ANOKA SAND PLAIN PARTNERSHIP

10 – Year Strategic Conservation Action Plan

Photo credit: Rogene Schnell creative commons

The Anoka Sand Plain (ASP) Partnership has set forth the following plan for interagency communication and cooperation toward the goal of conserving the rich biological diversity, good water quality, and outdoor recreation throughout the Anoka Sand Plain ecoregion.

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EXECUTIVE SUMMARY

The Anoka Sand Plain (ASP) Partnership has developed a conservation plan to collaboratively identify and implement projects that protect, restore and enhance the landscape through strategic actions and locations to maximize conservation goals. Strategic prioritization is critical due to the increased land conversion and development that threats the vital ecosystem services within the ASP Region.

This plan highlights the ecological significance of habitats within the Region and role in high quality surface and groundwater, including serving as a drinking water source for the Twin Cities. It outlines a shared conservation vision for the region, defines the Partnership's priorities and principles, and provides a strategic framework for prioritizing targeted conservation actions. Furthermore, this plan discusses the current threats, and opportunities for creating resilient landscapes, sustainable water resources and recreational opportunities with the ASP. This strategic action plan will be used by the ASP Partnership and its members to identify priority conservation opportunity areas, vet proposals pursued under the umbrella of the partnership, ensure all projects are consistent with the Partnership's mission, goals, and objectives, and serve as a tool for measuring success toward stated outcomes.

The ASP is located within the transitional zone between semi-arid prairie and semi-humid mixed forest. Its unique geology creates a mosaic of rare sand dunes, upland prairie, oak-savanna, woodlands, wetland complexes, and lakes. The Mississippi and Rum River, two of the seven Minnesota's Wild and Scenic Rivers are also within the ASP. The ASP Partnership envisions that increased protection, restoration and enhancement efforts will lead to a landscape that will provide high quality habitat core and corridors, recreational opportunities, clean drinking water, and a community that values its remarkable natural resources.

The Partnership defined conservation goals to collaboratively and efficiently conserve and restore the remarkable resources found in the ASP Region:

Outstanding Ecology and Healthy Ecosystems

- Protect key land to maintain habitat cores and conservation corridors to minimize the impacts of new development and enhance native plant communities and wildlife resiliency.
- Restore high priority native plant communities in sufficient scale and connectivity to ensure the long-term resilience and viability of the region's remarkable ecological heritage in the face of climatological, anthropogenic and environmental threats.
- Enhance native plant communities in the ASP across the public-private continuum utilizing appropriate ecological-based management techniques.

Quality Surface Water and Groundwater

- Protect, restore and enhance the hydrologic function of the ASP landscape.
- Ensure surface waters, including lakes, rivers and streams, meet state water quality standards to provide quality drinking water and aquatic habitats.
- Protect, restore and enhance groundwater in the ASP and specifically in areas that are important for recharge or local and regional aquifer to ensure long-term source water for the region.

Close to Home Recreation

- Increase public access to and use of public lands to strengthen appreciation of protection, restoration, and conservation activities.

Community Engagement

- Promote stewardship, transfer skills, and involve citizens in natural resource management projects and decision making to create a deeper understanding of and support for habitat and water resource conservation.

Collaborative Anoka Sand Plain Partnership

- Strengthen the ASP Partnership aimed at increasing ecosystem resilience, wildlife habitat and watershed health and function.

ACKNOWLEDGEMENTS

The development of this document was a joint effort with many contributors including:

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THE REMARKABLE ANOKA SAND PLAIN

The Anoka Sand Plain (ASP) region of Minnesota lies at a place of transition. Where prairie and northern forest communities meet, this region consists of a patchwork of plant communities resulting from shifting disturbance patterns, landform variation and climatic divergence. The historic glacial geology further defines the Anoka Sand Plain's unique environment within this transition zone. The ASP Ecoregion covers 1.2 million acres and the HUC 12 watersheds that are part of the ASP cover 2.3 million acres. Spanning from the Twin Cities Metro Area along the Mississippi River corridor to St. Cloud (Figure 1), the ASP ecoregion is comprised of a mosaic of deep glacial outwash, dry sandy uplands interspersed with wet prairies, kettle lakes, mostly free flowing riverine systems, and critically endangered oak savanna woodlands.

The unique geology and location of the region results in a landscape that is significant for both surface water supply and groundwater storage and recharge, making it critically important for supplying fresh drinking water to millions of Minnesotans. This region serves as a refuge for a diversity of globally unique species and rare native plant communities, including many state-listed species of greatest conservation need, and it is a top destination for a broad range of outdoor enthusiasts who reside in the Twin Cities Metro Area.

Once supporting expansive areas of sand dunes, dry prairie, and oak savanna interspersed within sprawling wetland complexes, habitat loss and degradation has significantly altered this landscape, leading conservation professionals and concerned citizens to come together to work to protect, restore and enhance key attributes that make this landscape so unique.

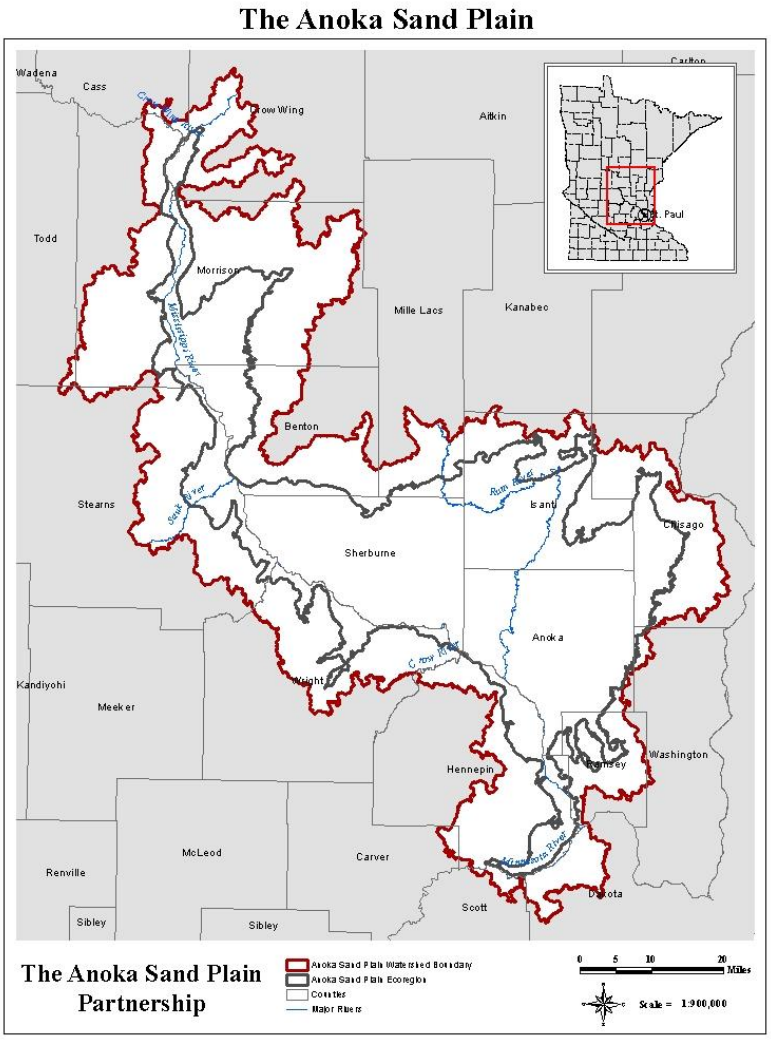

Figure 1: Anoka Sand Plain Landscape

A Vision for Conservation Success

Native prairies, oak savannas, wetland complexes, lakes and streams provide habitat for fish, wildlife, and native plants, and provide other natural benefits such as clean drinking water, flood abatement, and carbon sequestration.

The Anoka Sand Plain Partnership envisions a resilient mosaic landscape of diverse prairies, forests, wetlands, and waterbodies restored across portions of its former range on both public and private lands with sufficient scale and connectivity.

In strategic locations across this region, we will protect, restore and enhance portions of this important region so this landscape can continue to provide critical aquatic and terrestrial habitat, high quality recreational opportunities, and drinking water benefits for local and downstream communities.

Figure 2: The Rum River in Isanti County, Minnesota. One of two State-Designated Wild and Scenic Rivers within the Anoka Sand Plain region. Photo credit @Richard Hamilton Smith/TNC

Purpose of an Anoka Sand Plain Partnership

The role of the ASP in providing ecological services to the most populous region in the state, combined with the threats thereto, galvanized stakeholders to classify the ASP as a high priority for protection, restoration, and ecological management. This led to the formation of the ASP Partnership.

The ASP Partnership is a coalition of more than 25 federal, state, and local agencies, non-profit organizations, and academic institutions that come together to accelerate protection, restoration and enhancement actions. Partners work collaboratively to restore watershed health and function, improve wildlife habitat, conserve biodiversity, protect rare oak-savanna remnant patch communities, and restore the prairie-forest community mosaic to increase the region's resiliency. There is perhaps no better opportunity in Minnesota for a place-based partnership, allowing government agencies and nonprofit organizations to jointly pursue resource objectives, leverage accomplishments, and realize multiple benefits for ecological communities and human populations. The coalition brings together the members' collective expertise, resources, and energy to take targeted action that advances terrestrial and water resource conservation in the ASP.

Members have varying interests in the ASP, ranging from habitat integrity to drinking water sustainability. Their management roles are equally varied, with some members engaged in state-level policy and planning while others manage ecological restorations of varying scales. The breadth of member expertise spans the disciplines of hydrology, ecology, biology, geology, and sociology, as well as their application to planning, monitoring, management, engineering, construction, research, and education. This diversity is the foundation of the Partnership's strength. The development of this strategic plan serves to strengthen the working relationship of the multiple partners of the Sand Plain while focusing efforts toward more effective and efficient conservation action.

The partnership and this plan provide a forum and structure wherein members can identify common interests and coordinate joint action to create efficiencies and multiply outcomes to protect, enhance, restore, and manage the crucially important lands and waters of the Anoka Sand Plain region.

Outstanding Ecology and Healthy Ecosystems

The unique geology, high surficial water table, and historical use of fire creates a mosaic of dry sandy upland prairies, expansive wetlands, savanna, woodlands, and kettle lakes, which supports a unique assemblage of ecosystems. Remnant dunes within the Anoka Sand Plain provide unique habitat for rare sand-specific species. Tallgrass prairie and oak woodlands intergrade into globally imperiled oak savanna communities. Rich shallow waterbodies provide habitat for migrating and resident waterfowl. The Mississippi River and Rum River and their floodplain are a home to diverse populations of fish, amphibians, mammals, waterfowl, and birds. The well-known sandhill cranes, trumpeter swans, red-headed woodpeckers, Blanding's turtles, bald eagles and wild turkey make their home in the Anoka Sandplain.

Relic sand dunes, expansive wet prairies, and globally imperiled oak-savanna native plant communities are but a few reasons why this region in Minnesota is of conservation importance. As land has been converted for agriculture and development, fewer of these natural areas remain: oak savannas once covered over 600,000 acres of the region and now fewer than 8,000 acres remain; only 500 acres of the 160,000 acres of wet prairie in the Anoka Sand Plain remain. However, high quality remnant ecosystems are still found within the Anoka Sand Plain.

The MN County Biological Survey has ranked over 150,000 acres in the ASP Ecoregion as Outstanding or High Biodiversity. The ASP provides habitat for 97 known or predicted occurrences of Species in Greatest Conservation Need, 39 of which are federally or state endangered, threatened, or special concern. Roughly one-third of Minnesota's state listed rare plants and animals make their home in the ASP.

The State Wildlife Action Plan (Figure 3), displays the ecological significance of the ASP. The Wildlife Action Network analysis represents and scores quality aquatic and terrestrial habitats across Minnesota. The amount of habitat in the Anoka Sand Plain is remarkable given its location within the seven county Twin Cities Metropolitan area. Its proximity to the largest population center in Minnesota is important both in terms of the development pressures that threaten the Anoka Sand Plain's sustainability and the opportunity for many Minnesotans to enjoy its ecological values. The ASP Partnership is determined to protect, restore and enhance the key remaining ecosystems and habitat corridors that define this ecoregion.

- *Over 150,000 acres in the ASP Ecoregion are ranked Outstanding or High Biodiversity by the Minnesota County Biological Survey.*
- *The ASP Provides habitat for 97 known or predicted occurrences of Species of Greatest Conservation Need, 39 of which are federally or state endangered, threatened, or special concern.*
- *The ASP contains some of the best examples of the oak savanna, sand dunes, and shallow wetland plant communities.*

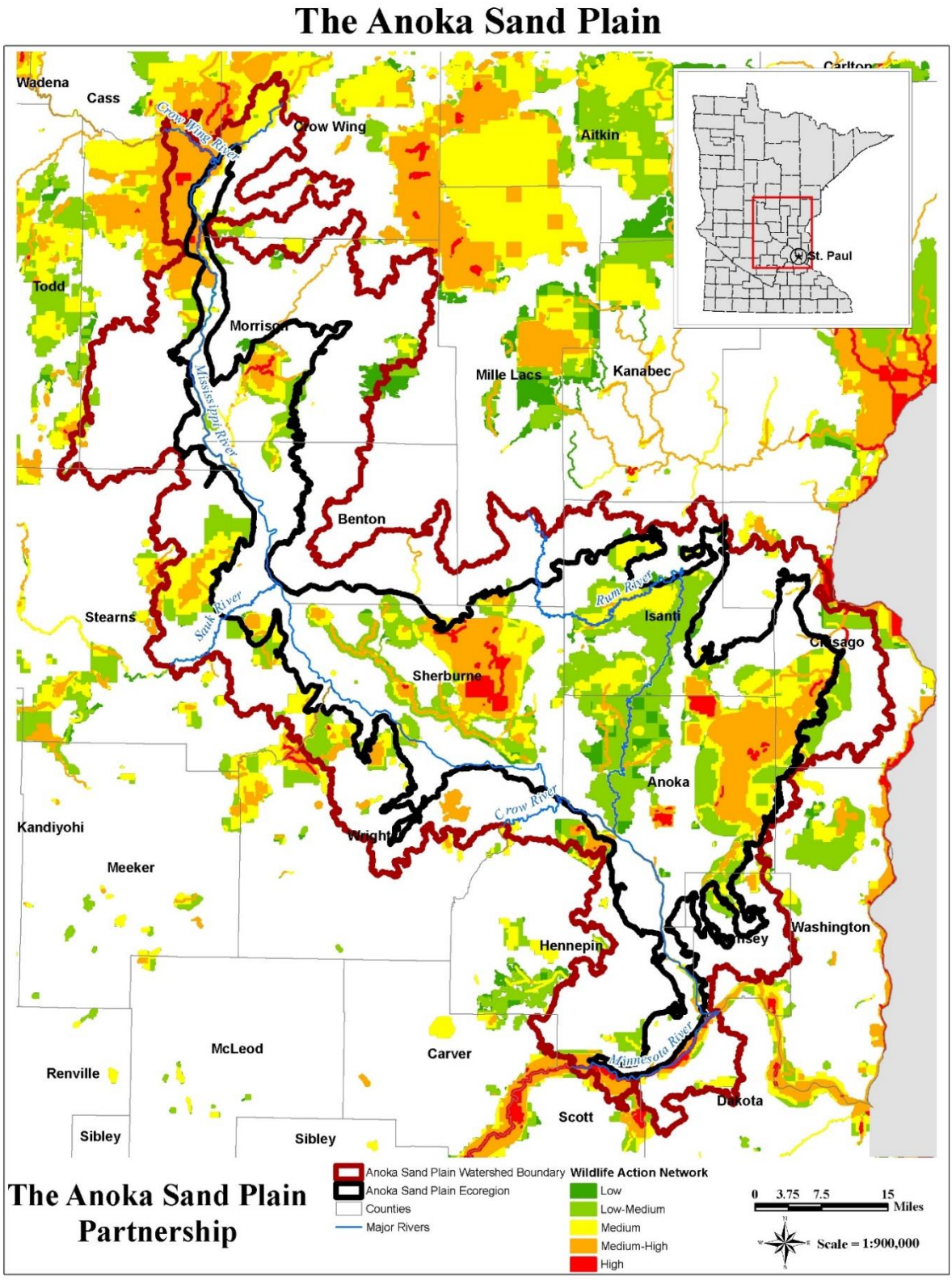

Figure 3: The Minnesota Department of Natural Resources Wildlife Action Network

QUALITY SURFACE WATER AND GROUNDWATER

The highly permeable sandy soils unique to this region optimize precipitation capture and infiltration. Precipitation is held in expansive wetlands and conveyed slowly downstream through a nearly level landscape. The numerous wetlands in the ASP provide flood protection, water purification, groundwater recharge and streamflow maintenance. The highly permeable sandy soils and numerous wetlands provide stable water levels and baseflow for the areas surface waters including the State-designated Wild and Scenic Mississippi River and Rum River.

The surficial sands in the ASP region intersect the recharge interfaces for many aquifers used for drinking water in the Twin Cities. The resultant high aquifer recharge potential is evident in Figure 4, which illustrates the much higher aquifer recharge potential of the ASP relative to the surrounding areas. The ASP also incorporates the highest priority portions of the Mississippi and Rum River watersheds for surface drinking water for the Twin Cities due to the proximity to the drinking water intake facilities. With its tremendous aquifer recharge rates as well as its influence on surface drinking water sources, the ASP is the single most important region for the supply of fresh, clean drinking water to Minnesotans. Without sufficient care and management in the ASP, source water for millions of Minnesotans will be in peril.

- *The ASP is a primary recharge area for the aquifers of the Twin Cities Metro Area due to its infiltration rates and geologic intersection with aquifer exposures.*
- *The Minneapolis and St. Paul Source Water Protection Area is composed largely of the ASP.*
- *The numerous wetlands in the ASP provide flood protection, water purification, shoreline stabilization, groundwater recharge, and streamflow maintenance.*

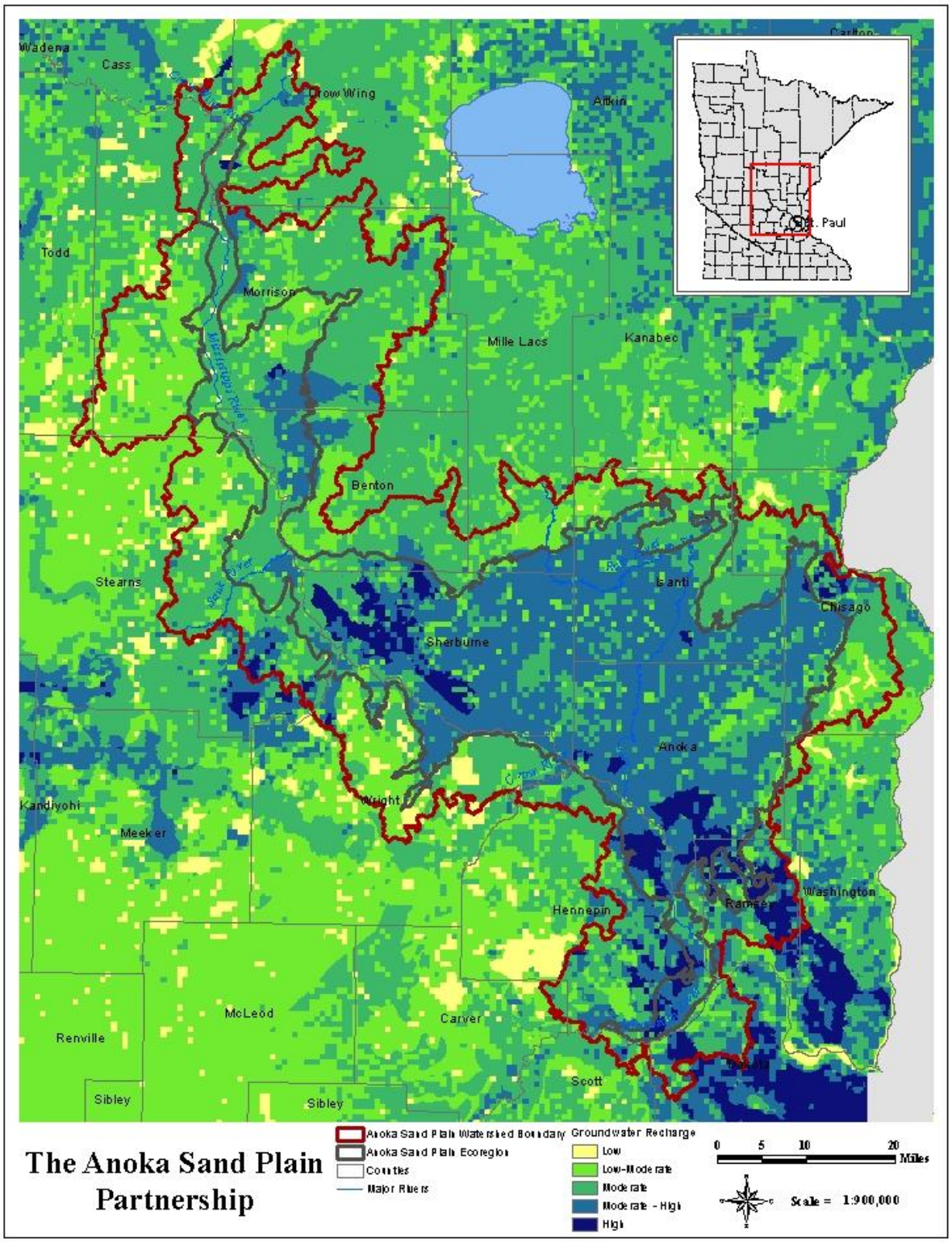

Figure 4: Groundwater recharge rates averaged over a 20-year period to yield a long-term average potential recharge.

Close to Home Recreation

The recreation potential of the Anoka Sand Plain is punctuated with two of the state's seven designated Wild and Scenic Rivers, the two largest public wildlife management areas within 50 miles of the Twin Cities, and an extensive network of county and municipal parks. These provide unparalleled nature-focused recreation opportunities within a short drive from the Twin Cities and St. Cloud including hunting, fishing, camping, kayaking, hiking, birding, and cross-country skiing. Numerous locations are open to the public for hunting including in 29 wildlife management areas (WMAs), two national wildlife refuges (NWRs), seven scientific natural areas (SNAs), one state forest, and several parks, preserves, and other properties. The ASP is a destination for paddling and fishing in the many lakes that dot the landscape and along the State Water Trails in the Sauk, Rum, and Mississippi Rivers.

The public lands in the ASP not only provide open space but also provide access to unique and highly diverse ecosystems (Figure 5). The public can explore sand dune complexes that display ecological succession, see firsthand the highly diverse remnant oak savanna that once dominated the region's landscape, and observe sandhill cranes that make their homes in wet meadows and open landscapes. The highly diverse ecosystems of the region have been identified by the MN DNR Wildlife Action Plan to support species in greatest conservation need. Audubon Minnesota designated ten sites in the ASP as Important Bird Areas that provide essential habitat for breeding, wintering, and migrating bird species. The shallow lake ecology of the region also supports the growth and traditional use of wild rice. As development inevitably increases, protection, restoration, and public engagement are necessary to ensure the public's ability to access and appreciate the ecosystems within the Anoka Sand Plain.

- *Notable ASP public open space include Sherburne NWR, Carlos Avery WMA, Crane Meadows NWR, Hellen Allison Savanna SNA, Sand Dunes State Forest, and Cedar Creek Ecosystem Science Reserve.*
- *Large tracts of protected and public land in the ASP provide habitat and access to the public: 189,615 acres of protected land; 16% of the land in the ASP is public land.*
- *The 78 miles of trout streams, 465 miles of State Water Trails along the Rum, Sauk, and Mississippi Rivers, and 108,747 acres of lakes provide aquatic recreation throughout the ASP.*

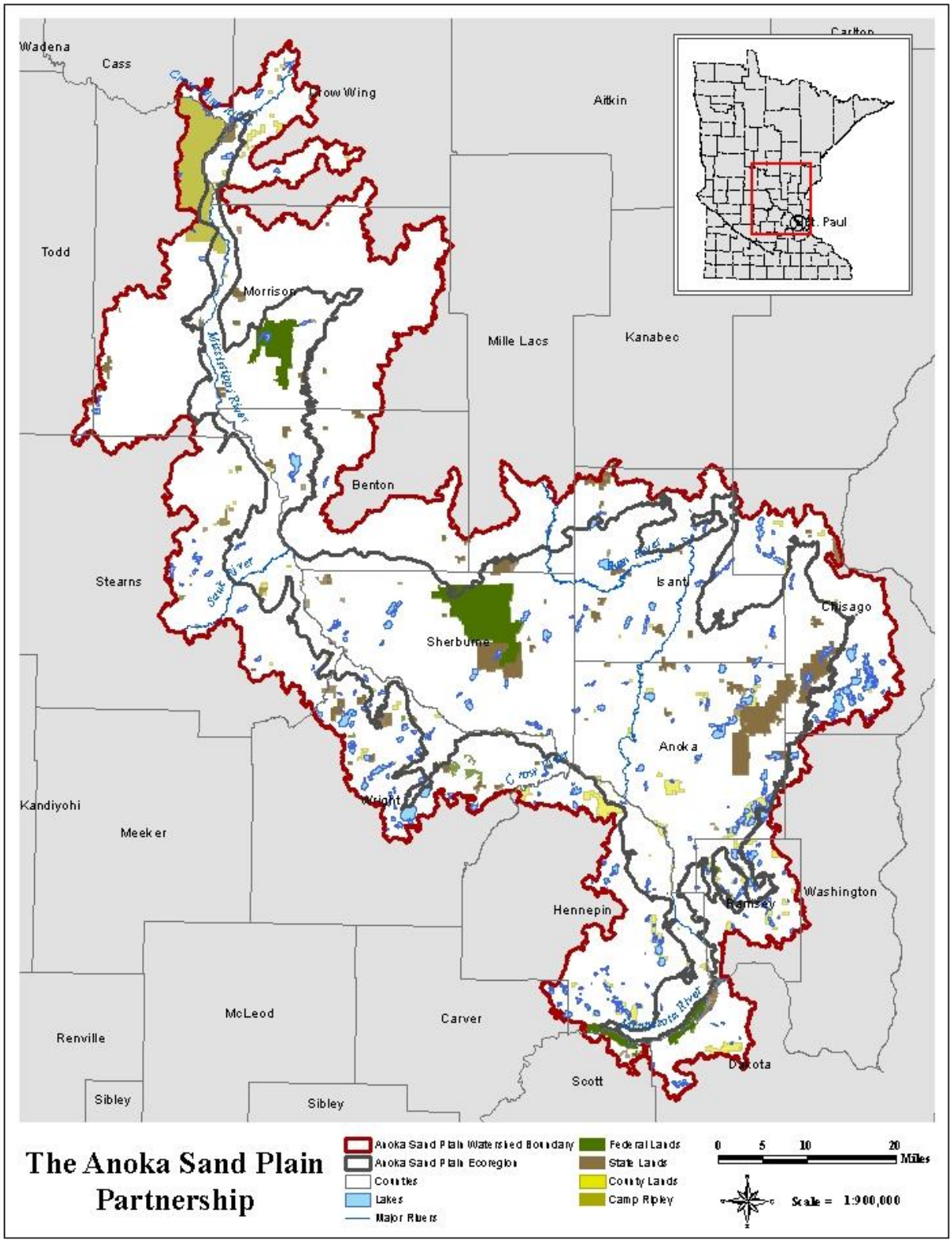

Figure 5: Public Land in the Anoka Sand Plain

LOOMING THREATS

The Anoka Sand Plain has seen an alarming rate of land conversion and development. Starting as early as the 1850's, sand dunes, dry prairie, and oak savanna gave way to grazing, crop production, and logging. Expansive wetland complexes were drained with extensive lattice works of open ditches to make the fertile underlying peat suitable for crop production. In the last fifty years, well-drained sandy upland soils, transitioned to residential housing and other development. State-wide projected growth in the region indicates that land conversion and development continue to be a threat to habitat and water quality. Minnesota's population is likely to grow from about 5.3 million people in 2010 to nearly 6.27 million people by 2030 (MNDC 2017), with much of this growth primarily focused around Minneapolis, St. Paul and St. Cloud (Figure 6).

Development disrupts habitat corridors and creates an altered edge effect to highly diverse ecosystems. The loss of habitat, introduction and spread of invasive species, and use of pesticides, cultivation and mowing to create monocultures has dramatically affected biodiversity. Land management efforts intent on keeping the region's highly erosive sandy soils in place and suppressing wild fires transformed the disturbance dependent ecosystems into plant communities unnatural to the area, pushing many species and ecosystems to the brink of collapse.

Development and land conversion with the associated irrigation, ditching, drain tile and increase in impervious surfaces also changed normal hydrologic processes, stormwater storage, and runoff characteristics of the landscape, resulting in more dramatic water level fluctuations in rivers, lakes, and wetlands. Increased runoff from impervious surfaces with commensurate reductions in infiltration suppressed shallow groundwater levels; shrinking surface waters. Not only is the quantity of water affected by land use change but the quality of water is affected as well. An increase in impervious surfaces causes stormwater to runoff, picking up trash, chemicals, oils, sediment, and nutrients, that if left untreated pollutes surface waters. The water quality of the Mississippi River that flows through the ASP region varies as land use changes. Upper reaches meet water quality standards for aquatic life, dissolved oxygen, nutrient pollution, and recreation but lower reaches fail to meet standards due to high phosphorus and bacteria levels in the water (MPCA 2017). The Anoka Sand Plain's sandy soil aquifers, which provide drinking water are highly vulnerable to contamination. Nitrate levels above the state's 10mg/L Health Risk Limit were found in the ASP counties of Morrison, Benton, Stearns, and Sherburne (MDA 2017). Strategic land protection, restoration, and land management can reduce the impacts that growth will have on the region's habitat and water quality.

- *State-wide projected growth through 2045 is estimated at 13% while growth in Anoka, Isanti, Sherburne counties is 16%, 20% and 32% respectively.*
- *ASP aquifers are highly vulnerable to contamination. Nitrate levels above the state's 10mg/L Health Risk Limit were found in the ASP counties of Morrison, Benton, Stearns, and Sherburne (MDA 2015).*
- *Oak savannas and prairies endemic to the ASP require disturbance such as fire and herbivory. Current management practices often discourage such disturbance.*

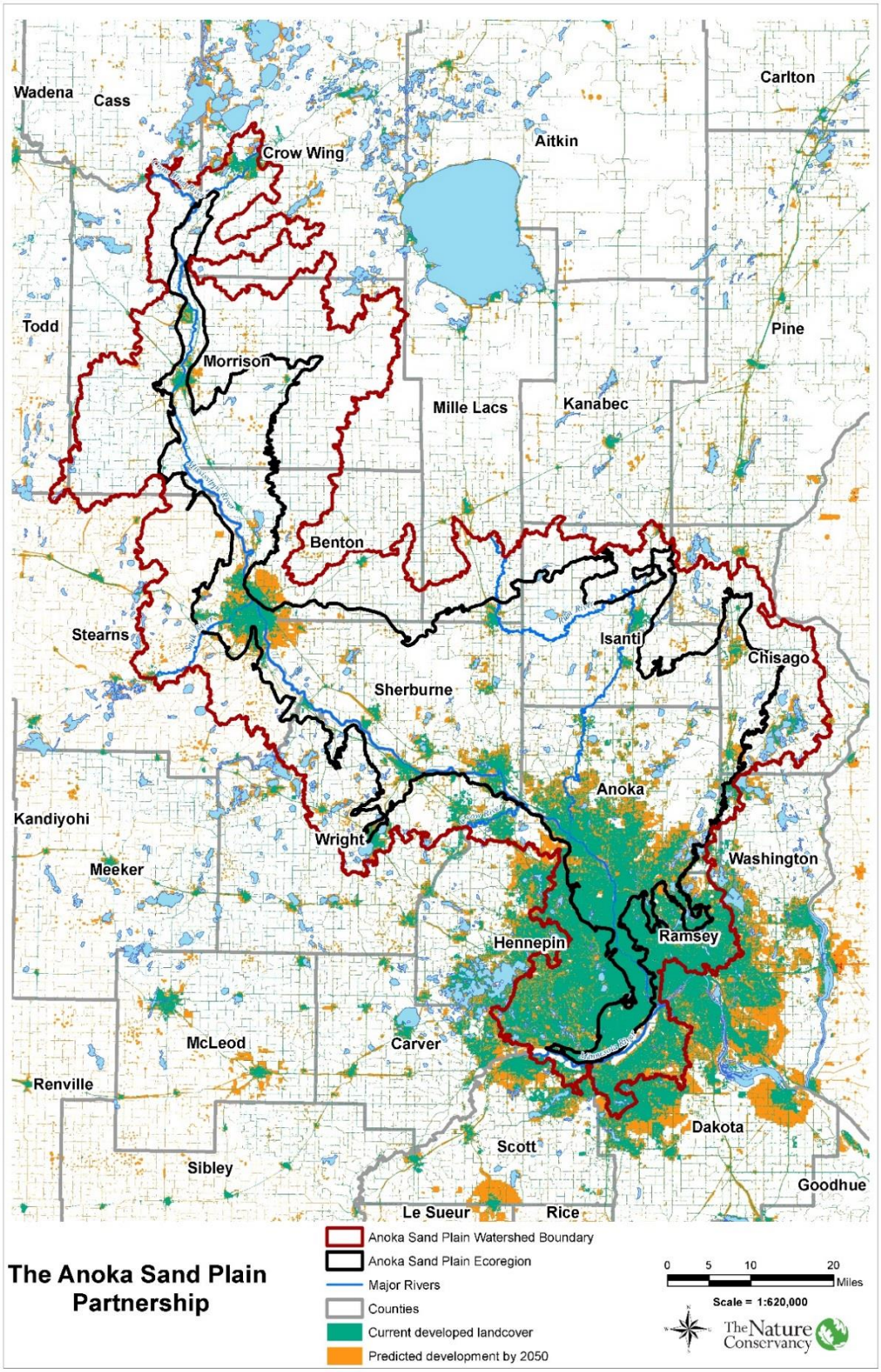

Figure 6: Current developed landcover and development conversion risk by 2050.

Opportunities in the Anoka Sand Plain

While change continues to significantly impact this landscape, the existence of large tracts of public lands containing high biodiversity, undeveloped private lands, agricultural working land, and robust buffer protection made possible through State-designated Wild and Scenic River ways and Minnesota's buffer law, there is a palpable potential to re-create large natural areas and conservation corridors (Figure 7) in the Anoka Sand Plain. As the land cover data of Minnesota shows (Figure 8), ASP has seen significant land-use change and development. However, there are also large areas where natural forests, prairies and wetlands remain. To the west, south and east of the Twin Cities there is little remaining native land cover remaining. The ASP to the north is unique in that large areas exist with native land cover. This allows the opportunity to do protection and cost-effective restoration and enhancement projects to create high quality habitat cores. Restoration and protection at scale means that natural landscape conditions can be preserved and developed that will improve ecological integrity, benefit wildlife habitat, sustain water quality and support recreational opportunities.

In addition, the natural mosaic of diverse ecosystems within many portions of the Anoka Sand Plain make it of high conservation value for creating resiliency needed when considering landscape scale stressors such as a changing climate. Natural cover in riparian corridors and large swaths of protected lands provide connectivity for plants and animals moving to adapt without running into habitat obstructions. This means a better chance of survival in the face of climate change. This greater possibility for migration and adaptation ultimately will help to maintain the region's high level of biodiversity, which keeps ecosystem strong and more resilient to any challenges climate change may bring.

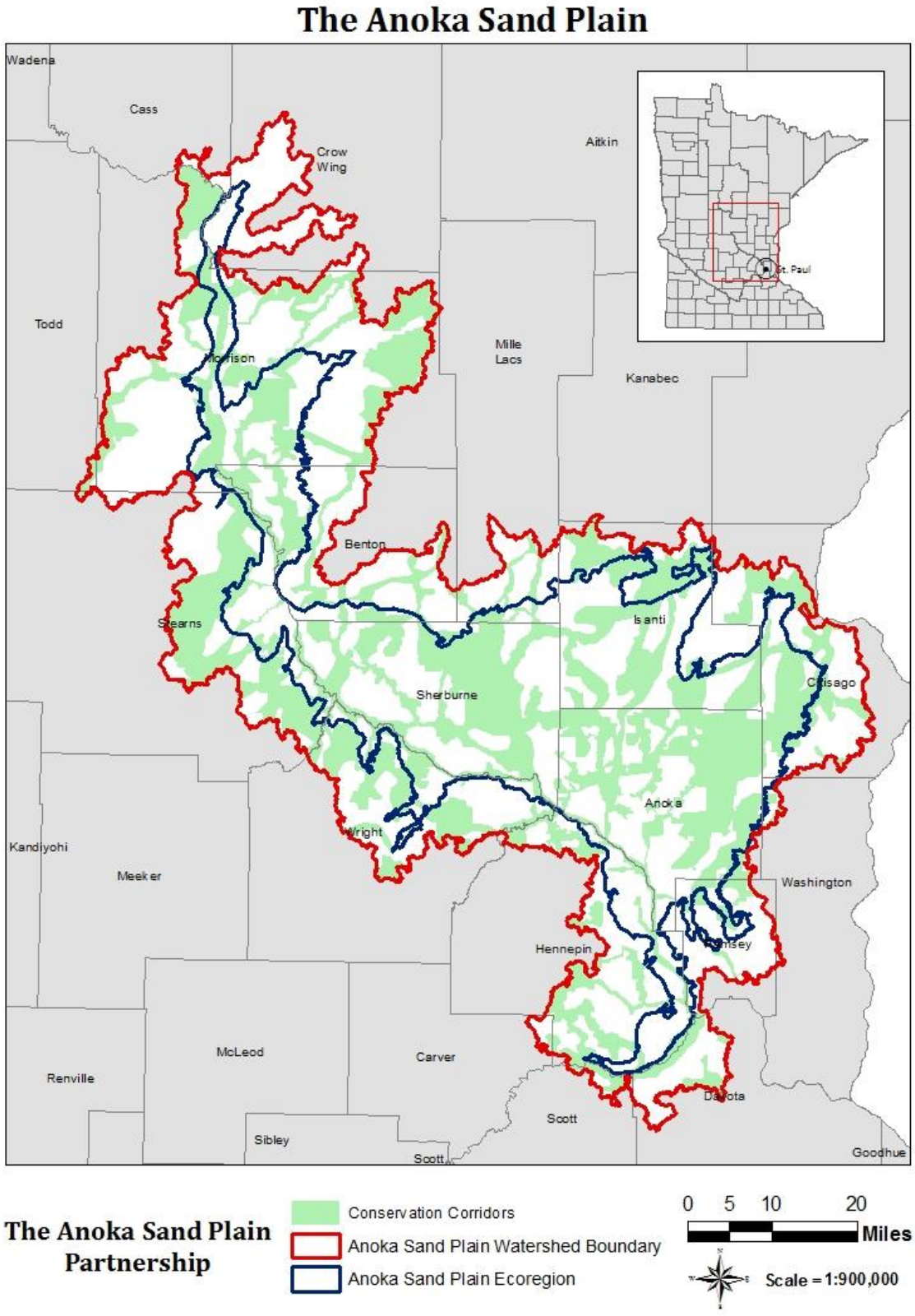

Figure 7: Conservation Corridors in the Anoka Sand Plain Watershed Boundary (Methods in Appx B.)

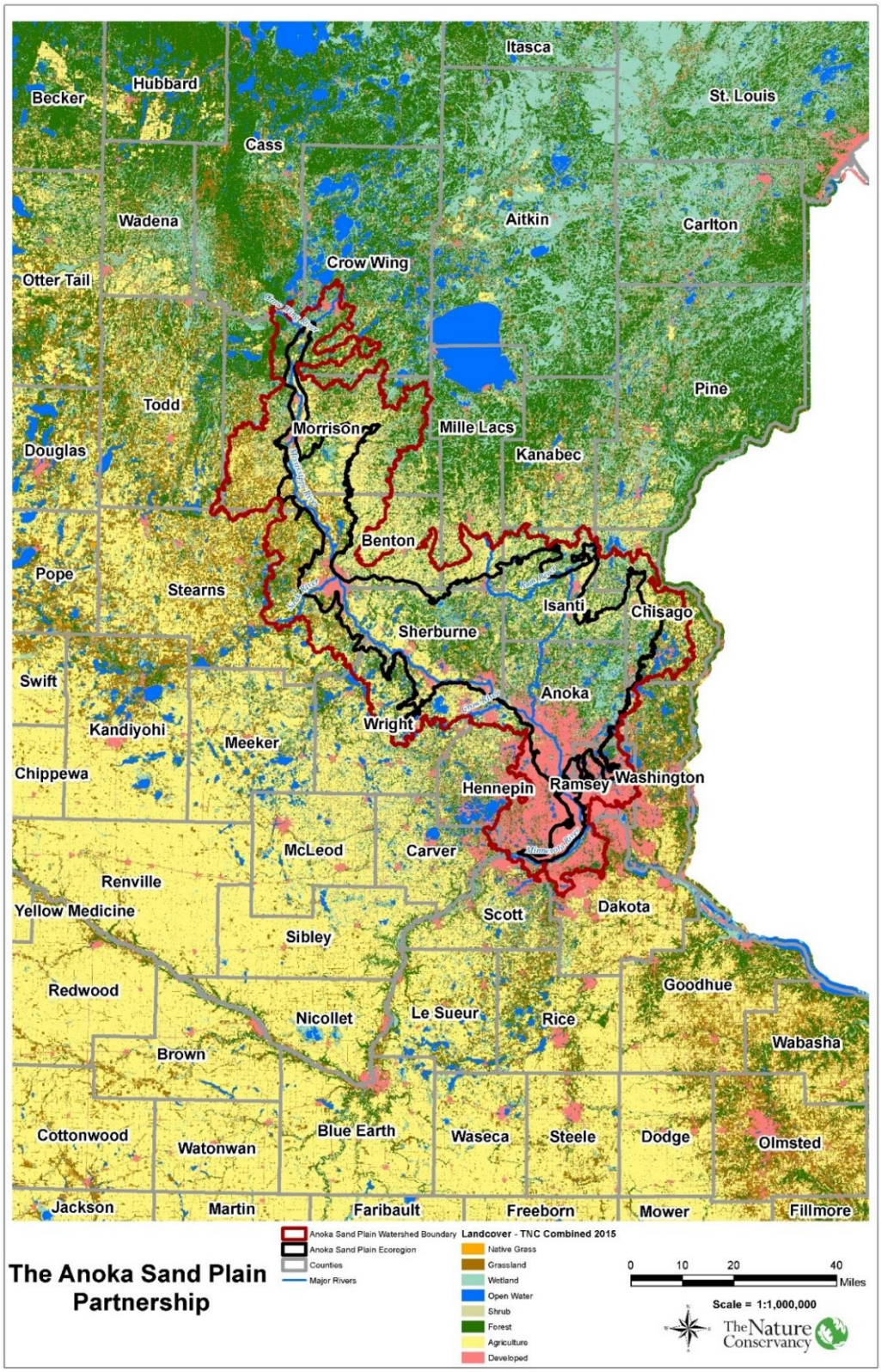

Figure 8: Landcover (2015) in ASP and the surrounding area

Planning and Management Framework

Two approaches will be taken for meeting conservation goals: Habitat Core and Corridor-based Conservation, and Watershed Management. Targeted protection, restoration and enhancement of habitat cores and corridors are necessary for achieving functional and resilient ecosystems in the ASP. Habitat cores are primarily centered around public lands with significant biodiversity. Corridors provide connectivity, and facilitate the movement of species and processes between intact habitat cores. The Partnership will also employ a watershed approach at various scales for restoring hydrologic functions and achieving water resources goals in the ASP. This approach looks at the watershed drainage area. Priority conservation activities will have multiple benefits including enhancing water quality, habitat, and outdoor recreation with the overall goal of creating a more resilient landscape.

Goals, Objectives and Actions

At the core of the Strategic Action Plan are the goals, objectives, and action items (Table 1). These are intended to help partners prioritize projects and protection efforts, seek appropriate funding, guide relationship and partner building, and communicate key functions. The section is organized into 5 main sections: 1) Outstanding Ecology and Healthy Ecosystems; 2) Quality Surface Water and Groundwater; 3) Close to Home Recreation; 4) Community Support and Engagement; and 5) Collaborative Anoka Sand Plain Partnership. Goals are the highest and most general level of direction. They provide a frame and foundation for objectives and actions. The objectives are more specific statements that provide greater detail on how and why the goal will be met. Actions are the most specific statements directing the partners on steps to take to accomplish the objectives and in turn the goals. This section is intended to be a guiding framework, where goals, objectives, and actions can be adapted as opportunities and landscape context change. Many ASP Partners share common goals and work collaboratively to fulfill those goals across the landscape.

Figure 9: A prescribed burn at Helen Allison Savanna SNA in Anoka County, Minnesota. Photo credit: © Colin McGuigan/TNC

Outstanding Ecology and Healthy Ecosystems

Goal	Objective	Action
Protect lands and parcels to maintain habitat cores and conservation corridors between larger protected core habitats to minimize the impacts of new development and enhance native plant communities and wildlife resiliency.	Expand existing protected lands to increase core habitat areas to improve ecological integrity, and buffer against invasive species and edge effects.	Establish a program aimed at increased land protection through fee acquisition, conservation easements, and voluntary protection to expand and buffer the Crane Meadows National Wildlife Refuge, Sherburne National Wildlife Refuge and Carlos Avery State Wildlife Management Area and others identified by the Anoka Sandplain Partnership.
	Identify, prioritize, protect and restore lands to maintain habitat corridors between core habitats.	Identify and prioritize parcels to buffer habitat cores and maintain corridors. Secure funding for engaging private landowners in protection programs and/or ecological restoration.
	Increase application of permanent land protection programs within the ASP, including BWSR RIM Conservation Easement, Healthy Forest Reserve.	Encourage NRCS, SWCDs, BWSR and other partners to actively engage private landowners of key parcels and offer them land protection options within these programs.
	Identify, prioritize and protect lands with rare, threatened and endangered species and lands given an "Outstanding" and "High" biodiversity significance ranking by the MN Biological Survey to protect the rarest species, the most outstanding native plant communities and the largest most ecologically intact or functional landscapes.	Currently 55% of the 159,872 acres ranked as Outstanding or High by the MCBS in the Anoka Sand Plain Ecoregion and 57% of the 325,816 acres ranked as Outstanding or High in the ASP extended HUC12 are protected*. Ensure that 85% of those lands are protected. * Protected lands include MN Land Trust, State, FWS easements; Cedar Creek Ecosystem Science Reserve; State Parks; Scientific and Natural Areas; Wildlife Management Areas; Aquatic Management Areas; State Forests; Camp Ripley; USFWS National Wildlife Refuge; MN County Lands
	Protect high priority shorelands and buffers around shallow lakes through acquisition.	Identify priorities and engage private landowners of key parcels in protection programs.
Restore high priority native plant communities in sufficient scale and connectivity to ensure the long-term resilience and viability of the region's remarkable ecological heritage in the face of climatological, anthropogenic and environmental threats.	Identify parcels that have a high potential to be restored to native plant communities (native prairie, degraded grasslands, oak savanna, oak woodlands and shallow lakes) on public and protected private lands that are part of habitat cores and corridors.	The ASP Partnership restored/enhanced 11, 640 acres and protected 101 acres with ASP Phase 1 – 5 Outdoor Heritage Funds. Restore and enhance an additional 12,000 acres of wetland, woodland, savanna, prairie and grassland habitat by 2027.
	Substantially increase active management on public land and protected private land. Develop action plans and implement management for priority sites to restore and connect native plant communities.	Seed and restore old fields and tame grass stands to diverse prairie, oak savanna and oak woodland communities, develop burn plans, introduce fire, mowing and/or grazing disturbance to fire-dependent ecosystems, control invasive species, control woody encroachment and simulate historic disturbance return intervals.
		Install new and/or replace aging water control infrastructure, conduct periodic growing-season drawdowns to stimulate aquatic plant growth, provide open water, control hybrid cattails to promote hemi-marsh conditions, control invasive species, seed wild rice in appropriate habitats, establish upland buffers and nesting habitats.
		Restore and enhance riparian cooridors of natural vegetation, floodplains, and littoral habitats on lakes to enhance water quality and fish habitat. Restore habitat structure within lakes and in-stream.
		Enhance age class and structural diversity to enhance habitat and improve landscape resilience.
		Re-establish the full suite of native species found in the region to increase species diversity and enhance the component of ecologically important and future adapted species.
Enhance native plant communities in the Anoka Sand Plain across the public-private continuum utilizing appropriate ecological-based management techniques.	Ensure that protected lands including public lands and protected private lands are managed and/or enhanced for increased ecological functionality, biological integrity, and improved community structure.	Improve aquatic habitat connectivity which may be broken due to perched culverts or similar anthropogenic features.
		Control invasive species.
		Enhance migratory habitat for waterfowl and related species, to increase migratory and breeding success.
		Increase the use of prescribed burning in oak woodland, savanna and healthy grassland habitats.
		Restore/Enhance sufficient habitat until it is no longer determined by DNR to be lacking in terms of SGCN habitat (10-year SWAP).

Quality Surface Water and Groundwater		
Goal	**Objective**	**Action**
Protect and restore the hydrologic function of the Anoka Sand Plain landscape.	Minimize hydrological modifications that result in increased flows, discharge rates, flooding and channel erosion.	Protect existing stands of near shore habitat.
	Model and mitigate the impacts of altered hydrology and landuse changes, including wetland drainage, ditching, forested to agriculture or agriculture to new development with increased impervious surfaces.	Identify and prioritize parcels for implementing best management practices.
		Restore wetlands, particularly ditched wetlands that offer water quality and habitat improvements.
		Protect and restore riparian buffers. Ensure surface water to floodplain connectivity.
Ensure surface waters, including lakes, rivers and streams, meet state water quality standards to provide quality drinking water and aquatic habitats.	Ensure water resources are assessed through a Watershed Restoration and Protection Strategies (WRAPS) process or similar, seek those recommendations, and periodically monitored thereafter.	Incorporate WRAP findings into local water plans or One Watershed One Plans.
		Identify and prioritize parcels for implementing best management practices.
	Implement restoration strategies to improve water quality to meet state standards, using TMDLs, Watershed Restoration and Protection Plans and local water plans as guidance.	Reduce pollutant loading so that all waters of the ASP meet the State standards. Replace subsurface sewage treatment systems that pose a threat to public health.
		Continue to assist large and small livestock operators with pature and manure management opportunities to reduce transport of bacteria to waterways.
		Implement erosison stabilization practices and vegetation buffers.
		Promote and install stormwater treatment best management practices near lakes, rivers and streams.
	Protect high quality water resources from degradation. Identify and prioritize restoration and protection strategies to ensure that surface waters that already meet or exceed water quality goals do not become impaired.	Protect and restore continuous natural vegetation within the riparian corridors, floodplains, shorelines and aquatic habitats.
		Prioritize protection of shallow wild rice lakes and recreational lakes near water quality thresholds.
		Promote and install stormwater treatment best management practices near lakes, rivers and streams.
		Monitor and implement management controls for aquatic invasive species.
		Restore wetlands, particularly those offering water quality and habitat improvements.
Ensure the long term supply of clean drinking water by protecting and enhancing water resources including those areas that are important for recharge of regional aquifers that serve the Twin Cities metro.	Identify areas sensitive to groundwater pollution and prevent pollution-generating facilities and activities, including high nitrates on sandy soils.	Identify and facilitate upgrading failing septic systems.
		Promote and install vegetative buffers and practies that lessen the impacts of nutrients in agriculture lands.
		Cooperate with and assist public water suppliers who are developing and implementing Source Water Protection Plans including Wellhead Protection Plans.
	Ensure water infiltration into the landscape to recharge the regional aquifer that serves the Twin Cities metro.	Address irrigation management in vulnerable aquifer recharge areas.
		Increase storage capacity and reduce nutrient loading by restoring wetlands or other appropriate BMPs within impaired waters.

Close to Home Recreation

Goal	Objective	Action
Increase public access to and use of public lands to increase appreciation of protection, restoration, and conservation activities.	Increase public access by purchasing land to add to the WMA system, securing easements with public use, and promoting use.	Establish relationships with landowners and willing sellers to pursue acqusuitions and easements that would improve access to existing WMAs and provide additonal acreage of public recreational lands.
	Incorporate educational and engagement oppurtunties into new and exisiting public land projects to highlight resoration, engagement, and protection efforts	Invite groups and members of the public to actively participate in ecological restoration field events (e.g., tree planting, invasive cutting, etc.) that have an educational component.
		Develop interpretive panels and conduct educational public field tours. Ensure that local naturalist programs have information on the Anoka Sandplain and the partnership activities.
	Increase hunting, fishing, and wildlife observation opportunities for the public, including abundant public lands to provide readily-accessible opportunities within two hour's drive from the downtown Metro area.	Enhance habitats to ensure quality hunting, fishing, and wildlife observation opporunities. Specifically, enhance and restore coldwater fisheries systems. Protect uplands adjacent to game lakes for waterfowl.
		Improve/create access to public lands to ensure all properties are accessible. Increase access for limited mobility hunters with ramps, trails, blinds, fishing piers, etc. Build wildlife observation platforms, blinds, etc.

Community Support and Engagement

Goal	Objective	Action
Promote stewardship, transfer skills, and involve citizens in natural resource management projects and decisions to create a deeper understanding of and support for habitat and water resource management.	Promote environmental education opportunities that further an appreciation of wildlife and habitat conservation.	Develop outreach materials about the environmental concerns and opportunities within the ASP.
	Use restoration/enhancement projects as an opportunity to engage non-land owning public in land management on public lands.	Engage volunteers with restoration activities on public lands.
	Engage private landowners within the ASP in active land management to restore degraded habitats, provide connectivity between public parcel and improve water quality.	Assist landowners with best management practices, including technical and cost-share assistance.
		Develop outreach materials for NRCS, SWCD, DNR and other agencies about the environmental concerns and opportunities within the ASP.

Collaborative Anoka Sand Plain Partnership

Goal	Objective	Action
Strengthen the ASP Partnership aimed at increasing ecosystem resilience, wildlife habitat and watershed health and function.	Identify partners that share specific goals and objectives, while facilitating maximization of partner strengths and networks.	Create ASP Partnership subcommittees to focus on actions of common interest.
	Encourage shared decision making among partners to determine priorities among the Anoka Sand Plain Ecoregion.	ASP Partnership Subcommittees should conduct strategic planning and prioritization around their action item.
	Share human, technical, and financial resources among partners as appropriate to meet other project goals.	Identify partners' resources and resouce needs and work collaboratively to meet project goals.
	Seek grant funding for conservation efforts, including protected land restoration and enhancement projects and water quality best management projects.	Partners cooperatively seek funding and work within their scope to achieve conservation goals.

PRIORITIES WITHIN THE ANOKA SAND PLAIN

The ASP Partnership has identified and prioritized actions and areas within the ASP Ecoregion and HUC 12 watersheds to ensure the conservation of clean water, critical habitat, and recreation opportunities.

Priorities include:

- Protect, restore and enhance habitat cores and conservation corridors to minimize the impacts of new development and enhance native plant communities and wildlife resiliency.
- Ensure the long-term supply of clean drinking water by protecting and enhancing water resources including surface water and groundwater that are important for the recharge of regional aquifers.
- Increase public access to and use of public lands to increase appreciation of protection, restoration and conservation activities.
- Engage citizens in natural resource management projects and decisions to create a deeper understanding of and support for habitat and water resource management.
- Strengthen the ASP Partnership aiming to increase ecosystem resilience, wildlife habitat and watershed health and function.

Given these priorities, three multiple-criteria decision analyses in GIS were performed to identify and prioritize critical areas for habitat, groundwater, and surface water protection, restoration and enhancement. Methods and details on data sources can be found in Appendix C. Source layers in the Ecological Analysis (Figure 10) capture habitat connectivity, habitats that support species in greatest conservation need, terrestrial and aquatic sites of biodiversity, potential locations of groundwater influenced shallow wetlands, and native plant communities. Source layers and weighting are 30% Wildlife Action Network (DNR 2015), 25% Habitat Connectivity (TNC 2017), 15% Groundwater Influenced Shallow Wetlands (Husveth 2017), 15% Native Plant Communities (MNBS 2016), 5% Targeted Pre-Settlement Vegetation (DNR), and 10% Active River Area Analysis (TNC 2008). The Groundwater Analysis (Figure 11) contains two source layers, Ground Water Recharge Multi-Benefits Analysis (TNC 2017) and Drinking Water Multi-Benefits Analysis (TNC 2017), each with 50% weighting. The components of the model include groundwater recharge, water use vulnerability index, drinking water management supply area vulnerability, wellhead protection areas, groundwater contamination susceptibility, proximity to main stem river water supply and private well density. The Surface Water Analysis (Figure 12) includes areas that are likely to contribute to overland runoff, wetlands, stream and river channels, aquatic and riparian habitats, and lands that interact and contribute to streams and rivers. Source layers and weighting are 40% Water Quality Risk (NRRI 2017), 30% Active River Area (TNC 2017), and 30% National Wetland Inventory (USFWS 2009). These analyses help to identify priorities areas however, despite the immense available data, limitations exist for comprehensive conservation planning including dynamic landscape changes due to land conversion and incomplete data, including the surveys for native plant communities and rare plants and animals.

In addition to the Ecological Analysis, Groundwater and Surface Water priority maps, a Ranking Criteria has been created to prioritize the protection, restoration and enhancement of parcels and projects within the Anoka Sand Plain and HUC 12 watersheds (Appendix D). The Ranking Criteria are linked directly with ecosystem, water quality, recreation, community engagement, and collaborative partnership goals. The ASP Partners will utilize the criteria to evaluate proposals pursued under the umbrella of the partnership to most effectively reach ASP Partnership goals.

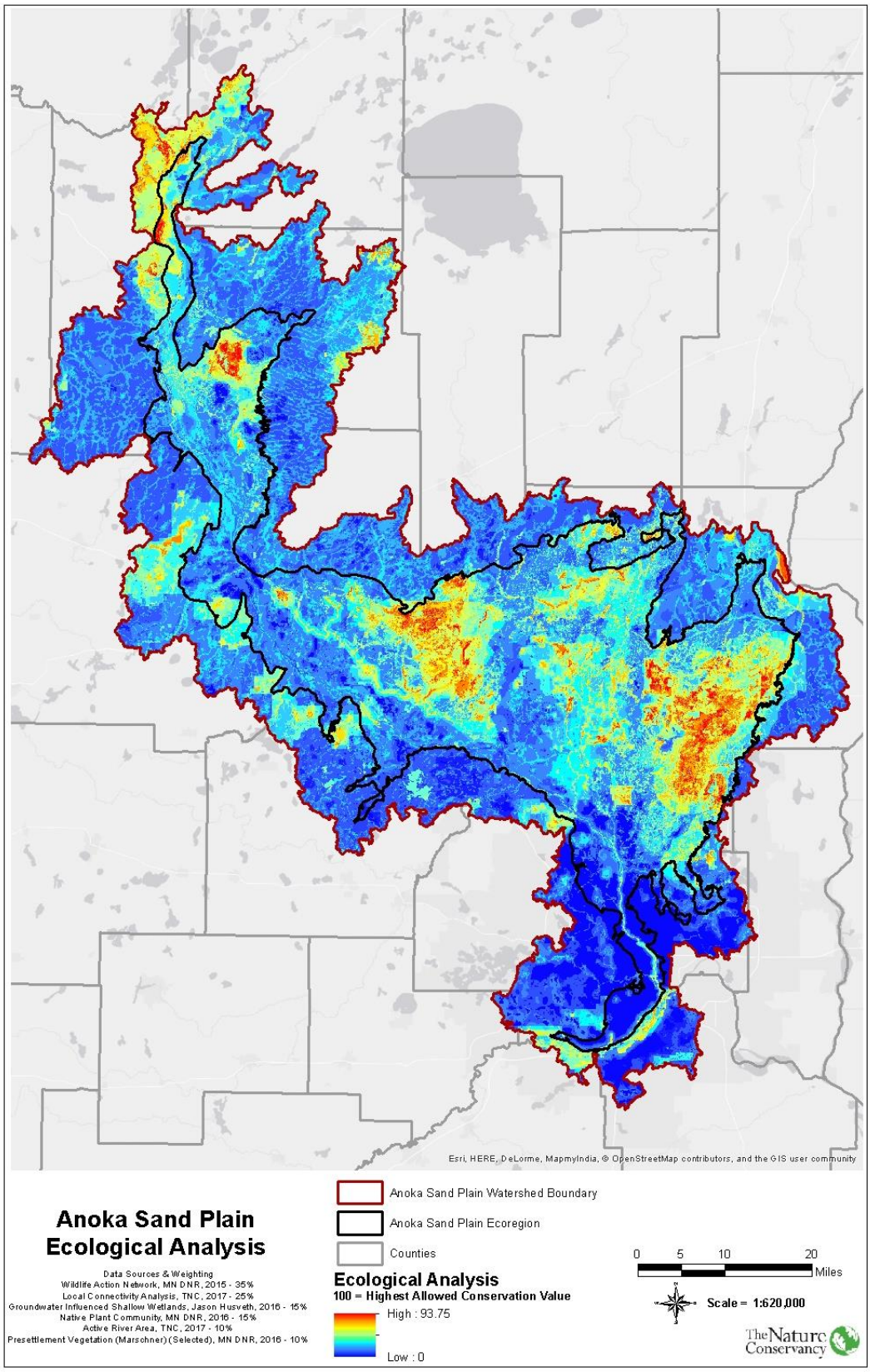

Figure 10: Anoka Sand Plain Ecological Analysis (Methods in Appx B.)

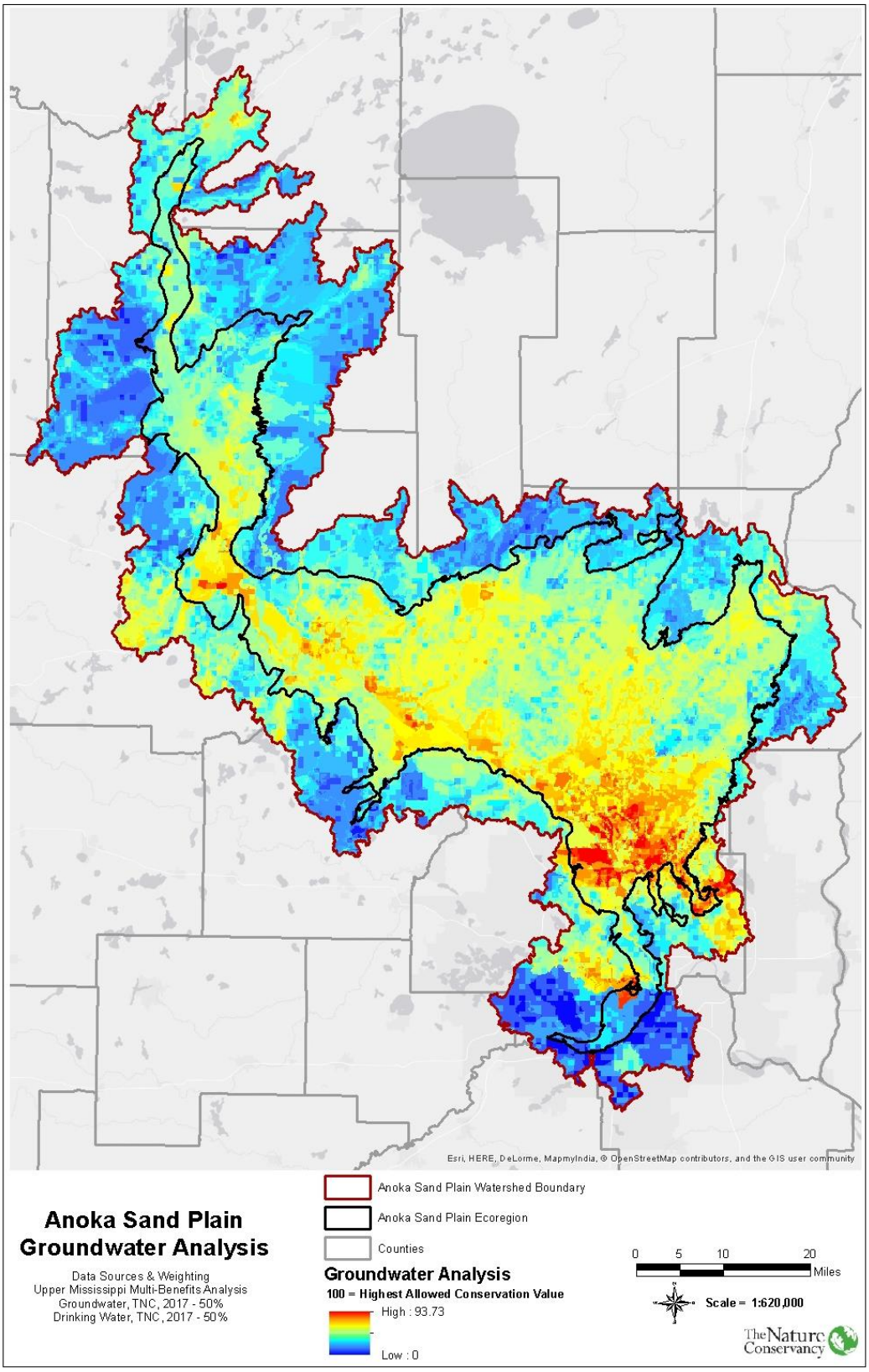

Figure 11: Anoka Sand Plain Groundwater Analysis (Methods in Appx B.)

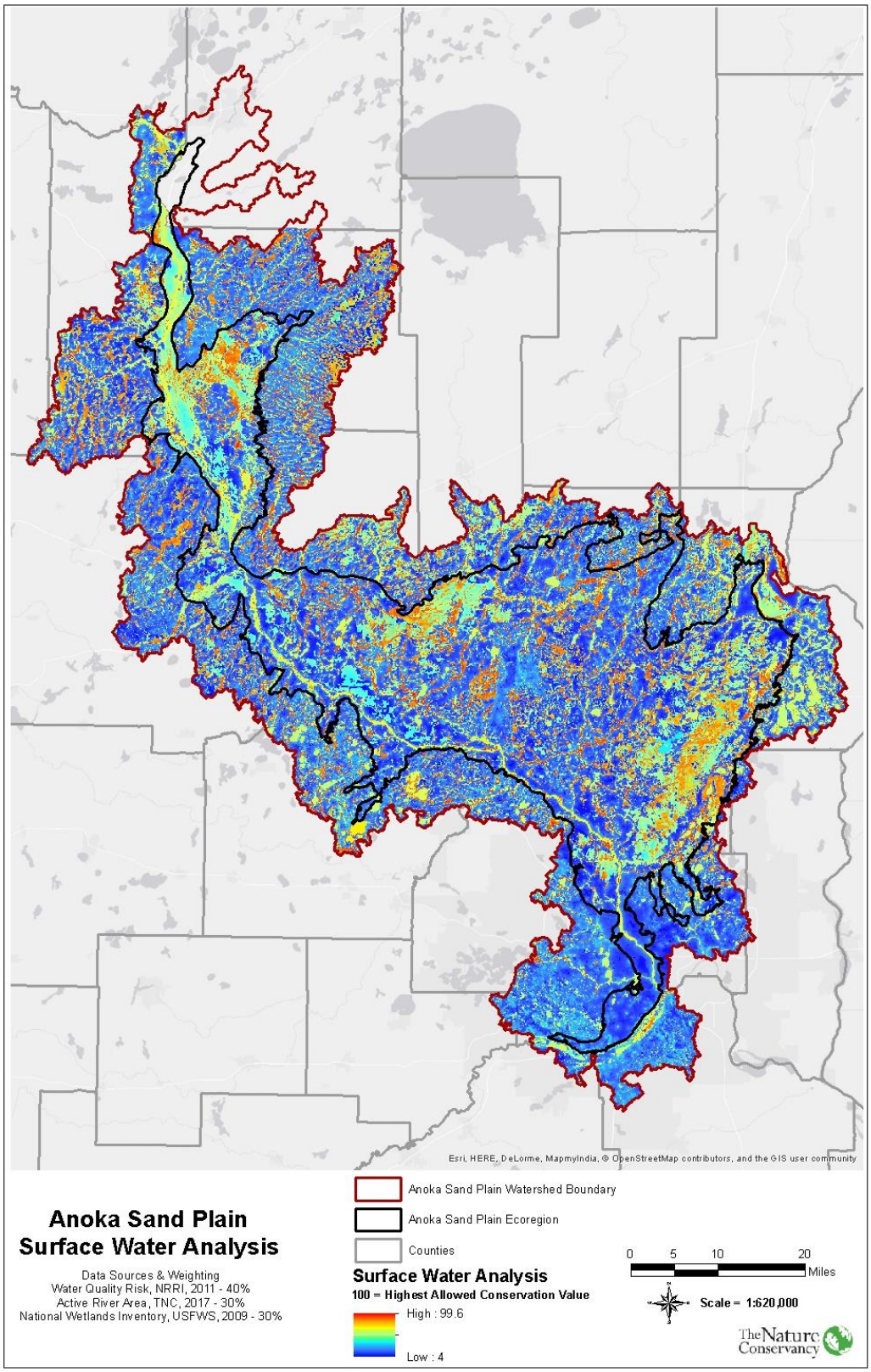

Figure 12: Anoka Sand Plain Surface Water Analysis (Methods in Appx B.)

MEASURES OF SUCCESS

Current Condition	Target Condition
A landscape with unique and high quality ecosystems and water resources that is under threat by an increase in development and land conversion. There is an opportunity with strategic protection, restoration, and management to curb the adverse effects of detrimental land use.	A resilient mosaic landscape of diverse prairies, forests, and wetlands restored across portions of its former range on both public and private lands with sufficient scale and connectivity to provide necessary habitat, quality surface water and groundwater, and recreation and community engagement opportunities.

This plan works to create a framework for identifying conservation threats, opportunities, and priorities in the ASP region and a means for Partners to work collaboratively and efficiently. As this plan is being implemented the Partnership will measure the progress toward reaching proposed goals. The defined goals of the plan provide a guide for partners to identify and prioritize conservation efforts, while the objectives and actions associated with each goal provide specific steps to accomplish goals. Monitoring and measuring progress towards these goals and objectives will help the Partnership know what is working and what needs to change. This will help achieve positive conservation impacts, as well as keep the Partnership accountable to itself, the stakeholders of the ASP region, and the funders of the Partnership's work.

Outstanding Ecology and Healthy Ecosystems

Current Condition	Target Condition
Unique ecosystems, and species that rely on them in the Anoka Sand Plain are increasingly fragmented and under threat from land conversion. Invasive species and suppression of natural fire disturbances have pushed systems to the brink of collapse.	Protection, restoration and enhancement efforts successfully achieve maintenance of habitat cores and corridors with diverse native plant communities to support wildlife and to create a landscape resilient to climate change.

Specific means for measuring progress toward reaching goals include:

- Number of acres protected/restored/enhanced that expand habitat core and corridors.
- Number of miles and acres protected/restored/enhanced of shorelands and buffers.
- Number of acres protected/restored/enhanced that include Outstanding or High Biodiversity MBS ranking.
- Number of acres protected/restored/enhanced that include Threatened, Endangered and Special Concern species.
- Number of wetland acres protected/restored/enhanced.

Quality Surface Water and Groundwater

Current Condition	Target Condition
The surface water and groundwater resources, including those important for the Twin Cities drinking water supply, are increasingly negatively impacted by detrimental land uses.	Protection, restoration and enhancement efforts improve water quality and water infiltration to recharge regional aquifers, minimize flooding, and ensure the long term supply of clean drinking water.

Specific means for measuring progress toward reaching goals include:

- Number of acres protected/restored/enhanced in Drinking Water Supply Management Areas.
- Number of wetland acres protected/restored/enhanced.
- Number of miles protected/restored/enhanced of shorelands and buffers.

- Number of waterbodies meeting federal/state water quality standards.
- Annual reductions in Total Suspended Solids (TSS), Total Phosphorus (TP), and water volume (acre-feet).

Close to Home Recreation

Current Condition	Target Condition
Demands on current recreation amenities increase as populations in the Twin Cities metro area rise.	Increased access to public lands, lakes, and rivers in the Anoka Sand Plain even as development increases.

Specific means for measuring progress toward reaching this goal include:

- Number of acres of public lands.
- Number of access points to public waters.

Community Support and Engagement

Current Condition	Target Condition
Generally, Minnesotans have a strong connection to place and an appreciation for the value of natural resources. As the population ages and grows, connection to nature and land management skills may be less prevalent.	Involved local citizens, connected to the Anoka Sand Plain landscape, promoting stewardship, transferring skills, and active in natural resource management decisions and projects.

Specific means for measuring progress toward reaching this goal include:

- Number of ASP projects that involve the community through decision-making and/or protection, restoration, and enhancement activities for volunteers.

Collaborative Anoka Sand Plain Partnership

Current Condition	Target Condition
Agencies and non-profit organizations have identified the Anoka Sand Plain as a priority region and are gaining momentum working in partnership to cohesively address the conservation needs of the area, but see benefits of more strategic partnerships and planning.	Partners work in collaboration to meet conservation goals that go beyond political boundaries and are defined by the Ecoregion and Watersheds. Additionally, Partners identify and share resources and collectively seek funding opportunities that are needed to meet protection, restoration, recreation and water quality goals.

The Anoka Sand Plain Partnership will utilize this plan and will continue to share decision-making to determine priorities within the Anoka Sand Plain. A dynamic document which indicates the Partners who pursue each of the ASP goals is used to facilitate Partner collaboration. The collaboration among the Partnership will be measured and prioritized when ranking proposed projects to determine whether projects have been developed in partnership and are a clear fit to the Partnership's priorities.

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APPENDIX A. GLOSSARY AND ACRONYMS

Glossary

Enhancement	Activities that improve the resource, such as inter-seeding into a prairie or treating invasive species.
Groundwater Recharge	Hydrologic process where water moves from surface water to groundwater. Recharge is the primary method that water enters an aquifer.
Habitat Core	Large tracks of land, generally larger than 1,000 acres, with significant biodiversity that provide habitat to sustain wildlife populations. The primary habitat cores in the ASP are public lands and include Camp Ripley, Crane Meadows and Sherburne National Wildlife Refuge, Carlos Avery State Wildlife Management Area, and other State Wildlife Management Areas and Scientific and Natural Areas.
Habitat Corridor / Conservation Corridor	An area that connects high quality natural communities and wildlife populations, and facilitates the movement of species and processes across the landscape.
Invasive Species	A species not native to the region that is likely to cause harm to the environment, economy, or human health.
Protection	Preserving land and shoreline in a natural state in perpetuity through land acquisition or conservation easements.
Restoration	Activities that return and ecosystem to a close approximation of its condition prior to disturbance. Both the structure and function of the ecosystem are recreated to emulate a natural, functioning, self-regulating ecosystem.

Acronyms

ASP	Anoka Sand Plain
MCBS	Minnesota County Biological Survey
NWR	National Wildlife Refuge
SGCN	Species in Greatest Conservation Need
SNA	Scientific Natural Area
WMA	Wildlife Management Area
WRAPS	Watershed Restoration and Protection Strategies

APPENDIX B. ASP PRIORITIES ANALYSIS METHODOLOGY

Rich Johnson, Andrea Brandon, Leah Hall, The Nature Conservancy; Carrie Taylor, Anoka Conservation District

Study Area: Anoka Sand Plain, plus adjoining HUC 12's

Ecological Analysis (Figure 10)

Source Layer	***Weighting***
Wildlife Action Network – DNR, 2015 (Low (20%), Low-Med (40%), Med (60%), Med-High (80%), High (100%)	30%
Habitat Connectivity (Local)– TNC, 2017 (Below Average (0%), Slightly Below Average (25%) Average (50%), Slightly Above Average (75%), Above Average (100%))	25%
Groundwater Influenced Shallow Wetlands – Jason Husveth, 2016 (All = 100%)	15%
Native Plant Communities - MN DNR, 2016 (All = 100%; All communities included in MN BS data)	15%
Active River Area – TNC, 2017 (All = 100%; Wet, Floodplain, Material Contribution Zone (MCZ))	10%
Targeted Pre-Settlement Vegetation – Marschner (selected) (All = 100%; Brush Prairie, Jack Pine Barrens and Openings, Oak Openings and Barrens, Prairie, Wet Prairie)	5%

1. **Wildlife Action Network**

   Minnesota Department of Nature Resources. Minnesota Wildlife Action Plan. 2015. http://files.dnr.state.mn.us/assistance/nrplanning/bigpicture/mnwap/mndnr_wildlife_action_network_description.pdf

   Overview:

   The Wildlife Action Network… is composed of mapped terrestrial and aquatic habitats, buffers, and connectors that represent a diversity of quality habitats that support Species in Greatest Conservation Need (SGCN). The Network is made up of mapped habitat representing viable or persistent populations and "richness hotspots" of Species in Greatest Conservation Need (SGCN). Added to this information are other data on the relative condition of habitat including spatially prioritized and connected Sites of Biodiversity Significance, Lakes of Biological Significance, and Streams with "exceptional" Indices of Biological Integrity…

   The Wildlife Action Network was created by overlaying several GIS layers… The following describes the GIS layers used in the Wildlife Action Network:

   a. *Top 95 percent of SGCN populations composite.*
   b. *Good or excellent populations of state or federally endangered and threatened species.*
   c. *Richness hotspots falling outside the top 95 percent of populations.*
   d. *Cores and Corridors from Minnesota Prairie Conservation Plan.*
   e. *Marxan outputs from the Scientific and Natural Area strategic plan.*
   f. *New Marxan runs of additional final and preliminary sites of biodiversity significance in remaining ecological subsections not analyzed for the SNA strategic plan.*

g. *Sites of Biodiversity Significance that intersect with Marxan outputs and high and outstanding sites where Marxan runs were not completed (Littlefork-Vermillion Uplands and the north half of the Agassiz Lowlands subsections).*
h. *High conservation value forests.*
i. *Lakes of biological significance.*
j. *Streams with an exceptional index of biotic integrity score.*

Scores are based on five scalable metrics:

a. SGCN population viability scores
b. SGCN richness
c. Spatially prioritized Sites of Biodiversity Significance
d. Ranks of Lakes of Biological Significance
e. Stream Indices of Biological Integrity (IBI).

2. **Terrestrial Habitat Connectivity Analysis**

The Nature Conservancy. Terrestrial Habitat Connectivity Analysis. 2017.

Local Connectedness Definition

The local connectedness metric measures how impaired the structural connections are between natural ecosystems within a local landscape. Roads, development, noise, exposed areas, dams, and other structures all directly alter processes and create resistance to species movement by increasing the risk (or perceived risk) of harm. This metric is an important component of resilience because it indicates whether a process is likely to be disrupted or how much access a species has to the microclimates within its given neighborhood.

The method used to map local connectedness for the region was resistant kernel analysis, developed and run by Brad Compton using software developed by the UMASS CAPS program (Compton et al. 2007, http://www.umass.edu/landeco/research/caps/caps.html). Connectedness refers to the connectivity of a focal cell to its ecological neighborhood when it is viewed as a source; in other words, it asks the question: to what extent are ecological flows outward from that cell impeded or facilitated by the surrounding landscape? Specifically, each cell is coded with a resistance value base on land cover and roads, which are in turn assigned resistance weights by the user. The theoretical spread of a species or process outward from a focal cell is a function of the resistance values of the neighboring cells and their distance from the focal cell out to a maximum distance of three kilometers.

3. **Groundwater Influenced Shallow Wetlands**

See: Husveth, Jason. Comprehensive GIS Analysis of Groundwater Influenced Shallow Wetlands in the Anoka Sand Plain Ecological Subsection. 2016.

Executive Summary:

> *Critical Connections Ecological Services has completed a remote sensing analysis of a 3.3-million-acre project area that encompasses the entire 1.1 million acre Anoka Sand Plain Ecological Subsection. The purpose of this remote sensing analysis was to predict potential locations of ASP groundwater influenced shallow wetlands as these wetland systems are*

known to contain unique native species assemblages including rare vascular plant species such as Xyris torta (MN-Endangered), Juncus marginatus (MN-Endangered), Aristida longespica var. geniculata (MN-Endangered), and Polygala cruciata (MN-Endangered). CCES utilized known locations of rare vascular plant species, associated soil catenas, and color infra-red aerial photograph imagery to develop a GIS-based spatial model that could prioritize areas within the project boundary down to the Minnesota DNR Level 07 Minor Watershed level that would be most likely to contain ASP groundwater influenced shallow wetlands. The results of this modeling effort will be used to direct future ground-truthing, research, and survey efforts which will allow for better rare plant and habitat mitigation and protection efforts. Of the 3.3-million-acre project area, CCES has created a spatial model which has targeted approximately 207,000 acres (or 6% of the total project area) which should become the priority areas for next steps pertaining to on the ground surveys, research and protection efforts related to these unique ASP groundwater influenced shallow wetlands.

4. **Native Plant Communities**

Minnesota Department of Nature Resources – Division of Ecological and Water Resources – Biological Survey. MNDNR Native Plant Communities. 2014. https://gisdata.mn.gov/dataset/biota-dnr-native-plant-comm

Overview:

This data layer contains results of the Minnesota County Biological Survey (MCBS). It includes polygons representing the highest quality native plant communities remaining in surveyed counties. These native plant communities are important areas for conservation. Native plant communities (sometimes also referred to as "natural communities") are groups of native plants that interact with each other and their surrounding environment in ways not greatly altered by modern human activity or by introduced plant or animal species. These groups of native species form recognizable units, such as an oak forest, a prairie, or a marsh, that tend to repeat across the landscape and over time. Native plant communities are generally classified and described by considering vegetation, hydrology, land forms, soils, and natural disturbance regimes. The native plant community types and subtypes in this data layer are classified primarily by vegetation and major habitat features. Classification and inventory of native plant communities is an ongoing effort of the Natural Heritage and Nongame Research Program and the Minnesota County Biological Survey.

The Minnesota County Biological Survey located higher quality native plant communities using aerial photo interpretation followed by field survey of selected sites. Areas that were not mapped as native plant community polygons primarily represent: 1) land where modern human activities such as farming, overgrazing, wetland drainage, recent logging and residential and commercial development have destroyed or greatly altered the natural vegetation; and 2) native plant community polygons that were below minimal size criteria. Note: some areas that were not mapped are important for conservation. They may include habitat for native plants and animals, corridors for animal movement, buffers surrounding high quality natural areas and open space, and target areas for restoration.

For our analysis, seven specific vegetation classifications were identified to represent the known present day location of high priority oak-woodland/oak-savannah and wetlands within the Anoka Sand Plain. These classifications include:

a) Fire-Dependent Forest/Woodland System
b) Upland Prairie System
c) Wetland Prairie System
d) Complex Community
e) Floodplain Forest System
f) Lakeshore System
g) River Shore System

5. **Active River Area**

The Nature Conservancy. Active River Area. 2017. https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/freshwater/floodplains/Pages/default.aspx

Overview:

The Active River Area (ARA) conservation framework provides a conceptual and spatially explicit basis for the assessment, protection, management, and restoration of freshwater and riparian ecosystems. The ARA framework is based upon dominant processes and disturbance regimes to identify areas within which important physical and ecological processes of the river or stream occur. The framework identifies five key subcomponents of the active river area: 1) material contribution zones, 2) meander belts, 3) riparian wetlands, 4) floodplains, and 5) terraces. These areas are defined by the major physical and ecological processes associated and explained in the context of the continuum from the upper, mid and lower watershed in the ARA framework paper (Smith et al. 2008). The framework provides a spatially explicit manner for accommodating the natural ranges of variability to system hydrology, sediment transport, processing and transport of organic materials, and key biotic interactions.

6. **Marschner Presettlement Vegetation**

Minnesota Department of Nature Resources. Presettlement Vegetation. 2014. http://files.dnr.state.mn.us/assistance/nrplanning/bigpicture/mnwap/mndnr_wildlife_action_network_description.pdf

Abstract:

Presettlement vegetation of Minnesota based on Marschner's original analysis of Public Land Survey notes and landscape patterns. Marschner compiled his results in map format, which was subsequently captured in digital format.

Five vegetation classifications are pulled out to represent the Oak-Savanna and Shallow Wetland communities that make the Anoka Sand Plain a high priority landscape.

a) Brush Prairie
b) Jack Pine Barrens and Openings
c) Oak Openings and Barrens
d) Prairie
e) Wet Prairie

Groundwater Analysis (Figure 11)

Source Layer	*Weighting*
Multi-Benefits Analysis - Groundwater Recharge - TNC, 2017	50%
Multi-Benefits Analysis - Drinking Water - TNC, 2017	50%

1. **Groundwater Recharge Model**

Model Components

a) Groundwater Recharge (inches/year) (Smith et. al 2015) and Groundwater recharge (inches/year) (Lorenz and Delin 2007)
The two layers are averaged together to yield a long term potential average recharge (in inches / year of rainfall that recharges groundwater and supports streamflow).

b) Water use vulnerability Index, Predicted Vulnerability -- DNR Watershed Health Assessment Framework Catchment Score
http://www.dnr.state.mn.us/whaf/about/scores/hydrology/waterwithdraw.html

The index is based on the sum of permitted withdrawal from surface water and groundwater. Using the State Water Use Database (SWUD), total potential consumption was calculated by summing permitted use and comparing to annual runoff. The "water use vulnerability index" is scaled as the greater the amount of water used as percent of runoff, the lower the score. The Catchment Predicted Vulnerability is the five-year trend in reported use as a percentage of runoff.

2. **Drinking Water Model**

The Drinking Water module is intended to represent priority areas for protection ***and/or*** restoration, weighted on the relative potential impact on estimated actual users where they obtain their drinking water. This module may be used with or without the groundwater recharge module. Inclusion of the groundwater recharge module reduces the apparent resolution of the visual output from the module, because the latter is based on larger, coarser grid cell resolution of the Smith et al. (2015) analysis.

Model Components

a) Drinking Water Management Supply Area Vulnerability: This is a delineation of areas of concern for and relative risk for a potential contaminant source within the drinking water supply management are to contaminate a public water supply well based on the aquifer's inherent geological sensitivity; and the chemical and isotopic composition of the ground water. Source: MDH.

b) Wellhead Protected Areas: WPA is the surface and subsurface area surrounding a public water supply 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. Source: MDH.

c) Groundwater Contamination Susceptibility: A broad, generalized interpretation of ground water contamination susceptibility for the state, based on modeling relying on data inputs from the MLMIS40 (40-acre raster) soils and geology data, with additional geology inputs[1]. The parameters that control ground water susceptibility to contamination are quite varied and overlapping, and include: soil media, topography, depth to water, aquifer media, vadose zone materials, net recharge, hydraulic conductivity of aquifer, hydraulic gradient, distance

[1] http://www.mngeo.state.mn.us/chouse/metadata/gwc.html

to nearest drinking water supply, depth to bedrock, unsaturated zone permeability and thickness, and net precipitation.

d) Proximity to mainstem river water supply Lands within the ARA upstream of surface water intakes for major drinking water supply areas are assigned zonal values based on downstream distance to the supply area.

e) Private well density – This layer summarizes the County Well Index (CWI) layer (Source: MDH[2]) by Huc12 watershed to summarize the number of private domestic water supply wells in each 12-digit watershed that are located in a vulnerable or highly vulnerable groundwater area, and is converted to 10 density classes by Huc12. The CWI layer is known to be dated and incomplete, but represents an accurate representation of the population density relying on private domestic groundwater wells.

Surface Water Analysis (Figure 12)

Source Layer	***Weighting***
Water Quality Risk – NRRI, 2009	40%
Active River Area (ARA) – TNC, 2017 (All = 100%; Wet, Floodplain, Material Contribution Zone (MCZ))	30%
National Wetland Inventory (NWI)– USFWS, 2009 (All = 100%)	30%

1. **Water Quality Risk**

Natural Resources Research Institute. Water Quality Risk. 2009.
https://beaver.nrri.umn.edu/EcolRank/water-quality/.

Summary:

The risk score for Water Quality ranges from 0-100, with larger values indicating areas that are more likely to contribute overland runoff than smaller values. This risk was defined by two data sources: Stream Power Index and Proximity to Water:

Stream Power Index

Stream Power Index (SPI) measures the erosive power of overland flow as a function of local slope and upstream drainage area. SPI was calculated statewide, but summarized by Terrain Zones, which represent physiographic regions of Minnesota with similar physiographic characteristics. The use of Terrain Zones removes bias from landscapes with extremely high relief. Large SPI values (i.e. those in the 85thpercentile or higher) from each of the five terrain zones were used to create a critical area layer where overland erosion is likely to occur. These critical SPI areas were summarized by SSURGO soil polygons: the proportion of SPI critical areas within each SSURGO polygon was used to assign a percentile rank to these polygons, the larger the proportion of critical SPI data, the larger risk score for that polygon. This percentile rank represents 50 of the total 100 points for this risk layer.

Proximity to Water

The remainder of points was determined by calculating proximity from SSURGO polygons to the nearest DNR 24k surface water feature (Lake or Intermittent/perennial stream). A percentile rank of these proximity values assigned to each SSURGO polygon represents the

[2] http://www.health.state.mn.us/divs/eh/cwi/

remaining 50 points, where the highest risk scores are given to the polygons closest to water features.

2. **Active River Area**

The Nature Conservancy. Active River Area. 2017. https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/freshwater/floodplains/Pages/default.aspx.

Overview:

The Active River Area (ARA) conservation framework provides a conceptual and spatially explicit basis for the assessment, protection, management, and restoration of freshwater and riparian ecosystems. The ARA framework is based upon dominant processes and disturbance regimes to identify areas within which important physical and ecological processes of the river or stream occur. The framework identifies five key subcomponents of the active river area: 1) material contribution zones, 2) meander belts, 3) riparian wetlands, 4) floodplains, and 5) terraces. These areas are defined by the major physical and ecological processes associated and explained in the context of the continuum from the upper, mid and lower watershed in the ARA framework paper (Smith et al. 2008). The framework provides a spatially explicit manner for accommodating the natural ranges of variability to system hydrology, sediment transport, processing and transport of organic materials, and key biotic interactions.

3. **National Wetlands Inventory**

U.S. Fish & Wildlife Service. National Wetlands Inventory. 2009. https://www.fws.gov/wetlands/data/data-download.html.

Abstract:

This data set represents the extent, approximate location and type of wetlands and deepwater habitats in the United States and its Territories. These data delineate the areal extent of wetlands and surface waters as defined by Cowardin et al. (1979). The National Wetlands Inventory - Version 2, Surface Waters and Wetlands Inventory was derived by retaining the wetland and deepwater polygons that compose the NWI digital wetlands spatial data layer and reintroducing any linear wetland or surface water features that were orphaned from the original NWI hard copy maps by converting them to narrow polygonal features. Additionally, the data are supplemented with hydrography data, buffered to become polygonal features, as a secondary source for any single-line stream features not mapped by the NWI and to complete segmented connections. Wetland mapping conducted in WA, OR, CA, NV and ID after 2012 and most other projects mapped after 2015 were mapped to include all surface water features and are not derived data. The linear hydrography dataset used to derive Version 2 was the U.S. Geological Survey's National Hydrography Dataset (NHD). Specific information on the NHD version used to derive Version 2 and where Version 2 was mapped can be found in the 'comments' field of the Wetlands_Project_Metadata feature class. 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. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and near shore coastal waters. Some deepwater reef communities (coral or tuberficid worm

reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery. By policy, the Service also excludes certain types of "farmed wetlands" as may be defined by the Food Security Act or that do not coincide with the Cowardin et al. definition. Contact the Service's Regional Wetland Coordinator for additional information on what types of farmed wetlands are included on wetland maps. This dataset should be used in conjunction with the Wetlands_Project_Metadata layer, which contains project specific wetlands mapping procedures and information on dates, scales and emulsion of imagery used to map the wetlands within specific project boundaries.

Conservation Corridors (Figure 7)

Habitat and Conservation Corridors are defined as an area that connects high quality natural communities and wildlife populations, and facilitates the movement of species and processes across the landscape. The ASP Partnership is utilizing the Central Region Green Infrastructure data as a source layer as a guide to identify areas for establishing Habitat and Conservation Corridors with an understanding that this data is outdated. The current Conservation Corridors map has modification based on Anoka County Conservation District Corridors map. The ASP Partnership will utilize updated corridor maps and tools as they become available.

Central Region Green Infrastructure
Minnesota Department of Nature Resources. 2016
https://gisdata.mn.gov/dataset/env-green-infrastructure
Overview:

This Green Infrastructure data is comprised of 3 similar ecological corridor data layers: Metro Conservation Corridors, green infrastructure analysis in counties just north of the metro area, and green infrastructure analysis in counties in the southeast part of the state.
This is an interpretation of both functional and conceptual natural habitat corridors that link high quality natural communities both within and between counties of Central Minnesota. Base maps that were referenced include the Minnesota County Biological Survey, the Regionally Significant Ecological Areas, DNR Public Recreation Information Map, 2003 Farm Service Agency color aerial photos, and various lakes and rivers data sets. Base maps were overlain and polygons developed in areas where there was a high density of mapped features: MCBS plant communities, RSEA, WMA. The resulting polygons were assessed for the connectivity. Stream connections were primarily used to create either conceptual and / or functional corridors connecting these polygons. Due to local geology, this may lead to connectivity along only one axis. Where necessary to create connectivity along the opposing axis, additional connections were created using both RSEA and FSA aerial photos along areas not served by surface water connections. Finally, the polygons were visually checked against the FSA aerial photos to adjust for areas that have been developed and to adjust for roadways and other limitations.
The southeast analysis also used steep slope areas, riparian areas, and geological edges.

APPENDIX C. ASP PROJECT RANKING CRITERIA

Outstanding Ecology and Healthy Ecosystems			
Criteria	**Indicators**	**Criteria score**	**Goal / Section score**
Project Size	6 – 120 acres or larger 4 – 60 – 119 acres 2 – 20 – 59 acres 1 – under 20 acres	/6	/30
Will expand protected area of interest/habitat cores (Crane Meadows National Wildlife Refuge, Sherburne National Wildlife Refuge and Carlos Avery State Wildlife Management Area and others) and habitat corridors	4 – Adjacent or within ½ mile of protected area of interest/ habitat core 3 – Adjacent or within ½ mile of habitat corridors 2- Within 2 miles of area of interest, habitat cores or habitat corridor 1 – Within 5 miles of area of interest, habitat cores or habitat corridors	/4	
Will restore or enhance area of interest/habitat corridors (e.g. Crane Meadows National Wildlife Refuge, Sherburne National Wildlife Refuge and Carlos Avery State Wildlife Management Area and others) and habitat corridors	4 – Project will restore habitat on protected land/ habitat core 3 – Project will enhance habitat on protected land/ habitat core 2 – Adjacent or within ½ mile of protected area of interest/ habitat core or habitat corridor 1 – Not adjacent to protected area of interest or corridor, but likely to be adjacent in future given potential acquisitions	/4	
Project protects, restores, or enhances riparian corridors	4 – Project protects high priority riparian corridors 3 – Project restores habitat in high priority riparian corridors 2 – Project enhances habitat in high priority riparian corridors 1 – Project protects, restores or enhances shoreland or buffer	/4	
Percentage of outstanding or high MCBS currently or that will	4 – 80% or higher 3 – 60-79%	/4	

be present after restoration completion	2 – 40 – 59% 1 – 20 – 39%		
Property/project area has documented threatened, endangered, special concern species or other species in greatest conservation need.	4 – Threatened, endangered, special concern or greatest need species currently documented on the property/project area 3 –T/E/SC/SGCN occurrence of transient species use of site 2 – T/E/SC/SGCN not documented on the property/project area but highly likely given documentation on adjacent properties or habitat type 1 – Future potential exists given conditions of the property/project area to serve as habitat for T/E/SC/SGCN	/4	
Property/project area contains native plant communities and/or key habitats as documented by formal assessment, plan or strategy (DNR native plant community data, sensitive shorelines, wild rice, sites of biological significance, old growth forest,).	4 – Native plant communities and/or key habitats are currently documented on the property/project area 2 – Native plant communities and/or key habitats are possible in the future given conditions of the property/project area	/4	

Quality Surface Water and Groundwater			
Criteria	**Indicators**	**Criteria score**	**Goal / Section score**
Shoreline feet protected or restored	6 – 2,000+ feet 4 – 1,000 – 1,999 feet 2 – 500 -999 feet 1 – < 500 feet	/6	/30
Protection or Project will restore hydrological functioning	3 –Best Management Practice (BMP)restores hydrological functioning 2- BMP improves hydrological functioning	/3	
Protection or Project will reduce flooding	3 – Protection, restoration or enhancement will reduce flooding/peak discharge	/3	

Water Quality – Targeting Pollution Source	3 – Protection/Restoration addresses critical pollution sources or risks impacting the identified water resource	/3	
Water Quality – Targeting Actions	2 – The protection or restoration action is a HIGH priority in an approved local water management plan 1 – The protection or restoration action has a MODERATE ranking in an approved local water management plan	/2	
Water Quality – Pollution Reduction	2 – Protection/Restoration project has a HIGHLY quantifiable reduction in pollution and directly addresses the water quality concerns of the associated water resource	/2	
Water Quality – Priority Water Resources	3 – Water resources associated with protection projects are not impaired or for restoration projects water resources are impaired and have a HIGH likelihood of being significantly improved by the project 2 – Water resources associated with the protection project are MODERATELY impaired, but have a completed TMDL which is actively being implemented or for restoration projects water resources are impaired and have a MODERATE likelihood of being significantly improved by the project 1 – Water resources associated with the protection project are impaired and have a TMDL, but with limited implementation or for restoration projects water resources are impaired and have a SLIGHT likelihood of being significantly improved by the project	/3	
Minimal AIS or opportunity to successfully manage for AIS	2 – There are currently no AIS issues associated with the water resources on the protection project or for a restoration project, following completion of restoration there will be no AIS issues associated with the water resources	/2	

	0 – There are AIS issues associated with water resource on the protection project and the opportunity for successful restoration is LOW or for a restoration project, following completion of restoration there will be no improvement in AIS issues		
Protection, restoration or enhancement increases water infiltration	2 – Protection is in an area with high infiltration rate in aquifer recharge areas 1 – Protection/project results in significant increases in water infiltration	/2	
Protection, restoration or enhancement reduces aquifer withdrawal	2 – Protection reduces future aquifer withdrawal 1 – Restoration or enhancement project reduces future aquifer withdrawal	/2	
Property or restoration project is/is not in a Drinking Water Supply Management Area	2 – Yes, is in a Drinking Water Supply Management Area	/2	

Close to Home Recreation			
Criteria	**Indicators**	**Criteria score**	**Goal / Section score**
Increases publically accessible recreational acreage	4 - Protection provides more acres to the public for recreation 2-Restoration project improves public recreation opportunities	/4	/10
Alignment with current community cultural/recreational uses and values	2– There is STRONG alignment with community uses and values 0 – The project is in OPPOSITION to current community uses and values – *proceed with caution*	/2	
Public access for hunting and fishing and related habitat based activities.	2 – Yes, there is/will be public access for a wide range of uses 1-Public access is available but use is restricted	/2	
Opportunities for environmental education activities	2 – There are opportunities for environmental education activities associated with the property/project	/2	

Community Support and Engagement			
Criteria	**Indicators**	**Criteria score**	**Goal / Section score**
Demonstrated interest and willingness of landowners to engage in restoration and protection activities	3– Landowner has given written approval for project and seems very engaged. 2- Landowner has given verbal permission and seems very engaged. 1-Landowner has given verbal or written permission but seems disengaged and not excited about the project. 0 – It is unlikely that the landowner will be willing to engage in restoration or protection activities– *proceed with caution*	/3	/10
The project is likely to have local community support and involvement	3 – The local community actively ADVOCATED for or brought the project forward for consideration 0 – There is strong likelihood of local community OPPOSITION –*proceed with caution*	/3	
The project provides opportunities for the community to volunteer in resource management activities	2 - The project provides opportunities for the community to volunteer in resource management activities	/2	
Environmental outreach materials or other means of education are part of the project outcomes	2 - Environmental outreach materials or other means of education are part of the project outcomes	/2	

Collaborative Anoka Sand Plain Partnership			
Criteria	**Indicators**	**Criteria score**	**Goal / Section score**
Project has been developed in partnership with other stakeholders or conservation entities.	2 – The project was developed with STRONG collaboration between stakeholders and conservation entities 1 – The project was developed with MODERATE collaboration between stakeholders and conservation entities 0 – The project was developed with NO collaboration between stakeholders and conservation entities - *proceed with caution*	/2	/10

Project is a clear fit with one or more partner areas of interest and/or program/funding areas	2 – The project is a STRONG fit with one or more partner areas of interest and/or program/funding areas 1 – The project is a MODERATE with one or more partner areas of interest and/or program/funding areas 0 – The project DOES NOT FIT partner or funding interests - *proceed with caution*	/2	
Partnership is able to come to consensus on value of potential project	2 – There is STRONG consensus among partners as to the value of the project 1 – There is MODERATE consensus among partners as to the value of the project 0 – There is NO consensus among partners as to the value of the project - *proceed with caution*	/2	
Project has support at local, state, and federal government levels	2- Project has support of local, state and federal government levels 1-Project has support of two levels of government	/2	
Protection or projects is included in a locally developed and approved plan	2- Protection or project is included in a locally developed and approved plan	/2	

Goal Section	**Total Section Score**
Outstanding Ecology and Healthy Ecosystems	/30
Quality Surface Water and Groundwater	/30
Close to Home Recreation	/10
Community Support and Engagement	/10
Collaborative Anoka Sand Plain Partnership	/10
Potential discretionary bonus points	/10
Total project score	/100