Cumulative Effects Analysis on Wildlife Habitat Loss/Fragmentation and Wildlife Travel Corridor Obstruction/Landscape Barriers in the Mesabi Iron Range and Arrowhead Regions of Minnesota

Prepared for the Minnesota Department of Natural Resources

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Background

Various people have contributed to a body of data from which this Cumulative Effects Analysis (CEA) is being developed. Decisions made by others which led to the particular focus of this CEA were made at the following completed stages of environmental review for the three Environmental Impact Statements for the proposed PolyMet, Minnesota Steel, and Ispat Inland mining operations.

1. Inventory of potentially cumulative effects – Scoping Environmental Assessment Worksheet (EAW)/ Scoping Decision Document (SDD)
2. Inventory of potentially affected resources – Scoping EAW/ SDD
3. Inventory of other actions that may affect the resources – Scoping EAW/ SDD
4. Selection of temporal and spatial scale of analysis – Scoping EAW/ SDD

From this background and direction for study the following activities are reported herein:

5. Selection of thresholds for carrying capacity of additional effects and establishment of significant impacts.
6. Prepare CEA

The goal of cumulative effects analysis for wildlife habitat is to identify 'truly meaningful' or significant impacts associated with habitat loss/fragmentation and travel corridor obstruction/landscape barriers. Cumulative Effect Analysis requires scaling both spatially and temporally. For this analysis a spatial scale on the order of magnitude that makes sense for wide-ranging mammals had to be selected. To capture a meaningful temporal scale the analysis had to consider at a minimum the actions encompassing the lifespan of various proposed mining projects in the Mesabi Iron Range region. The general scales for the following analyses were established in Step 4 as described above. How these scales were used to assess significant impacts is described in the Methods section of this report.

In summary, cumulative effects analysis includes:

1. the area in which the effects of the proposed projects will be felt;
2. the impacts that are expected in that area from the proposed projects;
3. other past, present, and reasonably foreseeable actions that have or are expected to have impacts in the area;
4. the impacts or expected impacts from these other actions; and
5. the overall impact that can be expected if the individual impacts are allowed to accumulate.

Methods of Evaluation

For this project two spatial scales were established. The travel corridor effects were evaluated according to the Mesabi Iron Range mineral deposit formation. The wildlife habitat effects were evaluated according to the Arrowhead Region. The temporal scale of analysis encompasses both past and future actions which have accumulated and affect both the regional travel patterns of large free-ranging mammals and habitat requirements for all mammals.

Threshold for Impacts

Further losses to key habitats for mammalian Species of Greatest Conservation Need (SGCN) is one major threshold for impacts. These species have been determined in Minnesota as part of the Minnesota Comprehensive Wildlife Conservation Strategy (CWCS). The species listings provided therein serve as the indicators of wildlife 'on the brink', so to speak, and the potentially cumulative losses to required habitat could be considered significant.

The threshold for impacts to regional travel is losses of, or obstructions to existing travel corridors across the minerals formation. Historically, prior to the cumulative actions which led to the existing mine features, wildlife travel was unrestricted from northwestern to southeastern sections of the Arrowhead across the Iron Range. Currently travel is restricted because of the extensive change to the landscape, including large mine pits, rock stockpiles, mining infrastructure, regional development associated with the Mesabi Iron Range, and highways.

Future Actions

The travel corridor and habitat data intersecting the Iron Range and the Arrowhead were screened against the future conditions scenarios for mining, forestry, and regional development, cumulatively referred to as the human footprint.

Human Footprint Data:

- 2004 Mine Features
- Tax-incentive job development zones
- Potential 4-lane highway corridors
- Proposed state forestry harvest scenarios
- Proposed mining actions

The Minnesota Department of Natural Resources (MNDNR) has identified and mapped past mine features, both active and inactive locations of mining activity in the Mesabi Iron Range region of Minnesota. These data are used here as the estimate of one of the past actions which contribute towards the cumulative effects on wildlife habitat loss/fragmentation and travel corridor obstruction/landscape barriers.

As part of the Human Footprint, it was assumed that Tax-incentive job development zones would decrease potential wildlife corridors and/or completely remove areas of wildlife habitat due to urban development activities.

These areas, defined as "JOBZ Tax Free Zones," were taken from the Arrowhead Regional Development Commission (ARDC) and are approximate locations of future urban development. The ARDC created an overlay called the JOBZ tax-free incentive zone. For the purposes of this analysis, they serve as one surrogate for future urban development and thus should be considered as the minimum known locations. Actual development may be somewhat more extensive and the locations are unknown at this time.

Roadways will create barriers between habitat requirements of wildlife and restrict regional travel patterns. These effects are limited to 4-lane divided highways of the type being designed for Minnesota Trunk Highway (TH) 169 and TH 53 in various segments.

The forestry loss approximation is based upon the timber harvest scenarios identified in statewide predictions of future timber harvest. The future forestry conditions are described by State harvest sites projected through 2014. Harvest sites can be classified by a range of prescriptive practices. Similar to the analysis of wildlife impacts performed for the Statewide Generic Environmental Impact Statement (GEIS) on Timber Harvesting and Forest Management, all harvest sites were considered together. That is, in the analysis presented here, there was no classification of impacts according to harvest prescription. In contrast, no threshold or de minimus amount of harvesting was granted below which no impact was calculated or considered significant. The GEIS harvest levels were of interest for future conditions, but it was not feasible to obtain or integrate the Forest Inventory and Analysis (FIA) layers into the GIS for the CEA project. In addition, those predictions were performed almost 15 years ago, and the MNDNR harvest projections were assumed to be more realistic at this point.

Use of more current FIA data was considered. But it is beyond the scope of this project to investigate the existence of a complete crosswalk between the national GAP land cover layer used for FIA, the MN-GAP program, and the modifications made to the MN-GAP land cover layer for the species-habitat relationships in the CWCS.

Proposed actions include the following projects known by the MNDNR as being considered in the Mesabi Iron Range region.

- Proposed PolyMet Mining Features
- Proposed Mesabi Nugget Plant
- Proposed Cliffs Erie Railroad Pellet Transfer Facility
- Proposed Minnesota Steel DRI/Steel Plant
- Proposed Ispat Inland and East Reserve Mine Pits
- Proposed Mesaba Energy Coal Gasification Plant

Impacts Evaluation

The set of SGCN resulted from the accumulation of many kinds of past actions. The potential reasons for listing are many, but analysis in the CWCS indicates that habitat degradation/loss is by far the most common. Thus, proposed actions which lead to cumulative future habitat losses are considered significant impacts if any of the SGCN

are dependent on those habitats. For this study, the evaluation of SGCN is limited to mammals.

Habitat data used to evaluate impacts included the following:

- MNDNR GAP land cover classification associated with subsections
- SGCN associated with GAP land cover types
- Ecological Subsections of the Arrowhead Region

As part of the Minnesota CWCS, the MNDNR has evaluated land cover types in terms of habitat needs for all groups of wildlife with respect to SGCN. These land covers have also been related spatially to the state ecological subsections as defined by the MNDNR and United State Forest Service (USFS). These studies provide the ability to evaluate habitat requirements for SGCN on an ecological subsection basis. This is applied to impact evaluation by examining the human footprint at a regional scale as it spatially overlaps with habitats in each ecological subsection of the Arrowhead Region.

Significant impacts to large mammal travel corridors were evaluated by examining the entire known minerals formation in the Mesabi Iron Range. This formation presents itself regionally as a long linear barrier to regional travel from northwestern to southeastern sections of the Arrowhead. The minerals formation is approximately 100 miles in length. Not surprisingly, there is a high correlation between existing mine features from past actions and the mineral formation.

Travel corridor data used to evaluate impacts included the following:

- Iron Range minerals formation
- Roadless blocks of the Superior Mixed Forest Ecoregional Plan
- Travel corridor crossings of the mineral formation

The Iron Range minerals formation was mapped by the MNDNR several years ago. It represents the known geologic deposits of minerals, and very closely matches the existing mine features map.

Significant areas of habitat to the northwest and the southeast of the corridors were represented by areas defined by The Nature Conservancy (TNC) as "Roadless Blocks." TNC defines these roadless blocks as "large roadless forest areas that predict to provide sufficient contiguous habitat to maintain viable populations of most species indigenous to those forest types. Minimum size depends on forest type. Roadless Blocks represent all areas without roads and areas with road densities less than or equal to 0.43 km/km2. Studies in Wisconsin, Michigan, Ontario and Minnesota indicate that Eastern Timber Wolf populations usually fail to sustain themselves in areas where rural roads open to the public have densities exceeding 0.43 km/km2." (Superior Mixed Forest Conservation Plan, The Nature Conservancy 2002). For the purposes of this study, these areas are referred to as habitat blocks.

A recent MNDNR study examined aerial photo imagery of the 100-mile minerals formation region for the presence of existing travel corridors or gateways across the formation that still exist after past mining actions. Each corridor varies in width and land cover and could be evaluated according to width and types and kinds of restrictions within the corridor. The impacts were not evaluated this way. Instead they were examined in the context of habitat blocks to the northwest and southeast from which wildlife species would travel through these passageways across the 100-mile long barrier. Thus the relative importance has been characterized in terms of its context with mapped "roadless blocks" within several miles on either side. The impacts were classified based upon the type and extent of proposed human footprint that affects the corridor directly or indirectly through its context with habitat blocks.

Summary of Data Sources

The following lists summarize data used for the evaluation of cumulative effects.

Minnesota Department of Natural Resources:
-Existing Mine Features
-Existing Wildlife Corridors
-Proposed Mine Features
-Ecological Provinces, Sections, and Subsections of Minnesota
-Minnesota's Comprehensive Wildlife Conservation Strategy (CWCS) Habitat Types (Tomorrow's Habitat for the Wild and Rare. January, 2006)
-Level 2 Gap (1991 - 1993)

The Nature Conservancy:
-Superior Mixed Forest Conservation Plan Shape files (roadless areas/Habitat Blocks)

Arrowhead Regional Development Commission:
-JOBZ Tax Free Zones

Geographic Information System and Variability in Spatial Data Precision

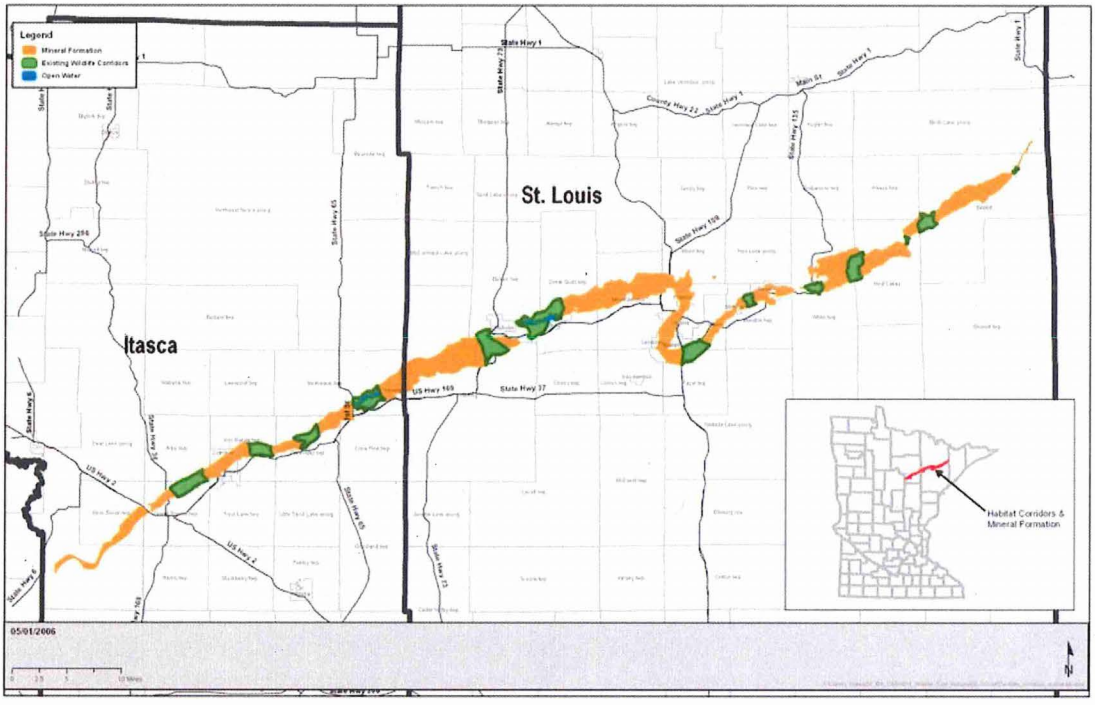
All data used in the analysis were related within a geographic information system (GIS). The spatial data were determined at different spatial scales and with different levels of precision. The GAP land cover classification was derived from satellite imagery. The scale of interpretation has about an 85% precision. This means that GAP habitat types will have a 15% margin of error. The resulting analysis of GAP data and various existing and proposed human footprints will thus present a few incongruities. For example, in reviewing the tables of future impacts on wildlife habitat it is possible to see a small amount of open water area as being impacted from mine activities. This is due to error in GAP image interpretation. Incongruities in land cover and proposed actions should be evaluated in light of the slight errors in GAP land cover.

Results of Analysis

Travel Corridors

The Mesabi Iron Range Minerals Formation extends for about 100 miles through Itasca and St. Louis Counties. The formation correlates with the past mining activities in Minnesota. The mine features provide a variety of impediments to travel and thus feasible travel between habitats northwest and southeast of the formation is restricted to travel corridors shown in Figure 1.

Figure 1. Wildlife Travel Corridors Across the Mesabi Iron Range Minerals Formation of Northern Minnesota.



Each of the travel corridors was evaluated for potential impacts from future actions. There were no forestry actions within the mineral formation region. This is not surprising, considering the deforestation from past mine features. The likely future impacts in and adjacent to the minerals formation are thus from mining, other economic development, and roadways. Impacts are presented in the following travel corridor figures for the 13 travel corridors. It is important to note that 'roadless block' habitat is not the only possible destination of traveling wildlife. The roadless block habitat may be considered as core habitat. Undesignated habitat is also present, as shown in this analysis. This analysis is not complete or applicable to specific impact assessment of an individual proposed future action.

Additional data required for this will include at minimum an interpretation of all habitat in and around the corridors and roadless blocks, documentation of species from state records, and field reconnaissance.

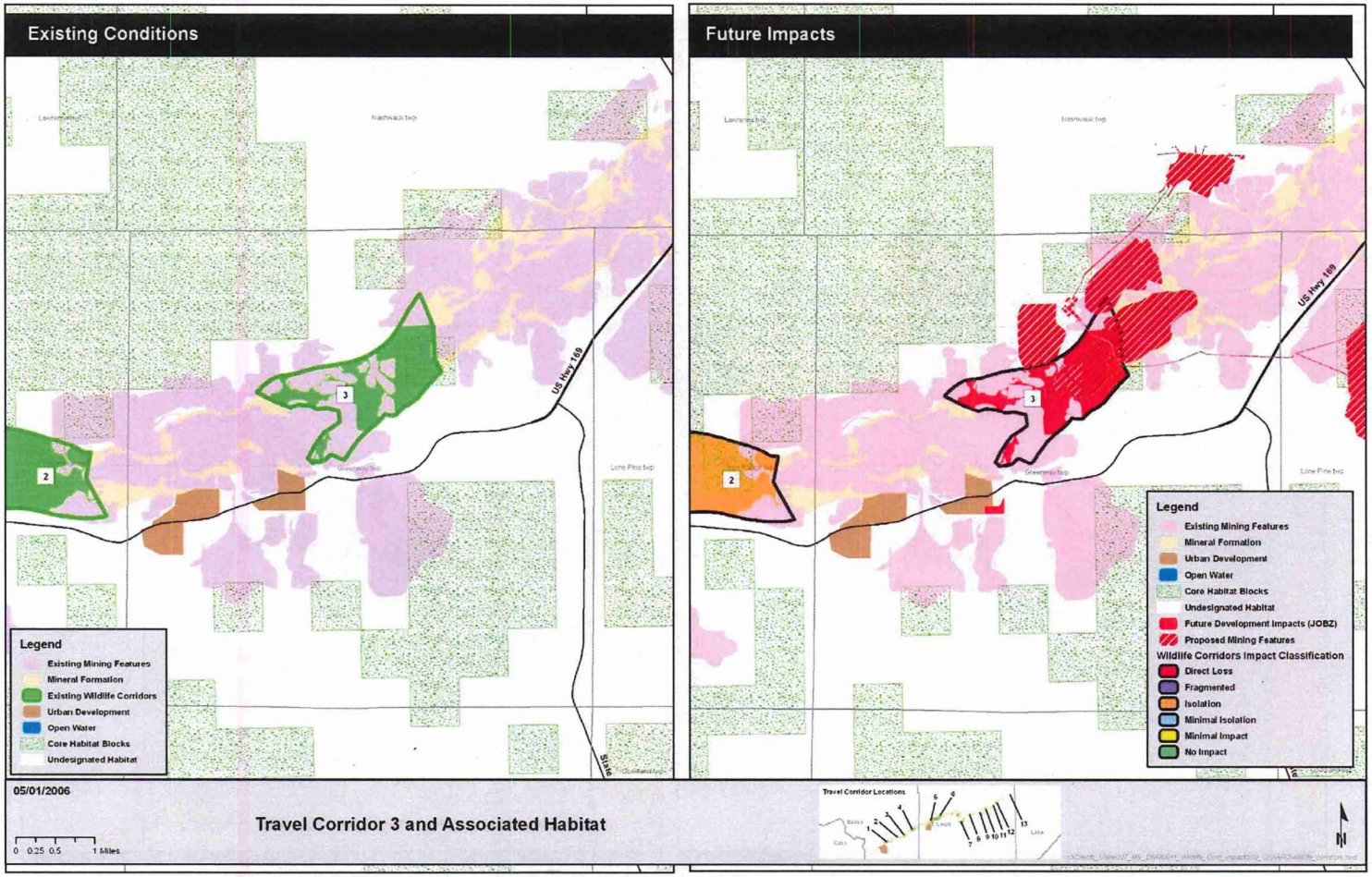
EXISTING CONDITIONS
Wildlife Corridor #1 is located adjacent to the urban developed area of Grand Rapids. It is defined by urban travel constraints to the southwest and urban/mining constraints to the northeast. Current mining activities impose upon this gateway and restrict travel within the corridor. Although several active mine features are within the corridor, it is tightly connected to core habitat blocks and still considered s a viable travel route. A 4-lane roadway to the southeast may make this corridor less valuable for regional travel between core habitat blocks.

FUTURE IMPACTS
Future development in the minerals formation to the south may restrict travel between core habitat blocks in that area. At this time, impact is ranked as minimal isolation because the value of the corridor may be low and it is assumed that feasible large animal travel corridors can be designed into the road barrier to improve travel potential.

EXISTING CONDITIONS
Under existing conditions Wildlife Corridor #2 is in close proximity to a large core habitat block to the north and smaller blocks to the south. The corridor is also unrestricted by mine features. This context suggests that the corridor is of rather high value for movement. However, there may be travel conflicts with the 4-lane highway in the eastern direction. Existing mine features restrict movement to this corridor for at least a mile in either direction along the minerals formation.

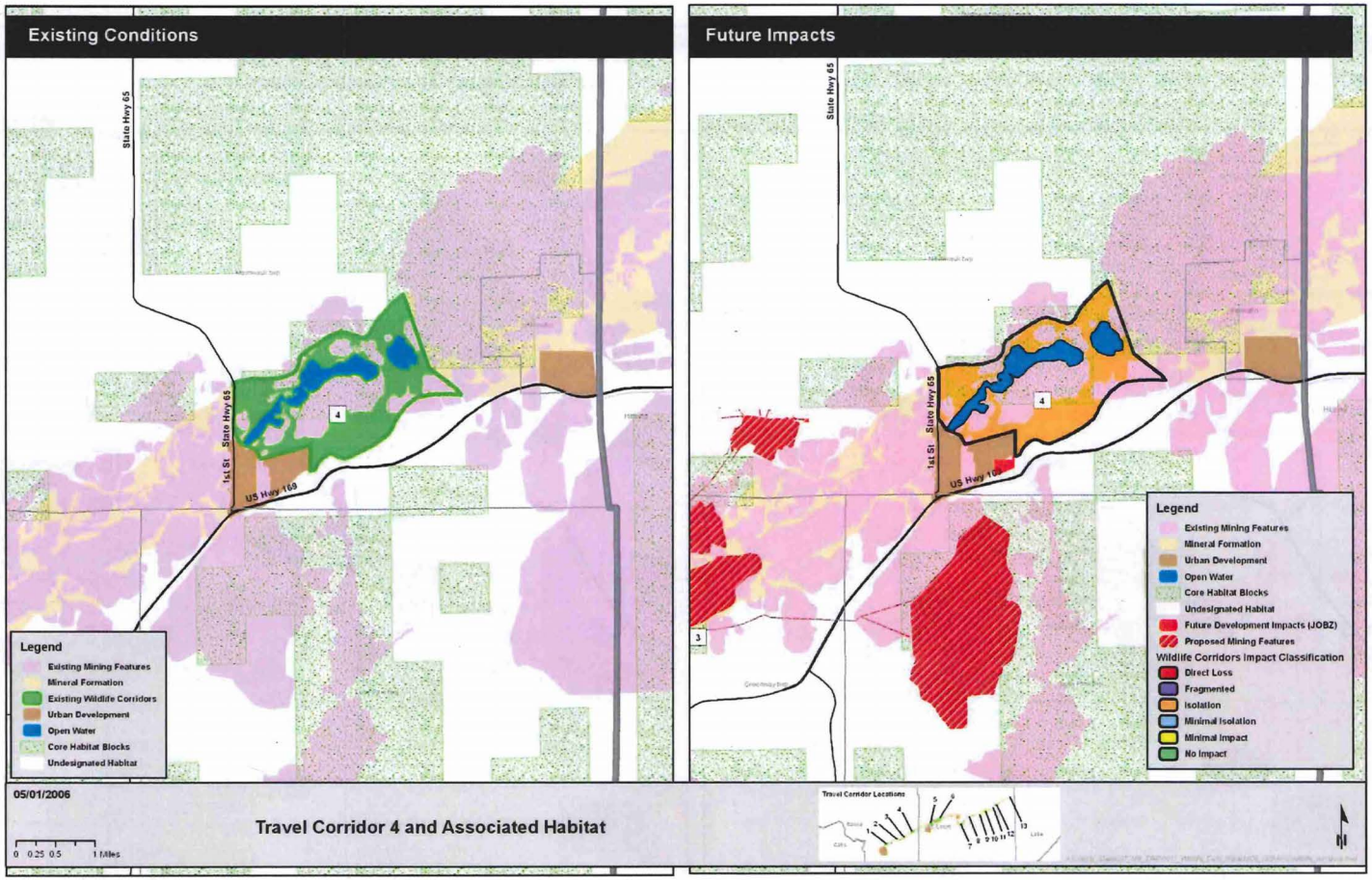
FUTURE IMPACTS
Movement across this corridor and between core habitat blocks to the north and south will likely be further affected by the 4-lane highway and increased vehicle traffic. This corridor has been isolated but could be minimal depending on field-determined use of this corridor and appropriate large mammal travel bridges designed into the 4-lane highway. It should be noted that the corridor is valuable in the context of closely aligned core habitat blocks.

EXISTING CONDITIONS
Under current conditions, Wildlife Corridor #3 serves to connect a large core habitat block to the northwest and southeast. Current and past mine features are concentrated to the northeast and southwest of this gateway. This corridor is of high value as the only travel route for several miles in either direction along the mineral formation, even though there are portions of current mine features existing within Wildlife Corridor #3.



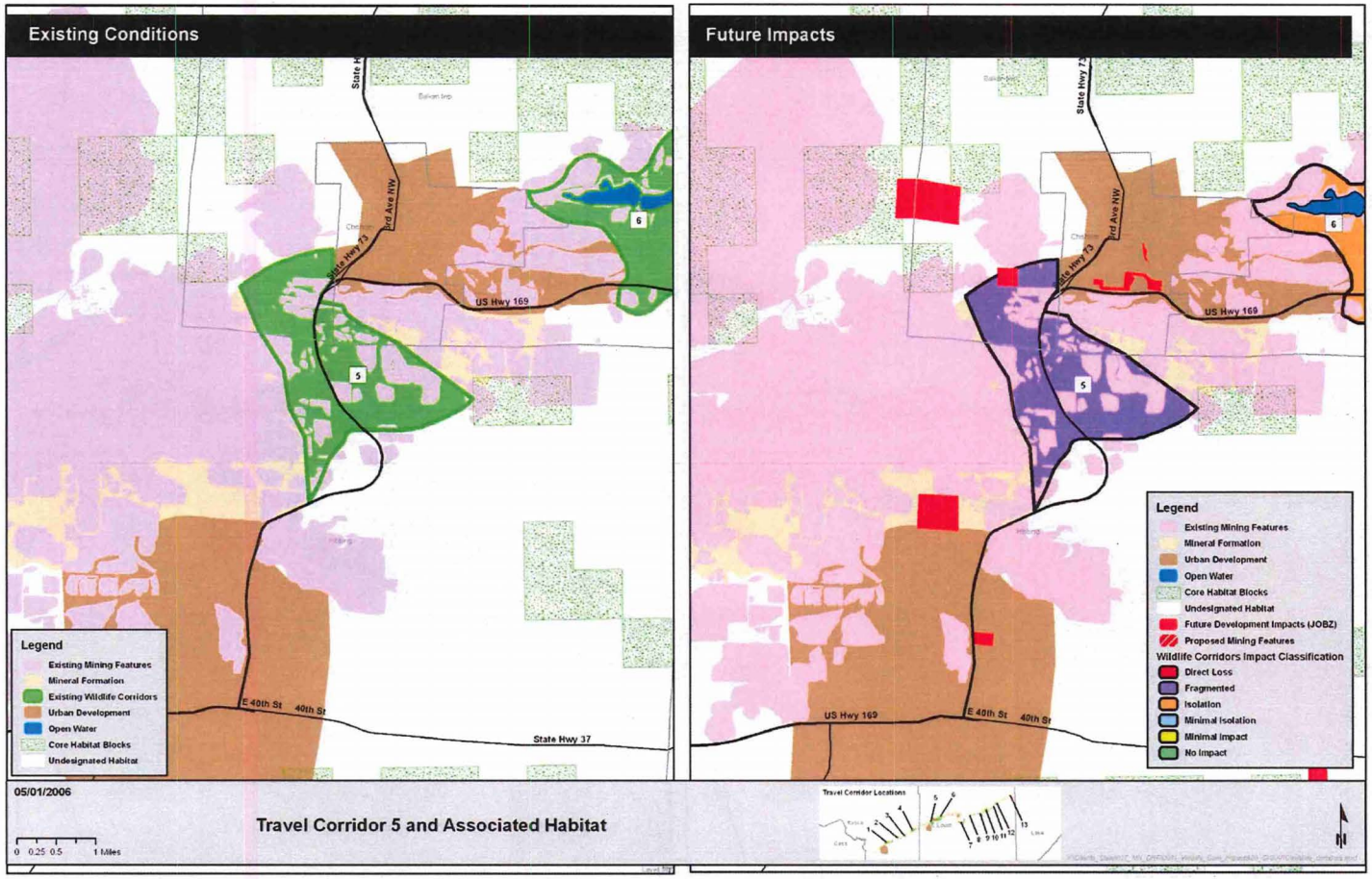
FUTURE IMPACTS
Under future conditions, there is direct loss of this entire travel corridor and isolation of the travel route from movement either north or south. This is a significant loss due to the high density of core habitat blocks within several miles of this corridor. Unless direct loss can be prevented, it is not feasible to consider large animal travel bridges across the 4-lane highway to the south.

EXISTING CONDITIONS
Under existing conditions, Wildlife Corridor #4 serves to connect a large core habitat block to the north with a slightly smaller block to southeast. Existing mine features and associated lake dissect the corridor, but close proximity of core habitat should provide high value. This corridor can be considered high value, and further ground reconnaissance may suggest widening this corridor to the northeast. The 4-lane highway likely conflicts with regional north/south travel.



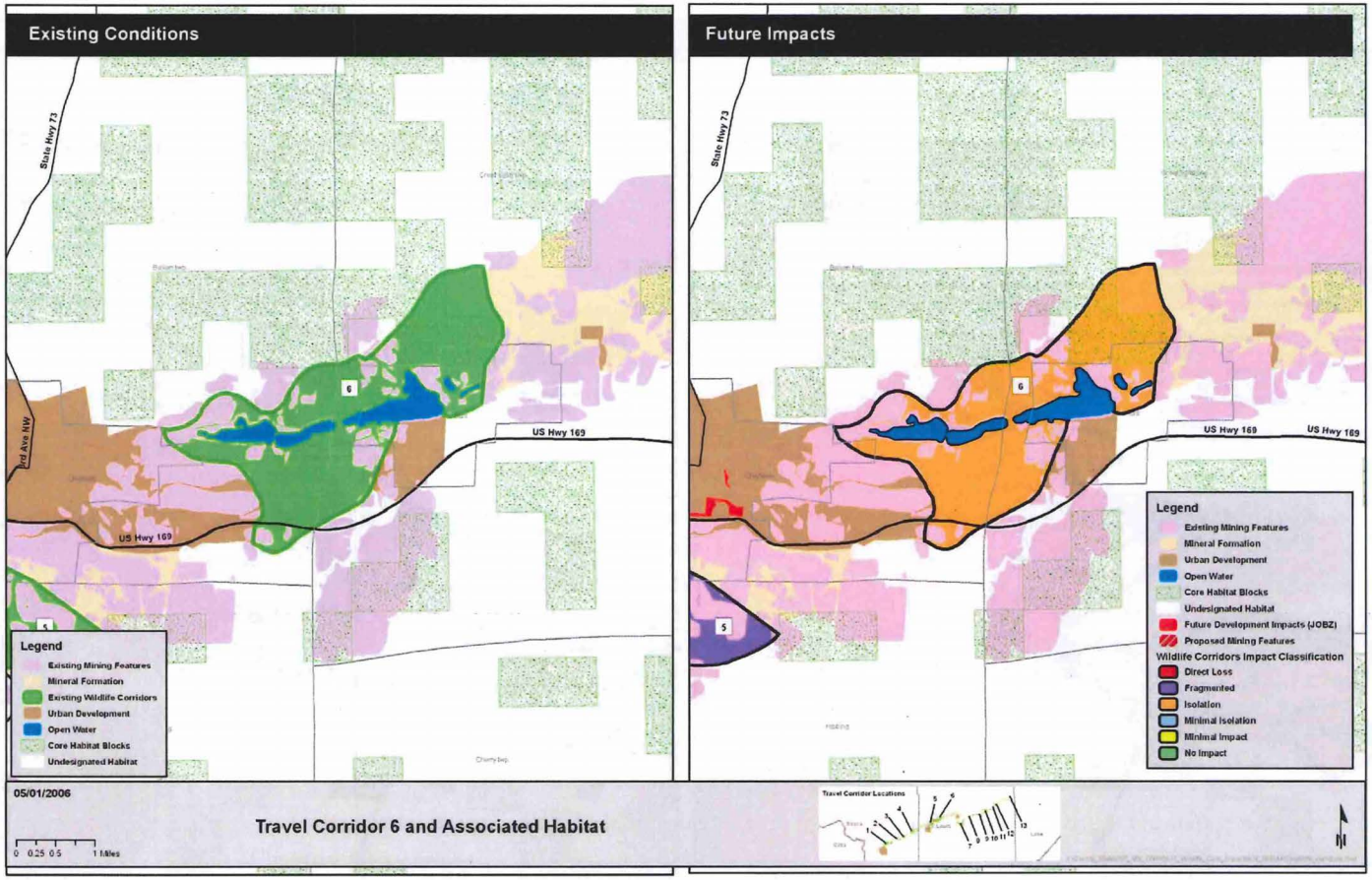
FUTURE IMPACTS
Under future scenarios, the value of habitat to the south declines due to direct loss. In the whole context, the core habitat value to the north can be expected to be devalued due to the loss of core habitat to the south and the potential for increased highway use and conflicts.

EXISTING CONDITIONS
Wildlife Corridor #5 does not link large core habitat blocks within a mile or two of the corridor. It is the only feasible route across the mineral formation for several miles in either direction. Given the extent of existing mine features and nearby urban development (Chisholm to the northeast and Hibbing to the south) this travel route can be expected to be of relatively lower value. In addition, movement within the corridor is likely restricted by the roadway.



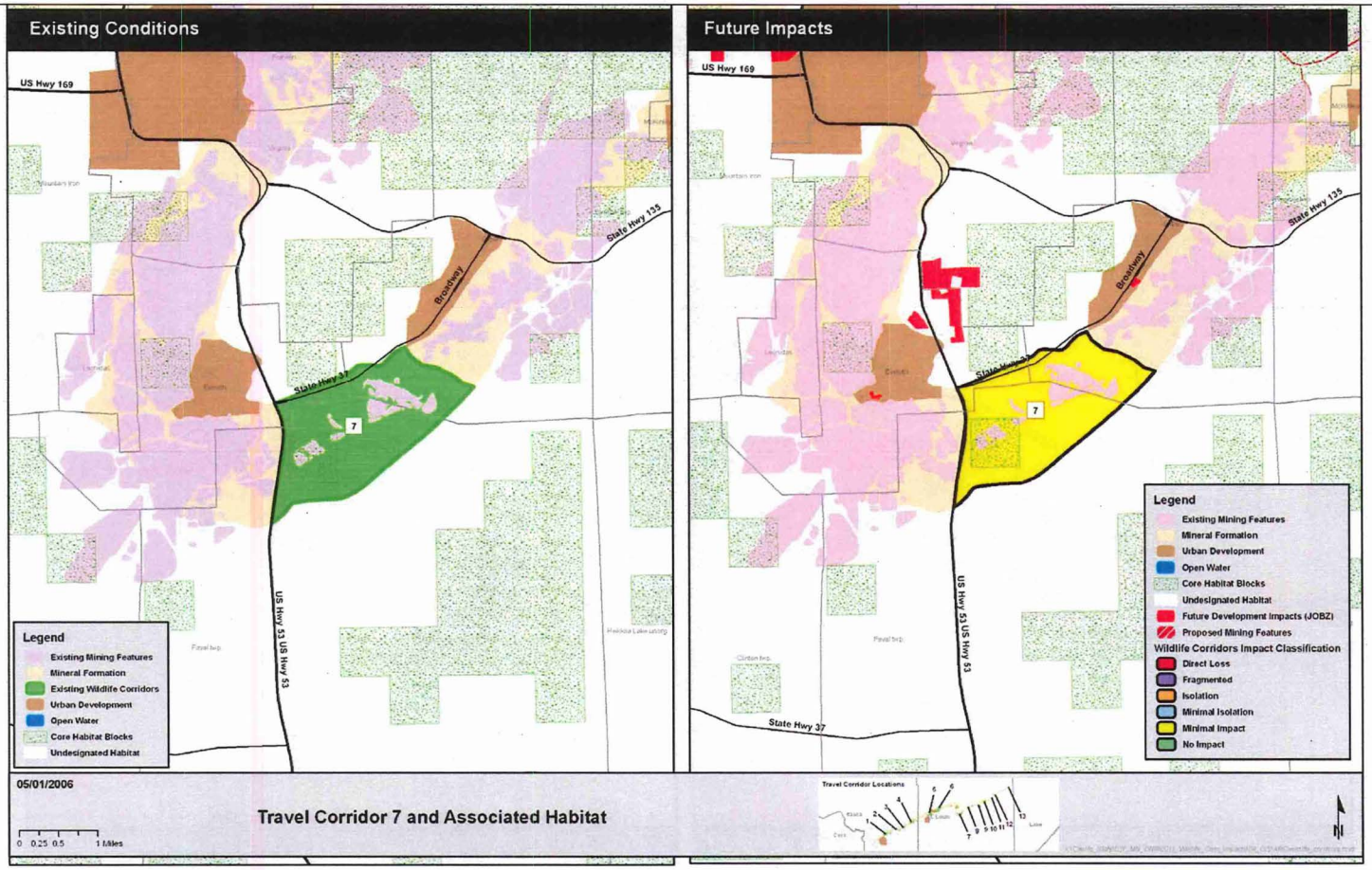
FUTURE IMPACTS
Under future conditions highway use is expected to further fragment travel. This could be mitigated with proper large animal travel bridges. But some loss will occur directly due to urban development Local and more regional travel is expected to decline in this area, putting more pressure on other corridors and further fragmenting larger scale regional travel.

EXISTING CONDITIONS
Wildlife Corridor #6 serves to connect larger core habitat blocks to the north with varied, undesignated habitat to the south. The urban developed area of Chisholm restricts passage to the west, and existing mining features limit connections to the east. The water features are related to mine features and do not necessarily provide high quality aquatic resource habitat within the corridor. The highway may restrict travel as well.



FUTURE IMPACTS
Under future conditions, the four-lane highway is expected to be more and more of a barrier to movement, thus isolating the corridor and regional north/south travel across the mineral formation. Mitigation may again be undertaken with large mammal travel bridges. No planned future development or mining will affect this corridor.

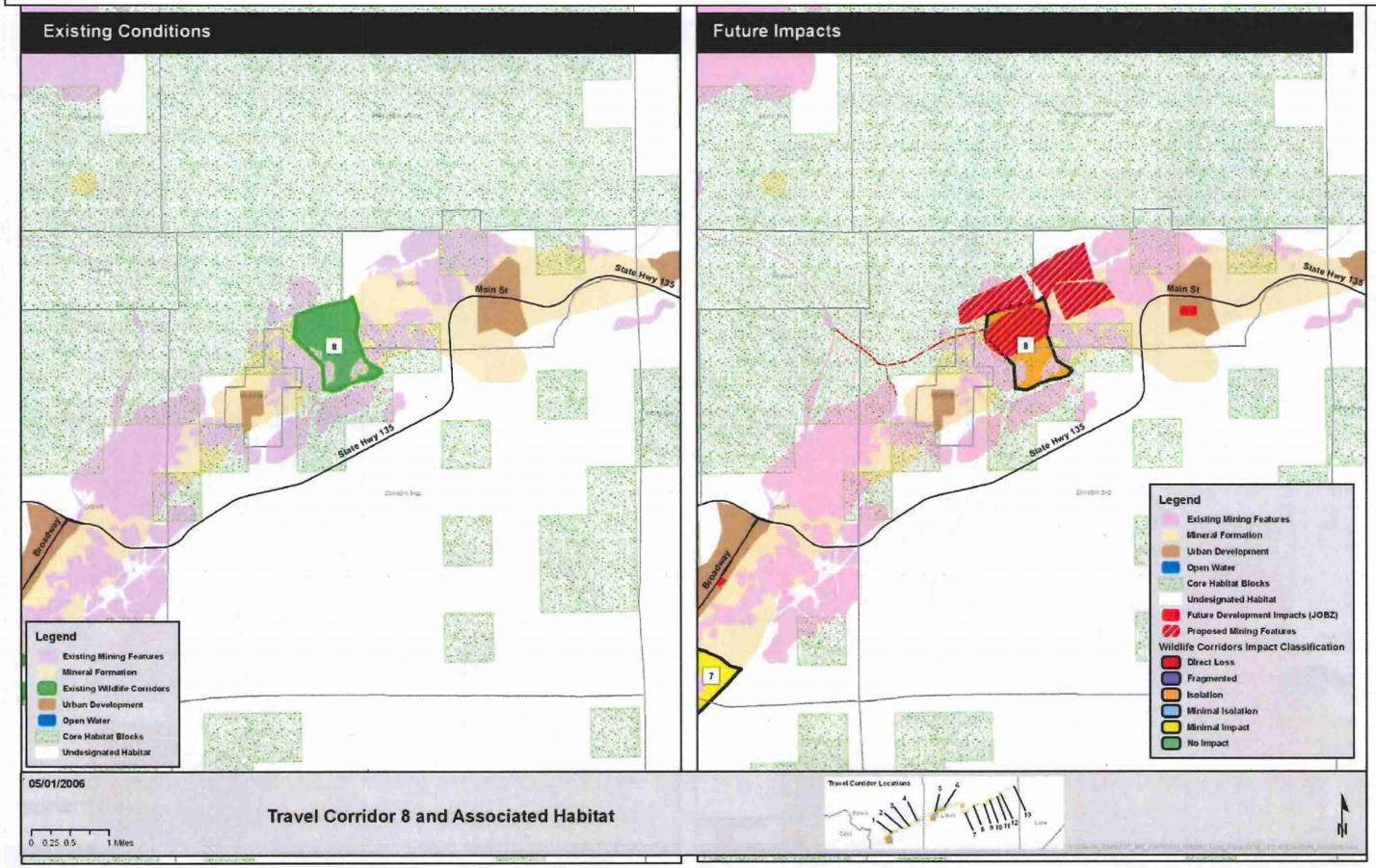
EXISTING CONDITIONS
Wildlife Corridor #7 is likely serving as an important gateway across the mineral formation because of the proximity of core habitat blocks and lack of conflicts with a 4-lane highway. Only small sites of existing mine features fragment the total travel corridor area. Existing mine features and the urban developed area of Eveleth mostly sever any possibly gateways to the west and northeast.



FUTURE IMPACTS
The impacts to this corridor are classified as minimal because of planned development to the northwest that does not cause a direct loss to core habitat. Core habitat to the north, as well as undesignated habitat to the south, may become more important to protect and thus preserve the existing flow between north and south.

EXISTING CONDITIONS

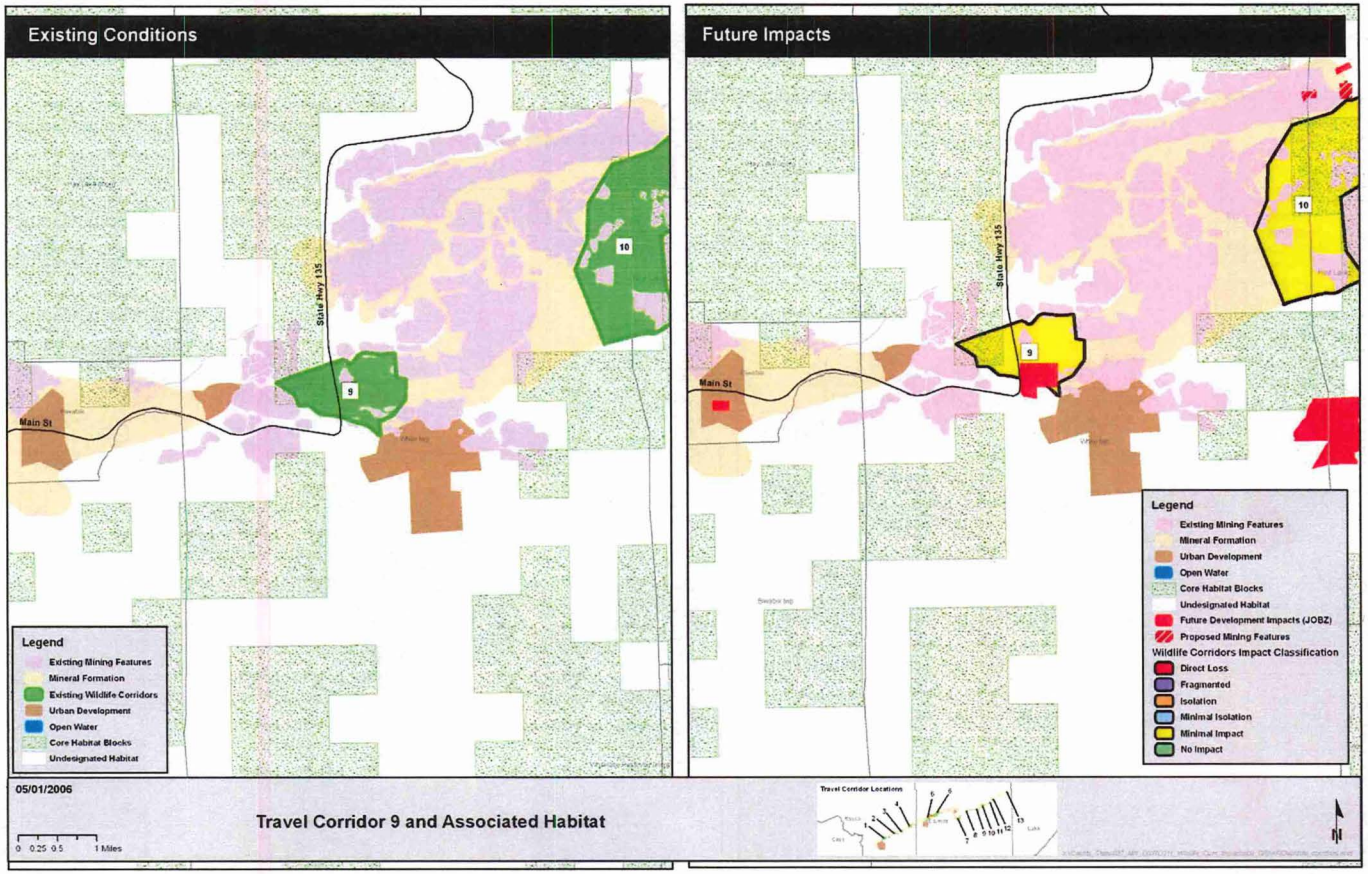
A very large core habitat block is adjacent to the minerals formation in the area of Corridor #8. Existing mine features may interfere to some extent with movement across the minerals formation in this area. The co-occurrence of core habitat blocks within the corridor suggests that the mine features do not severely restrict movement. Because of the size of the habitat block to the north, this route is likely very important for travel to undesignated habitat to the south and core habitat blocks several miles away. Additional evaluation of habitat suitability to the south should be undertaken.



FUTURE IMPACTS

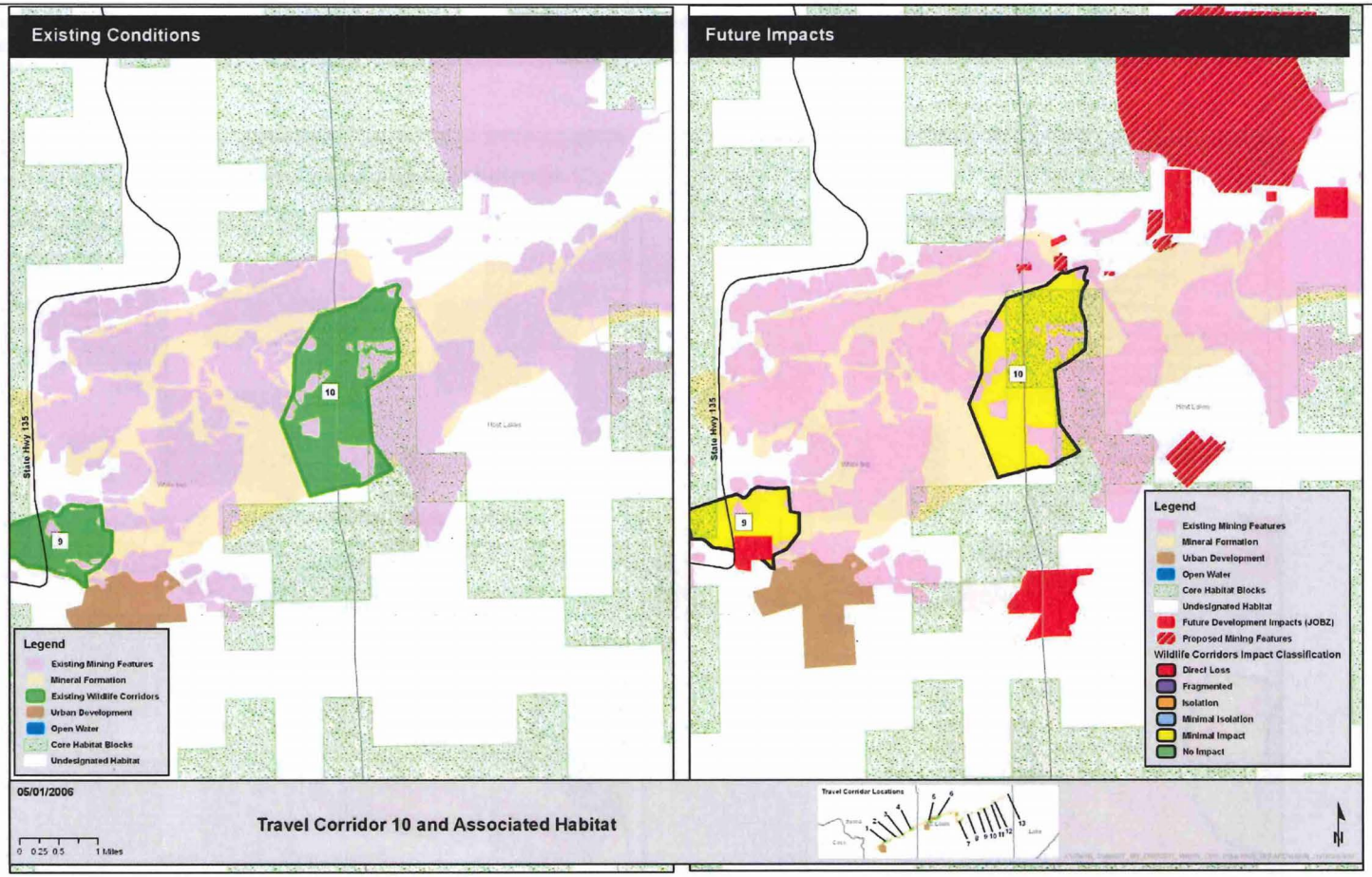
Under future conditions, there is significant impact to this corridor from direct loss. The core habitat block to the north may be devalued by losing this travel corridor. Regional wildlife movement will be forced towards travel corridors 7 or 9. The MNDNR may undertake further corridor assessment in this area for potential travel across the mineral formation to the east.

EXISTING CONDITIONS
Wildlife Corridor #9 serves to connect a large core habitat block to the northwest with undesignated and core habitat to the south.



FUTURE IMPACTS
Under future conditions, this corridor becomes restricted in its use because of expanded urban development. The impact is classified as minimal because the eastern side of the corridor was considered relatively less valuable to begin with, due to the urban and mine features surrounding it. Therefore Wildlife Corridor #9 will be minimally impacted under future conditions and still serve an important role as a small but valuable travel corridor. The MNDNR may further assess the corridor value of the mineral formation further to the west of this corridor to possibly mitigate effects on this corridor and #8.

EXISTING CONDITIONS
Wildlife Corridor #10 serves to connect a large core habitat block to the north and core and undesignated habitats to the south. Existing mine features restrict passage across the mineral formation for several miles in either direction.



FUTURE IMPACTS
Under future conditions, small sites of mining activity and urban development pose a threat to the passageway on the north side. With the significant increase in mining activity to the northeast this corridor may service increased movement as species shift in response to the action.

EXISTING CONDITIONS

Wildlife Corridor #11 currently serves as a very small but probably very important passageway between large core habitat blocks to the east/southeast and north/northwest. Current mining operations restrict travel across the minerals formation to the south and north of #11.

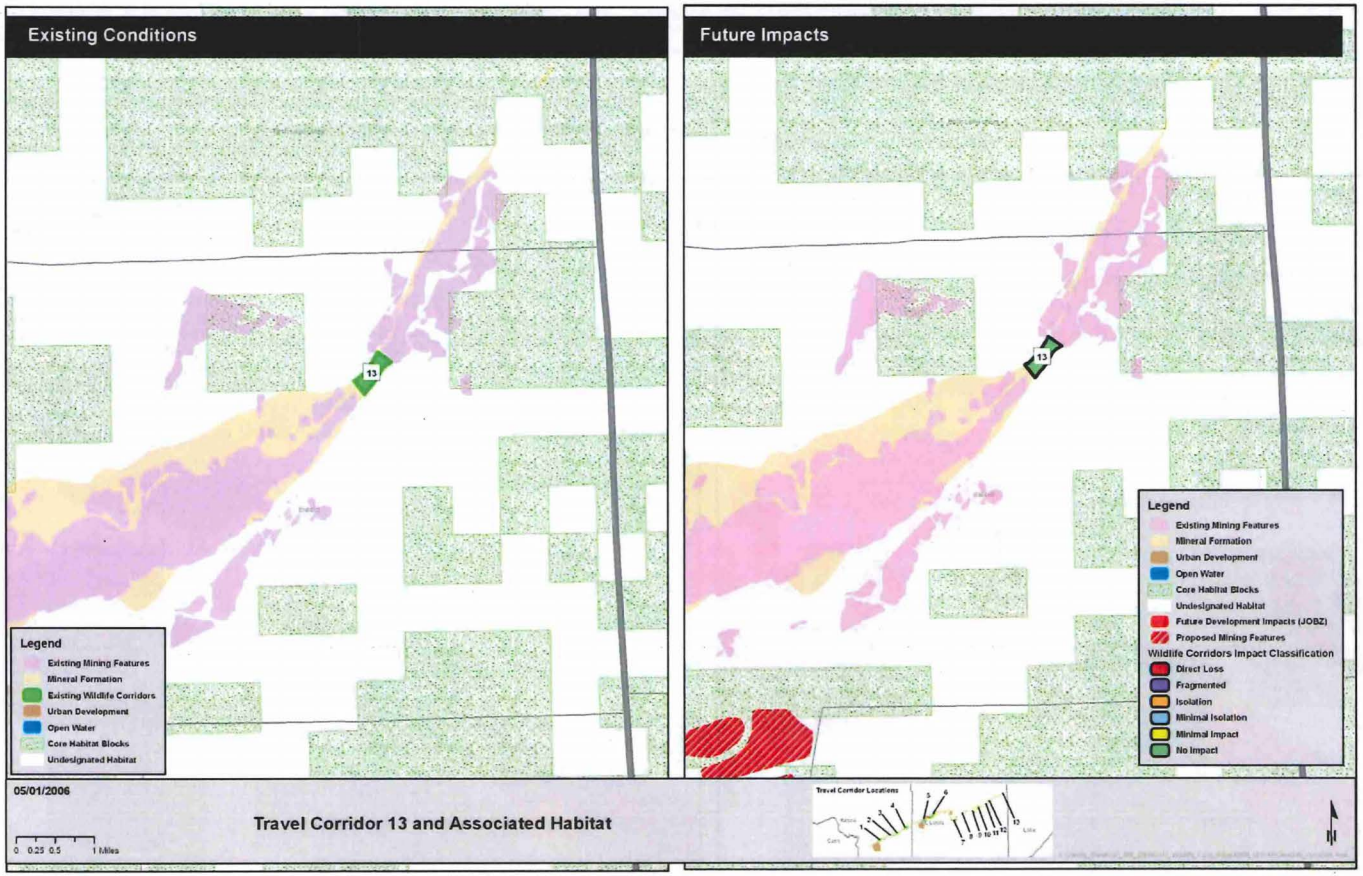
Wildlife Corridor #12 serves large core habitat blocks on either side of the minerals formation. It is likely a very important as the only gateway for several miles to the northeast.

FUTURE IMPACTS

Under future conditions, Wildlife Corridor #11 is classified for minimal impacts, with a possible effect on area wildlife as a result of planned urban development in an area to the southwest. Otherwise, the corridor should still continue to serve as an important connector.

Under future conditions no known actions will devalue Wildlife Corridor #12 directly. However, habitat blocks to the east and west will be devalued by proposed actions. The use of this corridor in the future will thus be dependent on both local and wider ranging species movements as a result of habitat destruction and species shifts.

EXISTING CONDITIONS
Wildlife Corridor #13 exists in a narrow belt of the minerals formation. However, it may serve as an important passageway for regional travel between core habitat blocks to the north/northwest and the south/southeast. Existing mine features restrict free travel for several miles in either direction along the minerals formation.

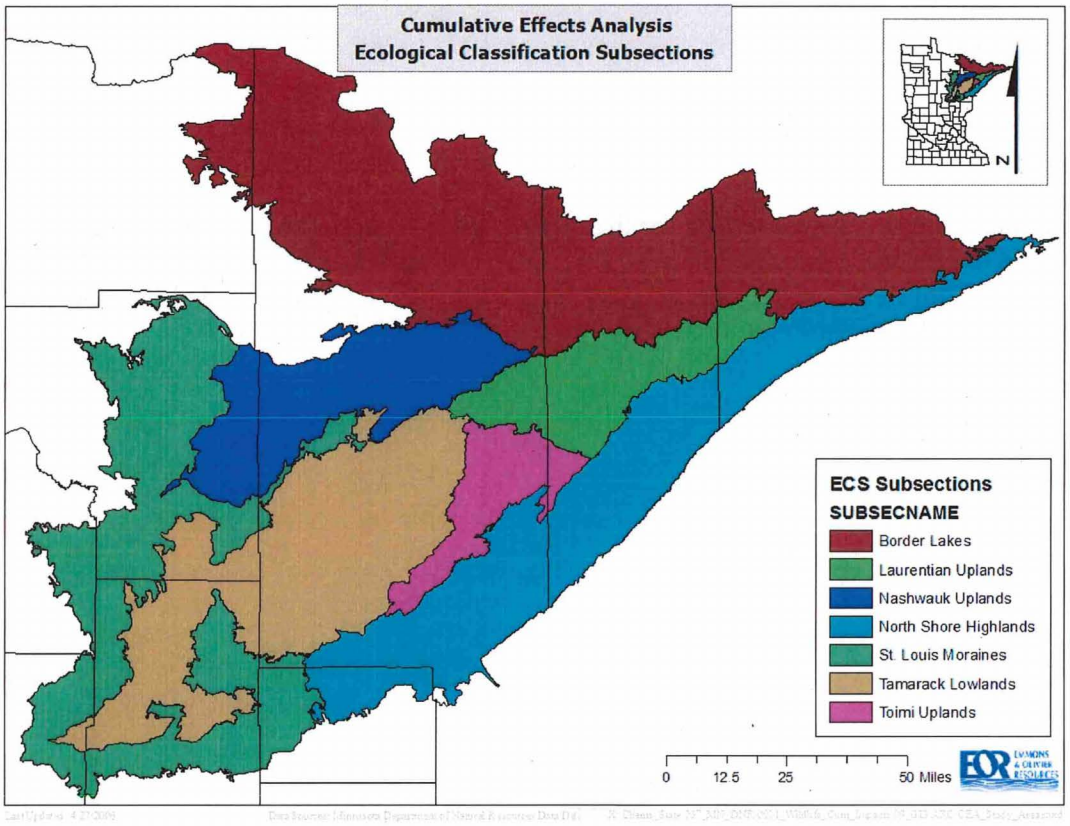


FUTURE IMPACTS
The known future impacts do not impact this corridor or associated undesignated or core habitat.

Wildlife Habitat

The wildlife habitat effects analysis has been performed for individual ecological subsections in the Arrowhead Region as well as for all subsections combined (Figure 2). The individual subsection analysis identifies losses for all proposed future actions combined. The regional assessment is differentiated into proposed future mining, regional development, and forestry actions as a summary of impacts.

Figure 2. Arrowhead Region Ecological Subsections.



The temporal scale of actions is similar for mining and regional development, and approximates actions for the next 20 years. Forestry data are available on a limited temporal scale. Specific state plans for harvesting are available through 2007 only. This means that beyond 2007 the cumulative effects with respect to all three actions are incomplete.

The ecological subsection maps displayed in this section of the report illustrate the GAP land covers in a simplified fashion. All forest cover types identified in the subsection histograms were collapsed into two categories. This feature allows for more clear visualization of the pattern of distribution of all cover types. In addition to simplifying the forest cover; the maps discriminate existing mine features from all urban land cover. Ordinarily the GAP urban cover includes mining along with other urban features.

The land cover histograms provide the following habitats breakouts:

- Upland Deciduous (Aspen/Birch)
- Upland Deciduous (Hardwoods)
- Upland Conifer
- Upland Shrub/Woodland
- Lowland deciduous
- Lowland Conifer/Shrubland
- Open wetland
- Water
- Grassland
- Cropland
- Urban/Developed
- Mining

GAP habitat types were assessed for their relationship to the life history requirements of species in greatest conservation need. This was performed as part of the Minnesota CWCS. Table 1 lists the mammals associated with habitats types listed above and analyzed for losses from future actions.

Table 1. Species in Greatest Conservation Need and Associated Habitat.

Habitat	Taxa	Scientific Name	Common Name
Forest- Upland Deciduous (Aspen)	Mammals	Canis lupus	Gray Wolf
Forest- Upland Deciduous (Aspen)	Mammals	Cervus elaphus	Elk
Forest- Upland Deciduous (Aspen)	Mammals	Lynx canadensis	Canada lynx
Forest- Upland Deciduous (Aspen)	Mammals	Microtus chrotorrhinus	Rock Vole
Forest- Upland Deciduous (Aspen)	Mammals	Myotis septentrionalis	Northern Myotis
Forest- Upland Deciduous (Aspen)	Mammals	Pipistrellus subflavus	Eastern Pipistrelle
Forest- Upland Deciduous (Aspen)	Mammals	Spilogale putorius	Eastern Spotted Skunk
Forest- Upland Deciduous (Hardwood)	Mammals	Canis lupus	Gray Wolf
Forest- Upland Deciduous (Hardwood)	Mammals	Lynx canadensis	Canada lynx
Forest- Upland Deciduous (Hardwood)	Mammals	Microtus pinetorum	Woodland Vole
Forest- Upland Deciduous (Hardwood)	Mammals	Mustela nivalis	Least Weasel
Forest- Upland Deciduous (Hardwood)	Mammals	Myotis septentrionalis	Northern Myotis
Forest- Upland Deciduous (Hardwood)	Mammals	Pipistrellus subflavus	Eastern Pipistrelle
Forest- Upland Deciduous (Hardwood)	Mammals	Spilogale putorius	Eastern Spotted Skunk
Forest- Upland Deciduous (Hardwood)	Mammals	Taxidea taxus	American Badger
Forest- Upland Conifer	Mammals	Canis lupus	Gray Wolf
Forest- Upland Conifer	Mammals	Felis concolor	Mountain Lion
Forest- Upland Conifer	Mammals	Lynx canadensis	Canada lynx
Forest- Upland Conifer	Mammals	Microtus chrotorrhinus	Rock Vole
Forest- Upland Conifer	Mammals	Mustela nivalis	Least Weasel
Forest- Upland Conifer	Mammals	Myotis septentrionalis	Northern Myotis
Forest- Upland Conifer	Mammals	Phenacomys intermedius	Heather Vole
Forest- Upland Conifer	Mammals	Sorex fumeus	Smoky Shrew
Forest- Upland Conifer	Mammals	Taxidea taxus	American Badger
Shrub/woodland- Upland	Mammals	Canis lupus	Gray Wolf
Shrub/woodland- Upland	Mammals	Cervus elaphus	Elk
Shrub/woodland- Upland	Mammals	Cryptotis parva	Least Shrew
Shrub/woodland- Upland	Mammals	Lynx canadensis	Canada lynx
Shrub/woodland- Upland	Mammals	Microtus chrotorrhinus	Rock Vole
Shrub/woodland- Upland	Mammals	Microtus ochrogaster	Prairie Vole
Shrub/woodland- Upland	Mammals	Myotis septentrionalis	Northern Myotis
Shrub/woodland- Upland	Mammals	Onychomys leucogaster	Northern Grasshopper Mous
Shrub/woodland- Upland	Mammals	Pipistrellus subflavus	Eastern Pipistrelle
Shrub/woodland- Upland	Mammals	Reithrodontomys megalotis	Western Harvest Mouse
Shrub/woodland- Upland	Mammals	Spermophilus franklinii	Franklin's Ground Squirrel
Shrub/woodland- Upland	Mammals	Spilogale putorius	Eastern Spotted Skunk
Shrub/woodland- Upland	Mammals	Taxidea taxus	American Badger
Forest- Lowland Deciduous	Mammals	Felis concolor	Mountain Lion
Forest- Lowland Deciduous	Mammals	Lynx canadensis	Canada lynx
Forest- Lowland Deciduous	Mammals	Microtus chrotorrhinus	Rock Vole
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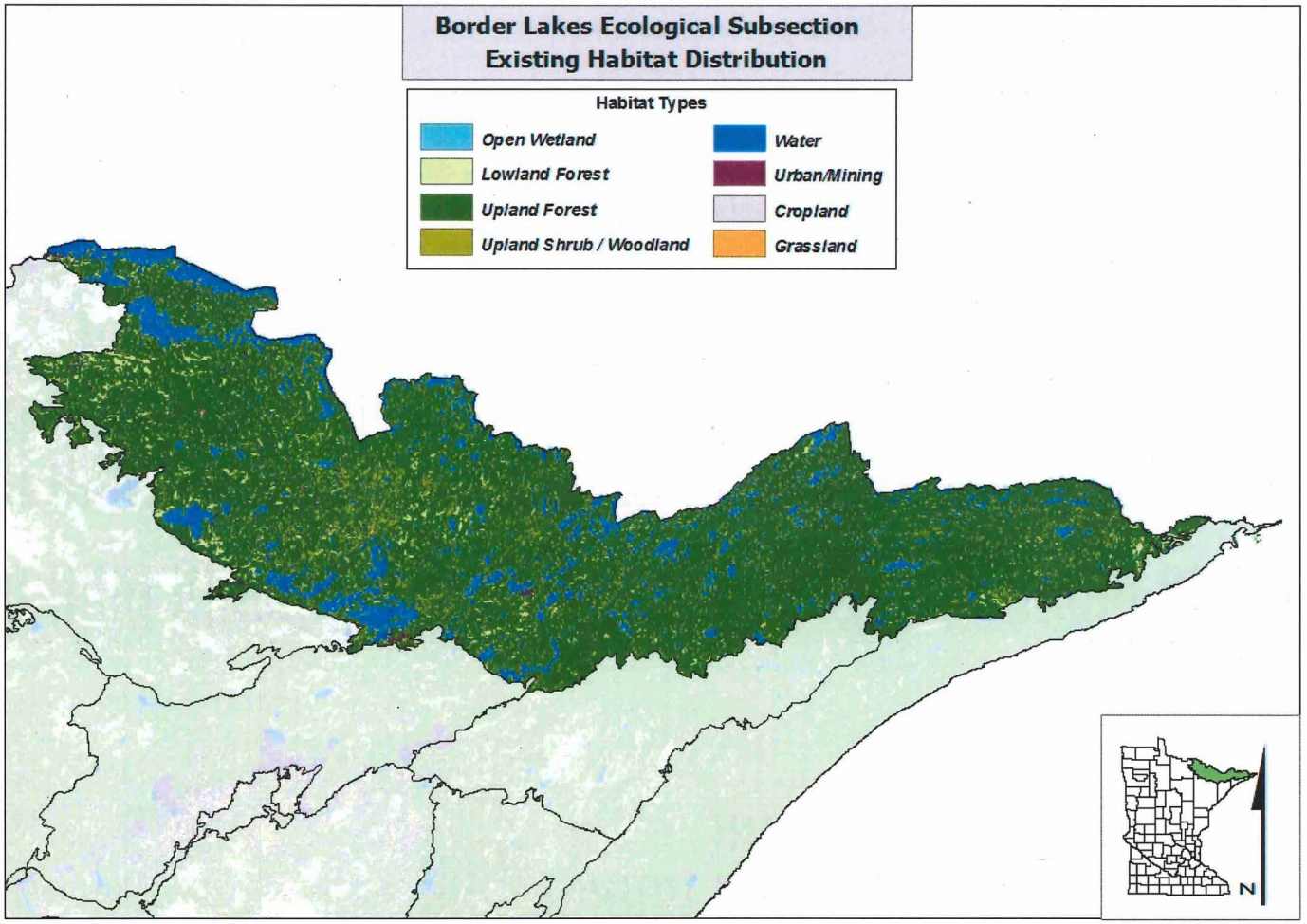
Forest- Lowland Conifer	Mammals	Phenacomys intermedius	Heather Vole
Forest- Lowland Conifer	Mammals	Sorex fumeus	Smoky Shrew
Forest- Lowland Conifer	Mammals	Synaptomys borealis	Northern Bog Lemming
Shrub- Lowland	Mammals	Canis lupus	Gray Wolf
Shrub- Lowland	Mammals	Cervus elaphus	Elk
Shrub- Lowland	Mammals	Felis concolor	Mountain Lion
Shrub- Lowland	Mammals	Lynx canadensis	Canada lynx
Shrub- Lowland	Mammals	Microtus chrotorrhinus	Rock Vole
Shrub- Lowland	Mammals	Mustela nivalis	Least Weasel
Shrub- Lowland	Mammals	Phenacomys intermedius	Heather Vole
Shrub- Lowland	Mammals	Spermophilus franklinii	Franklin's Ground Squirrel
Shrub- Lowland	Mammals	Spilogale putorius	Eastern Spotted Skunk
Shrub- Lowland	Mammals	Synaptomys borealis	Northern Bog Lemming
Wetland- Non-forest	Mammals	Canis lupus	Gray Wolf
Wetland- Non-forest	Mammals	Cervus elaphus	Elk
Wetland- Non-forest	Mammals	Mustela nivalis	Least Weasel
Wetland- Non-forest	Mammals	Myotis septentrionalis	Northern Myotis
Wetland- Non-forest	Mammals	Phenacomys intermedius	Heather Vole
Wetland- Non-forest	Mammals	Spermophilus franklinii	Franklin's Ground Squirrel
Wetland- Non-forest	Mammals	Synaptomys borealis	Northern Bog Lemming
Grassland	Mammals	Canis lupus	Gray Wolf
Grassland	Mammals	Cervus elaphus	Elk
Grassland	Mammals	Cryptotis parva	Least Shrew
Grassland	Mammals	Microtus ochrogaster	Prairie Vole
Grassland	Mammals	Mustela nivalis	Least Weasel
Grassland	Mammals	Myotis septentrionalis	Northern Myotis
Grassland	Mammals	Onychomys leucogaster	Northern Grasshopper Mous
Grassland	Mammals	Perognathus flavescens	Plains Pocket Mouse
Grassland	Mammals	Pipistrellus subflavus	Eastern Pipistrelle
Grassland	Mammals	Reithrodontomys megalotis	Western Harvest Mouse
Grassland	Mammals	Spermophilus franklinii	Franklin's Ground Squirrel
Grassland	Mammals	Spermophilus richardsonii	Richardson's Ground Squirre
Grassland	Mammals	Spilogale putorius	Eastern Spotted Skunk
Grassland	Mammals	Taxidea taxus	American Badger
Grassland	Mammals	Thomomys talpoides	Northern Pocket Gopher
Cropland	Mammals	Canis lupus	Gray Wolf
Cropland	Mammals	Microtus ochrogaster	Prairie Vole
Cropland	Mammals	Mustela nivalis	Least Weasel
Cropland	Mammals	Onychomys leucogaster	Northern Grasshopper Mous
Cropland	Mammals	Reithrodontomys megalotis	Western Harvest Mouse
Cropland	Mammals	Taxidea taxus	American Badger
Cropland	Mammals	Thomomys talpoides	Northern Pocket Gopher
Developed	Mammals	Cryptotis parva	Least Shrew
Developed	Mammals	Myotis septentrionalis	Northern Myotis
Developed	Mammals	Pipistrellus subflavus	Eastern Pipistrelle
Developed	Mammals	Spilogale putorius	Eastern Spotted Skunk
Developed	Mammals	Taxidea taxus	American Badger
Developed	Mammals	Thomomys talpoides	Northern Pocket Gopher



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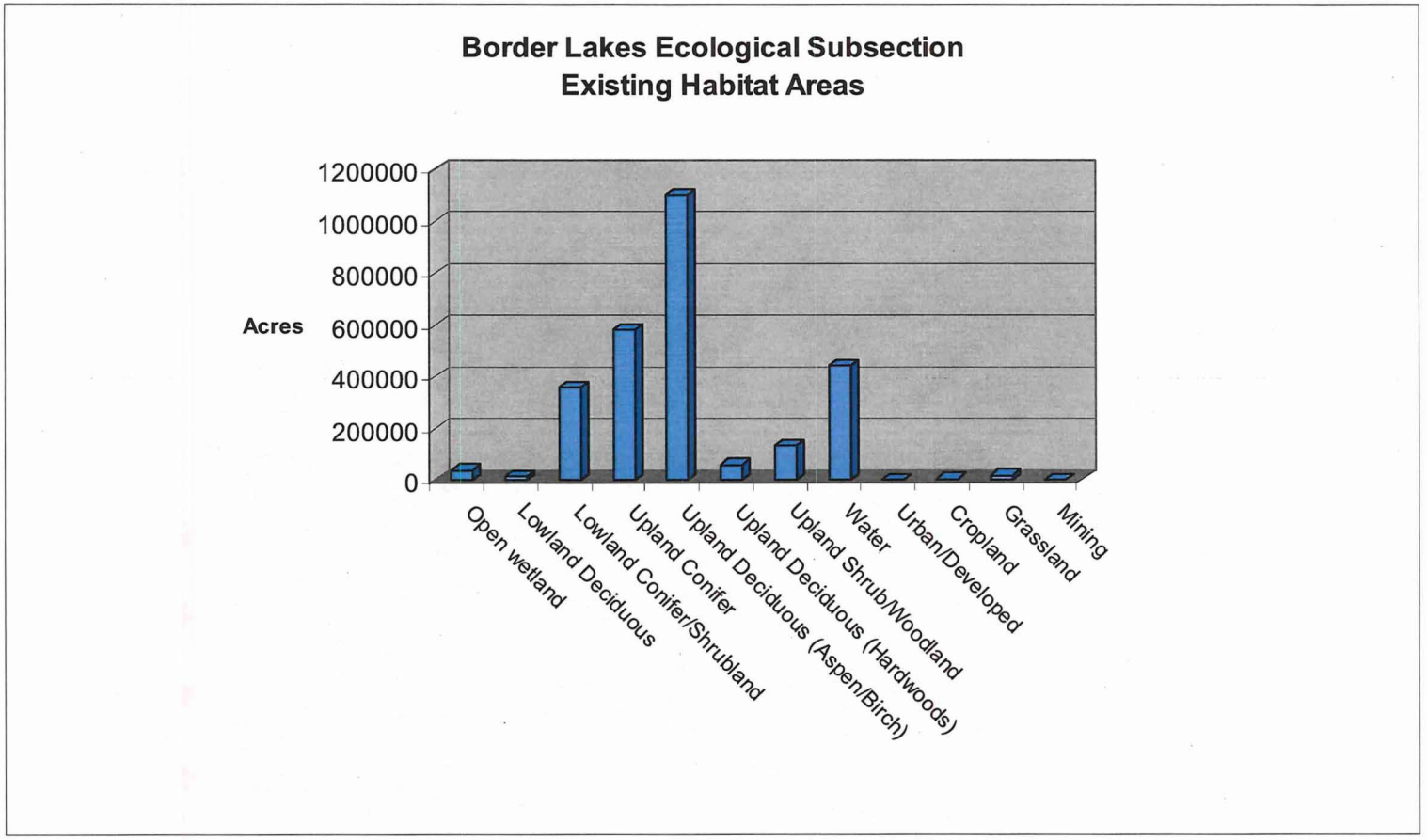
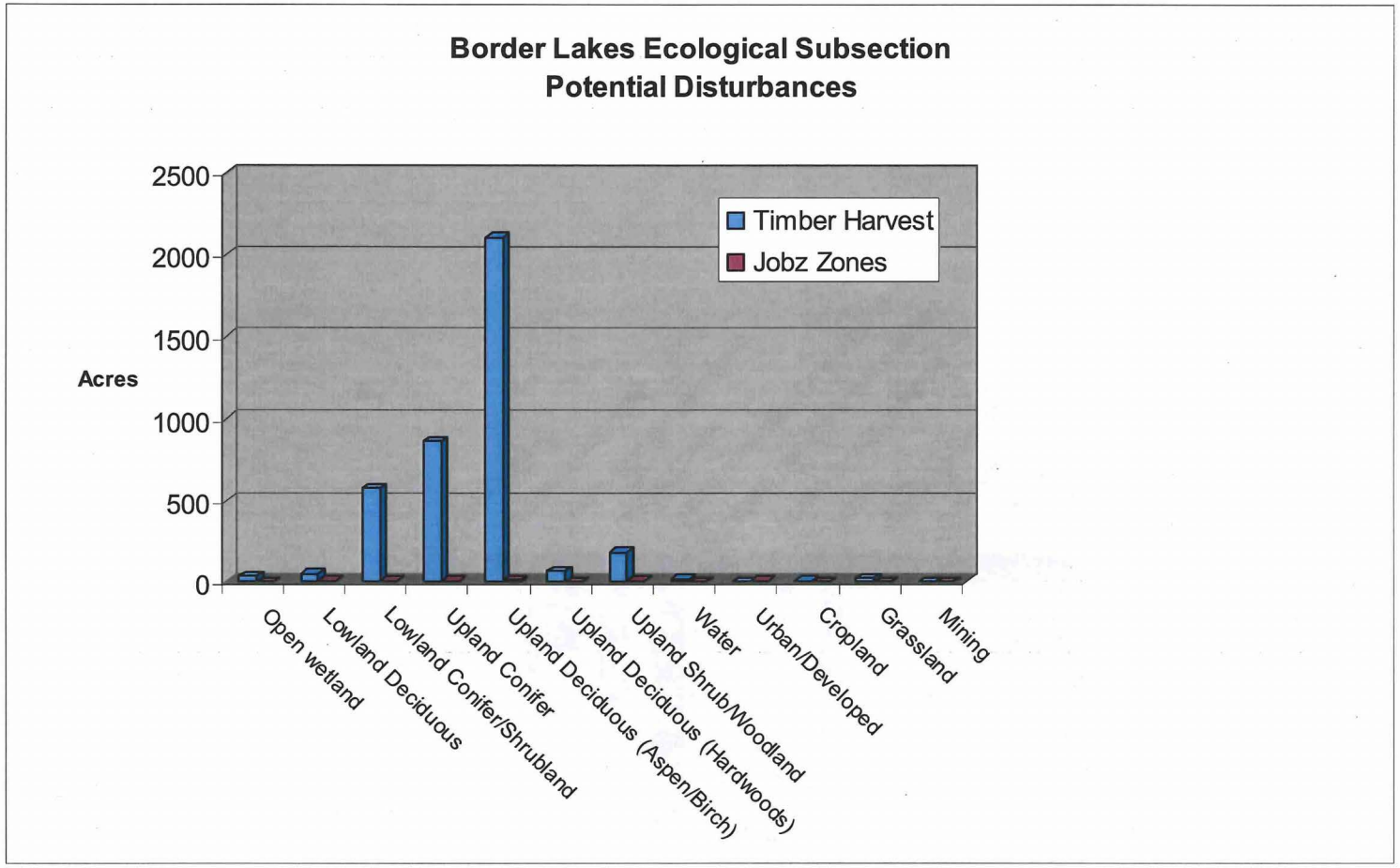

Border Lakes Ecological Subsection
Existing Habitat Areas
Acres
1200000
1000000
800000
600000
400000
200000
0
Open wetland
Lowland Deciduous
Lowland Conifer/Shrubland
Upland Conifer
Upland Deciduous (Aspen/Birch)
Upland Deciduous (Hardwoods)
Upland Shrub/Woodland
Water
Urban/Developed
Cropland
Grassland
Mining


Border Lakes Ecological Subsection
Potential Disturbances
Acres
2500
2000
1500
1000
500
0
Timber Harvest
Jobz Zones
Open wetland
Lowland Deciduous
Lowland Conifer/Shrubland
Upland Conifer
Upland Deciduous (Aspen/Birch)
Upland Deciduous (Hardwoods)
Upland Shrub/Woodland
Water
Urban/Developed
Cropland
Grassland
Mining

Border Lakes Ecoregion

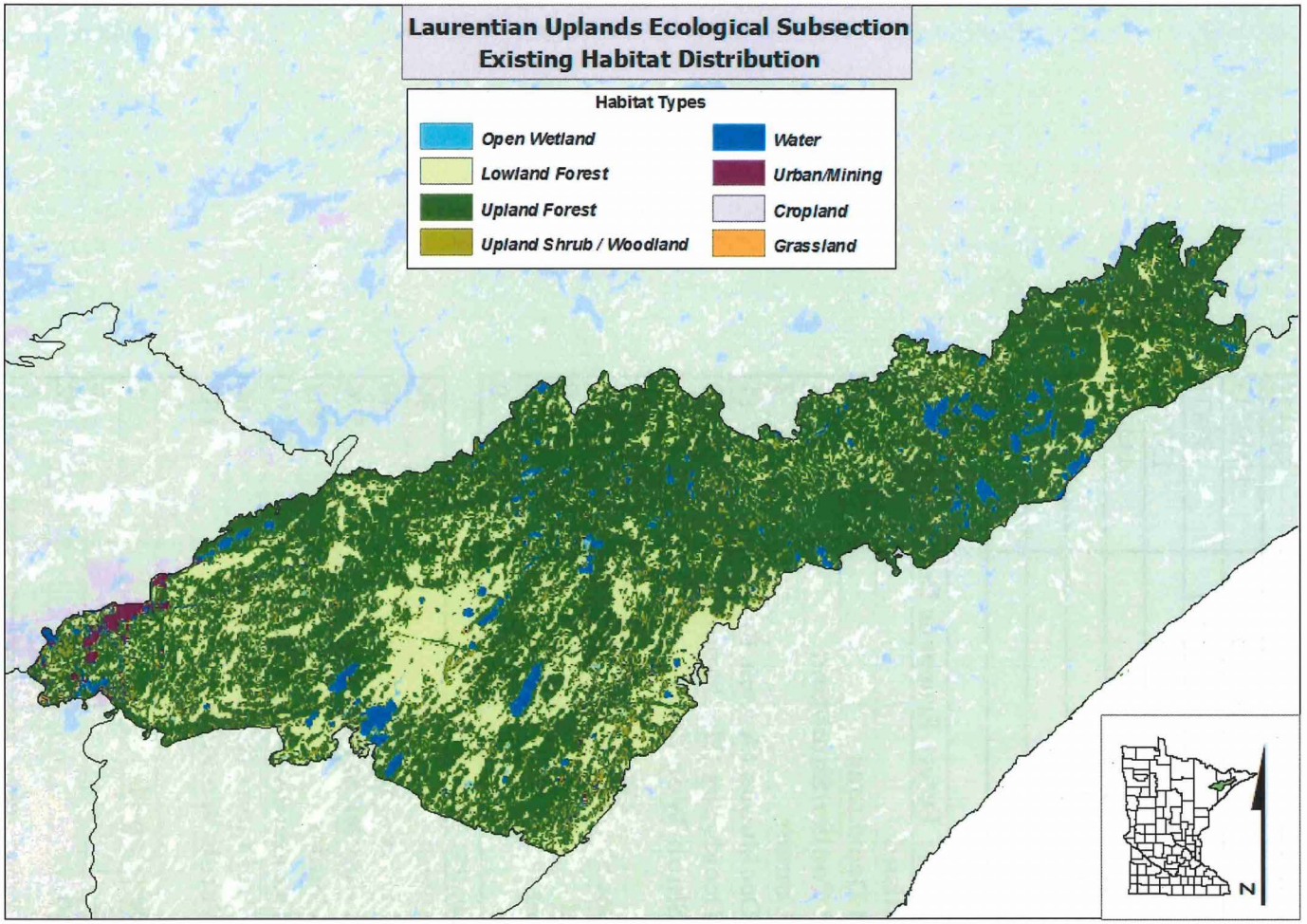
Habitat Type	Acres
Open wetland	39896
Lowland Deciduous	17648
Lowland Conifer/Shrubland	358933
Upland Conifer	585525
Upland Deciduous (Aspen/Birch)	1099543
Upland Deciduous (Hardwoods)	60821
Upland Shrub/Woodland	137243
Water	444405
Urban/Developed	3449
Cropland	4828
Grassland	18513
Mining	609

Habitat Losses: Future Economic Development

Open wetland	0
Lowland Deciduous	3
Lowland Conifer/Shrubland	4
Upland Conifer	2
Upland Deciduous (Aspen/Birch)	11
Upland Deciduous (Hardwoods)	0
Upland Shrub/Woodland	1
Water	0
Urban/Developed	3
Cropland	0
Grassland	0
Mining	0

Habitat Losses: Forestry

Open wetland	30
Lowland Deciduous	48
Lowland Conifer/Shrubland	576
Upland Conifer	862
Upland Deciduous (Aspen/Birch)	2111
Upland Deciduous (Hardwoods)	66
Upland Shrub/Woodland	182
Water	15
Urban/Developed	1
Cropland	6
Grassland	22
Mining	0



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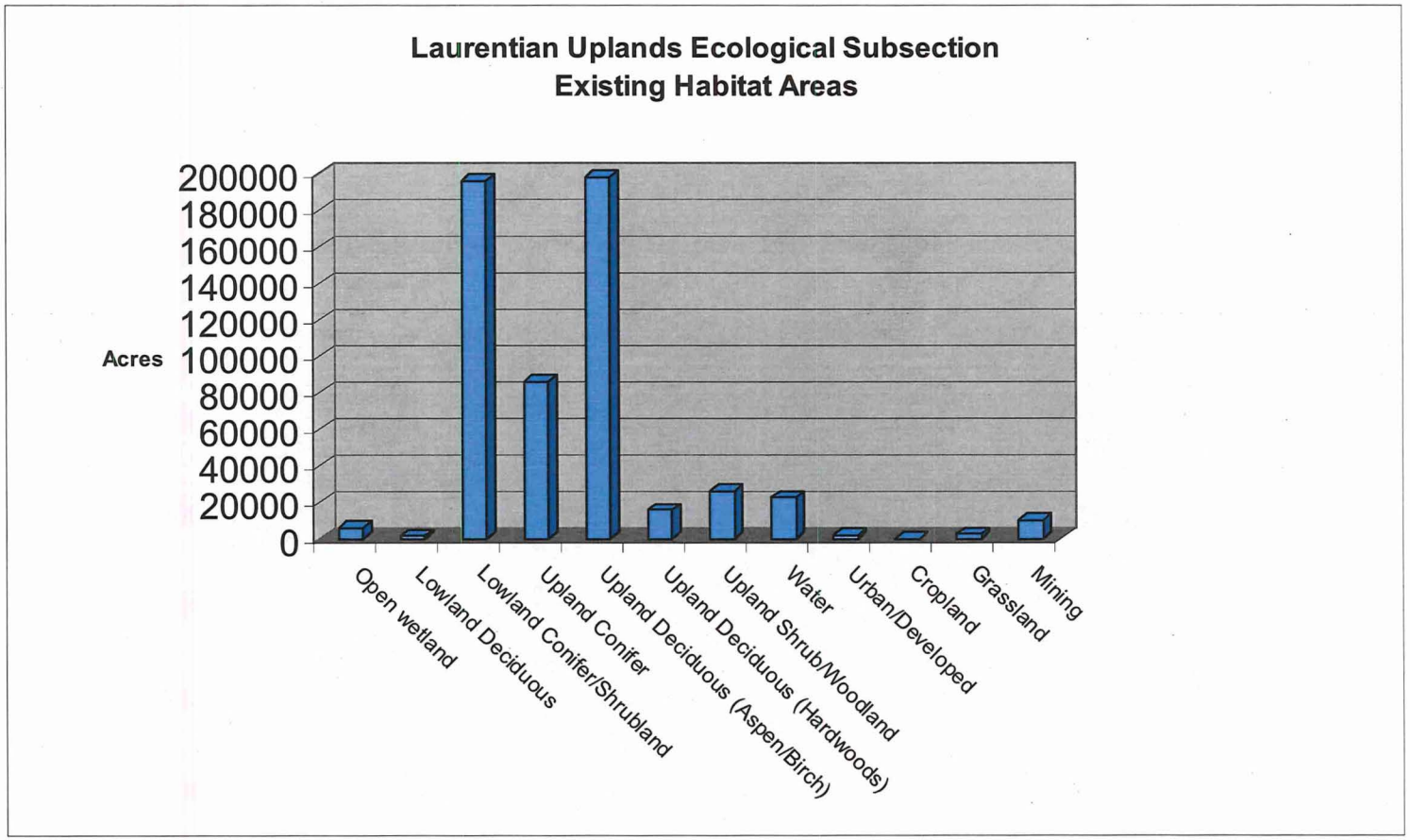
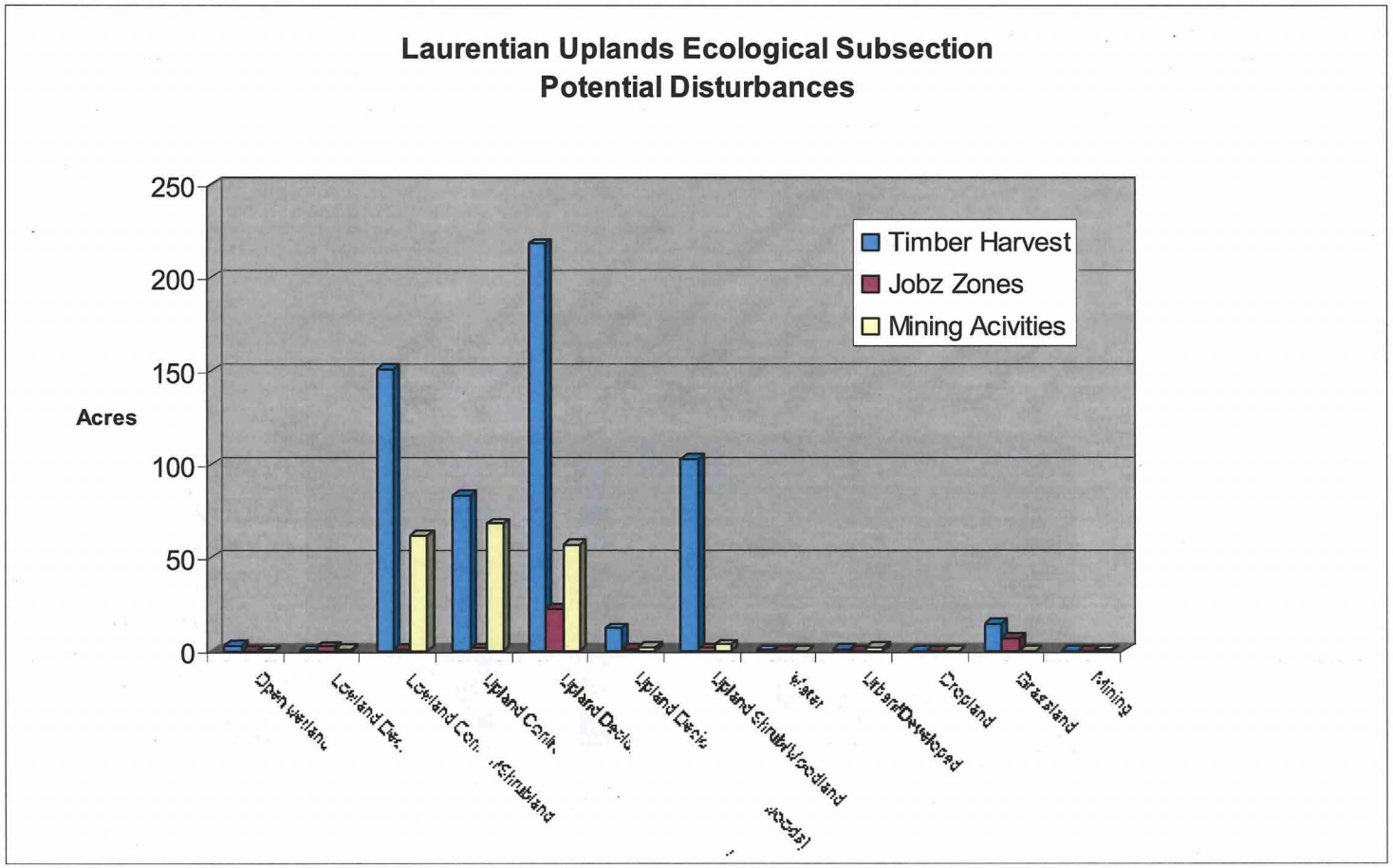

Laurentian Uplands Ecological Subsection
Existing Habitat Areas
Acres
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
Open wetland
Lowland Deciduous
Lowland Conifer/Shrubland
Upland Conifer
Upland Deciduous (Aspen/Birch)
Upland Deciduous (Hardwoods)
Upland Shrub/Woodland
Water
Urban/Developed
Cropland
Grassland
Mining

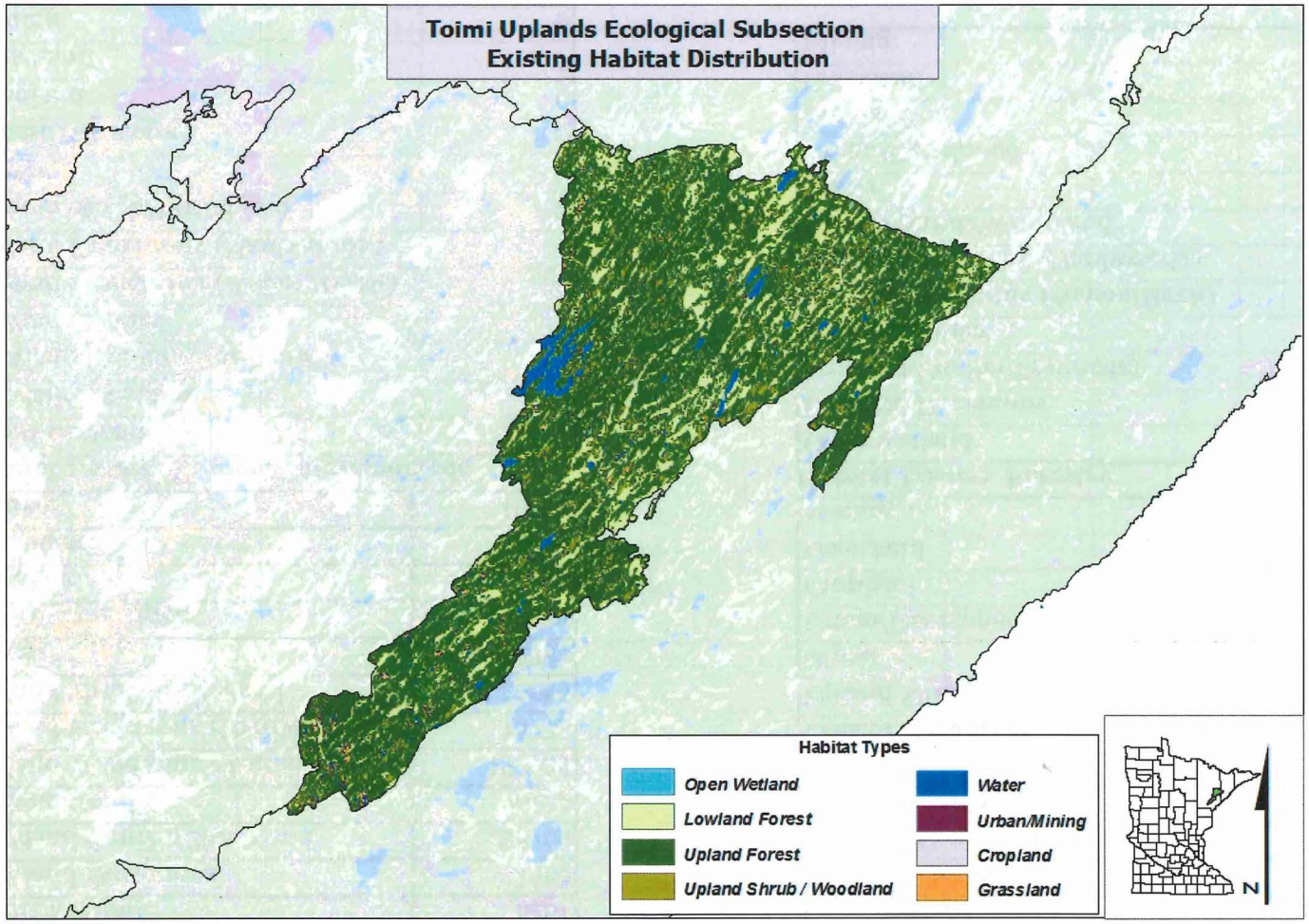

Laurentian Uplands Ecological Subsection
Potential Disturbances
Acres
250
200
150
100
50
0
Timber Harvest
Jobz Zones
Mining Acivities
Cropland
Grassland
Mining

Laurentian Uplands Habitat	Acres
Open wetland	6261
Lowland Deciduous	1580
Lowland Conifer/Shrubland	195764
Upland Conifer	86133
Upland Deciduous (Aspen/Birch)	197924
Upland Deciduous (Hardwoods)	15773
Upland Shrub/Woodland	26085
Water	22787
Urban/Developed	2236
Cropland	11
Grassland	2630
Mining	10081

Habitat Losses: Economic Development	
Open wetland	0
Lowland Deciduous	2
Lowland Conifer/Shrubland	1
Upland Conifer	2
Upland Deciduous (Aspen/Birch)	23
Upland Deciduous (Hardwoods)	1
Upland Shrub/Woodland	2
Water	0
Urban/Developed	0
Cropland	0
Grassland	7
Mining	0

Habitat Losses: Mining	Acres
Open wetland	1
Lowland Deciduous	1
Lowland Conifer/Shrubland	62
Upland Conifer	68
Upland Deciduous (Aspen/Birch)	57
Upland Deciduous (Hardwoods)	2
Upland Shrub/Woodland	3
Water	0
Urban/Developed	2
Cropland	0
Grassland	0
Mining	1

Habitat Losses: Forestry	
Open wetland	3
Lowland Deciduous	0
Lowland Conifer/Shrubland	151
Upland Conifer	83
Upland Deciduous (Aspen/Birch)	218
Upland Deciduous (Hardwoods)	13
Upland Shrub/Woodland	103
Water	1
Urban/Developed	1
Cropland	0
Grassland	15
Mining	0



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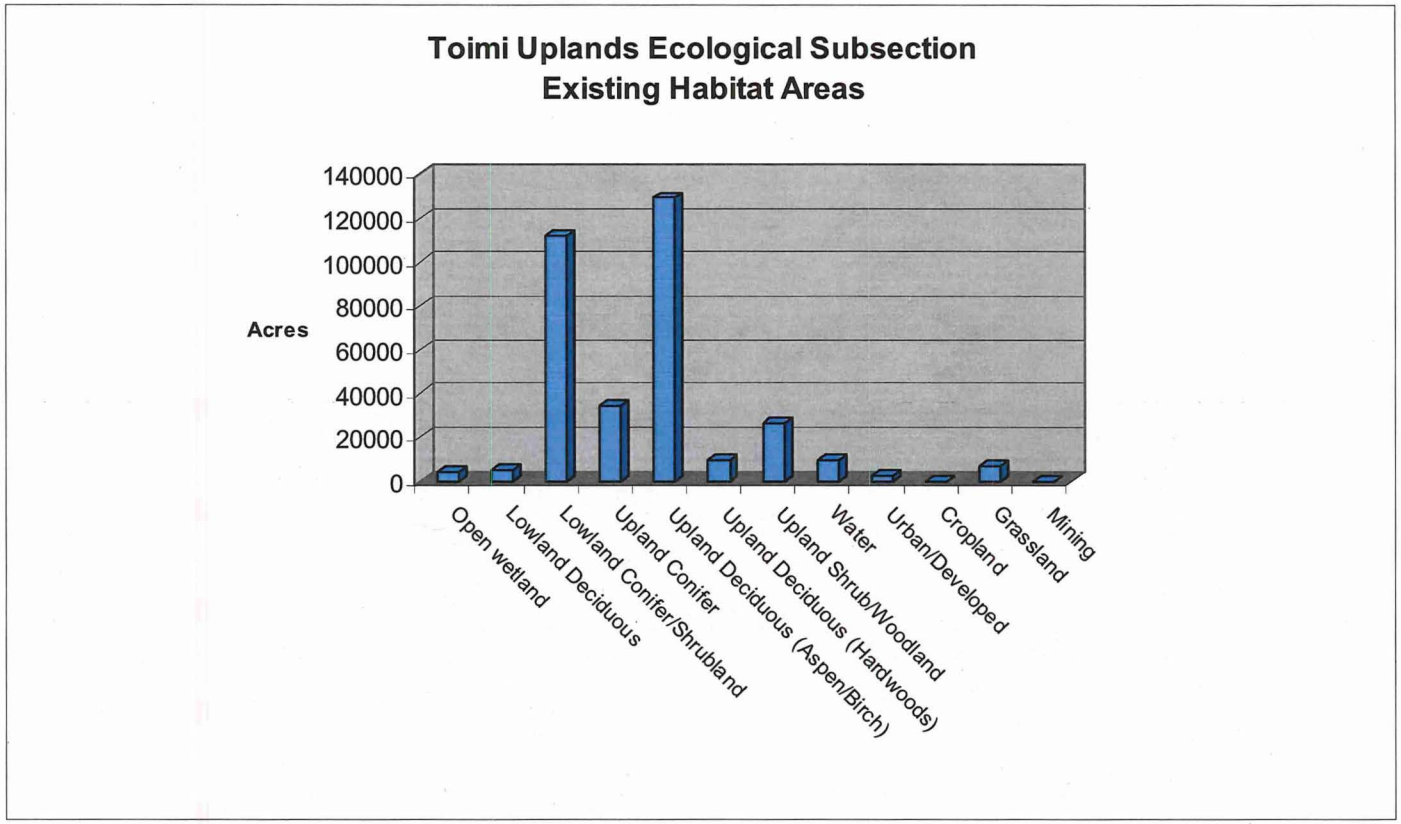
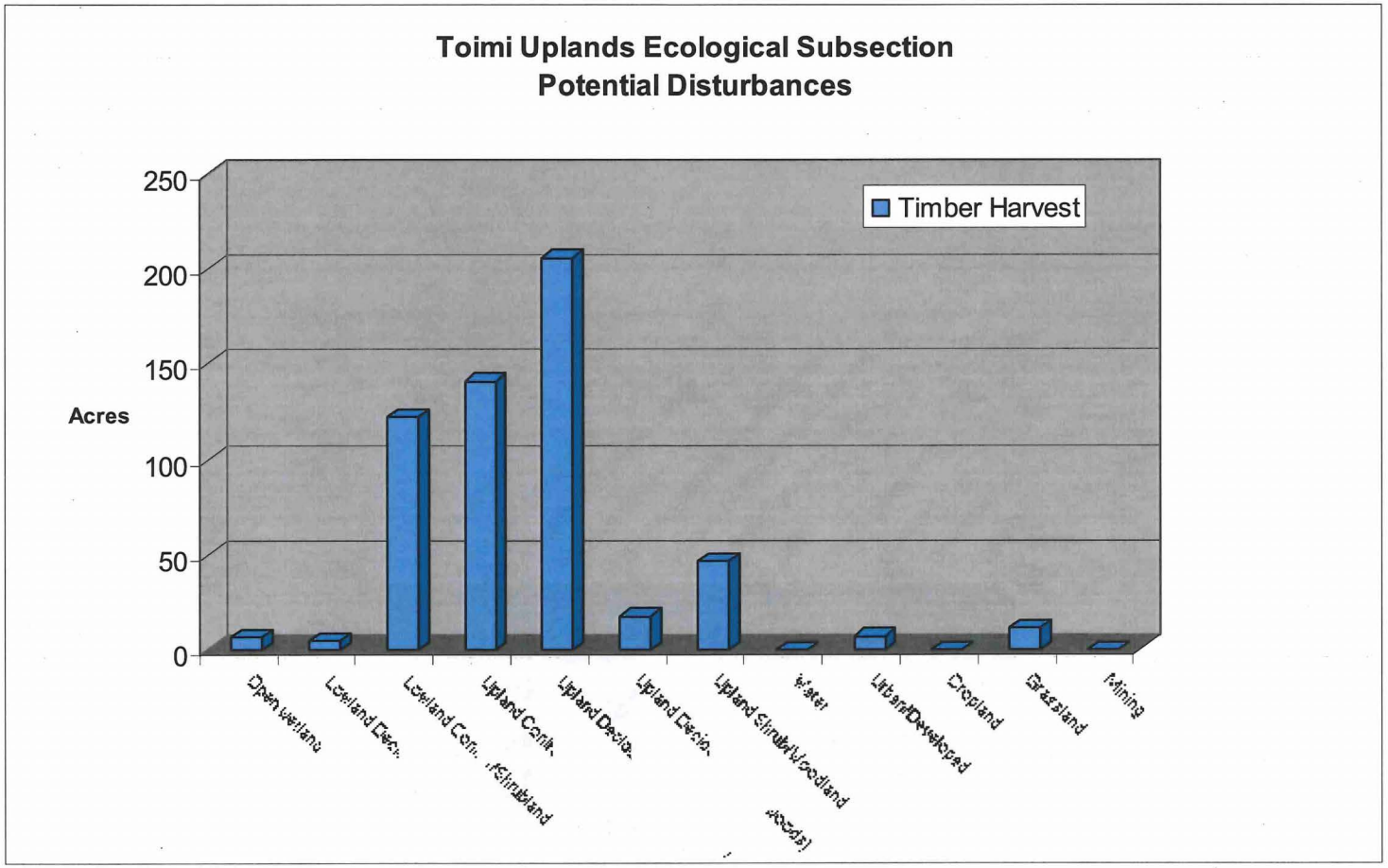
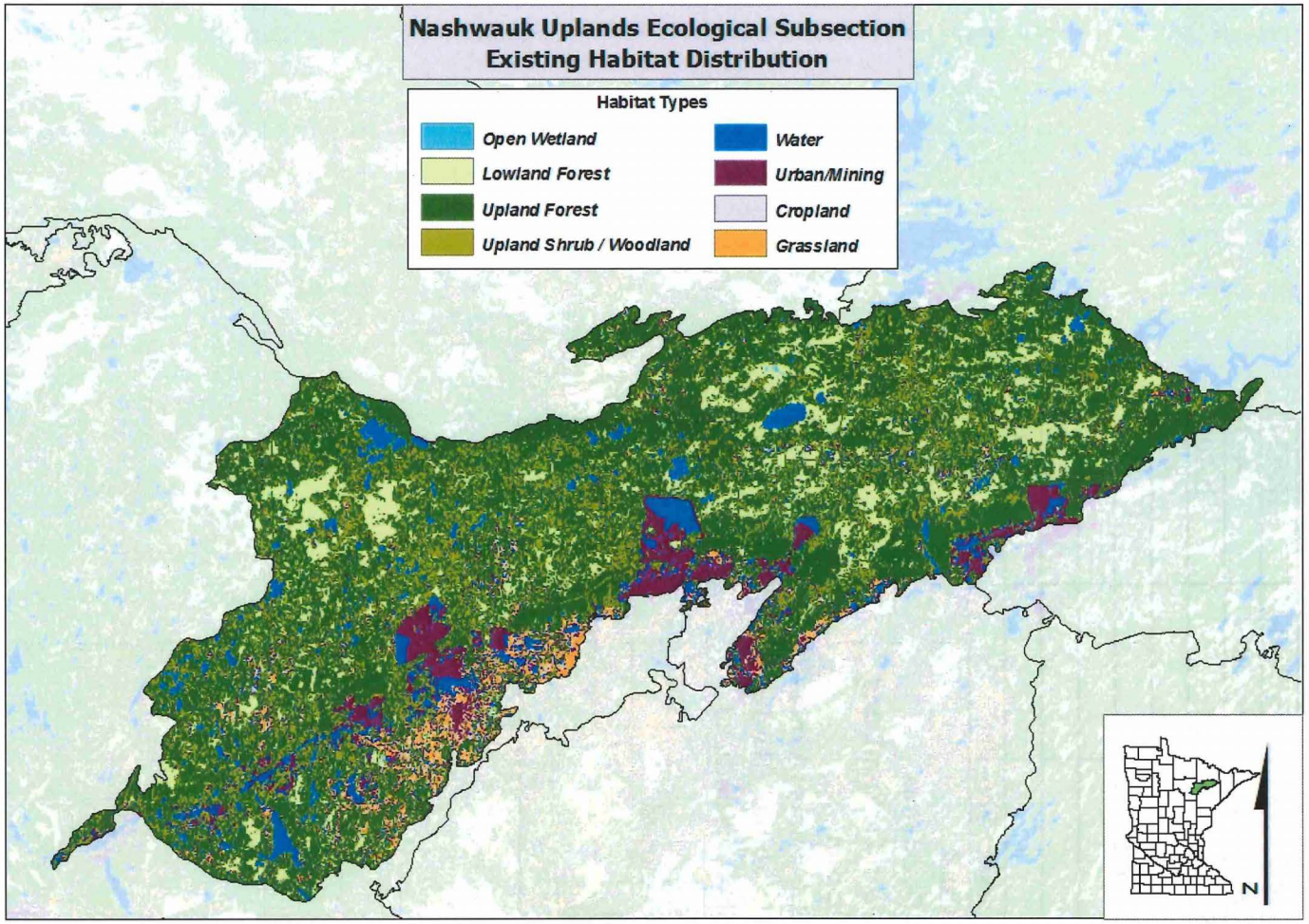

Toimi Uplands Ecological Subsection
Existing Habitat Areas
Acres
140000
120000
100000
80000
60000
40000
20000
0
Open wetland
Lowland Deciduous
Lowland Conifer/Shrubland
Upland Conifer
Upland Deciduous (Aspen/Birch)
Upland Deciduous (Hardwoods)
Upland Shrub/Woodland
Water
Urban/Developed
Cropland
Grassland
Mining


Toimi Uplands Ecological Subsection
Potential Disturbances
Timber Harvest
Acres
250
200
150
100
50
0
Open wetland
Lowland Decid.
Lowland Conif.
Lowland Conif. /Hardwood
Upland Conif.
Upland Decid.
Upland Decid.
Upland Shrub/Woodland
Water
Urban/Developed
Cropland
Grassland
Mining

Toimi Uplands Habitat	Acres
Open wetland	4252
Lowland Deciduous	4949
Lowland Conifer/Shrubland	112270
Upland Conifer	34115
Upland Deciduous (Aspen/Birch)	129136
Upland Deciduous (Hardwoods)	9489
Upland Shrub/Woodland	26201
Water	9734
Urban/Developed	2388
Cropland	70
Grassland	6676
Mining	0

Habitat Losses: Forestry	
Open wetland	7
Lowland Deciduous	5
Lowland Conifer/Shrubland	122
Upland Conifer	141
Upland Deciduous (Aspen/Birch)	205
Upland Deciduous (Hardwoods)	18
Upland Shrub/Woodland	47
Water	0
Urban/Developed	7
Cropland	0
Grassland	11
Mining	0



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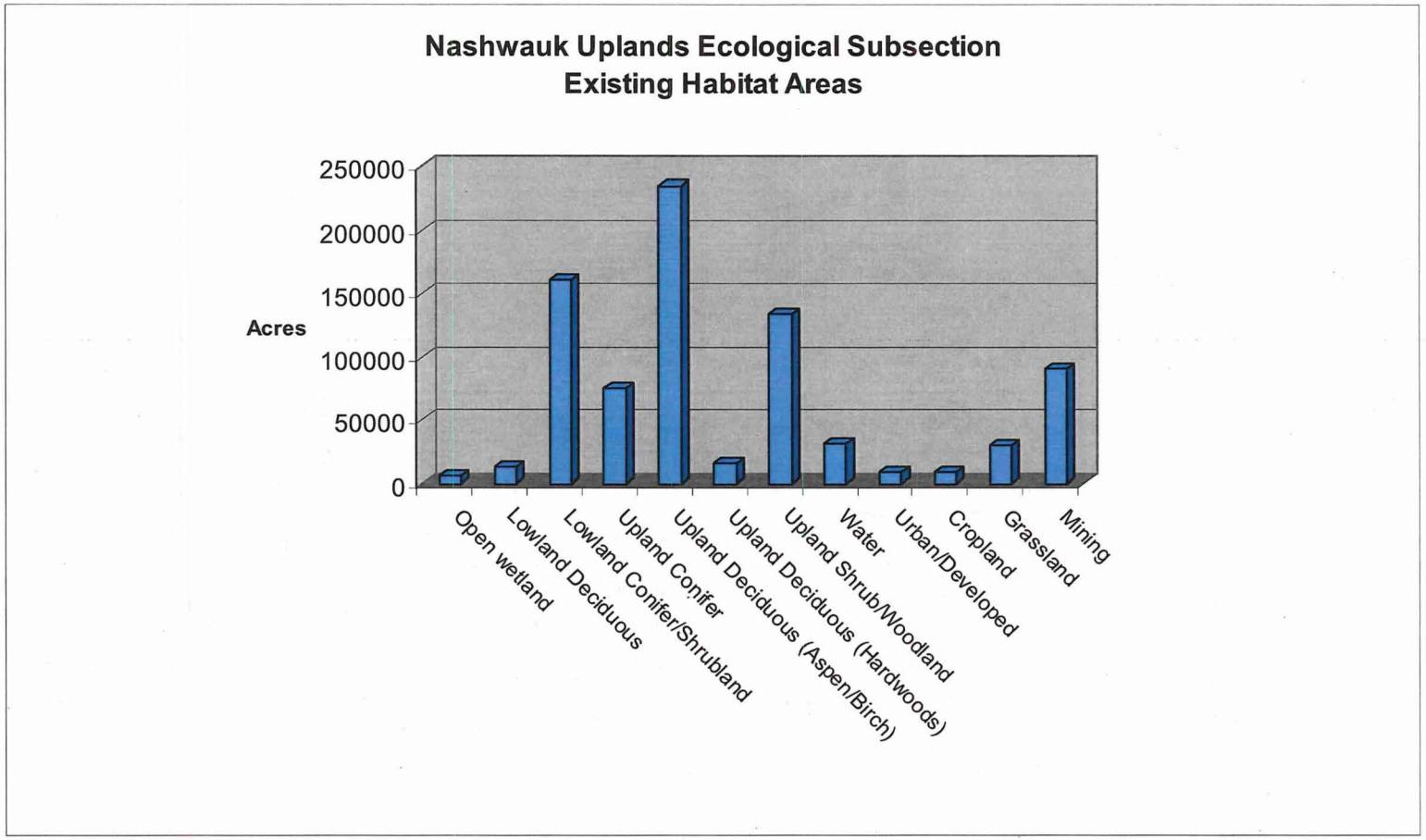
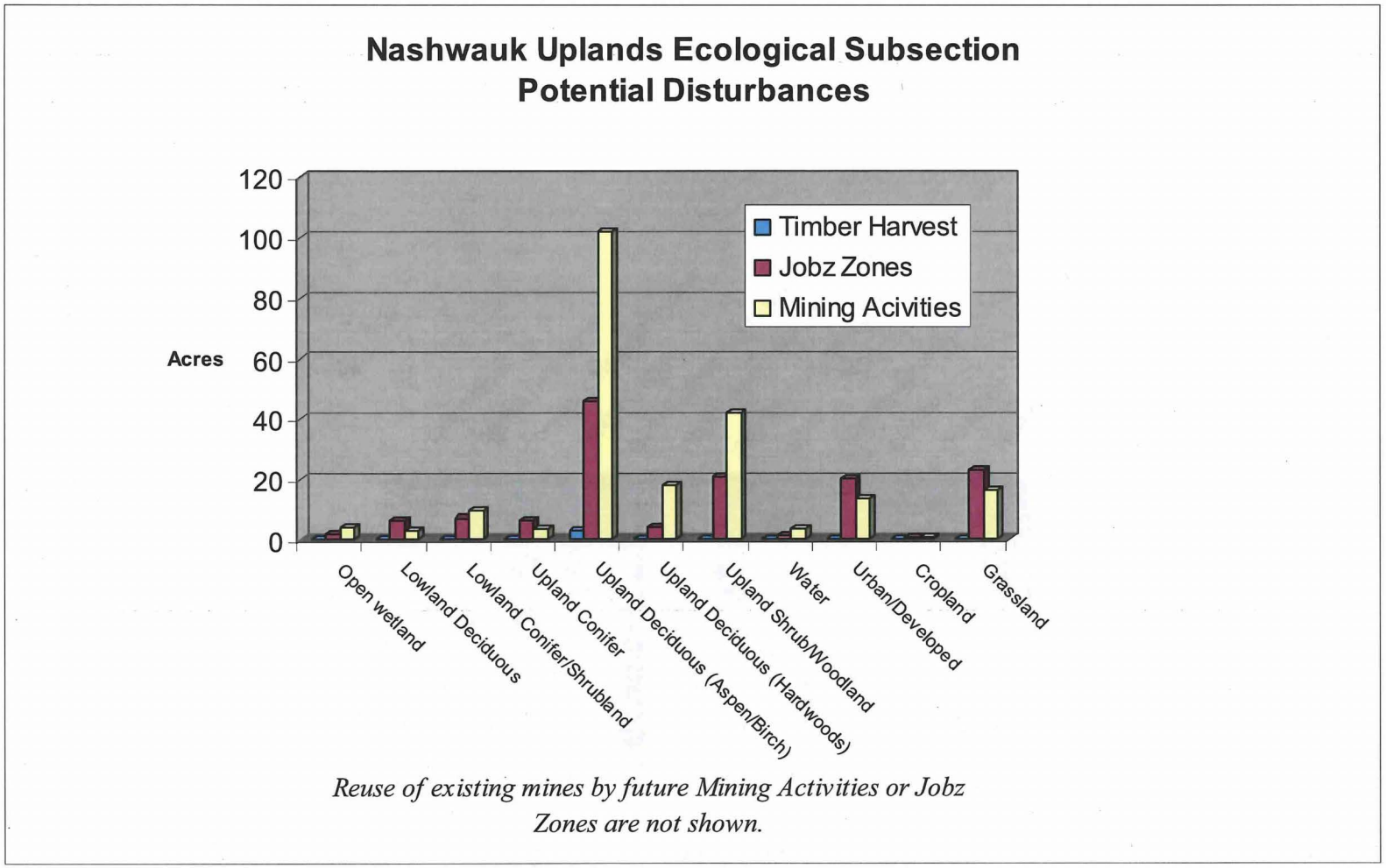

Nashwauk Uplands Ecological Subsection
Existing Habitat Areas
Acres
250000
200000
150000
100000
50000
0
Open wetland
Lowland Deciduous
Lowland Conifer/Shrubland
Upland Conifer
Upland Deciduous (Aspen/Birch)
Upland Deciduous (Hardwoods)
Upland Shrub/Woodland
Water
Urban/Developed
Cropland
Grassland
Mining



Reuse of existing mines by future Mining Activities or Jobz Zones are not shown.

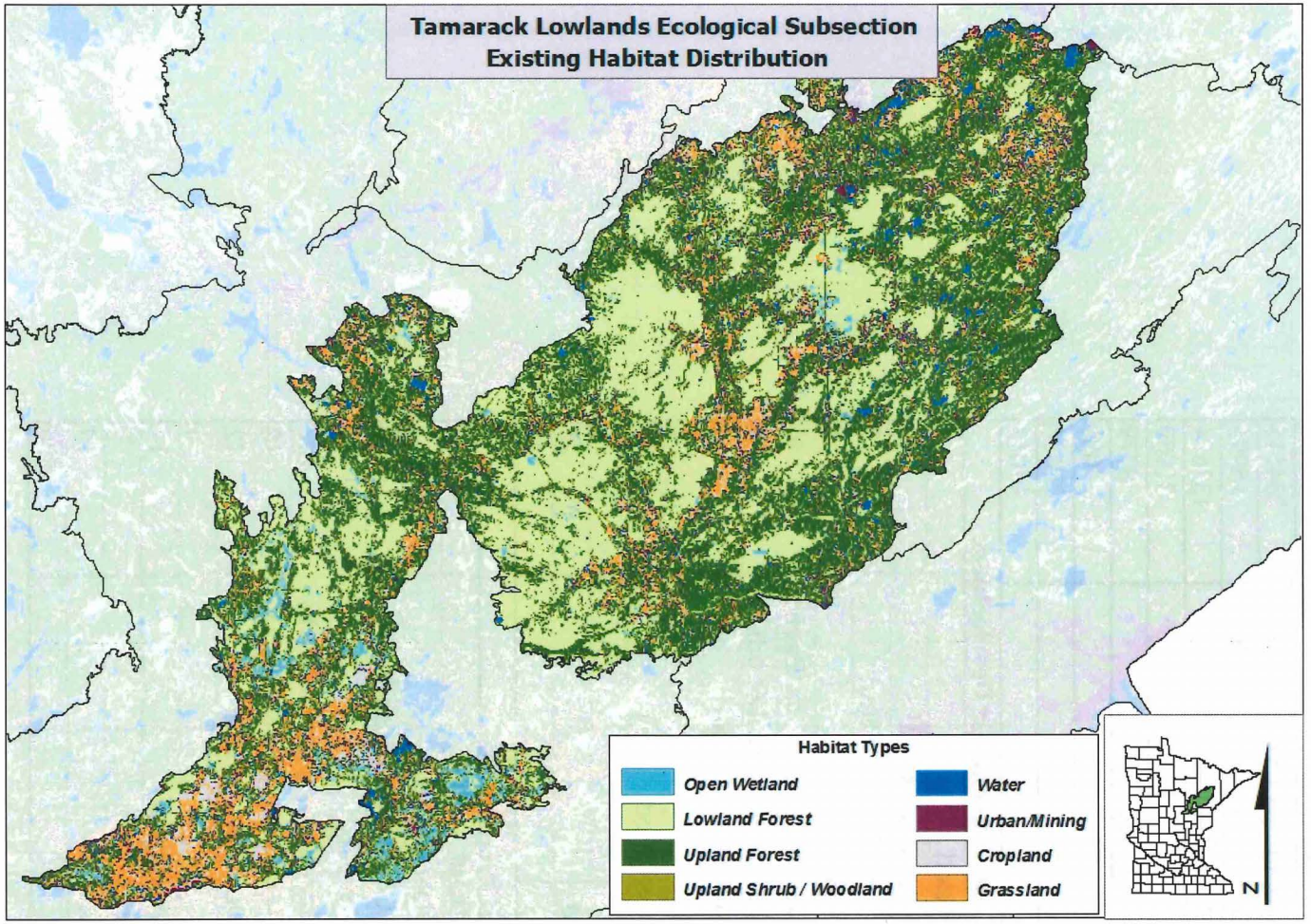
Nashwauk Uplands Habitat	Acres
Open wetland	6014
Lowland Deciduous	13000
Lowland Conifer/Shrubland	160541
Upland Conifer	75025
Upland Deciduous (Aspen/Birch)	234518
Upland Deciduous (Hardwoods)	15995
Upland Shrub / woodland	133684
Water	31989
Urban/Developed	8779
Cropland	9000
Grassland	30456
Mining	91013

Habitat Losses: Economic Development

Open wetland	2
Lowland Deciduous	6
Lowland Conifer/Shrubland	7
Upland Conifer	6
Upland Deciduous (Aspen/Birch)	46
Upland Deciduous (Hardwoods)	4
Upland Shrub/Woodland	21
Water	1
Urban/Developed	20
Cropland	1
Grassland	23
Mining	21

Habitat Losses: Mining

Open wetland	4
Lowland Deciduous	3
Lowland Conifer/Shrubland	10
Upland Conifer	3
Upland Deciduous (Aspen/Birch)	102
Upland Deciduous (Hardwoods)	18
Upland Shrub/Woodland	42
Water	4
Urban/Developed	14
Cropland	1
Grassland	17
Mining	500



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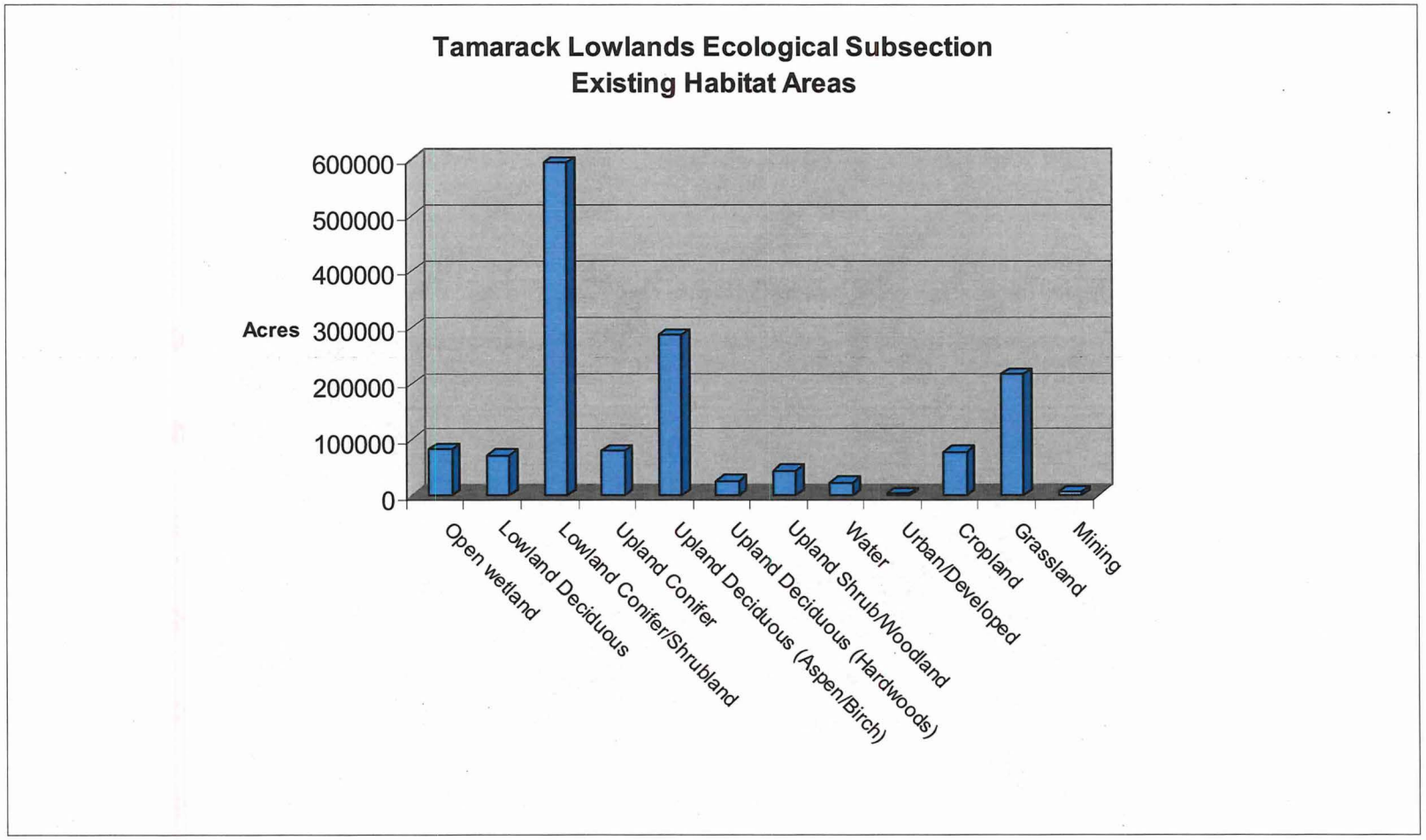
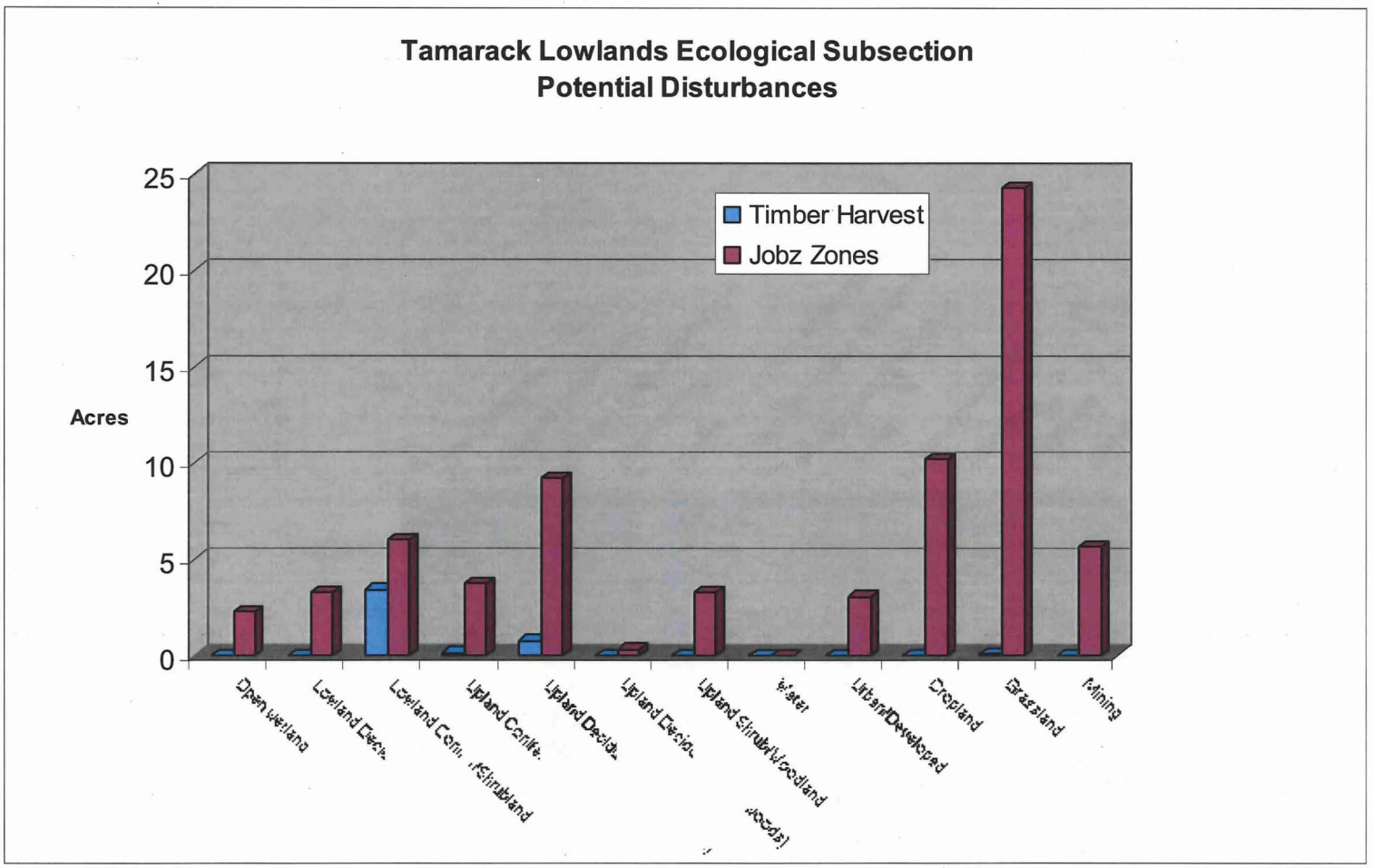

Tamarack Lowlands Ecological Subsection
Existing Habitat Areas
Acres
600000
500000
400000
300000
200000
100000
0
Open wetland
Lowland Deciduous
Lowland Conifer/Shrubland
Upland Conifer
Upland Deciduous (Aspen/Birch)
Upland Deciduous (Hardwoods)
Upland Shrub/Woodland
Water
Urban/Developed
Cropland
Grassland
Mining


Tamarack Lowlands Ecological Subsection
Potential Disturbances
Acres
25
20
15
10
5
0
Timber Harvest
Jobz Zones
Open wetland
Lowland Decid.
Lowland Conif.
Upland Conif.
Upland Decid.
Upland Decid.
Upland Shrub/Woodland
Water
Urban/Developed
Cropland
Grassland
Mining

Tamarack Lowlands Habitat Type Area

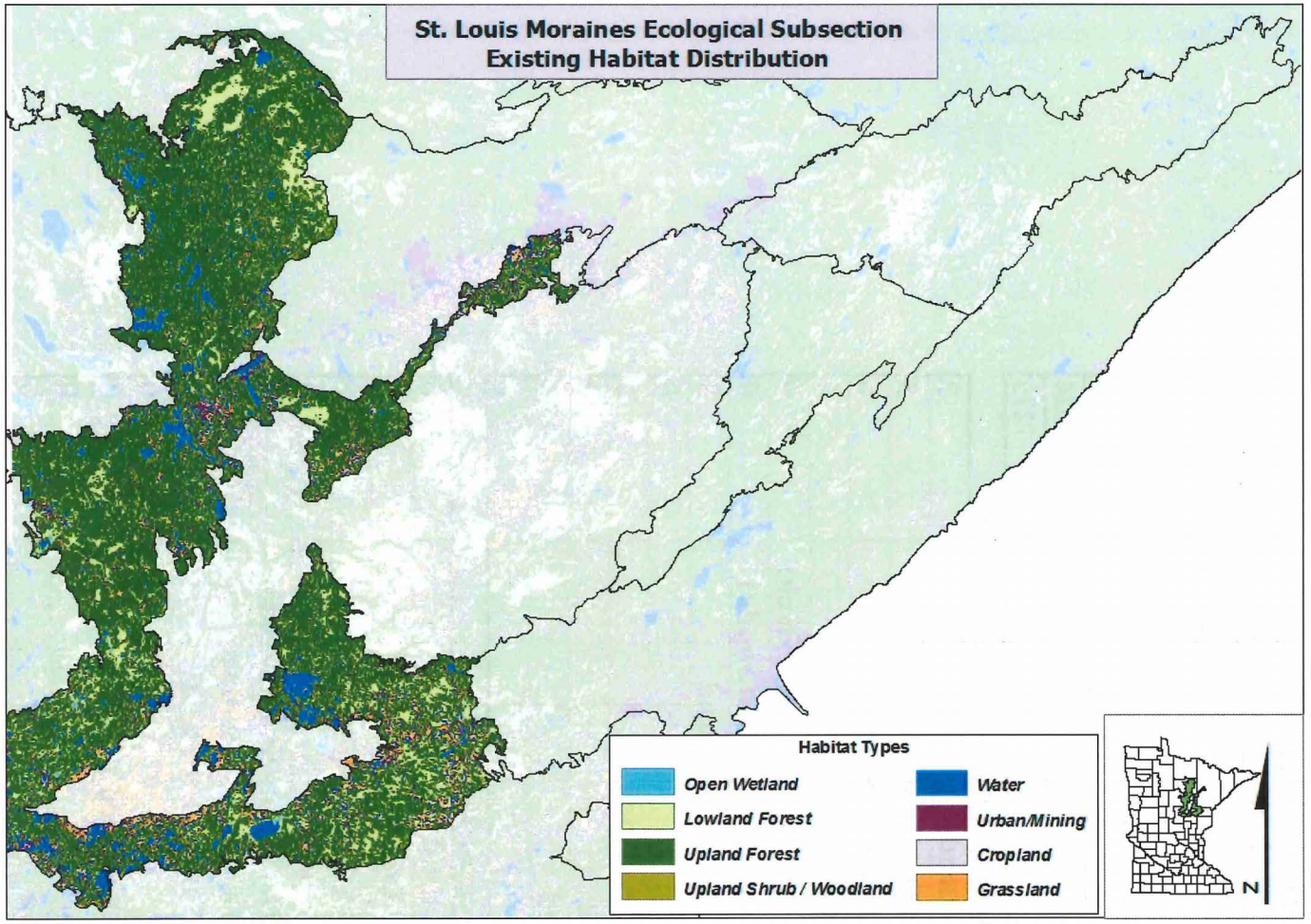
Open wetland	83267
Lowland Deciduous	72220
Lowland Conifer/Shrubland	592776
Upland Conifer	79319
Upland Deciduous (Aspen/Birch)	285979
Upland Deciduous (Hardwoods)	25682
Upland Shrub/Woodland	45241
Water	23044
Urban/Developed	3877
Cropland	78222
Grassland	217024
Mining	7275

Habitat Losses: Economic Development

Open wetland	2
Lowland Deciduous	3
Lowland Conifer/Shrubland	6
Upland Conifer	4
Upland Deciduous (Aspen/Birch)	9
Upland Deciduous (Hardwoods)	0
Upland Shrub/Woodland	3
Water	0
Urban/Developed	3
Cropland	10
Grassland	24
Mining	6

Habitat Losses: Forestry

Open wetland	0
Lowland Deciduous	0
Lowland Conifer/Shrubland	3
Upland Conifer	0
Upland Deciduous (Aspen/Birch)	1
Upland Deciduous (Hardwoods)	0
Upland Shrub/Woodland	0
Water	0
Urban/Developed	0
Cropland	0
Grassland	0
Mining	0



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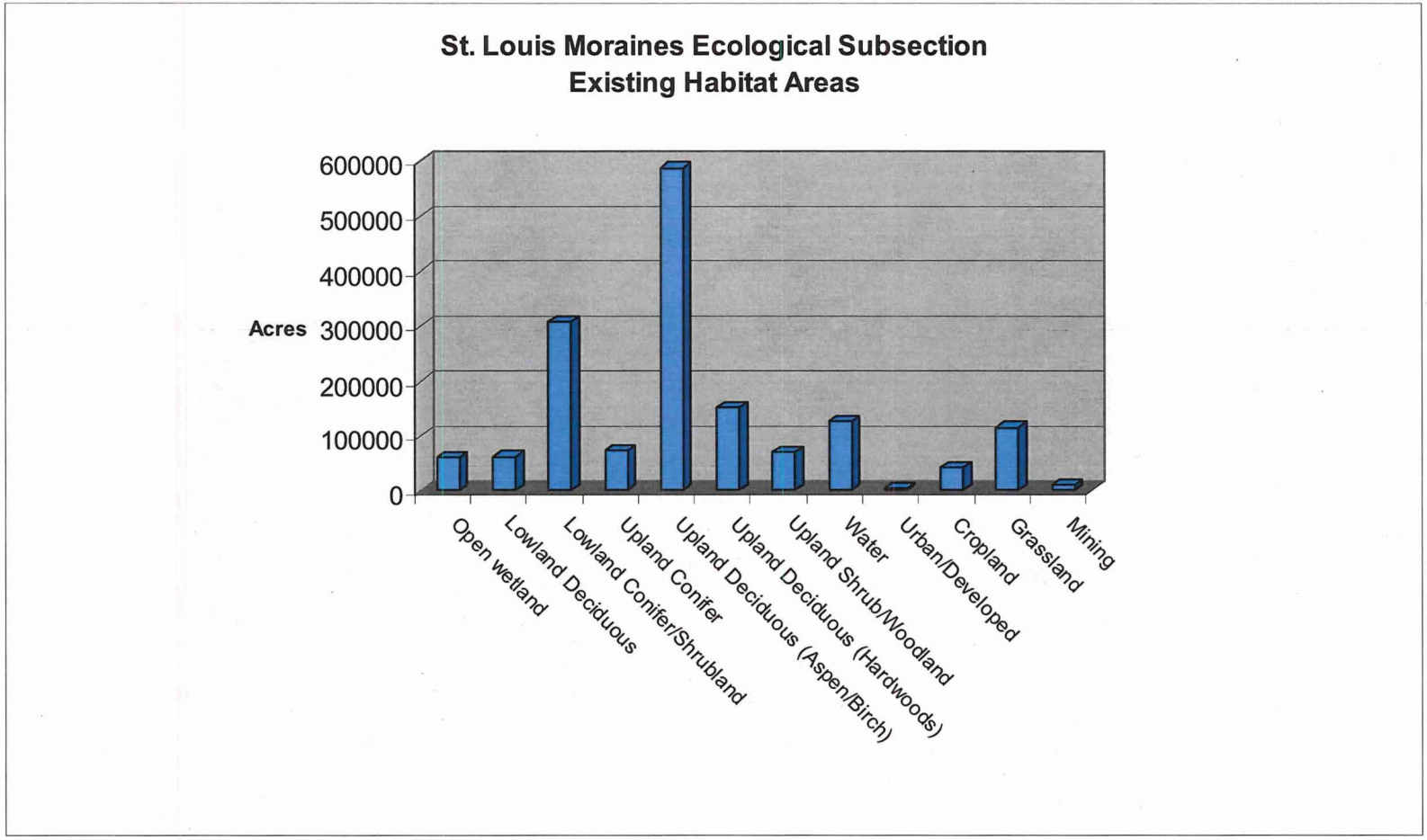
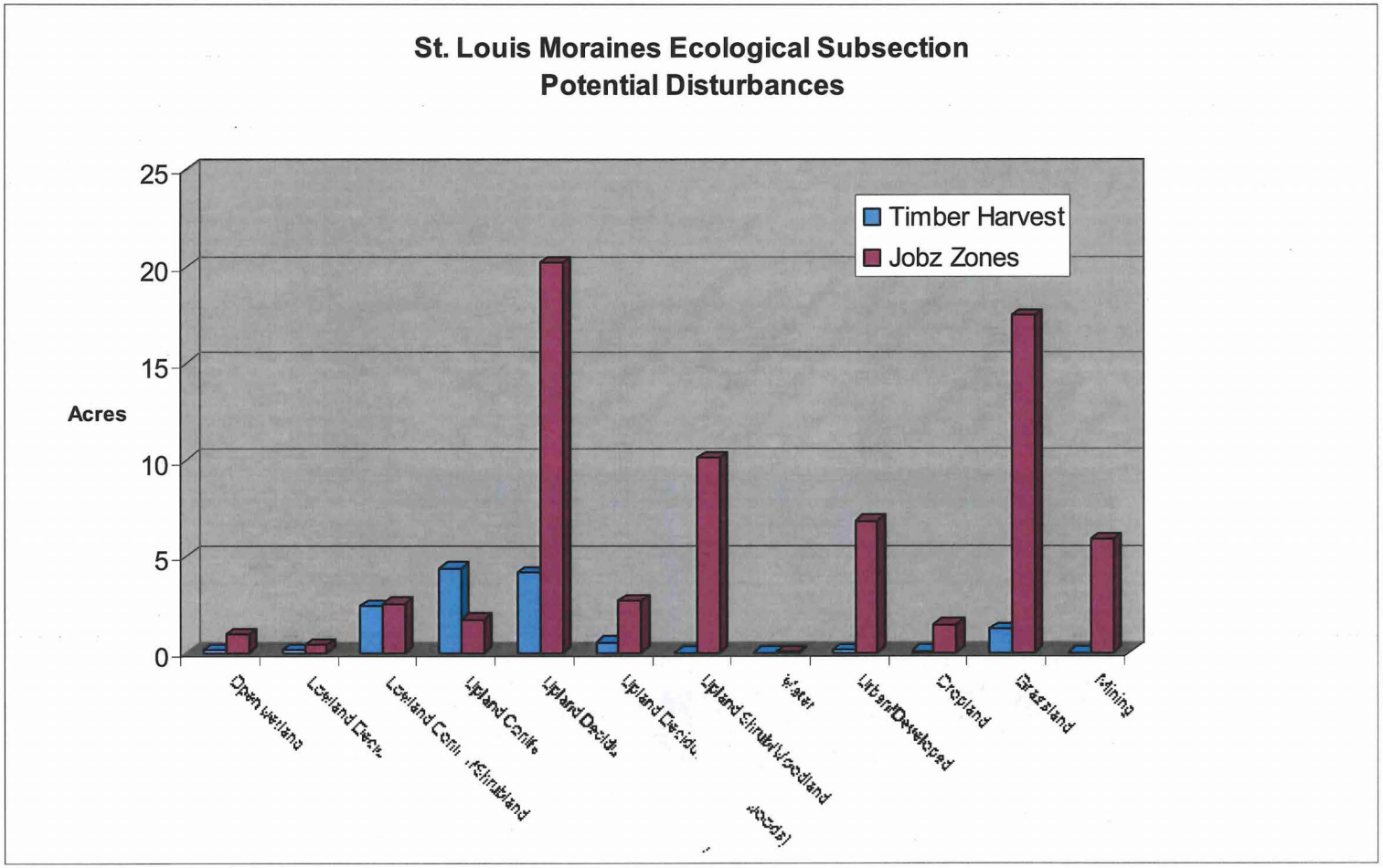

St. Louis Moraines Ecological Subsection
Existing Habitat Areas
Acres
600000
500000
400000
300000
200000
100000
0
Open wetland
Lowland Deciduous
Lowland Conifer/Shrubland
Upland Conifer
Upland Deciduous (Aspen/Birch)
Upland Deciduous (Hardwoods)
Upland Shrub/Woodland
Water
Urban/Developed
Cropland
Grassland
Mining


St. Louis Moraines Ecological Subsection
Potential Disturbances
Acres
25
20
15
10
5
0
Timber Harvest
Jobz Zones
Open wetland
Lowland Decid.
Lowland Conif. /Shrubland
Upland Conif.
Upland Decid.
Upland Decidu.
Upland Shrub/Sapling /Woodland
Water
Urban/Developed
Cropland
Grassland
Mining

St. Louis Moraine Habitat Type Area

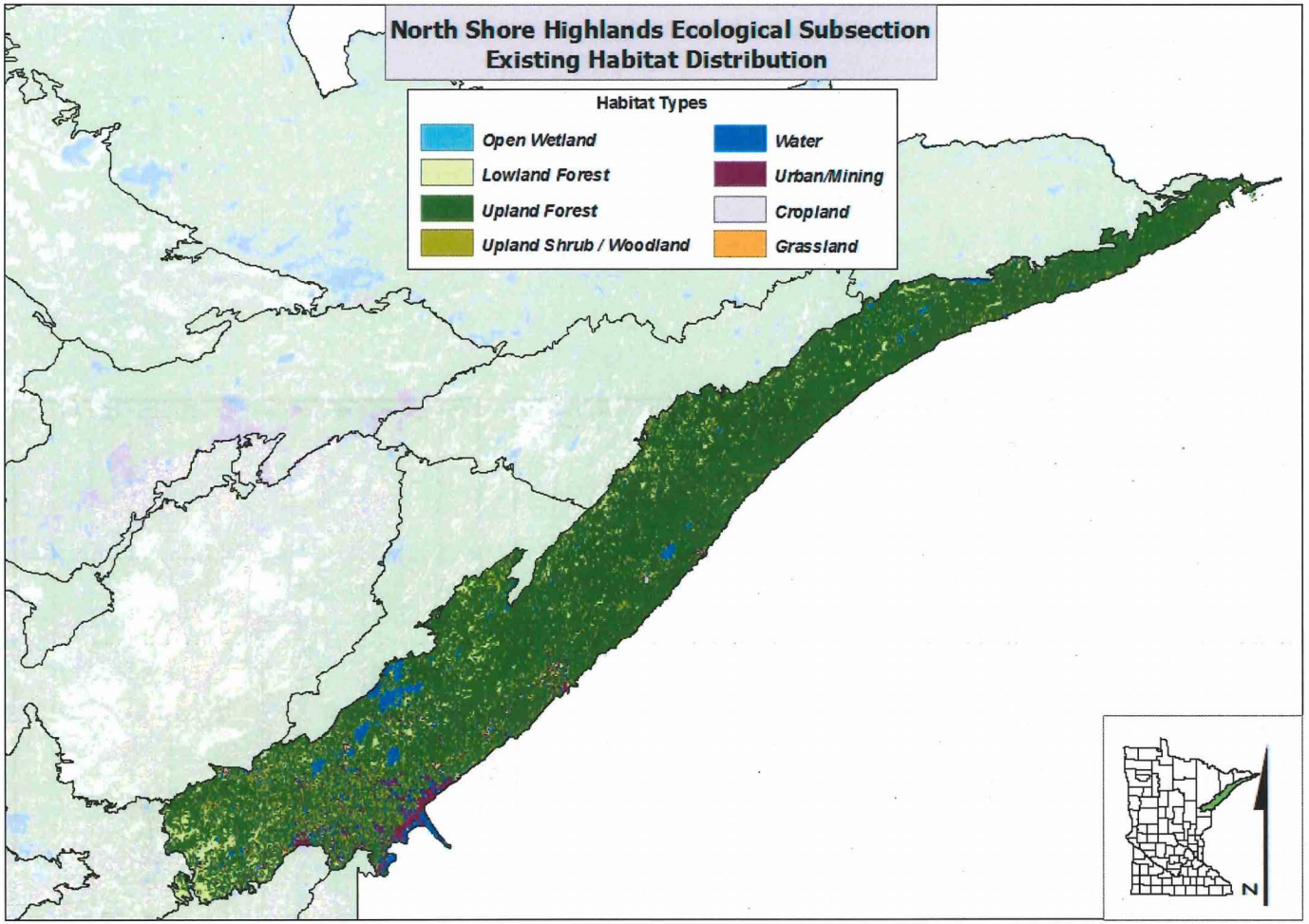
Open wetland	60342
Lowland Deciduous	62617
Lowland Conifer/Shrubland	307497
Upland Conifer	73604
Upland Deciduous (Aspen/Birch)	588261
Upland Deciduous (Hardwoods)	153717
Upland Shrub/Woodland	69926
Water	127826
Urban/Developed	4041
Cropland	41551
Grassland	116582
Mining	10131

Habitat Losses: Economic Development

Open wetland	1
Lowland Deciduous	0
Lowland Conifer/Shrubland	3
Upland Conifer	2
Upland Deciduous (Aspen/Birch)	20
Upland Deciduous (Hardwoods)	3
Upland Shrub/Woodland	10
Water	0
Urban/Developed	7
Cropland	1
Grassland	17
Mining	6

Habitat Losses: Forestry

Open wetland	0
Lowland Deciduous	0
Lowland Conifer/Shrubland	2
Upland Conifer	4
Upland Deciduous (Aspen/Birch)	4
Upland Deciduous (Hardwoods)	1
Upland Shrub/Woodland	0
Water	0
Urban/Developed	0
Cropland	0
Grassland	1
Mining	0



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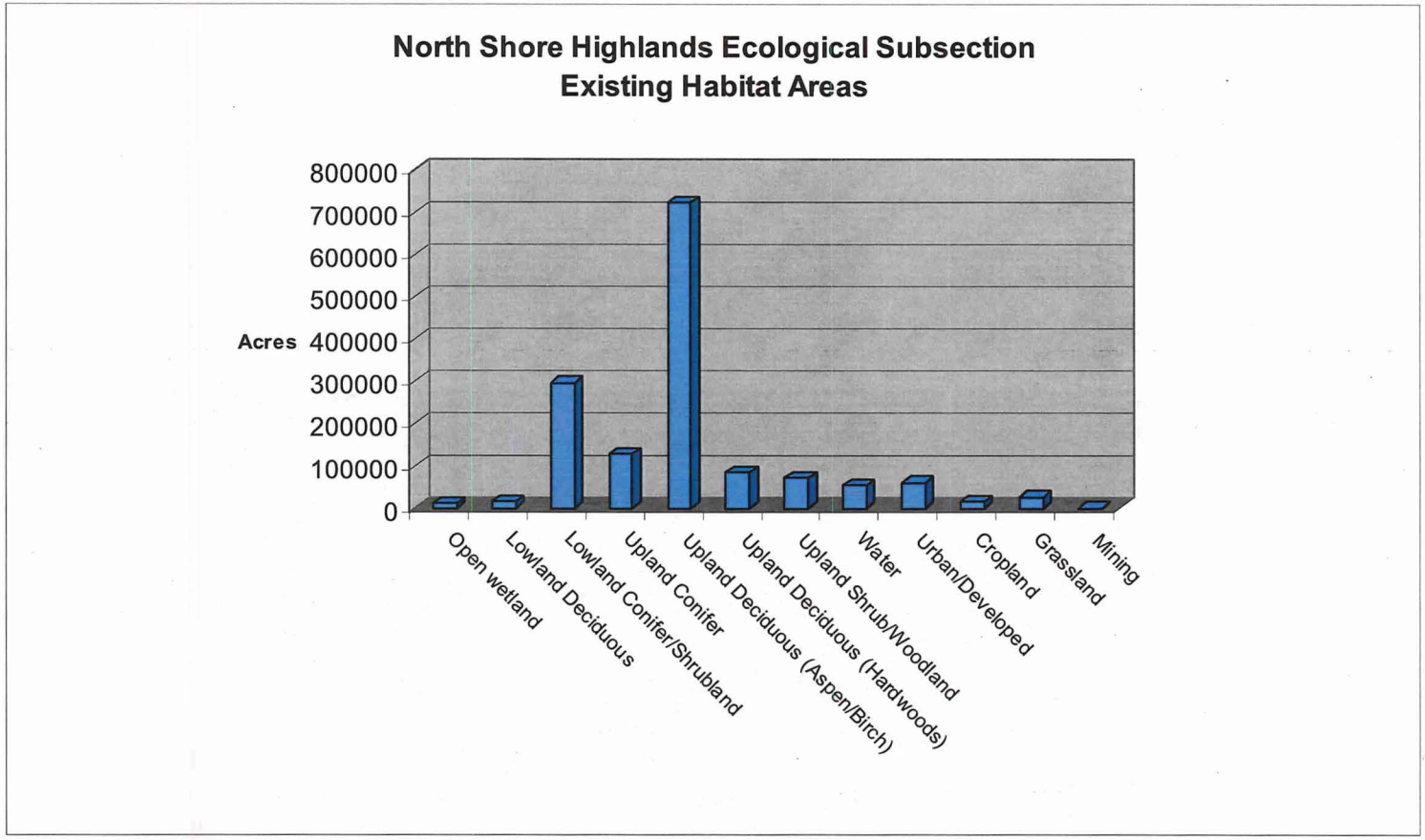
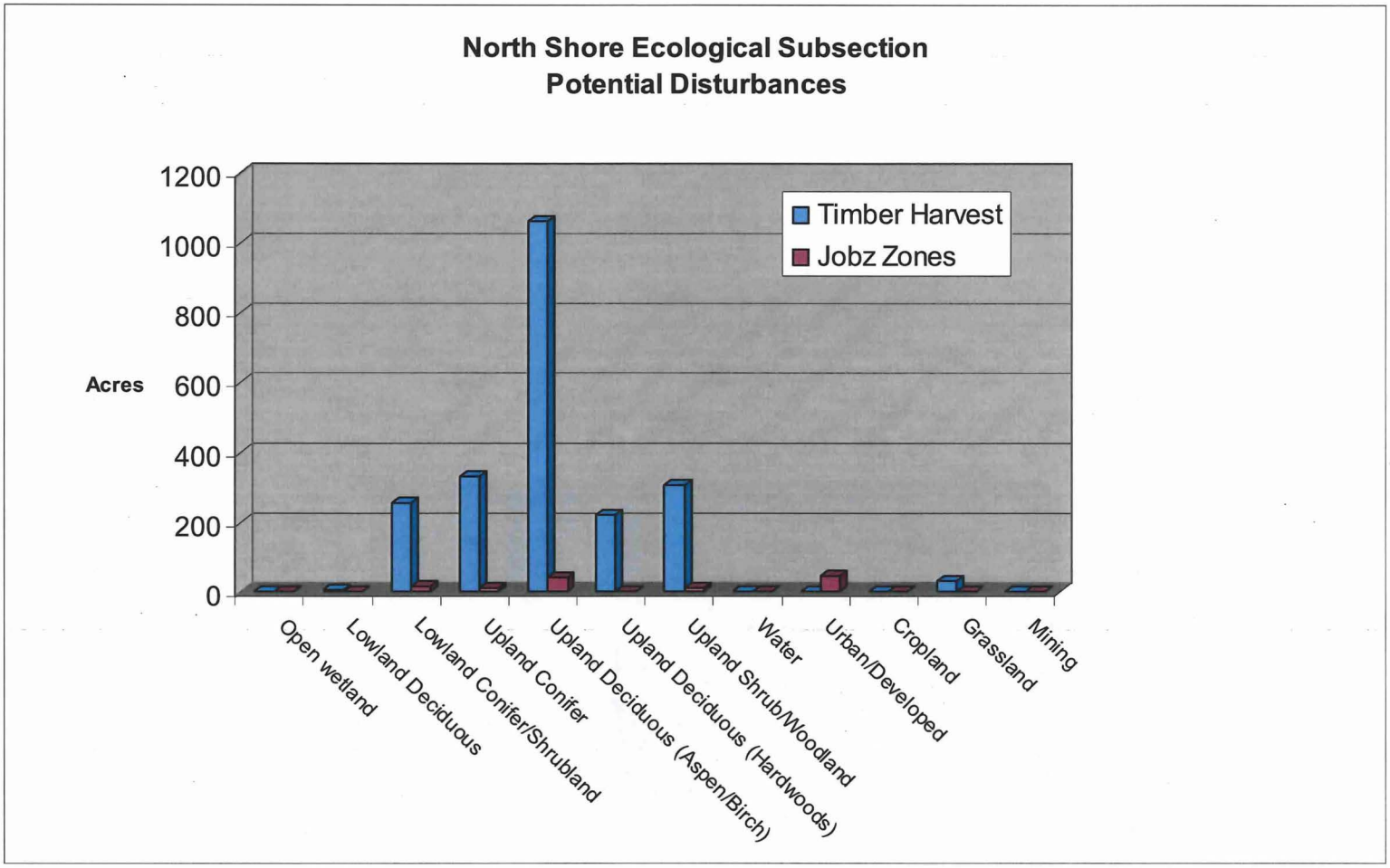

North Shore Highlands Ecological Subsection
Existing Habitat Areas
Acres
800000
700000
600000
500000
400000
300000
200000
100000
0
Open wetland
Lowland Deciduous
Lowland Conifer/Shrubland
Upland Conifer
Upland Deciduous (Aspen/Birch)
Upland Deciduous (Hardwoods)
Upland Shrub/Woodland
Water
Urban/Developed
Cropland
Grassland
Mining


North Shore Ecological Subsection
Potential Disturbances
Acres
1200
1000
800
600
400
200
0
Timber Harvest
Jobz Zones
Open wetland
Lowland Deciduous
Lowland Conifer/Shrubland
Upland Conifer
Upland Deciduous (Aspen/Birch)
Upland Deciduous (Hardwoods)
Upland Shrub/Woodland
Water
Urban/Developed
Cropland
Grassland
Mining

North Shore Highlands Habitat	Acres
Open wetland	10868
Lowland Deciduous	13866
Lowland Conifer/Shrubland	295137
Upland Conifer	127028
Upland Deciduous (Aspen/Birch)	723266
Upland Deciduous (Hardwoods)	83215
Upland Shrub/Woodland	72209
Water	54264
Urban/Developed	60156
Cropland	15725
Grassland	26039
Mining	0

Habitat Losses: Economic Development

Open wetland	1
Lowland Deciduous	0
Lowland Conifer/Shrubland	16
Upland Conifer	13
Upland Deciduous (Aspen/Birch)	42
Upland Deciduous (Hardwoods)	3
Upland Shrub/Woodland	12
Water	1
Urban/Developed	46
Cropland	2
Grassland	2
Mining	0

Habitat Losses: Forestry

Open wetland	4
Lowland Deciduous	7
Lowland Conifer/Shrubland	255
Upland Conifer	330
Upland Deciduous (Aspen/Birch)	1063
Upland Deciduous (Hardwoods)	222
Upland Shrub/Woodland	307
Water	2
Urban/Developed	4
Cropland	0
Grassland	30
Mining	0

Significant Impacts Summary

Travel Corridors

Travel corridors impacts were classified and described in the Methods section of this report. The following table summarizes the type of projected impact to each of the travel corridors analyzed. Cumulative effects of all past actions on wildlife travel across the approximately 100-mile mineral formation in the Mesabi Iron Range have currently led to at least thirteen relatively small identified travel corridors. In light of this, future losses of any of these corridors may be considered significant. Identified significant impacts should be assessed on a site or scale-specific basis.

Wildlife Travel Corridor	Type of Impact
1	Minimal Isolation
2	Isolation
3	Direct Loss
4	Isolation
5	Fragmented
6	Isolation
7	Minimal Impact
8	Isolation
9	Minimal Impact
10	Minimal Impact
11	Minimal Impact
12	No Impact
13	No Impact

Habitat

The habitat losses to mammalian species of greatest conservation need are reported below and are summed for all proposed future actions included in the cumulative effects analysis and described in the Methods section of this report. Effects to habitat types supporting mammalian species of greatest conservation need should be considered significant.

	Mining Losses	Economic Development Losses	Forestry Losses	Total Effects
All Habitat Types (all Arrowhead Region ecological subsections)	913 ac	498 ac	7,315 ac	8,727 ac

The rationale as described in the Methods section of this report is that the cumulative effect of all past actions has led to a limited list of mammalian species for which any future losses to the habitat requirements of these species could be considered significant. Thus, this analysis indicates that there may be significant cumulative effects.

This finding of significance mean that the specific projects should evaluate for the presence of habitat for these species and if shown to be present should avoid and then mitigate for the impacts. If this is done for all actions in the study area, then significant cumulative effects will be avoided. There are uncertainties in the large geographic scale and measurement parameters selected for this CEA. As a result, individual projects will want to develop finer scale habitat mapping in the project vicinity in order to assess whether or not there is a direct effect.