

# MINNESOTA ECOLOGICAL FLOOD REDUCTION STUDY

## LANDSCAPE ANALYSIS

### DATA SOURCES

The FEMA 100-year flood zone was acquired in digital form from the Minnesota Department of Natural Resources through the Minnesota Data Deli website.

Digital soil files were acquired from the Minnesota Land Management Information Website, the Soil Survey Information System (SISS) and the Metro GIS Datafinder website.

The National Wetlands Inventory (NWI) digital data created by the US Fish and Wildlife Service was provided by the Minnesota Department of Natural Resources through the Minnesota Data Deli website.

Two land cover datasets were available for the studied counties in Minnesota. A year 2000 Generalized Land Use data set is available for the seven county Twin Cities (Minneapolis and St. Paul) Metropolitan Area from the Metro GIS Datafinder website. The data set was developed by the Metropolitan Council and was interpreted from year 2000 air photos, with additional assistance from county parcel data and assessor's information. This vector data is georeferenced to UTM Zone 15, GRS80, NAD83.

The International Coalition Land Use/Land Cover data is available for counties outside the Twin Cities Metropolitan Area. It is derived principally from 1990 vintage aerial photography. Interpretation and coding of the land use were done by the International Coalition for Land/Water Stewardship in the Red River Basin. The data is available from the Land Management Information Center (LMIC) or the Minnesota Department of Natural Resources through the Minnesota Data Deli website. This vector data is georeferenced to UTM Zone 15, GRS80, NAD83.

Levee data was provided in digital format by the U. S. Army Corps of Engineers.

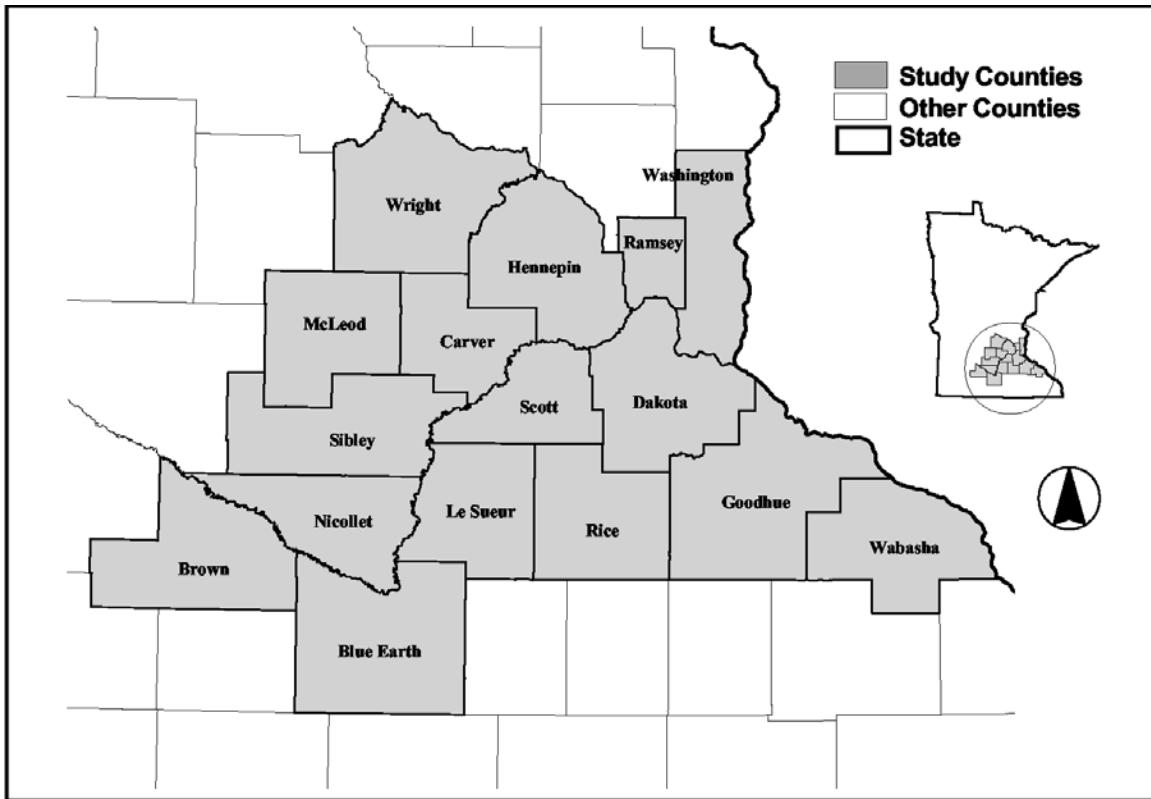
### RESULTS

Sixteen counties in Minnesota were included in the landscape analysis. They are located in the southeastern part of the state, along both the Minnesota and the Mississippi rivers (Figure 39).

#### **Sampled Flood Zone Characteristics**

Flood zone characteristics are given in Table 34 for the 16 sampled counties in Minnesota. The total area of the 100-year flood zone is 537,300 acres, ranging from a high in Goodhue County of 81,600 acres to a low in Sibley County of 13,900 acres. The managed Mississippi and Minnesota River flood zones, present in five of the counties,

**Figure 39. Minnesota Counties in Sample**



totals 114,300 acres. A small number of levees are present along the Minnesota and Mississippi rivers in Minnesota; however, these levees protect urban development and were not included in the study.

Within the available flood zone, 296,000 acres are underlain by hydric soil or NWI wetlands. The aeral extent of acres shows the expected locations of wetlands if the natural hydrology were present on the landscape. This is 295,700 acres of land that would naturally hold rain and floodwaters and would support backwater lakes and ponds.

The potential wetland flood storage area in the sampled counties, the area that could be managed to hold water during heavy rains or flooding, is also 295,700 acres. This flood storage area is the total of the NWI wetland or hydric soil outside the managed river system. No leveed areas were included in this computation.

The potential wetland flood storage volume in the sampled counties, the estimated volume of water that could be stored on the potential wetland flood storage area, is 887,000 acre-feet. The flood storage volume ranges from a high of 172,000 acre-feet in Hennepin County to a low of 24,000 acre-feet in Goodhue County. The potential flood storage volume was calculated assuming that the wetland areas could be managed to store a column of water an average 3 feet deep. (For comparison, an average football field, 160 feet wide and 360 feet long, covers approximately 1.3 acres. If a column of water 10 feet tall were contained on the field, 13 acre-feet of water would be stored.)

## **Current Land Cover**

The land cover directly overlying the regions of hydric soil or NWI wetlands in the sample counties is characterized in Table 35. In addition, the total amount of cropland (corn and beans) within the 100-year flood zone was calculated for each county and is used in the calculations of the benefits and costs of converting cropland to wetland (Tables 37 and 38).

Within the 296,000 acres underlain by hydric soil or NWI wetlands in the 100-year flood zone, cultivated land covers 41,800 acres (14 percent). Transitional agricultural land totals 119 acres or less than 1 percent of the landscape. In addition, grassland covers 33,500 acres (11 percent), mixed grass and trees totals 1,200 acres (less than 1 percent), forest extends over 39,500 acres (13 percent), park, recreational, preserve or golf courses, as identified in the metropolitan area, covers 17,600 acres (6 percent), and undeveloped urban land totals 38,800 acres (13 percent). Water currently covers 105,100 acres, or 36 percent, wetland extends over 11,700 acres or (4 percent) other areas, which includes gravel pits, open mines, bare rock, exposed soil and sand dunes, covers 1,000 acres or less than 1 percent, and developed urban land amounts to 5,000 acres (2 percent).

## **Potential Wetland Habitats**

The hydric soils and NWI wetlands within the 100-year flood zone in the study counties in Minnesota were coded to show the potential wetland habitat they would support if the hydrology in the region were restored. Table 36 indicates that the 295,700 acres of land underlain by hydric soil or NWI wetland could be developed into a wetland complex where open water to shallow marsh would cover 147,300 acres or 51 percent, shallow marsh to sedge meadow would cover 22,800 acres or 8 percent, sedge meadow to wet prairie would extend over 74,600 acres or 26 percent, wet savanna would include 4,300 acres or 1 percent, wet forest would cover 39,900 acres or 14 percent, and regions of fen would extend over 1,500 acres or 1 percent. The urban development, which currently covers 5,000 acres or 2 percent, was left unchanged.

A comparison of the distribution of the current land cover with that of the potential wetland habitats (Figure 40) shows that of the 295,700 acres that would naturally support wetlands in the study counties, 173,500 acres, or 53 percent, currently support wetland habitats (forest, water, wetland or park). This suggests that about 122,200 acres could be restored to wetlands, of which 75,300 acres are cultivated.

**Table 34. Minnesota Flood Zone Characteristics**

County	Sampled 100-Year Flood Zone <sup>a</sup> (acres)	Managed Major River 100-Year Flood Zone <sup>b</sup> (acres)	Total Levee Area Within 100-Year Flood Zone <sup>c</sup> (acres)	NWI Wetland or Hydric Soil not in Levees or Managed River <sup>d</sup> (acres)	NWI Wetland or Hydric Soil in Levees <sup>e</sup> (acres)	Total NWI Wetland or Hydric Soil <sup>f</sup> (acres)	Potential Wetland Flood Storage Area <sup>g</sup> (acres)	Potential Wetland Flood Storage Volume <sup>h</sup> (acre-feet)
<b>Blue Earth</b>	24,498	0	0	13,645	0	13,645	<b>13,645</b>	<b>40,935</b>
<b>Brown</b>	35,863	0	0	25,646	0	25,646	<b>25,646</b>	<b>76,939</b>
<b>Carver</b>	17,813	0	0	13,068	0	13,068	<b>13,068</b>	<b>39,203</b>
<b>Dakota</b>	45,753	16,206	0	17,295	0	17,295	<b>17,295</b>	<b>51,884</b>
<b>Goodhue</b>	81,631	50,151	0	8,030	0	8,030	<b>8,030</b>	<b>24,091</b>
<b>Hennepin</b>	68,846	0	0	57,373	0	57,373	<b>57,373</b>	<b>172,120</b>
<b>Le Sueur</b>	34,801	0	0	29,937	0	29,937	<b>29,937</b>	<b>89,811</b>
<b>McLeod</b>	16,184	0	0	11,724	0	11,724	<b>11,724</b>	<b>35,172</b>
<b>Nicollet</b>	17,325	0	0	11,451	0	11,451	<b>11,451</b>	<b>34,352</b>
<b>Ramsey</b>	16,327	5,372	0	9,609	0	9,609	<b>9,609</b>	<b>28,826</b>
<b>Rice</b>	30,088	0	0	22,209	0	22,209	<b>22,209</b>	<b>66,628</b>
<b>Scott</b>	26,675	0	0	17,542	0	17,542	<b>17,542</b>	<b>52,626</b>
<b>Sibley</b>	13,868		0	8,326	0	8,326	<b>8,326</b>	<b>24,979</b>
<b>Wabasha</b>	48,549	31,406	0	9,229	0	9,229	<b>9,229</b>	<b>27,686</b>
<b>Washington</b>	28,690	11,181	0	14,860	0	14,860	<b>14,860</b>	<b>44,579</b>
<b>Wright</b>	30,408	0	0	25,825	0	25,825	<b>25,825</b>	<b>77,476</b>
<b>Total</b>	<b>537,320</b>	<b>114,316</b>	<b>0</b>	<b>295,769</b>	<b>0</b>	<b>295,769</b>	<b>295,769</b>	<b>887,307</b>
<b>Percent</b>		21	0	55	0	55	55	

### Table 34. Notes

<sup>a</sup> Calculated using the county FEMA Q3 data.

<sup>b</sup> The total area of FEMA 100-year flood zone adjacent to the major rivers along the river stretch where the water levels are managed by control structures.

<sup>c</sup> Calculated using the levee database from the US Army Corps of Engineers using levees protecting less than 10% urban development

<sup>d</sup> Calculated using the sampled 100-year flood zone minus the managed major river 100-year flood zone plus the area within the major river levees.

<sup>e</sup> Total Aerial extent of the NWI wetlands or hydric soils in the 100-year flood zone inside the boundary of all the levee districts which protect less than 10% urban development

<sup>f</sup> Calculated by adding the NWI wetland or hydric soil in the flood zone not in the levee districts with the NWI wetland or hydric soil in the levee districts. Provides the total aerial extent of the NWI wetlands or hydric soil within the total available flood zone.

<sup>g</sup> The sum of the area of NWI wetland or hydric soil in the flood zone not in the levee districts and the total levee area within the 100-year flood zone.

<sup>h</sup> Calculated by multiplying the potential wetland flood storage area times a three foot column of water.

**Table 35. Minnesota Current Land Cover on NWI Wetlands or Hydric Soil**

County	Urban (acres)	Cultivated Land* (100, 21) (acres)	Pasture and Hay (22) (acres)	Trans Agricultural Land (23) (acres)	Grass land (31) (acres)	Grass land Shrub Tree Decid (32,33) (acres)	Forest (41,42, 43) (acres)	Park Recreational or Preserve (170) (acres)	Golf Course (173) (acres)	Undeveloped (210) (acres)	Water (220, 50) (acres)	Wetland (61) (acres)	Other <sup>a</sup> (71,72, 73, 80,153) (acres)	Total Land Cover (acres)
Blue Earth	49	2,429	-	7	2,039	36	6,242	-	-	-	1,910	515	425	13,652
Brown	125	9,763	-	2	5,073	211	5,358	-	-	-	4,151	867	47	25,597
Carver	190	1,863	-	26	-	-	-	1,504	10	6,309	3,119	-	41	13,063
Dakota	183	7,485	-	40	-	-	-	495	28	6,569	2,523	-	0	17,323
Goodhue	138	1,070	-	2	1,436	21	4,405	-	-	-	831	113	17	8,031
Hennepin	1,931	1,498	-	35	-	-	-	9,110	407	15,476	28,922	-	1	57,380
Le Sueur	330	4,047	-	-	6,619	174	3,229	-	-	-	12,026	3,337	131	29,893
McLeod	265	3,174	-	-	2,911	69	1,813	-	-	-	2,406	1,068	17	11,724
Nicollet	36	3,996	-	-	1,599	75	4,092	-	-	-	1,106	362	184	11,450
Ramsey	418	-	-	-	-	-	-	1,651	12	1,446	6,075	-	-	9,603
Rice	161	2,757	-	1	4,854	168	2,696	-	-	-	10,122	1,446	3	22,207
Scott	576	508	-	3	-	-	-	4,006	2	4,983	7,460	-	6	17,542
Sibley	14	1,220	-	-	1,716	20	1,927	-	-	-	2,311	1,055	21	8,283
Wabasha	57	496	-	-	1,590	37	5,485	-	-	-	1,190	295	78	9,228
Washington	276	406	-	5	-	-	-	357	40	4,113	9,706	-	-	14,903
Wright	289	1,096	-	-	5,675	444	4,285	-	-	-	11,261	2,702	73	25,824
<b>Total</b>	<b>5,039</b>	<b>41,808</b>	<b>-</b>	<b>119</b>	<b>33,512</b>	<b>1,256</b>	<b>39,532</b>	<b>17,123</b>	<b>498</b>	<b>38,896</b>	<b>105,119</b>	<b>11,758</b>	<b>1,043</b>	<b>295,702</b>
<b>Percent</b>	<b>2</b>	<b>14</b>	<b>-</b>	<b>0</b>	<b>11</b>	<b>0</b>	<b>13</b>	<b>6</b>	<b>0</b>	<b>13</b>	<b>36</b>	<b>4</b>	<b>0</b>	<b>100</b>

\*Numbers refer to the classification codes included on the attribute tables of the Minnesota Land Cover maps

<sup>a</sup>Other includes areas coded as gravel pit, open mine, bare rock, exposed soil, sand dune or unclassified

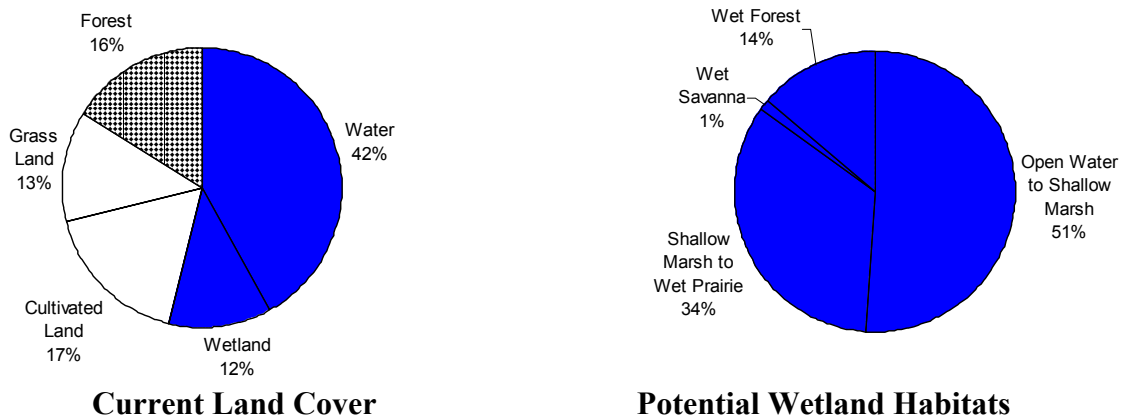
**Table 36. Minnesota Projected Wetland Habitats on NWI Wetlands and Hydric Soil**

County	Open Water to Shallow Marsh (acres)	Shallow Marsh to Sedge Meadow (acres)	Sedge Meadow to Wet Prairie (acres)	Wet Savanna (acres)	Wet Forest (acres)	Fen (acres)	Water Treatment Facility (acres)	Total Potential Wetland Habitat <sup>1</sup>
Blue Earth	2,235	2,461	2,659	0	6,241	0	0	<b>13,596</b>
Brown	13,703	5,901	556	0	5,361	0	0	<b>25,521</b>
Carver	5,759	3,599	1,618	1,901	0	0	0	<b>12,878</b>
Dakota	15,411	1,069	631		0			<b>17,111</b>
Goodhue	1,145	638	1,325		4,785			<b>7,893</b>
Hennepin	44,964	1,740	8,738	0	0	0	0	<b>55,443</b>
Le Sueur	13,497	944	11,933		3,233	0	0	<b>29,607</b>
McLeod	3,146	86	4,844	0	1,806	1,577	0	<b>11,459</b>
Nicollet	1,372	92	5,859		4,092	0	0	<b>11,415</b>
Ramsey	1,004	315	7,871		0			<b>9,190</b>
Rice	10,342	79	8,931		2,696	0	0	<b>22,048</b>
Scott	6,090	2,228	8,648	0	0	0	0	<b>16,966</b>
Sibley	2,836	22	3,527		1,927	0	0	<b>8,312</b>
Wabasha	1,852	38	1,796		5,485			<b>9,171</b>
Washington	9,914	110	4,559		0			<b>14,583</b>
Wright	14,118	3,508	1,174	2,450	4,285	0	2	<b>25,537</b>
					0			
<b>Total</b>	<b>147,388</b>	<b>22,831</b>	<b>74,669</b>	<b>4,351</b>	<b>39,912</b>	<b>1,577</b>	<b>2</b>	<b>290,731</b>
Percent	51	8	26	1	14	1	0	100

<sup>1</sup>Urban land use areas are not included in this total.

The amount of open water and forest/wet forest shows relatively little change in aerial extent when the areas of current land cover are compared to the areas of projected wetland habitat. The major change, then, from the current land use to the projected wetland habitat landscape is the replacement of cultivated and managed grass land with a wetland complex of shallow marsh, sedge meadow, wet prairie and wet savanna. It is likely that small regions of higher elevations present between the wetland areas would revert to prairie if managed naturally, but no estimate of their size or aerial extent was incorporated into this study.

**Figure 40. Comparison of Current Land Cover to Potential Wetland Habitats in the Sampled Counties of Minnesota**



A variety of hydrologic factors acting on this region in any one year may change the distribution of wetland habitats shown. In years of above average rainfall, or during times of flooding along the river, the entire area may support deeper water environments. Floodwaters may also be retained for extended periods of time as a series of backwater lakes, ponds and channels adjacent to the larger rivers.

## ECONOMIC STUDY

### RESULTS

Estimated annual social benefits and costs of cropland conversion by county for the studied counties in Minnesota are reported in Tables 37 and 38, respectively. Estimated annual social benefits and costs were estimated assuming all cultivated (corn and beans) acreage in the 100-year flood zone is converted to wetlands. Annual net social benefits of cropland conversion are positive for all counties. Annual net social benefits ranged from \$503,734 in Scott County to \$4.65 million in Brown County. Estimated total annual net benefit of cropland conversion for all counties in the study in Minnesota is \$8.62 million or \$91.11 per acre.

**Table 37. Estimated Social Benefits of Converting Cropland to Wetland in 100-year Flood zone---Minnesota**

County	Cropland in 100-year flood zone	Leveed cropland in 100-year flood zone	Un-leveed cropland in 100-year flood zone	Benefits									
				Expected mean annual damages to leveed cropland		Expected mean annual damages to un-leveed cropland		Total expected mean annual cropland damages	Annual reduction in crop subsidies		Non-flood related wetland benefits		Total annual benefits
				(\$/acre) <sup>a</sup>	(\$) <sup>b</sup>	(\$/acre) <sup>a</sup>	(\$) <sup>c</sup>	(\$) <sup>d</sup>	(\$/acre)	(\$) <sup>e</sup>	(\$/acre)	(\$) <sup>f</sup>	(\$) <sup>g</sup>
	(acres)												
Blue Earth	5,831	0	5,831	2.98	-	53.05	309,322	309,322	20.52	119,647	217.94	1,270,757	1,699,726
Brown	16,034	0	16,034	2.98	-	53.05	850,591	850,591	19.25	308,650	217.94	3,494,397	4,653,637
Carver	3,524	0	3,524	2.98	-	53.05	186,967	186,967	19.90	70,135	217.94	768,097	1,025,199
Dakota	16,603	0	16,603	2.98	-	53.05	880,778	880,778	20.93	347,496	217.94	3,618,413	4,846,688
Goodhue	6,694	0	6,694	2.98	-	53.05	355,105	355,105	23.59	157,906	217.94	1,458,844	1,971,856
Hennepin	2,805	0	2,805	2.98	-	53.05	148,791	148,791	16.41	46,026	217.94	611,263	806,079
Le Sueur	6,066	0	6,066	2.98	-	53.05	321,793	321,793	24.98	151,525	217.94	1,321,991	1,795,310
McLeod	5,316	0	5,316	2.98	-	53.05	282,024	282,024	20.89	111,055	217.94	1,158,612	1,551,691
Nicollet	7,881	0	7,881	2.98	-	53.05	418,079	418,079	20.61	162,424	217.94	1,717,550	2,298,053
Rice	6,592	0	6,592	2.98	-	53.05	349,727	349,727	25.16	165,865	217.94	1,436,750	1,952,342
Scott	1,709	0	1,709	2.98	-	53.05	90,667	90,667	23.75	40,591	217.94	372,477	503,734
Sibley	3,194	0	3,194	2.98	-	53.05	169,435	169,435	19.09	60,971	217.94	696,074	926,480
Wabasha	8,874	3	8,871	2.98	9	53.05	470,607	470,615	32.56	288,937	217.94	1,934,000	2,693,552
Washington	772	0	772	2.98	-	53.05	40,934	40,934	14.23	10,980	217.94	168,165	220,078
Wright	2,719	0	2,719	2.98	-	53.05	144,259	144,259	18.58	50,524	217.94	592,643	787,426
<b>Total/Average</b>	<b>94,613</b>	<b>3</b>	<b>94,610</b>	<b>2.98</b>	<b>9</b>	<b>53.05</b>	<b>5,019,079</b>	<b>5,019,087</b>	<b>21.36</b>	<b>2,092,733</b>	<b>217.94</b>	<b>20,620,031</b>	<b>27,731,852</b>

**Table 38. Estimated Social Costs and Annual Net Benefits of Converting Cropland to Wetland in 100-year Floodzone-Minnesota**

County	Cropland in 100-year flood zone	Leveed cropland in 100-year flood zone	Un-leveed cropland in 100-year flood zone	Costs					Annual Net Benefit
				Annual average rental income		Annual wetland construction and operating costs		Total annual costs	
	(acres)	(\$/acre)	(\$) <sup>h</sup>	(\$/acre)	(\$) <sup>i</sup>	(\$) <sup>j</sup>	(\$) <sup>k</sup>		
Blue Earth	5,831	0	5,831	82	478,123	120	699,692	1,177,814	521,912
Brown	16,034	0	16,034	82	1,314,768	120	1,924,051	3,238,819	1,414,819
Carver	3,524	0	3,524	82	288,997	120	422,922	711,919	313,280
Dakota	16,603	0	16,603	82	1,361,429	120	1,992,335	3,353,764	1,492,923
Goodhue	6,694	0	6,694	82	548,891	120	803,255	1,352,145	619,711
Hennepin	2,805	0	2,805	82	229,988	120	336,568	566,555	239,524
Le Sueur	6,066	0	6,066	82	497,400	120	727,902	1,225,302	570,008
McLeod	5,316	0	5,316	82	435,928	120	637,944	1,073,872	477,820
Nicollet	7,881	0	7,881	82	646,229	120	945,701	1,591,930	706,123
Rice	6,592	0	6,592	82	540,578	120	791,089	1,331,667	620,675
Scott	1,709	0	1,709	82	140,145	120	205,090	345,234	158,500
Sibley	3,194	0	3,194	82	261,898	120	383,265	645,163	281,317
Wabasha	8,874	3	8,871	82	727,668	120	1,064,880	1,792,548	901,004
Washington	772	0	772	82	63,272	120	92,593	155,865	64,213
Wright	2,719	0	2,719	82	222,982	120	326,315	549,297	238,129
<b>Total/Average</b>	<b>94,613</b>	<b>3</b>	<b>94,610</b>	<b>82</b>	<b>7,758,294</b>	<b>120</b>	<b>11,353,601</b>	<b>19,111,895</b>	<b>8,619,957</b>

**Table 37,38. Notes.**

- a. Estimated by Donald Hey, The Wetlands Initiative.
- b. Leveed cropland in 100-year flood zone times expected mean annual damages per acre to leveed cropland.
- c. Un-leveed cropland in 100-year flood zone times expected mean annual damages per acre to un-leveed cropland.
- d. Sum of expected mean annual damages to leveed cropland and expected mean annual damages to un-leveed cropland.
- e. Average crop subsidy payments per acre times cropland in 100-year flood zone. Average crop subsidy payment per acre equals total USDA subsidy payments estimated by the Environmental Working Group divided by total cropland acreage in 100-year flood zone for the county (<http://www.ewg.org/farm/progdetail.php?fips=19000&progcode=total&page=county>).
- f. Average user benefits per wetland acre times cropland in 100-year flood zone. Average user benefits determined by annualizing the median present values of non-marketed goods produced by wetlands, including general users (\$623), fishing (\$362), hunting (\$1,031) and recreation (\$244). Present values are for 1992 (Heimlich et al. 1998) and updated to 2002 using the Consumer Price Index for all items. Annualized values per acre based on 6% discount rate and 50-year evaluation period. Heimlich, R.E., K.D. Wiebe, R. Claassen, D. Gadsby and R.M. House. 1998. Wetlands and Agriculture: Private Interests and Public Benefits. Agricultural Economics Report No. 765, Economics Research Service, USDA, Washington, D.C.
- g. Sum of total expected mean annual damages to cropland, annual reduction in crop subsidies and non-flood related wetland benefits.
- h. Annual average rental income per acre times cropland in 100-year flood zone.
- i. Wetland construction cost of \$1,000/acre is for a medium-sized wetland taken from: Shultz, S.D. and J.A. Leitch. 2003. The feasibility of restoring previously drained wetlands to reduce flood damage. *Journal of Soil and Water Conservation* 58:21-29. Annualized wetland construction cost is \$80/acre based on a 20-year time horizon and 5% interest rate. Operating cost of \$40/acre is determined by updating the \$26/acre operating cost to 2003 using the Consumer Price Index. \$26/acre operating cost taken from Hey, D. L. 1988. Wetlands: a future non-point pollution control technology. Technical Publication Series No. 88-4, American Water Resources Association, Minneapolis, MN.
- j. Annual average rental income plus annual wetland construction and maintenance costs.
- k. Total annual wetland benefits minus total annual wetland cost.

## HABITAT BENEFITS

For simplicity and accuracy, only bird species that are officially recognized by the Minnesota Ornithologists' Union (MOU), as occurring *regularly* in Minnesota were considered in this report. Species recognized by the MOU as occurring only *casually* or *accidentally* within the state, were specifically excluded from consideration. Furthermore, only species recorded by the MOU, reported in a reliable reference source, or known to occur by Audubon Minnesota staff in the 16 studied counties are considered.

### RESULTS

#### Species and Families of Birds

When comparing the number of species of birds and the number of bird families using agricultural land vs. the number of species of birds and the number of bird families using the wetland habitat types that could be restored within the 100-year flood zones of Minnesota rivers and streams the contrast is dramatic (Table 39).

<b>Table 39. Summary of Bird Presence in Minnesota Study Area</b>						
<b>Landcover</b>			<b>Regularly Occurring Birds</b>			
	Acres	Percent	# of Families	# of Species	Threat or Endang or High Cons Priority	Population
<b>Today</b>						
Crop Land	41,808	14	12	24	3	very low
<b>Tomorrow</b>						
Shallow Marsh to Sedge Meadow	22,831	8	22	83	24	med-high
Sedge Meadow to Wet Prairie	74,669	26	17	63	17	med-high
Wet Savanna	4,351	1	20	51	17	med-high

Currently the agricultural land within 100-year flood zone areas is being used by **only about 24 species** of birds, and only three of these are a species of high conservation concern, in Minnesota. When the wetland complex is restored on the agricultural acres, 83 bird species (3.5 times more species, including 24 high-priority species) are expected to be supported by shallow marsh–sedge meadow wetlands. A total of 63 bird species (2.6 times more species, and 17 high-priority species), are expected to be supported by sedge meadow–wet prairie wetlands. And 51 bird species (twice as many species, 17 of which are high priority species) are expected to be supported by wet savanna wetlands.

Each species of bird belongs to a larger family of birds. The presence of this larger grouping (the family) is another useful way to compare biological diversity and the ecological health and stability of an ecosystem. Agricultural within the 100-year flood zone of rivers and streams in Minnesota currently support species from **only 12 bird families**. While shallow marsh–sedge meadow wetlands would support species from 22 families (1.8 times more than agricultural); sedge meadow–wet prairie wetlands would

support species from 17 families (1.4 times more); and wet savanna wetlands would support species from 20 families (1.6 times more).

Table 40 lists birds by family and by species, according to the taxonomic order used by the American Ornithologist's Union Checklist of North America Birds, 7<sup>th</sup> Edition (revised 2004). Species shown in **bold** on this table are among the "84 IBA Criteria Species" in Minnesota Audubon's statewide Important Bird Areas (IBA) Program. This includes species that are either Endangered or Threatened, or are of High Conservation Priority in Minnesota. All habitat categories used in this report are described in more detail in "Wetland Plants and Plant Communities of Wisconsin and Minnesota," Steve Eggers and Donald Reed, 1987, published by the U.S. Army Corps of Engineers.

### **Relative Density of Bird Species**

All technical evidence points to there being much higher densities of birds of various species within good quality wetland habitats as compared to the densities of birds found in monoculture areas such as agricultural. That this is true, is more than a rule of thumb, it is almost a law of nature among experts in ecological relationships and population dynamics. Wetland communities of various types also perform completely different and much more valuable hydrologic functions, than do monoculture agricultural areas. Thus the relative number of species of birds and the density of those bird populations can be a direct indicator of how well a unit of property provides valuable hydrological functions to the citizens of the nation. These benefits include flood reduction, removal of excessive nutrients and toxic chemicals, and various other important and very inexpensive and cost-effective services.

It is important to note that cropland within 100-year flood zones of the 16 Minnesota counties in this study currently support only three of Minnesota's highest conservation priority bird species (e.g., Minnesota IBA Criteria species). However, the wetlands that can be restored on those same cropland acres will support and expand the populations of 34 of Minnesota's highest conservation priority bird species. Furthermore, it is quite likely that wetlands restored in Minnesota could later receive official recognition as Important Bird Areas and become part of a worldwide network of Important Bird Areas.

## **SUMMARY CONCLUSIONS**

Currently, in Minnesota, 55 percent of the sampled flood zone (295,700 acres) is underlain by hydric soil or NWI wetland indicating that at least this much of the flood zone once existed as wetlands. If these wetland areas were managed to store water, an estimated 887,000 acre-feet of water could be contained within the sampled flood zone. If this flood storage calculation is extrapolated to the entire UMRB 100-year flood zone in Minnesota, an estimated 7 million acre-feet of water could be stored (Table 8, Summary Report).

The natural wetland system that once existed on this landscape has been altered somewhat, as managed agricultural land (corn and beans) has replaced 41,800 acres, or 14 percent, of this prior wetland area. If the percent of NWI wetland or hydric soil

determined in the sample counties is extrapolated to the entire UMRB 100-year flood zone in Minnesota, it is estimated that about 1.2 million acres of wetland were once present within the flood zone and that approximately 180,000 acres of this prior wetland has been converted to cropland (Table 11, Summary Report).

Restoration of the hydrology throughout the flood zone in Minnesota could result in the reemergence of more than 180,000 acres of wetlands, which would provide a variety of benefits for the region. First, management of the wetland areas within the flood zone to store water, rather than expedite its journey downstream, would result in lower flood stages and flood damage costs downstream. Slow movement of water through the restored wetland system would allow sediments to settle out and vegetation present in the wetland complex would begin to filter the contaminants, particularly nitrogen, from the water.

In addition, converting the monotypic vegetative cover of corn, soybeans, grass and hay to prairie, marsh and open water, would result in an increase in the regional bird habitat. It can be easily predicted that populations of at least 34 of the 84 IBA Criteria Species, as well as populations of many other species of birds that have not yet crossed the seriously threatened threshold, would expand substantially if large amounts of cropland acres within 100-year flood zone were restored to the wetland habitat types that are described in this study.

Results of the benefit-cost analysis imply that cropland conversion is socially efficient for all counties in the study area and for the study area as a whole. Estimated total annual net benefit of cropland conversion for all counties in the study in Minnesota is \$8.62 million or \$91.11 per acre. It appears, therefore, that society would be better off if cropland acreage in the 100-year flood zone in the study area was converted to wetlands than if it remained in cropland.

The proposed restoration of wetlands would complement and enhance numerous ongoing restoration projects. Included in these efforts are: local habitat projects, efforts to acquire, protect and improve management at Minnesota Department of Natural Resources Wildlife Management Areas (WMAs) that are largely found in areas of marginal agriculture; significant ongoing individual landowner projects—largely focused on wetlands and riparian areas, being conducted by Ducks Unlimited, Pheasants Forever, The Nature Conservancy and less well known conservation organizations. In addition to the above, there are several key provisions in the most recent federal Farm Bill that could be expanded and improved to assist private landowners to restore their flood corridors as suggested by this study.