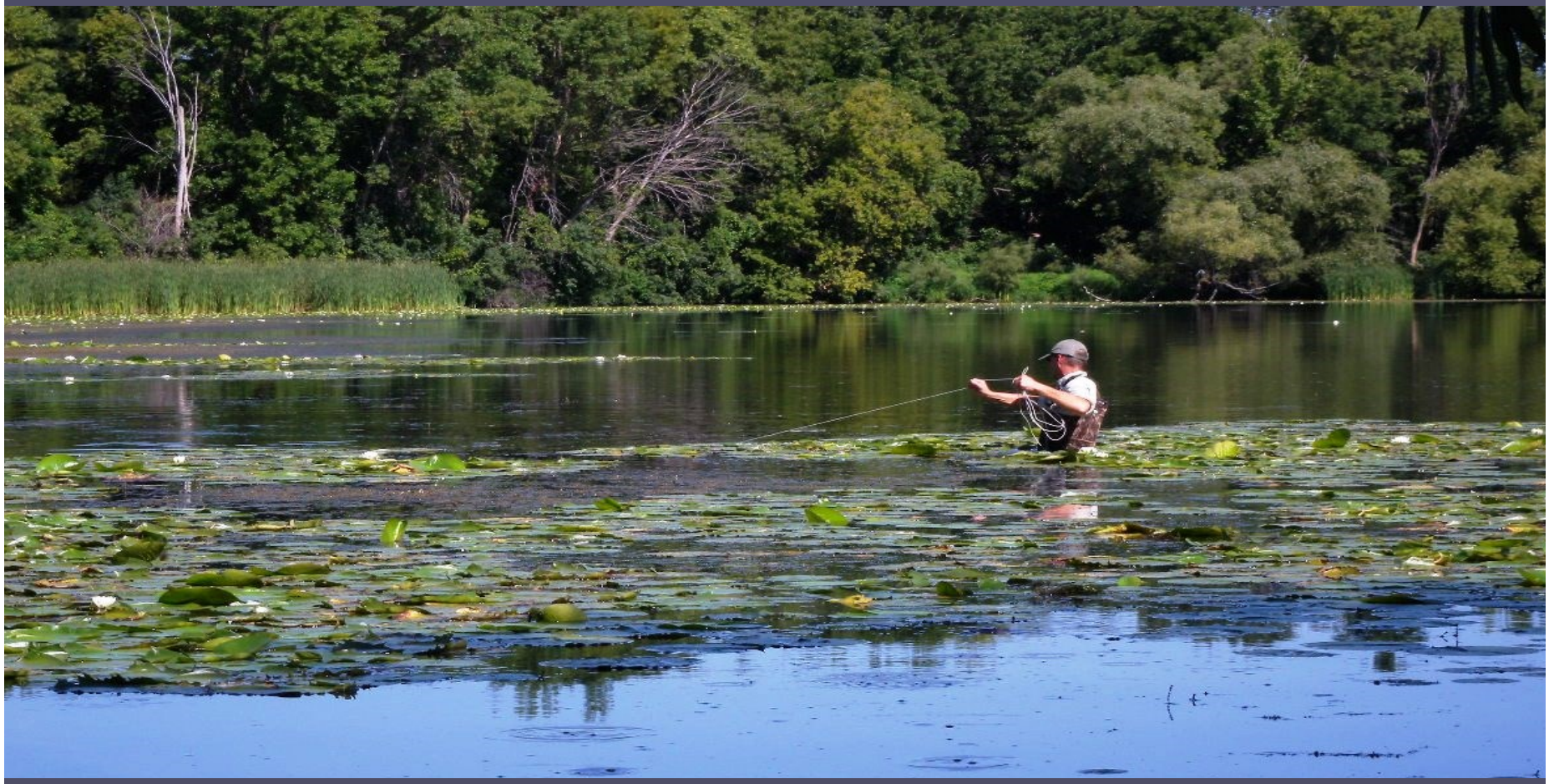
Blue Earth County
Water Management Plan
2017-2026



Final Draft

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Acronyms

AU- Animal Unit

ACE – Army Corps of Engineers

AUAR – Alternative Urban Area Review

BEC – Blue Earth County

BWSR – Board of Water and Soil Resources

BMP – Best management practice(s)

CD – County Ditch

CWI – County Well Index

CWF – Clean Water Fund

CWL – Clean Water Legacy (Act)

CWP - Clean Water Partnership, an MPCA-administered water quality grant

EAW – Environmental Assessment Worksheet

EIS – Environmental Impact Statement

EPA – Environmental Protection Agency

EQB – Environmental Quality Board

FEMA – Federal Emergency Management Agency

FSA – Farm Service Agency (division of the USDA)

GBERBA – Greater Blue Earth River Basin Alliance. GBERBA includes the Blue Earth River watershed and its tributary watersheds, the Le Sueur and Watonwan.

HEL- Highly erodible land

HUC - Hydrologic unit code

I&I – Inflow and Infiltration

JD – Judicial Ditch

MDA- Minnesota Department of Agriculture

MDH- Minnesota Department of Health

MNDNR – Minnesota Department of Natural Resources

MGS – Minnesota Geological Survey

MNDOT – Minnesota Department of Transportation

MPCA- Minnesota Pollution Control Agency

MS4 – Municipal Separate Storm Sewer System

MT – Metric Tons

NCED – National Center for Earth Surface Dynamics

NOAA – National Oceanic and Atmospheric Administration

NPDES – National Pollution Discharge and Elimination Standards

NRBG – Natural Resources Block Grant. The NRBG is administered by BWSR and is a consolidation of grants from MPCA, DNR and BWSR.

NRCS – Natural Resource Conservation Service (Division of the USDA)

PCB - Polychlorinated Biphenyls

POTW – Publicly owned treatment works, a government-owned wastewater treatment facilities

SSTS – Subsurface Soil Treatment System

SWCD - Soil and Water Conservation District (Blue Earth County)

SURGO Soils - USDA Soil Survey Geographic Database

SWPPP – Stormwater Pollution Prevention Plan

TEP – Technical Evaluation Panel (Wetland Conservation Act)

TMDL – Total Maximum Daily Load (Impaired Waters, Clean Water Act)

TSS – Total Suspended Solids

USDA- United States Department of Agriculture

USFWS – United States Fish and Wildlife Service

USGS – United States Geological Survey

WASCOB – Water and Sediment Control Basin

WCA – Wetland Conservation Act

WMA – Wildlife Management Area

WPA – Waterfowl Production Area

WRAPS- Watershed Restoration and Protection Strategies

WWTP – Wastewater Treatment Plant

Executive Summary

The content of this water plan update and the executive summary are organized as required by the Minnesota Board of Water and Soil Resources (BWSR) to facilitate the agency's review and approval of the plan, in accordance with the Comprehensive Water Management Act, Minnesota Statutes 2017, section 103B.301 to 103B.335.

Water Management Plan Authority

Blue Earth County is responsible for preparing the water plan update to meet the requirements of the Comprehensive Local Water Management Act, Minnesota Statutes 2017, section 103B.301 to 103B.335. The plan must be officially adopted by the Blue Earth County Board of Commissioners. All local units of government in the county and landowners are potential partners for implementing plan strategies.

Purpose of the Plan

The purpose of the *Blue Earth County Comprehensive Water Management Plan* is to identify and assess priority water resource concerns affecting the county, develop goals and strategies to address priority concerns, and guide the local selection of priority areas for project planning and implementation.

Priority Concerns

The *Blue Earth County Water Management Plan* addresses three priority concerns:

- Drinking water supplies and groundwater quality and quantity.
- Quality and quantity of surface waters in all local watersheds (lakes, rivers, steams)
- Protecting and managing wetlands for multiple benefits.

The process for identifying priority concerns for local water management plans is prescribed in Minnesota Statutes 2017, section 103B.312 and section 103B.313. The Priority Concerns Scoping Document is in the appendix.

Summary of Goals and Strategies

Drinking Water and Groundwater Protection Goals and Strategies

Goal: Protect the quantity and quality of groundwater resources to ensure long term sustainability of groundwater supplies.

Land Use Management Strategies

COUNTY-WIDE STRATEGY: LAND USE PLANNING AND REGULATIONS.

Action: Conduct education and training with local officials and staff using the *Geologic Atlas of Blue Earth County, Part B*, to support development and implementation of groundwater protection in local plans, ordinances and policies.

Action: The County will ensure groundwater protection is an integral part of local land use plans and ordinances.

Action: All jurisdictions will review development proposals to ensure required well isolation distances (setbacks) from existing and future wells will be maintained.

Action: Ensure land development proposals address storage, use and disposal of potentially hazardous substances and hazardous waste.

Action: Review development proposals and well disclosures to ensure abandoned wells are identified and properly sealed.

Action: Utilize the *Geologic Atlas of Blue Earth County, Part B*, to identify areas with high to moderate pollution sensitivity to ensure land use in those areas protect groundwater.

Action: Review development proposals in areas not served with publicly owned wastewater treatment systems to ensure there are no Class V injection wells for any type of wastewater or stormwater management in existing and proposed uses.

Action: The County will review feedlot permits in areas with moderate to high pollution sensitivity to ensure compliance with local and state regulations.

Action: The County will continue to assist the Minnesota Department of Health (MDH) and Minnesota Department of Natural Resources (MNDNR) with water appropriation permitting and the regulation of unrestricted flowing wells.

Well Construction and Well Use Strategies

ONGOING STRATEGY: DELEGATED WELL PROGRAM.

Action: The County will continue to administer the Minnesota Well Code, issue permits, inspect the construction of new domestic wells and non-community water supply wells, inspect the sealing of abandoned well, and ensure wells are maintained in accordance with the Minnesota Department of Health delegation agreement.

ONGOING COUNTY-WIDE STRATEGY: WELL SEALING.

Abandoned and improperly sealed wells are one of the most significant threats to groundwater quality in the county. State Law requires well owners to either repair abandoned wells and place them in service, or have them permanently sealed by a licensed well contractor. Abandoned wells are common in both rural areas and in municipalities and townsites that are presently served by public water supplies. Abandoned well identification and sealing efforts will help prevent contamination of groundwater.

Action: The County will continue to locate, permit and inspect well sealing throughout the county.

Action: The County will continue a minimum $10,000 locally-funded annual well sealing cost share program and will assess the adequacy and use of program to determine local needs and increase the cost-share funds available as needed.

Action: The County, Municipal Water Suppliers and other partners will identify priority areas and priority wells for sealing, such as DWSMAs, Source Water Protection Areas, floodplains, areas with moderate or high pollution sensitivity, areas of known contamination and other determined to be a priority based on land use, groundwater pollution sensitivity and well characteristics.

Public Water Supplier Strategies

STRATEGY: WELLHEAD PROTECTION.
Action: Support Public Water Suppliers' development and implementation of Wellhead Protection Plans required by the Minnesota Department of Health and Water Supply Plans required by the Minnesota Department of Natural Resources.

Action: The County will assist municipalities and the MDH with preparing wellhead protection plans and Water Supply Plans required by the MNDNR when requested by the municipality.

Waste Management Strategies

STRATEGY: HAZARDOUS WASTE MANAGEMENT.
Policy: Ensure hazardous substances, hazardous materials and hazardous wastes are managed at the site level to reduce the potential for groundwater contamination.

Action: Seek outside funding to address sites with contaminated soil with the potential to contaminate groundwater in areas with moderate and high pollution sensitivity as shown in the *Geologic Atlas for Blue Earth County, Part B*, and other areas with pollution sensitivity.

ONGOING STRATEGY: HAZARDOUS WASTE DISPOSAL.
Action: The County will continue to operate the Household Hazardous Waste Collection Program, Small Quantity Generator Program and Medicine Collection Program.

Well Testing Strategies

STRATEGY: PRIVATE WELL TESTING.
Action: The County will continue education programs and encourage private well water testing for contaminants, such as bacteria, nitrates and arsenic, and will coordinate with a MDH certified lab to provide water testing services to residents for a fee.

Action: The County Environmental Services will work with the County Public Health, local medical clinics and other appropriate partners in the community to promote the need for private well testing.

STRATEGY: PUBLIC WATER SUPPLY TESTING.
Action: Public water suppliers will continue water testing programs as required by the MDH and the Safe Drinking Water Act.

STRATEGY: OBSERVATION WELLS.
Action: Support expansion of the DNR observation well network in Blue Earth County.

Groundwater Recharge Strategies

Surficial Sands

Goal: Reduce nitrate nitrogen in rivers recharging surficial sands aquifers used for drinking water.

STRATEGY: REDUCE NITRATE NITROGEN IN THE BLUE EARTH RIVER.
Action: Identify, prioritize and implement best management and treatment practices that reduce nitrogen in the Blue Earth River watershed.

Action: Local partners will work with landowners to restore wetlands to provide nutrient treatment functions identified in this plan and other local, state or watershed plans that identify nitrogen treatment best practices.

Action: Local partners will work with counties and SWCDs in the Blue Earth, Le Sueur and Watonwan River watersheds to ensure nitrogen reduction is addressed in these watersheds during the Minnesota Pollution Control Agency (MPCA) watershed assessments and intensive monitoring programs, during development of MPCA Watershed Protection and Management Strategies and One Watershed One Plan.

STRATEGY: NITRATE NITROGEN MONITORING.
Action: The City of Mankato will continue its well and river monitoring programs.

Action: The City of Mankato and the County will work with the SWCD, MDH, USGS, MPCA, MDA, University of Minnesota and other appropriate local, state and federal agencies to develop and implement a coordinated, expanded monitoring plan to improve understanding of nitrates in surficial sands aquifers at the confluence of the Blue Earth and Minnesota Rivers.

Buried Aquifers

Goal: Recharge buried sands and bedrock aquifers.

STRATEGY: GROUNDWATER RECHARGE.
Action: Establish practices that recharge buried sands and bedrock aquifers.

Action: Protect, enhance and restore wetlands and similar conservation practices in areas where there is groundwater recharge potential as shown in the *Blue Earth County Water Management Plan*, high pollution sensitivity of buried sands aquifers as shown in the *Geologic Atlas of Blue Earth County, Part B,* or as shown in future plans and studies of groundwater recharge potential.

STRATEGY: LOW FLOW AUGMENTATION.
Action: Establish conservation easements in river corridors.

Action: Protect and restore wetlands in river corridors and former sand, gravel and rock mining sites.

STRATEGY: FLOWING WELLS.
Action: The County will identify flowing wells and ensure flowing wells are sealed as required by State law.

STRATEGY: MOUNT SIMON AQUIFER.
Action: Participate in Mount Simon Aquifer user group.

Action: Support reduced use of the Mount Simon Aquifer to the extent practicable.

Surface Water Goals and Strategies

Prioritizing and Targeting Strategies

Goal: Prioritize, target and measure watershed protection and restoration planning and implementation strategies in priority areas.

STRATEGY: WATER PLAN TASK FORCE.
Action: The County will support a water plan task force comprised of local elected and appointed officials, farmers, lake association members and other citizens for prioritizing, targeting, and measuring progress in implementing the goals, strategies and actions in the *Blue Earth County Water Management Plan* and related plans. The water plan task force will meet once a year or as needed.

STRATEGY: TARGET SUBWATERSHEDS FOR IMPLEMENTATION.
Action: Use the best available science, WRAPS, terrain analysis, project effectiveness analysis, and local knowledge to prioritize, target and measure watershed-based implementation in small watersheds.

Action: The County and SWCD will work with and seek recommendations from the water plan task force to prioritize HUC12 and smaller subwatersheds for local monitoring efforts, outreach and project development during the ten-year planning period.

Water Quality Monitoring for Prioritizing and Targeting

STRATEGY: WATER QUALITY MONITORING.
Action: Support lake association monitoring efforts.

Action: Support the MNDNR and MPCA sentinel lakes monitoring efforts for Madison Lake.

Action: Support farmer-led surface water and field-scale demonstrations and monitoring.

Action: The SWCD will continue to monitoring surface water, subsurface tile drainage water at the request of landowners in priority subwatersheds.

STRATEGY: NITROGEN MONITORING.
Action: Support nitrate monitoring to better understand the fate and transport of nitrogen in the Blue Earth, Le Sueur, Watonwan and Middle Minnesota River watersheds, with an emphasis of reducing nitrates in the lowest reach of the Blue Earth River.

Action: County, City of Mankato and other local government staff in the watershed will work with the University of Minnesota, United States Geological Survey, MPCA, MDA, MNDNR and MDH to seek funds and technical assistance for nitrate nitrogen monitoring in the greater Blue Earth River watershed and the Middle Minnesota River watershed with an emphasis on the lowest reach of the Blue Earth River.

Land Use Planning Goals, Policies and Strategies

Goal: Protect, enhance and restore aquatic and natural resources in priority areas to provide important water quality, wildlife habitat, water storage and groundwater protection functions with the greatest local public value in local watersheds.

Greenprint Priority Areas Strategies and Policies

STRATEGY: GREENPRINT AND LOCAL PLANS.
Land Use Policy: Protect, enhance and restore aquatic and natural resources in Greenprint priority areas with coordination among land use plans, comprehensive plans, transportation plans, stormwater

plans, water management plans and park and open space plans from all local government jurisdictions.

Land Use Policy: Local government units in the county will consider minimizing fragmentation and development of woodlands, wildlife habitat, open space, shoreland and wetlands in Greenprint priority areas. (Reference: Minnesota Statutes 2017, section 394.23, section 394.231 and section 462.357 subdivision 9)

Action: Local government units in the county will consider adopting land use policies and official controls requiring dedication of open space, including wetlands, for public use in Greenprint priority areas. (Reference: Minnesota Statutes 2017, section 394.25 subdivision 7 and 462.358 Subdivision 2b)

Action: Local government units in the county will consider developing programs and funding mechanisms for aquatic and natural resource protection such as conservation easements and external sources of funds targeted to water quality, wildlife habitat and recreation.

STRATEGY: SHORELAND PROTECTION.

Policy: Protect wetlands and aquatic vegetation in near-shore areas to provide critical fish and wildlife habitat and shoreline protection from waves and ice ridges.

STRATEGY: PRIORITY WETLAND FUNCTIONS FRAMEWORK.

Policy: Local units of government should consider the wetland functions classification framework when developing all types of land use and comprehensive plans. (Reference: Minnesota Statutes 2017, section 394.23, section 394.231 and section 462.357 subdivision 9)

POLICY STRATEGY: ENVIRONMENTAL REVIEW.

Policy: Aquatic and natural resource priority areas in the Greenprint and the *Blue Earth County Water Management Plan* should be included in environmental review documents, such as Environmental Assessment Worksheet (EAW), Environmental Impact Statement (EIS) and Alternative Urban Area Review (AUAR) to assess compatibility of proposed projects with local government plans. (Reference: Environmental Review, Minnesota Rules, part 4410.1200 subpart H. and Minnesota Rules, part 4410.2100)

STRATEGY: TRANSPORTATION PLANNING.

Policy: In the transportation planning and project design process, all road authorities should consider protection, enhancement and restoration of aquatic and natural resource in the Greenprint and the *Blue Earth County Water Management Plan*. (Reference: MATAPS 2035)

Action: Consider construction of appropriately sized culverts, bridges, tunnels or other types of safe passage to maintain, protect and restore wetland and aquatic habitat, minimize fragmentation and restore connectivity in the design and construction of transportation and trail systems. Seek funds for viable projects.

Goals and Strategies for Cropland

Goal: Increase adoption of voluntary best practices to protect and improve soil health and water quality.

Education and Outreach

STRATEGY: DEMONSTRATIONS.

On-farm trials and demonstrations led by farmers can help address perceptions of uncertainty, effectiveness about potential practices by testing their effectiveness and effect on yields in local soil conditions and landscapes.

Action: Increase adoption of voluntary best practices and support adaptive management to improve soil health, nutrient use efficiency with farmer-led, field scale demonstrations and monitoring.

Action: The SWCD and other partners will seek funding from public and private sources to establish farmer-led, field scale demonstration sites.

Nitrogen Management

Strategy: Nutrient Management.

Action: Work with land managers to establish in-field nutrient management (i.e., optimal fertilizer rates; apply fertilizer closer to timing of crop use; nitrification inhibitors; variable fertilizer rates) and best practices for nitrogen reduction are described in the MDA *Fertilizer and BMP Handbook*, *Best Management Practices for Nitrogen Use on Coarse-textured Soils* and *Best Management Practices for Nitrogen Use in South-Central Minnesota* and future guidance.

Strategy: Treat subsurface tile drainage water.

Action: Work with land managers to establish tile drainage water management and treatment practices that intercept or reduce nitrogen from subsurface tile drainage (i.e. shallower depth of tile drainage; control structures that let farmers adjust water levels; constructed and restored wetlands for treatment purposes; woodchip trench bioreactors; and saturated buffers).

Strategy: Vegetation.

Action: Work with land managers to establish vegetation practices and landscape diversification (i.e. cover crops; perennials planted in riparian areas or marginal cropland; extended rotations with perennials; energy crops in addition to corn).

Strategy: Monitoring.

Action: Support nitrogen monitoring in the Blue Earth River watershed.

Soil Erosion

Strategy: Vegetated Buffers.

Action: Establish and maintain vegetation in riparian areas and riparian buffers in accordance with Minnesota Statutes 2017, section 103F.401 to section 103F.445 and the *Blue Earth County Shoreland Ordinance* Agricultural Use Standards.

Strategy: Highly Erodible Land.

Action: Work with land managers to establish water and sediment control basins (WASCOBs), grassed waterways and grade stabilization structures on highly erodible land and potentially highly erodible land as shown in this plan and the USDA NRCS Soil Survey.

Action: The SWCD will work with land managers to establish practices to improve soil health.

Soil Erosion Law.

Enacted in 1984, Minnesota's Soil Erosion Law (Minnesota Statutes 2017, section 103F.401 to section 103F.455) set forth a broad public policy regarding excessive soil loss. This law prohibited excess soil loss only through county ordinance. In 2015, the requirement for a local ordinance was removed, so now affected property owners or elected officials can file a complaint. The law now also provides for enforcement through the administrative penalty order process.

Action: The SWCD will coordinate compliance monitoring and technical assistance as needed.

Action: The SWCD will work with the County and LGUs to evaluate the need for a soil loss ordinance.

Altered Hydrology

Strategy: Soil health.

Action: Enhance the ability of the soil to infiltrate and store precipitation. Soil and crop management in agricultural fields affects infiltration rates and water holding capacity through effects on soil structure and soil organic matter.

Strategy: Surface Flow.
Action: Manage overland flow with crop residue, contour farming, and vegetated flow pathways like waterways and filter strips that slow, filter, and partially infiltrate surface runoff.

Strategy: Subsurface Drainage.
Action: Manage subsurface drainage flow by sizing, depth, and spacing of drainage pipe to control rates of drainage water leaving the field. Control structures can also be installed in the drainage system to allow temporary water storage for later crop use or timed release.

Strategy: Water Storage.
Action: Increase water storage, including natural storage in wetlands and other depressions, and artificial storage with constructed wetlands, terraces, ponds, water and sediment control basins (WASCOBs), down-sized culvert retention, weirs, and large detention basins.

Phosphorus Strategies

Strategy: Nutrient Management.
Action: Work with land managers to encourage soil phosphorus testing and establish fertilizer best practices use and efficiencies for phosphorus management.

Strategy: Highly Erodible Land.
Action: Work with land managers to establish water and sediment control basins (WASCOBs), grassed waterways and grade stabilization structures on highly erodible land and potentially highly erodible land as shown in this plan and the USDA NRCS Soil Survey.

Action: Work with land managers to establish practices to improve soil health.

SWCD Ongoing Programs

Ongoing Strategy: Conservation Easement Delivery.
Action: The SWCD will continue to administer the Reinvest in Minnesota, Conservation Reserve Enhancement Program and similar conservation programs when signups are open, ensuring marginal cropland is taken out of production to improve water quality, reduce flooding, and increase wildlife habitat.

Ongoing Strategy: MDA State Revolving Fund (SRF).
Action: The SWCD will continue to administer the MDA AG Best Management Practices Loan Program to ensure low interest loans are available for equipment and projects.

Goals and Strategies for Feedlots

Goal: Minimize potential transport of bacteria and nutrients to surface water and groundwater from feedlots and manure applied to cropland.

Ongoing Strategies

Ongoing Strategy: MPCA Feedlot Delegation.
Action: The County will continue implementing the MPCA feedlot delegation agreement, submit annual feedlot reports and work plans to the MPCA, and report feedlot inspection and permitting activities using databases as required by the MPCA, as required in the feedlot delegation agreement.

Ongoing Strategy: County Regulations.
Action: The County will continue implementation of the zoning and livestock and manure management ordinances. These ordinances address feedlot siting and manure management for all feedlots more than 10 animal units.

Action: The County Feedlot Officer will meet with 100 percent of feedlot operators and meet with crop consultants periodically to improve manure management planning.

Action: The County Feedlot Officer will continue feedlot education programs related to manure management, including direct mail, press releases and annual meetings with producers.

Action: The County will continue the permitting and inspection program and will inspect each feedlot at least twice during the ten-year planning period.

Manure Management Strategies

STRATEGY: MANURE MANAGEMENT TRACKING.

Action: The County will reestablish a mapping system for tracking manure spreading acres associated with feedlot permits.

Action: The County will develop methods to monitor transferred manure among feedlot owners, commercial applicators, manure buyers, and crop consultants to minimize over-application of nutrients to the soil.

STRATEGY: MANURE MANAGEMENT.

Action: The County Feedlot Officer and SWCD will work with all feedlot operators to improve manure and nutrient management planning at the farm system and field scale by accounting for manure in nutrient management plans and soil phosphorus testing.

Action: During permitting and regular feedlot inspections, the County Feedlot Officer will evaluate each feedlot's manure spreading sites at the field scale with site visits and analysis of slope, proximity to surface waters and sensitive soils for nutrient management and work with the producer to manage manure in sensitive areas.

Priority Area Strategies

STRATEGY: MANAGE FEEDLOTS AND MANURE FOR SENSITIVE SOILS.

Action: The County will identify and assess open lots, manure stockpiles and manure spreading acres in areas with high and moderate pollution sensitivity (coarse textured soils and shallow depth to bedrock) or draining to intermittent streams, ravines, surface water and open tile intakes.

Action: The County Feedlot Officer will review feedlots and manure management at the farm system and field scale to identify sensitive areas and discuss requirements with producers.

Action: The County and SWCD will work with producers in sensitive areas to address runoff from open lots, manure stockpiles and manure management with vegetation, structural fixes, and improved manure management plans and programs.

Action: The County will display on its website information about sensitive areas and requirements (ground water contamination maps, bedrock, slope, soils, floodplains, ditches, surface water feature, two-foot contour maps, property boundaries, aerial photos and other information).

STRATEGY: OPEN LOTS AND SMALL FEEDLOTS.

Action: Re-evaluate each open lot for pollution problems during the County feedlot permit review.

Action: Provide technical assistance to feedlot operators and owners of small sites to address pollution problems and improve manure and nutrient management.

STRATEGY: PRIORITY SUBWATERSHEDS.

Action: The County will develop and begin implementing a plan to transition to inspecting and reviewing feedlots on a watershed basis.

Action: The County and SWCD will work together to assess feedlots and manure management systems in priority sub-watersheds and

determine roles and responsibilities for working with producers who may need feedlot improvements or improvements with manure and nutrient management.

Action: The County and SWCD will target manure and nutrient management strategies and land management strategies to sensitive areas and critical source areas in subwatersheds.

Feedlot Site Management Strategies

STRATEGY: ANIMAL MORTALITY BOXES.

Action: Environmental Services staff will consult with the Minnesota Board of Animal Health, the Minnesota Department of Agriculture, the Blue Earth County Highway Department, the County Ditch Manager, and local township officials to develop policies or regulations to reduce the potential for pollution and other hazards associated with the design and placement of animal mortality boxes.

STRATEGY: INACTIVE MANURE PITS.

Action: The County will continue to maintain an inventory of manure pits requiring proper abandonment and will continue to work with operators to properly abandon manure pits.

Flooding Goals and Strategies

Goal: Protect public safety and property in flood prone areas of the county.

Goal: Ensure resilience to extreme rainfall events.

POLICY STRATEGY: PREVENTION.

Action: Revise floodplain ordinances to prohibit filling or new dwellings in the General Floodplain and Flood Fringe District and to conform to the County Zoning Ordinance which requires lots to have the required buildable area outside of floodplains.

STRATEGY: NATIONAL FLOOD INSURANCE PROGRAM.

Action: Adopt the preliminary FEMA Flood Insurance Rate Maps when they are approved by FEMA.

Action: Revise floodplain ordinances to conform to FEMA/MNDNR standards and to properly reference the updated floodplain maps.

STRATEGY: FLOOD INUNDATION.

Action: Assess whether additional flood studies or flood inundation models are needed on streams, rivers, or ditches in the county that do not have FEMA identified floodplain boundaries like the Little Cottonwood River, Morgan Creek, and Minneopa Creek.

STRATEGY: WATER STORAGE CAPACITY.

Action: Maintain the existing water storage capacity in the floodplain by preventing further development and fill from being added to the floodplain.

Action: Increase the water storage capacity at or below 100-year flood elevations and in areas with known flood inundation to help minimize the severity and frequency of flooding and high water by targeting wetland restorations and water storage in floodplain areas.

STRATEGY: FLOOD PROTECTION STRUCTURES.

Action: Support protection and maintenance of flood control levees and other projects protecting infrastructure in the City of St. Clair.

Action: Support protection and maintenance of flood control protection systems, flood walls and pumping systems managed by the City of Mankato and South Bend Township on the Minnesota River at Mankato, Blue Earth River at Mankato and in the Indian Creek watershed flowing through Mankato.

Action: Increase water retention in the Indian Creek watershed to reduce ravine erosion and sedimentation in flood control systems on Indian Lake Road, Rasmussen Woods and Pleasant Street gate well.

Action: Prevent flooding in municipalities by maintaining, constructing and updating flood control protection systems, stormwater infrastructure and critical facilities.

STRATEGY: WATERSHED MANAGEMENT.

Action: Increase water storage by restoring wetlands and developing green infrastructure to increase water storage in watersheds with developed/developing land use.

Action: Increase water storage in drainage system watersheds and ravine watersheds with subsurface tile drainage outlets.

STRATEGY: NATURAL RESOURCE PROTECTION.

Action: Increase water storage by restoring wetlands and developing green infrastructure to increase water storage in watersheds with developed/developing land use.

Action: Increase water storage in drainage system watersheds and ravine watersheds with subsurface tile drainage outlets to reduce erosion and sedimentation that may reduce water storage capacity in wetlands, stormwater ponds and other water storage basins.

Action: Restore channelized stream corridors to provide flood water storage and attenuation, wildlife habitat and nutrient assimilation functions.

Action: Protect and restore forests and perennial vegetation to protect soils, increase the water holding capacity of soils and increase evapotranspiration while also providing wildlife habitat and nutrient assimilation.

Near Channel Erosion Goals and Strategies

Goal: Minimize near channel erosion, erosion hazards and mitigation costs throughout the county.

Planning

STRATEGY: PRIORITIZING AND TARGETING.

Action: The County will continue to address near channel erosion hazards in the *Blue Earth County All Hazard Mitigation Plan* update.

Action: The County will work with partners to assess and prioritize ravine and near channel erosion hazards for prevention, natural resource protection and structural practices in an ongoing local plan that involves multiple local and state partners. Blue Earth County Emergency Management, Public Works and Environmental Services, City of Mankato Public Works, Mankato Township, the SWCD, and the other six municipalities and 20 townships affected by near channel erosion in the county, and the MNDNR.

Action: The County and other partners will seek funds for technical analysis of soils, geology, engineering and other engineering and technical support.

Action: Evaluate the need for an updated LiDAR elevation dataset along the river valleys, bluffs, ravines and steep slopes in the county to help determine rates of erosion and change. Acquire updated LiDAR elevation data if needed.

Action: Evaluate the need for ground based LiDAR and/or drones to assess individual bluff and ravine changes over time. Acquire ground based LiDAR system and/or a drone if needed.

Land Use Strategies

STRATEGY: PREVENTION – STRUCTURE SETBACKS.

Action: Blue Earth County, Mankato Township and other jurisdictions affected by near channel erosion will work together with technical

support to develop science-based methods for increasing structure setbacks based on geology, soils and historic trends.

Action: Support the Minnesota Army Corps of Engineers Silver Jackets partnership with the MNDNR in the development of science-based methods for determining structure setbacks.

Action: Seek funds to support development of information and technical papers for elected officials, conservation, planning and zoning staff, and landowners making land use decisions in areas of near channel erosion hazards.

Action: Local government units in the county may consider requiring ground assessment and site specific analysis of vulnerability prior to land development and alterations in potential hazard areas.

STRATEGY: PREVENTION - STORMWATER REGULATIONS.

Action: Review and revise stormwater management and land use ordinances and policies to decrease surface runoff and subsurface tile drainage water discharges directed to streambanks, bluffs and ravines to reduce erosion with stormwater management practices.

STRATEGY: PREVENTION AND NATURAL RESOURCES PROTECTION:

Action: Restore wetlands and construct water storage practices in areas contributing runoff directly to bluffs streambanks, bluffs and ravines.

Education and Outreach Strategies

STRATEGY: EDUCATION AND PREVENTION:

Action: Seek funds and develop funding mechanisms to provide technical information for landowners about preventing and managing ravine erosion.

Education and Research Strategies

STRATEGY: STUDIES AND INFORMATION.

Action: Support continued investigation of near channel erosion caused by groundwater sapping and landslides.

Action: Identify and address research needs Identify research needs, information gaps to address near channel erosion and landslides in the county.

Action: Support continued investigation of near channel erosion hazards and development of predictive models and methods to analyze the unique near channel erosion and riverine evolution processes in Blue Earth County so that more specific erosion hazard area boundaries can be identified and development steered away from hazard areas with local plans and zoning ordinances.

STRATEGY: STATE SEDIMENT STUDY PRIORITIES.

Action: Support **"Studying changes in near-channel loading"** to gain a better understanding of how near-channel loading will change as recent increases in stream flows reach equilibrium." (Source: *Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River*, January 2015, MPCA)

Action: Support **"Predicting which other landscape features will erode at high rates."** "further analysis is needed to indicate the combination of bluff composition, geometry, and aspect that are most likely to produce large erosion rates in the future as well as the hydrologic (seepage and undercutting) and thermal (freeze-thaw) conditions that accelerate bluff failure (Gran et al. 2011)." (Source: *Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River*, January 2015, MPCA)

Action: Support **"Monitoring at knickpoints."** "Monitoring the erosive features directly using ground-based LiDAR, fingerprinting, and/or field surveys provides significant benefits. Load monitoring at the watershed outlets alone is insufficient to identify and ultimately target the appropriate areas for sediment reducing BMPs." (MPCA 2012a) (Source: *Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River*, January 2015, MPCA)

Project Strategies

STRATEGY: NATURAL RESOURCE PROTECTION.

Action: Implement low cost, natural resource protection projects to preserve the function of natural systems in addition to minimizing losses. Low cost options might include toe wood, bend way weirs, live willow staking, and turf reinforcement mats.

Action: Affected landowners will implement projects that reduce near-channel erosion and restore stream corridors and vegetation in areas with erosion hazards.

STRATEGY: NATURAL RESOURCE PROTECTION - WATER STORAGE.

Action: Control stormwater runoff to prevent convergence of surface water to prevent channelized flow and the formation of gullies.

Action: Restore wetlands, construct targeted stormwater retention projects and manage sub-surface discharges to reduce runoff to stream banks, bluffs, and ravines in priority areas identified in the *Blue Earth County Water Management Plan,* local engineering studies, stormwater management plans and other plans that address water storage.

Action: Establish or maintain deep rooted, permanent vegetation in shore impact zone and along stream channel bluffs.

STRATEGY: STRUCTURAL IMPROVEMENTS AND NATURAL RESOURCE PROTECTION.

Action: Stabilize and protect streambanks outlining the surficial sands aquifer and City of Mankato's public water supply wells at the confluence of the Minnesota and Blue Earth Rivers in Land of Memories Park.

Action: Restore and stabilize streambanks to protect existing roadways, bridges and infrastructure in the Blue Earth, Le Sueur, Middle Minnesota and Watonwan watersheds.

Action: Restore and stabilize streambanks to protect public parklands affected by near channel erosion.

STRATEGY: PROPERTY PROTECTION – REMOVE STRUCTURES.

Action: Landowners will remove structures that are immediately threatened by near channel erosion.

Action: When eligible for state and federal assistance for acquisition, appropriate local units of government will assist landowners with applications for state and federal agency acquisition programs.

Watershed Management Strategies

STRATEGY: PLANNING.

Action: Work with counties and SWCDs upstream in the Blue Earth River, Le Sueur River, Middle Minnesota and Watonwan River watersheds to identify and prioritize sites and establish water storage projects to reduce peak flows.

Ravine Implementation Goals and Strategies

Goal: Minimize ravine and gully erosion by managing hydrology and restoring stream channels in ravine watersheds.

ONGOING STRATEGY: PRIORITIZING AND TARGETING RAVINES.

Action: Identify, assess and prioritize ravine erosion, hazards and potential projects to facilitate coordination and implementation.

STRATEGY: STRUCTURAL AND NATURAL RESOURCE PROTECTION.

Action: Reduce drainage to ravines in priority areas with targeted wetland restoration and construction of water storage practices.

Action: Stabilize ravines in priority areas with channel restoration, water storage, grade control structures and other conveyance systems that manage water draining to ravines.

Action: Restore vegetation in ravine stream channels and side slopes.

Indian Creek Watershed

STRATEGY: INDIAN CREEK WATERSHED RAVINES STRUCTURAL NATURAL RESOURCE PROTECTION:

Action: Restore wetlands and increase water storage in the uplands draining to ravines in the Indian Creek Watershed.

Action: Increase water storage to reduce runoff from Minnesota State University Mankato MS4 draining to ravines and steep slopes in the Indian Creek Watershed.

Action: Restore wetlands and increase water storage in the County Ditch 69 and County Ditch 98 watersheds in areas identified in the Priority Areas for Protection and Restoration section of this plan, the *City of Mankato Park and Open Space Plan*, the Indian Creek watershed assessment or the Indian Creek Clean Water Partnership.

Action: Construct channel restoration and slope stabilization in ravines to reduce erosion in the Indian Creek Watershed as identified in the Indian Creek watershed assessment, the County's ravine assessment, Mankato Township or the City of Skyline.

Action: Enhance regional stormwater ponds to reduce discharges to ravines in the Indian Creek watershed.

Action: Restore wetlands and increase water storage in the uplands draining to ravines in the Indian Creek Watershed.

Thompson Creek Watershed

STRATEGY: STRUCTURAL AND NATURAL RESOURCE PROTECTION:

Action: Construct channel restoration, bluff protection and grade stabilization to reduce erosion in the Thompson Creek watershed as identified in the Thompson Creek watershed assessment and Thompson Creek Clean Water Partnership and City of Mankato stormwater plans.

Wilson Creek Watershed

STRATEGY: STRUCTURAL AND NATURAL RESOURCE PROTECTION:

Action: Protect and restore wetlands and increase water storage in the County Ditch 12 watershed in areas identified in the *Blue Earth County Water Management Plan, City of Mankato Park and Open Space Plan* or *City of Mankato Wilson Creek Stormwater Master plan*.

Action: Construct channel and slope stabilization practices in the Wilson Creek ravine as identified in the *City of Mankato Wilson Creek Stormwater Master Plan.*

103E Drainage System Goals and Strategies

Goal: Drainage project plans will identify potential wetland preservation and restoration projects, creation of water quality improvements or flood control projects to provide measurable water quality benefits in receiving waters.

Coordination and External Funding Strategies

STRATEGY: COORDINATION.

Action: A local drainage project coordination team will meet at least annually to identify and prioritize drainage projects, identify potential grant opportunities and coordinate preparation of grant applications for 103E drainage systems. The coordination team will include local staff of the drainage authority, SWCD and county water planning, project engineers and other agency representatives as needed.

STRATEGY: PRIORITIZING AND TARGETING.

Action: The local drainage project coordination team will identify and prioritize drainage systems for planning and implementation project activities by considering local knowledge and organizational capacity, state and watershed plans, and local priorities.

STRATEGY: GIS AND DEM DATA MANAGEMENT.

Action: Blue Earth County will centralize maintenance of a hydro-conditioned DEM.

Action: All Drainage Authority, Environmental Services, Public Works and SWCD projects will routinely provide GIS and hydro-conditioning updates to one department maintain the DEM for shared use by all.

Wetland Preservation and Restoration, Flood Control and Water Quality Improvement Strategies

STRATEGY: MULTIPURPOSE DRAINAGE PROJECTS.

Action: The Drainage Authority, County and SWCD will coordinate grant applications and construction at least two large scale multipurpose drainage projects in drainage systems during the ten-year planning period.

Altered Hydrology and Peak Flow Strategies

STRATEGY: IDENTIFY AND QUANTIFY WATER STORAGE AND PEAK FLOWS.

Action: The Drainage Authority will consider the importance of water storage in ditch systems by continuing to develop and implement policies that provide incentives for wetland restoration and water storage projects in the drainage system watershed.

Action: Identify and prioritize potential sites for multiple benefits, water storage and nutrient treatment by reviewing and referencing plans, such as the *Blue Earth County Water Management Plan* priority areas and potential sites for conservation projects or wetland restoration and enhancement in the Priority Areas for Protection and Restoration section of this plan, other local and state-approved watershed plans to identify potential wetland restoration and water storage projects, local government land use and stormwater management plans (county, municipal and townships).

Action: Quantify how potential wetland restoration and water storage practices, if established in the drainage system, could reduce project costs, pipe sizing and the magnitude and duration of peak flows and the total volume of discharge from the drainage system to provide multipurpose water management benefits and meet local, state and watershed goals.

Action: Identify potential field-scale best practices to increase water storage, and to the extent practical, quantify the water storage benefits using the best available models and decision support tools.

Action: Potential water storage practices and quantified, potential multipurpose benefits will be presented to landowners and the Drainage Authority.

Action: The County, SWCD and affected municipalities will seek external sources of funds for viable wetland restoration and water storage projects in drainage system watersheds.

STRATEGY: QUANTITY DOWNSTREAM FLOODING AND PEAK FLOWS.

Action: Before establishing a drainage project, the Drainage Authority will quantify current and potential flooding characteristics of property in the drainage project or system and downstream, including adequacy of the outlet for the drainage project, for 2-year and 100-year storm events in addition to the 5-year, 10-year, 25-year and 50-year events required in 103E.

Action: Flooding and potential erosion characteristics will be presented to the Drainage Authority and landowners in the drainage system watershed and jurisdictions located downstream.

Action Priority Areas/Watersheds: Drainage systems draining to municipalities in the county. Mankato- Indian Creek watershed, CD69 and CD98 and Le Sueur River CD12, City of Lake Crystal -CD56.

STRATEGY: SHALLOW LAKES AND WETLANDS.

Action: Drainage projects will quantify how drainage projects affect water levels in lake and wetlands, especially priority areas and

wetlands in the Greenprint and *Blue Earth County Water Management Plan*.

Action: Reduce impacts of drainage systems by protecting and enhancing wetland buffers to prevent sedimentation and loss of water storage function.

Nutrient Strategies

STRATEGY: NITROGEN TRANSPORT.

Action: The Drainage Authority will identify potential projects to reduce nitrate in subsurface tile drainage water and quantify how potential projects and practices, if established, could reduce nitrate in downstream waters.

Action: Potential projects and quantified, potential multipurpose benefits will be presented to landowners and the Drainage Authority.

Action Priority Areas/Watersheds: The lowest reach of the Blue Earth River and watershed areas contributing nitrogen to this reach. Areas with groundwater pollution sensitivity.

STRATEGY: PHOSPHORUS TRANSPORT.

Action: The Drainage Authority will identify projects to reduce phosphorus transport to surface water from surface runoff and subsurface tile drainage water and quantify how potential projects and practices, if established, could reduce phosphorus in downstream waters.

Action: Drainage projects will quantify and present to landowners and the Drainage Authority how potential projects and practices, if established, could reduce phosphorus in downstream waters.

Erosion and Sedimentation Strategies

STRATEGY: EROSION AND SEDIMENTATION.

Action: Use watershed targeting tools and local knowledge to Identify and prioritize the highest contributing areas in the drainage system where field erosion and runoff deposit sediment in the drainage ditch and increase ditch maintenance over time.

Action: The SWCD will recommend soil health, grass waterways, WASCOBs and other in-field practices that reduce erosion from the highest contributing areas to provide multiple benefits to the drainage system.

Action: The Drainage Authority and SWCD will identify near-ditch practices to trap or filter runoff to the drainage ditch if needed.

Action: The Drainage Authority will identify and quantify how in-field, near-ditch and other practices, if established, could make measurable erosion and sedimentation reductions in the drainage system.

STRATEGY: DITCH BUFFERS.

Action: The County Drainage Authority will ensure buffers are maintained over time in accordance with 103E during routine drainage system inspections, 103E repairs and improvement projects.

Action: The County Drainage Authority will submit reports to BWSR as required by Minnesota Statutes 2017, section 103E.067.

Action: The SWCD will provide technical assistance to landowners establishing ditch buffers required by Minnesota Statutes 2017, section 103F.48.

Action: The County and Drainage Authority will consider enforcement of Minnesota Statutes 2017, section 103F buffer requirements for Minnesota Statutes 2017, section 103E drainage systems.

Stormwater Goals and Strategies

Goal: Ensure community resilience with stormwater management that prevents flooding and protects water quality.

Education and Training Strategies

STRATEGY: PUBLIC EDUCATION AND TRAINING.

Action: Support lake associations and the City of Lake Crystal and City of Madison Lake's education efforts to reduce illicit discharge, manage yard waste and lawn chemicals and to restore shoreland vegetation to filter pollutants and provide critical habitat.

MS4 Action: Mankato Area Regional MS4 Stormwater Management Association will conduct annual stormwater meetings, maintain a website, and consider public input.

STRATEGY: CONTRACTOR TRAINING.

Action: Support contractor training in coordination with the Mankato Area Regional MS4 Stormwater Management Association, City of Lake Crystal, City of Madison Lake and other jurisdictions.

STRATEGY: TRAINING LOCAL OFFICIALS.

Action: The County will partner with local municipalities to conduct periodic training on shoreland and stormwater management for elected and appointed officials and staff.

Action: Interested local officials will participate in the MS4 Mankato Area Regional MS4 Stormwater Management Association meetings.

MS4 Action: The MS4 Mankato Area Regional MS4 Stormwater Management Association will train local staff on illicit discharge.

Land Use Management and Local Controls

STRATEGY: LAND USE PLAN.

Policy: Ensure community resilience with stormwater management programs, better site design and projects that protect communities from flooding, flash flooding and protect water quality.

Current County Land Use Plan Action: "To minimize negative impacts from storm water runoff, the County will enact development standards for stormwater management to insure no net increase in runoff."

STRATEGY: LAND USE AND STORMWATER POLICIES AND ORDINANCES.

Action: Work with multiple jurisdictions to evaluate existing and potential stormwater ordinances and policies and determine if uniform approaches are desired to develop or administer local stormwater regulations.

Action: Research existing stormwater guidance and regulations in Minnesota.

Action: Prepare and adopt changes to policies and ordinances in participating jurisdictions to help ensure that stormwater and its pollutants do not negatively impact surface waters.

Action: Seek funds for interested local communities and watersheds to develop ordinances and policies for stormwater management.

Action: Develop local funding mechanisms and seek funds to establish technical staff positions and/or services to implement stormwater ordinances and standards.

MS4 Action: To implement the SWPPP in accordance with the regional MS4 agreement, the County will develop additional ordinances and documents necessary to support the MS4 program.

Erosion Control Strategies

STRATEGY: CONSTRUCTION SITE EROSION.

Action: The County will continue to require site owners/contractors obtain required MPCA construction stormwater permits.

MS4 Action: The MS4s will review sites plans and conduct construction site inspections.

Stormwater Management Approaches

STRATEGY: GREENPRINT - GREEN INFRASTRUCTURE.

Action: Seek funds and develop local funding mechanisms to design and implement green infrastructure practices with interconnected wetlands, water storage, vegetated swales and buffers, trails, parks and open space to protect water quality and prevent pollution.

Stormwater Management System Strategies

STRATEGY: EXISTING STORMWATER RETENTION BASINS.

Action: The County will conduct an inventory and assessment of stormwater retention systems on privately-owned land outside of MS4 jurisdictions and develop means for inspecting these systems.

MS4 Action: Mankato Area Regional MS4 Stormwater Management Association members and other MS4s will inspect structural pollution control devices annually and ponds and outfalls within the permit cycle.

STRATEGY: STORMWATER RETROFITS.

Action: Support stormwater retrofits in areas with residential and urban development where water storage, flow attenuation, flood water storage or nutrient treatment functions are needed for water quality or to prevent flooding or erosion downstream.

STRATEGY: CONSTRUCTED WETLANDS AND WATER QUALITY TREATMENT WETLANDS.

Action: Constructed wetlands, stormwater wetlands or water quality treatment wetlands should be considered in watersheds where water storage, flow attenuation, flood water storage or nutrient treatment functions are needed to address water quality concerns or to prevent flooding or erosion downstream.

Centralized Wastewater Treatment Goals and Strategies

Goal: Eliminate discharge of untreated and undertreated wastewater to surface water and groundwater.

ONGOING STRATEGY: MUNICIPAL WASTEWATER TREATMENT.

All municipalities in the county utilize wastewater treatment facilities.

STRATEGY: MAINTAIN WASTEWATER TREATMENT CAPACITY.

Action: Support water reuse projects and water conservation measures to ensure treatment system capacity.

Action: Reduce inflow and infiltration (I&I) in all cities and townships using municipal wastewater treatment facilities.

Action: Reduce pollutants entering wastewater treatment facilities with pre-treatment and waste reduction measures.

STRATEGY: PLANNING.

Action: Plan and implement expansions of area served by publicly owned, centralized wastewater treatment where needed to serve existing populations and planned future growth.

Decentralized Wastewater Treatment Goals and Strategies

Goal: Ensure all subsurface sewage treatment systems (SSTS) are in compliance with Blue Earth County Code.

ONGOING STRATEGY: COUNTY SSTS PROGRAM.

Action: The County will maintain qualified staff to administer the local SSTS program.

Action: The County will issue permits, conduct inspections and maintain records for SSTS in Blue Earth County.

Action: The County will maintain and update the County Ordinance consistent with State Statutes and local goals.

Action: The County will continue to enforce compliance triggers in the Blue Earth County Code that require compliance inspections at 1) property transfer, and 2) in conjunction with all land use permits, including construction permits, conditional use permits and variances.

ONGOING STRATEGY: SSTS COMPLIANCE.

Action: Update and analyze all available data to reasonably estimate the number of imminent public health threats and determine a baseline to evaluate future results related to this goal.

Action: The County will continue to enforce compliance triggers in the Blue Earth County Code that require compliance inspections at 1) property transfer, and 2) in conjunction with all land use permits, including construction permits, conditional use permits and variances.

Action: The County will continue to ensure the availability of low interest loans for replacement SSTS construction for existing, occupied dwellings.

Action: Prioritize SSTS upgrades for systems in areas with high groundwater pollution sensitivity.

STRATEGY: SSTS MAINTENANCE.

Action: The County will evaluate compliance with SSTS maintenance requirements and will work with SSTS maintainers (pumpers) to identify and address education, disposal and other needs related to septic system maintenance issues.

Land Use Management Strategies

STRATEGY: LAND USE PERMITS.

Action: Coordinate review of land use permits in the county to ensure compliance inspections are conducted and replacement systems are constructed when required.

STRATEGY: CLASS V INJECTION WELLS.

Action: Blue Earth County, Lime Township and Mankato Township, and other jurisdictions with planning and zoning authority in areas where there is no centralized wastewater treatment will minimize the potential for Class V injection wells during the construction permit process by reviewing building plans and requiring holding tanks for floor drains and other practices to ensure a Class V injection wells are not constructed. This is especially important in areas with moderate and high pollution sensitivity.

Action: Jurisdictions in areas with moderate and high pollution sensitivity will eliminate Class V injection wells for stormwater management.

STRATEGY: LAND USE PLANS.

Policy: Support long term, sustainable wastewater treatment to protect groundwater and surface water from contamination from sewage and hazardous substances.

Policy: Continue to support orderly annexation agreements and coordinated sewer extension projects.

Policy: Continue County Land Use Plan policies that encourage growth in municipalities or areas with city sewer to ensure that wastewater treatment needs for the future are met and to help reduce long-term costs associated with growth to the taxpayers.

Septage Management Goals and Strategies

Goal: Manage septage to reduce potential contamination of surface and groundwater resources.

STRATEGY: MANAGE LAND APPLICATION.
Action: The County will evaluate SSTS maintainers' septage management systems, including disposal, storage and land application and will work with SSTS pumpers, contractors, municipalities and other representatives to assess needs related to septage management in the county.

Action: The County will display on its website maps of areas in the county with moderate and high groundwater pollution sensitivity as shown in *Blue Earth County Geologic Atlas, Part B.*

Aquatic Invasive Species Goals and Strategies

Goal: Help prevent the spread of aquatic invasive species throughout the region and Minnesota.

STRATEGY: AIS PREVENTION AID GUIDELINES.
Action: Prepare AIS Prevention Aid Guidelines as required by Minnesota Statutes 2017, section 477A.19.

Action: The County will work with lake associations, conservation organizations, the MNDNR and other local partners to prepare and implement AIS Prevention Aid Guidelines for the county.

STRATEGY: HERBICIDES FOR MANAGEMENT OF INVASIVE VEGETATION.
Action: Support herbicide treatment of infested waters when funds are available and allowed by the County's AIS Prevention Aid Guidelines, and only to the extent permitted and recommended by the MNDNR fisheries and AIS program staff.

STRATEGY: LAKE RECLAMATION.
Action: Support lake reclamation projects initiated and fully supported by lake associations and lake shore residents.

Wetland Protection and Management Goals, Policies and Strategies

Goal: Protect, enhance and restore wetlands in priority areas to provide important water quality, wildlife habitat and groundwater protection functions in local watersheds.

Wetland Conservation Act (WCA) Strategies and Policies

ONGOING PROGRAM: WETLAND CONSERVATION ACT, MINNESOTA RULES, PART 8420.
The County will continue to administer the Wetland Conservation Act, Minnesota Rules, part 8420, in accordance with Minnesota Rules and Statutes and with guidance from the *Blue Earth County Water Management Plan*.

Wetland Conservation Act (WCA) Implementation Policies

SEQUENCING POLICY: IMPACT AVOIDANCE AND MINIMIZATION.
When evaluating wetland impact avoidance and minimization, the LGU and TEP should consider the functional classification of the wetland(s) and their public value in relation to priority preservation and replacement areas as designated in the *Blue Earth County Water Management Plan*. (Reference: Minnesota Rules, part 8420.0520 subpart 3C (3) (f) and subpart 4E.)

Sequencing Policy: Flexibility.
When evaluating whether or not to exercise flexibility in the application of the sequencing steps, the LGU and TEP should consider the functional classification of the wetland(s) and the priority wetland replacement areas in the *Blue Earth County Water Management Plan*. (Reference: Minnesota Rules, part 8420.0520 subpart 7A(1) and subpart 7B.)

Replacement Standards Policy: Ecological Suitability.
When evaluating and determining the appropriate location, type, function, design and ecological suitability of replacement wetlands, the LGU and TEP should consider the priority wetland replacement areas in the *Blue Earth County Water Management Plan*. (Reference: Minnesota Rules, part 8420.0522 subpart 5D and Minnesota Rules, part 8420.0528 subpart 1.)

Wetland Planning

Strategy: Wetland replacement sites.
Action: The County may continue to collaborate with other local units of government, regulatory agencies and other entities to identify potential replacement opportunities in local watersheds to achieve plan goals. (Reference: Minnesota Rules, part 8420.0520 subpart 7F.)

Strategy: Comprehensive Wetland Protection and Management Plan.
The County may consider development of a Comprehensive Wetland Protection and Management Plan as an alternative to WCA rules in accordance with Minnesota Rules, part 8420.0830.

Wetland Protection, Enhancement and Restoration

Priority Wetlands Policy: Priority wetland functions framework.
Policy: Local units of government should consider the wetland functions classification framework and the natural resource priority areas in the Priority Areas for Protection and Restoration Section of the *Blue Earth County Water Management Plan* when developing all types of land use and comprehensive plans. (Reference: Minnesota Statutes 2017, section 394.23, section 394.231, section 462.357 subdivision9)

Strategy: Aquatic and natural resources in lake watersheds.
Action: Protect, enhance and restore wetlands and aquatic vegetation in near-shore areas to provide critical fish and wildlife habitat and shoreline protection from waves and ice ridges.

Action: Protect, enhance and restore water quality, water storage, fish and wildlife habitat and recreation functions with wetland restoration, wetland and upland buffers for habitat and erosion control, constructed wetlands, stormwater quality treatment wetlands or similar conservation projects in lake watersheds.

Strategy: Aquatic and natural resources in Greenprint Priority Areas.
Land Use Policy: Local government units in the county will consider minimizing fragmentation and development of woodlands, wildlife habitat, open space, shoreland, and wetlands in Greenprint priority areas. (Reference: Minnesota Statutes 2017, sections 394.23, 394.231, 462.357 subdivision 9)

Action: Protect, enhance and restore wetlands and natural resources and restore channelized streams in Greenprint river corridors to provide wildlife habitat, floodwater storage, groundwater recharge, nutrient assimilation, water quality, open space and recreation functions.

Action: Protect, enhance and restore wetlands and upland wildlife habitat and grasslands in Greenprint wetland complexes, shoreland and river corridors.

Action: Seek funds and support private and non-profit partnerships and investments to protect, enhance and restore wetlands, upland habitat, other natural resources and recreation in the Greenprint and

priority areas in the Priority Areas for Protection and Restoration Section of the *Blue Earth County Water Management Plan*.

STRATEGY: GROUNDWATER PROTECTION AND RECHARGE FUNCTIONS.
Action: Protect and restore wetlands and upland buffers in areas with the potential to recharge buried sand and bedrock aquifers and in areas with moderate or high pollution sensitivity as shown in the *Geologic Atlas of Blue Earth County, Part B* or the Priority Areas for Protection and Restoration Section of the *Blue Earth County Water Management Plan*.

STRATEGY: WATER STORAGE FUNCTIONS.
Action: Ensure community resilience with wetland protection, enhancement and restoration, constructed wetlands, water quality treatment wetlands and other water storage practices to minimize flooding and/or erosion in ravines and downstream channels.

STRATEGY: NUTRIENT ASSIMILATION AND TREATMENT FUNCTIONS.
Action: Protect, enhance and restore wetlands or wetland functions to provide treatment for nitrogen and phosphorus in priority areas and watersheds in the *Blue Earth County Water Management Plan.*

STRATEGY: STORMWATER AND WATER QUALITY TREATMENT WETLANDS.
Action: Constructed wetlands or water quality treatment wetlands should be considered in watersheds where water storage, flow attenuation, flood water storage or nutrient treatment functions are needed for water quality or to prevent flooding or erosion downstream.

Wetland Protection Strategies

STRATEGY: UPLAND BUFFERS AND SETBACKS FOR WETLANDS.
Action: The County will ensure wetland functions are protected with upland buffers a minimum of 16.5 feet from wetlands when subdivisions are created.

Action: Local units of government in the county will continue to ensure wetland functions are protected with existing structural setbacks and upland buffers.

Action: Local units of government in the county will consider wetland buffers and/or structural setback requirements, conservation easements, or open space dedication to protect wetlands from accelerated sedimentation and loss of water storage, loss of habitat or encroachment from surrounding land uses.

STRATEGY: CONSTRUCTION STORMWATER CONTROLS.
Action: Protect wetlands from development impacts during construction with vegetated buffers, perimeter controls and other erosion control strategies to ensure wetland storage volume is not diminished due to accelerated erosion and sedimentation. (Reference: MPCA NPDES Construction General Permit)

Action: Ensure that existing wetland hydrology is maintained and stormwater discharged from development projects and permanent stormwater systems does not cause a significant adverse impact to wetlands from inundation or decrease of flow. (Reference: MPCA NPDES Construction General Permit).

Projected Total Cost of Goals, Strategies and Actions

The estimated cost of implementing strategies and actions over the 10-year planning period is over $54,000,000. Groundwater strategies represent and estimated cost of over $4,900,000 and surface water strategies represent an estimated cost of $49,500,000. The estimated costs are itemized in the implementation section of this plan.

The costs represent a variety of ongoing programs and project costs. For example, $2.2 million of the estimated cost for groundwater strategies is from the operation of the Household Hazardous Waste Facility. In addition, over $1 million of the groundwater estimated costs is from the estimated cost of the County Well program over the ten-year planning period.

In the surface water estimated costs, over $10 million is from the installation of 750 replacement septic systems that are expected during the planning period.

Relationship with other plans

State Plans

The *Blue Earth County Water Management Plan* goals and strategies are consistent with state water plans and the priority concerns submitted by state review agencies.

Local Plans

Land Use Plans

The current *Blue Earth County Comprehensive Land Use Plan* was adopted in 1998. Goals and actions in the land use plan are included in the water plan. Goals and actions for future land use plan amendments are also included in this water management plan update.

The City of Mankato *Land Use Plan, Park and Open Space Plan* and stormwater plans were considered in this plan.

Blue Earth County All Hazard Mitigation Plan

Ravine and riverine erosion are addressed in the *Blue Earth County All Hazard Mitigation Plan*, and the water plan recommends new assessments of these potential hazards for future hazard mitigation plan updates.

Wellhead Protection and Source Water Plans

All municipalities have prepared or are in the process of preparing wellhead protection plans with assistance from the Minnesota Department of Health. This water management plan supports implementation of all wellhead protection and source water plans in the county.

Land Use Controls

Zoning ordinances, subdivision ordinances, stormwater management ordinances and policies were considered in development of the plan.

Watershed Plans

The priority areas, strategies and actions are locally supported and will be recommended to the Minnesota Pollution Control Agency for inclusion in Watershed Restoration and Protection Strategies reports for the Blue Earth, Le Sueur, Watonwan and Middle Minnesota watershed.

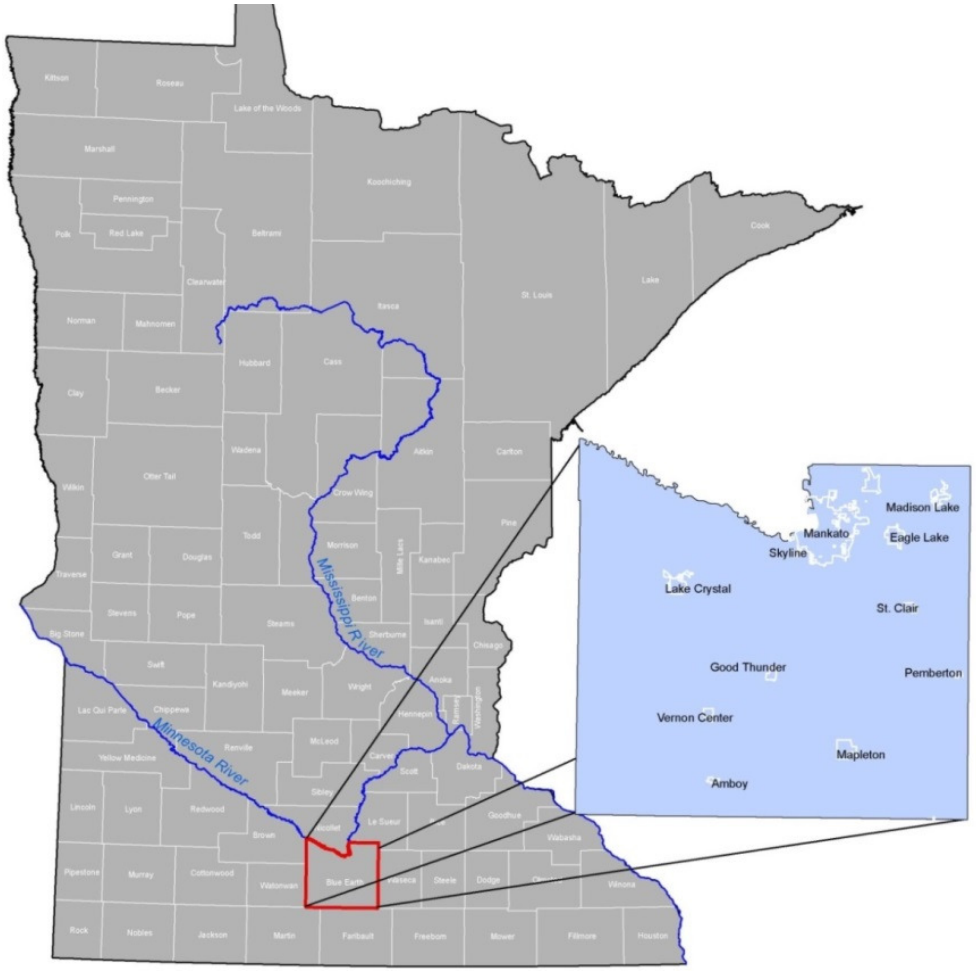
Minnesota Statutes requires counties transition by 2025 to comprehensive watershed plans, also known as “One Watershed One Plan.” Blue Earth County and other local partners will be participating in the development of four to five watershed plans in addition to implementing the *Blue Earth County Water Management Plan*.

These four or five ongoing watershed planning efforts as well as programs and mandates like the buffer law will limit the local time and resources available to implement the goals and strategies in the *Blue Earth County Water Management Plan*.

General Information - Background

General Description

Blue Earth County is located in south-central Minnesota approximately 75 miles southwest of the Twin Cities. The County is 765 square miles in area and had a population of 64,013 in 2010 according to the U.S. Census. The Minnesota River forms most of the northern border of the county. Located on the Minnesota River, the City of Mankato is the county seat and largest city in the county and the region with a population 41,198 in 2010. The County contains the confluence of three major rivers: the Le Sueur River, the Watonwan River, and the Blue Earth River. The Blue Earth River joins the Minnesota River at the "bend" in the Minnesota River in Mankato. Agriculture dominates the County's landscape as over 70-percent of the land in the County was used for cultivated cropland according to the 2012 United States Department of Agriculture's Census of Agriculture.



County Population

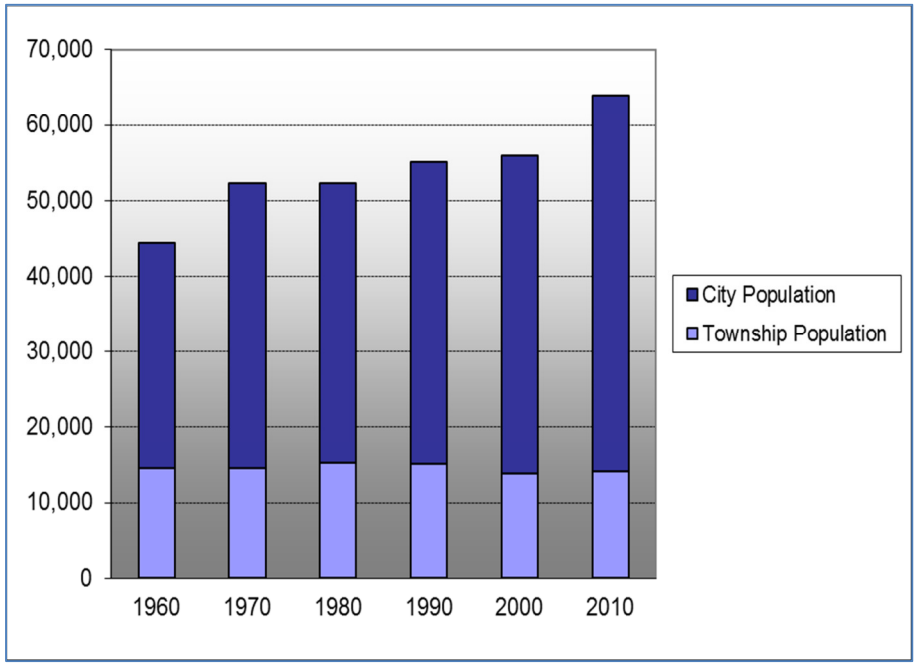
According to the United States Census Bureau's 2015 population estimate, the county population is 65,787. The Minnesota Demographic Data Center had a slightly higher estimate of 66,179 for the County population estimate in 2015.

The rate of population growth in the County since the year 2000 has increased at a faster rate compared to previous decades. Much of the growth has occurred in the cities of Mankato, Eagle Lake and Madison Lake. Mankato had the greatest population increase, while the percent of population increase in Eagle Lake was higher. Mankato's population grew from 34,427 in 2000 to an estimated 41,723 in 2015 according to the State Demographic Data Center. Eagle Lake population grew from 1,787 in 2000 to an estimated 2,932 in 2015. Madison Lake grew from a population of 837 in 2000 to an estimated 1,170 in 2015.

The County's population grew at an average annual rate of 1.3 percent from 2000 to 2010. The average annual rate of growth is estimated to have slowed to an average annual growth rate of .6 percent.

Population changes in County in the past fifty years show a shift in population from unincorporated areas in townships to municipalities. The figure to the right shows population changes between 1960 and 2010. This trend is common throughout agricultural regions of Minnesota as farms increased in size providing direct farm income to fewer people. In 1960, 33 percent of the total population was in townships. By 2010, townships represented 22 percent of the county population. While the total population of cities grew, the total population of the townships remained somewhat consistent. In 1960 the total township population was 14,512 and in 2010 the township population was 14,107. Population growth in the townships has been greatest in the townships close to Mankato. More recently, Lime Township's total population was reduced by an estimated 288 from 2010 to 2015 as subdivisions adjacent to the City of Mankato were annexed to the city. Jamestown Township also lost population from 2010 to 2014 as subdivisions around Duck Lake and Ballantyne Lake were annexed to the City of Madison Lake.

City and Township population in Blue Earth County - 1960 to 2010
(*Source: United States Census Bureau)*



Population and Population Estimates of Blue Earth County Cities

City	2000 Population	2010 Population	2015 Population Estimate	Population Change 2000 to 2015	2000 to 2015 Population Percent Change
Amboy	575	534	525	-50	-8.7%
Eagle Lake	1,787	2,422	2,932	1,145	64.1%
Good Thunder	592	583	551	-41	-6.9%
Lake Crystal	2,420	2,549	2,554	134	5.5%
Madison Lake	837	1,017	1,170	333	39.8%
Mankato	32,427	39,305	41,723	9,296	28.7%
Mapleton	1,678	1,756	1,756	78	4.6%
Minnesota Lake	0	4	2	2	-
North Mankato	0	0	5	5	-
Pemberton	246	247	239	-7	-2.8%
St. Clair	827	868	853	26	3.1%
Skyline	330	289	288	-42	-12.7%
Vernon Center	359	332	318	-41	-11.4%
Total	***42,078***	**49,906**	**52,916**	**10,838**	**25.8%**

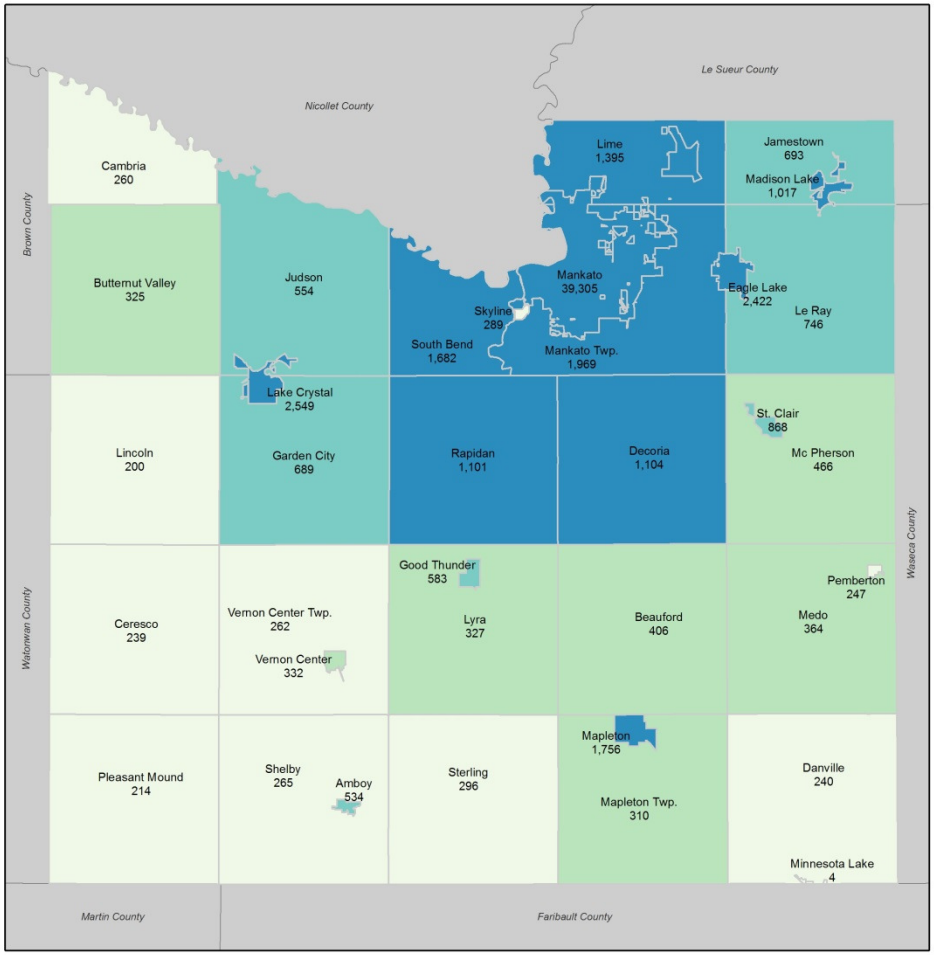
Source: United States Census Bureau and Minnesota Demographic Center

Population and Population Estimates of Blue Earth County Townships

Township	2000 Population	2010 Population	2015 Population Estimate	Population Change 2000 to 2015	2000 to 2015 Population Percent Change
Beauford	442	406	389	-53	-12.0%
Butternut Valley	382	325	305	-77	-20.2%
Cambria	271	260	246	-25	-9.2%
Ceresco	255	239	221	-34	-13.3%
Danville	262	240	229	-33	-12.6%
Decoria	922	1104	1,091	169	18.3%
Garden City	700	689	662	-38	-5.4%
Jamestown	628	693	609	-19	-3.0%
Judson	591	554	532	-59	-10.0%
Le Ray	846	746	716	-130	-15.4%
Lime	1,314	1395	1,026	-288	-21.9%
Lincoln	227	200	191	-36	-15.9%
Lyra	378	327	305	-73	-19.3%
McPherson	470	466	456	-14	-3.0%
Mankato	1,833	1969	1,965	132	7.2%
Mapleton	310	310	292	-18	-5.8%
Medo	374	364	350	-24	-6.4%
Pleasant Mound	235	214	203	-32	-13.6%
Rapidan	1,061	1101	1,074	13	1.2%
Shelby	294	265	247	-47	-16.0%
South Bend	1,491	1682	1,634	143	9.6%
Sterling	276	296	270	-6	-2.2%
Vernon Center	301	262	250	-51	-16.9%
Total	***13,863***	***14,107***	***13,263***	***-600***	**-4.3%**

Source: United States Census Bureau and Minnesota Demographic Center

Blue Earth County City and Township Population - 2010



2010 Population

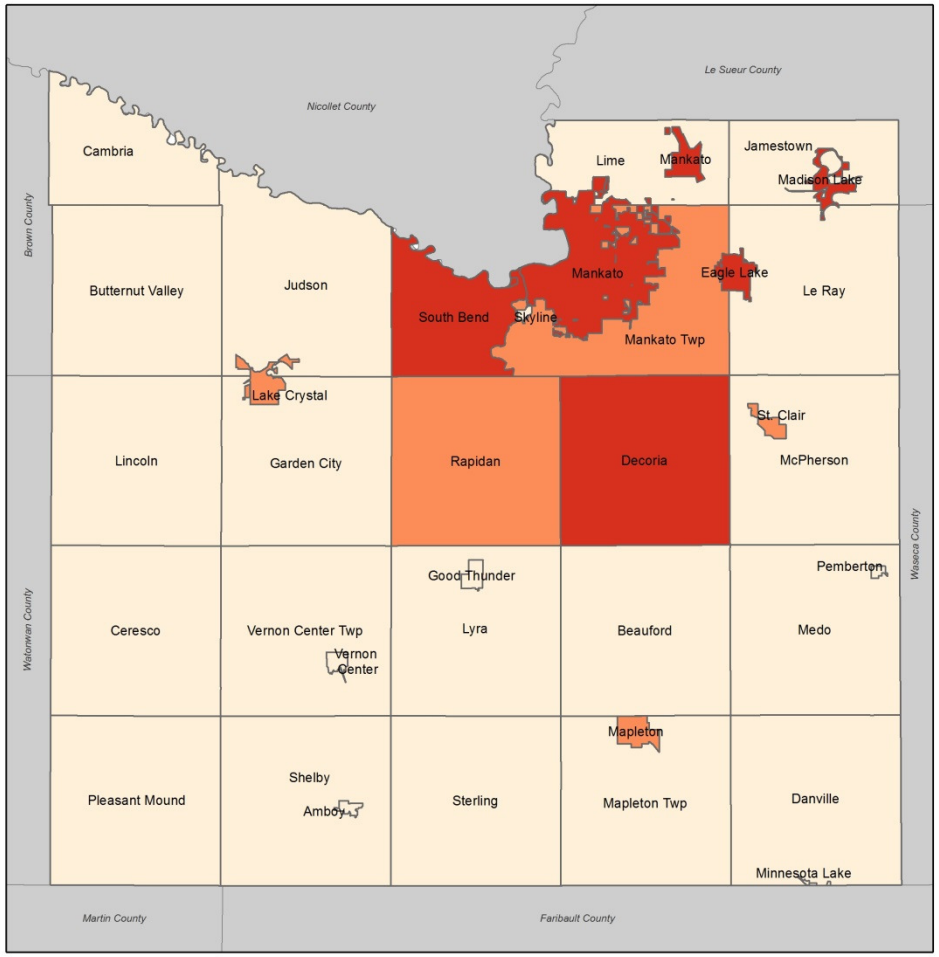
- 0 - 300
- 301 - 500
- 501 - 1,000
- 1,001 - 39,305

0 5 10 Miles

Prepared By: Blue Earth County

Source: 2010 U.S. Census

Blue Earth County City and Township Population Percent Change from 2000 to 2015



City or Township Percent Population Change from 2000 to 2014

- Population Decline
- Growth from 0 to 8 Percent
- Growth over 8 Percent

0 5 10 Miles

Prepared By: Blue Earth County

Source: MN Demographic Data Center

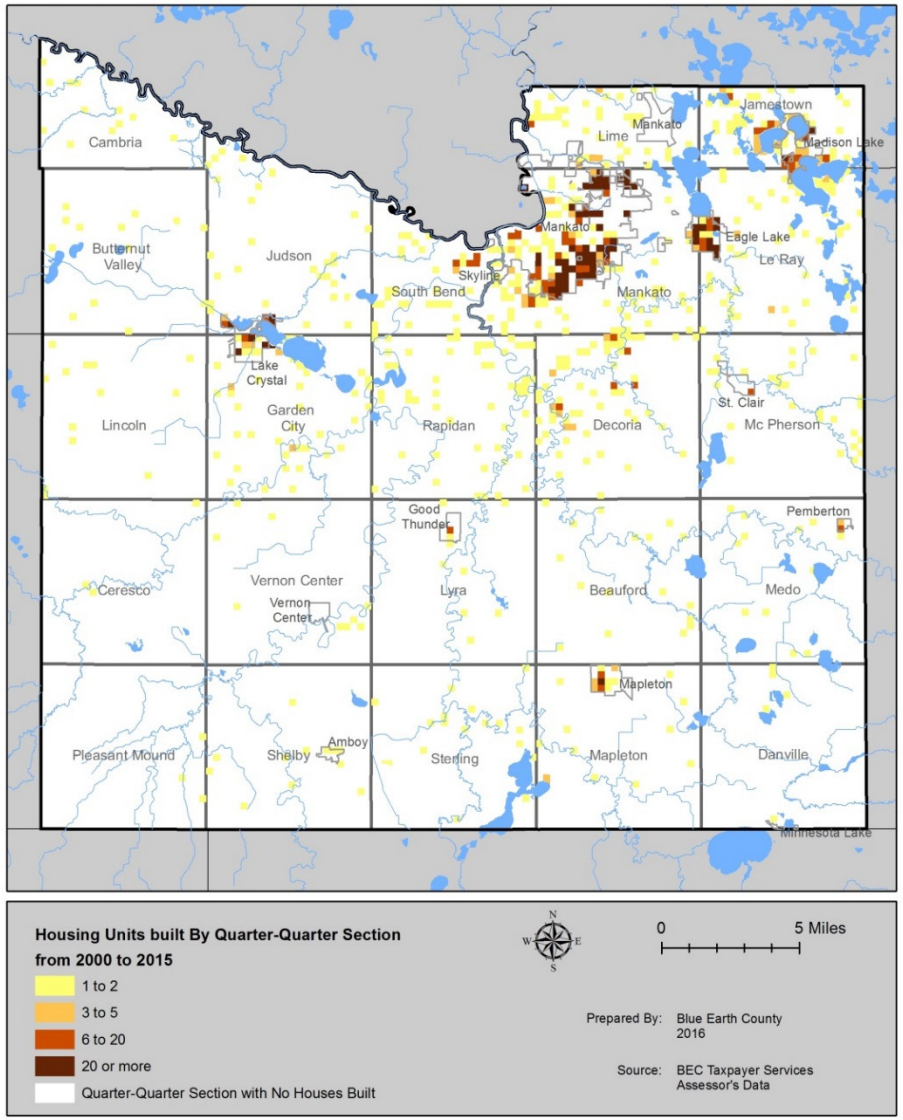
Development Trends

The primary growth areas in the County are in the northeast corner of the county. The map to the right shows the locations of housing units built from 2000 to 2015 by quarter-quarter section (40 Acres). The densest areas of growth are in the eastern portions of the City of Mankato as well as the City of Eagle Lake and Madison Lake. Smaller developments have also occurred in Lake Crystal, Mapleton, Good Thunder, St. Clair and Pemberton.

Scattered growth has also occurred in the unincorporated areas of the county in the last fifteen years. Much of the housing constructed in the last fifteen years in unincorporated areas has also been in the northeast quarter of the county. Some of that growth has occurred as subdivisions which were platted in the 1970's to the 1990's. Current County land use policies only allow one house per quarter-quarter section in the conservation and agriculture districts. However, prior to 1996 there was not a density restriction in the Conservation District and many subdivisions were created in that district along rivers and streams. Many of these subdivisions are in the final stages of development and nearly fully developed. These rural subdivisions are most common in Mankato Township and Decoria Township south of Mankato.

The table on the following page displays the number of houses built by township from 2000 to 2015. Decoria Township had the most houses built in that time period with 127. Mankato Township and South Bend Townships, adjacent to the City of Mankato, also have seen significant numbers of new houses. Since 2010, those townships are ranked second and fourth in the County in terms of new dwellings constructed. The townships of Jamestown and LeRay have also experienced more housing growth than other townships in the County. Many of these dwellings have been built in subdivisions around Madison Lake and Ballantyne Lakes. The subdivisions on those lakes are served by the Tri-Lakes sewer district.

Residential Housing Units Built from 2000-2015 by Quarter-Quarter Section



Summary of Dwellings Constructed Since 2000 by Township			
Township	Year Built from 2000 to 2009	Year Built from 2010 to 2015	Total
Decoria	98	29	127
Mankato	73	21	94
Jamestown	76	17	93
South Bend	64	12	76
Le Ray	44	22	66
Lime	49	16	65
Rapidan	47	15	62
Garden City	48	13	61
McPherson	23	6	29
Judson	25	4	29
Sterling	19	0	19
Beauford	13	5	18
Lincoln	7	7	14
Mapleton	12	2	14
Cambria	10	3	13
Butternut Valley	11	2	13
Medo	11	2	13
Shelby	9	1	10
Vernon Center	5	4	9
Lyra	8	1	9
Danville	4	2	6
Ceresco	2	1	3
Pleasant Mound	2	1	3

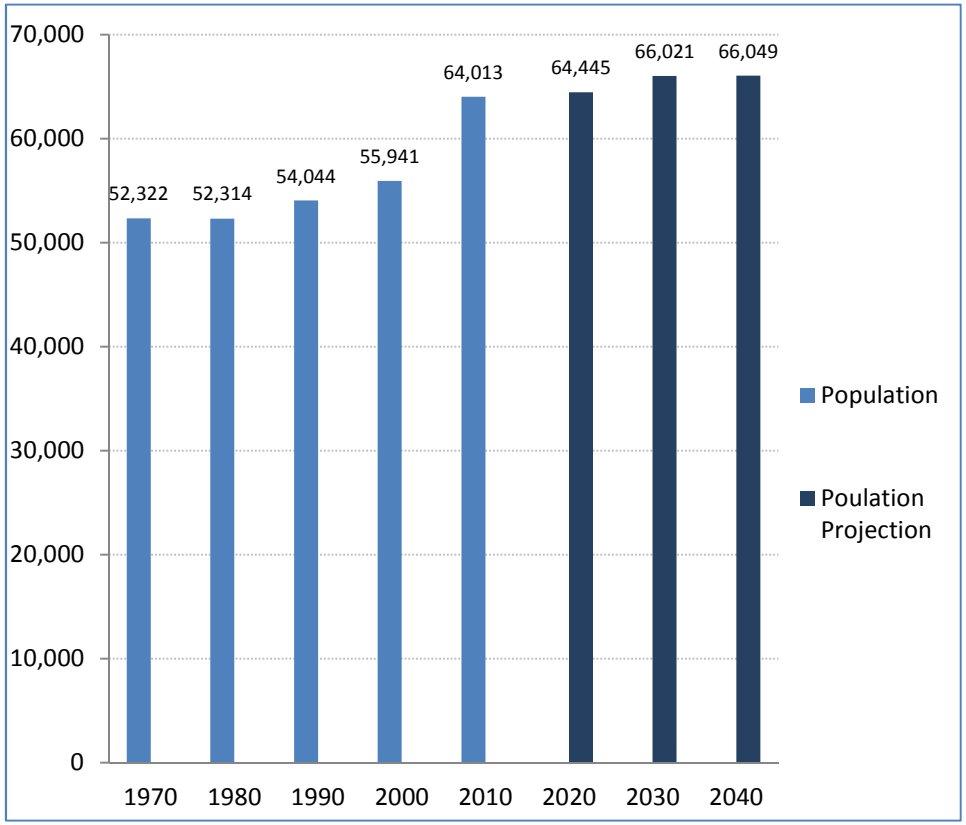
Population Projections

The Minnesota Demographic Data Center projects the county population to continue to grow, but at a slower rate than since 2000 and then become relatively stable. Their projections completed in 2014 projected that the county population would be 64,445 by the year 2020. A year later in 2015, the Demographic Data Center released their population estimates which showed the 2014 county population was estimated to have already exceeded the 2020 projected population. The 2014 estimate for the county population was 66,179. However, the average annual rate of growth has slowed as the Demographic Date Center Projections showed.

Blue Earth County Population and Population Projection

Source: U.S. Census – 1970 to 2010 population

Minnesota Demographic Center – 2020 to 2040 population projections (2014)



Physical Characteristics

Blue Earth County is located in South Central Minnesota, at the bend in the Minnesota River. Natural features, such as lakes and rivers, play a significant role in the county's development patterns, land management and conservation. The Minnesota River forms part of the county's northern border and is one of the county's most important features. Approximately 99 percent of the county is located within the Minnesota River Basin.

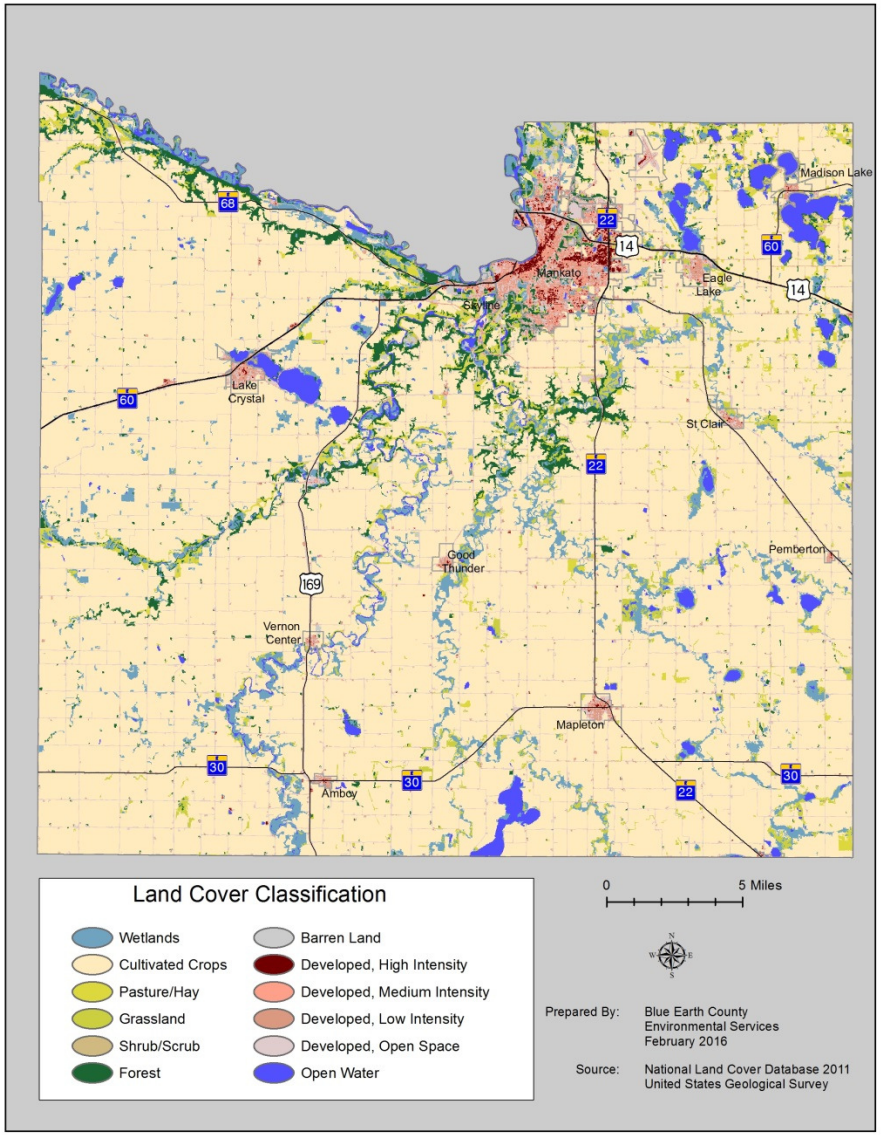
The relief of Blue Earth County is the product of a back-wasting continental glacier. Steep slopes and bluffs are common along the county's many deeply-incised river systems which developed during the retreat of the glacier. Most of the county ranges from nearly level on the lake plain and on ground moraines to rolling where the end moraines form a complex pattern. In areas where there were scattered ice block depressions, a few large lakes formed. There are also many small depressions throughout the county. Secondary drainage in much of the county is immature, and like much of southern Minnesota, the county has an extensive agricultural drainage system of open ditches and subsurface drainage tile.

Land Use and Land Cover

Blue Earth County's landscape is dominated by agricultural land uses. The map to the right displays the land cover data from the most recently available 2011 National Land Cover Database which classifies land cover from the 2011 Landsat satellite data. Over 75-percent of the County was classified as cultivated crops in 2011. The various classes of developed land represented 8.3 percent of land in the County in 2011. Land classified as wetlands were 5.5 percent. Forests, mostly along the steep slopes adjacent to the rivers, represented just over three percent of the county. The Figure to the right displays the percentage of each type of land cover classification.

Although a comprehensive land use analysis in the county has not been done, observable changes in land use have occurred. In

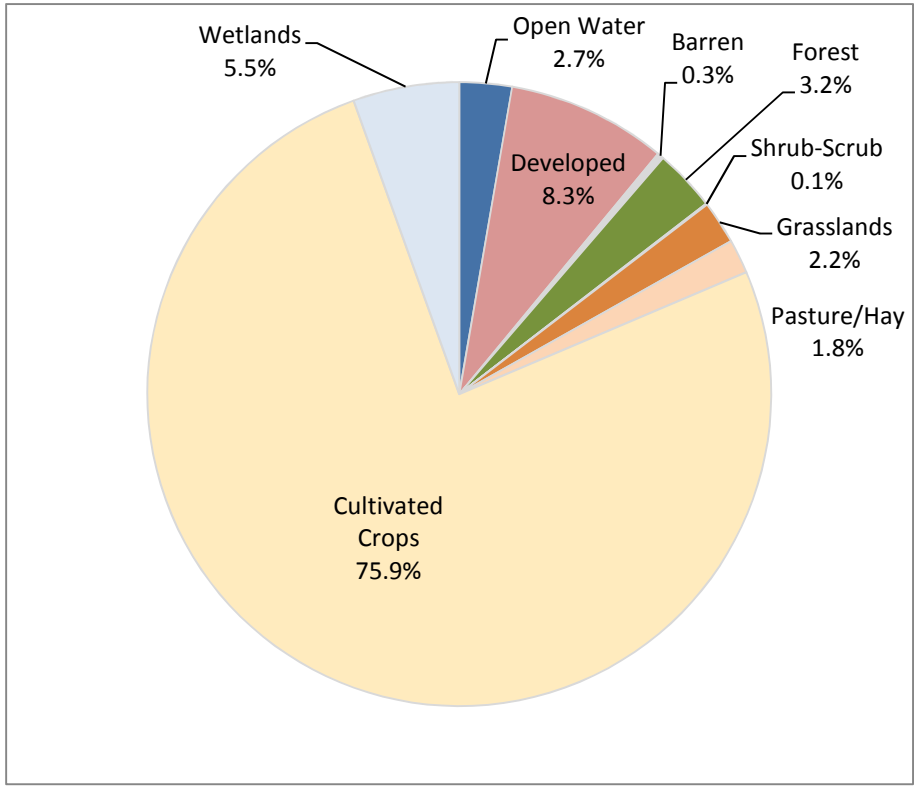
2011 Land Cover



Mankato, for example, there has been a great deal of residential, commercial, and industrial growth. In the smaller cities like Eagle Lake, Madison Lake, and Lake Crystal there has been residential growth. Much of this development involves permanent conversion of agricultural land. Rural residential growth has slowed since the 1990's

as the County's land use policies were revised to prevent scattered, residential development and preserve agricultural and environmentally sensitive land. Agricultural changes have also occurred since the early 1990's. The animal agriculture industry, primarily hog feedlots, has continued to grow in Blue Earth County.

2011 Blue Earth County Land Use Classifications from 2011 National Land Cover Database



Watersheds

More than 99 percent of Blue Earth County is located in the Minnesota River Basin. Two-square miles in the northeast corner of the county drains east to the Cannon River watershed. A Minnesota River Basin watershed map and map of major watersheds are displayed on the following pages.

Most of the county is in four of the 13 major watersheds in the Minnesota River Basin: Blue Earth, Le Sueur, Watonwan and Middle Minnesota. The confluences of all four rivers are in Blue Earth County. The Le Sueur River and Watonwan River are tributaries of the Blue Earth River. The confluence of the Blue Earth River and its 3,133 acre watershed with the Minnesota River is in the City of Mankato in Blue Earth County. When combined, the Blue Earth, Le Sueur and Watonwan rivers (also referred to as the Greater Blue Earth River) covers more than 75% of the County's total land area.

Of the four watersheds in the county, the Le Sueur occupies the largest percentage of land in the county (48%). The Le Sueur River watershed contains a number of relatively large tributary streams including the Maple River, Cobb River, Little Cobb River, and Rice Creek.

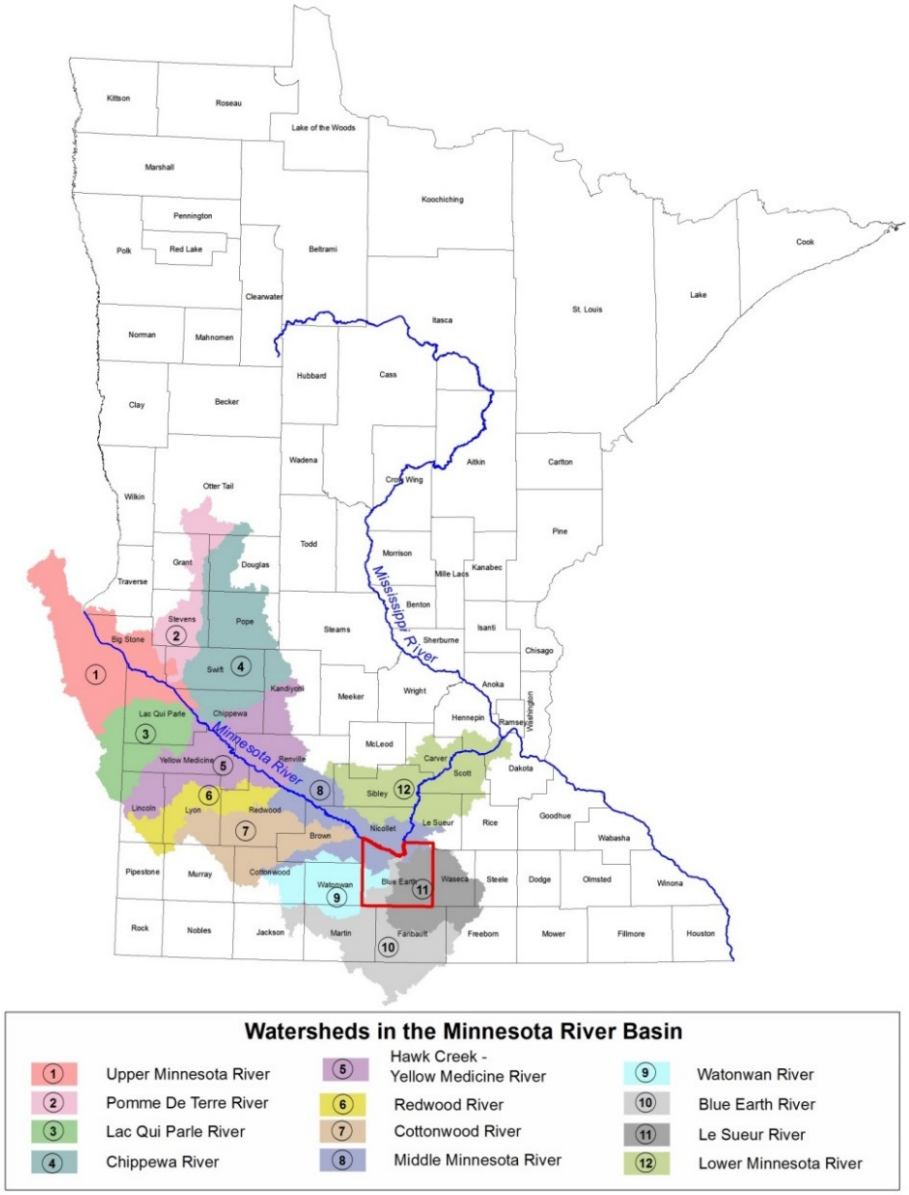
The Middle Minnesota River Watershed contains first order streams discharging directly to the Minnesota River. Minneopa Creek, Indian Creek, Morgan Creek and many unnamed streams make up the Middle Minnesota River watershed in the county. Most of the recreational lakes in the county are in the Middle Minnesota River Watershed.

The portion of the county in each of the four watersheds and the portion of each watershed in the county is shown in the table below.

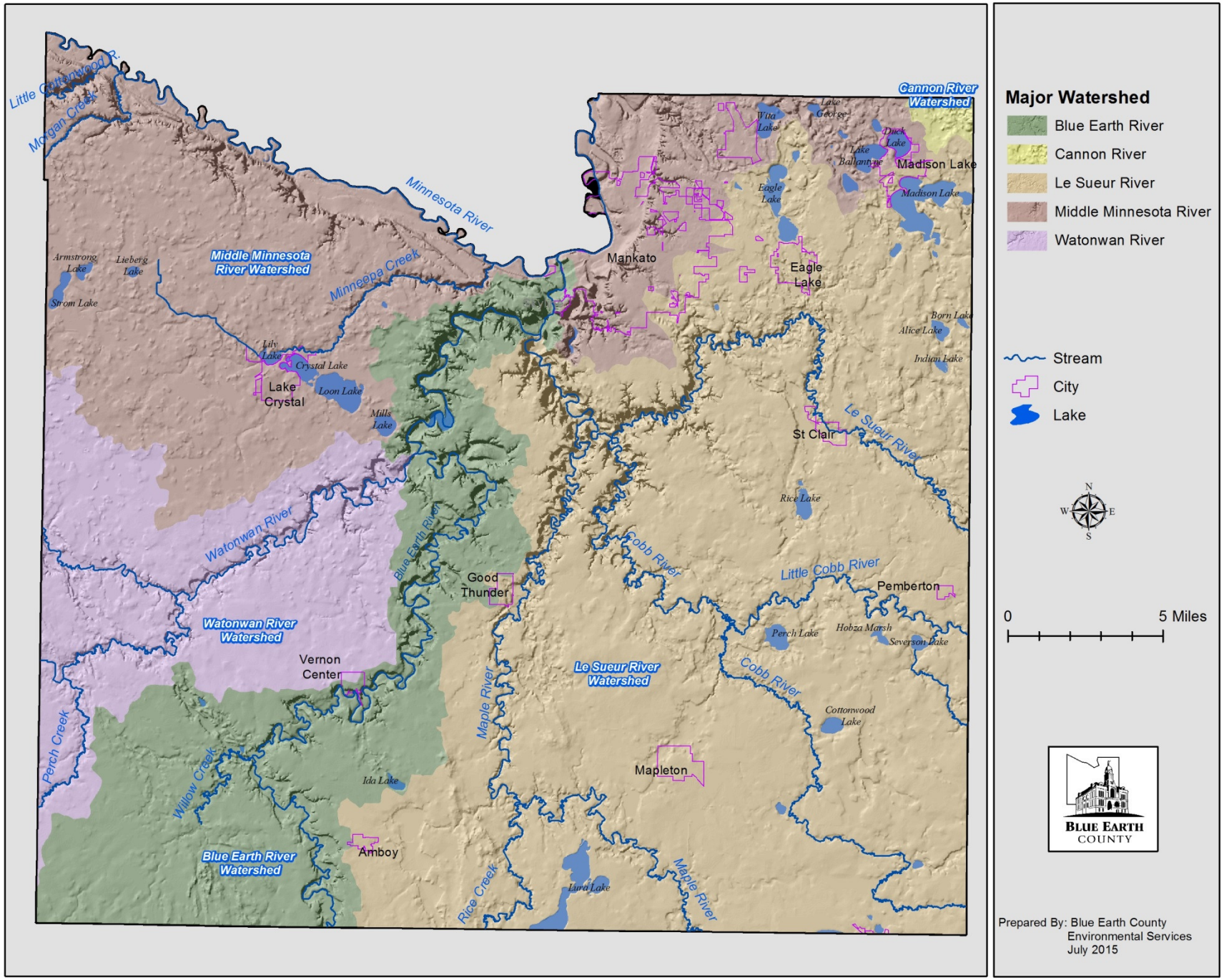
Comparison of Major Watersheds

Watershed	Total Square Miles	Square Miles in Blue Earth County	Land Coverage In Blue Earth County For Each Watershed	Percentage of Watershed in Blue Earth County
Blue Earth River	1,205	124	16.2%	10.2%
Le Sueur River	1,078	368	48.1%	34.1%
Middle Minnesota River	1,385	178	23.3%	12.8%
Watonwan River	850	93	12.2%	10.9%
Cannon River	1,482	2	0.2%	0.1%

Major watersheds comprising the Minnesota River Basin.



Major Watersheds - Blue Earth County

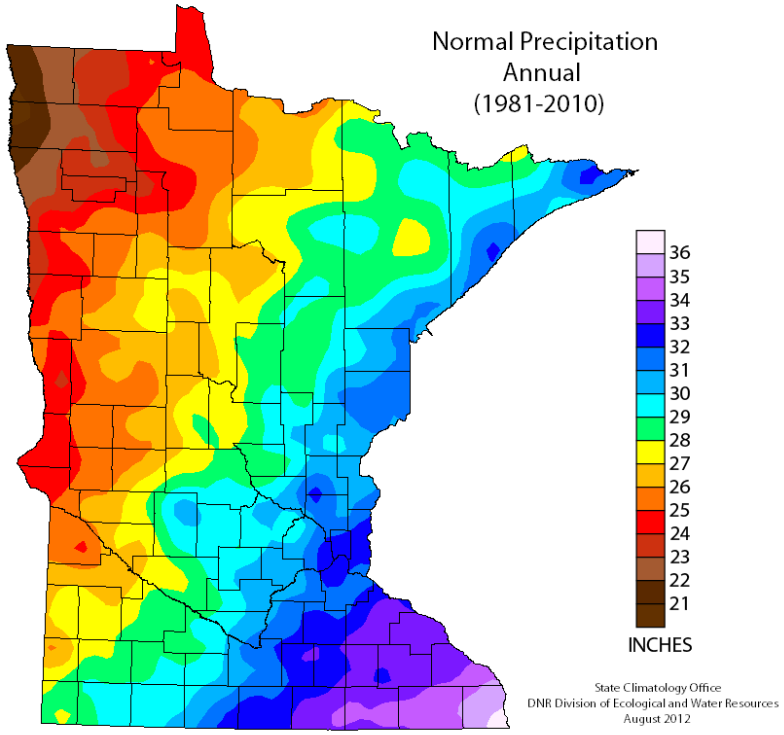


Precipitation and Climate Patterns

The normal annual precipitation in the county is between 30-inches in the western third of the county and 32-inches in the eastern corner of the county. The map to the right from the State Climatology Office displays the normal annual precipitation for Minnesota for the time period of 1981 to 2010. In the previous thirty-year time period of 1951 to 1980, the annual precipitation for the County was in the 27 to 29-inch range.

While total precipitation is important, the timing, frequency, duration, and amount of the precipitation are significant locally for industries like agriculture and for stormwater management planning purposes. The National Oceanic and Atmospheric Administration's (NOAA) Atlas 14 Precipitation Frequency was updated in 2013. It has replaced the National Weather Service's Technical Paper 40 as the guidelines for processes modelling, planning, engineering, and storm water design.

In Blue Earth County, the greatest changes are for the larger storm events. The 100-year rain event increased by just over 21% to 7.41 inches and the 50-year rain event increased by 16.4% to 6.4 inches. These changes reflect the trend in the region as more rain comes in heavy downpours. According to NOAA, the region has seen a 46-percent increase in heavy rainfall events (rain events of more than 2 inches in 48-hours).

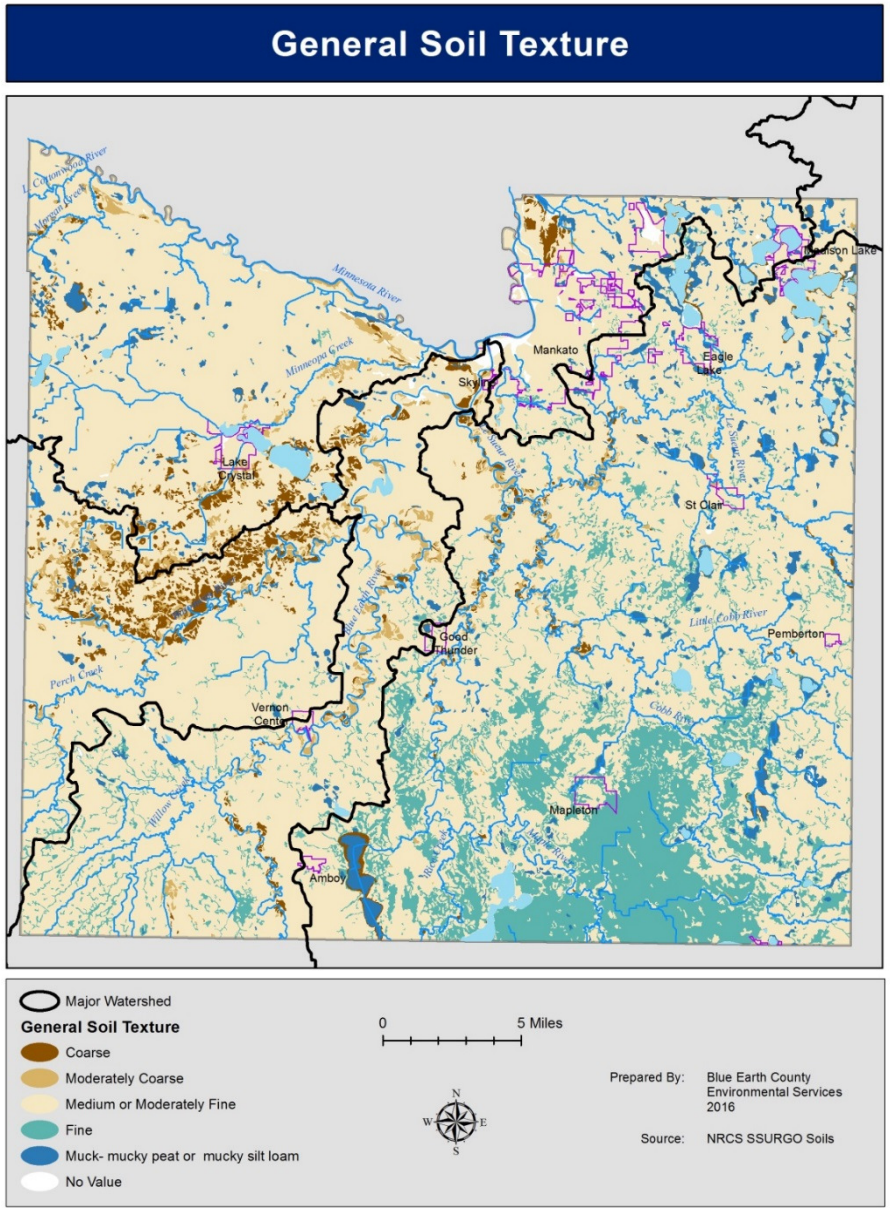


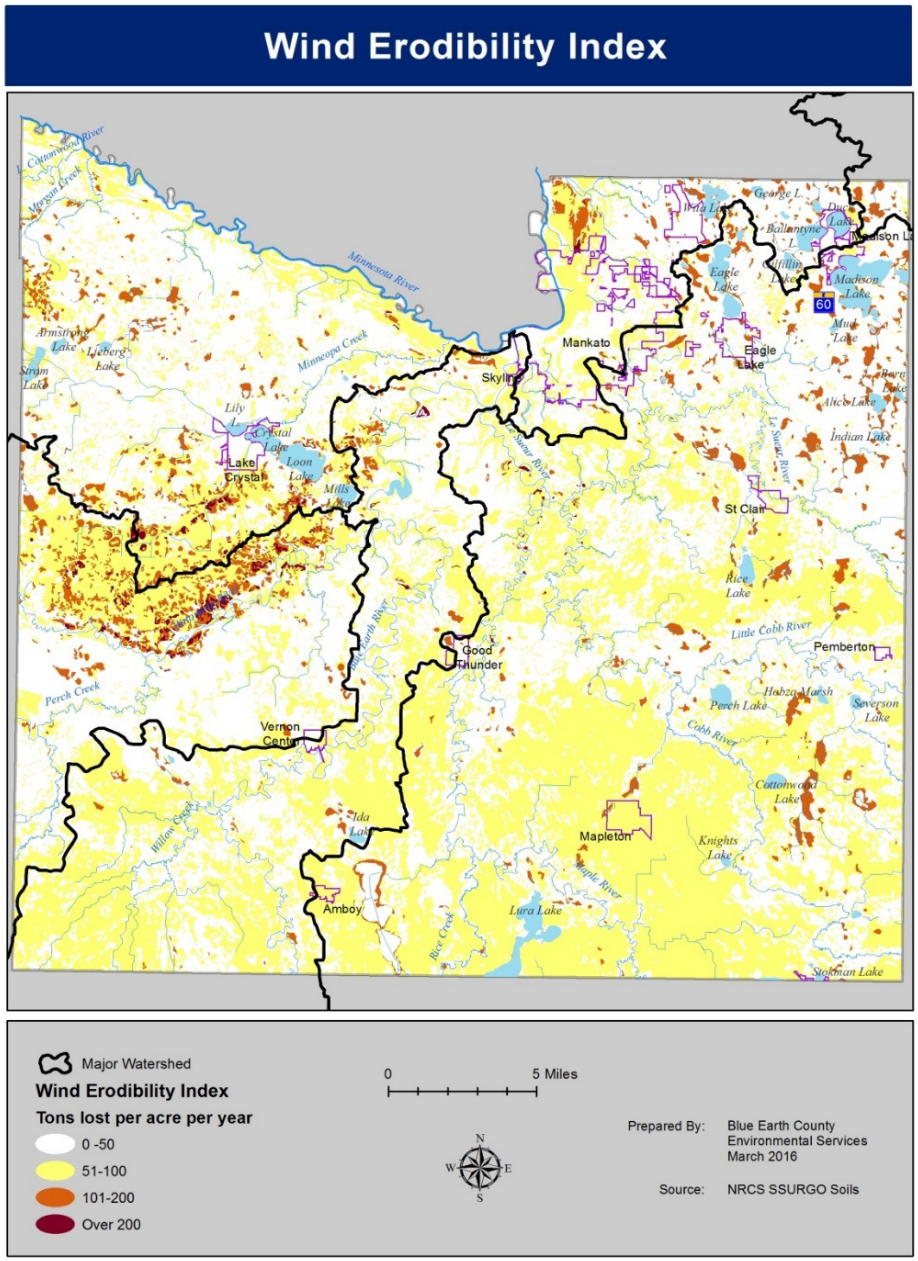
Average Amount and Frequency for 24-Hour Rainfall Events in Blue Earth County

Average Recurrence Interval	Technical Paper 40 (1961) Rainfall Amount (in)	NOAA Atlas 14 (2013) Rainfall Amount (in)	Difference (in)	Percent Change
1-year	2.4	2.51	0.11	4.6%
2-year	2.9	2.92	0.02	0.7%
5-Year	3.7	3.68	-0.02	-0.5%
10-Year	4.3	4.37	0.07	1.6%
25-Year	4.9	5.47	0.57	11.6%
50-Year	5.5	6.4	0.9	16.4%
100-Year	6.1	7.41	1.31	21.5%

General Soil Texture

The map on this page displays the general soil texture of soils in the county.





Wind Erodibility Index

The map on this page displays the wind erodibility index of soils in the county.

The USDA Soil Survey definition of Wind Erodibility Index:

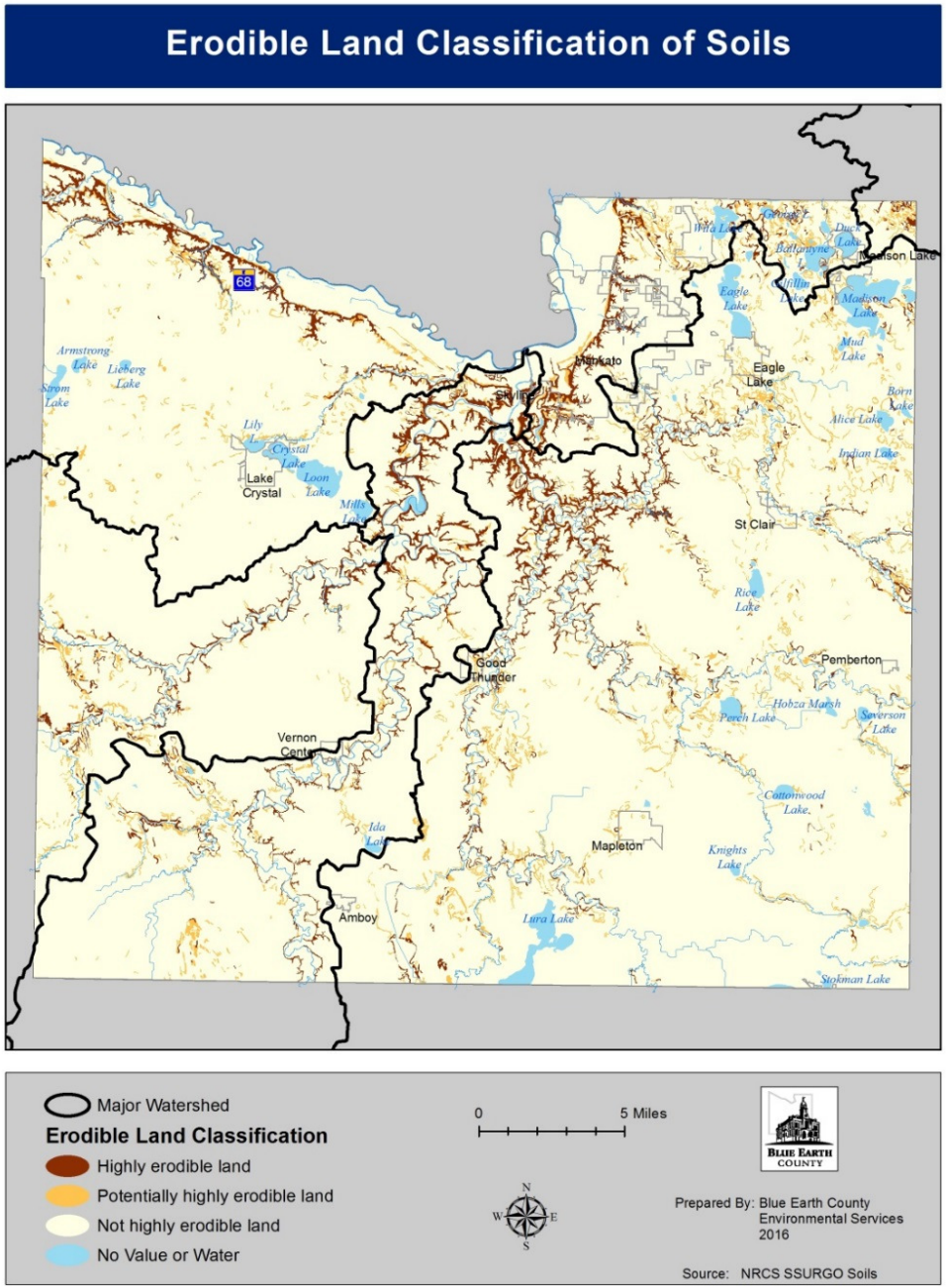
> "The wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion."

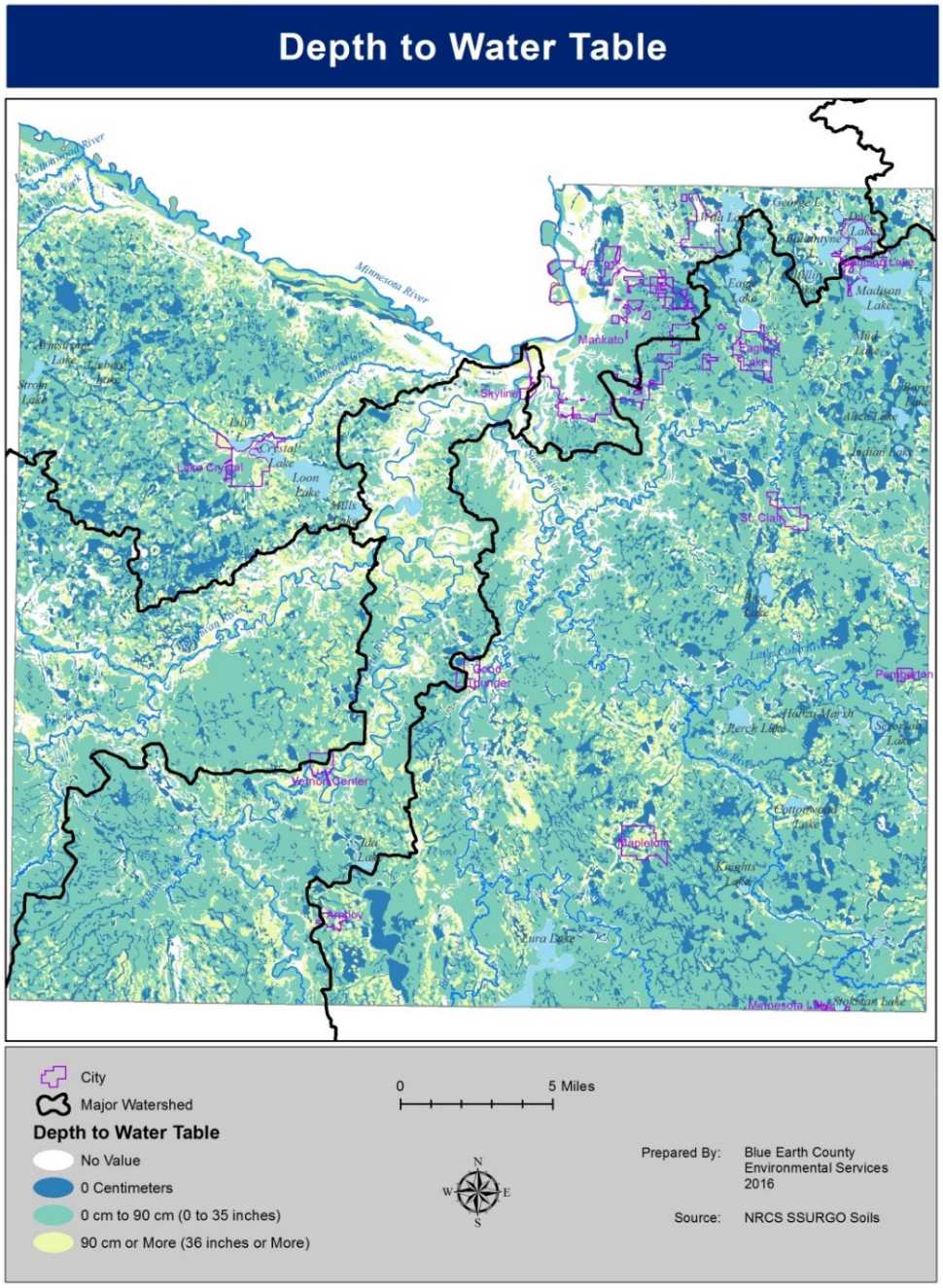
Erodible Land Classification of Soils

The map on this page displays the erodible land classification of soils in the county.

Just over 7-percent of the land in the County is considered highly erodible land or potentially highly erodible land.

> "Highly erodible land (HEL) is cropland, hayland or pasture that can erode at excessive rates. It would contain soils that have an erodibility index of eight or more. If a producer has a field identified as highly erodible land, that producer is required to maintain a conservation system of practices that keeps erosion rates at a substantial reduction of soil loss. Fields that are determined not to be highly erodible land are not required to maintain a conservation system to reduce erosion." (USDA NRCS)





Depth To Water Table

The map on this page displays the depth to water table of soils in the county.

Just over 88-percent of the county has a depth to water table of 35 inches or less according the to the USDA Soil Survey.

The USDA NRCS Soil Survey describes the water table:

> "Water table refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphicfeatures) in the soil. A saturated zone that lasts for less than a month is not considered a water table."

Hydrologic Soil Group

The hydrologic soil groups in the county are displayed on this page.

The USDA Soil Survey explains Hydrologic Soil Groups:

"Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

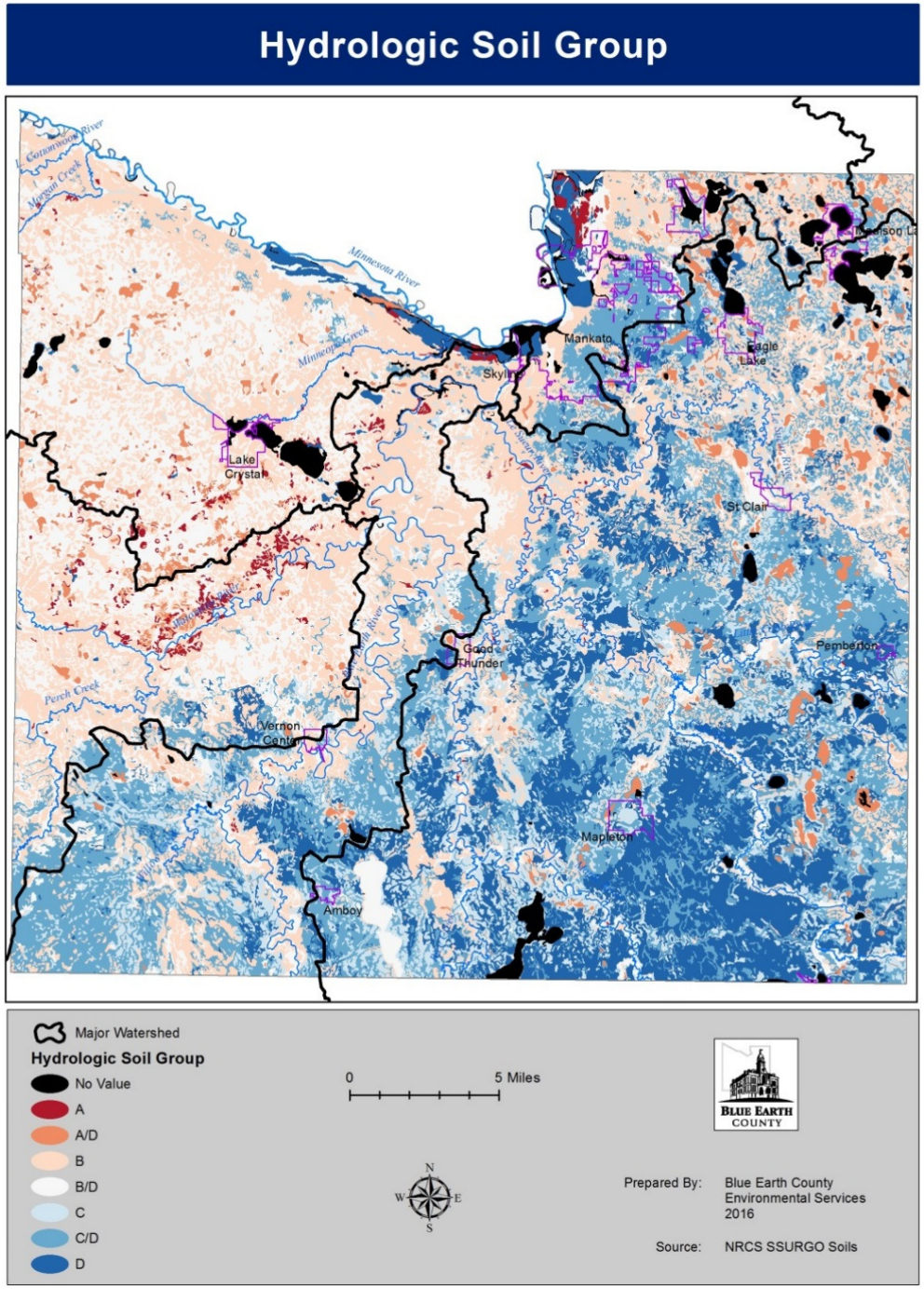
Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

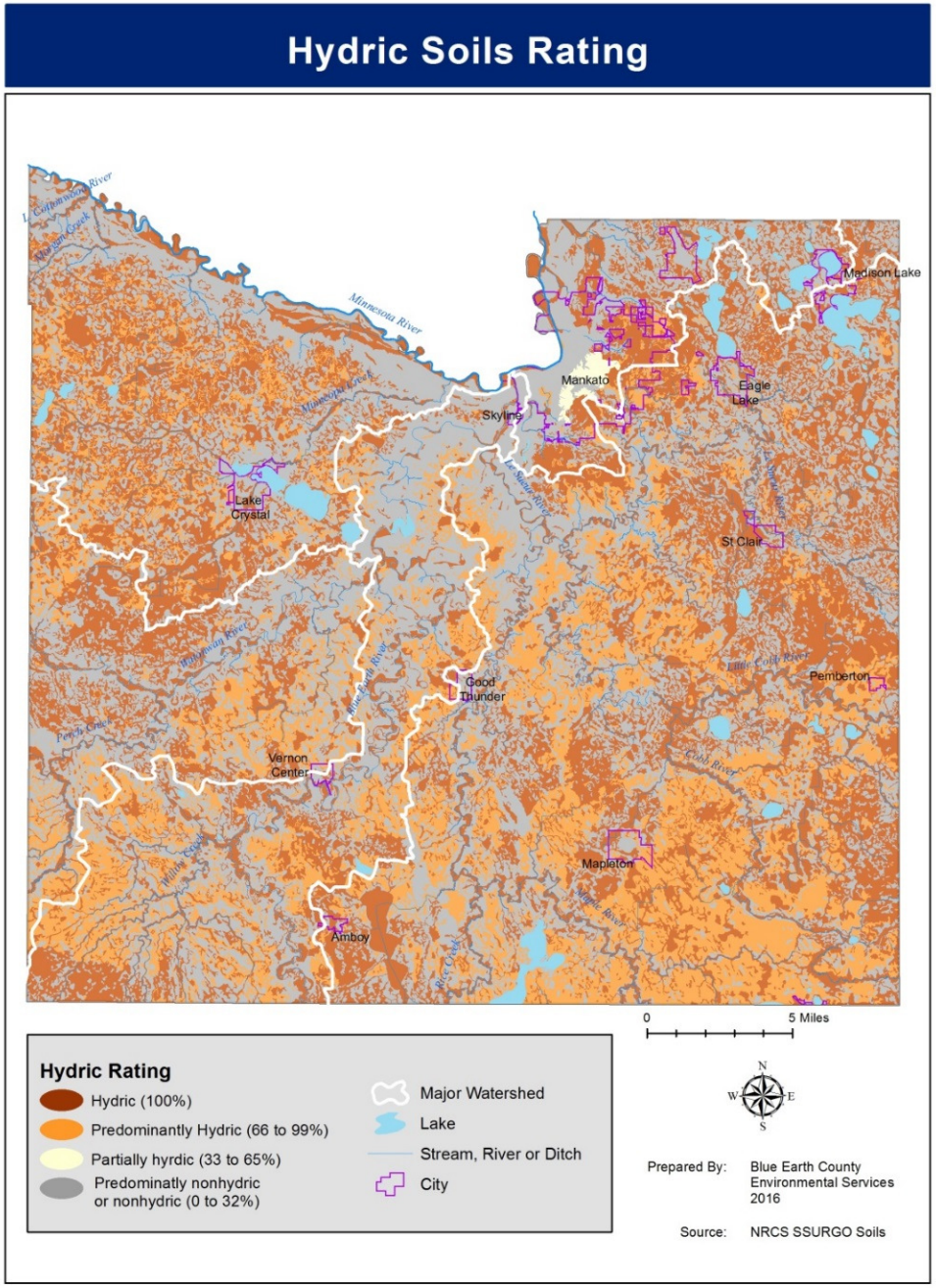
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes."





Hydric Soils Rating

The map on this page displays the hydric soils rating in the county.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as:

"soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation. The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria that identify those estimated soil properties unique to hydric soils have been established (Federal Register, 2002). These criteria are used to identify map unit components that normally are associated with wetlands. "

The USDA Soil Survey describes the hydric soils rating:

"This rating indicates the percentage of map units that meets the criteria for hydric soils. Map units are composed of one or more map unit components or soil types, each of which is rated as hydric soil or not hydric. Map units that are made up dominantly of hydric soils may have small areas of minor nonhydric components in the higher positions on the landform, and map units that are made up dominantly of nonhydric soils may have small areas of minor hydric components in the lower positions on the landform. Each map unit is rated based on its respective components and the percentage of each component within the map unit."

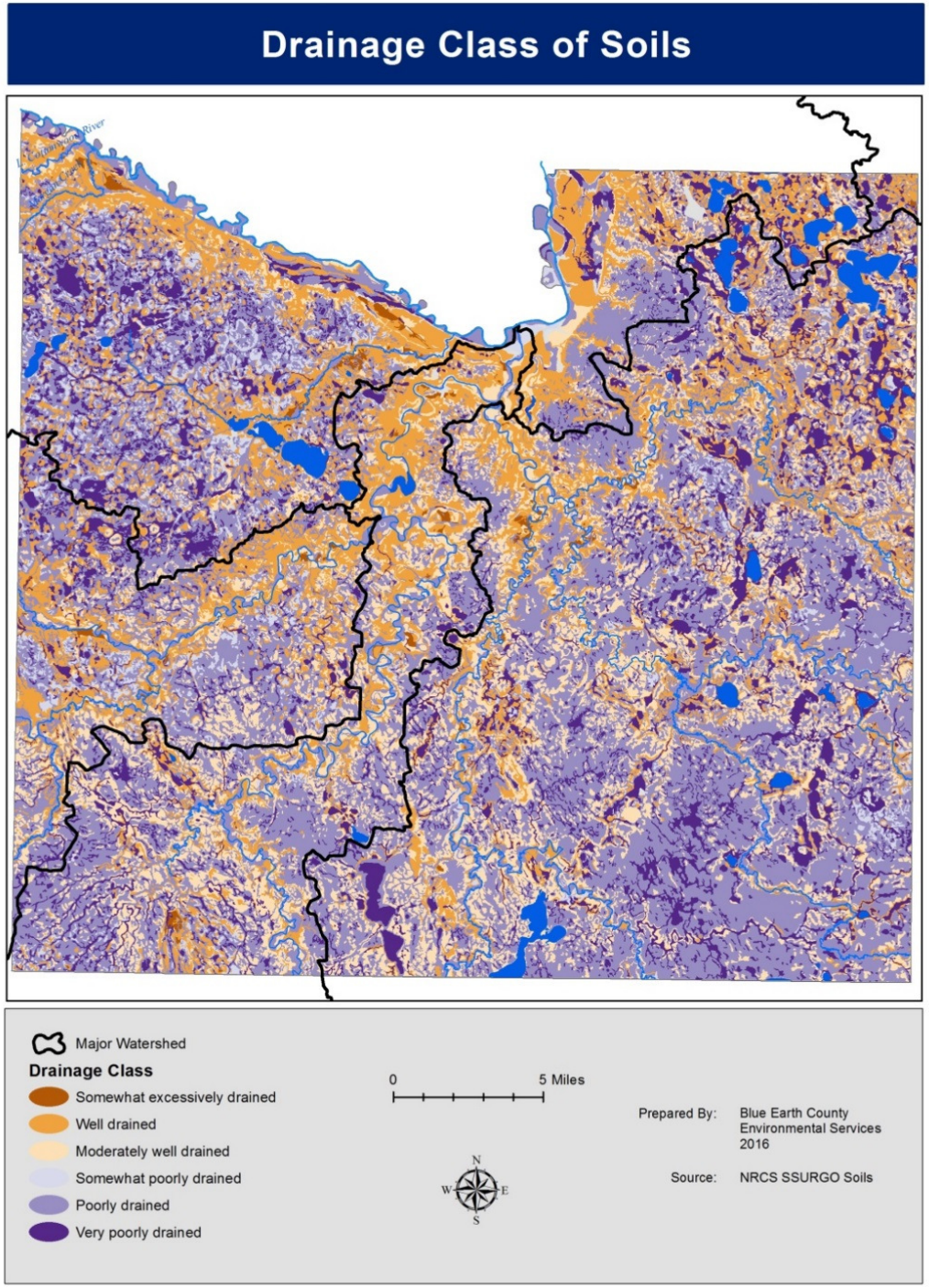
Drainage Class

The map on this page shows the drainage class of soils in the county.

Over 56-percent of the county has either poorly drained or verly poorly drained soils.

The USDA Soil Survey explains the drainage class of soils:

"Drainage class (natural)" refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil."



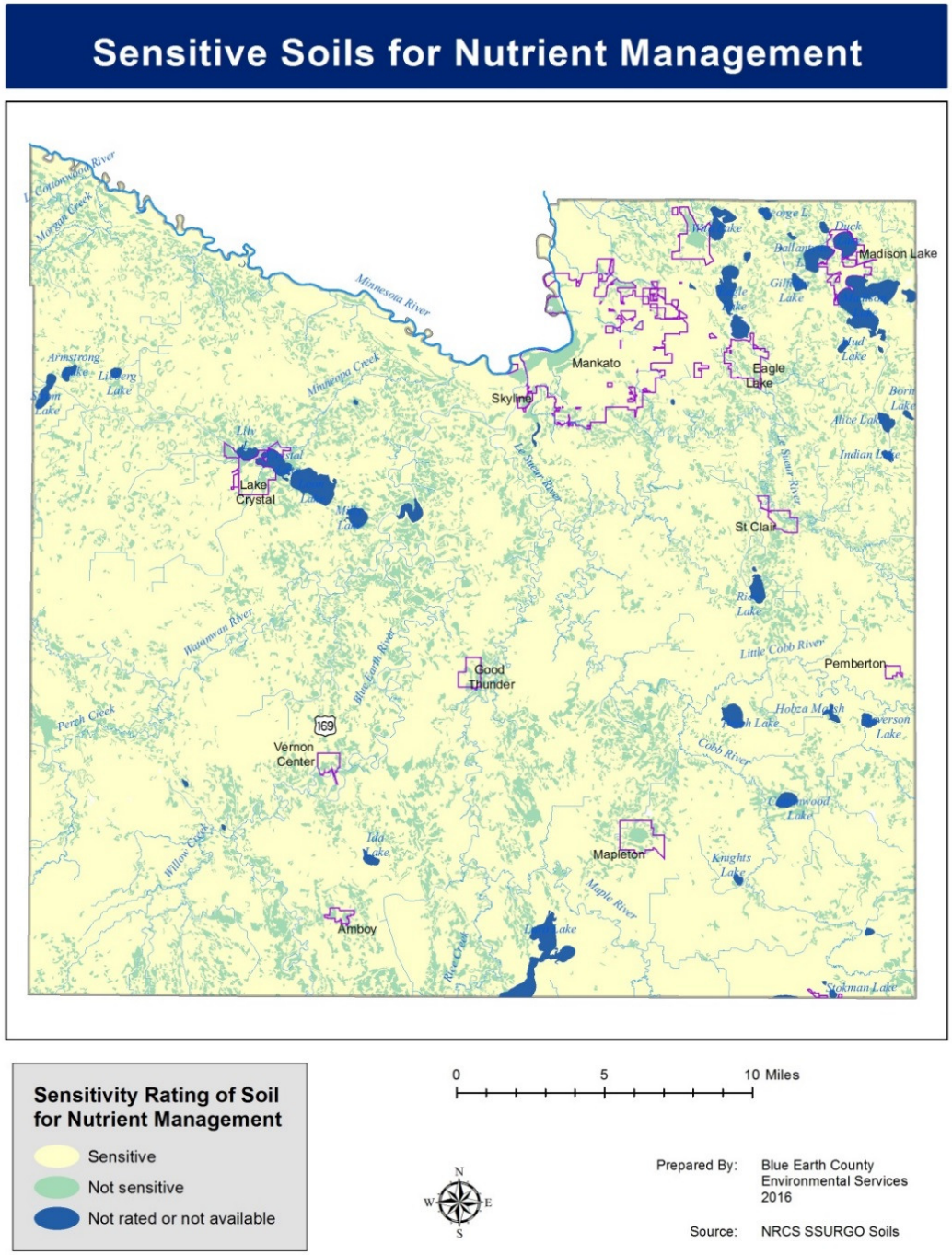
Sensitive Soils For Nutrient Management

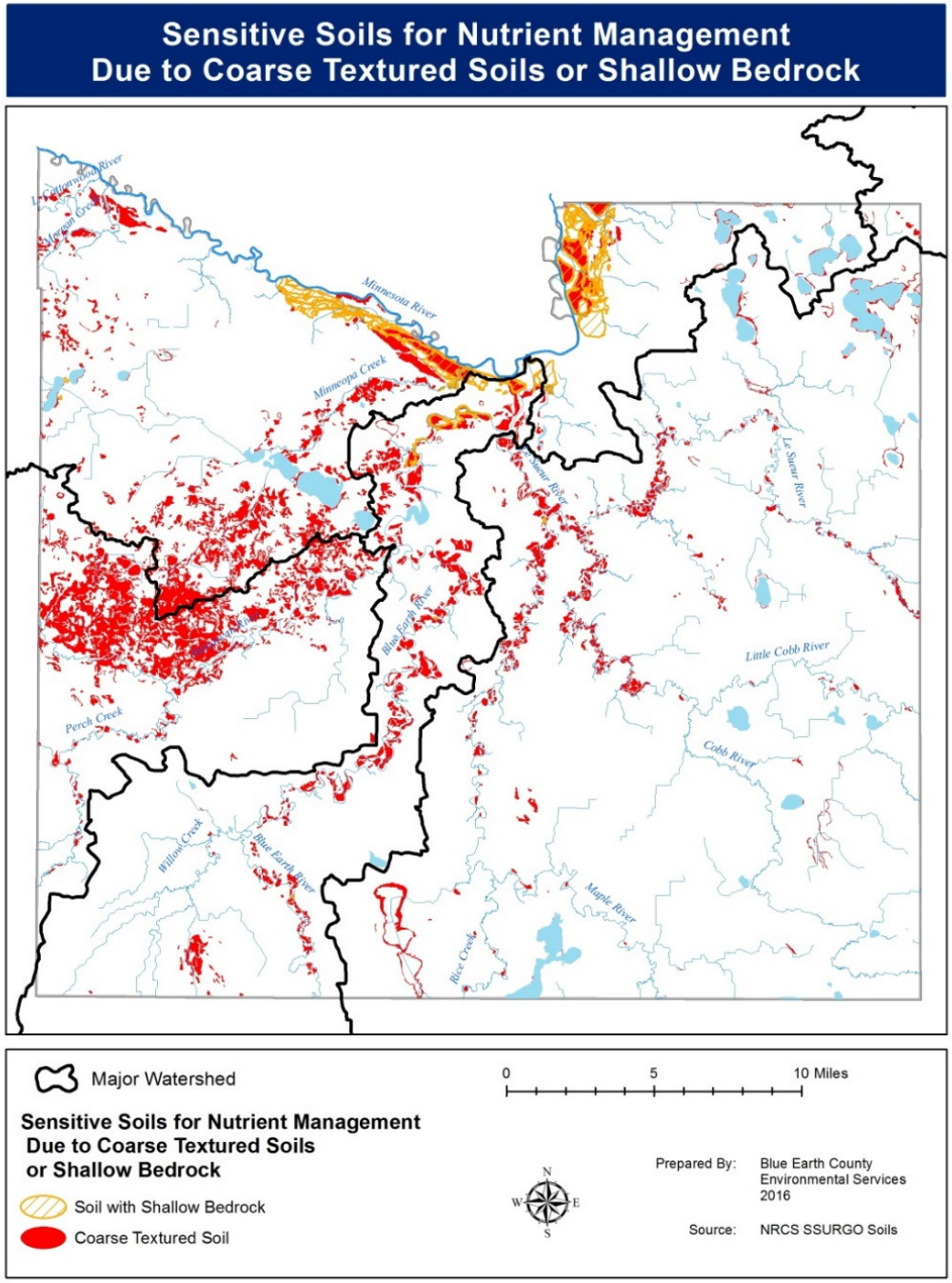
The map on this page displays the sensitivity rating of soils in the county for nutrient management for all of the categories.

Over 83-percent of the soils in the County are considered sensitive for nutrient management.

The USDA Soil Survey explains the soil sensitivity rating:

"This interpretation generates a soil sensitivity rating for nutrient management planning in Minnesota. Nutrient management plans are developed using the sensitive soil ratings classes. NRCS Conservation Practice Standard Nutrient Management (590) discusses nutrient management practices that should be used when sensitive soils are encountered. Careful planning is needed if manure or commercial fertilizers are applied. The physical properties and limitations of these soils can result in the leaching of nutrients downward beyond the root zone or the movement of nutrients toward surface waters. The ratings are based on physical properties of the soils and on soil features. Soils that are sensitive to nutrient applications include soils on flood plains, coarse textured soils, soils that are shallow to bedrock, soils that have a high water table, soils that are ponded, and sloping soils."





Sensitive Soils For Nutrient Management due to Coarse Textured Soils or Shallow Bedrock

The map on this page displays sensitive soils for nutrient management based on depth to bedrock or coarse textured soils in the county.

The USDA NRCS explains the importance of the soil sensitivity rating and nutrient management:

"This interpretation generates a soil sensitivity rating for nutrient management planning in Minnesota. Nutrient management plans are developed using the sensitive soil ratings classes. NRCS Conservation Practice Standard Nutrient Management (590) discusses nutrient management practices that should be used when sensitive soils are encountered. Careful planning is needed if manure or commercial fertilizers are applied. The physical properties and limitations of these soils can result in the leaching of nutrients downward beyond the root zone or the movement of nutrients toward surface waters."

Groundwater Pollution Sensitivity

Information about geology, groundwater pollution sensitivity and groundwater recharge for the county was recently updated in two parts. The MNDNR completed the *Geologic Atlas of Blue Earth County, Part B*, in 2016. The introduction of the atlas describes its purpose and general overview of pollution sensitivity in the county.

The purpose of this atlas is to help citizens and local governments understand the geologic setting and inherent pollution sensitivity of the aquifers in the county. This information can then potentially be used to make land-use decisions that take aquifer sensitivity, water quality, and sustainability into account. Protecting the quality and quantity of all groundwater ensures long-term access."

The focus of the atlas is the pollution sensitivity assessment in Blue Earth County for the water-table aquifer, seven buried sand aquifers, and the uppermost bedrock aquifers. Pollution sensitivity is defined by the physical properties that affect downward migration of pollutants to the groundwater. The main variable is the rate that water travels from the surface to the aquifers.

The pollution sensitivity evaluations indicated that the water table, at an assumed depth of 10 feet below ground surface, generally had slow infiltration rates (weeks to a year) in the eastern and southern portions of the county resulting in low to very low pollution sensitivity ratings.

The northwestern portion of the county is higher and results in moderate to high sensitivity where sandy sediment is common at the surface.

The major river valleys in the northern portion of the county (Watonwan, Blue Earth, Le Sueur, Maple, and Minnesota) showed moderate to very high sensitivity rating (pollutant infiltration rate–decades to hours) for most of the aquifers.

The majority of the buried aquifers had low or very low sensitivity, with the exceptions of some shallowly buried portions.

The majority of the buried aquifers, ranging in depths from approximately 50 to 200 feet below ground surface, were interpreted to have generally low or very low sensitivity ratings with an interpreted vertical travel rate of a pollutant from decades to centuries or more.

Water appropriation data showed that municipalities primarily pump from deep bedrock aquifers. The shallower water-table aquifer is used by some Minnesota River valley communities, but its primary value is to support surface water bodies.

The isotopic ratios characteristic of surface water were detected for long distances (approximately 8 miles) down gradient of Madison Lake suggesting a significant connection between the lake and the underlying aquifer system.

Detailed information about geology and groundwater are available in the *Geologic Atlas of Blue Earth County*, *Minnesota* Part A and Part B.

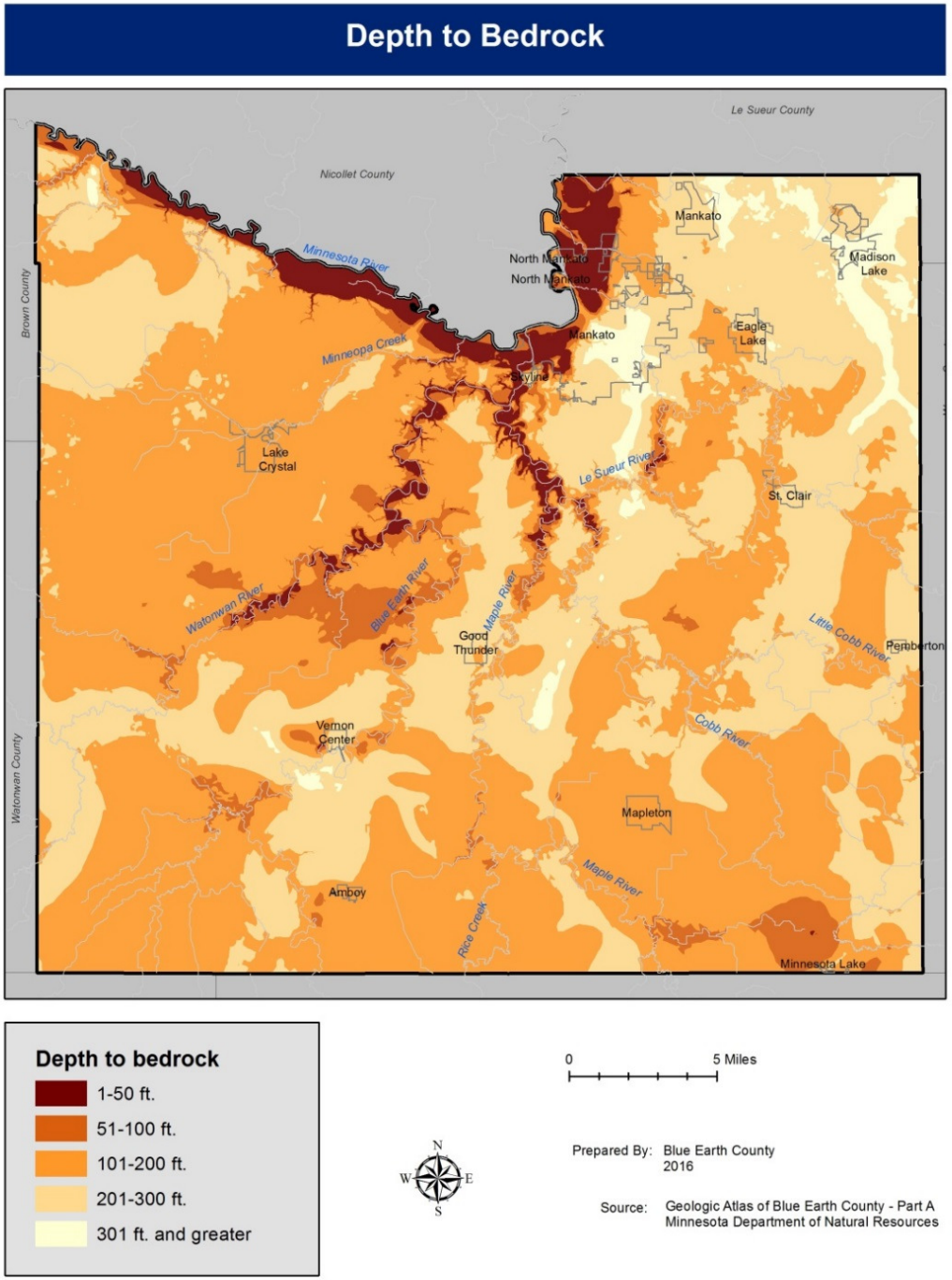
Maps on the following pages show depth to pollution sensitivity for bedrock surfaces, near surface materials and buried sands using data from *Geologic Atlas of Blue Earth County, Part B*.

Depth to Bedrock

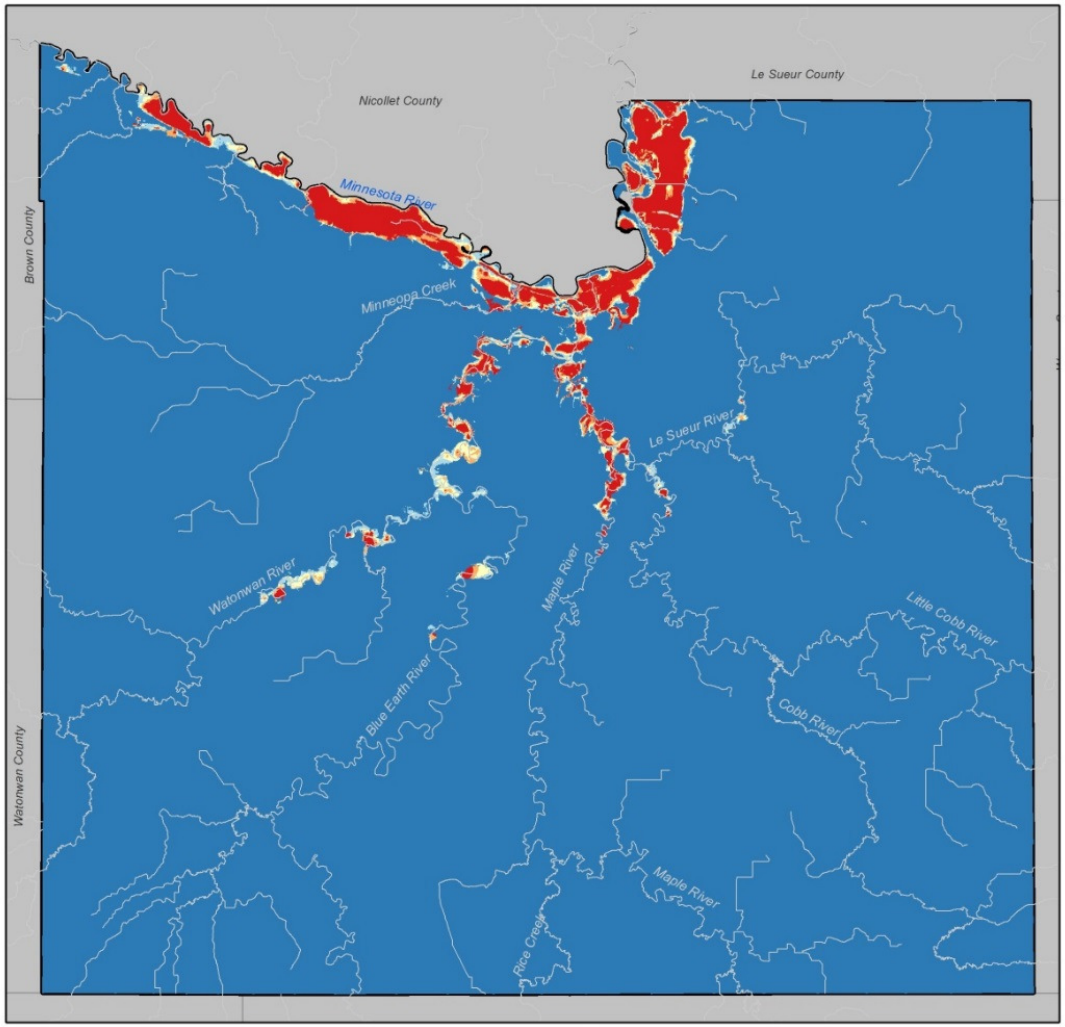
The map on this page diplays the depth to bedrock as shown in the *Geologic Atlas of Blue Earth County*, *Part A.*

The areas with the shallowest depth to bedrock are along the Minnesota River Valley and its major tributaries such as the Blue Earth, Le Sueur River, Watonwan Rivers. The majority of the County has a depth to bedrock of over 51-feet.

Areas with a depth to bedrock of 50-feet or less have the highest pollution sensitivy as shown on the following page.



Pollution Sensitivity of the Bedrock Surface



Pollution Sensitivity Rating:Estimated vertical travel time for water-borne contaminants to enter a bedrock aquifer

- Very High: hours to months
- High: weeks to years
- Moderate: years to decades
- Low: decades to a century
- Very Low: a century or more

N

0 5 Miles

Prepared By: Blue Earth County 2016

Source: Geologic Atlas of Blue Earth County - Part B Minnesota Department of Natural Resources 2016

Pollution Sensitivity of the Bedrock Surface

The map to the left displays the pollution sensitivity of the bedrock surface. For most of the county the bedrock surface has very low pollution sensitivity. The Minnesota River valley and the major river valleys in the County has areas with thehighest pollution sensitivity of the bedrock surface.

The *Geologic Atlas of Blue Earth County Part B* describes the pollution sensitivity of bedrock aquifers:

"The pollution sensitivity modeling process for buried aquifers provides a qualitative evaluation of recharge rate or flow of surface water into deeper aquifers. This, along with the flow direction (indicated by the potentiometric surface contours), gives a good indication of areas at the surface that are worthy of protection.

The travel times to buried aquifers vary from days to thousands of years. Areas with relatively short travel times of less than a few years are rated high or very high pollution sensitivity. Areas with estimated travel times of decades or longer are rated low or very low pollution sensitivity."

Pollution Sensitivity of Near Surface Materials

The map on this page shows the pollution sensitivity and combined travel time for soil and surfical geologic sediment.

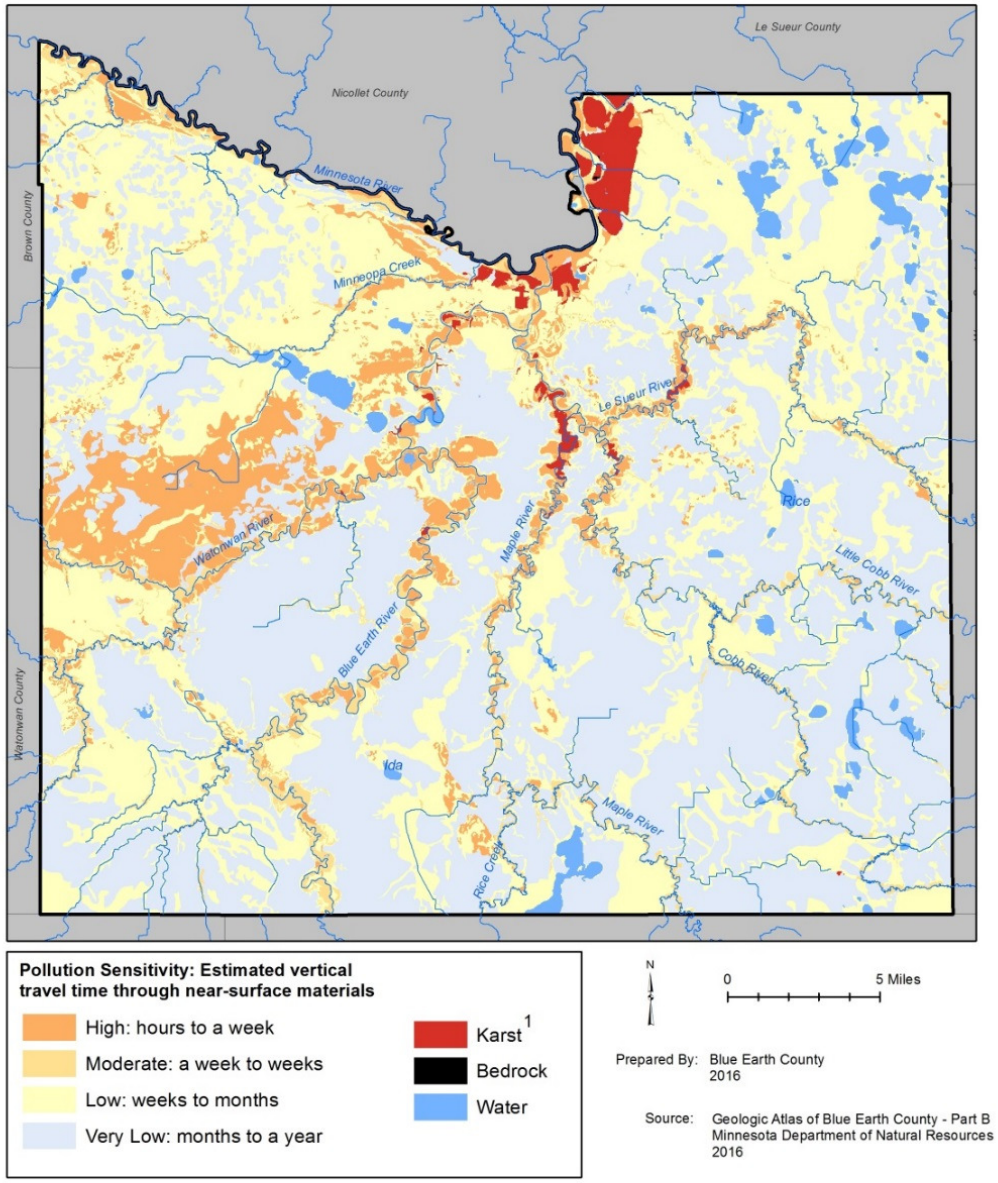
The *Geologic Atlas of Blue Earth County Part B* describes pollution sensitivity in some areas of the county:

- "The slower infiltration rates (low to very low pollution sensitivity) are common in the eastern and southern portions of the county. The exceptions are the larger stream valleys where sandier sediment and soil are present.
- Higher infiltration rates (moderate to high pollution sensitivity) occur in the northwestern portion of the county where sandier soil and sediment are common at the surface.
- Potentially very high infiltration rates (karst) exist in portions of the Minnesota, Blue Earth, Watonwan, Maple, Le Sueur, and Cobb river valleys."

The *Geologic Atlas of Blue Earth County Part B* explains geologic sensitvity as follows:

"Migration of contaminants dissolved in water through unsaturated and saturated sediments is a complex process. Because of this, large-scale assessments of pollution sensitivity require some generalizing assumptions. The rate that fluids travel from the surface to the aquifers is the main variable that affects the sensitivity of aquifers to pollution. Geologic sensitivity is defined by the physical properties and hydrologic controls that affect the ability of sediment to restrict the downward migration of pollutants to the groundwater of interest. In general, coarse-textured sediment have short travel times and high sensitivity ratings, whereas fine-textured sediment have longer travel times and low sensitivity ratings."

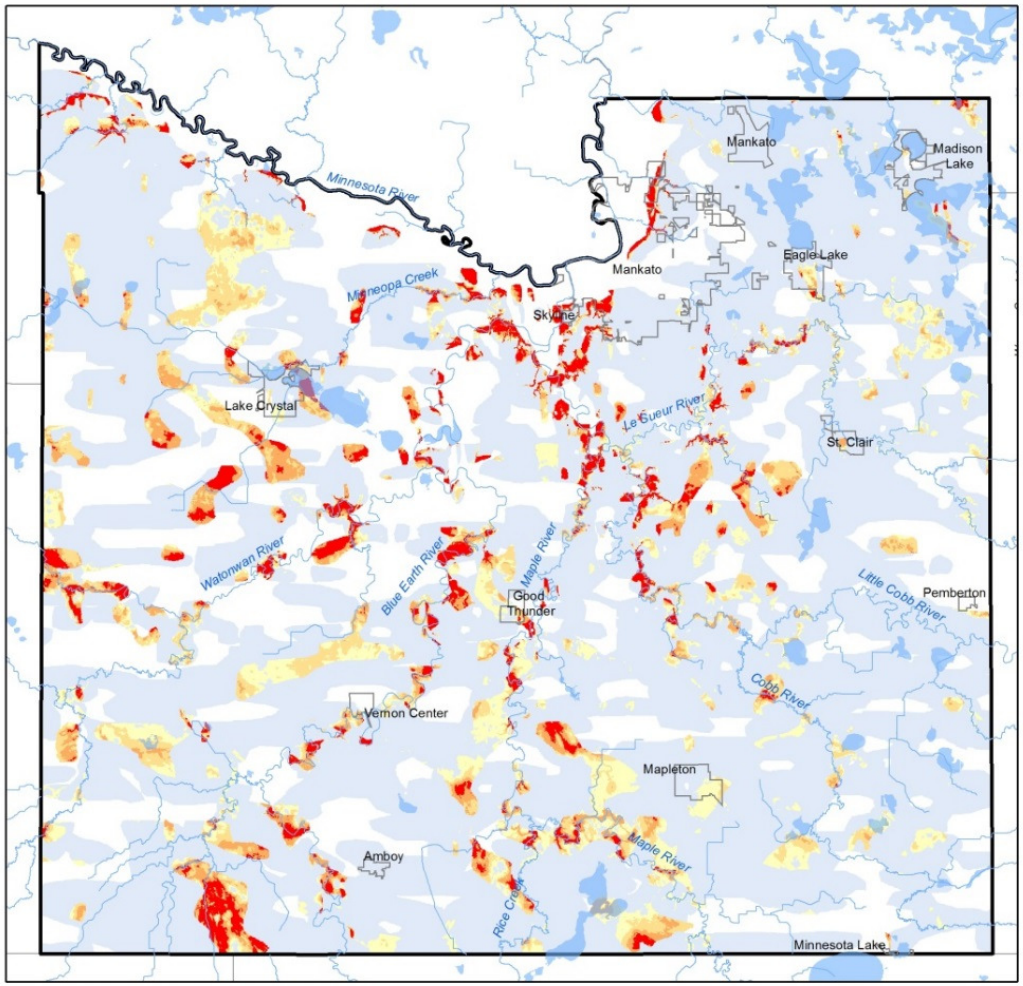
Pollution Sensitivity of Near-Surface Materials



1 Karst allows a direct, very rapid exchange between surface water and groundwater and significantly increases groundwater contamination risk from surface pollutants.

This pollution sensitivity model assumes a 10-foot-deep water table and vertical travel of possible pollutants through unsaturated, near-surface materials.

Pollution Sensitivity of Buried Sand Aquifers



Pollution Sensitivity: Estimated vertical travel time for water-borne contaminants to enter a buried sand aquifer

- Very High: Hours to Months
- High: Months to Years
- Moderate: Years to Decades
- Low: Decades to a Century
- Very Low: A Century or More

0 5 Miles

Prepared By: Blue Earth County 2016

Source: Geologic Atlas of Blue Earth County - Part B Minnesota Department of Natural Resources 2016

This map shows a compilation of the pollution sensitivity maps on pages 42-47 of the Geologic Atlas of Blue Earth County, Part B. Pollution sensitivity is defined by the physical properties that affect downward migration of pollutants to the groundwater. The main variable is the rate that water travels from the surface to the aquifers.

Pollution Sensitivity and Recharge for Buried Sand Aquifers

The map on this page shows a compilation of pollution sensitivity of buried sands aquifers maps on pages 42-47 in the *Geologic Atlas of Blue Earth County, Minnesota, Part B*.

"The pollution sensitivity modeling process for buried aquifers provides a qualitative evaluation of recharge rate or flow of surface water into deeper aquifers. This, along with the flow direction (indicated by the potentiometric surface contours), gives a good indication of areas at the surface that are worthy of protection. The travel times to buried aquifers vary from days to thousands of years. Areas with relatively short travel times of less than a few years are rated high or very high pollution sensitivity. Areas with estimated travel times of decades or longer are rated low or very low pollution sensitivity." (*Geologic Atlas of Blue Earth County Part B)*

"Simplifying assumptions used to produce the maps in this atlas are: flow paths are vertical and downward; pollutants move at the same rate as water (advection); and sediment texture, if known, is the primary factor controlling permeability. In confined-aquifer settings the texture and permeability of the aquitards are often unknown but assumed to be fine-grained and low, respectively. Therefore, the thickness of the layers overlying the sensitivity target layer (often an aquifer) is the primary variable affecting the sensitivity rating. The pollution sensitivity models used geologic data provided by the MGS. The model results for seven buried sand aquifers and the bedrock surface were evaluated with residence-time indicators from 116 water samples." (*Geologic Atlas of Blue Earth County Part B)*

Priority Areas for Protection and Restoration

Impaired Waters

Minnesota Water Quality Standards

The Minnesota Pollution Control Agency (MPCA) is responsible for assigning designated uses for water bodies and developing water quality standards to protect designated uses. The designated uses of water bodies in the county are Aquatic Life, Aquatic Recreation, and Aquatic Consumption.

Protection of Aquatic Life means:

- Maintenance of healthy, diverse, and successfully reproducing populations of aquatic organisms,
- Protection of the aquatic community from the direct harmful effects of toxic substances.
- Protection of human and wildlife consumers of fish or other aquatic organisms.

Protection of Aquatic Recreation means:

- Maintenance of conditions suitable for swimming and other forms of recreation.

Aquatic Consumption assesses whether fish can be eaten from a water body without special guidelines. (Excessive mercury in fish tissue is the leading contaminant statewide and is widespread in the County.)

Impaired Waters List

The Impaired Waters List is a list of water bodies and stream reaches that do not meet Minnesota water quality standards to protect lakes, streams and wetlands from pollution (bacteria, nutrients, turbidity, mercury, etc.).

To identify and restore impaired waters, Section 303(d) of the Federal Clean Water Act requires the MPCA to:

- Assess all waters of the state to determine if they meet water quality standards.
- List waters that do not meet standards (also known as the 303d list) and update every even-numbered year

The following is a summary of the waters in the county on the 2014 Impaired Waters List and new impairments on the proposed 2016 Impaired Waters List.

2016 Impaired Waters List

There are 38-stream segments in the county on the impaired waters list. Many of the impairments do not meet the designated uses for aquatic life or aquatic recreation. There are 16 stream segments that are listed as impaired for not meeting the designated use of aquatic consumption.

There are nine lakes on the impaired waters list: Crystal, Duck, Eagle (north), George, Hiniker Pond, Loon, Lura, Madison, and Washington. These lakes do meet water quality standards for aquatic recreation and aquatic consumption.

The map on the following page shows the water bodies that are impaired and the tables list the designated uses and pollutant or stressors that are causing the impairment.

Proposed 2016 Impaired Waters List

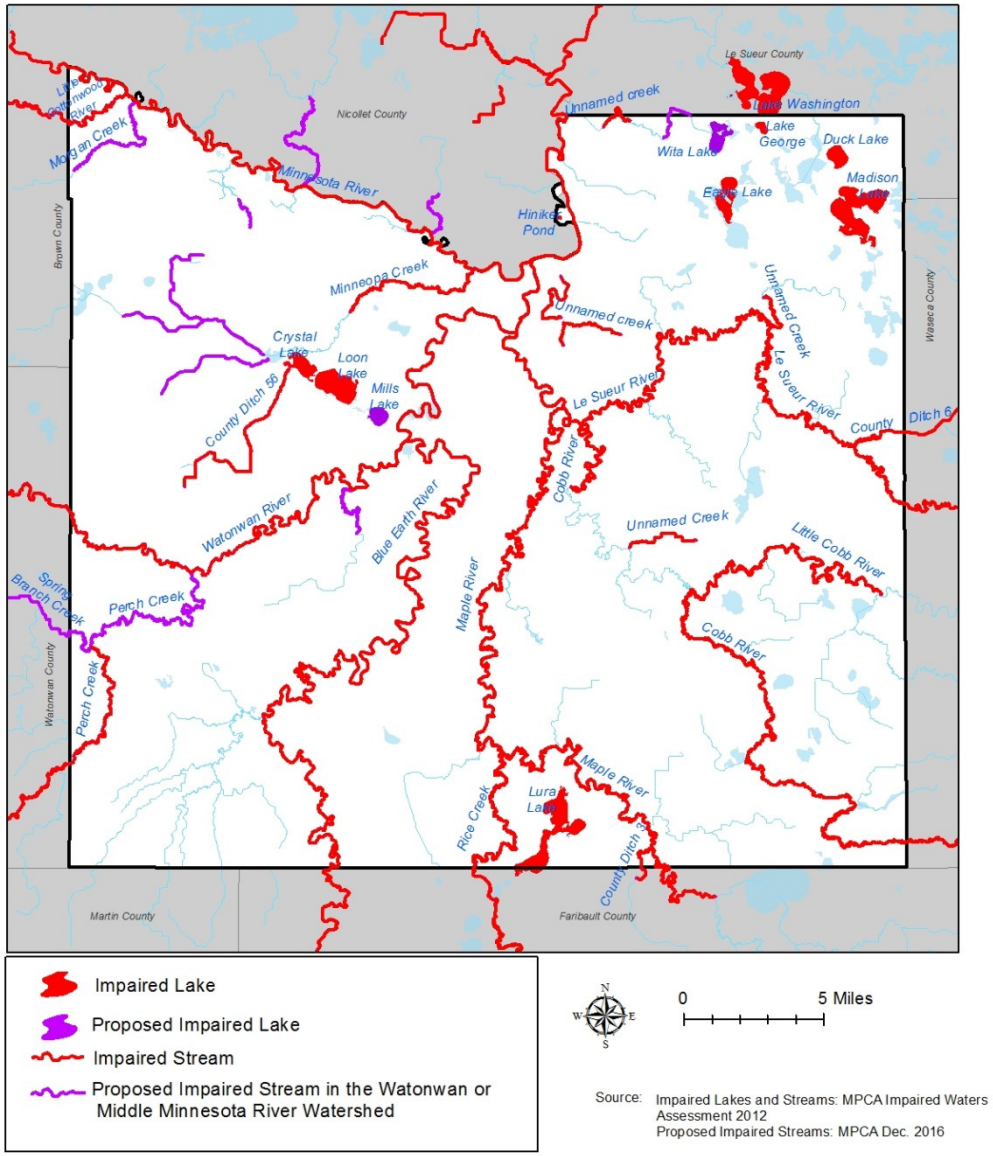
There are nine new stream segments on the 2016 proposed impaired waters list. The new impaired segments include Morgan Creek, Spring Branch Creek, Perch Creek, and six unnamed creeks (some of which

are County Ditches). There are also ten new stressors or pollutants added for stream segments that already had an existing impairment on the 2014 impaired waters list. Excess nutrients or eutrophication is a new stressor for several stream reaches including the Blue Earth River (from Rapidan Dam to the Le Sueur River), a segment of the Cobb River, the Little Cottonwood River, and the Minnesota River (from Swan Lake outlet to Minneopa Creek).

There are two newly-listed lakes on the proposed 2016 impaired waters list: Wita and Mills. Crystal Lake, George Lake and Washington Lakes have additional impairments added on the 2016 impaired waters list.

Water bodies and stream reaches on the existing and the proposed 2016 impaired waters list are shown on the map to the right and tables on the following pages.

Impaired Waters and Proposed Impaired Waters



Existing and Proposed Impaired Stream Reaches in Blue Earth County (Source: MPCA Proposed Impaired Waters List 2016) (Proposed Impairments are shown in Red Text)						
			Affected Designated Use			
River ID	River/Stream Name	Description	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Pollutant or Stressor
07020009-510	Blue Earth River	Watonwan R to Rapidan Dam			x	Mercury in fish tissue
07020009-515	Blue Earth River	Elm Cr to Willow Cr	x		x	Mercury in fish tissue, Fishes Bioassessment, Turbidity
07020009-501	Blue Earth River	Le Sueur R to Minnesota R	x	x	x	Fecal Coliform, Mercury in Fish Tissue Mercury in Water Column, Turbidity
07020009-509	Blue Earth River	Rapidan Dam to Le Sueur R	x	x	x	Fecal Coliform, Mercury in Fish Tissue Mercury in Water Column, Turbidity, Nutrient/eutrophication biological indicators
07020009-507	Blue Earth River	Willow Cr to Watonwan R	x		x	Mercury in Fish Tissue, Turbidity
07020011-556	Cobb River	T107 R26W S30, west line to Le Sueur R	x	x		Turbidity, E. Coli, Fishes Bioassessment, Nutrient/eutrophication biological indicators
07020011-568	Cobb River	T104 R23W S34, south line to Little Cobb R	x			Aquatic Macroinvertebrate Bioassessment, Fishes Bioassessment, Turbidity
07020011-552	County Ditch 3 (Judicial Ditch 9)	JD 9 to Maple R	x	x		Turbidity, E. Coli,
07020007-557	County Ditch 56 (Lake Crystal Inlet)	Headwaters to Lk Crystal	x	x		E. Coli, Fishes Bioassessment
07020011-522	County Ditch 6	T107 R25W S14, east line to Le Sueur R	x			Aquatic Macroinvertebrate Bioassessment
07020007-535	County Ditch 27	Headwaters to Lily Lk	x			Fishes Bioassessment
07020007-531	Judicial Ditch 48	Unnamed ditch to Minneopa Cr	x			Fishes Bioassessment
07020010-559	County Ditch 78	164th St to Watonwan R	x			Aquatic macroinvertebrate bioassessments, Fishes bioassessments
07020011-620	Le Sueur River	Boot Cr to CD 6	x		x	Turbidity, PCB in Fish Tissue
07020011-501	Le Sueur River	Maple R to Blue Earth R	x	x	x	Fishes Bioassessment, PCB in Fish Tissue, Fecal Coliform, Mercury in Water Column, PCB in Water Column, Turbidity, Nutrient/eutrophication biological indicators, Acetochlor[1]
07020011-506	Le Sueur River	Cobb R to Maple R	x		x	PCB in fish Tissue, Turbidity
07020011-507	Le Sueur River	CD 6 to Cobb R	x	x	x	PCB in fish Tissue, Turbidity, Fishes Bioassessments, E. Coli

Existing and Proposed Impaired Stream Reaches in Blue Earth County (Source: MPCA Proposed Impaired Waters List 2016) (Proposed Impairments are shown in Red Text)						
			Affected Designated Use			
River ID	River/Stream Name	Description	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Pollutant or Stressor
07020011-504	Little Cobb River	Bull Run Cr to Cobb R	x	x	x	Fecal Coliform, Mercury in Water Column, Turbidity, Dissolved Oxygen, Fishes Bioassessment, Nutrient/eutrophication biological indicators
07020007-515	Little Cottonwood River	T109 R31W S15, south line to Minnesota R	x	x		Fecal Coliform, Turbidity, Aquatic macroinvertebrate bioassessments
07020011-534	Maple River	Rice Cr to Le Sueur R	x	x		Aquatic Macroinvertebrate Bioassessments, Fecal Coliform, Turbidity
07020011-535	Maple River	Minnesota Lk outlet to Rice Cr	x			Aquatic Macroinvertebrate Bioassessments, Fishes Bioassessments, Turbidity
07020007-534	Minneopa Creek	T108 R28W S23, south line to Minnesota R	x	x		Turbidity, Escherichia coli, Fishes bioassessments, Aquatic macroinvertebrate bioassessments
07020007-531	Minneopa Creek	Headwaters to Lily Lk	x			Fishes bioassessments
07020007-502	Minnesota River	Blue Earth R to Shanaska Cr	x		x	Mercury in Fish Tissue, PCB in Fish Tissue, Turbidity
07020007-504	Minnesota River	Minneopa Cr to Blue Earth R	x		x	Mercury in Fish Tissue, PCB in Fish Tissue, Turbidity
07020007-507	Minnesota River	Little Cottonwood R to Morgan Cr			x	Mercury in Fish Tissue, PCB in Fish Tissue
07020007-506	Minnesota River	Morgan Cr to Swan Lk outlet			x	Mercury in Fish Tissue, PCB in Fish Tissue
07020007-503	Minnesota River	Cottonwood R to Little Cottonwood R	x		x	Mercury in Fish Tissue, PCB in Fish Tissue, Turbidity
07020007-505	Minnesota River	Swan Lk outlet to Minneopa Cr	x		x	Mercury in Fish Tissue, Mercury in Water Column, PCB in Fish Tissue, PCB in Water Column, Turbidity, Nutrient/eutrophication biological indicators
07020007-691	Morgan Creek	T109 R29W S30, south line to Minnesota R	x	x		Aquatic macroinvertebrate bioassessments, Fishes bioassessments, Escherichia coli
07020010-524	Perch Creek	Headwaters (Perch Lk 46-0046-00) to Spring Cr	x			Turbidity, Aquatic macroinvertebrate bioassessments, Fishes bioassessments
07020010-523	Perch Creek	Spring Branch Cr to Watonwan R	x	x		Escherichia coli, Fishes bioassessments
07020011-531	Rice Creek	Headwaters to Maple R	x	x		Aquatic Macroinvertebrate Bioassessment, Fishes Bioassessment, Turbidity, E. Coli
07020010-574	Spring Branch Creek	T106 R30W S22, west line to Perch Cr	x	x		Fishes bioassessments, Escherichia coli

Existing and Proposed Impaired Stream Reaches in Blue Earth County (Source: MPCA Proposed Impaired Waters List 2016) (Proposed Impairments are shown in Red Text)						
			Affected Designated Use			
River ID	River/Stream Name	Description	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Pollutant or Stressor
07020007-550	Unnamed creek	Unnamed cr to Unnamed ditch	x			Fishes Bioassessments, Aquatic macroinvertebrate bioassessments
07020011-510	Unnamed creek	Unnamed cr to Le Sueur R	x			Aquatic Macroinvertebrate Bioassessments
07020007-600	Unnamed creek	Unnamed cr to Unnamed cr		x		Fecal Coliform
07020007-603	Unnamed creek	Unnamed cr to Unnamed cr		x		Fecal Coliform
07020007-602	Unnamed creek	Headwaters to Unnamed cr		x		Fecal Coliform
07020007-604	Unnamed creek	Headwaters to Unnamed cr		x		Fecal Coliform
07020007-577	Unnamed creek	T108 R28W S6, south line to T108 R28W S6, north line	x			Aquatic macroinvertebrate bioassessments, Fishes bioassessments, Nitrates
07020007-696	Unnamed creek	Unnamed cr to -93.9413 44.228	x			Aquatic macroinvertebrate bioassessments, Fishes bioassessments
07020011-503	Unnamed creek (Little Beauford Ditch)	Headwaters to Cobb R	x	x	x	Acetochlor[1], Fecal Coliform, Mercury in Water Column, PCB in Water Column, Turbidity
07020007-598	Unnamed ditch	Unnamed cr to underground pipe		x		Fecal Coliform
07020010-501	Watonwan River	Perch Cr to Blue Earth R	x	x	x	Fecal Coliform, Mercury in Water Column, Turbidity, Mercury in Fish Tissue, Fishes bioassessments, Aquatic macroinvertebrate bioassessments
07020010-510	Watonwan River	S Fk Watonwan R to Perch Cr	x	x	x	Turbidity, Mercury in fish tissue, Aquatic macroinvertebrate bioassessments, Fishes bioassessments, Escherichia coli

[1] The Acetochlor impairments are on the list to be delisted due to restoration activities. The status of the delisting is listed as draft as of December 2016.

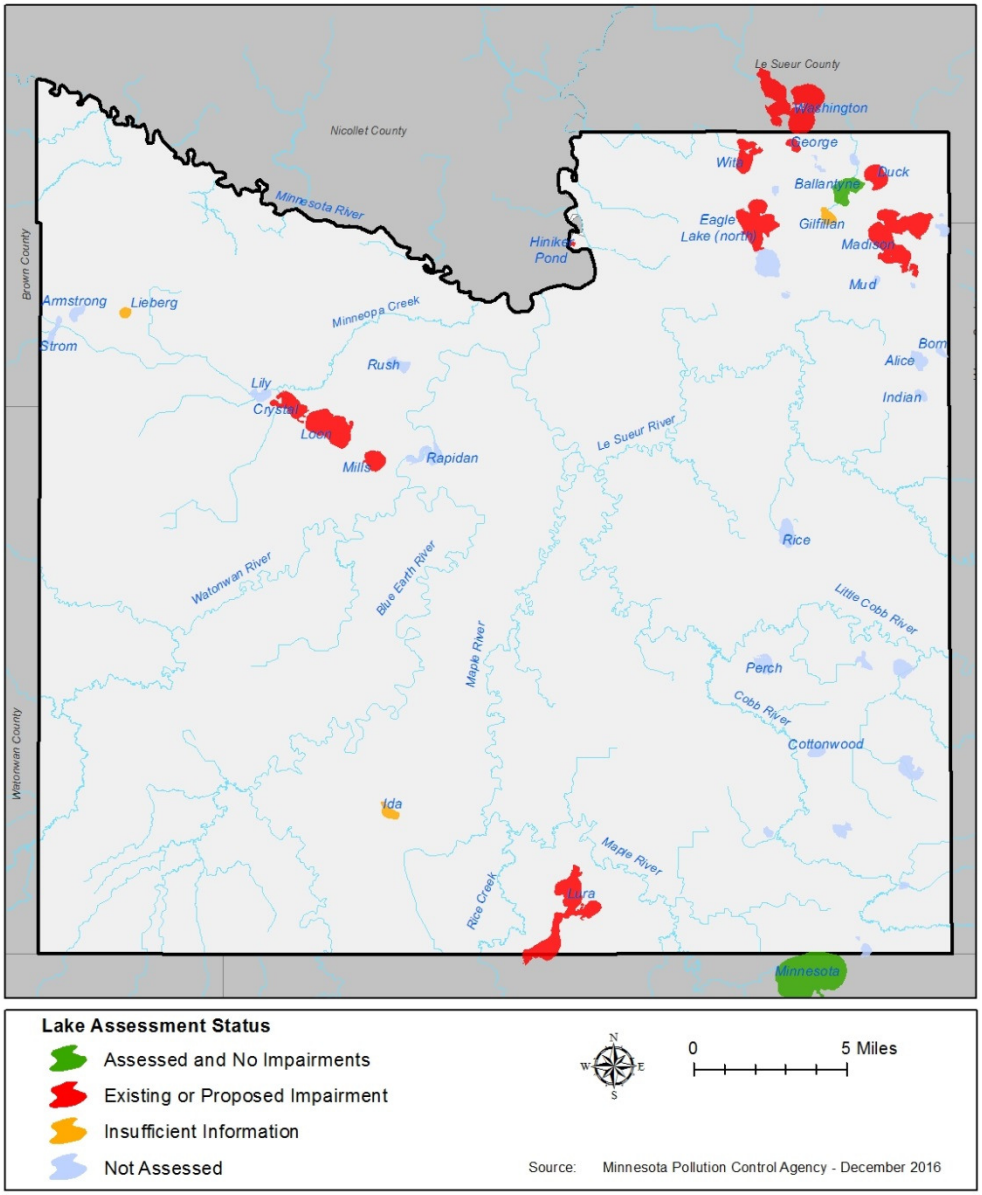
Existing and Proposed 2016 Impairments for Blue Earth County Lakes

Lake Name	Affected Use for Impairment: Aquatic Life	Aquatic Recreation	Aquatic Consumption	Pollutant or Stressor
Crystal	x	x		Nutrient/Eutrophication Biological Indicators, Fishes Bioassessment
Duck		x	x	Nutrient/Eutrophication Biological Indicators, Mercury in Fish Tissue
Eagle (North)		x		Nutrient/Eutrophication Biological Indicators
George		x	x	Mercury in Fish Tissue, Nutrient/eutrophication biological indicators
Hiniker Pond			x	Mercury in Fish Tissue
Loon		x	x	Nutrient/Eutrophication Biological Indicators, Mercury in Fish Tissue
Lura		x	x	Nutrient/Eutrophication Biological Indicators, Mercury in Fish Tissue
Madison		x	x	Nutrient/Eutrophication Biological Indicators, Mercury in Fish Tissue
Mills		x		Nutrient/eutrophication biological indicators
Washington	x	x	x	Nutrient/Eutrophication Biological Indicators, Mercury in Fish Tissue, Fishes Bioassessment
Wita		x		Nutrient/eutrophication biological indicators

Proposed Impairments are shown in RED TEXT

Source: Minnesota Pollution Control Agency 2016

Status of MPCA Lake Assessments



Surface Water Monitoring and Assessment

Intensive Monitoring Approach

The Minnesota Pollution Control Agency adopted an intensive watershed monitoring approach in 2008, as directed by the Legislature. A significant share of the funding for water quality management is provided by the Minnesota Clean Water Fund.

The water quality management cycles for the 80 major watersheds are staggered, with 8 to 10 watersheds beginning a new cycle each year. By 2017, all watersheds will have at least begun their first cycle, and those that began in 2008 will enter their next cycle.

The improved system allows efficient and effective use of public resources in addressing water quality challenges across the state. Concentrating efforts at the major watershed scale ensures:

- an ongoing, predictable cycle for water quality management and evaluation
- a more efficient approach to addressing impairments
- a common framework for monitoring, TMDL studies, assessments, setting required pollutant reductions, and implementation strategies
- improved collaboration and innovation
- increased stakeholder interest and local support

Total Maximum Daily Load (TMDL)

After impaired waters are listed, the MPCA organizes them into TMDL projects. Each project may contain one or more waterbodies or segments of a waterbody. A TMDL is the maximum amount of a pollutant a water body can receive without violating water quality standards, and an allocation of that amount to the pollutant's sources.

The TMDL process identifies all sources of the pollutant and determines how much each source must reduce its contribution in order to meet the standard. The source reduction strategies form the basis of an implementation plan which must be completed within one year after the U.S. Environmental Protection Agency approves a TMDL study. (Source: MPCA)

A TMDL is a pollution budget and includes a calculation of the maximum amount of a pollutant that can occur in a waterbody and allocates the necessary reductions to one or more pollutant sources. A TMDL serves as a planning tool and potential starting point for restoration or protection activities with the ultimate goal of attaining or maintaining water quality standards. Under section 303(d) of the Clean Water Act, states, territories and authorized tribes (included in the term State) are required to submit lists of impaired waters. These are waters that are too polluted or otherwise degraded to meet water quality standards. The law requires that the states establish priority rankings for waters on the lists and develop Total Maximum Daily Loads (TMDL) for these waters. (Source: EPA)

Watershed Restoration and Protection Strategies (WRAPS)

Along with the Watershed Approach, the MPCA developed a process to identify and address threats to water quality in each of these major watersheds. This process is called WRAPS or the Watershed

Restoration and Protection Strategy. WRAPS has four major steps or phases.

Step 1. Monitor water bodies and collect data

The cycle begins with a two-year intensive monitoring program of lakes and streams in which the MPCA determines their overall health and identifies impaired waters. Results of monitoring that other state, federal, and local organizations have performed for various purposes are included in the process. Additional information is collected on the watershed's physical characteristics, including land use, topography, soils, and pollution sources. Outcomes of this step include the creation of a Monitoring and Assessment Report and a Stressor Identification Report on the watershed's biota (fish, bugs, etc.).

Step 2. Assess the data

Based on the results of the monitoring in step one, MPCA water quality specialists evaluate the data to:

- determine whether or not water resources meet water quality standards and designated uses
- identify waters that do not meet water quality standards and list them as impaired waters
- identify waters that should be protected
- identify stressors affecting aquatic life in streams

Step 3. Develop strategies to restore and protect the watershed's water bodies

Based on the watershed assessment, a WRAPS report and a Total Maximum Daily Load (TMDL) are completed. The two provide details on water quality issues and identify what needs to be done to clean up streams and lakes that are impaired and to protect those that are at risk of becoming impaired.

Step 4. Conduct restoration and protection projects in the watershed

In this step, restoration and protection projects are implemented in the watershed. Various local units of government, including watershed districts, municipalities, and soil and water conservation districts, take the lead in developing and carrying out implementation plans based on what is learned during the earlier steps of the process. Civic engagement and public participation are core elements of all steps throughout the process.

State Plans and Priorities

Minnesota Pollution Control Agency studies of sediment and nutrient pollution sources show the Middle Minnesota, Blue Earth, Le Sueur and Watonwan watersheds are among the highest nutrient and sediment loading watersheds in the state. The MPCA plans referenced and summarized to show alignment with state priorities include the following:

- *Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River*, January 2015 Minnesota Pollution Control Agency
- *Nitrogen in Minnesota Surface Waters, Conditions, trends, sources, and reductions*, June 2013, Minnesota Pollution Control Agency
- *Minnesota Nutrient Reduction Strategy*, 2014, Minnesota Pollution Control Agency
- *Le Sueur River WRAPS Report: Watershed conditions and restoration and protection strategies*, August 2015, Minnesota Pollution Control Agency

Sediment

The *Sediment Reduction Strategy for the Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River* shows all local watersheds are high contributors of Total Suspended Solids (TSS) in the Minnesota River Basin. A map showing watersheds with the highest concentrations of TSS is on the following page followed by sediment reduction goals and a summary of the plan priorities and strategies.

The Minnesota River Basin's geologic history makes the basin vulnerable to high sediment loads. Near-channel sediment from bluffs, river banks and ravines has been identified as a dominant sediment source in many Minnesota River Basin Watersheds.

The *Sediment Reduction Strategy for the Sediment Reduction Strategy for the Minnesota River Basin* states the Blue Earth and Le Sueur contribute disproportionate sediment loads:

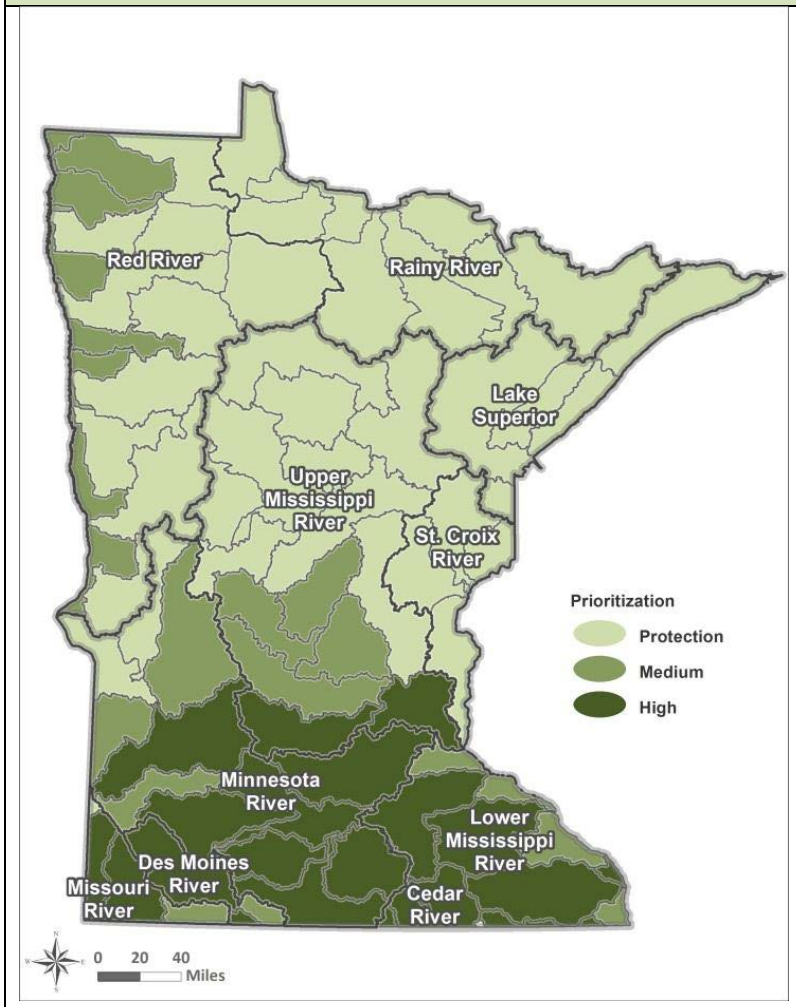
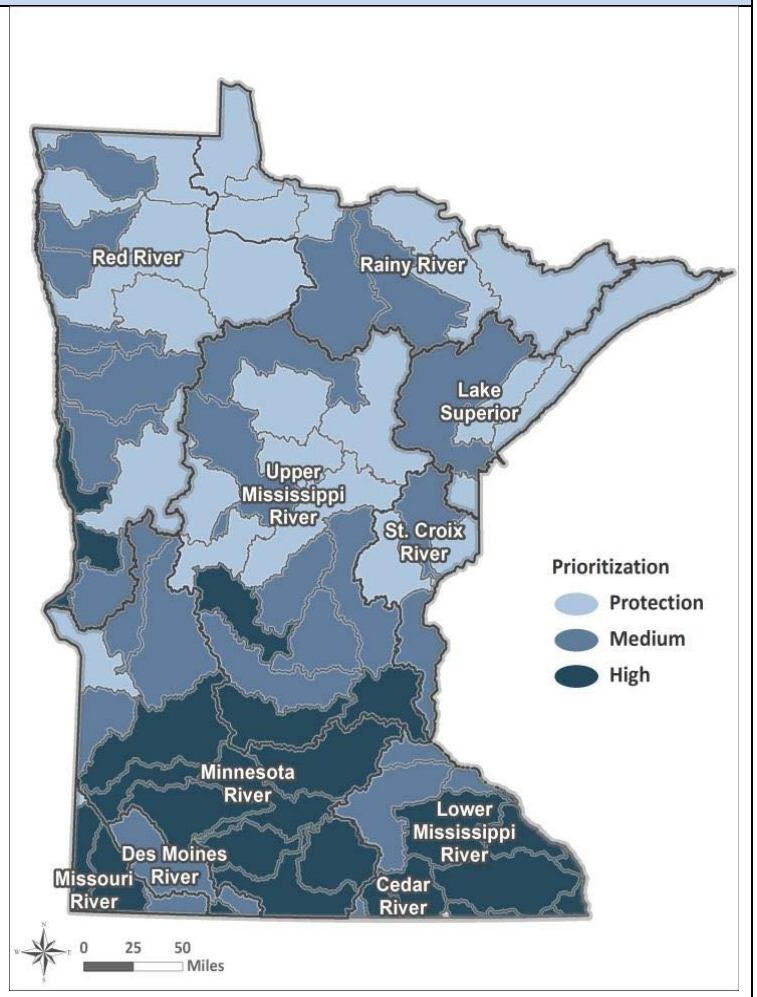
> "The Le Sueur Watershed contributes 24-30% of the total TSS load to the Minnesota River while only covering 7% of the watershed area in the Minnesota River Basin. "
>
> "The Blue Earth and Le Sueur River watersheds together contribute as much as half of the fine sediment load to the Minnesota River, even though they account for only one-fifth of its drainage area."

Nutrients

The *Minnesota Nutrient Reduction Strategy* shows all watersheds in the county are priority watersheds for nutrient reduction. Priority watersheds have the highest nutrient yields (loads normalized to area), and also include watersheds with high phosphorus levels in rivers. The *Minnesota Nutrient Reduction Strategy* shows the Blue Earth River is also a priority area to reduce nitrogen for groundwater protection.

Maps of Minnesota's major watershed and groundwater priority areas are shown on the following pages, followed by goals and a summary of the plan priorities and strategies.

Minnesota Nutrient Reduction Priorities

Nitrogen Priorities	Phosphorus Priorities
	

Source: *Minnesota Nutrient Reduction Strategy*, 2014, MPCA

Sediment Reduction Goals

The sediment reduction goals in the MPCA *Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River* shows major reductions are needed in the local watersheds to achieve State sediment reduction goals. The tables to the right show short and long term sediment reduction goals for the Minnesota River and local watersheds.

Minnesota River Basin Sediment Reduction Strategy

"Implementing practices and infrastructure to control upland and near-channel sources of sediment will require large commitments of time and money by all levels of government, many nongovernmental organizations, and individuals."

"To meet the Minnesota River turbidity TMDL, an estimated 80-90% reduction from the current baseline sediment loading is needed. The magnitude of reductions needed points to just how big of a problem this is and how much effort will be needed to meet the necessary reductions."

"Actions to reduce sediment loading in these waterbodies should not be delayed."

Source: *Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River*, January 2015, Minnesota Pollution Control Agency

Minnesota River Sediment Reduction Strategy

Sediment Reduction Goals	Milestone 2020	2030	Goal 2040
Watershed			
Minnesota River	**25% reduction**	**50% reduction***	**90% reduction****
Sediment Reduction Strategy - Appendix A			
Greater Blue Earth	25%	50%	90%
MN River at Mankato	25%	50%	88%
Watonwan	25%	50%	80%
Le Sueur	25%	50%	88%

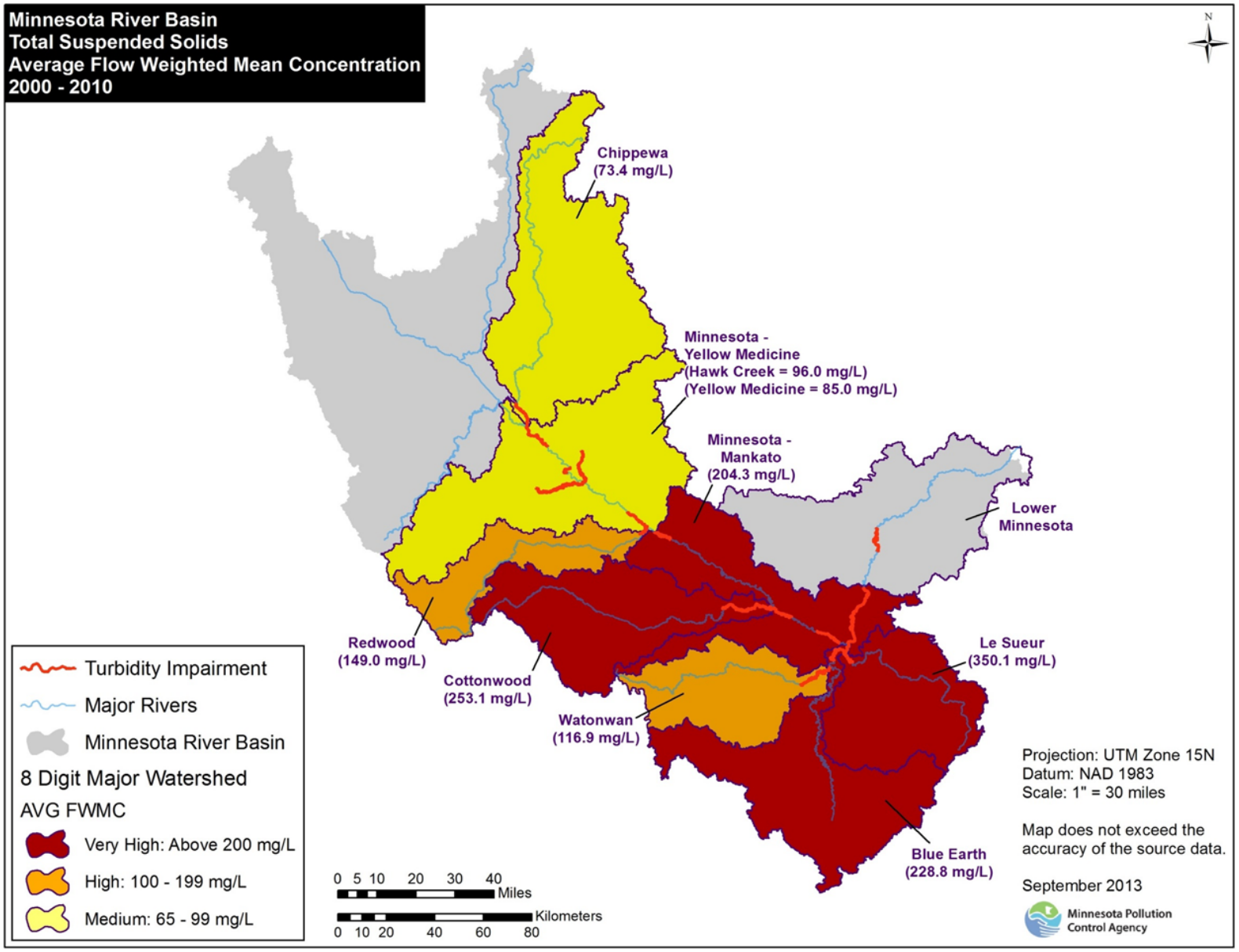
Source: *Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River*, January 2015, Minnesota Pollution Control Agency

Le Sueur River Watershed Sediment Reduction Goals

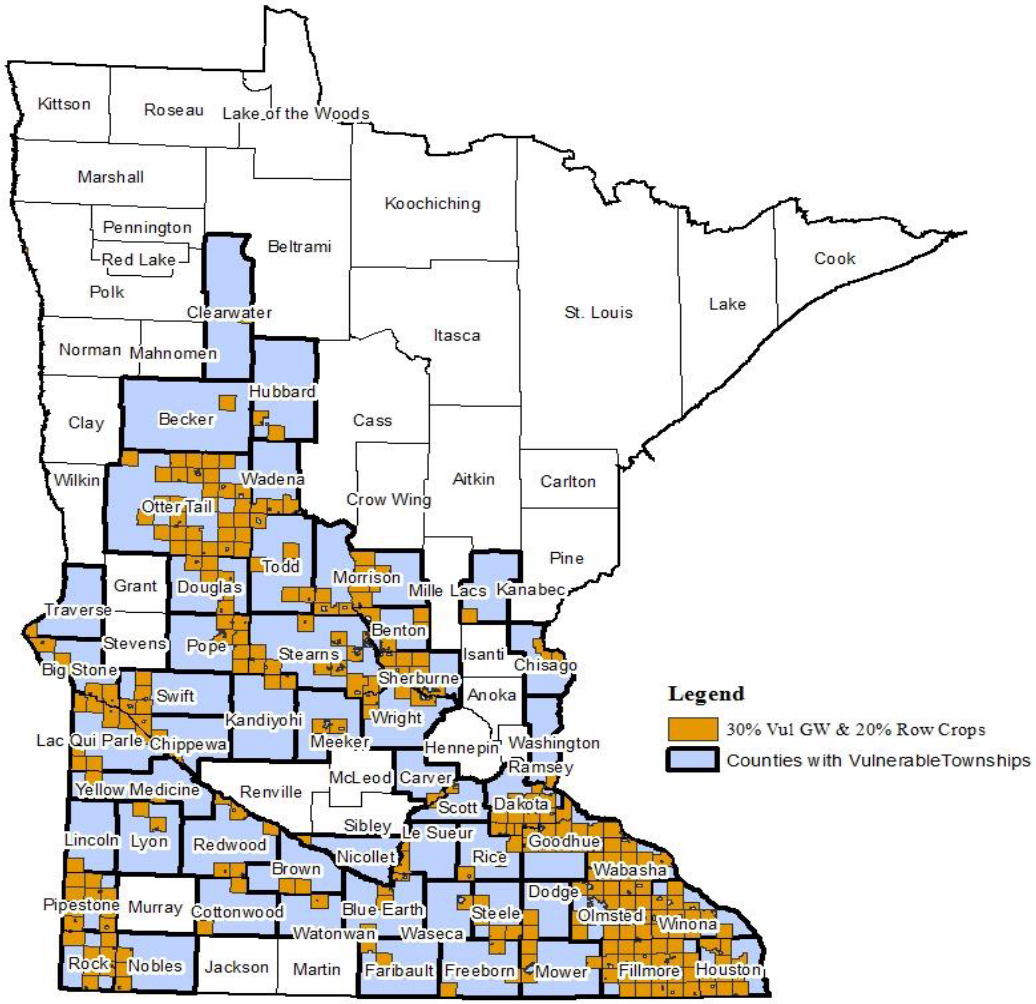
Sediment Reduction Goals	10-year goal	Years to goal	Goal
Le Sueur	10% reduction	65	65%reduction

Source: *Le Sueur River WRAPS Report: Watershed Conditions and restoration and protection strategies*, August 2015, Minnesota Pollution Control Agency

Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River January 2015 Minnesota Pollution Control Agency	
Priority Watersheds, Sources, Pathways	**Strategies and BMPs**
Watersheds Targeted sediment reduction strategies in high sediment yielding watersheds may have the greatest initial impact on the mitigation of excessive sediment loading. Le Sueur Watershed contributes 24-30% of the total TSS load to the Minnesota River, while only 7% of the watershed area. Blue Earth and Le Sueur watersheds together contribute as much as 50% of the fine sediment load to the Minnesota River, while only 1/5 of its drainage area. **Source: Upland Erosion** (27% in Le Sueur) Highly Erodible Land (HEL), Gullies **Source: Ravines – incised reaches** (9% in Le Sueur) Subsurface tile drainage outlets to ravines **Source: Near channel erosion – incised reaches** (57% in Le Sueur)	**Strategies** Reduced magnitude and duration of peak flows is the primary sediment reduction strategy. **Priority BMP Implementation Strategies:** 1. Reduce magnitude and duration of peak flows with wetland restoration, water storage and soil health 2. Control upland erosion with soil health practices 3. Preventing gulley erosion and trap sediment before it leaves fields 4. Structural controls in areas where runoff and off-site soil transport is occurring 5. Install direct near-channel protection near infrastructure A successful strategy needs to address both channel and upland loads and includes measures that reduce loading during large events (where upland loading is dominated by runoff from cropland) and other runoff events (where significant contributions come from impervious surfaces associated with developed land). Implementation of upland BMPs without addressing hydrology (flow reduction) will not meet sediment reduction goals.


Minnesota River Basin
Total Suspended Solids
Average Flow Weighted Mean Concentration
2000 - 2010
N
Chippewa
(73.4 mg/L)
Minnesota -
Yellow Medicine
(Hawk Creek = 96.0 mg/L)
(Yellow Medicine = 85.0 mg/L)
Minnesota -
Mankato
(204.3 mg/L)
Lower
Minnesota
Redwood
(149.0 mg/L)
Cottonwood
(253.1 mg/L)
Watonwan
(116.9 mg/L)
Le Sueur
(350.1 mg/L)
Blue Earth
(228.8 mg/L)
Turbidity Impairment
Major Rivers
Minnesota River Basin
8 Digit Major Watershed
AVG FWMC
Very High: Above 200 mg/L
High: 100 - 199 mg/L
Medium: 65 - 99 mg/L
0 5 10 20 30 40
Miles
0 10 20 40 60 80
Kilometers
Projection: UTM Zone 15N
Datum: NAD 1983
Scale: 1" = 30 miles
Map does not exceed the
accuracy of the source data.
September 2013
Minnesota Pollution
Control Agency

Minnesota Priority Groundwater Areas For Nitrogen



Source: *Minnesota Nutrient Reduction Strategy*, 2014, Minnesota Pollution Control Agency

Nutrient Reductions and Goals

The 2014 *Minnesota Nutrient Reduction Strategy* shows the four major watersheds in the county are high contributors of nitrogen and phosphorus in the Minnesota River Basin. The table to the right compares local watersheds with other major watersheds in the Minnesota River Basin. Watersheds are displayed starting from the headwaters.

The *Le Sueur River WRAPS* nutrient reduction goals for the watersheds are consistent with state goals. *The Le Sueur WRAPS* has phosphorus reduction goals for some lakes in the watershed. The *Le Sueur WRAPS* nutrient goals and timelines are shown on the following page.

A summary of priority watersheds, sources and strategies in the MPCA *Minnesota Nutrient Reduction Strategy* and MPCA Nitrogen *in Minnesota Surface Waters, Conditions, trends, sources, and reductions* reports follow.

Minnesota River Basin Major Watershed Nutrient Loads and Reductions

	Nitrogen			Phosphorus		
	Load (MT/year)	Reduction (MT/year)	Rank	Load (MT/year)	Reduction (MT/year)	Rank
Minnesota River Headwaters	512.9	102.6	12	42	5	12
Pomme de Terre	1643.4	328.7	11	135.2	16.2	19
Lac Qui Parle	1705	341	10	117.3	14.1	11
Minnesota River Yellow Medicine	6910.6	1382.1	5	435.7	52.3	1
Chippewa	3882.9	776.6	8	234.4	28.1	7
Redwood	1998.5	399.7	9	199.3	23.9	8
Cottonwood	5305	1661	6	261	31.3	6
Middle Minnesota	8245	1649	**2**	299.4	35.9	**5**
Blue Earth	8021.1	1604.4	**3**	376.5	45.2	**2**
Watonwan	4176.2	835.2	**7**	192	23	**9**
Le Sueur River	7067.9	1416.6	4	351.8	42.2	**3**
Lower Minnesota	9249.1	1849.8	1	338.4	40.6	4

Source: *Minnesota Nutrient Reduction Strategy*, 2014, Appendix E: "HUC8 Watershed Loads and Reductions." Minnesota Pollution Control Agency

Minnesota Nutrient Reduction Strategy Timeline for reaching goals and milestones				
Major Basin	**Pollutant**	**Reduction Goal**	**2010-2025**	**2025-2040**
Mississippi Basin (includes Minnesota River)	Phosphorus	45% reduction from average 1980–1996 conditions	45% reduction goal	Work on remaining reduction needs to meet water quality standards
	Nitrogen	45% reduction from average 1980–1996 conditions	20% reduction from baseline	45% reduction from baseline
Statewide Groundwater/ Source water	Nitrogen	Meet the goals of 1989 Groundwater Protection Act		

Source: *Minnesota Nutrient Reduction Strategy*, Table 2-2. Timeline for reaching goals and milestones

Le Sueur River Watershed Nutrient Reduction Goals			
Watershed Nutrients	**10-year Goal**	**Years to Goal**	**Goal**
Nitrogen (Multi-year Flow Weighted Mean Concentration from 9 to 5 mg/L)	12% reduction	38	45% reduction
Phosphorus Goal (Multi-year Flow Weighted Mean Concentration from 0.38 to 0.15)	10% reduction	60	60% reduction
Lakes Phosphorus	**10-year Goal**	**Years to Goal**	**Goal**
Eagle	10-15% reduction	50	49% reduction
Lura	10-15% reduction	50	53 reduction
Madison	10-15% reduction	50	49 reduction

Source: *Le Sueur River WRAPS Report: Watershed Conditions and restoration and protection strategies*, August 2015, Minnesota Pollution Control Agency

Nitrogen in Minnesota Surface Waters, Conditions, trends, sources, and reductions June 2013, Minnesota Pollution Control Agency	
Priority Watersheds, Sources and Pathways	**Strategies and Practices**
Priority Watersheds "Meaningful N reductions to surface waters at regional scales cannot be achieved by solely targeting small geologically sensitive areas, relatively small watersheds, or mismanaged lands. Little cumulative state-level progress will be made unless multiple watersheds (i.e. the top 10 to 20 N loading watersheds) all work to reduce N levels." Top 20 watersheds in Minnesota. Major Watershed Load ranking in Mississippi Basin: Middle Minnesota – 2 Blue Earth – 3 Le Sueur – 4 Watonwan – 13 **Priority Sources** Cropland sources account for an estimated 89 to 95% of the N load in the Minnesota River. Tile drainage contributes 67 to 72% of the nitrogen load in Minnesota River Basin. Surface runoff from cropland contributes 1% to 4% of major basin nitrogen loads. Nitrogen leaching into groundwater below cropped fields, and subsequently moving underground to streams, contributes an estimated 16% of the nitrogen to the Minnesota River, on average. **Priority Areas for Implementation** Row crops planted on tile-drained lands. Row crops in the karst areas and sandy soils.	**BMPs for reducing N losses to waters from cropland** • ***In-field nutrient management*** (i.e., optimal fertilizer rates; apply fertilizer closer to timing of crop use; nitrification inhibitors; variable fertilizer rates) • ***Tile drainage water management and treatment*** (i.e. shallower depth of tile drainage; control structures that let farmers adjust water levels; constructed and restored wetlands for treatment purposes; woodchip trench bioreactors; and saturated buffers) • ***Vegetation/landscape diversification*** (i.e. cover crops; perennials planted in riparian areas or marginal cropland; extended rotations with perennials; energy crops in addition to corn)

Minnesota Nutrient Reduction Strategy 2014, Minnesota Pollution Control Agency	
Priority Watersheds, Sources and Pathways	**Strategies and Practices**
Priority Watersheds For Nitrogen Appendix E – HUC 8 Reductions Nitrogen Load Rank in Minnesota Basin Middle Minnesota – 2 Blue Earth – 3 Le Sueur – 4 Watonwan – 7 **Priority Sources of Nitrogen** Agricultural tile drainage Cropland	**Strategies** • Agriculture BMPs • Education and Outreach • Involve Agricultural Producers in Identifying Feasible Strategies • Conduct Research Activities & Field Scale BMP Demonstration Projects • Create a Stable Funding Source to Increase Local Capacity to Deliver Agricultural BMPs **Agricultural BMPs** • ***Increase fertilizer use efficiencies***, emphasizing Nutrient management through reduction of nitrogen losses on corn following soybeans; Switch from fall to spring fertilizer applications (or use nitrification inhibitors; Application of phosphorus in accordance with precision fertilizer and manure application techniques, including applications based on soil test results and U of M recommendations. • ***Increase and target living cover***, emphasizing Cover crops on fallow and short season crops ; Perennials in riparian zones and on marginal cropland. • ***Field erosion control*****,** emphasizing: Tillage practices that leave more than 30 percent crop residue cover or alternative erosion control practices that provide equivalent protection: Grassed waterways and structural practices for runoff control. • ***Tile drainage water quality treatment and storage****,* emphasizing: Constructed and restored wetlands; Controlled drainage when expanding or retrofitting drainage systems; Water control structures; Research and development of bioreactors, two-stage ditches, saturated buffers and other ways to store and treat drainage waters.
Priority Watersheds for Phosphorus Appendix E – HUC 8 Reductions Phosphorus Load Rank in Minnesota Basin: Blue Earth – 2 Le Sueur – 3 Middle Minnesota - 5 Watonwan – 9 Phosphorus levels in the lower Blue Earth, Le Sueur and Minnesota River just upstream of the Blue Earth may exceed pending river eutrophication standards. **Priority Sources** Cropland Wastewater point sources Streambank erosion	

Local Priorities

Local Priorities

Priority concerns were identified during the priority concerns scoping process prior to the development of this ten-year plan update, as required by Minnesota Statutes 2017, section 103B.312 and section 103B.313. The Priority Concerns Scoping Document, approved by the Minnesota Board of Water and Soil Resources, is in the appendix.

An assessment of each priority concern is contained in this plan. To effectively protect and restore surface and ground water quality, wetlands and other natural resources, this plan identifies priority areas, subwatersheds and strategic locations for nutrient treatment, water storage and wetland restoration.

Brief summaries and examples of the processes that may be used for prioritizing in the ten year planning period are on the following pages.

Organizational Capacity

Making measurable progress to achieve watershed goals or to implement strategies in the *Blue Earth County Water Management Plan* cannot be accomplished with the current level of financial and staff resources directed to water management in the county.

Additional financial resources will be needed at the local level for project development and construction in priority areas and watersheds. To be positioned for external sources of funding, such as the Clean Water Fund and other grants, priority subwatersheds must be selected using science-based methods, and local staff must be in place with the necessary knowledge, skills and experience to conduct outreach, work with landowners and other key implementation partners to develop and establish projects and voluntary BMPs.

Updated and new regulations will be needed in many local jurisdictions to address drainage, stormwater management, soil erosion and land development in consideration of water quality and reducing risk of potential erosion hazards. Contracted technical staff resources as well as knowledgeable and experienced local staff will be needed to develop, update and implement plans, ordinances and other local regulations and policies.

Responsibility for implementing local priorities

Many local units of government will be responsible for implementing this plan.

The County and interested or affected municipalities and townships will be responsible for developing and updating local plans, regulations and polices for land use, stormwater and shoreland management, establishing and maintaining stormwater management systems, establishing ravine stabilization and erosion control projects, floodwater protection and attenuation systems, wastewater treatment systems, ground and drinking water protection systems and other water quality projects.

The SWCD will be responsible for coordinating outreach and project development with farmers in agricultural subwatersheds.

The Drainage Authority will be responsible for considering wetland restoration, water quality and reduced flooding according to Minnesota Statutes 2017, section 103E.015.

The WCA administrators in the county and the Technical Evaluation Panels (TEP) will be responsible for evaluating sequencing applications and replacement plans with consideration of the priority areas and important wetland functions in this plan.

Involving farmers and crop consultants in targeting, farmer-led, field-scale demonstrations and water quality monitoring will be important for meaningful progress and achieving watershed goals.

Interested landowners, conservation organizations and local governments will be involved with establishing voluntary conservation projects.

Landowners in shoreland areas and affected local government units will be responsible for protecting shoreland.

Relationship to Other Plans

Local Water Management Plan Authority

As provided in Minnesota Statutes 2017, section 103B.325 Subd.5, the Blue Earth County Water Management Plan was developed with consideration of new or amended comprehensive planning and official controls in Minnesota Statutes 2017, sections 394.23, 394.231 and 462.357 Subd. 1 and Subd. 1h.

Comprehensive Plans and Land Use Plans

Minnesota Statutes 2017, section 394.231 requires counties to consider natural heritage data from the county biological survey and consider adopting goals and objectives for the preservation of agricultural, forest, wildlife, and open space land, and minimizing development in sensitive shoreland areas. The county shall consider the following goals and objectives:

A. minimizing the fragmentation and development of agricultural, forest, wildlife, and open space lands, including consideration of appropriate minimum lot sizes;
B. minimizing further development in sensitive shoreland areas;
C. minimizing development near wildlife management areas, scientific and natural areas, and nature centers;
D. other goals and objectives a county may identify.

Other Plans

Components of this plan incorporate goals and objectives in many local and regional plans, including the following:

- *Blue Earth County Comprehensive Land Use Plan*
- *Blue Earth County All-Hazard Mitigation Plan*
- *City of Mankato Park and Open Space Plan*
- *City of Mankato Comprehensive Land Use Plan - Environmentally Sensitive Areas*
- *City of Mankato Alternative Urban Area Review (AUAR*)
- *Envision 2020 Community Plan for Greater Mankato – Community Planning and Regional Governance Green Infrastructure Mini-vision*
- *Mankato Area Transportation and Planning Study*
- *Greenprint Wetland Guidelines and Policy Framework Suggestions*

Once adopted, the natural resource, ecosystem and watershed management goals of this plan will be integrated in land use decisions, environmental review, and local recreation, transportation and land use plans and updates at the local and watershed scale.

Watershed Plans

Smaller watershed plans, such as regional stormwater management plans, lake watershed plans and multipurpose drainage plans for drainage systems managed by Minnesota Statutes 2017, section 103E Drainage, are likely to incorporate wetland conservation and priority areas in this plan.

Comprehensive Watershed Management Plans

The Blue Earth, Le Sueur, Watonwan and Middle Minnesota WRAPS will likely incorporate the high priority areas in this plan.

Minnesota Statutes 2017, section 103B.801 requires counties and SWCDs to transition to replace county water plans with comprehensive watershed management plans (also known as One

Watershed One Plan or 1W1P) by 2025. The comprehensive watershed plan transition is expected to follow the MPCA intensive monitoring schedule. The estimated schedule will likely correspond with the MPCA intensive monitoring schedule as follows:

Watershed	MPCA Intensive Monitoring Schedule	Estimated MPCA WRAPS Schedule	Estimated One Watershed One Plan Schedule
Le Sueur	2008-2012	2013-2015	unknown
Middle Minnesota	2013-2014	2016-2018	2019-2021
Watonwan	2013-2014	2016-2017	2018-2020
Blue Earth	2017-2018	2019-2021	2021-2023
Le Sueur	2018-2020	2021-2023	2023-2025

With four MPCA WRAPS and five comprehensive watershed plans replacing the *Blue Earth County Water Management Plan*, a significant amount of county staff time and resources will be diverted away from implementing this plan's local project and project planning priorities to these watershed planning efforts in the plan implementation period.

Measure – Monitoring Priorities

Water quality monitoring must be expanded to effectively prioritize, target and measure progress in local watersheds.

According to numerous MPCA studies and reports, the Middle Minnesota River, Blue Earth River, Le Sueur River and Watonwan River are among the highest contributors of phosphorus, nitrogen and sediment to surface waters in the State. MPCA studies and WRAPS rely on computer modeling to "extrapolate the known conditions of the watershed to areas with less monitoring data." While these models "incorporate stream pollutant monitoring data, land use, weather, soil type, etc. to estimate water quality conditions across the watershed," there is a general sense of mistrust of the model results in local watersheds.

The MPCA *Nitrogen in Minnesota Surface Waters, Conditions, trends, sources, and reductions* report and maps show there is no data in the lower reaches of the Blue Earth River where nitrogen reductions are needed most to protect the surficial sands aquifer at the confluence of the Blue Earth River and the Minnesota River.

Instead of modeled results, there is local interest and demand for more monitoring of tributaries in the Blue Earth, Le Sueur, Middle Minnesota and Watonwan watersheds for nitrogen, especially in the lowest reach of the Blue Earth River, as well as sediment and phosphorus.

The SWCD has been providing low tech monitoring services for farmers and other landowners in the watershed. Based on the positive response from farmers, the SWCD anticipates continuing to provide monitoring services.

Land Use Priorities

Developed Land Uses

Stormwater Management

Priorities for stormwater management are areas with high density development or where there is development in sensitive areas such lake shoreland and steep slopes near ravines and in river corridors.

More information about prioritizing and targeting stormwater management for developed land is in the Stormwater Management section of the plan.

Shoreland

Shoreland areas are a priority for protecting critical habitat and water quality as phosphorus runoff from developed land in shoreland is typically higher on a per-acre basis compared with other land uses.

More information about shoreland and lake watersheds is in the Stormwater Management and the Priority Areas for Restoration and Protection sections of the plan.

Wastewater

Managing wastewater is critical for protecting human health and surface water quality. Any type of development that utilizes onsite sewage treatment is a priority.

The MPCA regulates wastewater treatment plants (WWTP) with permits assigning pollutant discharge limits for phosphorus, ammonia, total suspended solids for example. Most of the county population lives in areas served by a WWTP.

More information about wastewater management is contained is in the Wastewater section of the plan.

Agricultural Land Uses

Soil Erosion

Priority areas have fields used for crop production with highly erodible or potentially highly erodible land as described in the USDA NRCS Soil Survey, and areas where there is soil erosion as shown using terrain analysis, local knowledge and observed gullies in fields.

Nitrogen

Priority areas for nitrogen reduction are tile-drained and coarse-textured soils used for crop production. Priority watersheds are the watersheds in the greater Blue Earth River watershed and the Middle Minnesota River watershed.

Phosphorus

Reducing phosphorus is a priority in lake watersheds. Lake Crystal, Madison Lake, Lake Ballantyne and Duck Lake will be the highest priority lake watersheds during the ten-year planning period. Additional lake priorities may be determined with a lake assessment in partnership with the MNDNR and with recommendations from the water plan task force.

Feedlots

Feedlot runoff potential is greatest for open lots and lots with less than 300 animal units. Priority areas are where there is runoff or soil erosion from cropland where manure was applied, where there is runoff from open lots and where manure is applied too close to tile inlets.

More information about reducing soil erosion and nutrient loss and transport and feedlot priorities are in the Cropland and Feedlot sections of the plan.

Flooding

Every municipality and nearly every township are affected by flash flooding. Flooding is of greatest concern in developed areas of the county where dwellings and infrastructure are the greatest hazard.

More information about flooding and goals and strategies are in the Flooding and Stormwater Management sections of this plan.

Ravine and Near Channel Erosion

Most of the highly erodible land and potentially highly erodible land in the county, as classified in the USDA NRCS Soil Survey, follow the river corridors. Ravines, banks and bluffs in these areas are prone to erosion and are grouped together as "near channel erosion."

More information about prioritizing ravine, stream bank and bluff erosion, goals and srategies are in the Near Channel Erosion section of this plan.

Multipurpose Practices in Drainage Systems

Increasing water storage and reducing peak flows is a priority in all drainage systems managed by Minnesota Statutes, 2017 section 103E. There are also opportunities for water quality improvement projects in drainage system watersheds. The Drainage Authority will consider potential projects for wetland restoration, water quality and flooding as required by Minnesota Statutes.

More information, goals and strategies are in the Drainage Ditches 103E section of this plan.

Wetland Protection Enhancement Restoration

Wetland restoration priorities will be related to the wetland's potential to provide one or more wetland functions, such as water storage, nutrient treatment, wildlife habitat or ability to provide multiple benefits with the greatest local public value.

Maps showing priority areas and potential sites that could be considered for voluntary wetland restoration, wildlife habitat, groundwater protection or recharge, water storage or nutrient treatment are shown in the on the following pages.

More information about historic and existing wetlands and wetland functions assessments are in the Wetland section of the plan.

Wetlands and water storage functions are also addressed in the Drainage Ditches 103E, Stormwater Management, Near-Channel Erosion, and Flooding sections of the plan.

Wetland Priorities

Wetland Functions and Local Public Value

Wetland functions are science based natural processes that occur in wetlands. The value of a wetland is an estimate of the importance or worth of one or more of its functions to society and individuals. Wetlands are considered valuable because they use and filter nutrients, recharge water supplies, retain water, reduce flooding, and provide fish and wildlife habitat. Wetlands also provide recreational opportunities and aesthetic benefits.

Local Public Values

Minnesota Statutes 2017, section 103B.3355 requires local public values of wetlands be determined based on the functions of wetlands.

The wetland functions most important in local watersheds were determined with consideration of watershed and ecological goals, an assessment of existing wetlands functions and citizen and technical stakeholders' input. Citizen surveys to determine important wetland functions and priority aquatic and natural resource concerns were conducted just prior to developing this plan.

Loss of wetlands, wildlife habitat, water quality and groundwater quality are priority management concerns. Protecting and restoring these functions are the highest priority for achieving watershed and ecological goals in local watersheds. The ability of wetlands to provide multiple benefits has the greatest local public value.

Most Important Wetland Functions

The following wetland functions were determined to be most important in local watersheds and have the greatest local public value:

- **Wildlife Habitat**, including terrestrial and aquatic habitat and connectivity of those habitats
- **Public Recreation,** including hunting and fishing areas, wildlife viewing areas, and nature areas
- **Water Storage**, including floodwater and stormwater attenuation and the potential for downstream flooding and downstream erosion in the watershed
- **Water Quality**, including utilization of nutrients that would otherwise pollute public waters, filtering of pollutants to surface and groundwater and shoreline protection
- **Groundwater Protection**, including utilization of the wetland for groundwater protection or as a recharge area for groundwater and low flow augmentation of streams and rivers
- **Rare Plant and Animal Habitat,** as mapped in the MNDNR Minnesota County Biological Survey
- **Ability to Provide Multiple Benefits,** including wildlife habitat, water storage, water quality, groundwater protection, rare plant and animal habitat and public recreation functions

These important wetland functions were grouped and/or divided into four priorities, including 1) the ability to provide multiple benefits, 2) water storage, 3) water quality and 4) groundwater protection.

All wetlands provide important functions, but not all wetlands provide all functions equally well.

Source: United States Geological Survey

High Priority Areas

Science-based, locally-defined criteria were developed to determine priority areas and potential wetland replacement sites in the Greenprint and the *Blue Earth County Water Management Plan* through a collaborative effort of local governments and representatives of the U.S. Fish and Wildlife Service, MNDNR, SWCD, MPCA, BWSR, engineering consultants and citizens.

The highest priority areas are interconnected ecological corridors and wetland complexes in the Greenprint. These priority areas contain important wildlife habitats and aquatic and natural resources that provide multiple wetland functions important in local watersheds.

Protecting and restoring wetlands and avoiding impacts to wetlands in priority areas is important for sustaining water quality and wildlife habitat functions in local watersheds. Impacts to and loss of wetlands in the Greenprint priority areas can result in critical loss or fragmentation of habitat or changes in hydrology that reduce the ability of the wetland and potentially the entire wetland complex or corridor to provide the desired functions important in their watershed.

Wetland enhancement and restoration in Greenprint priority areas are more likely to be ecologically sustainable as these areas provide connectivity to other aquatic resources and upland habitat and are more likely to be protected from future disturbance from the surrounding landscape.

Wildlife Habitat

Wildlife habitat and recreation are the wetland functions most valued by local residents. Protecting, enhancing and restoring wildlife habitat and restoring fragmented habitat in areas where wetlands provide multiple benefits is a long-term resource need in the county and local watersheds.

Habitat loss refers to the complete eradication of a parcel of habitat, such as conversion of native wetlands, lake and stream shoreline plant communities, prairies, forests, or brushlands to agricultural, residential, or industrial uses.

Habitat degradation occurs when the habitat is still present but its value to native plant, wildlife, and aquatic communities has been impaired or changed significantly. For example, wildlife habitats in urban and exurban developments retain some but not all important natural characteristics, so that some wildlife species can persist while others disappear or greatly decline. In lakes, near-shore habitats (needed by many aquatic species for breeding and juvenile rearing) become degraded when too much native vegetation is removed from shorelines and woody debris and aquatic plants are removed from near-shore waters.

Habitat fragmentation is the breakup of large contiguous areas of habitat into smaller and smaller parcels and fragments. The fragments are no longer close enough or sufficiently connected to allow fish, wildlife, and other native organisms to move freely among habitats in order to use optimal breeding and rearing sites. For example, road construction can fragment prairie, wetland, brushland, or forest; low-head dams in rivers and various water control structures in lakes disrupt natural movements of fish and amphibians. Habitat fragmentation may degrade the genetic capacity of wild populations to adapt to future environmental change because it fragments larger populations—which harbor more genetic variation—into smaller breeding groups. A cumulative effect of habitat loss, degradation, and fragmentation is large declines in abundance and productivity of wild populations, threatening their ability to adapt to future environmental changes and to persist for the enjoyment of future generations.

Long Term Resource Needs

Wetland Protection Buffers

Sustainable wetlands should include buffers and upland protection or treatment. Accelerated sedimentation may be the most detrimental impact on wetlands. Accumulation of sediment in wetlands decreases wetland volume, decreases the duration wetlands retain water, and changes plant community structure by burial of seed banks. (Source: ACE HGM)

Greenprint Priority Areas

Priority Areas - Greenprint

The Greenprint is a map of green infrastructure in the county. Priority areas include river corridors, lake shoreland and wetland complexes.

Green Infrastructure

Green infrastructure is a strategically planned, interconnected network of waterways, wetlands, woodlands, wildlife habitats, and other natural areas; greenways, parks, trails; conservation lands; and other open spaces that support natural ecosystem processes and contributes to the health and quality of life for communities and people.

Adapted from:
Green Infrastructure: Smart Conservation for the 21st Century
Mark A. Benedict and Edward T. McMahon
and ESRI

Green infrastructure is an organizational strategy that provides a planning framework for conservation and development.

Source: *Green Infrastructure:*
Linking Landscapes and Communities
Mark A. Benedict and Edward T. McMahon

Making the Greenprint

A land use planning approach was used to identify Greenprint priority areas based on the ability to provide multiple aquatic and natural resource benefits. An inventory of aquatic and natural resources, sensitive features, land cover, floodplains, rivers, streams, lakes, wetlands, rare plant and animal habitat, sensitive geology, park lands, and protected or publicly-owned lands was followed by an analysis of their landscape position, proximity and connectivity in four landscape settings - river corridors, shallow bedrock and karst, lake shoreland and wetland complexes. These diverse landscape settings, natural resources and hydrologic conditions were combined to make the Greenprint.

Protecting natural resources and open spaces in Greenprint priority areas is a land use management priority.

A map, detailed descriptions of the Greenprint river corridors, shoreland and wetland complexes and a summary of Greenprint criteria are on the following pages.

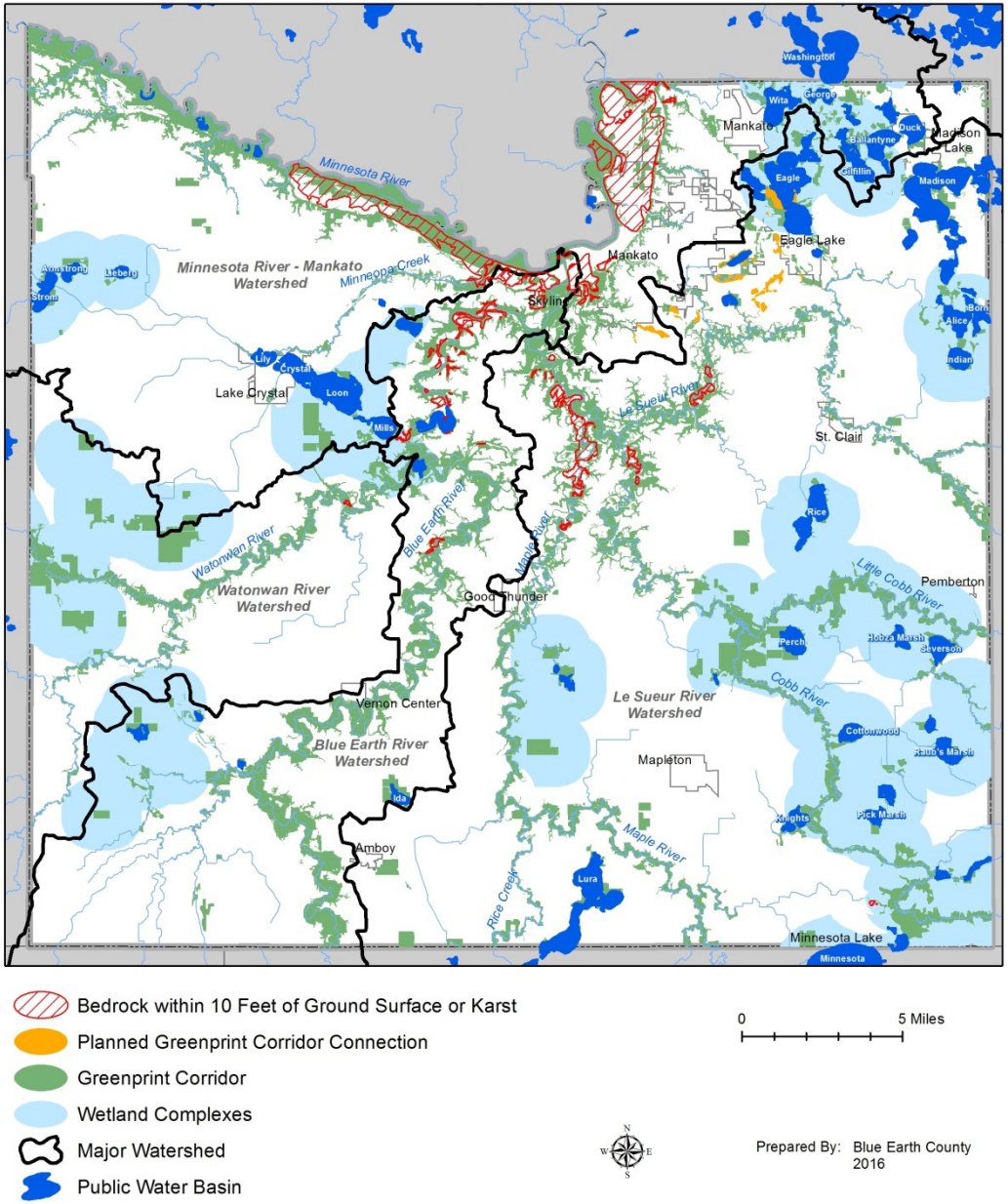
Relationship to Other Plans

The Greenprint incorporated goals and objectives in many local and regional plans, including the following:

- *Blue Earth County Comprehensive Land Use Plan*
- *City of Mankato Comprehensive Land Use Plan - Environmentally Sensitive Areas*
- *City of Mankato Park and Open Space Plan*
- *Envision 2020 Community Plan for Greater Mankato – Community Planning and Regional Governance Green Infrastructure Mini-vision*
- *Greenprint Wetland Guidelines and Policy Framework Suggestions*

Once adopted, the wetland ecosystem and management goals of the Greenprint and the *Blue Earth County Water Management Plan* can be integrated in land use decisions and local recreation, transportation and land use plans and updates at the local and watershed scale.

Greenprint, Wetland Complexes, Shallow Bedrock and Karst



Greenprint River Corridors

River corridors in the county contain a continuous band of flood plains, riparian habitat, wooded and grassy hillsides, marshes and swamps. This variety of landscapes provides excellent habitat for a wide variety of terrestrial and aquatic wildlife species.

River corridors are the least disturbed ecosystem in the county, and aquatic and terrestrial habitat connectivity is greatest in river corridors. Most of the outstanding, high and moderate value sites mapped by the Minnesota County Biological Survey are in the river corridors in the county.

Nearly half of the wetlands in the county are located in river corridors, and the majority of forested lands are in or adjacent to river corridors. The highest quality and greatest diversity of wetlands are located in the river corridors.

Shallow depth to bedrock and karst areas in the county naturally extend from river corridors along the Minnesota River and in the lower reaches of the Blue Earth River and Le Sueur River. Fens are located in these areas, and one Calcareous Fen was located by the MNDNR in the Minnesota River corridor.

The *Map of Original Vegetation at the Time of the Public Land Survey* shows Big Woods hardwoods extending along the river corridors in the lowest reaches of the Blue Earth, Le Sueur, Maple, Cobb and Watonwan River.

Greenprint River Corridor Inventory and Criteria

- Floodplain
- Native Plant Communities in the Minnesota County Biological Survey that have ratings of Outstanding, High or Moderate for level of biodiversity
- Steep slopes (18% slopes or greater that have connections to river corridors)
- Woodlands connected to floodplains, steep slopes or native plant communities

All areas with karst and fens and most areas with shallow depth to bedrock are in the Greenprint.

Greenprint Shoreland

A natural shoreline is more than an aesthetic buffer for the water; it is a complex ecosystem that provides critical habitat for fish and wildlife, protects water quality and water storage for fluctuating water levels. Near shore wetlands and aquatic plants protect the shore from high water and erosion from waves and ice dams and provide habitat. Often, shoreline development results in the loss of these essential shoreline protection buffers and habitat.

Wetlands connected to lakes and in the near shore area provide critical wildlife habitat, water storage and water quality benefits.

Minnesota Conservation Plan
Shoreland Impacts

"On average, there is a 66% reduction in aquatic vegetation coverage with shoreland development."

"Structures and turf-grass lawns have replaced natural shores along many lakes, and have had adverse impacts on water quality and the diverse wildlife that depend on a natural shore. Rainwater runoff from manicured lawns can be 5 times to 10 times higher than natural shorelines, and runoff from turf lawns can carry up to 9 times more phosphorus to the lake than runoff from natural shorelines."

Many wildlife species are highly dependent on naturally vegetated shorelines and adjacent wetlands as habitat for feeding, resting, and mating and as nursery areas for juvenile life stages.

Green frogs are shoreline-dependent species that prefer quiet bays and protected areas with a high abundance of aquatic plants. Male green frogs establish breeding territories within two feet from the lake edge.

Many fish depend on aquatic vegetation, woody habitat, and shorelines to provide spawning habitat, cover, and refuge from predators. Wetlands are critical for northern pike spawning. Downed trees provide important in-lake structure, habitat, food, and shelter for fishes, frogs, turtles, water birds, and mammals. Turtles need to bask on deadfalls or floating logs. Woody habitat is also important for aquatic invertebrates.

Shoreline buffers—corridors of natural vegetation along rivers, lakes, wetlands and sinkholes—protect water quality by trapping, filtering, and impeding runoff laden with nutrients, sediments, and other pollutants. Shoreline buffers also stabilize banks, screen shoreland development, reduce erosion, and provide critical habitat for shoreline species.

Greenprint Shoreland Criteria

- Public Water lakes or Public Water wetlands
- Wetlands adjacent to the shore
- Wetlands with a direct hydrologic connection to Public Waters or Public Water Wetlands

Greenprint Wetland Complexes

Priority wetland complexes are not located in river corridors but may be in close proximity to river corridors and/or lakes. Most wetlands outside of river corridors and shoreland are relatively isolated and surrounded by cropland, limiting the potential for providing multiple wetland functions. Wetland complexes provide habitat for most types of birds and waterfowl as well as other wildlife species and many forms of aquatic life. Direct hydrologic connections are not required for some species and may not be beneficial for some species. Habitat structure, proximity and connectivity are important for terrestrial wildlife habitat rather than watershed boundaries.

The criteria used to define priority wetland complexes for the Greenprint are based primarily on habitat and providing stepping stones of habitat connectivity to form corridors. The criteria used are consistent with numerous federal and state agency and conservation organization plans or criteria including the following:

- Minnesota MNDNR D*uck Recovery Plan*
- Minnesota Audubon Society I*mportant Bird Areas Upper Minnesota Valley* and *Blueprint for Minnesota Prairie Parkland Region*
- US Fish and Wildlife Service Minnesota Valley Waterfowl Management District – Small Wetlands Acquisition Program
- Minnesota MNDNR Working Lands Initiative
- 2015 *Minnesota Pheasant Summit Action Plan*

Common to all of these plans and programs is recognition that:

> "The best waterfowl production habitat occurs within prairie habitat complexes 4–9 square miles in size where at least 20% of the area is wetland and 40% is grassland. At least one-half of the wetland acreage should be temporary or seasonal basins and

ideally each complex will include one shallow lake over 50 acres. One-half of the grasslands should be under long-term protection."

Greenprint Wetland Complexes Criteria

The priority waterfowl habitat complexes were identified by first identifying 50-acre or greater shallow lakes and a one mile buffer around Wildlife Management Areas (WMA), Wildlife Protection Areas (WPA) and permanent conservation easements. The resulting 4 to 9 square mile areas are priority wetland complexes in the county. The following is a list of criteria used:

- 50-acre or greater public shallow lake
- Wildlife Management Area
- Waterfowl Production Areas
- Permanent conservation easement
- 4 to 9 square miles in total size

The Greenprint wetland complexes' boundaries will be dynamic as the elements in these complexes may change with establishment of new permanent conservation easements, WMAs, WPAs or other land use changes that may shift a 4 to 9 square mile wetland complex from the initial Greenprint maps.

Small seasonal basins less than two acres as well as grasslands are also important in wetland complexes, but these areas were not mapped for restoration in this plan. The U.S. Fish and Wildlife Service and Ducks Unlimited restorable depressional wetlands inventory for the Prairie Pothole region of Minnesota can provide information about smaller wetlands in the Greenprint wetland complexes and throughout the county.

Greenprint		
The Blue Earth County Greenprint is a strategically planned interconnected network of waterways, wetlands, woodlands, wildlife habitat, conservation lands and open spaces that support natural ecosystems. The Greenprint identifies priority areas and provides a planning framework for conservation and development that contributes to the health and quality of life for communities and people.		
Landscape Position	**Description**	**Greenprint Inventory & Criteria**
Corridors	River corridors contain a continuous band of flood plains, riparian wildlife habitat, wooded and grassy hillsides, marshes and swamps. This variety of landscapes provides excellent habitat for a wide variety of bird and other wildlife species as well as water storage and water treatment functions.	• Floodplain • Native Plant Communities in the Minnesota County Biological Survey that have ratings of Outstanding, High or Moderate for level of biodiversity • Steep slopes (18% slopes or greater that have connections to river corridors) • Woodlands connected to floodplains, steep slopes or native plant communities
Wetland Complexes	Wetland complexes are areas where wetlands are in close proximity, providing ideal habitat for most types of birds and waterfowl as well as other wildlife species. Hydrologic connections are not required. A variety of wetland types (seasonal and temporarily flooded) is preferred along with grassland. The working lands criteria were used to prioritize wetland complexes: • 4 to 9 square miles in size • 1 shallow lake over 50 acres • 20% total wetland acres • 50% seasonal wetland acres (few weeks to a few months) and temporary (few days to a few weeks) • 40% is grassland, one half in long term protection	• 50-acre or greater public shallow lake • Wildlife Management Area • Waterfowl Production Areas • Permanent conservation easements • 4 to 9 square miles in total size
Shoreland	Wetlands connected to lakes and near the shore provide critical wildlife habitat, water storage and water quality benefits. Near-shore wetlands protect the shore from erosion. Near-shore habitat is critical for many wildlife species. For example, male green frogs establish breeding territories within 2 feet from the lake edge.	• Lakes or wetlands that are Public Waters • Wetlands adjacent to the shore • Wetlands that have a direct hydrologic connection to Public Waters
Geology	The *Geologic Atlas of Blue Earth County, Part B*, 2016, shows areas with shallow depth to bedrock and karst. Fens are most likely to be in these areas.	• Bedrock within 10 Feet of ground surface • Karst
Recreation	Parks, trails and open spaces can provide important connections between population centers or developed landscapes to wetlands, woodlands and waterbodies.	• Park and Open Space Plans • Planned Greenways

Conservation Practices and Replacement Sites for Voluntary Conservation

Potentially restorable basins may provide important functions such as water storage, nutrient treatment and wildlife habitat, depending on site suitability, the landowner's goals, project engineering and design.

Function	Considerations	Basin Criteria
Water Storage	Basin has the potential to store a large volume of water and store surface runoff to the basin from a 10-year, 24-hour storm event. Volume assumes the basin is dry.* This will vary year-to-year and seasonally. 10-year: 4.37 inches. 2-year: 2.91 inches.	Capacity for 10-year, 24-hour storm event or larger* **Yes or No**
Nutrient Treatment	Vegetation is needed for nutrient treatment. The basin must be shallow to support wetland vegetation. For maximum nutrient treatment, the wetland/basin should be located near the bottom of its watershed and receive drainage from tile-drained fields. Iowa CREP: Depressions that have a watershed size of 494 acres or larger, have at least 75% of basin that is less than 3 feet in depth, and surface area is 0.5-2.0% of the total drainage area.	**High:** (Modified Iowa CREP) ***Depth:*** at least 75% of basin less than 3 feet ***Ratio of basin to watershed area:*** Basin 0.4% to 2.5% of watershed area ***No minimum watershed size*** **Medium:** ***Depth:*** *75%* or more of basin is less than 3 feet deep **Low:** ***Depth:*** Less than 75% of basin is under 3 feet deep
Pollution Sensitivity & Groundwater Recharge	Soil types in the county limit infiltration and groundwater recharge capabilities. Geologic Atlas of Blue Earth County Part B, maps of pollution sensitivity to buried sand aquifers and near surface materials provide a qualitative evaluation of recharge rate or flow of surface water to deeper aquifers.	Geologic Atlas of Blue Earth County Part B pollution sensitivity maps of surficial and buried sand aquifers **Very High:** hours to months **High:** weeks to years
Other	Determined by landowners. Basins owned by one landowner.	

Priority Sites for Wetland Water Quality Functions

Priority Replacement Sites

Potentially restorable basins were identified and prioritized based on ability to provide 1) water storage or 2) water quality functions. Shallow basins that support vegetation are needed for water quality treatment to utilize nutrients. Greater storage volume and potentially deeper basins are needed for water storage.

Replacing degraded wetlands in the Greenprint and priority areas identified in the *Blue Earth County Water Management Plan* is certain to provide a gain in wetland function and public value, especially in areas where impact avoidance will continue to maintain a degraded wetland or result in further degradation of the wetland from altered hydrology, invasive species, fertilized lawns, concentrated stormwater runoff, trash, or pet waste inputs.

Some of the potentially restorable basins identified in this plan will not be suitable for wetland restoration but might be suitable for constructed stormwater wetlands or conservation practices to provide water quality or water storage functions important in local watersheds. Ultimately, site conditions and landowner goals will determine how or if potential sites might be used for conservation projects.

Potentially Restorable Basins

The U.S. Fish and Wildlife Service and Ducks Unlimited produced a restorable depressional wetlands inventory for many counties in the Prairie Pothole region of Minnesota including Blue Earth County. This inventory includes over 32,787 (71,218 acres) potentially restorable wetlands in the county. The potentially restorable wetlands in this inventory range in size from under .1-acres to over 900 acres.

To prioritize potentially restorable basins for this plan, the County used terrain analysis based on the 2012 LiDAR Digital Elevation Model. For this analysis, a minimum size of two acres and depth of at least six inches were used as the starting criteria. A consultant, Houston Engineering Incorporated, performed the terrain analysis that allowed for many functions like storage volume, ability to hold certain rainfall events and ability for nutrient treatment to be assessed. There are over 3,000 total potentially restorable depressions of at least two acres in size analyzed to support prioritizing wetland replacements.

Priority Areas – Groundwater Protection and Recharge

Groundwater Pollution Sensitivity and Recharge

Groundwater protection and recharge are a high priority in the county and affect groundwater aquifers beyond county or watershed boundaries.

In most of the county soil infiltration and groundwater recharge of deeper aquifers is limited. Areas with shallow depth to bedrock, karst and potential for groundwater recharge were identified for this plan using the *Geologic Atlas of Blue Earth County, Part B*.

The 2016 *Geologic Atlas of Blue Earth County, Part B*, includes an analysis of pollution sensitivity and an evaluation of the recharge rate of surface water into deeper aquifers.

> "The travel times to buried aquifers vary from days to thousands of years. Areas with relatively short travel times of less than a few years are rated high or very high pollution sensitivity. Areas with

estimated travel times of decades or longer are rated low or very low pollution sensitivity."

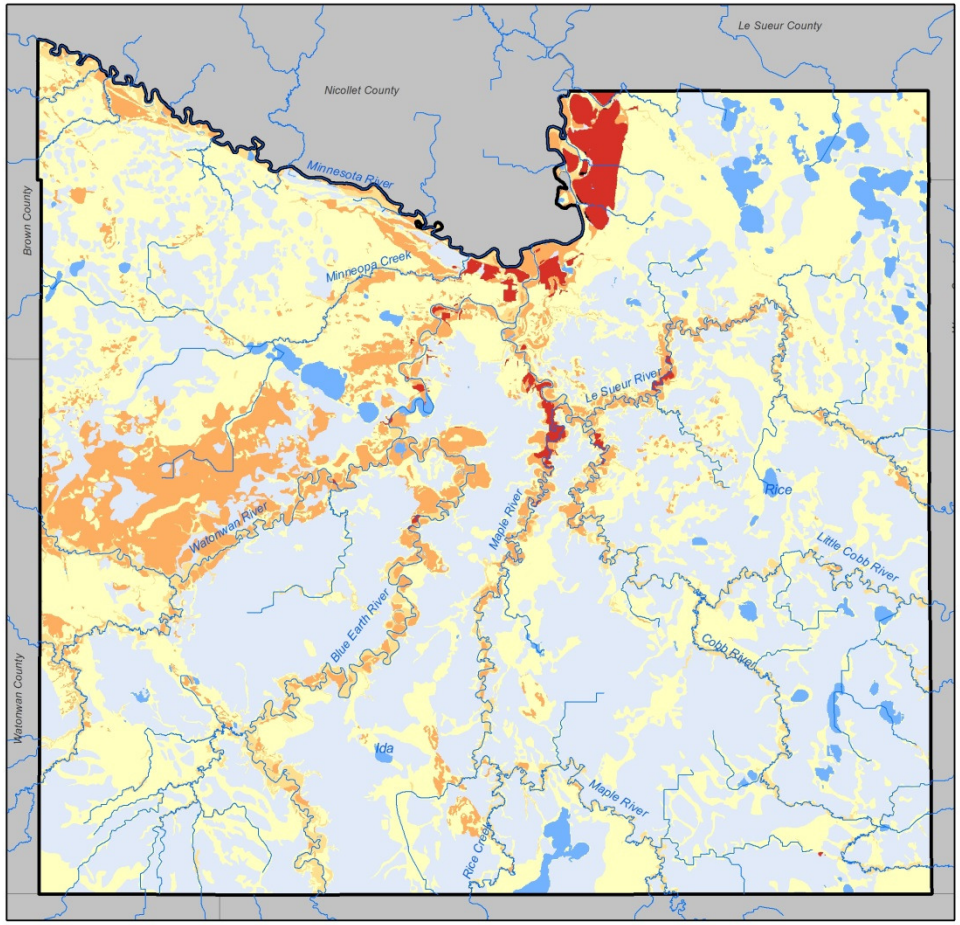
Maps of rapid or focused recharge for specific aquifers are show in in Figures 25 through 32 on pages 42 to 47 of the *Geologic Atlas of Blue Earth County, Part B*.

The map on the following page shows a compilation of the highest rates of recharge for each of the aquifers in the Geologic Atlas. It includes the "High" and "Very High" classes in which the vertical travel time for water to enter a buried sand aquifer is less than a year.

Of the potentially restorable wetlands identified in this plan, 316 are located in an area with "High" or "Very High" potential for groundwater recharge.

To determine whether a potential site can provide groundwater protection or groundwater recharge in practice, a more detailed field analysis will be necessary. Whether a potential site might be developed for a wetland restoration or another type of conservation practice will depend on site suitability and landowner goals. Site suitability should include an analysis of surrounding land uses and potential sources of pollution when restoring wetlands or constructing water storage and water quality practices in areas with high or very high pollution sensitivity to ensure the project will protect water quality instead of becoming a source of pollution. Additional buffers and other measures may be needed in these areas.

Pollution Sensitivity of Near-Surface Materials



Pollution Sensitivity: Estimated vertical travel time through near-surface materials

- High: hours to a week
- Moderate: a week to weeks
- Low: weeks to months
- Very Low: months to a year
- Karst[1]
- Bedrock
- Water

N

0 5 Miles

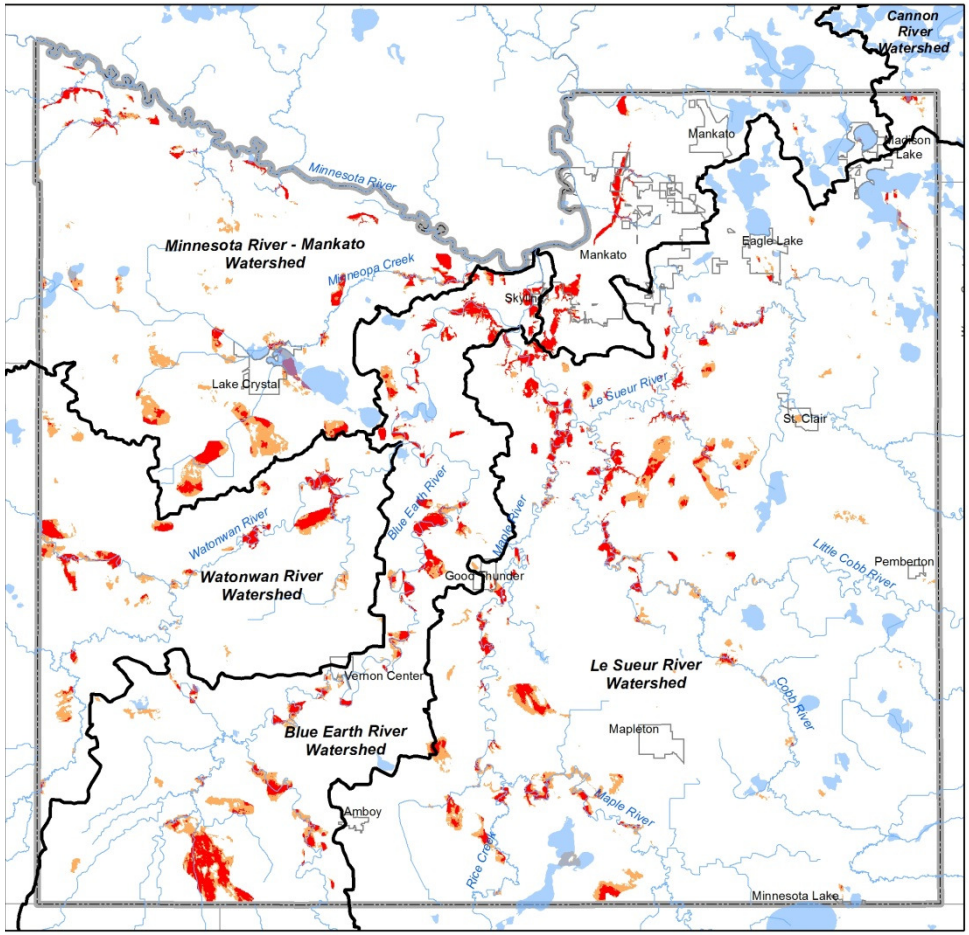
Prepared By: Blue Earth County 2016

Source: Geologic Atlas of Blue Earth County - Part B Minnesota Department of Natural Resources 2016

1 Karst allows a direct, very rapid exchange between surface water and groundwater and significantly increases groundwater contamination risk from surface pollutants.

This pollution sensitivity model assumes a 10-foot-deep water table and vertical travel of possible pollutants through unsaturated, near-surface materials.

Areas of Highest Potential Groundwater Recharge



Major Watershed

Recharge Potential and Estimated vertical travel time for water to enter a buried sand aquifer

- Very High: Hours to Months
- High: Months to Years

N W E S

0 5 Miles

Prepared By: Blue Earth County 2016

Source: Geologic Atlas of Blue Earth County - Part B Minnesota Department of Natural Resources 2016

This map shows a compilation from the pollution sensitivity maps on pages 42-47 of the Geologic Atlas of Blue Earth County, Part B. Pollution sensitivity is defined by the physical properties that affect downward migration of pollutants to the groundwater. The main variable is the rate that water travels from the surface to the aquifers.

Priority Areas – Water Storage – Flood water and Stormwater Attenuation

Description of Water Storage Function

Water storage functions relate to the capacity to collect and retain surface water runoff, direct precipitation and discharging groundwater. Water storage includes water standing in the basin and water held in the soil.

The source of the following description of water storage functions is from *A Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Wetland Functions of Prairie Potholes (HGM)*, Army Corps of Engineers.

Water that is delayed or stored in the wetland reduces the amount of runoff down slope, thereby ensuring a decrease in flood crests down gradient. Wetlands facilitate detention of runoff because many lack well-defined surface water outlets and, between basins, subsurface flows in glacial till are slow. When runoff is detained in a regionally dispersed manner by wetland basins, pulses of water that eventually enter downstream areas in most cases are staggered (desynchronized). This broadens the storm hydrograph and reduces streamflow peaks.

Land use activities also affect erosion up slope and sediment import into the wetlands. An increased sediment load will decrease the wetland's capacity to store water, sometimes nearly eliminating storage capacity.

Although accumulation and retention of sediments and particulates are recognized functions of wetlands resulting in improved water quality, it has a negative effect on wetland hydrology. Many wetlands are closed basins; thus, sediment inputs are derived primarily from wind and water erosion of upland soils within the catchment. Upland land use affects the movement of water, sediment, and pollutants into the wetland. Generally, the higher the percentage of catchment under perennial cover, the better the condition of the wetland. Properly managed perennial cover helps to slow the movement of water down slope, which aids in the filtering of sediments and entrapment of pollutants.

Prioritizing Potential Sites for Water Storage

Each potentially restorable basin (landscape depression) was analyzed for the ability to store surface water runoff from its catchment area. For planning purposes, this analysis assumes each basin is empty and allows for comparison among potential sites. However, most existing wetlands with the greatest storage capacity typically contain water because wetland (hydric) soils in the county are poorly- or very poorly-drained with very low infiltration rates. Water storage capacity in a wetland will vary seasonally and year-to-year as it will depend on recent rainfall as well rain and snow in previous years.

Potential sites were prioritized based on the ability to hold a 10-year, 24-hour storm event (4.37 inches), which sites hold the largest volume of water and which sites have the smallest footprint while storing the most water.

To determine whether a site can provide water storage functions in practice, a more detailed field analysis will be necessary. Whether a potential site might be developed for a wetland restoration or another type of conservation practice will depend on site suitability and landowner goals.

Potentially Restorable Basins - Priority Water Storage Criteria

Maps on the following pages display potential sites for water storage based on the following prioritization criteria:

1. Ability to store a 10-year 24-hour rain event (4.37 inches),
2. Largest potential storage volume (100 acre feet or more), and
3. Top 10% for ratio of volume to surface area – they hold the most water in the smallest footprint

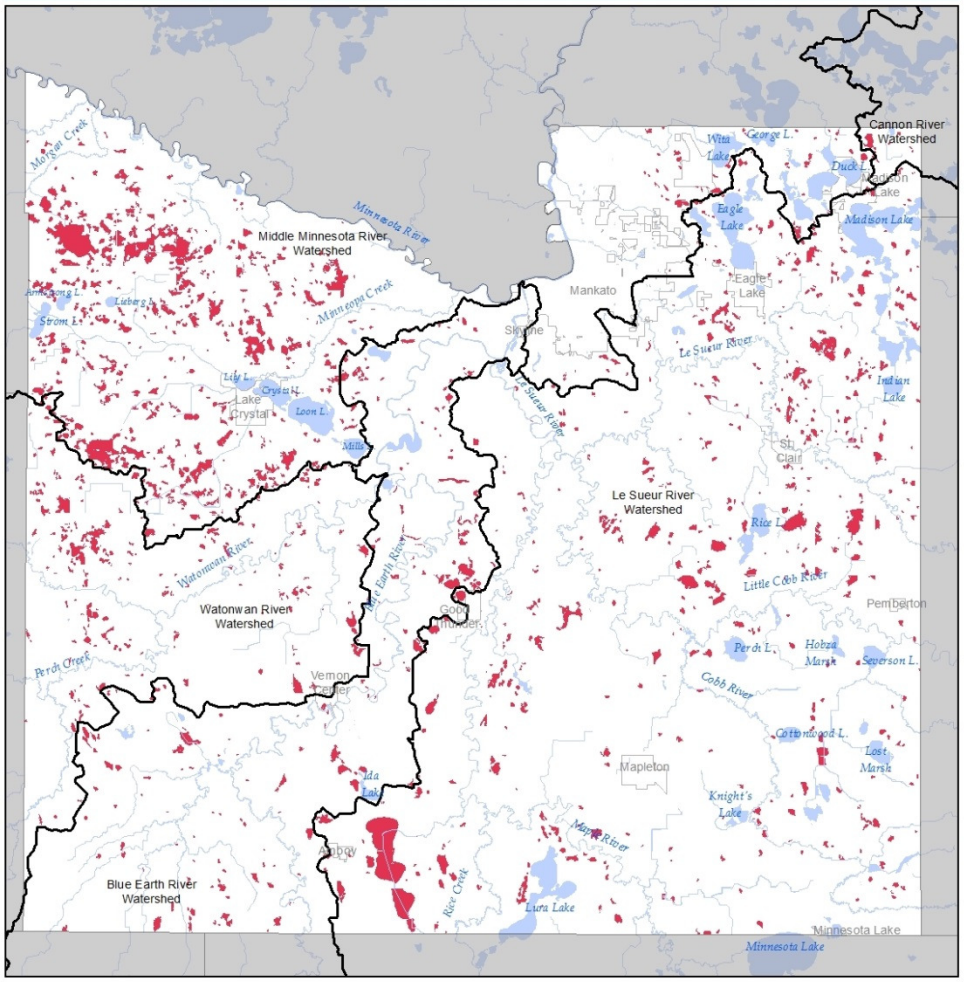
Priority Areas and Watersheds

Water storage is an important function in all watersheds in the county. Small watershed catchments such as ravines and lakes as well as watersheds at the minor (HUC 10-12) and major (HUC 8) watershed scale are affected by altered hydrology as a result of lost water storage. Every local unit of government in the county has been affected by flooding. Every municipality and most townships in the county have been affected by flooding or flash flooding.

Reduced water storage contributes the following water management concerns:

- Flooding in developed areas, roadways.
- Near channel erosion and channel incision in ravines, intermittent streams and rivers; significant sources of erosion and sedimentation downstream.
- Elevated water levels and negatively impacted aquatic vegetation and aquatic life in lakes and wetlands. Naturally fluctuating water levels best support maintenance of healthy aquatic and wetland vegetation.

Potentially Restorable Basins that can Store the 10-Year 24-Hour Rain Event (4.37 inches)



0 5 10 Miles

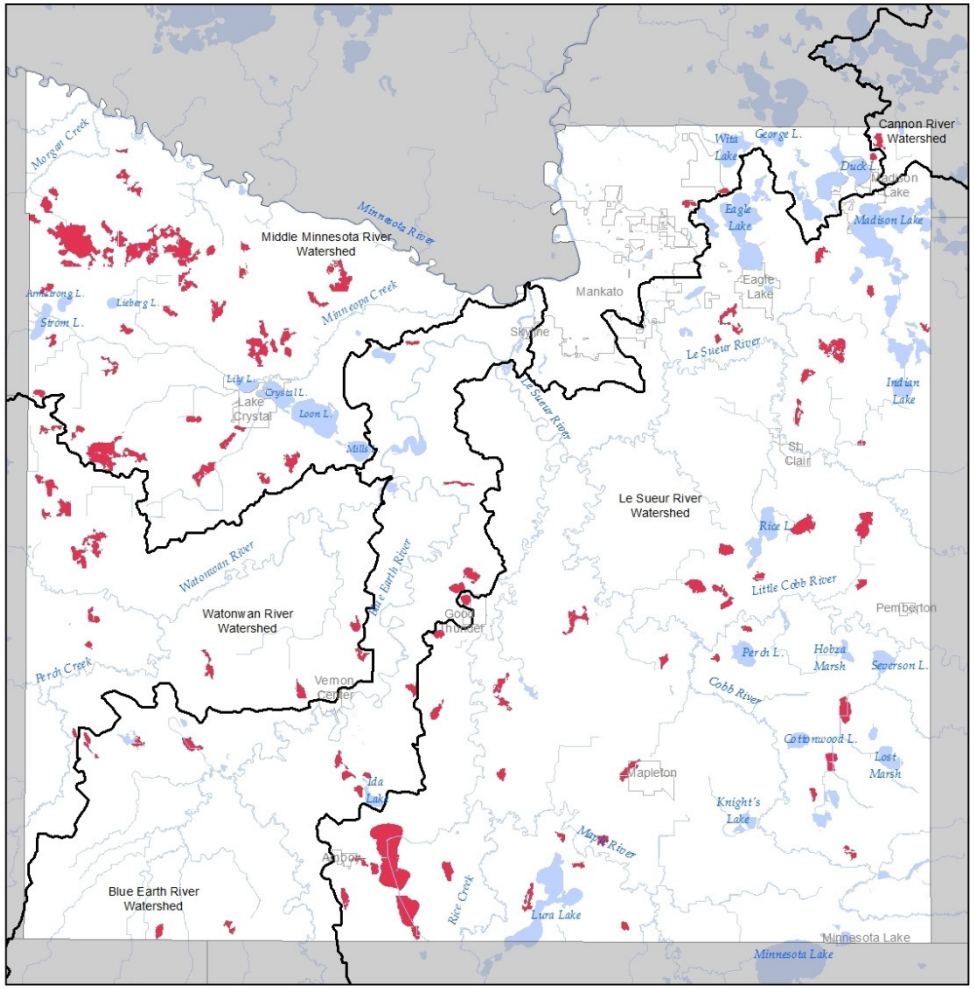
Potentially Restorable Basin that can Store the 10-Year 24-Hour Rain Event

Major Watershed (HUC 8)

Prepared By: Blue Earth County Environmental Services 2017

Source: Potentially Restorable Basin LiDAR Terrain Analysis - Houston Engineering Inc. 2015

Potentially Restorable Basins that Have a Volume of 100 Acre-Feet or More



0 5 10 Miles

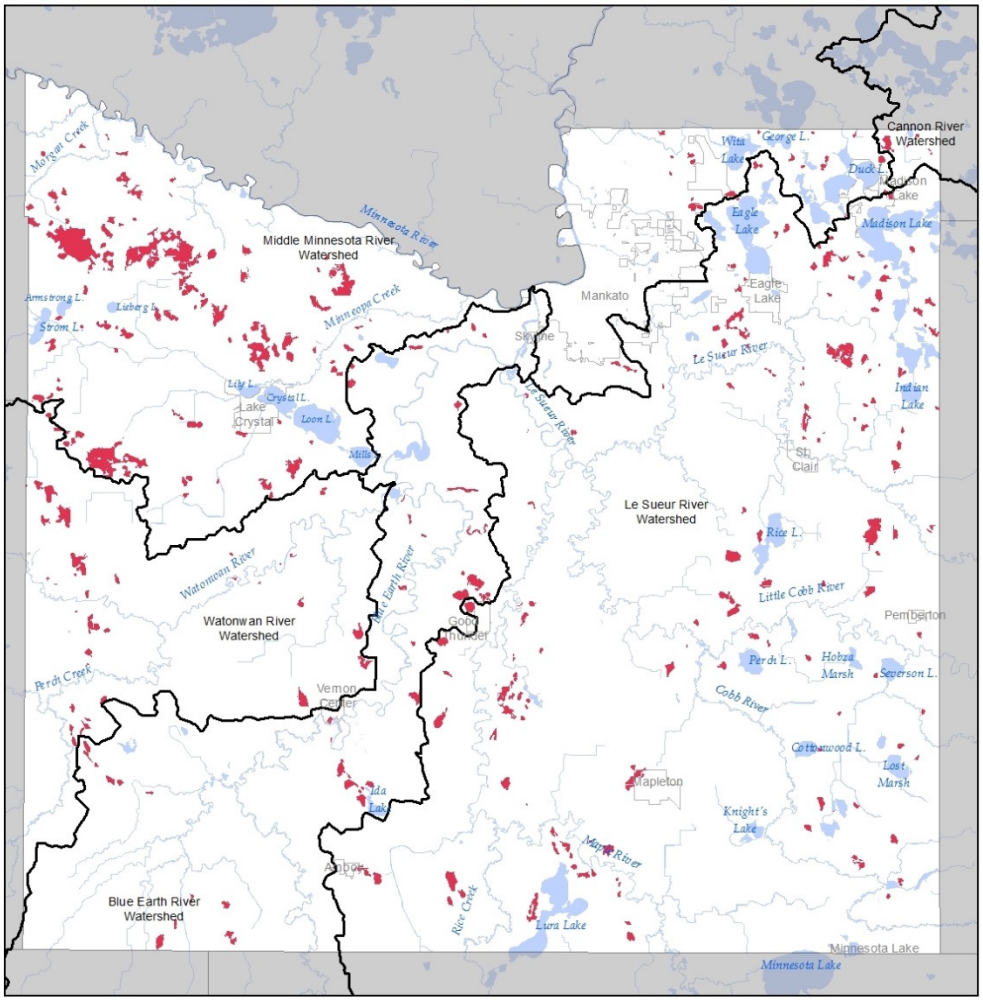
Potentially Restorable Basins that have A Volume of 100 Acre-Feet or More

Major Watershed (HUC 8)

Prepared By: Blue Earth County Environmental Services 2017

Source: Potentially Restorable Basins LiDAR Terrain Analysis - Houston Engineering Inc. 2015

Potentially Restorable Basin in the Top 10 percent for Ratio of Volume to Surface Area



0 5 10 Miles

Potentially Restorable Basin in the Top 10-Percent for Ratio of Volume to Surface Area

Major Watershed (HUC 8)

Prepared By: Blue Earth County Environmental Services 2017

Source: Potentially Restorable Basins LiDAR Terrain Analysis - Houston Engineering Inc. 2015

Priority Areas - Water Quality – Nutrient Treatment

Description of Nutrient Treatment Function

The source of the following description of nutrient treatment functions is *A Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Wetland Functions of Prairie Potholes (HGM)*, Army Corps of Engineers.

A wetland's ability to uptake, metabolize, sequester and/or remove nutrients and imported elements from the water is primarily dependent on wetland vegetative conditions. Microbial processing and bioaccumulation are associated with plant cover including floating, emergent or submergent vegetation. Vegetative density can serve as an index of primary production, which is an indicator of nutrient assimilation.

Wetland environments are effective at denitrification. Wetland vegetation needed for removing nutrients survives best in wetlands less than three feet deep. Forested wetlands retain ammonia during seasonal flooding.

Excessive nutrient loading to a wetland can cause nuisance algal blooms and the production of monotypic stands of invasive or weed species. Observed point source or nonpoint source of nutrients may include but is not limited to: fertilized lawns, agricultural runoff, manure storage or spreading, concentrated stormwater runoff, or pet waste inputs.

Phosphorus is removed from the water column in wetlands through plant uptake, immobilization by microorganisms into microbial cells during decomposition of plant material, adsorption of orthophosphate onto clay and oxyhydroxide surfaces, and precipitation with cations such as calcium, magnesium and iron. The best long-term removal process is uptake by growing plants, and the storage of plant remains as peat or removal of plant material by harvest.

There is a limit to the amount of phosphorous that can be adsorbed because adsorption sites can become saturated with phosphorous. Normally, most phosphorus is associated with particulate materials that are removed from the water column as sediments settle. Annual net uptake of phosphorus by growing vegetation, although significant, usually represents a small quantity relative to the soil/sediment sinks of phosphorus.

Prioritizing Potential Sites for Nutrient Treatment

The local technical and stakeholder advisory committee used the Iowa CREP criteria for nitrogen treatment wetlands as a starting point to identify potential sites for nutrient treatment. The number of potential sites that meet the Iowa CREP criteria was too few, so the watershed area and depth criteria were modified to include more potential sites by slightly modifying the ratio of basin to watershed size and removing the minimum watershed size criteria.

Wetland vegetation needed for removing nutrients survives best in wetlands less than three feet deep.

The map on the following page shows potential sites ranked High, Medium and Low for nutrient treatment potential.

To determine whether a site can provide nutrient treatment functions in practice, a more detailed field analysis will be necessary.

Potentially Restorable Basins – Priority Nutrient Treatment Criteria

High Potential for Nutrient Treatment

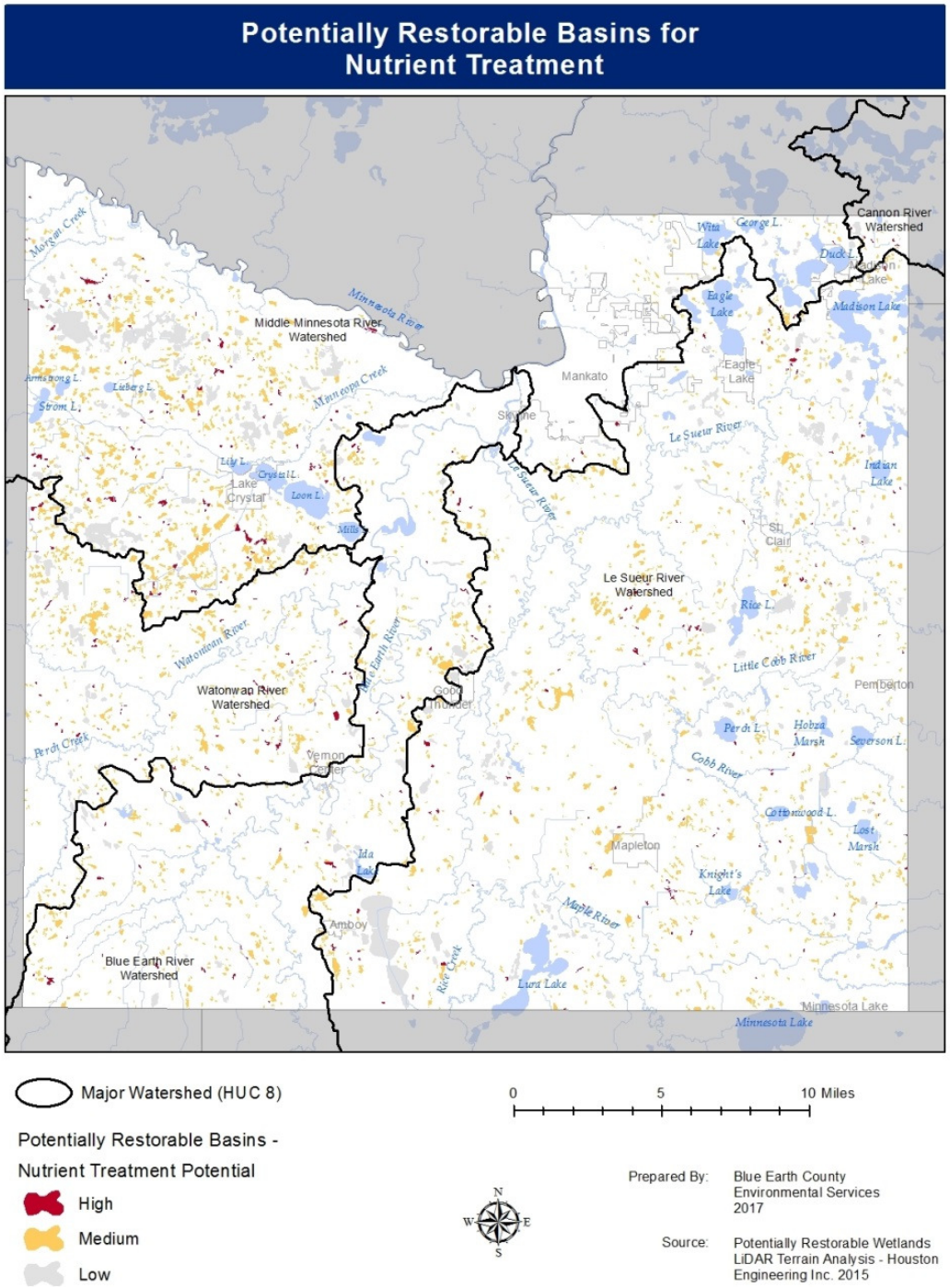
Depth: 75% or more of the basin is less than 3 feet
Ratio of basin to watershed area: Basin 0.4% to 2.5% of the site's watershed area
Size: No minimum watershed size

Medium Potential for Nutrient Treatment

Depth: 75% or more of the basin is less than 3 feet
No other criteria applied

Low Potential for Nutrient Treatment

Depth: Less than 75% of the basin is less than 3 feet
No other criteria applied



Stormwater Wetlands - Attenuation and Water Quality Treatment Functions

Natural wetland restoration is preferred county-wide and is generally preferred by the Wetland Conservation Act (Minnesota Rules part 8420.0522 subpart 5A).

In some watersheds, constructed wetlands or water quality treatment wetlands may best provide wetland functions to achieve watershed goals for improving water quality or flood and stormwater attenuation functions. The WCA design and monitoring requirements for water quality treatment system wetland creations would apply to these sites if constructed.

Priority Areas/Watersheds Floodwater and Stormwater Attenuation

Most rivers and streams have turbidity impairments largely due to ravine, stream bank and bluff erosion. When water quality wetlands are constructed in addition to the required stormwater management systems in municipalities and urbanizing areas of watersheds in the county, they can help buffer the effects of heavy rainfall in their local watersheds and in downstream gullies, ravines, rivers and lakes.

Ideal conditions for natural wetland restoration in urbanizing sub-watersheds of the Middle Minnesota River, Le Sueur River and Blue Earth River near Mankato, Eagle Lake, Skyline and Madison Lake are limited. These watersheds are impacted by loss of water storage and increased runoff, flooding and erosion in downstream channels, ravines, lakes and wetlands.

Near Mankato and Eagle Lake, soils are hydric, have very low infiltration rates (0.05 inches per hour), and the seasonal high water table is very high. This limits the type and effectiveness of stormwater management practices allowed by Minnesota NPDES Construction Stormwater Permit Rules and the MS4 SWPPPs in this area. Shallow depth to bedrock is also a limiting factor for stormwater treatment near Mankato.

Pollution sensitivity is high in areas with shallow depth to bedrock. Properly designed and constructed stormwater wetlands or water quality treatment wetlands could provide groundwater protection and recharge in areas with high or moderate pollution sensitivity.

Priority Watersheds for Water Quality Function

Protecting and restoring water quality and reducing nutrients in all lake watersheds is a high priority.

The Duck and Ballantyne watershed has the lowest percentage of wetland loss in the county. Of the lakes assessed in the county, these lakes have the best water quality. Wetland restoration opportunities in this watershed are limited. Wetlands in these watersheds lack upland buffers. The effect of residential and urban development stormwater quantity and quality and potential loss or impacts to wetlands in the Duck and Ballantyne watershed is a significant concern for protecting water quality in these lakes.

Madison Lake and Lake Crystal are on the MPCA impaired waters list. Both of these watersheds are affected by shoreline and urban development as well as agricultural land uses. The Lake Crystal watershed has a high percentage of drained wetlands. In the urbanizing areas of these lake watersheds there are limited opportunities for natural wetland restoration but stormwater wetlands may provide needed functions.

Wetlands in Urban Watersheds

"Urban development trends generally are detrimental to wetlands. Many wetlands are lost in the process and those that remain are degraded by the high intensity of uses in the urbanized surrounding areas. For example, the almost continuous concrete, asphalt, and rooftops that harden the landscape result in increased levels of stormwater runoff.

Attempts to restore urban watersheds include *softening* the watershed by restoring important resources in locations where their functions will add green structure (i.e., slow down the flow of stormwater and contribute in other ways to the overall improvement of the watershed).

In most situations, wetland restoration projects are planned to provide the highest level of ecological condition possible. Included in this planning tenet is the assumption that the wetlands will also perform their functions at the highest levels possible. Restorations in highly urbanized portions of watersheds can make this standard difficult or impossible to achieve.

The wetlands needed in some parts of urban watersheds end up being planned and implemented to perform functions such as flow attenuation, water quality improvement, and floodwater retention at the expense of overall wetland quality. These working wetlands, because of the constant stress they experience, may be mostly or completely comprised of an invasive species plant community and have poor water quality, high rates of sedimentation, and other indications of degradation. However, their role is not to be pristine examples of wetlands; instead, their mission is to perform their designed functions in a way that maximizes the overall good for the watershed. While these wetlands may not be "pretty to look at," some would consider them "true beauties" when the overall benefits they provide for the watershed are considered."

Source: *Incorporating Wetlands Into Watershed Plans,* EPA Region 5 Wetlands Supplement

Priority Watersheds
Constructed Wetlands or Water Quality Treatment Systems

Constructed wetlands or water quality treatment wetlands can provide important water quality and floodwater/stormwater attenuation functions to provide water quality treatment and/or reduce flooding and downstream flooding and erosion in all watersheds in the county. Priority watersheds where water quality treatment or constructed wetlands might best provide these functions are shown in this table.

Priority Minor Watersheds and 12-digit Hydrologic Unit Codes	Priority Subwatersheds in Minor Watershed	Priority Functions
City of Mankato - Minnesota River HUC12: 070200071102	Indian Creek Watershed County Ditch 98 watershed County Ditch 69 watershed City of Mankato South Bend Township Mankato Township	floodwater/stormwater attenuation
Le Sueur River HUC12: 070200110607 Eagle Lake HUC12: 070200110607	County Ditch 12 watershed County Ditch 43 watershed Drainage ditch watershed west of Eagle Lake city limits	floodwater/stormwater attenuation
Blue Earth River HUC 12:070200091103	City of Skyline City of Mankato South Bend Township	water quality treatment; floodwater/stormwater attenuation
Shanaska Creek HUC12: 070200071104	Duck Lake and Lake Ballantyne watershed City of Madison Lake draining to Duck and Ballantyne	water quality treatment; stormwater attenuation
Madison Lake HUC12: 070200110605	Portion of watershed draining to Madison Lake City of Madison Lake and shoreland areas	water quality treatment; stormwater attenuation
Lake Crystal HUC12: 070200070902	County Ditch 56 watershed and City of Lake Crystal Crystal Lake, Loon Lake and Mills Lake	water quality treatment; stormwater attenuation

Summary of Potential Sites for Wetland Restoration and Wetland Functions

There are ample opportunities for wetland restoration or conservation projects that provide important wetland functions.

The following tables show the number and land area of potentially restorable basins in major watersheds (8 digit HUC) and the priority areas for providing multiple natural resource and aquatic functions in the Greenprint, nutrient treat identified for this plan. Basins with one property owner were identified using GIS and August 2015 land records data. There are 3,285 potentially restorable basins greater than two acres in the county, and 1,436 of those are greater than five acres. There are 1,324 potentially restorable basins in Greenprint priority areas, and 624 of those are greater than five acres.

Potentially Restorable Wetlands over 2-Acres Summarized By Watershed

				Basin with One Owner*	
Watershed	**Number**	**Total Area in Acres**	**Median Area in Acres**	**Number**	**Percent**
Blue Earth	541	4,739	3.99	289	53.4%
Le Sueur	1,311	11,034	4.10	668	51.0%
Minnesota River-Mankato	975	12,139	4.89	514	52.7%
Watonwan	446	3,677	3.99	284	63.7%
Cannon	12	48	4.09	5	41.7%
Total	**3,285**	**31,638**	**4.28**	**1,760**	**53.6%**

*one owner based on 2016 Blue Earth County Taxpayer data Land Records data

Potentially Restorable Wetlands over 2-Acres Summarized By Area of Interest

Area of Interest*	Number	Total Area in Acres	Median Area in Acres	Basin Owned by One Property Owner	
				Number	Percent
Greenprint Wetland Complexes	941	10,338	4.89	506	54%
Greenprint Corridors and 500 feet adjacent to Greenprint**	643	8,032	4.48	324	50%
Total Greenprint Corridors and Wetland Complexes	1,324	14,737			
High or Very High Recharge areas for Buried Sands Aquifer	313	6,671	5.88	139	44%
High or Moderate Pollution Sensitivity	529	8,656	5.39	287	54%
North Central Planning Area	149	1,162	4.38	60	40%
More than 100 feet from a road	2,200	15,628	4.56		

*potentially restorable basins may be in more than one area of interest.

** includes Greenprint corridors plus potentially restorable basins within 500 feet.

Potentially Restorable Wetlands over 5-Acres Summarized By Area of Interest

Area of Interest**	Number	Total Area in Acres	Median Area in Acres	Basin Owned by One Owner*	
				Number	Percent
Greenprint Wetland Complexes	465	8,869	9.5	187	40%
Greenprint Corridors and 500 feet adjacent to Greenprint***	298	6,953	10.7	102	34%
Total Greenprint Corridors and Wetland Complexes	624	12,578	9.62	242	38%
High or Very High Recharge areas for Buried Sands Aquifer	170	6,222	12.48	45	26%
High or Moderate Pollution Sensitivity	280	7,975	11.73	107	38%
North Central Planning Area	66	898	8.8	17	25%

*one owner based on 2016 Blue Earth County Taxpayer data Land Records data
**potentially restorable basins may be in more than one area of interest
*** includes Greenprint corridors plus potentially restorable basins within 500 feet

Priority Subwatersheds

Science-Based Process for Prioritizing and Targeting Subwatersheds for Nonpoint Sources

Most river or stream reaches that have been assessed in the county are on the impaired waters list, and just one of the lakes in the county that has been assessed is not on the impaired waters list. Looking at the Le Sueur River WRAPS and the MPCA nitrogen, nutrient and sediment reduction studies and strategies, a case can be made for prioritizing every subwatershed in the county.

To achieve measurable outcomes at a watershed scale, non-point source project implementation should be prioritized at the subwatershed scale using science-based methods. Projects using State or Federal grants can be further targeted using terrain analysis and other tools designed for this purpose.

The following is a description of the process that may be used to target subwatersheds for nitrogen, phosphorus and upland erosion reduction strategies and project implementation.

Prioritizing Subwatersheds (HUC12)

Watersheds and subwatersheds can be subdivided and identified using USGS hydrologic unit codes (HUC). A hydrologic unit code (HUC) is a sequence of numbers that represent major basins, basins, watersheds, and smaller watersheds. The fewer numbers in the HUC, the larger the watershed. The following are examples of local watershed HUCs.

- Minnesota River Basin has a 6-digit HUC.
- Blue Earth, Le Sueur and Watonwan and Middle Minnesota River watersheds are 8-digit HUCs.
- Maple River, Cobb, Little Cottonwood watersheds are 10-digit HUCS.
- Smaller subwatersheds are 12-digit HUCs.

The map on the following page displays all 12-digit HUC watersheds in the county.

The county is in all or part of 45 HUC12 watersheds. Of the 45 HUC12 watersheds in the county, 27 have more than 50% of the watershed area in the county or are in the Middle Minnesota River where the Minnesota River divides the HUC12 watershed.

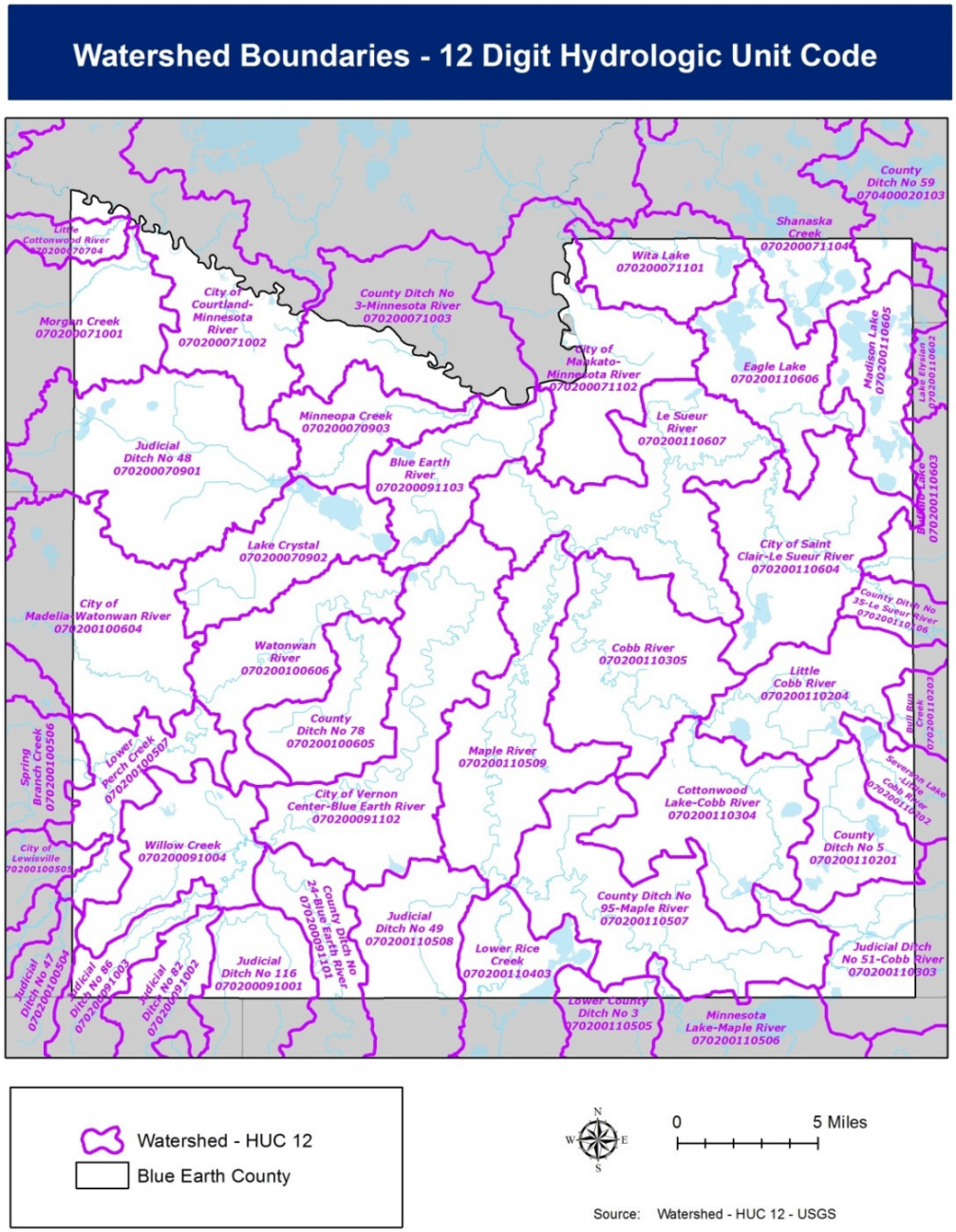
A description of a local, science based process that may be used to prioritize HUC12 watersheds for projects to reduce nitrogen, phosphorus and upland erosion follows.

Watershed Restoration and Protection Strategies (WRAPS)

The MPCA WRAPS reports are prepared for major watersheds. Only the Le Sueur WRAPS is completed.

The results of the Le Sueur River WRAPS show limitations in using the HSPF modeled results in the WRAPS report in lake watersheds and for prioritizing nitrogen reduction in subwatersheds. Lake watersheds and nitrogen reduction are priority concerns in the county.

In the WRAPS HSPF modeled pollutant yields from lake watersheds, the lakes subwatersheds are low contributors because lakes function as stormwater ponds in the watershed settling out nutrients and sediment in the river watershed scale. The HSPF modeled nitrogen yields in the WRAPS may not representative of nitrogen conditions, because the major pathway of nitrogen transport is subsurface tile drainage and the Hydrologic Simulation Program – Fortran (HSPF) model does not account for subsurface tile drainage.



Priority Subwatersheds and Areas for Water Storage

Water storage is an important function in all watersheds in the county. The effects of increasing precipitation trends in recent decades and increased drainage in both urban and rural landscapes has caused water quality and flooding concerns.

Priority Watersheds

Water storage is an important function in all watersheds in the county. Small watershed catchments such as ravines and lakes as well as watersheds at the minor (HUC 10-12) and major (HUC 8) watershed scale are affected by altered hydrology and loss of water storage. Every local unit of government in the county has been affected by flash flooding and nearly every local unit of government has been affected by near channel erosion.

Reduced water storage has altered hydrology and lake levels and negatively impacted aquatic vegetation and wildlife habitat in lakes and wetlands in local watersheds. Many lakes in the county function as sediment and nutrient traps in their watershed.

Reduced water storage has altered hydrology in ravines and intermittent and small streams where near channel erosion and stream channel migration are significant sources of sediment in these small watersheds as well as downstream. In addition to streams flow, drainage to ravines should be managed and reduced to reduce downstream impacts.

At the basin scale, near channel erosion in the incised reaches of the Blue Earth and Le Sueur watersheds has been accelerated by increasing precipitation and more water draining to these rivers.

The *Collaborative for Sediment Source Reduction – Greater Blue Earth River Basin Summary of Findings* state water storage for reducing high flows most associated with near channels is most likely to be effective when placed in upland areas above the lower, incised parts of the watershed, and investment in stabilizing ravines is worthwhile, but not sufficient to reduce sediment loading to meet water quality standards. Water storage in ravine watersheds as well as the uplands are both in Blue Earth County. Water storage management options are recommended for ravines and uplands.

In the Indian Creek watershed channel erosion threatens dwellings and infrastructure and the designed flood storage capacity for Army Corps of Engineers Flood Control Project on the Minnesota River and Blue Earth River.

Every stream in the Middle Minnesota River watershed would benefit from water storage. In the Morgan Creek watershed nearly all of the presettlement wetlands that covered 70% of the watershed were drained.

Priority Areas and Subwatersheds for Nutrient Management

Reducing nitrate-nitrogen is a high priority in the lowest reach of the Blue Earth River where the river recharges surficial sands aquifers used for public water supply wells, as well as the Watonwan River Watershed, Le Sueur River Watershed and Middle Minnesota River Watershed.

Reducing phosphorus is a priority in all lake watersheds in the county.

Nitrogen Reduction

Work to promote nitrogen management and treatment practices and strategies should be targeted to the most significant source and pathways of nitrogen transport to surface and groundwater. As described in the MPCA report, *Nitrogen in Minnesota Surface Waters, Conditions, trends, sources, and reductions*, cropland is the source of 89 to 95% of nitrogen in surface waters and subsurface tile drainage is the major pathway of nitrogen transport to surface waters as well as soils with sensitivity to nutrient management due to coarse texture.

Sandy and Coarse-textured Soils can be mapped using the USDA NRCS Soil Survey.

Maps on the following pages show a generalized analysis of HUC12 subwatersheds in the county with the highest percentage and the largest number of acres of coarse textured soils used for cropland.

The HUC12 subwatersheds with the highest percent of coarse textured soils in the county also have shallow depth to water table according to the USDA NRCS Soil Survey. These areas are shown to have "moderate" or "high" pollution sensitivity, taking hours to weeks travel time to near surface materials, according to the *Geologic Atlas of Blue Earth County, Part B.*

Subsurface Tile Drainage cannot be mapped because there is no database or inventory of tile-drained land.

There is extensive tile drainage of soils in the county, because many soils are poorly drained necessitating drainage for crop production due to wetness. "Poorly drained" and "very poorly drained" soils can be mapped using the USDA NRCS Soil Survey.

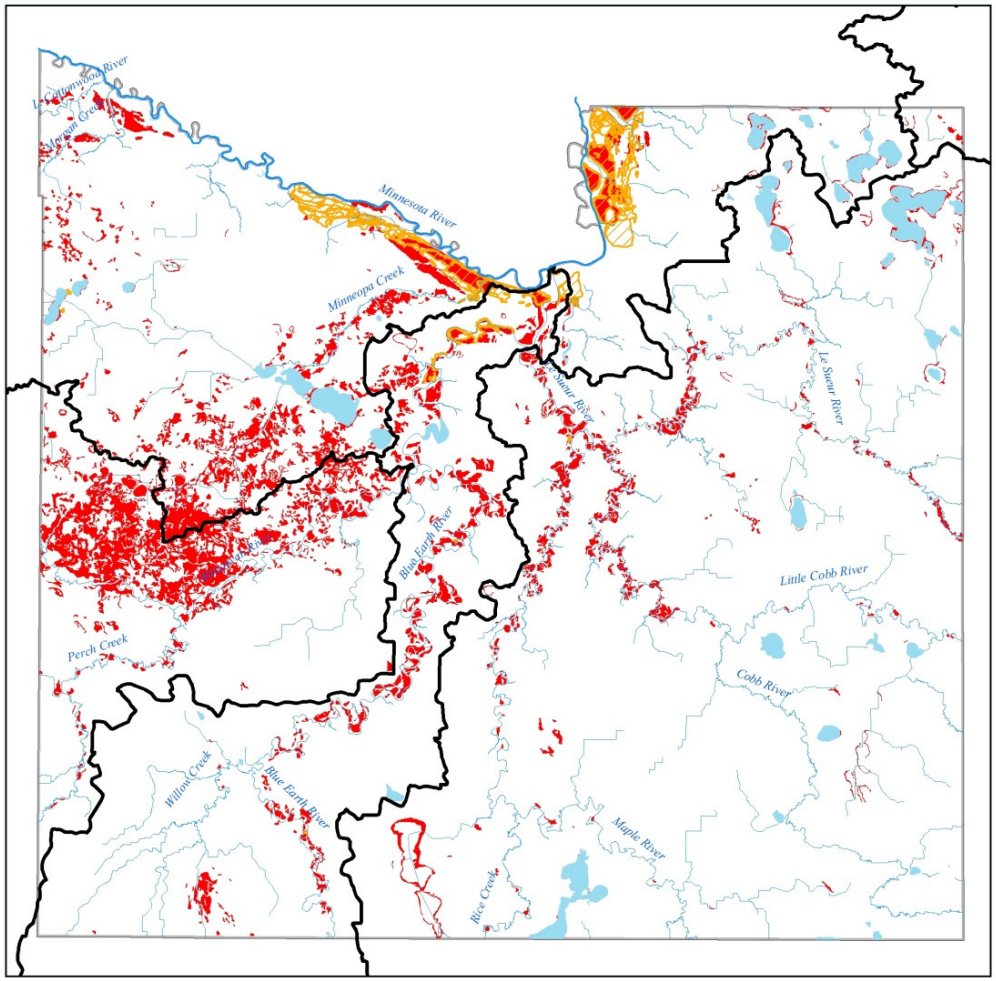
Maps on the following pages show a generalized analysis of HUC12 subwatersheds in the county with the highest percentage and the largest number of acres of "poorly drained" and "very poorly drained" soils used for cropland.

Priority Watersheds for Nitrogen Reduction

Reducing nitrogen is a priority in the greater Blue Earth River watershed. The highest priority subwatershed is the lowest reach of the Blue Earth River where the river recharges surficial sands aquifers used for a public water supply. Future nitrogen monitoring may help direct nitrogen reduction strategies and prioritize HUC12 watersheds for nitrogen reduction.

The MPCA N*itrogen in Minnesota Surface Waters, Conditions, trends, sources and reductions* report states that "Meaningful N reductions to surface waters at regional scales cannot be achieved by solely targeting small geologically sensitive areas, relatively small watersheds, or mismanaged lands. Little cumulative state-level progress will be made unless multiple watersheds (i.e. the top 10 to 20 N loading watersheds) all work to reduce N levels."

Sensitive Soils for Nutrient Management Due to Coarse Textured Soils or Shallow Bedrock



Major Watershed

Sensitive Soils for Nutrient Management Due to Coarse Textured Soils or Shallow Bedrock

Soil with Shallow Bedrock

Coarse Textured Soil

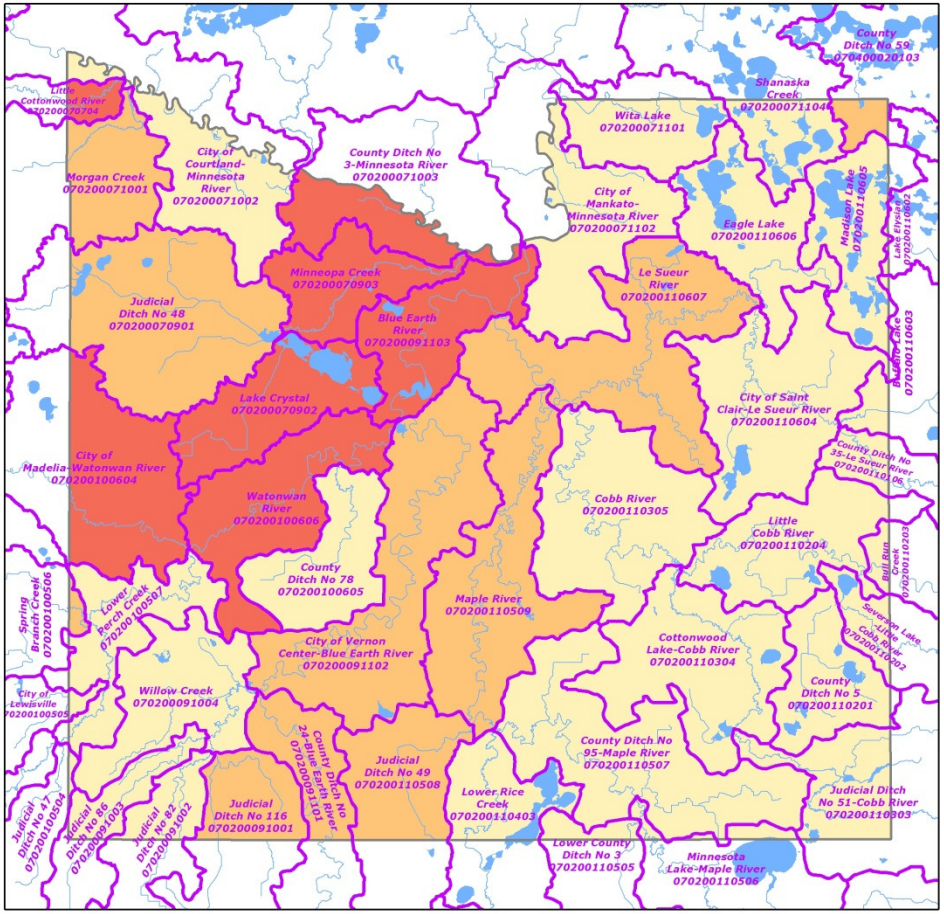
0 5 10 Miles

N W E S

Prepared By: Blue Earth County Environmental Services 2016

Source: NRCS SSURGO Soils

Percent of Cropland in 12 Digit HUC Classified as Sensitive Soil for Nutrient Management due to Coarse Textured Soils



Watershed - HUC 12

Blue Earth County

Percent of Cropland in HUC Classified as Sensitive Soil for for Nutrient Management due to Coarse Textured Soils

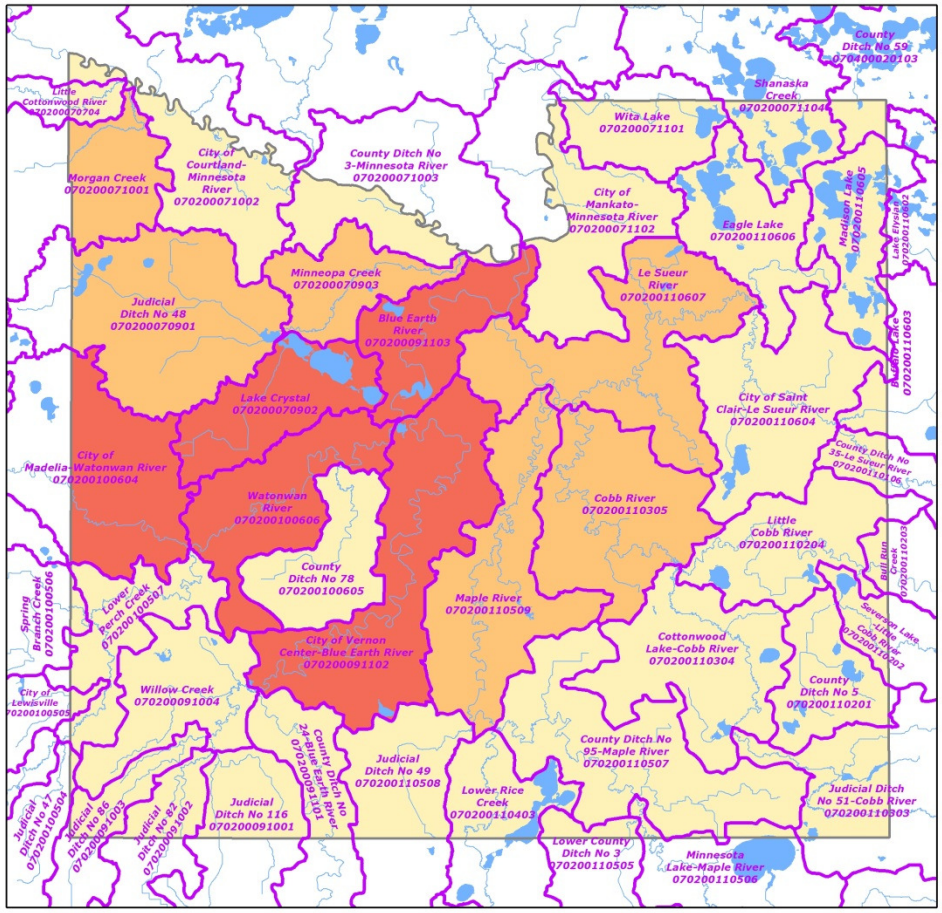
- 0 to 3 Percent
- 3 to 8 Percent
- Over 8 Percent

0 5 Miles

Prepared By: Blue Earth County Environmental Services 2016

Source: NRCS SSURGO Soils Watershed - HUC 12 - USGS

Acres of Cropland in 12-Digit HUC Classified as Sensitive Soil for Nutrient Management due to Coarse Textured Soils



Watershed - HUC 12

Blue Earth County

Acres of Cropland in HUC Classified as Sensitive Soil for Nutrient Management due to Coarse Textured Soils

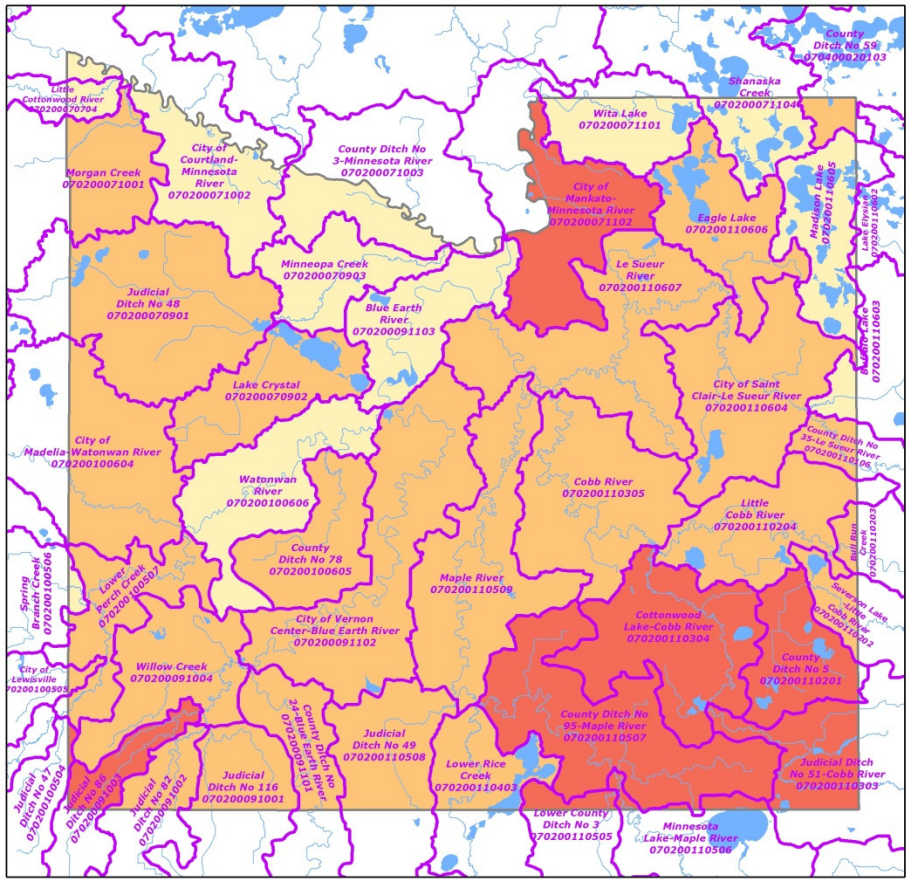
- 0 to 400 Acres
- 400 to 1,0000 Acres
- Over 1,000 Acres

0 5 Miles

Prepared By: Blue Earth County Environmental Services 2016

Source: NRCS SSURGO Soils Watershed - HUC 12 - USGS

Percent of Cropland in 12-Digit HUC Classified as Poorly Drained or Very Poorly Drained



Watershed - HUC 12

Blue Earth County

Acres of Cropland in HUC Classified as Poorly Drained or Very Poorly Drained

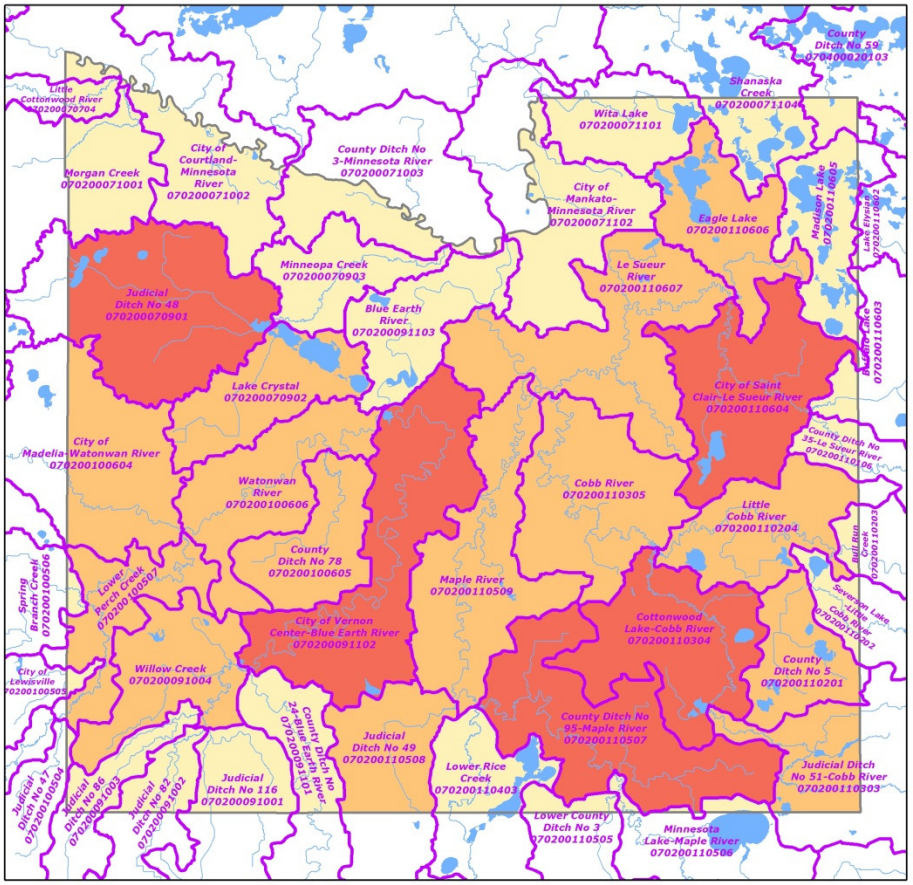
- 27 to 50 Percent
- 50 to 70 Percent
- 70 to 97 Percent

0 5 Miles

Prepared By: Blue Earth County Environmental Services 2016

Source: NRCS SSURGO Soils Watershed - HUC 12 - USGS

Acres of Cropland in 12 Digit HUC Classified as Poorly Drained or Very Poorly Drained



Watershed - HUC 12

Blue Earth County

Acres of Cropland in HUC Classified as Poorly Drained or Very Poorly Drained

- 53 to 4,000
- 4,000 to 11,000
- 11,000 to 18,230

0 5 Miles

Prepared By: Blue Earth County Environmental Services 2016

Source: NRCS SSURGO Soils Watershed - HUC 12 - USGS

Phosphorus Reduction

Phosphorus management and treatment practices and strategies can be targeted to the most significant sources and pathways of phosphorus transport to surface water. The 2004 *Detailed Assessment of Phosphorus Sources to Minnesota Watersheds* states that "cropland represents a significant portion of the total bioavailable phosphorus loadings in the Minnesota River Basin during each flow condition." In an average year, cropland contributes 41% and agricultural drainage contributes 10%.

As described in the University of Minnesota bulletin, *Phosphorus: Transport to and availability in surface waters,* the main factors affecting transport of phosphorus to surface water are soil erosion and runoff. Runoff of water either across the soil surface or via subsurface flow can contain significant concentrations of dissolved phosphorus.

The maps on the following pages show a generalized analysis of HUC12 subwatersheds in the county with the highest percentage of acres and number of acres with cropland classified as "highly erodible" or "potentially highly erodible" in the USDA NRCS Soil Survey.

Priority Watersheds for Phosphorus Reduction

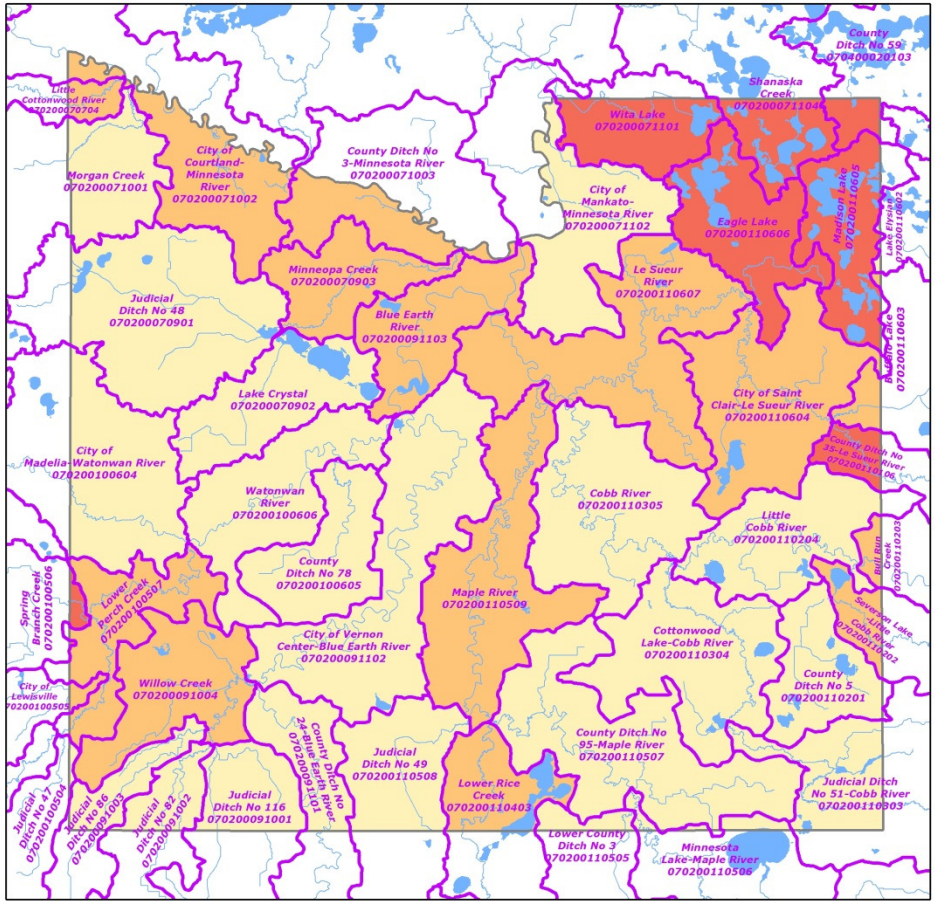
Reducing phosphorus in lake watersheds is a high priority.

The highest priority lake watersheds during the ten-year planning period are Crystal-Loon-Mills, Madison and Ballantyne-Duck.

Work is underway in the Lake Crystal and Madison Lake watersheds. Madison Lake, Ballantyne and Eagle Lake are located in HUC12 watersheds with the highest percentages of cropland classified as "highly erodible" or "potentially highly erodible" in the county. The Lake Crystal watershed is located in an area with sensitive soils for nutrient management due to coarse textured soils.

After the MPCA finalizes river eutrophication standards, there may be more information available to prioritize and target phosphorus reduction in HUC12 watersheds.

Percent of Cropland in 12-Digit Hydrologic Unit Code (HUC) Classified as Highly Erodible or Potentially Highly Erodible Land



Watershed - HUC 12

Blue Earth County

Percent of Cropland in HUC Classified as Highly or Potentially Highly Erodible Land

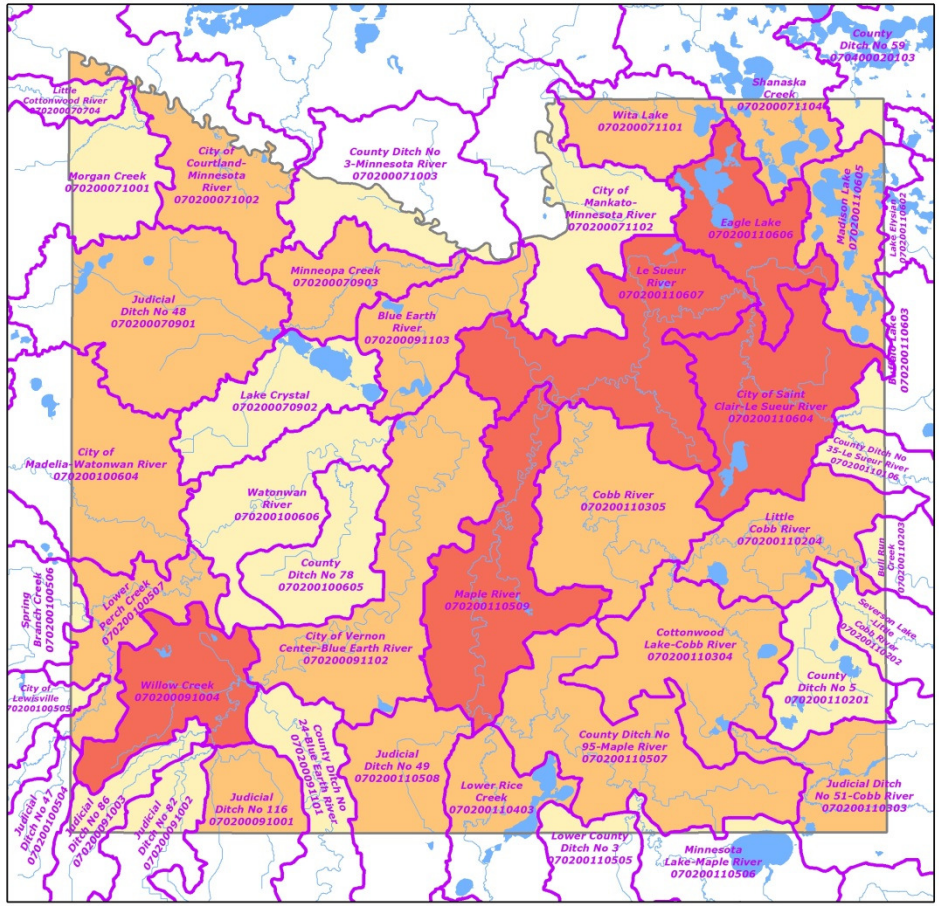
- 0 to 5 Percent
- 5 to 9 Percent
- Over 9 Percent

0 — 5 Miles

Prepared By: Blue Earth County Environmental Services 2016

Source: NRCS SSURGO Soils Watershed - HUC 12 - USGS

Acres of Cropland in 12-Digit Hydrologic Unit Code (HUC) Classified as Highly Erodible or Potentially Highly Erodible Land



Watershed - HUC 12

Blue Earth County

Acres of Highly Erodible Cropland In HUC in Blue Earth County

- 0 - 300 Acres
- 300 - 800 Acres
- Over 800 Acres

0 — 5 Miles

Prepared By: Blue Earth County Environmental Services 2016

Source: NRCS SSURGO Soils Watershed - HUC 12 - USGS

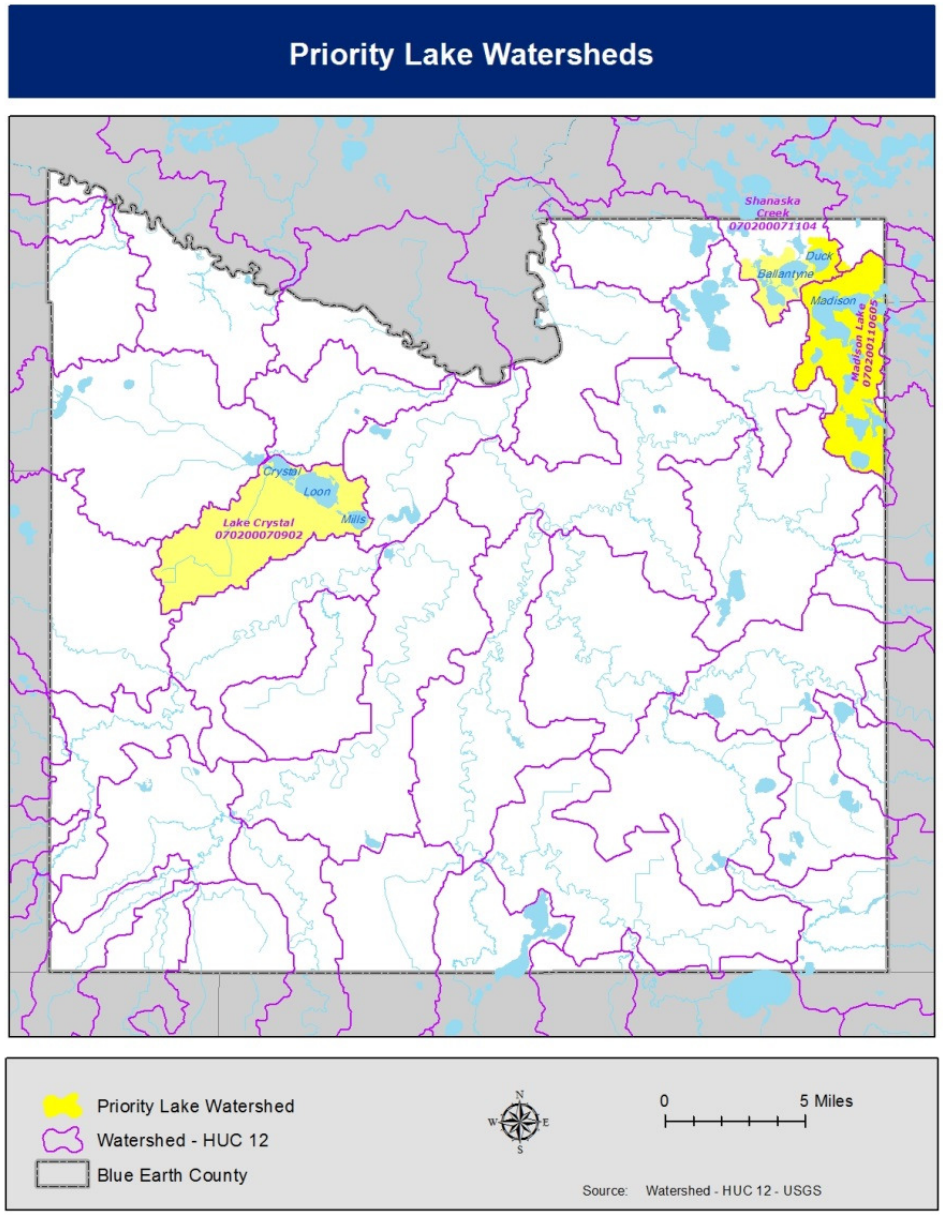
Priority Lake Watersheds

Priority Lake Watersheds

There is insufficient local funding to prioritize and target project development and implementation in more than three subwatersheds during the planning period.

- The Lake Crystal watershed (HUC12: 070200070902)
- Madison Lake watershed (HUC12: 070200110605)
- Lake Ballantyne and Duck Lake watershed in the upper reach of the Shanhaska Creek watershed (HUC12: 070200071104)

External sources of funding will be required to achieve state and local water quality goals during the planning period. In the future additional priority subwatersheds will be selected through local collaboration and the water plan task force.



Lake Crystal Watershed

Education and outreach and project implementation are underway and will be ongoing in the Lake Crystal watershed which includes Crystal, Loon and Mills lakes. The Crystal Waters Project, farmers, residents of Lake Crystal, the SWCD, Drainage Authority, City of Lake Crystal and Blue Earth County will continue working to improve water quality in this watershed. The following is a list of strategies underway or planned in this watershed.

Strategies

Education and outreach

- Crystal Waters Project website and social media
- Crystal Waters Project sponsoring and participating in special events
- SWCD work with farmers in the watershed

Soil Health – Coarse-textured soils

- Cover crops
- Tillage and nutrient management, strip-till and no-till plans

Nutrient treatment

- Denitrifying bioreactors
- Phosphorus removal structures

County Ditch 56

- Multipurpose Drainage Plan prepared for the Drainage Authority by ISG identified projects for implementation

Stormwater Management

- Retrofits
- Constructed wetlands and water quality treatment wetlands
- Phosphorus removal structures
- Construction site erosion control and training

Shoreland Management

- Shoreland restoration
- Training, education and outreach for local officials and citizen

Wetland restoration

- Greenprint priority areas

In-lake treatment

Aquatic invasive species of concern -Carp

Madison Lake Watershed

The Madison Lake Association has been working on education and outreach and projects, including a rain garden retrofit in the City of Madison Lake and a shoreline stabilization project in Bray Park. Agriculture, residential and urban land uses are a concern in the Madison Lake watershed.

Blue Earth County, the MPCA and MNDNR conducted civic engagement activities for Madison, Duck and Ballantyne lakes in 2017. The following is a list strategies suggested by citizens and local officials in the watershed.

Strategies

Project development, education and outreach

- Involve city officials, farmers and lake association with identifying developing plans and projects.

County Ditch 2

Consider multipurpose drainage plan

Stormwater Management

Involve city officials and lake association with identifying practices and other needs.

- Stormwater retrofits
- Constructed wetlands and stormwater wetlands
- Conduct shoreland ordinance and stormwater management training with city/county officials
- Consider updating stormwater ordinances
- Also see stormwater management section strategies

Shoreland management

- Coarse-textured soils in shoreland
- Disconnect impervious surfaces in residential
- Shoreland restoration
- Bluff stabilization with perennial and native vegetation
- Conduct shoreland ordinance and stormwater management training with city/county officials.
- MNDNR Score your shore

Soil Health, Nutrient Management and Soil Protection for Highly Erodible Land

Involve farmers in identifying and choosing BMPs

- Consider cover crops, tillage and nutrient management plans, nutrient removal structures, terraces, WASCOBs, grassed waterways.

Aquatic invasive species of concern -Eurasian water milfoil

Partners:

Madison Lake Association
City of Madison Lake officials, staff and engineers
Blue Earth County
Drainage Authority and engineers
MNDNR
MPCA
SWCD

Lake Ballantyne and Duck Lake

The Duck Lake Preservation Association completed many in-lake, aquatic vegetation restoration and watershed projects before and during the Clean Water Partnership many years ago. The Lake Ballantyne Association is in the process of reforming after many years.

The MPCA 2016 *Minnesota River-Mankato Watershed Monitoring* and *Assessment Report* states "Lake Ballantyne is a high priority for development of local protection strategies to prevent degradation into an impaired state in the future. Land use throughout this subwatershed as a whole is continuing to change rapidly from the pressure of urban sprawl and agricultural production. Finding a healthy balance using responsible land and water management practices will be vital to curbing future degradation of water quality."

The MPCA 2016 *Minnesota River-Mankato Watershed Monitoring* and *Assessment Report* states that Duck Lake is "fully supporting" aquatic life, but this lake does not support aquatic recreation due to nutrients and eutrophication. "There is concern from MPCA watershed assessment team members about Duck Lake possibly on the edge of impairment for aquatic life, because of the small watershed and high development potential from nearby cities. The team recommends local strategies should be developed to protect future water quality."

Strategies

Blue Earth County, the MPCA and MNDNR conducted civic engagement activities for Madison, Duck and Ballantyne lakes in 2017. The following is a list strategies suggested by citizens in the watershed.

Project development, education and outreach
Involve city officials and staff, lake association and farmers with identifying projects, practices and other needs.

- Madison Lake Association
- Conduct shoreland ordinance and stormwater management training with city/county officials.
- SWCD work with farmers in the watershed

Stormwater Management
Involve city officials and lake association with identifying practices and other needs.

- Stormwater retrofits
- Constructed wetlands, stormwater wetlands and water quality treatment wetlands
- Consider updating stormwater ordinances

Shoreland management

- Disconnect impervious surfaces in residential
- Shoreland restoration
- Bluff stabilization with perennial and native vegetation

Soil Health, Nutrient Management and Soil Protection
Involve farmers in identifying and choosing BMPs.

- Consider cover crops, tillage and nutrient management plans, nutrient removal structures, terraces, WASCOBs, grassed waterways.

Wetland restoration

- Greenprint priority areas

Aquatic invasive species of concern -Eurasian water milfoil

Partners
Duck Lake Preservation Association, Ballantyne Lake Association, City of Madison Lake staff and engineers, Blue Earth County, SWCD, MNDNR, MPCA

Targeting Critical Nonpoint Source Areas and Projects

Critical Source Areas (CSAs) are defined as portions of the landscape that combine high pollutant loading with a high propensity to deliver runoff to surface waters, either by overland flow or by sub-surface drainage. Critical source areas can be areas that are the most prone to erosion or areas that have the highest likelihood of delivering pollutants to surface waters.

Terrain Analysis can be used to identify critical source areas. Terrain analysis is a methodology that models the landscape for conservation planning purposes. It relies heavily on Geographic Information Systems (GIS) and remote sensing technology, such as LiDAR (Light Detection and Ranging) and LiDAR-derived Digital Elevation Model (DEM). Selected terrain attributes such as slope, aspect, or flow direction can be analyzed to identify problem sites related to upland erosion and surface runoff, such as gullies.

Targeting Tools. Terrain analysis is incorporated in many GIS tools and models that can further target critical source areas, and some can estimate the effectiveness of practices to reduce some types of pollutants in watersheds. There are several GIS targeting tools available and there will likely be many more developed during the ten-year planning period.

Examples of targeting and decision support tools available in 2016 include the following:

- Agricultural Conservation Planning Framework (ACPF)
- Prioritize Target and Measure Application (PTMApp)
- Hydrological Simulation Program FORTRAN (HSPF) Scenario Application Manager (SAM) BMP Selection Tool
- Greater Blue Earth River Collaborative for Sediment Source Reduction

In addition to terrain analysis, the County and SWCD will use these and new tools developed in the future for targeting in subwatersheds such as HUC12 watersheds and 103E drainage system watersheds.

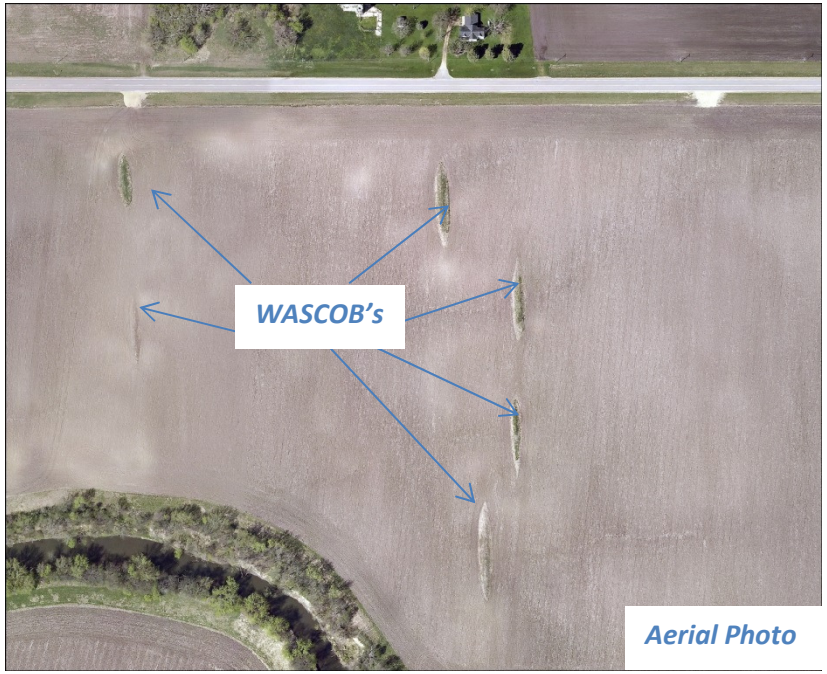
Local Knowledge

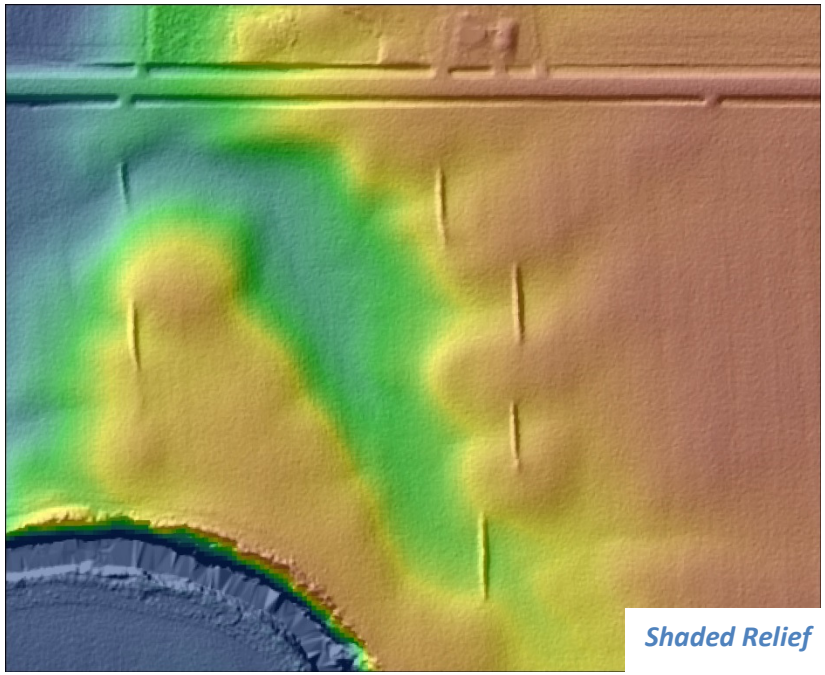
Local knowledge is important in interpreting the results of terrain analysis and targeting tools. Experienced local staff uses terrain analysis and targeting tools as a starting point for targeting outreach and identifying best practices and projects. In many cases there are already existing BMPs and other conservation practices established.

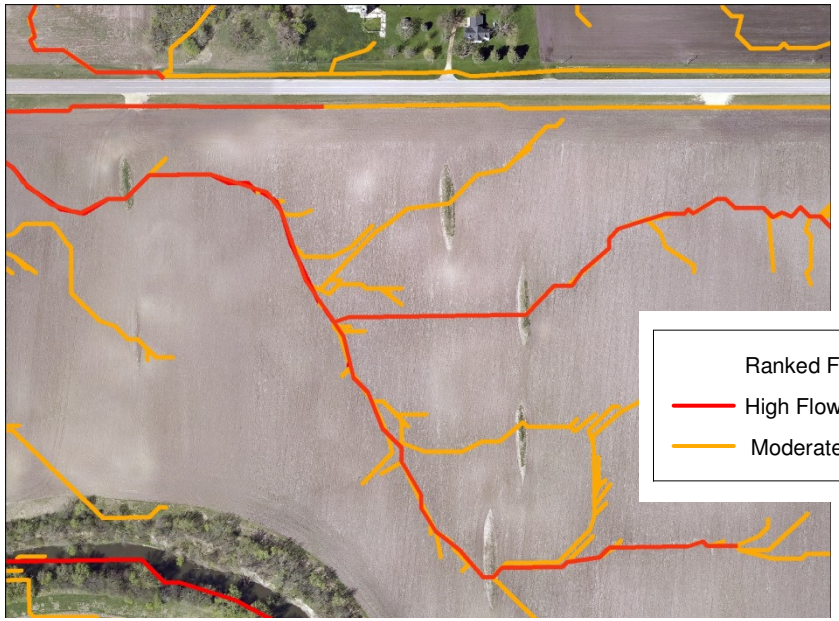
There are over 500 existing water and sediment control basins in the county (WASCOB's) and hundreds of conservation practices like grass waterways. Documenting existing conservation practices and maintaining their locations in a GIS database with attributes about their type and condition is important in general but it also helps the accuracy of terrain analysis and modelling.

The maps on the following two pages show examples of terrain analysis and concentrated overland water flow in the county. The first example shows a potential critical source area with 6-existing WASCOB's. The second example shows a field with concentrated flow where it appears that there may not be conservation practice in place.

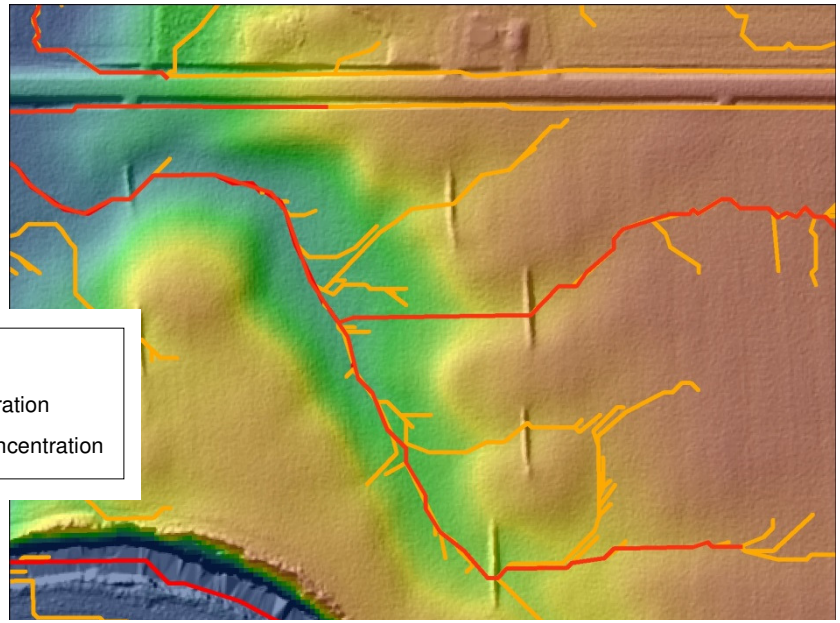
Example Showing Concentrated Water Flows and Terrain Analysis with Existing WASCOB's







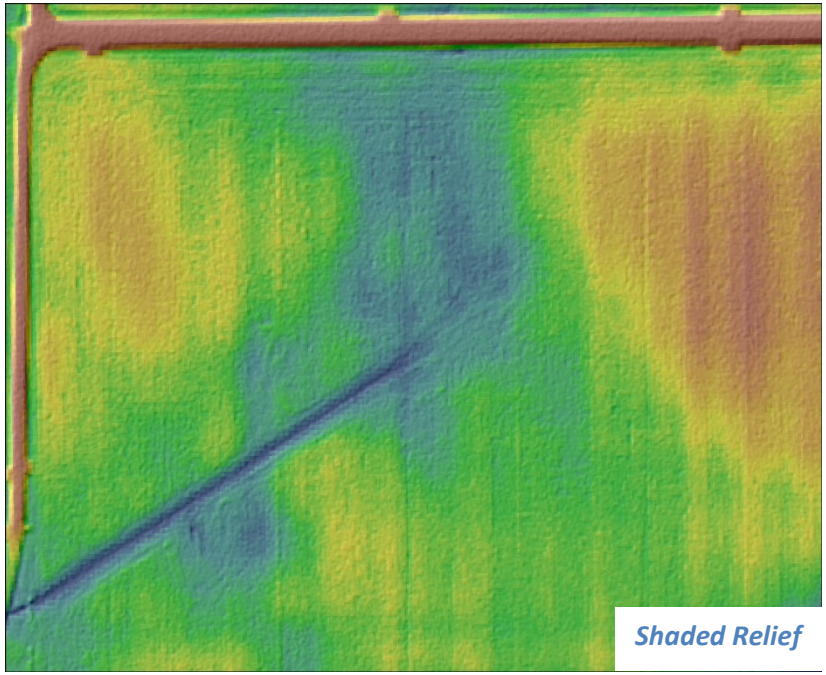
Aerial Photo with High Flow Concentration Identified with Terrain Analysis



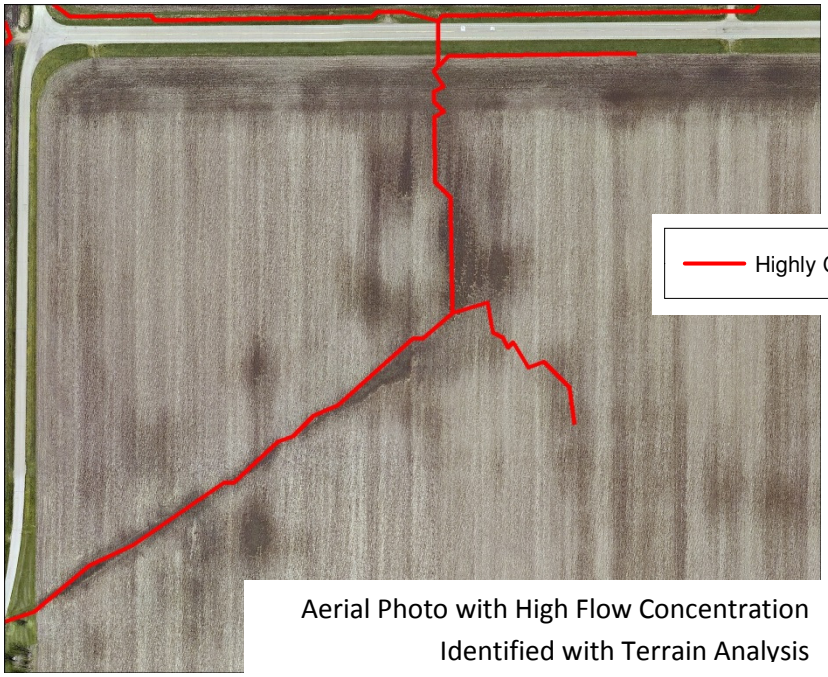
Shaded Relief with High Flow Concentration Identified with Terrain Analysis

Example Showing Concentrated Overland Water Flows and Terrain Analysis with no visible Conservation Practices

Aerial Photo

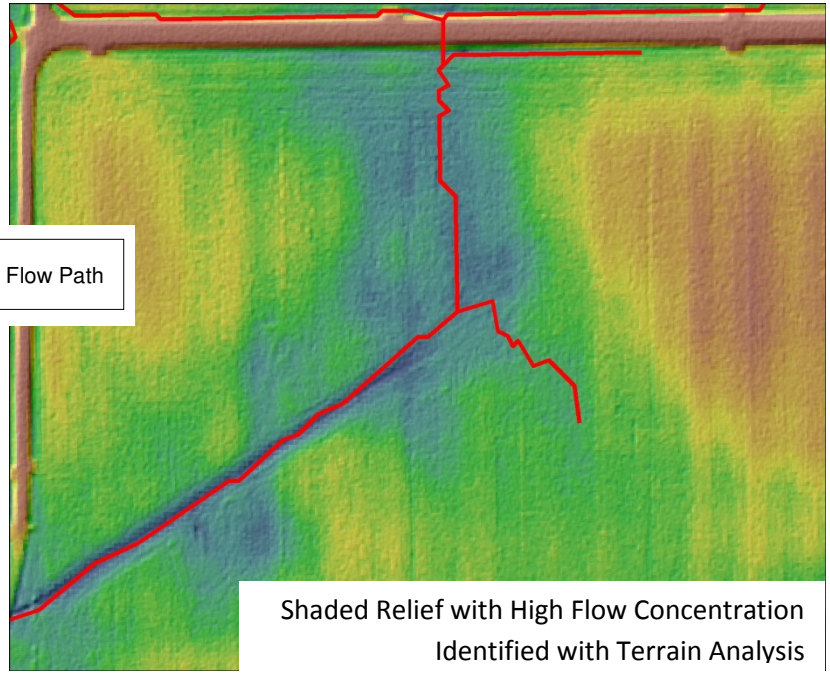


Shaded Relief



Highly Concentrated Flow Path

Aerial Photo with High Flow Concentration Identified with Terrain Analysis



Shaded Relief with High Flow Concentration Identified with Terrain Analysis

Prioritizing and Targeting Watersheds Strategies

Goal: Prioritize, target and measure watershed protection and restoration planning and implementation strategies in priority areas.

Local capacity to work with water quality monitoring, outreach, and project development in more than a few HUC12 priority subwatersheds during the ten-year planning period is limited.

STRATEGY: WATER PLAN TASK FORCE.
Action: The County will support a water plan task force comprised of local elected and appointed officials, farmers, lake association members and other citizens for prioritizing, targeting, and measuring progress in implementing the goals, strategies and actions in the *Blue Earth County Water Management Plan* and related plans. The water plan task force will meet once a year or as needed.

STRATEGY: TARGET SUBWATERSHEDS FOR IMPLEMENTATION.
Action: Use the best available science, WRAPS, terrain analysis, project effectiveness analysis, and local knowledge to prioritize, target and measure watershed-based implementation in small watersheds.

Action: The County and SWCD will work with and seek recommendations from the water plan task force to prioritize HUC12 and smaller subwatersheds for local monitoring efforts, outreach and project development during the ten-year planning period.

Water Quality Monitoring For Prioritizing and Targeting

STRATEGY: WATER QUALITY MONITORING.
Action: Support lake association monitoring efforts.

Action: Support the MNDNR and MPCA sentinel lakes monitoring efforts for Madison Lake.

Action: Support farmer-led surface water and field-scale demonstrations and monitoring.

Action: The SWCD will continue to monitoring surface water, subsurface tile drainage water at the request of landowners in priority subwatersheds.

STRATEGY: NITROGEN MONITORING.
Action: Support nitrate monitoring to better understand the fate and transport of nitrogen in the Blue Earth, Le Sueur, Watonwan and Middle Minnesota River watersheds, with an emphasis of reducing nitrates in the lowest reach of the Blue Earth River.

Action: County, City of Mankato and other local government staff in the watershed will work with the University of Minnesota, United States Geological Survey, MPCA, MDA, MNDNR and MDH to seek funds and technical assistance for nitrate nitrogen monitoring in the greater Blue Earth River watershed and the Middle Minnesota River watershed with an emphasis on the lowest reach of the Blue Earth River.

Land Use Planning Goals and Strategies

GOAL: Protect, enhance and restore aquatic and natural resources in priority areas to provide important water quality, wildlife habitat, water storage and groundwater protection functions in local watersheds.

Greenprint Priority Areas Strategies and Policies

The Blue Earth County Greenprint was built with a land use planning approach, including an inventory of aquatic and natural resources, sensitive features, land cover, park lands, and protected or publicly-owned lands, followed by an analysis of their landscape position, proximity and connectivity in four landscape settings - river corridors, shallow bedrock and karst, lake shoreland and wetland complexes.

STRATEGY: GREENPRINT AND LOCAL PLANS.
Land Use Policy: Protect, enhance and restore aquatic and natural resources in Greenprint priority areas with coordination among land use plans, comprehensive plans, transportation plans, stormwater plans, water management plans and park and open space plans from all local government jurisdictions.

Land Use Policy: Local government units in the county will consider minimizing fragmentation and development of woodlands, wildlife habitat, open space, shoreland and wetlands in Greenprint priority areas. (Reference: Minnesota Statutes 2017, sections 394.23, 394.231 and 462.357 Subd.9)

Action: Local government units in the county will consider adopting land use policies and official controls requiring dedication of open space, including wetlands, for public use in Greenprint priority areas. (Reference: Minnesota Statutes 2017, sections 394.25 Subd.7 and 462.358 Subd. 2b)

Action: Local government units in the county will consider developing programs and funding mechanisms for aquatic and natural resource protection such as conservation easements and external sources of funds targeted to water quality, wildlife habitat and recreation.

STRATEGY: SHORELAND PROTECTION.
Policy: Protect wetlands and aquatic vegetation in near-shore areas to provide critical fish and wildlife habitat and shoreline protection from waves and ice ridges.

STRATEGY: PRIORITY WETLAND FUNCTIONS FRAMEWORK.
Policy: Local units of government should consider the wetland functions classification framework when developing all types of land use and comprehensive plans. (Reference: Minnesota Statutes 2017, sections 394.23, 394.231 and 462.357 Subd.9)

POLICY STRATEGY: ENVIRONMENTAL REVIEW.
Policy: Aquatic and natural resource priority areas in the Greenprint and the *Blue Earth County Water Management Plan* should be included in environmental review documents, such as Environmental Assessment Worksheet (EAW), Environmental Impact Statement (EIS) and Alternative Urban Area Review (AUAR) to assess compatibility of proposed projects with local government plans. (Reference: Environmental Review, Minnesota Rules, part 4410.1200 subpart H. and 4410.2100)

STRATEGY: TRANSPORTATION PLANNING.

Policy: In the transportation planning and project design process, all road authorities should consider protection, enhancement and restoration of aquatic and natural resource in the Greenprint and the *Blue Earth County Water Management Plan*. (Reference: MATAPS 2035)

Action: Consider construction of appropriately sized culverts, bridges, tunnels or other types of safe passage to maintain, protect and restore wetland and aquatic habitat, minimize fragmentation and restore connectivity in the design and construction of transportation and trail systems. Seek funds for viable projects.

Priority Concern: Groundwater

Groundwater Contaminants

Water Contaminants

Common groundwater contaminants are bacteria, nitrate, hazardous substances such as petroleum, chemicals and naturally-occurring arsenic and magnesium.

Bacteria

Most of Minnesota's groundwater is free of disease-causing organisms, because water is filtered by upper layers of soil and rock as it soaks into the ground. To maintain this protection of groundwater, there must be:

- Proper well construction
- Proper well maintenance
- Prompt sealing of unused wells
- Regular water testing

Well Construction

Since 1974, Minnesota has regulated well related activities, including the construction of new wells. Wells must be separated from sources of contamination, such as sewers and septic systems. When wells are drilled, disinfectant chlorine must be added to the drilling fluid, and the well casing must consist of approved materials and assembled watertight. In addition, the space between the drill hole and the well casing must be grouted watertight with a bentonite slurry or cement. The top of the well must extend at least 12 inches above the ground surface, and be covered with an approved watertight well cap or seal.

Many old wells in Minnesota do not meet the current sanitary standard**s** for well construction and location, or they have deteriorated to the point where they can no longer keep surface contaminants out of the water. Examples of unsafe wells include old dug wells with leaking casing joints, rotten boards for covers, wells in well pits which are susceptible to flooding, wells with holes corroded through the casing, and wells too close to contamination sources such as municipal sewers or septic systems. These unsafe wells can present a very real health threat and can be a threat for safety. They need to be properly sealed by a licensed well contractor and replaced with a new, properly constructed well.

Maintenance

Modern, properly constructed wells require remarkably little regular maintenance. It is important, however, to protect the top of the casing from physical damage, especially from bumping by cars, snow plows, riding mowers, etc. The well cap should be securely fastened and the entry point for pump wiring properly sealed. Disinfection of the well with chlorine is required any time it is opened up for service. (To protect the well from chemical contamination, store paints; gasoline; and lawn, agricultural, and other household chemicals as far from the well as possible.)

Well Sealing

Unused wells provide an open channel for disease organisms and other contaminants to travel deep into the ground, by-passing the natural filtration which occurs when water moves through soil and rock. State law requires all unused wells to be either:

- sealed by a state licensed well contractor,
- restored to service, or
- maintained under a state issued annual maintenance permit.

Well Testing

New wells can operate for many years without showing signs of bacterial contamination, but there are no guarantees. The Minnesota Department of Health (MDH) recommends private wells should be

tested at least **once a year** for bacterial safety. It is also wise to test well water any time the water changes in taste, odor, or appearance.

Public Health and Nitrates

Too much nitrate in drinking water poses a risk to infants less than six months of age. If an infant is fed water or formula made with water that is high in nitrate, a condition called "blue baby syndrome" (or "methemoglobinemia") can develop. Bacteria which are present in an infant's stomach can convert nitrate to nitrite (NO_2), a chemical which can interfere with the ability of the infant's blood to carry oxygen.

The federal drinking water standard for nitrate is 10 mg/L of nitrate-nitrogen, which provides newborns with reasonable protection against blue baby syndrome. This level is mandatory for all public water systems, and recommended for private wells.

Natural levels of nitrate in Minnesota groundwater are usually quite low (less than 1 milligram per liter [mg/L] of nitrate-nitrogen). Nitrate is a nitrogen-oxygen compound that is found naturally in very low concentrations in ground and surface water but in much higher concentrations in areas affected by human activities.

Certain geologic settings, such as sand and gravel deposits and shallow limestone formations, are more prone to nitrate contamination of groundwater; in addition, certain types of wells (shallow wells, hand-dug wells, tile wells, and un-grouted or improperly grouted wells) are more vulnerable to nitrate contamination.

Nitrate in drinking water is a public health concern. Nitrate is also an environmental concern for aquatic organisms, and it contributes to hypoxia or the “dead zone” in the Gulf of Mexico. Nitrate is an essential plant nutrient critical for crop production; it can be present in fertilizers or produced by microorganisms in the soil from organic and inorganic nitrogen sources. It is also made by microorganisms as they break down sewage or manure.

Public water systems are monitored regularly for nitrate and other contaminants as part of the Safe Drinking Water Act. Any public supplier that exceeds the drinking water standard of 10 milligrams per liter (mg/L) must take corrective actions, which include notifying residents of the situation and possibly supplying them with a different source of water, such as bottled water. These systems must explore options and develop a way to reduce the nitrate levels in the water.

Private Wells

Wells most vulnerable to nitrate contamination include shallow wells, dug wells with casing which is not watertight, and wells with damaged, leaking casing or fittings.

Municipal Community Water Suppliers

All community water suppliers in the county consistently provide water to consumers that are below 10 milligrams per liter of nitrate-nitrogen as required by the Safe Drinking Water Act.

Impacts of Nitrate on Community Public Water Systems

A growing number of public water systems in Minnesota are concerned about increasing nitrate levels in their source water and are managing for nitrate using treatment and other options, including managing land use, taking a well out of service, drilling a new well, connecting to a nearby public water system, and blending high-nitrate water with lower-level nitrate water. (Source: Minnesota Department of Health)

Lead

Well water in Minnesota usually does not contain detectable levels of lead. The sources of lead in drinking water are the pipes and other components (such as faucets, valves, or fittings) in the household plumbing that may contain lead. If household plumbing does contain

lead, lead may dissolve into the water. The longer the water stands idle in the plumbing pipes and components, the more lead that can dissolve into the water. The most common cause for elevated lead levels in drinking water are:

- Lead pipes, which are typically the worst contributor to elevated lead levels.
- Lead solder, which was used in the past to join copper pipes, but has been illegal in Minnesota since 1985.
- Brass components such as faucets, coolers, and valves. Although brass usually contains low lead levels of 8 percent or less, it can still dissolve lead into the water, especially during the first few months of use.
- Wells drilled over 20 years ago may contain lead "packers" above the well screen. Some brands of submersible pumps manufactured before 1995 may contain leaded-brass components. Since January of 1995, all submersible pump manufacturers in America have agreed not to use leaded-brass components in submersible pumps.

Concerned about Lead?

Use Only Cold Water for Cooking and Drinking and
Let the water run for at least 60 seconds before using

Hot water dissolves lead more quickly than cold water. Water from hot-water faucet should not be used for cooking or drinking. It is especially important not to use the hot water for making baby formula.

Source: Minnesota Department of Health

Naturally Occurring Contaminants

Some chemicals present in water, such as arsenic and manganese, are naturally occurring but can potentially pose a human health risk.

Arsenic

Arsenic is a part of the earth's crust and occurs naturally in soil and rock. Arsenic from soil and rock can dissolve into groundwater, the primary source of drinking water for much of Minnesota. When arsenic occurs in well water, the source is almost always a natural source. According to the MDH, arsenic can occur in groundwater just about anywhere in Minnesota. Arsenic levels can vary from one well to the next, even within a very small area.

Arsenic in water has no taste or odor, so the only way to know if your well water contains arsenic is to have it tested. While well owners are not required to test existing private wells for arsenic, MDH recommends that every well be tested for arsenic at least once.

Beginning in 2008, State regulations now require licensed water well contractors (and anyone constructing a new well for his or her personal use) to have the water from each new drinking water well tested once for arsenic. The test result must be provided to the well owner before placing the well into service.

Human activities can sometimes contribute to arsenic in groundwater, as well as in soil and air. While arsenic is not in common use today, it was once an ingredient in some pesticides, and residues remain from past use and improper disposal. Until January 2004, arsenic-based wood preservatives were used to treat some wooden foundations, decks, and children's play structures. Arsenic from these sources does not usually move very far in the environment.

Manganese

Manganese (Mn) is considered a trace beneficial element, which means that low levels of manganese are a benefit to humans.

However, high exposures to Manganese can also harm the nervous system. At this time the State does not require manganese testing.

Manganese and Arsenic Testing

In preparing the *Geologic Atlas for Blue Earth County, Part B*, the MNDNR tested 93 wells throughout the county. The wells tested were in a wide range of aquifers to better understand groundwater movement and pollution sensitivity in the county. In addition to groundwater levels and movement, the MNDNR tested water samples for two naturally occurring contaminants: arsenic and manganese.

Arsenic water sampling results

Twenty-two of the groundwater samples (24 percent) exceeded the federal drinking water standard of 10 parts per billion (ppb) for arsenic (MDH, 2012). Elevated arsenic concentrations in deeper buried sand aquifers appear to be relatively rare. Only 4 of the 22 samples (19 percent) from aquifers associated with older glacial sediment exceeded the federal limit. Only 2 out of 37 bedrock water samples (5 percent) equaled or exceeded the federal limit of 10 ppb.

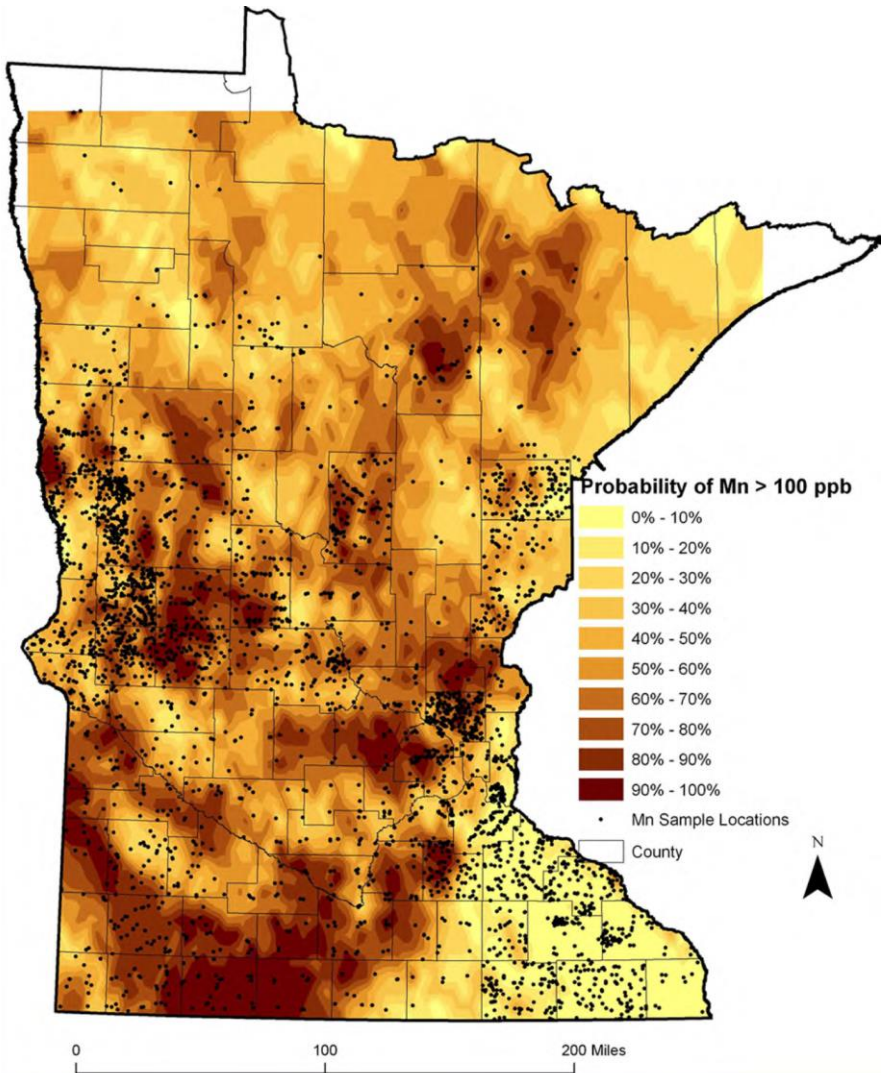
Manganese water sampling results

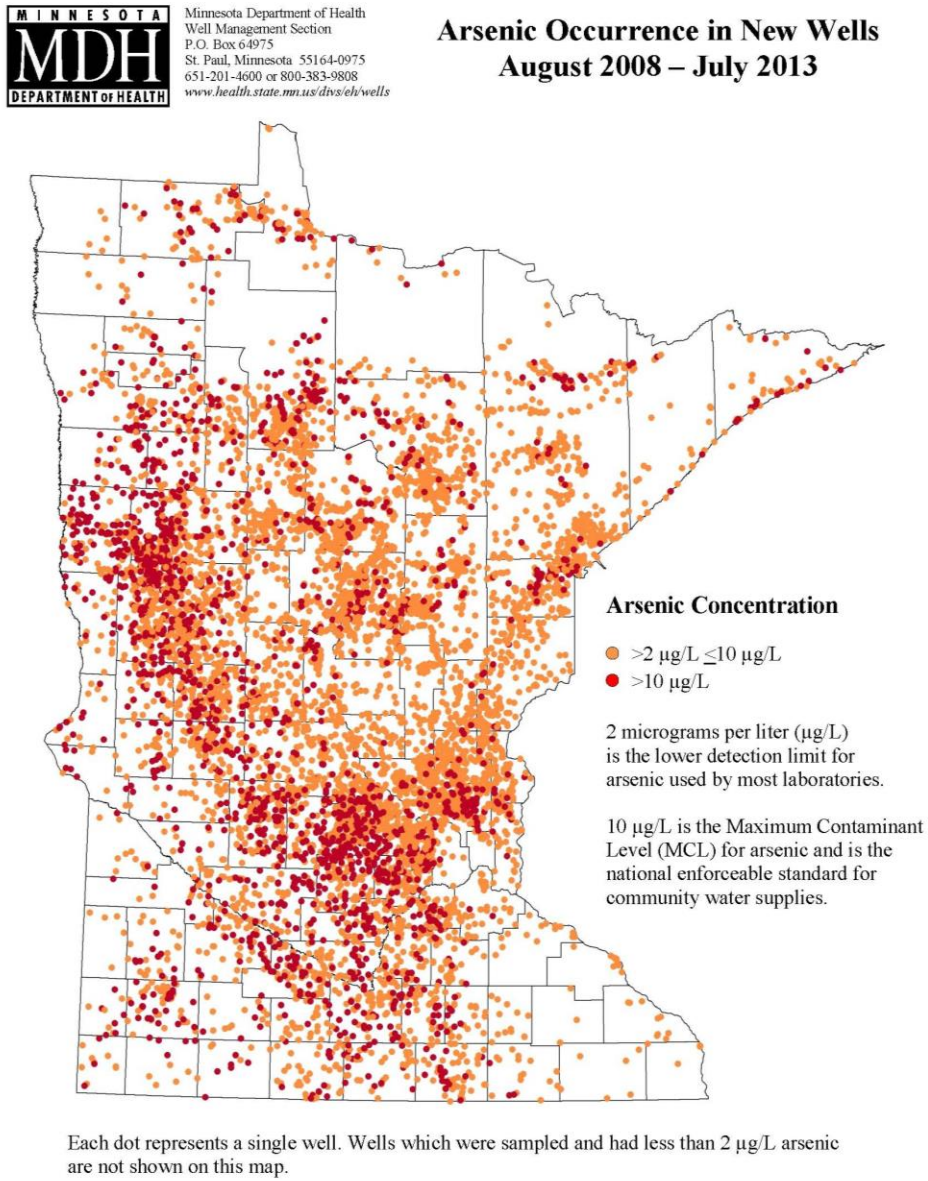
A large proportion of groundwater samples (74 samples, 80 percent) contained manganese concentrations that exceeded the lower proposed MDH Health Risk Limit (HRL) established for infants (100 ppb) indicating a natural water quality issue for the majority of well owners in the county. The standard for adults is 300 ppb. Low levels of manganese are a benefit to humans, but high exposures can harm the nervous system (MDH, 2012).

The following MDH maps show arsenic occurrence in new wells and the probability of manganese greater than 100 ug/L in Minnesota groundwater.

Probability of manganese greater than 100ug/L in Minnesota groundwater.

Probability of Manganese >100ug/L in Minnesota Groundwater.
Source: Minnesota Department of Health





Contaminants of Emerging Concern

Contaminants of emerging concern are substances that have been released to, found in, or have the potential to enter Minnesota waters (groundwater or surface water) and:

- do not have Minnesota human health-based guidance (how much of a substance is safe to drink);
- pose a real or perceived health threat; or
- have new or changing health or exposure information.

They can include pharmaceuticals, pesticides, and industrial effluents, personal care products that are washed down drains and processed by municipal wastewater treatment plants, SSTS, and others.

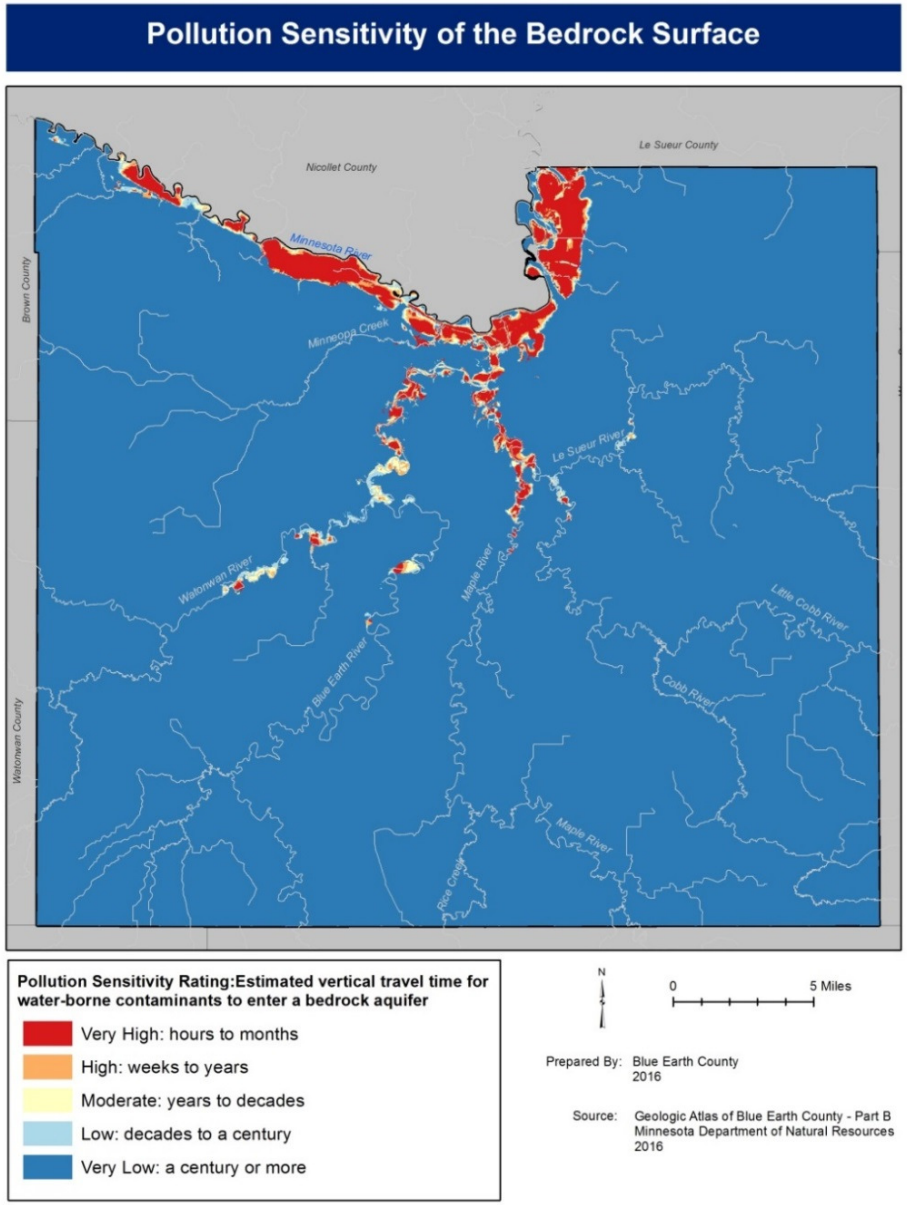
New contaminants are being found in Minnesota waters. This is due, in part, because:

- there are better methods for finding substances at lower levels;
- additional substances are being looked for;
- new substances are being used; and
- old substances are being used in new ways.

Petroleum Storage Tanks

Underground storage tank (UST) systems that contain petroleum or hazardous waste are a potential threat to water quality. The MPCA regulates the design and operating rules for UST systems including piping and dispensers. The County has no regulatory control over UST systems. According to the MPCA, the volume of contaminants leaking from failing tanks has been significantly reduced since the implementation of regulatory controls.

Above-ground storage tank (AST) systems that contain petroleum or hazardous waste are very safe when properly designed and operated.



However AST systems are subject to construction flaws, corrosion, cracking, weld and valve failures, spills during transfers, and occasionally tank rupture. When AST systems leak or spill, the stored substances may flow into lakes and rivers, migrate through the soil to the water table, or catch fire, thereby contaminating soil, groundwater, or surface water and creating hazards to aquatic life and human health.

AST systems which store liquid substances that may pollute the waters of the state are regulated by Minnesota Rules, part 7151, if site capacity is less than one million gallons. Larger facilities (facilities with a capacity of one million gallons or more) are regulated by permits negotiated with MPCA. The goal of regulating AST systems is to prevent spills and leaks by providing storage tank owners with various safeguard options.

Class V Injection Wells

Class V Injection Wells are regulated by the Federal government. The EPA has inspected many businesses in Blue Earth and other counties to determine if Class V floor drains were present. The EPA has ordered business owners to correct violations and the EPA has conducted follow up inspections to ensure the violations were resolved.

Dry wells, cesspools, and septic system leach fields taking floor drain wastes are examples of simple Class V wells. Because Class V floor drains often provides little or no pretreatment and fluids are injected directly into or above an underground source of drinking water, proper management is important. Most Class V wells are "low-tech" and depend on gravity to drain fluids directly below the land surface. (Source: EPA)

Examples of "low-tech" Class V injection wells that typically rely on gravity drainage include:

- **Motor vehicle disposal wells** include vehicle repair home businesses, new and used car dealers, boat yards, auto body shops, farm machinery dealers, where service floor drains or sinks lead to a septic system or otherwise discharged into the ground. Motor vehicle disposal wells are banned. Holding tanks or sanitary sewer systems are required.
- **Carwashes** where wastewater enters a floor drain that leads to a dry well or septic system

The County addresses potential Class V injection wells when issuing land use permits. Holding tanks are recommended for commercial garage floor drains.

Transportation of Hazardous Waste and Hazardous Waste Spills

Hazardous wastes are transported throughout the county by truck, rail and pipelines. The movement, loading, and off-loading of hazardous wastes pose potential threats of accidents, leaks, and spills. To reduce spill incidents and volume the Minnesota Legislature passed MN Chapter 115E, Oil and Hazardous Substance Discharge Preparedness. This requires hazardous waste transporters to prepare and train to respond to petroleum and chemical spills. Pipelines, trucking, and railroad businesses that transport more than 100,000 gallons of hazardous waste per month are mandated to develop spill prevention and preparedness plans.

When a spill does occur, State agencies and the party responsible for the spill are required to ensure environmental protection. Public safety is the responsibility of local first responders. All spills that have the potential to impact the environment must be reported to the State of Minnesota Office of Public Safety (Minnesota State Duty Officer) within 24 hours. The MPCA oversees the initial response and cleanup of non-agricultural spills, and the MDA oversees the clean-up of agricultural chemical spills.

Pipelines are regulated by the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration. The MPCA is responsible for responding to pipeline release incidents and local first responders are responsible for public safety. The County does not have direct pipeline regulatory authority, but does have the opportunity to review permit applications and comment on what efforts should be made to protect groundwater.

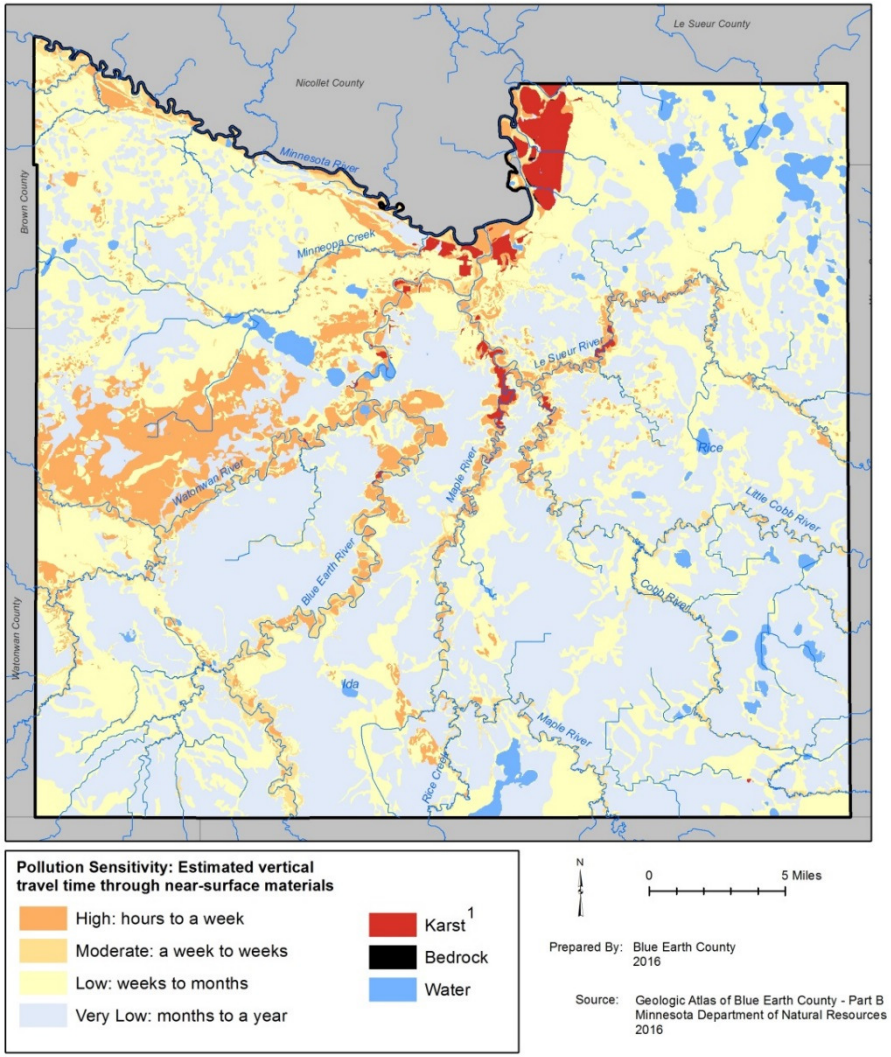
Blue Earth County Hazardous Waste Programs

Improperly handled hazardous waste has contaminated soil and groundwater in localized areas of Blue Earth County. The majority of hazardous waste releases that have contaminated groundwater occurred prior to the implementation of Federal and State regulations in the 1980s. Properly managed hazardous wastes should not pose a threat to groundwater.

Household Hazardous Waste

The County operates a Household Hazardous Waste (HHW) program and facility. The HHW facility provides a separate collection system for residents to dispose of common products such as paints, solvents, and petroleum wastes. The HHW program is important in reducing potential groundwater pollution by giving alternatives to residents who might otherwise dispose of hazardous waste down drains, septic systems, storm drains, ditches, alleys and in back yards.

Pollution Sensitivity of Near-Surface Materials



1 Karst allows a direct, very rapid exchange between surface water and groundwater and significantly increases groundwater contamination risk from surface pollutants.

This pollution sensitivity model assumes a 10-foot-deep water table and vertical travel of possible pollutants through unsaturated, near-surface materials.

Medicine Collection Program

The County started a Medicine Collection Program in December 2011. This program provides a method for the safe disposal of medication to keep these contaminants out of our groundwater. Between December 2011 and February 2016, 6,623.7 pounds of medicine have been collected for proper disposal to protect human health and the environment.

Locations

Blue Earth County Justice Center: A collection box is located in the lobby of the Sheriff's Department at the Blue Earth County Justice Center (401 Carver Road, Mankato, MN) open during business hours, 8:00 am to 5:00 pm, Monday – Friday.

Mankato Public Safety Center: A 24-hour collection box is located at the Mankato Public Safety Center (710 S. Front Street, Mankato, MN).

Very Small Quantity Generator Program

The County's Very Small Quantity Generator (VSQG) program helps businesses dispose of hazardous waste safely and affordably. Small quantity generators refers to the amount of hazardous waste generated, not the size of the company or institution. To be a VSQG, a business or organization must generate 660 pounds of hazardous waste or less per year. Wastes are accepted from businesses at the HHW facility only by appointment.

Farm Waste Drop Off

Farmers with old pesticides and herbicides may bring them to the Household Hazardous Waste Facility during regular hours for residential drop off.

Groundwater Quantity and Use

Water Use

Water use and ground water recharge have become a growing concern as general awareness of the value and limited availability of quality ground water increases. When compared with other natural resources needs and services, access to good quality drinking water is the number one priority for most people. Heavy water users, including for the production of ethanol recently, has raised concerns. Use of good quality ground water aquifers for snow making and lawn sprinkling is also criticized. A greater understanding of ground water supplies at the local, County and regional scale is needed to develop plans and policy to protect ground water.

Water Appropriations

The Minnesota Department of Natural Resources (MNDNR) is responsible for monitoring the utilization of both the ground and surface water. MNDNR water appropriation permits are required when either a designated public surface water is affected or the volume of groundwater exceeds either 10,000 gallons per day or 1 million gallons per year.

Minnesota's water appropriation law was first enacted in 1937. The purpose of the original act was to establish a water policy for the state and a permit system to regulate water users. The Water Appropriation Permit System is designed to control the use of the resource and to ensure that water use conflicts are avoided if possible. In 1973, the Minnesota Legislature established a priority system for water use to allocate water equitably to riparian owners when a water supply was limited. This priority system was revised in 1989 by the Legislature with the first priority being domestic water supplies and contingency power production as specified by law. The MNDNR

Minnesota Water Allocation Priorities
Minnesota Statute 103G.261

The commissioner shall adopt rules for allocation of waters based on the following priorities for the consumptive appropriation and use of water:

(1) first priority, domestic water supply, excluding industrial and commercial uses of municipal water supply, and use for power production that meets the contingency planning provisions of section 103G.285, subdivision 6;

(2) second priority, a use of water that involves consumption of less than 10,000 gallons of water per day;

(3) third priority, agricultural irrigation, and processing of agricultural products involving consumption in excess of 10,000 gallons per day;

(4) fourth priority, power production in excess of the use provided for in the contingency plan developed under section 103G.285, subdivision 6;

(5) fifth priority, uses, other than agricultural irrigation, processing of agricultural products, and power production, involving consumption in excess of 10,000 gallons per day; and

(6) sixth priority, nonessential uses.

Appropriation and use of surface water from lakes of less than 500 acres in surface area must be discouraged.

The treatment and reuse of water for nonconsumptive uses shall be encouraged.

recently implemented a preliminary assessment and approval prior to drilling a well which will require a water appropriation permit.

MNDNR Water Appropriation Permits in Blue Earth County

The MNDNR list of 2016 water appropriation permits in the county shows there are many large water users. The following is a list of types of users with water appropriation permits in the county in 2016.

Summary of 2016 MNDNR Water Appropriation Permits by Permit Use Type

Permit Use Type	Permits
Livestock Watering	24
Agricultural Crop Irrigation	22
Municipal/Public Water Supply	11
Golf Course Irrigation	4
Sand and Gravel Washing	3
Commercial/Institutional Water Supply	2
Private Water Supply	2
Sand/Gravel Pit Dewatering	2
Thermoelectric Power Cooling - Once Through	2
Agricultural/Food Processing	1
Aquaculture	1
Fire Protection Water Supply	1
Landscaping/Athletic Field Irrigation	1
Metal Processing	1
Mine Processing (excludes sand/gravel)	1
Quarry Dewatering	1
Snow/Ice Making	1
Sod Farm Irrigation	1
Total	**81**

Since 2007, the largest increase in water appropriation permits is for agricultural crop irrigation and livestock watering. In 2007 there were five water appropriation permits for crop irrigation, and there were 22 in 2016. The increase in MNDNR water appropriations for livestock watering is due to changes in MNDNR water appropriation permit requirements.

Water appropriation permit holders are required to report water use to the MNDNR annually. The *Geologic Atlas of Blue Earth County, Part B*, shows water use of aquifers as reported by water appropriation permit holders of various types. The table on the following page shows water use in the county in 2013 as reported to the MNDNR by permit holders.

Water Use Conflicts

There has been one water use conflict confirmed by the MNDNR. The water use conflict to be verified by the MNDNR was with Mount Kato snowmaking and a residential well more than 25 years ago.

2013 Water Appropriation Permit Use
Source: *Geologic Atlas of Blue Earth County, Part B*

	Aquifer Water Use – Million Gallons Per Year (MGY)				
Water Use Category	**Surficial Sand – Quaternary Water Table Aquifer**	**Buried Sand and Gravel Quaternary Artesian Aquifer**	**Bedrock**	**Total (MGY)**	**Percent**
Waterworks (municipal& private)	856	-	1,313	**2,169**	**56.9**
Industrial or commercial	-	-	1,396	**1,396**	**36.6**
Irrigation	-	160	32	**192**	**5**
Other*	-	10	47	**57**	**1.5**
Total (MGY)	**856**	**170**	**2,788**	**3,814**	
Total (Percent)	**22.4**	**4.5**	**73.1**		

Flowing Wells

Although not considered geologically sensitive areas by virtue of the soil cover, the unrestricted flow from old existing flowing wells is a waste of ground water resources. A flowing well with only 1.9 gallons of water per minute flow will waste nearly 1 million gallons of water in one year.

There are four general areas of the county where flowing wells present special circumstances relative to well construction and ground water conservation. These areas are generally located in the following areas:

Hungry Hollow: Hungry Hollow describes an area south of Mankato which is situated along the Le Sueur River in Sections 33 and 34 of Mankato Township (T108N-R26W) and Section 3 and 4 of Decoria Township (T107N-R26W). This river bottom is capable of producing 500 gallons per minute flows from five inch domestic wells. Double cased and grouted well construction must be employed to ensure the flow can be safely contained.

Big Cobb River: The Big Cobb River Valley, in the vicinity of the unincorporated community of Beauford has numerous small flowing wells that are developed in the glacial drift. While none have significant flows, it is an area requiring special well construction.

Maple River: A significant portion of the Maple River system that flows through Mapleton and Sterling Townships also has several small flow glacial drift wells. The situation is similar to those found in the Beauford area.

Judson and Cambria Township: Flowing wells are observed in the Minnesota River valley.

Flowing Well Description

Flowing groundwater is water that is found beneath the surface of the earth and has saturated the pore spaces in unconsolidated geologic materials and bedrock and in fractures in bedrock. Groundwater is usually recharged from water which has percolated through the soil from precipitation on the land surface or from bodies of water. Groundwater can flow from points of higher elevation or pressure to points of lower elevation or pressure.

An aquifer is a geologic formation, either unconsolidated material like sand and gravel or permeable bedrock, which readily transmits water and is tapped for supplying groundwater to water-supply wells. In some cases, the groundwater may be under pressure because the aquifer is overlain by a confining layer, such as clay or shale. The confining layer retards the movement of groundwater and pressure can then build up within the aquifer. This condition can occur when the aquifer is recharged at a point of higher elevation than the location where the aquifer is under pressure. When a well (or boring) taps the underlying aquifer, the water level will rise in the well to a level above the top of the aquifer. This type of well is an artesian well. If the water level rises in the well to an elevation above the land surface, the well will actually flow. This well is referred to as a flowing artesian well.

The figure at left from the MDH depicts the hydro-geologic conditions causing flowing artesian wells.

Problems with Flowing Wells

Pressures and flows in flowing wells can vary from slightly more than atmospheric pressure and flows less than one gallon per minute to tens of pounds of pressure and flows of hundreds or thousands of gallons per minute. Flowing artesian wells can present major problems for casing completion and sealing of wells and borings. Uncontrolled flows can cause land erosion and land subsidence, pose safety concerns, damage drilling equipment and structures, and waste groundwater. Un-grouted casings can allow water to migrate up the outside of the casing, causing bore hole erosion and uncontrolled flows. Once a flow becomes uncontrolled, it can be difficult or impossible to regain control.

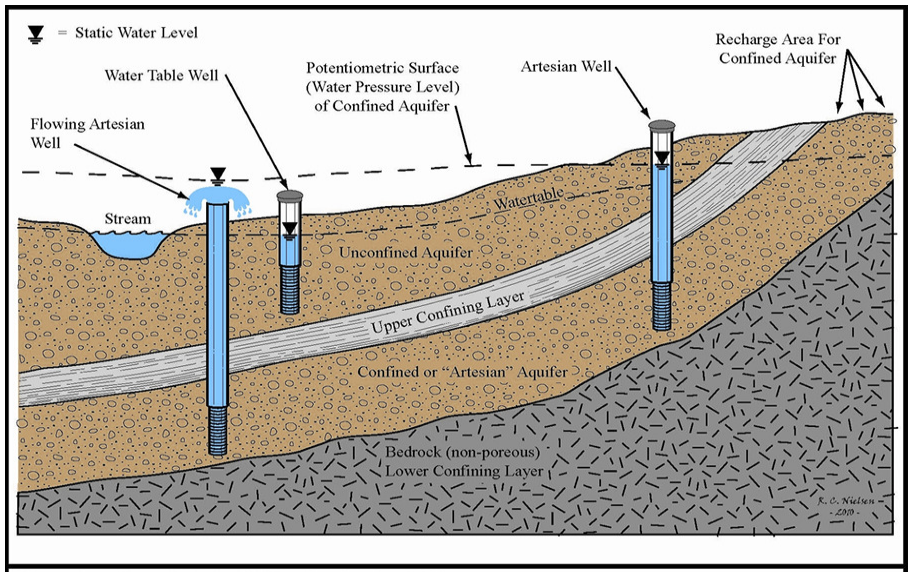


Figure 1. Terms Relating To Flowing Artesian Wells

Rules Pertaining to Flowing Wells and Borings

A well or boring with flows above the ground surface must be constructed to prevent erosion of the aquifer and the confining layer. The Minnesota Well Code requires casing be installed into the flowing aquifer to prevent water migrating up outside the casing.

The Minnesota Department of Health (MDH) has the authority to designate a Flowing Well and Boring Special Construction Area in a geographic area where high flow and high pressure conditions have been widely reported and flowing wells and borings have occurred.

Contractors installing a well or boring within the designated area must follow the construction requirements in Minnesota Rules, part 4725.3450.

Mount Simon Aquifer

All users of the Mount Simon Aquifer are required to participate in Mount Simon user group. The City of Mankato and local commercial/industrial users are part of the user group. A goal of the user group is to support monitoring the Mount Simon Aquifer as well as reduce water use from the aquifer. The MNDNR prepared two Mt. Simon reports. Excerpts from those reports are included to describe this aquifer and recharge areas.

South-Central Minnesota Groundwater Monitoring of the Mt. Simon Aquifer, MNDNR 2012

The deepest bedrock aquifer of south central/southeastern Minnesota, including the Minneapolis/St. Paul metro area, is the thick (50 to 200 feet) Cambrian sandstone Mt. Simon aquifer. It supplies all or some of the water used by over one million Minnesotans. The few water level measurements available from this aquifer in the Mankato and Minneapolis/St. Paul metro area indicate declining water levels in areas where water is being withdrawn for municipal and industrial use. To better understand the recharge dynamics of the Mt. Simon aquifer the western and northern edge of the Mt. Simon aquifer, where it is not overlain by relatively impermeable Paleozoic shale formations, was considered the most likely area for aquifer recharge. This edge of the Mt. Simon aquifer was investigated and characterized through observation well installations, water level monitoring, groundwater chemical analysis, and aquifer capacity testing to help determine recharge pathways and sustainable limits for this aquifer. Most data collected for this study are derived from the wells installed at 14 locations by contracted drilling companies.

The combinations of chemical residence time indictors, continuous water level data from nested well locations, and a general knowledge of the regional hydrostratigraphy, show an aquifer with a very slow recharge rate from a large source area located south of the Minnesota River and a smaller source area located in the northern portion of the study area. The younger ^{14}C residence time values of Mt. Simon groundwater (7,000-8,000 years) from this project roughly correspond to a time after the last ice sheet had receded from southern Minnesota suggesting groundwater in the Mt. Simon aquifer in this region began as precipitation that infiltrated during the post-glacial period. The stable isotope data of oxygen and hydrogen support this conclusion. A recharge estimate of the Mt. Simon aquifer south of the Minnesota River based on these minimum residence time data suggests a recharge rate of approximately 0.49 cm/yr. The resulting 1.2 billion gallons/year of recharge from the southern source area is less than the amount of groundwater used from the most recent year for which data are available (2009). The results of this project suggest that Mt. Simon aquifer groundwater use in the study area, for the most recent period (2009), may be more than the replacement rate along the Mt. Simon subcrop. Continued monitoring of the observation wells in this region should help determine if more water is used than is being replaced by recharge.

A major accomplishment of this project is the creation of a network of observation well nests along the western margin of this aquifer system. Long term water level data and geochemistry from these wells will enable future hydrologists to evaluate the local and regional effects of Mt. Simon groundwater pumping in the region.

South-Central Minnesota Groundwater Monitoring of the Mt. Simon Aquifer – Phase 2, MNDNR 2013

This project has shown that the most critical recharge area for the Mt. Simon-Hinckley aquifer and Minneapolis-St. Paul metropolitan area water supply includes portions of Wright, Sherburne, and Isanti counties. Protection of this region from water pollution should be a high priority for all levels of government. Continued monitoring of wells installed for this investigation will create a long term record that can be used to interpret changes in local and regional water supply due to water use or climate changes.

Observation Wells

According the *Geologic Atlas of Blue Earth County, Part B*, there is only one active observation well in the county near Lake Crystal. Because this well was only recently constructed, no data were available in 2015 when the atlas was written.

An objective in the *Blue Earth County Water Management Plan 2008-2016* was to support MNDNR establishing more observation wells in the county. The County continues to support the establishment of additional observation wells.

Ground and Drinking Water Quality
Private Wells and Non-community Wells

The most effective ways to protect groundwater and prevent well contamination are:

- Wise management, use, storage and disposal of hazardous substances
- Proper well construction
- Sealing of unused wells

Blue Earth County Delegated Well Program

Since 1987, the Commissioner of Minnesota Department of Health (MDH) has had the authority to delegate specific responsibilities for the regulation of water wells, monitoring wells and/or dewatering wells to local boards of health (Minnesota Statutes 2017, section 103I.111). In 2016 nine boards of health (covering eight counties and two cities) had responsibility for wells within their jurisdictions. These delegated programs provide local permitting and inspection of well construction and sealing.

Blue Earth County was delegated by the MDH to administer the Minnesota Well Code in Blue Earth County in 1989. The County oversees the construction and sealing of private wells and noncommunity wells. The MDH oversees community wells, monitoring wells and borings, dewatering wells, elevator shafts, and geothermal wells.

Minnesota Well Code

Well Construction and Well Sealing

Minnesota's rules governing well construction were first adopted in July 1974. (Minnesota Rules, part 4725, the "Well Code") The rules establish minimum standards for the location, construction, repair, and ultimate sealing (closure) of wells and borings in Minnesota, to protect public health and the state's invaluable groundwater.

In Minnesota, a person or contractor who provides services for the construction, repair, and sealing of wells and some borings (elevator borings, environmental bore holes, exploratory borings, and vertical heat exchangers) must be licensed by the Minnesota Department of Health (MDH).

Blue Earth County is delegated by the MDH to administer the well code. Blue Earth County Environmental Services staff handles all permitting and inspections of private and noncommunity wells in the county, ensures that new wells meet separation distances from contaminant sources, and ensures that the required water tests are conducted by the well driller.

Well Location – Isolation Distances

Observing minimum isolation distances (also known as setback or separation distances) from contamination sources and well construction standards required under the Minnesota Well Code help ensure the quality of the well water remains high.

The County reviews isolation distances in conjunction with permit review to help ensure existing and proposed wells meet setbacks. Landowners are responsible for ensuring isolation distances are maintained.

Water Testing

New wells

When a new well is constructed, Minnesota law requires that the water be tested for coliform bacteria, nitrate, and arsenic. Arsenic testing was required for new wells starting in 2008. The contractor who constructs the well is responsible for obtaining a water sample and having it tested by a certified laboratory. The well contractor must provide the owner with a copy of the water sample results and Well and Boring Construction Record.

A water test tells the owner only about the water quality at the time the sample was taken. Ongoing water testing is the responsibility of the well owner.

Well Owner Responsibilities

Water Well Testing

Private well owners are responsible for maintaining their drinking water quality. Private well owners need to be well informed and diligent in caring for their drinking water.

Drinking water should be tested any time a well system is serviced, or whenever there is a change in taste, color, or odor. Groundwater pumped from some wells, in particular shallow or old wells may vary in quality during the year, especially after heavy rainfall or melting of snow. More frequent testing of old wells or wells that are less than 50 feet deep is recommended. There are many old wells in the county but only a few wells less than 50 feet deep are used for drinking water supplies. At a minimum, private wells should be tested for coliform bacteria once a year and for nitrate every two years. If nitrate has been detected previously, the well should be tested for nitrate every year. The following table shows the MDH water testing recommendations.

Minnesota Department of Health
Water Testing Recommendations for Private Wells

Test for	Annually	Every 2 years	Once
Total Coliform Bacteria	X		
Nitrate*	X	X	
Arsenic			X
Lead			X

*Test nitrate annually or every two years and always test before giving to an infant.
* If nitrate has been detected previously, the well should be tested for nitrate every year.

Maintenance

When a well is properly located, constructed, and maintained it can provide a reliable safe source for drinking, food preparation, irrigation, or for any purpose be it for domestic, agricultural, or commercial uses.

Landowners are responsible for maintaining the well to prevent groundwater contamination by:

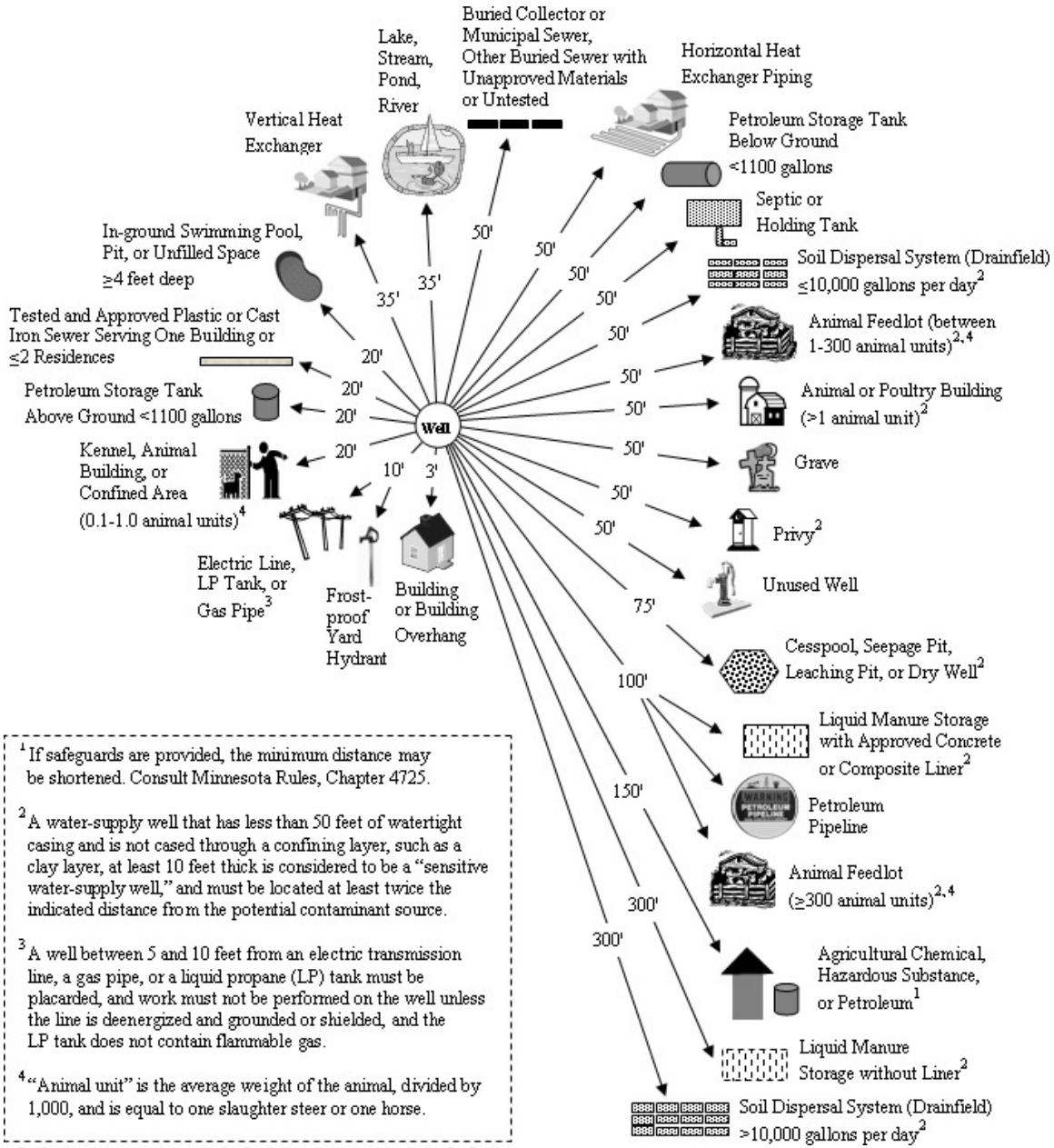
1. **Stopping Contaminants**
   - Keeping the top of the well at least 1 foot above the ground.
   - Not allowing runoff from the road, driveway, or rooftop to pond around the well.
   - Keeping the area around the well clear and free of debris, pet, and livestock wastes, hazardous chemicals, and any other potential pollutants.
   - Limit fertilizer and pesticide use in vicinity of wells.
   - Not disposing of wastes in dry wells or unused wells.

- Maintaining minimum setback or “isolation” distances from possible sources of contamination.

2. **Protecting the Wellhead**
   - Do not run into the well with lawn mowers, snowplows, or other equipment so as not to damage the wellhead or water distribution line. Mark the well location with a highly visible flag during winter.

3. **Routinely Inspect the Well**
   - Visually inspect the well for problems such as cracks, corrosion, loose wires, settling, or well casing damage.
   - Ensure the well cap is securely attached to the well casing, not broken or missing, and connections to the well are watertight.
   - Hire a licensed well contractor to inspect your well for defects every 10-15 years.

4. **Sealing Unused Wells**



Source: Minnesota Department of Health – (Minnesota Rules Chapter 4725 has a complete listing of Isolation Distances)

Unused and Abandoned Wells

Wells do not last forever. Abandoned wells are common in both developed, older areas of cities that are presently served by public water supplies and in older rural homesteads and farm fields. In cities and townsites, a well may have been a home or business's main water source before city water became available. Abandoned wells are also located in farm fields where wells were located to serve old farmsteads or previously pastured areas.

Unused or abandoned wells that have not been properly sealed can provide a direct pathway for contaminants to enter the groundwater aquifers, potentially threatening groundwater quality in other wells. Contaminants from surface water runoff, or sources, such as leaking sewers or septic system drainfields, can enter the well through casings that have deteriorated. Unused wells also pose a safety hazard, especially for children, pets, and livestock. In Minnesota it is illegal to dispose of wastes in an unused well, and it will result in additional costs to clean the well and possibly the groundwater before the well is sealed.

Well Sealing

According to Minnesota law, a well must be sealed in any of the following situations:

1) the well is contaminated and cannot be corrected;
2) the well has been improperly sealed in the past;
3) the well poses a threat to the health or safety of the public or to groundwater quality; or
4) the well is not in use and does not have a maintenance permit.

A water well is properly sealed when it is removed from service and is completely filled with grout (neat cement, bentonite or another MDH approved material). Only a licensed well contractor or a licensed well sealing contractor may seal a well. The contractor must seal the well in accordance with Minnesota law. Well owners cannot seal their own wells.

Legal Responsibilities - Well Disclosure Statement

When a home, farm, or other property is sold or transferred, Minnesota Statutes 2017, section 103I.235, requires that the seller of real estate to disclose the number and the status of all wells on the property and provide a sketch map showing the location of each well. The well disclosure statement indicates the location, number of wells, and if the well is being used or not used.

Well and boring sealing records are not available from the MDH County Well Index online.

Local Well Sealing

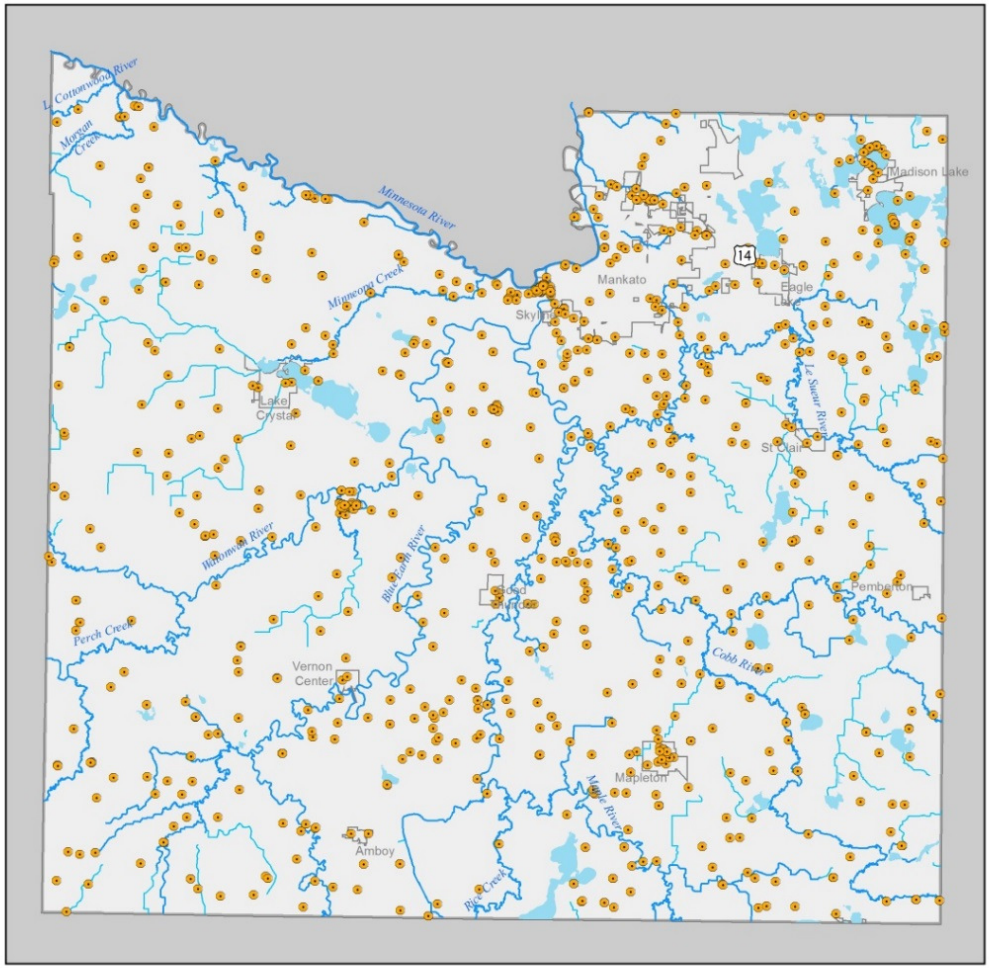
Blue Earth County is responsible for inspecting and permitting well sealing in all areas of the county. In conjunction with land use permit review, the County identifies potential abandoned and unused wells. The County also assists landowners and local government units with locating abandoned and unused wells.

Since 1989, more than 2,800 abandoned wells have been sealed in the county. The table on the following page summarizes well sealing and new well construction in the county from 1989 through 2016. A map of properly sealed wells that were field-located is also on the following page.

Summary of Sealed Wells and New Wells in Blue Earth County from 1989 to 2016

Year	Wells Sealed	New Wells
1989	95	99
1990	83	89
1991	203	71
1992	220	93
1993	141	94
1994	112	108
1995	104	95
1996	128	87
1997	117	92
1998	116	95
1999	148	81
2000	108	93
2001	109	93
2002	114	77
2003	106	79
2004	120	94
2005	78	82
2006	87	79
2007	94	67
2008	61	49
2009	57	43
2010	49	37
2011	58	39
2012	96	56
2013	88	49
2014	95	33
2015	88	35
2016	54	42
Total	**2,929**	**2,051**

Sealed Wells that have been Field Located



0 5 Miles

Sealed Well

City

Prepared By: Blue Earth County Environmental Services 2016

Source: Blue Earth County Sealed Well Database

Note: Map shows sealed wells that have been field located. Blue Earth County began field locating sealed wells with GPS units in 2008 so there are many sealed wells that are not shown on this map.

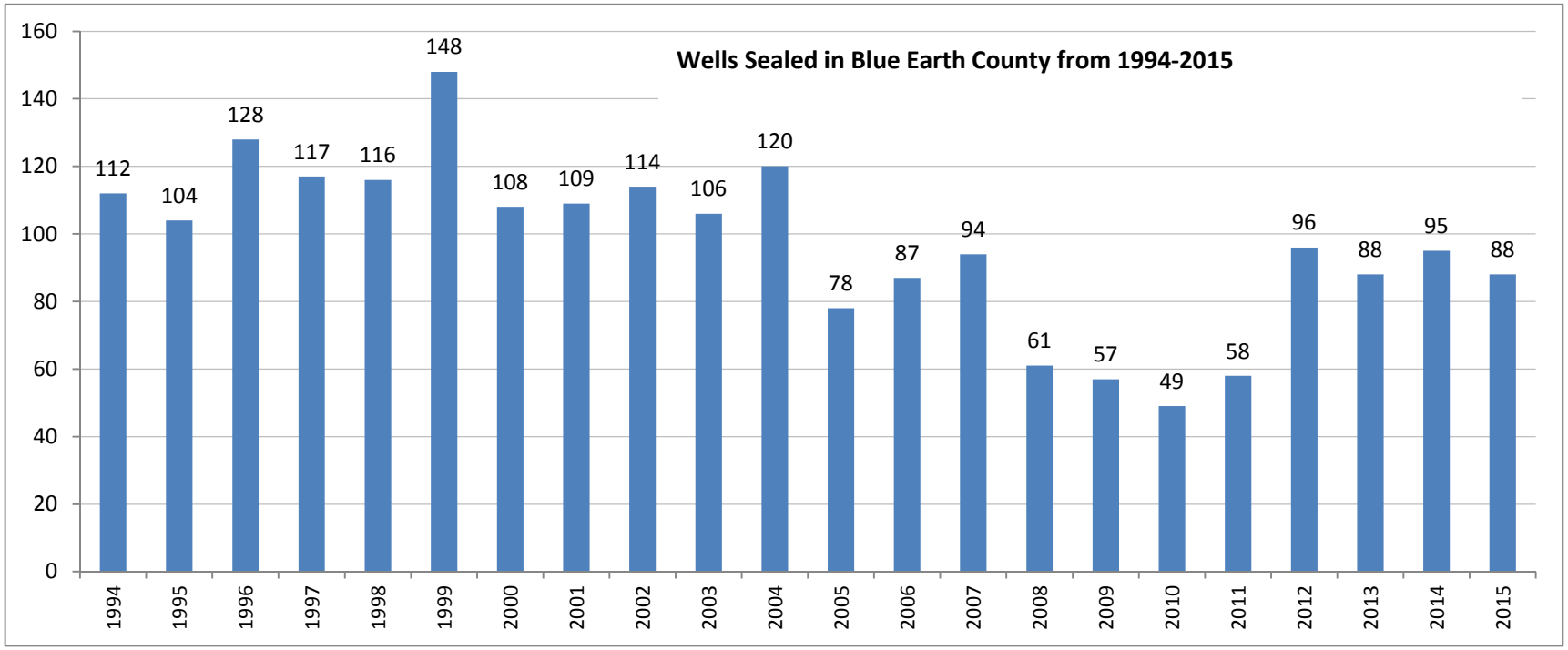
Well Sealing Cost-Share

The County started a locally-funded, abandoned well sealing cost-share program in 1989 and will continue funding this local program. Landowners are eligible for 50% cost share up to $1,000 which is enough to seal most wells. The local cost-share program has $9,000 to $10,000 available annually which in many years is not enough to meet all landowner requests for well sealing cost share. The County has also received a few grants to seal high priority wells and wells in high priority areas.

Community Wellhead Protection Plans

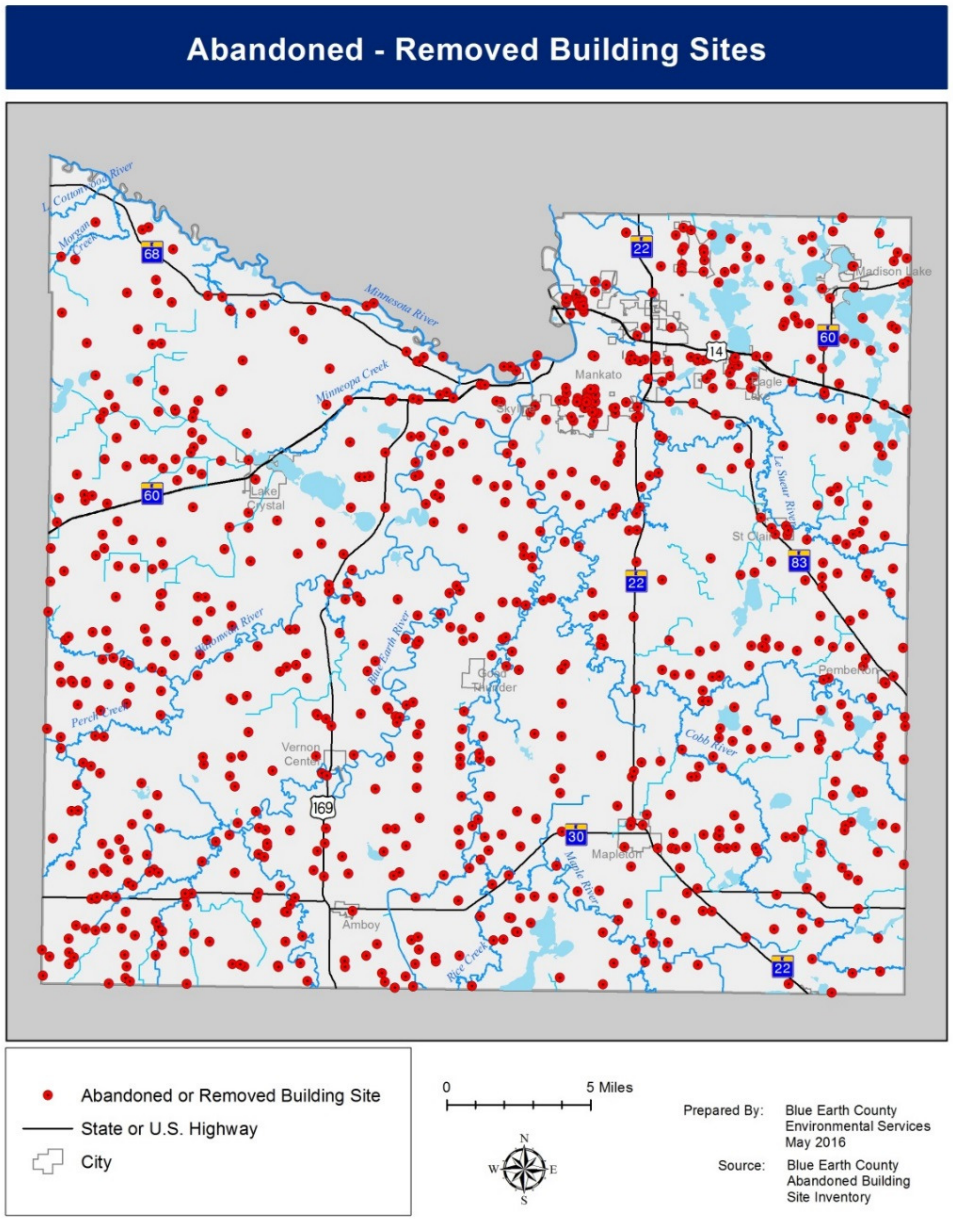
Community wellhead protection plans address the identification and sealing unused and abandoned wells in wellhead protection areas and Drinking Water Source Management Areas.

The MDH provides grants to municipalities for well sealing. Blue Earth County well sealing cost share can also be used in municipalities.



Abandoned-Removed Building Sites

The map on this page shows the location of building sites that were in existence in the late 1930's as shown on the 1938-1939 aerial photos but are no longer in existence or have been significantly reduced in size. More than 850 sites in the county were in the inventory. This inventory is used in the review of land use proposals to identify sites where there is likely at least one abandoned well.



Note: Abandoned building sites are building sites that were present as shown in 1938-39 aerial photos and have been removed, altered or significantly reduced in size as shown on 2005-2009 photos.

Special Well and Boring Construction Area

A Special Well and Boring Construction Area is also called a well advisory. It is a mechanism which provides for controls on the drilling or alteration of public and private water-supply wells, and monitoring wells in an area where groundwater contamination has, or may, result in risks to the public health. The purposes of a Special Well and Boring Construction Area are to inform the public of potential health risks in areas of groundwater contamination, provide for the construction of safe water supplies, and prevent the spread of contamination due to the improper drilling of wells or borings.

There is one Special Well and Boring Construction Area in Blue Earth County located in Le Hillier.

Le Hillier Special Well and Boring Construction Area

Le Hillier is a small community in Blue Earth County near the confluence of the Blue Earth and Minnesota Rivers. At the time of the advisory, there were no central water-supply or sewage systems serving the city. Most of the 200 homes in the area were supplied by individual drive-point wells driven to approximately 30 feet in depth. A few homes had wells cased to the St. Lawrence confining layer with open-hole construction into the Franconia or Ironton aquifer. Many of the individual sewage disposal systems consisted of septic tanks draining into leaching tanks or perforated 55-gallon steel barrels.

In 1981, following a tip on the Minnesota Pollution Control Agency (MPCA) "hotline" about dumping of hazardous wastes, groundwater contamination was verified. Major contaminants detected in the drift and alluvium and some bedrock wells were nitrates and volatile organic chemicals (VOCs), primarily trichloroethylene (TCE).

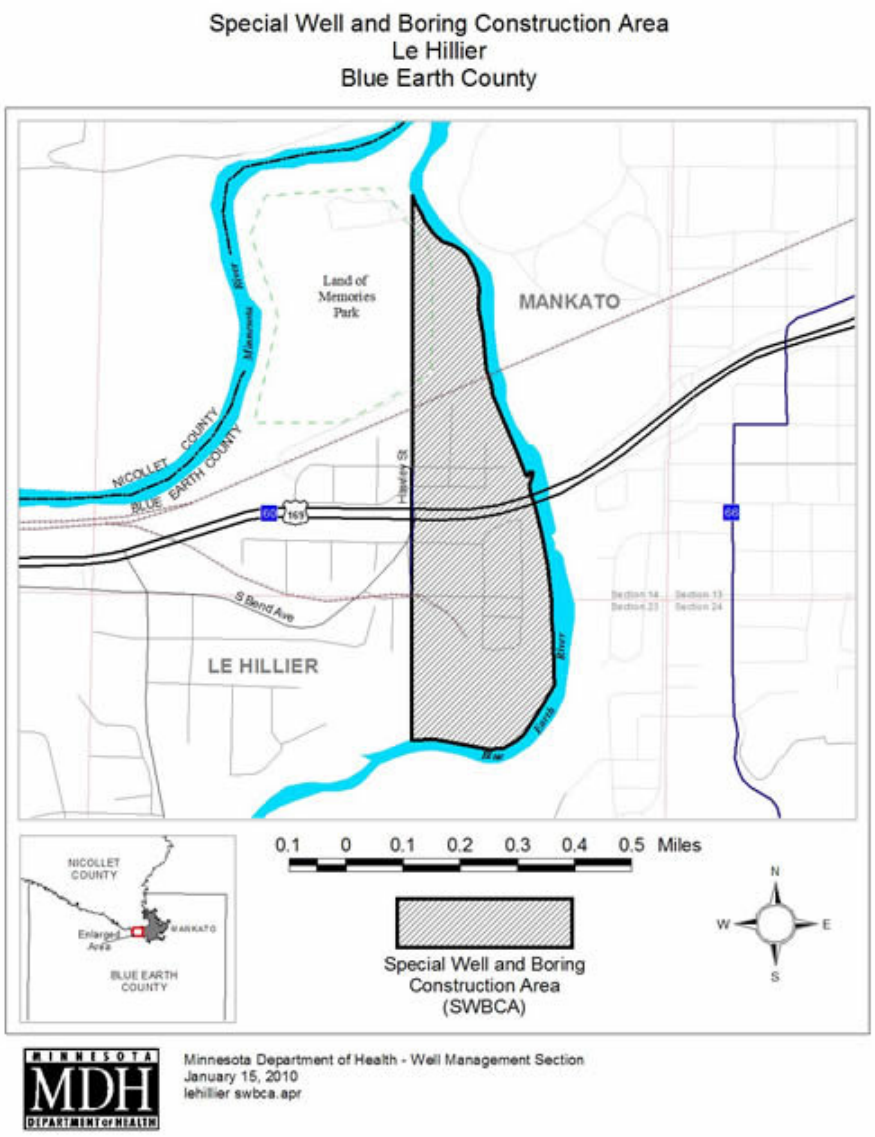
In September of 1981, an advisory was mailed to licensed well contractors working in the Mankato area. The advisory area is in parts of Sections 14 and 23, Township 108 North, Range 27 West, Blue Earth County, bounded by East Hawley on the west and the Blue Earth River on the east, north and south. The contractors were specifically told that residents with elevated levels of trichloroethylene had been advised to use alternate drinking water sources, and that the Health Department was not advising that contaminated wells be deepened or that new deeper wells be constructed until the source, extent, nature and hydraulics of the contamination was known.

The Minnesota Pollution Control Agency initiated several superfund studies for identifying the source of the contamination and furnishing the residents of the area a safe water supply. Le Hillier received a grant and constructed a rural water-supply system. Mankato required assurances that the contamination would be cleaned up and that the discharge of sewage into the ground up-gradient from their Ranney well would be discontinued. A wastewater collection system was constructed in Le Hiller and their wastewater is treated at the City of Mankato's wastewater treatment plant. A program was implemented to seal the private drinking water wells in the contamination plume in order to prevent contamination of the Franconia-Ironton-Galesville aquifer.

A remedial study was completed utilizing numerous monitoring wells and the U.S. Corp of Engineers dike flood control wells to pump out contaminated water. From 1989 to 1997, this contaminated water was treated through an air stripper before being discharged to the Blue Earth River. In 2006 and 2007 six of the pumping wells and monitoring wells were sealed. The MPCA has determined that no further remedial action was required at this site. The MPCA continues to monitor this site and the well construction advisory remains in effect.

One of the provisions of the Remedial Investigation/Feasibility Study Record of Decision for Le Hillier released in September 1985 was to: "Ensure private wells in Le Hillier are properly closed/capped under the provisions of Minnesota Department of Health Well Code."

Between October and December 1988 an effort was conducted to seal 83 private water wells within the main trichloroethylene (TCE) contamination plume generally covering the east half of Le Hillier. Between 1989 and 2012 Blue Earth County continued to inspect the proper sealing of wells, mostly located in the west half of Le Hillier. These wells have been identified through well disclosure and the County building permit review processes. Unfortunately, many properties are being sold in Le Hillier without proper well disclosure. Starting in 2013 the County has targeted the remaining wells in Le Hillier suspected of having possible unsealed wells issues and provided grant program incentives to property owners. Through this targeted well sealing initiative, an additional 52 wells were properly sealed in Le Hillier.



Public Water Supplies

Public Water Systems

The Federal Safe Drinking Water Act (SDWA) is the principal regulation governing public water systems in Minnesota. It defines what a public water system is, sets drinking water quality standards, institutes water sampling and survey schedules, and establishes requirements for source water protection and operator certification, and more.

The SDWA affects all water systems that serve water to the public (in general, to more than 25 people on a regular basis). The SDWA does not apply to private wells or bottled water, although bottlers in Minnesota who have their own source of water are regulated as noncommunity public water systems.

Minnesota Rules, part 4720 adopts the SDWA by reference with some amendments and also includes sections on Wellhead Protection. There are many significant Minnesota Rules that apply to public water systems:

Federal Safe Drinking Water Act
Minnesota Safe Drinking Water Rules
Minnesota Well Code
Minnesota Plumbing Code
Minnesota Operator Certification Rule

Public Drinking Water Supply Systems

According to 2016 MDH data, there are 78 entities in the county that own 100 public water supply wells. The well owners include municipalities, rural subdivisions, commercial businesses, churches, parks, campgrounds, bar/restaurants, and golf courses. A high percentage of public water supply wells (62 wells) are in sensitive aquifers, and 22 wells are sensitive to groundwater contamination because the well does not meet current construction standards or there is no information about the well available. Most of these are transient noncommunity public water suppliers. Most municipal wells in the county are not in sensitive aquifers.

Public Water System Categories

Public Water System is a water system with 15 or more service connections or regularly serves at least 25 people 60 or more days a year. A system that serves water 60 or mores day a year is considered to "regularly serve" water. Public water systems can be publicly or privately owned. Public water systems are subdivided into two categories: community and noncommunity water systems. This division is based on the type of consumer served and the frequency the consumer uses the water.

Noncommunity Water Supply System is a public water system that pipes water for human consumption to at least 15 service connections used by individuals other than year-round residents for 60 days a year, or serves 25 or more people at least 60 days a year.

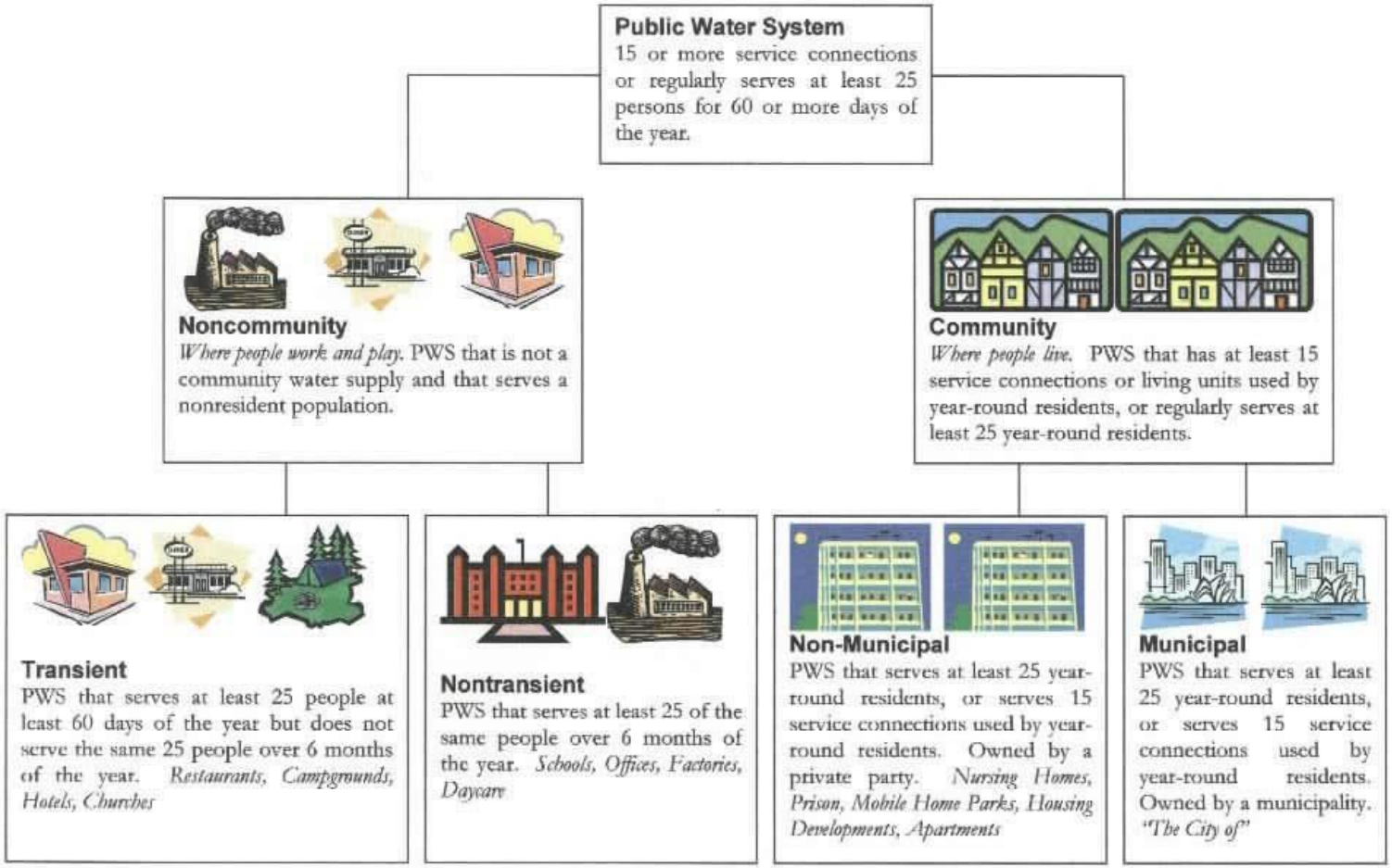
Nontransient Noncommunity Water Supply System is a noncommunity water system that serves at least 25 of the same persons over six months per year. Examples include schools, universities, colleges, factories, office parks or buildings, large-sized resorts and hotels, child care centers, and businesses.

Transient Noncommunity Water Supply System is a noncommunity water system that does not meet the definition of a non-transient noncommunity water system. Generally, these systems serve a

transient population such as parks, wayside rests, small-sized resorts and hotels, restaurants, bars, and campgrounds.

Like community water systems, noncommunity systems are required to meet the standards of the federal Safe Drinking Water Act. Should there be any issues with water quality, the owner of the system is responsible for identifying, correcting, and paying for corrective actions. For nitrate problems, these actions can include drilling a new well, installing a treatment system, or connecting to another public water system.

The following figure by the EPA shows the categories and definitions of public water supplies.


Public Water System
15 or more service connections or regularly serves at least 25 persons for 60 or more days of the year.
Noncommunity
Where people work and play. PWS that is not a community water supply and that serves a nonresident population.
Community
Where people live. PWS that has at least 15 service connections or living units used by year-round residents, or regularly serves at least 25 year-round residents.
Transient
PWS that serves at least 25 people at least 60 days of the year but does not serve the same 25 people over 6 months of the year. Restaurants, Campgrounds, Hotels, Churches
Nontransient
PWS that serves at least 25 of the same people over 6 months of the year. Schools, Offices, Factories, Daycare
Non-Municipal
PWS that serves at least 25 year-round residents, or serves 15 service connections used by year-round residents. Owned by a private party. Nursing Homes, Prison, Mobile Home Parks, Housing Developments, Apartments
Municipal
PWS that serves at least 25 year-round residents, or serves 15 service connections used by year-round residents. Owned by a municipality. "The City of"

Source: EPA

Community Public Water Supplies

All community water suppliers in the county provide water to consumers that meet Federal Drinking Water Act standards. Most community water wells are in bedrock aquifers.

Community public water supplies serve at least 26 persons or 15 service connections year-round. They include municipalities, manufactured mobile home parks, etc. These systems are required to provide a safe and adequate supply of water under the federal Safe Drinking Water Act (SDWA).

The Minnesota Department of Health (MDH) Community Water Supply Unit is responsible for assuring the compliance of community water supply systems with the SDWA. At least one certified water operator is required at each community public water supply system. That operator must hold a certificate that is at least the same class as the system (e.g., a Class B system requires a Class B certificate).

The MDH conducts on-site reviews of the adequacy of the water source, facilities, equipment, operation and maintenance of a public water supply system for producing and distributing safe drinking water at least every 18 months. All community water supplies are tested for contaminants such as pesticides, solvents, and metals.

If any of the samples collected from a community public water supply system show the presence of a contaminant above its health-based standard (called a maximum contaminant level or MCL), MDH will work with the system in resolving the contamination. Additional samples may be required to confirm the presence of the contaminant. If contamination is confirmed, the system is required to notify its users of the problem and it must take steps to correct the problem. Corrective actions may include repairs to the water system, disinfection of the water system, installation of treatment, or drilling a new well.

Primary Standards – Source EPA

The EPA has established National Primary Drinking Water Regulations (NPDWRs) that set mandatory water quality standards for drinking water contaminants. These are enforceable standards called "maximum contaminant level" (MCL). An MCL is the maximum allowable amount of a contaminant in drinking water which is delivered to the consumer. MCLs are established to protect the public against consumption of drinking water contaminants that present a risk to human health. The MCL Primary Standards include:

- Microorganisms
- Disinfectants
- Disinfection Byproducts
- Inorganic Chemicals
- Organic Chemicals
- Radionuclides

For microbiological contaminants, nitrate, and nitrite, the potential health effects can be immediate; for the others, the contaminant would have to be consumed at elevated levels over a long period of time for there to be any chance of adverse health effects. The federal standard for most contaminants is listed as a Maximum Contaminant Level (MCL), the lowest concentration at which that particular contaminant is believed to represent a potential health concern.

Because of technological limitations or other factors, it is not possible to test for some contaminants in a reliable fashion. Instead, public water systems are required to use specific Treatment Techniques (TT) that are designed to remove these particular contaminants from the water. In addition to the contaminants listed, monitoring is done for additional inorganic chemicals for which MCLs have not been established. If unacceptable levels are found of these “unregulated” contaminants—based on established state health standards and an assessment of the risks they pose—the response is the same as if an

MCL has been exceeded: the public water system must notify of those served by the system.

Secondary Contaminants – Source EPA

In addition, EPA has established National Secondary Drinking Water Regulations (NSDWRs) that set non-mandatory water quality standards for 15 contaminants. These contaminants are not considered to present a risk to human health. EPA does not enforce these "secondary maximum contaminant levels" (SMCLs). They are established only as guidelines to assist public water systems in managing their drinking water for aesthetic considerations, such as taste, color, odor, staining and corrosion.

Wellhead Protection Plans

Wellhead Protection is a way to prevent drinking water from becoming polluted by managing potential sources of contamination in the area which supplies water to a public well. Much can be done to prevent pollution, such as the wise use of land and use of hazardous substances and sealing wells. Wellhead protection can protect public health and expense of treating polluted water or drilling new wells is avoided though wellhead protection efforts.

The MDH is responsible for overseeing wellhead protection plans. The MDH is phasing in wellhead protection plans in existing community and noncommunity systems based on the vulnerability of their water supply wells.

The status of Wellhead Protection Plans in Blue Earth County communities in 2016 according to the MDH is shown to the right.

Non-Vulnerable/Protected aquifer:
Amboy
Eagle Lake
Good Thunder
Lake Crystal
Mapleton
Vernon Center
Mankato deep wells

Vulnerable/susceptible to contamination:
Madison Lake (Wellhead Protection Plan in progress)
Mankato shallow wells

Wellhead Protection Plans not yet started:
Pemberton
Skyline
South Bend Township
St. Clair

Wellhead Protection Area

Wellhead Protection Area (WHPA) is the surface and subsurface area surrounding a well or well field that supplies a public water system through which contaminants are likely to move toward and reach the well or well field.

Drinking Water Supply Management Area (DWSMA) is the area delineated using identifiable land marks that reflects the scientifically calculated wellhead protection area boundaries as closely as possible. The boundaries of the DWSMA can be 1) the center lines of highways, streets, roads, or railroad right-of ways; 2) section, half-section quarter-section, quarter-quarter section, or other fractional section lines of the United State public land survey; or 3) property lines.

Inner Wellhead Management Zone (IWMZ) is the area within 200 feet of a public water supply well.

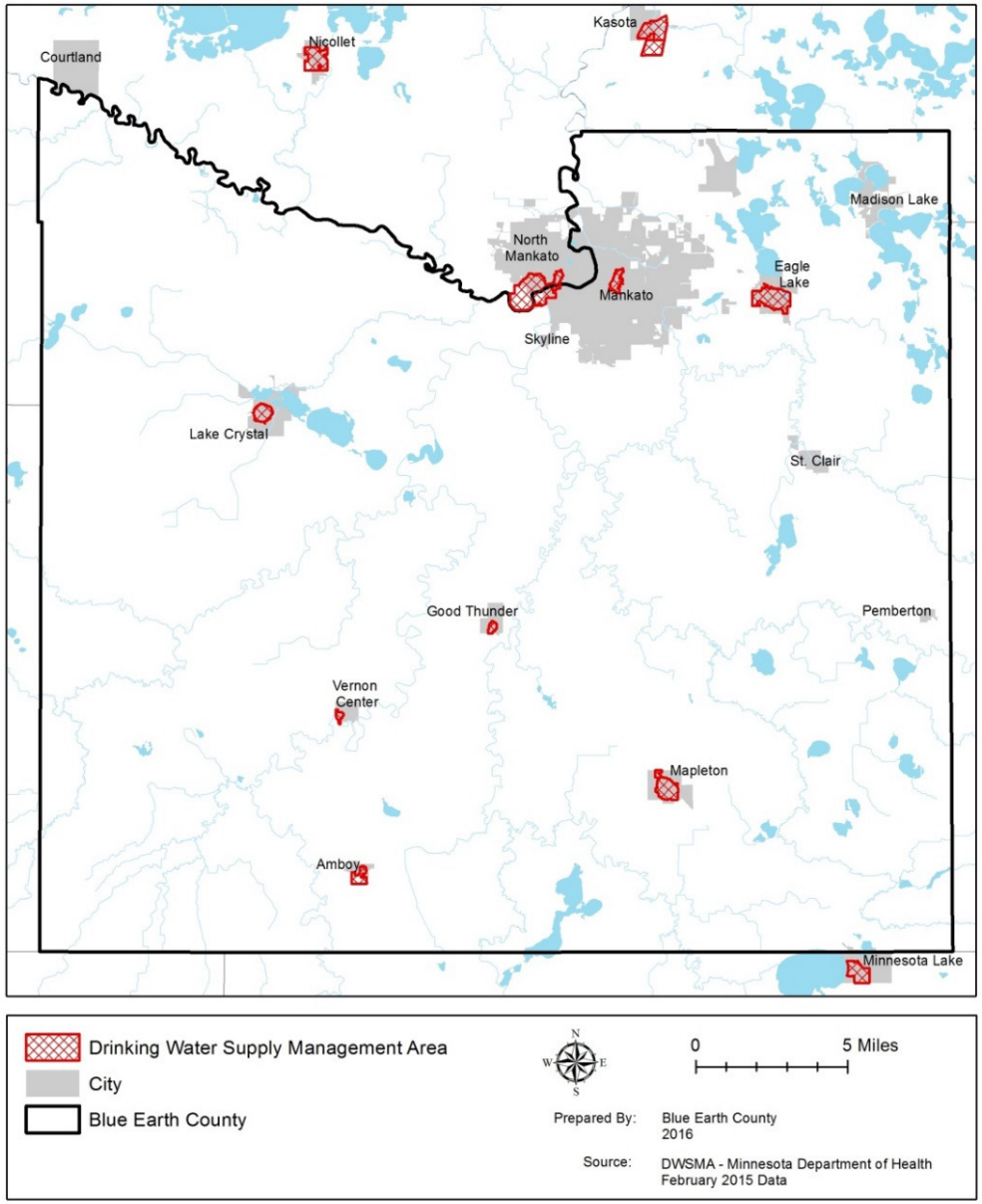
Criteria for Determining Wellhead Protection Area

The WHPA provides the focus for implementing a strategy to protect a public water supply well from contamination. A number of factors must be considered when delineating the WHPA to ensure that it actually reflects groundwater movement to the well. The following criteria must be used to delineate the WHPA:

- **Daily volume of water pumped** is derived from the maximum annual amount of water pumped over a five-year period and is needed to reflect the pumping stress the well has on the aquifer.

- **Aquifer transmissivity** defines the ability of the aquifer to yield water to a pumping well and strongly affects the size and shape of the calculated WHPA.

Drinking Water Supply Management Areas (DWSMA)



- **Groundwater flow field** defines the direction of groundwater flow and hydraulic gradient within the aquifer and is needed to "point" the WHPA in the proper direction and help determine the lateral extent of the WHPA. Groundwater moves preferentially toward a pumping well from the up gradient or "upstream" direction of groundwater flow. Most of the areal extent of a WHPA occurs up gradient of the well.

- **Flow boundaries** consist of features such as rivers, streams, lakes, wetlands, changes in the geologic composition of the aquifer and surrounding formations, and nearby wells which may impact the rate at which groundwater moves toward the public water supply well.

- **Time of travel or TOT** defines the time period over which groundwater moves through the aquifer to supply the public water supply well. The minimum TOT required is ten years although the public water supplier can select a longer time period.

Specific Requirements for Wellhead Protection

Specific wellhead protection requirements vary for the different classifications of public water systems in Minnesota (transient non-community, non-transient non-community, and community). The requirements for each type of system are described below:

Transient Noncommunity Public Water Systems (such as resorts, restaurants, and churches) are required to delineate a 200-foot radius around the well, known as an inner wellhead management zone, and then inventory and manage potential contaminant sources within the inner wellhead management zone.

Community and Nontransient Noncommunity Public Water Systems are required to delineate, inventory, and manage an inner wellhead management zone. Additionally, they must also create a formal wellhead protection plan. The wellhead protection planning process involves:

1. Delineation of the wellhead protection area and drinking water supply management area, as well as an assessment of the well(s) vulnerability.
2. Creation of the wellhead protection plan itself, including goals, objectives, plan of action, evaluation program, and contingency plan.

Wellhead Protection Grants

The MDH provides competitive grants to assist community public water suppliers implement Wellhead Protection Plans. For 2016 MDH grant programs, the following actions are eligible:

- Seal a well
- Construct a new well
- Install a monitoring well
- Well inspection (video log, gamma log)
- Educate public about drinking water protection
- Update well inventory
- Update contaminant source inventory
- Upgrade membrane filters
- Manage fuel storage tanks
- Clean up illicit dumping near well
- Support property owners to manage nitrogen
- Spill prevention and response

City of Mankato Public Water Supply Wells

The City monitors all drinking water supplies daily and consistently provides quality drinking water meeting all Federal and State drinking water standards. As required by Federal and State rules, the City prepares an annual drinking water safety report for its citizens every year.

The City of Mankato also operates a special water conservation facility as part of the wastewater treatment plant. This project is described in the Wastewater Section of the Water Management Plan and more information is available from the City of Mankato.

The City of Mankato operates water wells in shallow and bedrock aquifers.

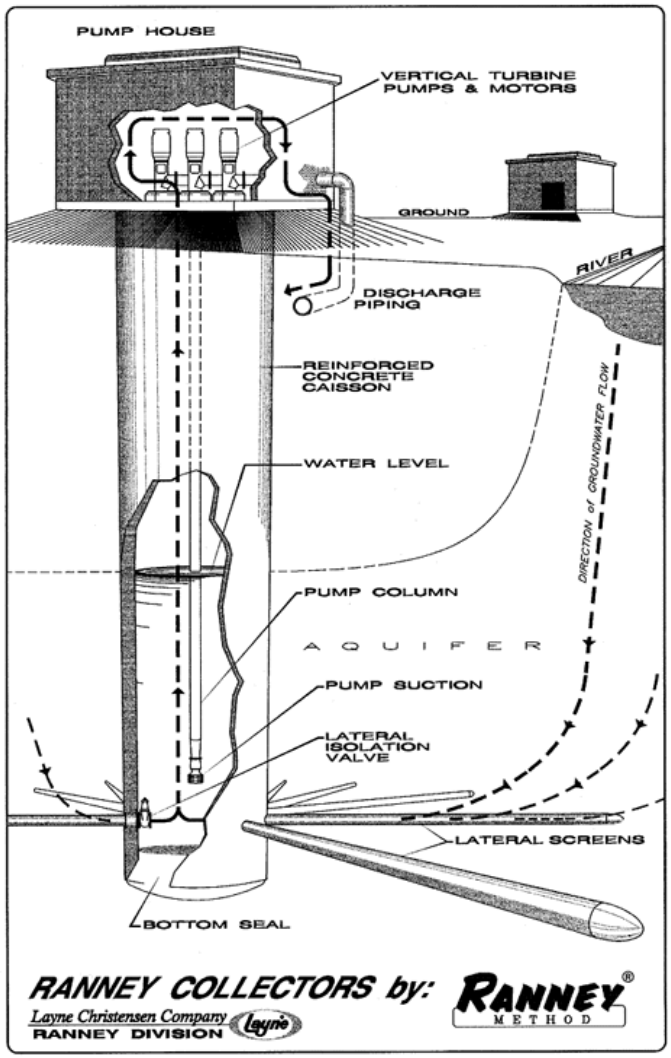
Bedrock Aquifer Wells

The City operates four deep wells drawing water from bedrock sources. The DWSMAs for these wells are relatively small and similar to other municipalities in the county.

Shallow Wells – Surficial Sands Aquifer

The City operates two shallow wells located in surficial sands aquifers near the Blue Earth and Minnesota River. The two shallow wells provide 61% of the total water volume for the City. These unique wells are called Ranney® collector wells. Ranney® wells are not surface water wells; however, the Blue Earth and Minnesota Rivers do influence the shallow aquifers below the rivers and their banks.

Ranney® wells consist of a large diameter, concrete caisson 16 feet in diameter and 50 to 60 feet in depth from which multiple well screens (laterals) are projected horizontally into the aquifer from near the base of the caisson. The Mankato Ranney® well laterals extend 95 to 220 feet along and below the Blue Earth and Minnesota Rivers providing a dependable source of water. The surficial sands provide



Ranney® Collector Well Example Schematic
Source: Layne Christianson Company

natural filtering. This natural filtration simplifies treatment needs and ensures high quality and high capacity water production.

Mankato's Ranney® wells conserve deep aquifer resources and require less energy to operate compared with deeper bedrock aquifer wells. The Mankato Ranney® Wells provide more than 850 million gallons per year. These wells use 39% of all the municipal groundwater appropriations reported to the MNDNR in 2013 by water appropriation permit holders in the county, according to the *Geologic Atlas of Blue Earth Count, Part B.*

Ranney® collector wells are a trademarked design invented in 1920. The Mankato Ranney® well near the Blue Earth River was constructed in 1974, and the Ranney® well near the Minnesota River was constructed in 2007.

Mankato Ranney® Well Source Water Assessment

The Minnesota Department of Health is responsible for preparing source water protection plans for public water supplies influenced by surface water sources, like Mankato. The City worked with the MDH in preparation of a source water protection plan in 2003. According to the MDH *City of Mankato Source Water Assessment*, the MDH determined three source water protection areas with two main source water priority areas. These include:

Inner Emergency Response Area is designed to help the City address contaminant releases which present an immediate health concern to users. This area was determined by the time required for the Mankato Water Department to shut off the Ranney® Well and a buffer time limit needed to accommodate unanticipated delays in notification and shut down.

The inner-emergency response area is about 57 square miles and includes the lower reaches of the Blue Earth, Le Sueur and Watonwan Rivers located entirely within Blue Earth County and part of the Minnesota River upstream of the Blue Earth River located in Blue Earth and Nicollet County.

Outer Source Water Management Area is designed to protect water users from long term effects related to low levels of chemical contamination or the periodic presence of contaminants at low levels in surface waters. This area should protect users from contaminants which may be usually present at treatable levels or occasionally present an acute health concern under certain conditions such as low stage of the Blue Earth River.

The outer-source water management area is about 120 square miles and is described as the minor watersheds that either flow directly into the four rivers upstream of the inner-emergency response area or are adjacent to the inner emergency response area. The outer-source water management area is located entirely within Blue Earth County and Nicollet County.

Watershed: The entire Greater Blue Earth River watershed and portions of the Minnesota River are also identified with a broad perspective in which to prioritize management efforts toward specific land uses that may impact the Ranney® Well. Maps displaying the source water protection area for the Blue Earth River Ranney® Well are available from the City of Mankato or the MDH.

Potential Pollutants

The main pollutants of concern include suspended solids, nitrate-nitrogen, pathogenic microorganisms and pesticides. The sources of contaminants are diverse. The MDH *City of Mankato Source Water Assessment* identified 348 potential contaminant sources including pipeline, highway, railroad river crossings and parallels; above- and below ground petroleum storage tanks; agriculture chemical facilities; animal feedlots; and hazardous waste storage facilities.

Nitrates

Nitrates in the Ranney® wells' shallow surficial sands aquifers are the City's primary management concern. To ensure the City water supply continuously meets Federal and State drinking water standards, the Ranney® well intakes have been monitored daily for decades. When nitrate levels are a potential concern, the City blends water from their deep aquifer wells with the Ranney® wells to obtain the desired nitrate level. At times when nitrate levels are very high, the City shuts off some or all the Ranney® wells' laterals.

Percent contribution of the TN delivered to the Mississippi River in Keokuk, Iowa, from each Minnesota Watershed which ultimately drains to the Mississippi River

Load ranking	Watershed name	% load contribution
1	Lower Minnesota River	7.3
2	Minnesota River - Mankato	6.7
3	Blue Earth River	6.4
4	Le Sueur River	5.7
5	Minnesota River - Yellow Medicine River	5.6
6	Cannon River	5.2
7	Root River	5.2
8	Zumbro River	4.9
9	South Fork Crow River	4.7
10	Cedar River	4.4
11	Cottonwood River	4.3
12	Mississippi River - Twin Cities	3.7
13	Watonwan River	3.4
14	Des Moines River - Headwaters	3.2
15	Chippewa River	3.1
16	North Fork Crow River	2.4
17	Sauk River	1.7
18	Redwood River	1.6
19	Mississippi - Winona	1.5
20	Mississippi - Sartell	1.4
21	Mississippi – Lake Pepin	1.4

Source: *MPCA Nitrogen in Minnesota Surface Waters*, June 2013

In addition to monitoring the Ranney® well intake, the City monitors the water depth of the Minnesota River during the months of the year when the river is not frozen. Monitoring results show a strong correlation of nitrate in the Ranney® wells corresponding to the river depth. Nitrates are consistently highest in the spring and during periods of high flow and lowest in winter and during dry periods of the year when river water depths are low. In recent years there has been a trend of increasing nitrates in the Ranney® wells observed during all times of the year.

Reducing nitrates in the Blue Earth River is a priority concern for protecting the surficial sands aquifer at the confluence of the Blue Earth and Minnesota River, managing the City's water supply wells as well as Minnesota surface waters.

The Blue Earth and Le Sueur Watersheds are among the highest contributors of total nitrogen to the Minnesota and Mississippi River. The following table from the *Nitrogen in Minnesota Surface Waters: Conditions, trends, sources, and reductions, MPCA 2013* shows the top watersheds ranked for percent of the total load of nitrogen delivered to the Mississippi River in Iowa. Local watersheds are highlighted.

Nitrate Monitoring

The City of Mankato's nitrate trend observations are consistent with the MPCA report *Nitrogen in Minnesota Surface Waters: Conditions, trends, sources, and reductions, MPCA 2013.* According to the report, previous studies show that total nitrogen loads as well as nitrate loads have increased in the Minnesota River Basin. What the report lacks is any data on the Blue Earth River below the Rapidan Dam. This lack of nitrate data in this reach of the Blue Earth is explained in Appendix B5-2, *Nitrogen Transport and Transformation in Surface Waters of Minnesota:*

> "Monitoring transport along a stream network is expensive, and existing water-quality monitoring programs are often not designed to specifically estimate fate and transport of N. Thus, available monitoring data is often used to calibrate models to estimate N transport over greater temporal and spatial scales than the original monitoring covered. Even though models are never perfect, they can be useful for estimating the impact of a stream network on the downstream movement of N."

Appendix B5-2 of *Nitrogen in Minnesota Surface Waters Conditions, trends, sources, and reductions, MPCA 2013* states "that more complicated models need to be developed over the next decade to address multiple pathways of N transport in river networks (Figure 3). Improved models will include approaches to terrestrial-aquatic linkages including hydrologic exchanges between the channel, floodplain/riparian complex, and subsurface waters, and interactions between coupled biogeochemical cycles."

The diagram on the following page is from Appendix B5-2, "Nitrogen Transport and Transformation in Surface Waters of Minnesota"

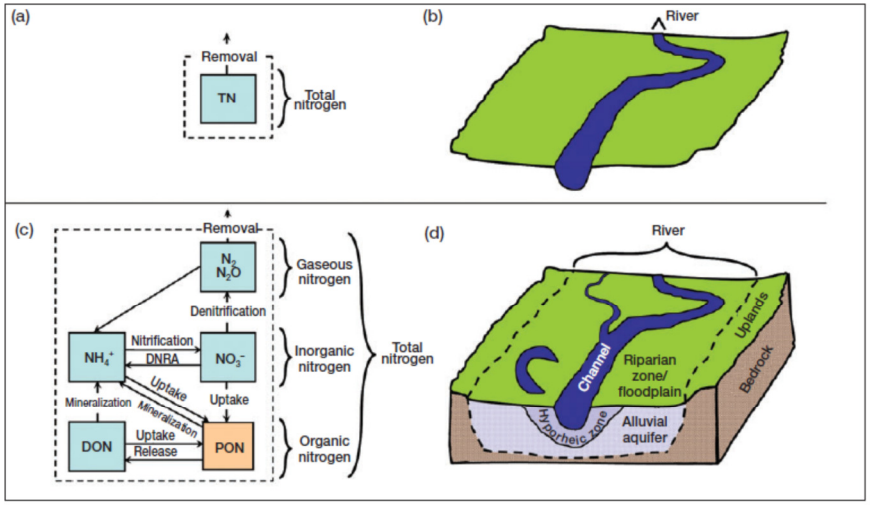


Figure 5. River-network models typically describe (a) one-way total nitrogen flux from (b) river channels. A more holistic conceptual model of nitrogen cycling in river ecosystems recognizes (c) multiple forms of nitrogen that undergo numerous transformations and (d) the role of non-channel river ecosystem components in nitrogen dynamics, including the hyporheic zone, alluvial aquifer, and floodplain/riparian complex. DON = dissolved organic nitrogen; PON = particulate organic nitrogen; NH_4^+ = ammonium; NO_3^- = nitrate; N_2 = dinitrogen gas; N_2O = nitrous oxide; DNRA = dissimilatory nitrate reduction to ammonium.

Existing river- network models typically describe one-way TN flux (a) from simple river channels (b). Future models will include more complicated N cycling (c) in both channel and off-channel ecosystem components (d). DON= dissolved organic N, PON = particulate organic N. Reprinted from Helton et al. (2011) Source: Figure 3 from *Nitrogen in Minnesota Surface Waters: Conditions, trends, sources, and reductions, MPCA 2013.*

Wetlands

Appendix B5-2 of *Nitrogen in Minnesota Surface Waters* describes wetlands ability to reduce nitrogen.

> "Wetlands are generally considered as aquatic systems with a high capacity to assimilate and ultimately denitrify N inputs. Wetlands have several characteristics that allow for TN removal including abundant labile organic carbon, anoxic sediments, generally long residence times and small watersheds. Mitsch and Day (2006) proposed the creation and restoration of wetlands throughout Mississippi-Ohio-Missouri Basin to intercept field drainage along with diversion wetlands fed by flooding river waters as a means to mitigate eutrophication in the Gulf of Mexico. They based this recommendation on an extensive review of field studies that demonstrated 33% to 95% NO_X-N retention in wetlands. Flow-through and riparian wetlands must be strategically positioned within a watershed to have the most impact on N transport. Many of the principles discussed in the lake and riverine backwater sections of this chapter also apply to wetlands. For instance, a large wetland receiving a modest load of TN from a small watershed would generally remove more N than a small wetland receiving a large load of TN from a large watershed."

Blue Earth County has identified potentially restorable basins that could be considered and further analyzed for nutrient treatment based on the above criteria. A description and map of these areas is in the priority areas for protection and restoration section of the *Blue Earth County Water Management Plan 2017-2026*.

Drinking Water and Groundwater Protection Goals

Goal: Protect the quantity and quality of groundwater resources to ensure long term sustainability of groundwater supplies.

Land Use Management Strategies

Land use planning and management have an in important role in protecting groundwater resources. Groundwater protection strategies will be incorporated in local comprehensive land use plans, zoning, water and wastewater ordinances, programs and policies to protect groundwater resources. Land development should be managed in areas with high to moderate pollution sensitivity and karst, when siting home occupations, commercial and industrial development using hazardous substances and wastewater treatment in areas without publicly-owned wastewater treatment.

COUNTY-WIDE STRATEGY: LAND USE PLANNING AND REGULATIONS.
Action: Conduct education and training with local officials and staff using the *Geologic Atlas of Blue Earth County, Part B*, to support development and implementation of groundwater protection in local plans, ordinances and policies.

Action: The County will ensure groundwater protection is an integral part of local land use plans and ordinances.

Action: All jurisdictions will review development proposals to ensure required well isolation distances (setbacks) from existing and future wells will be maintained.

Action: Ensure land development proposals address storage, use and disposal of potentially hazardous substances and hazardous waste.

Action: Review development proposals and well disclosures to ensure abandoned wells are identified and properly sealed.

Action: Utilize the *Geologic Atlas of Blue Earth County, Part B*, to identify areas with high to moderate pollution sensitivity to ensure land use in those areas protect groundwater.

Action: Review development proposals in areas not served with publicly owned wastewater treatment systems to ensure there are no Class V injection wells for any type of wastewater or stormwater management in existing and proposed uses.

Action: The County will review feedlot permits in areas with moderate to high pollution sensitivity to ensure compliance with local and state regulations.

Action: The County will continue to assist the MDH and MNDNR with water appropriation permitting and the regulation of unrestricted flowing wells.

Well Construction and Well Use Strategies

ONGOING STRATEGY: DELEGATED WELL PROGRAM.
Action: The County will continue to administer the Minnesota Well Code, issue permits, inspect the construction of new domestic wells

and non-community water supply wells, inspect the sealing of abandoned well, and ensure wells are maintained in accordance with the Minnesota Department of Health delegation agreement.

ONGOING COUNTY-WIDE STRATEGY: WELL SEALING.
Abandoned and improperly sealed wells are one of the most significant threats to groundwater quality in the county. State Law requires well owners to either repair abandoned wells and place them in service, or have them permanently sealed by a licensed well contractor. Abandoned wells are common in both rural areas and in municipalities and townsites that are presently served by public water supplies. Abandoned well identification and sealing efforts will help prevent contamination of groundwater.

Action: The County will continue to locate, permit and inspect well sealing throughout the county.

Action: The County will continue a minimum $10,000 locally-funded annual well sealing cost share program and will assess the adequacy and use of program to determine local needs and increase the cost-share funds available as needed.

Action: The County, Municipal Water Suppliers and other partners will identify priority areas and priority wells for sealing, such as DWSMAs, Source Water Protection Areas, floodplains, areas with moderate or high pollution sensitivity, areas of known contamination and other determined to be a priority based on land use, groundwater pollution sensitivity and well characteristics.

Public Water Supplier Strategies

STRATEGY: WELLHEAD PROTECTION.
Action: Support Public Water Suppliers' development and implementation of Wellhead Protection Plans required by the Minnesota Department of Health and Water Supply Plans required by the Minnesota Department of Natural Resources.

Action: The County will assist municipalities and the MDH with preparing wellhead protection plans and Water Supply Plans required by the MNDNR when requested by the municipality.

Action: Support municipalities implementing Wellhead Protection Plans, including activities such as:

- Well sealing
- Constructing a new well
- Installing a monitoring well
- Well inspection (video log, gamma log)
- Educating the public about drinking water protection
- Updating well inventories
- Updating contaminant source inventory
- Upgrading membrane filters
- Managing fuel storage tanks
- Cleaning up illicit dumping near well
- Support property owners to manage nitrogen
- Spill prevention and emergency response plan
- Water conservation and reuse projects

Waste Management Strategies

STRATEGY: HAZARDOUS WASTE MANAGEMENT.
Policy: Ensure hazardous substances, hazardous materials and hazardous wastes are managed at the site level to reduce the potential for groundwater contamination.

Action: Seek outside funding to address sites with contaminated soil with the potential to contaminate groundwater in areas with moderate and high pollution sensitivity as shown in the *Geologic Atlas for Blue Earth County, Part B*, and other areas with pollution sensitivity.

Ongoing Strategy: Hazardous waste disposal.
Action: The County will continue to operate the Household Hazardous Waste Collection Program, Small Quantity Generator Program and Medicine Collection Program.

Well Testing Strategies

Strategy: Private well testing.
Action: The County will continue education programs and encourage private well water testing for contaminants, such as bacteria, nitrates and arsenic, and will coordinate with a MDH certified lab to provide water testing services to residents for a fee.

Action: The County Environmental Services will work with the County Public Health, local medical clinics and other appropriate partners in the community to promote the need for private well testing.

Strategy: Public Water Supply Testing.
Action: Public water suppliers will continue water testing programs as required by the MDH and the Safe Drinking Water Act.

Strategy: Observation Wells.
Action: Support expansion of the MNDNR observation well network in Blue Earth County.

Groundwater Recharge Strategies

Goal: Reduce nitrate nitrogen in rivers recharging surficial sands aquifers used for drinking water.

The Blue Earth River recharges surficial sands aquifers. Use of this aquifer preserves the quantity of groundwater supplies in deeper bedrock aquifers like the Mount Simon.

Strategy: Reduce nitrate nitrogen in the Blue Earth River.
Action: Identify, prioritize and implement best management and treatment practices that reduce nitrogen in the Blue Earth River watershed.

Action: Local partners will work with landowners to restore wetlands to provide nutrient treatment functions as identified in this plan and other local, state or watershed plans that identify nitrogen treatment best practices.

Action: Local partners will work with counties and SWCDs in the Blue Earth, Le Sueur and Watonwan River watersheds to ensure nitrogen reduction is addressed in these watersheds during the MPCA watershed assessments and intensive monitoring programs, during development of MPCA Watershed Protection and Management Strategies and One Watershed One Plan.

Strategy: Nitrate Nitrogen Monitoring.
Action: The City of Mankato will continue its well and river monitoring programs.

Action: The City of Mankato and the County will work with the SWCD, MDH, USGS, MPCA, MDA, University of Minnesota and other appropriate local, state and federal agencies to develop and

implement a coordinated, expanded monitoring plan to improve understanding of nitrates in surficial sands aquifers at the confluence of the Blue Earth and Minnesota Rivers.

Goal: Recharge buried sands and bedrock aquifers.

STRATEGY: GROUNDWATER RECHARGE.

Action: Establish practices that recharge buried sands and bedrock aquifers.

Action: Protect, enhance and restore wetlands and similar conservation practices in areas where there is groundwater recharge potential as shown in the *Blue Earth County Water Management Plan*, high pollution sensitivity of buried sands aquifers as shown in the *Geologic Atlas of Blue Earth County, Part B,* or as shown in future plans and studies of groundwater recharge potential.

STRATEGY: LOW FLOW AUGMENTATION.

Action: Establish conservation easements in river corridors.

Action: Protect and restore wetlands in river corridors and former sand, gravel and rock mining sites.

STRATEGY: FLOWING WELLS.

Action: The County will identify flowing wells and ensure flowing wells are sealed as required by State law.

STRATEGY: MOUNT SIMON AQUIFER.

Action: Participate in Mount Simon Aquifer user group.

Action: Support reduced use of the Mount Simon Aquifer to the extent practicable.

Priority Concern: Surface Water

Cropland

Agriculture dominates the landscape in the county and is a vital part of the local economy. Over 70-percent of the total area of the county is used for cultivated cropland. USDA, National Agricultural Statistics Service Census of Agriculture 2002, 2007 and 2012 data show a decrease in the number of farms, farmers and land in farms and an increase in the acres of irrigated land between 2002 and 2012.

The table on this page shows summary statistics of the number of farms, the occupation of the farm operator, the land in farms, the harvested cropland, and the irrigated land in the County. The statistics are from the USDA, Census of Agriculture from 2002, 2007 and 2012.

Blue Earth County Agriculture Summary			
	Year		
Item	2002	2007	2012
Number of Farms	1,125	1,247	1,070
Principal Operator of a Farm with primary occupation of Farming	775	655	575
Principal Operator of a Farm with primary occupation of Other	300	592	495
Land In farms (Acres)	405,564	415,326	376,460
Harvested Cropland (Acres)	355,277	356,656	323,701
Irrigated Land (Acres)	48	614	1,707

USDA, National Agricultural Statistics Service Census of Agriculture 2002, 2007 and 2012

To most observers it appears all agricultural cropland is used and managed by farmers in the same way across the landscape. In reality each farmer manages a more complex farming system based on the farmer's production goals, soils and topography which influence planting, tillage and drainage, and nutrient management. Every aspect of the farming system is translated into costs and farm income.

Involving farmers in watershed management, identifying practices and monitoring will be key to addressing water quality concerns related to agricultural land use.

Water Quality

Concerns related to cropland are 1) soil erosion and transport to surface water, 2) nitrogen loss and transport to surface and groundwater through subsurface tile drainage systems, and 3) phosphorus loss and transport with eroded soil in runoff and in subsurface tile drainage.

Soil Erosion

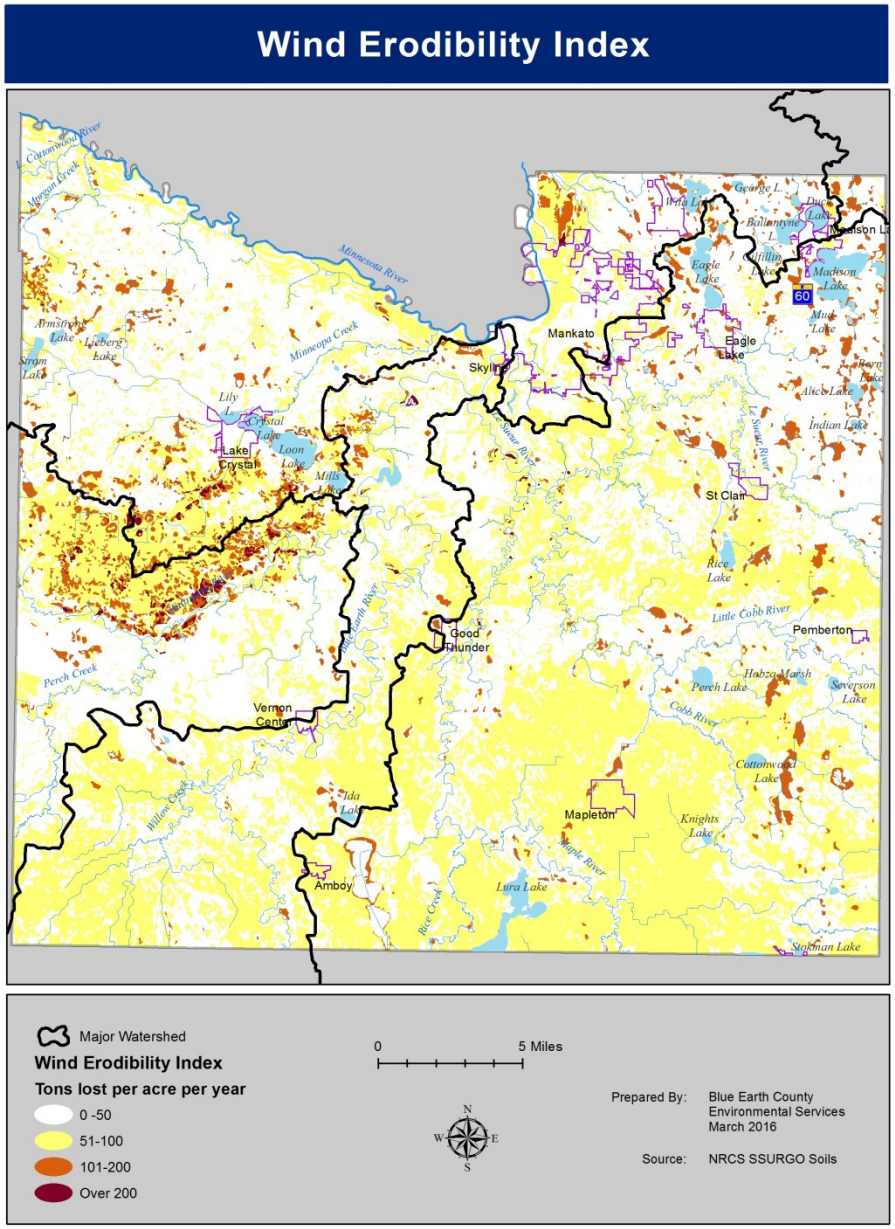
There are different types and degrees of severity of soil erosion. The USDA characterizes erosion with the following definitions:

Sheet and Rill: Detachment and transport of soil particles caused by rainfall splash and runoff degrade soil quality.

Ephemeral Gully: Small channels caused by surface water runoff degrade soil quality and tend to increase in size. On crop land they can be obscured by heavy tillage.

Classic Gully: Deep, permanent channels caused by the convergence of surface runoff degrade soil quality. They enlarge progressively by head-cutting and lateral widening.

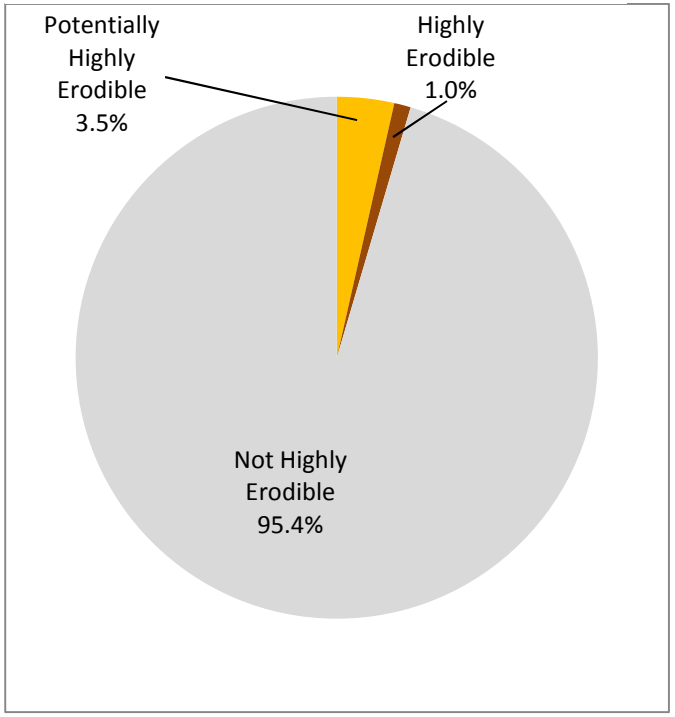
Wind erosion is also a source of sediment and soil-related pollutants that may be delivered by atmospheric deposition. The USDA does not consider wind erosion a wide-spread problem in Blue Earth County. Soils with the greatest potential for wind erosion are found mainly south of Lake Crystal. Drifts of windblown soil in this area are commonly observed collecting along fence lines and ditches adjacent to broad expanses of open fields lacking crop residue or vegetation in the winter and spring. At times windblown soil in this area seriously limits visibility on US Highway 169.



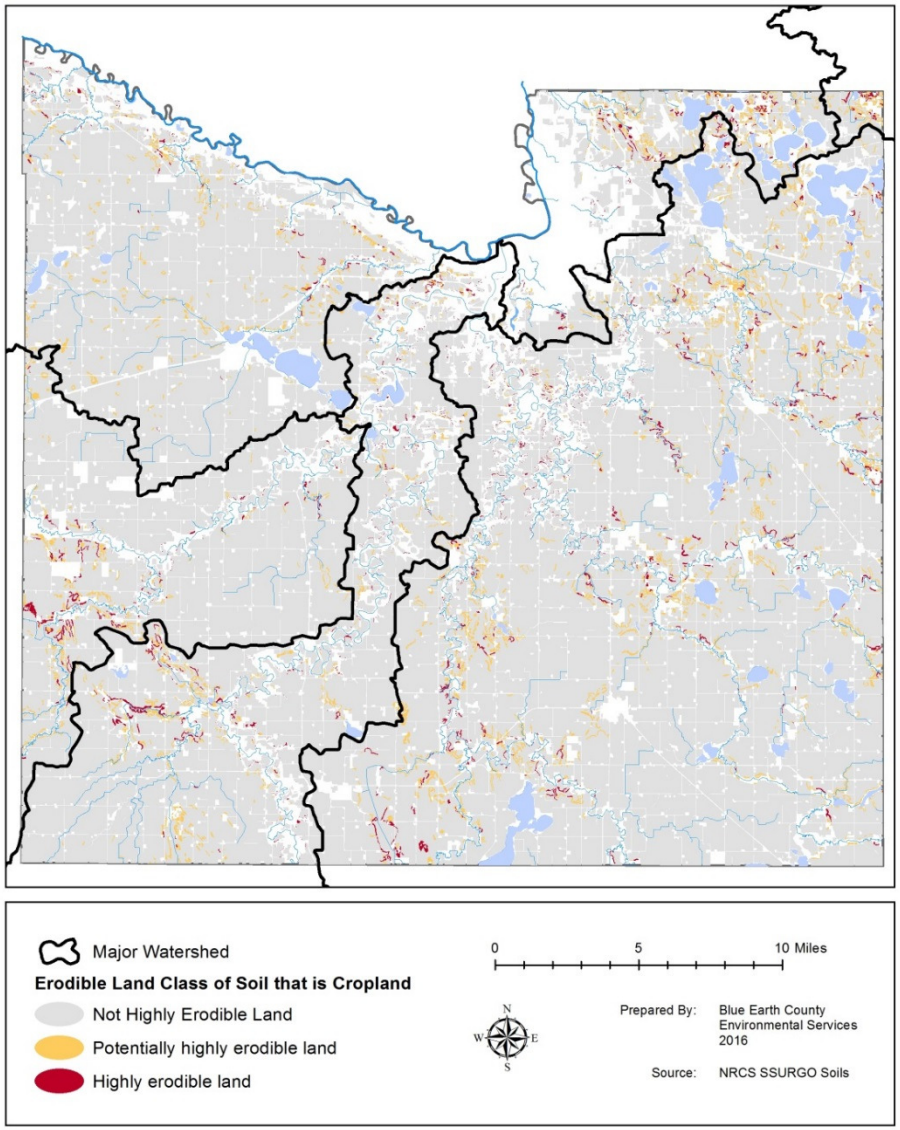
Erodible Land Class for Cropland

Over 95-percent of the cropland in the County is classified as not highly erodible land. Only 3.5-percent of the cropland is classified as potentially highly erodible land and 1-percent is classified as highly erodible land. While the percentage of highly erodible land that is being cropped is quite small, there are a total of 3,760-acres of cropland classified as highly erodible land.

Summary of Erodible Land Class for Cropland



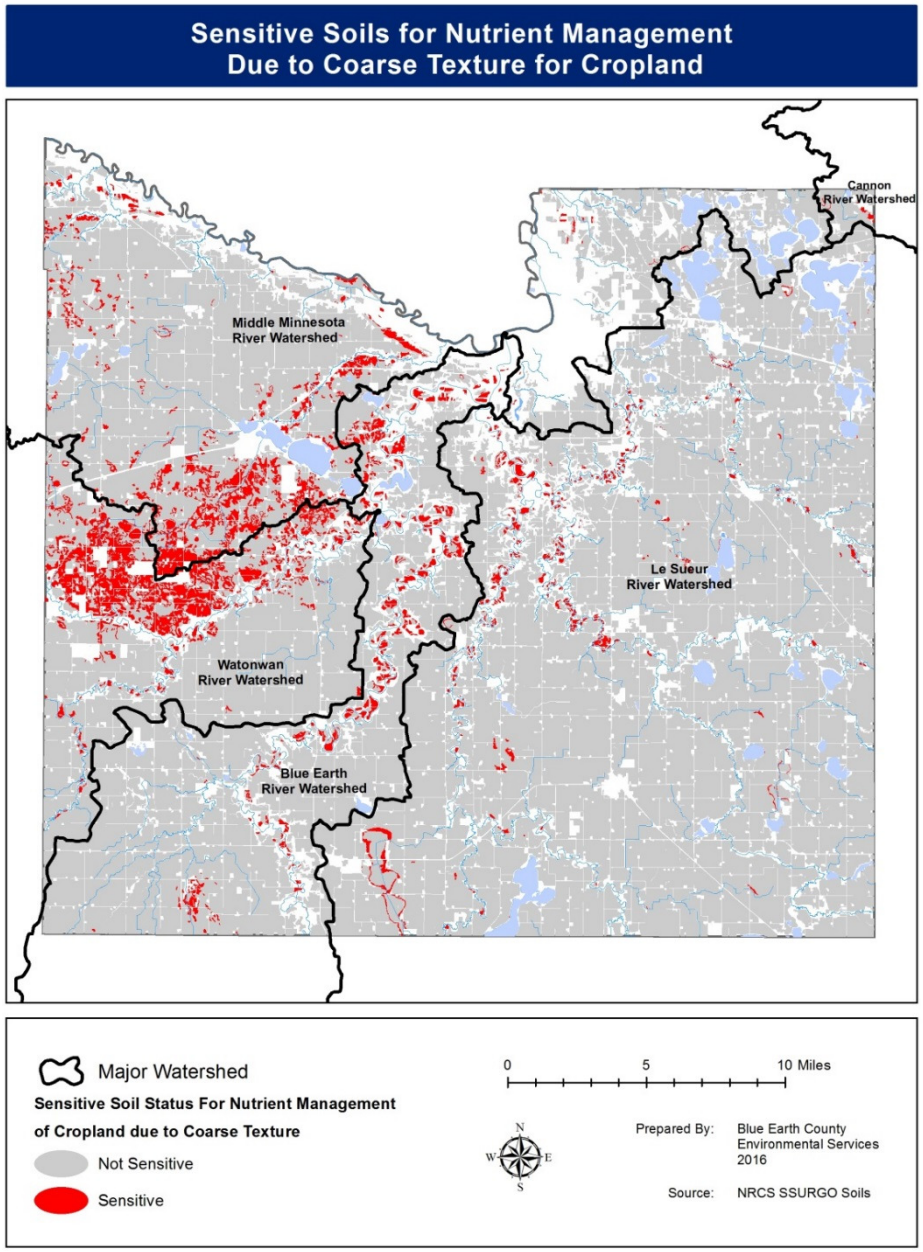
Erodible Land Classification of Soils that are Cropland



Sensitive Soils For Nutrient Management due to Coarse Texture

"This interpretation generates a soil sensitivity rating for nutrient management planning in Minnesota. Nutrient management plans are developed using the sensitive soil ratings classes. NRCS Conservation Practice Standard Nutrient Management (590) discusses nutrient management practices that should be used when sensitive soils are encountered. Careful planning is needed if manure or commercial fertilizers are applied. The physical properties and limitations of these soils can result in the leaching of nutrients downward beyond the root zone or the movement of nutrients toward surface waters. The ratings are based on physical properties of the soils and on soil features. Soils that are sensitive to nutrient applications include soils on flood plains, coarse textured soils, soils that are shallow to bedrock, soils that have a high water table, soils that are ponded, and sloping soils." (USDA NRCS)

The map to the right displays the sensitivity rating of soils for nutrient management for coarse soil texture. There are 19,896-acres or 5.4% of the cropland in the County that is a sensitive soil for nutrient management due to coarse soil texture. The majority of these soils are in the Middle Minnesota River Watershed and the Watonwan River Watershed.



Soil Erosion Law

Enacted in 1984, Minnesota's Soil Erosion Law (Minnesota Statutes 2017m section 103F.401 to 103F.455) set forth a broad public policy regarding excessive soil loss. This law prohibited excess soil loss only through county ordinance. In 2015, the requirement for a local ordinance was removed from this statute, so now affected property owners or elected officials can file a complaint. The law now also provides for enforcement through the administrative penalty order process.

Altered Hydrology and Water Storage

Altered hydrology is a stressor related to ravine, stream bank and bluff erosion described in the MPCA *Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River* and the *Le Sueur River WRAPS.*

The University of Minnesota *Fields to Streams* describes how individual land managers can reduce peak flows by keeping water on the land with the following practices and projects:

Soil Management: Enhancing the ability of the soil to infiltrate and store precipitation. Soil and crop management in agricultural fields affects infiltration rates and water holding capacity through effects on soil structure and soil organic matter.

Transpiration: Managing the amount and distribution of crop transpiration throughout the year. Transpiration is the largest user of precipitation water, and its timing relative to rainfall distribution has a great influence on how much surplus water will move off the land.

Surface Flow: Managing overland flow with crop residue, contour farming, and vegetated flow pathways like waterways and filter strips that slow, filter, and partially infiltrate surface runoff.

Subsurface Drainage: Managing subsurface drainage flow by sizing, depth, and spacing of drainage pipe to control rates of drainage water leaving the field. Control structures can also be installed in the drainage system to allow temporary water storage for later crop use or timed release.

Water Storage: Increasing water storage, including natural storage in wetlands and other depressions, and artificial storage with constructed wetlands, terraces, ponds, water and sediment control basins (WASCOBs), down-sized culvert retention, weirs, and large detention basins.

Nitrogen

Reducing nitrogen in the Blue Earth River is a high nutrient management priority in the county.

MPCA *Nitrogen in Minnesota Surface Waters, Conditions, trends, sources, and reductions,* study shows that cropland is a major source of nitrogen in local watersheds and subsurface tile drainage is the main pathway and recommends the following BMPs for reducing nitrogen losses to waters from cropland:

1) ***In-field nutrient management*** (i.e., optimal fertilizer rates; apply fertilizer closer to timing of crop use; nitrification inhibitors; variable fertilizer rates)

2) ***Tile drainage water management and treatment*** (i.e. shallower depth of tile drainage; control structures that let farmers adjust water levels; constructed and restored wetlands for treatment purposes; woodchip trench bioreactors; and saturated buffers

3) ***Vegetation/landscape diversification*** (i.e. cover crops; perennials planted in riparian areas or marginal cropland; extended rotations with perennials; energy crops in addition to corn)

The MDA 2015 *Nitrogen Fertilizer Plan* describes best practices for nitrogen summarized in best management guides. The following relate to soils and cropland in the county:

- *Best Management Practices for Nitrogen Use on Coarse-textured Soils*
- *Best Management Practices for Nitrogen Use in South-Central Minnesota*

The MDA *Fertilizer and BMP Handbook* also provide BMP guidance for fertilizer and nutrient management.

Phosphorus

The *Minnesota Extension Service, Phosphorus: Transport to and availability in surface waters* bulletin describes phosphorus concerns in surface water:

> "Phosphorus is a somewhat unique pollutant in that it is an essential element, has low solubility, and is not toxic itself, but may have detrimental effects on water quality at quite low concentrations.
>
> All agricultural cropland has the potential for contributing nutrients to surface waters; however, some sites are more likely to contribute significant amounts than others. Highly erodible cropland enriched with fertilizer and manure nutrient inputs has a higher probability of degrading surface water quality due to greater runoff and soil losses.
>
> Because phosphorus is attached to soil materials, erosion largely determines the particulate phosphorus movement in the landscape.
>
> Most soils have a large capacity to retain phosphorus. Even large additions of phosphorus will be mostly retained by soils provided there is adequate contact with the soil.
>
> Increasing the amounts of phosphate in soils results in increased levels of phosphate in soil solutions. This will generally result in small but potentially important increases in the amounts of phosphate in water that passes over or through soils.
>
> Runoff of water either across the soil surface or via subsurface flow can contain significant concentrations of dissolved phosphorus."

> "Phosphorus losses from agriculture can be a significant source of P entering lakes and rivers. However, P budget and management information indicates that P losses in runoff represent a small portion (1 to 2%) of annual P inputs to agricultural land. Many watersheds contain acreage that does not contribute appreciably to runoff of P, and most of the annual P loss occurs during a few high-runoff events. These characteristics suggest that management strategies to remediate water quality problems associated with P losses from the landscape will be most effective if used on high-risk, sensitive or source areas within a watershed rather than implementing general strategies over a broad area.
>
> General management practices that can be focused in these high-risk areas include minimizing erosion and runoff, avoiding P additions to very high testing soils where a crop response is unlikely, and incorporating or injecting P inputs (fertilizer and manure) below the soil surface."

Buffers and Other Waters

Minnesota Statutes 2017, section 103F.48 requires SWCDs to develop, adopt and submit to each local water management authority within its boundary a summary of "Other watercourses" for inclusion in the local water management plan.

The Blue Earth SWCD assessed water quality benefits that buffers or alternative practices could provide to local water resources that were not included on the Buffer Protection Map. The SWCD determined that the rationale for inclusion of "Other Watercourses" is that "once water is moving in a buffered channel, it is most beneficial if that water stayed in a buffered channel."

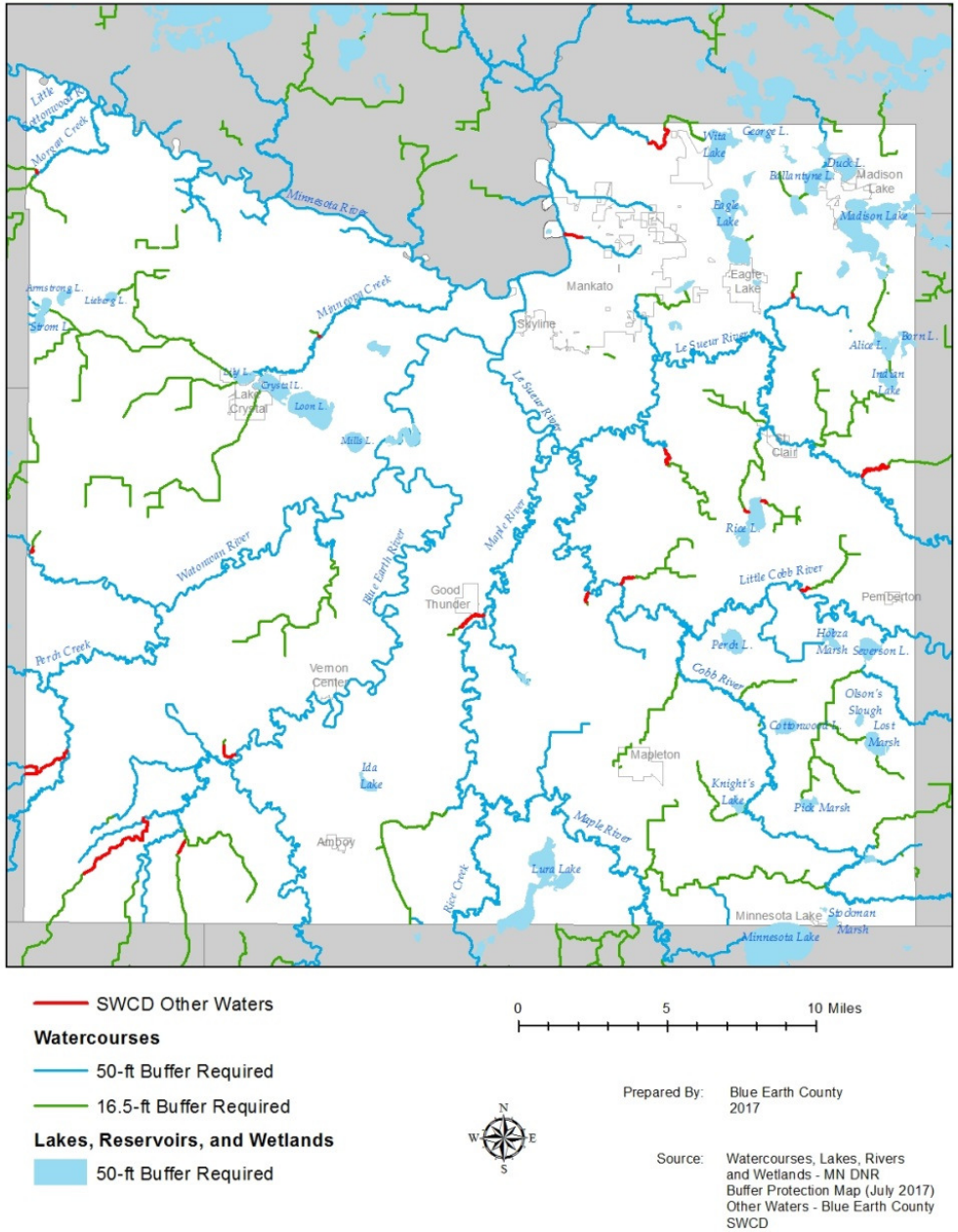
The July 2017 map of required buffers from the State Buffer Protection Map and the "Other Watercourses" is displayed on this page. Other waters identified by the SWCD are also shown in the Appendix of this plan.

Best Management Practices

Best management practices and agricultural BMPs are summarized on the following pages. These lists of BMPs are from the following sources.

- *Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River*, January 2015, Minnesota Pollution Control Agency
- *Minnesota Nutrient Reduction Strategy*, 2014, Minnesota Pollution Control Agency
- *Le Sueur River WRAPS Report: Watershed conditions and restoration and protection strategies*, August 2015, Minnesota Pollution Control Agency
- *Fields to Farms, Part Two, Managing Sediment and Water, 2016,* University of Minnesota Water Resources Center

Required Buffers from the State Buffer Potection Map and Other Waters Identified by the SWCD



MPCA Minnesota Nutrient Reduction Strategy - AG BMPs			
	AG BMP PRACTICE TYPE		
	AVOIDING	CONTROLLING	TRAPPING
Core Practices	328 - Conservation Crop Rotation 340 - Cover Crop 528 - Prescribed Grazing 590 - Nutrient Management 633 - Waste Utilization	329 - Residue and Tillage Management - No Till/Strip Till 330 - Contour Farming 345 - Residue and Tillage Management - Mulch Till 346 - Residue and Tillage Management - Ridge Till 412 - Grassed Waterway 512 - Pasture and Hayland Planting 554 - Drainage Water Management 585 - Stripcropping 600 – Terrace	332 - Contour Buffer Strips 390 - Riparian Herbaceous Cover 391 - Riparian Forest Buffer 393 - Filter Strip 601 - Vegetative Barriers 635 - Vegetated Treatment Area 656 - Constructed Wetland 657 - Wetland Restoration 658 - Wetland Creation 659 - Wetland Enhancement 747 - Denitrifying Bioreactor
Supporting Practices	313 - Waste Storage Facility 317 - Composting Facility 327 - Conservation Cover 381 - Silvopasture Establishment 382 - Fence 472 - Access Control 511 - Forage Harvest Management 558 - Roof Runoff Structure 561 - Heavy Use Area Protection 612 - Tree and Shrub Planting 634 - Waste Transfer	324 - Deep Tillage 342 - Critical Area Planting 362 - Diversion 386 - Field Border 410 - Grade Stabilization Structure 430 - Irrigation Water Conveyance 449 - Irrigation Water Management 468 – Lined Waterway or Outlet 484 - Mulching 587 - Structure for Water Control 606 - Subsurface Drainage 607 - Surface Drainage 638 - Water & Sediment Control Basin	342 - Critical Area Planting 350 - Sediment Basin 356 - Dike 436 - Irrigation Storage Reservoir 490 - Forest Site Preparation 587 - Structure for Water Control 629 - Waste Treatment 638 - Water and Sediment Control Basin 646 - Shallow Water Development and Management

Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River 2015 Minnesota Pollution Control Agency		
Source Area	**Sediment Reduction Best Management Practices**	
Upland Erosion	Soil Health Field buffer, borders and filter strips Cover crops Conservation tillage WASCOBs	Terraces In/near ditch retention treatment Conservation cover Grassed waterways
Near channel erosion Reduce peak flows. Practices and activities designed to reduce the elevated flows are expected to address the cause of near-channel erosion more effectively than direct controls.	Wetland restoration Created wetlands for storage/treatment Grassed waterways WASCOBs	Terraces Conservation tillage Cover crops In/near ditch retention and treatment Tile drainage design – controlled drainage
	Direct controls to protect infrastructure	
Source: Ravines	Flow Reduction Water storage Grade stabilization structures	

PRACTICES / EFFECTS	Increase spring transpiration	Increase infiltration	Increase soil water holding capacity	Reduce total water (and nitrogen) delivery	Increase denitrification	Reduce P and sediment delivery	Increase open water evaporation	Reduce peak flows	Reduce in-stream velocity
1. IN-FIELD: CROP AND SOIL MANAGEMENT									
Perennial crops, and crop rotations with perennials or winter annuals	●	●	●	●		●		●	
Cover crops	●	●	●	●		●		●	
Reduced tillage, contour cropping and residue management		●	●			●			
Compaction management		●	●						
Manure application[1]		●	●			●			
2. IN-FIELD: DRAINAGE WATER MANAGEMENT									
Alternative drainage design (depth, spacing, capacity)[2]				●				●	
Controlled drainage				●				●	
Alternative tile inlets		●				●		●	
3. IN-FIELD AND EDGE-OF-FIELD: SURFACE FLOW MANAGEMENT									
Grassed waterways	●	●		●		●		●	
Filter strips, contour buffer strips	●	●		●		●		●	
4. IN-FIELD AND EDGE-OF-FIELD: WATER STORAGE AND INFILTRATION									
Saturated buffers		●		●	●			●	
Restored and constructed wetlands		●		●	●	●	●	●	
WASCOBs, terraces, and detention basins		●		●		●		●	
Ponds and irrigation reservoirs				●	●	●	●	●	
Large retention basins		●		●	●	●	●	●	
5. DITCH CHANNEL: WATER RETENTION									
Structures for water control, including weirs and restricted size cluverts						●		●	●
Two-stage ditch with restricted size culverts						●		●	●
6. RIPARIAN AREA: RESTORATION AND PROTECTION									
Riparian vegetation	●	●			●	●			
Streambank, bluff, and shoreline protection						●			
Restore channel meanders					●				●

[1] Depends on the rate and method of application

[2] Effects relative to conventional drainage design

Le Sueur River WRAPS Report:
Watershed conditions and restoration and protection strategies,
August 2015, Minnesota Pollution Control Agency

Ag BMP strategy NRCS project code and Additional Notes

See the NRCS design guidance and/or the Ag BMP handbook for additional information

Ag BMP	NRCS code(s)	Additional Notes
Conservation cover	327, 643	native vegetation best including grasses, trees, shrubs
Conservation tillage	329, 345, 346	no till or strip till with very high residue
Cover crops	340	locally recommended to use in conjunction with cons tillage
Crop rotation	328	consider in conjunction with cover crops and cons tillage
Feedlot runoff control	635, 362	
Field buffers, borders, filter strips	393, 386, 332	edge-of-field or within field
Grassed waterways	412	
In/near ditch retention and treatment	410, 587	Includes any practice where the ditch itself is incorporated in to practice: 2-state ditch, side inlet control, weirs and berms, etc.
Livestock exclusion	382, 472, 614	exclusion from water bodies, can help to create watering station
Manure application setbacks	590	one specific component of nutrient management
Nutrient (including manure) management	590	considers amount, source, form, timing, etc..
Ravine (grade) stabilization	410	first address hydrology before costly stabilization
Restored wetlands	657, 643, 644	restoring wetland (where one historically was located)
Rotational grazing	528	managing for improved vegetation improves water quality
Saturated buffers	739	
Streambank stabilization	580	using bioengineering techniques as much as possible
Tile system design; controlled drainage	554	managing for less total runoff; includes alternative tile intakes
Treatment wetlands	656, 658	specifically designed to treat tile drainage and/or surface runoff
Water and sediment basins, terraces	638, 600	managing for extended retention and settling
Woodchip bioreactors	747	

Cropland Goals and Strategies

Goal: Increase adoption of voluntary best practices to protect and improve soil health and water quality.

Education and Outreach

Most farmers want data that is relatable to their farms. Farmers are sometimes skeptical of research from other areas of the state because soils and drainage may be different than farmland in local watersheds.

STRATEGY: DEMONSTRATIONS.
On-farm trials and demonstrations led by farmers can help address perceptions of uncertainty, effectiveness about potential practices by testing their effectiveness and effect on yields in local soil conditions and landscapes.

Action: Increase adoption of voluntary best practices and support adaptive management to improve soil health, nutrient use efficiency with farmer-led, field scale demonstrations and monitoring.

Action: The SWCD and other partners will seek funding from public and private sources to establish farmer-led, field scale demonstration sites.

Nitrogen Management

Reducing nitrate nitrogen in the Blue Earth River watershed is a high priority.

STRATEGY: NUTRIENT MANAGEMENT.
Action: Work with land managers to establish in-field nutrient management (i.e., optimal fertilizer rates; apply fertilizer closer to timing of crop use; nitrification inhibitors; variable fertilizer rates) and best practices for nitrogen reduction are described in the MDA *Fertilizer and BMP Handbook*, *Best Management Practices for Nitrogen Use on Coarse-textured Soils* and *Best Management Practices for Nitrogen Use in South-Central Minnesota* and future guidance.

STRATEGY: TREAT SUBSURFACE TILE DRAINAGE WATER.
Action: Work with land managers to establish tile drainage water management and treatment practices that intercept or reduce nitrogen from subsurface tile drainage (i.e. shallower depth of tile drainage; control structures that let farmers adjust water levels; constructed and restored wetlands for treatment purposes; woodchip trench bioreactors; and saturated buffers).

STRATEGY: VEGETATION.
Action: Work with land managers to establish vegetation practices and landscape diversification (i.e. cover crops; perennials planted in riparian areas or marginal cropland; extended rotations with perennials; energy crops in addition to corn).

STRATEGY: MONITORING.
Action: Support nitrogen monitoring in the Blue Earth River watershed.

Soil Erosion

STRATEGY: VEGETATED BUFFERS.
Action: Establish and maintain vegetation in riparian areas and riparian buffers in accordance with Minnesota Statutes 2017, sections 103F.401 to 103F.445 and the *Blue Earth County Shoreland Ordinance* Agricultural Use Standards.

STRATEGY: HIGHLY ERODIBLE LAND.
Action: Work with land managers to establish water and sediment control basins (WASCOBs), grassed waterways and grade stabilization

structures on highly erodible land and potentially highly erodible land as shown in this plan and the USDA NRCS Soil Survey.

Action: Work with land managers to establish practices to improve soil health.

Soil Erosion Law.
Enacted in 1984, Minnesota's Soil Erosion Law (Minnesota Statutes 2017, section 103F.401 to 103F.455) set forth a broad public policy regarding excessive soil loss. This law prohibited excess soil loss only through county ordinance. In 2015, the requirement for a local ordinance was removed, so now affected property owners or elected officials can file a complaint. The law now also provides for enforcement through the administrative penalty order process.

Action: The SWCD will coordinate compliance monitoring and technical assistance as needed.

Action: The SWCD will work with the County and LGUs to evaluate the need for a soil loss ordinance.

Altered Hydrology

Strategy: Soil health.
Action: Enhance the ability of the soil to infiltrate and store precipitation. Soil and crop management in agricultural fields affects infiltration rates and water holding capacity through effects on soil structure and soil organic matter.

Strategy: Surface Flow.
Action: Manage overland flow with crop residue, contour farming, and vegetated flow pathways like waterways and filter strips that slow, filter, and partially infiltrate surface runoff.

Strategy: Subsurface Drainage.
Action: Manage subsurface drainage flow by sizing, depth, and spacing of drainage pipe to control rates of drainage water leaving the field. Control structures can also be installed in the drainage system to allow temporary water storage for later crop use or timed release.

Strategy: Water Storage:
Action: Increase water storage, including natural storage in wetlands and other depressions, and artificial storage with constructed wetlands, terraces, ponds, water and sediment control basins (WASCOBs), down-sized culvert retention, weirs, and large detention basins.

Phosphorus Strategies

Strategy: Nutrient Management.
Action: Work with land managers to encourage soil phosphorus testing and establish fertilizer best practices use and efficiencies for phosphorus management.

Strategy: Highly Erodible Land.
Action: Work with land managers to establish water and sediment control basins (WASCOBs), grassed waterways and grade stabilization structures on highly erodible land and potentially highly erodible land as shown in this plan and the USDA NRCS Soil Survey.

Action: Work with land managers to establish practices to improve soil health.

SWCD Ongoing Programs

Ongoing Strategy: Conservation Easement Delivery.
Action: The SWCD will continue to administer the Reinvest in Minnesota, Conservation Reserve Enhancement Program and similar conservation programs when signups are open, ensuring marginal cropland is taken out of production to improve water quality, reduce flooding, and increase wildlife habitat.

Ongoing Strategy: MDA State Revolving Fund (SRF).

Action: The SWCD will continue to administer the MDA AG Best Management Practices Loan Program to ensure low interest loans are available for equipment and projects.

Ongoing Strategy: Riparian buffers and water quality practices.

Action: The SWCD will provide landowners technical assistance with implementation of water resource protection and will track compliance with requirements established in Minnesota Statutes 2017, section 103F.48.

Action: The SWCD, Drainage Authority and Environmental Services Department will promote establishing buffers and alternative practices on "Other Watercourses" identified by resolution of the SWCD.

Action: The County and Drainage Authority will consider accepting jurisdiction of enforcement of Minnesota Statute 2017, section 103F.48.

Feedlots and Manure Management

The livestock industry is vital part of the local economy. There have been many changes in livestock production methods in the past 30-40 years. Modern livestock production involves fewer but larger, totally confined feedlots. Total confinement barns have replaced open lots, partial confinement barns, shelters and pastures. Manure management plans, facility inspections, enforcement, permitting, technical assistance, and record keeping are all used to protect water quality. Feedlot producers, working with manure and nutrient management planning consultants, the SWCD, NRCS and the County, are critical partners in achieving water management goals

Pollutants of concern

Phosphorus, nitrogen and bacteria from feedlots and manure are surface and ground water quality concerns.

Regulations

The MPCA regulates large concentrated animal feeding operations (CAFOs) with greater than or equal to 1,000 animal units, in accordance with state and the federal Clean Water Act.

Blue Earth County regulates feedlots in accordance with County ordinances, State rules and a delegation agreement with the MPCA. The delegation agreement has been in effect since the mid-1990's.

The Zoning Section of the County Code defines feedlots:

> ***Animal feedlot:*** means a lot or building, or combination of contiguous lots and buildings, intended for the confined feeding, breeding, raising or holding of animals and specifically designed as a confinement area in which manure may accumulate, or where the concentration of animals is such that a vegetative cover cannot be maintained within the enclosure. For purposes of this article, open lots used for feeding and rearing of poultry (poultry ranges) and barns, dairy facilities, swine facilities, beef lots and barns, horse stalls, mink ranches and domesticated animal zoos shall be considered to be animal feedlots. Pastures shall not be considered animal feedlots under this article.

Feedlot Inventory

Swine, cattle, cows, turkeys and chickens are the most common, but swine production dominates the livestock industry in the county. According to the 2012 United States Department of Agriculture's 2012 Census of Agriculture, Blue Earth County was ranked second in hog and pig sales in Minnesota. Only Martin County had more hog and pig sales in the state. Nationally, Blue Earth County was ranked 10th in hog and pig sales in 2012. In terms rankings of counties based on pig inventory, Blue Earth County was ranked second in Minnesota and sixteenth nationally in 2012 according to the U.S. Census of Agriculture.

There are 424 feedlots in the county according to 2016 County permit records. Most of the feedlots are located in the southern half of the county. The map on the following page displays the location of each permitted feedlot. While there are 18 fewer feedlots in the County than in 2003, there are 21,290 more total animal units. The average size of feedlots in the County was 311 animal units in 2003, while in 2016 the average size feedlot is 374 animal units.

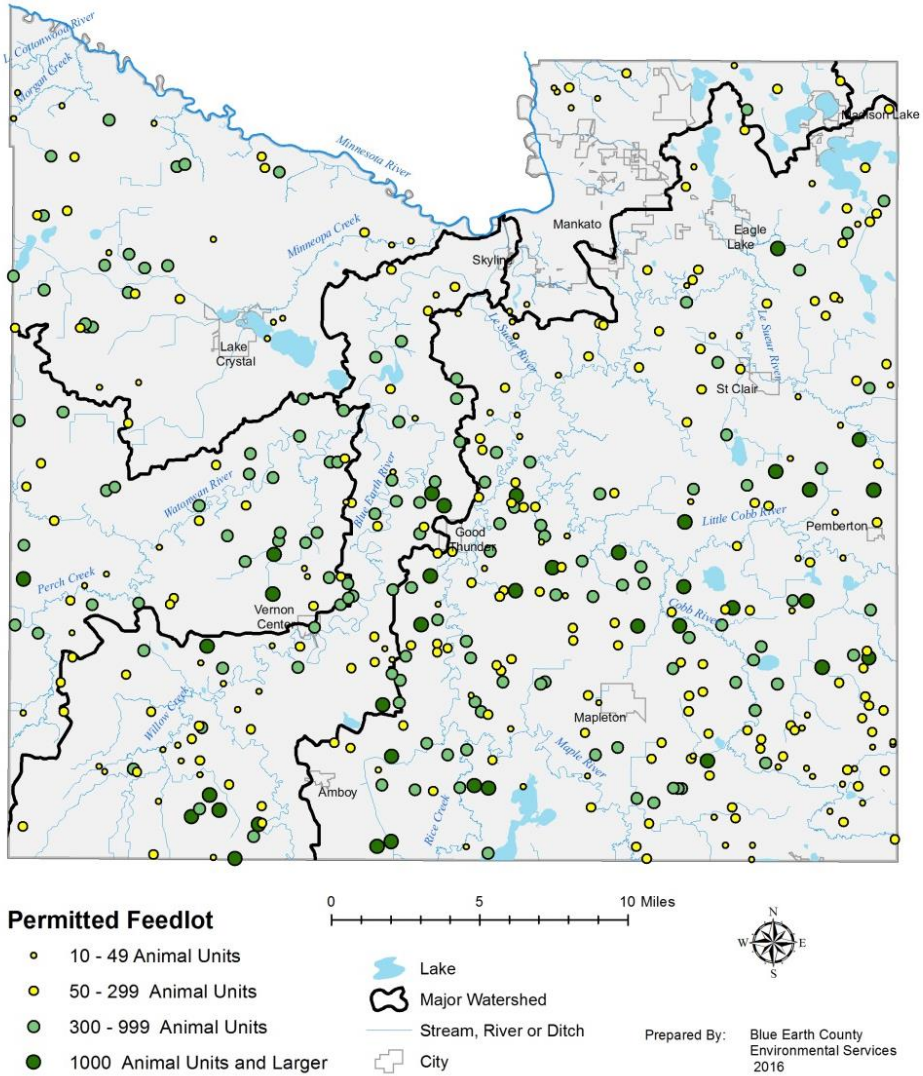
2003 Blue Earth County Feedlot Inventory

Major Watershed	Number of Feedlots	Number of Animal Units (State AU)	Average Size (AU)
Blue Earth	86	28,703	333.8
Le Sueur	256	83,183	324.9
Middle MN	48	8,767	182.6
Watonwan	51	16,728	328.0
Cannon	1	96	96.0
Total	**442**	**137,477**	**311.0**

2016 Blue Earth County Feedlot Inventory

Major Watershed	Number of Feedlots	Number of Animal Units (State AU)	Average Size (AU)
Blue Earth	76	30,562	402.1
Le Sueur	245	91,743	374.5
Middle MN	51	13,305	260.9
Watonwan	51	22,967	450.3
Cannon	1	90	90.0
Total	**424**	**158,667**	**374.2**

Permitted Feedlots



Areas of Concern

- Manure and nutrient management
- Environmentally sensitive areas
- Open lots
- Manure storage
- Placement and design of dead boxes

Manure Management

Ideally manure is fully utilized as crop fertilizer and applied at rates related to crop needs and nutrients available using methods to prevent manure or nutrient runoff to surface water according to the feedlot operator's manure and nutrient management plans. Most feedlot operators do a good job with manure management and are continuing to improve as awareness of water quality is increasing and manure management plans are required for feedlots with 300 or more animal units.

Nutrient Pollution Concerns

Land applied manure has the potential to pollute surface water two ways: 1) manure runoff from the field, and 2) manure/fertilizer applied above agronomic rates running off or leaching to subsurface tile drainage. Manure is more likely to run off when applied without incorporation, applied on slopes, applied close to sensitive areas, or applied on frozen ground. Applying more manure than needed by the crop results in an accumulation of nutrients in the soil. When applied at agronomic rates for phosphorus, most fields require less or less frequent manure than if applied with consideration of only nitrogen needs for crops. Excess phosphorus is transported with stormwater and eroded soil particles. Nitrogen and excess phosphorus leach through soil to subsurface tile drainage and groundwater.

Environmentally Sensitive Areas

State Rules require sensitive areas be addressed in manure management plans. MPCA guidance shows the following are considered sensitive areas: lake, stream, intermittent stream, drainage ditch without protective berms, public waters wetland, open tile intakes, floodplain, road ditch, sinkhole, well, mine, quarry, shallow soil over fractured rock, and other conduits to water.

Shallow Depth to Bedrock and Coarse Textured Soils

Shallow soils over bedrock and coarse textured soils are sensitive for nutrient management according to the USDA Soil Survey. A map of these soils is shown on the following page.

Shallow soil over bedrock is found in or near some of the river valleys in the county including the Minnesota River, Blue Earth River, Le Sueur River and Minneopa Creek. The shallowest depth to bedrock (zero-12 inches) is found along the Minnesota River most notably in Judson Township, South Bend Township, City of Mankato and Lime Township.

Livestock and animal manure is a potential threat to ground water in areas with shallow depth to bedrock. Open lots for cattle and swine and are the most common type of livestock in areas of the county with shallow depth to bedrock. Many of these open lots have fewer than 10 animal units, so they do not meet the definition of a feedlot and are not included in the County feedlot inventory.

Most of the horse feedlots, horse barns and pastures for horses in the county are in areas with shallow depth to bedrock in Lime Township. Many sites with horses have fewer than 10 animal units, so they do not meet the definition of a feedlot and are not included in the County feedlot inventory.

Coarse textured soils are located along river channels and in some lake shoreland. Feedlots in and nearest river valleys are mostly open lots. Outside of river channels, the largest extent of coarse textured soils are in the Watonwan River watershed, the Lake Crystal/Minneopa Creek watershed, Morgan Creek watershed and the Little Cottonwood River watershed. There are many feedlots of all sizes and manure storage systems in the Watonwan River watershed. In the Lake Crystal and downstream Minneopa Creek watershed there are few feedlots, but all are open lots and most are fewer than 300 animal units. Regardless of the presence or size of a feedlot in these areas, manure used as fertilizer is likely a common practice and a management concern.

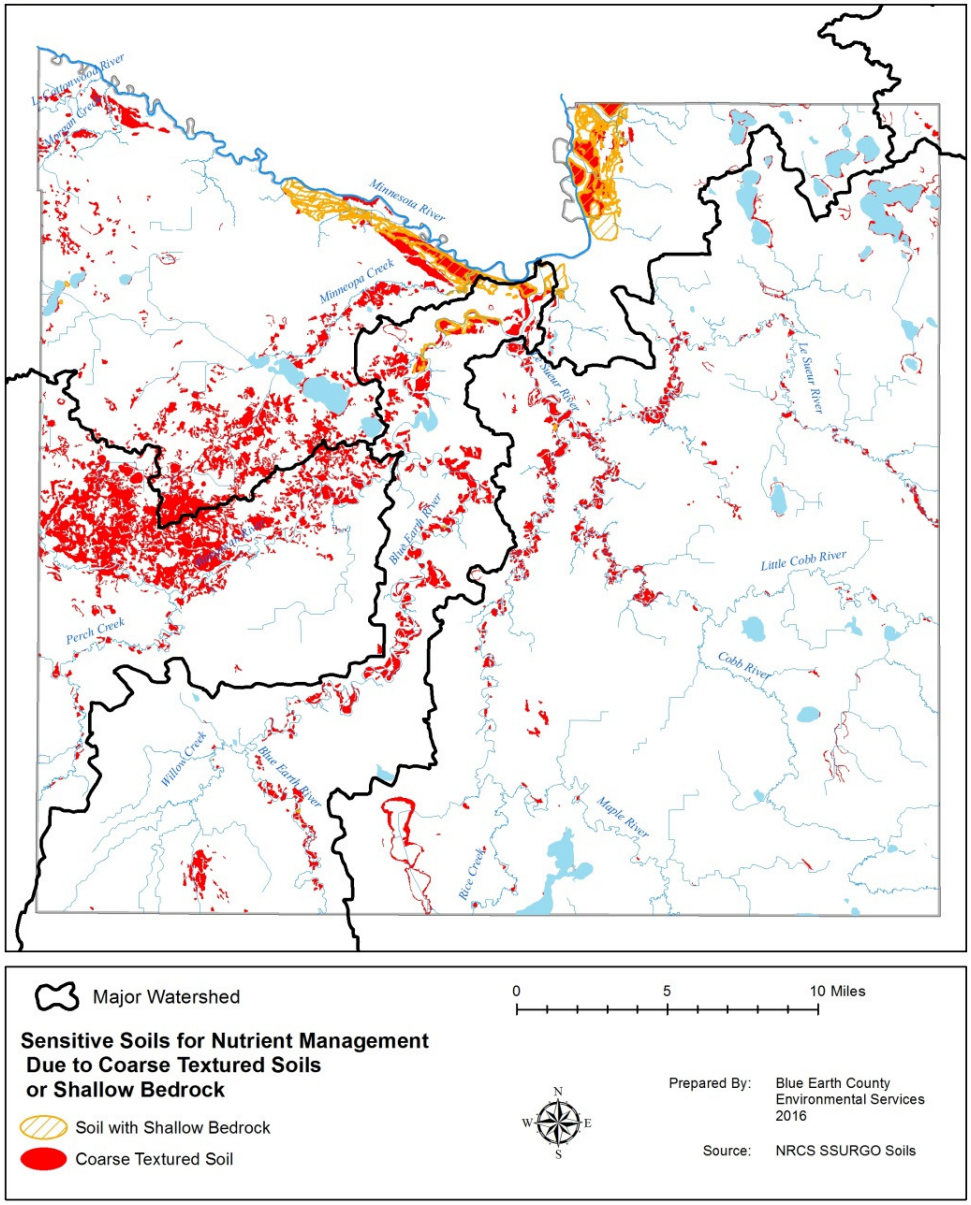
Drinking water wells

Public water suppliers Wellhead Protection Plans, Drinking Water Source Management Areas (DWSMA) completed by 2016 for Amboy, Eagle Lake, Good Thunder, Lake Crystal, Mapleton and Vernon Center have very small DWSMAs that do not include feedlots or cropland or feedlots. (See public water supplier section)

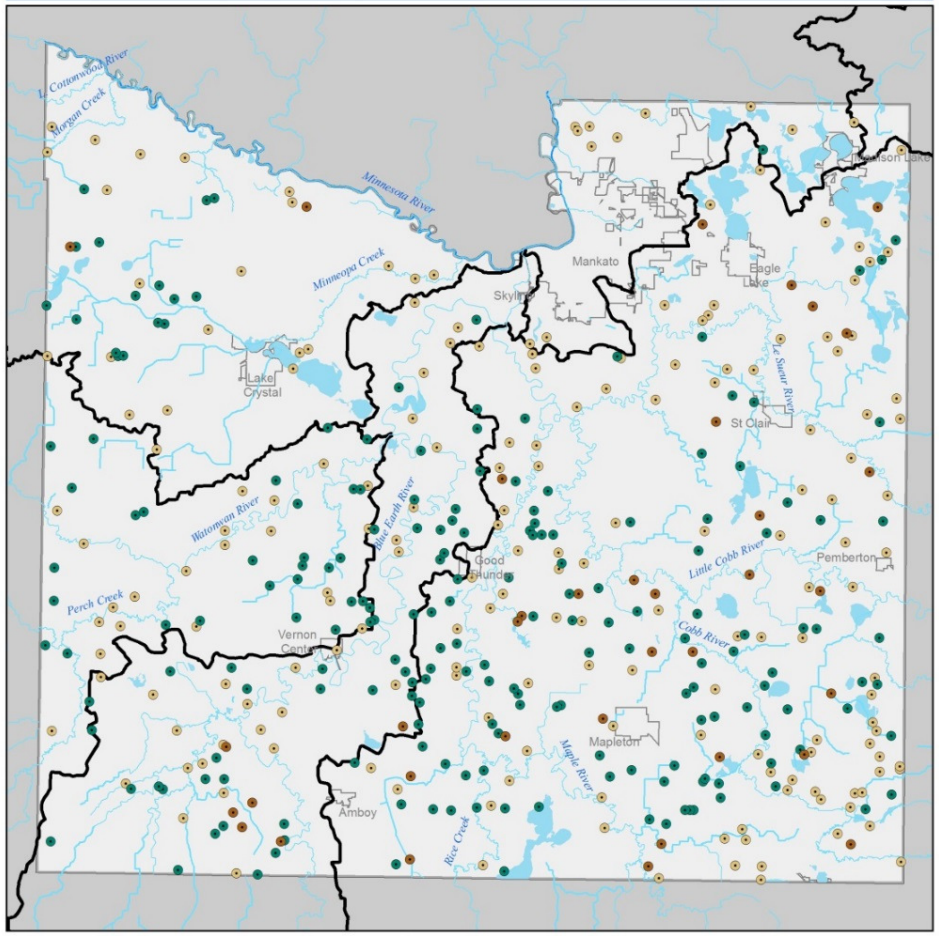
Surface Water

Feedlots in shoreland are a concern due to greater potential for runoff directly to surface water. Most feedlots in shoreland are along rivers throughout the county. There are 1-2 feedlots on each of these recreational lakes: Crystal, Loon, Lura and Madison. Manure application in shoreland, especially on slopes and near tile intakes is a concern. The maps on the following pages show feedlots in shoreland and manure storage type.

Sensitive Soils for Nutrient Management Due to Coarse Textured Soils or Shallow Bedrock



Feedlots by Manure Storage Type



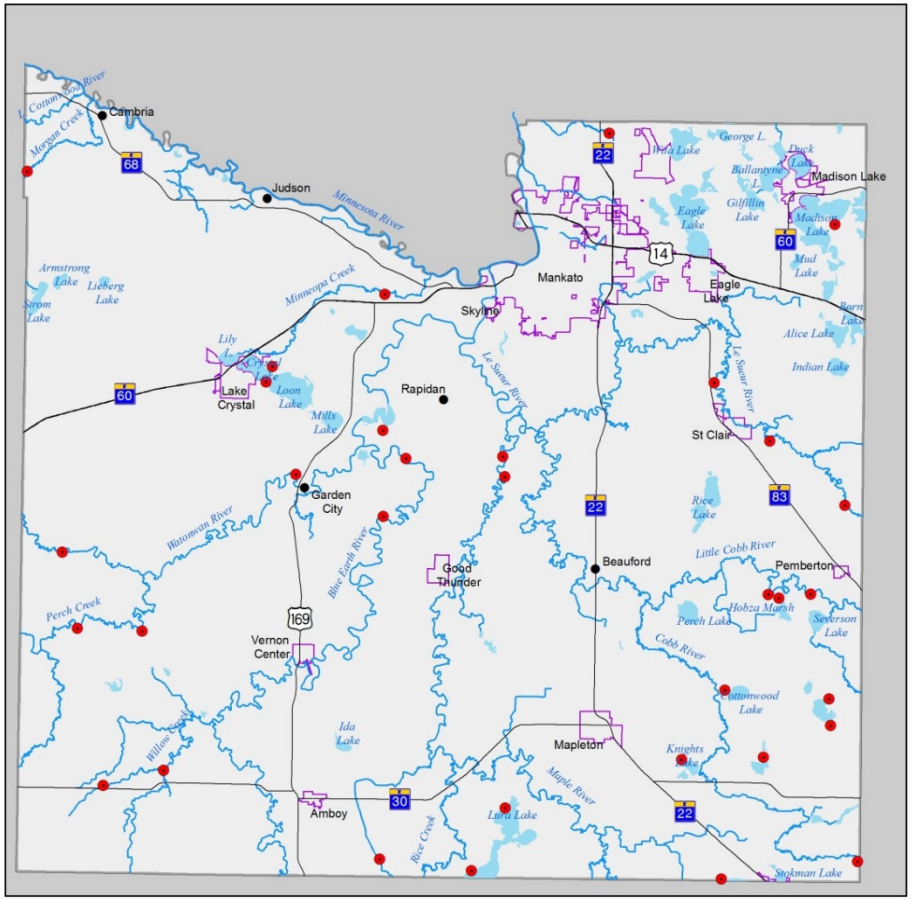
- Feedlot with Earthen Basin(s)
- Feedlot with Total Confinement Barn(s)
- Feedlot with Open Lot(s)
- Major Watershed
- City

0 5 Miles

Prepared By: Blue Earth County Environmental Services 2016

Source: Blue Earth County Feedlot Inventory 2016

Feedlots within Designated Shoreland Areas



- Permitted Feedlot in a Shoreland District
- DNR Protected Basin
- State or U.S. Highway
- Protected Stream or River
- City

0 5 Miles

Prepared By: Blue Earth County Environmental Services 2016

Source: Blue Earth County Feedlot Inventory 2016

Note: Shoreland means land located within the following distances from public waters: 1,000 feet from the ordinary high water level of a lake, pond, or flowage; and 300 feet from a river or stream, or the landward extent of a floodplain designated by ordinance on a river or stream, whichever is greater.

Manure Storage

A map showing the manure storage type of each feedlot is shown on the previous page.

Under-barn Manure Storage

Most feedlots in the county have under-barn, concrete manure storage pits. Manure pit construction is engineered and inspected.

Open Lots

According to 2016 County permit records, there are 208 permitted feedlots with open lots. Because open lots are unprotected from precipitation they have greater potential for feedlot runoff from the feeding lot as well as manure storage and manure stockpiles. Most open lots in the county have fewer than 300 animal units. Manure management plans or programs are not required for feedlots with less than 300 animal units. Concern about manure application are also greater at sites with open lots as operators of lots are more likely to apply manure repeatedly in the same areas in the same fields near the open lot.

Earthen manure storage basins

Construction of new earthen manure storage basins for swine is no longer allowed in the State of Minnesota. To be certified for continued use, earthen basins must have been designed to NRCS standards. All earthen manure storage basins still in use in the county are certified. Earthen basins do require ongoing maintenance such as tree and weed removal and rodent control. Earthen basins are regularly inspected as part of the County's feedlot program and site review.

The County and the MPCA do not allow the owners of these sites to utilize uncertified basins for manure storage. The County has worked with feedlot owners to discontinue use and properly abandon uncertified earthen basins. The County does keep these facilities in the County feedlot inventory by requiring a feedlot permit until they are properly abandoned.

Unused Manure Pits

Manure pits that are no longer in use for livestock confinement typically have some manure and sludge in the pit. Unused manure pits may fall into disrepair and are a potential environmental hazard. The County requires the removal and land application of all manure, liquid and solids, before the feedlot permit becomes inactive. This requirement and procedures for abandonment were confirmed with the MPCA.

Animal Mortality

The Minnesota Board of Animal Health regulates the disposal of dead animals. Most feedlot operators place dead animals in animal mortality boxes near public roadways for collection by rendering facilities. Animal mortality boxes have the potential to pollute surface and groundwater where effluent from these areas could leach to groundwater or runoff to ditches or surface tile intakes as most are located in the right of way of county or township public roadways. The placement of animal mortality boxes can be addressed by local governments working with the Board of Animal Health and other agencies.

Best Practices for Feedlots and Manure Management

- Manure and nutrient management – take credit for manure
- Soil phosphorus testing
- Manure incorporation
- Riparian Buffers
- Manure composting
- Avoid steep slopes
- Manure application setbacks
- Increase organic matter in coarse textured soils

Feedlots and Manure Management Goals and Strategies

Goal: Minimize potential transport of bacteria and nutrients to surface water and groundwater from feedlots and manure applied to cropland.

Ongoing Strategies

ONGOING STRATEGY: MPCA FEEDLOT DELEGATION.
Action: The County will continue implementing the MPCA feedlot delegation agreement, submit annual feedlot reports and work plans to the MPCA, and report feedlot inspection and permitting activities using databases as required by the MPCA, as required in the feedlot delegation agreement.

ONGOING STRATEGY: COUNTY REGULATIONS.
Action: The County will continue implementation of the zoning and livestock and manure management ordinances. These ordinances address feedlot siting and manure management for all feedlots more than 10 animal units.

Action: The County Feedlot Officer will meet with 100 percent of feedlot operators and meet with crop consultants periodically to improve manure management planning.

Action: The County Feedlot Officer will continue feedlot education programs related to manure management, including direct mail, press releases and annual meetings with producers.

Action: The County will continue the permitting and inspection program and will inspect each feedlot at least twice during the ten year planning period.

Manure Management Strategies

STRATEGY: MANURE MANAGEMENT TRACKING.
Improve manure management systems to reduce the potential for surface and groundwater contamination by tracking manure spreading acres and transfer of manure.

Current MPCA rules require feedlot operators and commercial applicators to maintain records of the volume or tonnage of manure delivered, the nutrient content of manure delivered, and the location and application rate, for all fields where the feedlot manure is applied regardless of ownership of the fields.

Action: The County will reestablish a mapping system for tracking manure spreading acres associated with feedlot permits.

Action: The County will develop methods to monitor transferred manure among feedlot owners, commercial applicators, manure buyers, and crop consultants to minimize over-application of nutrients to the soil.

STRATEGY: MANURE MANAGEMENT.
Reduce nutrient runoff and leaching to groundwater and subsurface drainage tile with manure and nutrient management.

State Rules require sensitive areas be addressed in manure management plans. The MPCA defines sensitive areas to include: lakes, streams, intermittent streams, drainage ditches without protective berms, public water wetlands, open tile intakes, floodplains, road ditches, sinkholes, wells, mine, quarries, shallow soil over fractured rock, and other conduits to water.

Manure/fertilizer applied above agronomic rates results in an accumulation of nutrients in the soil. When applied at agronomic rates for phosphorus, most fields require less or less frequent manure than if applied with consideration of only nitrogen needs for crops. Excess phosphorus is transported with stormwater and eroded soil particles. Nitrogen and excess phosphorus can also leach through soil to subsurface tile drainage and groundwater.

Action: The County Feedlot Officer and SWCD will work with all feedlot operators to improve manure and nutrient management planning at the farm system and field scale by accounting for manure in nutrient management plans and soil phosphorus testing.

Action: During permitting and regular feedlot inspections, the County Feedlot Officer will evaluate each feedlot's manure spreading sites at the field scale with site visits and analysis of slope, proximity to surface waters and sensitive soils for nutrient management and work with the producer to manage manure in sensitive areas.

Priority Area Strategies

Priority Areas

- Blue Earth, Le Sueur and Watonwan River watersheds (Greater Blue Earth River Bacteria TMDL)
- Sensitive Soils for Nutrient Management (USDA SURGGO Soils and MPCA feedlot rules)
- Shoreland (MPCA feedlot rules)
- Open lots
- Priority sub-watersheds

STRATEGY: MANAGE FEEDLOTS AND MANURE FOR SENSITIVE SOILS.

Reduce the potential for pollution of surface water and groundwater from feedlots in areas where soils are sensitive for nutrients (coarse texture and shallow bedrock) as shown in the USDA NRCS Soil Survey.

Action: The County will identify and assess open lots, manure stockpiles and manure spreading acres in areas with high and moderate pollution sensitivity (coarse textured soils and shallow depth to bedrock) or draining to intermittent streams, ravines, surface water and open tile intakes.

Action: The County Feedlot Officer will review feedlots and manure management at the farm system and field scale to identify sensitive areas and discuss requirements with producers.

Action: The County and SWCD will work with producers in sensitive areas to address runoff from open lots, manure stockpiles and manure management with vegetation, structural fixes, and improved manure management plans and programs.

Action: The County will display on its website information about sensitive areas and requirements (ground water contamination maps, bedrock, slope, soils, floodplains, ditches, surface water feature, two foot contour maps, property boundaries, aerial photos and other information).

STRATEGY: OPEN LOTS AND SMALL FEEDLOTS.

Work with owners of open lots and small feedlots to reduce manure runoff and improve manure and nutrient management.

Manure management plans or programs are not required for feedlots with less than 300 animal units. Because open lots are unprotected from precipitation they have greater potential for feedlot runoff from the feeding lot as well as manure storage and manure stockpiles. Concerns about manure application are also greater at sites with open lots as operators of lots are more likely to apply manure repeatedly in

the same areas in the same fields near the open lot. There are 208 feedlots in the county with open lots.

Action: Re-evaluate each open lot for pollution problems during the County feedlot permit review.

Action: Provide technical assistance to feedlot operators and owners of small sites to address pollution problems and improve manure and nutrient management.

STRATEGY: PRIORITY SUBWATERSHEDS.

Assess all feedlots and manure management systems in priority sub-watersheds and determine roles and responsibilities for working with producers who may need feedlot fixes or improve manure and nutrient management.

Action: The County will develop and begin implementing a plan to transition to inspecting and reviewing feedlots on a watershed basis.

Action: The County and SWCD will work together to assess feedlots and manure management systems in priority sub-watersheds and determine roles and responsibilities for working with producers who may need feedlot improvements or improvements with manure and nutrient management.

Action: The County and SWCD will target manure and nutrient management strategies and land management strategies to sensitive areas and critical source areas in subwatersheds.

Feedlot Site Management Strategies

STRATEGY: ANIMAL MORTALITY BOXES.

Manage the placement of animal mortality boxes to reduce potential pollution and environmental hazards. There are a number of dead boxes in the county where effluent from animal mortalities could come in contact with ditches or tile intakes as well as individual boxes being within the right of way of county and township roads.

Action: Environmental Services staff will consult with the Minnesota Board of Animal Health, the Minnesota Department of Agriculture, the Blue Earth County Highway Department, the County Ditch Manager, and local township officials to develop policies or regulations to reduce the potential for pollution and other hazards associated with the design and placement of animal mortality boxes.

STRATEGY: INACTIVE MANURE PITS.

Ensure inactive manure pits are properly abandoned to prevent groundwater pollution. Manure pits that are no longer in use for livestock confinement typically have some manure and sludge in the pit. Unused manure pits may fall into disrepair and are a potential environmental hazard. The Environmental Services Department requires the removal and land application of all manure, liquid and solids, before the feedlot permit becomes inactive, and has confirmed this procedure with the MPCA.

Action: The County will continue to maintain an inventory of manure pits requiring proper abandonment and will continue to work with operators to properly abandon manure pits.

Flooding

Flooding is a concern related to public safety, loss of property and infrastructure, and water quality.

There are different definitions and categories of floods and affects that can be addressed with mitigation action, such as prevention, property protection, public education and awareness, natural resources protection, emergency services and structural improvements.

Definition

The *State of Minnesota All-Hazard Mitigation Plan* definition of "flooding is the accumulation of water within a water body (e.g., stream, river, lake, and reservoir) and the overflow of excess water onto adjacent floodplains."

The Federal Interagency Floodplain Management Task Force divides flooding in the United States into categories including the following:

- riverine floods
- flash floods
- alluvial fan floods
- ice-jam floods
- dam-break floods
- local drainage floods
- high groundwater floods
- fluctuating lake level floods
- debris flows and subsidence

In Minnesota, the most common types of flooding are riverine, flash, and local drainage.

Flood Mitigation Actions

Prevention: Government, administrative, or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and stormwater management regulations.

Property Protection: Actions that involve the modification of existing buildings or structures to protect them from a hazard or removal from the hazard area. Examples include acquisition, elevation, structural retrofits, storm shutters, and shatter-resistant glass.

Public Education and Awareness: Actions to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them.

Natural Resource Protection: Actions that, in addition to minimizing hazard losses, preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.

Emergency Services: Actions that protect people and property during and immediately after a disaster or hazard event. Services include warning systems, emergency response services, and protection of critical facilities.

Structural Improvements: Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include dams, levees, floodwalls, seawalls, retaining walls, and safe rooms.

Flash Flooding

Flash flooding occurs in all areas of the county. According to the *Minnesota All Hazard Mitigation Plan*, flash flooding occurs somewhere in the state three times a year on average.

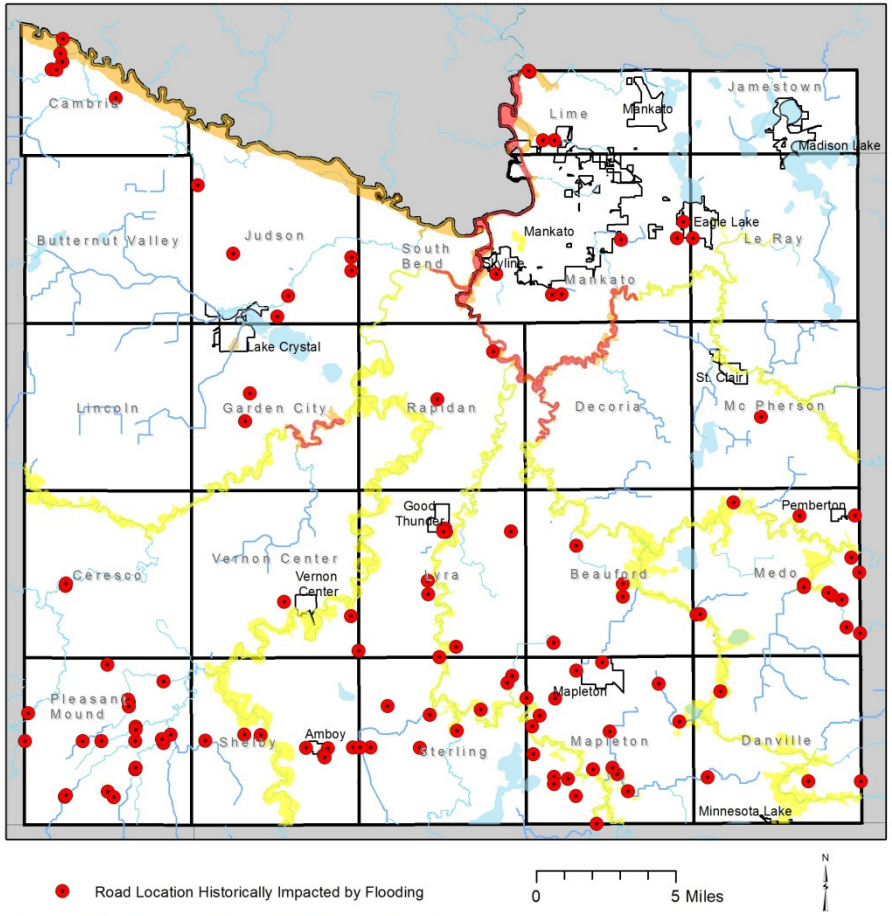
Flash floods involve a rapid rise in water level, high velocity, and large amounts of debris, which can lead to significant damage that includes the tearing out of trees, undermining of buildings and bridges, and scouring new channels. The intensity of flash flooding is a function of the intensity and duration of rainfall, steepness of the watershed, stream gradients, watershed vegetation, natural and artificial flood storage areas, and configuration of the streambed and floodplain.

Flash flooding in the county can be most destructive in steep watersheds and in narrow valleys and ravines. Flash flooding in these areas can cause severe erosion, debris flows, damage to property and sedimentation in waterways.

- Ravines in every watershed in the county
- Indian Creek
- Little Cottonwood River
- Morgan Creek

Every municipality in the county is affected by flash floods. The map to the right displays the FEMA flood insurance floodplains and the roads impacted by flooding in September 2010. Most of the roads impacted were not in FEMA flood hazard areas.

FEMA Preliminary Flood Insurance Floodplains and Road Locations Impacted by Flooding



Road Location Historically Impacted by Flooding

0 5 Miles

N

Special Flood Hazard Area (1% Chance Flood)

Zone AE - Floodway

Zone AE - Floodfringe

Zone A - No Base Flood Elevations

Prepared By: Blue Earth County 2016

Source: BEC Townships and Cities

This map depicts roads that were flooded during after the September 22-23, 2010 rain event and also roads that were reported by townships and cities as being historically impacted by flooding.

FEMA National Flood Insurance Program

Maps of Flood Zones

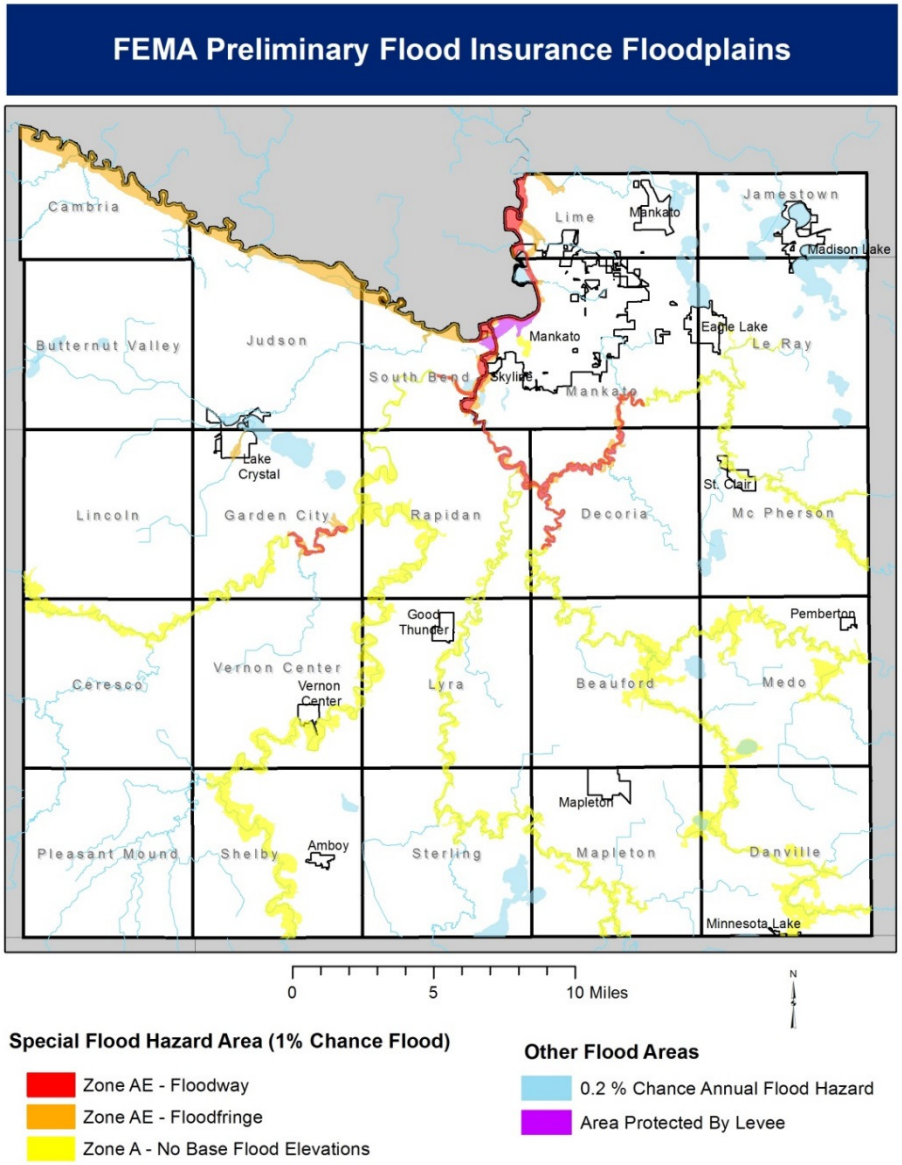
Not all waterways in the county are included in the FEMA Flood Insurance Rate Map. There are many small streams in the county which do not have areas mapped as special flood hazard areas. These areas do experience floods and flash floods. Examples of these streams in the county are Indian Creek, Perch Creek, Minneopa Creek, Morgan Creek, Rice Creek, Providence Creek, Willow Creek, and sections of the Little Cottonwood River and the Little Cobb River.

The jurisdictions with no mapped special flood hazard areas include: Amboy, Good Thunder, Madison Lake, Mapleton, and Pemberton, Butternut Valley Township, Jamestown Township, and Pleasant Mound Township.

Zone A is the flood insurance risk zone that corresponds to the 1-percent-annual chance floodplains that are determined in the FEMA Flood Insurance Study using approximate methods. The 1-percent chance flood is also referred to as the base flood or the 100-year flood. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or base flood depths are shown within this zone.

Zone AE is the flood insurance risk zone that corresponds to the 1-percent-annual chance floodplains that are determined in the flood insurance study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X is the flood insurance risk zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-



annual-chance flood by levees. No base flood elevations or base flood depths are shown within this zone.

Existing Development in Mapped Flood Zones

With more than 300 miles of rivers and streams in the county, there is a relatively small percentage of existing development in special flood hazard areas. On most of the rivers in the county the flood zones are contained in deeply-incised channels. The Le Sueur River and the Maple River have the narrowest flood hazard areas.

With 29,791 acres mapped as special flood hazard areas in the county there appear to be less than forty dwellings located in the mapped areas that are within the 1-percent chance flood areas. In the unincorporated areas of the county, there are currently 29 dwellings located in the extent of a special flood hazard area. Most of the dwellings in flood hazard area are located along the Watonwan River in Garden City Township and the Minnesota River in Cambria and Judson Townships. There are also a few houses in the special flood hazard areas along the Blue Earth River and Le Sueur River. Within the cities in the county there appears to be less than five dwellings in areas mapped as special flood hazard areas on the 2011 preliminary FEMA floodplain maps.

There are 479-acres of Blue Earth County located in areas protected by levees. The Mankato-North Mankato-South Bend Township levee protects the areas along the Blue Earth River and Minnesota River. These land uses within the protected by the levee include a mixture of parks, opens space, residential and commercial development. Since they are protected by the levee, these areas are not special flood hazard areas according to FEMA.

Summary of Flood Zones in the 2011 Preliminary Flood Insurance Data for Blue Earth County

FEMA Flood Zone	Acres	Percent
Zone A - 1 % Chance Annual Flood Hazard	22,223	4.54%
Zone AE - 1 % Chance Annual Flood Hazard with Base Flood Elevations	7,568	1.55%
Zone X - Areas outside of .2% Chance Flood	458,387	93.60%
Zone X - Areas of the 0.2 % Annual Chance Flood Hazard	1,074	0.22%
Zone X - Areas Protected by Levee	479	0.10%
Total	**489,731**	**100.00%**

Map Modernization

FEMA is in the process of updating flood insurance rate maps nationwide. Digital Flood Insurance Rate Maps for Blue Earth County will be available as part of this process and maps of the floodplain will be seamless across the county rather than having individual maps for each city. The preliminary digital flood insurance rate maps have been available in the county since 2011. FEMA estimates they will finalize and approve the new maps in 2017. FEMA estimates the effective date for the new maps will be in 2018.

Map Limitations

While the maps are based on highly accurate digital elevation information, there are limitations with the accuracy of the maps. First, the elevation information used for the maps was from a LiDAR data collection that was completed in 2005. There was more recent LiDAR elevation data collected in 2012 after the FEMA prepared the preliminary digital flood insurance rate maps in 2011. There have been significant river channel changes throughout the county since that time. There are areas where rivers or streams have migrated outside

of areas that are mapped as special flood hazard areas. Secondly, not all areas of the county have detailed flood studies. Only 25-percent of the areas mapped as being in a special flood hazard area in the county have a detailed flood study. For the 75-percent of the special flood hazard areas in the county without a detailed flood study, the mapping was done using approximate methods and the maps do not include actual elevations for the 1 percent chance flood. Additionally, some of the areas of the county with detailed flood studies are based on flood models that are as old as 1986.

Flood Control

There are publicly and privately owned levees along some river floodplains in the county.

Following spring floods in the 1950s and 1960s, the Army Corps of Engineers Flood Control Project was constructed to protect parts of Mankato, North Mankato and South Bend Township along the Blue Earth River and Minnesota River.

The City of St. Clair constructed a levee along the Le Sueur River floodplain in the city to protect the wastewater treatment plant and other infrastructure from Le Sueur River flooding. St. Clair's levee was constructed for a 100-year flood event following the 2010 flood. In 2016 Le Sueur River flood waters breached the levee as the river exceeded the 100-year flood stage and 2010 flood.

Privately owned levees and earthen berms were constructed by farmers to protect farmland along channelized river segments.

Dams

There are many publicly owned dams. The Rapidan Dam was developed to generate hydroelectric power. Some dams are designed for water storage to prevent flooding, like those in the Indian Creek watershed designed to store flood waters to reduce flooding in the City of Mankato. Others maintain water levels for recreation and habitat. A list of dams is shown in the following table.

Dam Name	Owner	Type
Eagle Lake	MNDNR	Gravity
Cottonwood Lake Dam	MNDNR	Gravity-Earth
Perch Lake Dam	MNDNR - Fisheries	Earth
Rapidan	Blue Earth County	Other
Blue Earth River	MNDNR	Concrete-Gravity
Warren St. Detention	City of Mankato	Earth
Gilfillin Lake Outlet	MNDNR	Earth
Madison Lake	MNDNR	-
Rice Lake	MNDNR - Fisheries	Earth
McPherson 25	Rye, Gordon	Earth
Lost Marsh WMA	MNDNR - Fisheries	Earth
Lake Crystal	Blue Earth County	Sheet Pile Weir

Previous Flood Occurrences

The National Climatic Data Center (NCDC) database reported 27 flood events in Blue Earth County since 1996. The table on the following page displays a list of flood occurrences since 1996. The NCDC database goes back to the 1950s; however it has no documented flooding occurrences in the county prior to 1996. Blue Earth County has had other flooding occurrences prior to 1996. There were major spring floods in the 1950s and 1960s.

FEMA has documented significant flooding events in Blue Earth County prior to 1996. These significant flooding events fit into one of two categories:

A Major Disaster (denoted as "DR" under the "Declaration Number" column) can be a result of hurricanes, earthquakes, flood, tornados or major fires; the President then determines supplemental federal aid.

The event must be clearly more than state or local governments can handle. If declared, funding comes from the President's Disaster Relief Fund, managed by FEMA and disaster aid programs of other participating federal agencies.

An Emergency Declaration (denoted as "EM" under the "Declaration Number" column) is more limited in scope and without the long-term Federal recovery programs of a Major Disaster Declaration. Generally, federal assistance and funding are provided to meet a specific emergency need or to help prevent a major disaster from occurring.

FEMA Declared Flood Disasters in Blue Earth County

Type	Declaration Date	Declaration Number
Flooding	4/11/1965	DR-188
Heavy Rains, Flooding	8/15/1968	DR-249
Flooding	4/18/1969	DR-255
Flooding, Severe Storm, Tornadoes	6/11/1993	DR-993
Flooding	6/1/1996	DR-1116
Severe Storms and Flooding	4/8/1997	DR-1175
Flooding	3/19/2010	EM-3310
Flooding	4/19/2010	DR-1900
Severe Storms, Tornadoes, Flooding	7/2/2010	DR-1921
Severe Storms and Flooding	10/13/2010	DR-1941
Severe Storms and Flooding	5/10/2011	DR-1982
Severe Storms, Straight-line Winds, Flooding, Landslides, and Mudslides	07/21/14	DR-4182
Flooding	11/02/2016	DR-4290

Blue Earth County Previous Occurrences of Flooding

Date	Type	Cause
6/16/1996	Flash Flood	
9/2/1996	Flash Flood	
3/15/1997	Flood	
4/1/1997	Flood	
5/1/1997	Flood	
8/9/1999	Flood	
4/1/2001	Flood	
5/1/2001	Flood	
6/9/2004	Flash Flood	
6/9/2004	Flood	
5/12/2005	Flood	
8/18/2005	Flash Flood	
10/4/2005	Flash Flood	
6/9/2006	Flash Flood	
6/16/2006	Flash Flood	
5/19/2007	Flash Flood	Heavy Rain
8/19/2007	Flash Flood	Heavy Rain
3/15/2010	Flood	Heavy Rain / Snow Melt
3/17/2010	Flood	Heavy Rain / Snow Melt
6/25/2010	Flash Flood	Heavy Rain
6/26/2010	Flash Flood	Heavy Rain
9/23/2010	Flash Flood	Heavy Rain
9/23/2010	Flood	Heavy Rain
3/21/2011	Flood	Heavy Rain / Snow Melt
6/21/2013	Flash Flood	Heavy Rain
6/16/2014	Flash Flood	Heavy Rain
6/17/2014	Flash Flood	Heavy Rain
6/18/2014	Flood	Heavy Rain
9/21/2016	Flood	Heavy Rain

Flooding Goals and Strategies

Goal: Protect public safety and property in flood prone areas of the county.

Goal: Ensure resilience to extreme rainfall events.

There is a greater understanding of the location of floods and the potential for flash floods in the county as the result of experiencing numerous flood and flash flood occurrences since 2010, updated climate data and water quality research related to near channel erosion in local watersheds.

Near channel erosion is a widespread problem in the county addressed in a separate section of this plan. Stormwater management is addressed in a separate section of this plan.

POLICY STRATEGY: PREVENTION.

The most cost effective way to protect public safety and property is to prevent development in areas where there is a reasonable expectation of floods or the effects of flash floods. The City of St. Clair, for example, has adopted land use development policies to ensure landowners do not develop land, construct berms or otherwise place fill in Le Sueur River floodplains.

Action: Revise floodplain ordinances to prohibit filling or new dwellings in the General Floodplain and Flood Fringe District and to conform to the County Zoning Ordinance which requires lots to have the required buildable area outside of floodplains.

STRATEGY: NATIONAL FLOOD INSURANCE PROGRAM.

Prevent losses from flood hazards through implementation of the National Flood Insurance Program, updating floodplain Maps, and updating floodplain ordinances.

Action: Adopt the preliminary FEMA Flood Insurance Rate Maps when they are approved by FEMA.

Action: Revise floodplain ordinances to conform to FEMA/MNDNR standards and to properly reference the updated floodplain maps.

STRATEGY: FLOOD INUNDATION.

Action: Assess whether additional flood studies or flood inundation models are needed on streams, rivers, or ditches in the county that do not have FEMA identified floodplain boundaries like the Little Cottonwood River, Morgan Creek, and Minneopa Creek.

STRATEGY: WATER STORAGE CAPACITY.

Action: Maintain the existing water storage capacity in the floodplain by preventing further development and fill from being added to the floodplain.

Action: Increase the water storage capacity at or below 100-year flood elevations and in areas with known flood inundation to help minimize the severity and frequency of flooding and high water by targeting wetland restorations and water storage in floodplain areas.

STRATEGY: FLOOD PROTECTION STRUCTURES.

The City of Mankato, South Bend Township, and the City of St. Clair flood protection structures protect infrastructure, development and public safety in floodplain areas.

The most cost effective way to minimize the effects of flash floods is to design and establish natural and structural stormwater management systems to manage heavy rainfall.

Action: Support protection and maintenance of flood control levees and other projects protecting infrastructure in the City of St. Clair.

Action: Support protection and maintenance of flood control protection systems, flood walls and pumping systems managed by the City of Mankato and South Bend Township on the Minnesota River at Mankato, Blue Earth River at Mankato and in the Indian Creek watershed flowing through Mankato.

Action: Increase water retention in the Indian Creek watershed to reduce ravine erosion and sedimentation in flood control systems on Indian Lake Road, Rasmussen Woods and Pleasant Street gate well.

Action: Prevent flooding in municipalities by maintaining, constructing and updating flood control protection systems, stormwater infrastructure and critical facilities.

STRATEGY: WATERSHED MANAGEMENT.

Increase water storage to enhance stormwater storage within and draining to developed areas.

Action: Increase water storage by restoring wetlands and developing green infrastructure to increase water storage in watersheds with developed/developing land use.

Action: Increase water storage in drainage system watersheds and ravine watersheds with subsurface tile drainage outlets.

STRATEGY: NATURAL RESOURCE PROTECTION.

Actions that, in addition to minimizing losses from floods and flash floods, preserve or restore the functions of natural systems.

Action: Increase water storage by restoring wetlands and developing green infrastructure to increase water storage in watersheds with developed/developing land use.

Action: Increase water storage in drainage system watersheds and ravine watersheds with subsurface tile drainage outlets to reduce erosion and sedimentation that may reduce water storage capacity in wetlands, stormwater ponds and other water storage basins.

Action: Restore channelized stream corridors to provide flood water storage and attenuation, wildlife habitat and nutrient assimilation functions.

Action: Protect and restore forests and perennial vegetation to protect soils, increase the water holding capacity of soils and increase evapotranspiration while also providing wildlife habitat and nutrient assimilation.

Near Channel Erosion

Stream channel migration and bluff erosion are natural processes in river systems. Due to its glacial history, Blue Earth County is in area predisposed to near channel erosion and landslides. Near channel erosion includes eroding stream banks, bluffs and ravines along river channels. Scenic areas near river channels and ravines in the county are attractive for residential development. These same areas are often vulnerable to near channel erosion, and in some cases runoff from development causes or worsens near channel erosion. Dwellings, other structures and infrastructure often constructed decades ago are threatened by near channel erosion hazards in all watersheds in the county.

Relationship to Other Plans

This plan relates to the *Blue Earth County All-Hazard Mitigation Plan 2013 Update* and includes goals and strategies that can be addressed in future updates of the hazard mitigation plan and local stormwater management and watershed plans to address near channel erosion to achieve water quality and hazard mitigation goals.

Erosion Hazard Area

"Erosion hazard area means, based on erosion rate information and other historic data available, an area of erosion or avulsion is likely to result in damage or loss of property or infrastructure within a 60 year period."

Source: 1999 *FEMA Riverine Erosion Hazard Mapping Feasibility Study*, erosion hazard area is defined by Section 577 of National Flood Insurance Reform Act (NIFRA)

Near Channel Erosion - Glacial History and Influence

The sources for this section are numerous and include published papers by Stephanie Day, Karen Gran, Carrie Jennings, Patrick Belmont, and Peter Wilcox.

Clay-rich soils were left behind by glacial lakes Agassiz, Benson, and Minnesota. The lakes are shown here at their maximum extents, but were present at different times. (Source: MNDNR)

Tributaries of the Minnesota River are adjusting to a profound 230 foot base level fall at the end of the most recent period of glaciation, the Pleistocene.

Base level is the elevation of the surface of the water body into which a river ultimately drains. A drop in base level causes a response by the river system to carve into the landscape. This incision begins at the formation of a knickpoint, and its upstream migration depends heavily

upon the drainage area (and so the discharge of the river), material through which it cuts, and how large the drop in base level was.

Knickpoint is a term in geomorphology to describe a location of a river or channel where there is a sharp change in channel slope, such as a waterfall or lake. Knickpoints reflect different conditions and processes on the river often caused by previous erosion due to glaciation or variance in lithology. Glaciations resulting in hanging valleys are often prime spots for knickpoints. If lithology of the rock varies, such as shale amongst igneous rock, erosion will occur more steadily in the softer rock than the surrounding, tougher rock.

Base level fall in the Blue Earth, Le Sueur, Watonwan and Minnesota River Basin was caused by drainage of glacial Lake Agassiz through glacial River Warren. The resulting glacial River Warren channel is the valley of the modern Minnesota River. Glacial River Warren played an important role in shaping the Blue Earth, Le Sueur and Watonwan. The river scoured 213 feet below the till surface at the mouth of the Blue Earth River, initiating channel incision towards the lower base level. Incision moves upstream on the Blue Earth, Le Sueur and Watonwan channels as a knickpoint. Currently, the knickpoint is 21 to 39 river miles upstream of the Minnesota River on the three major tributaries: the Blue Earth, Watonwan and Le Sueur. Fluvial adjustment of the Blue Earth, Le Sueur and Watonwan to base level fall appears to prime these rivers for high near-channel erosion rates.

Knickpoints divide the basin into two distinct regions. Below knickpoints, channel gradients are steep, channels are deeply incised below the upland surface, and they flow through narrow valleys lined in bluffs and ravines. Above knickpoints, streams flow through a low-gradient landscape dominated by agricultural fields. The steep landscape below knickpoints is the result of watershed adjustment to knickpoint migration. About half of the Blue Earth, Le Sueur and Watonwan sediment load comes from reaches below knickpoints where response to base level fall drives erosion of near-channel features like bluffs.

Streambanks

Banks are the boundaries of stream channel networks which are low enough that the river can overtop them during floods. Near-channel sediment sources erode by a variety of mechanisms but are fundamentally driven by excess energy on the banks. Erosion occurs when bank sediments cannot resist the force of water in the channel. High bedload supply, low bank strength and high stream power promote lateral migration and can lead to high erosion rates.

Channel widening is a further source of channel-derived sediment. Flows have increased in many Minnesota watersheds in the last-half century. When annual discharges increase, channel geometry changes in order to move more water. Channels may widen, deepen, straighten or steepen to accommodate higher discharge rates. MNR tributaries have widened since 1975 to accommodate increased annual discharge relative to the period from 1940–1974.

Below the knickpoints, channels in the Blue Earth, Le Sueur and Watonwan are incising rapidly. This has implications for the movement of sediment in the channel. First, channel incision itself becomes a sediment source. Because the river is down-cutting through the landscape below the knickpoints, meander migration is not balanced by floodplain deposition. Incision deepens the channels to the point that floodwaters are not able to access the floodplain, and sediment is transported downstream rather than deposited back onto floodplains.

Bluffs

Bluffs can be impressive features: the largest in the county have nearly vertical faces up to 230 feet high and 1,640 feet long, and they line about 50% of the lower parts of Blue Earth, Le Sueur and Watonwan River valleys. Bluffs are most often composed of glacial till, but when they are not the full height of the river valley they are capped with thin layers (usually < 10 feet) of alluvial sediment. Many bluffs in the Blue Earth, Le Sueur and Watonwan are recently stranded terraces

and stand just a few yards above the modern channel and floodplain. In contrast to banks, bluffs are out of reach of typical annual floods and purely erosional features.

Bluff erosion is driven by a number of factors. Researchers have found no statistically significant correlations between decadal bluff retreat rates and parameters such as bluff vegetative cover, slope, size, aspect, sediment texture or stream power. Bluff erosion is primarily driven by fluvial incision, sapping, and freeze thaw.

Sapping or erosion by groundwater seeping

Groundwater flow from the bluff face increases pore pressure and can cause erosion at and below the seep. Groundwater sapping from the face of a bluff, is visible on the Blue Earth, Le Sueur and Watonwan bluffs.

Freeze-thaw

Aspect is well-correlated to bluff retreat rates along some tributaries of the Le Sueur, suggesting the importance of freeze-thaw to bluff erosion. Bluffs composed of overconsolidated tills appear to be more resistant to fluvial erosion than normally-consolidated bluffs, but overconsolidated bluffs have joint patterns that may make them more susceptible to frost wedging.

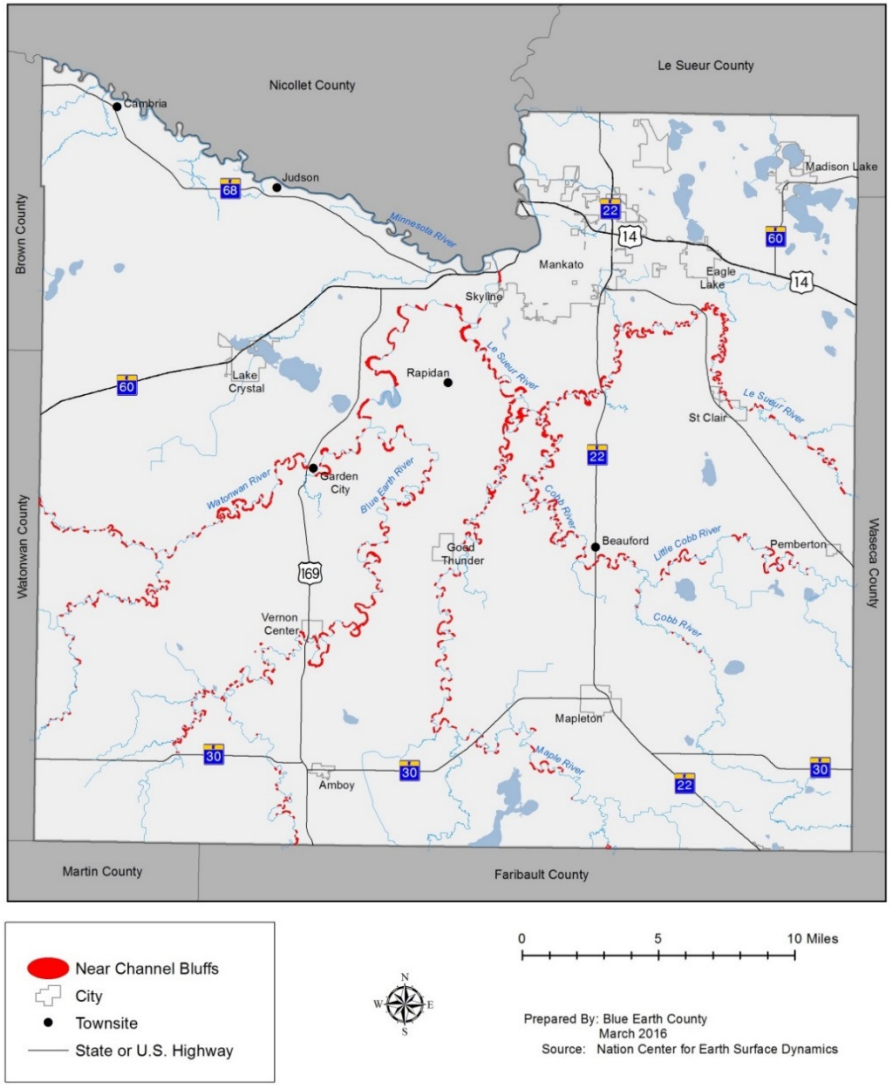
Sediment that erodes from a bluff will often collect in a fan at the bluff toe. This material is less dense and less cohesive than its parent material, and probably does not remain in place for long. Even low flows are able to easily entrain such material. The erodibility of colluvial bluff toes and of bluff parent material is influenced by moisture content. Higher flows that saturate channel materials are strongly correlated with high bluff erosion in the Le Sueur and in other watersheds.

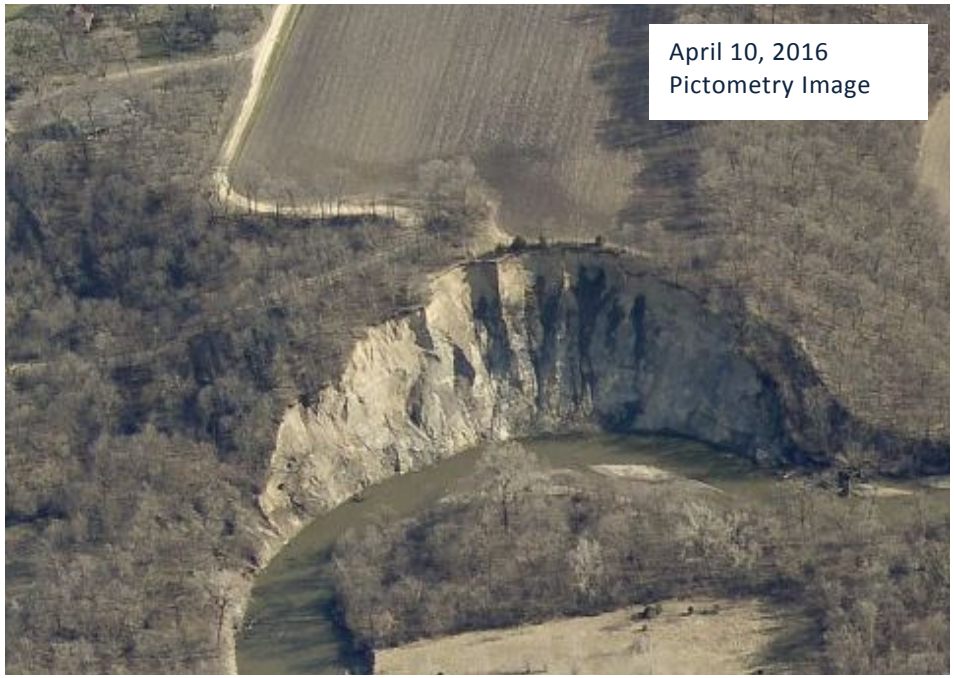
Toe erosion occurs when a stream channel migrates into a bluff toe. Erosion of the bluff toe oversteepens the bluff face and reduces support for material above leading to mass wasting.

Vegetation can play a role in stabilizing river banks, but bluffs in the Blue Earth, Le Sueur and Watonwan are generally too tall for tree roots to have any influence on erosional processes near the channel. If a bluff has been spared from lateral channel migration for decades, it will trend towards a gentle angle of repose. Often inactive bluffs have dense tree cover on their slopes right down to the channel. However, even in this seemingly stable configuration, bluffs become rapidly steepened again when the river resumes migration into their toes.

A map showing some of the extent of near channel bluffs in the Blue Earth, Le Sueur and Watonwan watershed is on the following page. Two photos of the same bluff eight days apart show an example of a bluff failure on the Le Sueur River.

Near Channel Bluffs in the Greater Blue Earth River Watershed





Mass wasting

"Erosion associated with mass wasting processes is extremely difficult to predict due to the episodic nature of climatic events that initiate movement. Often landslides occur many years following vegetation and land use changes due to complex interactions of root mass decay and soil saturation from major storms."

Source: EPA, Hillslope Processes: Mass Wasting

Landslides - Mass Wasting

Blue Earth County is located in one of the few areas of Minnesota the USGS has mapped with greater than a low susceptibility of landslides. The USGS *Landslide Overview Map of the Conterminous United States* shows the Blue Earth, Le Sueur and Minnesota River watersheds have a "moderate susceptibility" of landslides.

The USGS definition of landslides includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over-steepened slope is the primary reason for a landslide, there are other contributing factors:

- erosion by rivers create over-steepened slopes
- rock and soil slopes are weakened through saturation by snowmelt or heavy rains
- excess weight from accumulation of rain or snow, or from man-made structures may stress weak slopes to failure and other structures

Slope material that becomes saturated with water may develop a debris flow or mud flow. The resulting slurry of rock and mud may pick up trees, houses, and cars, thus blocking bridges and tributaries causing flooding along its path.

The erosional processes associated with mass wasting include two primary types:

- shallow, fast movements of debris avalanche/debris torrents and mudflows that generally move only once
- slow, deep-seated slump/earthflow erosional processes that move intermittently over varying time scales in response to infrequent events and/or disturbance factors

According to the USGS the following areas are generally prone to landslide hazards:

- On existing old landslides.
- On or at the base of slopes.
- In or at the base of minor drainage hollows.
- At the base or top of an old fill slope.
- At the base or top of a steep cut slope.
- Developed hillsides where leach field septic systems are used.

According to the USGS, the Landslide Warning Signs are:

- Springs, seeps, or saturated ground in areas that have not typically been wet before.
- New cracks or unusual bulges in the ground, street pavements or sidewalks.
- Soil moving away from foundations.

- Ancillary structures such as decks and patios tilting and/or moving relative to the main house.
- Tilting or cracking of concrete floors and foundations.
- Broken water lines and other underground utilities.
- Leaning telephone poles, trees, retaining walls or fences.

It is suspected that landslides in the county are common and have historically been attributed exclusively to riverine erosion. Many of the landslide warning signs have been observed near river channels and bluffs in the county For example: new sites of groundwater sapping or seeps are observed or are changing, and large, newly-formed cracks in the ground within feet of the top of bluffs and the edge of ravines and leaning trees and retaining walls. Areas downslope of septic systems and footing drain tiles near channels and ravines appear to increase sapping in some locations.

Jurisdictions with near channel erosion hazard areas

Most of local government jurisdictions in the county are affected by near channel erosion hazards. Only three of 23 townships and five of 11 municipalities are not affected by ravine or near channel erosion. A list of jurisdictions is shown to the left.

List of Jurisdictions in Blue Earth County with Potential Near Channel Erosion Hazard Areas

6 Municipalities	20 Townships	
Good Thunder	Beauford	McPherson
Mankato	Cambria	Mankato
Pemberton	Ceresco	Mapleton
Skyline	Danville	Medo
St. Clair	Decoria	Pleasant Mound
Vernon Center	Garden City	Rapidan
	Judson	Shelby
	Le Ray	South Bend
	Lime	Sterling
	Lyra	Vernon Center

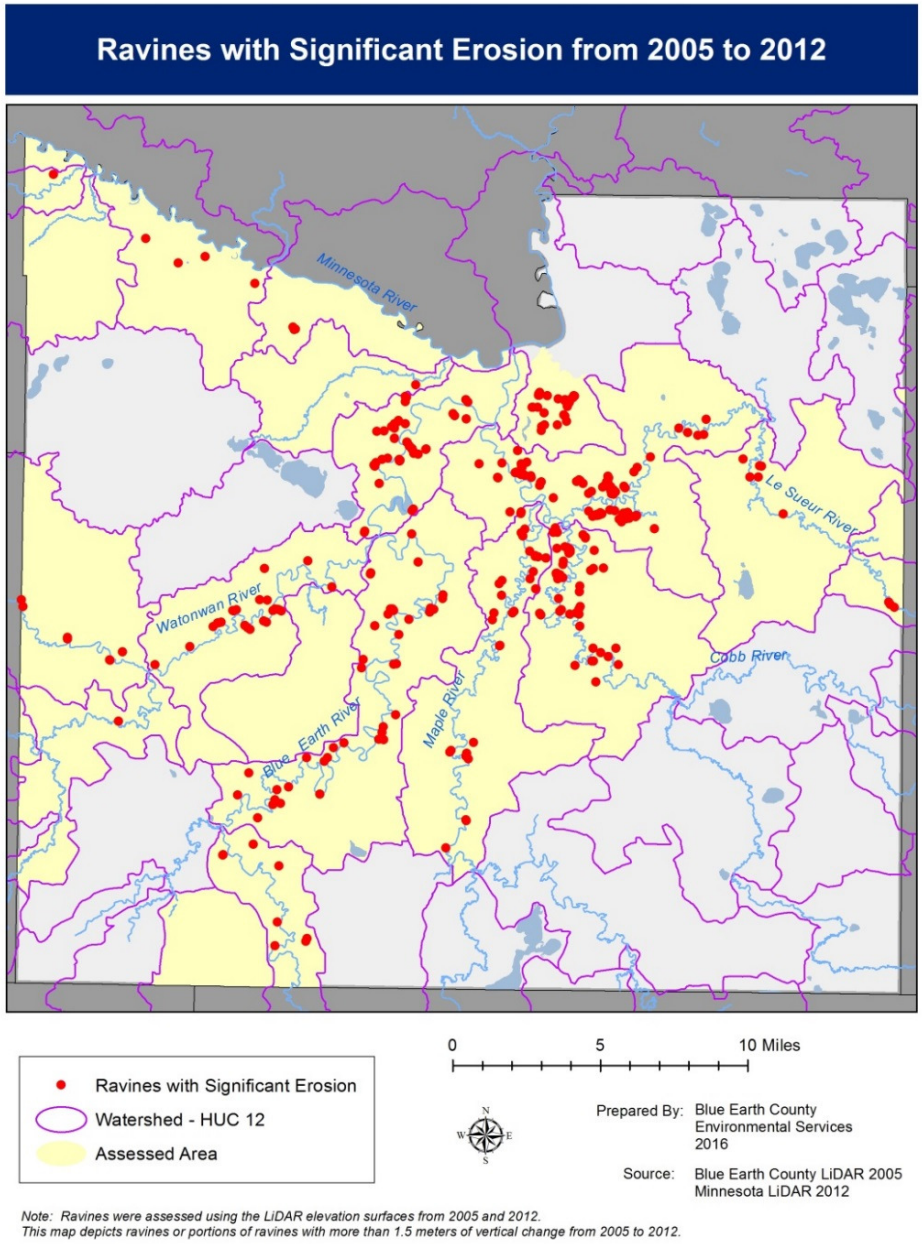
Ravines

Ravines are steep, deep, incised gullies at the tips of a drainage channel network. Seeps may occur on steep or near-vertical slopes. Ravines connect the uplands to the river valleys, and are often formed by ephemeral streams with only seasonal discharge. Such sites in the Blue Earth, Le Sueur and Watonwan display a diverse array of sizes and relief. Erosion in ravines proceeds by a combination of fluvial and hillslope processes. Channel incision and migration leads to over-steepened slopes and mass wasting.

A significant factor in ravine bluff and bank erosion is the presence or absence of subsurface tile drain and other stormwater outlets at the head of a ravine. Tile drains often accumulate flow from a large area before exiting into a ravine. This drained area is often greater than the surface drainage area draining to the ravine, leading to increased erosion.

Ravine discharges and sediment loads are highly variable. Ravine discharges also vary seasonally. Since most of the discharge in a ravine comes from the upland above it, flow depends on seasonal variation in precipitation, infiltration and evapotranspiration. Ravines are most active in the spring, when the upland landscape has little or no crop cover and may quickly route precipitation to ravines. Ravines often dry up in mid-summer when crop evapotranspiration is highest and precipitation is low.

Sediment from ravines is a small fraction of the Le Sueur sediment budget. In dry years ravines are responsible for as little as 2% of the Le Sueur sediment budget. However, ravine loads are very nonlinear. In a wet year, ravines can be responsible for as much as 15% of the Le Sueur sediment yield. They can have very high sediment load concentrations and can locally add a lot of sediment to the system. Sandbars at ravine mouths, probably deposited during spring floods, can persist in the Blue Earth, Le Sueur and Watonwan river channels throughout the summer.



Local Ravine Assessment

Ravines are a significant source of sediment in nearly all local watersheds. In addition to steepness and elevation differences, there are many factors contributing to ravine erosion. Based on local staff observations and knowledge, ravine erosion can be attributed to groundwater sapping, groundwater seeps, and altered hydrology in the ravine watershed. Altered hydrology in a ravine catchment can be the result of grading and filling or impervious surfaces changing the rate or volume of drainage to the ravine, decreased water storage and increased subsurface tile drainage.

Comparing 2012 LiDAR with 2005 LiDAR, the County identified more than 300 ravines with more than five feet of erosion in the seven years between LiDAR data. The map on the previous page shows the ravines identified and the areas of the county that were assessed with LiDAR comparison.

Subsurface tile drainage outlets to ravines increase the ravine watershed area as they often drain a much larger area than the surface drainage area. Drainage ditches in the county drain about 52% of the land area in the county. Much of the remaining area is drained directly to ravines, rivers, streams, lakes and wetlands.

Heavy rain events in 2010, 2014 and 2016 worsened erosion problems in many ravines in the county.

Some of the worst ravine erosion is in Middle Minnesota and Le Sueur River subwatersheds near Mankato where there is a relatively high density of single family dwellings and large ravine systems.

Mitigation Actions

Prevention: Government, administrative, or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and stormwater management regulations.

Property Protection: Actions that involve the modification of existing buildings or structures to protect them from a hazard or removal from the hazard area. Examples include acquisition, elevation, structural retrofits, storm shutters, and shatter-resistant glass.

Public Education and Awareness: Actions to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them.

Natural Resource Protection: Actions that, in addition to minimizing hazard losses, preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.

Emergency Services: Actions that protect people and property during and immediately after a disaster or hazard event. Services include warning systems, emergency response services, and protection of critical facilities.

Structural Improvements: Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include dams, levees, floodwalls, seawalls, retaining walls, and safe rooms.

Near Channel Erosion Goals and Strategies

Goal: Minimize near channel erosion, erosion hazards and mitigation costs throughout the county.

Near channel erosion includes ravines, landslides and stream bank and bluff erosion. Strategies include planning and prioritizing, land use management, prevention,

Planning

There are many local, state and federal agencies responsible for near channel erosion depending on whether the goal is prevention, natural resource protection, structural practices or elimination of an erosion hazard. A coordinated assessment and a planned unified response to near channel erosion hazards is needed.

STRATEGY: PRIORITIZING AND TARGETING.

Action: The County will continue to address near channel erosion hazards in the *Blue Earth County All Hazard Mitigation Plan* update.

Action: The County will work with partners to assess and prioritize ravine and near channel erosion hazards for prevention, natural resource protection and structural practices in an ongoing local plan that involves multiple local and state partners. Blue Earth County Emergency Management, Public Works and Environmental Services, City of Mankato Public Works, Mankato Township, the SWCD, and the other six municipalities and 20 townships affected by near channel erosion in the county, and the MNDNR.

Action: The County and other partners will seek funds for technical analysis of soils, geology, engineering and other engineering and technical support.

Action: Evaluate the need for an updated LiDAR elevation dataset along the river valleys, bluffs, ravines and steep slopes in the county to help determine rates of erosion and change. Acquire updated LiDAR elevation data if needed.

Action: Evaluate the need for ground based LiDAR and/or drones to assess individual bluff and ravine changes over time. Acquire ground based LiDAR system and/or a drone if needed.

Land Use Strategies

STRATEGY: PREVENTION – STRUCTURE SETBACKS.

Increase structure and other setbacks to prevent future erosion hazards and reduce mitigation costs.

Action: Blue Earth County, Mankato Township and other jurisdictions affected by near channel erosion will work together with technical support to develop science-based methods for increasing structure setbacks based on geology, soils and historic trends.

Action: Support the Minnesota Army Corps of Engineers Silver Jackets partnership with the MNDNR in the development of science-based methods for determining structure setbacks.

Action: Seek funds to support development of information and technical papers for elected officials, conservation, planning and zoning staff, and landowners making land use decisions in areas of near channel erosion hazards.

Action: Local government units in the county may consider requiring ground assessment and site specific analysis of vulnerability prior to land development and alterations in potential hazard areas.

Potential Partners: Affected planning and zoning authorities: Blue Earth County, Mankato Township, City of Mankato and Lime Township.

STRATEGY: PREVENTION - STORMWATER REGULATIONS.
Action: Review and revise stormwater management and land use ordinances and policies to decrease surface runoff and subsurface tile drainage water discharges directed to streambanks, bluffs and ravines to reduce erosion with stormwater management practices.

STRATEGY: PREVENTION AND NATURAL RESOURCES PROTECTION:
Action: Restore wetlands and construct water storage practices in areas contributing runoff directly to bluffs streambanks, bluffs and ravines.

Education and Outreach Strategies

There are hundreds of actively eroding ravines in the county. Landowner reports and requests for technical and financial assistance increase dramatically after major storms. LGUs in the county lack the organizational capacity to provide technical assistance to landowners. Landowners frequently mismanage ravines with unsuccessful fixes that worsen the problem.

STRATEGY: EDUCATION AND PREVENTION:
Action: Seek funds and develop funding mechanisms to provide technical information for landowners about preventing and managing ravine erosion.

Education and Research Strategies

STRATEGY: STUDIES AND INFORMATION.
Action: Support continued investigation of near channel erosion caused by groundwater sapping and landslides.

Action: Identify and address research needs Identify research needs, information gaps to address near channel erosion and landslides in the county.

Action: Support continued investigation of near channel erosion hazards and development of predictive models and methods to analyze the unique near channel erosion and riverine evolution processes in Blue Earth County so that more specific erosion hazard area boundaries can be identified and development steered away from hazard areas with local plans and zoning ordinances.

STRATEGY: STATE SEDIMENT STUDY PRIORITIES.
Action: Support **"Studying changes in near-channel loading** to gain a better understanding of how near-channel loading will change as recent increases in stream flows reach equilibrium. Once flows stabilize, channel widening should also stabilize along with near-channel sediment mobilization and transport. When will this happen, how large the decrease may be, and what a new baseline will be remains unclear." (Source: *Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River*, January 2015, MPCA)

Action: Support studies **"Predicting which other landscape features will erode at high rates."** "Air photo analysis has identified bluffs that have eroded rapidly over the past 60 years, although this is not a guarantee that these bluffs will continue to erode at a high rate in the future (e.g., the bluff erosion may have resulted after only one or two large events). Further analysis is needed to indicate the combination of bluff composition, geometry, and aspect that are most likely to produce large erosion rates in the future as well as the hydrologic (seepage and undercutting) and thermal (freeze-thaw) conditions that accelerate bluff failure (Gran et al. 2011)." (Source: *Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River*, January 2015, MPCA)

Action: Support **"Monitoring at knickpoints."** "Monitoring above and below these features can help to identify sediment sources and constrain sediment loading. Monitoring the erosive features directly using ground-based LiDAR, fingerprinting, and/or field surveys provides significant benefits. Load monitoring at the watershed

outlets alone is insufficient to identify and ultimately target the appropriate areas for sediment reducing BMPs. Hence there is a need to keep many of the intermediate monitoring stations in place." (MPCA 2012a) (Source: *Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River*, January 2015, MPCA)

Project Strategies

STRATEGY: NATURAL RESOURCE PROTECTION.
Action: Implement low cost, natural resource protection projects to preserve the function of natural systems in addition to minimizing losses. Low cost options might include toe wood, bend way weirs, live willow staking, and turf reinforcement mats.

Action: Affected landowners will implement projects that reduce near-channel erosion and restore stream corridors and vegetation in areas with erosion hazards.

STRATEGY: NATURAL RESOURCE PROTECTION - WATER STORAGE.
Action: Control stormwater runoff to prevent convergence of surface water to prevent channelized flow and the formation of gullies.

Action: Restore wetlands, construct targeted stormwater retention projects and manage sub-surface discharges to reduce runoff to stream banks, bluffs, and ravines in priority areas identified in the *Blue Earth County Water Management Plan,* local engineering studies, stormwater management plans and other plans that address water storage.

Action: Establish or maintain deep rooted, permanent vegetation in shore impact zone and along stream channel bluffs.

STRATEGY: STRUCTURAL IMPROVEMENTS AND NATURAL RESOURCE PROTECTION.
Action: Stabilize and protect streambanks outlining the surficial sands aquifer and City of Mankato's public water supply wells at the confluence of the Minnesota and Blue Earth Rivers in Land of Memories Park.

Action: Restore and stabilize streambanks to protect existing roadways, bridges and infrastructure in the Blue Earth, Le Sueur, Middle Minnesota and Watonwan watersheds.

Action: Restore and stabilize streambanks to protect public parklands affected by near channel erosion.

STRATEGY: PROPERTY PROTECTION – REMOVE STRUCTURES.
Action: Landowners will remove structures threatened by near channel erosion or in hazard areas.

Action: When eligible for state and federal assistance for acquisition, appropriate local units of government will assist landowners with applications for state and federal agency acquisition programs. ($12,000 per site x 4 sites in ten-year planning period)

Watershed Management Strategies

STRATEGY: PLANNING.
Action: Work with counties and SWCDs upstream in the Blue Earth River, Le Sueur River, Middle Minnesota and Watonwan River watersheds to identify and prioritize sites and establish water storage projects to reduce peak flows.

Ravine Implementation Goals and Strategies

Goal: Minimize ravine and gully erosion by managing hydrology and restoring stream channels in ravine watersheds.

Ravines are natural drainage ways located in every watershed in the county. There are hundreds of ravines in the county. Some ravines are relatively stable while others can contribute massive amounts of sediment to surface waters. Managing the flow of water to a ravine with conveyance and water retention practices can reduce ravine erosion.

Priority watersheds include:

- **Watersheds and ravines identified in ongoing local ravine and watershed assessments**
- **City of Mankato – Minnesota River, HUC 070200071102**, Indian Creek Watershed, Thompson Creek watershed, and other unnamed stream/ravine systems in the City of Mankato and Mankato Township
- **Le Sueur River, HUC 070200110607**, Mankato Township, Decoria Township and City of Mankato
- **City of St. Clair – Le Sueur River, HUC 070200110604**
- **Eagle Lake, HUC 0702001110606**
- **Cobb River, HUC 070200110305**
- **Maple River, HUC 070200110509**
- **Blue Earth River, HUC070200091103**
- **City of Vernon Center-Blue Earth River, HUC070200091102**
- **County Ditch No 24 Blue Earth River, HUC070200091101**
- **City of Madelia – Watonwan River, HUC 070200100604**
- **Watonwan River, HUC 070200100606**
- **Little Cottonwood, HUC 070200070704**
- **City of Courtland – Minnesota River, HUC070200071002**

ONGOING STRATEGY: PRIORITIZING AND TARGETING RAVINES.

Action: Identify, assess and prioritize ravine erosion, hazards and potential projects to facilitate coordination and implementation.

STRATEGY: STRUCTURAL AND NATURAL RESOURCE PROTECTION.

Action: Reduce drainage to ravines in priority areas with targeted wetland restoration and construction of water storage practices.

Action: Stabilize ravines in priority areas with channel restoration, water storage, grade control structures and other conveyance systems that manage water draining to ravines.

Action: Restore vegetation in ravine stream channels and side slopes.

Indian Creek Watershed

The Indian Creek watershed is located in the Middle Minnesota River watershed. Indian Creek is the drainage outlet for many ravines draining farmland, urbanized upland areas and stormwater ponds. A Clean Water Partnership in 2003 showed erosion in Indian Creek ravine systems to be a major source of sediment in the Indian Creek watershed. The Indian Creek Watershed contains water storage and flood control systems designed by the Army Corps of Engineers to store water during major floods. The City of Mankato is responsible for maintaining water storage in Rasmussen Park in the city limits and a stormwater basin along Indian Lake Road. To maintain the required water storage, the City must remove sediment from these water storage areas every one or two years. Township and County roads in the Indian Creek watershed are also affected by flooding and ravine erosion.

STRATEGY: INDIAN CREEK WATERSHED RAVINES STRUCTURAL NATURAL RESOURCE PROTECTION:

Action: Restore wetlands and increase water storage in the uplands draining to ravines in the Indian Creek Watershed.

Action: Increase water storage to reduce runoff from Minnesota State University Mankato MS4 draining to ravines and steep slopes in the Indian Creek Watershed.

Action: Restore wetlands and increase water storage in the County Ditch 69 and County Ditch 98 watersheds in areas identified in the Priority Areas for Protection and Restoration section of this plan, the *City of Mankato Park and Open Space Plan*, the Indian Creek watershed assessment or the Indian Creek Clean Water Partnership.

Action: Construct channel restoration and slope stabilization in ravines to reduce erosion in the Indian Creek Watershed as identified in the Indian Creek watershed assessment, the County's ravine assessment, Mankato Township or the City of Skyline.

Action: Enhance regional stormwater ponds to reduce discharges to ravines in the Indian Creek watershed.

Thompson Creek Watershed

STRATEGY: STRUCTURAL AND NATURAL RESOURCE PROTECTION:

Action: Construct channel restoration, bluff protection and grade stabilization to reduce erosion in the Thompson Creek watershed as identified in the Thompson Creek watershed assessment and Thompson Creek Clean Water Partnership and City of Mankato stormwater plans.

Wilson Creek Watershed

The Wilson Creek watershed is located in the Le Sueur River watershed. There are significant erosion problems in the meandering stream channel/ravine locally-named Wilson Creek. The watershed is drained by extensive urban stormwater systems and a county ditch. Urban land use and soil types with low infiltration capability in the Wilson Creek watershed are a challenge for managing hydrology to reduce erosion in this watershed.

STRATEGY: STRUCTURAL AND NATURAL RESOURCE PROTECTION:

Action: Protect and restore wetlands and increase water storage in the County Ditch 12 watershed in areas identified in the *Blue Earth County Water Management Plan, City of Mankato Park and Open Space Plan* or *City of Mankato Wilson Creek Stormwater Master plan*.

Action: Construct channel and slope stabilization practices in the Wilson Creek ravine as identified in the *City of Mankato Wilson Creek Stormwater Master Plan.*

Drainage Ditches - 103E Drainage Systems

Drainage systems were constructed to drain land and to collect water quickly and efficiently to improve soil productivity and increase land available for production of crops. Concerns about water quality and altered hydrology have brought more attention to County drainage systems and the potential to manage drainage system watersheds for multiple benefits.

This section of the plan and its goals and objectives for drainage systems managed under Minnesota Statutes 2017, section 103E are intended to be consistent with Minnesota Statutes 2017, sections 103E.011 and 103E.015. Minnesota Statutes 2017, section 103E regulates publicly administered drainage systems. These statutes require the Drainage Authority (County Board of Commissioners) to investigate potential external sources of funding, coordinate with the SWCD and water planning and consider land use, environment and multipurpose drainage criteria and public values and private benefits of the ditch system. As descried in the 2011 *Minnesota Drainage Law Analysis Evaluation Final Report*, considering and quantifying conservation public values is not defined in statute.

With the understanding that the Drainage Authority is required by statute only to *consider* multipurpose drainage criteria and coordinate with water planning, the goals and strategies in this plan for 103E drainage systems are intended to provide direction for considering watershed based goals and objectives that have the potential to provide multiple benefits to the drainage system and downstream waters. Watershed goals applicable to drainage systems include the following.

- Reduce the magnitude and duration of peak flows with wetland restoration and water storage
- Reduce erosion and sedimentation in the drainage system
- Reduce nitrogen in downstream waters
- Reduce phosphorus in lakes and rivers

Coordination and External Sources of Funding

External Sources of Funding

Minnesota Statutes 2017, section 103E.011 DRAINAGE AUTHORITY POWERS.
Subdivision 5. Use of external sources of funding
The Drainage Authority is allowed to use external sources of funds "for the purposes of wetland preservation or restoration or creation of water quality improvements or flood control" within the watershed of the drainage system.

Minnesota Clean Water Accountability Act and State Funding

The Minnesota Clean Water Accountability Act requires state agencies allocating money from the Clean Water Fund for nonpoint restoration and protection strategies to target the money according to the priorities identified in the BWSR nonpoint priority funding plan to address state and watershed goals. Grant recipients must propose measurable water quality outcomes.

Landscape and hydrologic analytical tools are available and continually being developed for use at major and minor watershed and field scales to support prioritizing and targeting practices and directing state funding to support measurable outcomes and progress toward watershed goals.

State Agency Plans and Priorities

The Minnesota Clean Water Accountability Act requires the MPCA and BWSR to develop reports and plans that contain specific strategies for achieving measurable results.

The MPCA is required to prepare Watershed Restoration and Protection Strategies (WRAPS) reports for all watersheds and report on the MPCA website progress toward meeting implementation milestones and water quality goals in TMDLs and WRAPS. The MPCA Federal 319 grants also require money be used to achieve measurable actions identified in WRAPS and TMDLs.

The BWSR is required to prepare and post on its web site a nonpoint priority funding plan to prioritize potential nonpoint restoration and protection actions based on available MPCA WRAPS, TMDLs and local water plans.

Clean Water Fund Grants

The priorities and criteria for Clean Water Fund grants are determined annually by the BWSR.

In recent years grants have been available to facilitate multipurpose drainage planning and on-field, on-farm, and on-drainage system practices within the watershed of a priority Chapter 103E drainage system to reduce erosion and sedimentation, reduce peak flows and flooding, and improve water quality, while protecting drainage system efficiency and reducing drainage system maintenance.

Clean water fund grants for projects and practices are also available. CWF grants have not paid enough for landowners to consider wetland restoration projects.

Reinvest in Minnesota (RIM) program

RIM program grants are available sporadically, and when available, there is inadequate funding for all the county landowners' project applications.

103E Coordination

Minnesota Statutes 2017, section 103E.015 CONSIDERATIONS BEFORE DRAINAGE WORK IS DONE.
Subdivision 1a. Investigating potential use of external funding and technical assistance.
When planning a drainage project or a repair under section 103E.715 and prior to making an order on the engineer's preliminary survey report for a drainage project or engineers report for a repair, the

drainage authority is required to coordinate with the SWCD and local water planning to investigate the potential use of external sources of funding and technical assistance to facilitate wetland preservation and restoration, flood control or creation of water quality improvements (103E.011, Subd.5) and alternative measures (103E.015, Subd 1, clause 2), including measures in the county water plan, to:

(i) conserve, allocate, and use drainage waters for agriculture, stream flow augmentation, or other beneficial uses;
(ii) reduce downstream peak flows and flooding;
(iii) provide adequate drainage system capacity;
(iv) reduce erosion and sedimentation; and
(v) protect or improve water quality

Wetlands, Water Quality and Flood Control

Wetland Preservation and Restoration

All wetlands provide important functions, but not all wetlands provide all functions equally well. Priority areas for protecting, enhancing and restoring wetlands to provide multiple benefits are shown in the Priority Areas for Protection and Restoration section of this plan. Potentially restorable basins that might provide important water storage or nutrient treatment functions are also shown in the Priority Areas for Protection and Restoration section of this plan.

Flood Control

Potential Flooding Characteristics, Minnesota Statutes 2017, section 103E.015, Subdivision 1

The Drainage Authority is required to consider current and potential flooding characteristics of property in the drainage system and downstream for 5-year, 10-year, 25-year, and 50-year flood events, including adequacy of the outlet for the drainage project.

These analyses are estimated using hydrologic models. Once the models are set up to estimate the 5-year, 10-year, 25-year, and 50-year flood event analysis required by statute, it is not difficult to add 2-year and 100-year flood events. The 2-year, 5-year, 10-year, 25-year, and 50-year flood events are already being analyzed in county ditch projects.

Reducing the magnitude and duration of peak flows associated with 2-year storm events is the focus of water quality goals, but 50-year and 100-year storm events have had devastating effects with massive erosion in ravines and stream channels in the county as observed in 2010, 2014 and 2016.

Water Quality Improvements

As described in this plan, state plans and watershed plans, water quality concerns in all watersheds where the county is located are:

- Altered hydrology – magnitude and duration of downstream peak flows
- Erosion and sedimentation
- Nitrogen transport to surface and ground water
- Phosphorus transport to surface water, especially lake watersheds

Many best practices can address multiple water quality concerns. Wetland restoration and creation can provide water storage and nitrogen treatment. Soil health practices can increase soil water holding capacity, nutrient efficiency and reduce erosion. Practices at the field scale and in the drainage system watershed headwaters are often the most cost effective means to improve water quality. Addressing multiple concerns should be considered when identifying and prioritizing water quality practices in 103E drainage systems.

Hydrology and Peak Flows

The effects of increasing precipitation trends in recent decades and increased drainage have multiple drainage and water quality concerns:

- Drainage system capacity is limited
- Increasing drainage to drainage systems
- Local flooding in some watersheds
- Increased volume of water draining from drainage systems to downstream water bodies accelerating natural stream channel migration, channel widening and near channel erosion in streams and ravines
- Downstream lakes and wetlands are affected by fluctuating water levels and sediment altering vegetation and habitat

Research shows agricultural drainage systems have impacts on surface waters by altering the hydrologic cycle, increasing the total volume of water discharged to downstream water bodies and extending peak flows.

The MPCA 2015 *Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River* states that "A priority initiative for this strategy is to reduce peak streamflow magnitude and duration, since the cause of much of the near-channel erosion is high flows that exert erosional energy on streambanks and bluffs. River flow goals include reducing the two-year annual peak flow by 25% by 2030, and to decrease the number of days that the two-year peak flow is exceeded by 25% by 2030."

Magnitude goal: Reduce two-year annual peak flow by 25% by 2030

Duration goal: Decrease the number of days the 2-year annual peak flow is exceeded by 25% by 2030 (average duration and median duration)

The MPCA 2015 *Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River* states that near channel sources contribute 60-85% of fine sediment load to the Minnesota River, and "the Blue Earth and Le Sueur River watersheds together contribute as much as half of the fine sediment load to the Minnesota River, even though they account for only one-fifth of its drainage area." "In addition to streams flow, drainage to ravines should be managed and reduced to reduce downstream impacts from drainage systems."

Upland Erosion and Sedimentation

Reducing erosion and sedimentation addresses multiple concerns:

- Increased maintenance in drainage system from erosion and sedimentation
- Sediment and phosphorus discharged from drainage system to downstream lakes, wetlands and streams affect water quality, vegetation and wildlife habitat
- Loss of soil from farm fields

Blue Earth County is located in watersheds with disproportionately high sedimentation in rivers, streams, lakes and wetlands. There are highly erodible soils in all watersheds in the county in areas near channels and ravines and in uplands. As described in the University of Minnesota *Fields to Streams*, "While subsurface tile drainage reduces overland flow and soil erosion in many cases, overland flow still occurs on tiled land if surface soil structure is poor which blocks infiltration or if the soil is saturated."

The MPCA 2015 *Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River* states "Even in watersheds such as the Le Sueur, which has considerable bluff erosion, upland sediment contributions are estimated to be as much as one-third of the sediment budget (Gran et al. 2011)."

The most cost effective best practices for managing upland erosion are established in the field. Soil health practices can increase soil's water holding capacity, nutrient efficiency and reduce erosion.

Soil health principles include:

- keep the soil covered as much as possible
- disturb the soil as little as possible
- keep plants growing throughout the year to feed the soil
- diversify as much as possible using crop rotation and cover crops

Vegetated buffers on open diches in 103E drainage systems reduce ditch channel erosion and transport of sediment from adjacent fields to the ditch system. As observed by the Drainage Authority and many landowners, maintenance costs are reduced when ditch buffers are in place. Minnesota Statutes require buffers on ditches and require the Drainage Authority to make annual reports of the status of ditch buffers to the BWSR.

Nutrients

Watersheds in the county are among the highest contributors of nutrient loads in the Minnesota River, according to the MPCA *Minnesota Nutrient Reduction Strategy*. Nutrient reduction goals for the Minnesota River Basin are a 45% reduction in nitrogen and a 45% reduction in phosphorus.

The MPCA 2015 *Le Sueur River Watershed Restoration and Protection Strategy (WRAPS)* contains the following nutrient reduction goals:

> **Nitrogen Reduction Goal: 45%** reduction in multi-year flow weighted mean concentration (from 9 to 5 mg/L). Years to meet

goal: 38 years with implementation of strategies in the LeSueur WRAPS.

Phosphorus Reduction Goal: 60% reduction in flow weighted mean concentration (from 0.38 to 0.15 mg/L). Years to meeting goal: 60 years with implementation of strategies in the LeSueur WRAPS.

Phosphorus

Phosphorus is a concern for multiple reasons:

- Phosphorus fertilizer losses from cropland
- Small concentrations of phosphorus cause eutrophic have serious Excessive plant growth in lakes, wetlands and streams causes eutrophic conditions

Reducing phosphorus is a priority in lake watersheds in the county.

Nitrogen

Nitrogen is a concern for multiple reasons:

- Nitrogen fertilizer losses from cropland
- Nitrogen is easily transported in drainage waters
- Nitrate nitrogen in surficial sands and gravel groundwater aquifers and shallow bedrock
- Aquatic life toxicity

Reducing nitrogen is a priority in all surface waters in the county and downstream. Reducing nitrate-nitrogen in the lowest reach of the Blue Earth River is a high priority.

As described in the MPCA Nutrient Reduction Strategy, cropland is the dominate source (89-95%) of nitrogen loading the Minnesota River. The dominant pathway is tile drainage. Tile drainage contributes 67% of the nitrogen load in an average year and 72% in a wet year. Surface runoff contributes 1-4% of nitrogen loads to the Minnesota River.

Land Use

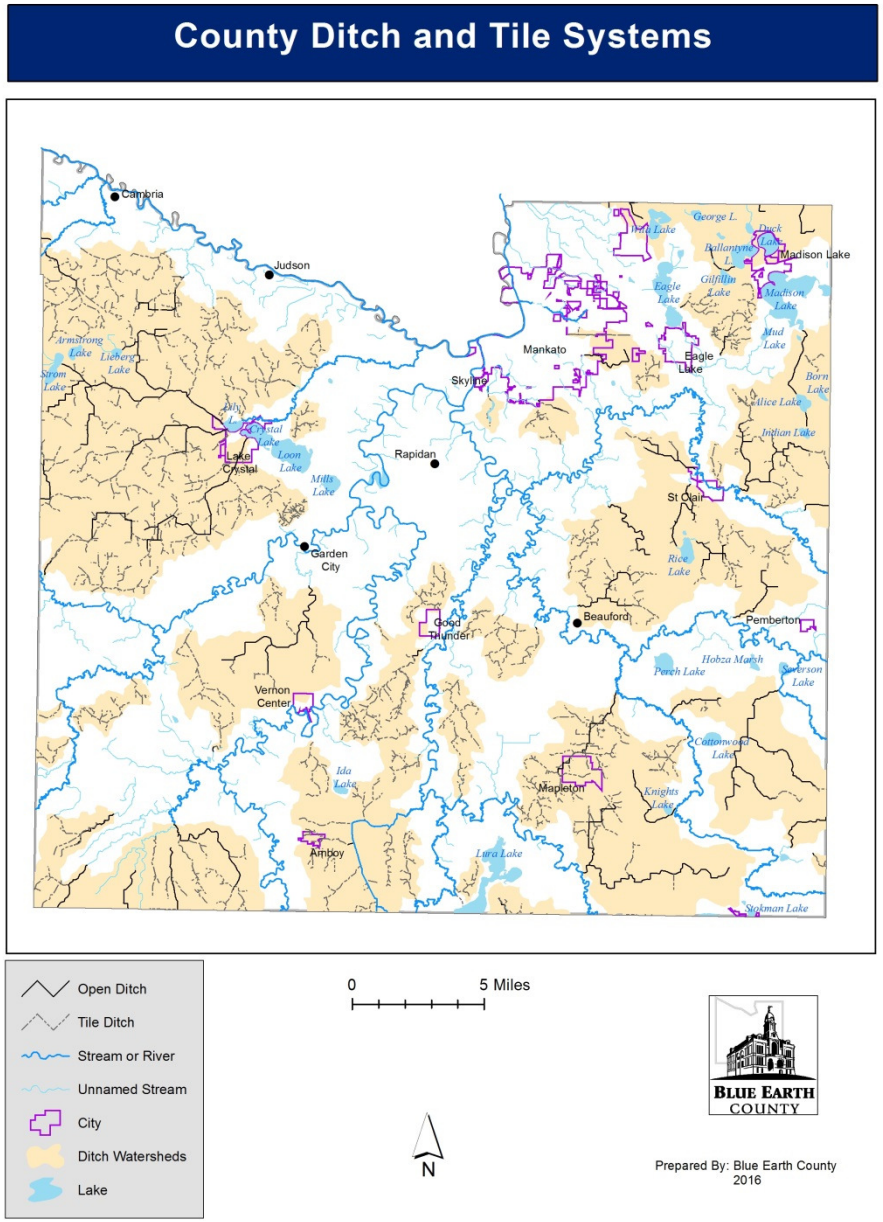
Before establishing a drainage project, the Drainage Authority must consider the present and anticipated land use within the drainage project or system, including compatibility of the project with local land use plans. Local land use plans may include comprehensive land use plans, park and open space plans, transportation plans, MATAPS, Alternative Urban Area Review (AUAR), stormwater plans, and MS4 plans, for example.

103E Drainage System Area

The Drainage Authority manages 696-miles of 103E drainage systems in the county, including open and tile main ditches. The following table displays the length of each ditch type. A map of 103E drainage system area is shown to the right.

Ditch type	Miles
Open	162
Tile	534

The 103E drainage systems drain 53% of the cropland acres in the county. Much of the remaining cropland is drained with private ditches and subsurface tile drainage that discharge directly to ravines, rivers, lakes and wetlands instead of 103E drainage systems.



Municipalities in 103E Drainage System Watersheds

Municipality	103E System	Watersheds	Description	Issues / Potential Projects
Amboy	JD38 JD49	Maple River - Le Sueur	JD38 tile ditches drain through the city to JD49 (drained Jackson Lake) and also collects city stormwater. City wastewater treatment discharges to ditch.	Water storage in areas draining to the city.
Eagle Lake	None			
Good Thunder	JD43	Blue Earth	A small area of agricultural land in the far west city limits is in JD43 drainage area draining west.	Most of city limits drain east and south to Maple River.
Lake Crystal	CD 56	Crystal Lake- Middle Minnesota	CD56 drains through city and collects city stormwater. FEMA floodplain along ditch in portion of the city.	Flooding is concern in the city limits. Water storage in the city and in the drainage system watershed. Phosphorus and nitrogen treatment.
Madison Lake	None			
Mankato Airport	JD1	Middle Minnesota	The north end of the airport runway in JD1 drainage area.	Minimize potential avian conflict. Avoid water storage adjacent to the airport.
Mankato	CD46	Thompson Creek – Middle Minnesota		
Mankato	CD 12	Wilson Creek- Le Sueur River	Land Use Plan, Park and Open Space Plan Wilson Creek Improvement	Increase Water Storage Downstream erosion in CD outlet, Wilson Creek ravine
Mankato	CD98	Ravine- Indian Creek-	CD98 drains to a ravine with significant residential development and water storage structures and Indian Creek	Increase water storage Downstream flooding and erosion in CD outlet ravines, Sediment filling Indian Lake Road Watershed Flood Control Structures – Indian Lake Road and Rasmussen Woods
Mankato/ Mankato Township	CD 71	Indian Lake- Indian Creek- Middle Minnesota	CD 71 drains to a County Wetland Bank and the City of Mankato Indian Lake Road flood control structure.	Non-related flooding downstream of Indian Lake. Recreation.
Mankato	CD 69	Ravine- Indian Creek- Middle Minnesota	CD69 tile drains to a ravine with residential development.	Increase water storage in drainage system. Recreation.
Mapleton	CD 57	Cobb River - Le Sueur River	CD 57 collects stormwater and wastewater from city.	Increase water storage in the city's drainage area.
Pemberton	None			
St Clair	CD88 CD25	Le Sueur River	CD88 and CD25 drain to ravines in the north, undeveloped city limits. CD88 terminates just outside of the city limits, west of State Highway 83, but drains to a ravine.	The existing developed areas in the city limits are not affected by nor drain to CD88 or CD25.
Skyline	None			
Vernon Center	None			

Shallow Groundwater

Before establishing a drainage project, the Drainage Authority must consider the effects of the proposed drainage project on shallow groundwater availability, distribution, and use.

Drainage systems in the Watonwan River and Lake Crystal watersheds drain shallow groundwater in coarse textured soils with high pollution sensitivity as mapped by the *Geologic Atlas of Blue Earth County, Part B.* Irrigation is also most common in these areas. Maps of areas with high pollution sensitivity and are in the Background and Priority Areas for Protection and Restoration sections of this plan.

Lakes

Phosphorus transport from drainage systems to lakes is a concern as well as the effect of altered hydrology and increased water levels on lake vegetation and habitat. Reducing phosphorus and increasing water storage are important functions in lake watersheds for protecting and restoring lakes water quality in the county.

The models used to analyze major watersheds for the MPCA WRAPS and other State studies typically show lake subwatersheds to be low contributors of phosphorus, nitrogen or sediment to the watershed. Lakes retain water and are sinks for sediment and phosphorus at the major watershed scale.

The following table displays a list of lakes with 103E drainage systems flowing in or out of the lake.

Lake	Ditch	Direction of Ditch Flow to Lake
Strom Lake	JD48	Out
Lieberg Lake	JD48	Out
Lily Lake	CD27 and JD 48	In
Crystal	CD 56	In
Lura	JD1	Out
Knights	CD16	In and Out
Rice	CD77	In
Rice	CD 88	Out
Alice	CD 2	In and Out
Indian	CD 2	Out
Goolsbey	CD 2	In and Out
Goolsbey	CD 49	In
Schoolhouse	CD 2	In and Out
Madison	CD 2	In
Gilfillin	CD15	In and Out
Ballantyne	CD15	In
Eagle	JD34	In
Indian (Conservation Area)	CD71	In and Out

Buffers

Ditch buffers will be established on all 103E drainage systems as required by Minnesota Statutes 2017. sections 103E.021 and 103F.48.

Minnesota Statutes 2017, section 103E.021. DITCHES MUST BE PLANTED WITH PERENNIAL VEGETATION. The County Drainage Authority has responsibility for ditch buffers required by Minnesota Statutes 2017, section 103E. Not all drainage systems are required by Minnesota Statutes 2017, section 103E to establish a buffer.

Minnesota Statutes 2017, section 103E.067 DITCH BUFFER STRIP ANNUAL REPORTING requires the Drainage Authority to submit annual reports to BWSR including number and types of actions related to buffers established under Minnesota Statutes 2017, section 103E.

Minnesota Statutes 2017, section 103F.48 RIPARIAN PROTECTION AND WATER QUALITY PRACTICES requires landowners establish a buffer in compliance with Minnestoa Statutes 2017, section 103E.

Drainage Ditches Goals and Strategies

GOAL: Drainage project plans will identify potential wetland preservation and restoration projects, creation of water quality improvements or flood control projects to provide measurable water quality benefits in receiving waters. (Reference: Minnesotat Statutes 2017, section 103E.015, subdivision 1 and 1a and Clean Water Accountability Act)

Coordination and External Funding Strategies

STRATEGY: COORDINATION.

The County Drainage Authority will coordinate with the SWCD and County water planning to identify and prioritize projects and opportunities to obtain external sources of funding in drainage system watersheds for the purpose of wetland preservation or restoration, creation of water quality improvements or flood control in drainage systems. (Minnesota Statutes 2017, section 103E.015, subdivision 1a)

Action: A local drainage project coordination team will meet at least annually to identify and prioritize drainage projects, identify potential grant opportunities and coordinate preparation of grant applications for 103E drainage systems. The coordination team will include local staff of the drainage authority, SWCD and county water planning, project engineers and other agency representatives as needed.

STRATEGY: PRIORITIZING AND TARGETING.

Environmental and multipurpose drainage activities in drainage systems will be prioritized and targeted using science-based processes to address nitrogen, phosphorus and the magnitude and duration of peak flows in receiving waters. (Minnesota Nonpoint Priority Funding Plan 2016, Clean Water Accountability Act)

Action: The local drainage project coordination team will identify and prioritize drainage systems for planning and implementation project activities by considering local knowledge and organizational capacity, state and watershed plans, and local priorities which may include the following methods and criteria:

- Watershed identified as a high priority in a WRAPS, TMDL, Blue Earth County Water Management Plan or Comprehensive Watershed Management Plan. (BWSR Nonpoint Funding Priority Plan)
- Priority sub-watersheds identified using the best available models, decision support tools and data related to the most significant water quality problems or threats in major watersheds. (BWSR Nonpoint Funding Priority Plan)
- Align with priority sub-watersheds in the county as recommended by the water plan task force.
- Downstream flooding and erosion concerns. (Minnesota Statutues 2017, section 103E.015, subdivision 1 and 1a)
- Landowners' interest in water quality improvement.
- Erosion and sedimentation documented in drainage system repair history.
- Environmental, land use and multipurpose drainage criteria in accordance with Minnesota Statutes 2017, section 103E.015, subdivision 1 and 1a.
- Criteria in updated BWSR nonpoint funding priority plans or similar state funding plans.

STRATEGY: GIS AND DEM DATA MANAGEMENT.

A hydro-conditioned DEM is useful for many purposes and by the many county LGUs. Many water quality targeting tools require a hydro-conditioned DEM. Maintaining an accurate hydro-conditioned

DEM is beneficial for all potential users. There are some errors and limitations in the hydro-conditioned DEM. Over time land development and other land changes can affect its accuracy and use.

Action: Blue Earth County will centralize maintenance of a hydro-conditioned DEM.

Action: All Drainage Authority, Environmental Services, Public Works and SWCD projects will routinely provide GIS and hydro-conditioning updates to one department maintain the DEM for shared use by all.

Wetland Preservation and Restoration, Flood Control and Water Quality Improvement Strategies

The Drainage Authority is required to facilitate wetland preservation and restoration, flood control or creation of water quality improvements (103E.011, Subd.5) and alternative measures (103E.015, Subd 1, clause 2), including measures in the county water plan, to:

(i) conserve, allocate, and use drainage waters for agriculture, stream flow augmentation, or other beneficial uses;
(ii) reduce downstream peak flows and flooding;
(iii) provide adequate drainage system capacity;
(iv) reduce erosion and sedimentation; and
(v) protect or improve water quality;

Implementing strategies to identify and quantify the benefits of potential projects to manage downstream peak flows and reduce nitrogen, phosphorus and sediment transport from drainage systems to downstream water bodies will ultimately lead to project implementation and maximize opportunities for external sources of funding when measurable benefits are considered by the Drainage Authority and landowners.

STRATEGY: MULTIPURPOSE DRAINAGE PROJECTS.

Action: The Drainage Authority, County and SWCD will coordinate grant applications and construction at least two large scale multipurpose drainage projects in drainage systems during the ten-year planning period.

Altered Hydrology and Peak Flow Strategies

STRATEGY: IDENTIFY AND QUANTIFY WATER STORAGE AND PEAK FLOWS.

Increase water storage in drainage systems to manage peak flows in downstream waters.

Minnesota Statutes 2017, section 103E.015, Subdivision 1

Drainage projects should analyze and consider how water storage, through wetland restoration and constructed wetlands and water storage practices, can provide multiple benefits in a drainage system by reducing demands on the drainage system as well as downstream impacts, such as flooding, near- channel and ravine erosion, fluctuating water levels in lakes and wetlands, and providing nutrient treatment benefits.

In addition to water storage, restored wetlands and some water storage practices can provide nitrogen treatment in addition to water storage benefits.

Action: The Drainage Authority will consider the importance of water storage in ditch systems by continuing to develop and implement policies that provide incentives for wetland restoration and water storage projects in the drainage system watershed.

Action: Identify and prioritize potential sites for multiple benefits, water storage and nutrient treatment by reviewing and referencing plans, such as the following:

- *Blue Earth County Water Management Plan* priority areas and potential sites for conservation projects or wetland restoration and enhancement in the Priority Areas for Protection and Restoration section of the plan.
- Other local and state-approved watershed plans to identify potential wetland restoration and water storage projects.
- Local government land use and stormwater management plans (county, municipal and townships) to identify opportunities for wetland preservation and restoration and stormwater management projects.

Action: Quantify how potential wetland restoration and water storage practices, if established in the drainage system, could reduce project costs, pipe sizing and the magnitude and duration of peak flows and the total volume of discharge from the drainage system to provide multipurpose water management benefits and meet local, state and watershed goals.

Action: Identify potential field-scale best practices to increase water storage, and to the extent practical, quantify the water storage benefits using the best available models and decision support tools.

Action: Potential water storage practices and quantified, potential multipurpose benefits will be presented to landowners and the Drainage Authority.

Action: The County, SWCD and affected municipalities will seek external sources of funds for viable wetland restoration and water storage projects in drainage system watersheds.

STRATEGY: QUANTITY DOWNSTREAM FLOODING AND PEAK FLOWS.
Action: Before establishing a drainage project, the Drainage Authority will quantify current and potential flooding characteristics of property in the drainage project or system and downstream, including adequacy of the outlet for the drainage project, for 2-year and 100-year storm events in addition to the 5-year, 10-year, 25-year and 50-year events required in 103E.

Action: Flooding and potential erosion characteristics will be presented to the Drainage Authority and landowners in the drainage system watershed and jurisdictions located downstream.

Action Priority Areas/Watersheds: Drainage systems draining to municipalities in the county. Mankato- Indian Creek watershed, CD69 and CD98 and Le Sueur River CD12, City of Lake Crystal -CD56.

STRATEGY: SHALLOW LAKES AND WETLANDS.
Action: Drainage projects will quantify how drainage projects affect water levels in lake and wetlands, especially priority areas and wetlands in the Greenprint and *Blue Earth County Water Management Plan*.

Action: Reduce impacts of drainage systems by protecting and enhancing wetland buffers to prevent sedimentation and loss of water storage function.

Nutrient Strategies

STRATEGY: NITROGEN TRANSPORT.
Reduce nitrate nitrogen discharged to surface waters from drainage systems.

Action: The Drainage Authority will identify potential projects to reduce nitrate in subsurface tile drainage water and quantify how potential projects and practices, if established, could reduce nitrate in downstream waters.

Action: Potential projects and quantified, potential multipurpose benefits will be presented to landowners and the Drainage Authority.

Action Priority Areas/Watersheds: The lowest reach of the Blue Earth River and watershed areas contributing nitrogen to this reach. Areas with groundwater pollution sensitivity.

STRATEGY: PHOSPHORUS TRANSPORT.

Action: The Drainage Authority will identify projects to reduce phosphorus transport to surface water from surface runoff and subsurface tile drainage water and quantify how potential projects and practices, if established, could reduce phosphorus in downstream waters.

Action: Drainage projects will quantify and present to landowners and the Drainage Authority how potential projects and practices, if established, could reduce phosphorus in downstream waters.

Action Priority Areas/Watersheds: All lake watersheds in the county as shown on the following table list.

Lake	Ditch
Lily Lake	CD27 and JD 48
Crystal	CD 56
Knights	CD16
Rice	CD77
Alice	CD 2
Goolsbey	CD 2
Goolsbey	CD 49
Schoolhouse	CD 2
Madison	CD 2
Gilfillin	CD15
Ballantyne	CD15
Eagle	JD34
Indian(Conservation Area Mankato)	CD71

Erosion and Sedimentation Strategies

STRATEGY: EROSION AND SEDIMENTATION.

Action: Use watershed targeting tools and local knowledge to Identify and prioritize the highest contributing areas in the drainage system where field erosion and runoff deposit sediment in the drainage ditch and increase ditch maintenance over time.

- Ditch inspection records
- Field inspections
- Watershed analysis and targeting tools

Action: The SWCD will recommend soil health, grass waterways, WASCOBs and other in-field practices that reduce erosion from the highest contributing areas to provide multiple benefits to the drainage system.

Action: The Drainage Authority and SWCD will identify near-ditch practices to trap or filter runoff to the drainage ditch if needed.

Action: The Drainage Authority will identify and quantify how in-field, near-ditch and other practices, if established, could make measurable erosion and sedimentation reductions in the drainage system.

Action Priority Areas/Watersheds: All watersheds in the county. Watersheds with the most acres and percent HEL classification of cropland according to the USDA NRCS Soil Survey.

STRATEGY: DITCH BUFFERS.

Action: The County Drainage Authority will ensure buffers are maintained over time in accordance with 103E during routine drainage system inspections, 103E repairs and improvement projects.

Action: The County Drainage Authority will submit reports to BWSR as required by Minnesota Statutes 2017, section 103E.067.

Action: The SWCD will provide technical assistance to landowners establishing ditch buffers required by Minnesota Statutes 2017, section 103F.48.

Action: The County and Drainage Authority will consider enforcement of 103F buffer requirements for 103E drainage systems.

Stormwater Management

Developed land and its effect on stormwater runoff and management is a concern both within and outside of municipalities in the county. Concerns about the potential adverse effects of stormwater runoff on water quality include altered hydrology, pollutants in runoff and construction site runoff.

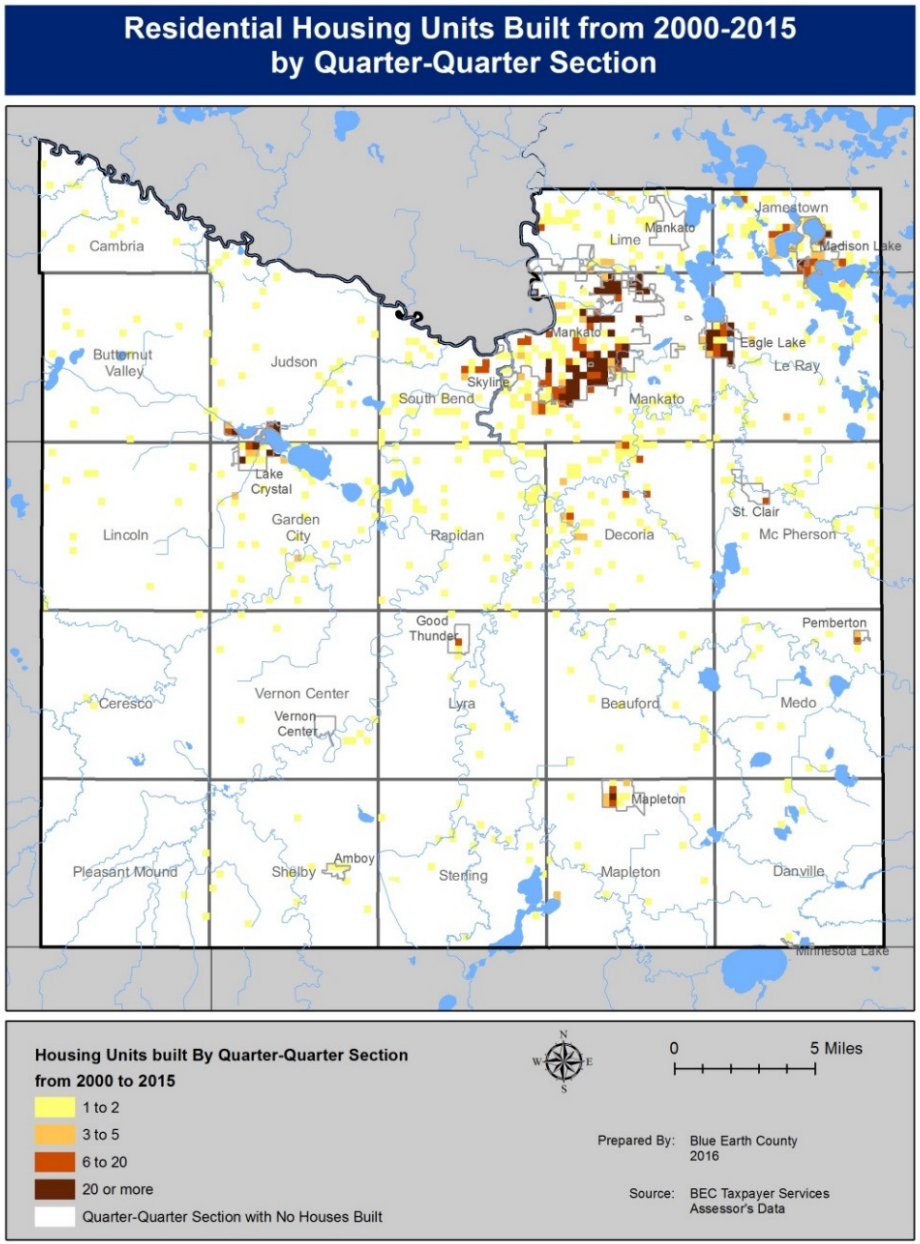
Altered hydrology. Impervious surfaces, site grading and drainage can alter hydrology, increase runoff and cause erosion and flooding. Increased runoff is usually collected and channelized into ditches, drainage ways, storm sewers and road gutters designed to quickly move water away from developed areas.

Pollutants. Stormwater runoff carries with it fine sediment and pollutants from paved surfaces and lawns, such as nitrogen, phosphorus, bacteria, oil, pesticides and metals and sands or salts used on icy roads.

Construction Site Runoff. When stormwater drains off a construction site, it carries sediment, phosphorus and other pollutants that harm lakes, streams and wetlands. The U.S. Environmental Protection Agency estimates that 20 to 150 tons of soil per acre is lost every year to stormwater runoff from construction sites.

Development Patterns

Most new development in the county is occurring in municipalities. Outside of municipalities, the most attractive areas for development are in sensitive areas near ravines, rivers, streams, lakes and wetlands. The map to the right displays new construction density in quarter-quarter sections (40 acres) between 2000 and 2015.



Responsibility for Stormwater Management

Local government units are responsible for regulating stormwater management to protect water quality and prevent flooding and damage to infrastructure from stormwater. Through regulation of stormwater, erosion and sedimentation, communities can enhance and protect water resources. Subdivision and zoning ordinances and local permitting are examples of regulations to manage stormwater.

The County's and many local jurisdictions' stormwater regulations were adopted when awareness of stormwater management for water quality was just beginning 20 years ago. For example, the County Land Use Plan, adopted in 1998, states "To minimize negative impacts from storm water runoff, the County will enact development standards for stormwater management to insure no net increase in runoff."

Updating local regulations may be needed to address priorities for managing stormwater for water quality, potential flooding and erosion and sedimentation.

Priority Areas

Priorities for stormwater management are in areas of the county prone to erosion and runoff due to slope and soil drainage characteristics, lake watersheds and regulated, urbanized areas.

Lake watersheds

In addition to managing water quality volume of stormwater runoff rate and volume to reduce erosion and sedimentation, managing stormwater runoff to reduce phosphorus is needed throughout lake watersheds.

Lake shoreland development is greatest around Madison, Duck, Ballantyne, George, Crystal and Loon. Ensuring there is effective stormwater management in lake watersheds in the county is mainly the responsibility of Blue Earth County, the City of Madison Lake and the City of Lake Crystal.

In many residential areas of these lakes, the shore and bluff impact zones have impervious surface connections to the lake that transport fine sediment, nutrients and other pollutants. Natural vegetation in most shoreland areas of these lakes has been converted to impervious surfaces and mowed lawns resulting in less filtration and infiltration and loss of critical habitat. Shoreland vegetation protects the lake from the effects of polluted runoff, stabilizes the soil along the lake's edge, and provides habitat, shelter, food, and cooling shade for fish.

The sources of phosphorus and sediment in these lakes do include agricultural sources as the watershed area contains significant cropland. The impact of stormwater runoff from residential land use should not be ignored in watershed restoration. The Minnesota Stormwater Manual states that "Urban and urbanizing lakes receive higher phosphorus loads than non-urban lakes because urban watersheds, particularly those under construction, produce higher unit area phosphorus loads from stormwater runoff, compared to other watersheds."

Ravines, steep slopes, rivers and streams

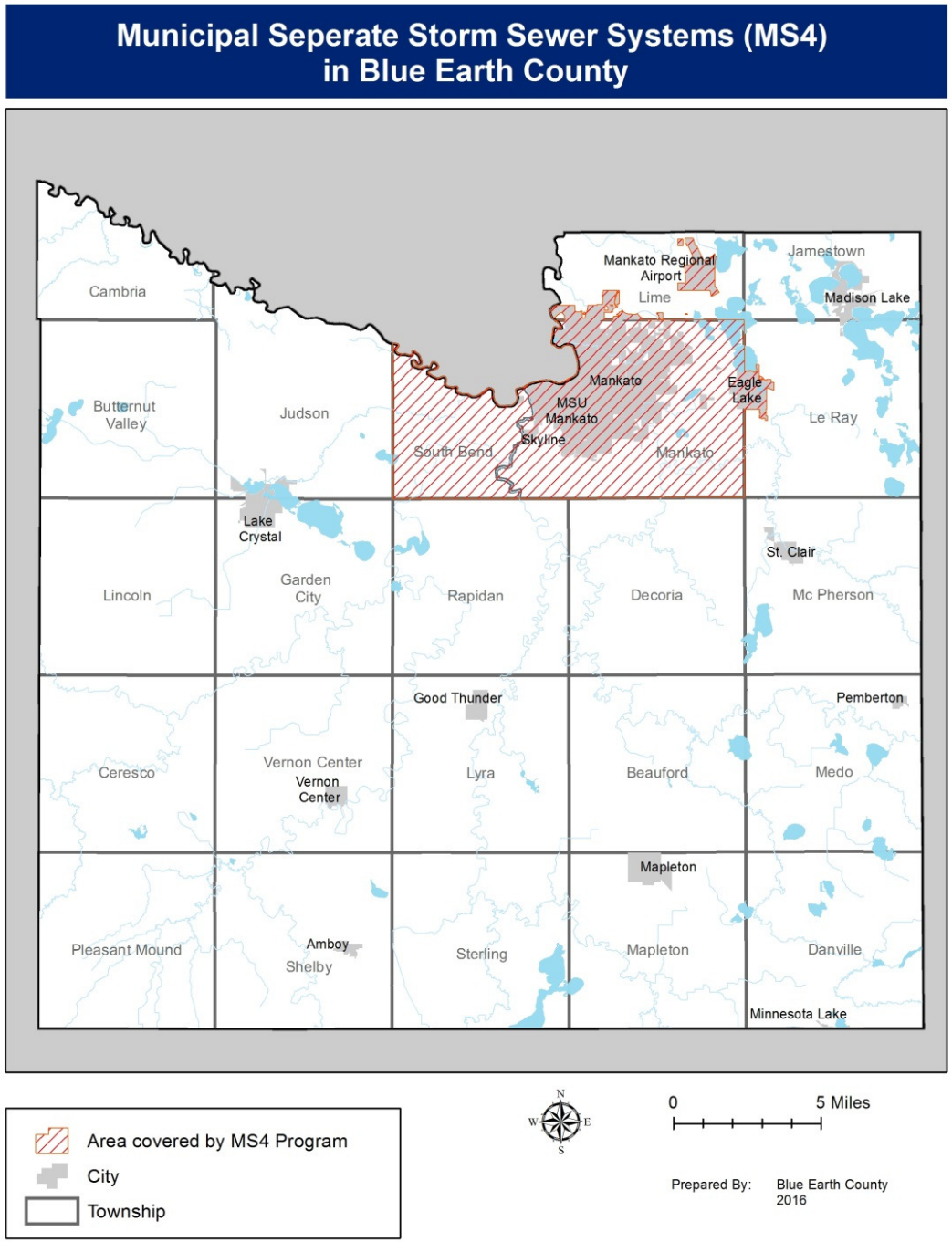
Ravines and river and stream corridors are prone to near channel erosion yet continue to be attractive for residential development. Altered hydrology and erosion in ravine watersheds in the county is a significant source of sediment in the Blue Earth, Le Sueur, Middle Minnesota River watersheds. A County GIS analysis of ravine erosion shows there are more than 300 ravines where there was more than five feet of erosion between 2005 and 2012. Ravine and near channel erosion are assessed in more detail in the Near Channel Erosion section of this plan.

Regulated Urbanized Areas
MS4 - Municipal Separate Storm Sewer System

Prior to 2016, the only MS4 jurisdiction in the county was the City of Mankato. The MPCA added to the Mankato MS4 the City of Eagle Lake, City of Skyline, Mankato Township, South Bend Township and Minnesota State University Mankato.

The jurisdictions in the county with regulated Municipal Separate Storm Sewer Systems (MS4) are shown on the map to the right and include the following:

MS4	Watersheds
City of Mankato Mankato Regional Airport	Middle Minnesota Blue Earth Le Sueur
Mankato Township	Middle Minnesota Blue Earth Le Sueur
City of Eagle Lake	Le Sueur
City of Skyline	Blue Earth Middle Minnesota
South Bend Township	Blue Earth Middle Minnesota
Minnesota State University Mankato	Indian Creek Middle Minnesota



Mankato Area Regional MS4 Stormwater Management Association

An MS4 management association was forming in 2016 for the purpose of meeting the requirements and goals of the NPDES MS4 Permit in an efficient and effective manner with consistent

implementation and regulations across participating agency boundaries. The members of the association include:

- City of Mankato
- Blue Earth County
- Mankato Township
- South Bend Township
- Minnesota State University Mankato
- MNDOT District 7
- Nicollet County

Other public entities which may benefit from collaborative partnerships that may result in improved services or cost savings to the residents of the region are encouraged to participate in the Association as nonvoting members.

The association will be contracting much of the work from the City of Mankato.

MS4 Description and Purpose

A municipal separate storm sewer system (MS4) is a conveyance or system of conveyances (roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, storm drains, etc.) that is also:

- owned or operated by a public entity (which can include cities, townships, counties, highway departments, universities, etc.) having jurisdiction over disposal of sewage, industrial wastes, stormwater, or other wastes
- designed or used for collecting or conveying stormwater;
- which is not a combined sewer; and
- which is not part of a publicly owned treatment works.

The primary goal of the MS4 general permit is to improve water quality by reducing pollutants in stormwater discharges. Specifically, the program aims to ensure proper management of stormwater discharges into waters of the state.

MS4 Regulation

Stormwater discharges associated with MS4s are subject to regulation under the National Pollutant Discharge Elimination System/State Disposal System (NPDES/SDS). Through the MS4 General Permit, the system owner or operator is required to develop a stormwater pollution prevention program (SWPPP) that incorporates best management practices (BMPs) applicable to their MS4. The MS4 general permit is a requirement, but also a tool in the hands of city, township and county officials who want to improve the quality of lakes and rivers that receive their stormwater discharges.

Stormwater Pollution Prevention Plan (SWPPP)

Pollution prevention is a “front-end” method to decrease costs, risks, and environmental concerns. In contrast to managing pollution after it is created, pollution prevention reduces or eliminates pollutants and wastes at its source.

The NPDES/SDS General MS4 Permit requires each regulated MS4 to develop, implement and enforce a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP must be designed and managed to reduce the discharge of pollutants from storm sewer systems to the maximum extent practicable (MEP). As part of the SWPPP, an MS4 must define best management practices (BMPs) appropriate for its community that address the following six Minimum Control Measures (MCM):

MCM 1 - Public Education and Outreach
MCM 2 - Public Participation/Involvement
MCM 3 - Illicit Discharge Detection and Elimination
MCM 4 - Construction Site Stormwater Runoff Control
MCM 5 - Post-construction Stormwater Runoff Control
MCM 6 - Pollution Prevention/Good Housekeeping for Municipal Operations

The MS4 Minimum Control Measures for pollution prevention are many of the same strategies identified in State plans for sediment and nutrient reduction statewide and in local watersheds.

MS4 – SWPPP - Impaired waters and TMDLs

MS4 Permittees with assigned Waste Load Allocations (WLA) as part of a Total Maximum Daily Load (TMDL) project approved by US EPA prior to the effective date of the latest Permit reissuance must address additional information in their Stormwater Pollution Prevention Program (SWPPP). Permittees must develop a compliance schedule that outlines interim milestones it will achieve during the permit term, strategies for continued implementation beyond the permit term, and target dates to achieve the applicable WLAs.

TMDLs

In 2016 there were two TMDLs approved by the US EPA in the MS4 area: Lower MN DO and the GBE Fecal TMDL. The Greater Blue Earth River Fecal Coliform TMDL includes urban stormwater strategies but no WLA or goals for municipal sources.

New TMDLs - New TMDLs are expected during the ten-year planning period.

Sediment – The MPCA Minnesota River Turbidity TMDL Project was drafted and awaiting approval.

The Le Sueur WRAPS does not contain goals for MS4 permittees but does include goals for non-point source city/residential contributions and stormwater.

River Eutrophication - In 2016 MPCA River Eutrophication Standards were proposed. The draft River Eutrophication standards show the lower reaches of the Le Sueur, Blue Earth and the Minnesota River upstream of the Blue Earth River are impaired.

Nitrogen - In 2016 the MPCA nitrogen standards were still in development. The Blue Earth, Le Sueur and Middle Minnesota River watersheds rank in the top four contributing watersheds for nitrogen in the Minnesota River Basin.

MS4 – Nonpoint Source Pollution

Nonpoint sources of nutrients, erosion and sediment within and draining to Mankato Township and South Bend Township MS4 jurisdictions are a concern. Nonpoint sources of pollution are expected to be the major source of pollution in these MS4 jurisdictions since future development is currently restricted by orderly annexation agreements and the Urban Fringe Overlay District.

Stormwater Challenges and Needs

Soils

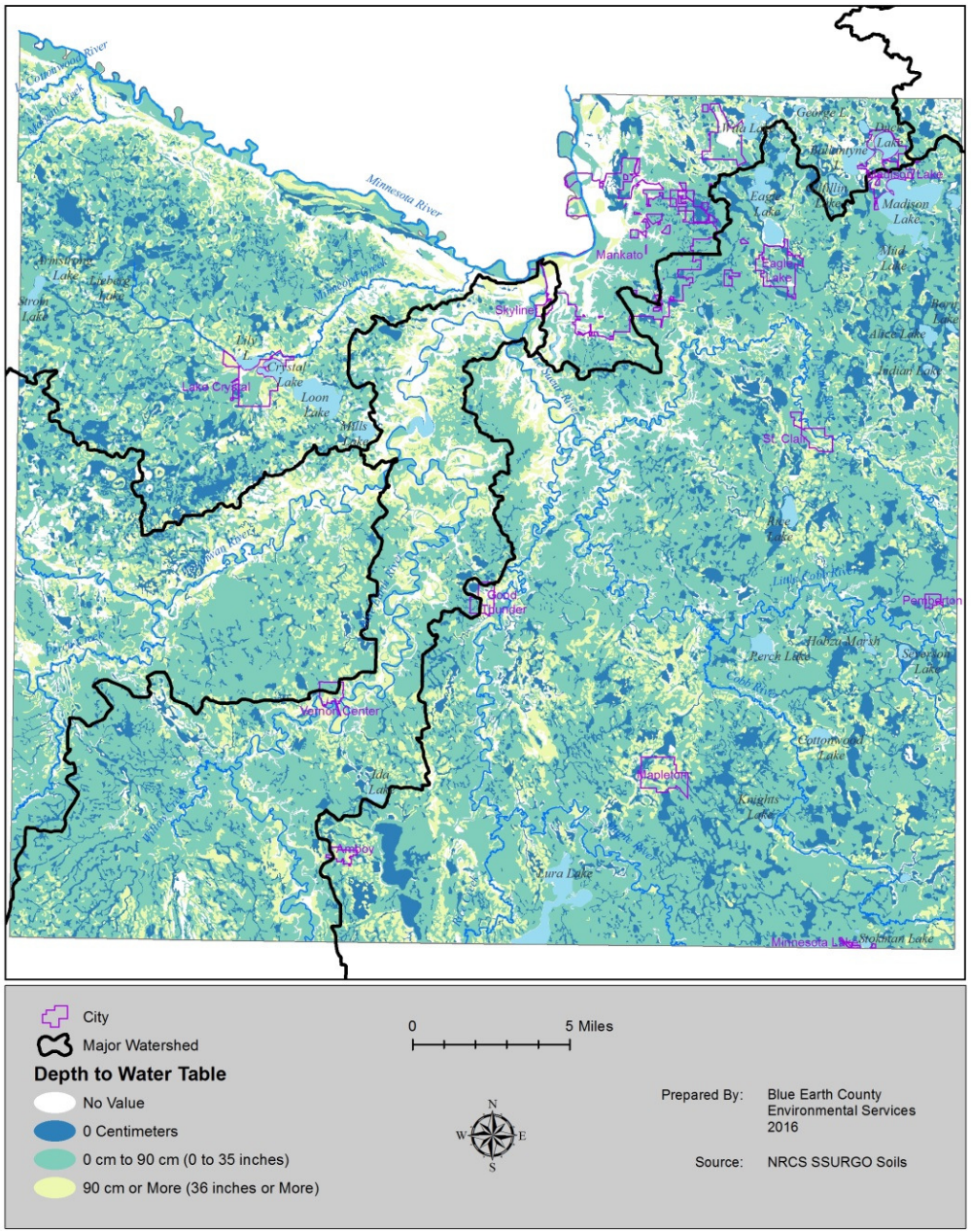
Soil permeability, high water tables, hydrologic soil groups. Most of the soils in developing areas of the county are poorly-drained or very poorly-drained and have a depth to water table less than 36 inches. Hydrologic Group D soils do not absorb as much water and have a high run-off potential, and have a layer of high clay content near the surface or are shallow soils over bedrock or other material which does not absorb water. Limited infiltration presents a challenge for managing stormwater. These soil conditions are poorly suited for stormwater infiltration practices like rain gardens.

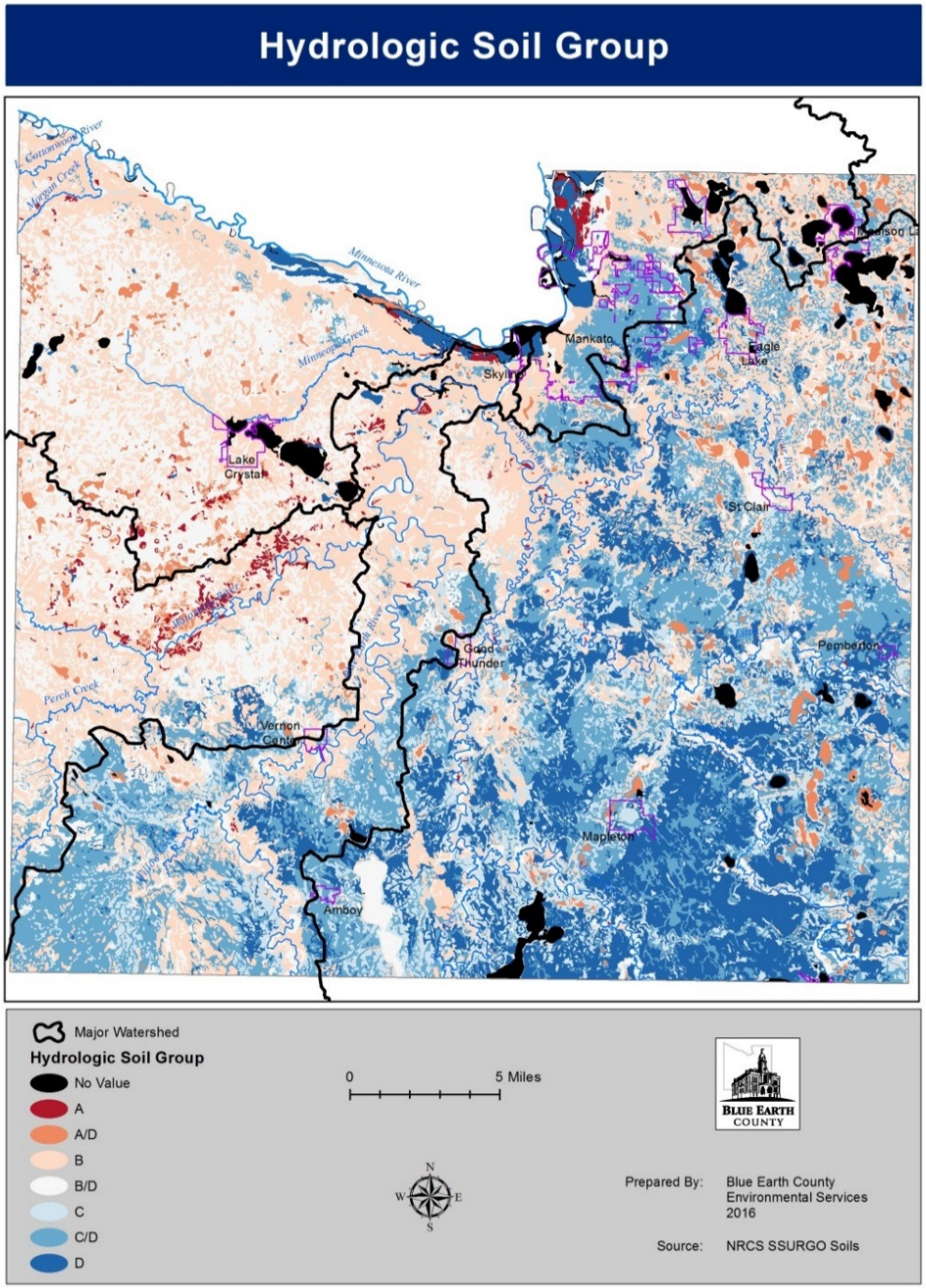
Maps on this page and the following page display depth to water table and hydrologic soil groups in the county, according to the USDA Soil Survey.

Highly Erodible Land

Development near ravines, rivers, streams and some lakes is located on or near highly erodible land or potentially highly erodible land. The USGS *Landslide Overview Map of the Conterminous United States* shows that the river corridors and ravines in the county have a medium susceptibility but low incidence of landslides but are more susceptible to landslides than most parts of the state.

Depth to Water Table





Local Stormwater Management Needs

To effectively address stormwater management for water quality purposes, technical staff, regulations, education and training will be needed. The following is a summary of local stormwater needs.

Construction Sites

Development that disturbs less than one acre is exempt from MPCA NPDES Construction General Permit requirements. There are many sites in the county that do not meet this threshold but where development is occurring in sensitive areas where bare soil or new site grading greatly increase runoff and erosion, especially during the construction phase but may continue post construction.

Compliance with MPCA NPDES Construction General Permit requirements in the county is spotty. The MPCA does not review the SWPPP required for the permit nor does the MPCA typically conduct inspections in this area.

There are ongoing problems at many construction sites outside of the City of Mankato, regardless of whether the owners/contractors have MPCA NPDES permits and a SWPPP. Encroachment on wetlands, shoreland and bluff impact zones are ongoing problems. This concern may be better addressed at the local level with county or township level stormwater ordinances or standards.

Erosion and Sediment Control Training

Construction contractors need training on erosion and sediment control practices as well as regulations. Training programs may vary from formal classroom settings to independent study and testing, to hands-on site work experience.

Training Topics

The following list of regulatory and BMP training topics is from the MPCA Pollution Prevention and the MS4 Program.

- NPDES requirements and the MPCA's permit process

- Permanent and temporary erosion and sediment control BMPs
- Site phasing
- Construction entrances
- Protecting natural vegetation and undisturbed areas
- Low impact development
- Temporary diversions
- Sediment retention basins
- Dewatering
- Perimeter control
- Stockpile protection
- Surface roughening and slope tracking
- Minimize slopes
- Storm drain inlet protection
- Outlet protection
- Temporary and permanent stabilization
- Specific BMPs related to working near or around water

Education

Watershed management techniques rely on stewardship and cooperation of all individuals in watersheds to reduce phosphorus and other pollutants running off or discharging to the lake, rivers, streams and wetlands. Frequently, individuals are unaware that their activities are causing water problems. They may be quite willing to take corrective action if they understand what to do and why.

The Crystal Waters Project has worked to educate and engage citizens with a website, newsletter and community events promoting best practices in the city and shoreland areas. The Crystal Waters Project continues to work reestablishing vegetation in shoreland areas like Robinson Park (Plant the Park) and leaf- raking events in Lake Crystal.

Local units of government also need periodic education about stormwater management. Training and information about shoreland ordinances and stormwater management for elected and local officials from the City of Lake Crystal, City of Madison Lake and Blue Earth County are a priority.

Retrofits

In developed areas of the county, retrofits are needed in some watersheds. While rain gardens and other infiltration practices have limited application in the county due to soil characteristics, there are areas in some lake watersheds where soils are suitable. For example, the Madison Lake Association worked to establish a large rain garden for intercepting and treating a portion of the city's stormwater with a direct discharge to the lake.

Retrofitting can be used to achieve highly effective stormwater management that reduces runoff volume, increases ground water recharge, improves surface water quality and helps mimic pre-development hydrology. Retrofits such as rain gardens and swales are versatile because they can be constructed in small areas and easily integrated into existing residential and commercial sites.

Retrofitting is a way to rehabilitate watersheds that have a significant amount of imperviousness and little stormwater treatment. When properly designed, constructed, and maintained, BMP retrofits can increase the aesthetics of an area by providing green space and/or stormwater educational opportunities. Retrofitting has the potential to protect resources that may be experiencing increased pressure from other areas of the watershed. Stormwater retrofits are generally employed to:

- fix past mistakes and maintenance problems;
- solve chronic flooding problems;
- serve as stormwater demonstration and education opportunities;
- trap trash and floatables;
- reduce runoff volumes to combined sewers;
- restore stream corridors;
- reduce specific pollutants;
- reduce downstream channel erosion;
- support stream restoration efforts; and/or
- recharge shallow ground water.

Retrofit programs can be effectively implemented on both public and private properties. Municipally driven projects can be used as examples to encourage private landowner participation.

The following list of retrofit BMPs are examples categorized based on the likely application of each. Individual project constraints will dictate which BMP is the most appropriate in a given situation. Descriptions of these practices and design recommendations can be found in the Minnesota Stormwater Manual.

- **Intensive land use retrofit BMPs**
  - Cisterns
  - Stormwater tree pits
  - Permeable pavers
  - Underground sand filters
  - Impervious cover conversion
  - Stormwater planter
  - Sub-grade storage/infiltration
- **Residential retrofit BMPs**
  - Pond (new or alteration of existing system)
  - French drains
  - Rain barrels
  - Rain gardens
  - Small and large bioretention
  - Water quality swale
  - Structural sand filter

Retrofit BMP maintenance considerations can be substantial, vary considerably based on the type of practice installed, and are paramount to the short and long term success of the BMP function.

Priority Areas for Retrofits

Stormwater retrofits are a priority for addressing water quality in Madison Lake and Lake Crystal watersheds and developed shorelands of all lakes. Stormwater retrofits for water storage is a priority in most municipalities in the county.

Wetlands

Wetlands provide water storage functions that are important in developing watersheds. Stormwater runoff and sedimentation decreases the wetland storage capacity and impacts wetlands habitat functions. Encroachment on wetlands during and after development is an ongoing problem in the county. Buffers and buffer ordinances are needed to protect wetlands in developed areas to ensure wetlands continue to provide important water storage functions.

Stormwater staff

Trained stormwater or water quality staff is needed to review development applications (i.e. certified professionals in stormwater quality, SWCD staff, professional engineers trained in Minimum Impact Development Standards,).

During the ten year planning period, there may be opportunities to develop coordination with the Mankato Regional Mankato Area Regional MS4 Stormwater Management Association to review development applications outside of the MS4.

Stormwater Management System Maintenance and Inspections

Outside of municipalities most stormwater ponds and retention basins platted in subdivisions are located on private property. Long term maintenance of these basins is problematic as there is little if any maintenance or oversight to ensure the ponds function as designed over time. Common problems are ponds and basins filling with sediment due to lack of maintenance, encroachment on wetlands and stormwater retention sites with structures, or removal of vegetation.

Stormwater Standards and Ordinances

There is need and interest among some jurisdictions in the county to update ordinance requirements to manage the rate and volume of stormwater discharge, channel protection sizing, accounting for all drainage in the watershed where development is proposed, nutrient

reduction in lake watersheds and other management and maintenance needs to address bluff protection.

Often a combination of ordinances and education is needed to positively change land management practices. These ordinances or regulations set minimum standards for land and water protection. Ordinances may include:

- Erosion and sediment control
- Stormwater management
- Open space
- Vegetated buffers
- Shoreland setbacks
- Bluff setbacks
- Limitations on the use of phosphorus in fertilizers

Sample ordinances for Minimum Impact Development (MID), Low Impact Development (LID) and Better Site Design are available to assist local governments in the county update stormwater ordinances.

During the ten-year planning period, there may be opportunities for coordination among small communities to update stormwater regulations. There may also be opportunities for coordination with the Mankato Regional Mankato Area Regional MS4 Stormwater Management Association to adopt or modify ordinances used by the City of Mankato to regulate and control erosion and sediment as listed in the Mankato regional MS4 agreement:

- Erosion and Sediment Control Ordinance
- Grading Manual
- Land Disturbance Permit Application
- Storm Water System
- Nuisance Abatement

Stormwater Management Goals and Strategies

Goal: Ensure community resilience with stormwater management systems that effectively provide flood water and stormwater attenuation to prevent flooding and protect water quality.

Education and Training Strategies

STRATEGY: PUBLIC EDUCATION AND TRAINING.

Action: Support lake associations and the City of Lake Crystal and City of Madison Lake's education efforts to reduce illicit discharge, manage yard waste and lawn chemicals and to restore shoreland vegetation to filter pollutants and provide critical habitat.

MS4 Action: Mankato Area Regional MS4 Stormwater Management Association will conduct annual stormwater meetings, maintain a website, and consider public input.

STRATEGY: CONTRACTOR TRAINING.

Action: Support contractor training in coordination with the Mankato Area Regional MS4 Stormwater Management Association, City of Lake Crystal, City of Madison Lake and other jurisdictions.

Potential Training Topics

Source: Pollution Prevention and the MS4 Program

- NPDES requirements and the MPCA's permit process
- Permanent and temporary erosion and sediment control BMPs.
- Site phasing
- Construction entrances
- Protecting natural vegetation and undisturbed areas
- Low impact development
- Temporary diversions
- Sediment retention basins
- Dewatering
- Perimeter control
- Stockpile protection
- Surface roughening and slope tracking
- Minimize slopes
- Storm drain inlet protection
- Outlet protection
- Temporary and permanent stabilization
- Specific BMPs related to working near or around water

STRATEGY: TRAINING LOCAL OFFICIALS.

Action: The County will partner with local municipalities to conduct periodic training on shoreland and stormwater management for elected and appointed officials and staff.

Priority Jurisdictions: City of Madison Lake, City of Lake Crystal, Blue Earth County.

Action: Interested local officials will participate in the MS4 Mankato Area Regional MS4 Stormwater Management Association meetings.

MS4 Action: The MS4 Mankato Area Regional MS4 Stormwater Management Association will train local staff on illicit discharge.

Land Use Management and Local Controls

STRATEGY: LAND USE PLAN.

Policy: Ensure community resilience with stormwater management programs, better site design and projects that protect communities from flooding, flash flooding and protect water quality.

County Land Use Plan Action: "To minimize negative impacts from storm water runoff, the County will enact development standards for stormwater management to insure no net increase in runoff."

STRATEGY: LAND USE AND STORMWATER POLICIES AND ORDINANCES.
Action: Work with multiple jurisdictions to evaluate existing and potential stormwater ordinances and policies and determine if uniform approaches are desired to develop or administer local stormwater regulations, such as

- Erosion and sediment control – Grading and Construction
- Stormwater management
- LID, MIDS, Green Infrastructure, Better Site Design Ordinances and Standards
- Open space
- Vegetated buffers
- Shoreland setbacks
- Bluff setbacks
- Limitations on the use of phosphorus in fertilizers

Action: Research existing stormwater guidance and regulations in Minnesota.

Action: Prepare and adopt changes to policies and ordinances in participating jurisdictions to help ensure that stormwater and its pollutants do not negatively impact surface waters.

Action: Seek funds for interested local communities and watersheds to develop ordinances and policies for stormwater management.

Action: Develop local funding mechanisms and seek funds to establish technical staff positions and/or services to implement stormwater ordinances and standards.

MS4 Action: To implement the SWPPP in accordance with the regional MS4 agreement, the County will develop additional ordinances and documents necessary to support the MS4 program. The County may also choose to adopt or slightly modify the following Mankato ordinances and programs:

- Erosion and Sediment Control Ordinance
- Grading Manual
- Land Disturbance Permit Application
- Storm Water System
- Nuisance Abatement

Erosion Control Strategies

Large amounts of soil can be eroded from unprotected construction sites, more than 20 tons per acre according to the MPCA website and EPA. Construction site erosion is regulated by the MPCA for disturbances more than one acre or part of the common plan of development. Many construction sites in the county impact less than one acre.

STRATEGY: CONSTRUCTION SITE EROSION.
Action: The County will continue to require site owners/contractors obtain required MPCA construction stormwater permits.

MS4 Action: The MS4s will review sites plans and conduct construction site inspections.

Stormwater Management Approaches

STRATEGY: GREENPRINT - GREEN INFRASTRUCTURE.
Green infrastructure consists of an interconnected network of open spaces and natural areas (such as forested areas, floodplains and wetlands) that improve water quality while providing recreational opportunities, wildlife habitat, and other community benefits. At the site scale, green infrastructure consists of site-specific management practices (such as interconnected natural areas) that are designed to maintain natural hydrologic functions by absorbing and infiltrating precipitation where it falls. Additional information on green infrastructure is available on EPA's Managing Wet Weather with Green Infrastructure website. (Source: EPA)

Action: Seek funds and develop local funding mechanisms to design and implement green infrastructure practices with interconnected wetlands, water storage, vegetated swales and buffers, trails, parks and open space to protect water quality and prevent pollution.

Priority Areas: Indian Creek Watershed, Eagle Lake Watershed, Madison Lake Watershed, Lake Crystal watershed, Greenprint priority corridors and wetland complexes. Other municipalities may be interested during the planning period.

Stormwater Management System Strategies

STRATEGY: EXISTING STORMWATER RETENTION BASINS.

Maintenance of stormwater management systems is critical to their functioning as designed to protect water quality and prevent erosion and flooding. There are many stormwater retention basins on private property in older subdivisions and development in unincorporated areas that have never been inspected.

Action: The County will conduct an inventory and assessment of stormwater retention systems on privately-owned land outside of MS4 jurisdictions and develop means for inspecting these systems.

MS4 Action: Mankato Area Regional MS4 Stormwater Management Association members and other MS4s will inspect structural pollution control devices annually and ponds and outfalls within the permit cycle.

STRATEGY: STORMWATER RETROFITS.

Action: Support stormwater retrofits in areas with residential and urban development where water storage, flow attenuation, flood water storage or nutrient treatment functions are needed for water quality or to prevent flooding or erosion downstream.

Priority Areas and Watersheds: Stormwater retrofits are a priority for addressing water quality in Madison Lake, Duck Lake, Lake Ballantyne and Lake Crystal watersheds and developed shorelands of all lakes in the county. Stormwater retrofits for stormwater retention and floodwater attenuation is a priority in all municipalities in the county.

STRATEGY: CONSTRUCTED WETLANDS AND WATER QUALITY TREATMENT WETLANDS.

Action: Constructed wetlands, stormwater wetlands or water quality treatment wetlands should be considered in watersheds where water storage, flow attenuation, flood water storage or nutrient treatment functions are needed to address water quality concerns or to prevent flooding or erosion downstream.

Priority Areas and Watersheds: Constructed wetlands, stormwater wetlands and water quality treatment wetlands are a priority for addressing water quality in Madison Lake, Duck Lake, Lake Ballantyne and Lake Crystal watersheds. Constructed wetlands, stormwater wetlands and water quality treatment wetlands are a priority for stormwater retention and floodwater attenuation functions Indian Creek watershed, Le Sueur River watershed, Blue Earth River watershed and Middle Minnesota River watershed in Mankato, Eagle Lake, Madison Lake and all municipalities and townships in the county and where there is flooding or downstream erosion due to increased precipitation and loss of water storage in the watershed. (see Flooding and Near Channel Erosion sections of this plan.)

Wastewater Treatment

Wastewater contains bacteria, pathogens, chemicals, nutrients, and solids. Untreated wastewater is a potential threat to public health and can pollute surface and ground water. The bulk of the County population (79 percent in 2014) and commercial and industrial uses are located in one of the 11 municipalities utilizing State-permitted wastewater treatment facilities.

An estimated 5,000 seasonal and year-round dwellings, commercial, industrial, and public land uses utilize subsurface soil treatment systems (SSTS) regulated by State Rules and County ordinance.

Centralized Publicly-Owned Treatment Works

Centralized wastewater treatment refers to a community wastewater treatment plant (WWTP) and unincorporated areas in the county served by the WWTP. Of the 11 municipalities in the County, seven own and operate their own MPCA-permitted, publicly owned treatment works (POTW) and three are partners with the City of Mankato. The remaining wastewater is generated in lower density, decentralized areas.

Blue Earth County Municipalities

Seven municipalities in the county operate wastewater treatment systems. Most of these municipalities are in the LeSueur River watershed. Two municipalities' wastewater treatment systems discharge to County Ditch systems. Mapleton discharges to County Ditch 57 in the Cobb River watershed. Amboy's wastewater treatment system discharges to County Ditch 49 in the Maple River watershed. The Good Thunder and Pemberton wastewater treatment facilities were constructed within the last 20 years and were issued phosphorus permits by the MPCA.

City of Mankato Wastewater Treatment Plant and Regional System

Mankato's wastewater treatment plant, located at 701 Pine Street, serves the cities of Mankato, North Mankato, Eagle Lake, Madison Lake, Skyline, South Bend Township and the Lake Washington Sanitation District. In addition to the City of Madison Lake and the areas of Duck, Ballantyne and Madison Lake that were annexed to the City of Madison Lake, there were 399 parcels in the county located outside of the city limits connected to the Lake Washington sewer district on Lake Washington, Lake George, Lake Ballantyne and Madison Lake.

The wastewater treatment plant (WWTP) has grown from the mid-1950's primary settling tanks to the current tertiary treatment facility that produces water which is generally about 0.4 mg/l Total Phosphorus,<5 mg/l in Total Suspended Solids and <2 mg/l Biochemical Oxygen Demand. Current flows are approximately 7.0 million gallons per day (MGD) with a maximum month capacity of 11.25 MGD.

The City permits and monitors industrial dischargers through the City's delegated pretreatment program. Local industries have spent millions of dollars to reduce pollutants in their effluent resulting in cleaner water and biosolids end products at the wastewater treatment plant.

Summary of Wastewater Treatment Plants in Blue Earth County

Municipality	Size	Watershed
Amboy	Large (0.2 -1 mgd)	Maple River
Good Thunder	Small (0- 0.2 mgd)	Maple River
Lake Crystal	Large (0.2 -1 mgd)	Minneopa Creek
Mapleton	Large (0.2-1 mgd)	Cobb River
Pemberton	Small (0- 0.2 mgd)	Little Cobb
St. Clair	Large (0.2 -1 mgd)	Le Sueur
Vernon Center	Small (0- 0.2 mgd)	Blue Earth River

Source: 2016 Pollution Report to the Legislature, April 2016

Decentralized Wastewater Treatment

Most wastewater in unincorporated areas of the county is treated in subsurface sewage treatment systems (SSTS). Treatment of wastewater in decentralized areas is the responsibility of the individual property owner.

Through local ordinance consistent with State Rules, Blue Earth County regulates SSTS, including some SSTS located within municipalities. All other wastewater treatment systems are regulated and permitted by the MPCA with the exception of additional EPA regulations for Class V wells. Class V wells are subsurface discharge systems or septic systems most often associated with a business but also include systems serving more than twenty persons.

The MDH also regulates and licenses food, beverage and lodging establishments, manufactured home parks, and other public facilities that use decentralized wastewater treatment.

Blue Earth County Program

Blue Earth County's program is administered by the Environmental Services Department and includes permitting, inspections and enforcement. The County's program requirements are prescribed by Minnesota Rules, County Code and administrative policy.

Subsurface Soil Treatment Systems (SSTS)

SSTS are grouped by their status as either in-compliance, "failing to protect ground water," or are considered an "imminent public health threat."

From 2010 through 2015, 282 straight pipes in Blue Earth County were replaced.

Permitting and Inspections

The County has required permits for septic systems for nearly 45 years. Permit records have been maintained since 1972. Since 1972 the County has issued more than 6,000 permits for septic systems and holding tanks. The table to the right displays a numeric summary of the septic system permits issued since 1972 and the table below shows the number of systems for new construction or existing dwellings.

Summary of Septic Systems Installed from 2008 to 2016

Year	Number of Replacement Residential Systems	Number of Residential System for New Construction	Number of Business/ Other System	Total
2008	94	45	4	143
2009	71	35	6	112
2010	83	28	5	116
2011	97	18	14	129
2012	98	37	15	150
2013	112	27	12	151
2014	87	23	7	117
2015	87	27	7	121
2016	75	32	9	116

Blue Earth County Septic System Permit Summary 1972-2016

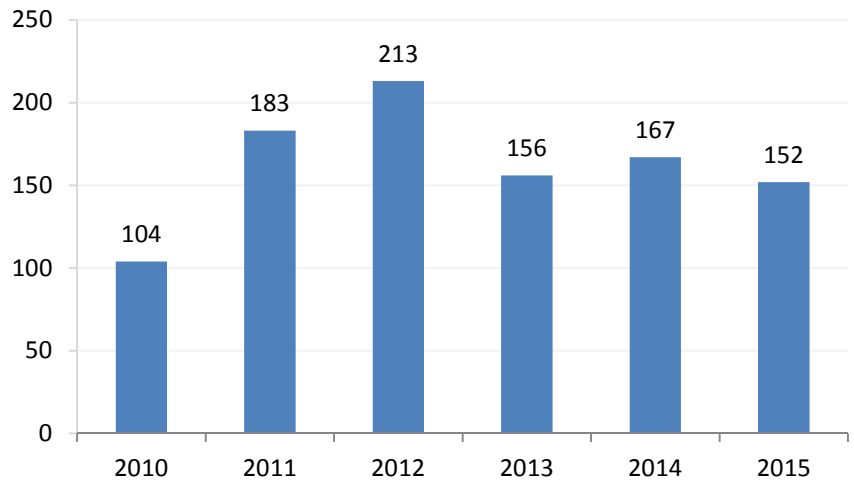
Year	Number of Permit Records	Year	Number of Permit Records
1972	113	1994	252
1973	117	1995	240
1974	138	1996	189
1975	86	1997	187
1976	100	1998	217
1977	172	1999	240
1978	169	2000	211
1979	86	2001	220
1980	66	2002	162
1981	81	2003	157
1982	66	2004	188
1983	71	2005	150
1984	88	2006	161
1985	90	2007	127
1986	102	2008	143
1987	117	2009	112
1988	85	2010	116
1989	92	2011	129
1990	85	2012	150
1991	126	2013	151
1992	176	2014	117
1993	177	2015	121
		2016	116
		Total	6,259

Compliance Inspections

Blue Earth County ordinances require compliance inspections for septic systems at the time of property transfer, with all applications for construction permits in Shoreland Areas, and conditional use permits or variance application. In addition, compliance inspections are required in non-shoreland areas with an application for a construction permit if the septic system is more than 15 years old. Some property owners forgo the compliance inspection and simply install a new system.

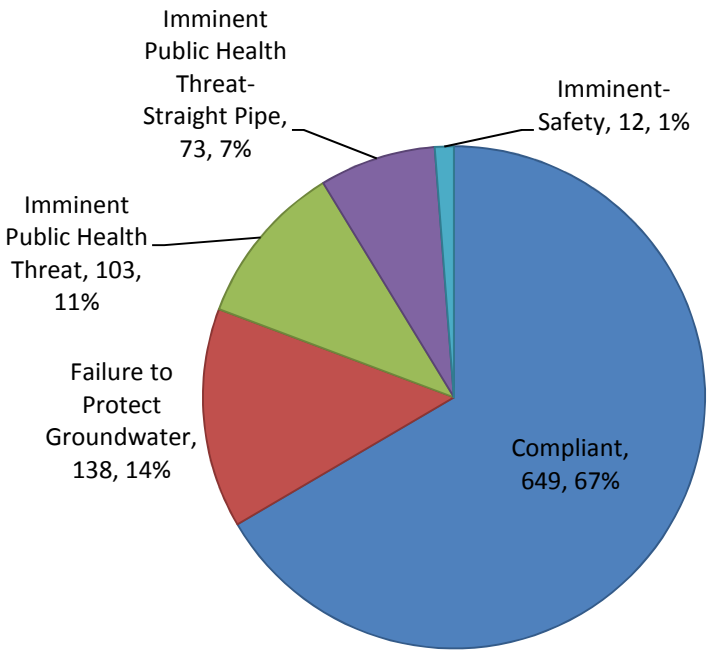
The chart below shows the number of compliance inspections completed from 2010 to 2015 in Blue Earth County. In that time period, there were just over 162 compliance inspections completed on average each year and a total of 975 inspections completed.

Number of Septic System Compliance Inspections Completed from 2010 to 2015



From 2010 to 2015, 67-percent of the systems that were inspected were found to be compliant. Fourteen percent of the systems that were inspected were found to be a failure to protect groundwater systems, and 19-percent of the systems were classified as one of the Imminent Threats to Public Health classifications.

Result of Compliance Inspections from 2010 to 2015



The most common triggers for a compliance inspection in Blue Earth County are property transfers and construction permits. Combined those categories reflect 87.9-percent of all compliance inspections completed in the County. From 2010 to 2015 there were 523 compliance inspections for property transfers and 334 for construction permits. The table below shows the number of compliance inspections by the reason for the compliance inspection.

Summary of "Triggers"/Reasons for a Septic System Compliance Inspection for Inspections from 2010 through 2015

Reason for Compliance	Number Of Compliance Inspection Submitted	Percent
Property Transfer	523	53.6%
Construction Permit	334	34.3%
Complaint	46	4.7%
Not Listed	23	2.4%
Conditional Use	18	1.8%
Variance	15	1.5%
Property Split	5	0.5%
Shoreland Alteration	4	0.4%
Subdivision	3	0.3%
Change in Use	2	0.2%
Rezoning	2	0.2%
Total	975	100.0%

Extension of Municipal Services

In recent years municipal sewer has been extended to serve residential areas that were developed in the 1950's through the 1980's. Municipal sewer was extended to parts of Lime and Mankato Township around the City of Mankato and the extensions of the Lake Washington Sewer District to shoreland areas around Ballantyne, Duck and Madison lakes. Even though the lots now served by the sewer extension were often too small to accommodate replacement septic systems meeting today's standards, the developments are not as dense as many subdivisions in municipalities. Because of the lack of density, extending sewer is costly for home owners and the entity providing the services as well tax dollars used to fund grants and loans for these projects. The cost for individual home owners in recent sewer extensions has been upward of approximately $25,000 per lot.

County Comprehensive Land Use Plan. In 1998 the County Land Use Plan was updated. Addressing wastewater treatment and other issues on lots platted near municipalities and around lakes was addressed in the land use plan because accommodating new and replacement SSTS in these areas was unsustainable due to lot size and suitability for SSTS.

The County's 1998 Comprehensive Land Use Plan guides growth to areas where municipal utilities can be provided. These goals and policies were aimed at protecting water quality and reducing the short- and long-term costs of providing government services and addressing unplanned growth. The applicable County Land Use Plan goals and policies include:

- It is in the best interest of the County to limit the development of uses that may eventually require the extension of urban utilities. The County supports orderly growth out from urban areas with utility services.
- The County will encourage housing to locate in areas that can be serviced by city utilities.
- Adopting an urban fringe overlay district around the cities of Mankato, Eagle Lake and Madison Lake to require that any development in that district be connected to city utilities.

- Promoting annexation agreements between municipalities and townships to encourage development to occur in areas with municipal services.
- Prohibiting residential subdivisions with more than four lots in unincorporated areas of the county unless they are served by city services.

Maintenance

Minnesota Rules and County ordinance requires the owner of the septic system to maintain their septic system at least every three years. The owner must hire a state-licensed maintenance contractor to determine if pumping the septic tank is needed to remove septage (scum, grease and sludge). While pumping septage, the contractor will assess whether the tank leaks. A good maintenance contractor will also check inspection pipes in the drainfield to assess overuse.

The quantity of septage removed from septic tanks each year is not tracked by the county, state or the federal government at this time. If all SSTS owners comply with state rules, an average of 1,500 of the estimated total 5,000 systems in the county will require pumping each year and the average tank capacity is 1,500 gallons. Using these assumptions, about 2,250,000 gallons of septage are pumped in the county each year.

Systems may not receive proper maintenance because owners are either unaware of the need for maintenance, or believe it to be unnecessary or too costly. Improper operation and maintenance will result in premature clogging of the soil's infiltrative surface which may result in system back-up or seepage on the ground surface. Generally improper maintenance does not result in groundwater contamination; improper operation of SSTS (such as the discharge of hazardous waste or other non-treatable wastes into the system) will result in groundwater contamination.

Class V Injection Wells

Class V Injection Wells are regulated by the Federal government. The EPA has inspected many businesses in Blue Earth and other counties to determine if floor drains were present. The EPA ordered business owners to correct violations and the EPA conducted follow up inspections to ensure the violations were resolved.

Dry wells, cesspools, and septic system leach fields are examples of simple Class V wells. Because their construction often provides little or no pretreatment and these fluids are injected directly into or above an underground source of drinking water, proper management is important. A Class V well is used to inject non-hazardous fluids underground. Most Class V wells are "low-tech" and depend on gravity to drain fluids directly below the land surface. (Source: EPA)

Examples of "low-tech" Class V injection wells that typically rely on gravity drainage include:

- **Motor vehicle disposal wells** include **v**ehicle repair home businesses, new and used car dealers, boat yards, auto body shops, farm machinery dealers, where service floor drains or sinks lead to a septic system or otherwise discharged into the ground. Motor vehicle disposal wells are banned. Holding tanks or sanitary sewer systems are required.
- **Carwashes** where wastewater enters a floor drain that leads to a dry well or septic system

The County addresses potential Class V injection wells when issuing land use permits. Holding tanks are required for garage floor drains and floor drains.

Septage Management

Septage carries pathogens and emerging contaminants which are a public health concern. This assessment is a summary of the MPCA

2016 *Septage and Restaurant Grease Trap Waste Management Guidelines*.

Definition of Septage

As defined by the EPA, "domestic septage is either liquid or solid material removed from a septic tank, cesspool, portable toilet, Type III marine sanitation device, or similar treatment works that receives only domestic sewage. Domestic septage does not include liquid or solid material removed from a septic tank, cesspool, or similar treatment works that receives either commercial wastewater or industrial wastewater and does not include grease removed from a grease trap at a restaurant."

Septage Regulations

Septage is regulated by federal laws. Federal requirements for land application provide limited information on how to prevent runoff or contamination of groundwater. As stated in the MPCA *Septage and Restaurant Grease Trap Waste Management Guidelines*, "the federal 503 rule simply states that these things cannot occur." The MPCA does not permit or inspect septage storage or land application.

Septage Management and Storage

Septage is managed in a variety of ways throughout Minnesota. Common methods of management include: 1) transfer of septage to a Publicly Operated Treatment Works (POTWs), 2) direct land application after pumping, and 3) the temporary storage of septage in locally permitted sewage tanks prior to land application at a better time. Temporary storage and land application are used for managing most septage in the county.

All septage must be land applied by a Minnesota licensed SSTS maintenance contractor (Maintainer). Certified Maintainers are required to provide proper training and oversight of work done by noncertified employees (Minn. R. Ch. 7083.0770).

The MPCA guidelines provide Maintainers with detailed information on site suitability, separation distances to features such as surface waters and wells, and detailed site management requirements. These are practices commonly used for land application of other by-products and wastes in Minnesota.

Temporary storage of septage is regulated by Minnesota Rules and local land use controls.

Septage Site Suitability

The Maintainer must determine whether land application sites are suitable. The Maintainers' land application sites are not reviewed or approved by any local, state or federal agency. According to MPCA guidelines, sites are considered suitable if the soil conditions, slope restrictions and separation distances are met.

Septage Land Application

Maintainers are not required to analyze septage before it is land applied. Both state and federal requirements use average septage analysis results to calculate allowable application rates. The MPCA Guidelines contain specific nitrogen management requirements.

Record Keeping

The Maintainer must be keep records of the source of all loads of septage applied to the site.

Wastewater Treatment Goals and Strategies

Centralized Wastewater Treatment Goals and Strategies

Goal: Eliminate discharge of untreated and undertreated wastewater to surface water and groundwater.

ONGOING STRATEGY: MUNICIPAL WASTEWATER TREATMENT.
All municipalities in the county utilize wastewater treatment facilities.

STRATEGY: MAINTAIN WASTEWATER TREATMENT CAPACITY.
Action: Support water reuse projects and water conservation measures to ensure treatment system capacity.

Action: Reduce inflow and infiltration (I&I) in all cities and townships using municipal wastewater treatment facilities.

Action: Reduce pollutants entering wastewater treatment facilities with pre-treatment and waste reduction measures.

Responsible agency: Municipalities and their regional partners.

STRATEGY: PLANNING.
Action: Plan and implement expansions of area served by publicly owned, centralized wastewater treatment where needed to serve existing populations and planned future growth.

Decentralized Wastewater Treatment Goals and Strategies

Goal: Ensure all subsurface sewage treatment systems (SSTS) are in compliance with Blue Earth County Code.

ONGOING STRATEGY: COUNTY SSTS PROGRAM.
Action: The County will maintain qualified staff to administer the local SSTS program.

Action: The County will issue permits, conduct inspections and maintain records for SSTS in Blue Earth County.

Action: The County will maintain and update the County Ordinance consistent with State Statutes and local goals.

ONGOING STRATEGY: SSTS COMPLIANCE.
Action: Update and analyze all available data to reasonably estimate the number of imminent public health threats and determine a baseline to evaluate future results related to this goal.

Action: The County will continue to enforce compliance triggers in the Blue Earth County Code that require compliance inspections at 1) property transfer, and 2) in conjunction with all land use permits, including construction permits, conditional use permits and variances.

Action: The County will continue to ensure the availability of low interest loans for replacement SSTS construction for existing, occupied dwellings.

Action: Prioritize SSTS upgrades for systems in areas with high groundwater pollution sensitivity.

STRATEGY: SSTS MAINTENANCE.

Maintaining SSTS every three years ensures longevity of the system reducing long term costs.

Action: The County will evaluate compliance with SSTS maintenance requirements and will work with SSTS maintainers (pumpers) to identify and address education, disposal and other needs related to septic system maintenance issues.

Land Use Management Strategies

STRATEGY: LAND USE PERMITS.

Action: Coordinate review of land use permits in the county to ensure compliance inspections are conducted and replacement systems are constructed when required.

STRATEGY: CLASS V INJECTION WELLS.

A Class V well is used to inject non-hazardous fluids underground. Dry wells, cesspools, and septic system leach fields are examples of simple Class V wells. Because their construction often provides little or no pretreatment and these fluids are injected directly into or above groundwater sources of drinking water, proper management is important. (Source: EPA) Class V injection wells are not a concern in municipalities where all wastewater is collected and conveyed to a wastewater treatment plant.

Action: Blue Earth County, Lime Township and Mankato Township, and other jurisdictions with planning and zoning authority in areas where there is no centralized wastewater treatment will minimize the potential for Class V injection wells during the construction permit process by reviewing building plans and requiring holding tanks for floor drains and other practices to ensure a Class V injection wells are not constructed. This is especially important in areas with moderate and high pollution sensitivity.

Examples of "low-tech" Class V injection wells that typically rely on gravity drainage include:

- **Motor vehicle disposal wells** include **v**ehicle repair home businesses, new and used car dealers, boat yards, auto body shops, farm machinery dealers, where service floor drains or sinks lead to a septic system or otherwise discharged into the ground. Motor vehicle disposal wells are banned. Holding tanks or sanitary sewer systems are required.
- **Carwashes** where wastewater enters a floor drain that leads to a dry well or septic system

Action: Jurisdictions in areas with moderate and high pollution sensitivity will eliminate Class V injection wells for stormwater management.

STRATEGY: LAND USE PLANS.

Policy: Support long term, sustainable wastewater treatment to protect groundwater and surface water from contamination from sewage and hazardous substances.

Policy: Continue to support orderly annexation agreements and coordinated sewer extension projects.

Policy: Continue County Land Use Plan policies that encourage growth in municipalities or areas with city sewer to ensure that wastewater treatment needs for the future are met and to help reduce long-term costs associated with growth to the taxpayers.

Septage Management Goals and Strategies

Goal: Manage septage to reduce potential contamination of surface and groundwater resources.

Septage management is regulated by federal laws. The MPCA published *Septage and Restaurant Grease Trap Waste Management Guidelines* in 2016 for state-licensed SSTS maintainers (pumpers). Most septage is land applied in the county. The MPCA does not permit or inspect sites used for septage land application.

STRATEGY: MANAGE LAND APPLICATION.

Action: The County will evaluate SSTS maintainers' septage management systems, including disposal, storage and land application and will work with SSTS pumpers, contractors, municipalities and other representatives to assess needs related to septage management in the county.

Action: The County will display on its website maps of areas in the county with moderate and high groundwater pollution sensitivity as shown in *Blue Earth County Geologic Atlas, Part B.*

Aquatic Invasive Species

Definition

Aquatic invasive species (AIS) are non-native plants, animals, or pathogens that live primarily in water and thrive in their new environment, often out-competing native species. Non-native species are a concern when they:

1. Cause or may cause economic or environmental harm or harm to human health.
2. Threaten or may threaten natural resources or the use of natural resources in the state.

List of Aquatic Invasive Species

The MNDNR maintains the list of water bodies with aquatic invasive species. In Minnesota there are many aquatic invasive plants and animals. Well known AIS include: zebra mussels, curly-leaf pondweed, Eurasian watermilfoil, and carp. Some AIS are omitted from the list, presumably because some, like common carp, curly-leaf pondweed (*Potamogeton crispus)* and reed canary grass, are long-established and virtually ubiquitous in many parts of the state. Common carp, curly-leaf pondweed and reed canary grass are widespread and abundant in Blue Earth County and have substantial environmental and human impacts.

On December 31, 2016, the following lakes are listed on the MNDNR List of Infested Waters:

- Ballantyne Lake - Eurasian watermilfoil
- Eagle Lake (North and South) - Eurasian watermilfoil
- Lura Lake - Eurasian watermilfoil
- Madison Lake - Eurasian watermilfoil

Water Quality

For both carp and curly-leaf pondweed, abundance is to some degree a function of poor water quality. In the longer term, water-quality improvement will be the most effective means of reducing impacts. Fish Lake in neighboring Le Sueur County is a good local example of this concept: both carp and curly-leaf pondweed are present in Fish Lake but neither AIS seems to achieve nuisance abundance in the setting of clear water, stable habitat, diverse aquatic macrophytes and a diverse native fish community.

Blue Earth County Role

Prior to 2014 and establishment of Aquatic Invasive Species Prevention Aid (Minnestoa Statutes 2017, section 477A.19), counties had no aquatic invasive species management responsibilities. The County's new role is limited to preventing the spread of aquatic invasive species by establishing local guidelines for use of Aquatic Invasive Species Prevention Aid and using the funds in accordance with those guidelines.

AIS Prevention Aid is granted to counties in Minnesota based on the number of boat trailer launches and parking spaces. The following table shows the boat trailer launches and parking spaces at each water body with public access in the county.

Water Body Name	Number of Trailer Launches	Total Number of Trailer Parking Spaces	Percent of Total Trailer Parking Spaces
Madison Lake	3	75	26.00%
Lura Lake	4	53	18.40%
Loon Lake	1	23	8.00%
Duck Lake	1	20	6.90%
George Lake	1	16	5.60%
Watonwan River	3	14	4.90%
Ballantyne Lake	1	10	3.50%
Blue Earth River	1	10	3.50%
Crystal Lake	1	10	3.50%
Eagle Lake	1	10	3.50%
Mills Lake	1	10	3.50%
Minnesota River	1	10	3.50%
Rice Lake	1	8	2.80%
Wita Lake	1	7	2.40%
Ida Lake	1	6	2.10%
Indian Lake	1	6	2.10%
Total	**23**	**288**	**100%**

Source: MNDNR 2014

Blue Earth County AIS Guidelines

Blue Earth County's AIS Prevention Aid Guidelines contains the following general implementation strategies:

1) Assess the county's resources and risk of AIS introduction
2) Increase public awareness and participation in prevention
3) Increase county enforcement resources
4) Increase available resources and leverage partnerships
5) Manage existing populations of aquatic invasive species
6) Address specific pathways of introduction
7) Broaden knowledge of and participation in early detection and rapid response activities

Participants in this plan will actively seek to prevent the introduction of new invasive species in Blue Earth County and throughout Minnesota.

Manage existing populations of aquatic invasive species

Common Carp

Common carp were systematically introduced to waters of the United States in the late 19th century by means of a large stocking program. This fish can have an enormous impact on the recreational value of surface waters under certain conditions by reducing water clarity, competing with fish species of higher recreational value and the abundance of phytoplankton. It typically achieves nuisance abundance in shallow lakes following winter kill. Carp do not tolerate low oxygen concentrations but they are powerful colonizers of vacant environments and the females are very fecund, often carrying several million eggs. Lakes like Lura, which have a history of winter kill, have supported enormous populations of carp from time to time.

Fish barriers are constructed on most recreational lakes in the county to prevent carp colonization in hydrologically connected wetlands.

Management of this species in Blue Earth County and elsewhere has consisted of isolating infested lakes with fish barriers to prevent re-entry; followed by eradication of carp using fish toxicants and re-stocking of a replacement fish community of higher recreational value. These "lake reclamation" initiatives often result in spectacular, if sometimes temporary, gains in water clarity, angler use and aquatic macrophytes. Longevity of benefits varies, depending on the effectiveness of isolation and other factors. Lura Lake, Ida and Mills have been reclaimed this way.

Lake reclamation is costly and lake drawdowns require take years of planning and organizing support and commitment of the lakeshore land owners. There is some interest in a lake reclamation project for Crystal Lake in the Minneopa Creek watershed. A successful Crystal Lake reclamation would require treatment of all lakes in the Minneopa Creek watershed upstream of the natural fish barrier at Minneopa Falls. Lakes included would be Crystal, Loon, Mills, Lily, Strom, Armstrong, and Lieberg. In 2014, the MNDNR rough estimate of costs to be more than $500,000. This cost alone is likely a limiting factor for the key local partners, the Crystal Waters Project, Crystal-Loon Recreation Association, and City of Lake Crystal.

Curly-leaf pondweed

Curly-leaf pondweed was inadvertently introduced to Minnesota waters as a by-product of the 19th century carp stocking program. Its presence in the state may have been first documented in a St Paul hatchery pond. It seems to have spread across southern Minnesota lakes in the second half of the 20th century and it is now essentially ubiquitous in the county and much of southern Minnesota. The MNDNR no longer includes curly-leaf pondweed on its lists of aquatic invasive species. This plant differs from other local macrophytes (lake vegetation) in that it begins growing in the fall, forms dense stands by the following spring and then senesces by approximately the end of June. It is generally considered to be a huge nuisance by lakeshore homeowners, partly because of the large stands that interfere with boating and partly because of the masses of heavy, wet plant material that wash up on windward shores following senescence. These can require laborious removal during the peak season for recreational lake use.

Eurasian Water Milfoil

Eurasian watermilfoil was accidentally introduced to North America from Europe. It spread westward into inland lakes primarily by boats and also by waterbirds between the 1950s and 1980s.

Removing native vegetation creates perfect habitat for invading Eurasian watermilfoil. Eurasian watermilfoil has difficulty becoming established in lakes with well-established populations of native plants. In some lakes the plant appears to coexist with native flora and has little impact on fish and other aquatic animals.

In nutrient-rich lakes it can form thick underwater stands of tangled stems and vast mats of vegetation at the water's surface. In shallow areas the plant can interfere with water recreation such as boating, fishing, and swimming. The plant's floating canopy can also crowd out important native water plants. A key factor in the plant's success is its ability to reproduce through stem fragmentation and runners. A single segment of stem and leaves can take root and form a new colony. Fragments clinging to boats and trailers can spread the plant from lake to lake. The mechanical clearing of aquatic plants for beaches, docks, and landings creates thousands of new stem fragments.

Likely means of spread: Milfoil may become entangled in boat propellers, or may attach to keels and rudders of sailboat. Stems can become lodged among any watercraft apparatus or sports equipment that moves through the water, especially boat trailers.

Source: MNDNR, 2016

Herbicides

Lake associations have expressed serious concerns about the nuisance aspect of curly-leaf pondweed and Eurasian water milfoil. The Duck Lake Preservation Association has an extensive annual herbicide application program aimed at reducing the abundance of curly-leaf pondweed. Many years ago Duck Lake also established healthy aquatic vegetation in shallow areas along the shore. The Madison Lake Association has an herbicide application program aimed at Eurasian water milfoil. The Lake Ballantyne Association is considering herbicide application for Eurasian water milfoil.

These herbicide applications have been funded by the lake associations or have received MNDNR grants for this purpose. Herbicide application should be viewed as temporary relief rather than prevention, although some lake associations believe that they are achieving a longer term reduction in curly-leaf pondweed abundance by cutting off turion (winter bud) deposition.

Pathways

There are many pathways of introduction and spread of aquatic invasive species. Most species introductions are the result of people's actions. Invasive species are often unknowingly carried in or on animals, vehicles, ships, commercial goods, water. Some introductions, such as common carp, were intentional and caused unexpected harm. But many other introductions are unintentional.

Two primary pathways for introduction of AIS are human-facilitated (transported with watercraft and associated hardware) and active and passive movement of AIS via surface water connections.

Surface Water Connections

Blue Earth County has many miles of streams which drain surface waters to the Minnesota River. Connectivity has been increased substantially over the years by the construction of drainage ditches and most surface water features now have some sort of surface connection to downstream waters.

Surface water connections are potential pathways for both large animals capable of actively moving upstream (common carp, bighead carp, silver carp) and for a larger number of AIS that can be passively transported between connected waters as eggs, larvae, seeds or plant fragments. Potential drift of Eurasian Water Milfoil fragments from upstream infested waters (Ballantyne) to downstream non-infested waters (Washington) seems possible, for example.

An array of dams, gradient control structures, outlet structures and fish barriers exists in the county and waters immediately downstream. Some are natural features (Minneopa Falls) but most have been installed for a variety of purposes that include lake level control (Madison Lake outlet), power generation (Rapidan Dam) or gradient control. Some of these structures are multipurpose and include features intended to prevent the upstream movement of fish (Lura Lake). A few were installed solely for the purpose of preventing upstream fish movement (Shanaska Creek barrier at Kasota, installed in the 1950s to prevent carp from migrating upstream into Emily, Washington, George, Ballantyne and Duck Lakes).

Bighead carp were found in the Minnesota River in 2016. Movement into the Blue Earth and Le Sueur is likely. In 2017 the MNDNR plans to install an electric fish barrier in a surface water connection between the Le Sueur River and Madison Lake.

Human-facilitated movement of AIS

Some AIS are clearly more likely than others to transport in the complex architecture of a recreational boat trailer and then to colonize a new surface water. In Blue Earth County and adjacent counties, Eurasian Water Milfoil seems particularly likely to spread by this method. This plant can grow from small fragments, making it particularly suitable for transport from lake to lake on boat trailers and fishing gear.

Level of Risk

The MNDNR *Aquatic Invasive Species (AIS) Watercraft Inspection Handbook* describes the risk of watercraft and personal equipment.

Personal Equipment

Personal equipment such as waders, fishing gear, and decoys can be vectors for transport mussels, and other AIS, such as New Zealand mudsnails, faucet snails, spiny water fleas, and Eurasian water milfoil. Personal equipment should be cleaned and dried, especially if leaving an infested body of water.

Types of Watercraft

Marina boats and other boats moored in the water are the highest risk, especially commercially hauled boats because they likely have

Risk of transporting mussels and other AIS

Types of Water-Related Equipment	Risk Level
• Moored boats, boat lifts, docks, weed rollers	High Risk—possible adult mussels attached
• Ski and wakeboard boats with ballast tanks • Sailboats with ballast tanks • Fishing boats with livewells	Medium to High Risk—veligers or water fleas in water, plants, and plants with zebra mussels or other aquatic animals on trailers
• Smaller open boats with outboard motors (no livewells, no ballast tanks) • Personal watercraft (PWC, Jet Skis)	Medium Risk—adults and veligers unlikely, plants with animal species attached may be on trailers
• Hand-launched craft: canoes, kayaks, belly boats, inflatables	Low Risk—if dirty from being moored may be risky

Source: MNDNR Aquatic Invasive Species (AIS) Watercraft Inspection Handbook 2014

adult mussels attached. Hand-launch craft like kayaks or canoes have very low biological risk.

Situations that pose higher risk include: boats leaving infested waters that were moored, watercraft coming in from another state, boats which show a lot of dirt or algae growth below a clear waterline, or boats which have water on board.

Minnesota Aquatic Invasive Species Regulations

Transportation Regulations

- Under state law, it is unlawful to:
  - transport aquatic plants
  - transport zebra mussels and other prohibited species of animals
  - place or attempt to place into waters of the state a boat, seaplane, or trailer that has aquatic plants, zebra mussels, or other prohibited invasive species attached

Regulations on Transport of Water

- A person leaving waters of the state must drain all water from water-related equipment, including bait containers, live wells, and bilges, by removing the drain plug before transporting the watercraft and equipment from the water access or riparian property.
- Drain plugs, bailers, valves, or other devices used to control the draining of water from ballast tanks, bilges, and live wells must be removed or opened while transporting watercraft and water-related equipment.

Source: MNDNR 2016

Aquatic Invasive Species Goals and Strategies

Goal: Help prevent the spread of aquatic invasive species throughout the region and Minnesota.

STRATEGY: AIS PREVENTION AID GUIDELINES.

Action: Prepare AIS Prevention Aid Guidelines as required by Minnesota Statutes 2017, section 477A.19.

Action: The County will work with lake associations, conservation organizations, the MNDNR and other local partners to prepare and implement AIS Prevention Aid Guidelines for the county.

STRATEGY: HERBICIDES FOR MANAGEMENT OF INVASIVE VEGETATION.

While herbicides treatment does not prevent the spread of invasive plants, it can be used to manage an infestation of invasive plants.

Action: Support herbicide treatment of infested waters when funds are available and allowed by the County's AIS Prevention Aid Guidelines, and only to the extent permitted and recommended by the MNDNR fisheries and AIS program staff.

STRATEGY: LAKE RECLAMATION.

Action: Support lake reclamation projects initiated and fully supported by lake associations and lake shore residents.

Lake reclamation projects are costly and can be controversial. The Crystal Waters Project explored the possibility of a lake reclamation with MNDNR Fisheries in 2015. The MNDNR estimated the reclamation cost in 2015 would be $520,000. The reclamation would include Crystal, Loon, Mills, Lily, Armstrong, Strom and Lieberg lakes where it is possible for common carp to migrate between these lakes.

Wetland Protection, Enhancement and Restoration

Wetland Functions and Local Public Value

Wetland functions are science based natural processes that occur in wetlands. The value of a wetland is an estimate of the importance or worth of one or more of its functions to society and individuals. Wetlands are considered valuable because they use and filter nutrients, recharge water supplies, retain water, reduce flooding, and provide fish and wildlife habitat. Wetlands also provide recreational opportunities and aesthetic benefits.

Local Public Values

Minnesota Statutes 2017, section 103B.3355 requires local public values of wetlands be determined based on the functions of wetlands.

The wetland functions most important in local watersheds were determined with consideration of watershed and ecological goals, an assessment of existing wetlands functions and citizen and technical stakeholders' input. Citizen surveys to determine important wetland functions and aquatic resources were conducted just prior to developing this plan.

Loss of wetlands, wildlife habitat, water quality and groundwater quality are priority management concerns. Protecting and restoring these functions are the highest priority for achieving watershed and ecological goals in local watersheds. The ability of wetlands to provide multiple benefits has the greatest local public value.

Most Important Wetland Functions

The following wetland functions were determined to be most important in local watersheds and have the greatest local public value:

- **Wildlife Habitat**, including terrestrial and aquatic habitat and connectivity of those habitats
- **Public Recreation,** including hunting and fishing areas, wildlife viewing areas, and nature areas
- **Water Storage**, including floodwater and stormwater attenuation and the potential for downstream flooding and downstream erosion in the watershed
- **Water Quality**, including utilization of nutrients that would otherwise pollute public waters, filtering of pollutants to surface and groundwater and shoreline protection
- **Groundwater Protection**, including utilization of the wetland for groundwater protection or as a recharge area for groundwater and low flow augmentation of streams and rivers
- **Rare Plant and Animal Habitat,** as mapped in the MNDNR Minnesota County Biological Survey
- **Ability to Provide Multiple Benefits,** including wildlife habitat, water storage, water quality, groundwater protection, rare plant and animal habitat and public recreation functions

All wetlands provide important functions, but not all wetlands provide all functions equally well.

Source: United States Geological Survey

Less Important Wetland Functions

The wetland functions determined to be less important in local watersheds reflect a realistic view of existing wetland conditions and functions, watershed and ecological needs and use of wetlands in the county. The least important wetland functions include the following:

- **Native Plant Habitats**
- **Commercial uses,** including wild rice and cranberry growing and harvesting and aquaculture

The commercial use function is less important because there are no wetlands providing wild rice or cranberry growing in the county at this time. However, wetlands in the county and in much of the state were historically used for growing and harvesting reed canary grass seed.

The USDA 1978 *Soil Survey of Blue Earth County,* description of Muskego muck soils states "Several of the larger bogs in the northeastern part of the county are used for growing reed canary grass seed." This was not uncommon in southern Minnesota. According to the MNDNR, reed canary grass has been planted throughout the U.S. since the 1800s for forage and erosion control. While many Minnesota state agencies have recently removed reed canary grass from their planting lists, it is still being planted in the state.

Reed canary grass seed likely remain in large wetlands, and the seed is easily transported in watersheds. Invasive species like reed canary grass and invasive cattails flourish in the nutrient rich conditions in watersheds where the county is located.

Wetlands and Ecological Conditions

Blue Earth County is located in two of the three major biomes that meet in Minnesota: the Tallgrass Prairie and the Eastern Deciduous Forest commonly called the Big Woods. The vegetation types that defined these biomes were distributed on the landscape according to climate, soil and landform patterns. The county is located in a vegetation ecotone known as the forest/prairie border. As described in the USDA 1978 *Soil Survey of Blue Earth County*, "The County extends along a northern margin of an extensive zone of ecological tension between prairie and forest regions. Throughout the centuries this margin advanced and retreated as shifts in the climate pattern affected temperature, relative humidity, wind velocity and precipitation."

Historic Wetlands

Soil characteristics and historic maps are the best available indicators of the extent of pre-settlement wetlands in the County.

Hydric Soils

One of the criteria used to delineate wetlands is the presence or absence of hydric soil. The USDA Soil Survey shows 34.9 percent of the land in the county is hydric soil and another 20.9 percent is predominately hydric.

The presence of wetlands leaves signatures in the soil for centuries and these soils should be capable of wetland restoration. As described in the USDA NRCS Soil Survey:

> "…hydric soils formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Soils in which the hydrology has been artificially modified are hydric if the soil, in an unaltered state, was hydric. Hydric soils that have been converted to other uses should be capable of being restored to wetlands."

Native Vegetation

The USDA 1978 *Soil Survey of Blue Earth County* describes native vegetation and its importance in soil formation**:**

> "Before this county was settled, the native vegetation was most important in the complex of living organisms that affect the formation of soils. Two types of vegetation, forest and prairie, have strongly influenced the formation of soils. The survey area is along the northern margin of a large area covered partly by prairie and partly by forest. Throughout the centuries this margin advanced and retreated as shifts in the climate pattern affected temperature, relative humidity, wind velocity and precipitation."

The map of native vegetation in the USDA 1978 *Soil Survey of Blue Earth County* shows more extensive areas of Big Woods and oak openings along the rivers in the county compared to the *Map of Natural Vegetation at the Time of the Public Land Survey 1847-1907.*

Historic maps

The Original Public Land Survey, completed in Minnesota between 1847 and 1907, shows lakes, rivers, waterfalls and smaller wetlands surveyors observed along the one mile section lines being surveyed. Subsequent historic maps, including an 1877 map of the county, and the 1908 Soil Survey show the location of many large shallow lakes and wetlands in the county that were later drained.

Woodlands and Forests

The *Map of Natural Vegetation at the Time of the Public Land Survey 1847-1907* shows river bottom forest and Big Woods hardwoods extended along the lower, incised reaches of the major rivers in the county and their tributaries, including the Blue Earth, Le Sueur, Maple, Cobb, Watonwan and Perch Creek, as well as the Minnesota River and the lowest reaches of the Little Cottonwood, Morgan Creek, and

Minneopa Creek. Oak openings and barrens and aspen-oak land were also along parts of the Watonwan, Blue Earth, Maple, Cobb, Little Cobb, Bull Run Creek, Le Sueur and the Minnesota River near Mankato.

In the greater Blue Earth River watershed, the pre-settlement, forested and wooded areas were almost entirely along the rivers in Blue Earth County and north of the Le Sueur River in the Big Woods. The remainder of land in these watersheds was tall grass prairie except near some of the lakes.

Today most of the wooded areas in the county and in the major watersheds are along the rivers in the incised reaches, ravines and floodplains.

Prairie and Wet Prairie

The *Map of Natural Vegetation at the Time of the Public Land Survey 1847-1907* shows significant wet prairies in every watershed in the county, including watersheds in the historic Big Woods.

The largest expanse of wet prairie in the county extended from just north of the Watonwan River from the county line to near the mouth of the Watonwan River and north into part of the Lake Crystal watershed. The soils in this area are largely hydric, with coarse texture and a shallow depth to water table.

Lakes

In addition to the lakes that exist today, the 1908 Soil Survey map shows several large lakes in the county that no longer exist.

Wetland Losses

Wetland resources in all local watersheds have changed significantly since pre-settlement. Conversion of the pre-settlement landscape to cities, towns, roads, farmsteads and agricultural uses required wetland drainage and removing native vegetation from the tall grass prairie and woodlands. More than 90% of wetlands in the county have been drained.

Many large shallow lakes and wetlands in the county were drained in the early 1900's. Historic Jackson Lake (1,627 acres) near Amboy in the Le Sueur watershed and Solberg Lake (620 acres) and Dakins Lake (200 acres) in Butternut Valley Township in the Middle Minnesota watershed are examples of large wetlands and shallow lakes that were drained in the early 1900's.

Wetlands of all sizes were easily drained for agriculture with subsurface tile and ditches. The USDA 1978 *Soil Survey of Blue Earth County* states "About 54 percent of the county is wet and requires artificial drainage for crop production."

The U.S. Fish and Wildlife Service and Ducks Unlimited produced a restorable depressional wetlands inventory for many counties in the Prairie Pothole region of Minnesota including Blue Earth County. This inventory includes over 32,787 (71,218 acres) potentially restorable wetlands in the county. The potentially restorable wetlands in this inventory range in size from under .1-acres to over 900 acres.

Reaches of some streams and rivers were channelized, and in some cases berms or levees were constructed with pumping systems to prevent flooding of adjacent farmland. Riverine and floodplain wetlands were eliminated along with wildlife habitat and important wetland functions for flood and stormwater attenuation, nutrient assimilation and wildlife habitat. The rivers and streams with the most channelized areas in the county are in the Cobb, Little Cobb and Maple in the Le Sueur watershed and small streams in the Blue Earth and Watonwan watershed.

The Army Corps of Engineers Flood Control Project that protects Mankato, North Mankato and South Bend Township from Minnesota River and Blue Earth River flooding eliminated wetlands between the river and the floodplain.

The Rapidan dam on the Blue Earth River created a reservoir that flooded riparian and floodplain wetlands.

Water control structures and dams maintain lake levels on all recreational lakes in the county. This affects wetlands and limits the growth of wetland vegetation in aquatic zones and riparian areas as water levels are maintained at consistently higher levels.

Filling wetlands in the near shore areas of lakes for residential and urban development and beaches is a common practice. Wetlands near lakes are also being developed for second- or third-tier development.

Permanent loss and impacts from urban and residential development is the greatest threat to existing wetlands at this time.

Existing Wetlands

The best available information about existing wetlands is the National Wetland Inventory (NWI).

National Wetlands Inventory (NWI)

The National Wetlands Inventory (NWI) maps and data for Blue Earth County were updated in 2015 by the MNDNR. The NWI wetland boundaries should not be used to delineate wetland boundaries.

The NWI does not show all wetlands in the county nor does it show the regulatory boundaries of wetlands. Many wetlands in cultivated fields and some smaller wetlands were excluded from the NWI. Wetlands in wooded areas are either excluded or the regulatory boundaries of the NWI wetlands in wooded areas are much larger or smaller than shown in the NWI.

Description

The National Wetlands Inventory (NWI) was established by the U.S. Fish and Wildlife Service (FWS) in 1974 to conduct a nationwide inventory of U.S. wetlands. The FWS's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources to aid in conservation efforts. The NWI relies on trained image analysts to identify and classify wetlands and deepwater habitats from aerial imagery.

National Wetlands Inventory Data Limitations, Exclusions and Precautions

The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

Exclusions - Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. By policy, the U.S. Fish and Wildlife Service also excludes certain types of "farmed wetlands" as may be defined by the Food Security Act or that do not coincide with the FWS definitions or classification.

Precautions - Persons intending to engage in activities involving modifications within or adjacent to suspected wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

Wetland Conditions

Degraded wetlands

Existing wetlands have been negatively impacted by human factors such as hydrologic alterations, nutrient loading, accelerated sedimentation, loss or manipulation of upland vegetation and invasive species. Degraded wetlands are common in both agricultural and developed landscapes in all watersheds in the county.

Sedimentation and Nutrient Loading

Army Corps of Engineers *A Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Wetland Functions of Prairie Potholes (HGM):*

> "Accelerated sedimentation may be the most detrimental impact on wetlands. Accumulation of sediment in wetlands decreases wetland volume, decreases the duration wetlands retain water, and changes plant community structure by burial of seed banks."

> "Excessive nutrient loading to a wetland can cause nuisance algal blooms and the production of monotypic stands of invasive or weed species. Observed point source or nonpoint source of nutrients may include but is not limited to: fertilized lawns, agricultural runoff, manure storage or spreading, concentrated stormwater runoff, or pet waste inputs."

Invasive Vegetation

The MnRAM wetland vegetation diversity/integrity of wetlands in local watersheds is generally low to moderate or the FQA Biological Condition Gradient Tier is fair or poor, based on the functional assessments of sample wetlands conducted to support this plan. These findings were consistent with the MPCA *Status and trends of wetlands in Minnesota: Depressional Wetland Quality Assessment (2007-2012)* report findings for wetlands in the temperate prairie region.

The USDA 1978 *Soil Survey of Blue Earth County,* description of Muskego muck soils in "Several of the larger bogs in the northeastern part of the county are used for growing reed canary grass seed." This was not uncommon in southern Minnesota. According to the MNDNR, reed canary grass has been planted throughout the U.S. since the 1800s for forage and erosion control. While many Minnesota state agencies have removed reed canary grass from their planting lists, it is still being planted in the state.

Reed canary grass seed likely remain in large wetlands, and the seed is easily transported in watersheds. Invasive species like reed canary grass and invasive cattails flourish in the nutrient rich conditions in the county and common in southern Minnesota.

Developed Land Uses

The quality of wetlands in urban settings is generally low or medium. The surrounding landscape of nearly continuous areas of impervious surfaces, stormwater collection systems and shallow-rooted turf grass unavoidably result in degraded wetlands. Land modification is extensive. Soil protection is usually accomplished with hard surfacing and terracing. Vegetative cover is largely manicured turf-grass with shallow root systems. Buffering between wetlands and adjacent upland uses is typically low. The water management philosophy tends to emphasize conveyance, rate control, and flood prevention. Water management tends to focus on storm water by using curb, gutter, and sewer systems augmented by ponds. Altered local hydrology sometimes negatively impacts wetlands by increasing or decreasing natural surface and subsurface drainage to the wetland.

Agricultural Land Uses

Wetlands located in cultivated fields and on agricultural land provide minimal wetland functions due to drainage, filling, sedimentation and excessive nutrient loading. During floods, drained wetlands provide some flood or stormwater retention functions for a short time.

A significant extent of land in the county is drained by ditches and subsurface drainage tile that drain directly to ravines, rivers, lakes and wetlands.

Priority Areas and Replacement Sites

More than 90% of the pre-settlement wetlands in the county have been lost due to draining and filling activities undertaken to increase the economic productivity of the land, so there is an abundance of wetland restoration opportunities.

All wetlands provide important functions for people and wildlife while human values and priorities drive policy and management decisions. Restoration of the pre-settlement landscape or protecting all wetlands is not desirable or consistent with local comprehensive plans. At the same time there is interest in protecting, enhancing and restoring wetlands in the county to provide wildlife habitat and water quality functions in a way that serves multiple interests.

High Priority Areas

The purpose of identifying and prioritizing wetlands and potential wetland restoration or replacement sites is to link high priority areas and watershed goals with voluntary conservation projects and wetland management and mitigation to the benefit of both.

Science-based, locally-defined criteria were developed to determine priority areas and potential replacement sites in the Greenprint and the *Blue Earth County Water Management Plan* through a collaborative effort of local governments and representatives of the U.S. Fish and Wildlife Service, MNDNR, SWCD, MPCA, BWSR, engineering consultants and citizens.

Priority areas and potential replacement sites (potentially restorable basins) were aligned with the ability to provide natural resource and wetland functions important in local watersheds and with the greatest local public value, including the following:

- **Wildlife Habitat,** including terrestrial and aquatic habitat and connectivity of habitat
- **Public Recreation**, including hunting and fishing areas, wildlife viewing areas, and natural areas
- **Water Storage,** including floodwater and stormwater retention and the potential for downstream flooding and erosion in the watershed
- **Water Quality**, including utilization of nutrients that would otherwise pollute public waters, filtering of pollutants to surface and groundwater and shoreline protection
- **Groundwater Protection,** including utilization of the wetland for groundwater protection or as a recharge area for groundwater and low flow augmentation of streams and rivers
- **Rare Plant and Animal Habitat,** as shown in the MNDNR County Biological Survey
- **Ability to Provide Multiple Benefits,** including wildlife habitat, water storage, water quality, groundwater protection, rare plant and animal habitat and public recreation functions

These important wetland functions were grouped and/or divided into four priorities, including 1) the ability to provide multiple benefits, 2) water storage, 3) water quality and 4) groundwater protection.

Priority Areas and Replacement Sites for Multiple Benefits

The highest priority areas are interconnected ecological corridors and wetland complexes in the Greenprint. These priority areas contain important wildlife habitats and aquatic resources and provide multiple wetland functions important in local watersheds.

Protecting and restoring wetlands and avoiding impacts to wetlands in priority areas is important for sustaining water quality and wildlife habitat functions in local watersheds. Impacts to and loss of wetlands in the Greenprint priority areas can result in critical loss or fragmentation of habitat or changes in hydrology that reduce the ability of the wetland and potentially the entire wetland complex or corridor to provide the desired functions important in their watershed.

Making the Greenprint

A land use planning approach was used to identify Greenprint priority areas based on ability to provide multiple benefits important in local watersheds. An analysis of landscape position, proximity and connectivity of important features was used to identify Greenprint priority areas in river corridors, wetland complexes, and shorelands. Features analyzed were land cover, vegetation, floodplains, rivers, streams, lakes, wetlands, rare plant and animal habitat, sensitive geology, recreation and protected or publicly-owned lands.

The Greenprint contains diverse landscapes, hydrologic conditions, natural buffers, and all wetland types present in southern Minnesota. Wetland restoration or replacement in Greenprint priority areas will likely be more ecologically sustainable as these areas provide connectivity of aquatic resources and upland habitat, and most are more likely to be protected from future disturbance from the surrounding land uses.

The Greenprint contains wetlands that would have critical wetland resource designations if using the BWSR Minnesota Rapid Assessment Method (MnRAM). The MnRAM Version 3.4 states that wetlands should be evaluated for designation as critical resources based on several features defined in Minnesota Statutes. These critical wetland resources should be classified into the “Preserve” management class due to their special functions. Criteria for designating wetlands as critical resources are as follows:

1. Outstanding Resource Value Waters
2. Designated Scientific and Natural Areas
3. Wetlands with known occurrences of Threatened or Endangered Species
4. State Wildlife Management Areas
5. State Aquatic Management Areas
6. Wellhead Protection Areas
7. Sensitive Ground Water Areas
8. Designated trout streams or trout lakes
9. Calcareous fens
10. High priority areas for wetland preservation, enhancement, restoration and establishment
11. Designated Historic or Archaeological Sites

More information and criteria used for the Greenprint are in the Priority Areas for Protection and Restoration section of this plan.

Priority Areas and Replacement Sites for Groundwater Quality and Recharge

Groundwater protection and recharge are a high priority in the county and affect groundwater aquifers beyond county or watershed boundaries. In most of the county soil infiltration and groundwater recharge of deeper aquifers is limited.

Areas with shallow depth to bedrock, karst and potential for groundwater recharge were identified using the *Geologic Atlas of Blue Earth County, Part B*. A map of areas with shallow depth to bedrock is in the General Background section of this plan. Most, but not all, of these areas are in Greenprint priority areas.

In most of the county soil infiltration and groundwater recharge of deeper aquifers is limited. The 2016 *Geologic Atlas of Blue Earth*

County, Part B, includes an analysis of pollution sensitivity and an evaluation of the recharge rate of surface water into deeper aquifers.

Maps of rapid or focused recharge for specific aquifers are show in in Figures 25 through 32 on pages 42 to 47 of the *Geologic Atlas of Blue Earth County, Part B.*

A map showing a compilation of the highest rates of recharge for each of the aquifers in the *Geologic Atlas of Blue Earth County, Part B* is in the Priority Areas for Protection and Restoration section of the *Blue Earth County Water Management Plan.* It includes the High and Very High classes in which the vertical travel time for water to enter a buried sand aquifer is less than a year. Many private water wells in the county are in buried sands aquifers.

Priority Replacement Sites

Potentially restorable basins were identified and prioritized based on ability to provide 1) water storage or 2) water quality functions. Shallow basins that support vegetation are needed for water quality treatment to utilize nutrients. Greater storage volume and potentially deeper basins are needed for water storage.

Replacing degraded wetlands in the Greenprint and priority areas identified in the *Blue Earth County Water Management Plan* is certain to provide a gain in wetland function and public value, especially in areas where impact avoidance will continue to maintain a degraded wetland or result in further degradation of the wetland from altered hydrology, invasive species, fertilized lawns, concentrated stormwater runoff, trash, or pet waste inputs.

Some of the potentially restorable basins identified in this plan will not be suitable for wetland restoration but might be suitable for constructed stormwater wetlands or conservation practices to provide water quality or water storage functions important in local watersheds. Ultimately, site conditions and landowner goals will determine how or if potential sites might be used for conservation projects.

Strategic Sites for Water Storage - Flood and Stormwater Attenuation

Each potentially restorable basin (landscape depression) was analyzed for the ability to store surface water runoff from its catchment area. Potential sites were prioritized based on three water storage criteria: 1) ability to hold a 10-year, 24-hour storm event (4.37 inches), 2) which sites hold the largest volume of water, and 3) sites that have the smallest footprint while storing the most water.

More information about water storage priority areas and maps of potentially restorable basins that best provide water storage functions are in the Priority Areas for Protection and Restoration section of this plan.

Strategic Sites for Water Quality – Assimilation of Nutrients

Wetland vegetation needed for removing nutrients survives best in wetlands less than three feet deep. Each potentially restorable basin was analyzed to determine which basins were three feet or fewer deep. The ratio of the wetland to its contributing watershed was also analyzed.

A map of potential priority sites for nutrient assimilation is in the Priority Areas for Protection and Restoration section of this plan.

Sites for Stormwater Wetlands - Attenuation and Water Quality Treatment Functions

Natural wetland restoration is preferred county-wide and is generally preferred by the Wetland Conservation Act (Minnesota Rules part 8420.0522 subpart 5A).

Wetlands in Urban Watersheds

"Urban development trends generally are detrimental to wetlands. Many wetlands are lost in the process and those that remain are degraded by the high intensity of uses in the urbanized surrounding areas. For example, the almost continuous concrete, asphalt, and rooftops that harden the landscape result in increased levels of stormwater runoff.

Attempts to restore urban watersheds include *softening* the watershed by restoring important resources in locations where their functions will add green structure (i.e., slow down the flow of stormwater and contribute in other ways to the overall improvement of the watershed).

In most situations, wetland restoration projects are planned to provide the highest level of ecological condition possible. Included in this planning tenet is the assumption that the wetlands will also perform their functions at the highest levels possible. Restorations in highly urbanized portions of watersheds can make this standard difficult or impossible to achieve.

The wetlands needed in some parts of urban watersheds end up being planned and implemented to perform functions such as flow attenuation, water quality improvement, and floodwater retention at the expense of overall wetland quality. These working wetlands, because of the constant stress they experience, may be mostly or completely comprised of an invasive species plant community and have poor water quality, high rates of sedimentation, and other indications of degradation. However, their role is not to be pristine examples of wetlands; instead, their mission is to perform their designed functions in a way that maximizes the overall good for the watershed. While these wetlands may not be "pretty to look at," some would consider them "true beauties" when the overall benefits they provide for the watershed are considered."

Source: *Incorporating Wetlands Into Watershed Plans,* EPA Region 5 Wetlands Supplement

In some watersheds, constructed wetlands or water quality treatment wetlands may best provide wetland functions to achieve watershed goals for improving water quality or flood and stormwater attenuation functions. The WCA design and monitoring requirements for water quality treatment system wetland creations would apply to these sites if constructed.

Priority areas and watersheds for constructed wetlands and water quality treatment wetlands are in the Priority Areas for Protection and Restoration and the Stormwater Management sections of this plan.

Wetland Replacement Sites

There are more than 3,000 potentially-restorable basins in the county that are two acres or larger, and of those more than 1,400 are greater than five acres.

In Greenprint priority areas there are more than 1,300 potentially restorable basins, and of those 624 are five acres or larger with a median area of 9.6 acres. In addition to 3,000 potentially-restorable basins two acres and larger, there are thousands of opportunities to restore smaller basins or enhance and restore existing wetlands.

More information about potentially restorable wetlands and priority areas is in the Priority Areas for Protection and Restoration section of this plan. The following tables summarize the availability of potentially restorable wetlands in each major watershed.

Potentially Restorable Wetlands over 2-Acres Summarized By Watershed

Watershed	Number	Total Area in Acres	Median Area in Acres	Basin Owned by One Property Owner	
				Number	Percent
Blue Earth	541	4,739	3.99	289	53.4%
Le Sueur	1,311	11,034	4.10	668	51.0%
Minnesota River-Mankato	975	12,139	4.89	514	52.7%
Watonwan	446	3,677	3.99	284	63.7%
Cannon	12	48	4.09	5	41.7%
Total	**3,285**	**31,638**	**4.28**	**1,760**	**53.6%**

Wetland Functions Classification Framework

A classification system and prioritization framework was developed to predetermine wetland functions and the local public value of wetlands in the county. Predetermining and classifying wetland functions and values establishes expectations for wetland protection in the county.

This function based classification system can be used by the WCA local government unit (LGU) and technical evaluation panel (TEP) to evaluate the public value and associated functions of wetlands when considering applications and making decisions regarding wetland impact sequencing (impact minimization, avoidance and replacement) and the adequacy of proposed wetland replacement.

The four functional classes in the classification framework are based on an analysis of landscape position, proximity and connectivity to important natural resources, environmentally sensitive areas, wildlife habitat, recreation and the ability to provide important wetland functions for water quality and wildlife habitat in local watersheds.

The following factors were considered to classify wetland functions:

- Proximity to Greenprint corridors and wetland complexes or planned or existing contiguous open space. This is based on an analysis of landscape position and ability to provide important wetland functions and the greatest local public value. (Blue Earth County Greenprint map)
- Whether the wetland is identified in a formally-adopted municipal stormwater management plan
- Connection to Protected Lakes or Protected Wetlands
- Whether the wetland is in an area with shallow depth to bedrock or karst area mapped in the *Geologic Atlas of Blue Earth County Part B* and as shown in the *Blue Earth County Water Management Plan*
- Whether the wetland is in a well head or source water protection plan area

The highest priority areas for wetland preservation, protection, enhancement and restoration are interconnected, continuous and stepping-stone corridors in the Greenprint. These priority areas contain important wildlife habitats and aquatic resources where wetland impacts can result in critical loss or fragmentation of habitat or changes in water storage and hydrology that reduce the ability of the entire wetland complex or corridor to provide the desired functions in the watershed.

Some wetlands in the Greenprint may not have high or exceptional functional ratings for all functions, but high or exceptional functional ratings are not required for a wetland to be a high priority for protection as the location, distribution, proximity and connectivity was considered at the landscape scale in local watersheds.

Wetland restoration or enhancement projects and replacement of degraded wetlands in the Greenprint priority areas are more likely to provide sustainable ecological functions and important wetland functions with local public value.

Potential replacement sites that may provide water quality functions such as water storage and nutrient assimilation functions important in local watersheds are also identified in this plan.

The Wetland Functions Classification Framework and the criteria used to assign each of the four wetland functions classes are described on the following pages.

Maps of NWI wetlands that were assigned wetland functions classifications using the framework are on the following pages. The Wetland Management Classification maps in this plan shows only wetlands in the National Wetland Inventory (NWI). Wetlands not mapped for the NWI may be assigned a wetland function classification by local government units administering the WCA.

Functional Class 1 (Preserve) and Class 2 (Protect) wetlands

These wetlands are important anchors and connections in the Greenprint priority corridors and wetland complexes. Wetlands in the Greenprint were predetermined to provide water quality, wildlife habitat, water storage, groundwater quality or public recreation functions important in local watersheds. Preserving and protecting these wetlands is important for achieving the immediate and long term resource needs and watershed and ecological goals in local watersheds.

Functional Class 1 (Preserve) wetlands have important habitat, hydrologic, vegetation/floral characteristics, or are extremely difficult or impossible to replace through wetland creation or restoration. These wetlands and the functions they provide should be preserved.

Functional Class 2 (Protect) wetlands provide or enhance connections for habitat diversity within open green spaces and form connectivity between habitats and open green spaces. Their functions and values are difficult or impossible to replace once lost. These wetlands, in addition to their value in river corridors, lake watersheds, wetland complexes and open green spaces, can contribute important water quality functions. These wetlands and the functions they provide should be protected to the greatest extent possible.

Functional Class 3 (Manage) wetlands

These wetlands may be degraded by surrounding land uses and are generally isolated in cultivated agricultural landscapes. These wetlands may provide some wetland functions for wildlife habitat, water quality or water storage depending on proximity to Greenprint corridors and wetland complexes, water storage capability in its catchment area, and vegetation. Potential for degradation of wetland quality and functions by development and/or expected future development could result in further degradation of these wetlands.

Wetland Function Class 4 (General Use) wetlands

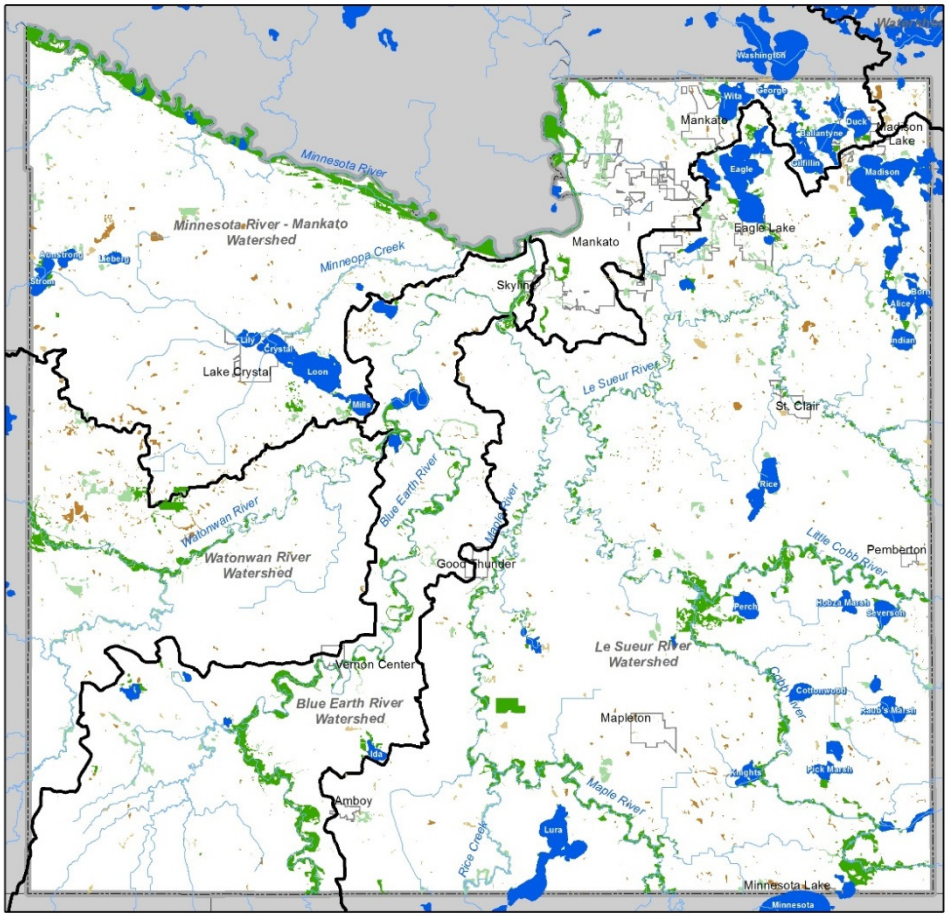
These wetlands are known to be degraded. They are cultivated in agricultural fields and provide minimal functions due to drainage, diversion of the contributing watershed, filling, pollutant runoff, and manipulation of vegetation or adjacent upland. Most of these wetlands are typically Type 1 wetlands defined by the Fish and Wildlife Service Circular 39, and many are not included in the NWI. Replacing or restoring degraded wetlands in priority areas identified in this plan is certain to provide a gain in wetland function and public value, especially in areas where impact avoidance will continue to maintain a degraded wetland or result in further degradation of the wetland from altered hydrology, invasive species, fertilized lawns, concentrated stormwater runoff, litter, or pet waste inputs.

Wetland Functions Classification Framework

Function Class & Description		Criteria
1	"Preserve" wetlands are valuable for protection of important native species or wildlife habitat; OR they are important to provide multiple important wetland functions in Greenprint priority wetland complexes and corridors.	A wetland is classified as Class 1 "Preserve" if **any** of the following apply: • Is within a Greenprint priority corridor or wetland complex • Mapped Moderate, High, or Outstanding importance for native vegetation in biological diversity by the Minnesota Department of Natural Resources Minnesota County Biological Survey (MCBS). • Is a calcareous fen • Is in a designated FEMA floodplain • Is a Protected Lake or Wetland • Is in a Wildlife Management Area, Waterfowl Production Area, or government-owned conservation area • Is a riparian wetland of a Protected Lake or Protected Wetland • Is identified in a local wellhead protection plan or source water protection plan
2	"Protect" wetlands are important in Greenprint wetland complexes or corridors, interconnected park and open spaces, or are important for water storage or water quality protection.	A wetland is classified as Class 2 "Protect" if **any** of the following apply: • Is within or provides connections to Greenprint priority wetlands complexes or corridors • Is located in an area with shallow depth to bedrock or karst, as shown in the Geologic Atlas for Blue Earth County, Part B maps • Provides connection to existing or planned, interconnected park and open green spaces • Is adjacent to or has a hydrologic connection to a Public Water Lake or Public Water Wetland • Is identified in a municipal stormwater plan showing wetlands for water quality
3	"Manage" wetlands may be important for water storage, water quality protection, or interconnected green space but have moderate or low ecological value due to surrounding land uses.	A wetland is classified as Class 3 "Manage" if **all** of the following apply: • Is neither within nor provides connectivity to Greenprint priority wetland complexes or corridors or other planned parks or interconnected open green space • Is not in a local municipality or county engineered and adopted stormwater management plan • Is not in a cultivated field or agricultural land
4	"General" wetlands have been significantly altered and degraded through past disturbances. Most of these are Type 1 wetlands in cultivated fields.	A wetland is classified as "General Use" Class 4 if **all** of the following apply: • Is not within or does not provide connectivity to priority wetland complexes, Greenprint Corridors or other interconnected open green space • Is not in a local municipality or county stormwater management plan • Is in a cultivated field or agricultural land

Agricultural land is land used principally for horticulture, the cultivation or production of row crops, pasture or hay land crops; or farm animals; and public and private drainage systems and field roads located on any of these lands.

Wetland Management Classification



Wetland Management Class

- Class 1
- Class 2
- Class 3
- Class 4

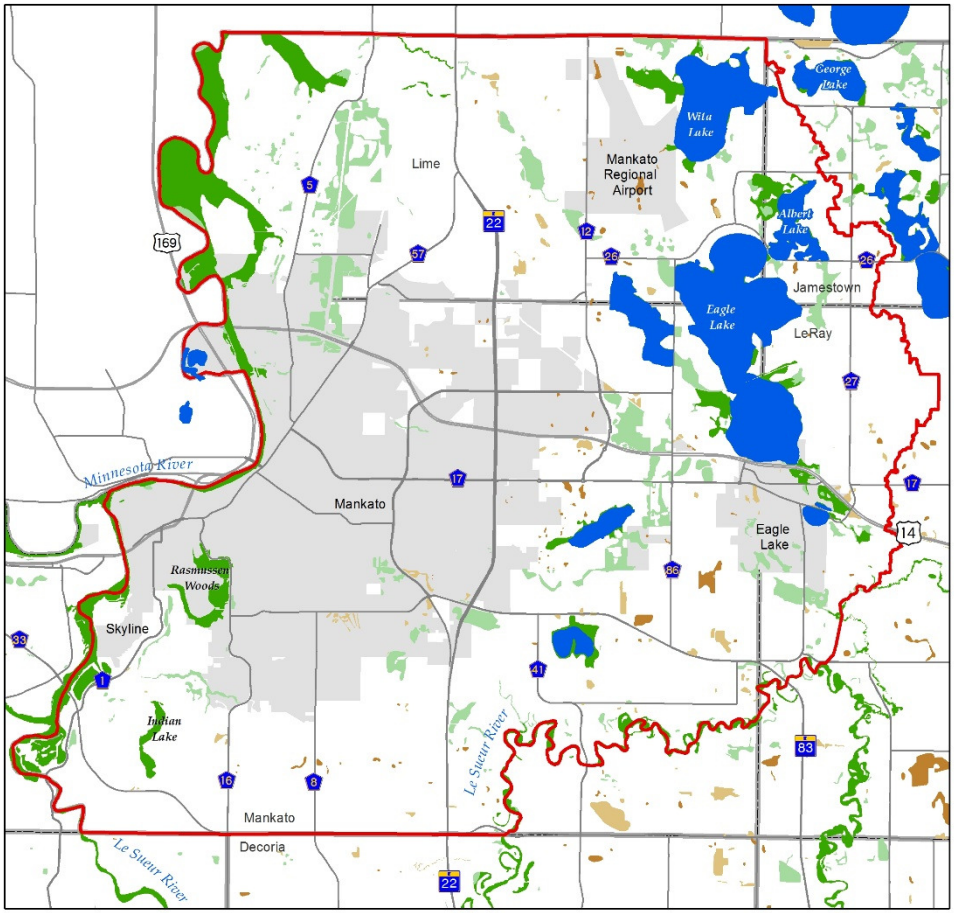
- Major Watershed
- Public Water Basin

0 — 5 Miles

Prepared By: Blue Earth County 2016

The National Wetlands Inventory (NWI) is the base layer for the classification. The boundaries of NWI are different than actual wetland delineations and are shown for planning purposes only.

North Central Planning Area - Wetland Management Classification



0 — 1 — 2 — 3 — 4 Miles

Wetland Management Class

- Class 1
- Class 2
- Class 3
- Class 4

- North Central Planning Area
- Public Water Basin
- City
- Township

Prepared By: Blue Earth County 2016

Regulations and Regulatory Agencies

Specific regulation of activities that may impact individual wetlands are based on wetland boundary delineations and evaluation of proposed activities as required by the Minnesota Wetland Conservation Act, and Federal Laws administered by the United States Army Corps of Engineers and the Minnesota Pollution Control Agency.

Federal

Army Corps of Engineers
Under the Federal Clean Water Act (CWA), the Corps has been delegated authority to issue permits for dredge or fill impacts to waters of the U.S. The Corps CWA Section 404 jurisdiction includes waters that are either navigable or that have a "significant nexus" to navigable water or waters of the United States.

While delineations determine if an area is a wetland, the Jurisdictional Determination (JD) is made by the Corps to determine whether an area is subject to Corps jurisdiction. Case by case evaluations are sometimes required to determine if there is a "significant nexus" to navigable waters. JDs can be requested early or as part of the permit application.

Minnesota Pollution Control Agency (MPCA)
Water quality certification authority under the Clean Water Act Section 401 is delegated by the Federal government to the MPCA. A 401 water quality certification or waiver is required for every Corps permit; however, for general permits and letters of permission, a 401 certification or waiver has been completed in advance. For individual permits, the MPCA conducts an individual review.

State of Minnesota

Wetland Conservation Act
The purpose of the Wetland Conservation Act, Minnesota Rules, part 8420.0100, is to:

1. achieve no net loss in the quantity, quality, and biological diversity of Minnesota's existing wetlands;
2. increase the quantity, quality, and biological diversity of Minnesota's wetlands by restoring or enhancing diminished of drained wetlands;
3. avoid direct or indirect impacts from activities that destroy or diminish the quantity, quality, and biological diversity or wetlands; and
4. replace wetland values where avoidance to activity is not feasible or prudent.

Implementation of Wetland Conservation Act (WCA) is the responsibility of both State and local government units (LGU).

Minnesota Board of Water and Soil Resources (BWSR)
In conjunction with Local Government Units (LGUs), BWSR administers the Minnesota Wetland Conservation Act (WCA), which regulates all wetlands except those that are deemed Public Waters (Wetland Conservation Act of 1991, Laws of Minnesota 1991, Chapter 354, as amended and Minnesota Rules, part 8420)). WCA approval does not preclude the need for a Corps permit.

The Board of Water and Soil Resources (BWSR) promulgates administrative rules for the program, provides training to local government units (LGUs), participates on technical evaluations panels (TEP), hears appeals from local government determinations, and assures proper implementation by LGUs.

Blue Earth County and the City of Mankato
In conjunction with BWSR, the WCA LGUs administer the WCA. The WCA LGU is responsible for making the initial regulatory determinations for the WCA program. There are three WCA local government units in the county that administer WCA: Blue Earth County Environmental Services and Public Works, and the City of Mankato. Blue Earth County and the City of Mankato each has a Technical Evaluation Panel (TEP).

The County's administration of the WCA is partially funded with the BWSR Natural Resources Block Grant (NRBG), County funds and the County's wetland determination fees paid by the land owner/developer. The SWCD's participation in WCA administration is partially funded through an annual transfer of NRBG WCA funds to the SWCD from the County. The minimum amount of the transfer of the NRBG to the SWCD is determined by the BWSR.

Minnesota Department of Natural Resources (MNDNR)
The MNDNR is the WCA LGU for MNDNR managed property of the State of Minnesota. The MNDNR has jurisdiction for Public Waters and Public Waters Wetlands, defined by Minnesota Statutes 2017, section 103G.005 and as shown on the Public Waters Map. Some Public Waters may also be under Army Corps of Engineers jurisdiction. The MNDNR administers a Public Waters Work Permit Program that covers an inventoried subset of lakes, rivers and larger wetlands within the state (Minnesota Statutes 2017, section 103G). MNDNR permits may be necessary if the project affects inventoried waters. The MNDNR permit would be in addition to a Corps permit.

Road Projects
The Minnesota Department of Transportation (MnDOT) is the WCA LGU with jurisdiction for State road projects. Blue Earth County Public Works is the WCA LGU for road projects in the county. MnDOT and local road project planning typically involves consultation and coordination with local governments and a public engagement process.

The WCA allows qualifying township, city, or county road impacts to be mitigated via the BWSR road replacement bank. These banks should be used when available.

All road authorities developing road projects should consider the *Blue Earth County Water Management Plan* priority areas for protection and restoration and wetlands sections during environmental review and project development phases of road projects as well as establishing mitigation sites and wetland banks in priority areas.

Wetland Conservation Act Implementation

WCA rules require the local government unit (LGU) and technical evaluation panel (TEP) to evaluate the public value and associated functions of wetlands when considering applications and making decisions regarding wetland impact sequencing (impact minimization, avoidance and replacement) and the adequacy of proposed wetland replacement.

The *Blue Earth County Water Management Plan* has identified priority areas for wetland and natural resource protection, enhancement and restoration and a function-based classification system and prioritization framework for evaluating the function and public value of wetlands. This framework will be used to assess the function and value of wetlands when evaluating the eligibility and assessing sequencing and sequencing flexibility applications and when evaluating the ecological suitability and sustainability of replacement sites.

WCA Sequencing Requirements
The Wetland Conservation Act (WCA), Minnesota Rules, part 8420.0520 sequencing requirements are, in priority order, to:

1) avoid direct or indirect impacts,

2) minimize impacts,
3) rectify impacts,
4) reduce or eliminate impacts, and
5) replace unavoidable impacts.

Reference Minnesota Rules, part 8420.0520 Subp. 3C (3) (f) and Minnesota Rules, part 8420.0520 Subp. 4E.

Wetland Replacement Standards

The Wetland Conservation Act (WCA), Minnesota Rules, part 8420.0522 and part 8420.0528 requires wetland replacement projects to replace the public value of wetlands lost as a result of an impact. The public value is based on wetland functions. The preferred method of restoration takes advantage of naturally occurring hydrogeomorphic conditions with minimal landscape alteration is most likely to result in a wetland that functions wholly, perpetually and naturally. Wetland restoration is generally preferred over creation. Restoration sites must be ecologically suitable for the landscape and sustainable.

Replacement Sites

Science-based, locally-defined criteria were developed to determine priority areas and potential replacement sites in the Greenprint and the *Blue Earth County Water Management Plan* through a collaborative effort of local government staff and representatives of the U.S. Fish and Wildlife Service, MNDNR, SWCD, MPCA, BWSR, engineering consultants and citizens.

Wetlands impacts replaced in the Greenprint and *Blue Earth County Water Management Plan* priority areas have the greatest potential to address watershed and ecological goals, provide sustained wetland functions and connect communities with ecosystems.

The County will continue to collaborate with other local units of government, regulatory agencies and other entities in the county and major watersheds to identify potential replacement opportunities.

Comprehensive Wetland Protection and Management Plan

The authority to prepare Comprehensive Wetland Protection and Management Plans is provided in the Minnesota Wetland Conservation Act (WCA), Minnesota Rules, part 8420.0830, and Minnesota Statutes 2017, section 103G.2243.

The idea for developing a local wetland plan for the county was first recommended during the local Greenprint planning efforts in 2006 that involved local citizens, local units of government and state agencies in a years-long planning process. Developing a Comprehensive Wetland Protection and Management Plan was a priority objective of the *Blue Earth County Water Management Plan 2008-2016.*

The County worked with local partners, stakeholders and technical committees for several years from 2014-2016 to develop a Comprehensive Wetland Protection and Management Plan. One of the most widely supported objectives of the plan was to replace wetland impacts in the county, because many wetland impacts were replaced in other counties. Much of that work involved updating the Greenprint, assessing wetland functions, types and conditions in the county, identifying and prioritizing wetlands and replacement sites and proposing alternatives to some parts of the WCA.

As an alternative to the wetland plan, the BWSR recommended incorporating the work done to prioritize wetlands and replacement sties and the function-based classification system and prioritization framework in this *Blue Earth County Water Management Plan* to be used by the WCA LGUs and the TEP when evaluating sequencing and replacement plan applications instead of a wetland plan. Depending on how well this approach addresses the County's watershed and ecological goals, the County may consider working with local partners, stakeholders and the TEP to complete a wetland plan during the planning period.

The technical work analyzing the location, type and functions of historical and existing wetlands, identifying and prioritizing wetlands, and the strategic locations of replacement sites for the wetland plan was used to support wetland and other priority concerns in the *Blue Earth County Water Management Plan* and will be available in a technical report.

Wetland Protection

Importance of Wetland Buffer Areas

Wetland storage capacity and other wetland functions are diminished by human activities that degrade wetlands. The Army Corps of Engineers describes some of the problems with wetlands that lack upland buffer protection in the *A Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Wetland Functions of Prairie Potholes (HGM)*:

> "Accelerated sedimentation may be the most detrimental impact on wetlands. Accumulation of sediment in wetlands decreases wetland volume, decreases the duration wetlands retain water, and changes plant community structure by burial of seed banks."

In developed areas of the county there are chronic problems with encroachment in wetland areas by all types of building structures, construction site runoff, paving, filling, mowing and vegetation removal.

A buffer of undisturbed vegetation around a wetland can provide a variety of benefits. Buffers reduce the impacts of surrounding land uses on wetland functions by stabilizing soils to prevent erosion; filtering solids, nutrients, and other harmful substances; and moderating water level fluctuations during storms.

Buffers also provide essential habitat for feeding, roosting, breeding and rearing of young birds and animals; and cover for safety, movement and thermal protection for many species of birds and animals. Since many animal species require both wetland and upland habitats as part of their life cycles, and also require opportunities to move to escape predators or find food and cover, buffers should be planned to maximize these connections. Wider buffers provide additional water quality and habitat benefits.

Buffers can be planned to connect important upland habitats to wetlands, or connect wetlands and other waters. Buffers will be most effective if the landowners around a wetland make a continuous buffer, and connect desirable wetland and upland habitats.

Blue Earth County Wetland Protection Requirements

Blue Earth County requires a one-rod (16.5 feet) buffer around delineated wetlands in subdivisions, and the City of Mankato requires a 16.5 foot building setback from wetlands. Structural setbacks and protection of the shoreland areas of Public Waters and Public Waters Wetlands are greater than 16.5 feet and are regulated by municipal and county shoreland ordinances in accordance with Minnesota Rules, part 6120.

Blue Earth County subdivision and shoreland ordinances require construction or land alteration activities avoid a net increase in impervious surfaces that drain to surface waters or wetlands, or relocation of impervious surfaces closer to wetlands, or changes to drainage patterns (slopes, meander patterns, etc.) that increase the velocity or rate of runoff to wetlands. Graded slopes adjacent to wetland protection areas should be no steeper than 3:1 and protected to control erosion and sediment runoff to the wetland.

Construction Site and Stormwater Requirements

Construction projects where there is one acre or more of land disturbance are regulated by the MPCA National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General or Individual Permit. The NPDES permit definition of surface water includes "all streams, lakes, ponds, marshes, wetlands, reservoirs, springs, rivers, drainage systems, waterways, watercourses, and irrigation systems whether natural or artificial, public or private…"

The MPCA NPDES Construction Stormwater General Permit requires a Stormwater Pollution Prevention Plan (SWPPP) that identifies the location of wetlands, buffers, protection of impaired waters and the design of permanent stormwater management systems.

Buffer requirements for surface waters, including wetlands, are a minimum of 50-feet and are summarized in the Stormwater Section of this plan and in the MPCA NPDES Construction Stormwater General Permit.

All stormwater discharged from the project during construction and from permanent stormwater systems after construction should not cause a significant adverse impact to wetlands from inundation or decreased flow to the wetland.

Wetland Protection and Setback Recommendations

Blue Earth County and local units of government in the county with land use controls may consider revising existing or establishing new wetland setbacks to protect wetland functions for water storage and wildlife habitat and minimize encroachment and filling wetlands in the county.

The MPCA *Pollution Prevention and the MS4 Program: A Guide on Utilizing Pollution Prevention Activities to Meet MS4 General Permit Requirements* recommends the determination of buffer widths on individual wetlands be based on the following minimum guidelines:

- 50 feet for reduction of human impact
- 50 to 100 feet for overall water quality protection
- 50 to 200 feet for habitat protection and species diversity

The high end of the range is recommended for sensitive water bodies, steep slopes and surrounding land uses that could adversely impact the water body. Buffer width should be added to off-set the adverse impacts of slope, poor soils, human land use pressures, or to add extra protection for sensitive aquatic organisms or wildlife.

The Army Corps of Engineers *St. Paul District Compensatory Mitigation Policy for Minnesota,* January 2009, recommends varying the width of upland buffer "depending upon the goals for the site (e.g., water quality, wildlife habitat), adjacent land use (golf fairway vs. parking lot), slope (steep vs. gentle), vegetation and soils. For example, a 25-50 foot width may be adequate to achieve water quality improvements, while a 90-330 foot width may be necessary for certain wildlife habitat functions." For wetland replacement projects the Army Corps of Engineers requires a 25 foot minimum average buffer width in urban settings and 50 feet in rural settings, and buffer widths can be adjusted upward for site-specific conditions such as slope, soils, vegetation, etc.

Additional Wetland Protection and Management Strategies

Green Infrastructure - Greenprint

Wetlands and upland buffers are important elements of the Greenprint vision for the county. The Greenprint consists of strategically planned, interconnected networks of waterways, wetlands, woodlands, wildlife habitats, and other natural areas; greenways, parks, trails; conservation lands; and other open spaces that support natural ecosystem processes and contributes to the health and quality of life for communities and people in the county. More information about the Greenprint is in Priority Areas for Protection and Restoration section of this plan.

Wetland Protection Easements

Wetland buffers are integral to the preservation of natural wetland functions and public values in the county. Wetland buffer or

protection easements may be considered for wetlands in priority areas where wetlands have high greater public value for wildlife, water quality, water storage or are important for open green space connections. Minnesota Statutes 2017, section 462.357 Subdivision 1 allows municipalities to purchase development rights in the form of conservation easements.

Wetland Dedication

Minnesota Statutes 2017, section 394.25 subdivision 7 allows counties and Minnesota Statutes 2017, section 462.358 subdvision 2b allows municipalities to require that a portion of any proposed subdivision be dedicated to the public or preserved for public use as parks, recreational facilities, playgrounds, trails, wetlands or open space. Any cash payments received in lieu of dedication must be used only for the acquisition of development or improvement of parks, recreational facilities, playgrounds, trails, wetlands or open space. Blue Earth County, the City of Mankato and other local governments in the county currently require park dedication of land or payment of fees in-lieu of land dedication.

Wetland Stewardship Opportunities for Commercial and Industrial Land Use

The MPCA *Pollution Prevention and the MS4 Program: A Guide on Utilizing Pollution Prevention Activities to Meet MS4 General Permit Requirements* recommends additional wetland stewardship activities to incorporate site-level and regional planning as summarized below.

Commercial and industrial sites have a higher degree of impact on wetlands than most land uses, due to their typically large amounts of impervious surfaces. Summer heat and winter salt on large parking lots, conversion of green space and natural communities to impervious surfaces with increased stormwater runoff and other factors, can create adverse impacts on wetland ecosystems. Extra protection efforts for wetlands adjacent to industrial and commercial land to preserve their functional values is recommended.

The following strategies may be applied in cooperation between the local government unit and developers of commercial and industrial sites to preserve functions and values.

- Concentrate open space and/or green space adjacent to wetland buffers.
- Provide natural landscaping around wetlands and buffers, and in areas away from building entrances.
- Plant wetland buffers to provide screening between adjacent land uses, or to mitigate for tree removal during construction.
- Cooperate among businesses to increase the overall size and connections among buffers.

Benefits:

These actions can further protect wetlands and provide additional habitat components that are valuable to wetland ecosystems.

- Wildlife use of these areas will likely increase.
- Compared to traditional turf, native landscaping will reduce maintenance costs.
- Native plantings can provide an attractive setting for businesses that want to emphasize their concern for environmental and habitat quality.
- These areas can be used for walking trails, lunch areas, or other employee activities.

Wetland Protection, Restoration and Enhancement Goals and Strategies

Goal: Protect, enhance and restore wetlands in priority areas to provide important water quality, wildlife habitat and groundwater protection functions in local watersheds.

Wetland Conservation Act (WCA) Strategies and Policies

ONGOING PROGRAM: WETLAND CONSERVATION ACT, MINNESOTA RULES, PART 8420.
The County will continue to administer the Wetland Conservation Act, Minnesota Rules, part 8420, in accordance with Minnesota Rules and Statutes and with guidance from the *Blue Earth County Water Management Plan*.

Wetland Conservation Act (WCA) Implementation Policies

WCA rules require the local government unit (LGU) and technical evaluation panel (TEP) to evaluate the public value and associated functions of wetlands when considering applications and making decisions regarding wetland impact sequencing (impact minimization, avoidance and replacement) and the adequacy of proposed wetland replacement. The *Blue Earth County Water Management Plan* provides a function-based classification system and prioritization framework for wetlands in consideration of local public values. This framework will be used to assess the function and value of wetlands.

The following policies related to the implementation of the WCA are adopted to help achieve the plan's wetland goals.

SEQUENCING POLICY: IMPACT AVOIDANCE AND MINIMIZATION.
When evaluating wetland impact avoidance and minimization, the LGU and TEP should consider the functional classification of the wetland(s) and their public value in relation to priority preservation and replacement areas as designated in the *Blue Earth County Water Management Plan*. (Reference: Minnesota Rules, part 8420.0520 subpart 3C (3) (f) and subpart 4E.)

SEQUENCING POLICY: FLEXIBILITY.
When evaluating whether or not to exercise flexibility in the application of the sequencing steps, the LGU and TEP should consider the functional classification of the wetland(s) and the priority wetland replacement areas in the *Blue Earth County Water Management Plan*. (Reference: Minnesota Rules, part 8420.0520 subparts 7A(1) and 7B.)

REPLACEMENT STANDARDS POLICY: ECOLOGICAL SUITABILITY.
When evaluating and determining the appropriate location, type, function, design and ecological suitability of replacement wetlands, the LGU and TEP should consider the priority wetland replacement areas in the *Blue Earth County Water Management Plan*. (Reference: Minnesota Rules, part 8420.0522 subpart 5D and part 8420.0528 subpart 1.)

Wetland Planning

STRATEGY: WETLAND REPLACEMENT SITES.

Science-based, locally-defined criteria were developed to determine priority areas and potential replacement sites in the Greenprint and the *Blue Earth County Water Management Plan* through a collaborative effort of local government staff and representatives of the U.S. Fish and Wildlife Service, MNDNR, SWCD, MPCA, BWSR, engineering consultants and citizens.

Action: The County may continue to collaborate with other local units of government, regulatory agencies and other entities to identify potential replacement opportunities in local watersheds to achieve plan goals. (Reference: Minnesota Rules, part 8420.0520 Subp. 7F.)

STRATEGY: COMPREHENSIVE WETLAND PROTECTION AND MANAGEMENT PLAN.

The County may consider development of a Comprehensive Wetland Protection and Management Plan as an alternative to WCA rules in accordance with Minnesota Rules, part 8420.0830.

Wetland Protection, Enhancement and Restoration Strategies

PRIORITY WETLANDS POLICY: PRIORITY WETLAND FUNCTIONS FRAMEWORK.

Policy: Local units of government should consider the wetland functions classification framework and the natural resource priority areas in the Priority Areas for Protection and Restoration Section of the *Blue Earth County Water Management Plan* when developing all types of land use and comprehensive plans. (Reference: Minnesota Statutes 2017, sections 394.23, 394.231, 462.357 Subd.9)

STRATEGY: AQUATIC AND NATURAL RESOURCES IN LAKE WATERSHEDS.

Action: Protect, enhance and restore wetlands and aquatic vegetation in near-shore areas to provide critical fish and wildlife habitat and shoreline protection from waves and ice ridges.

Action: Protect, enhance and restore water quality, water storage, fish and wildlife habitat and recreation functions with wetland restoration, wetland and upland buffers for habitat and erosion control, constructed wetlands, stormwater quality treatment wetlands or similar conservation projects in lake watersheds.

STRATEGY: AQUATIC AND NATURAL RESOURCES IN GREENPRINT PRIORITY AREAS.

Land Use Policy: Local government units in the county will consider minimizing fragmentation and development of woodlands, wildlife habitat, open space, shoreland, and wetlands in Greenprint priority areas. (Reference: Minnesota Statutes 2017, sections 394.23, 394.231, 462.357 subdivision 9)

Action: Protect, enhance and restore wetlands and natural resources and restore channelized streams in Greenprint river corridors to provide wildlife habitat, floodwater storage, groundwater recharge, nutrient assimilation, water quality, open space and recreation functions.

Action: Protect, enhance and restore wetlands and upland wildlife habitat and grasslands in Greenprint wetland complexes, shoreland and river corridors.

Action: Seek funds and support private and non-profit partnerships and investments to protect, enhance and restore wetlands, upland habitat, other natural resources and recreation in the Greenprint and priority areas in the Priority Areas for Protection and Restoration Section of the *Blue Earth County Water Management Plan*.

STRATEGY: GROUNDWATER PROTECTION AND RECHARGE FUNCTIONS.

Action: Protect and restore wetlands and upland buffers in areas with the potential to recharge buried sand and bedrock aquifers and in areas with moderate or high pollution sensitivity as shown in the *Geologic Atlas of Blue Earth County, Part B* or the Priority Areas for

Protection and Restoration Section of the *Blue Earth County Water Management Plan*.

STRATEGY: WATER STORAGE FUNCTIONS.

Action: Ensure community resilience with wetland protection, enhancement and restoration, constructed wetlands, water quality treatment wetlands and other water storage practices to minimize flooding and/or erosion in ravines and downstream channels.

STRATEGY: NUTRIENT ASSIMILATION AND TREATMENT FUNCTIONS.

Action: Protect, enhance and restore wetlands or wetland functions to provide treatment for nitrogen and phosphorus in priority areas and watersheds in the *Blue Earth County Water Management Plan.*

STRATEGY: STORMWATER AND WATER QUALITY TREATMENT WETLANDS.

Action: Constructed wetlands or water quality treatment wetlands should be considered in watersheds where water storage, flow attenuation, flood water storage or nutrient treatment functions are needed for water quality or to prevent flooding or erosion downstream.

Wetland Protection Strategies

Erosion and sedimentation, filling and encroachment from surrounding land uses result in wetland degradation are common throughout the county. The result is loss of stormwater retention and flood storage functions as well as wildlife habitat. Wetlands in urban areas, lake watersheds and Greenprint priority areas are the highest priority for wetland protection.

STRATEGY: UPLAND BUFFERS AND SETBACKS FOR WETLANDS.

Action: The County will ensure wetland functions are protected with upland buffers a minimum of 16.5 feet from wetlands when new subdivisions are platted.

Action: Local units of government in the county will continue to ensure wetland functions are protected with existing structural setbacks and upland buffers.

Action: Local units of government in the county will consider wetland buffers and/or structural setback requirements, conservation easements, or open space dedication to protect wetlands from accelerated sedimentation and loss of water storage, loss of habitat or encroachment from surrounding land uses.

STRATEGY: CONSTRUCTION STORMWATER CONTROLS.

Action: Protect wetlands from development impacts during construction with vegetated buffers, perimeter controls and other erosion control strategies to ensure wetland storage volume is not diminished due to accelerated erosion and sedimentation. (Reference: MPCA NPDES Construction General Permit)

Action: Ensure that existing wetland hydrology is maintained and stormwater discharged from development projects and permanent stormwater systems does not cause a significant adverse impact to wetlands from inundation or decrease of flow. (Reference: MPCA NPDES Construction General Permit)

Implementation Plan

The *Blue Earth County Water Management Plan 2017-2026* includes goals, strategies and actions that are practical, measurable and achievable in a ten-year period. It will take much longer to observe measurable improvements in water quality and achieve local, watershed and State water quality goals.

The implementation program is displayed in a table that includes:

- The list of goals strategies and actions in the plan;
- The responsible agency for the strategy or action;
- The timeframe of when the strategy or action will start and end;
- The estimated financial resources or budget needed;
- The anticipated or expected measurable results expected from the action.
- The major watershed benefitting from the strategy if it relates to surface water. There are many individual actions that are targeted to smaller watersheds. In those cases, the action specifically mentions the smaller watershed by name.

There are actions where the budget amount is not specifically stated.

In some cases, these actions are a part of a larger program that is ongoing like feedlots, the county well program or septic system management. When actions are part of an overall program budget, the budget for those ongoing activities is not included but measurable results are included.

There are many water management activities not identified in this plan or there is no budget shown. Municipalities' wastewater treatment and drinking water facilities operation, maintenance and water testing costs are not shown. For example, cities and industry in the county spend millions of dollars every year on wastewater treatment and pretreatment. The cities' budgets for ongoing programs are not shown in the implementation plan.

The responsible agencies listed are the agency or group of agencies responsible for the implementing or leading actions and have the following abbreviations:

- BEC = Blue Earth County
- BEC DA = Blue Earth County Drainage Authority
- SWCD = Blue Earth County SWCD
- MS4 = Communities designated as an MS4
- LGU = Local Governmental Unit

The implementation table is on the following pages.

Drinking Water and Groundwater

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result
Protect the quantity and quality of groundwater resources to ensure long term sustainability of groundwater supplies.				
COUNTY-WIDE STRATEGY: LAND USE PLANNING AND REGULATIONS.	All LGU's	2017-2026		
Action: Conduct education and training with local officials and staff using the Geologic Atlas of Blue Earth County, Part B, to support development and implementation of groundwater protection in local plans, ordinances and policies.	MNDNR - All LGU's	2017-2018	$1,000	Participation in training session by at least 10 staff of various LGU's
Action: The County will ensure groundwater protection is an integral part of local land use plans and ordinances.	BEC	2017-2026	Budget Covered in Well program budget shown below	Ground water protection in county by using plans and ordinances
Action: All jurisdictions will review development proposals to ensure required well isolation distances (setbacks) from existing and future wells will be maintained.	All LGU's	2017-2026	-	Groundwater protection by ensuring that isolation distances from wells are maintained
Action: Ensure land development proposals address storage, use and disposal of potentially hazardous substances and hazardous waste.	All LGU's	2017-2026	Budget Covered in Well program budget shown below	Groundwater protection by reviewing development proposals. (170 reviews per year and 1,700 reviews total)
Action: Review development proposals and well disclosures to ensure abandoned wells are identified and properly sealed.	BEC and other LGU's	2017-2026	Budget Covered in Well program budget shown below	Groundwater protection by Sealing Wells
Action: Utilize the Geologic Atlas of Blue Earth County, Part B, to identify areas with high to moderate pollution sensitivity to ensure land use in those areas protect groundwater.	BEC and other LGU's	2017-2026	Budget Covered in Well program budget	Groundwater protection by reviewing development proposals in sensitive areas.
Action: Review development proposals in areas not served with publicly owned wastewater treatment systems to ensure there are no Class V injection wells for any type of wastewater or stormwater management in existing and proposed uses.	BEC and other LGU's	2017-2026	Budget Covered in Well program budget	Groundwater protection by continuing to review development proposals for Class V injection wells. (150 reviews per year)
Action: The County will review feedlot permits in areas with moderate to high pollution sensitivity to ensure compliance with local and state regulations.	BEC	2017-2026	Budget Covered in Feedlot program budget	Groundwater protection by reviewing feedlots in sensitive areas.
Action: The County will continue to assist the MDH and MNDNR with water appropriation permitting and the regulation of unrestricted flowing wells.	BEC	2017-2026	Budget Covered in Well program budget	Hep address groundwater quantity issues and help protect groundwater quantity by addressing flowing wells.
STRATEGY: CONTINUE WELL PROGRAM.	BEC	2017-2026	$1,000,000	Staffing and equipment for well program to protect groundwater by administering the well code.

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result
COUNTY-WIDE STRATEGY: WELL SEALING.	BEC	2017-2026		
Action: The County will continue to locate, permit and inspect well sealing throughout the county.	BEC	2017-2026	$487,500	650 properly sealed wells
The County will continue a minimum $10,000 locally-funded annual well sealing cost share program and will assess the adequacy and use of program to determine local needs and increase the cost-share funds available as needed.	BEC	2017-2026	$100,000	$100,000 in local funds used to cost share on well sealing
Action: The County and Community Public Water Suppliers will seek outside funds to expand well sealing opportunities in priority areas, such as Drinking Water Supply Management Areas, Source Water Protection Areas, areas of known contamination and other areas determined to be a priority based on land use, groundwater pollution sensitivity and well characteristics.	BEC and other LGU's	2018-2026	$200,000	Funding for priority well sealing
PUBLIC WATER SUPPLIER STRATEGIES				
STRATEGY: WELLHEAD PROTECTION.				
Action: Support Public Water Suppliers' development and implementation of Wellhead Protection Plans required by the Minnesota Department of Health and Water Supply Plans required by the Minnesota Department of Natural Resources.	BEC and other LGU's	2017-2018	$200,000	Completion of Wellhead protection plans and water supply plans
Action: The County will assist municipalities and the MDH with preparing wellhead protection plans and Water Supply Plans required by the MNDNR when requested by the municipality.	BEC	2017-2018	See Well program budget	Assistance with Wellhead protection plans and water supply plans
Action: Support municipalities implementing Wellhead Protection Plans.	BEC	2017-2018	$15,000	Support and assistance with Wellhead protection plans and water supply plans
Waste Management Strategies				
Policy: Ensure hazardous substances, hazardous materials and hazardous wastes are managed at the site level to reduce the potential for groundwater contamination.	BEC	2017-2026	no budget	Ground water protection in county land use plan and ordinances
Action: Seek outside funding to address sites with contaminated soil with the potential to contaminate groundwater in areas with moderate and high pollution sensitivity as shown in the Geologic Atlas for Blue Earth County, Part B, and other areas with pollution sensitivity.	BEC	2018-2022	no known sites	Remove contaminated soil if/when it is discovered.
ONGOING STRATEGY: HAZARDOUS WASTE DISPOSAL. Action: The County will continue to operate the Household Hazardous Waste Collection Program, Small Quantity Generator Program and Medicine Collection Program.	BEC	2017-2026	$2,200,000	Continued operation of programs to properly dispose of hazardous waste and medicines. (Source: Ten-year budget for HHW program from County Solid Waste Plan)
Well Testing Strategies				
STRATEGY: PRIVATE WELL TESTING.				
Action: The County will continue education programs and encourage private well water testing for contaminants, such as bacteria, nitrates and arsenic, and will coordinate with a MDH certified lab to provide water testing services to residents for a fee.	BEC	2017-2026	$25,000	Protection of public health, increased data/knowledge about potential issues.

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result
Action: The County Environmental Services will work with the County Public Health, local medical clinics and other appropriate partners in the community to promote the need for private well testing.	BEC	2017-2026	$25,000	Continue existing promotions of well tests such as articles in newsletters and coordinate well testing services. (Reach estimated 2,000 households using private wells annually with County Communicator Article.)
STRATEGY: PUBLIC WATER SUPPLY TESTING.				
Action: Public water suppliers will continue water testing programs as required by the MDH and the Safe Drinking Water Act.	LGU's	2017-2026		
STRATEGY: OBSERVATION WELLS.				
Action: Support expansion of the MNDNR observation well network in Blue Earth County.	BEC	2017-2026	See Well program budget	Potential expansion of observation wells in Blue Earth county and Surrounding areas.
Groundwater Recharge Strategies				
Goal: Reduce nitrate nitrogen in rivers recharging surficial sands aquifers used for drinking water.				
STRATEGY: REDUCE NITRATE NITROGEN IN THE BLUE EARTH RIVER.				
Action: Identify, prioritize and implement best management and treatment practices that reduce nitrogen in the Blue Earth River watershed.	BEC- SWCD-Mankato	2018-2026	$165,000	Prioritized locations for nitrogen treatment/denitrification. Construct 10 projects.
Action: Local partners will work with landowners to restore wetlands to provide nutrient treatment functions and other local, state or watershed plans that identify nitrogen treatment best practices.	BEC,SWCD	2017-2026	$120,000.00	4 treatment wetlands for nitrogen treatment
Action: Local partners will work with counties and SWCDs in the Blue Earth, Le Sueur and Watonwan River watersheds to ensure nitrogen reduction is addressed in these watersheds during the MPCA watershed assessments and intensive monitoring programs, during development of MPCA Watershed Protection and Management Strategies and One Watershed One Plan.	BEC- SWCD-Mankato	2017-2026	$30,000.00	Participate in WRAPS process and One Watershed One Plan
STRATEGY: NITRATE NITROGEN MONITORING.				
Action: The City of Mankato will continue its well and river monitoring programs.	City of Mankato	2017-2026	city budget	Monitoring data collected
Action: The City of Mankato and the County will work with the SWCD, MDH, USGS, MPCA, MDA, University of Minnesota and other appropriate local, state and federal agencies to develop and implement a coordinated, expanded monitoring plan to improve understanding of nitrates in surficial sands aquifers at the confluence of the Blue Earth and Minnesota Rivers	City of Mankato, BEC	2017-2026	$50,000	3 meetings with agencies and partners to develop monitoring plan
Goal: Recharge buried sands and bedrock aquifers.				
STRATEGY: GROUNDWATER RECHARGE.				
Establish practices that recharge buried sands and bedrock aquifers.	BEC,SWCD	2017-2026	$100,000	1 restored wetland

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result
Action: Protect, enhance and restore wetlands and similar conservation practices in areas where there is groundwater recharge potential as shown in the Blue Earth County Water Management Plan, high pollution sensitivity of buried sands aquifers as shown in the Geologic Atlas of Blue Earth County, Part B, or as shown in future plans and studies of groundwater recharge potential.	BEC	2017-2026	$100,000	1 wetland
STRATEGY: LOW FLOW AUGMENTATION. Support wetland protection, enhancement and restoration in river corridors.				
Action: Establish conservation easements in river corridors.	SWCD	2017-2026	$80,000	4 easements
Action: Protect and restore wetlands in former sand, gravel and rock mining sites in Greenprint priority areas	BEC	2017-2026	unknown	unknown
STRATEGY: FLOWING WELLS.				
Action: The County will identify flowing wells and ensure flowing wells are sealed as required by State law	BEC	2017-2026	$3,750	2 sealed flowing wells
STRATEGY: MOUNT SIMON AQUIFER.				
Action: Participate in Mount Simon Aquifer user group.	Mt. Simon Users	2017-2026	City of Mankato budget	Participation in 10 meetings
Action: Support reduced use of the Mount Simon Aquifer to the extent practicable.	Mt. Simon Users	2017-2026	unknown	Sustainable use of the aquifer.

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Local Prioritizing and Targeting					
Prioritizing and Targeting Strategies					
Goal: Prioritize, target and measure watershed protection and restoration planning and implementation strategies in					
STRATEGY: WATER PLAN TASK FORCE.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: The County will support a water plan task force comprised of local elected and appointed officials, farmers, lake association members and other citizens for prioritizing, targeting, and measuring progress in implementing the goals, strategies and actions in the Blue Earth County Water Management Plan and related plans. The water plan task force will meet once a year or as needed.	BEC - Task Force	2017-2026	$30,000	At least 10 Meetings for planning and prioritizing	
STRATEGY: TARGET SUBWATERSHEDS FOR IMPLEMENTATION.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: Use the best available science, WRAPS, terrain analysis, project effectiveness analysis, and local knowledge to prioritize, target and measure watershed-based implementation in small watersheds.	BEC, SWCD	2017-2026	no budget		
Action: The County and SWCD will work with and seek recommendations from the water plan task force to prioritize HUC12 and smaller subwatersheds for local monitoring efforts, outreach and project development during the ten-year planning period.	BEC, SWCD	2017-2026	no budget		
Water Quality Monitoring For Prioritizing and Targeting					
STRATEGY: MONITORING.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Support lake association monitoring efforts.	BEC, SWCD	2017-2026			
Action: Support the MNDNR and MPCA sentinel lakes monitoring efforts for Madison Lake.	MNDNR & MPCA	2017-2026	state funds	MNDNR & MPCA conducts monitoring and prepare reports	
Action: Support farmer-led surface water and field-scale demonstrations and monitoring.	SWCD, Farmers, BEC	2020-2026	$150,000	Establish 2 demonstration sites	
Action: The SWCD will continue surface and tile drainage monitoring for farmers county-wide and in priority subwatersheds.	SWCD	2017-2026	$20,000	Monitoring for 20 farmers	

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
STRATEGY: NITROGEN MONITORING.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Support nitrate monitoring to better understand the fate and transport of nitrogen in the Blue Earth, Le Sueur, Watonwan and Middle Minnesota River watersheds, with an emphasis of reducing nitrates in the lowest reach of the Blue Earth River.	BEC	2018-2026	no budget	Better data on nitrogen transport	
Action: County, City of Mankato and other local government staff in the watershed will work with the University of Minnesota, United States Geological Survey, MPCA, MDA, MNMNDNR and MDH to seek funds and technical assistance for nitrate nitrogen monitoring in the greater Blue Earth River watershed and the Middle Minnesota River watershed with an emphasis on the lowest reach of the Blue Earth River.	City Mankato, BEC	2017-2023	$500,000	Ten year watershed monitoring	

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Land Use Planning					
GOAL: Protect, enhance and restore aquatic and natural resources in priority areas to provide important water quality, wildlife habitat, water storage and groundwater protection functions with the greatest local public value in local watersheds.					
STRATEGY: GREENPRINT AND LOCAL PLANS.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Land Use Policy: Protect, enhance and restore aquatic and natural resources in Greenprint priority areas with coordination among land use plans, comprehensive plans, transportation plans, stormwater plans, water management plans and park and open space plans from all local government jurisdictions.	All LGU	2017-2026	no budget		
Land Use Policy: Local government units in the county will consider minimizing fragmentation and development of woodlands, wildlife habitat, open space, shoreland and wetlands in Greenprint priority areas. (Reference: Minnesota Statutes 2017, sections 394.23, 394.231 and 462.357 subdivision 9)	All LGU	2018-2026	no budget		
Action: Local government units in the county will consider adopting land use policies and official controls requiring dedication of open space, including wetlands, for public use in Greenprint priority areas. (Reference: Minnesota Statutes 2017, section 394.25 subdivision7 and section 462.358 subdivision 2b)	All LGU	2018-2026	no budget		
Action: Local government units in the county will consider developing programs and funding mechanisms for aquatic and natural resource protection such as conservation easements and external sources of funds targeted to water quality, wildlife habitat and recreation.	All LGU	2018-2026	no budget		
STRATEGY: SHORELAND PROTECTION.					Blue Earth, Le Sueur, Middle MN, Watonwan,
Policy: Protect wetlands and aquatic vegetation in near-shore areas to provide critical fish and wildlife habitat and shoreline protection from waves and ice ridges.	All LGU	2017-2026	no budget		
STRATEGY: PRIORITY WETLAND FUNCTIONS FRAMEWORK.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Policy: Local units of government should consider the wetland functions classification framework when developing all types of land use and comprehensive plans. (Reference: Minnesota Statutes 2017, sections 394.23, 394.231 and 462.357 subdivision 9)	All LGU	2017-2026	no budget		
POLICY STRATEGY: ENVIRONMENTAL REVIEW.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Policy: Aquatic and natural resource priority areas in the Greenprint and the Blue Earth County Water Management Plan should be included in environmental review documents, such as Environmental Assessment Worksheet (EAW), Environmental Impact Statement (EIS) and Alternative Urban Area Review (AUAR) to assess compatibility of proposed projects with local government plans. (Reference: Environmental Review, Minnesota Rules, parts 4410.1200 H. and 4410.2100)	All LGU	2017-2026	no budget		
STRATEGY: TRANSPORTATION PLANNING.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Policy: In the transportation planning and project design process, all road authorities should consider protection, enhancement and restoration of aquatic and natural resource in the Greenprint and the Blue Earth County Water Management Plan. (Reference: MATAPS 2035)	All LGU	2017-2026	no budget	Consideration of Greenprint in transportation projects	
Action: Consider construction of appropriately sized culverts, bridges, tunnels or other types of safe passage to maintain, protect and restore wetland and aquatic habitat, minimize fragmentation and restore connectivity in the design and construction of transportation and trail systems. Seek funds for viable projects.	All LGU	2017-2026	no budget		

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Cropland					
GOAL: Increase adoption of voluntary best practices to protect and improve soil health and water quality.					
Education and Outreach					
STRATEGY: DEMONSTRATIONS.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Increase adoption of voluntary best practices and support adaptive management to improve soil health, nutrient use efficiency with farmer-led, field scale demonstrations and monitoring.	SWCD	2018-2026	Budget covered in Prioritizing and Targeting Section	Increase in BMP Adoption	
Action: The SWCD and other partners will seek funding from public and private sources to establish farmer-led, field scale demonstration sites.	SWCD	2018-2026	Budget covered in Prioritizing and Targeting Section	Establish 2 demonstration sites	
Nitrogen Management					
STRATEGY: NUTRIENT MANAGEMENT.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Work with land managers to establish in-field nutrient management (i.e., optimal fertilizer rates; apply fertilizer closer to timing of crop use; nitrification inhibitors; variable fertilizer rates) and best practices for nitrogen reduction are described in the MDA Fertilizer and BMP Handbook, Best Management Practices for Nitrogen Use on Coarse-textured Soils and Best Management Practices for Nitrogen Use in South-Central Minnesota and future guidance.	SWCD	2017-2026	unknown	will be determined in future priority subwatersheds	
TREAT SUBSURFACE TILE DRAINAGE WATER.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Work with land managers to establish tile drainage water management and treatment practices that intercept or reduce nitrogen from subsurface tile drainage (i.e. shallower depth of tile drainage; control structures that let farmers adjust water levels; constructed and restored wetlands for treatment purposes; woodchip trench bioreactors; and saturated buffers).	SWCD	2017-2026	unknown	will be determined in future priority subwatersheds	
STRATEGY: VEGETATION.					
Action: Work with land managers to establish vegetation practices and landscape diversification (i.e. cover crops; perennials planted in riparian areas or marginal cropland; extended rotations with perennials; energy crops in addition to corn).	SWCD	2017-2026	unknown	will be determined in future priority subwatersheds	
STRATEGY: MONITORING.					Blue Earth
Action: Support nitrogen monitoring in the Blue Earth River watershed. .	SWCD	2017-2026	unknown		
Soil Erosion					

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
STRATEGY: VEGETATED BUFFERS.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Establish and maintain vegetation in riparian areas and riparian buffers in accordance with Minnesota Statutes 2017, sections 103F.401 to 103F.445 and the Blue Earth County Shoreland Ordinance Agricultural Use Standards.	SWCD - BEC	2017-2026	$500,000	100 percent compliance with buffer law	
STRATEGY: HIGHLY ERODIBLE LAND.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Work with land managers to establish water and sediment control basins (WASCOBs), grassed waterways and grade stabilization structures on highly erodible land and potentially highly erodible land as shown in this plan and the USDA NRCS Soil Survey. .	SWCD	2017-2026	unknown	will be determined in future priority subwatersheds	
Action: The SWCD will work with land managers to establish practices to improve soil health.	SWCD	2017-2026	unknown	will be determined in future priority subwatersheds	
SOIL EROSION LAW.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: The SWCD will coordinate compliance monitoring and technical assistance as needed.	SWCD	2020-2026	unknown	Coordination and technical assistance as needed	
Action: Work with the County and LGUs to evaluate the need for a soil loss ordinance.	SWCD	2020-2024	$15,000	Determine need for soil loss ordinance and implement if needed	
Altered Hydrology					
STRATEGY: SOIL HEALTH.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Enhance the ability of the soil to infiltrate and store precipitation. Soil and crop management in agricultural fields affects infiltration rates and water holding capacity through effects on soil structure and soil organic matter.	SWCD	2017-2026	unknown	will be determined in future priority subwatersheds	
STRATEGY: SURFACE FLOW.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Manage overland flow with crop residue, contour farming, and vegetated flow pathways like waterways and filter strips that slow, filter, and partially infiltrate surface runoff.	SWCD	2017-2026	unknown	will be determined in future priority subwatersheds	
STRATEGY: SUBSURFACE DRAINAGE.					Blue Earth, Le Sueur, Middle MN, Watonwan

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Action: Manage subsurface drainage flow by sizing, depth, and spacing of drainage pipe to control rates of drainage water leaving the field. Control structures can also be installed in the drainage system to allow temporary water storage for later crop use or timed release.	SWCD	2017-2026	unknown	will be determined in future priority subwatersheds	
STRATEGY: WATER STORAGE.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Increase water storage, including natural storage in wetlands and other depressions, and artificial storage with constructed wetlands, terraces, ponds, water and sediment control basins (WASCOBs), down-sized culvert retention, weirs, and large detention basins.	SWCD	2017-2026	unknown	will be determined in future priority subwatersheds	
Phosphorus					
STRATEGY: NUTRIENT MANAGEMENT.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: The SWCD will work with land managers to encourage soil phosphorus testing and establish fertilizer best practices use and efficiencies for phosphorus management.	SWCD	2017-2026	unknown	will be determined in future priority subwatersheds	
STRATEGY: HIGHLY ERODIBLE LAND.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: The SWCD will work with land managers to establish water and sediment control basins (WASCOBs), grassed waterways and grade stabilization structures on highly erodible land and potentially highly erodible land as shown in this plan and the USDA NRCS Soil Survey.	SWCD	2017-2026	unknown	will be determined in future priority subwatersheds	
Action: The SWCD will work with land managers to establish practices to improve soil health.	SWCD	2017-2026	unknown	will be determined in future priority subwatersheds	
SWCD Ongoing Programs					
ONGOING STRATEGY: CONSERVATION EASEMENT DELIVERY					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: The SWCD will continue to administer the Reinvest in Minnesota, Conservation Reserve Enhancement Program and similar conservation programs when signups are open, ensuring marginal cropland is taken out of production to improve water quality, reduce flooding, and increase wildlife habitat.	SWCD	2017-2026	unknown	20 Easements	
ONGOING STRATEGY: MDA STATE REVOLVING FUND (SRF).					Blue Earth, Le Sueur, Middle MN, Watonwan

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Action: The SWCD will continue to administer the MDA AG Best Management Practices Loan Program to ensure low interest loans are available for equipment and projects.	SWCD	2017-2026	$50,000	Operate the MDA program every year	
ONGOING STRATEGY: RIPARIAN BUFFERS AND WATER QUALITY PRACTICES.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: The SWCD will provide landowners technical assistance with implementation of water resource protection and will track compliance with requirements established in Minnesota Statutes 2017, section 103F.48.	SWCD	2017-2026	$1,000,000	Compliance with Buffer Law	
Action: The SWCD, Drainage Authority and Environmental Services Department will promote establishing buffers and alternative practices on “Other Watercourses” identified by resolution of the SWCD.	BEC	2017-2016	$200,000	Establish buffers on other watercourses	
Action: The County and Drainage Authority will consider accepting jurisdiction of enforcement of Minnesota Statutes 2017, section 103F.48.	BEC	2017-2026	$1,000,000	Compliance with Buffer Law	

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Feedlots and Manure Management					
Goal: Minimize potential transport of bacteria and nutrients to surface water and groundwater from feedlots and manure applied to cropland.					
ONGOING STRATEGY: MPCA FEEDLOT DELEGATION.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: The County will continue implementing the MPCA feedlot delegation agreement, submit annual feedlot reports and work plans to the MPCA, and report feedlot inspection and permitting activities using databases as required by the MPCA, as required in the feedlot delegation agreement.	BEC	2017-2026	$1,200,000	Surface and	
ONGOING STRATEGY: COUNTY REGULATIONS.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: The County will continue implementation of the zoning and livestock and manure management ordinances. These ordinances address feedlot siting and manure management for all feedlots more than 10 animal units.	BEC	2017-2026	Budget covered above in Feedlot delegation strategy		
Action: The County Feedlot Officer will meet with 100 percent of feedlot operators and meet with crop consultants to improve manure management planning.	BEC	2017-2026	Budget covered above in Feedlot delegation strategy	Individual Meetings with 400 feedlot operators during feedlot inspection process	
Action: The County Feedlot Officer will continue feedlot education programs related to manure management, including direct mail, press releases and annual meetings with producers.	BEC	2017-2026	$15,000	10 annual manure management seminars to reach on average 50 people. 10 annual direct mailings to 430 feedlots in County about manure management	
Action: The County will continue the permitting and inspection program and will inspect each feedlot at least twice during the ten-year planning period.	BEC	2017-2026	Budget covered above in Feedlot delegation strategy	At least 850 feedlot inspections	
Manure Management Strategies					
STRATEGY: MANURE MANAGEMENT TRACKING.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: The County will reestablish a mapping system for tracking manure spreading acres associated with feedlot permits.	BEC	2020-2021	$10,000	GIS mapping system for tracking manure spreading acres	

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Action: The County will develop methods to monitor transferred manure among feedlot owners, commercial applicators, manure buyers, and crop consultants to minimize over-application of nutrients to the soil.	BEC	2020-2021	$5,000	Database upgrade to track transfers of manure	
STRATEGY: MANURE MANAGEMENT.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: The County Feedlot Officer and SWCD will work with all feedlot operators to improve manure and nutrient management planning at the farm system and field scale by accounting for manure in nutrient management plans and soil phosphorus testing.	BEC-SWCD	2017-2026	Budget covered above in Feedlot delegation strategy	100 phosphorus soil tests	
Action: During permitting and regular feedlot inspections, the County Feedlot Officer will evaluate each feedlot's manure spreading sites at the field scale with site visits and analysis of slope, proximity to surface waters and sensitive soils for nutrient management and work with the producer to manage manure in sensitive areas.	BEC	2017-2026	Budget covered above in Feedlot delegation strategy	430 manure management evaluations	
Priority Area Strategies					
STRATEGY: MANAGE FEEDLOTS AND MANURE FOR SENSITIVE SOILS.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: The County will identify and assess open lots, manure stockpiles and manure spreading acres in areas with high and moderate pollution sensitivity (coarse textured soils and shallow depth to bedrock) or draining to intermittent streams, ravines, surface water and open tile intakes.	BEC	2017-2026	in feedlot program budget	Map of sites in areas with sensitive soils.	
Action: The County Feedlot Officer will review feedlots and manure management at the farm system and field scale to identify sensitive areas and discuss requirements with producers.	BEC	2017-2026	in feedlot program budget	435 evaluations	
Action: The County and SWCD will work with producers in sensitive areas to address runoff from open lots, manure stockpiles and manure management with vegetation, structural fixes, and improved manure management plans and programs.	BEC, SWCD	2017-2026	unknown	Address manure management at 10 sites in sensitive areas	
Action: The County will display on its website information about sensitive areas and requirements (ground water contamination maps, bedrock, slope, soils, floodplains, ditches, surface water feature, two foot contour maps, property boundaries, aerial photos and other information).	BEC	2018	$10,000	Mapping system online to display sensitive Areas	
STRATEGY: OPEN LOTS AND SMALL FEEDLOTS.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Re-evaluate each open lot for pollution problems when the during the County feedlot permit review.	BEC-SWCD	2017-2026	$20,000	Re-evaluate each of the 208 feedlots with open lots in the County	

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Action: Provide technical assistance to feedlot operators and owners of small sites to address pollution problems and improve manure and nutrient management.	BEC, SWCD	2017-2026	$120,000	Technical assistance for 40 feedlots	
STRATEGY: PRIORITY SUBWATERSHEDS.					Middle MN, Le Sueur
Action: The County and SWCD will work together to assess feedlots and manure management systems in priority sub-watersheds and determine roles and responsibilities for working with producers who may need feedlot fixes or improve manure and nutrient management.	BEC, SWCD	2017-2026	$4,000	Detailed Assessment of feedlots and Manure Management in priority watersheds	
Action: The County will develop and begin implementing a plan to transition to inspecting and reviewing feedlots on a watershed basis.	BEC	2018-2026	Budget in feedlot delegation strategy	Watershed Based Inspections schedule for annual inspections	
Action: The County and SWCD will target manure and nutrient management strategies and land management strategies to sensitive areas and critical source areas in subwatersheds.	BEC, SWCD	2017-2026	$4,000	Refine processes and targeting for nutrient management in sensitive areas	
Feedlot Site Management Strategies					
STRATEGY: ANIMAL MORTALITY BOXES.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Environmental Services staff will consult with the Minnesota Board of Animal Health, the Minnesota Department of Agriculture, the Blue Earth County Highway Department, the County Ditch Manager, and local township officials to develop policies or regulations to reduce the potential for pollution and other hazards associated with the design and placement of animal mortality boxes.	BEC	2017-2019	$15,000	Evaluation of Local ordinance or standards and best practices, Development of a Local ordinance and/or standards	
STRATEGY: INACTIVE MANURE PITS.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: The County will continue to maintain an inventory of manure pits requiring proper abandonment and will continue to work with operators to properly abandon manure pits.	BEC	2017-2026	$240,000	20 Properly Abandoned manure pits	

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Flooding					
GOAL: Protect public safety and property in flood prone areas of the county.					
GOAL: Ensure resilience to extreme rainfall.					
POLICY STRATEGY: PREVENTION.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Revise floodplain ordinances to prohibit filling or new dwellings in the General Floodplain and Flood Fringe District and to conform to the County Zoning Ordinance which requires lots to have the required buildable area outside of floodplains.	BEC	2017-2019	$5,000	Revise floodplain ordinance to prohibit development in all floodplain areas	
STRATEGY: NATIONAL FLOOD INSURANCE PROGRAM.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Adopt the preliminary FEMA Flood Insurance Rate Maps when they are approved by FEMA.	All LGU's with Floodplain	2017-2019	$1,000	Adopt Floodplain Maps	
Action: Revise floodplain ordinances to conform to FEMA/MNDNR standards and to properly reference the updated floodplain maps.	All LGU's with Floodplain	2017-2018	$18,000	Revise Floodplain Ordinances to reference new maps and new standards	
STRATEGY: FLOOD INUNDATION:					Middle MN is primary
Action: Assess whether additional flood studies or flood inundation models are needed on streams, rivers, or ditches in the county that do not have FEMA identified floodplain boundaries like the Little Cottonwood River, Morgan Creek, and Minneopa Creek.	BEC-MNDNR - Brown Co - MNDNR	2017-2018	$15,000	Determine if areas need further study and implement studies/models if needed	
STRATEGY: WATER STORAGE CAPACITY.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Maintain the existing water storage capacity in the floodplain by preventing further development and fill from being added to the floodplain.	BEC	2017-2026	no budget	Maintaining water storage in floodplain through local ordinances	
Action: Increase the water storage capacity at or below 100-year flood elevations and in areas with known flood inundation to help minimize the severity and frequency of flooding and high water by targeting wetland restorations and water storage in floodplain areas. .	BEC	2017-2026	$100,000	At least 1-wetland restoration in the floodplain	
STRATEGY: FLOOD PROTECTION STRUCTURES.					Blue Earth, Le Sueur, Middle MN are primary
Action: Support protection and maintenance of flood control projects protecting infrastructure in the City of St. Clair.	BEC, St. Clair	2017-2026	$50,000	Flood control structures maintained	
Action: Support protection and maintenance of flood control protection systems, flood walls and pumping systems managed by the City of Mankato and South Bend Township on the Minnesota River at Mankato, Blue Earth River at Mankato and in the Indian Creek watershed flowing through Mankato.	BEC, Mankato, South Bend	2017-2026	$7,200,000	River Bank Restoration and stabilization projects, sediment reduction, and pump station renewal projects	

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Action: Increase water retention in the Indian Creek watershed to reduce ravine erosion and sedimentation in flood control systems on Indian Lake Road, Rasmussen Woods and Pleasant Street gate well.	BEC, Mankato Twp., Others	2017-2026	$3,800,000	Water storage in unincorporated areas	
Action: Prevent flooding in municipalities by maintaining, constructing and updating flood control protection systems, stormwater infrastructure and critical facilities.	All LGU's	2017-2026	no budget	Reduced flood losses	
STRATEGY: WATERSHED MANAGEMENT.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Increase water storage by restoring wetlands and developing green infrastructure to increase water storage in watersheds with developed/developing land use.	All LGUs	2020-2026	unknown	to be determined when implementing ravine plan	
Action: Increase water storage in drainage system watersheds and ravine watersheds with subsurface tile drainage outlets.	All LGUs	2019-2026	unknown	to be determined when implementing ravine plan	
STRATEGY: NATURAL RESOURCE PROTECTION.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Increase water storage by restoring wetlands and developing green infrastructure to increase water storage in watersheds with developed/developing land use	All LGU's	2017-2026	no budget	Increased Water Storage	
Action: Increase water storage in drainage system watersheds and ravine watersheds with subsurface tile drainage outlets to reduce erosion and sedimentation that may reduce water storage capacity in wetlands, stormwater ponds and other water storage basins.	All LGU's	2017-2026	no budget	Increased Water Storage	
Action: Restore channelized stream corridors to provide flood water storage and attenuation, wildlife habitat and nutrient assimilation functions	All LGU's	2017-2026	no budget		
Action: Protect and restore forests and perennial vegetation to protect soils, increase the water holding capacity of soils and increase evapotranspiration while also providing wildlife habitat and nutrient assimilation.	All LGU's	2017-2026	no budget		

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Near Channel Erosion					
GOAL: Minimize near channel erosion hazards and mitigation costs throughout the county.					
STRATEGY: PRIORITIZING AND TARGETING.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: The County will continue to address near channel erosion hazards in the Blue Earth County All Hazard Mitigation Plan update.	BEC	2018	$200,000	Address near channel erosion in more detail in hazard mitigation plan with updated data	
Action: The County will work with partners to assess and prioritize ravine and near channel erosion hazards for prevention, natural resource protection and structural practices in an ongoing local plan that involves multiple local and state partners. Blue Earth County Emergency Management, Public Works and Environmental Services, City of Mankato Public Works, Mankato Township, the SWCD, and the other six municipalities and 20 townships affected by near channel erosion in the county, and the MNDNR.	BEC ES, PW Sheriff, SWCD, Mankato, Mankato Twp.,	2018-2019	$300,000	Ongoing inventory and description of sites, Near channel implementation plan	
Action: The County and other partners will seek funds for technical analysis of soils, geology, engineering and other engineering and technical support.	BEC	2017-2026	$25,000	Seek and receive grant funds for all actions in this strategy.	
Action: Evaluate the need for an updated LiDAR elevation dataset along the County's river valleys, bluffs, ravines and steep slopes to help determine rates of erosion and change. Acquire updated LiDAR elevation data if needed.	BEC-MNDNR	2022-2026	$150,000	Assessment of whether updated LiDAR is needed and potentially update LIDAR dataset	
Action: Evaluate the need for ground based LiDAR and/or drones to assess individual bluff and ravine changes over time. Acquire ground based LiDAR system and/or a drone if needed.	BEC-MNDNR	2018-2022	$120,000	Assessment of whether ground based LiDAR and/or a drone is needed and potential purchase.	
Land Use Strategies					
STRATEGY: PREVENTION – STRUCTURE SETBACKS.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Blue Earth County, Mankato Township and other jurisdictions affected by near channel erosion will work together with technical support to develop science-based methods for increasing structure setbacks based on geology, soils and historic trends.	BEC, Mankato Twp., MNDNR, Others	2018-2020	$50,000	Study and establish updated setbacks from bluffs and ravines	
Action: Support the Minnesota Army Corps of Engineers Silver Jackets partnership with the MNDNR in the development of science-based methods for determining structure setbacks.	BEC	2018-2020	$10,500 + state funds	Army Corps develops pilot project.	
Action: Seek funds to support development of information and technical papers for elected officials, conservation, planning and zoning staff, and landowners making land use decisions in areas of near channel erosion hazards.	BEC, Mankato, Mankato TWP SWCD	2018-2020	$40,000	1 Erosion Technical paper and Guidance for Ravines and 1 Erosion technical paper and guidance for Steam Bank and bluff erosion	

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Action: Local government units in the county may consider requiring ground assessment and site specific analysis of vulnerability prior to land development and alterations in potential hazard areas.	All LGU's	2018-2026	no budget	Potential site specific requirements prior to developing in hazard areas	
STRATEGY: PREVENTION. STORMWATER REGULATIONS.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Review and revise stormwater management and land use ordinances and policies to decrease surface runoff and subsurface tile drainage water discharges directed to streambanks, bluffs and ravines to reduce erosion with stormwater management practices.	All LGU's	2017-2026	no budget	Updated Ordinances to manage stormwater	
STRATEGY: PREVENTION AND NATURAL RESOURCES PROTECTION:					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Restore wetlands and construct water storage practices in areas contributing runoff directly to bluffs streambanks, bluffs and ravines.	BEC, Mankato Twp., Mankato, Lime Township	2017-2026	unknown	Restore wetlands and establish water storage	
Education and Outreach					
STRATEGY: EDUCATION AND PREVENTION:					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Seek funds and develop funding mechanisms to provide technical information for landowners about preventing and managing ravine erosion.	BEC	2018-2020	$500,000	Grant for technical assistance	
Research and Study Strategies					
Action: Support continued investigation of near channel erosion caused by groundwater sapping and landslides.	BEC, SWCD	unknown	unknown	Information will be used to identify potential practices to address groundwater seepage and sapping	
Action: Identify and address research needs Identify research needs, information gaps to address near channel erosion and landslides in the county.	BEC, MNDNR	unknown	unknown	Information will help prioritize and target near channel erosion and landslide projects and local prevention and mitigation policies	
Action: Support continued investigation of near channel erosion hazards and development of predictive models and methods to analyze the unique near channel erosion and riverine evolution processes in Blue Earth County so that more specific erosion hazard area boundaries can be identified and development steered away from hazard areas with local plans and zoning ordinances.	BEC, MNDNR	unknown	unknown	Information will help prioritize and target near channel erosion and landslide projects and local prevention and mitigation policies	
STRATEGY: STATE SEDIMENT STUDY PRIORITIES.					Blue Earth, Le Sueur, Watonwan

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Action: Support "Studying changes in near-channel loading" to gain a better understanding of how near-channel loading will change as recent increases in stream flows reach equilibrium. Once flows stabilize, channel widening should also stabilize along with near-channel sediment mobilization and transport. When will this happen, how large the decrease may be, and what a new baseline will be remains unclear." (Source: Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River, January 2015, MPCA)	BEC	unknown	state budget	The County will use the results of the study for land use, hazard mitigation and watershed planning.	
Action: Support "Predicting which other landscape features will erode at high rates." "Air photo analysis has identified bluffs that have eroded rapidly over the past 60 years, although this is not a guarantee that these bluffs will continue to erode at a high rate in the future (e.g., the bluff erosion may have resulted after only one or two large events). Further analysis is needed to indicate the combination of bluff composition, geometry, and aspect that are most likely to produce large erosion rates in the future as well as the hydrologic (seepage and undercutting) and thermal (freeze-thaw) conditions that accelerate bluff failure (Gran et al. 2011)." (Source: Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River, January 2015, MPCA)	BEC	unknown	state budget	The County will use the results of the study for land use, hazard mitigation and watershed planning.	
Action: Support "Monitoring at knickpoints." "Monitoring above and below these features can help to identify sediment sources and constrain sediment loading. Monitoring the erosive features directly using ground-based LiDAR, fingerprinting, and/or field surveys provides significant benefits. Load monitoring at the watershed outlets alone is insufficient to identify and ultimately target the appropriate areas for sediment reducing BMPs. Hence there is a need to keep many of the intermediate monitoring stations in place." (MPCA 2012a) (Source: Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River, January 2015, MPCA)	BEC	unknown	state budget	The County will use the results of the study for land use, hazard mitigation and watershed planning.	
Project Strategies					
STRATEGY: NATURAL RESOURCE PROTECTION.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Implement low cost, natural resource protection projects to preserve the function of natural systems in addition to minimizing losses. Low cost options might include toe wood, bend way weirs, live willow staking, and turf reinforcement mats.	BEC, SWCD	2018-2026	unknown	2 Low cost natural resources protection projects	
Action: Affected landowners will implement projects that reduce near-channel erosion and restore stream corridors and vegetation in areas with erosion hazards.	BEC, SWCD	2018-2026	$100,000	2 stream channel restoration projects	
STRATEGY: NATURAL RESOURCE PROTECTION - WATER STORAGE.					Blue Earth, Le Sueur, Middle MN, Watonwan

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Action: Control stormwater runoff to prevent convergence of surface water to prevent channelized flow and the formation of gullies.	BEC, SWCD, All LGUs	2019-2026	unknown	to be determined with near channel and ravine erosion implementation plans and future stormwater ordinances	
Action: Restore wetlands, construct targeted stormwater retention projects and manage sub-surface discharges to reduce runoff to stream banks, bluffs, and ravines in priority areas identified in the Blue Earth County Water Management Plan, local engineering studies, stormwater management plans and other plans that address water storage.	BEC, SWCD, All LGUs	2019-2026	unknown	to be determined with near channel and ravine erosion implementation plans	
Action: Establish or maintain deep rooted, permanent vegetation in shore impact zone and along stream channel bluffs.	BEC, SWCD, All LGUs	2019-2026	unknown	to be determined with near channel and ravine erosion implementation plans	
STRATEGY: STRUCTURAL IMPROVEMENTS AND NATURAL RESOURCE PROTECTION.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Stabilize and protect streambanks outlining the surficial sands aquifer and City of Mankato's public water supply wells at the confluence of the Minnesota and Blue Earth Rivers in Land of Memories Park.	Mankato	2017-2019	$2,000,000	Stabilized stream banks	
Action: Restore and stabilize streambanks to protect existing roadways and bridges in the Blue Earth watershed, Le Sueur River, Middle Minnesota watershed and the Watonwan River watersheds.	BEC	2017-2026	$3,000,000	1 stabilization project in each watershed	
Action: Restore and stabilize streambanks to protect public parklands affected by near channel erosion.	BEC	2017-2026	$2,000,000	3 stabilization projects	
STRATEGY: PROPERTY PROTECTION – REMOVE STRUCTURES.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Landowners will remove structures that are immediately threatened by near channel erosion.	landowners	2017-2026	$800,000	Remove an estimated 4 dwellings in hazard areas	
Action: When eligible for state and federal assistance for acquisition, appropriate local units of government will assist landowners with applications for state and federal agency acquisition programs.	BEC	2017-2026	$75,000	Administer 4 FEMA acquisition grant applications	
Watershed Management Strategies STRATEGY: PLANNING.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Work with counties and SWCDs upstream in the Blue Earth River, Le Sueur River, Middle Minnesota and Watonwan River watersheds to identify and prioritize sites and establish water storage projects to reduce peak flows.	BEC, SWCD, Brown County, Waseca County Watonwan County, Martin County, Faribault Count	2019-2023	$60,000	Landscape depression analysis in all upstream Counties	
Goal: Minimize ravine and gully erosion by managing hydrology and restoring stream channels in ravine watersheds.					

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
ONGOING STRATEGY: PRIORITIZING AND TARGETING RAVINES.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Identify, assess and prioritize ravine erosion, hazards and potential projects to facilitate coordination and implementation.	**BEC, SWCD**	2017-2026	unknown		
Action: Reduce drainage to ravines with targeted wetland restoration and construction of water storage practices.	SWCD	2017-2026	unknown	unknown	
Action: Stabilize ravines with water storage, grade control structures and other conveyance systems that manage water draining to ravines.	SWCD	2017-2026	$1,200,000	Stabilize 20 ravines	
Action: Restore vegetation in ravine stream channels and side slopes.	SWCD	2017-2026	$25,000	10 sites planted with native grass	
Indian Creek Watershed					
STRATEGY: INDIAN CREEK WATERSHED RAVINES STRUCTURAL and NATURAL RESOURCE PROTECTION:					Middle MN
Action: Restore wetlands and increase water storage in the uplands draining to ravines in the Indian Creek Watershed.	BEC, Mankato, Mankato TWP, SWCD, BEC DA	2018-2026	$1,500,000	Water storage in wetlands and/or stormwater storage improvements on land currently outside of city limits in Indian Creek Watershed	
Action: Increase water storage to reduce runoff from Minnesota State University - Mankato MS4 draining to ravines and steep slopes in the Indian Creek Watershed.	State of Minnesota	2018-2026	state property	Correction/stabilization of at least 2 problem erosion sites	
Action: Restore wetlands and increase water storage in the County Ditch 69 and County Ditch 98 watersheds in areas identified in the Priority Areas for Protection and Restoration section of this plan, the City of Mankato Park and Open Space Plan, the Indian Creek watershed assessment or the Indian Creek Clean Water Partnership.	BEC, Mankato	2018-2026	Cost above		
Action: Construct channel restoration and slope stabilization in ravines to reduce erosion in the Indian Creek Watershed as identified in the Indian Creek watershed assessment, the County's ravine assessment, Mankato Township or the City of Skyline.	Skyline, Mankato TWP, BEC	2018-2026	unknown		
Action: Enhance regional stormwater ponds to reduce discharges to ravines in the Indian Creek watershed.	Mankato	2018-2026	Cost above	Additional Water Storage	
Thompson Creek Watershed					
STRATEGY: STRUCTURAL AND NATURAL RESOURCE PROTECTION:					Middle MN
Action: Construct channel restoration, bluff protection and grade stabilization to reduce erosion in the Thompson Creek watershed as identified in the Thompson Creek watershed assessment and Clean Water Partnership and City of Mankato stormwater plans.	City Mankato	2019-2026	unknown	Ravine/creek stabilization and channel restoration	
Wilson Creek Watershed					

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
STRATEGY: STRUCTURAL AND NATURAL RESOURCE PROTECTION:					Le Sueur
Action: Protect and restore wetlands and increase water storage in the County Ditch 12 watershed in areas identified in the Blue Earth County Water Management Plan, City of Mankato Park and Open Space Plan or City of Mankato Wilson Creek Stormwater Master plan.	City Mankato, BEC	2017-2026	$300,000	2 wetland restoration projects	
Action: Construct channel and slope stabilization practices in the Wilson Creek ravine as identified in the City of Mankato Wilson Creek stormwater master plan.	City Mankato	2018-2026	$1,000,000	1 Ravine/creek stabilization and channel restoration	

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
County Ditches - 103E Drainage Ditches					
GOAL: Drainage project planning will identify potential wetland preservation and restoration projects, creation of water quality improvements or flood control					
Coordination and External Funding Strategies					
STRATEGY: COORDINATION.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: A local drainage project coordination team will meet at least annually to identify and prioritize drainage projects, identify potential grant opportunities and coordinate preparation of grant applications for 103E drainage systems. The coordination team will include local staff of the drainage authority, SWCD and county water planning, project engineers and other agency representatives as needed.	BEC	2017-2026	no budget	Coordination of at least 10 annual meetings	
STRATEGY: PRIORITIZING AND TARGETING.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: The local drainage project coordination team will identify and prioritize drainage systems for planning and implementation project activities by considering local knowledge and organizational capacity, state and watershed plans, and local priorities which may include the following methods and criteria: • Watershed identified as a high priority in a WRAPS, TMDL, Blue Earth County Comprehensive Water Management Plan or One Watershed One Plan. (BWSR Nonpoint Funding Priority Plan) • Priority sub-watersheds identified using the best available models, decision support tools and data related to the most significant water quality problems or threats in major watersheds (BWSR Nonpoint Funding Priority Plan) • Align with priority sub-watersheds in the county as recommended by the water plan task force. • Downstream flooding and erosion concerns (Minnesota Statutes 2017, section 103E.015, subdivision 1 and 1a) • Landowners' interest in water quality improvement • Erosion and sedimentation documented in drainage system repair history • Environmental, land use and multipurpose drainage criteria in accordance with Minnesota Statutes 2017, section 103E.015, subdivision 1 and 1a • Criteria in updated BWSR nonpoint funding priority plans or similar state funding plans	BEC, SWCD	2017-2026	$21,000	Prepare for 11 coordination meetings. Review WRAPS, 1W1P, State plans and county plan information for prioritizing sites at annual meetings	
Action: Blue Earth County will centralize maintenance of a hydro-conditioned DEM.	BEC	2017-2026	$12,000	Centralized DEM storage	
Action: All Drainage Authority, Environmental Services, Public Works and SWCD projects will routinely provide GIS and hydro-conditioning updates to one department maintain the DEM for shared use by all.	BEC	2017-2026	$75,000	Annual Updated DEM to include changes to drainage patterns and additional culverts, etc.	

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Wetland Preservation and Restoration, Flood Control and Water Quality Improvement Strategies					
STRATEGY: MULTIPURPOSE DRAINAGE PROJECTS.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: The Drainage Authority, County and SWCD will coordinate grant applications and construction of large scale multipurpose drainage projects in drainage systems.	BEC DA, SWCD	2017-2026	$400,000	implement 2 multipurpose drainage projects	
Altered Hydrology and Peak Flow Strategies					
STRATEGY: IDENTIFY AND QUANTIFY WATER STORAGE AND PEAK FLOWS.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: The Drainage Authority will consider the importance of water storage in ditch systems by continuing to develop and implement policies that provide incentives for wetland restoration and water storage projects in the drainage system watershed.	BEC DA	2017-2026	$15,000	Maintain and update water storage ditch benefits policy	
Action: Identify and prioritize potential sites for multiple benefits, water storage and nutrient treatment by reviewing and referencing plans, such as the Blue Earth County Water Management Plan priority areas and potential sites for conservation projects or wetland restoration and enhancement in the Priority Areas for Protection and Restoration section of this plan, other local and state-approved watershed plans to identify potential wetland restoration and water storage projects, local government land use and stormwater management plans (county, municipal and townships).	BEC DA, SWCD, BEC	2017-2026	$6,000	List or map of prioritized water storage sites for 4 ditch projects/year	
Action: Quantify how potential wetland restoration and water storage practices, if established in the drainage system, could reduce project costs, pipe sizing and the magnitude and duration of peak flows and the total volume of discharge from the drainage system to provide multipurpose water management benefits and meet local, state and watershed goals.	BEC DA	2017-2026	$250,000	Water Storage practices Contained in Drainage Repair or Improvement Report. 4 projects/year	
Action: Identify potential field-scale best practices to increase water storage, and to the extent practical, quantify the water storage benefits using the best available models and decision support tools.	BEC DA, SWCD	2017-2026	$20,000	Map of practices for 4 drainage projects/year	
Action: Potential water storage practices and quantified, potential multipurpose benefits will be presented to landowners and the Drainage Authority.	BEC DA	2017-2026		Water storage practices Include in ditch project	
Action: The County, SWCD and affected municipalities will seek external sources of funds for viable wetland restoration and water storage projects in drainage system watersheds.	BEC, SWCD, DA	2017-2026	$200,000	One wetland restoration project completed	

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
STRATEGY: QUANTITY DOWNSTREAM FLOODING AND PEAK FLOWS.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Before establishing a drainage project, the Drainage Authority will quantify current and potential flooding characteristics of property in the drainage project or system and downstream, including adequacy of the outlet for the drainage project, for 2-year and 100-year storm events in addition to the 5-year, 10-year, 25-year and 50-year events required in 103E.	BEC DA	2017-2026	Included in ditch project	Quantify current and potential flooding characteristics of property in the drainage project or system and downstream	
Action: Flooding and potential erosion characteristics will be presented to the Drainage Authority and landowners in the drainage system watershed and jurisdictions located downstream.	BEC DA	2017-2026	Included in ditch project	Flooding and erosion characteristics included in ditch project presentations	
Action Priority Areas/Watersheds: Drainage systems draining to municipalities in the county. Mankato- Indian Creek watershed, CD69 and CD98 and Le Sueur River CD12, City of Lake Crystal - CD56.					
STRATEGY: SHALLOW LAKES AND WETLANDS.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Drainage projects will quantify how drainage projects affect water levels in lake and wetlands, especially priority areas and wetlands in the Greenprint and Blue Earth County Water Management Plan.	BEC DA	2017-2026	$20,000	Quantified in Drainage Repair or Improvement Report. 2 projects/year	
Action: Reduce impacts of drainage systems by protecting and enhancing wetland buffers to prevent sedimentation and loss of water storage function.	BEC DA	2017-2026	unknown	Reduction of impacts through buffers	
Nutrient Strategies					
STRATEGY: NITROGEN TRANSPORT.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: The Drainage Authority will identify potential projects to reduce nitrate in subsurface tile drainage water and quantify how potential projects and practices, if established, could reduce nitrate in downstream waters.	BEC DA	2017-2026	$120,000	Potential projects identified for Drainage Repair or Improvement Report. 4 projects/year	
Action: Potential projects and quantified, potential multipurpose benefits will be presented to landowners and the Drainage Authority.	BEC DA	2017-2026	Included in ditch project	Nutrient reduction practices and potential quantified reductions contained in Drainage Repair or Improvement Report. 4 projects/year	
STRATEGY: PHOSPHORUS TRANSPORT.					Blue Earth, Le Sueur, Middle MN, Watonwan

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Action: The Drainage Authority will identify projects to reduce phosphorus transport to surface water from surface runoff and subsurface tile drainage water and quantify how potential projects and practices, if established, could reduce phosphorus in downstream waters	BEC DA, SWCD	2017-2026	$100,000	Potential projects identified for Drainage Repair or Improvement Report. 4 projects/year	
Action: Drainage projects will quantify and present to landowners and the Drainage Authority how potential projects and practices, if established, could reduce phosphorus in downstream waters.	BEC DA	2017-2026	Included in ditch project	Phosphorus reduction practices contained in Drainage Repair or Improvement Report. 4 projects/year	
Erosion and Sedimentation Strategies					
STRATEGY: EROSION AND SEDIMENTATION.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: Use watershed targeting tools and local knowledge to Identify and prioritize the highest contributing areas in the drainage system where field erosion and runoff deposit sediment in the drainage ditch and increase ditch maintenance over time.	BEC DA, SWCD	2017-2026	$80,000	Potential projects identified for Drainage Repair or Improvement Report. 4 projects/year	
Action: The SWCD will recommend soil health, grass waterways, WASCOBs and other in-field practices that reduce erosion from the highest contributing areas to provide multiple benefits to the drainage system.	SWCD	2017-2026	$70,000	Recommend practices in 4 drainage projects/year	
Action: The Drainage Authority and SWCD will identify near-ditch practices to trap or filter runoff to the drainage ditch if needed.	BEC DA	2017-2026	$220,000	Potential projects identified in 10 ditch systems	
Action: The Drainage Authority will identify and quantify how in-field, near-ditch and other practices, if established, could make measurable erosion and sedimentation reductions in the drainage system	BEC DA	2017-2026	$100,000	Potential projects identified in Drainage Repair or Improvement Report presented to landowners. 4 projects/year	
STRATEGY: DITCH BUFFERS.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: The County Drainage Authority will ensure buffers are maintained over time in accordance with 103E during routine drainage system inspections, 103E repairs and improvement projects.	BEC DA	2017-2026	$200,000	Inspect 10 drainage ditches each year	
Action: The County Drainage Authority will submit reports to BWSR as required by Minnesota Statutes 2017, section 103E.067.	BEC DA	2017-2026	no budget	Reports submitted	
Action: The SWCD will provide technical assistance to landowners establishing ditch buffers required by Minnesota Statutes 2017, section 103F.48.	SWCD	2017-2026	$100,000	Provide technical assistance to 300 landowners.	
Action: The County and Drainage Authority will consider enforcement of Minnesota Statutes 2017, section 103F buffer requirements for Minnesota Statutes 2017, section 103E drainage systems.	BEC DA	2017-2026	no budget		

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Stormwater Management					
GOAL: Ensure community resilience with stormwater management that prevents flooding and protects water quality.					
Education and Training Strategies					
STRATEGY: PUBLIC EDUCATION AND TRAINING.					Blue Earth, Le Sueur, Middle MN
Action: Support lake associations and the City of Lake Crystal and City of Madison Lake's education efforts to reduce illicit discharge, manage yard waste and lawn chemicals and to restore shoreland vegetation to filter pollutants and provide critical habitat.	BEC, SWCD, Madison Lake, Lake Crystal	2017-2026	$80,000	Education program to reach all Lake Crystal residents and all Madison Lake residents	
MS4 Action: Mankato Area Regional MS4 Stormwater Management Association will conduct annual stormwater meetings, maintain a website, and consider public input.	Mankato	2017-226	$50,000	1 annual stormwater meeting/year. 100 participants each year	
STRATEGY: CONTRACTOR TRAINING.					Blue Earth, Le Sueur, Middle MN
Action: Support contractor training in coordination with the Mankato Area Regional MS4 Stormwater Management Association, City of Lake Crystal, City of Madison Lake and other jurisdictions.	BEC, MS4	2017-2026	$8,000	2 contractor training sessions with estimated 35 people at each session	
STRATEGY: TRAINING LOCAL OFFICIALS.					Blue Earth, Le Sueur, Middle MN
Action: The County will partner with local municipalities to conduct periodic training on shoreland and stormwater management for elected and appointed officials and staff.	BEC, Madison Lake, Lake Crystal	2017-2026	$30,000	2 training sessions with 20 people at each session	
Action: Interested local officials will participate in the MS4 Mankato Area Regional MS4 Stormwater Management Association meetings.	All LGUs	2017-2026	no budget	20 regional meetings	
MS4 Action: the MS4 Mankato Area Regional MS4 Stormwater Management Association will train local staff on illicit discharge.	MS4	2020	$20,000	10-Annual Training Sessions for local staff	
Land Use Management and Local Controls					
STRATEGY: LAND USE PLAN.					Blue Earth, Le Sueur, Middle MN, Watonwan
Policy: Ensure community resilience with stormwater management programs, better site design and projects that protect communities from flooding, flash flooding and protect water quality. Current County Land Use Plan Action: "To minimize negative impacts from storm water runoff, the County will enact development standards for stormwater management to insure no net increase in runoff."	BEC	2017-2026	no budget	Resilience with betting design and planning	
STRATEGY: LAND USE AND STORMWATER POLICIES AND ORDINANCES.					Blue Earth, Le Sueur, Middle MN, Watonwan

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Action: Work with multiple jurisdictions to evaluate existing and potential stormwater ordinances and policies and determine if uniform approaches are desired to develop or administer local stormwater regulations.	BEC - All LGU's	2018-2024	$50,000	Contact and coordinate meetings with 11 municipalities and 4 townships with land use controls.	
Action: Research existing stormwater guidance and regulations in Minnesota.	BEC	2017-2019	$20,000	Analysis, Technical memo of existing local rules and State Rules	
Action: Prepare and adopt changes to policies and ordinances in participating jurisdictions to help ensure stormwater and its pollutants do not negatively impact surface waters.	All LGUs	2018-2026	$30,000	Updated Ordinances to manage stormwater	
Action: Seek funds for interested local communities and watersheds to develop ordinances and policies for stormwater management.	All LGUs	2018-2024	$10,000	Grant funds for develop ordinances and policies	
Action: Develop local funding mechanisms and seek funds to establish technical staff positions and/or services to implement stormwater ordinances and standards.	All LGUs	2020-2026	$750,000	One full time staff	
MS4 Action: To implement the SWPPP in accordance with the regional MS4 agreement, the County will develop additional ordinances and documents necessary to support the MS4 program.	BEC	2017	$15,000	• Erosion and Sediment Control Ordinance • Grading Manual • Land Disturbance Permit Application	
Erosion Control Strategies					
STRATEGY: CONSTRUCTION SITE EROSION.					Blue Earth, Le Sueur, Middle MN, Watonwan
Action: The County will continue to require site owners/contractors obtain required MPCA construction stormwater permits.	BEC	2017-2026	$50,000	20 new dwellings each year with proper permits and erosion control	
MS4 Action: The MS4s will conduct site inspections	MS4	2017-2026	$300,000	Site inspections for MS4. 10 sites/year	
Stormwater Management Approaches					
STRATEGY: GREENPRINT GREEN INFRASTRUCTURE.					Blue Earth, Le Sueur, Middle MN
Action: Seek funds and develop local funding mechanisms to design and implement green infrastructure practices with interconnected wetlands, water storage, vegetated swales and buffers, trails, parks and open space to protect water quality and prevent pollution.	BEC - MS4	2018-2026	$50,000	Receive grants and establish funding mechanisms to construct multi-million dollar green infrastructure projects	
Stormwater Management System Strategies					
STRATEGY: EXISTING STORMWATER RETENTION BASINS.					Blue Earth, Le Sueur, Middle MN

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Action: The County will conduct an inventory and assessment of stormwater retention systems on privately-owned land outside of MS4 jurisdictions and develop means for inspecting these systems.	BEC	2018-2020	$5,000	Inventory and Assessment of privately owned stormwater systems	
MS4 Action: Mankato Area Regional MS4 Stormwater Management Association members will inspect structural pollution control devices annually and ponds and outfalls within the permit cycle.	MS4	2017-2026	$40,000	Annual Inspections	
STRATEGY: STORMWATER RETROFITS.					Blue Earth, Le Sueur, Middle MN
Action: Support stormwater retrofits in areas with residential and urban development where water storage, flow attenuation, flood water storage or nutrient treatment functions are needed for water quality or to prevent flooding or erosion downstream.	All LGU's	2018-2026	$200,000	Five projects	
STRATEGY: CONSTRUCTED WETLANDS AND WATER QUALITY TREATMENT WETLANDS.					Blue Earth, Le Sueur, Middle MN
Action: Constructed wetlands, stormwater wetlands or water quality treatment wetlands should be considered in watersheds where water storage, flow attenuation, flood water storage or nutrient treatment functions are needed to address water quality concerns or to prevent flooding or erosion downstream.	All LGU's	2018-2026	$400,000	Up to four projects	

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Wastewater Treatment					
Goal: Eliminate discharge of untreated and undertreated wastewater to surface water and groundwater.					
ONGOING STRATEGY: MUNICIPAL WASTEWATER TREATMENT.					Blue Earth, Le Sueur, Middle MN
STRATEGY: MAINTAIN CAPACITY.					Blue Earth, Le Sueur, Middle MN
Action: Support water conservation and reuse projects to ensure treatment system capacity.	All cities	2017-2026	No budget	Maintain wastewater treatment plant capacity	
Action: Reduce inflow and infiltration (I&I) in all cities and townships using municipal wastewater treatment facilities.	All cities	2017-2026	$1,700,000	Conduct I&I inspections in multiple cities	
Action: Reduce pollutants entering wastewater treatment facilities with pre-treatment and waste reduction measures.	All cities	2017-2026	Local industries have spent millions on pre-treatment	More efficient and effective wastewater treatment	
STRATEGY: PLANNING.					Blue Earth, Le Sueur, Middle MN
Action: Plan and implement expansions of area served by publicly owned, centralized wastewater treatment where needed to serve existing populations and planned future growth.	All cities	2017-2026	no budget	More efficient and effective wastewater treatment	
Decentralized Wastewater Treatment **Goal: Ensure all subsurface sewage treatment systems (SSTS) are in compliance with Blue Earth County Code.**					
ONGOING STRATEGY: COUNTY SSTS PROGRAM.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: The County will maintain qualified staff to administer the local SSTS program.	BEC	2017-2026	$1,200,000	Staff and equipment to ensure that SSTS program is maintained to protect ground water, surface waters, and public health	
Action: The County will issue permits, conduct inspections and maintain records for SSTS in Blue Earth County.	BEC	2017-2026	Included in SSTS program budget	Records maintenance and inspections to ensure protection of ground water and surface water	
Action: The County will maintain and update the County SSTS Ordinance consistent with State Statutes and local goals.	BEC	2017-2026	Included in SSTS program budget	Local ordinance Updates	

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
ONGOING STRATEGY: SSTS COMPLIANCE.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: Update and analyze all available data to reasonably estimate the number of imminent public health threats and determine a baseline to evaluate future results related to this goal.	BEC	2017-2026	$10,000	Updated data and analysis to accurately determine baseline number of systems that are imminent threats to public health	
Action: The County will continue to enforce compliance triggers in the Blue Earth County Code that require compliance inspections at 1) property transfer, and 2) in conjunction with all land use permits, including construction permits, conditional use permits and variances.	BEC	2017-2026	$10,125,000	Replacement of 75 septic systems per year for total of 750 systems replaced (cost reflects $13,500 average cost per system)	
Action: The County will continue to ensure the availability of low interest loans for replacement SSTS construction for existing, occupied dwellings.	BEC	2017-2026	$25,000	Availability of low interest loan program	
Action: Prioritize SSTS upgrades for systems in areas with high groundwater pollution sensitivity.	BEC	2017-2026	Included in SSTS program budget	Replacement of SSTS in sensitive areas	
STRATEGY: SSTS MAINTENANCE.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: The County will evaluate compliance with SSTS maintenance requirements and will work with SSTS maintainers (pumpers) to identify and address education, disposal and other needs related to septic system maintenance issues.	BEC	2019-2021	Included in SSTS program budget	Develop compliance report and assessment	
Land Use Management Strategies					
STRATEGY: LAND USE PERMITS.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: Coordinate review of land use permits in the county to ensure compliance inspections are conducted and replacement systems are constructed when required.	BEC	2017-2026	Included in SSTS program budget		
STRATEGY: CLASS V INJECTION WELLS.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: Blue Earth County, Lime Township, Mankato Township and jurisdictions with planning and zoning authority will ensure the types of land uses likely to be defined as Class V injection wells, such as automotive repair, vehicle washes, health care, multifamily dwellings, and manufacturing are steered to areas with centralized wastewater treatment. This is especially important in areas with moderate and high pollution sensitivity.	BEC, Lime Twp., Mankato TWP	2017-2026	no budget	Land Use Plan updates and ordinance administration to ensure protection of ground water	

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Action: Jurisdictions in areas with moderate and high pollution sensitivity will eliminate Class V injection wells for stormwater management.	MS4, Lime Twp.,	2017-2026	unknown	Elimination of Class V Wells when necessary	
STRATEGY: LAND USE PLANS.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Policy: Support long term, sustainable wastewater treatment to protect groundwater and surface water from contamination from sewage and hazardous substances.	BEC	2017-2026	no budget	County Land Use Plan	
Policy: Continue to support orderly annexation agreements and coordinated sewer extension projects.	BEC	2017-2026	no budget	County Land Use Plan	
Policy: Continue County Land Use Plan policies that encourage growth in municipalities or areas with city sewer to ensure that wastewater treatment needs for the future are met and to help reduce long-term costs associated with growth to the taxpayers.	BEC	2017-2026	no budget	County Land Use Plan	
SEPTAGE MANAGEMENT GOALS AND STRATEGIES **Goal: Septage will be managed to reduce potential contamination of surface and groundwater resources.**					
STRATEGY: MANAGE LAND APPLICATION.					Middle MN, Blue Earth, Le Sueur
Action: The County will evaluate SSTS maintainers' septage management systems, including disposal, storage and land application and will work with SSTS pumpers, contractors, municipalities and other representatives to assess needs related to septage management in the county.	BEC	2017-2026	$18,000	Evaluations of land application sites and at least one inspection per year of sites	
Action: The County will display on its website maps of areas in the county with moderate and high groundwater pollution sensitivity as shown in Blue Earth County Geologic Atlas, Part B.	BEC	2017-2026	$1,000	On-line map that can be used to assess land application sites to determine sensitivity for groundwater pollution	

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Aquatic Invasive Species					
Goal: Help prevent the spread of aquatic invasive species throughout the region and Minnesota.					
STRATEGY: AIS PREVENTION AID GUIDELINES.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: Prepare AIS Prevention Aid Guidelines as required by Minnesota Statutes 2017, section 477A.19.	BEC	2017-2026	no budget	Updated Guidelines for the AIS Aid	
Action: The County will work with lake associations, conservation organizations, the MNDNR and other local partners to prepare and implement AIS Prevention Aid Guidelines for the county.	BEC	2017-2026	$1,000,000	AIS Prevention Education and outreach to prevent spread of AIS in accordance with the County Guidelines	
STRATEGY: HERBICIDES FOR MANAGEMENT OF INVASIVE VEGETATION.					Le Sueur, Middle MN are Primary
Action: Support herbicide treatment of infested waters when funds are available and allowed by the County's AIS Prevention Aid Guidelines, and only to the extent permitted and recommended by the MNDNR fisheries and AIS program staff.	BEC	2017-2026	$60,000	Annual treatment of Lakes recommended by MNDNR	
STRATEGY: LAKE RECLAMATION.					Middle MN
Action: Support lake reclamation projects initiated and fully supported by lake associations and lake shore residents.	BEC	2017-2026	$520,000	Lake reclamation of Crystal Lake if supported by Lake Crystal, property owners, Crystal Waters project and MNDNR	Middle MN

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Wetlands					
GOAL: Protect, enhance and restore wetlands in priority areas to provide important water quality, wildlife habitat and groundwater protection functions in local watersheds.					
Wetland Conservation Act (WCA) Strategies and Policies					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: The County will continue to administer the Wetland Conservation Act, Minnesota Rules part 8420, in accordance with Minnesota rules and statutes and with guidance from the Blue Earth County Water Management Plan.	BEC	2017-2026	$1,000,000	Administration of WCA to protect wetlands in accordance with State and County Rules	
SEQUENCING POLICY: IMPACT AVOIDANCE AND MINIMIZATION.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Policy: When evaluating wetland impact avoidance and minimization, the LGU and TEP should consider the functional classification of the wetland(s) and their public value in relation to priority preservation and replacement areas as designated in the Blue Earth County Water Management Plan. (Reference: Minnesota Rules, part 8420.0520 subpart 3C (3) (f) and subpart 4E.)	BEC other WCA LGU's	2017-2026	In Wetland program budget	Policy Implementation	
SEQUENCING POLICY: FLEXIBILITY.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Policy: When evaluating whether or not to exercise flexibility in the application of the sequencing steps, the LGU and TEP should consider the functional classification of the wetland(s) and the priority wetland replacement areas in the Blue Earth County Water Management Plan. (Reference: Minnesota Rules, part 8420.0520 subpart 7A(1) and 7B.)	BEC other WCA LGU's	2017-2026	In Wetland program budget	Policy Implementation	
REPLACEMENT STANDARDS POLICY: ECOLOGICAL SUITABILITY.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Policy: When evaluating and determining the appropriate location, type, function, design and ecological suitability of replacement wetlands, the LGU and TEP should consider the priority wetland replacement areas in the Blue Earth County Water Management Plan. (Reference: Minnesota Rules, part 8420.0522 subpart 5D and part8420.0528 subpart 1.)	BEC other WCA LGU's	2017-2026	In Wetland program budget	Policy Implementation	

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Wetland Planning					
STRATEGY: WETLAND REPLACEMENT SITES.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: The County may continue to collaborate with other local units of government, regulatory agencies and other entities to identify potential replacement opportunities in local watersheds to achieve plan goals. (Reference: Minnesota Rules, part 8420.0520 subpart 7F.)	BEC other WCA LGU's	2017-2026	In Wetland program budget	Policy Implementation	
STRATEGY: COMPREHENSIVE WETLAND PROTECTION AND MANAGEMENT PLAN. The County may consider development of a Comprehensive Wetland Protection and Management Plan as an alternative to WCA rules in accordance with Minnesota Rules part 8420.0830.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Wetland Protection, Enhancement and Restoration Strategies					
PRIORITY WETLANDS POLICY: PRIORITY WETLAND FUNCTIONS FRAMEWORK.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Policy: Local units of government should consider the wetland functions classification framework and the natural resource priority areas in the Priority Areas for Protection and Restoration Section of the Blue Earth County Water Management Plan when developing all types of land use and comprehensive plans. (Reference: Minnesota Statutes 2017, section 394.23, 394.231, 462.357 subdivision 9)	BEC other WCA LGU's	2017-2026	In Wetland program budget	Policy Implementation	
STRATEGY: AQUATIC AND NATURAL RESOURCES IN LAKE WATERSHEDS.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: Protect, enhance and restore wetlands and aquatic vegetation in near-shore areas to provide critical fish and wildlife habitat and shoreline protection from waves and ice ridges.	BEC other WCA LGU's	2017-2026	In Wetland program budget	Policy Implementation to protect critical habitat and shorelines	
Action: Protect, enhance and restore water quality, water storage, fish and wildlife habitat and recreation functions with wetland restoration, wetland and upland buffers for habitat and erosion control, constructed wetlands, stormwater quality treatment wetlands or similar conservation projects in lake watersheds.	BEC other WCA LGU's	2017-2026	In Wetland program budget	Policy Implementation to protect critical habitat and shorelines	

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
STRATEGY: AQUATIC AND NATURAL RESOURCES IN GREENPRINT PRIOIRTY AREAS.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Land Use Policy: Local government units in the county will consider minimizing fragmentation and development of woodlands, wildlife habitat, open space, shoreland, and wetlands in Greenprint priority areas. (Reference: Minnesota Statutes 2017, sections 394.23, 394.231, 462.357 subdivision 9)	BEC other WCA LGU's	2017-2026	No budget	Policy Implementation to protect wetlands	
Action: Protect, enhance and restore wetlands and natural resources and restore channelized streams in Greenprint river corridors to provide wildlife habitat, floodwater storage, groundwater recharge, nutrient assimilation, water quality, open space and recreation functions.	BEC other WCA LGU's	2017-2026	No budget	Policy Implementation to protect wetlands	
Action: Protect, enhance and restore wetlands and upland wildlife habitat and grasslands in Greenprint wetland complexes, shoreland and river corridors.	BEC other WCA LGU's	2017-2026	No budget	Policy Implementation to protect wetlands	
Action: Seek funds and support private and non-profit partnerships and investments to protect, enhance and restore wetlands, upland habitat, other natural resources and recreation in the Greenprint and priority areas in the Priority Areas for Protection and Restoration Section of the Blue Earth County Water Management Plan.	BEC other WCA LGU's	2017-2026	Unknown	Wetland Restorations in priority areas	
STRATEGY: GROUNDWATER PROTECTION AND RECHARGE FUNCTIONS.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: Protect and restore wetlands and upland buffers in areas with the potential to recharge buried sand and bedrock aquifers and in areas with moderate or high pollution sensitivity as shown in the Geologic Atlas of Blue Earth County, Part B or the Priority Areas for Protection and Restoration Section of the Blue Earth County Water Management Plan.	BEC other WCA LGU's	2017-2026	No budget	Policy Implementation to protect wetlands and Wetland Restorations in priority areas	
STRATEGY: WATER STORAGE FUNCTIONS.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: Ensure community resilience with wetland protection, enhancement and restoration, constructed wetlands, water quality treatment wetlands and other water storage practices to minimize flooding and/or erosion in ravines and downstream channels.	BEC other WCA LGU's	2017-2026	No budget		
STRATEGY: NUTRIENT ASSIMILATION AND TREATMENT FUNCTIONS.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon

	Responsible Agency	Timeframe	Expected Cost - Estimated Budget	Anticipated Result	Watersheds Benefitting from Strategy
Action: Protect, enhance and restore wetlands or wetland functions to provide treatment for nitrogen and phosphorus in priority areas and watersheds in the Blue Earth County Water Management Plan.	BEC other WCA LGU's	2017-2026	No budget		
STRATEGY: STORMWATER AND WATER QUALTY TREATMENT WETLANDS.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: Constructed wetlands or water quality treatment wetlands should be considered in watersheds where water storage, flow attenuation, flood water storage or nutrient treatment functions are needed for water quality or to prevent flooding or erosion downstream.	BEC other WCA LGU's	2017-2026	No budget		
Wetland Protection Strategies					
STRATEGY: UPLAND BUFFERS AND SETBACKS FOR WETLANDS.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: The County will ensure wetland functions are protected with upland buffers a minimum of 16.5 feet from wetlands when subdivisions are created.	BEC other WCA LGU's	2017-2026	No budget	Wetland quality protection through buffers	
Action: Local units of government in the county will continue to ensure wetland functions are protected with existing structural setbacks and upland buffers.	BEC other WCA LGU's	2017-2026	No budget	Wetland quality protection through buffers	
Action: Local units of government in the county will consider wetland buffers and/or structural setback requirements, conservation easements, or open space dedication to protect wetlands from accelerated sedimentation and loss of water storage, loss of habitat or encroachment from surrounding land uses.	BEC other WCA LGU's	2017-2026	No budget	Wetland quality protection through buffers	
STRATEGY: CONSTRUCTION STORMWATER CONTROLS.					Blue Earth, Le Sueur, Middle MN, Watonwan, Cannon
Action: Protect wetlands from development impacts during construction with vegetated buffers, perimeter controls and other erosion control strategies to ensure wetland storage volume is not diminished due to accelerated erosion and sedimentation. (Reference: MPCA NPDES Construction General Permit)	BEC other WCA LGU's	2017-2026	No budget	Wetland protection through best stormwater practices	
Action: Ensure that existing wetland hydrology is maintained and stormwater discharged from development projects and permanent stormwater systems does not cause a significant adverse impact to wetlands from inundation or decrease of flow. (Reference: MPCA NPDES Construction General Permit)	BEC other WCA LGU's	2017-2026	No budget	Wetland protection through best stormwater practices	