INDICATORS OF SUCCESS

Once the implementation of the Habitat Plan is underway, it is critical to periodically assess whether the strategies being implemented are successfully mitigating threats and improving the health of the conservation targets. If the strategies implemented are not meeting the conservation goals of each target—typically, improving or maintaining the health of species and ecosystems—it is necessary to revise strategies. Monitoring the responses to management strategies and adjusting the strategies accordingly is referred to as “adaptive management.” In this Habitat Plan, “adaptive management” includes adjustments not only to traditional ecosystem management strategies (e.g., prescribed fires, wetland restoration), but to the entire suite of strategies developed through this planning effort.

There are three levels at which the success of implementation of the Habitat Plan should be measured:

- health of the conservation targets;
- mitigation of the threats to the conservation targets; and
- implementation of the strategies.

Change in the health of conservation targets (plant communities, aquatic habitats, species) is the most fundamental measure of the successful implementation of any conservation plan. However, measurable changes for many of the conservation targets in this Plan will occur over widely varying time periods. For many conservation targets of the Lower St. Louis River, changes will not be measurable within three to five years of implementing the strategies intended to improve their health. At one extreme, the initial changes to upland forests may not be noticeable for a decade or more, and significant, long-term changes may not be measurable for several decades. At the other extreme, initial changes to piping plover populations could be noticeable within the first three to five years of implementing strategies intended to improve their health.

Since it will take some time for the health of conservation targets to show improvement, a second important indicator to monitor is how well threats to the conservation targets are mitigated. The mitigation of threats will be measurable somewhat earlier than changes in the overall health of conservation targets.

Finally, it is necessary to track the strategies outlined in this Plan to ensure that the appropriate actions are taken to successfully implement them. Since more than one strategy may improve the health of a single conservation target, it may be not be immediately clear which strategy is responsible for improvements in the health of that conservation target. Monitoring at all three levels—health of conservation targets, mitigation of threats, and implementation of strategies—will help clarify which strategies are successful and which strategies need to be revised or eliminated. Although the ultimate effects of each strategy will take several years to be measurable, the implementation of strategies should be tracked immediately.

To effectively assess changes in the health of conservation targets, it is critical for each monitoring effort to be clearly linked to the factors that define the health of the conservation targets. Those factors are described in the earlier text on the conservation targets and are also summarized in Table 6. A preliminary list of broadly defined monitoring efforts is included. Though extensive, this is not a final or comprehensive list of all necessary monitoring efforts. It represents priority areas where work should be initiated. Beginning to monitor the factors identified will be necessary to both measure success and refine future monitoring efforts.

Table 6. Factors indicating the health of the conservation targets and preliminary considerations for monitoring those factors.

*This is not a comprehensive list.

Conservation Target	Indicator of Health to be Measured	Preliminary Monitoring Considerations*
Estuarine Aquatic Habitat Targets		
Large riverine reach	Hydrologic regime (volume, rate, timing of river flow) Water quality (sediments, nutrients, chemistry) Habitat morphology Diversity and relative abundance of fish species Diversity and relative abundance of bird species Lake sturgeon spawning, reproduction	Develop hydrologic model for estuary that includes regime under natural range of variation. Sample peak, low, and base flows on periodic basis; compile seasonal and annual measurements and compare to hydrologic model under natural range of variation. Develop model of sediment and nutrient loads to estuary; describe loads expected under natural range of variation. Measure sediment and nutrient loads under range of conditions (“normal,” post-storm, during spring thaw). Sample water chemistry. Periodically assess seasonal fish use and abundance in habitat. Periodically assess seasonal bird use and abundance in habitat. See also lake sturgeon.
Upper estuarine (un-dredged) river channel	Hydrologic regime (volume, rate, timing of river flow) Water quality (sediments, nutrients, chemistry) Habitat morphology Diversity and relative abundance of fish species Diversity and relative abundance of bird species	See large riverine reach.
Lower estuarine (dredged) river channel Lower estuary (industrial harbor) flats	Hydrologic regime (volume, rate, timing of river flow) Water quality (sediments, nutrients, chemistry) Diversity and relative abundance of fish species Diversity and relative abundance of bird species	See large riverine reach.

Upper estuary flats Sheltered bays Clay-influenced river mouths Clay-influenced bay	Hydrologic regime (volume, rate, timing of river flow) Water quality (sediments, nutrients, chemistry) Habitat morphology Diversity and relative abundance of fish species Diversity and relative abundance of bird species Diversity and relative abundance of wetland plant species Extent (acreage) of wetland vegetation	See large riverine reach. Conduct field surveys every three years; record native species composition, presence and abundance of any non-native species, and overall health ranking. Photo-monitoring should be part of these field surveys. Air photo interpretation every five years should be used to assess patterns of various wetland types (e.g., emergent marsh, submergent marsh, wet meadow, etc.) and compare changes in extent of the various wetland plant communities within the estuarine aquatic habitats.
Industrially-influenced bays	Hydrologic regime (volume, rate, timing of river flow) Water quality (sediments, nutrients, chemistry) Habitat morphology Diversity and relative abundance of fish species Diversity and relative abundance of bird species Diversity and relative abundance of wetland plant species Extent (acreage) of wetland vegetation (restored bays or slips)	See upper estuary flats, sheltered bays, clay-influenced river mouths, and clay-influenced bay. May not apply to all industrially-influenced bays.
Industrial slips	Water quality (sediments, nutrients, chemistry) Habitat morphology Diversity and relative abundance of fish species Diversity and relative abundance of bird species	Sample water chemistry. Periodically assess seasonal fish use and abundance in habitat. Periodically assess seasonal bird use and abundance in habitat.
Clay-influenced tributaries Bedrock-influenced tributaries	Hydrologic regime (volume, rate, timing of river flow) Water quality (sediments, nutrients, chemistry) Habitat morphology Diversity and relative abundance of fish species	See large riverine reach.

Estuarine Plant Community Targets		
Great Lakes coastal wetland complex	Diversity and relative abundance of wetland plant species Rare plant species Lack of non-native species Extent (acreage) of wetland vegetation Spatial patterns of wetland plant community types (e.g., emergent marsh, submergent marsh, wet meadow, etc.)	See upper estuary flats, heltered bays, clay-influenced river mouths, and clay-influenced bay.
Baymouth Bar Community Targets		
Beaches	Erosion and deposition of sand	Air photo or satellite imagery interpretation every five years to assess erosion and deposition patterns on Points and around western Lake Superior coastline.
Beachgrass dunes Dune shrublands Interdunal wetlands	Diversity and relative abundance of plant species Rare plant species Extent (acreage) of each community type Lack of non-native species	Conduct field surveys every three years; record native species composition, presence and abundance of any non-native species, and overall health ranking. Photo-monitoring should be part of these field surveys. Air photo interpretation every ten years should be used to assess extent and spatial patterns of these community types.
Dune pine forests	Diversity and relative abundance of plant species Rare plant species Extent (acreage) of each community type (increased from current area) Lack of non-native species	Conduct field surveys every three years; record native species composition, presence and abundance of any non-native species, and overall health ranking. Photo-monitoring should be part of these field surveys. Air photo interpretation every ten years should be used to assess extent and spatial patterns of this community type.
Upland Forest Community Targets		
White pine-red pine forests Northern conifer-hardwoods forest / Northern hardwoods forest Spruce-fir boreal forest	Diversity and relative abundance of plant species Age class structure of dominant tree species Extent (acreage) of each community type (increased from current area)	Map land cover and complete a change detection analysis, using satellite imagery, to assess species composition. Conduct field surveys to evaluate age class structure; every ten years may be an appropriate frequency.

Other Inland Plant Community Targets		
Eroding clay bluffs Clay seeps Conifer swamps Hardwood swamps Shrub swamps Inland marshes Wet meadows Fens	Diversity and relative abundance of plant species Hydrologic regime (volume, rate, timing, source of flow)	Conduct field surveys to evaluate the species diversity and structure of these finer-scale communities. Photo monitoring may be a good technique for assessing the eroding clay bluffs and clay seeps.
Cliffs and rock outcrops	Diversity and relative abundance of plant species	Conduct field surveys to evaluate the species diversity and structure of these finer-scale communities.
Species Targets		
Native fish assemblage	Diversity and relative abundance of native fish species Non-native aquatic animal species declining or eradicated	Continue existing fisheries sampling efforts; determine whether additional, more comprehensive sampling is necessary.
Lake sturgeon	Population size, age class structure	Continue WDNR's and MDNR's monitoring of population size and reproductive success; expand to include radio-tag monitoring.
Native mussel assemblage	Diversity and relative abundance of native mussel species Zebra mussel controlled or eradicated	Continue MDNR's mussel sampling effort to develop estimates of current populations of native species; continue field sampling to monitor both native and zebra mussel populations.
Migratory bird aggregations Breeding bird aggregations	Diversity and numbers of migratory birds Diversity and numbers of breeding birds	Coordinate with existing survey and other sampling efforts. Conduct a comprehensive breeding survey to estimate current breeding status and populations of breeding birds. Conduct periodic monitoring to estimate long-term trends. Conduct a comprehensive migratory survey to estimate current diversity and numbers of birds utilizing estuary.
Piping plover	Population size, reproduction	Conduct detailed annual surveys; coordinate with U.S. FWS recovery and monitoring efforts.
Common tern	Population size, reproduction	Conduct detailed annual surveys; coordinate with U.S. FWS recovery and monitoring efforts.
Wild rice	Population size/areal extent, reproduction	Conduct field surveys.

*This is not a comprehensive list.

Effective evaluations of how well threats are being mitigated also requires a clear link between the threats and the factors that indicate mitigation. These factors are summarized in Table 7.

Table 7. Threats and factors to be evaluated that indicate how well threats are being mitigated.

Stress	Sources of Stress	Indicator of Mitigation to be Measured
Loss of habitat	Development Commercial shipping (dredging and filling) Other sources	# of acres developed in/on "natural" communities or habitats (vs. acres redeveloped within existing developed areas). Monitor whether dredged area expands or remains stable.
Increased sedimentation	Development Forest management practices Other sources	Change in sediment load.
Competition from non-native species	Commercial shipping Development (accidental release or dispersal of non-native species) Other sources	Rate of introduction of new non-native species declines, or new introductions are eliminated. Populations of non-native species decline, are eliminated, or are controlled.
Exposure to sediment-associated contaminants	Contaminated sediments (from historical, municipal sewage, commercial, and industrial releases) Other sources	Acreage of highly contaminated sediments (acreage should decrease as problem is addressed).
Degraded water quality	Development Commercial shipping Contaminated sediments (from historical, municipal sewage, commercial, and industrial releases) Forest management practices Other sources	Water quality measures improve from current levels.

Measuring the health of conservation targets and the level of threat mitigation requires integration of monitoring activities and data across agencies and jurisdictional borders. Implementation of an ecological monitoring program should include application of a strong, statistically robust design and should utilize Geographic Information Systems (GIS) for analysis and display of results. Ideally, all of the specific examples described above will be part of a single coordinated monitoring effort among many agencies. It will be necessary for this integrated program to go beyond the levels of monitoring and coordination currently being done in the Lower St. Louis River.