additional information, please contact Mr. Mark Buck at 612-713-3822.

Sincerely,

A handwritten signature in cursive script, reading "James F. Phillips", is written above the typed name.

James F. Phillips
Lieutenant Colonel, USAR
Regional Engineer



DEPARTMENT OF THE NAVY
NAVAL AND MARINE CORPS RESERVE CENTER
6400 BLOOMINGTON ROAD, FORT SNELLING
ST. PAUL, MINNESOTA 55111-4051

IN REPLY REFER TO:

11000

Ser 02/201

21 Mar 00

Mr. Ronald Harnack
Executive Director
Minnesota Board of Water Resources
One Water Street, Suite 200
Saint Paul, MN 55107

Subj: PETITION FOR BOUNDARY CHANGE MINNEHAHA CREEK WATERSHED
DISTRICT

Dear Mr. Harnack:

This letter is in response to the subject petition requested by the Minnehaha Creek Watershed District (MCWD) to your office, dated 9 February 2000. The Navy property located in the Fort Snelling area will be a part of this proposed boundary change if it is approved as submitted. The Navy only became aware of this petition on this date and would request additional information from your office explaining the petition process and the expected milestones and dates for any future hearings or proceedings that are expected to occur.

The Navy is aware of an engineering study being conducted by the Metropolitan Airports Commission to map the drainage watersheds that are present at the airport and adjacent federal lands at Fort Snelling. The Navy would request it be given an opportunity to review this study before any public hearings occur or any ruling is reached by your office. Once the Navy has completed review of this study it would be in a better position to comment its support or nonsupport for this petition.

We look forward to continued discussions on this matter. If there are any questions, I can be contacted at (612) 726-9391 extension 301.

Sincerely,

ROBERT H. PORTER
Captain, U.S. Naval Reserve
Commanding Officer

Copy to:

Mr. Gary Warren, Metropolitan Airports Commission

METROPOLITAN AIRPORTS COMMISSION



Minneapolis-Saint Paul International Airport

6040 - 28th Avenue South • Minneapolis, MN 55450-2799

Phone (612) 726-8100 • Fax (612) 726-5296

March 21, 2000

Mr. Lawrence Samstad, P.E.
Administrator and Engineer
Lower Minnesota River Watershed District
327 Marshall Road, #200
Shakopee, MN 55379-1680

Subject: Lower Minnesota River Watershed District affiliation

Dear Mr. Samstad:

Thank you for the opportunity to participate in the March 15, 2000 Board of Manager's meeting. This meeting proved to be a positive step in our on-going relationship with the Lower Minnesota River Watershed District (LMRWD). As indicated at the meeting, MAC feels there is a logical relationship between Minneapolis-St. Paul International Airport (MSP) and LMRWD and we are interested in formalizing our affiliation.

In up-coming weeks, MAC will be working with staff from neighboring federal properties to determine a logical watershed boundary. While hydrologic boundaries should be the primary basis for establishing boundaries, MAC also feels it is important to consider the relationship that adjoining properties share with MSP. MAC believes that these properties will also make a request to be included in LMRWD. Once a proposed watershed boundary has been defined, MAC will provide a formal request to the Board of Managers for consideration. It is our desire that LMRWD take action to petition the Board of Water and Soil Resources (BWSR) to incorporate this area into the LMRWD management area.

MAC understands that this is a significant request. However, due to anticipated deadlines imposed by BWSR for the review of a petition by the Minnehaha Creek Watershed District, MAC is requesting that the Board of Managers act as quickly as possible to ensure adequate representation in the petition process. MAC will provide staff support as necessary to LMRWD in developing this petition.

MAC looks forward to continuing our cooperative relationship and to participating in the Lower Minnesota River Watershed District (LMRWD). If you have any questions, please contact me at 612-726-8131.

Sincerely,

Gary Warren, P.E.
Director, Airside Development

cc: Ronald Harnack, Board of Water and Soil Resources



Metropolitan Division

Waters Edge

1500 West County Road B2

Roseville, MN 55113

March 16, 2000

Mr. Ronald Harnack

Executive Director

Minnesota Board of Water and Soil Resources

One Water Street, Suite 200

Saint Paul, MN 55107

Re: Minnehaha Creek Watershed District

2/9/2000 Petition for Boundary Change

Dear Mr. Harnack:

The Minnesota Department of Transportation (MnDOT) has reviewed a copy of the February 9, 2000, petition from the Minnehaha Creek Watershed District (MCWD) requesting a boundary change. The area proposed for annexation includes the Veterans Administration complex and other federal properties located on the north side of the airport complex.

MnDOT has several concerns with this proposal and is taking this opportunity to note our objection to the boundary change. We request that the Minnesota Board of Water and Soil Resources (BWSR) consider our comments during your review process.

At the outset, it is important to understand the true impetus behind the request for the boundary change. MnDOT attended a MCWD meeting on the night of January 6, 2000, to discuss the monitoring we are conducting as part of the TH 55 construction near Minnehaha Creek. Near the close of that meeting TH 55 protestors requested that the MCWD Managers consider extending the Watershed boundaries to include the area surrounding Coldwater Spring. Subsequently the "Preserve Camp Coldwater Coalition" wrote the attached January 19, 2000, letter to the MCWD requesting that the MCWD petition BWSR for the boundary change. This was prompted by the fact that MnDOT has a contract letting scheduled in June of 2000 for the final portion of TH 55 that connects to TH 62. At their January 20, 2000, meeting the MCWD Managers directed their staff and attorney to prepare the boundary change request in response to the TH 55 protestors.

The Proposed Boundary Change Will Needlessly Continue the TH 55 Controversy

The TH 55 project now under construction has been under development since the 1960's. It is strongly supported by the City of Minneapolis and Hennepin County. As the project developed it was modified significantly to address concerns of the City, the Minneapolis Park Board, and the Citizen Task Force representing residents and businesses. After

Mr. Ronald Harnack
March 16, 2000
Page 2

more than thirty years of planning and public involvement the project is now nearing completion. While the project has broad support from the local government agencies, elected officials and residents, protest groups continue to refuse to recognize or accept the fact that the TH 55 reconstruction and the subsequent LRT project address critical transportation needs of the region. Numerous lawsuits have been filed in court. In all cases, the county, state, and federal court systems have upheld the project development and environmental review process MnDOT utilized. Unfortunately these challenges have simply served to consume substantial public funds in legal costs, staff time and project delays.

The proposed boundary change represents yet another attempt by the protest groups to extend this controversy and voice their opposition to the TH 55 and LRT projects. Redefining Watershed District boundaries in response to the goals of protest groups is simply poor public policy. It is time to end the TH 55 controversy and complete this public works project.

Development Activities in This Area Are Being Appropriately Managed By the Responsible Regulatory Agencies

The MCWD petition implies that since the area is currently not within a watershed district or management area, water resource issues are not being adequately considered. That is simply not the case. For the proposed TH 55 and 62 interchange project MnDOT has been coordinating and obtaining permits from the Corp of Engineers, Department of Natural Resources, and Pollution Control Agency. Erosion control, wetland impacts, and groundwater monitoring requirements are already being addressed by these agencies which have current jurisdiction in this area. In fact, as a courtesy we have included MCWD representatives in meetings with the Corp of Engineers and DNR to include their input in developing the agreed upon monitoring plans with those agencies. Further, the courts have determined that this project complies with the provisions of Section 4(f) of the Department of Transportation Act of 1988, the National Environmental Policy Act, the federal Clean Air Act, the Native American Grave Protection Act, and the National Historic Preservation Act. Within the next month the project design will have been completed. The design complies with the rules and requirements of all agencies that currently have permit oversight. We object to the proposed redefinition of Watershed District boundaries to unnecessarily add yet another permitting requirement at the eleventh hour and possibly delay our project.

The Area To Be Annexed Is Beyond The Hydrologic Boundaries of Minnehaha Creek Drainage Area

The Minnehaha Creek Watershed District was established in 1967 to protect the water resources of the Minnehaha Creek watershed. The area to be annexed drains to the

Mr. Ronald Harnack

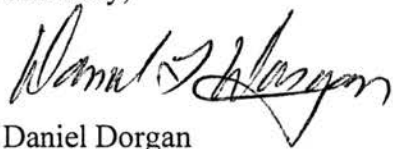
March 16, 2000

Page 3

Mississippi River, not Minnehaha Creek. Extending the Watershed District boundaries to the proposed area of annexation is inconsistent with the primary mission of the MCWD to protect Minnehaha Creek. While we understand it is difficult or sometimes impractical to legally define a watershed boundary along strict hydrologic boundaries, this proposal goes far beyond the hydrologic boundaries of Minnehaha Creek.

For the reasons noted above we object to the petition proposal and request that the Minnesota Board of Water and Soil Resources deny this request.

Sincerely,

A handwritten signature in black ink, appearing to read "Daniel Dorgan", written in a cursive style.

Daniel Dorgan
Assistant Division Engineer
Project Development

Attachment: January 19,2000 letter

cc: Margo Labau

PRESERVE CAMP COLDWATER COALITION

January 19, 2000

Minnehaha Creek Watershed District
Gray Freshwater Center, Navarre
2500 Shadywood Road, Suite 149
Excelsior, Minnesota 55331

Dear Managers:

The Preserve Camp Coldwater Coalition urgently requests the Minnehaha Creek Watershed District (MCWD) to petition the Minnesota Board of Water and Soil Resources (BOWSR) to change the MCWD boundary to include the Camp Coldwater watershed and Coldwater Spring.

We are a coalition of neighborhood, business, environmental and religious groups focused on preserving the historic Camp Coldwater area. We recognize and appreciate your commitment and accomplishments to date in working towards your stated goal to enhance the water quality of the water resources within the Minnehaha Creek watershed. We believe your experience in this endeavor makes you eminently qualified and the logical choice to also manage the water resources of the neighboring Camp Coldwater area.

Coldwater Spring is believed to be the last remaining free-flowing bedrock spring in Hennepin County. Other springs of this type have stopped flowing due to changes in their watersheds, including roadway construction. Coldwater Spring is now imminently threatened by construction activities associated with the reroute of Highway 55, scheduled to begin this spring. This activity just 400 feet west of the spring, threatens to disturb or cut the groundwater flow as it travels eastward to Coldwater Spring. This flow includes waters of the Minnehaha Creek watershed, waters that are now under your jurisdiction.

The Camp Coldwater watershed has no local unit of government to protect or manage its water resources. The 15-year-old EIS and the 8-year-old EAW completed by MNDOT made no mention of Coldwater Spring. No detailed site-specific hydrogeologic study has been done on this area nor is any planned.

As watershed managers you know firsthand of MNDOT's insensitivity to groundwater flows, its inability and unwillingness to obtain baseline data, and non-compliant behavior regarding groundwater monitoring plans. MNDOT's history of violations of your surface water management guidelines alone moved you to initiate daily site inspections. With this in mind, imagine the fate of this 10,000 year old treasure in the face of unsupervised and uncontrolled construction deadlines. As environmental stewards, can we watch this precious resource be rubbed out without acting?

Watershed districts are established to protect and manage water resources based on hydrologic as opposed to political boundaries. While the Minnehaha Creek and the Camp Coldwater watersheds may not be directly connected via surface water flows, these areas are connected

PRESERVE CAMP COLDWATER COALITION

January 19, 2000

by shared groundwater flows. MNDOT's senior geologist, Chuck Howe, stated that the supply of water for the Coldwater Springs come from a vast recharge area extending as far west as Lake Minnetonka, which would include groundwater flow regimes within MCWD jurisdiction. We believe the supply area may be much smaller based on flow rate. However, until a detailed site-specific assessment is conducted the recharge zone cannot be defined

The Camp Coldwater surface watershed is too small to form a new independent watershed district. The Lower Minnesota Watershed District is too far to the south, shares no common boundary with Camp Coldwater, and does not engage in enforcement activities.

The MCWD is the logical unit of government to take on this special stewardship. Both the Minnehaha Creek and Camp Coldwater watersheds lie adjacent to each other as they flow to the Mississippi River sharing a contiguous boundary alignment.

We know that our land is blessed with many human beings who share our concern and commitment, and work to preserve and defend our precious remaining natural resources. These people work at all levels of every local, county, state and federal entity acting on behalf of our shared environment, including MNDOT. From our discussions with BOWSR staff we know they look forward to receiving your petition and we feel confident that the BOWSR board will see its merits and act favorably on this boundary realignment.

We believe the MCWD is best suited to take on this important responsibility and respectfully request that you take action at your Thursday, January 20, 2000 meeting to expeditiously initiate this important petition process.

Please let us know how we can be of assistance in achieving our shared vision of protected waters from the falls to the springs.

Sincerely,

Jim Anderson

Jeanne Hollingsworth

Lynn Levine

John Steinworth 651 653-7517 (h) 651 205-1864 (w)

MINNESOTA SHORELAND MANAGEMENT RESOURCE GUIDE

The **Minnesota Shoreland Management Resource Guide** will improve the implementation of effective and sustainable shoreland management practices in Minnesota. Through fact sheets, technical and scientific information, selections from existing publications, and an extensive bibliography, we will empower individuals to adopt practices to protect Minnesota's shorelands and waters. Our effort recognizes the similarities and differences in lake, river, and wetland shorelands across Minnesota.

Funding: The 1998 Legislature appropriation of \$100,000 passed through BWSR to Minnesota Sea Grant Extension. The stated purpose was "to review, update, and consolidate existing shoreland and lake related guidebooks, manuals, fact sheets, and publications into a single comprehensive document".

Outcome: The outcome will be an accurate, up-to-date source of shoreland education in an easy-to-use format.

Eight original documents were identified for this project:

- A Citizen's Guide to Lake Protection*
- A Guide to Land and Water Resource Management Programs in Minnesota*
- A Guidebook for Lake Associations*
- Best Management Practices for Protecting Your Shoreline*
- Developing a Lake Management Plan*
- Lake Prioritization for Protecting Swimmable Use*
- Minnesota Lake and Watershed Data Collection Manual*
- Mississippi Headwaters River Watch*

In addition to those documents, the Guide will include:

- new material on limnology, watersheds, and rivers
- a bibliography, glossary, and acronyms
- new resources on frequently asked questions (FAQs)

We have queried potential users of the product to assess the most frequently asked questions (FAQs) that are difficult to answer with existing publications. We are compiling these questions into one-page FAQ sheets that will be easy to download and distribute at a seminar or workshop.

We are initiating the project on a web site, which will mean educational materials can be more comprehensive and accessible. Updated links to agency and other useful web sites will ensure the information is accurate and remains current. The materials will also be compiled and summarized on CD. One thousand copies of the CD will be distributed to counties, MLA, WDs, SWCDs, WMOs, and COLAs, and other appropriate groups. Hard copies will be available on request.

For more information, please contact:

Marybeth Block, BWSR – 651-297-7965 <marybeth.block@bwsr.state.mn.us>

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National Resources Inventory:

Background and Highlights

Seven Decades of Resources Inventories



January 2000

Background

The National Resources Inventory (NRI) is a statistically based survey that has been designed and implemented using scientific principles to assess conditions and trends of soil, water, and related resources on non-Federal lands in the United States. The NRI is conducted by the U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS), in cooperation with the Iowa State University Statistical Laboratory. The NRI provides scientifically valid, timely, and relevant information that is used to formulate effective agricultural and environmental policies and legislation, implement resource conservation programs, and enhance the public's understanding of natural resources and environmental conditions.

See NRI information on the Internet at: <http://www.nhq.nrcs.usda.gov/NRI>

The Natural Resources Conservation Service

The NRCS is an agency of the USDA. Formerly known as the Soil Conservation Service (SCS), its mission is to provide leadership in a partnership effort to help people conserve, improve, and sustain our natural resources and the environment. The SCS was established through the Soil Conservation Act of 1935 after the Dust Bowl catastrophe. This legislation was based, in part, upon results from the 1934 National Erosion Reconnaissance Survey, which was the first formal study of erosion conducted in the Nation. Hugh Hammond Bennett, the agency founder and first administrator, convinced the U.S. Congress that soil erosion was a national menace and that a permanent agency within USDA was needed to call landowners' attention to their land stewardship opportunities and responsibilities. NRCS champions the

vitality of the land as USDA's lead conservation agency. No other Federal agency speaks for the health of America's private land.

Information and knowledge about natural resources in the United States are critical for sustaining conservation and agriculture, and for preserving the Nation's well-being. As part of its mission, NRCS collects large quantities of data, both at the field level and at larger scales. Data are collected at the field and farm levels by thousands of NRCS employees who are highly skilled in many scientific and technical disciplines. These specialists provide technical assistance to farmers and ranchers in the development of conservation systems that are tailored to their land and their way of doing business. Assistance also is provided to rural and urban communities to solve resource problems, such as soil erosion, and to conserve and protect water.

The National Resources Inventory

The Rural Development Act of 1972, the Soil and Water Resources Conservation Act of 1977, and other supporting acts direct NRCS to assess the status, condition, and trends of soil, water, and related resources on the Nation's non-Federal lands at intervals of 5 years or less. To help accomplish this assessment, the NRI was developed to augment NRCS' soil survey program to provide critical information regarding natural resources.

The NRI is a compilation of natural resource information on non-Federal land in the United States—about 75 percent of the total land area. Conducted by NRCS, this inventory captures data on land cover and use, soil erosion, prime farmland soils, wetlands, habitat diversity, selected conservation practices, and related resource attributes at

more than 800,000 scientifically selected sample sites. The NRI covers all 50 States, Puerto Rico, the U.S. Virgin Islands, and some Pacific Basin locations.

The NRI provides a record of trends in the Nation's resources over time and documents conservation accomplishments as well. At each sample point, information is available for 1982, 1987, 1992, and 1997, so that trends and changes in land use and resource characteristics over 15 years can be examined and analyzed. Because the NRI is based on recognized statistical sampling methods and is scientifically designed and executed, NRI data are valuable in examining issues at National, regional, and State levels.

Purpose and Use

The NRI is conducted to obtain scientifically valid, timely, and relevant data on natural resources and environmental conditions. Information derived from the NRI is used by natural resource managers, policy makers and analysts, consultants, the media, other Federal agencies, State governments, universities, environmental, commodity, and farm groups, and the public. These constituents use NRI information to formulate effective public policies, fashion agricultural and natural

resources legislation, develop State and National conservation programs, allocate USDA financial and technical assistance in addressing natural resource concerns, and enhance the public's understanding of natural resources and environmental issues.

Seven Decades of Resources Inventories

- Hugh Hammond Bennett directed the pioneer National Erosion Reconnaissance Survey of 1934. This survey, the first well-documented nationwide resources inventory, estimated the degree of erosion caused by wind and water on the total land area of the United States. Six months after its completion, Congress passed the Soil Conservation Act of 1935, which established the SCS.
- By the early 1940s, SCS realized that natural resources information was required to develop programs and set priorities for various conservation needs throughout the country. After assembling and analyzing the available resources data, SCS published in 1945 a report on U.S. soil and water conservation needs, which became the Conservation Needs Inventory (CNI) and prepared the ground for future inventories.

- In 1956, SCS began a cooperative endeavor to maintain and update the CNI. Seven other USDA agencies assisted. Data were collected from sample areas for the 1958 CNI. It was the first time that SCS used statistical sampling to collect natural resource inventory data and the first time since 1934 that new data were actually collected in the field.

- The 1967 CNI was an update of the 1958 CNI, but featured data collection at specific sample points within randomized sample units; this method simplified data collection and processing. By the mid-1970s, SCS had developed a way to link resources inventory data to soils data collected by the agency's nationwide soil mapping program, the National Cooperative Soil Survey.

- The Rural Development Act of 1972 set guidelines for the present inventory program. The Act's language specified that information on urban spread and rural economic survival, prime farmland, flood plains, and conservation practices was needed to devise community guidance for balanced rural-urban growth. The Act also shortened the interval between resources inventories from 10 years to 5 years.

- SCS undertook the 1975 Potential Cropland Study in response to the recognition that urban development was taking place on some of the Nation's best cropland. The study also addressed issues of wetland preservation and conversion of marginal lands to cropland. For the first time, SCS used the statistical techniques that would characterize later inventories.

- The 1977 NRI gathered data on soil erosion, wetlands, prime farmland, and flood-prone areas, as well as soil capability, land use, and conservation treatment needs. The 1977 NRI used nearly 70,000 sample areas and was statistically reliable to the State level.

- The 1982 NRI was more comprehensive with respect to the kinds of data gathered and the number of sample areas covered. Its findings included the extent and distribution of highly erodible croplands throughout the Nation. It laid the groundwork for development of the Conservation Reserve Program and Conservation Compliance, Sodbuster, and Swampbuster conservation provisions of the Food Security Act of 1985.

- The 1987 NRI initiated changes in how the data were gathered and analyzed. Previously, SCS employees collected data onsite and manually entered it onto worksheets. Almost 30 percent of the 1987 sample data were collected using remote sensing. SCS used trained teams to collect and enter the data into computers. New software allowed SCS State offices to quickly deliver NRI data to the public.

- The 1992 NRI relied heavily on remote sensing and computer-based technologies. Aerial photography was used, where available, to collect the new data, verify the 1982 and 1987 data, and fill in missing data for those years. The 1982 and 1987 databases were updated to current standards of technology, enabling SCS to establish and track trends in natural resource use and conditions over 10 years.

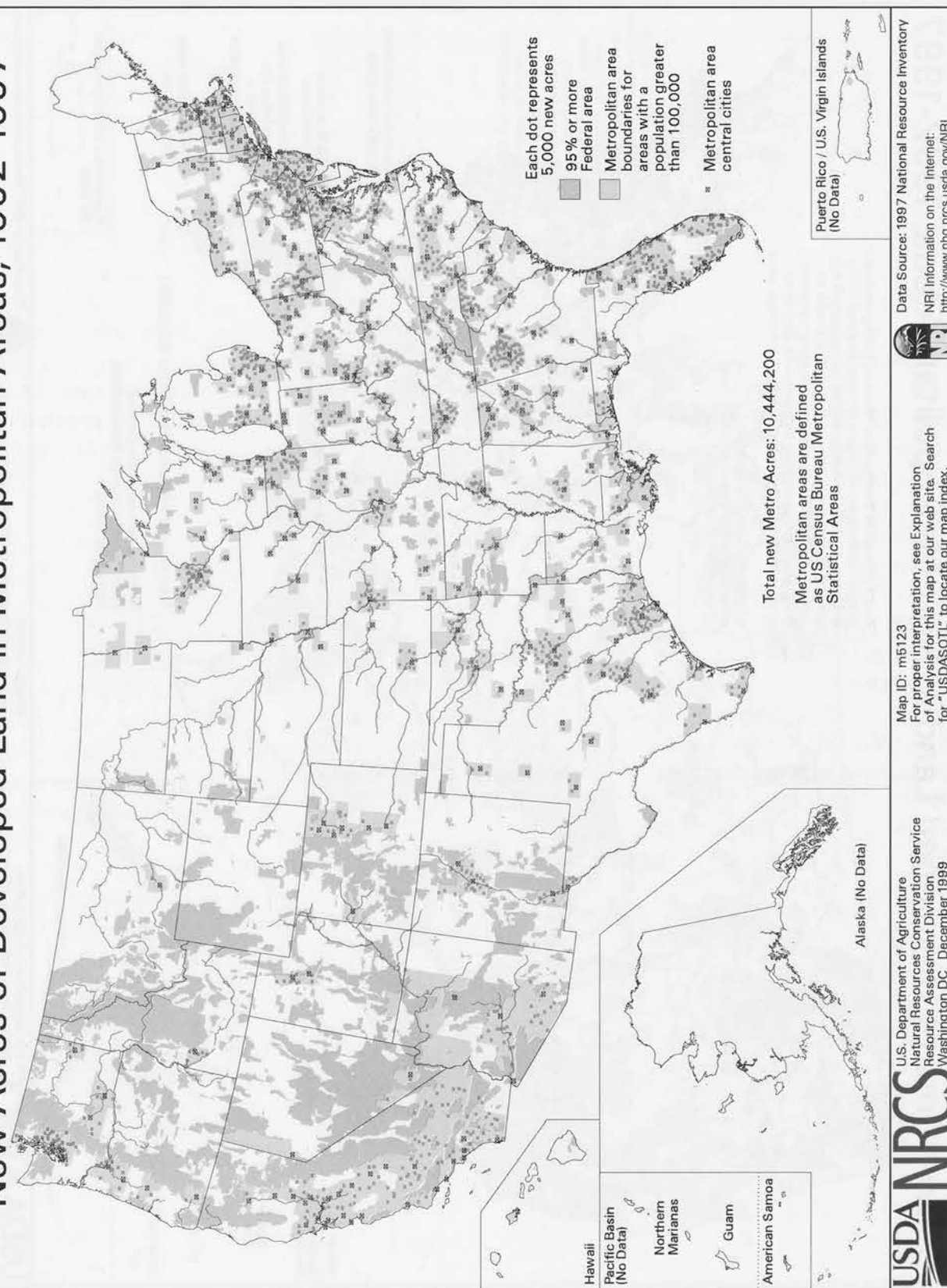
- From 1995 to date, NRCS has conducted special small-scale inventories each year that investigate topical matters of concern and supplement the major NRI. Data from these reports are statistically reliable for national and some regional analyses.

- Data used for the most current NRI were collected using 1997 (growing season) imagery, field office records, historical records and data, a variety of ancillary materials, and a limited number of on-site visits. Historical data were carefully reviewed and edited. Data gatherers recorded information with the assistance of personal digital assistants and computer-assisted survey instruments. Data collected in 1997 enable an analysis of trends extending over 15 years.

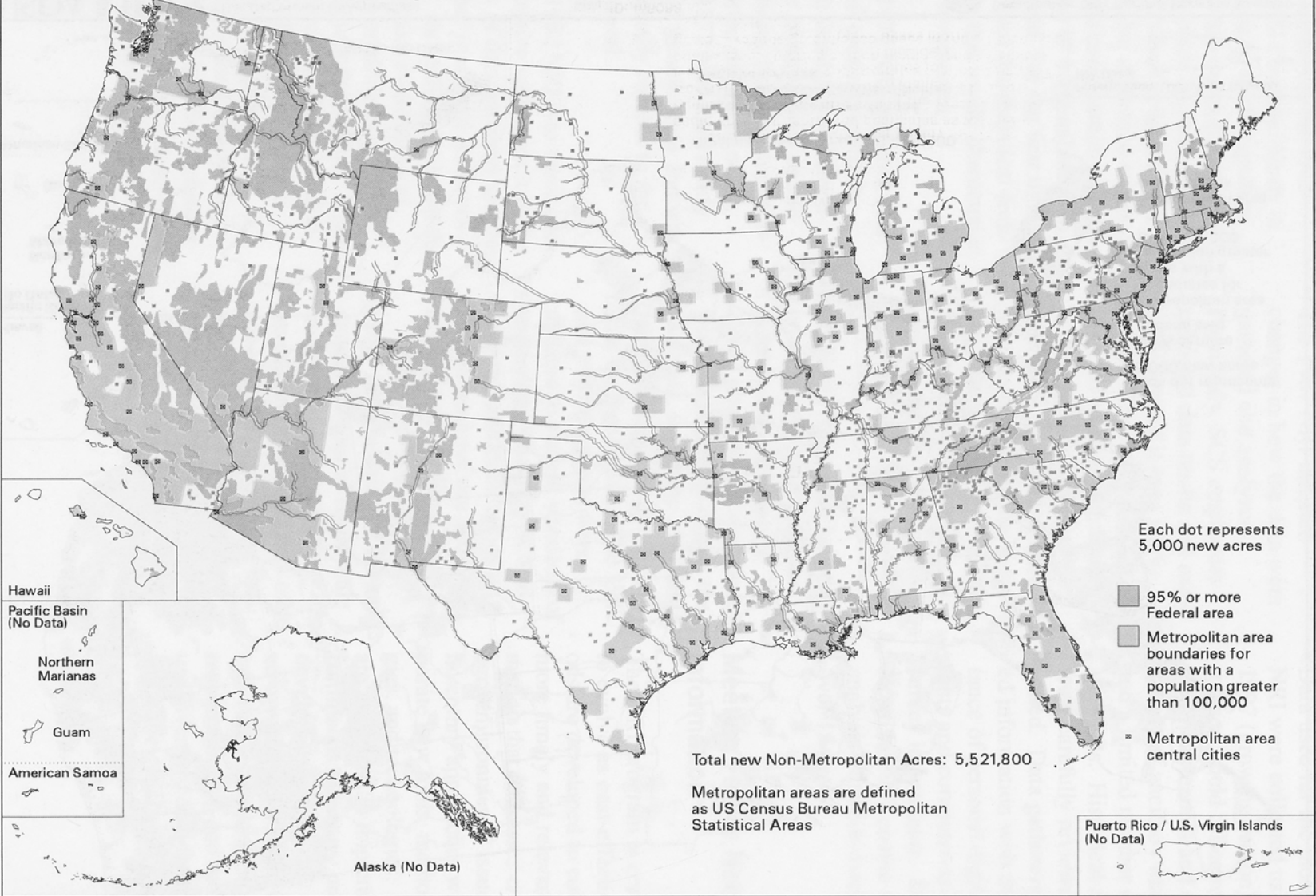
Meeting Future Needs for Information

The NRI program is continuing to evolve as cost-effective methods are developed to collect more timely and relevant information that addresses emerging agri-environmental issues. New inventory approaches will incorporate new tools, methodologies, and technologies. Efforts are underway to implement a continuous inventory process, develop a multi-agency integrated inventory approach, incorporate various assessment tools for resource health, and more fully use inventory data for modeling and policy analysis.

New Acres of Developed Land in Metropolitan Areas, 1992-1997



New Acres of Developed Land in Non-Metropolitan Areas, 1992-1997

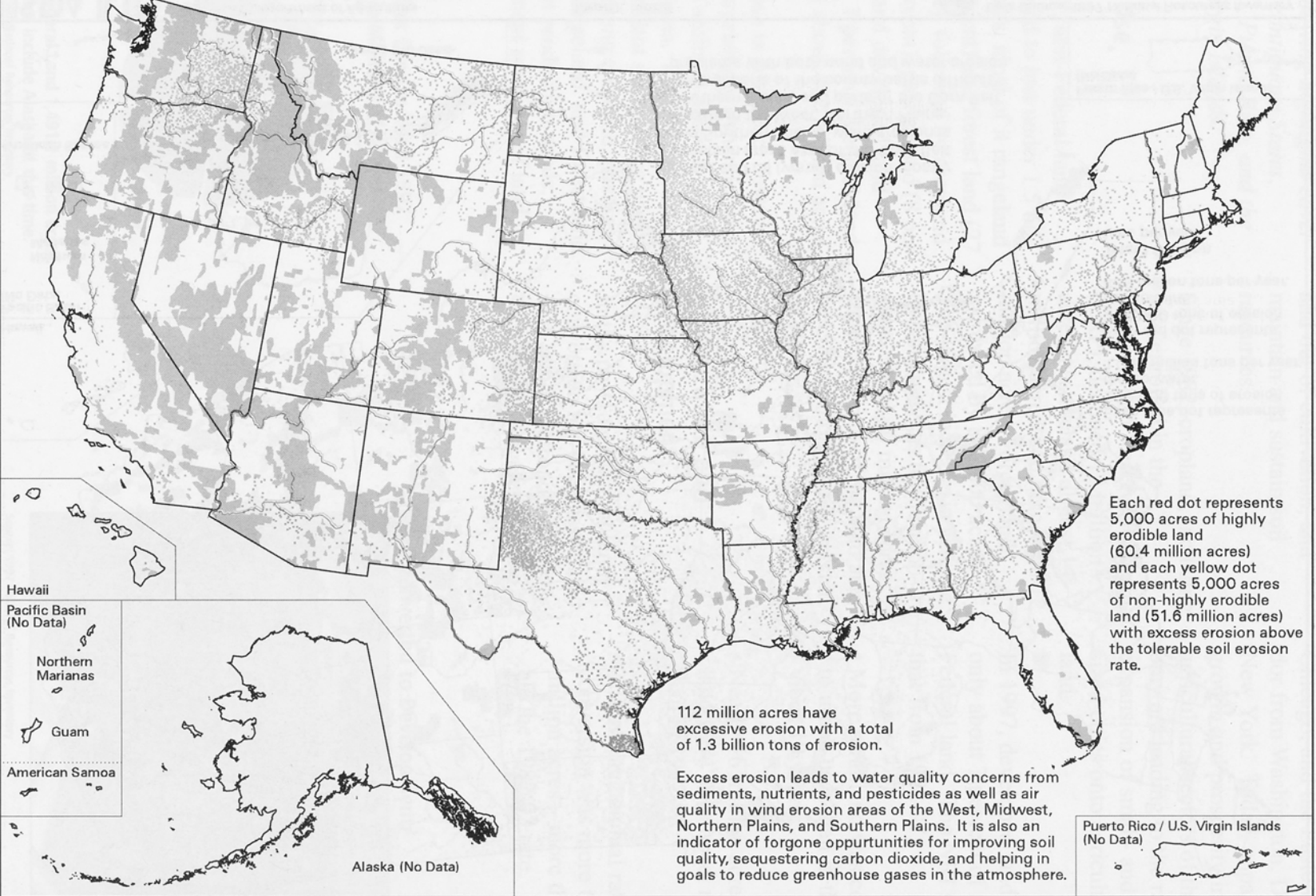


U.S. Department of Agriculture
Natural Resources Conservation Service
Resource Assessment Division
Washington DC December 1999

Map ID: m5124
For proper interpretation, see Explanation of Analysis for this map at our web site. Search for "USDASOTL" to locate our map index.

Data Source: 1997 National Resource Inventory
NRI Information on the Internet:
<http://www.nhq.nrcs.usda.gov/NRI>

Excessive Erosion on Cropland, 1997

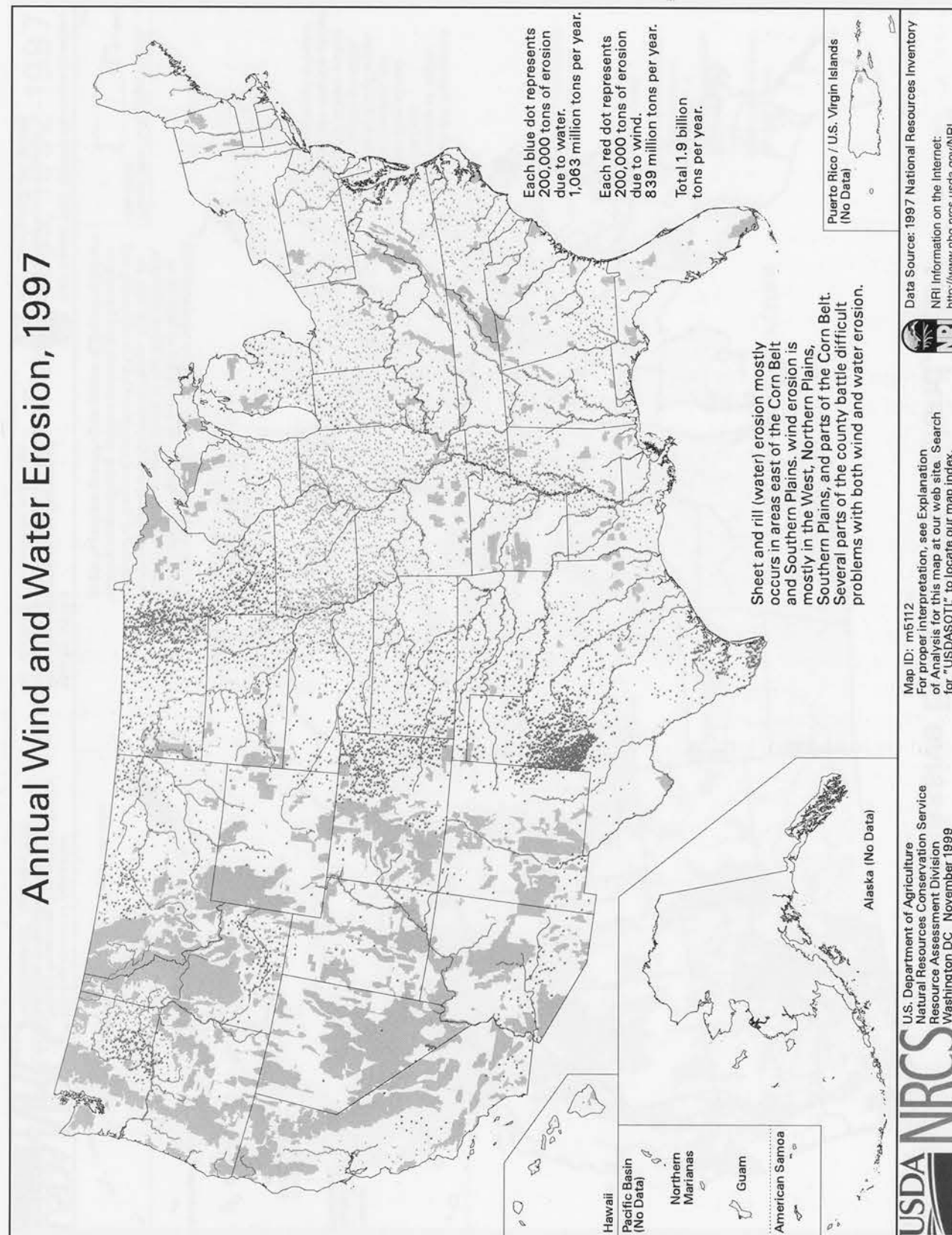


U.S. Department of Agriculture
Natural Resources Conservation Service
Resource Assessment Division
Washington DC November 1999

Map ID: m5083
For proper interpretation, see Explanation of Analysis for this map at our web site. Search for "USDASOTL" to locate our map index.

Data Source: 1997 National Resources Inventory
NRI Information on the Internet:
<http://www.nhq.nrcs.usda.gov/NRI>

Annual Wind and Water Erosion, 1997



The following highlights cover the 48 contiguous States, Hawaii, Puerto Rico, and the U.S. Virgin Islands.

Land Use

In 1997, non-Federal land amounted to just under 1.5 billion acres, most of it rangeland (27 percent) and forest land (27 percent), followed by cropland (25 percent), pastureland (8 percent), and developed land (about 7 percent). Federal land totaled about 402 million acres.

Land use is not static, however. It is surprisingly dynamic, with annual shifts in and out of different uses. In agriculture there are constant shifts in the use of land among cropland, pastureland, rangeland, and forest land to meet production needs, implement rotations of land in

and out of cultivation, and maintain and sustain soil resources.

Since 1982, cropland, including land enrolled in the Conservation Reserve Program (CRP), declined 13 million acres, pastureland almost 14 million acres, and rangeland 12 million acres. Forest land increased by 800,000 acres. The largest increase in acreage by land use was for development, about 30 million acres, from 5 percent of the land area in 1982 to more than 7 percent in 1997.

Urbanization and Development

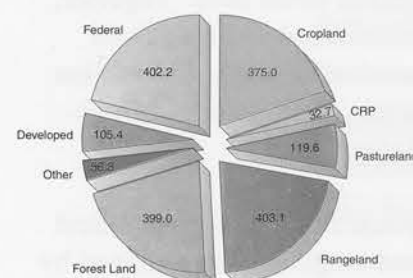
In the past, agricultural land conversion has been associated with major metropolitan areas, such as Los Angeles, Atlanta,

Chicago, and the Eastern corridor from Washington, D.C., to New York. Today, unparalleled growth and prosperity in non-agricultural sectors of the economy are leading to the rapid expansion of small- and mid-sized cities onto agricultural land.

In 1997, developed land totaled only about 7 percent of non-Federal land. The NRI shows that from 1992-97:

- More rural land was converted to urban uses than in the previous 10 years.
- Nearly 16 million acres of land were developed, more than in 1982-92.
- The average annual rate of conversion was more than 3 million acres—more than double the 1982-92 rate.

How Our Land is Used 1997
Data in Millions of Acres*



* Non-Federal Land 1,491.1 million acres. Does not include Alaska at this time.
Source: 1997 National Resources Inventory

Land Converted to Development



Source: 1997 National Resources Inventory

- Although not considered to be a threat to food production nationally, urbanization and development lead to the fragmentation of agricultural land and the loss of prime farmland.

Soil Erosion

Successful implementation of 1985 and 1990 Farm Bill programs has put landowner stewardship at an all-time high. For example, since 1982, erosion on cropland and land enrolled in the USDA's Conservation Reserve Program (CRP) has been reduced by 38 percent. Slowing that erosion improves soil quality, sequesters carbon in the soil, and reduces greenhouse gases in the atmosphere. NRI statistics show, however, that:

- Since 1995, the erosion rate has not decreased, and has leveled off to about 1.9 billion tons per year.
- Nearly 112 million acres, or 30 percent of the Nation's cropland, has been determined to be excessively eroding at a rate of 1.3 billion tons per year.

Excessive erosion continues to be a serious problem in many parts of the country. More than 60 million acres of fragile highly erodible cropland was determined to have excessive erosion.

Nearly 52 million acres of non-highly erodible cropland was determined to have erosion that exceeded the tolerable soil loss rate.

Excessive erosion of 1.3 billion tons per year leads to concerns about sediments, nutrients, and pesticides impacting water quality, as well as air quality in wind erosion areas of the West, Midwest, Northern Plains, and Southern Plains.

Excessive erosion rates indicate where there are opportunities to improve soil quality, sequester carbon dioxide, and reach goals to reduce greenhouse gases in the atmosphere.

Grazing Lands

Maintaining and improving the amount and condition of grazing lands is important for sequestering greenhouse gases, protecting water quality and quantity, providing vegetation for livestock and wildlife, as well as enhancing wildlife habitat and the landscape.

The Nation's grazing lands total 583 million acres and include pastureland, rangeland, and grazed forest land. Together, pastureland and rangeland amount to nearly 523 million acres, or 35 percent, of non-Federal land.

Since 1982, total pastureland and rangeland has declined by 26 million acres. From 1992-97, because of changes in land use, the combined decline in pastureland and rangeland

acreage was nearly 10 million acres; 26 million acres were converted from pastureland and rangeland to other uses, while 16 million acres were converted to pastureland and rangeland. Development accounted for nearly 18 percent of decreases in pastureland and rangeland. Shifts in usage from pastureland and rangeland to development and cultivation cause dramatic changes in condition and hydrology.

Most of the decreases and increases in pastureland and rangeland acreage involved conversion from or conversion to

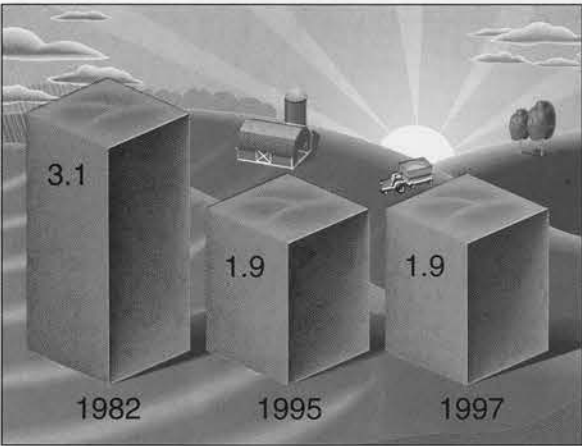
cultivated cropland. Twenty-four percent of decreases in pastureland and rangeland resulted in increases in the amounts of cultivated cropland. And 45 percent of the increase in pastureland and rangeland came from cultivated cropland.

Irrigated Land

The number of irrigated acres continues to rise and fall with competition for water, changes in agricultural economics, and risk-management measures to compensate for shortages of rainfall. According to the NRI:

- The number of irrigated acres continued to decline in the West and South Central States, while increasing in the Midwest, Northern Plains, East, and Southeast.
- States with the largest decreases in irrigation since 1982 were Texas, California, New Mexico, Nevada, and Idaho.
- Regional decreases were greatest in the Southern Plains, Pacific, and Mountain States, while the greatest increases were in the Delta, Northern Plains, Corn Belt, Appalachian, Northeastern, and Great Lake States.

Total Erosion on Cropland and CRP
Billions of Tons



Source: 1997 National Resources Inventory

Changes in Irrigated Acres, 1982-1997

Region	Change 82-87	Change 87-92	Change 92-97	Change 82-97
Northeast	7,900	49,900	48,200	106,000
Lake States	35,800	120,200	-62,700	93,300
Corn Belt	-15,400	280,100	43,200	307,900
Northern Plains	305,600	325,400	207,000	838,000
Appalachian	60,300	12,200	60,600	133,100
Southeast	-48,400	128,800	-159,400	-79,000
Delta States	255,800	1,033,900	104,800	1,394,500
Southern Plains	-720,400	-491,900	-425,900	-1,638,200
Mountain	-162,400	-249,200	-264,500	-676,100
Pacific	16,900	-506,000	-397,100	-886,200
Total	-264,300	703,400	-845,800	-406,700

- The largest increases since 1982 were in Arkansas, Nebraska, Mississippi, Missouri, Michigan, and North Carolina.

The greatest shifts in distribution of irrigated acres occurred from 1987-92. From 1992-97, this trend continued, but at a slower rate, in every region except the Great Lake States and the Southeast.

Competition for water, the economics of production agriculture, and risk management to ensure crop production to compensate for shortages of rainfall have driven regional shifts in demand for irrigation.

In the future, continued severe and prolonged droughts may lead to concerns about surface and ground-water withdrawals

in irrigation growth areas. This may lead to water supply issues in areas where they have not been major concerns in the past.

Wetlands

Wetlands are a vital natural resource that provide flood protection and enhance water quality, wildlife habitat, and air quality.

The NRI data indicate that an annual average of 54,000 acres of wetlands was lost from 1992-97 on cropland, pastureland, and land enrolled in the Conservation Reserve Program, while an average of 30,000 acres was gained.

The net loss of wetlands on these lands has decreased from a level of 27,000 acres lost each

year (1982-92 study period) to 24,000 acres from 1992-97.

This improvement is the result of programs designed to restore or enhance wetlands, such as the Wetlands Reserve Program, as well as State, local, and private initiatives.

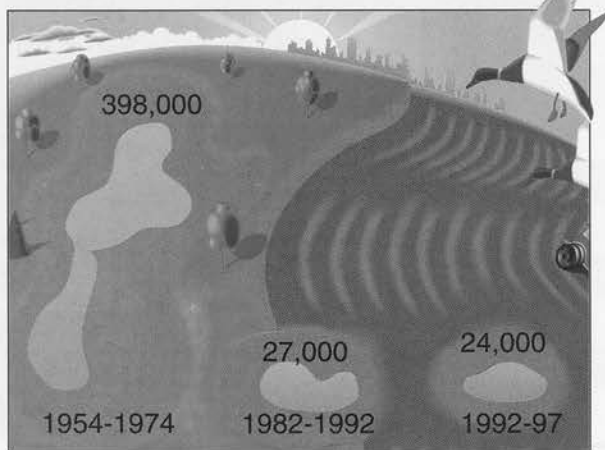


See NRI information on the Internet at:

<http://www.nhq.nrcs.usda.gov/NRI>

Wetland Losses on Agricultural Land

Average Annual in Acres Per Year



Source: 1997 National Resources Inventory

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Minnesota National Resources Inventory

NRI Design and Data Collection
Data Use/Information
1997 Results

National Resources Inventory is the largest natural resource database in the world.

This presentation will cover:

- the design of the inventory
- the selection of sample sites
- the data collection process
- processing of the raw data
- parameters of the database
- using the NRI data
- examples of information products
- examples of 1997 analyses

NRI Design and Data Collection

- Scientifically designed and conducted
- Based on recognized statistical sampling methods
- Statistically reliable for national, regional, state, and substate analysis
- Assesses conditions and trends of soil, water, and related resources
- Conducted on non-Federal lands in the U.S.

NRI is a scientifically designed and conducted inventory of natural resources.

It is based on statistical sampling methods and therefore is not a complete census. Data are statistically reliable for national, regional, state, and substate analysis. The inventory was designed to provide reliable information at the level of Major Land Resource Areas (MLRA's), but data can be displayed by river basins, watersheds, and counties with varying reliability.

The database contains data for 1982, 1987, 1992, and 1997. All of the data elements are designed to provide trends.

- Only non-Federal lands in the U.S. are included in the inventory.

Sample Design

- Probability Sampling
- Stratification
- Area Sampling
- Two-Stage Sampling

Primary Sampling Unit



For simplicity, a PSU may be visualized as a square of 160 acres with sides of one-quarter mile; the PSU has internal sample points.

The geographic locations of the PSU and points are the same for each year of observation.

Data is collected for both the PSU, and data is collected at the specific point.

Minnesota has 22,000 PSU's. In 1997 a sample of 8,166 PSU's was used.

Data Collection - PSU Data

- General Information including geographic locations
- Farmsteads and Built-up Areas
- Rural Transportation
- Perennial Streams and Waterbodies
- Shoreline Characteristics

Data Collection - Point Data

- Ownership
- CRP Information
- Land Cover/Use
- Cropping History
- Use of the Land

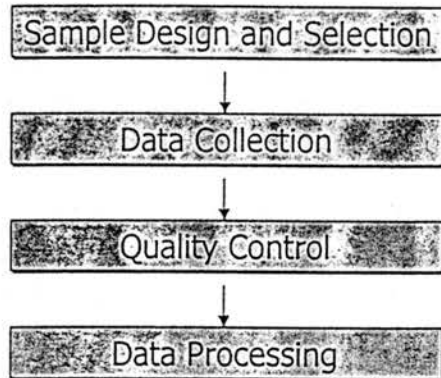
Data Collection - Point Data Continued

- Double Cropping
- Forest Type
- Native Pasture
- Soils
- Habitat Composition

Data Collection - Point Data Continued

- Overland Flow/Delivery to Water
- Irrigation
- Erosion Data
 - USLE Erosion Data (Sheet and Rill)
 - WEQ Erosion Data (Wind)
- Wetlands Data
- Conservation Practices
- Salinity

Data Development Process



Following the data collection process quality control measures are applied to ensure consistent results nationwide.

Quality data are processed at Iowa State University Statistical Laboratory and a final database is developed.

Developing Information



To be useful, the raw data must be analyzed and interpreted. The NRI has developed an analysis system called OASys.

Data Use and Information Development

1997 Results

Data/Information Sources

- National Web Site
<http://www.nhq.nrcs.usda.gov/NRI>
- Minnesota Web Site
<http://www.mn.nrcs.usda.gov/nri>

Data/Information Sources Continued

- OASys

<http://www.nhq.nrcs.usda.gov/NRI/1997/OASys97.html>

- Resources Inventory Specialist

Susan Ploetz

(651)602-7888

susan.ploetz@mn.usda.gov

1997 NRI Online Analysis System

1997 NRI Online Analysis System - version 1

Estimate Type: Value

Reporting Unit: Area (Acres in thousands)

Reporting Unit Year: 1997 1992 1987 1982

Title: UNKNOWN

Geographic Area

Qualifiers

Rows

Columns

Create ASCII data file

Submit

Email address: UNKNOWN

The On Line Analysis System (OASys) has been developed for the analysis of NRI data

A tutorial is available to assist users in learning the OASys.

After the query form entries are completed, your email address is entered. Checking the "Create ASCII data file" block will facilitate moving data into other applications such as Excel. Query results will be returned to your email address.

NRI Database Characteristics

- Provides basis for 5, 10, and 15-year trends in resource conditions (1982, 1987, 1992, 1997)
- Linked to soils interpretation records
- Can be integrated with other data sources through spatial linkages in a Geographic Information System

The NRI database is fully relational and allows analyses of infinite combinations of data elements. The linkage of the NRI with the soils interpretation records and the ability of NRI data to be combined with many other data sources spatially makes it an extremely powerful tool for resource planning.

Analyzed Data in ASCII Format

```
#### Table for Broad Land Cover/Use92 to urban 97-New England ####
"row name"      " Other est"      " Other err"      " Connecticut est"
"Other" 0.000    0.000    0.000    0.000    0.000    0.000    0.000
"Cropland-cultivated" 0.000    0.000    8.500    2.142    26.900    5.927
"Pastureland" 0.000    0.000    3.100    1.394    6.700    1.886    17.400
"Forest land" 0.000    0.000    41.400    4.227    119.200    10.685    216.900
"Minor land cover/uses" 0.000    0.000    7.900    4.413    10.800    4.960
"Urban-small and large built-up" 0.000    0.000    762.300    23.761
"Rural transportation-roads and railroads" 0.000    0.000    0.100
"Water-small-streams < 660 feet wide and water bodies < 40 acres"
"Federal land-cover/use not recorded" 0.000    0.000    0.000    0.000
"Conservation Reserve Program" 0.000    0.000    0.000    0.000
"Total" 0.000    0.000    823.300    25.472    582.200    38.057    1463.200
```

The ASCII data file will accompany the email as an attachment.

ASCII Files Loaded in Spreadsheet

Microsoft Excel - Worksheet

File Edit View Insert Format Tools Data Window Help

Read Table for Broad Land Cover/Use92 to Urban 97-New England area

row name	Other est	Connected	Connected	Marine est	Marine est	Massach.	Massach.	New Ham	New Ham	New York	New York	Rhode Is	Rhode Is	Vt
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	8.5	2,142	28.9	5,927	24.8	4.86	8	1,704	103	11,235	1.7	0.899
5	0	0	3.1	1,394	6.7	1,886	17.4	3.56	3	1,404	101.9	12.29	0.2	0.2
6	0	0	41.4	4,227	119.2	10,685	214.9	12,181	85.2	9,031	292.9	13,071	3.7	1,231
7	0	0	7.9	4,413	10.8	4,98	20.3	6.43	7.2	3,149	25.7	7,812	1.4	0.814
8	0	0	782.3	23,781	418.3	34,612	1181.9	33,96	444.8	26,013	2434.8	60,221	170.6	7,816
9	0	0	0.1	0.1	0.3	0.173	2	0.598	0.5	0.285	1	0.348	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	823.3	25,472	582.2	38,057	1483.2	35,046	548.5	28,551	2019.3	66.1	188.5	8,551
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Ready

It can be imported into Microsoft Excel and "cleaned up".

Spreadsheet Organized for Display

Microsoft Excel - NRI_NE_no mar

File Edit View Insert Format Tools Data Window Help

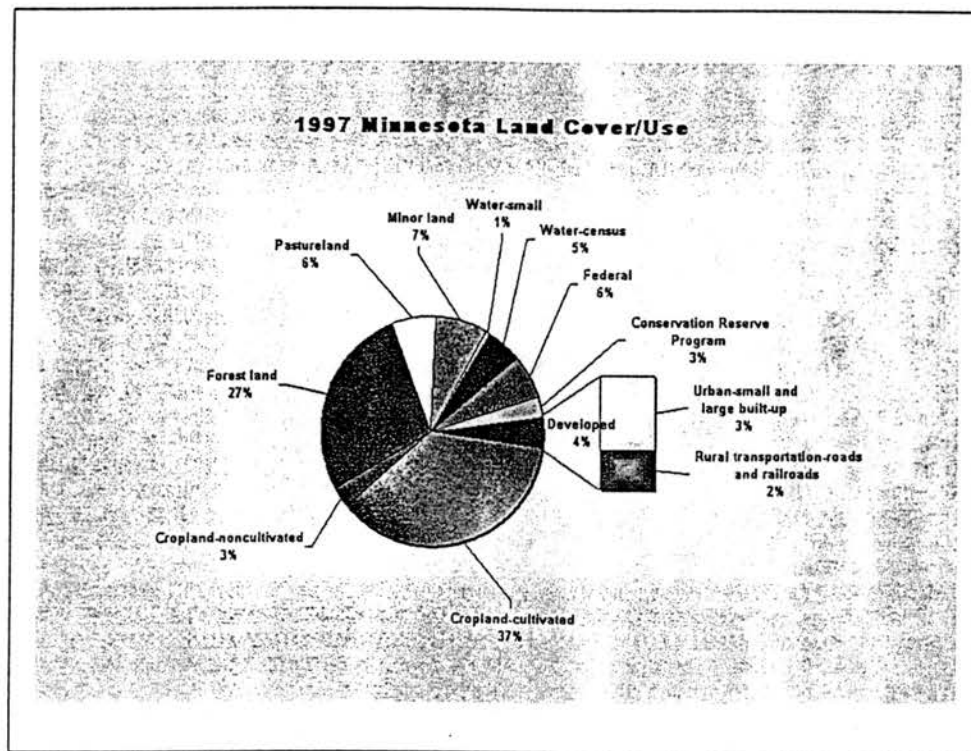
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PrintTable

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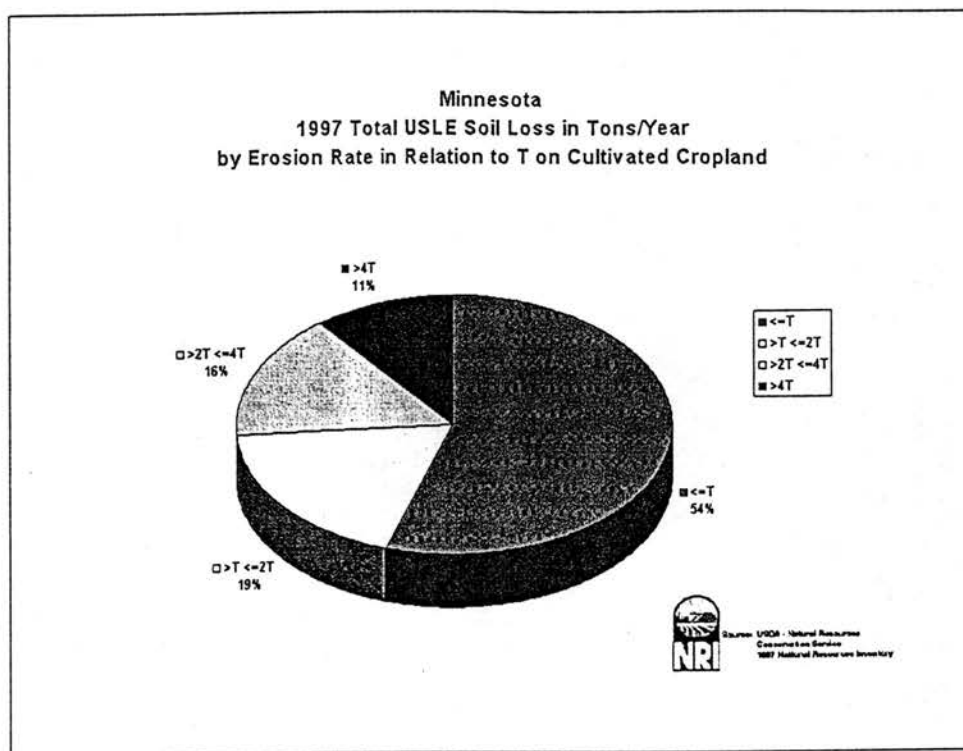
	A	B	C	D	E	F	G	H	I
1	Broad Land Cover/Use 92 to urban 97-New England								
2		CT	ME	MA	NH	NY	RI	VT	Total
3		Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres
4									
5	Cropland	8,500	26,900	24,800	8,000	1,030,000	1,700	5,500	178,400
6	Pastureland	3,100	6,700	17,400	3,000	1,019,000	200	6,500	138,800
7	Forest land	41,400	119,200	216,900	85,200	2,529,000	3,700	13,400	732,700
8	Minor land	7,900	10,800	20,300	7,200	257,000	1,400	0	73,300
9	Urban	762,300	418,300	1,181,800	444,600	24,348,000	176,600	215,900	5,634,300
10	Rural transportation	100	300	2,000	500	10,000	0	0	3,900
11	Water	0	0	0	0	0	0	0	0
12	Federal land	0	0	0	0	0	2,900	0	2,900
13	CRP	0	0	0	0	0	0	0	0
14	Total	823,300	582,200	1,463,200	548,500	29,193,000	186,500	241,300	6,764,300

After adding more “bells and whistles” data takes the form of information that can be distributed or presented.

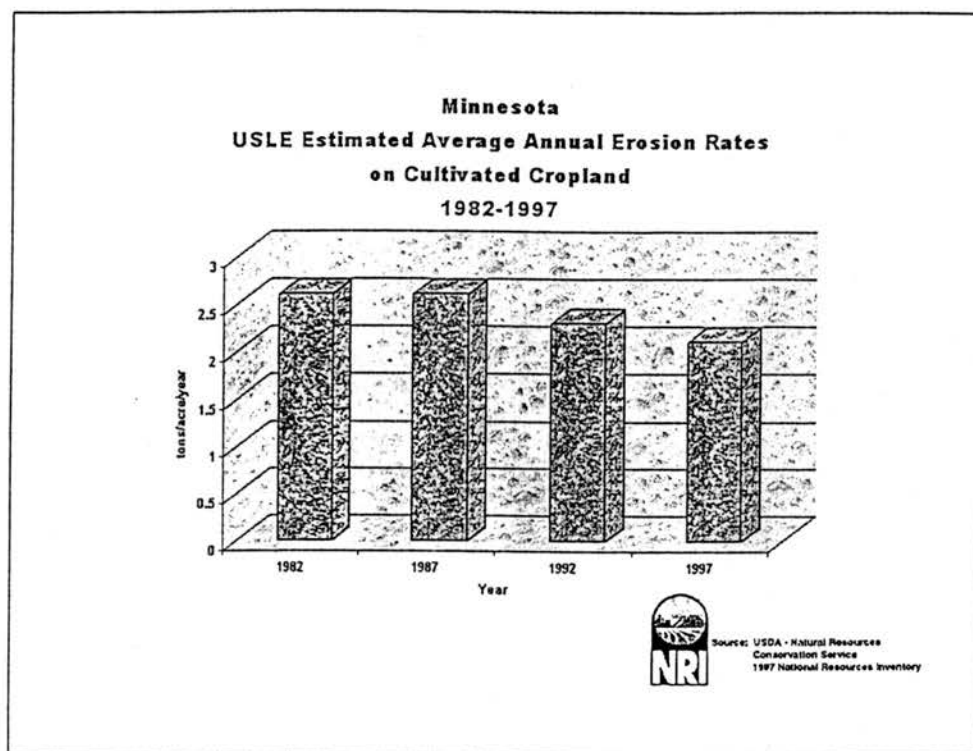


Data can be easily displayed as pie charts.

This example shows the relative acreage of different Land Cover/Use categories in Minnesota in 1997.

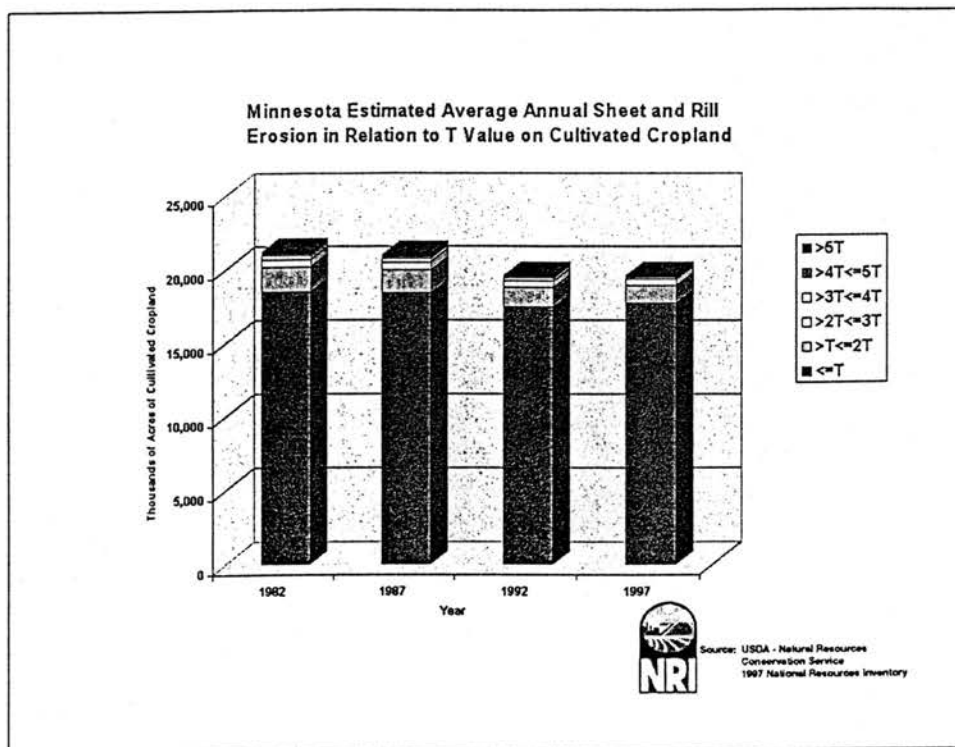


This example shows the total sheet and rill erosion soil loss as measured by the Universal Soil Loss Equation (USLE), in relation to tolerable soil loss level (T) in Minnesota on cultivated cropland in 1997.



A simple bar chart can be used to illustrate changes over time.

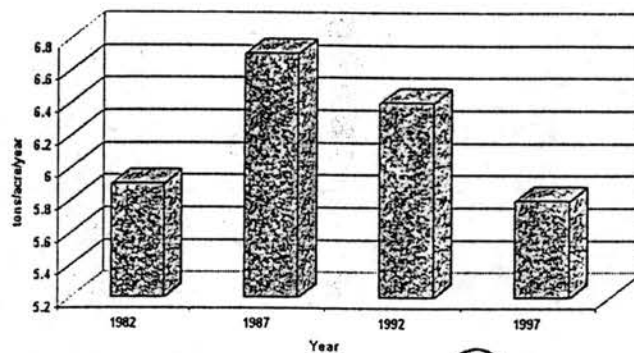
This example shows the changes in USLE estimated annual erosion rates in tons/acre/year on cultivated cropland.



A stacked bar chart can show a change over time as well as another relationship.

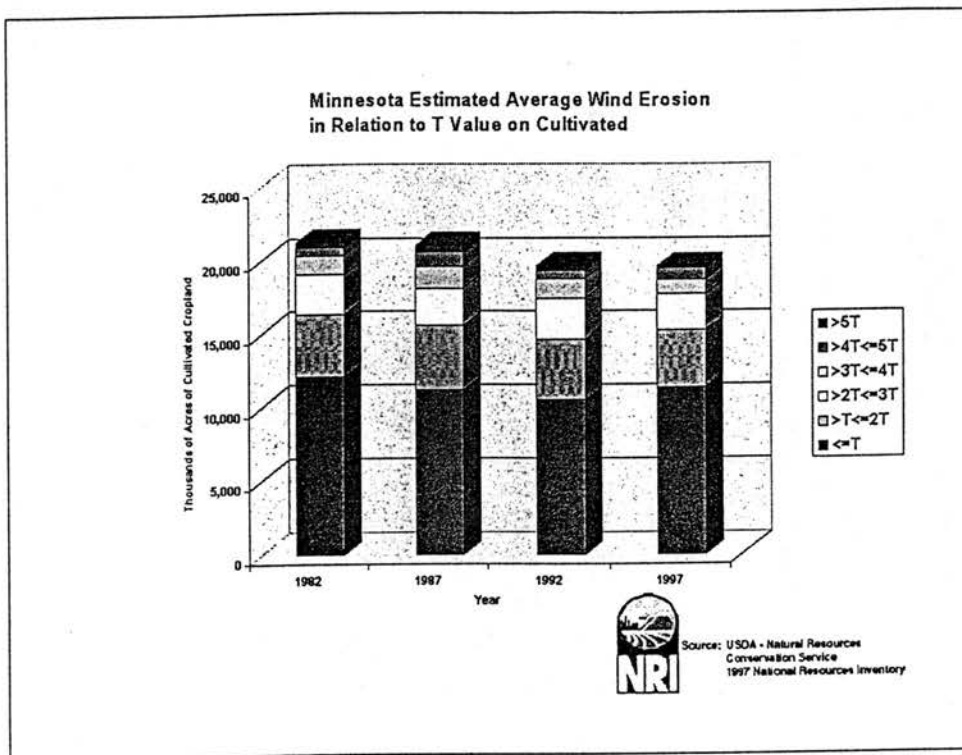
This example shows the changes in acres of sheet and rill erosion in relation to T value over time as well as the relative proportions of acres in relation to T.

Minnesota
WEQ Estimated Average Annual Erosion Rates
on Cultivated Cropland
1982-1997

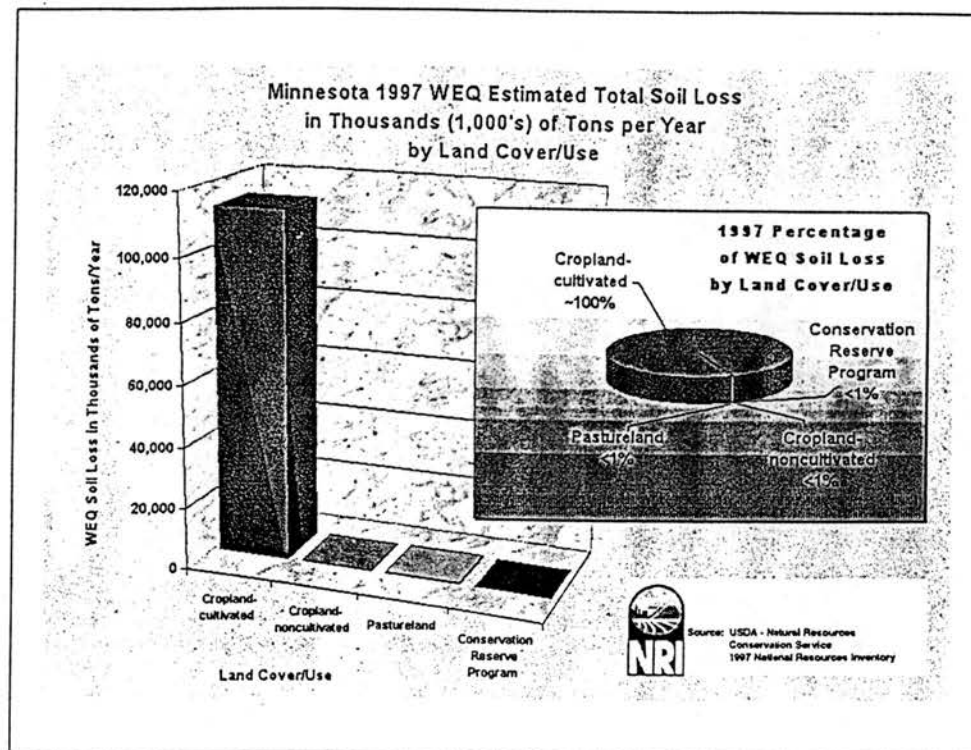


Source: USDA - Natural Resources
 Conservation Service
 1997 National Resources Inventory

This example shows changes in Minnesota wind erosion as estimated by the Wind Erosion Equation (WEQ) on cultivated cropland.

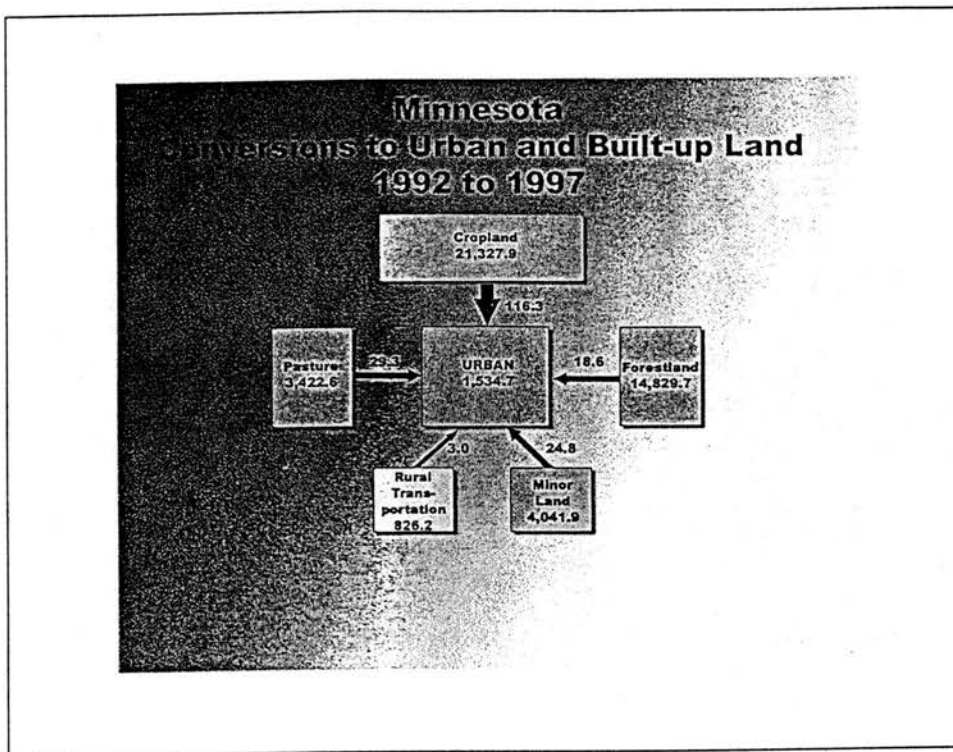


This example shows the relative proportions of acres of WEQ wind erosion potentials in relation to T values and the changes over time.



Multiple charts displayed together can be used to illustrate multi-dimensional relationships.

This example shows Minnesota 1997 estimated wind erosion soil loss and the relative proportions attributable to different land cover/uses.

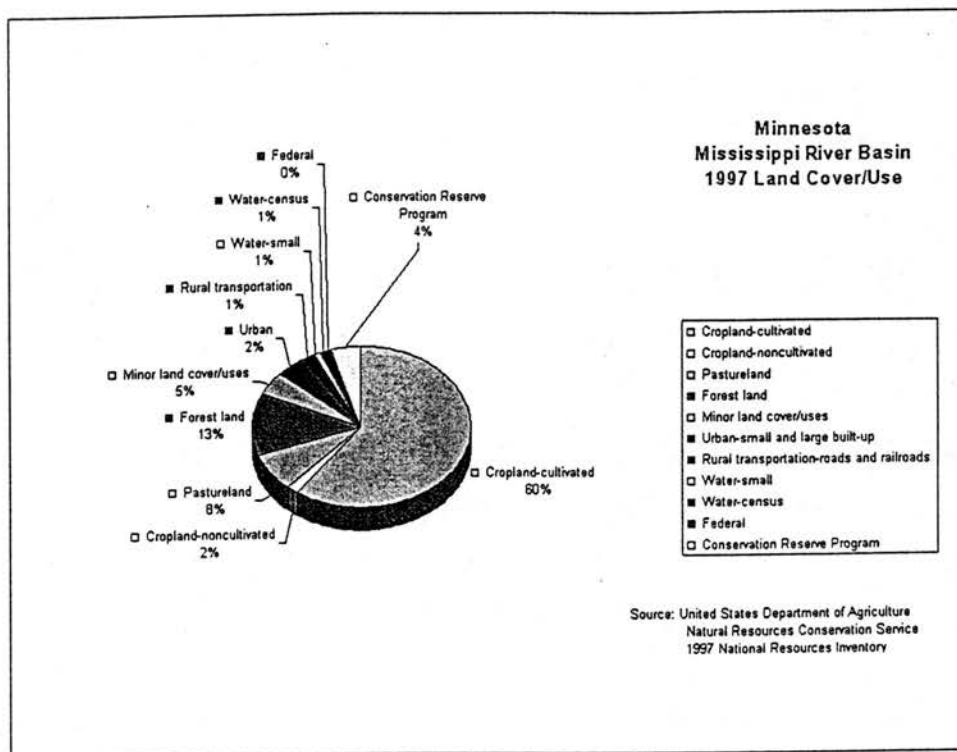


Flow charts can be used to illustrate the dynamics of land cover/use changes over time.

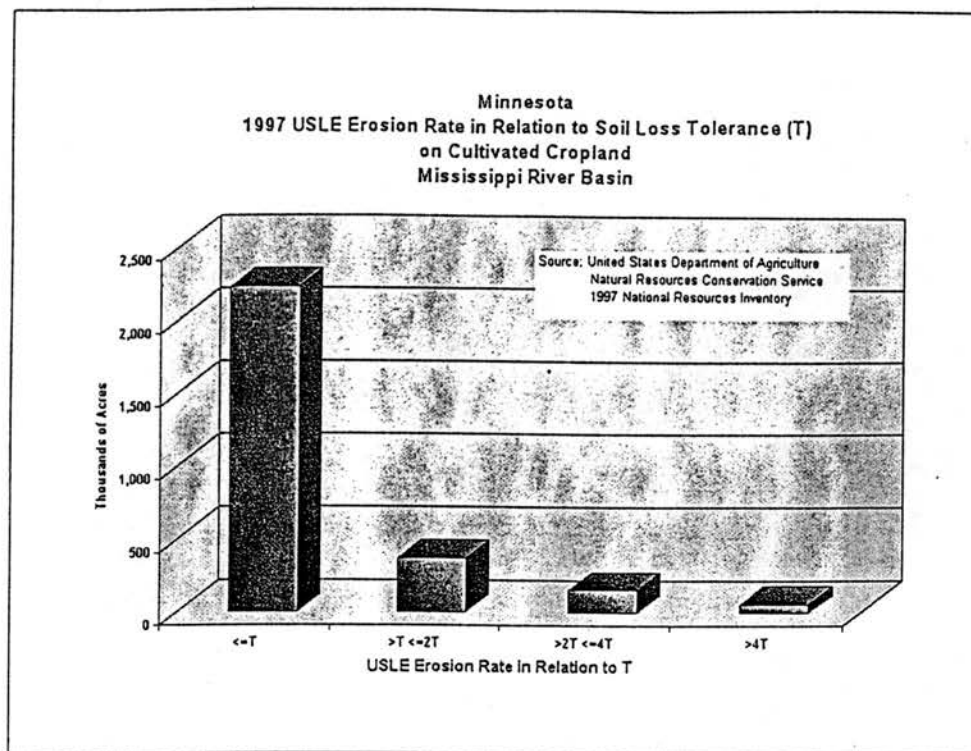
In this example showing the conversion of land to urban use, the changes are irreversible and therefore the arrows go in only one direction. A more complex chart might have multiple direction arrows showing conversions into and out of the various land uses.

The Minnesota River Basin

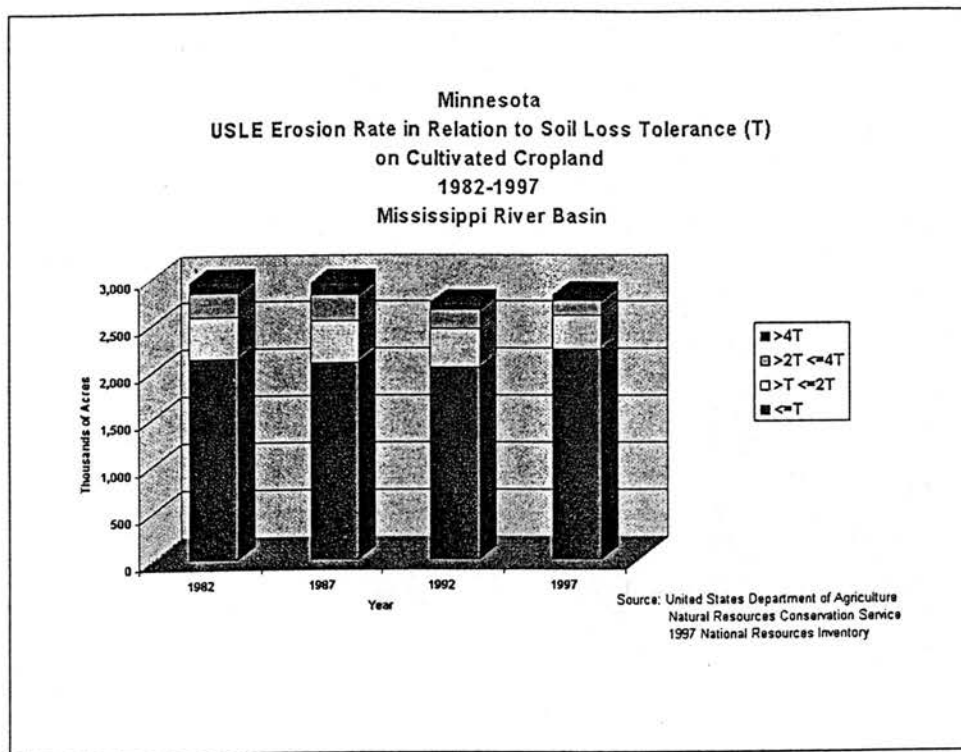
- 1997 Land Cover/Use
- 1997 USLE Erosion Rate in Relation to T on Cultivated Cropland
- 1982-1997 USLE Erosion Rate in Relation to T on Cultivated Cropland
- 1997 USLE Total Soil Loss in Relation to T on Cultivated Cropland



The 1997 land cover/use ratios in the Mississippi river basin.

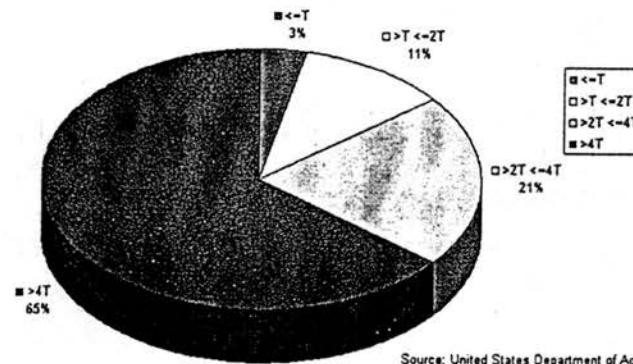


1997 USLE sheet and rill erosion rate in relation to soil loss tolerance (T) on cultivated cropland in the Mississippi River basin.



This example show the changes in USLE erosion in relation to T on cultivated cropland in the Mississippi River basin.

Minnesota
1997 Total USLE Soil Loss in Tons/Year
by Erosion Rate in Relation to T on Cultivated Cropland
Mississippi River Basin



Source: United States Department of Agriculture
Natural Resources Conservation Service
1997 National Resources Inventory

When displayed as proportion of total soil loss, it is easier to visualize that small acreage's are responsible for large percentages of the total soil loss.

Summary

- NRI - largest natural resource database in the world
- Data available for hundreds of elements
- Accessible through the WWW

FOR YOUR INFORMATION

- Education Committee Minutes
- Board Member Update
- Children's Water Festival Information
- Article "Where Are We Falling Short" from *Conservation Voices*
- Article "Q & A with Tom Karl, director of the National Climatic Data Center, from *Conservation Voices*
- Updated listing of BWSR Members (include in your Board Member Handbook)
- Updated listing of BWSR Staff (include in your Board Member Handbook)

From: Ron Struss
To: #Board Conservationists; #M Team; #Regional Sup's and Secretaries
Date: 3/17/00 9:58AM
Subject: BSWR Education Committee Minutes

Education and Public Relations Committee
Minnesota Board of Soil and Water Resources
=====

Minutes of 2/23/00 Meeting

Attending
=====

Members: Jim Anderson, Ginny Imholte, and Paul Krabbenhoft. Claire Nelson was unable to attend due to a Cost Share Committee meeting held at the same time, and Leland Coe was unable to attend because of poor traveling conditions. Staff: Ron Struss

Kamal Alsharif - Water Resource Educator, Northern Region
=====

As part of a series of presentations by BWSR education staff, Kamal shared with the Committee his areas of involvement and opportunities and challenges for education in the Northern Region. A PowerPoint presentation given by Kamal is attached.

On 3/22/00, Susan Tsakakis will present on BWSR outreach communications, and on 4/26/00 Derek Fisher will present on his work in nutrient and tillage education in the Southern Region.

Drainage Law Education Proposal
=====

Ron Struss presented the current evolution of the drainage education project. Dan Eklund, BWSR Wetlands Specialist, worked with Ron to come up with the current proposal. The proposal provides technical support to counties that would benefit from developing a more formal structure for administering drainage law. The concept is to obtain funds to cover half the anticipated \$10,000 per county cost. It is anticipated that seven counties would participate. The project proposal is attached.

The Committee thought the program had merit, and liked the direct targeting approach. Their recommendation for moving ahead is: 1. Review the proposal with impacted BC's and Regional Supervisor, 2. Gain AMC support, 3. Seek funding sources.

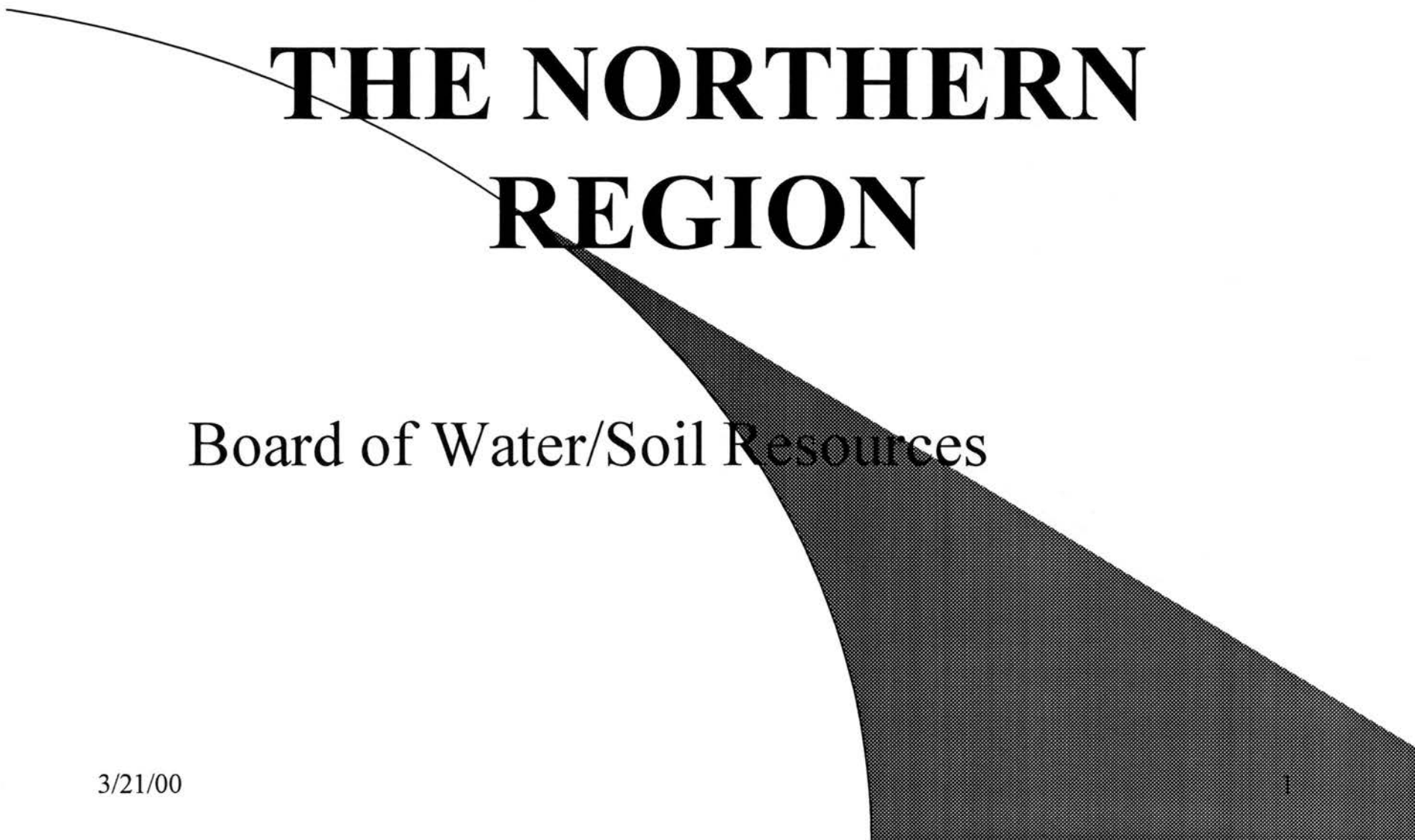
"History of BWSR" Board Room Display
=====

Ron Struss presented briefly an idea to start capturing BWSR history in framed wall displays. Each display would cover a decade, and feature photos of Board Members, photos of key staff, listing of all staff, and year-by-year summaries of key events. Further discussion of the display idea was tabled until next meeting. A copy of the proposed display design is attached.

Adjourn - Next meeting 3/22/00
=====

Submitted by Ron Struss, 1/26/00

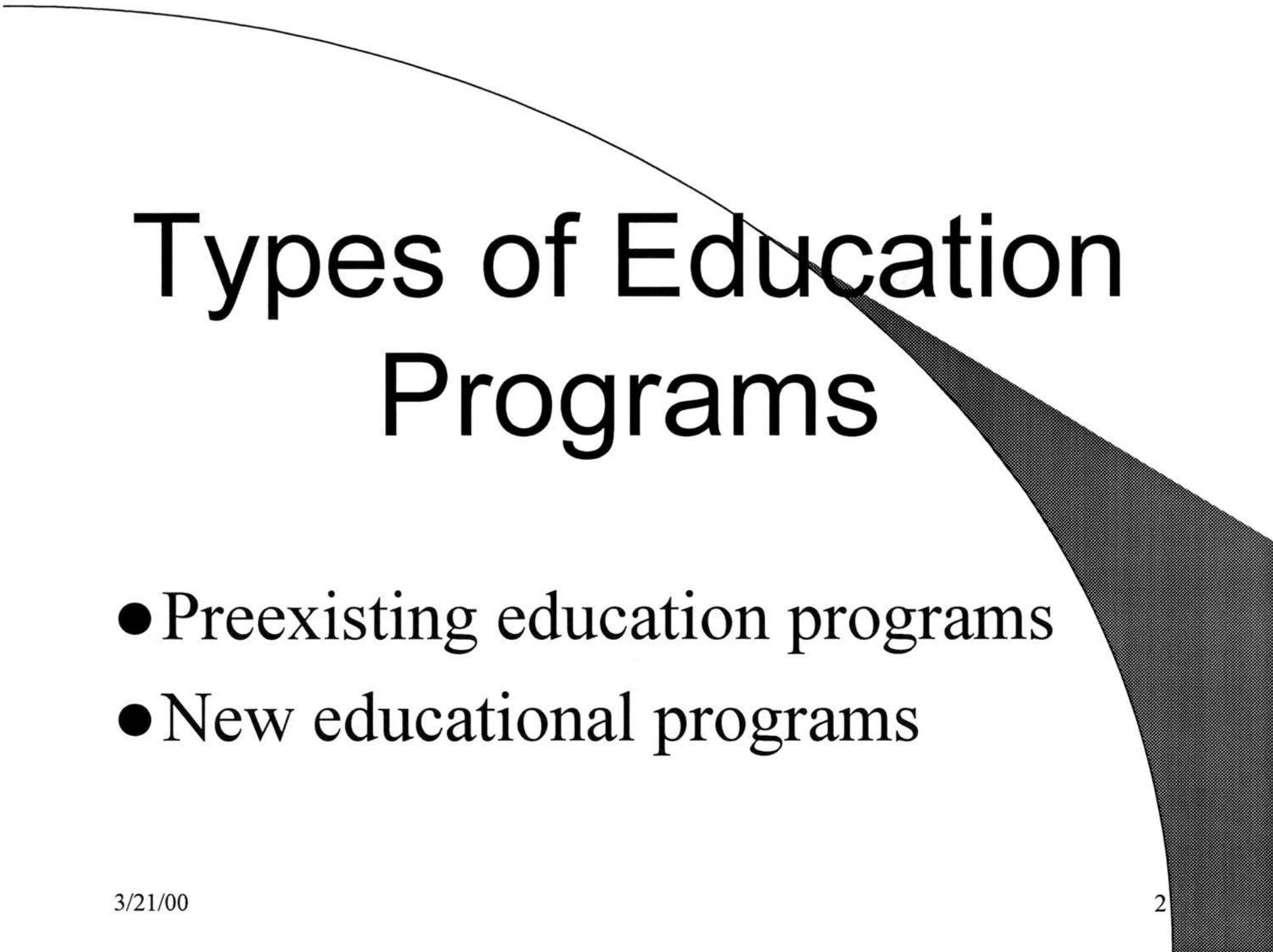
BWSR EDUCATION IN THE NORTHERN REGION



Board of Water/Soil Resources

3/21/00

1

A thin black curved line starts from the top left and arcs across the top of the slide. A large, dark gray shaded area with a fine grid pattern is located on the right side, extending from the top right towards the bottom right.

Types of Education Programs

- Preexisting education programs
- New educational programs

Preexisting Educational Programs

Examples:

Envirothons

Environmental days for kids

MASWCD Education Team

Project Wet Workshops

Preexisting Educational Programs Challenges:

- Do an evaluation of these programs, keep track of who is doing what
- Avoid duplicate efforts in the counties
- Lack of communication about some of these programs
- Let the LGUs know about our educational efforts and keep reminding them of the educational resources
- How to improve old programs to fit the demographical and socioeconomical changes

Preexisting Educational Programs

Advantages:

- Less time and money
- LGUs appreciate the type of service we provide
- Gives us credibility
- Strengthen ties among state and non-state agencies

New Educational Programs

Examples:

Lakeshore Education Workshops

EQIP Education programs

New water education teams

MASWCD Poster Calendar

New Educational Programs Challenges:

- Always changing
- Difficult for people to adapt to changes
- Many issues and subjects to cover
- Time constraint
- Too many issues

New Educational Programs

Advantages:

- Makes the job interesting and unique
- Adopt new methods that will benefit the water resources in the state
- Continued support and funding
- Enhance the partnership between Extension and BWSR

Vision of the future

- Follow the BWSR current Education Plan and Northern Plan
- Continue to support LGU education
- Look for new ideas to share with the LGUs
- Continue to find funding sources for water education programs
- Increase and enhance University resources so they can work effectively with LGUs

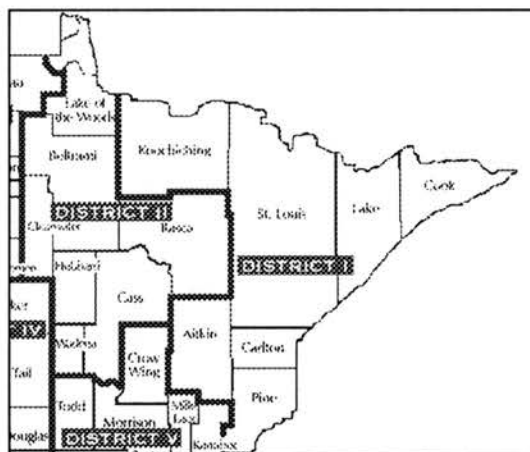
Drainage law education proposal

Developed for the BWSR Education Committee – Ron Struss – 651/215-1950

On 3/21/00 Dan Eklund, BWSR Brainard, and Ron Struss, BWSR / UM Extension Metro, discussed the idea to include drainage education at upcoming AMC (Association of Minnesota Counties) regional workshops. This was following up on the BWSR's Education Committee request that such training be investigated.

Conclusions arrived at:

- The most pressing need is for counties that are not actively administering drainage law to develop an administrative system to do so.
- For various reasons of history and geology, counties that need to improve their structure for drainage law administration are in NE Minnesota (All of AMC Districts 1 and 2, and northern half of District 5).
- Drainage workshops are good for raising awareness and some understanding, but do not always equate in actual administrative changes at the county level.



The following educational strategy is proposed for review and comment:

1. Have AMC secure a grant to contract with an individual or firm knowledgeable in drainage law. This individual or firm will work one-on-one with counties to develop lasting structures for administering drainage law. It is estimated that the contracted individual or firm would require forty hours per county.
2. Cost per county for developing a drainage law administrative structure is estimated at \$10,000 per county. The AMC grant would cover half this cost, with participating counties covering the other half.
3. It is estimated that seven counties would participate for a total cost of \$70,000; \$35,000 in grant funds, and \$35,000 in county funds.
4. The availability of the AMC grant program would be made known with short presentations at AMC regional meetings in Region 1, 2, and 5. These presentations could be made by AMC, BWSR, or UM Extension staff. Presentations will feature case stories of how lack of adherence to drainage law has led to costly complications.

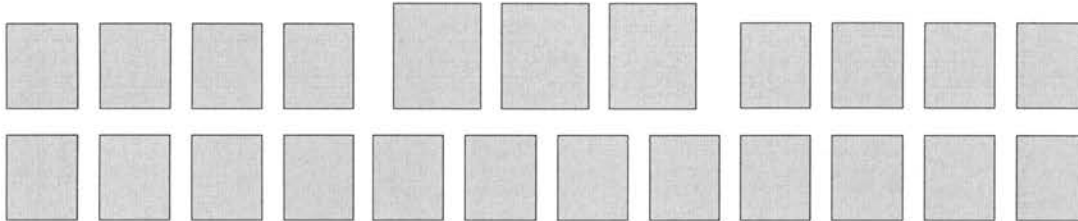
OVER >

Implementation steps:

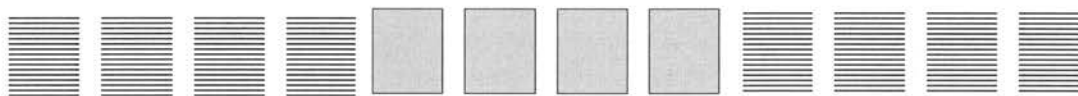
1. Refine program with input from AMC, BWSR, and UM Extension.
2. Develop program objectives and implementation strategy.
3. Seek and secure grant funding.
4. Implement and evaluate program.

Minnesota Board of Water and Soil Resources

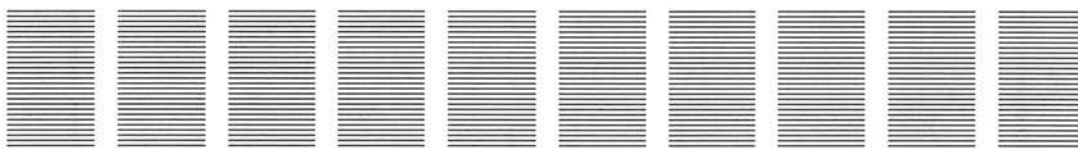
1987 - 1997



Staff



Milestones





Board member Update

March 2000

Land and Water Section

Note: Last month at a section meeting, staff discussed the Board Member Update and our section's contribution. Traditionally we haven't provided monthly updates as much of the section's work is covered by committee reports – e.g., cost-share, dispute resolution, wetlands. Occasionally section staff has submitted articles about a hot topic. Staff collectively agreed that this is a valuable contribution to the update, and made a commitment to try and submit feature articles on a monthly basis highlighting the section's interesting and important work in areas such as pasture management planning, soils mapping, wetland banking/restoration plans, and watershed planning. We hope you enjoy the articles and welcome any comments you'd like to offer.

Lake Management Forum held in Brainerd

At the January meeting, the board agreed to co-sponsor reconvening

the Lake Management Forum. The Interagency Lakes Coordinating Committee (ILCC) coordinated the meeting, which was held in Brainerd on February 22 and 23. It had been eight years since the forum was originally created and since it had published a report focusing on seven recommendations for managing Minnesota's lakes. Those recommendations focused on determining the economic value of lakes; making lake sustainability a primary goal of lake management; fostering a collaborative approach to lake management in the state; managing lakes on watershed boundaries; coordinating lake data collection and application; developing a comprehensive lake classification system; and developing a comprehensive lake management education and information delivery system.

Over 65 participants participated in small groups and 1) evaluated the progress made towards those recommendations; 2) identified current issues relevant to the recommendations; and 3) identified what steps need to be taken to address those issues and who should lead that effort. The participants represented a broad base of lake interests – the

At the January meeting, the board agreed to co-sponsor reconvening the Lake Management Forum.

Other recurring comments included the need for improved coordination and communication, the need to develop and convey a sense of urgency, and the desire to make local water plans more comprehensive and inclusive with reference to lake management issues.

Minnesota Lakes Association, county water planners, watershed district managers, Coalition of Lake Association (COLA) representatives, and state and federal agencies. Not surprisingly, a lot of progress had been made with respect to some of the recommendations (managing on watershed boundaries, collaborative management efforts) and hardly any progress on others (economic data). While no time was budgeted to identify other important lake management initiatives, increasing surface use and the resulting conflicts, as well as the lack of systematic funding for lake management, were voiced time and time again. Other recurring comments included the need for improved coordination and communication, the need to develop and convey a sense of urgency, and the desire to make local water plans more comprehensive and inclusive with reference to lake management issues.

BWSR staff attending the forum meeting included Special Projects Coordinator Marybeth Block and Board Conservationists Dale Krystosek and Dan Steward.

Northern Region

Wetland Conservation Act

Wetland Specialist Dan Eklund and Board Conservationist (BC) Bill Best have reviewed the draft revision of the Harbott Violation restoration order and guidance for Thief River Falls and Pennington

SWCD. This violation involves some illegal fill on the flood plain of Thief River in the city of Thief River Falls. Darcy Harbott and Bryan Malone (Pennington SWCD) met on March 13 to review and discuss the restoration order. Bryan (and/or the city of Thief River Falls) will be assisting Darcy in the completion of a wetland replacement plan application. Harbott has gotten some bids to remove the fill from the land that he doesn't own. The revised restoration order will be delivered to Harbott when he returns from vacation. It is hoped that the restoration work can be completed before the ice and water from the Red Lake River removes the fill from the site.

BWSR, Mille Lacs Planning and Zoning, Mille Lacs SWCD, Mille Lacs County Attorney, the U.S. Army Corps of Engineers (USACOE), and the DNR Division of Enforcement are working to resolve the final Kreger WCA violation in Mille Lacs County. An additional violation by Mr. Kreger was discovered on an adjacent landowner's property. The landowner is in the farm program and, ultimately, it may not be a WCA issue.

Lake Flooding Cost-Share

After approval of \$100,000 of special project funds for lakeshore erosion caused by record precipitation last year, Bemidji BC Dale Krystosek, in conjunction with Grants Coordinator Wayne Zellmer, developed cost-share application materials. Most of the eligible counties are preparing applications to utilize the special project funds. Funding recommendation will be

presented to the Board at the April board meeting.

Watershed Districts

In the Roseau Watershed District, BC Brian Dwight met with the county commissioners to explain the Hay Creek Project and clarify some misconceptions. The commissioners passed a motion to support the Hay Creek Project concept, provided local citizen's concerns would be addressed.

Forestry

Forester Jim Lemmerman is working with Doug Thomas to develop a web-based system to inventory sites that need protection from blowing snow. This system would enable local units to report their living snow fence establishment.

Miscellaneous

BCs Dale Krystosek and Dan Steward, as members of the Interagency Lakes Coordinating Committee, worked to reconvene the Lake Management Forum at Cragun's on February 22 and 23. Approximately 70 people attended, including representatives of lake associations, private organizations, local units of government and state agencies. Small group discussions spawned many ideas about using Local Water Planning as a mechanism for many lake protection efforts.

On February 1, Dan Steward attended a meeting in Walker for the Cass/Crow Wing County

Upland Suitability Model. The project started out as an action with the Whitefish Chain of Lakes Septic Upgrade project, funded by BWSR and the Legislative Commission on Minnesota Resources (LCMR). The upland model portion of the project has grown. The purpose of the model is to be able to crank a proposed development through the model and have it evaluate the suitability of the property to the use being proposed. Some land will rank very high in development suitability, while other parcels will rank very high for protection. Hopefully, the model can give local decision-makers a better information base from which to make land use decisions in rapidly developing lake country.

Engineering and Technical Services Section

Conservation Reserve Enhancement Program (CREP)

Current status

Number of easements	460
Acres	16,500
State \$ spent, encumbered or needed*	\$11.2 M
CRP funding leveraged	\$24.7 M
Wetland restorations	100
30-yr. marginal pasture easements	11

**102 applications for \$2.2 M are pending new state funding.*

The purpose of the model is to be able to crank a proposed development through the model and have it evaluate the suitability of the property to the use being proposed.

Many landowners were interested in the CRP extensions on riparian buffers throughout the state; these accounted for 73 percent of the funded applications.

Reinvest in Minnesota (RIM)/Wetland Restoration Program (WRP) Partnership

BWSR and the Natural Resources Conservation Service (NRCS) recently approved 33 new applications for 1,646 acres with 66 restorable wetland basins and 629 wetland acres.

RIM/WRP easements	122
Acres	7,839
State funding	\$3.5 M
Federal WRP funding	\$7.8 M

BWSR staff are coordinating with NRCS and Ducks Unlimited to establish a partnership agreement for staffing to accelerate implementation of RIM/WRP projects. The mutual goal is to get additional WRP funding in Minnesota.

Regular RIM

The most recent regular sign-up resulted in the following:

TYPE	NO.	ACRES	\$\$
Wetland restorations	22	479	\$460,000
Riparian	29	807	\$747,000
Marginal Cropland	11	334	\$298,000
PWP	7	276	\$258,000
CRP extension	183	3,318	\$1.586 M
TOTAL	252	5,214	\$3,340 M

Many landowners were interested in the CRP extensions on riparian buffers throughout the state; these accounted for 73 percent of the funded applications. These extensions place a perpetual RIM easement on top of existing CRP contracts and pay the "CREP-like" bonus payment, which reduces the state easement cost by about 50 percent.

Lakeshore Engineering

BWSR staff recently submitted pre-proposals to the Minnesota Lake Superior Coastal Program, which is an outgrowth of the national Coastal Zone Management Program in Minnesota. These proposals are for BWSR and soil and water conservation district (SWCD) staffing assistance to help implement shoreline stabilization and other nonpoint pollution abatement practices. We're exploring new partnership possibilities for conservation practice implementation.

Gene Clark, lakeshore engineer, reports that he and Brad Matlack, lakeshore technician, will assist SWCDs and landowners with construction of seven North Shore stabilization projects this year. These projects have received financial assistance from the Lake Superior Clean Water Partnership and EPA 319 grants, as well as state cost-share. Contractor and rock availability could be challenging.

A geographic information system (GIS) database, including shoreline erosion hazard classification and fishery habitat sensitivity, is being

developed via a Great Lakes Commission grant to the BWSR. This database is being coordinated with the Department of Natural Resources (DNR) and the Pollution Control Agency (PCA).

Engineering Training and Support

Justin Jeffery, training and design engineer, has developed training for Ag Waste Management Systems Planning and recently presented the course in Marshall. He also provided training in Marshall for the Feedlot Evaluation Model and training in Fridley for Hydrology – Peak Flow Determination. At this time, Justin has 10 more training sessions planned for this year. This state level training supplements the area level training provided via the partnership training system.

Justin is assisting NRCS, BWSR and SWCDs to develop an interim standard for alternative tile inlets. The interest in alternatives to open tile inlets has been growing very fast in the past year or so. Al Kean, chief engineer, and John Brach, NRCS state conservation engineer, are having Justin lead efforts to consolidate available design information to develop an interim standard to assist front-line technical assistance staff. The available science for designing gravel pack inlets is very limited.

Feedlots

Feedlot rule development, feedlot

legislation and interagency coordination have dominated a substantial portion of Al's time during the past couple of months. PCA made a number of modifications to the proposed rule based on public hearings and comments. The administrative law judge overseeing feedlot rule development will now consider all the comments and recommended rule changes and issue a report in four to six weeks. The PCA received more than 1,000 comments on the proposed rules.

A feedlot partners training session was held on March 15, involving county, PCA, SWCD, NRCS and BWSR staff, as well as a few private consultants involved in feedlot pollution abatement. Two Minnesota Department of Agriculture (MDA) dairy inspector supervisors also attended. The primary objective was to help get everyone on the same page regarding roles, regulations, technical and financial assistance program criteria and definition of "what's good enough". Al and Justin were involved in planning and delivery, along with PCA and NRCS staff.

PCA made a number of modifications to the proposed rule based on public hearings and comments.

Southern Region

Conservation Reserve Enhancement Program

CREP marketing and delivery continue to be high priority for BWSR and local government units (LGUs). Many presentations have been made to partner organizations to stimulate interest and enthusiasm for this short-

There will be unimaginable opportunities for SWCDs to build capacity and put conservation on the ground within their districts.

term opportunity. Our internal and external capacity to deliver is being assessed and a process put in place to deal with the implementation of the largest conservation program ever attempted in this state. There will be unimaginable opportunities for SWCDs to build capacity and put conservation on the ground within their districts. The count down to September 30, 2002, continues.

BC David Sill also reports meeting individually with each of the five CREP easement specialists in his work area. Discussion has centered on the past year's program successes and/or problems and the development of strategies and goals for CREP in 2000. These individual meetings with SWCD offices are extremely valuable.

Hot Topics

BC Dave Peterson attended an Albert Lea Chamber of Commerce meeting explaining a proposal for a lake improvement project for Albert Lea Lake. Part of the proposal involves formation of a watershed district. Petitions were circulated in February for formation of the Shell Rock River Watershed District. The proposal is very controversial locally with strong groups for and against the project and the watershed district.

TIME SENSITIVE - FORWARD TO ALL METROPOLITAN AREA 5TH GRADE TEACHERS.

Metro Area fifth grade teachers and their classes are invited to attend the:

2000 METRO CHILDREN'S WATER FESTIVAL



IMPORTANT NOTES:

- A. This program is provided at no cost to schools (including bus transportation).
- B. The DEADLINE is March 31, 2000: a lottery drawing will select the participant classes.
- C. A registration form is on the reverse side of this sheet.

PURPOSE: The purpose of the Metro Children's Water Festival is to raise the awareness of water in everyday life and enhance County and Watershed Management Organization water quality protection programs through education. The festival brings the topic of water alive through interactive activities. Participants learn that water is found in a variety of forms (solid, liquid, and vapor) and why water is called the "universal solvent." By understanding the water cycle, groundwater, surface water, and other related natural resources, participants learn to appreciate their natural environment and celebrate Minnesota's abundant water resources.

WHO SHOULD ATTEND: The Festival is open to all Metro Area 5th grade classes (or combined classes).

WHEN and WHERE: Wednesday, September 27, 2000 from 9:00 a.m. to 2:30 p.m. at the Minnesota State Fairgrounds.

TRANSPORTATION AND LUNCH PROVIDED: Busing costs will be reimbursed by the sponsor. Lunch and refreshments are being provided by sponsoring agencies.

ACTIVITIES: This year's event promises to be exciting with fun activities and interactive displays including: *Wetland Metaphors*, *Water Pictionary*, *Build Your Own Aquifer*, *Fish Prints*, and *Would You Drink This Water?* Students will participate in presentations by professionals in the education and environmental fields. The learning stations are located inside and outside. The Science Museum's production "WATER!" will return for an encore performance.

TEACHER'S RESOURCE: A Water Sourcebook, full of classroom activities, will be provided to teachers who attend.

SPONSORS: The Metro Area Groundwater Alliance (MAGWA) is sponsoring the Festival in cooperation with the US Environmental Protection Agency, Minnesota Department of Natural Resources, Minnesota Department of Health, Minnesota Office of Environmental Assistance, Metropolitan Council Environmental Services, Board of Environmental Assistance, U of M Cooperative Extension Service, Minnesota Board of Water & Soil Resources, Watershed Districts, metropolitan county and municipal units of government, private businesses and individuals.



WHAT HAVE TEACHERS SAID ABOUT THE FESTIVAL: "The Water Festival was one of the most interesting field trips my class has ever taken. It was well organized, interesting, fast-paced, educational and a lot of fun. Students, chaperones, and teachers will have a fulfilling day and want to come back again for years to come!" (Brad Stamman, 5th Grade Teacher, Rice Lake Elementary, Lino Lakes, MN). Of the 17 surveyed teachers that participated in the 1999 festival, 16 said that they would definitely attend the 2000 Festival (one said maybe).

REGISTRATION INFORMATION: Because there is a limit on the number of students - a random drawing will select the applicant classes until we reach our capacity. This year we have established multi-class registration of up to 150 students. Four multi-class slots are available. The first 1,200 students selected in the drawing will attend the Festival. Classes not chosen in the drawing will be placed on an alternate list (we have had cancellations before).

YOUR REGISTRATION MUST BE POSTMARKED OR E-MAILED BY MARCH 31, 2000

REGISTRATION PROCEDURE: To register provide information on the following nine (9) items:

1. We can arrive by (X): ☐ 9:00am ☐ 9:30am ☐ 10:00am
2. We must leave by (X): ☐ 1:30pm ☐ 2:00pm ☐ 2:30pm
3. School Name
4. Address
5. Number of classrooms
6. Number of students attending per classroom
7. Teacher name(s)
8. Teacher phone number(s)
9. Teacher E-mail address(es)

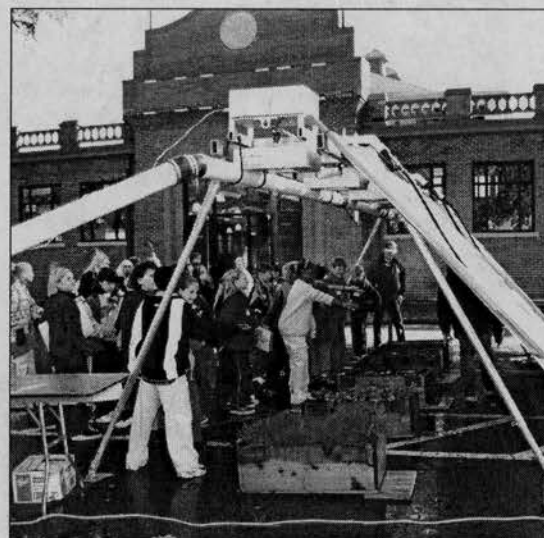
Either mail or E-mail the information to:

Bart Biernat (bfbierna@co.anoka.mn.us)
c/o Metro Children's Water Festival
360 Government Center
2100 Third Avenue
Anoka, MN 55303-2264.

NOTIFICATION: A drawing will be held in April and you will be notified of the result before the end of the school year. You will be notified of the lottery selection results. Details about the Festival will be provided to the selected classes at that time.

FOR MORE INFORMATION: Call Bart Biernat at (612) 422-6985 or E-mail bfbierna@co.anoka.mn.us.

MAIL (E-MAIL) NO LATER THAN MARCH 31, 2000!



Where are we falling short?

THE NATURAL RESOURCES INVENTORY

Nearly 75 percent of our nation's land is privately owned. How the owners care for that land affects all of us—people in rural and urban areas alike. It affects how clean our tap water is, how pure the air we breathe might be, and how safe and healthy the food we eat is.

So what is the condition of privately owned land these days? The latest Natural Resources Inventory (NRI) provides some answers.

In December, U.S. Agriculture Secretary Dan Glickman released the 1997 NRI. Glickman says the report, which is completed every five years, documents the extraordinary strides that were made between 1992 and 1997, but also spotlights new conservation challenges.

The NRI is a statistically based survey conducted by the U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service in cooperation with the Iowa State University Statistical Laboratory. The 1997 NRI compiles data from 800,000 sample sites in all 50 states, Puerto Rico, the U.S. Virgin Islands, and the Pacific Rim.

"Conservation challenges are mounting and intensifying more quickly than we are solving them," said Glickman, at the USDA's National Summit on Private Land Conservation in December. The troubling trends, encompass three issues—soil erosion, urban sprawl, and irrigation.

Soil erosion

The NRI found that nearly 2 billion tons of soil erodes into water- ways each year in the United States. That's like taking 60 million semitrailer trucks full of soil and carting it away. And although erosion on cropland has been reduced nearly 40 percent since 1982, 30 percent of our cropland continues to erode excessively. That's 112 million acres—nearly twice the size of Wyoming.

Excessive erosion is a concern because once the soil is gone, it's gone. And with the soil often goes pesticides and nutrients in concentrations too high for our streams and rivers to absorb safely. These

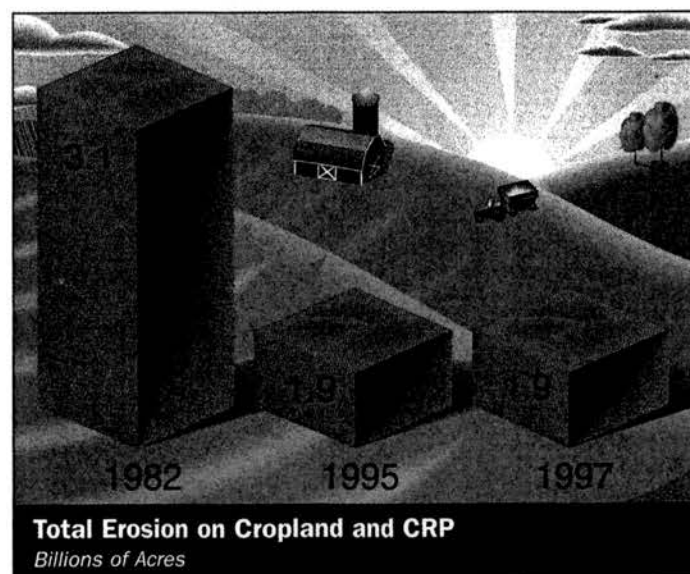
During this presidential election year, with Congress beginning to debate the next farm bill, we need more than ever, as a nation, to have concrete measures of what is happening on private land so we can act.

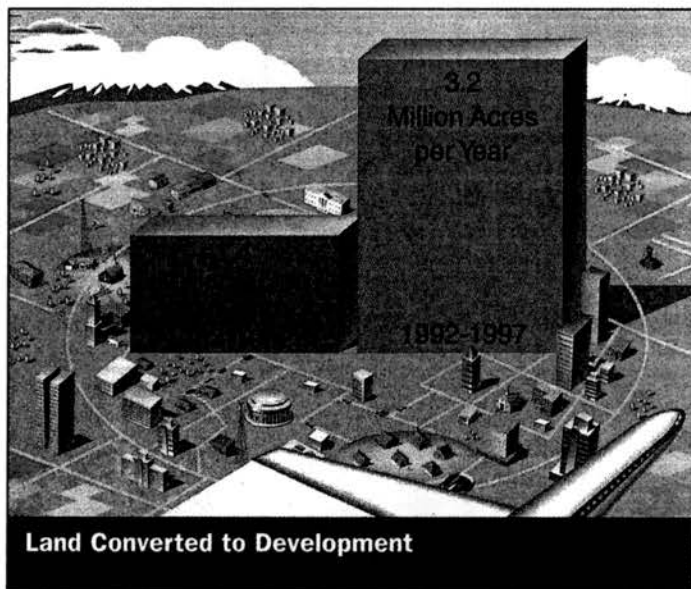
pesticides and nutrients may kill fish and aquatic plants and pollute our drinking water.

Excessive erosion is not only caused by water, but wind as well. The NRI found that wind erosion negatively impacts air quality in the West, Midwest, northern plains, and southern plains.

What is disturbing is that in the last five years there haven't been any gains in erosion control on a national scale.

The Conservation Reserve Program (CRP), a 1985 farm bill initiative, has been particularly instrumental in reducing soil erosion. The CRP converts highly erodible cropland to permanent vegetation—grasses, trees, or shrubs—by offering cost-share and annual rental payments.





Urban sprawl

Another concern is the nation's green space being converted to concrete. The data shows the farm acres converted to development have increased dramatically. Between 1992 and 1997, more than twice as much agricultural land was developed than in the decade before. From 1992 to 1997, we have lost 3 million acres per year of agriculture land to development—a rate nearly triple to the development between the previous 10 years.

This situation is not a threat to our source of food and fiber products, but the loss of prime farmland can result in disjointed patches of agriculture acres and affect quality-of-life. Ralph Grossi, president of the American Land Trust, says, "Many communities are deciding they would like to have agriculture remain as part of the socioeconomic structure of their community." He suggests that the federal government use a new model to work with local communities on the issue of farmland loss.

Irrigation

The NRI data also shows that the distribution of irrigation is changing. Irrigation in the West and south central states has gone down, while irrigation has increased in the Midwest, northern plains, and the East.

The significance of this shift is irrigation can deplete surface and groundwater, straining the supply of quality water. With an increase in irrigation around populated areas in the East, the competition for water may increase which for this area has been uncommon in the past. Irrigation on soils containing soluble salts can lead to salinization—the buildup of salt—in the soil and water supplies. Salinization is a problem because it leads to reduced soil productivity and water pollution.

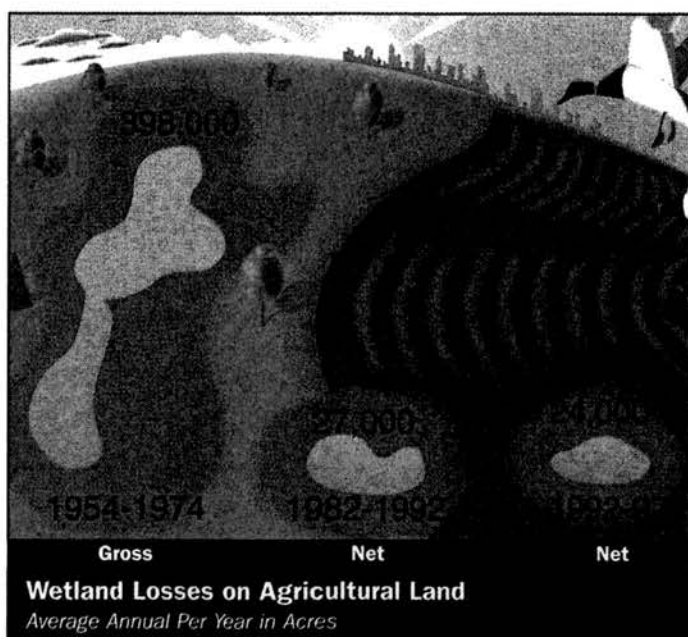
Other trends

The NRI also notes changes in the composition of the nation's grazing land. In the five years of the study, from 1992 to 1997, pastureland and rangeland declined by nearly 10 million acres. A net decline in acres means fewer acres for sequestering carbon, providing food for animals, and protecting water quality and quantity. The changes that occurred to grazing land are mostly due to the conversion—to or from—cultivated cropland.

Wetlands are another natural resource the NRI surveyed. USDA's goal is to work with landowners to achieve "no net loss" of wetlands. Analysis of the NRI data shows that progress is being made to meet this goal. Data shows an increase in 30,000 wetland acres per year compared to the 4,000-acre-per-year gains from 1982 to 1992 but there is still a net loss. The wetland loss in the five years from 1992 to 1997—24,000 acres—is close to the acre loss the decade before—27,000.

Glickman's response to the NRI results was that conservation efforts are falling short of the need. He called for a renewed national commitment to conserving private land. "All Americans concerned about clean water, clean air, and preserving our quality of life should come together to do more to address these conservation challenges," he says.

NRI information is available on the Internet at www.nrcs.usda.gov



Q & A

with Tom Karl, director of the National Climatic Data Center

Changes in Patterns of Precipitation Noted

The National Climatic Data Center (NCDC) is the world's largest active weather data archive. Recently the NCDC reported on precipitation trends in the twentieth century. One of the most striking is an increase in precipitation: not just amount, but also intensity. Tom Karl, director of the National Climatic Data Center, gives more details.

Voices: What do you mean by "precipitation intensity," and how do you measure it?

Karl: To understand what we mean by intensity, think of the rainstorms you get in Florida in the summer—heavy downpours that don't last long. Compare that to winter rain or snowfall in the northern United States: it's usually more gentle, although precipitation can last an entire day. Intensity itself is a rate measurement; you measure the amount of rainfall or other precipitation in a 24-hour period.

Voices: Tell us about precipitation trends in the past century.

Karl: Precipitation intensity has definitely increased across the United States. The total amount of precipitation has also increased, by about 10 percent since 1910. Increased intensity has been a factor in that total increase. Rainfall has gone up both because the number of rainy days has increased, and because when it does rain, it rains harder. More than half of the total increase in precipitation is due to the trend toward more heavy-precipitation events.

Voices: Is the change in intensity a recent development?

Karl: The trend has become most apparent in the last several decades. As for the decade that just ended, I can't yet say. We are about to update our data series through 1999, but it seems like intensity is still going up.

Voices: Obviously the next question is, why has precipitation intensity increased?

Karl: We think it's no coincidence that precipitation intensity has increased at the same time that global temperature has increased. In a warmer climate, there's more water vapor in the atmosphere, so there's a greater likelihood of heavier precipitation in shorter amounts of time. Various climate models support the idea that warmer temperatures are connected to increased precipitation intensity.

Voices: What are some implications of increased precipitation intensity for soil erosion?

Karl: It seems to me there's been a lot of interest in soil erosion from the standpoint of better practices—which are extremely important—but not a lot of attention has been paid to how climate change may have an impact on soil erosion. I would be very interested to identify some additional research funds to study how soil erosion has changed with recent precipitation changes, and to come up with some quantitative estimates for the future. One question to look at is, what's the relationship. If we have a 20 percent increase in heavy precipitation, will that result in 20 percent more soil erosion, or 50 percent more, or 100 percent more? This kind of scientific issue really needs to be addressed.

—Cynthia Berger

\$1.3 billion proposed

Vice President Al Gore announced in January that the Administration will seek nearly \$1.3 billion in the FY 2001 budget for conservation programs. This conservation package is part of a larger Administration budget proposal to strengthen the farm safety net.

"Farmers are among the most important stewards of our land and water," Vice President Gore says. "Despite the accomplishments made in recent years in stopping soil erosion and protecting water quality, agriculture's environmental challenges are multiplying."

The centerpiece of the proposal is a new \$600 million program providing additional income to family farmers who voluntarily adopt comprehensive plans to curb erosion and protect water supplies from pesticide and nutrient runoff.

An additional \$125 million will be used to provide opportunities for farmers to benefit through USDA's Conservation Reserve Program (CRP) for farmers to establish buffer strips along waterways to improve water quality. The proposal also asks Congress to expand CRP so that an additional 4 million acres of farmland (for a total of 40 million acres) may be enrolled in the program.

An additional \$550 million will be used to strengthen several other USDA programs to assist farmers with conservation and environmental efforts.

This historic conservation Initiative will be financed within the context of the FY 2001 balanced budget, which protects Social Security, that the President will submit to Congress on February 7, 2000.

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Jim Dahlvang, 1201 Oak Drive Montevideo, 56265	Co. Commr.	01-01-01	320-269-7265 320-269-8664 <i>Fax</i>
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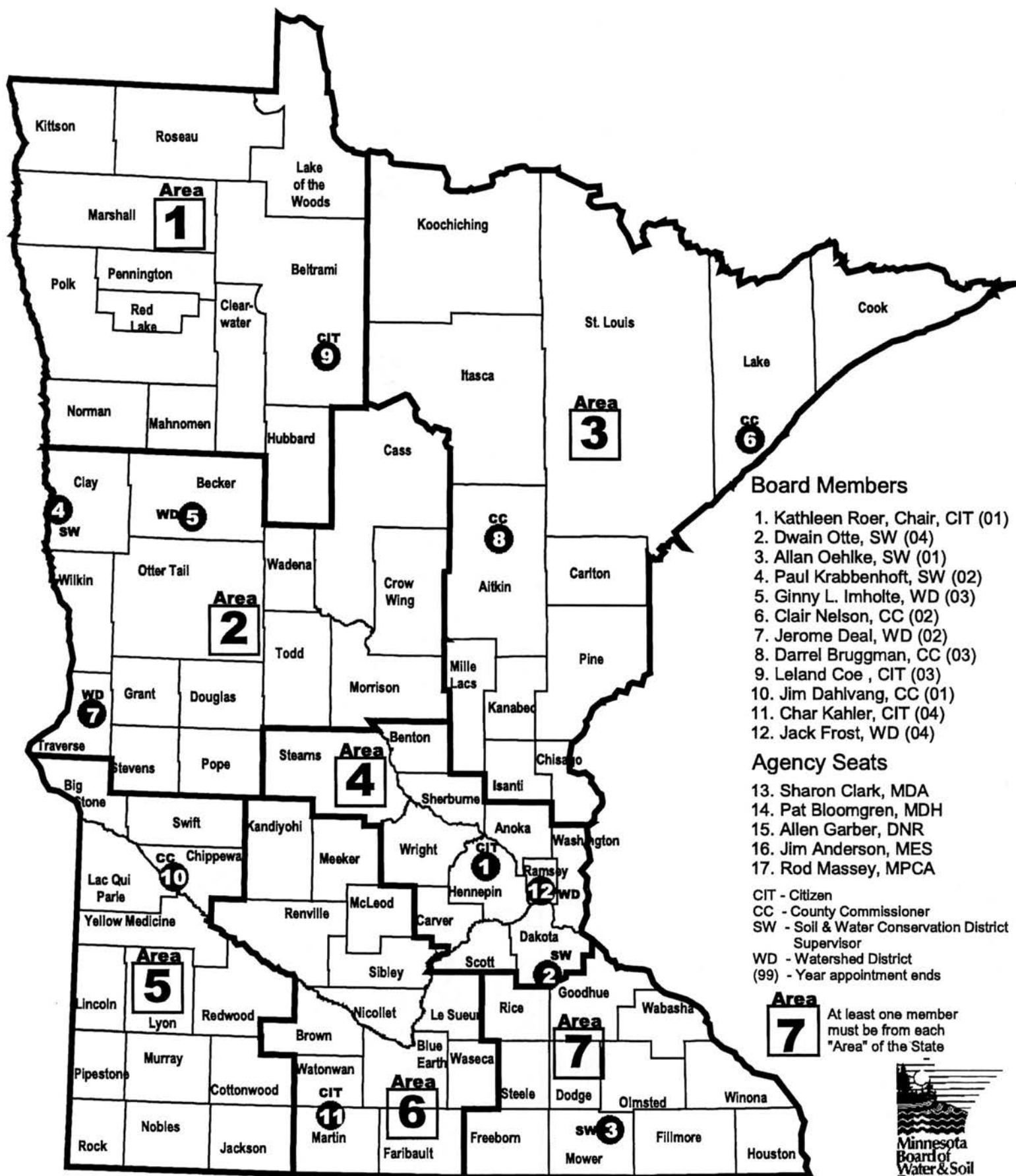
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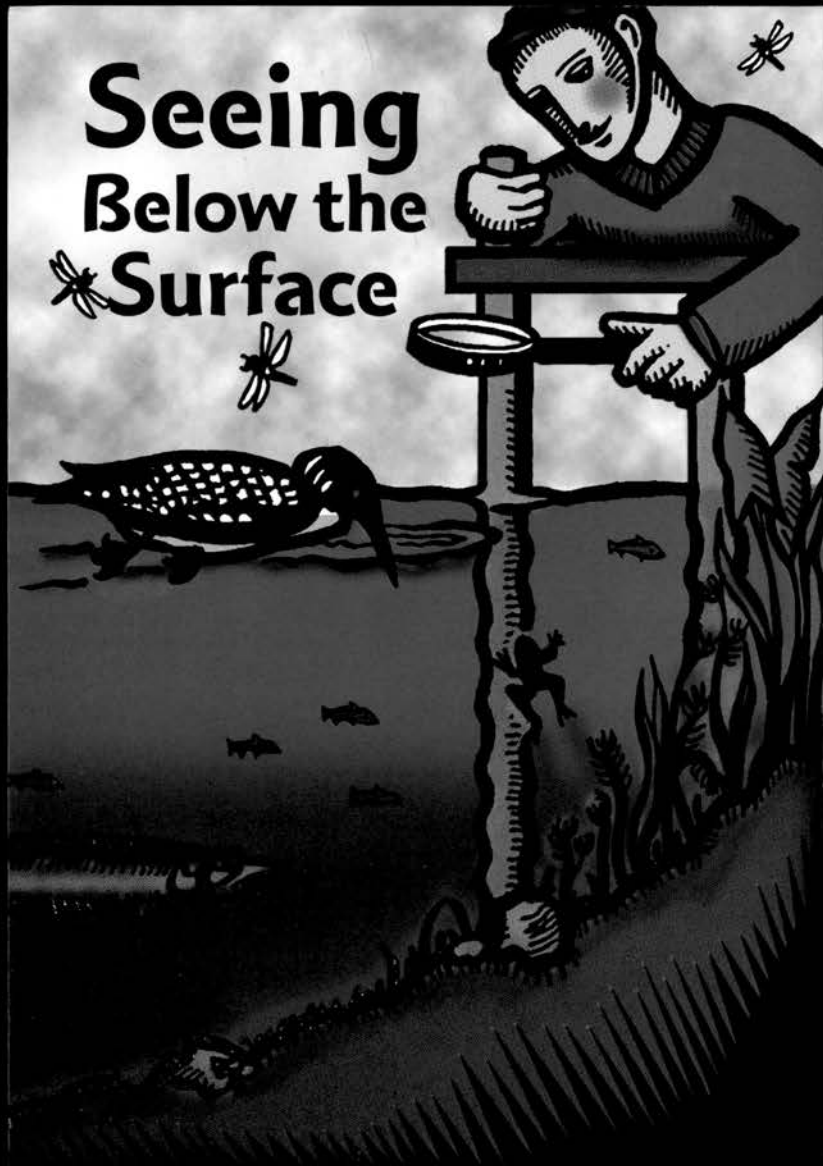
Board of Water & Soil Resources Appointed Member Location Map (2000)



3/2000



Seeing Below the Surface



Lake Data Comes Alive in Minnesota!

Thanks to technological advances, all of us, not just scientists, can see below the surface!

Lake Access allows you to:

- Track daily changes on Lake Minnetonka and Lake Independence.
- Study how choices we make on the shoreline and in the water affect the health of our lakes.
- Witness the way storms and seasonal changes mix lake water and impact fish and fishing.
- Gauge how our lakes have changed over time.

Lake Access was made possible by a two-year grant from the U.S. Environmental Protection Agency's **EMPACT** (Environmental Monitoring for Public Access and Community Tracking) initiative. **Lake Access** partners include: Hennepin Parks, the Natural Resources Research Institute, UM-Duluth Department of Education, University of Minnesota Sea Grant, the Minnehaha Creek Watershed District, Minnesota Science Museum, and Apprise Technologies, Inc.

Lake Access cooperators welcome your comments and suggestions. For more information contact: George Host, (218) 720-4264, Natural Resources Research Institute, ghost@sage.nrri.umn.edu.

www.nrri.umn.edu/empact



Seeing Below the Surface

Remote Underwater Sampling System (RUSS) units are the yellow platforms anchored in Lakes Minnetonka and Independence. Beneath the platform, an underwater sensor package cycles between the surface and the lake bottom to gather data on turbidity, acidity, conductivity, dissolved oxygen, and temperature.

Transmitting Daily Data

Every six hours, RUSS units transmit the data they have gathered to an on-shore base station over a cellular phone.

Accessing Information

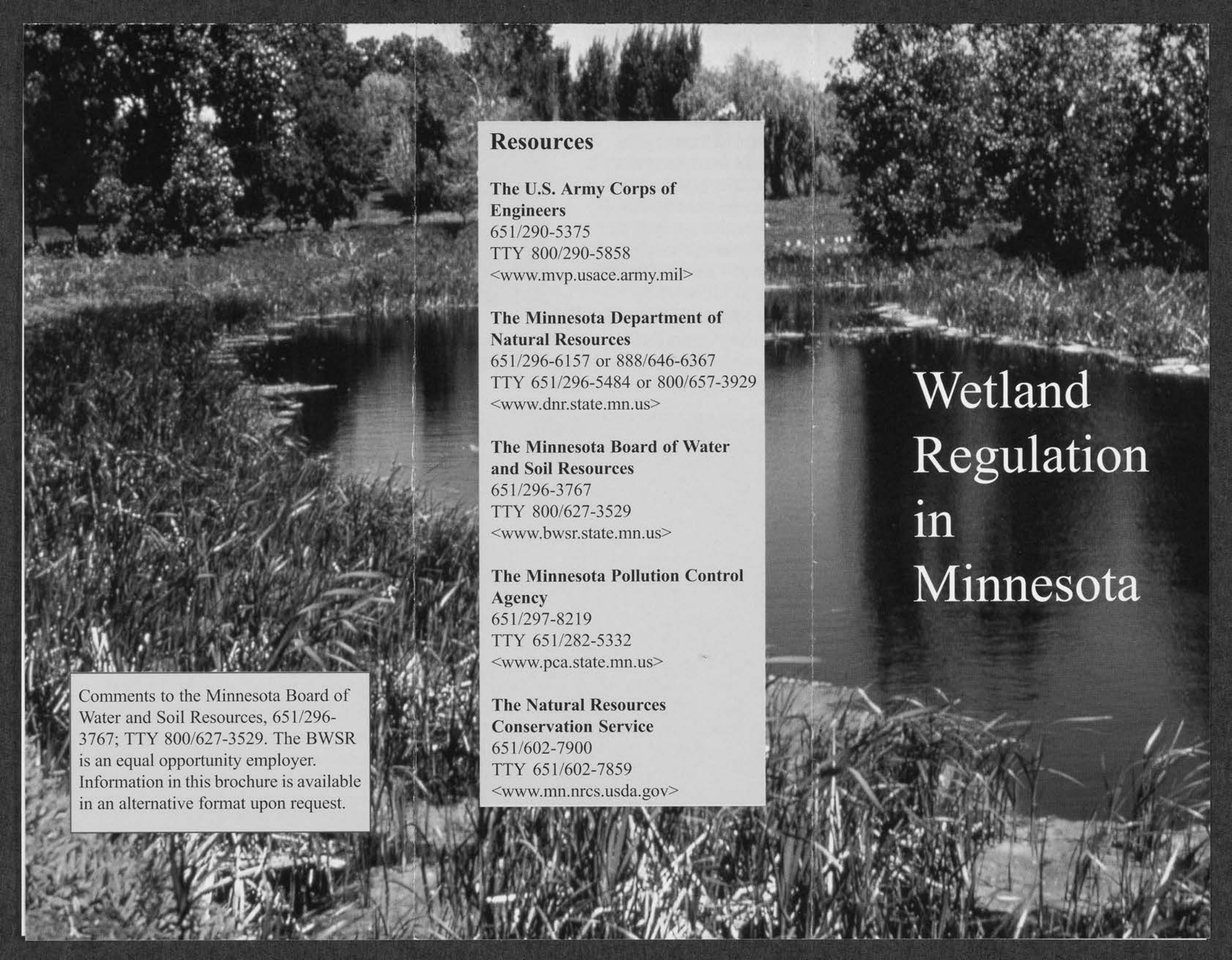
You can access the continual stream of data from the RUSS units over the World Wide Web site: www.nrri.umn.edu/empact. Soon, **Lake Access** kiosks linked to the RUSS units will be constructed at Lake Minnetonka Regional Parks Visitor's Center, Richardson Nature Center, and other locations around Minneapolis.

Understanding the Data

The **Lake Access** Web site and kiosks will contain interactive tools and informational links that allow you to interpret easily data through maps, graphics, and text.

Making a Difference

What you and resource professionals learn from the RUSS units could change the way we manage our shorelines. **Lake Access** information may encourage lakeshore owners to landscape with more native plants and fewer chemicals. City planners may use RUSS information to develop lake-friendly practices. You may decide how deep to fish or when to swim based on the day's data.



Comments to the Minnesota Board of Water and Soil Resources, 651/296-3767; TTY 800/627-3529. The BWSR is an equal opportunity employer. Information in this brochure is available in an alternative format upon request.

Resources

The U.S. Army Corps of Engineers

651/290-5375

TTY 800/290-5858

<www.mvp.usace.army.mil>

The Minnesota Department of Natural Resources

651/296-6157 or 888/646-6367

TTY 651/296-5484 or 800/657-3929

<www.dnr.state.mn.us>

The Minnesota Board of Water and Soil Resources

651/296-3767

TTY 800/627-3529

<www.bwsr.state.mn.us>

The Minnesota Pollution Control Agency

651/297-8219

TTY 651/282-5332

<www.pca.state.mn.us>

The Natural Resources Conservation Service

651/602-7900

TTY 651/602-7859

<www.mn.nrcs.usda.gov>

Wetland Regulation in Minnesota

What is a wetland?

When most people think of wetlands, they think of swampy, marshy areas complete with ducks and cattails. While those areas are indeed wetlands, many other wetlands look quite different and may even have no surface water for all or part of the year. Some wetlands support trees and shrubs; some are farmed.

Technically, a wetland must meet three criteria:

- 1) it must have mostly hydric soils;
- 2) it must have standing water or saturated soil for at least part of the growing season; and
- 3) it must support mostly vegetation adapted to wet soil conditions.



Why are wetlands important?

Wetlands were once considered wasted space, a hindrance to urban development and crop production. In Minnesota, an estimated 11 million acres of wetlands have been drained or filled over the last hundred years, leaving about 10 million acres. While this represents a 50 percent loss statewide, some areas of Minnesota have lost more than 90 percent of their original wetlands.

Far from being wasted space, wetlands provide a number of key environmental benefits:

- Wetlands reduce flooding by slowing excess water runoff during times of heavy rainfall.
- Wetlands improve water quality by filtering sediments, nutrients and toxic substances out of water before it washes into rivers and lakes.
- Wetlands provide habitat for many fish, wildlife and plants, some of which can only survive in wetlands.
- Wetlands provide opportunities for recreation such as canoeing, hunting, hiking, fishing and birding.
- Wetlands offer commercial uses like growing wild rice or cranberries and trapping animals.
- Wetlands are important outdoor science and art classrooms and laboratories.

A growing awareness of these benefits has led to many laws regulating wetland draining and filling, as well as the discharge of pollutants into wetlands.

Wetland regulation

In most cases, draining or filling a wetland will require a permit or some other authorization in Minnesota; applicants will often need to show efforts to avoid wetlands and may be required to replace drained or filled wetland area. The following agencies will typically be involved:

The U.S. Army Corps of Engineers (ACOE):

Work in any wetland or water area generally requires a permit from the ACOE regardless of whether other state, local, or U.S. Department of Agriculture Natural Resources Conservation Service (USDA NRCS) permits are required. You may contact the ACOE St. Paul office at 651/290-5375; TTY 800/290-5858; or consult its web site at <www.mvp.usace.army.mil> (click on the Corps Permits button). The U.S. Fish and Wildlife Service (USFWS) and the State Historic Preservation Officer (SHPO) review ACOE permit applications for their impact on cultural resources and federal endangered species. Applicants are encouraged to contact the USFWS and the SHPO early in project planning to avoid later permit delays. The USFWS can be reached at 612/725-3548, or check its web site at http://www.fws.gov/r3pao/eco_serv/endangrd/lists/minnesot.html; the SHPO can be reached at 651/296-5434.

The Minnesota Department of Natural Resources (DNR):

The DNR administers the Public Waters Work Permit Program on certain lakes, watercourses and wetlands in Minnesota. To determine whether a particular wetland is regulated by the DNR, contact the DNR hydrologist in the DNR regional office closest to the wetland area (this number is listed in the



government section of the phone book). If you cannot find the number, you may call the main DNR office at 651/296-6157 in the Twin Cities; toll-free at 888/646-6367 (888/MINNDNR); TTY 651/296-5484 in the Twin Cities; toll-free TTY 800/657-3929. This information is also available at the web site address <www.dnr.state.mn.us/waters/resources/index.html>.

Local governments: Minnesota's **Wetland Conservation Act (WCA)** regulates wetland draining and filling activities on all wetlands not covered by the DNR's Public Waters Work Permit Program. Although the Minnesota Board of Water and Soil Resources (BWSR) administers the WCA on a statewide basis, local governments--including cities, counties, townships, soil and water conservation districts, and watershed management organizations--implement the WCA locally. Local governments may also have their own wetland ordinances. To find out who carries out the WCA in your area, contact your county soil and water conservation district (SWCD)--listed in the government section of the phone book--or the main office of the BWSR (651/296-3767; TTY users can call 800/627-3529).



Agencies that have some jurisdiction over wetlands but generally need not be contacted directly by landowners include:

The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service:

Under stipulations contained in the Federal Agricultural Improvement and Reform Act, a landuser who alters a wetland for agricultural purposes loses eligibility for many USDA benefits, including the Conservation Reserve Program, federal farm loans, price support programs, etc. Farmers should contact the USDA Natural Resources Conservation Service (NRCS) prior to any drainage activity. Potential agricultural land buyers should also contact NRCS to check for the presence of wetlands. Please contact your local NRCS office, listed under the United States government in the telephone directory; or the NRCS state office at 651/602-7900; TTY 651/602-7859.

The Minnesota Pollution

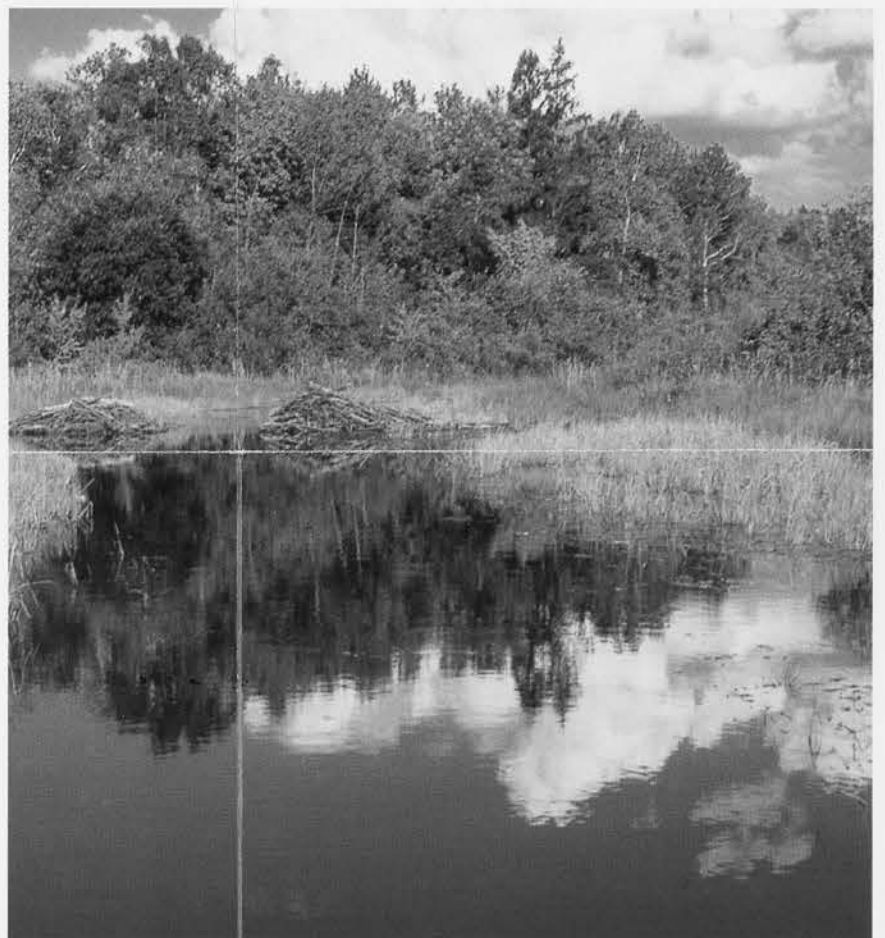
Control Agency (MPCA): ACOE permits are not valid unless the MPCA has certified that the project will comply with state water quality standards. This certification is handled by the two agencies as part of the ACOE permit review process; applicants generally do not need to contact the MPCA directly. The MPCA also regulates the discharge of pollutants, including stormwater, into wetlands.

Wetland violations

The Enforcement Division of the DNR enforces most of Minnesota's wetland regulations. People with concerns that specific wetland draining or filling activities occurring in their area may be unauthorized should contact their local DNR conservation officer and the ACOE. Phone numbers for conservation officers are available by calling 651/296-6157 in the Twin Cities; or toll-free at 888-646-6367. The ACOE number is 651/290-5375.

If you have a project that might affect a wetland...

1. Early in the process, contact your county soil and water conservation district, listed in the government section of the phone book. The SWCD should be able to give you appropriate guidance.
2. Find out if the land you want to alter is a wetland. Remember, an area can be a wetland even if it does not appear wet on the surface. Your SWCD will either help you make this determination or direct you appropriately.
3. Fill out a Combined Project Application form. You will need to mail copies of this form to all agencies listed on the form. This form is available from your SWCD, on the internet at <www.bwsr.state.mn.us/programs/major/wca/comprap.html> or by calling the Minnesota Board of Water and Soil Resources at 651/296-3767.
4. You should hear back from the agencies within 45 days of mailing the Combined Project Application form. If you do not, contact them before beginning work.



Advice for project applicants

- Begin early! Visit your SWCD and fill out the Combined Project Application form as soon as possible.
- BEFORE you purchase property for development, consider the existence of any wetlands and weigh the environmental impact and financial cost of disturbing those areas against the project's benefits. Be aware of state, federal and local regulations.
- If you proceed with a project, determine where the wetlands are and design your project accordingly.
- Thoroughly consider and document the alternatives you have considered to avoid wetland impacts.
- Consider the possible concerns of the community and the project's neighbors and involve them early in the process.
- Provide truthful and complete descriptions of all relevant project components.

The RIM Program

Reinvest in Minnesota

Reinvest in Minnesota Reserve

January 2000



Annual Report

The history of RIM

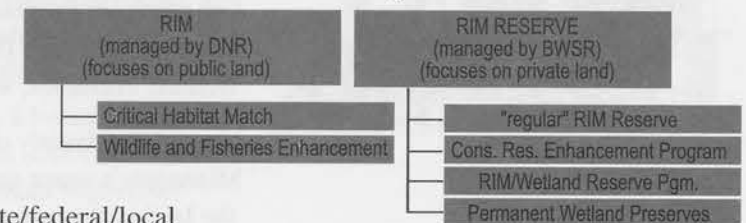
Reinvest in Minnesota's natural resources. That was the recommendation of a coalition of environmental, conservation, and agricultural groups formed in 1984 to address the future needs of the state's natural environment. The state legislature responded to the commission's concerns and created the RIM Program in 1986. RIM is basically a reinvestment of tax dollars and private donations into Minnesota's priceless natural resources and its billion dollar plus fish and wildlife-based recreation industry.

RIM has two primary components: RIM and RIM Reserve. RIM, which is managed by the Department of Natural Resources, focuses on improving fish and wildlife habitat on public lands. Components of RIM include Critical Habitat Match, which allows citizens and others to donate land and money for resource protection and development; and Wildlife and Fisheries enhancement. RIM Reserve, which is managed by the Board of Water and Soil Resources (BWSR), focuses on acquiring easements on private land. Components of RIM Reserve include "regular" RIM Reserve; two state/federal/local partnerships, the Conservation Reserve Enhancement Program (CREP) and the RIM Reserve/Wetland Reserve Program (WRP); and Permanent Wetland Preserves (PWP), which acquires easements on existing wetlands.

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The RIM Program



RIM Reserve

The Reinvest in Minnesota (RIM) Reserve Program protects water quality, reduces soil erosion and enhances fish and wildlife habitat through retiring marginal lands from agricultural production and restoring previously drained wetlands.

The owners of these lands are paid a percentage of the assessed value of their land to voluntarily enroll it in a conservation easement. A variety of land types are eligible, including drained wetlands, riparian agricultural lands, erodible cropland, pastured hillsides and sensitive groundwater areas.

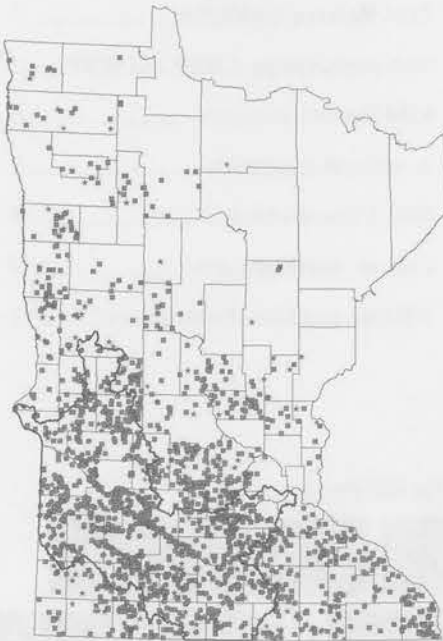
After land is enrolled, it is managed under a conservation plan, which generally includes items like wetland restoration (for areas with drained wetlands) and seeding vegetative cover (on riparian areas).

RIM Reserve has several different "arms" under which it enrolls land: "regular" RIM Reserve; two state/federal partnerships, the Conservation Reserve Enhancement Program (CREP) and the Wetland Reserve Program/RIM Reserve; and Permanent Wetland Preserves, which enrolls existing wetlands.

Managing privately owned land is key to improving Minnesota's water quality. For example, 92 percent of the land in the watershed of the Minnesota River--one of the most polluted rivers in the country--is privately owned and cropped. RIM Reserve effectively targets these lands.

RIM Reserve Easements

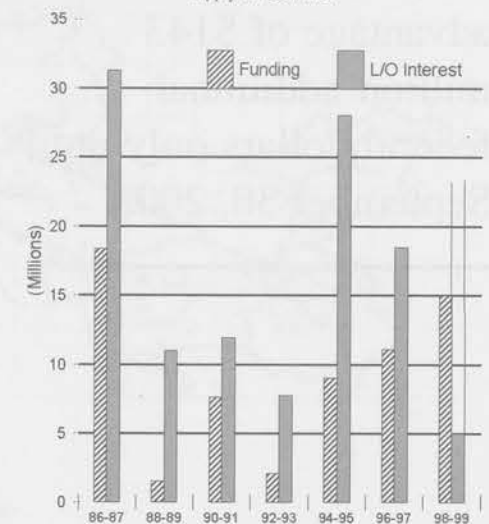
December 1, 1999



RIM Reserve highlights

- Since the program began in 1986, landowners have enrolled about 2,400 easements, covering about 83,000 acres.
- RIM Reserve has leveraged more than \$25 million in federal funding, and will leverage another \$143 million over the next two years if the state provides matching funds.
- RIM Reserve is one of the most successful conservation programs in the country. Costs of implementation are just 16% of easement dollars (20.5% when linked with federal programs).
- RIM Reserve has formed the basis for local partnerships between soil and water conservation districts, environmental groups, conservation groups such as Ducks Unlimited and Pheasants Forever, and state and federal agencies.
- Minnesota's 91 soil and water conservation districts (SWCDs) have successfully implemented the program locally, using knowledge of local resources to manage each easement to get the most environmental benefit.
- RIM Reserve is supported by a broad coalition, including conservation groups (Ducks Unlimited, Pheasants Forever, the Minnesota Waterfowl Association), environmental groups (the Audubon Society, The Nature Conservancy, the Isaak Walton League) and farming groups.
- Landowner interest has consistently far outpaced available funding.

RIM Conservation Easements Supply vs. Demand



New partnerships: CREP and WRP

The Conservation Reserve Enhancement Program (CREP) is the best example Minnesota has of one of RIM Reserve's most important successes: its ability to leverage outside dollars for conservation in Minnesota.

CREP is a state/federal/local partnership to retire land in the Minnesota River valley, home to one of the most polluted rivers in the country. In 1992, Minnesota began a major effort to determine the river's problems, their sources and their solutions. Years of study pointed to a variety of problems. While implementing all of the recommendations to improve the river would cost Minnesota millions of dollars, CREP provides a once-in-a-lifetime opportunity to leap ahead in our efforts in the Minnesota River valley by leveraging large amounts of federal dollars.

Under CREP, the federal government will provide Minnesota landowners with up to \$163 million to retire land in the Minnesota River valley. This money must be matched by \$70 million in state funding. Through combining a federal Conservation Reserve Program (CRP) contract with a RIM Reserve easement, this funding will retire approximately 100,000 acres and more than double the amount of acreage currently enrolled in RIM Reserve. As with RIM Reserve, the lands targeted are low-lying drained wetlands, riparian lands and flood-prone lands.

So far, Minnesota has allocated \$9.2 million for CREP, which the federal government matched with

Minnesota can take advantage of \$143 million additional federal dollars only until September 30, 2002.

\$20 million, to retire about 14,000 acres. Additional state funding of about \$60 million is needed to obtain the remaining \$143 million and retire an additional 90,000 acres.

A coalition of environmental organizations, agricultural interests and sporting groups support CREP and recognize it as a unique opportunity to truly leave an environmental legacy. The federal offer of support expires in 2002.

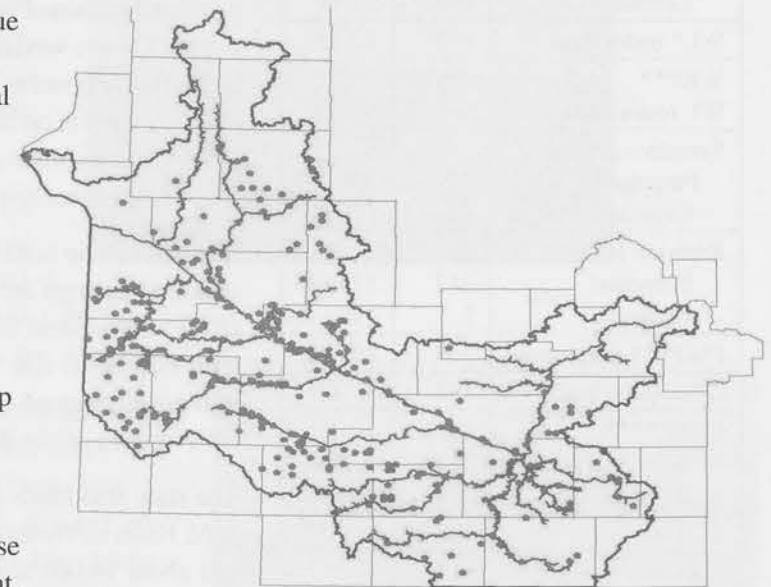
RIM Reserve/Wetland Reserve Program

The RIM Reserve/Wetland Reserve Program (WRP) partnership is another state/federal/local partnership that provides Minnesota with an opportunity to leverage federal dollars to increase conservation easement enrollment.

Under the partnership, drained wetlands are enrolled and restored by combining WRP's 30-year easement option with a perpetual RIM Reserve easement. Permanent protection ensures that Minnesota's tax dollars are benefiting all citizens, both current and future.

About 6,208 acres of RIM Reserve/WRP easements have been enrolled since the program began in 1997, costing about \$5 million federal dollars and \$2.8 million state dollars.

Conservation Reserve Enhancement Program Easements



RIM Reserve numbers

EASEMENT TYPE	# OF ESMNTS	ACRES
Marginal Ag Land		
Perpetual	445	11,069
Limited	152	2,649
WL* restoration	457	18,127
WRP**		
WL restoration	90	6,208
Sensitive grwater		
Perpetual	29	999
Limited	7	135
Riparian land		
Perpetual	447	17,064
Limited	5	131
PWP*** perpetual	269	10,765
Other perpetual	104	3,542
CREP****		
WL restoration	76	4,306
Riparian	310	9,640
TOTAL	2,391	84,635

*wetland

**Wetland Reserve Program

***Permanent Wetland Preserves

****Conservation Reserve Enhancement Program

Of the eligible land types (drained wetlands, riparian agricultural lands, erodible cropland, pastured hill-sides and sensitive groundwater areas), BWSR has placed the highest priority on obtaining easements on previously drained wetlands for restoration. Once restored, these wetlands provide many water quality and wildlife benefits. BWSR's second priority has been easements on riparian buffer strips, since these areas serve to filter out sediment and other pollutants before they enter rivers and lakes.

Minnesota also holds about 11,000 acres of easements obtained through the Permanent Wetland Preserves (PWP) component of RIM Reserve. PWP enrolls land with existing at-risk wetlands, thus ensuring that they will not be drained or filled. The Legislature approved PWP as part of the Wetland Conservation Act of 1991.

The state also holds about 6,208 acres through the RIM Reserve/Wetland Reserve Program partnership; and about 14,000 acres through the Conservation Reserve Enhancement Program (see pages 4-5).

Since RIM Reserve began, Minnesota has allocated approximately \$72.3 million for easement programs, mostly through bonding. Generally, funding has hovered around \$11 million biennially. The 1997-98 state funding is \$11.5 million.

Landowner interest has consistently outpaced available funding.

A wetland restoration

After years of throwing away money on about 400 acres of frequently flooded land on his farm in Renville County, Les Hagen decided in 1998 he'd had enough. He visited the local soil and water conservation district (SWCD) to check about enrolling some of his land into RIM Reserve.

Today, Hagen has 144 acres of his 5,500-acre farm in a RIM Reserve conservation easement that includes a restored wetland. The area around the easement is tiled and drains into the wetland.

Before, Hagen said, even with drain tile and a pump, the farm had about 300-400 acres that frequently flooded. "Every time there was more than three inches of rain, it flooded out," Hagen said. He and his partners—his children and spouses—only cropped it about three out of every 10 years, and even then, they frequently lost part of the crop to flooding.

Today, Hagen has the best of two worlds: a wetland area his nephews use for hunting, and farmland that is far less likely to flood.

"We're all happy with it now," Hagen said. "At least we know that we're not going to be throwing away money on a marginal crop."



Before



After

RIM Critical Match

The largest part of the public lands portion of RIM is the Critical Habitat Match. Over the past 13 years, Minnesota citizens, groups, and businesses have donated over \$20 million in land and cash to the RIM Program to help fund the cost of acquiring or improving critical fish, wildlife and native plant habitats. State funds in the Minnesota Critical Habitat Private Sector Matching account (RIM Match) are matched dollar-for-dollar by private contributions of land, easements, or cash to the program. Land donations and purchases have been primarily for wildlife management areas (WMA). Other projects involving acquisitions are scientific and natural areas (SNA), state parks, aquatic management areas (AMA), and state forests.

In addition to helping buy land containing important habitat, these private donations have been used to protect and restore fish and wildlife populations and native plant communities. The most common projects are planting critical winter cover and secure nesting cover, restoring wetlands, and improving forest habitat. Fisheries habitat is protected or improved by acquiring riparian lands, stabilizing lake or stream shores, restoring aquatic vegetation, improving fish habitat in streams, reclaiming watersheds, and other fisheries management activities. Nongame species benefit, too. The private match for the nongame wildlife projects comes from the contributions made by Minnesotans on their state income tax form.

Of the more than 426 donations, 193 were from private individuals, 212 from conservation groups, 16 from corporations, and 5 were from miscellaneous groups.

Critical match projects

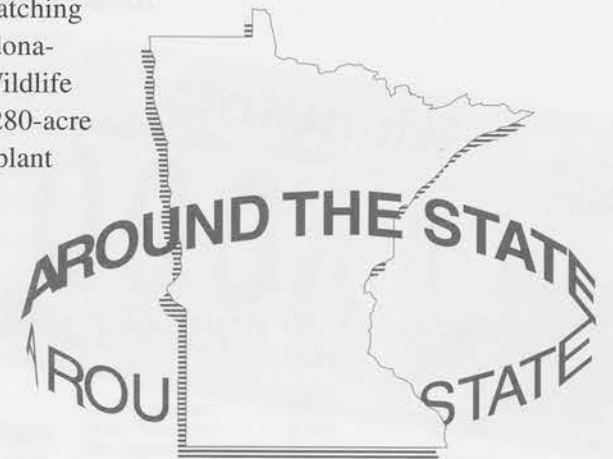
Cook County

The Swamp River Project, located just north of Hovland (Cook County), was purchased from The Nature Conservancy (TNC) with RIM matching funds generated by previous TNC land donations. The DNR Divisions of Fish and Wildlife and Forestry will manage this unique 3,280-acre ecosystem for timber, fish, wildlife, and plant communities, and for public recreation.

The lands lie within the Grand Portage State Forest and border the Hovland Woods Scientific and Natural Area. They contain many important natural resources, including the Swamp River Reservoir, the Swamp River designated trout stream and the Stevens Lake fishery, as well as forested wetlands and old growth hardwood stands. Waterfowl habitat adjacent to the Swamp River Reservoir is critical for nesting, breeding, and feeding. The marsh complex supports wild rice, northern pike and walleye habitat, and aquatic feeding areas for moose. The upland provides waterfowl nesting, browse for moose, and excellent habitat for bear, grouse, timber wolves, and nongame wildlife species such as warblers, loons and turtles.

Greening the Great River Park Project

St. Paul is greening up under a cooperative project with the St. Paul Foundation to restore permanent, native vegetation along the Mississippi River





migratory corridor in St. Paul. The newly planted native trees, shrubs, prairie grasses, and wildflowers will reconnect existing fragmented cover to provide habitat for migrating warblers, waterfowl and a variety of other wildlife species. A total of \$300,000 in RIM matching funds is helping pay for more than 20,000 native trees and shrubs, which are being planted by 2,500 volunteers.

Vision WMA, Stearns County

Pheasants and other farmland wildlife will find vital habitat on a new 160-acre wildlife management area donated by the Stearns County Chapter of Pheasants Forever and several other local conservation and sporting groups. Uplands, wetlands, brushlands, and

small areas of native prairie provide a valuable mix of food and cover that will benefit pheasants and other wildlife species such as deer, ducks and songbirds.

Duck Delights

Ducks Unlimited (DU), through their "MARSH Program," has been a major donor to the RIM Match Program. Several new wildlife projects, including a 300-acre wetland restoration in Lincoln County and a 137-acre addition to the Stokman WMA in Blue Earth County, have been recently completed with DU cash donations and the matching funds.

Beltrami County

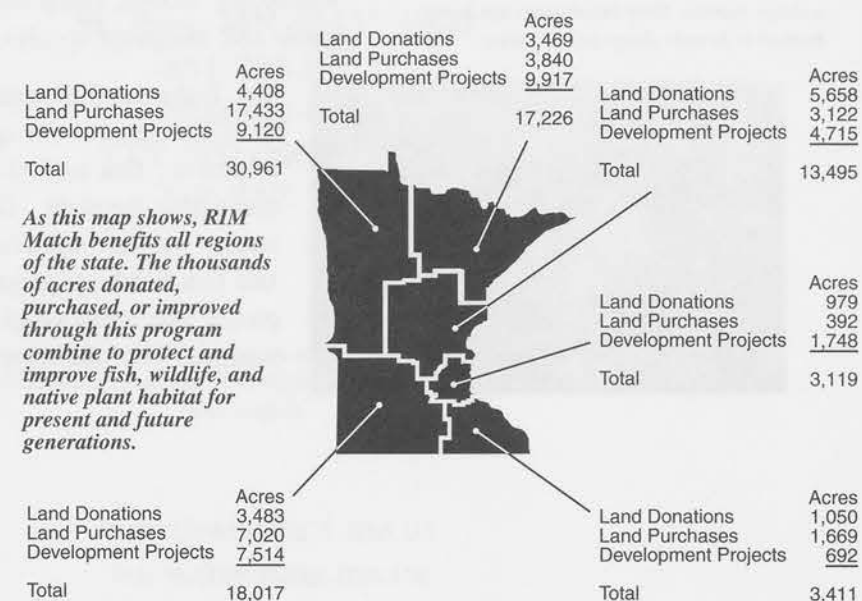
James Fern had a long-term plan for his 137-acre property in Beltrami County. In his last will and testament, Fern bequeathed the property to the DNR

for use as a wildlife management area. The James B. Fern WMA, dedicated in 1992, today features a stand of 80-year-old red and white pine, as well as mature birch, aspen and northern hardwoods. In addition, the RIM Matching funds from Mr. Fern's donation were used to purchase a valuable 42-acre wildlife parcel just outside of Bemidji.

Hennepin County

What's old and guaranteed to get older? An old growth forest dedicated as a state natural area. The DNR recently received a gift of a superb old growth forest in the heart of the metropolitan area. The area, known as Wood Rill, is designated as a scientific and natural area. The 150-acre site is habitat for rare red-shouldered hawks and it contains the state record green ash. It also holds many giant red oak, basswood, and black maple trees up to 400 years old. A system of walking trails allows the public easy access to the many delights of this picturesque forest preserve.

RIM Match Region by Region



Fish and Wildlife Enhancement



Controlled burns are one of the practices funded under the RIM Program to improve wildlife habitat. Here brushlands are being burned to benefit sharp-tailed grouse.



To produce healthy fish and wildlife populations, active management is necessary on the areas where fish and wildlife live. **RIM's enhancement programs** help manage these habitats on public lands.

The **RIM Wildlife Enhancement Program** restores natural plant communities, improves habitat, conducts prescribed burns on grasslands and brush lands, and develops and protects wildlife lands for public use. Over 240,000 acres of forests, brush land, wetland and prairie have been enhanced for white-tailed deer, pheasants, waterfowl, moose, sharp-tailed grouse and other game and nongame species.

The **Fisheries Enhancement Program** helps meet the demand for quality fishing by improving fish habitat and fishing opportunities across the state. Over 100 lake and stream habitat improvement, lake aeration and fish hatchery projects have been completed under this program, making for healthier fish and happier anglers.

Minnesota Board of Water
and Soil Resources
One West Water Street
Suite 200
St. Paul, MN 55107
651/296-3767
TTY 800/627-3529

Minnesota Dept. of Natural Resources
500 Lafayette Rd.
St. Paul, MN 55155-4020
651/296-6157
888/646-6367
TTY: 651/296-5484 or
800/657-3929

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upon request.

www.bwsr.state.mn.us
www.dnr.state.mn.us

The cost of printing and staff time for
this report is about \$2,175.

You are invited to the

First Annual
University of Minnesota
and
Iowa State University

**DRAINAGE RESEARCH
FORUM**

A Memorandum of Agreement between UM and ISU is being signed that will lead to new cooperative efforts in drainage research. As part of this agreement, this first Drainage Research Forum is being held to discuss the past, present, and future of agricultural drainage research.

Your participation in this discussion is welcomed.

To help us plan, please pre-register by March 17th.

Place
First Class
Postage
Here

Southern Research and Outreach Center
35838 120th St.
Waseca, MN 56093-4521

University of Minnesota
and
Iowa State University

**Drainage
Research
Forum**

March 23, 2000

9:00 a.m. - 3:00 p.m.

**Meeting Room
at Cabela's Retail Store
Owatonna, MN**

Early Registration \$15.00



9:00 Registration & Refreshments

9:15 Introduction

9:30 Drainage Research of the Past

- ❖ Stewart Melvin, Head, Ag and Biosystems Engineering, Iowa State University
- ❖ Bruce Wilson, Biosystems and Ag Engineering, University of Minnesota

10:30 Drainage Research of the Present

- ❖ Jim Baker, Ag and Biosystems Engineering, Iowa State University
- ❖ Jeff Strock, Dept. of Soil, Water, and Climate, Southwest Research and Outreach Center

11:30 LUNCH

12:30 Ceremonial Signing of Memorandum of Agreement

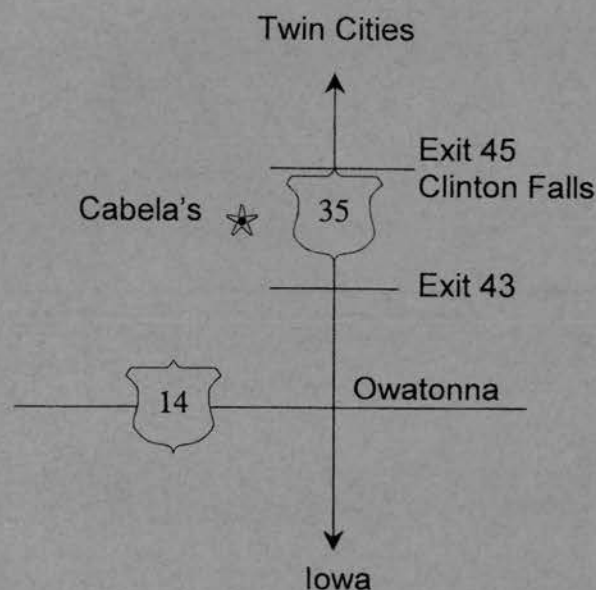
12:45 Watershed Scale Impacts on Drainage

- ❖ Dave Mulla, Dept. of Soil, Water and Climate, University of Minnesota

1:30 Drainage Research in the Future

- ❖ A panel that will include farmers, land improvement contractors, and representatives from agriculture and natural resource agencies from Iowa and Minnesota will discuss future research needs.
- ❖ Panel Discussion will be led by Gary Sands Biosystems and Ag Engineering, University of Minnesota, and Lowell Busman, University of Minnesota Extension, Southern Research and Outreach Center, Waseca

3:00 Adjourn



Early Registration Due by Friday, March 17, 2000

Name

Address

City

State

Zip

Make checks payable to University of Minnesota

Registration Fee: \$15/person

Refreshments and lunch will be served.

Registration after March 17 or at the door \$20/person.

Send registration to:

Jeanette Williams
Southern Research & Outreach Center
35383 120th Street
Waseca, MN 56093-4521

Participant Survey

What questions or concerns do you have regarding this topic?

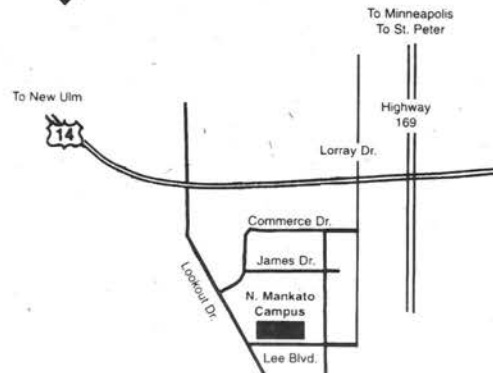
If you are planning to do a drainage improvement project, what question would you like to see covered at this conference?

Sponsors

The Minnesota River Basin Joint Powers Board
 Minnesota River Educational Initiative (U of M)
 Minnesota West Community Technical College
 Minnesota Pork Producers
 Minnesota River Public Input Committee
 Minnesota Department of Agriculture
 South Central Technical College North Mankato
 Minnesota Center for Environmental Advocacy



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MN West Community and Technical College



1593 11th Avenue
 Granite Falls, MN 56241
 1-800-657-3247

Better Drainage Without the Legal Challenges



Friday, March 31, 2000
 MN West Technical & Community College
 Granite Falls

Wednesday, April 5, 2000
 South Central Technical College
 North Mankato



Why Attend?

Agricultural drainage in both private and public drainage systems, is considered an increasingly important contributor to stream flow and pollutant loadings into our rivers and streams. Local drainage authorities are being challenged in court on how to improve the removal of water from cropland while also protecting water quality. This workshop will tackle how local units of government can keep from being sued over drainage improvements and repairs; how proposed projects can accommodate suggestions and comments regarding downstream water quality; and, how the current drainage law allows for holding water on the landscape longer.



Who Should Attend?

- ▼ Land owners and operators considering drainage projects
- ▼ Environmental groups
- ▼ Representatives from local and state agencies
- ▼ Elected officials
- ▼ Citizens
- ▼ Crop consultants
- ▼ Engineers
- ▼ Drainage Contractors

Preliminary Agenda

- | | |
|---------------|---|
| 8:00 - 8:30 | Registration |
| 8:30 - 8:45 | Welcome, <i>Steve Hansen, MRBJPB</i> |
| 8:45 - 9:30 | Opportunities and Barriers
Kurt Deter, Rinke Noonan |
| 9:30 - 10:00 | Break |
| 10:00 - 11:00 | Science and Engineering From
Three Perspectives:
Bolten & Menk
North American Wetlands
Engineering,
<i>Scott Wallace</i>
Board of Water and Soil
Resources,
<i>John Jaschke</i> |
| 11:30-12:15 | Lunch |
| | Facilitated Workshop Discussions: The afternoon session will feature facilitated discussion to develop a common understanding in four areas:
Facilitator: Kurt Deter |
| 12:15 - 1:00 | • Drainage authority consideration of land use and environmental criteria: What should it include? |
| 1:00 - 1:45 | • Information and evaluation included in drainage project engineering: What should it address? |
| 1:45 - 2:30 | • Public process for drainage development: Where in the process are comments from the public best addressed? |
| 2:30 - 3:15 | • Funding sources for drainage projects that provide habitat and water quality benefits. Where are they and what are the barriers to access funding? |
| 3:15 | • Wrap-up |

Registration Form

Please complete this form,
include registration fee and send to:

Minnesota River Basin Joint Powers Board
600 E. 4th Street • Chaska, MN 55318-2102
Attn: Tricia Jacobs

Registration Fee: \$25.00
(Scholarships available to agricultural producers)
Pre-Registration Deadline March 17, 2000

Name _____

Title _____

Organization _____

Address _____

City _____ State _____ Zip _____

Phone _____ Fax _____

E-mail _____

I will attend the forum at:

- ☐ Granite Falls ☐ North Mankato
Fri., March 31 Wed., April 5

***All people registering after March 17, 2000
must register on site.**

**All cancellations will be kept for future
Minnesota River Basin Conferences.**

Questions? Please call us Toll Free & leave a message at
1-800-809-1101 or Direct Office at (612) 361-6590

Registration Form for Haubenschild April 6 & 7 Field Days

Name _____
Address _____
City _____ State _____ Zip _____
Phone _____ E-mail _____

Please sign me up for:

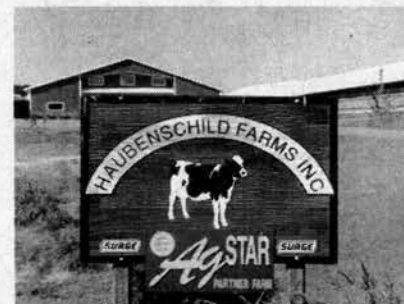
- ☐ **Policy Implications:** Thursday, April 6, 10 a.m. – 2 p.m.
☐ **Technical:** Friday, April 7, 10 a.m. – 2 p.m.

Energizing Agriculture
The Minnesota Project
1885 University Avenue West, Suite 315
St. Paul, Minnesota 55104

ENERGIZING AGRICULTURE

MANURE MANAGEMENT FOR ENERGY

Farm Tour



Featuring
A Digester System
at Haubenschild Farms,
near Princeton, Minnesota.

THREE TOURS TAILORED TO YOUR NEEDS

POLICY IMPLICATIONS

APRIL 6, 10 a.m.-2 p.m.

For agencies and elected officials

Pre-registration required

TECHNICAL: HOW IT WORKS

APRIL 7, 10 a.m. – 2 p.m.

For electric utilities, farmers, lenders

Pre-registration required

GENERAL PUBLIC TOUR

APRIL 8, 10 a.m. – 2 p.m.

For the public, no registration required

THE MINNESOTA PROJECT

...CONNECTING RURAL AND ENVIRONMENTAL ISSUES
...CONNECTING PEOPLE WITH POLICY

651-645-6159

mnproject@mnproject.org

HOW DOES IT WORK?

A plug-flow digester is a system for collecting and breaking down manure, and capturing the gas produced from this process. The gas, mostly methane, can be used to produce electricity and hot water for heating. Haubenschild's dairy cows produce enough methane to generate about 2000 KWh per day of electricity, most of which is used on farm, the remainder is sold to East Central Energy to power additional local homes. The dairy also saves \$400 per month in heating costs by using waste heat from the generator.

**"WE'VE GOT TO STOP TREATING
MANURE AS A WASTE, IT IS A
VALUABLE RESOURCE."**

- DENNIS HAUBENSCHILD

WHAT ARE THE BENEFITS?

- Electricity to use and to sell
- Reduced odor & greenhouse gas emissions
- Reduced pathogens in the digested product
- Nutrient rich digestate to apply to fields
- Possible sale of digested product as a garden amendment
- Better manure management
- Payback on the investment, profit thereafter

A TEST CASE FOR MINNESOTA

The Haubenschild farm is being studied to see if plug-flow digesters make sense in Minnesota.

Many state and federal agencies and other project partners are involved in this process. A final report will be produced which will examine environmental benefits, the financial feasibility of digesters for farmers, and implications for policy in Minnesota.



Generator

Place
Stamp
Here

THE DAIRY FARM AND THE FAMILY

The Haubenschild family - three generations living and working on the farm - milk 436 cows and grow feed crops on about 700 acres.

DIRECTIONS TO THE FARM:

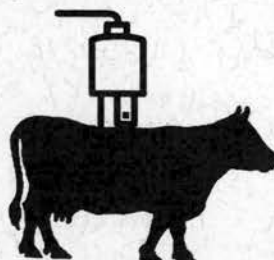
FROM PRINCETON: go east on State Highway 95 about 7 miles to Nacre Road. Take a left (north) and proceed about 1.5 miles to the dairy.

FROM CAMBRIDGE: go west on State Highway 95 for about 11 miles to Nacre Road. Take a right (north) and proceed about 1.5 miles to the dairy.

PRE-REGISTRATION REQUIRED

Please pre-register to attend on April 6 or April 7.

Contact Minnesota Project at 651-645-6159 to pre-register or e-mail your name, address and phone number with the date you will be attending to: mnproject@mnproject.org



Energizing Agriculture
The Minnesota Project
1885 University Avenue West, Suite 315
St. Paul, Minnesota 55104



Robert Iwan

Management Analyst

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UNIVERSITY OF MINNESOTA
Seventh Biennial Conference

Minnesota Water 2000



**A Watershed Year:
Looking Back; Planning Ahead**

April 25-26, 2000

**Minneapolis Convention Center
Minneapolis, Minnesota**

Sponsored by
University of Minnesota Water Resources Center

*in cooperation with water management and research agencies and
organizations throughout Minnesota*

Conference Overview

Our seventh biennial conference, *Minnesota Water 2000: A Watershed Year*, will examine the integration of science and policy into water resource management in Minnesota. This year's conference will provide a forum to discuss emerging state policy issues, as well as an opportunity to learn about new research and technology.

The theme, *A Watershed Year: Looking Back, Planning Ahead*, emphasizes the divide between the old millennium and new ways of managing water resources. Plenary sessions, including Dr. Robert Hirsch, Chief Hydrologist, U.S. Geological Survey, will offer a retrospective on how water resources science, policy, and management have evolved over the past century; a summary of current issues and challenges ahead; and visions of how we'll respond to these challenges through education, policy and legislation, and citizen involvement. Betsy Damon, Tuesday's luncheon speaker, will inspire us with images of the water park in Chengdu, China, to demonstrate how to engage the public in water resources issues.

Concurrent sessions will be diverse, including ground and surface water research; impacts on water quality; remediation and restoration projects; water supply and treatment alternatives, policy and economic issues; new tools for modeling and monitoring; and a focused series on Lake Pepin. Posters will be displayed in a special session following lunch on Wednesday, at which participants will have a chance to peruse new research findings and outreach activities and talk with presenters.

Who Should Attend

Federal, state, and local agency personnel, researchers, consultants, educators, students, planners and policy makers, and water resource managers.

Cooperating Organizations

Metropolitan Council
Minnesota Board of Water and Soil Resources
Minnesota Department of Agriculture
Minnesota Department of Natural Resources
Minnesota Pollution Control Agency
U. S. Geological Survey

For Further Information

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University of Minnesota Water Resources Center
173 McNeal Hall
1985 Buford Avenue
St. Paul, MN 55108
Phone: 612-624-9282 Fax: 612-625-1263
E-mail: thoma032@tc.umn.edu
wrc.coafes.umn.edu/water2000/

Conference Schedule at a glance

Tuesday, April 25

8:30 a.m.	Registration
8:55	Welcome Plenary Sessions
10:15	Break
10:40	Plenary Sessions
12:15 p.m.	Luncheon/Speaker
1:30	Concurrent Sessions A. Water Supply and Wastewater Issues B. Toxic Substances C. Lake Pepin D. New Tools for Monitoring and Modeling
2:50	Break
3:20	Concurrent Sessions A. Watershed Management: Policy and Economics B. The Changing Face of Agriculture C. Groundwater Investigations D. Case Studies in Remediation

Wednesday, April 26

8:00 a.m.	Registration
8:30	Plenary Sessions
9:45	Break
10:15	Plenary Sessions
11:30	Luncheon
12:00 p.m.	Poster Session (dessert buffet)
1:00	Concurrent Sessions A. Drainage Issues in Water Management B. Lakes and Wetlands C. Rivers and Streams D. Ecological Indicators
3:20	Adjourn

Day 1: Tuesday, April 25

8:30 a.m. Final Registration

Plenary Sessions 1

8:55	Welcome <i>Minnesota's Water Unification Plan</i> , Governor Ventura (invited)
9:10	<i>National Trends in Water Quality, Policy, and Management</i> , Robert Hirsch , U.S. Geological Survey
9:50	<i>Changes in Water Use in Minnesota</i> , John Linc Stine , MN Department of Natural Resources
10:15	Break

Plenary Sessions 2

10:40	<i>Trends in Surface and Ground Water Quality and Quantity in Minnesota</i> , Michael Sandusky , MN Pollution Control Agency
11:20	<i>Water Resource Management in Minnesota: Past Successes and Future Challenges</i> , Gene Hugoson , Commissioner, MN Department of Agriculture
12:15	Luncheon/Speaker
12:40	<i>Where Art and Science Meet - Engaging the Public in Water Resources</i> , Betsy Damon , Keepers of the Waters

Concurrent Sessions 1

1:30-2:50	Session A: Water Supply and Wastewater Issues. Moderator: Bruce Olsen, MN Department of Health <i>Agricultural Concerns in Source Water Assessment Programs.</i> Joseph Zachmann , MN Department of Agriculture <i>Radionuclides Removal with Optimized Iron/Manganese Filtration.</i> Karla Peterson , MN Department of Health <i>Evaluation of Biostability and Microbiological Quality in a Full-Scale Distribution System.</i> Raymond Hozalski and Miao Zhang , U of MN Department of Civil Engineering <i>A Novel Biomolecule Active in the Degradation of Common Groundwater Contaminants.</i> Jenny Baeseman and Paige Novak , U of MN Department of Civil Engineering
1:30-2:50	Session B: Toxic Substances. Moderators: Jeff Jeremiason, Ed Swain, MN Pollution Control Agency <i>Distribution and Flux of Toxaphene in the Water and Sediment of the Upper Great Lakes.</i> Daniel Symonik , Deborah Swackhamer , U of MN Department of Environmental and Occupational Health, et al. <i>Pesticide and Nutrient Behavior in a Southeastern Minnesota Trout Stream.</i> Paul Wotzka , MN Department of Agriculture <i>Assessing the Effects of Endocrine Disrupters Found in Sewage Treatment Plant Effluent on the Fertility of Male Fish.</i> Heiko Schoenfuss , James Levitt , et al., U of MN Department of Fisheries and Wildlife <i>Arsenic In Ground Water Of Minnesota: Occurrence and Hydrogeochemistry.</i> Roman Kanivetsky , MN Geological Survey

1:30-2:50 **Session C: Lake Pepin.** Moderators: Cathy Larson, Kent Johnson, Metropolitan Council
Lake Pepin Phosphorus Study. **Kent Johnson**, **Rebecca Flood**, et al., Metropolitan Council
Two Centuries of Human Impact on Sediment and Nutrient Loading to the Upper Mississippi River as Recorded in the Sediments of Lake Pepin. **Daniel Engstrom**, Science Museum of Minnesota and **James Almendinger**, Metropolitan Council Environmental Services
Sources of Phosphorus, Sediment, and Chlorophyll to Lake Pepin. **Michael Meyer** and **Scott Schellhaass**, Metropolitan Council
Kinetic and Diffusive Fluxes of Phosphorus in Lake Pepin, Upper Mississippi River. **William James**, **John Barko**, USAE Waterways Experiment Station, et al.
Advanced Eutrophication Modeling of the Upper Mississippi River, Lock and Dam No. 1 Through Lake Pepin. **Edward Garland**, HydroQual, Inc., and **James Szydluk**, Metropolitan Council, et al.

1:30-2:50 **Session D: New Tools for Monitoring and Modeling.** Moderators: Sharon Kroening, U.S. Geological Survey; Dave Mulla, U of MN Department of Soil, Water, and Climate
Web Based Watershed Information System. **Chris Sanocki** and **Brian Fisher**, U.S. Geological Survey
Storm Water Modeling and Scenario Analysis in a Mixed Urban-Open Watershed. **Jesse Schomberg**, Natural Resources Research Institute; **Carl Richards**, Minnesota Sea Grant, et al.

Development of a Remote Sensing Method for Synoptic, Regional Water Quality Assessment. **Steve Kloiber**, Metropolitan Council; **Patrick Brezonik**, U of MN Water Resources Center, et al.

Predicting Nonpoint Source Pollution in Bevens Creek Watershed. **Brent Dalzell**, **Prasanna Gowda**, et al., U of MN Department of Soil, Water, and Climate

2:50 **Break**

Concurrent Sessions 2

3:20-5:00	Session A: Watershed Management - Policy and Economics. Moderators: Mary Renwick and Kathy Draeger, U of MN Water Resources Center <i>Evaluation of Regional Differences in Water Quality Across Minnesota Ecoregion, Agroecoregion, and Watershed Boundaries.</i> Adam Birr , David Mulla , et al., U of MN Department of Soil, Water, and Climate <i>The Minnesota River Basin: Organization, Strategies, Success and Failure.</i> Kathryn Draeger , Water Resources Center; Dan Ray , The McKnight Foundation, et al. <i>The Creative Use of the Improvement Statute to Create Upstream Impoundments.</i> Arvid Wendland , Wendland Timmerman <i>The Use of Permit Trading for Regulating Minnesota River Phosphorus.</i> Robert Johansson and William Easter , U of MN Department of Applied Economics <i>Facilitating Upgrades in Small Unsewered Communities.</i> Becky Schlorf Von Holdt , Blue Earth River Basin Initiative (BERBI)
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3:20-5:00 **Session B: The Changing Face of Agriculture.** Moderators: Mark Dittrich, MN Department of Agriculture; Jodi DeJong, U of MN Extension Service

Cropping Systems, Precipitation, and Runoff Trends in Southwestern Minnesota: The case for cover crops. **Paul Porter**, U of MN Department of Agronomy and Plant Genetics; **Michael Russele**, USDA-ARS

Minnesota's Tillage Transect Survey for Monitoring Trends in Crop Residue Management. **Derek Fisher**, MN Board of Water and Soil Resources and U of MN Extension Service

FANMAP: Farm Nutrient Management Assessment Program, a diagnostic system for benchmarking existing agricultural practices. **Denton Bruening**, MN Department of Agriculture

Interagency Development of Educational Tools for Reduction of Agricultural Non-Point Source Pollution. **Kevin Blanchet**, U of MN Extension Service

Accelerating Adoption of Environmentally Sound farming Systems Using a Paired Watershed Technique. **John Moncrief**, **Neil Hansen**, U of MN Department of Soil, Water, and Climate, et al.

3:20-5:00 **Session C: Groundwater Investigations.** Moderator: Jim Lundy and Jennifer Maloney, MN Pollution Control Agency

Geochemical and Isotopic Identification of Ground Water Recharge Environments. **Scott Alexander**, U of MN Department of Geology and Geophysics; **Randy Bradt**, MN Department of Natural Resources, et al.

Petrographic and Geochemical Analysis of Ground Water Movement through the Hinckley Sandstone, Banning State Park, Minnesota. **Beverly Shade**, **Scott Alexander**, U of MN Department of Geology and Geophysics, et al.

Ground-Water Quality in Three Different Land Use Settings, 1996-98. **Alison Fong**, U.S. Geological Survey

Rochester Groundwater Recharge Management Area Project. **Terry Lee**, Olmsted County Environmental Services

Changes in the Natural Attenuation of Perchloroethylene Associated with Sparging. **Mark Ferry** and **Jim Lundy**, MN Pollution Control Agency

3:20-5:00 **Session D: Case Studies in Remediation.** Moderators: Judy Sventak, Gary Oberts, Metropolitan Council

Storm Water Treatment and Disposal. **Terry Kita**, Federal Cartridge Company

Revegetation of a Constructed Road-side Water Control Pond with Native Prairie Plant Species. **Joel Tallaksen** and **Iris Charvat**, U of MN Department of Plant Biology

Protecting our County's Water: Shoreland Restoration in Action. **Terry Port Wright**, Carlton County Master Gardener

Seed bank variation under different levels of Phalaris arundinacea L. cover in a restored wetland. **Marcia Raley**, U of MN and **Iris Charvat**, U of MN Department of Plant Biology

Factors Influencing Condition and Long-term Retention of Restored Prairie Pothole Wetlands From The Landowner's View. **Laurie Fairchild**, U of MN Water Resources Science Program; **Susan Galatowitsch**, U of MN Department of Horticulture

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Day 2: Wednesday, April 26

8:00 a.m. Registration

Plenary Sessions 1

- 8:30 Evolution of Water Policy and Management in Minnesota, **Ron Nargang**, The Nature Conservancy
- 9:15 A Historical Look at Water Resources Science in Minnesota, **Pat Brezonik**, U of MN Water Resources Center
- 9:45 Break

Plenary Sessions 2

- 10:15 Panel Discussion: How to respond to the challenges of future water resource management
- Education. **Jim Perry**, Interim Head, U of MN Department of Fisheries and Wildlife
- State Legislation and Policy. **Steve Morse**, Minnesota Department of Natural Resources (invited)
- Involving Citizens in Decision-Making. **Peter Bachman**, Minnesota Center for Environmental Advocacy (invited)

11:30 Luncheon

Poster Session

12:00 Poster Session and Dessert Buffet

Concurrent Sessions

- 1:00-3:20 **A. Drainage Issues in Water Management.** Moderator: Lowell Busman, U of MN Extension Service
- Chemical Hydrogeology of Drainage from Agricultural Fields into the Minnesota River. **Suzanne Magdalene** and **Calvin Alexander**, U of MN Department of Geology and Geophysics
- Effects of Subsurface Drainage System Design on Water Quality and Hydrology. **Gary Sands**, U of MN Department of Biosystems and Agricultural Engineering; **Lowell Busman**, U of MN Extension Service, et al.
- Evaluation of Alternative Surface Inlet Designs. **Bruce Wilson, Hung Nguyen**, U of MN Department of Biosystems and Agricultural Engineering
- Tile Intake and Rock Inlet Comparative Study and Implementation Project. **Tim Gieseke**, Carver County SWCD
- Investigating the Agronomic and Environmental Impacts of Controlled Drainage for Southern Minnesota: Methodology and Preliminary Modeling Results. **Gary Feyereisen** and **Gary Sands**, U of MN Department of Biosystems and Agricultural Engineering
- Temporal Discharge of Subsurface Tile Drainage from Long-Term Drainage Plots at Waseca. **Gyles Randall**, U of MN Department of Soil, Water, and Climate
- Tillage and Timing of Manure Application Impact on Surface and Subsurface Water Quality in Karst Terrains. **Satish Gupta, E. Munyankusi**, et al., U of MN Department of Soil, Water, and Climate

- 1:00-3:20 **Session B. Lakes and Wetlands.** Moderator: Dave Wright, MN Department of Natural Resources
- Dissolved Oxygen Dynamics in a Deep Metropolitan Area Lake. **Omid Mohseni, Heins Stefan**, U of MN St. Anthony Fall Laboratory, et al.

Inflow Dynamics and Potential Effects on Water Quality of Lake McCarrons. **D.E. West, Chris Ellis**, U of MN St. Anthony Falls Laboratory, et al.

Watershed, Phosphorus, Eutrophication: It's Time for a Different Approach for Lake Management. **Dick Osgood**, Ecosystem Strategies

An exploratory search to investigate how the cumulative impacts of developmental pressures and other land-uses affect water quality using satellite remote sensing and statistical analysis. **Erin Day**, U of MN Water Resources Science Program; **Patrick Brezonik**, U of MN Water Resources Center, et al.

Wetlands for Wildlife and Lake Protection: A Continuing Story. **Steve McComas**, Blue Water Science; **Rochelle Nustand**, North Dakota State University, et al.

Hydrologic Assessment of Sites Where Frog Malformations Are Present in Minnesota. **Perry Jones**, U.S. Geological Survey; **Joseph Magner**, MN Pollution Control Agency, et al.

- 1:00-3:20 **Session C. Rivers and Streams.** Moderator: Pam Davis, U of MN Water Resources Science Program
- Nutrients, Suspended Sediment, and Algae in Streams in Part of the Upper Mississippi River Basin, 1984-98. **Sharon Kroening**, U.S. Geological Survey

Phytoplankton Community Composition in Streams in Part of the Upper Mississippi River Basin, April – September, 1996. **Kathy Lee, Jeremy ZumBerge**, U.S. Geological Survey, et al.

Water Quality, Physical Habitat, and Fish-Community Composition in Streams in the Twin Cities Metropolitan Area. **Philip Talmage**, MN Department of Natural Resources; **Kathy Lee**, U.S. Geological Survey, et al.

Catchment and Riparian Scale Influences on Streams in South-eastern Minnesota. **Kristen Blann**, U of MN Cooperative Fish and Wildlife Research Unit (CFWRU) and Conservation Biology Program; **Bruce Vondracek**, CFWRU and U of MN Water Resources Science Program

The Appropriate Scale of Managing Nonpoint Source Pollution: The Case of Phosphorus in the Minnesota River Basin. **Cynthia Fang** and **William Easter**, U of MN Department of Applied Economics

Stream Morphological Response to Drainage in the Minnesota River Basin. **Joe Magner**, MN Pollution Control Agency and **Ken Brooks**, U of MN Department of Forest Resources

- 1:00-3:20 **Session D. Ecological Indicators.** Moderator: Clarence Turner, MN Department of Natural Resources
- Sociocultural "Eco-Regimes" as Multi-scale Ecological Indicators in Natural Resource Management. **Richard Currie Smith**, U of MN Department of Anthropology

Development of an Index of Biotic Integrity for Minnesota Lakes. **Melissa Drake** and **Donald Pereira**, MN Department of Natural Resources

Development of Macroinvertebrate Biocriteria for Streams of Minnesota's Lake Superior Watershed. **Kevin Stroom**, Natural Resources Research Institute; and **Carl Richards**, MN Sea Grant

Minnesota caddisflies (Insecta: Trichoptera): increased data analysis and accessibility for increased water quality indicator utility. **David Houghton**, U of MN Department of Entomology

Dakota County (MN) Wetland Health Evaluation Project: A volunteer citizen wetland monitoring project. **Charlotte Shover**, Dakota County Environmental Education

Amphibians as Indicators of Wetland Ecosystem Conditions. **Lucinda Johnson** and **Cathy Johnson**, Natural Resources Research Institute, et al.

3:20 Adjourn

Registration and Fees

The registration fee is **\$95**, when postmarked by April 7. Late registration (postmarked after April 7) is **\$110**. Registration includes plenary and concurrent sessions, luncheon each day, breaks, and a book of abstracts. Student registration is **\$55** with meals, **\$30** without meals. One-day registration is **\$60** and includes luncheon (postmarked by April 7).

If you cancel your registration by April 17, a refund, minus **\$25**, will be issued. If you cancel after this date, you will not be eligible for a refund. A full refund will be issued if the conference is canceled by the University of Minnesota.

Location

The conference will be held at the **Minneapolis Convention Center**, 1301 Second Avenue South, Minneapolis, MN 55403. The Convention Center is located in downtown Minneapolis, near Orchestra Hall and the Nicollet Mall. Parking is available in several nearby ramps: Leamington (612-673-9650), Orchestra Hall (612-339-2554), Plaza (612-339-9061), Hilton Ramp (612-673-9644). A map including parking information is available on the Minnesota Water 2000 web page at wrc.coafes.umn.edu/water2000/.

Registration will be set up at the top of the escalators in Lobby 2 (Plaza 2 entrance).

Accommodations

A block of rooms has been reserved for the conference at the **Regal Minneapolis Hotel**, adjacent to the Minneapolis Convention Center. Room reservations should be made directly with the hotel by calling 1-800-522-8856 or 612-332-6000. The rooms are reserved under "U of M Water Resources Center" for Monday and Tuesday, April 24 and 25, at a rate of **\$79** single, **\$89** double, plus tax. To receive the conference rate, reservations must be made by **April 3, 2000**. Skyway access to the Minneapolis Convention Center is available 6:30 a.m. to 10:00 p.m.



Minnesota Rivers

a primer

Mary E. Renwick
Susanna Eden

Water Resources Center
University of Minnesota

Public Report Series #13
November 1999

Minnesota Rivers: a primer

by

**Mary E. Renwick
Susanna Eden
Water Resources Center
University of Minnesota**

This is Public Report #13 of the Water Resources Center.

The following people provided suggestions for additions and deletions, as well as reviewed drafts of this report: Patrick Brezonik, Jim Anderson, Tracy Thomas, Barbara Liukkonen and Marcey Westrick. We greatly appreciate all their input.

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Preface

Natural waters play a central role in the lives of Minnesotans. The State's great rivers — the Red River of the North, Mississippi, St. Croix and Minnesota — provide water for many purposes: hydropower, irrigation, drinking water, recreation, fishing resources, as well as waste disposal. Minnesota boasts substantial river resources with over 92,000 miles of rivers. It contains the headwaters for three major U.S. river systems: the Mississippi, the Red River of the North and the St. Lawrence.

Given the prominence of rivers in the lives of Minnesotans, these resources need to be managed wisely. A prerequisite for rational management of any natural resource is an understanding of the characteristics of the resource, the current and potential stresses acting upon it, and the way the resource responds, or is expected to respond, to such stresses. The purpose of this primer is to provide the reader with a basic understanding of how river systems function, their specific uses, and management and monitoring of Minnesota river systems. A brief profile of the State's rivers is also provided. Future publications will provide detailed profiles of the State's four great rivers including the Red River of the North, Mississippi, St. Croix and Minnesota.

This primer is intended as a basic reference for those interested in Minnesota's river systems. It is written for both a general audience with no background in river sciences as well as individuals with training and experience in rivers science and management. It is organized into five chapters. Many factors, including geologic, hydrologic, climactic and human land-use conditions, determine how a river functions. Understanding a river system involves understanding the complex interaction of these factors. Chapter 1 provides an overview of the principal components of river systems. Chapter 2 details Minnesota's river systems. The various uses of Minnesota river water are detailed in Chapter 3. Who controls Minnesota's rivers? This question is explored in Chapter 4, which introduces how policy, planning and management activities affect Minnesota rivers. Monitoring plays an essential role in policy, planning and management activities related to streams and rivers. Chapter 5 provides an overview of monitoring activities affecting Minnesota's rivers and streams and the agencies responsible for collecting, analyzing, reporting and storing the information.

CHAPTER 1

RIVER SYSTEM FUNCTIONS: A RIVER SCIENCES PRIMER

INTRODUCTION

Many factors, including physical, climatic, chemical and biological conditions, determine how a river functions. Understanding a river system involves understanding the complex interactions of these factors. This chapter provides an overview of the principal components of river systems. The discussion focuses initially on the basic components of a cross-section of the river system including the stream channel, the floodplain, and the transitional upland fringe. The discussion then focuses on how characteristics of a river system change from its headwaters to its mouth. Particular attention is given to identifying longitudinal changes in watershed functions, channel formation and other characteristics. The next section examines stream processes, such as hydrologic, hydraulic, geomorphic, and physical and chemical processes, and the last section discusses other important features of stream corridors, such as biological communities and system equilibrium.

BASIC PHYSICAL COMPONENTS OF THE STREAM CORRIDOR: A CROSS-SECTIONAL VIEW

Before examining the dynamic interactions of flowing water in the stream corridor, it is important to understand the basic structural components of the corridor itself. This section identifies the key structural components of the stream corridor cross-sectionally.

Most stream corridors contain three main components: the stream channel, the floodplain and the transitional upland fringe (Figure 1.1). The stream channel contains flowing water for at least a portion of the year. The floodplain, the land adjacent to stream channel, receives floodwaters and concomitant sediment when the stream channel overflows. The nature and size of floodplain vary both along river systems and between river systems. Depending on the surrounding topography, the floodplain may include land on one or both sides of the channel, and the area may vary considerably along a river. The transitional upland fringe is defined as the upland area on one or both sides of the floodplain that delineates the floodplain from the surrounding landscape.

Stream Channel

Flowing water and the sediment it carries form, maintain and modify the stream channel. Although the form of a stream channels can vary greatly, from meandering gentle streams to fast flowing rivers, it tends to take on a rounded u-shape. When scientists study a stream cross-sectionally, they invariably examine two key attributes of the system — stream flow and channel size. Stream flow is the volume and velocity of water entering the channel. Precipitation is the original source of all stream flow; the pathways it takes after falling to the

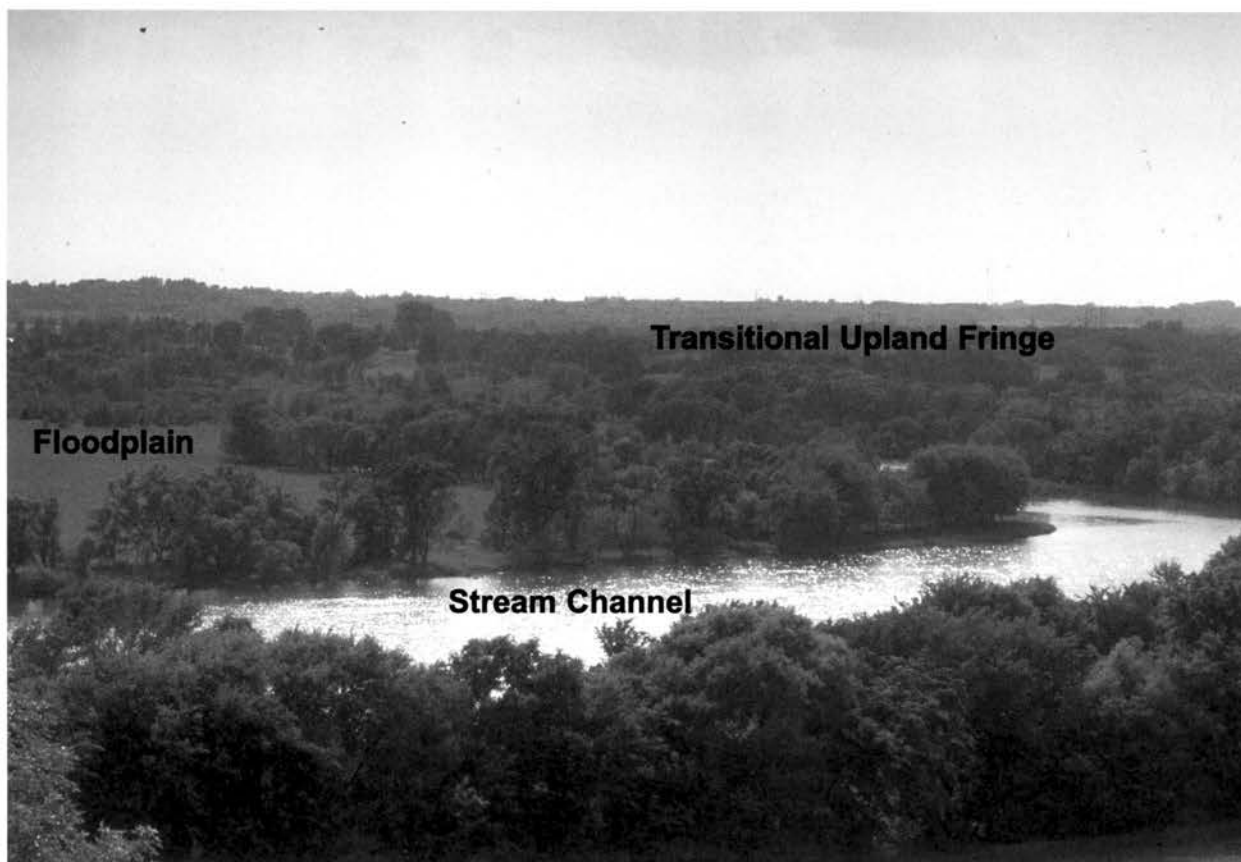


Figure 1.1 The Major Cross-Sectional Components of the Stream Corridor. Photo courtesy of the University of Minnesota Extension Service

earth affect the quantity, quality and timing of the stream flow. The two basic flow pathways are storm flow and base flow. Storm flow is precipitation that reaches the channel very soon after precipitation via overland or underground routes. Base flow is precipitation that percolates to the ground water and moves slowly through the substrate before reaching the channel. Base flow provides stream flow during periods of little or no precipitation. The measure of stream flow used by those studying river systems is known as the discharge rate, which is the volume of water moving down the channel per unit of time. It is measured in cubic feet per second (cfs) in the U.S. Discharge rates depend both on the average velocity at which the water is moving downstream and the size of the channel through which the water is flowing.

Channel size is determined by stream flow and sediment load. Sediment load refers both to the amount of sediment the stream is transporting and depositing and to its characteristics. These characteristics are described in more detail below. A *stream balance equation* formally describes the dynamic relationship between channel size and sediment load and stream flow. This equation states that the channel is in equilibrium when the sediment load is balanced with stream flow. If changes in either sediment load or stream flow occur, the balance will be lost

temporarily. These changes will modify the channel over time, by either building up or scouring the riverbed, to bring the system back into equilibrium. The stream balance equation is useful for conceptualizing the potential impacts on a channel resulting from changes in runoff or sediment loads from the watershed.

MOVING ALONG THE STREAM CORRIDOR: A LONGITUDINAL VIEW

Structural Changes in the Stream Corridor from its Headwaters to Outlet

The physical structure of the channel and floodplain changes as a river travels from its headwaters to its outlet. Channel width and depth increase downstream as the drainage area and discharge increase. A simplified longitudinal model captures these observed changes by disaggregating the river into three zones: headwaters zone, transfer zone, and depositional zone (Figure 1.2). The headwaters zone generally has the steepest slope. As the water moves over these slopes, sediment erodes and is carried downstream. In the transfer zone, which receives sediment from upstream, the gradient decreases. The river widens as smaller streams merge. In the depositional zone, the gradient flattens from a build-up of sediment over time. The river widens further and meanders toward its mouth.

These same three zones are also evident on a much smaller scale within the watersheds of contributing streams. A watershed is defined as the “area of land that drains water, sediment, and dissolved materials to a common outlet at some point along a stream channel” (Dunne and Leopold, 1978). The size and structure of watersheds vary significantly due to geologic, morphologic, vegetative, soil and climatic differences. Differences in topographic and geologic structure also influence watershed drainage patterns.

Stream Order Models

As water moves along pathways of least resistance in the watershed, it forms streams that join larger and yet larger streams. The resulting river is branched like a tree; the particular form of the branching depends on the watershed through which the water flows. A method of classifying the hierarchy of natural channels according to their position in the drainage system, referred to as stream order, permits comparison of the behavior of a river with others similarly situated. It is useful for developing and testing generalizations and predictions about river processes. Several modifications exist of the original stream-order system developed by Horton in 1945. In the most commonly cited and used system (Strahler, 1957), small headwater streams are designated Order I. Streams formed by the confluence of two Order I streams are referred to as Order II, and so on, with larger numbers indicating larger rivers with multiple tributary streams (Figure 1.3). Stream order is used primarily by hydrologists to construct models of stream flow. Stream order correlates generally with gradient, drainage area, channel width, and discharge; but because of multiple intervening factors, the statistical variance of the correlations is large.

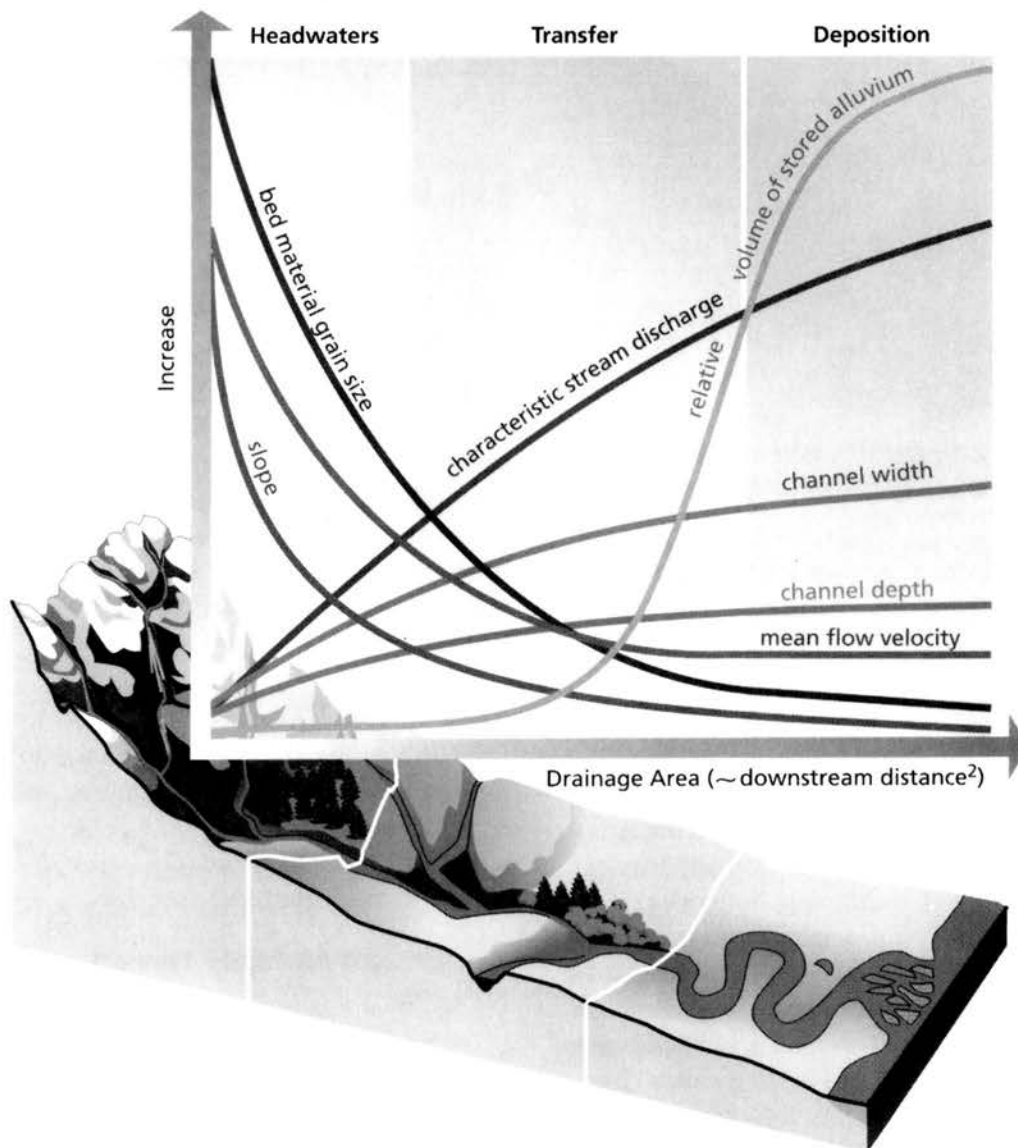


Figure 1.2 The Three Longitudinal Zones and Channel Characteristics. Reprinted with permission of Federal Interagency Stream Restoration Working Group (1998).

Longitudinal Changes in Stream Ecosystems

Beyond structural changes in the stream channel, there are observable changes in stream ecosystems from the headwaters to the mouth. The characteristics of biological communities vary in different reaches of a river system. Observation of abrupt changes in species associated with changes in stream size, channel width, gradient, stream flow and temperature supports the concept of stream zones, as described above.

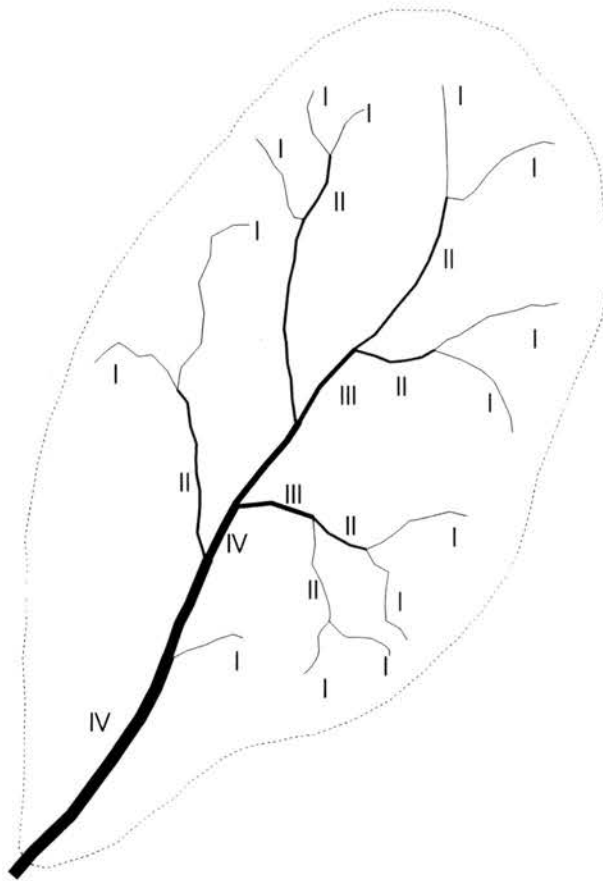


Figure 1.3 Stream Order Classification. By permission, Ojakangas, Richard W. 1982. *Minnesota's Geology*. With Charles L. Matsch. Drawings, charts, and graphs by Dan Beedy. Minneapolis : University of Minnesota Press. p. 114.

The best known longitudinal model for rivers, the River Continuum Concept (RCC), attempts to generalize and explain observed longitudinal changes in stream ecosystems (Figure 1.4). It proposes that rivers exhibit continuous longitudinal changes and identifies the relationships between the progressive changes in stream structure, such as channel size and stream flow, and the distribution of species (Table 1.1). According to the RCC, characteristics of particular reaches are associated not only with discrete factors such as water temperature, but with their positions along the length of the river. The model is especially useful at the basin and stream scale, because it accounts for observed longitudinal shifts in biotic communities.

The RCC as originally defined was most successful in describing rivers that emerge in forested mountains and descend into regulated channels on the floodplain. Since its initial development, the RCC has been expanded to include several alternative models. Rivers that regularly overtop their banks and inundate the floodplain have been characterized by a 'Flood Pulse' model that describes habitat characteristics and biotic communities along a temporal continuum. A temporal dimension is embedded in the RCC because the main features of a time-based river

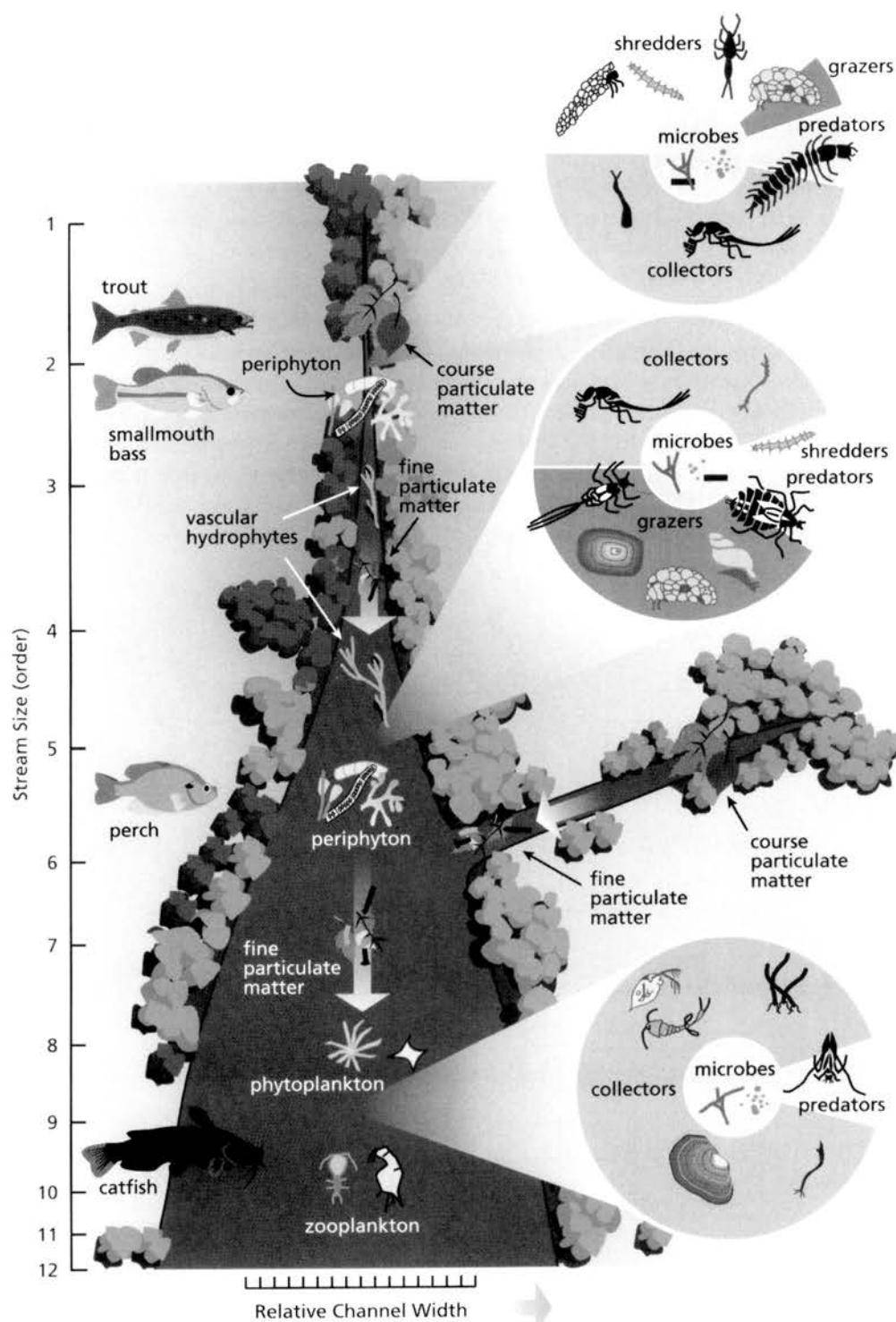


Figure 1.4 River Continuum Concept. Reprinted with permission of the Federal Interagency Stream Restoration Working Group (1998).

Table 1.1 Commonly Observed Changes Associated with River Continuum Concept.
Adapted from Ward. 1992. A Mountain River, Chapter 23 in River Handbook, P. Calow and G.E. Petts, eds. pp. 499.

Simplified RCC	Upper reaches	Middle reaches	Lower reaches
Stream order	1 - 3	3 - 6	6 and above
Substrate	coarse	sand, gravel	fine
Current	fast		slow
Oxygen	saturated		periodic deficits
Sunlight	low	high	low
Temperature	max. <20°C, fairly constant	highly variable	max. >20°C, variable
Particulate matter	coarse		fine
Nutrients	low	high	low
Dominant energy source	leaf litter	primary producers	transport detritus
Dominant primary producers	primary producers rare	attached	plankton
Dominant invertebrates	shredders, collectors	grazers (scrapers), collectors	collectors
Fish habitat and food preferences	cool water, swift current insects	fish and insects	slow current plankton, bottom matter
Biological diversity	low	high	low

model (e.g., duration of inundation) vary longitudinally in a predictable fashion.

An alternative model adopted by some ecologists is referred to as "patch dynamics". According to this model, stream habitat and species distribution exhibit patchiness. Stream communities are not determined by the nature of a given zone or stream reach but are viewed as random phenomena (Townsend, 1989). The patch dynamics concept reflects relatively short-term observations on a stream-reach scale at which the nature and distribution of biotic communities appear unpredictable. It is complementary with the RCC because most running waters that show local patch effects will exhibit predictable longitudinal patterns over larger scales and longer time periods (Brezonik, 1996).

KEY STREAM PROCESSES AND OTHER IMPORTANT SYSTEM CHARACTERISTICS

The observed structure in a particular stream corridor is a result of hydrologic, geomorphic and physical and chemical processes operating within the river corridor as well as the influence of biological functions and overall system equilibrium. This section examines how these processes and characteristics influence the structure of the stream corridor.

Hydrologic and Hydraulic Processes

The hydrologic cycle illustrates the cyclic transfer of water from precipitation through storage and runoff, to surface and ground water, and eventually back to the atmosphere through evaporation and transpiration, as shown in Figure 1.5 (Federal Interagency Stream Restoration Work Group, 1998). When precipitation reaches the earth it moves along one of three possible routes described by the hydrologic cycle. It evaporates/transpires back into the atmosphere, infiltrates the soil profile, or runs across the earth's surface into a water body. These pathways influence how water moves in the stream corridor. The relationship between the amount of water that falls on the watershed and the water that flows in the river channel (discharge) is determined by three major factors: (1) the nature, timing, and location of the water input in the watershed, (2) water demands of the system — interception, evaporation and evapotranspiration, and (3) flow pathways and water storage in the watershed. A dynamic interaction occurs between climatic variables, such as precipitation and temperature, and physical attributes, such as hydraulic gradient (slope or head) and watershed topography.

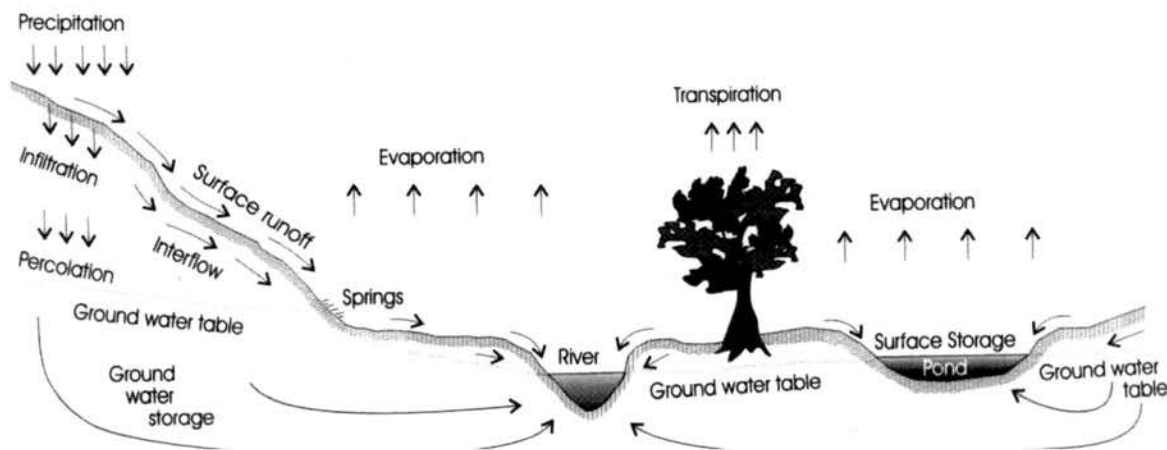


Figure 1.5 Hydrologic Cycle. Adapted from Black, P. 1990. Watershed Hydrology. p. 267.

Water inputs to the river system come ultimately from precipitation — rain or snow — via overland and underground routes. The nature, timing and location of the water input influence the force of a river's flow. For example, precipitation in the form of snowfall does not reach the river as runoff until it melts in the spring.

Water demands on the system due to interception, evaporation and transpiration also influence river flow. In the U.S., more than two-thirds of precipitation evaporates back into the atmosphere. Some precipitation is intercepted by vegetation and other surfaces and evaporates into the atmosphere from the interception sites. How quickly the water evaporates from the interception sites after a precipitation event depends on climatic conditions. Evapotranspiration describes the movement of water back into the atmosphere through the diffusion of water vapor from vegetation, known as transpiration, and through evaporation of moisture contained in the soil.

Precipitation that is not evaporated or intercepted succumbs to the law of gravity and becomes runoff. Gravity pulls the water down from the surface of leaves, along the stems of plants, over land, through soil pores and rock fractures, downhill as far as it will go to oceans and land-locked lakes. It may seep underground and flow for short distances to emerge, for example, as a spring, or it may remain beneath the earth's surface for years or even millennia. The nature of the watershed's topography, soils and vegetation influences its capability to store water. Forested watersheds with active wetlands can store large quantities of water, slowing and damping the peak flood pulse and acting as a kind of flood control system.

Geomorphic Processes

Geomorphology is the study of the earth's surface forms and the processes and mechanisms that create these forms (Federal Interagency Stream Restoration Work Group, 1998). The hydrologic processes that characterize flowing water provide the mechanisms for the geomorphic processes discussed in this section. The three fundamental geomorphic processes associated with flowing water are erosion, sediment transport and sediment deposition.

As water flows along pathways in its watershed, it shapes the terrain through erosion, transport and deposition of sediments. Climate, topography, geology and land use influence the amount of sediment flowing through the watershed. Intense precipitation, steep slopes, easily erodible rock and soil, and land clearing all tend to increase sediment yields. In Minnesota, flowing water carries off more than 60 million tons of upland topsoil each year (Tester, 1995).

Stream transported sediment is classified either as suspended load or bedload. Suspended load consists of small particles such as clays, silts, and fine sands that are easily carried suspended in the flowing water. Bedload consists of large particles such as coarse sands, gravels and boulders that move by rolling, sliding, or hopping along the bed. River bed materials, referred to as the substrate, tend to vary downstream according to how easily the particles are transported (Figure 1.6). Beds of headwater streams usually contain large particles such as

gravel and boulders that are too heavy for the stream to move. Downstream, the size of particles decreases, as large rocks are broken and worn down, and smaller particles such as finer sands and silts are sorted out, carried off and eventually deposited in the river's delta. Natural and artificial obstructions in a stream cause localized changes in the stream's ability to transport particles.

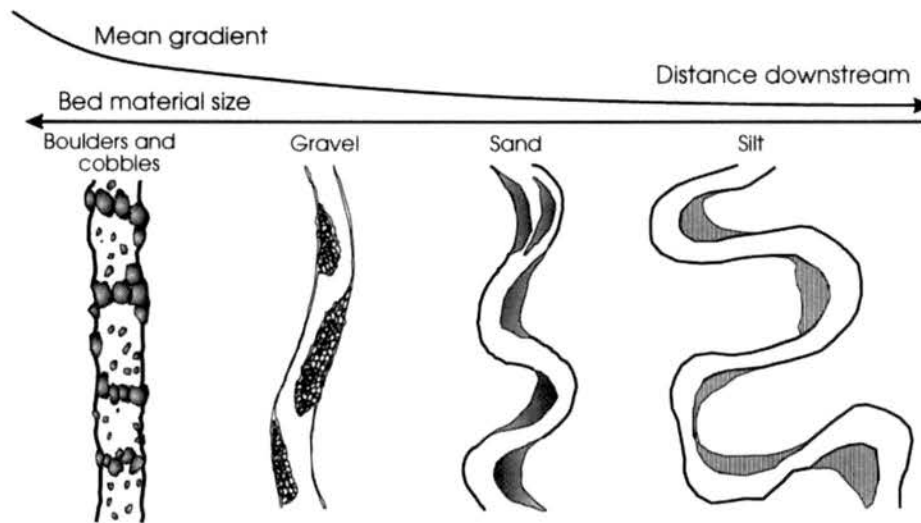


Figure 1.6 Sediment Transport. Adapted from Church, M. 1992. Channel Morphology and Typology. Chapter 6 in *The River Handbook*, vol. 1, P. Calow and G.E. Petts, eds. pp. 130, 136.

The amount of sediment a river can transport depends on stream energy or power. Stream energy is a function of the velocity of its flow, the gradient of the channel and the channel depth. Other factors such as surface roughness also influence sediment transport. When stream energy is just sufficient to transport the sediment supplied to the river, the river is said to be in equilibrium, or graded. If an imbalance exists between the amount of sediment supplied to the river and stream's power to transport the sediment, the channel characteristics will change over time to bring the river system into equilibrium. When sediment supplied exceeds stream carrying capacity, sediment deposition builds up (or aggrades) the stream bed, increasing its slope downstream and thereby increasing stream power. In contrast, when a river can carry more sediment than it receives, 'excess' stream energy scours (or degrades) the channel, decreasing downstream slope and stream energy.

Physical and Chemical Processes

The physical characteristics and chemistry of water change as water comes in contact with air, soil, rocks, bacteria, vegetation and biological communities. This section provides a brief description of the physical materials and chemical processes influencing stream water quality.

As water moves along pathways in a watershed, eroded soil and plant materials enter the flowing water. Addition of these materials, in conjunction with chemical and biological processes operating within the river, influences the physical and chemical properties of the flowing water (Figure 1.7). External (or allochthonous) materials entering the river include eroded soils, salts carried by rain or leached from rock and soil, and leaves and woody material washed or dropped into the stream. Internal (or autochthonous) processes operating within the river include physical breakdown of rocks and plant materials, microbial decomposition of organic matter, cycling of carbon and dissolved nutrients in the presence of sunlight by plants and animals, and chemical transformations of inorganic ions under changing conditions of temperature, pH, and oxygen concentration.

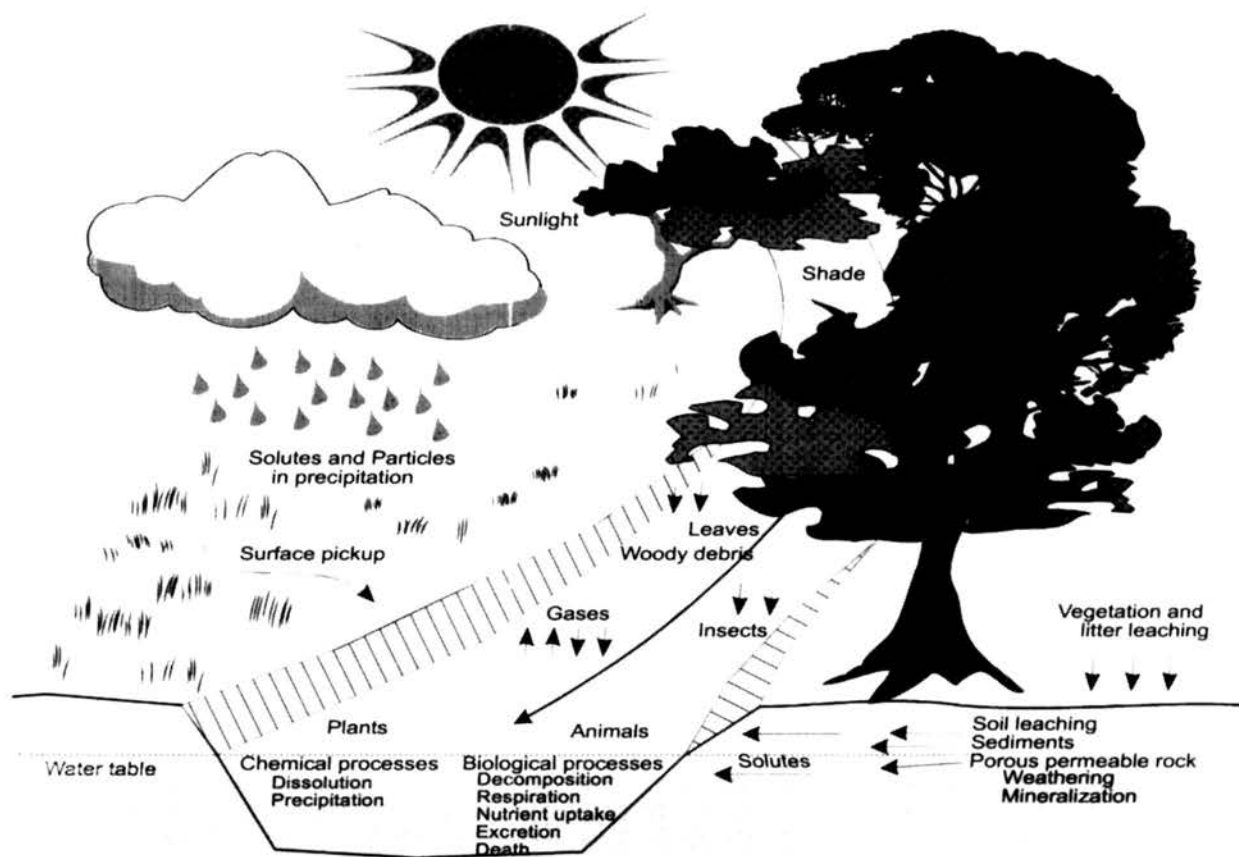


Figure 1.7 Materials and Processes Contributing to the Physical and Chemical Properties of a Stream

The chemical constituents resulting from these external and internal processes may be suspended or dissolved in the stream water. Suspended particles are classified either as sediment or colloids, depending upon their size. Suspended particles measuring 0.1 mm or greater in diameter are considered coarse sediment and they will settle rapidly out of still water. Smaller suspended particles include silts, clays, and organic particles (sometimes called organic detritus)

derived from plants and animal activity. Bacteria and suspended algae (phytoplankton) also are in this size range (see next section). Clay-sized particles ($< 63 \mu\text{m}$) settle very slowly, even in still water, unless they become coagulated into larger particles. Colloidal particles are smaller than about $0.5 \mu\text{m}$ in diameter. Although colloids are too small to be seen with the naked eye, they provide surfaces for absorption of dissolved chemicals and affect water color and clarity (turbidity).

Dissolved constituents include organic compounds, gases, and inorganic ions (salts) such as calcium, magnesium, and sodium. Some inorganic chemicals, such as phosphorus, are common in all natural stream waters and are beneficial and even necessary for life. For example, phosphorus is an essential nutrient for plant life. These solutes are considered pollutants only when their levels are elevated to the point where they threaten the health of the ecosystem. Elevated concentrations of trace constituents are usually linked to anthropogenic factors, such as industrial discharges or runoff carrying agricultural fertilizers.

Stream water chemistry can vary both daily and seasonally. Much of this variability results from changes in the proportions of stormflow and baseflow, which often have very different chemical properties. Water chemistry also is affected by changes in the amount of flow. While periods of high flows decrease the concentration of some point source pollutants through dilution, they also may increase nonpoint source pollutants, such as those from atmospheric deposition, that accompany higher runoff.

Biological Community

The morphometric and physical properties of a stream determine the availability of suitable habitat for biota. The unidirectional flow of water is one of the most important factors controlling survival in rivers. River-adapted organisms must have strategies to protect themselves from being flushed downstream. Other factors that determine the suitability of habitat are flow regime, water quality, temperature, sunlight, oxygen, food, and protection from predators.

The organisms in an ecosystem are interconnected to form a food web. The food relationships commonly observed among stream biota are shown in Figure 1.8. In rivers, the primary producers that compose the base of the food web include aquatic plants (macrophytes) and algae. Some types of algae, known as periphyton, attach to surfaces in the stream channel, whereas others, known as phytoplankton, are suspended in the water. Primary producers use energy from sunlight to turn dissolved inorganic nutrients (nitrogen, phosphorus, carbon) into organic matter through photosynthesis. Organisms that feed on this plant tissue convert it to animal tissue, waste and energy. Decomposition of organic materials occurs as other organisms break down dead plant and animal tissue and wastes.

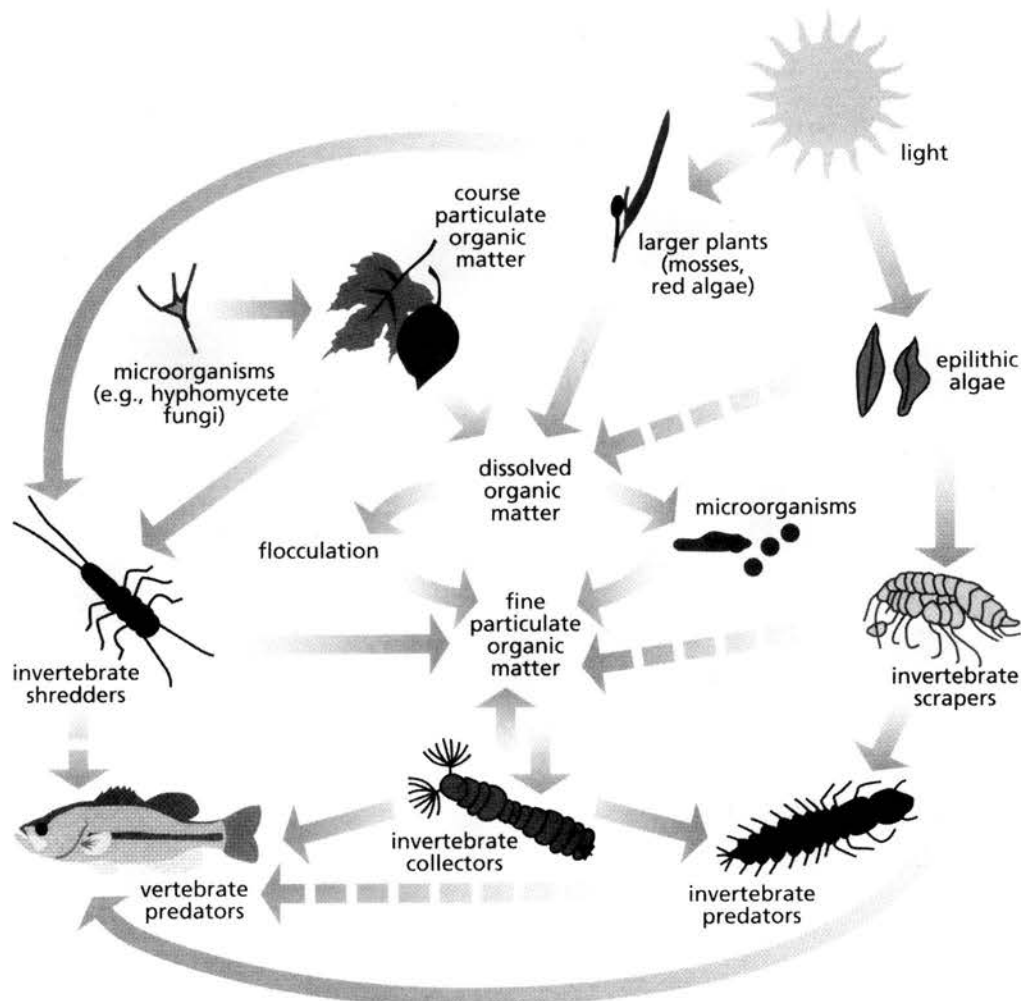


Figure 1.8 Stream Biota. Reprinted with permission of the Federal Interagency Stream Restoration Working Group (1998).

The relationship between the rate of primary production and the rate of decomposition influences the availability of habitat for stream biota. If primary production exceeds decomposition, the stream reach is described as autotrophic. If decomposition exceeds primary production, as occurs in most streams, the stream reach is described as heterotrophic. Most of the organic matter for the food web in heterotrophic stream reaches comes from external sources, such as the leaves of riparian trees and soil organic matter.

Primary producers that anchor themselves to the bottom substrate, such as large aquatic plants and attached algae, are more abundant in stream reaches where sunlight is unobstructed by riparian shade or suspended sediment. These producers tend to thrive in mid-reaches with substrates composed of coarser materials, ranging from sands to gravels. Other primary producers, such as phytoplankton, remain suspended in water and prefer slow-moving flow

conditions found near stream banks, behind obstructions, and in the backwaters of lowland rivers.

Organisms that feed directly on non-living coarse particulate organic matter (detritus) include bacteria, fungi, and some invertebrates known as shredders. These organisms proliferate in forested headwater streams, where detritus is plentiful and where the substrate allows for attachment. Other organisms, such as scrapers and grazers, feed directly on primary producers and thrive where the plants they feed on are most abundant. Both shredders and scrapers produce fine particulate organic material, bits of shredded and partly decomposed detritus and wastes. Invertebrates that feed on fine particulate organic material (collectors) flourish in lowland reaches where they collect food supplied by upstream activities. Fish and other vertebrate predators feed on collectors, shredders and other invertebrate predators.

Fish species have adapted to different stream habitats over time by modifying their forms, habits, and reproductive strategies. For example, the small agile bodies of fish in high-gradient upland streams allow them to accelerate quickly and move through the swift and rolling flow of these streams. In response to seasonal variability of water levels, from periods of flood to periods of low or no flow, some species mature rapidly and have short life spans. They usually require higher oxygen content and lower temperatures ($<20^{\circ}\text{C}$) than downstream species. Low gradient floodplain rivers provide a greater variety of environments and therefore are populated by a wider variety of organisms. Fish in these rivers may be larger and are tolerant of wider ranges of temperature, higher temperatures, and lower oxygen concentrations.

For some fish, upland streams provide habitat for spawning and for young, while the lowland river is home to adults. In floodplain rivers where seasonal flood pulses provide a full range of flowing to still-water habitats, fish use shallow, seasonally flooded pools for reproduction and maturation.

Self-Correcting Mechanisms and Dynamic Equilibrium

Stream corridors exhibit a dynamic form of stability, known as dynamic equilibrium. Dynamic equilibrium refers to the ability of system to persist within a range of conditions (Federal Interagency Stream Restoration Work Group, 1998). Maintaining this balance requires the presence of a series of self-correcting mechanisms in the ecosystem. A disturbance to the stream ecosystem triggers a response from these self-correcting mechanisms allowing maintenance of the dynamic equilibrium.

Disturbances result from both naturally occurring and human-induced events. Climatic factors often play a role in naturally occurring disturbances and generally involve below- or above-normal precipitation and concomitant runoff. Human-induced disturbances often relate to changing land use patterns associated with development activities within the watershed.

Disturbances and the river system's response to them occur at both temporal and spatial scales,

and a crude correlation can be drawn between them (Figure 1.9). At the stream reach scale, for example, cumulative effects of wave action from recreational boating over decades can be a major cause of bank erosion along popular reaches. At the river basin scale, the composite effect of major land-use changes in a watershed over a century, such as clearing of hardwood forests and substitution of agricultural crop production, may cause substantial chronic disturbances with long-term consequences for the river system.

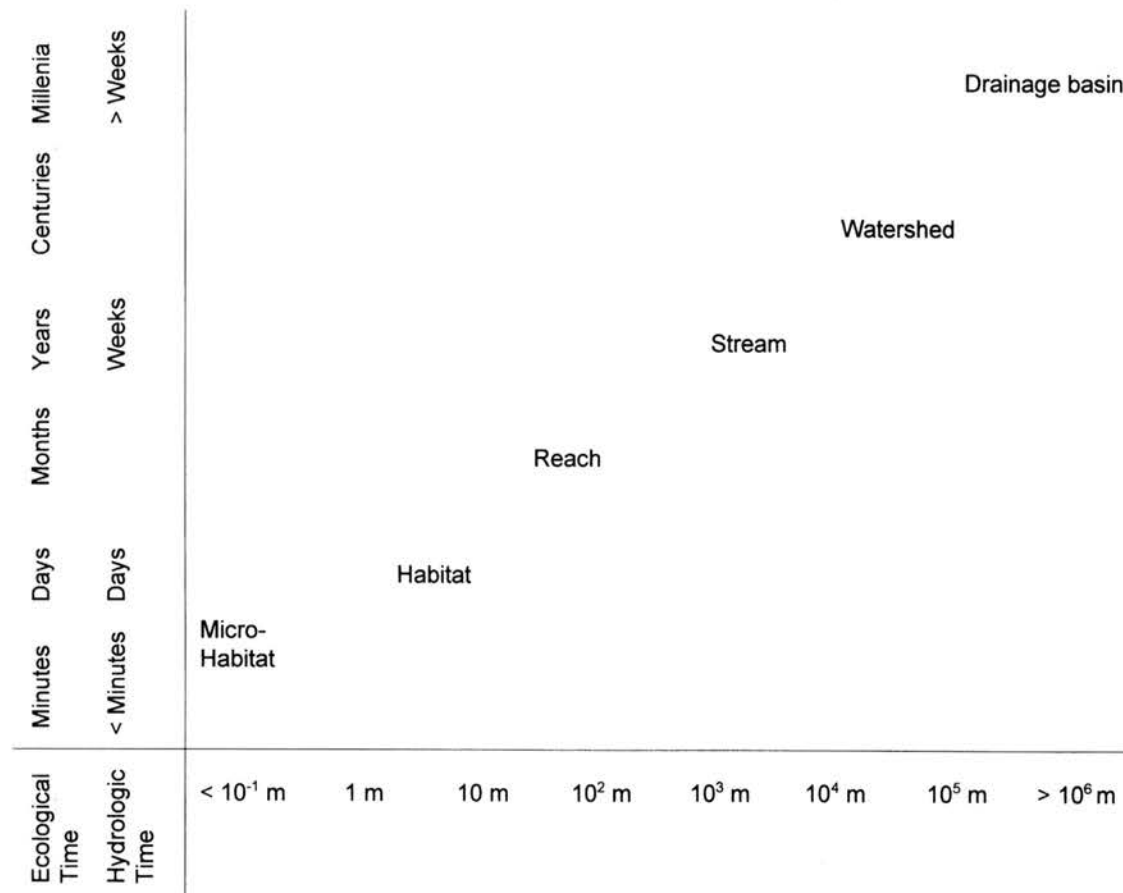


Figure 1.9 Temporal and Spatial Factors Influence Ecosystem Response

While many stream ecosystems can tolerate fairly significant disturbances and maintain dynamic equilibrium, threshold levels exist. When thresholds are exceeded, the system becomes unstable. As the ecosystem adjusts over time, it moves towards a new dynamic equilibrium that may be different than the one that existed prior to the disturbance. In some instances, disturbances alter the system to such an extent that it cannot recover unless the cause of the disturbance is removed or actions are taken to restore stream functions. At present, the relationships between threshold levels and the associated range of conditions required for ecosystem stability are not well understood. Research efforts in this area currently focus on identifying and quantifying threshold levels.

CHAPTER 2

AN OVERVIEW OF MINNESOTA'S RIVERS

INTRODUCTION

Minnesota contains eight major river basins with 92,000 miles of river. Eighty-one major watersheds compose these eight river drainage basins: Red River, Rainy River, Lake Superior, Upper Mississippi, Lower Mississippi, St. Croix, Minnesota, and Missouri (Figure 2.1).¹ A continental divide in Northeastern Minnesota partitions the surface flows from these eight river drainage basins into three major flow ways that constitute headwaters areas for the Hudson Bay, the Atlantic Ocean and the Gulf of Mexico.

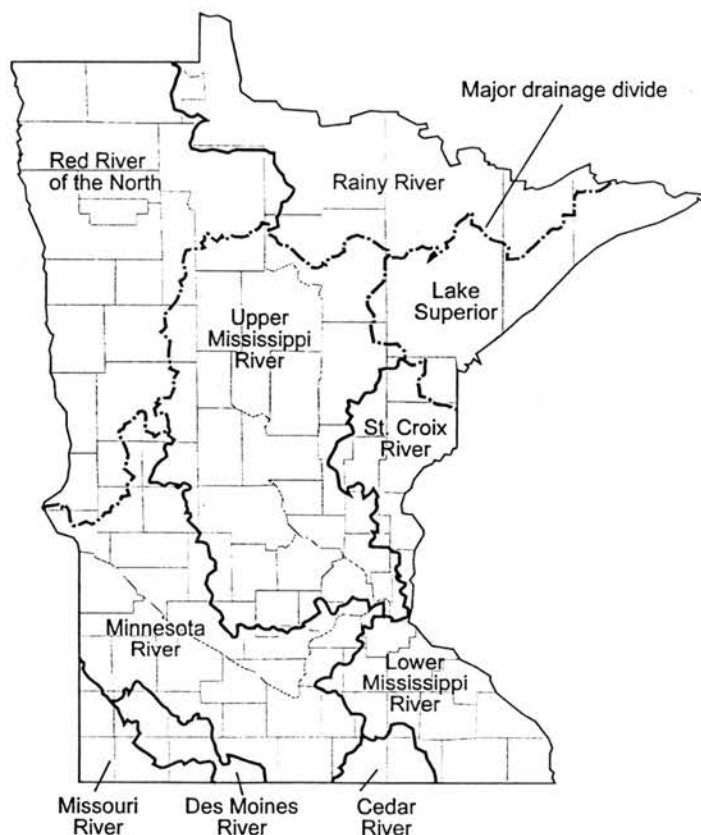


Figure 2.1 Major Watersheds in Minnesota. Rivers Council of Minnesota, 1999.

¹ As described in Chapter 1, a watershed is the land area that contributes surface flow to a single river system. Watersheds are nested such that the watershed of a large river is composed of several smaller tributary river basins, each of which is composed of several stream basins.

GEOMORPHOLOGIC FEATURES

A generally low relief surface characterizes the topography through which Minnesota's streams and rivers flow, as shown in Figure 2.2. The areas of greatest relief are located along the north shore of Lake Superior and in southeastern and southwestern Minnesota where streams descend into the Mississippi and Minnesota rivers, respectively. The state's topographical features, created largely during the most recent glacial periods, reflect a long period of geologic stability.

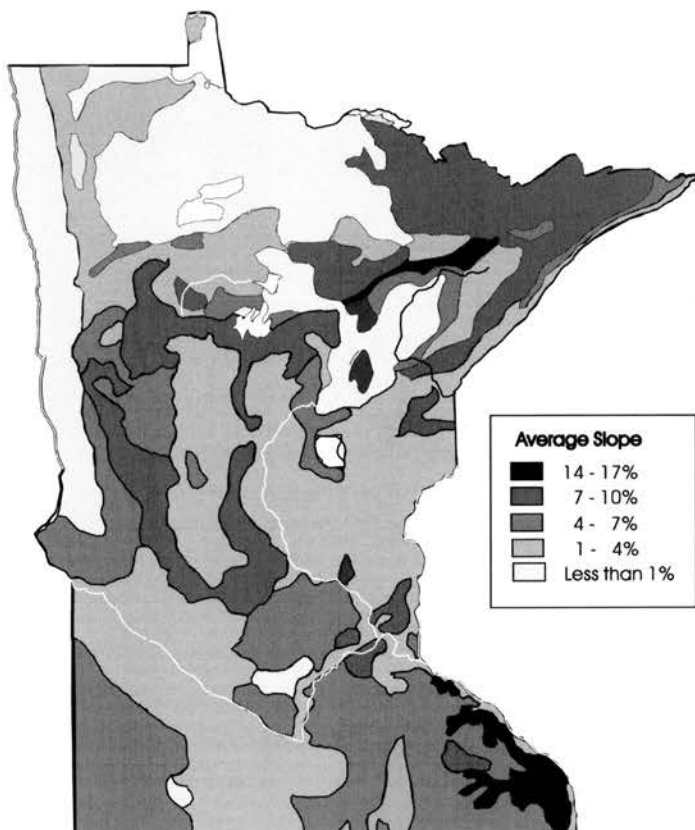


Figure 2.2 Topographic Regions of Minnesota. Adapted from MEQB-Lakes (1994). Minnesota Lake and Watershed Data Collection Manual, p. 69.

Minnesota's soils developed within the last 15,000 years from glacial sediments. A blanket of glacial sediments and meltwater deposits covers the state's older bedrock. The depth of glacial sediments is thickest (up to 150 meters) in northwestern Minnesota and thinnest in the Arrowhead and the southeastern Mississippi River valley regions. The variation in soil types across the state reflects differences in local erosion patterns and deposition of sediments during and after recent glacial periods. In general, however, soils tend to be rich in minerals because they are relatively new.

HYDROLOGIC CYCLE and STREAM FLOW

Water inputs into Minnesota's streams and rivers come primarily from runoff associated with precipitation. The majority of the state's annual precipitation (65 to 75 percent) occurs from May through October. Average precipitation varies widely across the state—from an average of 19 inches in the northwestern corner to 32 inches in the southeastern corner (Figure 2.3). Normal snowfall from November through April totals roughly 46 inches. Average annual runoff also varies widely across the state—from less than two inches in the west central border region to greater than 15 inches in the Arrowhead region (Figure 2.4). These differences reflect geographic trends in precipitation and other climatic conditions. Although snowfall accounts for only about 15% of annual precipitation, it contributes significantly to the amount and timing of peak stream runoff (Baker et al., 1979). High flows also occur as a result of intense summer thunderstorms.

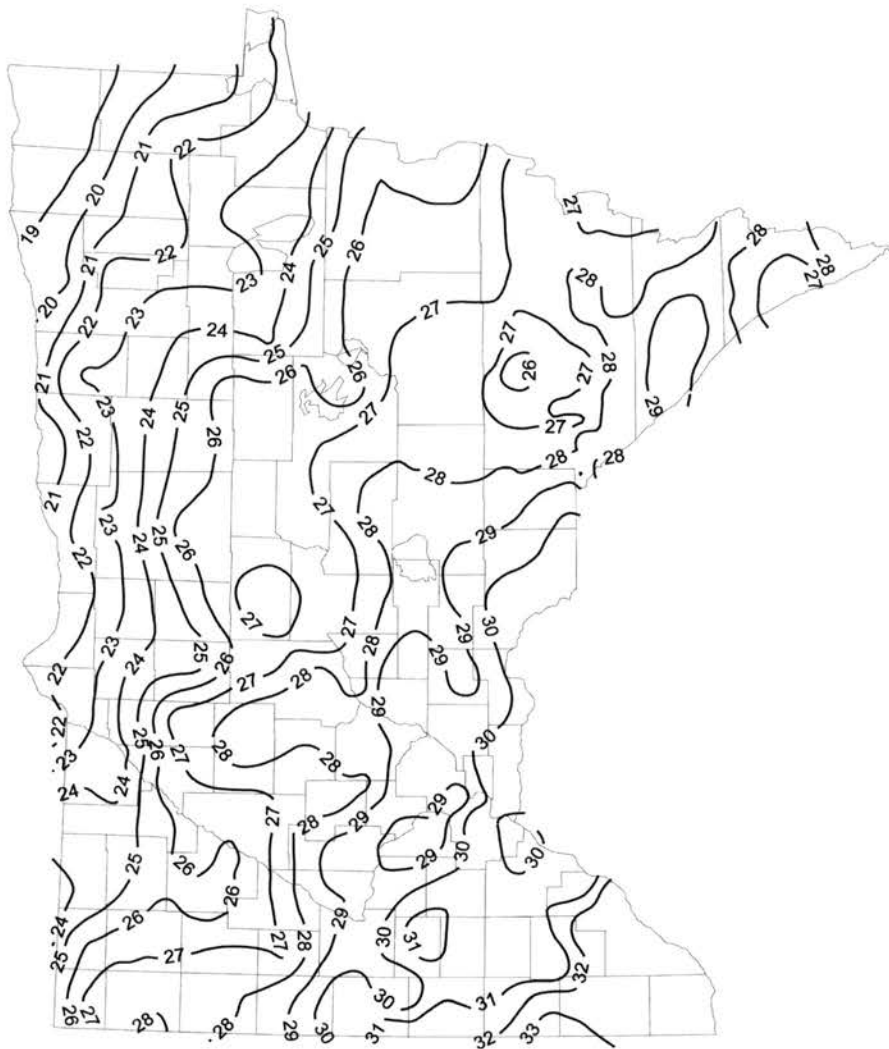


Figure 2.3 Average Annual Precipitation in Minnesota: 1961-1990. Courtesy of State Climatology Office, DNR-Waters Division, September, 1999.

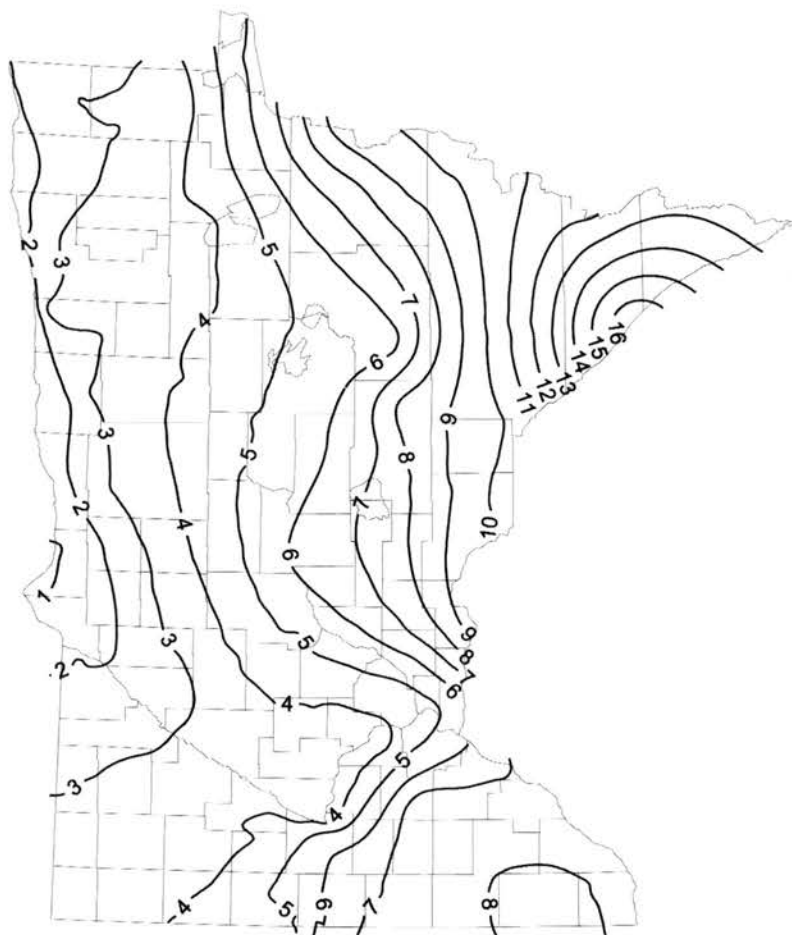


Figure 2.4 Annual Mean Runoff in Minnesota Measured in Inches: 1961-1990. Courtesy of State Climatology Office, DNR-Waters Division, September, 1999.

When precipitation reaches the earth it moves along one of three routes. It evaporates/transpires back into the atmosphere, infiltrates the soil profile or runs across the earth's surface into a body of water. According to the U.S. Geological Survey, about 78 percent (30 trillion gallons) of Minnesota's annual precipitation either evaporates or is transpired by natural vegetation (USGS, 1991). The remaining 22 percent of total precipitation (8 trillion gallons) either infiltrates the soil profile or runs off.

The topographical features and soil characteristics influence water storage capacity in the watershed. Forested watersheds with active wetlands can store substantial quantities of water and operate as a flood control mechanism by slowing and dampening peak flood impulse. In contrast, watersheds prone to flooding contain large areas of bare flat land that cannot store significant amounts of water.

Among the eight river basins in Minnesota, differences in the geomorphology of the flow pathways and water storage capacities in the watershed influence stream flows and the potential for flooding. The Rainy River and Lake Superior basins in northeastern Minnesota possess

limited water storage capabilities because most tributaries flow over impermeable bedrock covered by only a thin layer of glacial drift. Despite limited storage capability of the soil profile, flows in the Rainy River basin remain relatively stable due to the substantial holding capacity of headwater lakes and wetlands. In contrast, very limited storage capacity in headwater areas in the Lake Superior basin makes these areas prone to flash flooding.

In the Red River basin, extensive areas of wetland, peat bogs, and marshes in northern tributary headwaters provide natural flood protection. However, the flat topography of the lower basin makes flooding a major problem in Red River valley. Spring flood waters can extend for miles, flowing over agricultural and municipal lands. Increased vulnerability of this area to floods stems from both stream channelization and draining of upland areas and prairie marshes. The most damaging floods on record occurred in 1950, 1966, 1979 and 1997. The 1979 flood resulted in property damage totaling \$43.7 million. According to the 1998 Minnesota Recovery Disaster Task Force Anniversary Report, expenditures to remedy 1997 flood-induced damages totaled more than \$830 million. Funding sources include \$125 million from the state flood recovery fund, \$573 million from the Federal flood recovery fund, and \$132 million of private flood recovery funds.

The rivers of central Minnesota drain the Upper Mississippi basin. Natural regulation provided by extensive areas of lakes and swamps at the headwater areas contributes to stable stream flows. In addition, a series of headwater reservoirs regulates flows in the Upper Mississippi for navigational and other purposes. Flooding is a major problem along tributaries in the Lower Mississippi Basin of southeastern Minnesota. Spring snow melt and torrential summer thunderstorms may produce flash floods, a problem exacerbated by clearcutting on steep slopes for lumber and cattle grazing in the past.

In the Minnesota River Basin, which flows from west to east through the southern third of the state, stream flows have been modified greatly by human activities over the past 150 years. Over 90 percent of the land contained in the basin is under agricultural production. To support agricultural activities, the basin been extensively ditched, channelized, and drained by a vast network of drainage ditches and subsurface tiles.

PHYSICAL and CHEMICAL PROPERTIES

Concentrations of chemical constituents commonly found in rivers affect plant and animal life, as well as other water users. Figure 2.5 shows the typical concentrations of major ions found in large rivers of Minnesota at selected sampling sites. In addition to major ions, common metal, other elements and trace amounts of organic compounds from human activities are found in Minnesota's rivers. Mercury, phosphorus, and polychlorinated biphenyls (PCBs) have been found in concentrations high enough to trigger concern for some rivers.

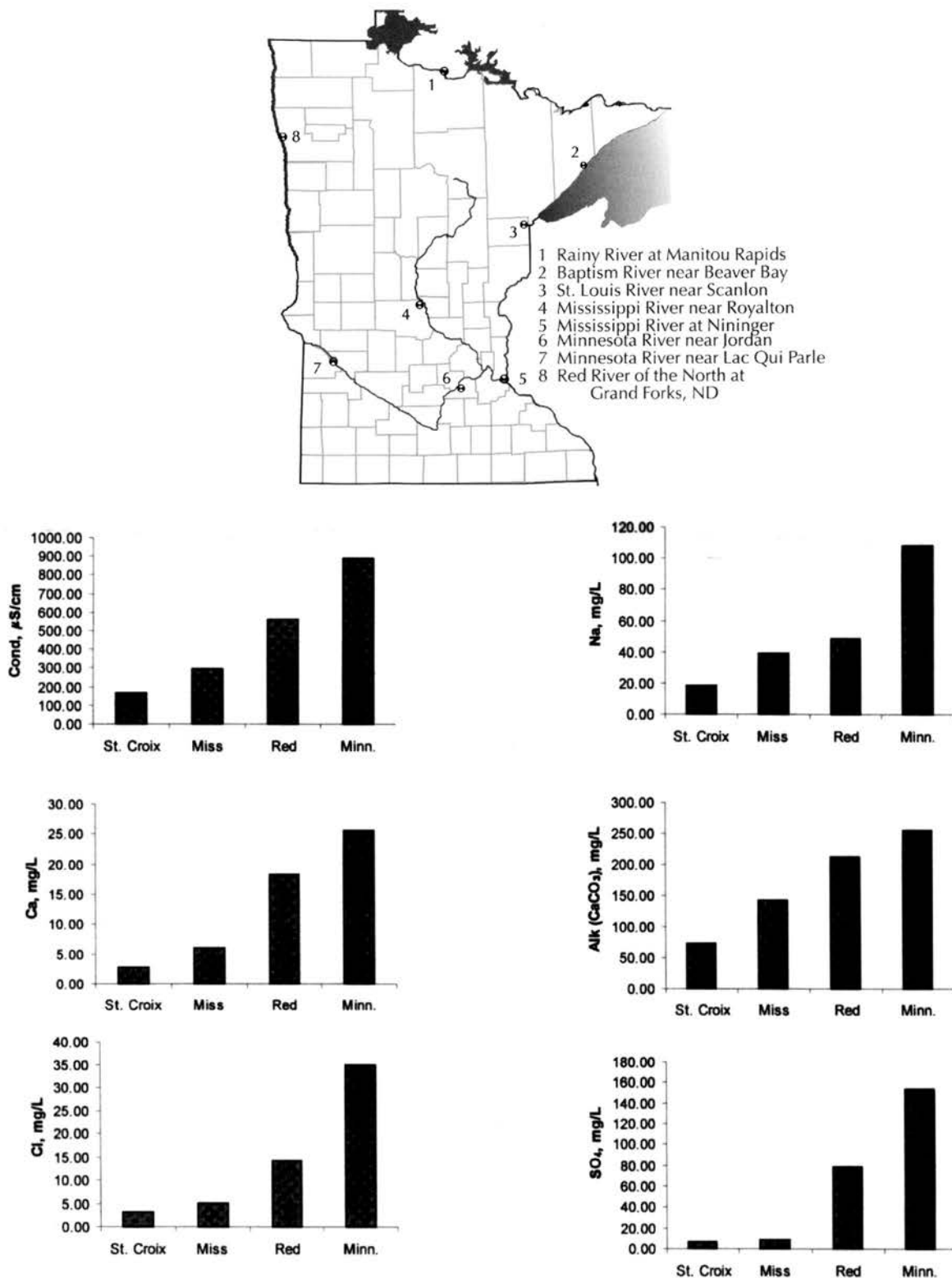


Figure 2.5 Average Concentrations of Major Ions Found in Minnesota Rivers.
USGS NASQAN Station data, 1999.

Overview of Water Quality in Selected Basins

Lake Superior Basin. Most of the streams in the Lake Superior Basin have near-pristine water quality, but wood processing facilities and urban centers have increased concentrations of some pollutants in the St. Louis and Rainy Rivers. Nitrogen, sulfate, chloride and suspended sediment concentrations are generally low. Low alkalinity values and dissolved solids concentrations are the result of low solubility of the thin soils and crystalline bedrock in the area.

Red River Basin. In the Red River Basin, dissolved solids and alkalinity are high because of geologic and climatic conditions. Sediments left behind by ancient glaciers and lakes are 200-300 feet thick. During low flow periods, highly mineralized groundwater seeps into the river and increases the load of dissolved solids. Concentrations of dissolved chemical constituents normally fall during spring runoff and after thunderstorms because of dilution. Total nitrogen and phosphorus concentrations are elevated in the south due to agricultural run-off. Some persistent pesticides, such as atrazine and 2,4-D, also have been detected although pesticide concentrations rarely approach drinking or ambient water-quality standards.

Minnesota River Basin. In the Minnesota River, alkalinity is generally high because of calcareous (limestone) glacial sediments. The river is turbid (carries large amounts of sediment) and high in sulfate and carbonate. As in the Red River Basin, highly mineralized groundwater contributes to the river's dissolved solids load. Contamination from agricultural chemicals also is a major problem.

St. Croix River Basin. The St. Croix is relatively unpolluted. It is slightly colored by humic matter from bog sources, but has low turbidity. Levels of water quality variables are good relative to other waters in the region and generally fall within standards set for the St. Croix River. Concentrations of a few metals, such as mercury, iron, and manganese, exceed standards, but iron and manganese are high because of natural sources.

Mississippi River Basin. In the Mississippi River, concentrations of chemical constituents generally increase from the source to the Iowa border. Differences in agricultural and urban development cause nitrogen concentrations to differ greatly among the sub-basins that make up the upper river system. Headwater streams drain an area that has little agriculture. Areas with more agriculture have higher concentrations of associated pollutants, but these generally do not exceed the limit for untreated drinking-water.

Trends in Water Quality. Trends in stream water quality over time are detected by statistical analysis of monitoring data. No clear statewide trends exist for Minnesota rivers over the last 20 years. Trend analyses show local increases in concentration of some constituents and decreases in others (USGS, 1999). Increases are probably due (primarily) to population pressures, unimproved treatment facilities, nonpoint control practices, and agricultural activities. Increases in chloride concentrations in the Minnesota River probably resulted from

road deicing and may be associated with population increases (USGS, 1993). A decreasing trend in dissolved nutrients in the Minnesota River may be attributable to reductions in agriculture activities because of the droughts of the 1980s. Increasing dissolved oxygen concentrations in the Mississippi River south of Minneapolis-St. Paul, for example, resulted from reduced input of oxygen-demanding substances from the metropolitan sewage treatment facility and better control of urban nonpoint runoff.

LAND USE PATTERNS and ECOREGIONS

Various plant and animal species prefer different habitat conditions and therefore establish distinct communities in areas that provide preferred conditions. Prior to the influence of human activities, conditions in Minnesota favored establishment of mixed prairie and hardwood forests in the southwestern quarter of the state, grading through mixed pine and hardwood into pine forests in the northeast, with peat bogs developing in the northwest. Human activities, such as clearing of forests and draining of wetlands for agriculture, have altered the native landscape significantly. Current land use patterns in the state are shown in Table 2.1. Land uses range from dense managed forests in the northeast to heavily tilled cropland in western and southern parts of the state. In the central portion of the state there is a mixture of land uses, including cropland, woodland and prairie.

Table 2.1 Land Use in Minnesota. Land Management Information Center (1999), St. Paul, MN.

Description	Acreage	Percent
Cultivated land	22,694,200	42.0
Forested	14,434,482	26.7
Bog/marsh/fen	5,728,056	10.6
Hay/pasture/grass land	4,977,451	9.2
Water	3,211,643	5.9
Urban and rural development	1,472,267	2.7
Brushland	1,326,796	2.5
Mining	147,175	0.3
State Total	53,992,070	100.0

Climate, topography, and land-use patterns, along with soil and water conditions, form habitat for plants and animals. Large areas that contain similar communities of plants and animals are called ecoregions. Ecoregions are determined based on mapped information on land use, soil types, land surface form, and potential natural vegetation. Streams draining watersheds within the same ecoregion are believed to exhibit similar characteristics, such as physical habitat, hydrology, water chemistry, and biotic communities. According to the classification system for

ecoregions developed by the U.S. Environmental Protection Agency, seven ecoregions are found in Minnesota: Red River Valley, Northern Minnesota Wetlands, Northern Lakes and Forests, North Central Hardwood Forests, Northern Glacial Plains, Western Corn Belt and Driftless Area. Land uses, topography, soil types and other information for each of the seven ecoregions are described in Figure 2.6.

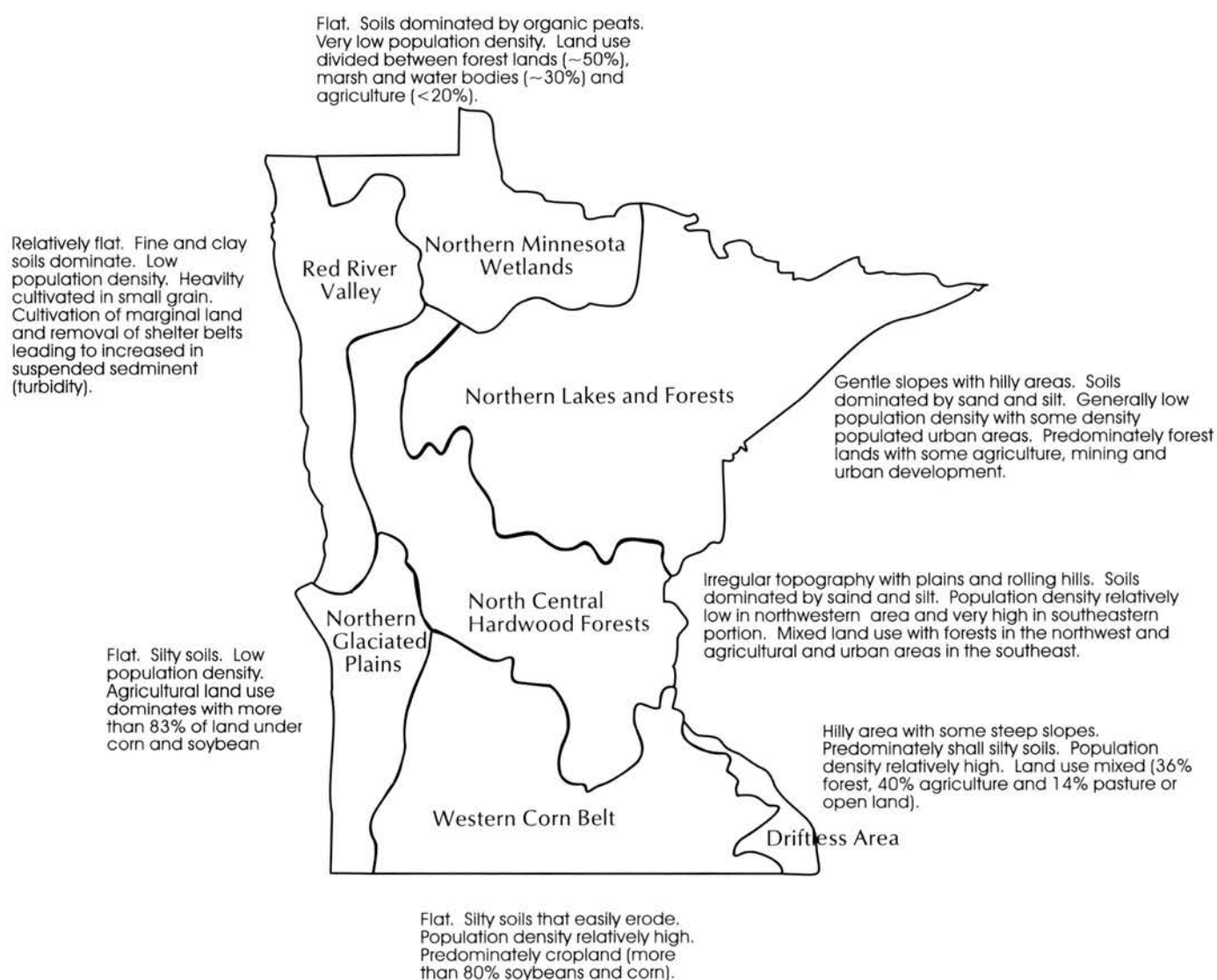


Figure 2.6 Minnesota's Seven Ecoregions

CHAPTER 3

STREAM WATER USES

INTRODUCTION

This chapter explores both the offstream and instream uses of stream water resources in Minnesota. Offstream uses involve withdrawing water, as for municipal and industrial uses, while instream uses require that water be left in the stream, as for commercial navigation and recreational boating. Conflict among users often erupts on rivers with many competing users due to the interdependence of offstream and instream uses. Offstream uses covered in this chapter are: municipal, thermoelectric, industrial and agricultural uses. Instream uses discussed are: hydropower, commercial navigation, commercial fishing and hunting, recreational boating, other recreational uses and *in situ* uses such as for natural amenities and waste disposal.

OFFSTREAM WATER USES

The U.S. Geological Survey (USGS) estimates total water use by geographic area and type of use for the United States every five years. The 1995 estimated withdrawals for offstream water uses in Minnesota totaled 3,390 million gallons per day (mgd) (Table 3.1)¹. Offstream withdrawals may be for consumptive or non-consumptive use. Consumptive use is defined as water withdrawn from its source and not returned directly to the source (M.S. 103G.005, subd 8). In contrast, water diverted for non-consumptive use is immediately returned to its source after use.

Approximately 79 percent of withdrawals in 1995 came from surface water sources. Although some water is withdrawn from lakes, notably Lake Superior, the majority comes from rivers. Thermoelectric plants constitute the largest single offstream user with 60 percent of total withdrawals, followed by public water supply (14 percent), mining (9 percent) and irrigation (5 percent). Thermoelectric power production returns most of the water withdrawn to surface sources and is considered a non-consumptive use. Groundwater withdrawals make up 55 percent of total withdrawals when non-consumptive use for power generation is excluded.

The Minnesota Department of Natural Resources (DNR) provides annual information on actual withdrawals by users holding water appropriation permits. Under state law, users withdrawing more than 10,000 gallons per day or one million gallons per year must obtain an appropriation permit. Permit holders must report to the DNR each year the volume of water withdrawn, accurate to within 10 percent. Based on these individual reports, the DNR calculates total permitted withdrawals for the state by type of use (DNR, 1997).

¹ Under M.S. 103G.005, subd. 8, all groundwater withdrawals not returned to the same aquifer are considered consumptive use. Surface withdrawals are considered consumptive use if they are not directly returned to the originating source so that it is immediately available for further use (DNR, 1997).

Table 3.1 Estimated Total Water Use for Minnesota by Type of Use in 1995

Type of Use	Surface	Ground water	Total
..... million gallons/day (mgd)			
Public Supply	154	331	485
Domestic	0	88	88
Commercial	20	46	66
Irrigation	37	120	157
Livestock	0	62	62
Industrial	83	58	140
Mining	292	6	298
Thermoelectric	2,090	2	2,090
Total*	2,680	714	3,390

Source: <http://www.usgs.gov/public/watuse/>

* Figures may not add up to totals because of rounding

Table 3.2 shows Minnesota's total permitted water use for the 1986-95 period. Over this period, total permitted usage trended upward due predominantly to increased thermoelectric demands. Based on available information, permitted use data represent a relatively good proxy for total usage. A comparison of the 1995 U.S. Geological Survey's total estimated water use of 3,390 mgd with the 1995 DNR total permitted use of 3,277 mgd reveals the two measures of total use are very close. These data also suggest that there are very few small diverters (those withdrawing less than 10,000 gallons per day).

Thermoelectric Power Generation Water Use

The largest volume of surface water withdrawals reported for the 1986-95 period was for nuclear and stream power plant cooling. During this period, Minnesota's power plants withdrew an average of 1.86 billion gallons of surface water per day. Usage trended upward over the period, increasing 28 percent between 1986 and 1995 (Table 3.2). Approximately 90 percent of total withdrawals for power plants return to their originating source and therefore are defined as non-consumptive use. This means that in 1995 while power plant withdrawals made up about 78% of total surface water withdrawals, consumptive use by power plants was

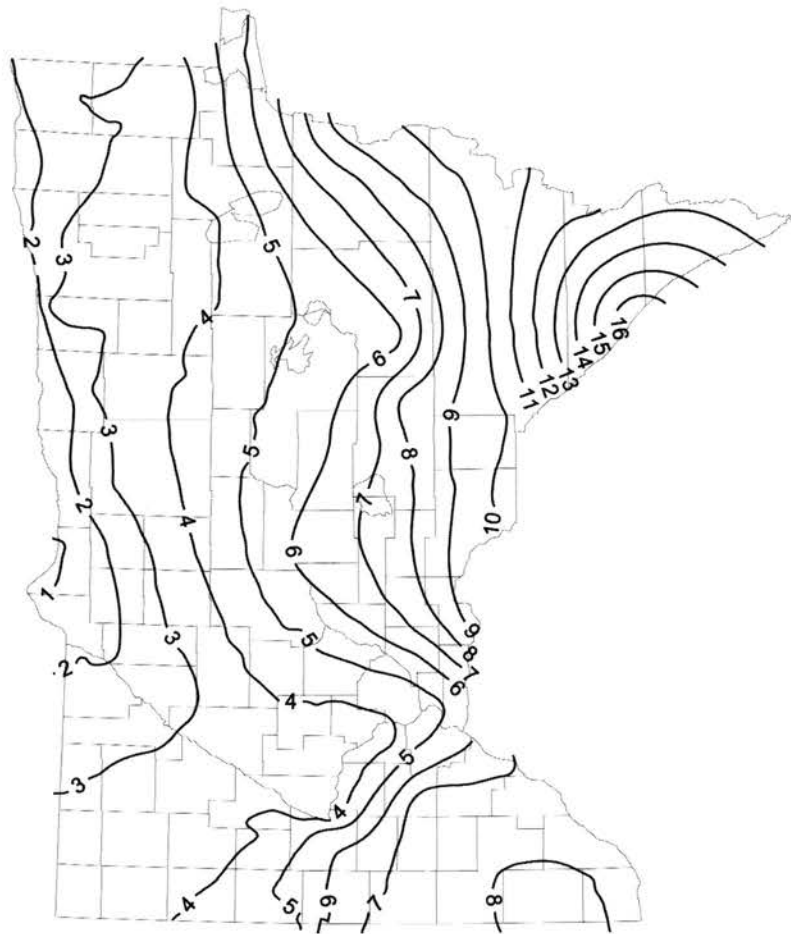


Figure 2.4 Annual Mean Runoff in Minnesota Measured in Inches: 1961-1990. Courtesy of State Climatology Office, DNR-Waters Division, September, 1999.

When precipitation reaches the earth it moves along one of three routes. It evaporates/transpires back into the atmosphere, infiltrates the soil profile or runs across the earth's surface into a body of water. According to the U.S. Geological Survey, about 78 percent (30 trillion gallons) of Minnesota's annual precipitation either evaporates or is transpired by natural vegetation (USGS, 1991). The remaining 22 percent of total precipitation (8 trillion gallons) either infiltrates the soil profile or runs off.

The topographical features and soil characteristics influence water storage capacity in the watershed. Forested watersheds with active wetlands can store substantial quantities of water and operate as a flood control mechanism by slowing and dampening peak flood impulse. In contrast, watersheds prone to flooding contain large areas of bare flat land that cannot store significant amounts of water.

Among the eight river basins in Minnesota, differences in the geomorphology of the flow pathways and water storage capacities in the watershed influence stream flows and the potential for flooding. The Rainy River and Lake Superior basins in northeastern Minnesota possess

limited water storage capabilities because most tributaries flow over impermeable bedrock covered by only a thin layer of glacial drift. Despite limited storage capability of the soil profile, flows in the Rainy River basin remain relatively stable due to the substantial holding capacity of headwater lakes and wetlands. In contrast, very limited storage capacity in headwater areas in the Lake Superior basin makes these areas prone to flash flooding.

In the Red River basin, extensive areas of wetland, peat bogs, and marshes in northern tributary headwaters provide natural flood protection. However, the flat topography of the lower basin makes flooding a major problem in Red River valley. Spring flood waters can extend for miles, flowing over agricultural and municipal lands. Increased vulnerability of this area to floods stems from both stream channelization and draining of upland areas and prairie marshes. The most damaging floods on record occurred in 1950, 1966, 1979 and 1997. The 1979 flood resulted in property damage totaling \$43.7 million. According to the 1998 Minnesota Recovery Disaster Task Force Anniversary Report, expenditures to remedy 1997 flood-induced damages totaled more than \$830 million. Funding sources include \$125 million from the state flood recovery fund, \$573 million from the Federal flood recovery fund, and \$132 million of private flood recovery funds.

The rivers of central Minnesota drain the Upper Mississippi basin. Natural regulation provided by extensive areas of lakes and swamps at the headwater areas contributes to stable stream flows. In addition, a series of headwater reservoirs regulates flows in the Upper Mississippi for navigational and other purposes. Flooding is a major problem along tributaries in the Lower Mississippi Basin of southeastern Minnesota. Spring snow melt and torrential summer thunderstorms may produce flash floods, a problem exacerbated by clearcutting on steep slopes for lumber and cattle grazing in the past.

In the Minnesota River Basin, which flows from west to east through the southern third of the state, stream flows have been modified greatly by human activities over the past 150 years. Over 90 percent of the land contained in the basin is under agricultural production. To support agricultural activities, the basin been extensively ditched, channelized, and drained by a vast network of drainage ditches and subsurface tiles.

PHYSICAL and CHEMICAL PROPERTIES

Concentrations of chemical constituents commonly found in rivers affect plant and animal life, as well as other water users. Figure 2.5 shows the typical concentrations of major ions found in large rivers of Minnesota at selected sampling sites. In addition to major ions, common metal, other elements and trace amounts of organic compounds from human activities are found in Minnesota's rivers. Mercury, phosphorus, and polychlorinated biphenyls (PCBs) have been found in concentrations high enough to trigger concern for some rivers.

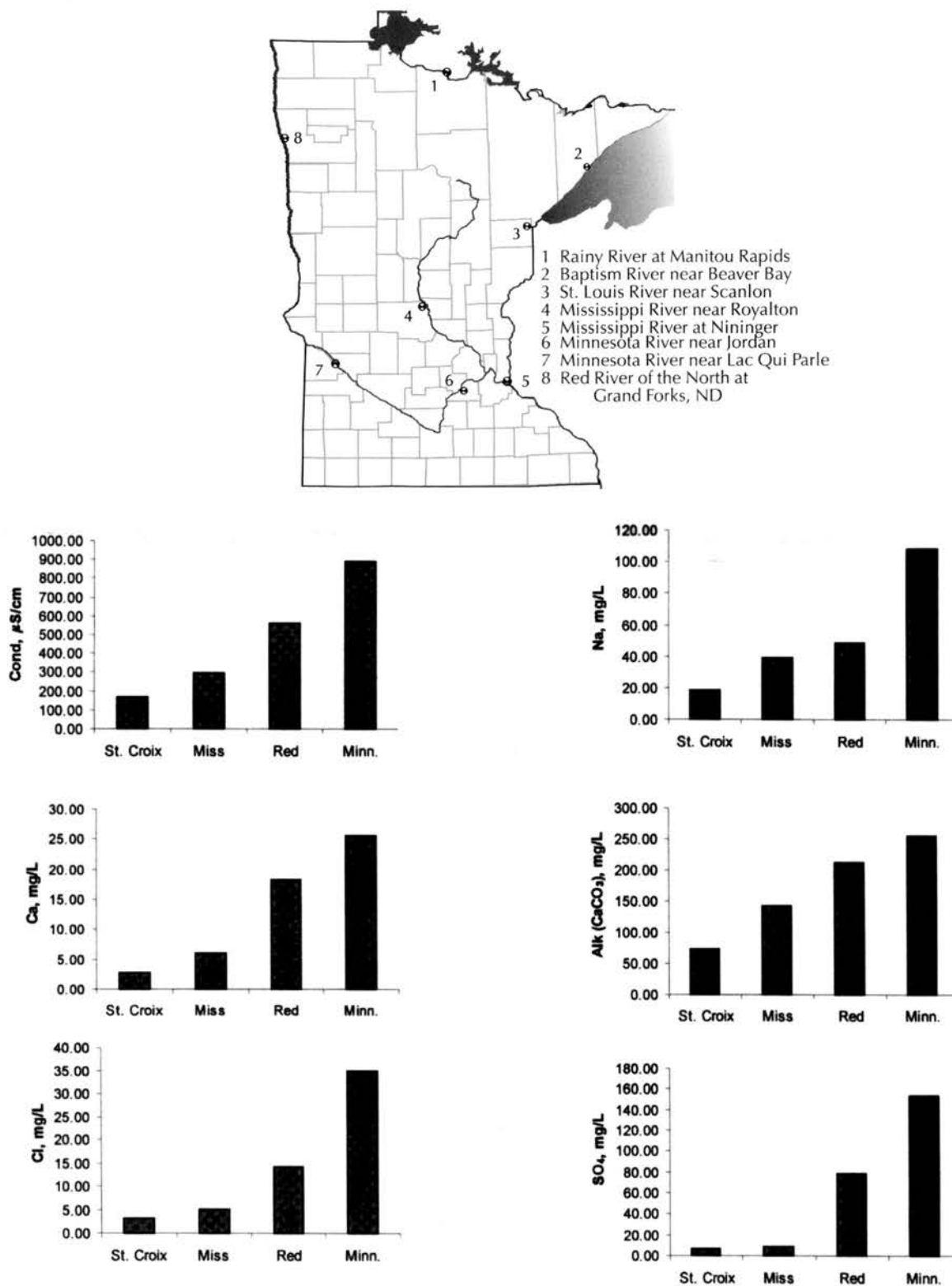


Figure 2.5 Average Concentrations of Major Ions Found in Minnesota Rivers.
USGS NASQAN Station data, 1999.

Overview of Water Quality in Selected Basins

Lake Superior Basin. Most of the streams in the Lake Superior Basin have near-pristine water quality, but wood processing facilities and urban centers have increased concentrations of some pollutants in the St. Louis and Rainy Rivers. Nitrogen, sulfate, chloride and suspended sediment concentrations are generally low. Low alkalinity values and dissolved solids concentrations are the result of low solubility of the thin soils and crystalline bedrock in the area.

Red River Basin. In the Red River Basin, dissolved solids and alkalinity are high because of geologic and climatic conditions. Sediments left behind by ancient glaciers and lakes are 200-300 feet thick. During low flow periods, highly mineralized groundwater seeps into the river and increases the load of dissolved solids. Concentrations of dissolved chemical constituents normally fall during spring runoff and after thunderstorms because of dilution. Total nitrogen and phosphorus concentrations are elevated in the south due to agricultural run-off. Some persistent pesticides, such as atrazine and 2,4-D, also have been detected although pesticide concentrations rarely approach drinking or ambient water-quality standards.

Minnesota River Basin. In the Minnesota River, alkalinity is generally high because of calcareous (limestone) glacial sediments. The river is turbid (carries large amounts of sediment) and high in sulfate and carbonate. As in the Red River Basin, highly mineralized groundwater contributes to the river's dissolved solids load. Contamination from agricultural chemicals also is a major problem.

St. Croix River Basin. The St. Croix is relatively unpolluted. It is slightly colored by humic matter from bog sources, but has low turbidity. Levels of water quality variables are good relative to other waters in the region and generally fall within standards set for the St. Croix River. Concentrations of a few metals, such as mercury, iron, and manganese, exceed standards, but iron and manganese are high because of natural sources.

Mississippi River Basin. In the Mississippi River, concentrations of chemical constituents generally increase from the source to the Iowa border. Differences in agricultural and urban development cause nitrogen concentrations to differ greatly among the sub-basins that make up the upper river system. Headwater streams drain an area that has little agriculture. Areas with more agriculture have higher concentrations of associated pollutants, but these generally do not exceed the limit for untreated drinking-water.

Trends in Water Quality. Trends in stream water quality over time are detected by statistical analysis of monitoring data. No clear statewide trends exist for Minnesota rivers over the last 20 years. Trend analyses show local increases in concentration of some constituents and decreases in others (USGS, 1999). Increases are probably due (primarily) to population pressures, unimproved treatment facilities, nonpoint control practices, and agricultural activities. Increases in chloride concentrations in the Minnesota River probably resulted from

road deicing and may be associated with population increases (USGS, 1993). A decreasing trend in dissolved nutrients in the Minnesota River may be attributable to reductions in agriculture activities because of the droughts of the 1980s. Increasing dissolved oxygen concentrations in the Mississippi River south of Minneapolis-St. Paul, for example, resulted from reduced input of oxygen-demanding substances from the metropolitan sewage treatment facility and better control of urban nonpoint runoff.

LAND USE PATTERNS and ECOREGIONS

Various plant and animal species prefer different habitat conditions and therefore establish distinct communities in areas that provide preferred conditions. Prior to the influence of human activities, conditions in Minnesota favored establishment of mixed prairie and hardwood forests in the southwestern quarter of the state, grading through mixed pine and hardwood into pine forests in the northeast, with peat bogs developing in the northwest. Human activities, such as clearing of forests and draining of wetlands for agriculture, have altered the native landscape significantly. Current land use patterns in the state are shown in Table 2.1. Land uses range from dense managed forests in the northeast to heavily tilled cropland in western and southern parts of the state. In the central portion of the state there is a mixture of land uses, including cropland, woodland and prairie.

Table 2.1 Land Use in Minnesota. Land Management Information Center (1999), St. Paul, MN.

Description	Acreage	Percent
Cultivated land	22,694,200	42.0
Forested	14,434,482	26.7
Bog/marsh/fen	5,728,056	10.6
Hay/pasture/grass land	4,977,451	9.2
Water	3,211,643	5.9
Urban and rural development	1,472,267	2.7
Brushland	1,326,796	2.5
Mining	147,175	0.3
State Total	53,992,070	100.0

Climate, topography, and land-use patterns, along with soil and water conditions, form habitat for plants and animals. Large areas that contain similar communities of plants and animals are called ecoregions. Ecoregions are determined based on mapped information on land use, soil types, land surface form, and potential natural vegetation. Streams draining watersheds within the same ecoregion are believed to exhibit similar characteristics, such as physical habitat, hydrology, water chemistry, and biotic communities. According to the classification system for

ecoregions developed by the U.S. Environmental Protection Agency, seven ecoregions are found in Minnesota: Red River Valley, Northern Minnesota Wetlands, Northern Lakes and Forests, North Central Hardwood Forests, Northern Glacial Plains, Western Corn Belt and Driftless Area. Land uses, topography, soil types and other information for each of the seven ecoregions are described in Figure 2.6.

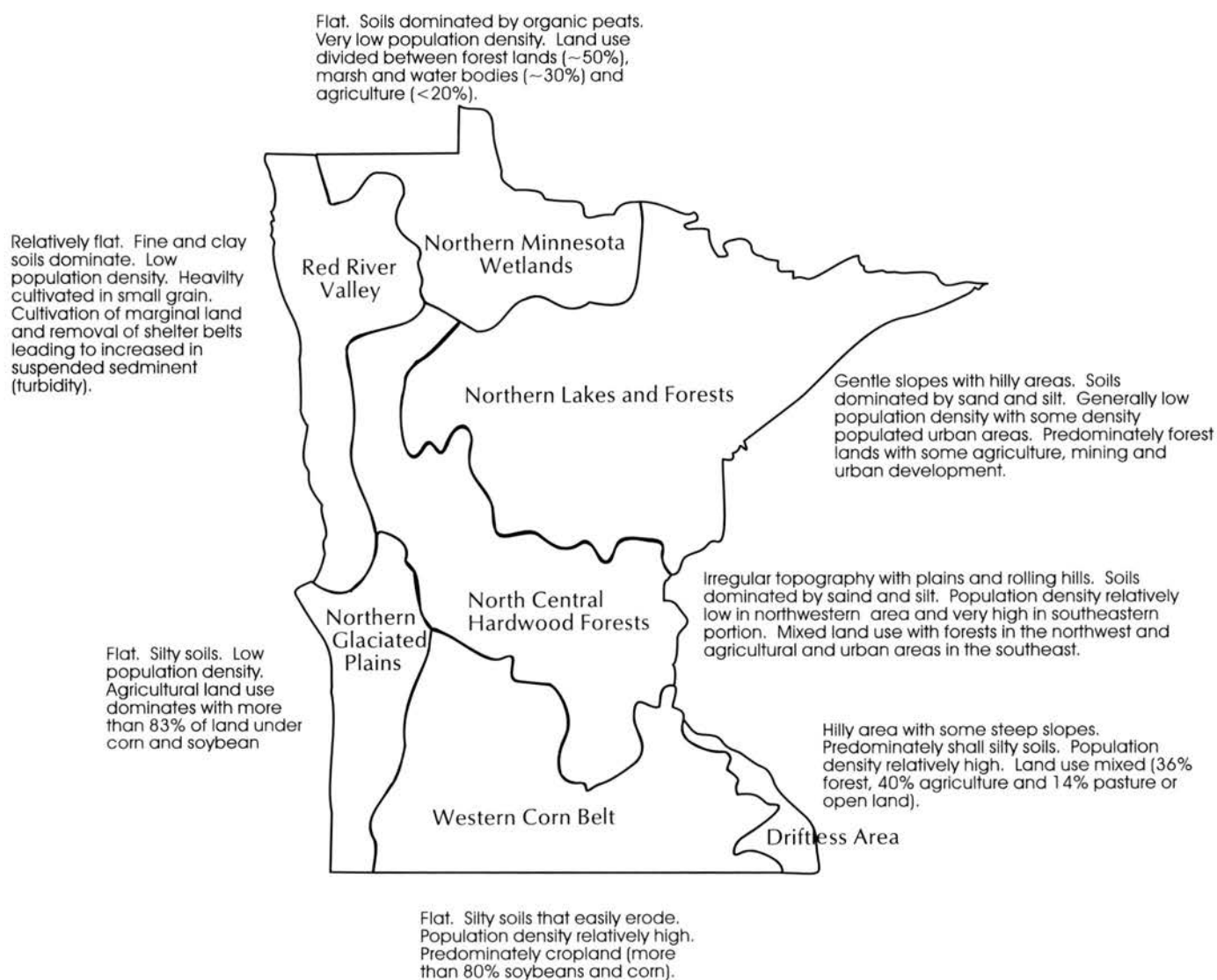


Figure 2.6 Minnesota's Seven Ecoregions

CHAPTER 3

STREAM WATER USES

INTRODUCTION

This chapter explores both the offstream and instream uses of stream water resources in Minnesota. Offstream uses involve withdrawing water, as for municipal and industrial uses, while instream uses require that water be left in the stream, as for commercial navigation and recreational boating. Conflict among users often erupts on rivers with many competing users due to the interdependence of offstream and instream uses. Offstream uses covered in this chapter are: municipal, thermoelectric, industrial and agricultural uses. Instream uses discussed are: hydropower, commercial navigation, commercial fishing and hunting, recreational boating, other recreational uses and *in situ* uses such as for natural amenities and waste disposal.

OFFSTREAM WATER USES

The U.S. Geological Survey (USGS) estimates total water use by geographic area and type of use for the United States every five years. The 1995 estimated withdrawals for offstream water uses in Minnesota totaled 3,390 million gallons per day (mgd) (Table 3.1)¹. Offstream withdrawals may be for consumptive or non-consumptive use. Consumptive use is defined as water withdrawn from its source and not returned directly to the source (M.S. 103G.005, subd 8). In contrast, water diverted for non-consumptive use is immediately returned to its source after use.

Approximately 79 percent of withdrawals in 1995 came from surface water sources. Although some water is withdrawn from lakes, notably Lake Superior, the majority comes from rivers. Thermoelectric plants constitute the largest single offstream user with 60 percent of total withdrawals, followed by public water supply (14 percent), mining (9 percent) and irrigation (5 percent). Thermoelectric power production returns most of the water withdrawn to surface sources and is considered a non-consumptive use. Groundwater withdrawals make up 55 percent of total withdrawals when non-consumptive use for power generation is excluded.

The Minnesota Department of Natural Resources (DNR) provides annual information on actual withdrawals by users holding water appropriation permits. Under state law, users withdrawing more than 10,000 gallons per day or one million gallons per year must obtain an appropriation permit. Permit holders must report to the DNR each year the volume of water withdrawn, accurate to within 10 percent. Based on these individual reports, the DNR calculates total permitted withdrawals for the state by type of use (DNR, 1997).

¹ Under M.S. 103G.005, subd. 8, all groundwater withdrawals not returned to the same aquifer are considered consumptive use. Surface withdrawals are considered consumptive use if they are not directly returned to the originating source so that it is immediately available for further use (DNR, 1997).

Table 3.1 Estimated Total Water Use for Minnesota by Type of Use in 1995

Type of Use	Surface	Ground water	Total
..... million gallons/day (mgd)			
Public Supply	154	331	485
Domestic	0	88	88
Commercial	20	46	66
Irrigation	37	120	157
Livestock	0	62	62
Industrial	83	58	140
Mining	292	6	298
Thermoelectric	2,090	2	2,090
Total*	2,680	714	3,390

Source: <http://www.usgs.gov/public/watuse/>

* Figures may not add up to totals because of rounding

Table 3.2 shows Minnesota's total permitted water use for the 1986-95 period. Over this period, total permitted usage trended upward due predominantly to increased thermoelectric demands. Based on available information, permitted use data represent a relatively good proxy for total usage. A comparison of the 1995 U.S. Geological Survey's total estimated water use of 3,390 mgd with the 1995 DNR total permitted use of 3,277 mgd reveals the two measures of total use are very close. These data also suggest that there are very few small diverters (those withdrawing less than 10,000 gallons per day).

Thermoelectric Power Generation Water Use

The largest volume of surface water withdrawals reported for the 1986-95 period was for nuclear and stream power plant cooling. During this period, Minnesota's power plants withdrew an average of 1.86 billion gallons of surface water per day. Usage trended upward over the period, increasing 28 percent between 1986 and 1995 (Table 3.2). Approximately 90 percent of total withdrawals for power plants return to their originating source and therefore are defined as non-consumptive use. This means that in 1995 while power plant withdrawals made up about 78% of total surface water withdrawals, consumptive use by power plants was

less than 8 percent of total consumptive use (Table 3.1). Sixty-nine percent of reported water use in the state took place in the eight counties where power plant cooling was identified as the primary use. For example, water for cooling power plants in Goodhue and Wright counties accounted for 28 percent of total 1995 reported use for the state (DNR, 1997).

Table 3.2 Permitted Water Use in Minnesota by Type of Use: 1986–95

Type of Use	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
..... million gallons/day (mgd)										
Public Supply	466	526	556	477	449	466	479	449	488	477
Irrigation	82	184	282	236	195	164	173	82	153	156
Industrial/Mining	208	189	258	329	279	315	433	348	329	441
Other	115	104	115	132	145	142	159	173	175	156
Thermoelectric	1,477	1,745	1,816	1,819	1,912	1,901	1,860	1,978	2,096	2,047
Total*	2,348	2,748	3,027	2,992	2,981	2,989	3,104	3,030	3,241	3,277

Source: DNR Division of Waters, "1995 and 1996 Water Year Data Summary," May 1997.

* Figures may not add up to totals because of rounding

Public Supply Water Use

Public supply includes water distributed to domestic, commercial, small industrial, and public users such as city parks, government buildings and hospitals. It does not include self-supplied domestic users or those served by small water companies (fewer than 25 customers).

Withdrawal to meet the demands of this user group varies seasonally in Minnesota. Water usage increases in the summer months because of landscape irrigation and other outdoor uses of water. A rapid increase in demand for public water supplies has accompanied significant growth in Minnesota since the 1950s. While reliance on surface water sources increased until 1980, the majority of public supplies now come from groundwater. Increased dependence on groundwater to meet drinking and other public supply needs has raised new issues for water utility managers related to water quality and long-term sustainability of current withdrawal rates.

Industrial Processing Water Use

Industrial water use includes milling activities, paper and forest product operations, and food processing. It does not include smaller industrial facilities that receive water from public water suppliers. According to 1995 U.S. Geological Survey data, industrial use constituted 4 percent of total estimated water use and 11 percent of total consumptive use (Table 3.1). Surface water sources contribute 60 percent of the water used in industry. The mining industry is the third largest water user in the state with nine percent of total withdrawals and the second largest consumptive user with 23 percent of total.

Annual permitted water use data for industrial processing reported by the Minnesota DNR provide aggregated industrial and mining use data. In 1995, mining-related water-use activities accounted for 65 percent of reported industrial usage, pulp/paper processing for 16 percent and agricultural processing for 7 percent (DNR, 1997). Total water usage for industrial processing increased 33 percent between 1994 and 1995 because of increased mining demands in Lake County (Table 3.2). Counties with the highest industrial processing water use, ranked in decreasing order of use, include: Lake (mine processing), Cook (mine processing), Koochiching (pulp/paper processing), St. Louis (mine processing), Itasca (pulp/paper processing) and Ramsey (general and agricultural processing).

Agricultural Water Use

In 1995, agricultural use accounted for five percent of Minnesota's total usage and 13 percent of consumptive use (Table 3.2). Although agricultural use is relatively small, most applied water is used consumptively. Most of this water (76%) comes from groundwater sources (Table 3.1).

Irrigation is the primary agricultural use. The DNR's irrigation category includes major crops, orchard, and nursery irrigation, as well as some uses that are not agricultural, such as landscaping, cemetery, and golf course irrigation. Major crops accounted for 77 percent of total use in 1995 (DNR, 1997). Virtually every county in the state reports irrigation water use to the DNR. Otter Tail and Sherburne Counties reported the highest irrigation water use in 1995 with 17 percent and 12 percent of total irrigation use, respectively.

Livestock watering and other on-farm water uses make up most of non-irrigation use. Non-irrigation uses generally do not require a DNR permit because they constitute a relatively minor usage. The U.S. Geological Survey estimated 1995 livestock usage at 62 million gallons per day or five percent of consumptive use (Table 3.1).

Other Offstream Water Uses

Other uses as defined by the Minnesota DNR include air conditioning, water level maintenance, fisheries, construction dewatering, pollution confinement and other specialty uses (DNR, 1997). In 1995, these uses represented only five percent of total permitted use.

INSTREAM USES

Instream uses depend upon the water in the stream channel. These uses often require alteration, stabilization, or protection of the channel itself to create desired flow conditions. Measuring instream uses raises complex issues. Unlike offstream uses, for which the quantity of water withdrawn provides a measure of the level of use, instream uses can be measured in many different ways. In addition, the extent of *in situ* use, such as for fish and wildlife habitat, is extremely difficult to quantify. Instream uses, such as hydropower and commercial fishing, may generate revenue for the user or provide other non-market related values, such as protecting endangered species. This section identifies and describes major instream uses of Minnesota's streams and rivers.

Hydropower

Minnesota's rivers have 32 active hydropower dams with a combined electrical capacity of about 215 megawatts, about 2 percent of the state's total electricity production. The State of Minnesota and the Federal Energy Regulatory Commission (FERC) regulate all hydropower dams (DNR, 1995). Most generate power for profit; only six use the power directly for manufacturing. Minnesota Power Company owns and operates the largest hydropower plant in the State with a capacity of 72.6 megawatts. Otter Tail Power Company owns the smallest hydropower plant with a 0.4-megawatt capacity.

Commercial Navigation

Approximately 230 miles of river in Minnesota are designated as navigable riverways for commercial vessels and belong to the national Shallow Draft Navigation System. This system consists of 22,000 miles of river channel across the United States. The Mississippi River contains 80 percent of navigable channels and terminals, and the St. Croix and Minnesota Rivers each have 10 percent (Table 3.3).

The Army Corps of Engineers maintains channel conditions and related lock and dam facilities. They dredge channels along the upper river system in Minnesota to ensure a depth of at least nine feet. A fully loaded barge requires a minimum depth of nine feet to maneuver safely in the channel. Regular dredging keeps the channels open in areas where fast moving tributaries discharge into the main river and deposit large amounts of sediment. The Corps also operates the lock and dam facilities that lift and lower river vessels. The locks in Minnesota were designed and built to accommodate barges up to 290 feet long with a 50-foot width and a maximum cargo-carrying capacity of 3,000 tons.

Table 3.3 Miles of Channel and Terminals on Upper Mississippi River System in Minnesota

River	Miles of channel	# of Terminals	
		Grain	Other
Mississippi	183.8	15	33
Minnesota	21.8	4	6
St. Croix	24.5	0	3
Total	230.1	19	41

Commercial navigation includes both freight and passenger traffic. Freight traffic generates significant economic returns to the state. A substantial amount of freight moves through Minnesota's 58 active river terminals, including: grain, coal, liquid and dry fertilizer, iron and steel, sand and gravel, crude oil and petroleum products, newsprint, and all types of heavy general cargo.

Historically, grain constituted at least one half of annual freight tonnage. Over 60 percent of Minnesota's grain exports are shipped by river (MDOT, 1993). In addition, grain shipments from North and South Dakota, western Wisconsin, and northern Iowa move through Minnesota's river terminals. Between 1972 and 1992, these terminals handled an average of 11 percent of the grain exported from Gulf Coast terminal or roughly 7 percent of total annual grain exports from the United States (MDOT, 1993).

Commercial passenger use of the state's riverways is relatively limited compared with freight traffic. Passenger traffic includes both large cruise and local excursion boats. Large cruise boats make occasional visits to the city of St. Paul in the summer months. For example, in 1992 seven cruise boats docked near downtown St. Paul. Each cruise boat visit generates an estimated \$500,000 in revenue to the city. Many excursion boats carry passengers on trips of one day or less. A total of 17 vessels holds the required U.S. Coast Guard certification to carry passengers. Active passenger terminals on the Mississippi River are located in Minneapolis, St. Paul, Red Wing, Lake City, and Winona. Active passenger terminals on the St. Croix are located in Afton, Bayport, Stillwater, and Taylors Falls. The only active terminal on the Minnesota River is in Shakopee. Excursion boats carry nearly a quarter of a million passengers each season in Minnesota. For example, the Paddleford Pacquet Company in St. Paul carries more than 100,000 passengers annually, over half of whom reside outside the metropolitan area (MDOT, 1993).

Commercial Fishing and Trapping

Commercial fishing and trapping activities depend upon Minnesota's river resources. Commercial fish harvested from Minnesota rivers include: carp, sucker, sheepshead, and other varieties of non-game (rough) fish from the upper river. The St. Paul District generates about

\$720,000 annually from commercially caught fish. Other commercial fishing activity on the Upper Mississippi River includes minnow and turtle trapping. Minnesota has long been a major supplier of turtle meat.

Commercial clamming produces shells for export to the Asian cultured pearl industry. This industry finds Minnesota clamshells desirable because of their unique color and luminescence. In 1990, shells harvested from the Otter Tail River in west central Minnesota were valued at between \$30,000 and \$40,000 (Tester, 1995). Minnesota and Wisconsin limit clam harvests to help protect the resource. Since 1991, all Minnesota rivers except the Mississippi below Red Wing have been closed to commercial shell harvesting.

Minnesota's commercial trapping activity remains limited. Trappers seek out raccoon, muskrat, mink, and beaver on backwaters and tributary streams. In 1992, furs taken on the navigable portion of the state's rivers were valued at an estimated \$2 million (MDOT, 1993).

Recreational Boating

Recreational boating constitutes one of the largest uses of Minnesota's rivers. Many Minnesotans consider boating access to the state's rivers to be a basic right. The state contains 2,850 miles of designated canoe and boating river with some 2,300 state-maintained public access ramps and drop-in points (Figure 3.1).

In 1992, small recreational boats made up almost 50 percent of the traffic in locks on the river navigation system operated by the U.S. Army Corps of Engineers in Minnesota. The boats range in size from canoes to speedboats to houseboats. The Minnesota DNR provides 22 public boat launching ramps on the navigable portions of the Minnesota, St. Croix, and Mississippi rivers. The U.S. Army Corps of Engineers, the U.S. Fish & Wildlife Service and the Minnesota Department of Transportation maintain 15 ramps, and another 74 are owned and operated by commercial businesses, towns, sports organizations, churches, and other non-profit groups. In addition, the Minnesota portion of the Mississippi River contains 104 private boat launches and canoe drop-in sites. Numerous marinas for large recreational boats also exist. They range in size from as few as six boat slips to as many as 600. Forty-eight boat rental operations and 21 private yacht clubs further contribute to recreational boating traffic on Minnesota's rivers.

Other Recreational Uses

Minnesota's streams and rivers provide many other recreational uses such as fishing, hunting and wildlife viewing. According to a 1996 U.S. Department of Interior Fish and Wildlife Service survey, people spent an estimated 27,002,000 person-days fishing on Minnesota's lakes and rivers (U.S. Dept. of Interior, 1997). Anglers spent an estimated \$69 per person-day on average for fishing-related travel, equipment and other expenditures in 1996². In the same year, wildlife watchers engaged in 6,807,000 person-days of wildlife watching and spent an estimated \$53 per person-day for equipment, food, lodging, transportation and other travel-related costs (U.S. Dept. of Interior, 1997).

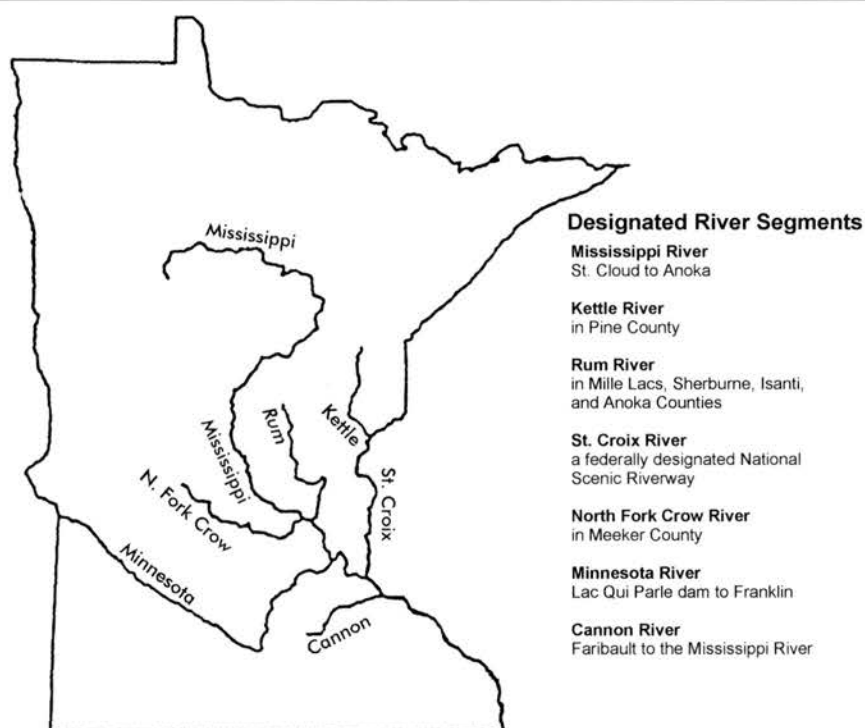


Figure 3.1 Minnesota's Designated Canoeing and Boating Streams. Minnesota Dept. of Natural Resources, Division of Trail and Waterways.

In Minnesota as a whole, hunters spent 6,984,000 person-days and an average of \$258 per person-day for equipment, food, lodging, transportation, and other trip costs associated with hunting in 1996. River-bottom lands associated with the Upper Mississippi River system provide over 185 thousand acres of hunting area for upland birds, small game, and deer. Hunters spend an average of 350,000 person-days each year in the Mississippi River-bottom forests. In addition, duck hunters spend over 275,000 person-days on the water (U.S. Fish and Wildlife Service, 1997). Clearly, recreational use of water resources contributes significantly to the state as well as local economies.

Natural Amenity Uses

Non-game wildlife. The navigable portion of the Upper Mississippi River in Minnesota contains thousands of acres of state and federally managed fish and wildlife areas. Besides protecting habitat, these areas provide recreational services. For example, the Upper Mississippi River National Fish and Wildlife Refuge, which contains 32,900 acres and extends from Wabasha, Minnesota to Rock Island, Illinois, has the largest annual public use of any fish and wildlife refuge in the national refuge system. In Minnesota, 685,000 acres of refuge and park land fall under the auspices of the state. In some refuges, management plans encourage

² Average estimated based on total angler expenditures of \$1,874,835,000 divided by 27,002,000 angler days for the State of Minnesota (U.S. Department of Interior, 1997).

regulated hunting, fishing, and camping activities. In others, management plans prohibit human activity (at least seasonally) to achieve species protection objectives.

Species preservation. Several species designated as endangered or threatened on state and federal lists depend on river habitats for survival. Table 3.4 lists river-dwelling vertebrate animal species on the state's endangered and threatened list that depend on river habitats. The state list also includes 25 endangered and threatened species of mollusk and one endangered species of the caddis fly. Minnesota's threatened and endangered river plants include floating marsh marigold, sweet-smelling Indian plantain, kitten-tails, glade mallow, and the dwarf trout lily, which is native only to southeast Minnesota and appears on the federal endangered species list.

Waste disposal

Sewage disposal systems use rivers to dilute treated effluent and move it downstream. Figure 3.2 shows major wastewater treatment plants that discharge into Minnesota's rivers. Most cities located along a river depend on river water dilution for at least part of their disposal requirements. For example, the Twin Cities' Metropolitan Plant discharges treated wastewater into the Mississippi River with about 3 parts per million (ppm) phosphorus. A study conducted for the Plant in 1992 concluded that reducing phosphorus discharge from 3 ppm to 1 ppm would cost \$180 million in capital costs and add \$20 million annually to operating costs. The plant currently avoids these costs by relying on the Mississippi for phosphorus dilution.

Table 3.4 Minnesota's Endangered and Threatened Vertebrate Animal Species Dependent upon River Habitat

Species	Status	Habitat
Northern Cricket Frog	Endangered	Small, pebbly streams in grasslands and near marshes and ponds
Massasauga (snake)	Endangered	River bottom lands
Paddlefish	Threatened	Open water of large rivers, river lakes, and backwaters
Wood Turtle	Threatened	Small, fast-moving, clear-water streams with hard bottoms (sand, gravel, or rock) grassy margins, and elevated sandbars for nesting, in relatively undisturbed areas in forests
Blandings Turtle	Threatened	Calm, shallow water with rich, aquatic vegetation, and sandy uplands for nesting
Bald Eagle	Federal: Threatened	Lakes and rivers in forested areas with large trees

Source: Information from Coffin and Pfannmuller, eds. (1988) Minnesota's Endangered Flora and Fauna and DNR. 1996. Minnesota's List of Endangered, Threatened and Special Concern Species (Effective 7/1/96) Natural Heritage and Non-Game Research Program.

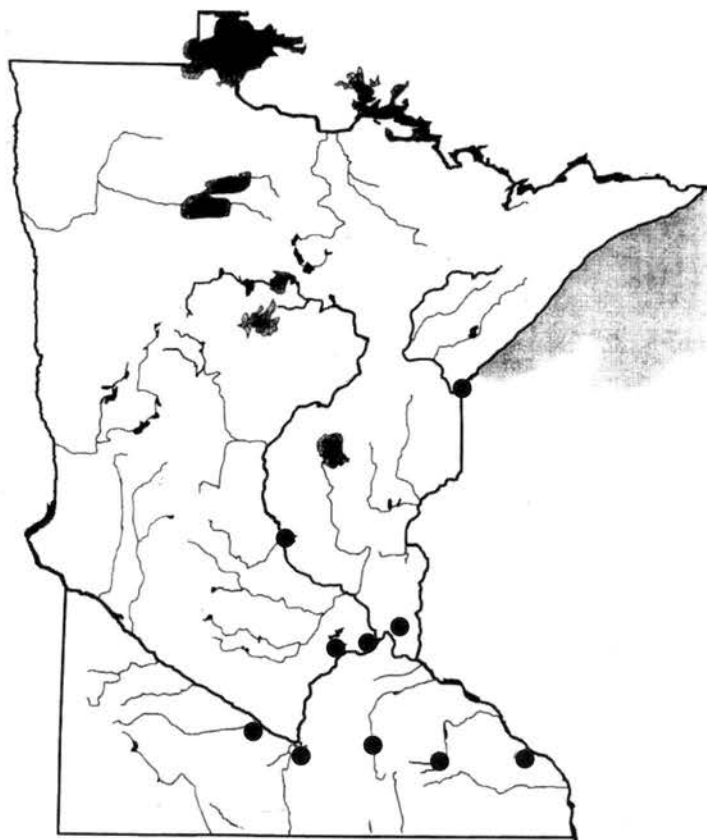


Figure 3.2 Wastewater Treatment Plants Processing More than 5 mgd.

CHAPTER 4

WHO CONTROLS MINNESOTA'S RIVERS?

POLICY, PLANNING, AND MANAGEMENT

INTRODUCTION

This chapter provides an introduction to policy, planning and management activities related to Minnesota's rivers. Policy and planning efforts occur at state, regional and local levels. The management of Minnesota's water resources is highly dispersed. A conglomeration of federal, state, and local agencies manages different river functions. The role of various agencies and their management activities are explored in this chapter.

POLICY AND PLANNING

Statewide Policy and Planning

The Minnesota Environmental Quality Board (EQB) develops statewide policy and engages in planning activities relating to environmental issues affecting rivers and watersheds. The EQB also plays a role in resolving conflicts among state agencies with regard to programs, rules, permits, and procedures significantly affecting the environment. Under the Minnesota Environmental Policy Act, the EQB retains the authority to request an environmental review for certain projects affecting the state's rivers and watersheds. The EQB consists of representatives from ten state agencies and the governor's office and five individuals from the general public. The ten participating state agencies are the Departments of Agriculture, Health, Natural Resources (DNR), Commerce, Trade and Economic Development and Transportation; Pollution Control Agency (PCA); Board of Water and Soil Resources (BWSR); Minnesota Planning; and the Office of Environmental Assistance. A small professional staff supports EQB activities.

If implementation of EQB policy decisions requires changes in state laws, BWSR, in conjunction with DNR and PCA commissioners, recommends such changes to the legislature. When questions arise regarding specific water policy issues, the governor, state or federal agencies, district court judges or affected individuals may assert the right to petition the BWSR to intervene. If the BWSR agrees to intervene, it conducts a public hearing and makes recommendations based on evidence presented at the hearing.

In addition to statewide activities, Minnesota participates in interstate planning and policy related to the Upper Mississippi and the St. Croix rivers. The Upper Mississippi River Basin Association, with members representing Minnesota, Iowa, Illinois, Missouri, and Wisconsin, coordinates policy development, planning, and implementation on issues related to use of the Upper Mississippi River system. The Association also commissions and conducts studies on common water resource concerns.

Minnesota state law also addresses several policy, planning, and management activities related specifically to wild and scenic rivers, floodplains, and shoreline. These laws include the Minnesota Wild and Scenic Rivers Act of 1990, The Minnesota Floodplain Management Act of 1969, and the Shoreline Management Act of 1969.

Minnesota's Wild and Scenic Rivers Act. Minnesota's Wild and Scenic Rivers Act, provides statutory protection for rivers and adjacent lands that possess outstanding scenic, recreational, natural, historical and scientific attributes. River areas protected by the Act fall into three classifications: wild, scenic or recreational. Rivers designated as wild flow freely through primitive adjacent lands. These rivers generally exhibit excellent water quality. Rivers receiving protection under the scenic category flow freely through predominately undeveloped adjacent lands, while rivers designated as recreational may flow through relatively developed adjacent lands. Classification of a river as recreational does not require the river to be free-flowing. Recreational channels may include modifications such as dams and diversions and receive protection under the Act.

The Minnesota DNR administers Minnesota's wild and scenic rivers system program. DNR's responsibilities include identifying and proposing rivers for wild and scenic designation, establishing a management plan, and specifying minimum standards. All aspects of use and development of protected rivers and adjacent lands become regulated. Ownership influences management activities on lands adjacent to protected areas of a river. On public lands, the state retains the administrative authority to ensure that management activities remain consistent with the management plan. On private lands, local governments facilitate protection and preservation goals through zoning ordinances. These ordinances must meet the minimum management standards specified by the DNR. The Wild and Scenic Rivers Act requires local governments to "... preserve and protect, reduce the effects of overcrowding and poorly planned development, to prevent pollution, to provide space for sanitary facilities, to preserve natural beauty and quietude, and to maintain property values, and promote the general welfare (Minn. Rules 6105.0080).¹ In addition, the DNR has the authority to approve variances granted by local governments.

Watercourses designated as "State Wild and Scenic Rivers" under Minnesota law include portions of the Mississippi, Minnesota, St. Croix, Crow, Rum, Kettle and Cannon rivers (see Table 4.1 and Figure 4.1).

In 1968, when the United States Congress approved the National Wild and Scenic Rivers System, it designated the St. Croix River as one of the eight rivers initially protected under the Act. The protected portion of the river runs from its headwaters in Wisconsin to Taylors Falls. In 1972, the protected area was expanded to include the Lower St. Croix from Taylors Falls to the Mississippi. This scenic river is managed according to the federal Wild and Scenic Rivers Act, the federal Lower St. Croix Act and the Lower St. Croix National Scenic Riverway

¹ Minn. Rules 6105.0080.

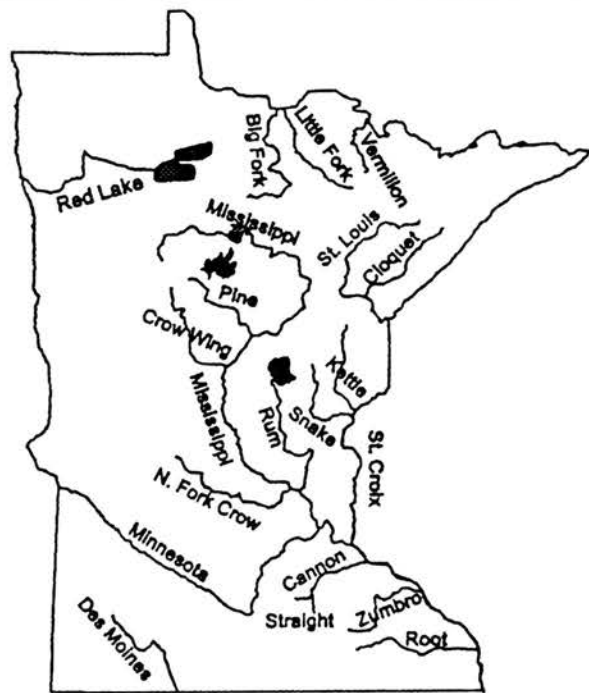


Figure 4.1 Minnesota's Wild, Scenic and Recreational Rivers and Lower St. Croix National Scenic Rivers. Minnesota Dept. of Natural Resources, Division of Waters and Trailways.

Table 4.1 Protected River Areas in Minnesota

River	Protected Area
Mississippi	from St. Cloud to the city of Champlin
Minnesota	from Lac Qui Parle Dam to near the city of Franklin
St. Croix	from the Wisconsin border to the Mississippi
Crow	north fork portion of the river in Meeker County
Rum	from Ogechie Lake to the city of Anoka
Kettle	in Pine County
Cannon	from the city of Faribault to the Mississippi

Cooperative Management Plan. The state of Minnesota recognized and concurred with the designated federal protection status. The Minnesota and Wisconsin DNRs provide administrative leadership and operate in partnership with the National Park Service and local governmental units. To date, the St. Croix remains the only Minnesota river among the 212 U.S. rivers on the federal Wild and Scenic Rivers list.

Floodplain Management Act. Floodplains receive floodwaters and the sediment they carry when stream channels overflow. Minnesota's Floodplain Management Act of 1969 provides the State authority to regulate land uses on floodplains to minimize potential flood damage. The Act requires the DNR, in conjunction with other state agencies, to map floodplains, determine

the probability of different flooding scenarios, identify measures to mitigate against flood damage and enforce compliance among local governments responsible for adopting local floodplain zoning ordinances.

The sizes of floodplains vary both along river systems and among river systems. Depending on surrounding topography, the floodplain may include land on one or both sides of the channel, and the area may vary considerably along a river. Mapping a floodplain involves identifying the land area covered by flood waters under various flooding scenarios. For planning and management purposes, the outer perimeter of the floodplain is determined by the worst possible flood that would occur (on average) over a 100-year period. Historical data, provided by the Natural Resources Conservation Service (NRCS) and the Army Corps of Engineers, are used to estimate this 100-year event. Floodplain mapping includes delineation of the floodway and flood fringe. The floodway, the land immediately adjacent to the stream channel, provides a natural conduit for flood waters. During flooding, it becomes part of the river, carrying much of the floodwater downstream. The flood fringe extends from the outer border of the floodway to the edge of the floodplain. Shallow, slow-moving flood water covers this area during a 100-year flood event.

When data availability permits development of floodplain maps, local communities must adopt floodplain zoning ordinances. These zoning ordinances include management rules and guidelines established by the DNR, which retains responsibility for enforcing compliance by local governments. These rules and guidelines strongly encourage the use of non-structural protection mechanisms in lieu of levees, dikes and dams. Floodplain management rules also specify the type of development allowed on the floodway and flood fringe. For example, to ensure unobstructed flow of flood waters, management rules permit only open land uses with low flood vulnerability, such as agriculture or parks. On the flood fringe, proposed structures must comply with flood protection elevation, flood proofing construction codes and other applicable ordinances.

The National Flood Insurance Program requires flood insurance policies on new structures in floodplain areas recognized by the Federal Emergency Management Agency (FEMA) prior to granting loans. FEMA, the agency responsible for administering federal flood relief programs, maintains a data base on lands vulnerable to flooding in the United States.

Shoreland Management Act. In 1969, the Minnesota State Legislature passed the Shoreland Management Act to ensure preservation and wise development of land bordering lakes and rivers. The DNR Division of Waters, Land Use Management Section, administers the Shoreland Management Program. The Act defines river shorelands as land within 300 feet of a public watercourse or the landward extent of the delineated floodplain, whichever is greater. The DNR classified the state's public waters for allowable intensity of shoreland development. These classifications are remote, forested, transition, agricultural, urban, and tributary. For each classification, the DNR developed minimum standards for land uses, structure placement, lot sizes, shoreland alterations, and construction of sanitary facilities.

Counties and municipalities with shoreland areas covered by the Act, must adopt and enforce shoreland zoning ordinances that meet or exceed the minimum standards developed by the DNR. To assist localities with the development of appropriate ordinances, the DNR developed a Model Shoreland Ordinance. The DNR reviews local ordinances to ensure that the minimum standards are met. If a county or municipality fails to adopt a satisfactory ordinance, the DNR retains the authority to require adoption and implementation of the Model Shoreland Ordinance. As of March 1996, approximately 170 cities and 85 counties in Minnesota had implemented shoreland zoning ordinances.

Regional Policy and Planning

In Minnesota, many organizations and agencies play a role in regional policy and planning activities related to streams and rivers. Given space constraints, this section describes only a few of these organizations and agencies.

Under state law, two or more local governmental units can form a regional river basin joint powers organization if each unit agrees to work cooperatively with the other member units to protect, preserve or enhance an identified river resource. Some of the current joint powers organizations include: the Red River Watershed Management Board, Area II Minnesota River Basin Projects, Inc., Redwood-Cottonwood Rivers Control Area, Upper North Branch Root River Watershed, Whitewater Joint Powers Board, Minnesota River Joint Powers Board, Southeastern Water Resources Board, and Mississippi Headwaters Board.

The Mississippi Headwaters Board (MHB) is a well-established regional river basin joint powers organization. The Board maintains responsibility for protecting the natural, cultural, scenic, scientific, and recreational values of the first 400 miles of the Mississippi River. The MHB includes representatives from the eight headwaters counties: Aitkin, Beltrami, Cass, Clearwater, Crow Wing, Hubbard, Itasca, and Morrison.

In 1967, the state legislature authorized the creation of the Metropolitan Council as a regional planning authority for the Twin Cities Metropolitan Area. The Council coordinates planning and development of major systems in Minneapolis, St. Paul and their surrounding communities. Its areas of responsibility include water quality protection and river corridor development. The Council's Environmental Services division, which owns and operates the regional sewage system, assists with implementation of water quality protection policies. For river corridor development, the Council works with developers and local governments to implement its policies.

Local Water Policy and Planning

Most Minnesota communities participate in water policy and planning activities that affect local water resources. This section focuses on four key pieces of legislation designed to facilitate community involvement in local water policy and planning activities in Minnesota: Soil and

Water Conservation Law, Minnesota Watershed Act, Metropolitan Surface Water Management Act, and the Comprehensive Local Water Management Act. In 1987, the state legislature authorized the Board of Water and Soil Resources (BWSR) to provide oversight for local activities related to these laws. Prior to 1987, oversight responsibilities were shared by three independent entities: the Soil and Water Conservation Board, Southern Minnesota Rivers Basin Advisory Council, and the Water Resources Board.

Soil and Water Conservation Law. The Soil and Water Conservation Law authorized the creation of Soil and Water Conservation Districts (SWCDs). SWCDs encourage land owners and tenants to implement management practices to preserve natural resources, protect soil productivity, and control flooding. Management practices tend to emphasize prevention and reduction of soil erosion, sedimentation, and nonpoint pollution. Ninety-one SWCDs presently operate in Minnesota.

Minnesota Watershed Act. Managing natural resources by watershed allows an integrated, holistic approach to resource conservation. The Minnesota Watershed Act provides a means for local governments to engage in cooperative planning and policy activities on a watershed basis to solve and prevent local water-related problems. The Act gives county boards, city councils, or landowners within one or more watersheds the right to petition the BWSR to establish a watershed district. Watershed districts are authorized to construct projects, identify and assess properties that benefit, levy taxes, acquire property by eminent domain, and regulate activities that affect the district's objectives. Forty-two watershed districts currently exist in Minnesota.

Metropolitan Surface Water Management Act. The Metropolitan Surface Water Management Act requires the development and implementation of watershed management plans by Watershed Management Organizations (WMOs) within the seven-county Twin Cities Metropolitan Area. The Act further requires that each city or township in the Metropolitan Area develop and administer its own plan. To ensure the plans all work together to protect local watersheds, each city or township must demonstrate that its plan is consistent with all other plans in the affected watersheds. The DNR, PCA, Department of Health, and Metropolitan Council must review and approve each city and township plan before it receives final approval by the BWSR. There are 38 WMOs in the Metropolitan Area. Thirteen are organized as watershed districts, 23 are organized based on joint powers agreements and two are county operated WMOs. Joint powers agreements are agreements made among affected units of government.

Comprehensive Local Water Management Act. The Comprehensive Local Water Management Act encourages Minnesota counties outside the Twin Cities Metropolitan Area to develop and implement comprehensive water plans. Comprehensive plans must cover the entire county and conform with any existing plans enacted by watershed districts within the county. Comprehensive plans must also address existing local, city or township plans. However, once a comprehensive plan for the county receives approval, local plans conform with it. The BWSR reviews plans for conformance with state laws and regulations and resolves

disputes over the interpretation of plans that may arise between and among the various units of local government. All 80 counties currently have comprehensive water plans and revise them every five years.

MANAGEMENT OF MINNESOTA'S RIVERS

River management in Minnesota is dispersed. A variety of federal, state, and local agencies is involved with different management activities (Table 4.2). Key management agencies include: U.S. Army Corps of Engineers, U.S. EPA, Minnesota DNR, Minnesota PCA, Minnesota EQB, BSWR, and the Metropolitan Council. Counties, watershed districts, and soil and water conservation districts also have important river management roles. Some management functions are performed primarily by a single agency. For example, navigation on the Upper Mississippi River system is controlled by the U.S. Army Corps of Engineers, and the DNR has sole responsibility for issuing water withdrawal permits. Some functions are shared by federal and state agencies. The Army Corps of Engineers and the DNR both regulate alterations to river channels; the EPA and PCA have complementary roles protecting water quality. Some functions, however, are dispersed among many jurisdictions, which has led to interjurisdictional conflicts, multiple interpretations of rules, and patchy management success. This section focuses on river management activities in Minnesota and the agencies responsible for administering them. Appendix B contains a listing of each agency's address and telephone number.

Regulating Withdrawals of Water from Rivers and Reservoirs

The DNR's Water Appropriation Permit Program office manages surface and ground water withdrawals in the state. State law requires an appropriation permit for withdrawals exceeding either 10,000 gallons per day or one million gallons per year (MN Stat. 6115.0620). The DNR evaluates each water appropriation permit application to determine potential impacts on the water resource, other resource users, and fish and wildlife habitat, and assesses the efficiency of the proposed water use. Local governments may review and comment on permit applications for withdrawals within their jurisdiction prior to the DNR's granting the permit. The DNR maintains the right to restrict withdrawals to protect the resource.

Minnesota statutes identify the priority of water uses during periods of limited water availability. Water uses, ranked according to highest priority, are as follows:

- (1) domestic water supply and power production that meets contingency planning requirements;
- (2) withdrawals of less than 10,000 gallons per day;
- (3) irrigation and processing of agricultural products;
- (4) power production that does not meet contingency planning requirements;
- (5) industrial and commercial water uses, and;
- (6) nonessential water uses.

Table 4.2 Federal, State and Local Agencies and Their River Management Activities

Management Activity	Federal				State				Local	
	U.S. EPA	U.S. Fish & Wildlife Service	U.S. Park Serv.	U.S. Coast Guard	MN Dept. of Nat. Res.	MN Board of Soil & Wtr Res.	MN Dept. of Health	MN Pollution Control Agency	Local Govt./ Other Agencies	Other
Regulate withdrawals of water from rivers and reservoirs					X					
Construct, maintain and operate public dams, reservoirs and navigation related facilities	X				X				X	X
Regulate construction and other alterations to river channels and related wetlands	X				X					
Manage public lands in stream corridor for recreational, fish and wildlife and other natural values			X	X	X					
Regulate commercial and recreational navigation vessels					X				X	
Water quality		X				X	X	X	X	

Constructing, Maintaining and Operating Public Dams, Reservoirs and Navigation Related Facilities

Federal, state and local governmental agencies, as well as private individuals, own and operate dams, reservoirs, and navigation of facilities on Minnesota's rivers. These dams and associated reservoirs provide a variety of services, such as: flood control, hydroelectric power, recreation, fish and wildlife habitat and irrigation (see Figure 4.2).

RESERVOIR	CAPACITY (acre feet)	PURPOSE(S)
1 Leech Lake	1,000,000	Flood Control/Recreation
2 Lake Winnibigoshish	1,072,000	Flood Control/Recreation
3 Mud and Goose Lake	44,000	Wildlife
4 Pokegama	129,600	Flood Control/Recreation
5 Prairie Lake	15,840	Hydroelectric
6 Big Rice Lake	13,465	Lake Control/Irrigation
7 Pine River Reservoir	193,500	Flood Control/Recreation
8 Gull Lake Reservoir	111,000	Flood Control/Recreation
9 Sylvan Lake	10,430	Hydroelectric
10 Rice Lake	16,300	Hydroelectric
11 Sandy Lake	109,200	Flood Control/Recreation
12 Rice River Pool	38,000	Waterfowl
13 Rice Lake Pool	13,820	Waterfowl
14 Indian Head Flowage	12,750	Hydroelectric/Recreation
15 Blanchard Dam	15,500	Hydroelectric
16 Sauk River	10,000	Hydroelectric
17 Sauk Lake	19,600	Recreation
18 Lake Florida Slough	14,500	Fish and Wildlife
19 Lac Qui Parle Reservoir	122,800	Flood Control/Recreation
20 Marsh Lake	121,300	Flood Control
21 Big Stone Lake/ Whetstone River	122,500	Flood Control/Recreation
22 Byllesby Reservoir	25,000	Recreation
23 Zumbro Lake	35,000	Hydroelectric

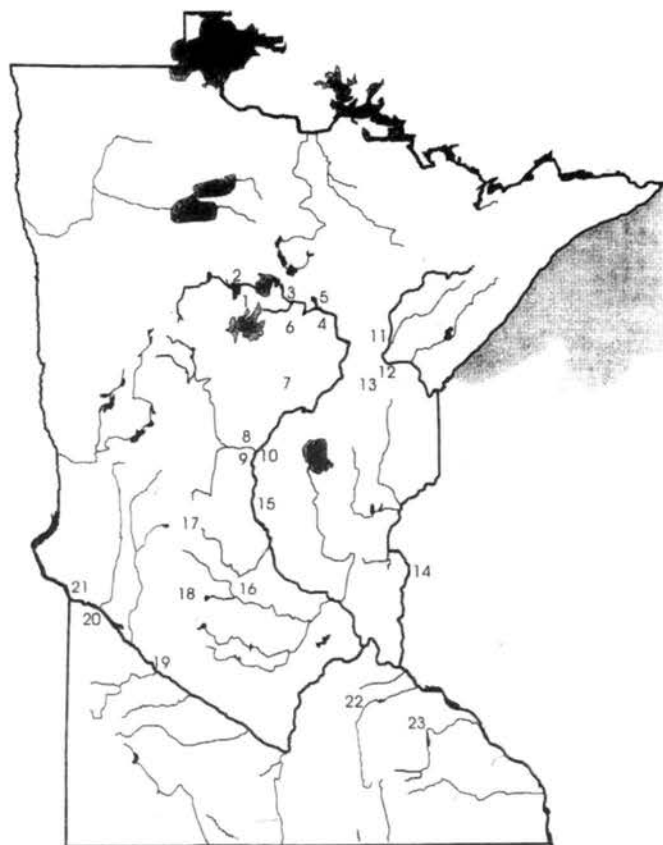


Figure 4.2 Minnesota's Main Reservoirs and Dams. UMRBC, 1981.

The U.S. Army Corps of Engineers (Corps) operates and maintains the navigation system on the Upper Mississippi River, including the headwaters reservoirs, locks, dams, channels, levees, and pools associated with the locks and dams on the river below St. Anthony Falls. The Corps maintains a nine-foot-deep channel by periodic dredging, and makes modifications to the system as deemed necessary.

The Corps operates the reservoirs based on guidelines established in an informal agreement with the state of Minnesota. The headwaters reservoirs, constructed primarily for flood control and to ensure sufficient flows for navigation, serve primarily to maintain lake levels for recreation. Reservoir level maintenance also provides benefits for the Leech Lake Band of Chippewa's wild rice production and harvesting. A lower priority objective is to augment river flow when low-flow conditions threaten Twin Cities' water supply and waste water systems. The Corps also operates flood control and low-flow augmentation projects on other Minnesota rivers, such as the Minnesota, Otter Tail, Bois de Sioux, and Red Lake rivers.

The DNR's Surface Water and Hydrographics Section within the Waters Division bears responsibility for examination, maintenance and repair of approximately 315 state-owned dams. Local governments and private landowners own and maintain dams built to protect agricultural land and towns from flooding. The federal Natural Resources Conservation Service built many of these dams and then turned them over to local or private ownership. In addition, private companies and local governments operate dams and related reservoirs for power generation. The DNR inspects all private and public dams and associated structures and administers a grant program to local governments that provides up to 50% of the cost to repair locally owned dams.

Regulating Construction and Other Alterations to River Channels and Related Wetlands

Both the Corps and the DNR regulate construction and other activities that modify river channels and related wetlands. The Corps regulates activities affecting the navigation capacity of designated navigable water waterways in the U.S. under Section 10 of the Rivers and Harbors Act. Permitted activities must not cause substantial adverse effects on navigation or the environment. Designated navigable waterways in Minnesota include: Big Fork River, Bois De Sioux River, Kawishiwi River, Kettle River, Little Fork River, Minnesota River, Mississippi River and Headwaters Reservoirs, Pigeon River, Pike River, Rainy River, Red River of the North, Red Lake River, Rum River, Snake River, St. Croix River, St. Louis River, Vermillion River, and the streams of the International Boundary Waters. The Corps also regulates activities related to placing dredged materials or other types of fill into any U.S. body of water or wetlands area, under Section 404 of the Clean Water Act. By this authority, the Corps holds jurisdiction over virtually every water body and wetland in Minnesota.

The DNR regulates activities pertaining to physical changes in the channel, current, or cross-section of protected waters including docks, boat ramps, shore protection, beach development, and drainage construction. Jurisdiction with regard to physical changes in protected

watercourses is limited to the elevation at the top of the channel bank (Figure 4.3). The DNR also regulates protected riverine wetlands along with protected lakes, reservoirs, and other types of wetlands. Under the current regulatory guidelines, the DNR requires a permit for some activities. However, activities that do not require a permit generally must conform to established standards.

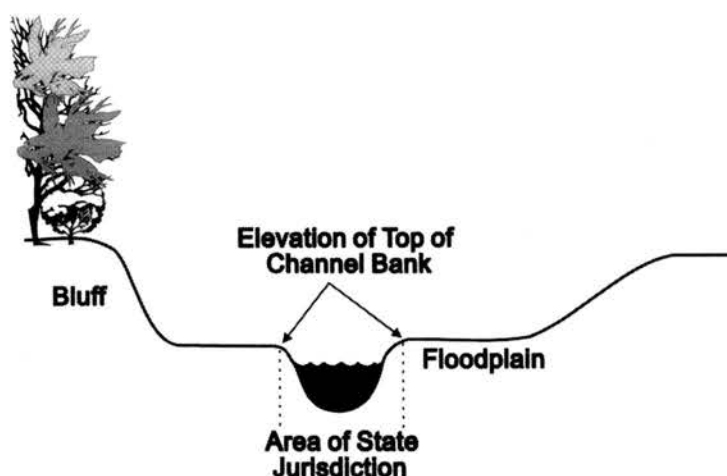


Figure 4.3 Area of State Jurisdiction Regarding Physical Alterations to Streams

Managing Public Lands in Stream Corridor for Recreational, Fish and Wildlife and Other Natural Values

The U.S. Fish and Wildlife Service, the National Park Service, and the Minnesota DNR manage public lands located along Minnesota's stream corridors for a variety of uses including: habitat protection and other natural amenity uses, boating, fishing, camping and other recreational uses.

The National Park Service manages the Mississippi National River and Recreation Area (MNRRA), which Congress added to the National Park System in 1988. The MNRRA consists of 72 miles of the Mississippi River and 54,000 acres of adjacent corridor lands within the Twin Cities Metropolitan Area. It contains more than 350 local, regional and state parks and national wildlife areas. A 22-member commission coordinates activities with the MNRRA. The U.S. Fish and Wildlife Service has responsibility for wildlife management on over 32,900 acres of land bordering the Mississippi in Minnesota.

The National Park Service also administers the St. Croix National Scenic Riverway and the Lower St. Croix National Scenic River under the National Wild and Scenic Rivers System. Other governmental agencies and organizations participate in managing the Upper River in accordance with the requirements of the National Wild and Scenic Rivers Act and state-adopted rules (see section on Wild and Scenic Rivers). The Minnesota and Wisconsin Departments of Natural Resources collaborate with the U.S. National Park Service in management activities on the Lower River (the southerly 52 miles).

The Minnesota DNR is the primary state agency involved in managing public lands located in river corridors. For example, the DNR Trails and Waterways Unit maintains almost 2,300 public access ramps and drop-in points for boating and canoeing on rivers and lakes in Minnesota. It also provides recreational amenities (campsites, picnic areas, and portages) on 19 designated canoe and boating routes comprising 2,850 river miles. The DNR Parks and Recreation Division operates and maintains 66 state parks with a total area of 220,000 acres.

The DNR Division of Fisheries and Wildlife manages and develops spawning areas, improves trout streams, constructs rough fish barriers, and obtains easements along streams for aquatic management and fishing access. The DNR manages more than 1,000 state wildlife management areas, containing about 685,000 acres, to preserve and enhance habitat for game and nongame animals. The Upper Mississippi system contains approximately 530,000 acres of wildlife refuge and management land. A 1992 amendment to Minnesota's Outdoor Recreation Act provided the DNR Division of Fisheries and Wildlife with statutory authority to acquire property and easements for aquatic management. It identifies and acquires lake and stream shoreland for access by anglers and fisheries management personnel, for protection of important habitat areas such as spawning and feeding and nesting sites, and for research on natural history. Aquatic management areas in Morrison County were acquired recently to protect adult river muskie habitat.

Regulating Commercial and Recreational Navigation Vessels

Federal, state and local communities all play roles in regulating navigational activities in Minnesota. The U.S. Coast Guard provides and maintains channel buoys, marker lights, and other navigational aids on U.S. waters to ensure compliance with navigation-related public safety standards. The Minnesota DNR establishes standards for operating watercraft and approves local water surface use ordinances. All owners of watercraft, with few exceptions, must obtain and display a license issued by the DNR to operate on Minnesota's rivers.

Local county agencies enforce many of the DNR's navigation-related standards. The DNR reviews the budgets of local county offices responsible for enforcement of DNR's standards, including search and rescue operations, to assure that the county maintains an appropriate level of service in these areas. Localities have some authority to limit or prohibit the use of watercourses within their jurisdictions. For example, they may designate particular stream reaches exclusively for swimming or unpowered watercraft (e.g., canoes) or impose watercraft speed limits.

Protecting and Enhancing Water Quality

Federal, state and local governmental agencies all play roles in water quality management in Minnesota. Key agencies include the U.S. Environmental Protection Agency (U.S. EPA), the Minnesota Pollution Control Agency (PCA), the Minnesota Department of Natural Resources (DNR), and the Minnesota Board of Soil and Water Resources (BSWR). Management efforts

focus on protecting and enhancing water quality primarily by controlling and preventing sources of pollution. The mechanisms used to control and prevent pollution depend on whether targeted pollutants emanate from point or nonpoint sources. Point source polluters are identifiable because the source of the pollutants can be pinpointed. Examples of point sources of pollution include discharge pipes from municipal wastewater treatment and industrial processing plants. In contrast, nonpoint source pollutants come from a variety of sources such that the origin of the pollutants cannot be pinpointed. Examples of nonpoint sources of pollution include contaminated runoff and seepage from agricultural, construction, forestry, and mining activities as well as from urban pavement.

While the U.S. EPA provides leadership in the area of water quality under the Clean Water Act, the PCA in Minnesota designs programs and develops, administers, monitors and enforces standards to protect and enhance the quality of the state's surface water resources. Provisions contained in federal statutes related to the 1972 Clean Water Act, and subsequent amendments in 1977 and 1987, encourage each state to administer standards, provided the state's standards meet or exceed those set by the EPA. Within the PCA's northern, southern, and metro districts and in the environmental outcomes division, water quality staff assist individuals and organizations in meeting pollution control mandates.

The Water Quality Division's Monitoring and Assessment Section develops water quality standards, including numerical standards for 53 toxic pollutants (at the time of this writing) and detailed procedures for establishing standards for additional toxic pollutants. River water quality is assessed based on the number of violations of both conventional and toxic pollutant standards. The PCA reports these assessments to the EPA and Congress every two years in accordance with section 305(b) of the federal Clean Water Act.

The PCA's Point-Source Compliance Section issues wastewater treatment permits for municipalities and businesses, tracks compliance and enforces permit conditions. It administers point source discharge permits under both the National Pollutant Discharge Elimination System permit and the Minnesota State Disposal System permit program. Before the PCA will grant or renew a discharge permit, the point source discharger must demonstrate both the intention and ability to comply to effluent limits. The PCA reviews and selects proposals for funding. The BWSR also assists local governments by developing model rules and ordinances for point and nonpoint source pollution prevention and control, based on U.S. Soil Conservation Service technical guidelines, for use by local governments.

The Clean Water Act, as amended in 1987, mandates development of a Nonpoint Source Pollution Assessment Report and Management Program in each state. In Minnesota, the PCA's Nonpoint-Source Compliance Section develops standards and administers programs to control nonpoint source pollution from farmland, feedlots, construction sites, septic systems, roadways, and other sources. Controlling and preventing nonpoint source pollution raises difficult management issues because specific polluters often cannot be identified directly. Management efforts are coordinated by an interagency Project Coordination Team composed of

representatives of 13 state and federal agencies and directed towards activities known to cause nonpoint pollution.

The Board of Soil and Water Resources (BWSR) addresses river pollution issues related to sediment and agricultural or urban nonpoint sources. The BWSR operates as a state administrative agency for local Soil and Water Conservation Districts (SWCDs), which assist local owners in protecting community soil and water resources. SWCDs provide assistance in developing and funding projects. They identify lands that contribute substantial amounts of nonpoint source pollution and ask landowners to participate in projects to reduce soil erosion and pollutant flow from their property. The state provides up to 75% of the funding for these projects for eligible participating landowners. The PCA's Watershed Assistance Section oversees and integrates efforts related to monitoring, assessment and point and nonpoint pollution control and prevention to protect and restore water resources within Minnesota's nine major drainage basins.

Other initiatives in Minnesota designed to prevent and control nonpoint source pollution and enhance water quality include the Metropolitan Surface Water Management Act (1982), the Comprehensive Local Water Management Act (1985), the Individual Sewage Treatment Systems Act (1994), and the Clean Water Partnership Program (1987). Under the Clean Water Partnership Program, the PCA provides grants to local government for water quality protection and improvement projects.

The Minnesota DNR plays only a minor role in regulatory issues related to water quality. However, through its land-use planning and zoning policies it influences developmental decisions and concomitant potential for point and nonpoint source pollution to Minnesota's waterways. Through monitoring and inspections programs, the DNR Ecological Services Section enforces federal and state laws regarding the use of aquatic pesticides in public waters. It also investigates major pollution spills and fish and wildlife kills, and collects specimens for toxic substance and pesticide analyses.

The DNR also engages in education and outreach programs designed to enhance and protect river resources. The DNR's Trails and Waterways Unit administers the state's Adopt-A-River Program, which solicits public involvement in river cleanup and provides organizations with information and guidance on organizing and carrying out river cleanup projects. It also publishes a newsletter on progress achieved on "adopted" rivers. To reduce and prevent point and nonpoint pollution from lands adjacent to Minnesota rivers, the DNR developed voluntary Best Management Practice (BMP) guidelines for use by landowners.

Moving Toward a More Integrated Management Approach for Minnesota's Rivers

While the current approach to river management has achieved some notable successes in sustaining or restoring some river values, opportunities for improvements exist. Many advocate restructuring the current fragmented system and adopting a watershed management model that

acknowledges the natural linkages and boundaries of the system. They argue that since rivers are inextricably linked with their watersheds, management efforts must extend to shorelands, floodplains, and upland areas. The watershed management approach takes a holistic view of a river system by recognizing that all lands within the contributing watersheds, by reason of their position, use, topography, soils, geology, or other characteristics, may significantly impact the river.

In recent years, some state and regional agencies and grassroots organizations have undertaken a number of watershed-focused initiatives, but much work remains. Efforts to adopt watersheds as units of management run into resistance from established jurisdictions determined to maintain decision-making power. In addition, efforts to control land use through regulation often are met with stiff resistance because regulation reduces individual control over private property. While voluntary programs that encourage stewardship activities or provide incentives to protect and enhance Minnesota's river resources may create a relatively effective alternative to regulation, limits exist to these types of programs. To maintain and enhance the quality of its river resources, Minnesota must find a solution to this watershed management conundrum.

CHAPTER 5

MONITORING AND DATA ON MINNESOTA'S RIVERS

INTRODUCTION

Monitoring is essential to policy, planning, and management of Minnesota's streams and rivers. Monitoring efforts focus on both the quantity of water flowing in Minnesota's streams and rivers and its quality. Numerous federal, state and local agencies, as well as some non-governmental organizations, engage in monitoring activities. This chapter provides an overview of monitoring activities affecting Minnesota's rivers and streams and the agencies responsible for collecting, analyzing, reporting and storing the information. The discussion focuses first on flow-related monitoring activities and then examines water quality-related endeavors.

RIVER AND STREAM FLOW MONITORING

Flow-related monitoring activities permit tracking of stream flow conditions and forecasting extreme events such as floods and droughts. Monitoring data accumulated over many years enable managers to describe flow characteristics, assess in-stream flow needs, define available supplies, and ensure adequate water availability to meet long-term needs. These data also contribute to understanding how stream flow conditions in the state affect water quality and ecosystems.

Formal water quantity-related monitoring began in Minnesota with rainfall record-keeping in the early 1800s. The collection of stream-flow data began in 1909 when the U.S. Geological Survey (USGS) and Minnesota state agencies entered into cooperative agreements for the systematic collection of stream-flow records. State agencies that assist in collecting data through cooperative agreements with the USGS include the DNR, PCA, and Department of Transportation (MDOT); watershed management organizations, native American tribal government organizations, and watershed and conservation districts also have such agreements.

In the late 1930s, the USGS began a national stream gaging program with the establishment of a network of state-USGS gaging stations. Gaging stations measure the stream's stage (water level) and discharge rate (rate of flow). This national network is the principal tool used to measure surface-water supplies in each state. Stream gages with continuous stage-recording devices provide an ongoing record of stage and individual measurements of discharge. Agencies also obtain high-flow data by discrete measurements at "partial-record stations."

The size of the stream-gage network in Minnesota reached its peak in 1975 with 150 continuous-recording gage sites. In 1989, technological advances allowing 'real-time' electronic data collection and transmission at stations enhanced network capabilities. However, because of federal and state budgetary cuts, only 104 continuous-recording gaging stations have

been in operation since 1993. Only 43 of the 81 major watersheds in Minnesota contain continuous recording gages. The locations of gaging stations operated by the USGS and DNR are shown in Figure 5.1.

The National Weather Service River Forecast Center uses stream gage data in order to model flows and forecast river flooding. About 95% of the gaging sites used by the NWS are shared with state agencies and the USGS. Where continuous data are not available, the NWS collects data manually. Data at these sites are collected on a daily basis during critical periods of high flow. The NWS uses its data to issue daily flow reports and to forecast future flows. It stores the data for only 30 days; however, the information is available to other agencies. The U.S. Army Corps of Engineers (Corps) also relies on stream flow monitoring data in the operation of its reservoirs, locks, and dams. It partially funds sites it shares with the USGS in the Upper Mississippi River Basin.

Flow Data Analysis, Reporting and Storage

Stream-flow data for Minnesota consists of information on stages (water levels) and discharge rates (flow in cubic feet per second). These data, in conjunction with other factors that may affect the relationships between stage and discharge rates, such as weather records, are used to construct stage-discharge relation curves or tables. Stage-discharge curves and tables are used to provide estimates of daily mean discharge rates from daily mean stage data.

The Water Resources Division of the USGS stores the data from Minnesota's gaging stations in the national USGS Streamflow database called WATSTORE. The USGS publishes an annual report for the state entitled "Water Resources Data - Minnesota," for each water year. The USGS water year, beginning October 1 and ending September 30, is identified by the calendar year in which it ends. Annual flow data also are available on-line from the USGS at <http://h2o.er.usgs.gov/>.

The Stream Flow Unit of the Minnesota DNR gathers and analyzes data on rivers and streams throughout Minnesota. The unit produces a weekly report on stream flow conditions during the open water season for water managers and other concerned interests. Data from these reports come from a variety of federal, state, and regional agencies and volunteer gage readers. The DNR also prepares special reports when conditions within certain rivers and streams approach significantly low- or high-flow levels. The DNR identifies several threshold levels for each gaging station and time of year: Q90 - stream flow is at least this high 90 percent of the time; Q75 - stream flow is at least this high 75 percent of the time; Q25 - stream flow is as high as this only 25 percent of the time, and; Q10 - stream flow is as high as this only 10 percent of the time (Table 5.1).

When flows fall below the Q90 level, the river is considered to be in a critically low flow condition, and it is closely monitored as long as flows remain below the threshold. The DNR Division of Waters may restrict appropriation of water from the river to maintain adequate flow for in-stream needs such as fish and wildlife and ensure adequate supplies for higher priority

users such as municipal supplies and for power generation. At the other end of the spectrum, critically high levels, those exceeding the Q10 level, indicate potential flood conditions that threaten damage to property. Flood flows are generally defined using the flood stages identified by the NWS or other agencies. In watersheds where a flood stage has not been identified, the highest monthly Q10 is used as an interim estimate of flood flow.

Table 5.1 Definition of DNR Threshold Stream Flow Values

Critically Low	< <i>annual Q90</i> (Q90 = streamflow is at least this high 90% of the time at this station during the open water season)
Low	< <i>monthly Q75</i> (Q75 = streamflow is at least this high 75% of the time at this station during this month)
Normal	<i>monthly Q75 - Q25</i>
High	> <i>monthly Q25</i> (Q25 = streamflow in this month at this station has been as high as this only 25% of the time)
Critically High	> <i>monthly Q10</i> (Q10 = streamflow in this month at this station has been as high as this only 10% of the time)

Based on historical monitoring data.

Using the Stream and Watershed Information System under development at the Minnesota Land Management Information Center (LMIC), interested people can compare and analyze different kinds of water and land related data. The Legislative Commission on Minnesota Resources funded its development in 1991. Presently, Geographic Information System (GIS) data have been created, and some data from monitoring agencies have been integrated to the map layers. Data can be obtained online at the LMIC website (www.lmic.state.mn.us).

WATER QUALITY MONITORING

Information on Minnesota's river water quality comes from monitoring activities undertaken by federal, state and local agencies and by non-governmental organizations. This section first describes the general uses of water quality data and how it is collected and analyzed. The remainder of this section focuses on specific federal, state and local water quality efforts.

Water quality sampling is undertaken to establish baseline conditions and monitor trends, to monitor compliance with environmental regulations, and to study specific issues or locales. Monitoring data that describe ambient conditions are used to establish baselines and trends. Consistent, long-term ambient monitoring assists in the detection problems or threats to resources before they become obvious or irreversible. Ambient monitoring also provides the information needed to evaluate the effectiveness of management programs and projects. Compliance monitoring data are used to evaluate the effectiveness of point source contaminant

controls. Discharge permits generally require permit holders to collect and report data on the quality of water discharged to ensure it meets state and federal quality guidelines.

Special monitoring programs also are established to develop basic water quality information in relation to a particular issue of concern. These programs generally run for a limited period and data from such efforts may not be useful for drawing conclusions about temporal trends. However, they can be more useful when integrated with compliance and ambient data.

Monitoring the state's surface water quality entails collection and analysis of water samples from locations throughout Minnesota. In theory, monitoring stations are chosen to reflect water conditions in all regions of the state. Minnesota's ambient water quality monitoring program began in 1953. Although the number and location of sampling sites have varied, extensive data are available for 42 sites. Over the past 40 years, the PCA monitored each of these sites for 20 or more years. The PCA also oversees monitoring of discharge sites for municipal and industrial facilities, such as wastewater treatment plants, to ensure compliance with permit conditions. The local operator of the treatment plant does most compliance monitoring, and it involves testing the effluent to determine that it meets discharge limits, rather than testing in the stream for impacts. The state also tests rivers for the presence of pesticides and nutrients to track compliance with regulations. The types of analyses conducted depend on specifics of the applicable law or permit. The state does a limited amount of fish tissue monitoring in rivers, usually in the most heavily-fished ones. When fish tissue analyses indicates a potential problem, sediments are sampled and analyzed to identify the source of contamination.

Monitoring agencies use several approaches to measure water quality: chemical analyses of water and sediment samples, biological surveys and toxicity testing, and analyses of fish and wildlife tissue to measure accumulation of toxic pollutants. Routinely measured parameters that affect designated uses of streams and rivers fall into six categories: sediment (total suspended solids and turbidity), nutrients (dissolved oxygen, biochemical oxygen demand, nitrate and phosphorus), major ions (total dissolved solids, chloride and sulfates), pathogens (fecal coliform bacteria), toxic substances (metals and organic compounds), and other basic water quality parameters (pH and temperature) (Table 5.2). Analyses of fish tissue to measure accumulation of toxic pollutants include PCBs, dioxin, organochlorine pesticides, and mercury. To identify potential human health threats to those consuming fish exposed to toxic pollutants, only the commonly eaten parts are analyzed. To measure the incidence of bioaccumulation of toxic pollutants, organs and fat that are known to accumulate contaminants are analyzed.

Other indicators of stream water quality include bioassays for toxicity and biological community assessments. Bioassays test the ability of organisms, like *Daphnia* (a relatively large-bodied zooplankton) and fathead minnows, to live in effluent, ambient water or sediment over a fixed time period. Biological community assessments provide a holistic indicator of stream water quality on a seasonal basis by evaluating the structure of the biological community in a specific area using data on the type and population of observed aquatic species.

Table 5.2 Commonly Measured River Water Quality Parameters

Category	Parameter	Human source	Environmental Effect
Sediment loading	• Total suspended solids (TSS)	• Suspended sediment is the product of erosion, either natural or the result of land-cover disturbances related to human activities.	• After runoff periods, fine particles can settle to the bottom of streams smothering fish eggs, larvae, and aquatic insects. TSS transports other pollutants with it. Sediment can fill reservoirs within a matter of years.
	• Turbidity is suspended silt and finely divided organic matter that scatters and absorbs light. It is perceived as cloudy water.	• High turbidity is associated with nonpoint sources of suspended solids washed into rivers and streams during rain storms.	• High turbidity is aesthetically displeasing, degrades habitat for some fish species such as smallmouth bass, decreases light penetration needed for plant growth, increases water temperature by absorbing more solar radiation, may significantly increase water treatment costs, and may decrease sport-fishing success.
Nutrient loading	• Dissolved Oxygen (DO)	• Low dissolved oxygen is usually caused by inadequate treatment and discharge of organic wastes or decomposing vegetation.	• Adequate dissolved oxygen is necessary for the survival and propagation of fish and other aquatic life and for the prevention of offensive odors.
	• Biochemical Oxygen Demand (BOD)	• Inadequate waste water treatment and runoff carrying fertilizers and animal wastes are common sources of BOD.	• Oxygen demanding pollutants increase oxygen consumption of the river. Lack of oxygen kills aquatic life.
	• Ammonium (NH_4^+) and Ammonia (NH_3)	• Ammonium is a natural part of the nitrogen cycle in surface waters, but high concentrations usually indicate inadequate wastewater treatment, discharge of organic wastes, or decomposing vegetation.	• Nitrification (conversion of ammonium to nitrate) consumes great quantities of oxygen. Ammonia, the un-ionized basic counterpart of ammonium, is toxic to fish.
	• Nitrite+nitrate ($\text{NO}_2^- + \text{NO}_3^-$) are oxidized forms of nitrogen that make up most of the nitrogen in well-aerated streams.	• Nitrate is found in agricultural fertilizers and often is the main nitrogen form in agricultural runoff.	• Nitrate fertilizes the river, promoting growth of algae and weeds, either in the river itself or in downstream lakes. It also may make water unsuitable for public supply.
	• Total Phosphorus	• Runoff from agricultural areas, over-fertilization, and effluent from sewage treatment plants are the main sources of phosphorus contamination in Minnesota streams.	• Phosphorus increases the growth of aquatic plants and can promote heavy algal blooms and excessive weed growth. It reduces water clarity and creates unsuitable conditions for many species of fish.
Major Ions	• Total Dissolved Solids (TDS) is sometimes measured indirectly as conductivity.	• Dissolved solids in stream water result primarily from rock weathering, but also can be introduced as a byproduct of human activities.	• Dissolved solids can make water unsuitable for some uses and can harm aquatic organisms.

Table 5.2 Commonly Measured River Water Quality Parameters cont.

Category	Parameter	Human source	Environmental Effect
Major Ions cont.	• Chloride	• Chloride is present in all natural waters but usually in low concentrations. High chloride levels in Minnesota streams usually result from road deicing with salt or runoff from storage areas.	• Can make water unsuitable for some uses and can harm aquatic organisms.
	• Sulfate	• Sulfate in streams occurs naturally from rock weathering processes. Human activities such as mining and waste discharge also can be important sources. It is also a major constituent of acid rain.	• Sulfate can make water unsuitable for some uses and can harm aquatic organisms. As a constituent of acid precipitation, it is of particular concern in northeastern Minnesota.
	• Alkalinity as CaCO_3 (consists mainly of bicarbonate ions, HCO_3^-)	• Derived naturally from rock weathering processes.	• High alkalinity can make water unsuitable for some agricultural and industrial uses, but alkalinity is not considered a problem but a beneficial attribute of water.
	• pH is a measure of the acid-base status of a water, represented on a scale from 0 to 14 (0 is most acidic, and 14 is most basic).	• Most natural waters are fairly neutral, with pH in the range of 6.0 to 8.5. Acid precipitation lowers pH in streams and lakes.	• The pH of water affects the solubility of metals and other constituents. Low pH (acidity) creates toxic conditions for aquatic organisms, and it may play a role in the bioaccumulation of mercury in fish and wildlife.
Pathogens	• Fecal coliform bacteria, common in the intestinal tract of man and animals, are used as indicators of fecal contamination from humans or other warm-blooded animals.	• A major source of fecal coliform bacteria is inadequately disinfected municipal sewage. Other sources include agricultural runoff, feedlots, combined sewer overflows, urban runoff, and septic tanks.	•
Toxic sub- stances	• Metals (mercury, copper, chromium)	• Mining and industrial process wastes are among the major sources of metals.	• Mercury accumulates in the food chain. It can be harmful or lethal to some wildlife and humans.
	• Organic compounds (e.g., PCBs, dioxins, and some pesticides). PCBs are a class of organic, industrial chemicals very persistent in the environment.	• PCB contamination is found in river reaches below major population centers where PCBs were widely used before they were known to be environmental hazards.	• PCBs accumulate to high concentrations in animals and may cause adverse health effects in humans.
Physical	• Stream Flow	• Stream flow varies with climate and watershed factors. Human activities can alter watersheds in ways that affect the amount and timing of flows.	• Flow affects dilution/concentration of chemical constituents, pollutant loadings, and biological processes.
	• Temperature	• Temperature varies naturally but also may be affected by human activities such as discharges of power plant cooling water.	• Increased temperatures may make a stream unsuitable for certain kinds of aquatic species such as trout. Temperature also affects chemical and biological processes in streams.

Stream Water Quality Monitoring Programs

A number of federal, state, regional and local governmental agencies monitors the quality of Minnesota's streams and rivers including the USGS, PCA, DNR, the Metropolitan Council Environmental Services (MCES), and certain local units of government. In addition, a number of citizen groups engages in monitoring activities. Each agency designs its monitoring program to meet its specific needs.

Federal Programs. The Water Resources Division of the U.S. Geological Survey (USGS) currently operates two nationwide stream water-quality monitoring networks, the Hydrologic Benchmark Network and the National Stream Accounting Network (NASQAN). Samples from stations in each program are sampled approximately four or five times during the year and analyzed for the parameters listed in Appendix C. A 20-year record of data exists for most sites. The USGS stores all water-quality data in their WATSTORE database available via STORET, the U.S. EPA's large water-quality database. Requests for small amounts of data from STORET (total costs under \$25) may be obtained by contacting the EPA Region 5 Freedom of Information Officer. Data can also be obtained online or from the PCA. There are no fees for this service, except for unusually large data retrievals, and the wait time for most data requests is approximately two weeks. (Contacts for data requests are listed in Appendix B.)

The nationwide Hydrologic Benchmark Network Program provides information on baseline water quality conditions. The network consists of a set of stations located in small, pristine drainage basins. Because point source pollution is not a problem in these areas, this program has been especially useful in describing the effects of non-point atmospheric deposition of pollutants on streams. Only one Hydrologic Benchmark Network station is located in Minnesota on the Kawishiwi River near Ely. Another station, located on the North Fork of the Whitewater River, closed in 1993.

The National Stream Accounting Network (NASQAN) was established in 1973 to obtain information on the quality and quantity of water draining into the oceans, describe geographic variability in water quality, detect temporal trends, and provide a nationally consistent database. Most NASQAN stations are located at the mouths of rivers and tributaries. As a result, this program's stations are broadly representative of their basins, but they cannot provide specific, detailed data to characterize the basins. This has limited the ability of the program to analyze geographic patterns in water quality. In the early 1990s, this program experienced a significant reduction in size declining from ten NASQAN stations in Minnesota in 1993 to four in 1994. Existing stations are located on the Minnesota River at Jordan, the Mississippi River at Royalton and Nininger, and the St. Louis River at Scanlon. Figure 5.1 shows the locations of the NASQAN stations, the USGS Hydrological benchmark stations and other USGS water quality monitoring stations.

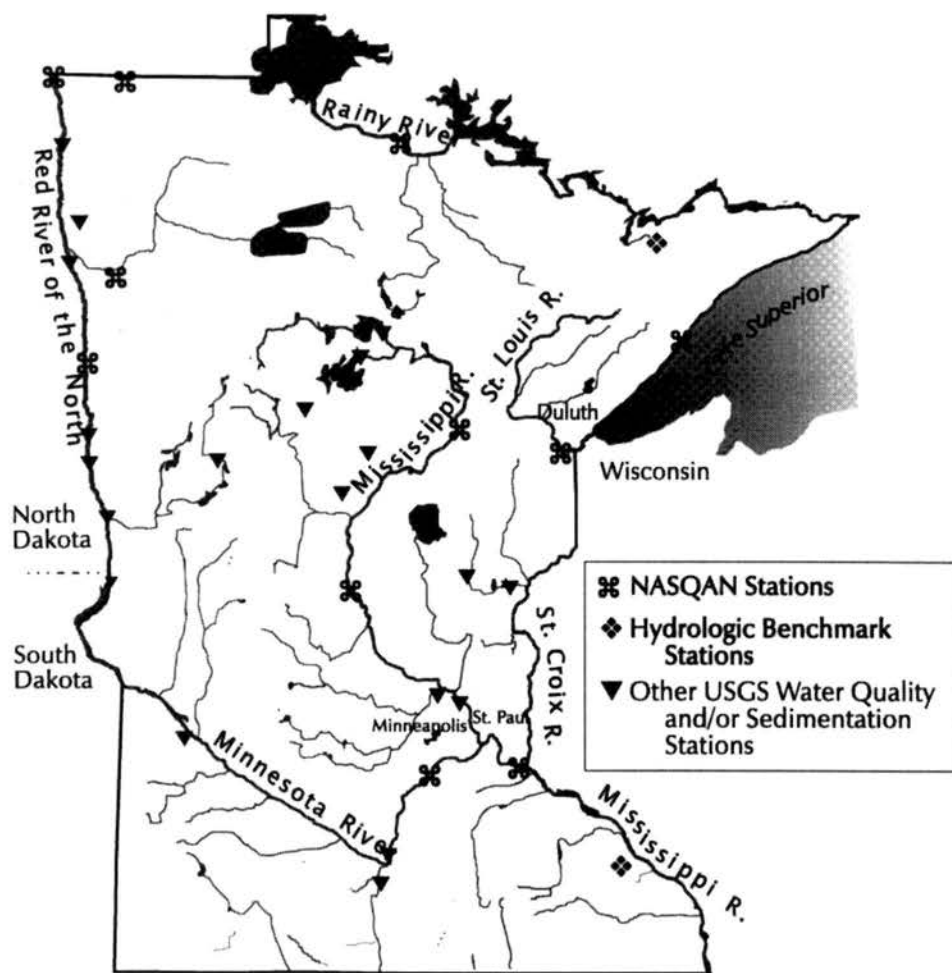


Figure 5.1 Locations of NASQAN, USGS Hydrological Benchmark and other water quality monitoring stations. U.S. Geological Survey, 1993.

To assess the quality of the nation's surface and ground water, the National Water-Quality Assessment Program (NAQWA) began in 1991. The program was designed to describe the status and identify trends in water quality and identify natural and anthropogenic factors affecting water quality. The scope of the program is large, covering approximately 60 to 70% of the water used by the entire U.S. population. This information will provide water managers and policy makers with a better understanding of the geographic differences water quality and concomitant causes.

Two basins that lie partially within Minnesota are being studied as part of NAWQA: the Red River of the North Basin and the Mississippi Basin in the Minneapolis-St. Paul metropolitan area. The Red River of the North project began in 1991 and the Mississippi River project in 1994. Both projects were recently completed. USGS Water Resources Investigations Reports contain information summarizing the water quality of the basin. (See reports 3 and 4 in this series of WRC River reports for further information on these studies.)

State Programs. Minnesota's water quality programs are designed to address the state's standards for seven designated types of use. The seven designated classes of water use in Minnesota, from the most stringent to the least stringent water quality standards, are:

- aquatic fish and wildlife [fishable use]
- domestic water supply [drinking water]
- recreation [swimmable use]
- agricultural
- industrial
- navigation
- limited resource value

For each designated use, increasingly stringent sets of water quality parameters exist. Depending on the level of standards met, the water body is described as fully supporting, partially supporting or not supporting. The fishable use classification includes two sets of standards, one for aquatic life support and the other for fish consumption, which are separately assessed. Aquatic life support standards are based on ambient standards for conventional pollutants and toxicity levels for dissolved solids on aquatic organisms. Stream reaches classify as partially supporting if standards are violated 11- 25% and not supporting if violations exceed 25%. Fish consumption standards are based on analyses of fish tissue. Table 5.3 shows standards for fish consumption.

The PCA cautions the users of its biennial reports that sites are not selected by a random process, and frequency of sampling and choice of parameters vary from site to site. Therefore the water quality assessment "cannot be considered or used to represent the overall water quality" of Minnesota's rivers and streams (PCA, 1994). The PCA initiated a random-site, statistically-based monitoring effort in 1996 to give a valid, unbiased assessment of overall water quality in Minnesota. At program initiation, 80 sites in the St. Croix basin were monitored for basic water chemistry, habitat, fish, and macro invertebrates.

Table 5.3 Fish Contaminant Advisory Levels

Use Category	Contaminant		
	TCDD* (ng/kg)	PCB** (µg/g)	Hg (µg/g)
Fully Supporting (unrestricted consumption)	<.032	<.025	< 0.150
Partially Supporting (moderate consumption)	.032 - .060	.025 - .470	0.150 - 2.810
Not Supporting (no consumption advised)	>.060	>.470	>2.810

*Tetrachlorodibenzodioxin, commonly known as dioxin

**Polychlorinated biphenyls

PCA, 1994. *Minnesota Water Quality*.

The PCA monitors rivers water quality routinely in compliance with state law and section 305(b) of the Clean Water Act. Section 305(b) requires that each state submit a biennial report to Congress on their progress toward meeting the goals of the act. Approximately 6% of Minnesota's total river miles are assessed each year. The program has been aimed primarily at monitoring point source pollution. For many years, 78 stations were monitored, the majority of which were located on the state's largest rivers. Tributary sampling sites generally are located near their mouths. Monitoring activities also included an additional 15 stream sites from a specific geographic area of emphasis; this rotates every three years from the southern to northeastern to northwestern portions of the state (PCA, 1992).

In 1996, the PCA routine monitoring program consisted of 90 sites statewide which were monitored for 10 months each year for two years of a five-year cycle. The Minnesota Department of Health analyzes the samples for standard and site-specific water-quality parameters. (Parameters are listed in Appendix C.)

The PCA recently made several changes in its monitoring program, including reduced reliance on routine, fixed-station monitoring and increased efforts on "longitudinal surveys" of streams of particular interest and "statistically-based monitoring." The PCA's monitoring activities include "basin assessments" that take into account relationships within a watershed, including nonpoint sources of pollution. In addition, to measure a river's ability to support its aquatic community, biological monitoring is being used to complement chemical monitoring. The PCA's water quality data are stored on the EPA's STORET database. Monthly data exist for the 1968 through 1978 period. Prior to 1968, sampling was sporadic, and since 1978, samples have not been collected in December, January, and February.

Local Programs. The Metropolitan Council Environmental Services (MCES), and its predecessor organizations, have monitored river water quality in the Twin Cities since the 1930s. Monitoring activities have focused on determining the adequacy of wastewater treatment to ensure public safety and the survival of fish and other aquatic life. The MCES routinely samples 27 sites, mostly on the Mississippi and Minnesota Rivers. Additional sites are located on the St. Croix, Vermillion, and Rum rivers. Sampling stations are usually placed upstream and downstream of the MCES-operated treatment facilities.

All sites are sampled continuously using automatic sample devices. Analytical measurements are based on a set of water-quality parameters to track compliance with state standards. Additional parameters such as nutrients, biochemical oxygen demand (BOD), and chlorophyll-*a*, are also analyzed. Data are available from 1976 and are stored internally at the MCES.

Several citizen monitoring programs, such as the River Water Program, engage in water quality monitoring activities in Minnesota. If the data collected by these programs meet scientific protocols, the PCA enters the data into STORET.

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APPENDICES

APPENDIX A. RIVER FACTS

Caution data users. The following information was compiled from various sources, and entries are approximations. Drainage area, river length, gradient, and discharge were measured or estimated by separate agencies for different purposes and may not be complementary.

Rainy River Drainage Basin

Rainy River:

Kawishiwi River (Basswood): Lake Co., 1,376 sq.mi., 70 mi. from White Iron Lake, 340 ft. drop, mean q=1,100cfs; max q=16,000 cfs.

Vermilion River (Namakan): St. Louis Co., 1,034 sq.mi., 40 mi. from Vermilion Lake, 240 ft. drop, mean q=600 cfs; max q=4,000 cfs.

Little Fork River: St. Louis, Koochiching and Itasca Co., 1,843 sq.mi., 157 mi. from Lost Lake Swamp, 300 ft. drop, mean q=1,000cfs, max q=25,000cfs

Big Fork River: Koochiching and Itasca Co., 2,063 sq.mi., 213 mi from Jessie Lake, 250 ft. drop, mean q=950cfs, max q=20,000cfs

Red River of the North Drainage Basin

Red River of the North:

Bois de Sioux River: Traverse, Otter Tail, Grant and Wilkin Co., 1880 sq.mi. (564 in MN),

Mustinka River: Otter Tail, Grant, Stevens, Wilkin, and Traverse Co., 878 sq.mi., 69 mi. from Orwell Reservoir, 160 ft. drop, mean q=50cfs

Otter Tail River: Clearwater, Becker, Otter Tail, and Wilkin Co., 1,952 sq.mi., 189 mi. from Big Rock Lake, 540 ft. drop, mean q=300cfs, max q=2,000cfs

Buffalo River: Becker, Otter Tail, Wilkin, and Clay Co., 1,108 sq.mi., 130 miles, 635 ft. drop, mean q=150 cfs; max q=1500 cfs

Wild Rice River: Clearwater, Becker, Clay, Mahnomen, and Norman Co., 1,629 sq.mi., 168 mi. from lakes, 700 ft. drop, mean q=260cfs

Marsh River: Norman Co., 300 sq.mi., 47 mi., 100 ft. drop, mean q=90cfs, receives overflow from Wild Rice River

Sand Hill River: Polk Co., 484 sq.mi., 95 mi., 480 ft. drop, mean q=70cfs; max q=5,000 cfs

Red Lake River: Beltrami, Clearwater, Marshall, Pennington, Red Lake, and Polk Co., 5,754 sq.mi. (1,974 sq.mi. in Red Lakes), from 244 mi. From lakes, 345 ft. drop, mean q=1,100cfs, max q=30,000cfs

Thief River: Beltrami, Marshall, Pennington Co., 1,076 sq.mi., mean q=160cfs; max q=5,000 cfs

Clearwater River: Clearwater, Beltrami, Pennington, Polk, and Red Lake Co. 1,385 sq.mi., mean q=300cfs; max q=10,000 cfs.

Snake River: Marshall Co., 1,785 sq.mi., 81 mi.

Middle River: Marshall Co., 324 sq.mi., 67 mi.; mean q=40 cfs; max q=4,000 cfs

Tamarac River: Marshall Co., 333 sq.mi., 56 mi.

Two Rivers: Roseau and Kittson Co., 1,076 sq.mi., 72 mi., mean q=100cfs

Roseau River: Roseau and Kittson Co., 1505 sq.mi. (440 in Canada), 113 mi. (15 in Canada), mean q=300cfs; max q=4,000 cfs (at Canadian border)

Lake Superior Drainage Basin

Nemadji River: Carlton and Pine Co., 270 sq.mi., 32 mi., 500 ft. drop

St. Louis River: St. Louis, Carlton, Aitkin, and Lake Co., 3,647 sq.mi., 190 mi., 1,100 ft. drop, mean q=2,500cfs, max q=38,000cfs

Whiteface River: St. Louis Co., 600 sq.mi., 80 mi. from Whiteface Reservoir, 430 ft. drop, mean q=400cfs

Cloquet River: Lake and St. Louis Co, 794 sq.mi., 97 mi. from Cloquet Lake, 300 ft. drop, mean $q=500$ cfs

Brule River: Cook Co., 282 sq.mi., 40 mi. from Brule Lake

Pigeon River: Cook Co., 610 sq.mi. (235 sq.mi. in U.S.), 60 mi. from South Lake, 950 ft. drop; mean $q=500$ cfs; max $q=11,000$ cfs

Baptism River: Cook Co., 140 sq.mi.; mean $q=170$ cfs; max $q=10,000$ cfs

Upper Mississippi Sub-basin above St Anthony Falls

Leech Lake River: Cass Co., 49 mi.

Pine River: Cass and Crow Wing Co.; 785 sq.mi.; 71 mi.

Crow Wing River: Hubbard Becker, Cass, Wadena, Otter Tail, Douglas, Todd, Crow Wing, and Morrison Co., 3,764 sq.mi., 115 mi., mean $q=1,300$ cfs, max $q=16,600$ cfs

Shell River: Becker, Wadena, and Hubbard Co., 40 mi. from Shell Lake, mean $q=250$ cfs

Leaf River (Red Eye River): Becker, Otter Tail, Todd, and Wadena Co., 899 sq.mi.; 61 mi.; mean $q=150$ cfs

Long Prairie River: Douglas, Todd, Cass, and Morrison Co., 862 sq.mi., 118 mi from northeast Douglas Co., mean $q=200$ cfs

Gull River: Morrison Co., mean $q=100$ cfs

Sauk River: Douglas, Todd, and Stearns Co., 1042 sq.mi.; 115 mi. from Lake Osakis, 340 ft. drop, mean $q=280$ cfs; max $q=9,000$ cfs

Elk River: Benton and Sherburne Co., 50 mi from northern Benton Co.; 630 sq.mi.; 200 ft. drop, mean $q=280$ cfs; max $q=7,500$ cfs

Crow River: Pope, Stearns, Kandiyohi, Meeker, Renville, McLeod, Carver, Wright, and Hennepin Co., 2,752 sq.mi., 175 mi. from Grove Lake (North Fork), plus 25 mi. of mainstem, mean $q=750$ cfs, max $q=22,000$ cfs

Rum River: Crow Wing, Aitkin, Mille Lacs, Morrison, Benton, Sherburne Isanti, and Anoka Co. 1,558 sq.mi. (200 in Mille Lacs Lake), 163 mi. from Mille Lacs, 145 ft. drop, mean $q=600$ cfs, max $q=10,000$ cfs

Minnesota River Sub-basin

Minnesota River:

Pomme de Terre River: Otter Tail, Grant, Stevens, and Swift Co., 909 sq.mi., 125 mi.; 350 ft. drop, mean $q=110$ cfs, max $q=5,500$ cfs

Lac qui Parle River: Lincoln, Yellow Medicine, and Lac qui Parle Co., 749 sq.mi. in Minn. (343 in SD), 110 mi.; 800 ft. drop, mean $q=140$ cfs, max $q=17,000$ cfs

Chippewa River: Otter Tail, Douglas, Grant, Stevens, Pope, Swift, Kandiyohi, and Chippewa Co., 2,072 sq.mi., 154 mi., 585 ft. drop, mean $q=300$ cfs, max $q=11,000$ cfs

Hawk Creek: Chippewa and Renville Co., 503 sq.mi., 65 mi. from , mean $q=150$ cfs

Yellow Medicine River: Lincoln, Lyon, Yellow Medicine Co., 665 sq.mi., 80 mi. from Lake Shaokatan, 850 ft. drop, mean $q=130$ cfs, max $q=17,000$ cfs

Redwood River: Lincoln, Pipestone, Murray, Marshall, Yellow Medicine, and Redwood Co., 716 sq.mi., 122 mi., 1,000 ft. drop, mean $q=130$ cfs, max $q=20,000$ cfs

Cottonwood River: Marshall, Murray, Cottonwood, Redwood, and Brown Co., 1,316 sq.mi., 140 mi. from Rock Lake, 750 ft. drop, mean $q=340$ cfs, max $q=28,700$

Blue Earth River: Brown, Cottonwood, Jackson, Martin, Faribault, Freeborn, Steele, Waseca, Watonwan, and Blue Earth Co., 3,161 sq.mi. (3,106 in Minn.), 109 mi, 285 ft. drop, mean $q=1,500$ cfs, max $q=68,000$ cfs

Watonwan River: Brown, Cottonwood, Jackson, Martin Watonwan, and Blue Earth Co., 848 sq.mi., 107 mi.; mean $q=380$ cfs, max $q=14,000$ cfs

Le Sueur River: Steele, Freeborn, Waseca, Faribault, and Blue Earth Co., 1,103 sq.mi., 98 mi.; 400 ft drop, mean $q=500$ cfs, max $q=25,000$ cfs

Upper Mississippi River Sub-basin in Minnesota below Fort Snelling*Upper Mississippi River:*

- St Croix River:* Pine, Chisago, Isanti, Anoka, and Washington Co., 7,650 sq.mi., (3,500 in Minn.), 154 mi. from Gordon Dam in Wisc. (125 from border). 325 ft. drop, mean q=5,000cfs; max q=60,000 cfs
- Kettle River:* Carlton, Aitkin, Kanabec, and Pine Co., 1,050 sq.mi., 79 mi. from Corona Bog, 500 ft. drop, mean q=750cfs
- Snake River:* Mille Lacs, Aitkin, Kanabec, and Pine Co., 1,009 sq.mi., 98 mi.; 500 ft. drop, mean q=600cfs, max q=15,000cfs
- Vermillion River:* Scott and Dakota Co., 47 mi.,
- Cannon River:* LeSueur, Rice, Waseka, Steele, Dakota, Goodhue Co., 1,479 sq.mi., 117 mi.; 400 ft. drop, mean q=560cfs, max q=40,000cfs
- Zumbro River:* Steele, Dodge, Goodhue, Wabasha Co., 1,423 sq.mi., 109 mi from , 600 ft. drop, mean q=650cfs, max q=30,000cfs
- Whitewater River:* Olmstead, Wabasha, and Winona Co., 15 mi. mainstem only from confluence of the forks, 75 ft. drop (mainstem only-forks much greater), mean q=200cfs?, max q=20,000cfs??
- Root River:* Mower, Olmsted, Winona, Fillmore, and Houston Co., 1,659 sq.mi.; 138 mi; 550 ft. drop; mean q=1,000cfs, max q=50,000cfs

Mississippi River (tributaries flowing into Iowa)

- Upper Iowa River:* Mower and Fillmore Co., 218 sq.mi.; 49 mi.
- Cedar River:* Freeborn, Dodge, and Mower Co., 711 sq.mi., 51 mi. (40 mi. in MN)
- Shell Rock River:* Freeborn Co., 570 sq.mi. (246 sq.mi. in MN), 12 mi. in MN
- Des Moines River:* Murray, Lyon, Cottonwood, and Jackson Co., 1,545 sq.mi., 123 mi. in Minn.; 235 ft. drop, to Iowa border, mean q=350cfs, max q=20,000 (To Missouri River)
- Little Sioux River:* Jackson Co., 312 sq.mi. in MN
- Rock River:* Pipestone and Rock Co., 913 sq.mi., 86 mi.; 450 ft. drop, max q=3,500 cfs near Iowa border

Data sources: LMIC (S. Maeder) compiled from DNR River Kilometer Index GIS River Trace Files and DNR 1993 WSHED23 Major/Minor GIS Coverage; USGS *Water Resource Data*—Minnesota, 1993 (2 vols.); and Waters, Thomas, 1977, *Streams and Rivers of Minnesota*, University of Minnesota Press, Minneapolis.

APPENDIX B. AGENCY CONTACTS AND DATA SOURCES**STATE OF MINNESOTA****Board of Water and Soil Resources**

Ronald D. Harnack, Executive Director
One W. Water St., St. Paul, MN 55107
(612) 296-3767

INFORMATION OFFICER 297-1893

The board's staff can assist the public with questions concerning local water and soil management authorities and responsibilities. Copies of laws and rules, sample petitions, informational materials, and general information and assistance at no charge.

Department of Agriculture

90 W. Plato Blvd., St. Paul 55107
INFORMATION 297-2200
Minnesota River Ag Team (MNRAT), (612) 296-1482/282-5140

Department of Health**Environmental Health Division**

Director, Patricia A. Bloomgren
121 E. 7th Place, Minneapolis, 55414
INFORMATION (612) 215-0870
Drinking Water Protection, 215-0746
Licensing and regulation of water supply systems, public water supply operators, plumbers, individual sewage disposal systems.

Department of Natural Resources

500 Lafayette Rd., St. Paul, MN 55155-4001
INFORMATION CENTER, 296-6157
Fish and Wildlife Division, 297-1308
Ecological Services Section, 296-2835
Fisheries Section, 296-3325
Wildlife Section, 296-0703
Information and Education Bureau, 396-3336
Library, 297-4929
Trails and Waterways Unit, 297-1151
Waters Division, 296-4800
State Climatologist, 296-4214

Department of Transportation**Office of Railroads and Waterways**

925 Kelly Annex, 395 John Ireland Boulevard, St. Paul, MN 55155
Ports and Waterways Section, (612) 297-5179

Environmental Conservation Library

Minneapolis Public Library and Information Center
300 Nicollet Mall, Minneapolis, MN 55401
(612) 372-6570
Depository for state environmental assessments and impact statements.

Environmental Quality Board

Michael Sullivan, Executive Director
300 Centennial Office Bldg., 658 Cedar St., St. Paul, MN 55155
(612) 296-2603
Charged with coordinating and integrating water policy development and water planning in Minnesota. The EQB Water Planning Committee carries out specific water planning functions of the Board.

Legislative Commission on Minnesota Resources

John R. Velin, Director
65 State Ofc. Bldg., 100 Constitution Ave., St. Paul 55155
(612) 296-2406
Recommends funding for programs every two years.

Metropolitan Council

230 E. 5th St., St. Paul, MN 55101
PUBLIC INFORMATION (612) 291-6359
Data Center, (612) 291-8140
Library, (612) 291-6310
Water Management 291-6402
Data and information about the seven-county Twin Cities Areas, including natural resources.

Metropolitan Council Environmental (Wastewater) Services

INFORMATION 229-2129
Communications, Tours, and Public Relations, 229-3279
Collects and treats wastewater in the Twin Cities area. Provides information services through as speaker's bureau, video presentations, general information publications, newsletter, and numerous technical reports and documents, including water quality monitoring, available from the Office of Communications.

Minnesota Agricultural Statistics Service

500 Commerce Bldg., 8 E. 4th ST., St. Paul 55101
INFORMATION (612) 296-2230

Minnesota Geological Survey

Director, David L. Southwick
2642 University Ave., St. Paul 55113
Maps & Publications, (612) 627-4782
Waterwell Records, 627-4784

Minnesota Planning

Office of Strategic & Long Range Planning
Director, Linda Kohl
658 Cedar St., St. Paul, MN 55155
INFORMATION (612) 296-3985
State Demographer, 296-4100
Staff support for EQB. Information and assistance to local governments on the environment and natural resources.

Land Management Information Center (LMIC)
INFORMATION 296-1211

Minnesota-Wisconsin Boundary Area Commission

Administrative Director, Dan McGuiness
619 Second St., Hudson, WI 54016
(612) 436-7131 or (715) 386-9444
Serves as coordinator and chairman of the Upper and Lower St. Croix National Riverway Management Commissions on major segments of the National Wild and Scenic Rivers System, a cooperative venture of the Minnesota and Wisconsin Departments of Natural Resources and the National Park Service. Information on the St. Croix and Mississippi Rivers.

Mississippi Headwaters Board

Molly MacGregor, Director
Cass County Courthouse, 300 Minnesota Ave., Walker, 56484

Pollution Control Agency

520 Lafayette Rd., St. Paul, MN 55155
INFORMATION (612) 296-6300
Public Information Office, (621) 296-7283
Water Quality Division, (621) 296-7202

University of Minnesota

Minnesota Extension Service
GENERAL INFORMATION (612) 625-1915

UNITED STATES**Army Corps of Engineers**

1421 U.S. Post Office Bldg., 180 E. Kellogg Blvd., St. Paul, MN 55101-9808
(612) 220-0200

Coast Guard

Marine Safety Detachment Marine Inspection-Marine Environmental Protection
180 E. Kellogg Blvd., St. Paul 55101
(612) 290-3991

Environmental Protection Agency

Region 5, 77 W. Jackson Blvd., Chicago, IL 60604
Freedom of Information Officer, (312) 886-6686
Water Division, 886-3000

Fish and Wildlife Service

4101 East 80th St., St. Paul, MN 55425-1665
(612) 725-3548

Geological Survey

St. Paul District Office
2280 Woodale Drive, Mounds View, MN 55112
(612) 783-3100

Natural Resource Conservation Service

600 Farm Credit Svcs. Bldg., 375 Jackson St., St. Paul, MN 55101-1854
(612) 290-3675

INFORMATION AND DATA ON-LINE**MN Planning**

<http://www.mnplan.state.mn.us/>

Land Management Information Center

<http://www.lmic.state.mn.us/welcome.html>

Minnesota River Basin Agricultural Resources & Research <http://www.soils.agri.umn.edu/research/mn-river/index.html>

National Weather Service

National Climatic Data Center
<http://www.ncdc.noaa.gov/homepg/online.html>
Midwestern Climate Center
<http://mcc.sws.uiuc.edu>

U.S. Army Corps of Engineers

St. Paul District
<http://www.ncs.usace.army.mil/>

U.S. Environmental Protection Agency

Office of Water
Information Resources & Services
<http://www.epa.gov/ow/index.html>

STORET DATA SYSTEM

<http://www.epa.gov/OWOW/STORET/>

U.S. Geological Survey

<http://h2o.er.usgs.gov/>

Minnesota Surface-Water Data Retrieval

<http://h2o.usgs.gov/swr/MN/>

USGS in Minnesota - NAWQA

<http://www.cr.usgs.gov/>

APPENDIX C. WATER QUALITY PARAMETERS

MINNESOTA POLLUTION CONTROL AGENCY *Routine Water Quality Monitoring Program (1992-93)*

Temperature-C - field
Dissolved Oxygen - field
Fecal coliform
BOD5
Suspended Solids
pH
Conductivity
Nitrite + Nitate
Total Phosphorus
Total Kjeldahl Nitrogen
Ammonia Nitrogen
Organic Nitrogen

Additional Monthly Analyses at Selected Stations

Chloride
Phenols
Total Lead
Calcium (as CaCO₃)
Total Sodium
Total Sulfate
Reactive Silicate (silica)
Turbidity
COD
TOC
Ortho Phosphorus
Total Solids
Total Vol. Solids
Dissolved Vol. Solids
Water Level Gage Reading
Total Alkalinity
E-coli
Magnesium
Total potassium
Asbestos fiber

Additional Analyses at Selected Stations

BOD5-Carbonaceous

Turbidity
Fecal Coliform
Nitrite-N
Nitrate-N
Carbonaceous BOD5
Total BOD5
Total Phosphorus
Suspended Solids
Volatile Suspended Solids
Total Dissolved Solids
Total Chlorophyll-a
Viable Chlorophyll-a
Conductivity
Ortho-phosphorus
Particulate Phosphorus
Total Kjeldahl-N
Particulate Kjeldahl-N

Quarterly

Dissolved: Chloride, Sulfate, Sodium, Potassium,
Calcium, Magnesium
Alkalinity
Carbon Dioxide
Bicarbonate
Carbonate
Ultimate BOD Series
Grease and Oil

Toxics Monitoring*

Total: Antimony, Arsenic, Beryllium, Cadmium,
Chromium, Copper, Cyanide, Lead, Mercury,
Nickel, Phenol, Selenium, Silver, Thallium, Zinc

Dissolved: Arsenic, Cadmium, Chromium,
Copper, Lead, Mercury, Nickel, Zinc
Total Organics: Volatiles, Acids, Base/Neutrals,
Pesticides, PCBs

MET COUNCIL ENVIRONMENTAL SERVICES

Comprehensive River Monitoring Conventional Pollutant Sampling*

Auto

Temperature
Dissolved Oxygen
pH
Ammonia-N

* For Biomonitoring parameters, see Water Quality Summary Reports available from MCES contacts listed above.

U.S. GEOLOGICAL SURVEY

National Stream-Quality Accounting Network**

Instantaneous Discharge, cfs

Specific Conductance, field and lab, US/CM

pH - field and lab

Temperature, °C

Turbidity, NTU

Barometric Pressure, mm of HG

Dissolved Oxygen

Fecal Coliform, cols/100ml

Fecal Streptococci, cols/100ml

Dissolved Calcium

Dissolved Magnesium

Dissolved Sodium

Dissolved Potassium

Alkalinity as CaCO₃ - field and lab

Carbonate

Bicarbonate

Dissolved Sulfate

Dissolved Chloride

Dissolved Fluoride

Dissolved Silica

Residue solids at 180° C

Dissolved Nitrite

Dissolved NO₂+NO₃

Dissolved Ammonium

Total Ammonia

Total Phosphorus

Dissolved Phosphorus

Dissolved Orthophosphorus

Dissolved Aluminum, Barium, Cobalt, Iron,
Lithium, Manganese, Molybdenum, Nickel,
Selenium, Silver, Strontium, Vanadium

Dissolved Organic Carbon

Suspended Organic Carbon

Suspended Sediment

** These same parameters are measured for Hydrologic Benchmark Monitoring, plus several radiological parameters. See U.S. Geological Survey data sources listed above for radiological parameters.