



Two Hearted River Riparian Analysis

By
Emily Wessels, The Nature Conservancy in Michigan
and
Lisa Niemi, The Nature Conservancy in Michigan

December 2007



Table of Contents

| | | |
|------|---|---------|
| I. | Executive Summary..... | page 1 |
| II. | Background | page 2 |
| | • Existing Protection Measures | |
| | • Riparian Areas | |
| | • Riparian Area Analysis Summary | |
| III. | Two Hearted River Riparian Areas | page 6 |
| | • Defining Riparian Areas | |
| | • Riparian Area Characteristics | |
| | • Comparison with Existing Regulations | |
| IV. | Sensitive Areas | page 28 |
| | • Sensitivity to Development | |
| | • Sensitivity to Forestry Management | |
| V. | Management Recommendations | page 35 |
| | • Development | |
| | • Forest Management | |
| VI. | References | page 37 |
| VII. | Appendices | |
| | A. Maps | |
| | B. Summary of Riparian Area Characteristics | |
| | C. Methods for Establishing Riparian Areas | |
| | D. Methods for Identifying Sensitive Areas | |
| | E. Field Data Collection Methods | |
| | F. Unique Natural Feature Occurrence Status and Ranks Defined | |
| | G. Conservation Easements | |
| | H. Geodatabase File Lists and Description | |

I. Executive Summary

The Two Hearted River watershed is renowned for its high quality, intact aquatic system and remote wilderness, due to the extensive wetlands complexes. Much of the land within the watershed is state owned, with other large land holders being The Nature Conservancy, forest product producers, hunting clubs, and small private holdings. The Two-Hearted River is a cold water trout fishery and was designated as a Michigan Natural River (Part 305, P.A. 451) in December of 1973. It has also been designated as an Outstanding State Resource Water (OSRW). The Nature Conservancy identified the Two Hearted River watershed as a unique and priority place for conservation within the Great Lakes ecoregion due to its diverse and high quality aquatic and terrestrial systems.

In addition to the land/water interface laws in Michigan, a number of existing measures provide degrees of protection to this high quality aquatic system. These include its status as a Michigan Natural River, Luce County zoning ordinances, and the voluntary Best Management Practices (BMPs) regarding forest management.

The overarching goal of this analysis was to identify the functional riparian area of the Two Hearted River system and to assess its sensitivity to further development and forest management activities based on the characteristics. This analysis goes beyond the fixed buffer width concept (largely focused on the floodplain), which may not capture all of the diversity and ecosystem function that the riparian area represents. The objectives of this project were to:

- Identify potential critical habitat and areas sensitive to environmental degradation, and to assess natural community condition by conducting a Geographic Information System (GIS) analysis on the Two Hearted River riparian area;
- Verify the GIS analysis through field work conducted on representative and accessible lands; and
- Develop management recommendations for critical areas within the riparian corridor.

In this analysis, sensitive areas are defined as locations within the riparian area that, given their multiple attributes, create a unique area that if disturbed may affect the water quality of the Two Hearted River or its riparian area. A GIS analysis was conducted to identify these potentially sensitive areas, and was followed by limited field visits to monitor the accuracy of the data input. Characteristics such as physical distance from river, slope, erosion potential, presence of unique natural features, presence of wetlands, and other soil attributes related to building/ development conditions were utilized to identify these sensitive areas.

Overall, the most limiting factors for development and forest management within the riparian area include the extensive hydric soils, the mosaic of wetland complexes, the topographic relief in certain areas, the erodibility of the sandy soils, and presence of unique natural features. Only a few sites stood out in both analyses as having a very high sensitivity to these land use activities. Recommendations for development and forest management include a range from the exclusion of these activities in certain areas to various limitations based on the more site specific characteristics.

II. Background

“The Two Hearted River in northern Luce County flows through a ‘wilderness-like’ watershed on its way from its headwaters at Whorl Lake to the mouth at Lake Superior” (MI DNR, 2002). Much of the land within the watershed is state owned, with other large land holders being The Nature Conservancy, forest product producers such as The Forestland Group, LLC and Plum Creek Timber, large hunting clubs, and small private holdings (mainly used for hunting and fishing camps). The Two-Hearted River is a cold water trout fishery and was designated as a Michigan Natural River (Part 305, P.A. 451) in December of 1973. It has also been designated as an Outstanding State Resource Water (OSRW).

Through the process of setting conservation priorities at an ecoregional scale, The Nature Conservancy identified the Two Hearted River watershed as a unique and priority place for conservation within the Great Lakes ecoregion due to its diverse and high quality aquatic and terrestrial systems (TNC, 2007). Many people are attracted to the Two Hearted River area not only for its wilderness-like nature but also for the recreational opportunities that it supports, such as excellent brook trout and steelhead fishing, canoeing, and hunting. The Two Hearted River Natural Rivers Plan (2002) sums up the potential threat to this pristine water resource by stating, “As the demand for quality recreation increases, the natural beauty and wilderness characteristics of the area could be destroyed by unregulated land use”.

Existing Protection Measures

In addition to the land/water interface laws in Michigan, there are a number of existing measures that provide a degree of protection to this high quality aquatic system. These include its status as a Natural River, Luce County zoning ordinances, and the voluntary Best Management Practices (BMPs) regarding forest management.

Natural River Designation

The Michigan Department of Natural Resources (MDNR) developed a Two Hearted River Natural River Plan in 1973, which was updated in 2002. The plan identifies the Natural River District as a 400 foot buffer along either side of the designated natural river portions, including the mainstem, North Branch, South Branch, West Branch, East Branch, and Dawson Creek. This District “establishes a zoning district in which certain types of future development and land use will be regulated so as not to be injurious to the river resource, property values and scenic and recreation values” (MDNR, 2002). The plan regulates activities near or adjacent to the River in order to protect the aquatic resources. The regulations outlined in the plan include:

- a natural vegetation strip 100 feet wide is maintained on each side of the water’s edge,
- commercial timber harvest is permitted beyond 100 feet of water’s edge,
- mining and extractive industries are permitted beyond 300 feet of water’s edge, and
- construction of structures are permitted beyond 75 – 100 feet of water’s edge, depending on the river bank erodibility.

Other regulations address camping, boat launching, and specifics for development such as septic system placement and minimum lot size. The plan does not limit the Luce County Zoning Board from strengthening these regulations through County zoning.

Luce County Zoning

The planning authority that encompasses the vast majority of the Two Hearted River watershed is the Luce County Planning Commission. In 2002, the Commission developed a comprehensive plan for the County, laying the framework for informing future land use decisions. The Plan identifies the County's vision "to define the path that will provide an opportunity for controlled growth and progress while maintaining Luce County's unique setting, attitude, community and independent way of life" (Gove Associates, 2002). The goals outlined in the Plan include the preservation of the area's natural character and forestlands, expansion of services and facilities, improvement of commercial corridors, and the development of Lake Superior shoreline management plan. In 2005, the Planning Commission began the process of revising the County's zoning ordinances. The proposed ordinances work to begin to implement the Comprehensive Plan and include provisions to expand freshwater resource protection. Some of these provisions include:

- identifying wetlands, waterfront setback areas, sand dunes (with >18% slope), lands with steep slopes and other environmentally sensitive areas as "undevelopable land";
- limiting impervious surfaces, both within the greater watershed and specifically within 500 - 700 feet of the waterbody to protect overall watershed health, and lessen the local impacts to the stream channel and aquatic communities;
- maintaining a 50-100 foot vegetated buffer along the lake, stream or wetland with indigenous species;
- setting a minimum river frontage width (330') for all lots; and
- including all rivers and streams in the "River/stream overlay" in addition to those designated as Natural Rivers.

Voluntary Best Management Practices (Buffer Strips)

The Michigan Department of Environmental Quality (MDEQ) and MDNR have developed guidelines for forest landowners in order to maintain high quality water on their land. This guide, "Water Quality Management Practices on Forest Land", is part of "Michigan's Nonpoint Source Pollution Control Management Plan", and includes practices for road construction and maintenance, use of log landings, and forest harvest within the riparian buffers, among others. Although these guidelines are voluntary, they are often utilized as mandatory practices for third party forest certification, such as Forest Stewardship Council (FSC). The guidelines outline the importance of buffer strips along rivers and streams with suggested limited activities within these areas that minimize soil disturbance and compaction and retain adequate tree cover. Table 1 outlines the minimum width of the buffer strips, based on slope, provided in the manual. The manual is currently being reviewed and revised by the MDEQ and MDNR.

Table 1. Buffer strip widths according to slope

| Slope of land above water body or stream (%) | Minimum width of strip feet |
|---|--|
| 0 – 10 | 100 ft |
| 10 – 20 | 115 ft |
| 20 – 30 | 135 ft |
| 30 – 40 | 155 ft |
| 40 – 50 | 175 ft |
| 50 + | Activity may not be advisable due to erosion potential. Extreme care must be taken to prevent movement of soil |

Riparian Areas

Riparian areas have been defined in various ways, from a static area extending a fixed distance from a river (as in Table 1) to a more dynamic and variable width area defined by the ecosystem functions it performs in that particular system. For the purpose of this analysis, we adopted a definition closer to the latter example, as outlined by Ilhardt, Verry, and Palik (2000),

“Riparian areas are the three-dimensional ecotones of interaction that include terrestrial and aquatic ecosystems that extend down into the groundwater, up above the canopy, outward across the floodplain, up the near-slopes that drain to the water, laterally into the terrestrial ecosystem, and along the water course at a variable width.”

The riparian areas are extremely important since they play many different roles both at a local scale (ie. neighboring aquatic and terrestrial ecosystems) and at a watershed scale. From the aquatic ecosystem perspective, the riparian area provides energy and nutrient inputs to the system while filtering sediments and absorbing nutrients and water from the uplands. These services help buffer aquatic organisms and maintain key aquatic ecosystem functions such as temperature regulation, energy flow, and hydrologic flow (Flaspohler et al, 2002). The riparian areas also provide the vital connection from the aquatic habitat to the upland habitats. At the watershed scale, riparian areas contain distinct species pools altogether (Sabo, 2005) and support habitat for diverse vegetation and increased species richness due to the diversity of the fluvial landforms (ie. floodplain, terrace, slope, etc) (Goebel et al, 2003).

Riparian Area Analysis Summary

Based on the above discussion, it became clear that in order to truly provide added protection to the Two Hearted River System, we needed to identify its functional riparian areas. This goes beyond the fixed buffer width concept (largely focused on the floodplain), which may not capture all of the diversity and ecosystem function that the riparian areas represent.

The objectives of this project were to:

- Identify potential critical habitat and areas sensitive to environmental degradation, and to assess natural community condition by conducting a Geographic Information System (GIS) analysis on the Two Hearted River riparian area;
- Verify the GIS analysis through field work conducted on representative and accessible lands; and
- Develop management recommendations for critical areas within the riparian corridor.

The initial step was the identification of the riparian areas. This was done by utilizing the concepts of the riparian area as a functional and dynamic component of both the aquatic and terrestrial systems (Ilhardt, Verry, and Palik, 2000). Areas within the riparian area potentially sensitive to development and forestry were determined by using a rating system based on the areas' attributes such as slope, soil characteristics, land ownership, and significant natural communities. The riparian areas were categorized (e.g. high, medium, or low) based on the probability that degradation would occur as a result of development or forestry in these areas. Data was collected from 30 sites in or near the riparian area to confirm the riparian area extent and attributes. Management recommendations were developed based on the areas' attributes. Each of these steps is further described in the following sections.

III. Two Hearted River Riparian Areas

Defining Riparian Areas

The general process of identifying the riparian areas included a GIS analysis and limited field sampling. The GIS analysis incorporated soils, topography, and adjacent and/or nearby waterbodies (ie. wetlands and lakes) to determine the extent of the riparian area along the Two Hearted River mainstem and major tributaries. Initially, two riparian areas were identified: one with a defined maximum extent of 500 m from the river (500 m Based Riparian Area) and one without a defined maximum extent (Wetland Based Riparian Area) (see Figure 1). Both methods yielded identical results for the riparian area along the mainstem, the majority of the East Branch, downstream portions of Dawson Creek, the South Branch, and headwaters of the North Branch. The 500 m Based Riparian Area recognized the wetlands adjacent to the river, but did not include the full extent of these wetlands. The Wetland Based Riparian Area (WBRA) included the full extent of the wetlands adjacent to or near the river. Due to the nature of the watershed, a wetland-dominated system, the WBRA was utilized as the basis for the GIS analysis. The methodology utilized in establishing the riparian areas of the Two Hearted River can be found in Appendix C.

In conducting any GIS analysis, the result is only as accurate as the original input data. The most evident data limitation encountered was the coarse scale topographic information utilized to decipher the various fluvial landforms, terrace, slope and floodplain. The watershed is largely characterized by slight topographic relief with microtopography playing a key role in determining specific habitats, especially in the peatland wetlands; therefore coarse scale data is definitely a limiting factor. Field sampling was conducted at thirty sites within the identified riparian areas across the watershed to further assess the accuracy of the GIS analysis. For more information on the field sampling methodology, see Appendix E.

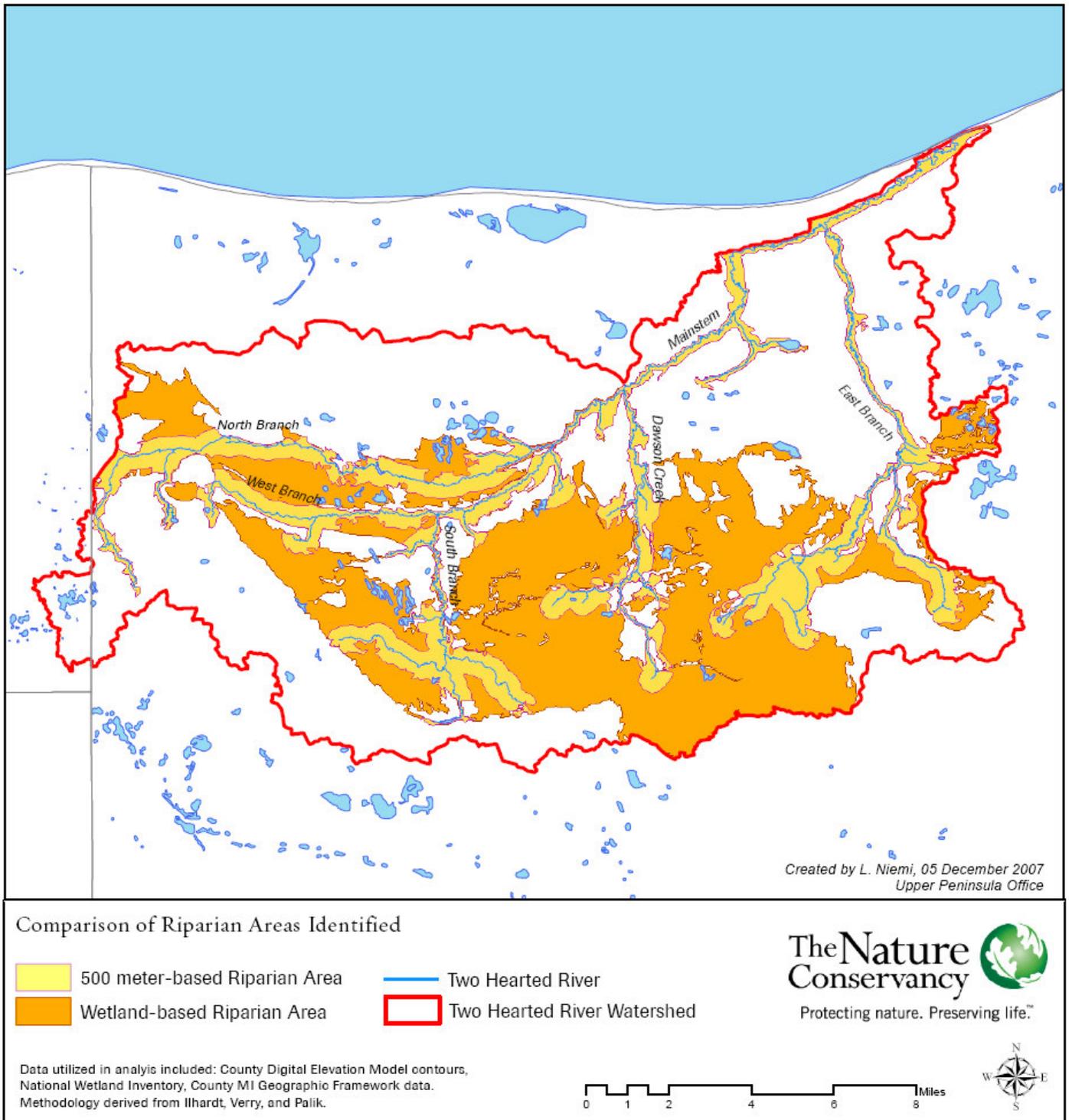


Figure 1. Comparison of Riparian Areas identified for the Two Hearted River

Riparian Area Characteristics

As stated above, the riparian area methodology that encompassed the extensive adjacent wetlands was utilized for the remainder of this analysis. Therefore, the following information only pertains to these riparian areas.

The Two Hearted River riparian area contains approximately 58,000 acres, roughly 40% of the entire watershed's area. This large percentage is greatly due to the extensive wetland complexes found in the headwaters of the East Branch, throughout Dawson Creek, and the middle portions of the South Branch (see Figure 2). Only 13% of the riparian area is considered non-wetland. The wetland types within the riparian area are dominantly forested and scrub-shrub with some emergent wetlands (see Table 2). A number of lakes are included within the riparian area such as North Branch Lakes, Otter Lake, Long Lake, Two Hearted Lakes, Beaver Lake, McMahan Lake, Sleeper Lake, Stuart Lake, Chris Brown Lake, and the Swamp Lakes.

Table 2. Wetland Types in Riparian Area

| Type of Wetland | Acres |
|-----------------|---------------|
| Beach | 10 |
| Emergent | 1,282 |
| Forested | 28,669 |
| Open Water | 1,159 |
| Scrub-Shrub | 19,325 |
| Total | 50,445 |

Groundwater Recharge

The groundwater recharge potential in the riparian area is estimated to be 13 – 16 inches/year. Those areas with the greatest recharge potential (15-16 inches/year) are at the mouth of the Two Hearted River, along portions of the mainstem (just downstream from Wabash Creek confluence) and the East Branch, and in the very headwaters of the North Branch. The areas with the least groundwater recharge potential are located along the middle of the North Branch, West Branch, and the downstream portions of the South Branch. See Figure 3.

Topography

Similar to the watershed as a whole, the riparian area of the Two Hearted River has little topographic relief, especially within the extensive wetland areas. More than 80% of the riparian area has a slope of 0 – 5% (see Table 3). Locations with the greatest percent slope (30 – 100%) include the extreme headwaters of the North Branch and West Branch and along portions of the West Branch, Dawson Creek, the East Branch, and the mainstem (see Figure 4).

Table 3. Percent Slope in Riparian Area

| Percent Slope | Acres |
|---------------|--------|
| 0 to 5 | 46,493 |
| 5 to 10 | 3,712 |
| 10 to 20 | 1,181 |
| 20 to 30 | 1,163 |
| 30 to 100 | 5,354 |

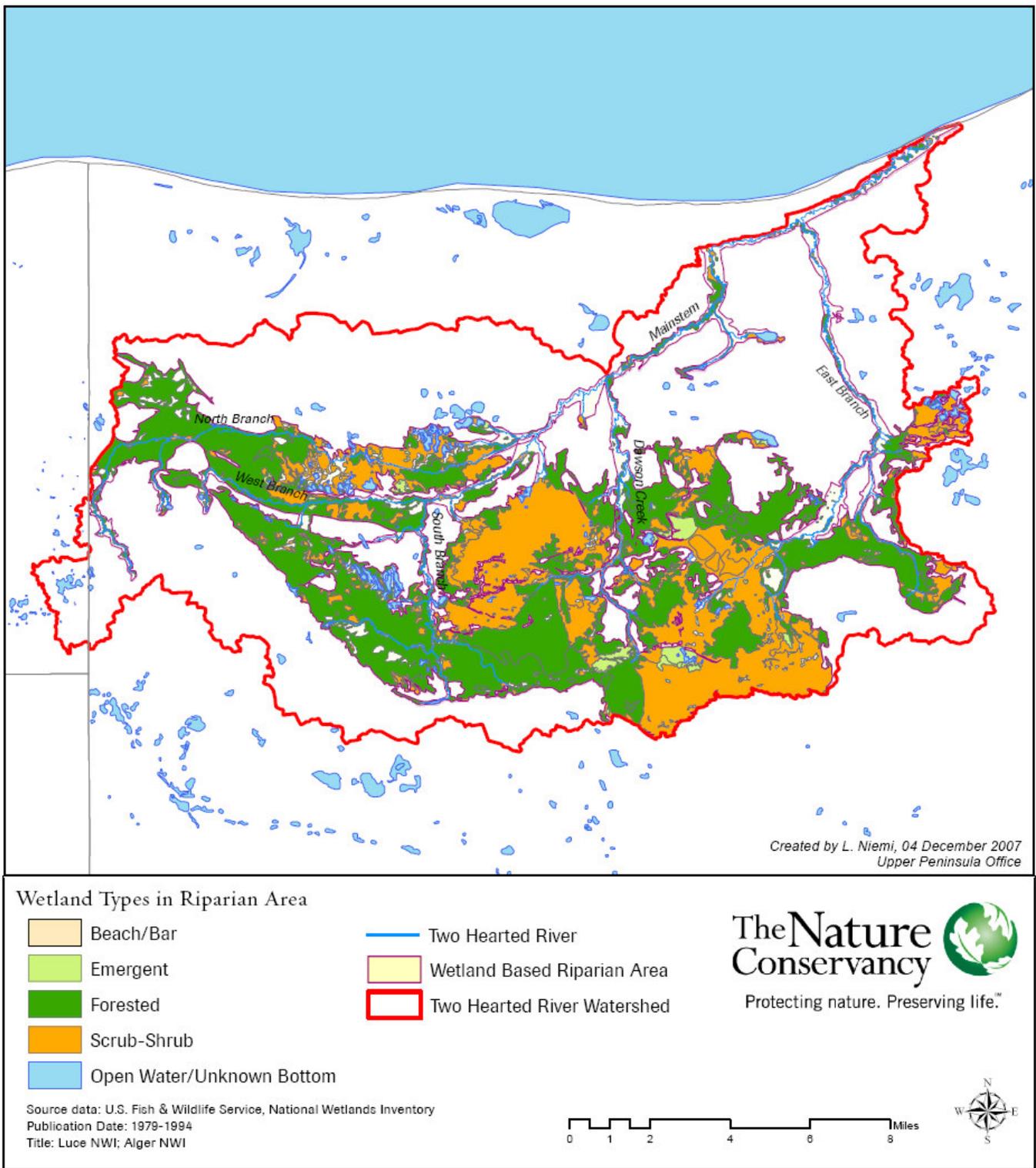


Figure 2. Wetland Types in Riparian Area

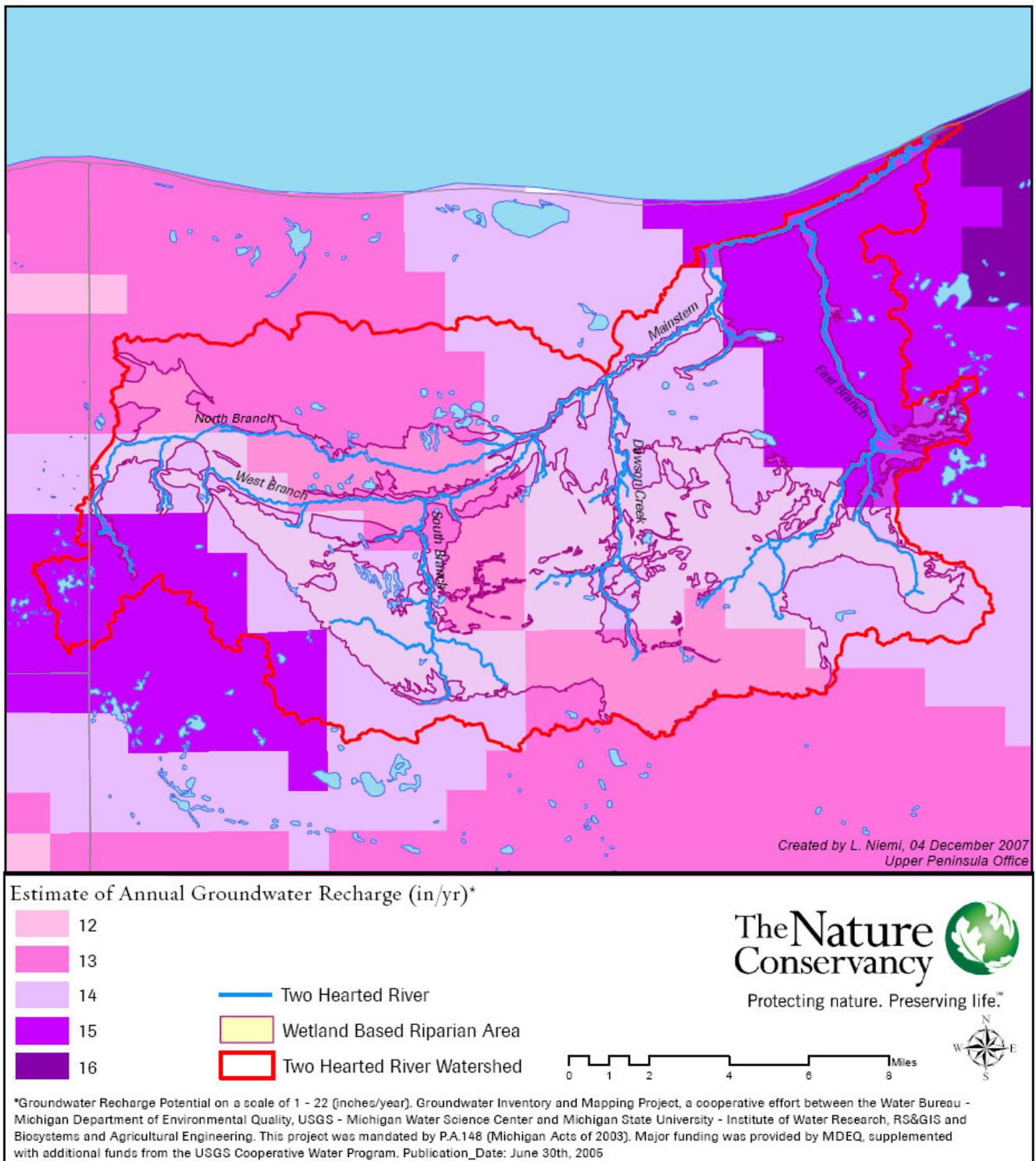


Figure 3. Groundwater Recharge in Riparian Area

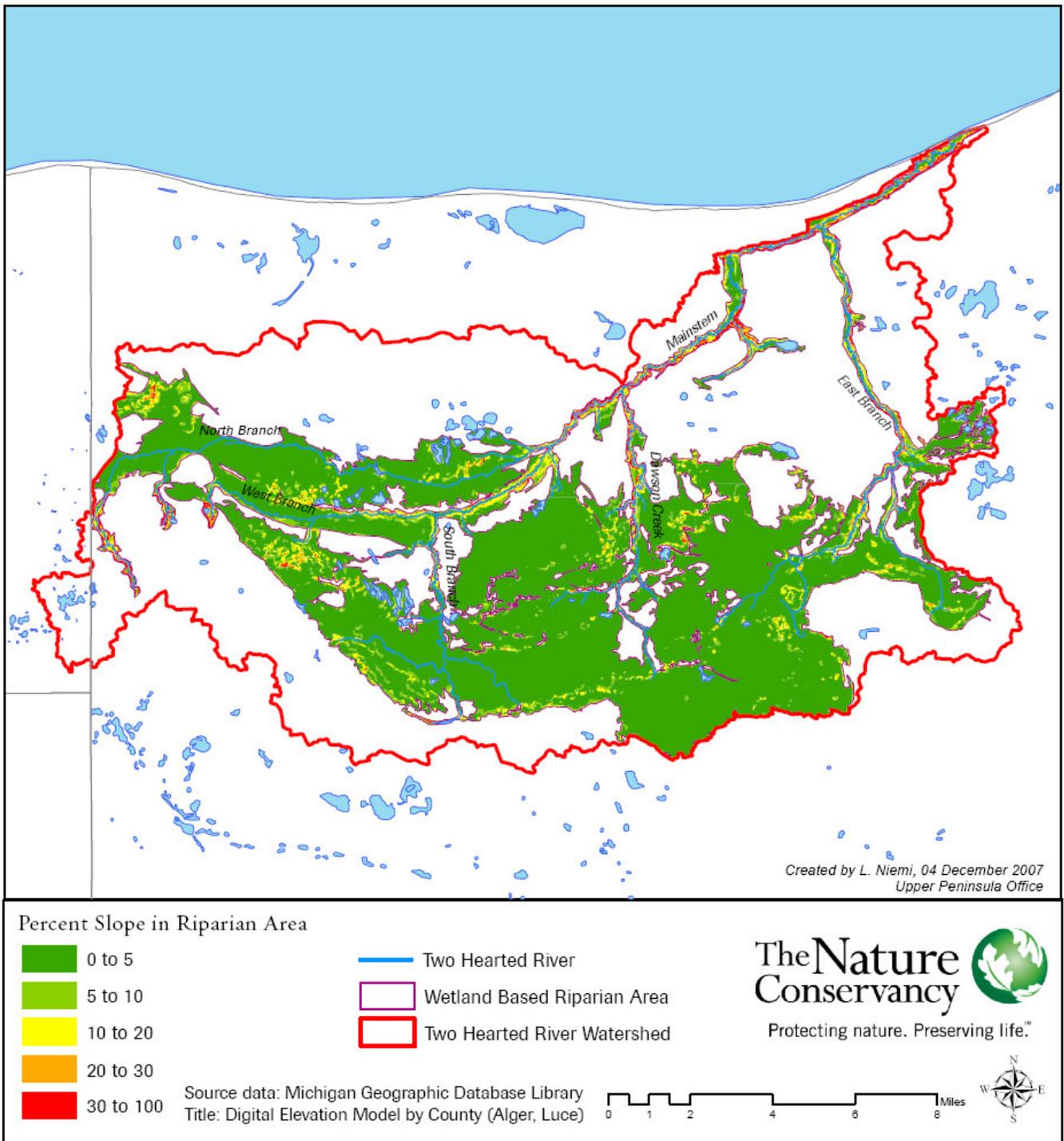


Figure 4. Topographic relief in Riparian Area

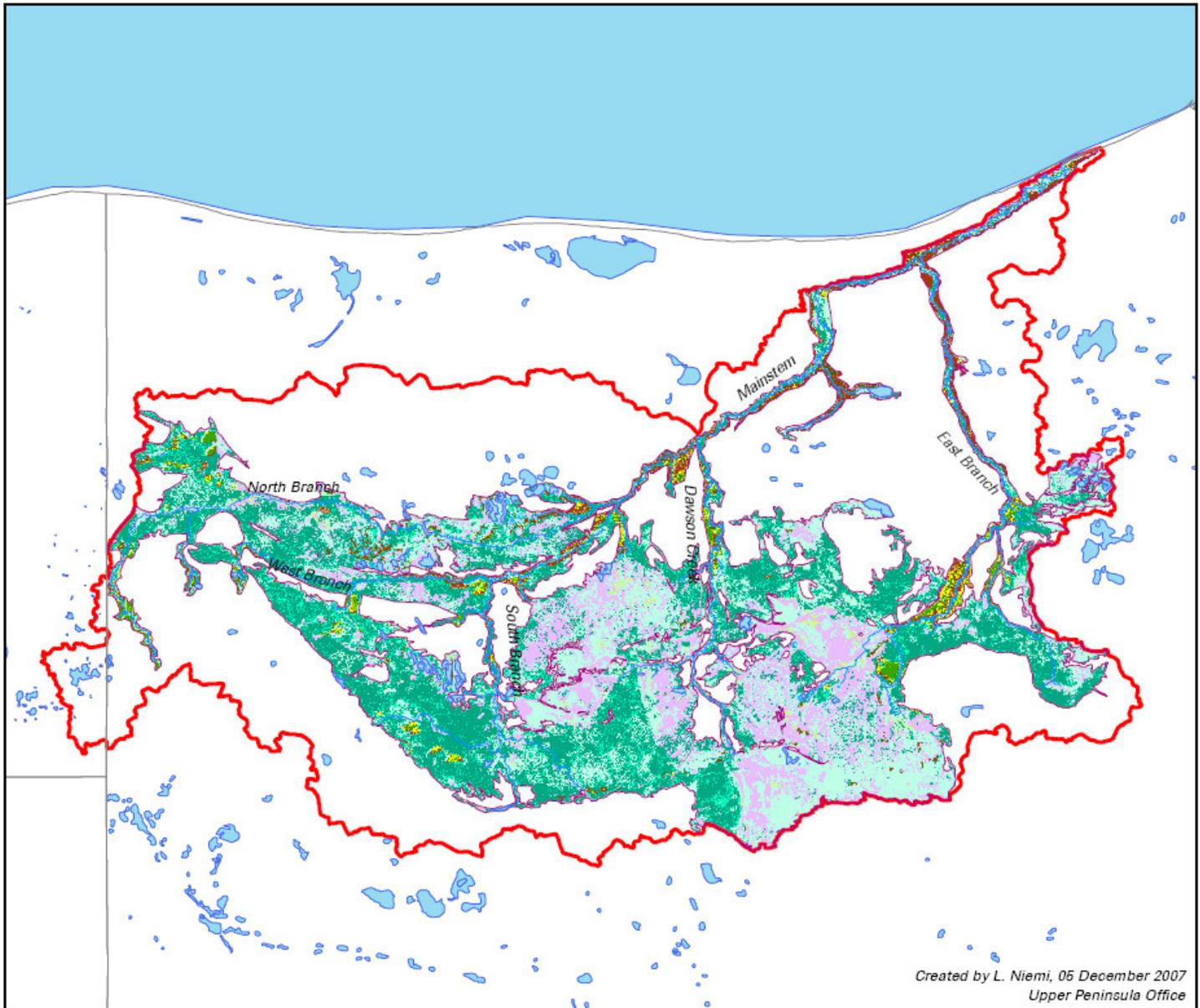
Land Use/ Land Cover

Due to the methodology utilized in defining the riparian area, the majority of the riparian area largely consists of lowland communities (see Table 4). This is especially true where the riparian area is extensive, in the Dawson Creek and South Branch subwatersheds (see Figure 5). These lowland areas create a matrix and include conifer forests, mixed deciduous-conifer forests, shrublands (eg. alder), non-forested wetlands, and patches of emergent wetlands. The few areas of upland communities found in the riparian areas, such as northern hardwood and pine forests, are isolated to the locations where the riparian area boundary was determined by topography, not by the extent of a wetland associated with the river. Similar to the land cover at a watershed wide scale, pine forests largely dominate the riparian area in the lower portions of the watershed on the sandy upland soils. Aspen is found in small patches associated with other upland forests.

Table 4. Land Use/ Land Cover Types in Riparian Area

| Land Use Class Name | Acres | Percent of Riparian Area |
|----------------------------------|--------|--------------------------|
| Lowland Coniferous Forest | 20,810 | 36% |
| Lowland Shrub | 15,049 | 26% |
| Mixed Non-Forest Wetland | 10,707 | 19% |
| Lowland Mixed Forest | 4,101 | 7% |
| Pines | 2,301 | 4% |
| Aspen Association | 728 | 1% |
| Northern Hardwood Association | 716 | 1% |
| Water | 649 | 1% |
| Emergent Wetland | 571 | 1% |
| Floating Aquatic | 528 | <1 % |
| Mixed Upland Conifers | 461 | <1 % |
| Upland Mixed Forest | 406 | <1 % |
| Other Upland Conifers | 399 | <1 % |
| Herbaceous Openland | 191 | <1 % |
| Mixed Upland Deciduous | 180 | <1 % |
| Oak Association | 52 | <1 % |
| Roads / Paved | 47 | <1 % |
| Sand / Soil | 19 | <1 % |
| Upland Shrub / Low-density trees | 8 | <1 % |

The land cover within the riparian area has remained relatively unchanged since the early 1800's. This is most likely due to the remoteness of certain areas and limitations based on soil and topography. An analysis conducted by the Michigan Natural Features Inventory (MNFI) compared land cover data from circa 2000 with that of the early 1800s and categorized the change that occurred on the landscape. Figure 6 illustrates the land cover change classes for the Two Hearted riparian area, categorized as *changed to urban*, *other change*, and *no change*. The few changes to a more urban (or developed) landscape cannot be seen at the watershed-wide scale; however, most are concentrated along the river corridor and include the County Road 407 corridor. See inset in Figure 6 for an example.



Created by L. Niemi, 05 December 2007
Upper Peninsula Office

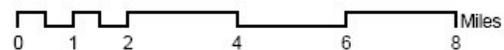
Land Use circa 2000

- | | |
|--|---|
|  Aspen Association |  Mixed Non-Forest Wetland |
|  Mixed Upland Deciduous |  Lowland Shrub |
|  Northern Hardwood Association |  Lowland Mixed Forest |
|  Mixed Upland Conifers |  Lowland Coniferous Forest |
|  Upland Mixed Forest |  Herbaceous Openland |
|  Other Upland Conifers |  Floating Aquatic |
|  Pines |  Emergent Wetland |
|  Oak Association |  Sand / Soil |
|  Upland Shrub / Low-density trees |  Roads / Paved |
|  Water | |



Protecting nature. Preserving life.™

-  Two Hearted River
-  Two Hearted River Watershed
-  Wetland Based Riparian Area



Source Data: MDNR, Forest, Mineral and Fire Management Division
Title: IFMAP/GAP Upper Peninsula Land Cover
Publication date: 20030401

Figure 5. Land Use circa 2000 in Riparian Area

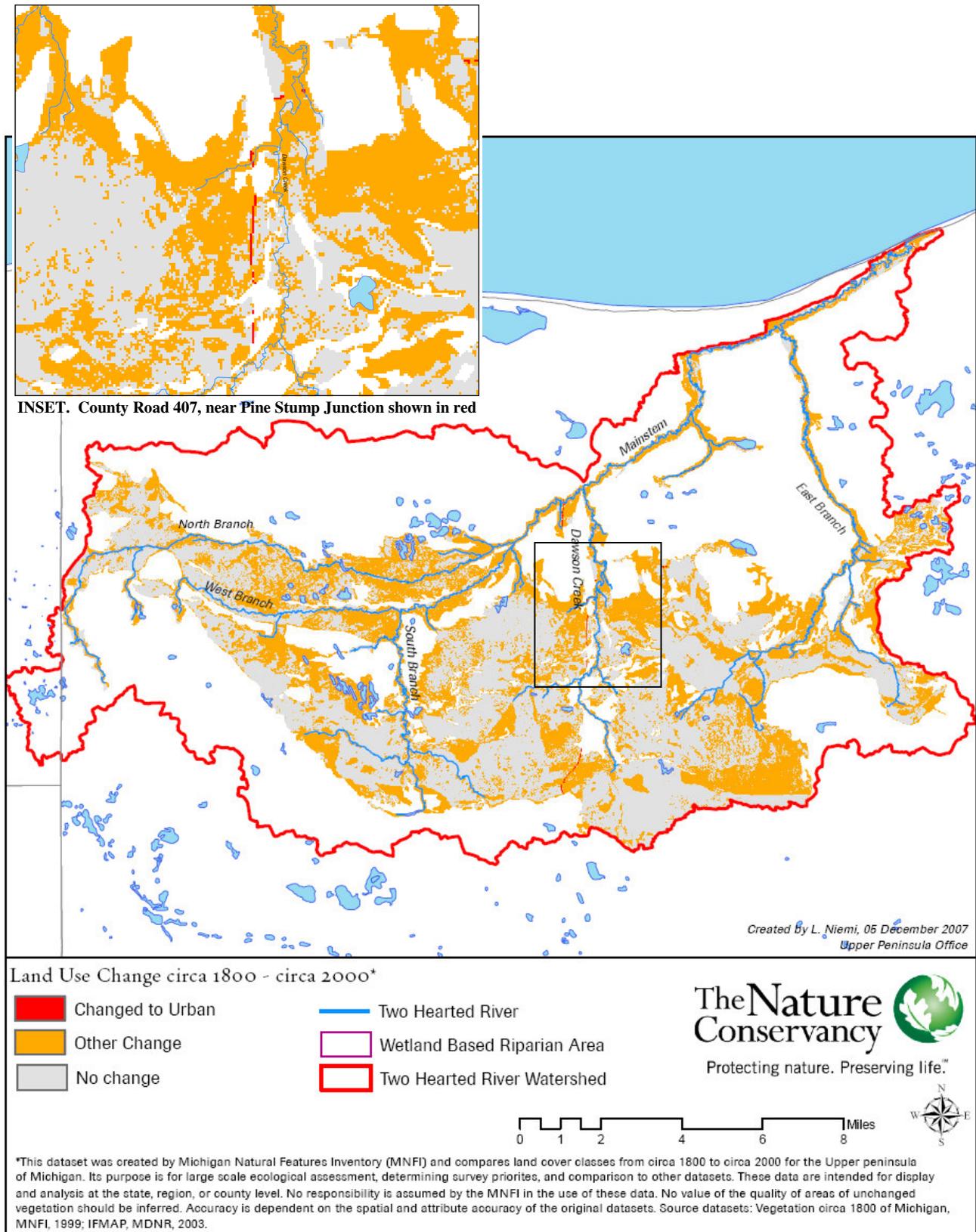


Figure 6. Land Use Change 1800 - circa 2000 in Riparian Area

Unique Natural Features

In addition to the general land cover types, there are a number of natural features found within the riparian area. According to the MNFI, these include six species listed as state threatened (protection status = T), two plant species of special concern (protection status = SC), and a host of natural communities that are either significant at a global or statewide scale (see Table 5).

Table 5. Natural Features found within Riparian Area

| Common Name | Scientific name | Protection Status | Global Rank* | State Rank* |
|---------------------------|-----------------------------------|-------------------|--------------|-------------|
| Bald Eagle | <i>Haliaeetus leucocephalus</i> | T | G4 | S4 |
| Common Loon | <i>Gavia immer</i> | T | G5 | S3S4 |
| Merlin | <i>Falco columbarius</i> | T | G5 | S1S2 |
| Yellow Rail | <i>Coturnicops noveboracensis</i> | T | G4 | S1S2 |
| Dry northern forest | | | G3? | S3 |
| Intermittent wetland | | | G2 | S3 |
| Patterned Fen | | | GU | S2 |
| Muskeg, Bog | | | G4 | S3 |
| Dry-mesic northern forest | | | G4 | S3 |
| Mesic northern forest | | | G4 | S3 |
| Rich conifer swamp | | | G4 | S3 |
| Hardwood-conifer swamp | | | G4 | S3 |
| Alga Pondweed | <i>Potamogeton confervoides</i> | SC | G4 | S3 |
| English Sundew | <i>Drosera anglica</i> | SC | G5 | S3 |
| Panicled Screw-stem | <i>Bartonia paniculata</i> | T | G5 | S2 |
| Wiegand's Sedge | <i>Carex wiegandii</i> | T | G3 | S2 |

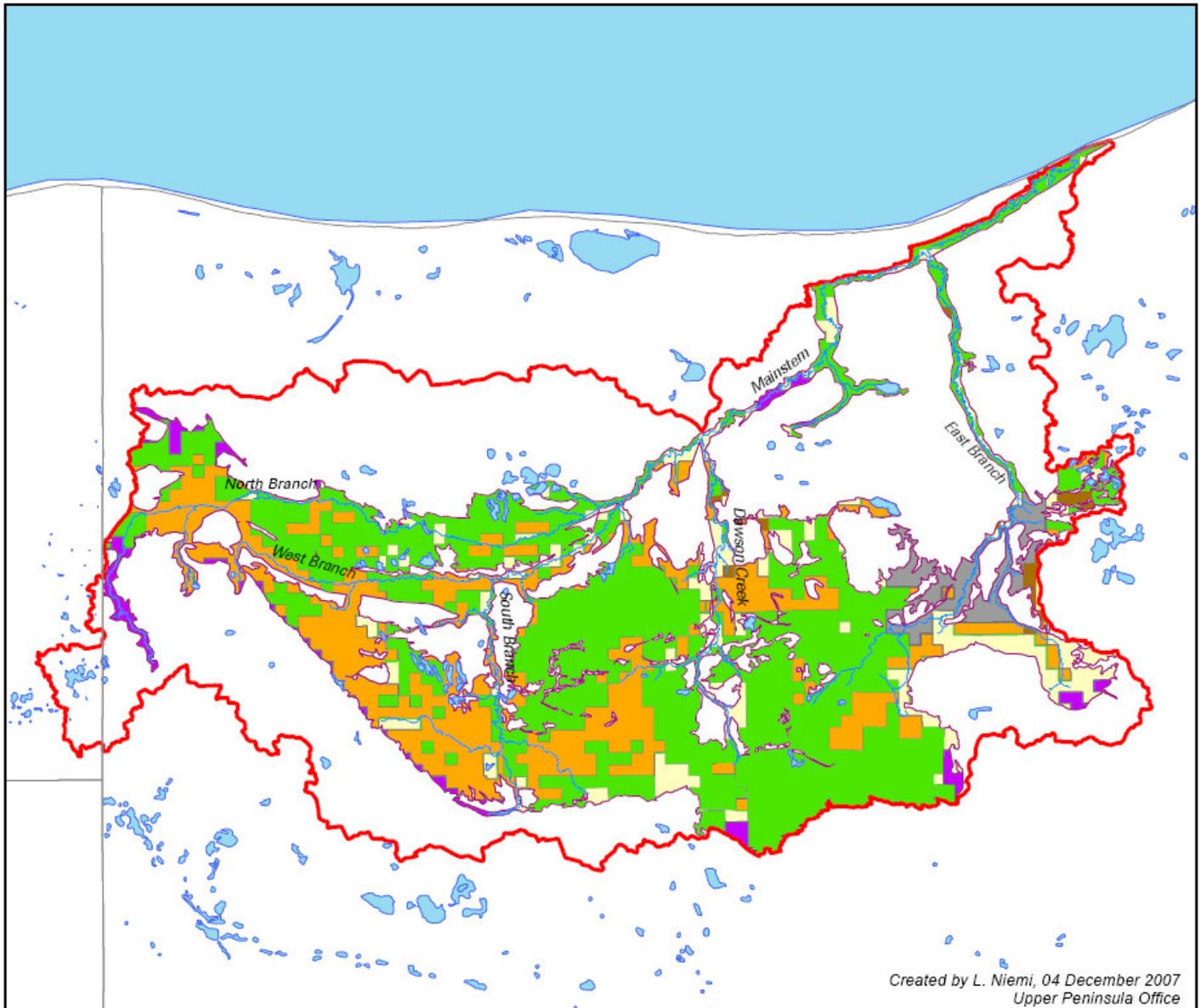
* see Appendix F for key to global and state ranks.

Land Ownership

The land ownership pattern within the riparian area reflects that of the overall watershed with a few exceptions. The State of Michigan and The Nature Conservancy together own approximately 82% of the riparian area, small private landowners own 11% of the riparian area, and the remainder is owned by private hunt clubs and forest product producers (see Table 6). There is less land owned by the forest product producers in the riparian area compared to the overall watershed land ownership statistics. These entities tend to concentrate ownership on the watershed's uplands for forest management; however their ownership is dominant in the headwaters of both the North Branch and East Branch (see Figure 7).

Table 6. Landowners within the Riparian Area

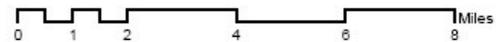
| Landowners | Acres | Percent of riparian area |
|---|--------|--------------------------|
| State of Michigan | 30,962 | 53% |
| The Nature Conservancy | 16,159 | 29% |
| Small Private landowners | 6,627 | 11% |
| Hunting Clubs | 2,169 | < 4% |
| Forest Product Producer (Working Forest Conservation Easement) | 1,496 | < 3% |
| Other Forest Product Producer | 491 | < 1% |



Created by L. Niemi, 04 December 2007
Upper Peninsula Office

Land Ownership in Riparian Area

- State of Michigan
- The Nature Conservancy
- Forest Product Producer
- Forest Product Producer*
- Hunt Clubs
- Small Private
- Two Hearted River
- Wetland Based Riparian Area
- Two Hearted River Watershed



Source data: Duoks Unlimited, Inc.
Title: Conservation and Recreation Lands
Publication Date: June 4, 2007

* under Working Forest Conservation Easement, part of Northern Great Lakes Forest Project

Figure 7. Land Ownership in Riparian Area

Soil Characteristics

Based on the most current Luce County soils data, the following characteristics were obtained: soil texture, hydric and non-hydric soils, suitability for structures (without basements), septic system ability, suitability for timber harvesting, and erosion potential.

The majority of the soils within the riparian area are considered to be hydric soils, or soils that were likely formed under saturated conditions and continue to be maintained under periods of flooding or saturation, hence the extensive wetlands in the landscape. The pockets of non-hydric soils are associated with the coarser textured soils, such as sand and silt loam found along portions of the mainstem and East Branch, and in areas of the South Branch and North Branch subwatersheds (see Figure 8).

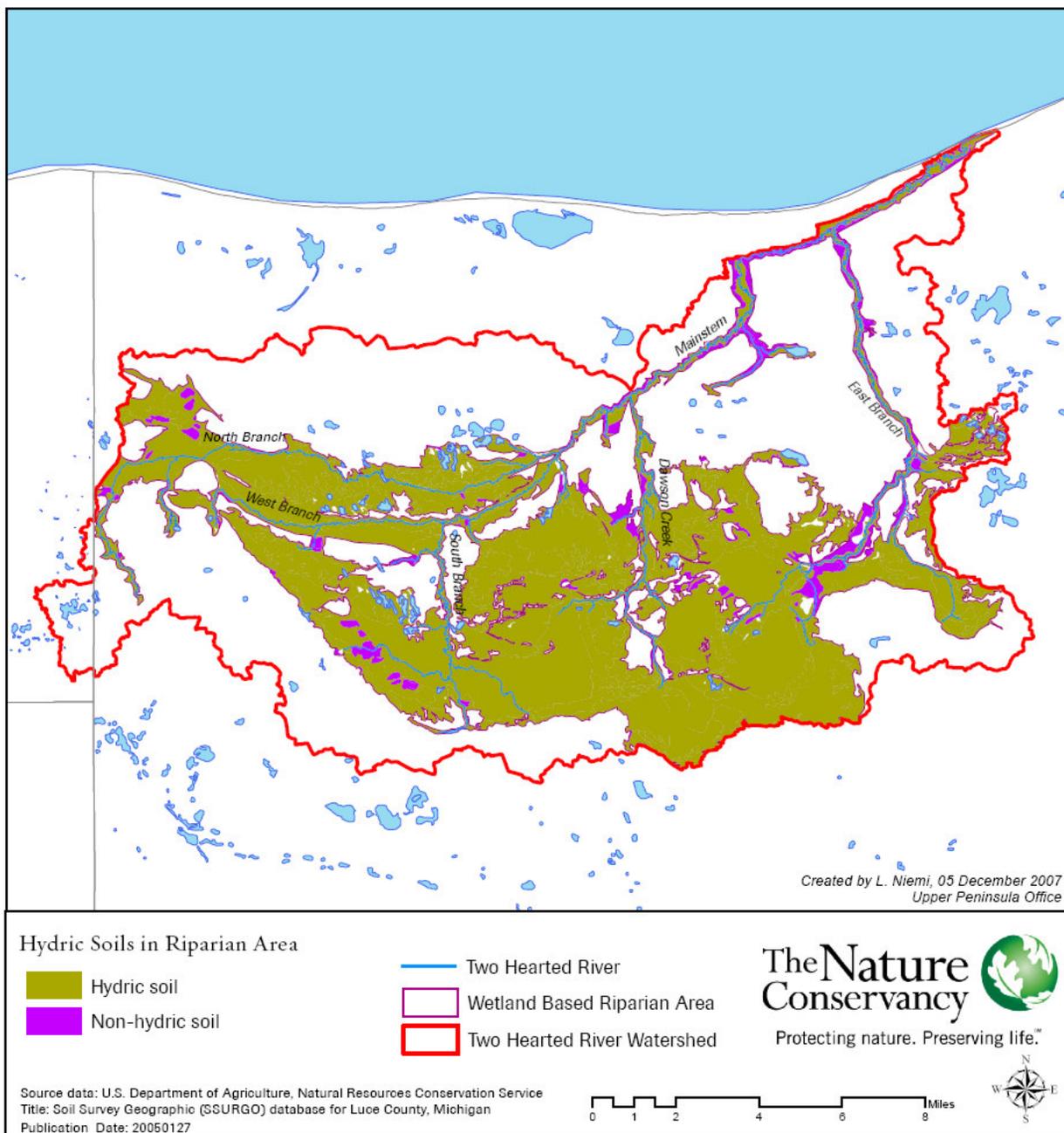


Figure 8. Hydric Soils in Riparian Area

In addition to the pockets of sand and silt loam soils, there are extensive areas within the riparian area of organic soils, such as peat and mucky peat (see Figure 9). These soil types support the unique patterned peatland found in the McMahon Lake area in the headwaters of Dawson Creek and East Branch of Two Hearted River, and the wetland communities between the North and West Branches. These soils are largely moist or saturated year round, except during extreme drought conditions, such as that experienced during the summer of 2007.

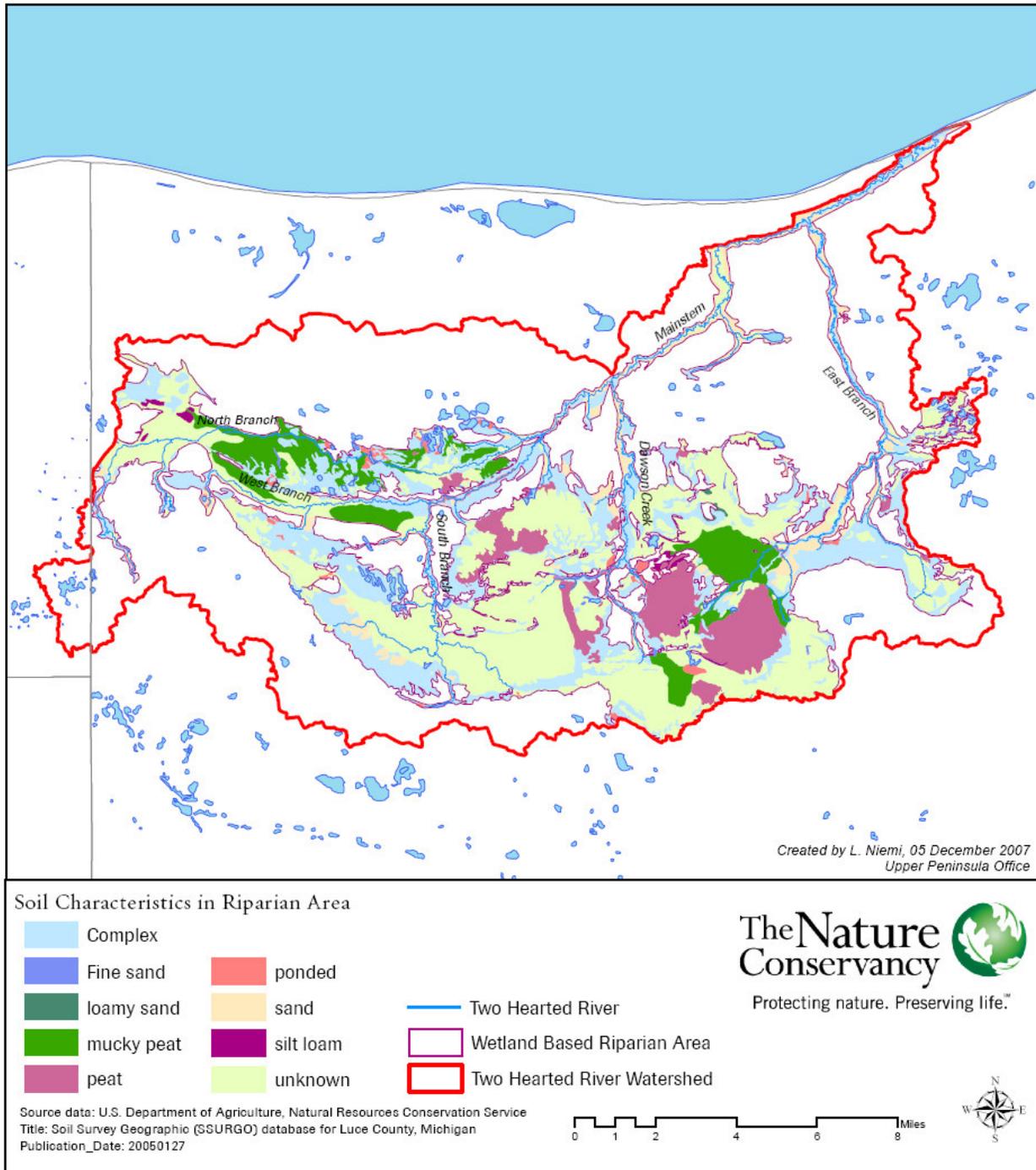


Figure 9. Soil Characteristics in Riparian Area

Soil erosion potential is based on the probability that damage will occur as a result of timber management activities such as site preparation and harvesting where the soil is exposed. This attribute is directly connected with slope and other attributes of the soil type. The ratings, *slight* – *severe*, indicate the degree at which erosion-control measures should be taken in silvicultural activities, with *severe* requiring the most precautions (USDA NRCS, 1997). In the Two Hearted River riparian area, the majority of the land is characterized as having a *slight* erosion potential rating with only 11% of the riparian area under a *moderate* or *severe* rating (see Table 7). The locations with a *severe* erosion potential rating mostly correspond with locations within the riparian area that have greater percent slopes such as in the headwaters of the North Branch and West Branch (see Figure 10).

Table 7. Soil Erosion Potential

| Erosion Potential Rating | Acres |
|--------------------------|-----------|
| slight | 50,175.82 |
| moderate | 4,317.61 |
| severe | 2,178.88 |
| Unknown or open water | 1,230.47 |

Table 8. Suitability for Timber Harvesting

| Suitability for Harvesting | Acres | Percent of riparian area |
|----------------------------|--------|--------------------------|
| Well suited | 2,909 | 5% |
| Moderately Suited | 10,609 | 18% |
| Poorly suited | 43,154 | 75% |
| Unknown or open water | 1,230 | 2% |

The degree to which the lands are suitable for timber harvesting reflects the characteristics and conditions of the soil that restrict the use of equipment generally utilized in timber management and harvesting. Based on this information, only 5% of the Two Hearted River riparian is considered *well suited* for timber management, whereas 75% is considered

poorly suited (see Table 8). However, this does not mean that the lands categorized as *poorly suited* for timber harvesting cannot be harvested; rather, specific precautions for harvest in these areas should be implemented, such as harvesting during frozen conditions or adequate snow cover. These *poorly suited* lands mostly correspond with the extensive wetlands, and those lands considered well suited for harvesting largely correspond with the pockets of uplands in the riparian area (see Figure 11).

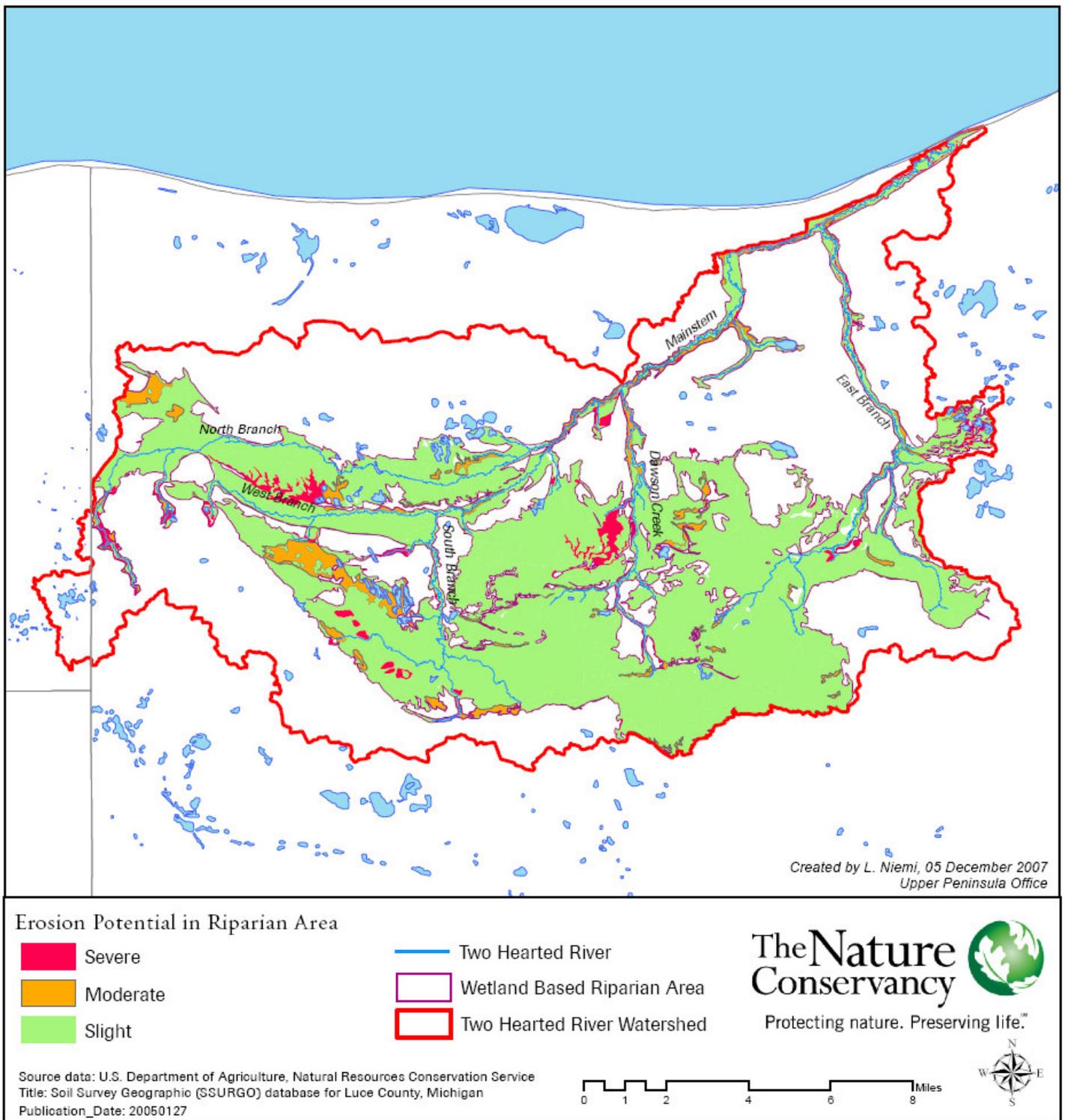


Figure 10. Erosion Potential in Riparian Area

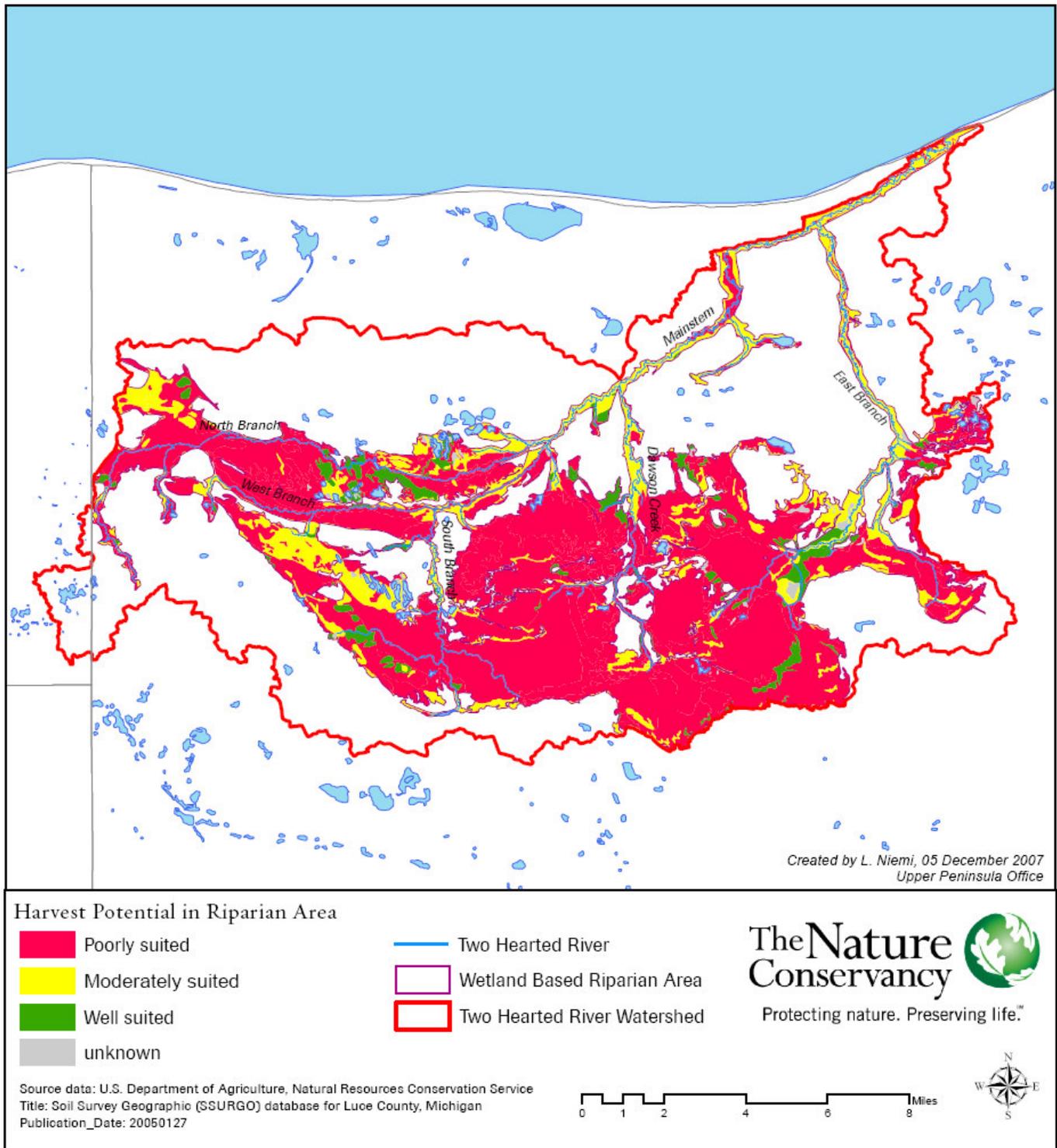


Figure 11. Suitability for Timber Harvesting

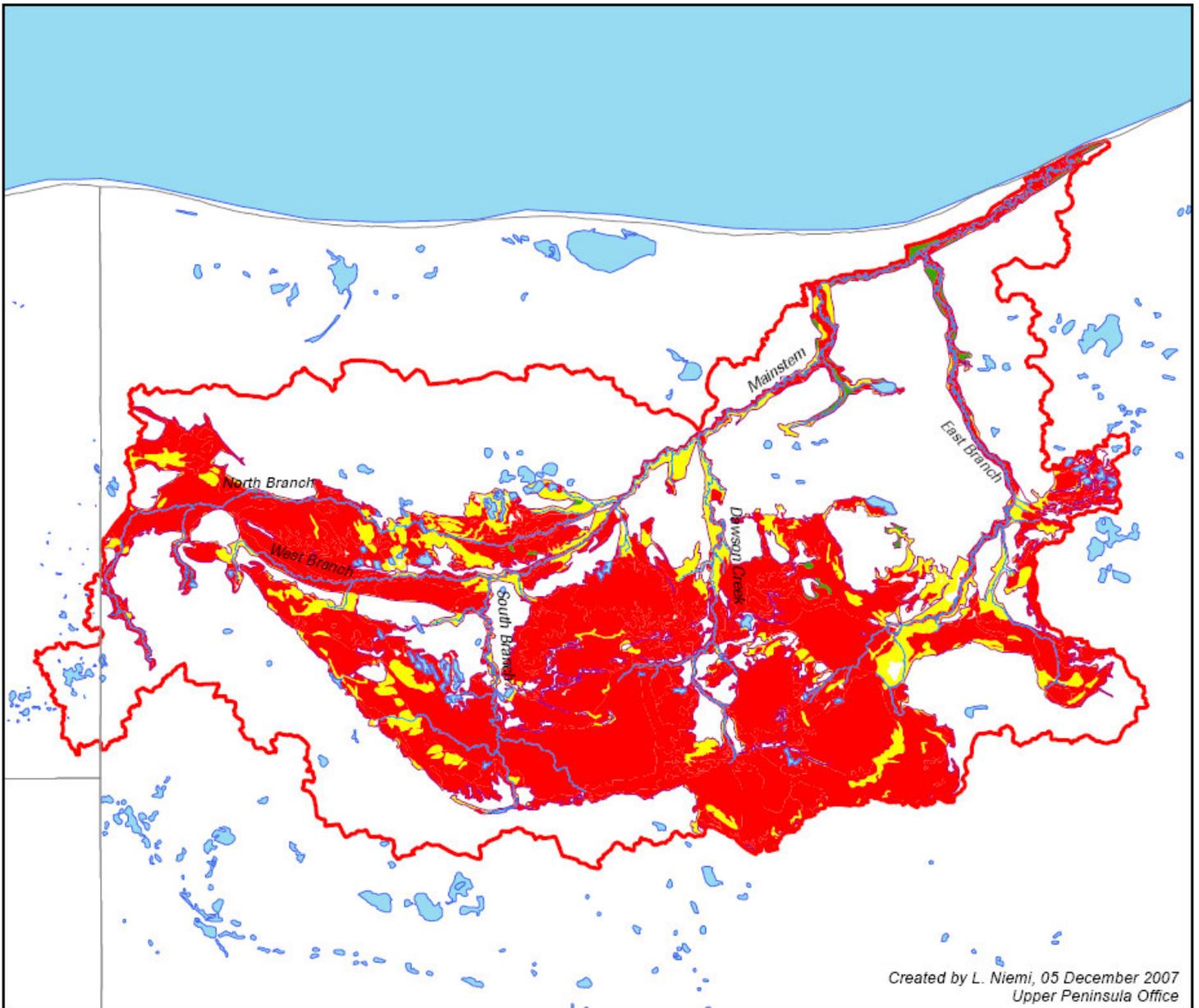
Soil characteristics also play a role in determining the suitability of a site for building construction and sanitary facilities. Within the Two Hearted River riparian area, the majority of the land is not considered to be well suited for building construction (without basement) (83%) or for a septic system (98%) (see Tables 9 and 10). This means that overcoming the limitations, due to soil properties or features at the site, would most likely be too cost prohibitive, both due to initial and potential ongoing maintenance costs. Those areas that are *somewhat limited* for building construction indicate that although the site conditions are unfavorable, these limitations may be overcome through special planning, design and maintenance. Lands in this category are located north of the West Branch and North Branch, in the headwaters of the South Branch and East Branch, and along Dawson Creek, the mainstem, and Wabash Creek. Less than 1% of the land is considered to have no limitations for buildings and occur in small pockets along Wabash Creek, the mainstem, and the East Branch (see Figure 12). The entire riparian area should be considered to be unsuitable for septic systems (see Figure 13).

Table 9. Suitability for Buildings (*without basement)

| Suitability for Buildings* | Acres | Percent of riparian area |
|----------------------------|--------|--------------------------|
| Very Limited | 48,308 | 83% |
| Somewhat Limited | 7,873 | 14% |
| Not Limited | 480 | <1% |
| Not rated | 11 | <1% |
| Unknown or open water | 1,230 | 2% |

Table 10. Septic Suitability

| Septic System Suitability | Acres | Percent of riparian area |
|---------------------------|--------|--------------------------|
| Very Limited | 56,661 | 98% |
| Not Rated | 11 | <1% |
| Unknown | 1,230 | 2% |



Created by L. Niemi, 05 December 2007
Upper Peninsula Office

Suitability for Buildings (w/out basements)

- | | |
|--|---|
|  Very limited |  Two Hearted River |
|  Somewhat limited |  Wetland Based Riparian Area |
|  Not limited |  Two Hearted River Watershed |
|  Not rated | |



Protecting nature. Preserving life.™

Source data: U.S. Department of Agriculture, Natural Resources Conservation Service
Title: Soil Survey Geographic (SSURGO) database for Luce County, Michigan
Publication_Date: 20050127

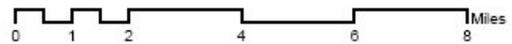


Figure 12. Suitability for Building (without basement)

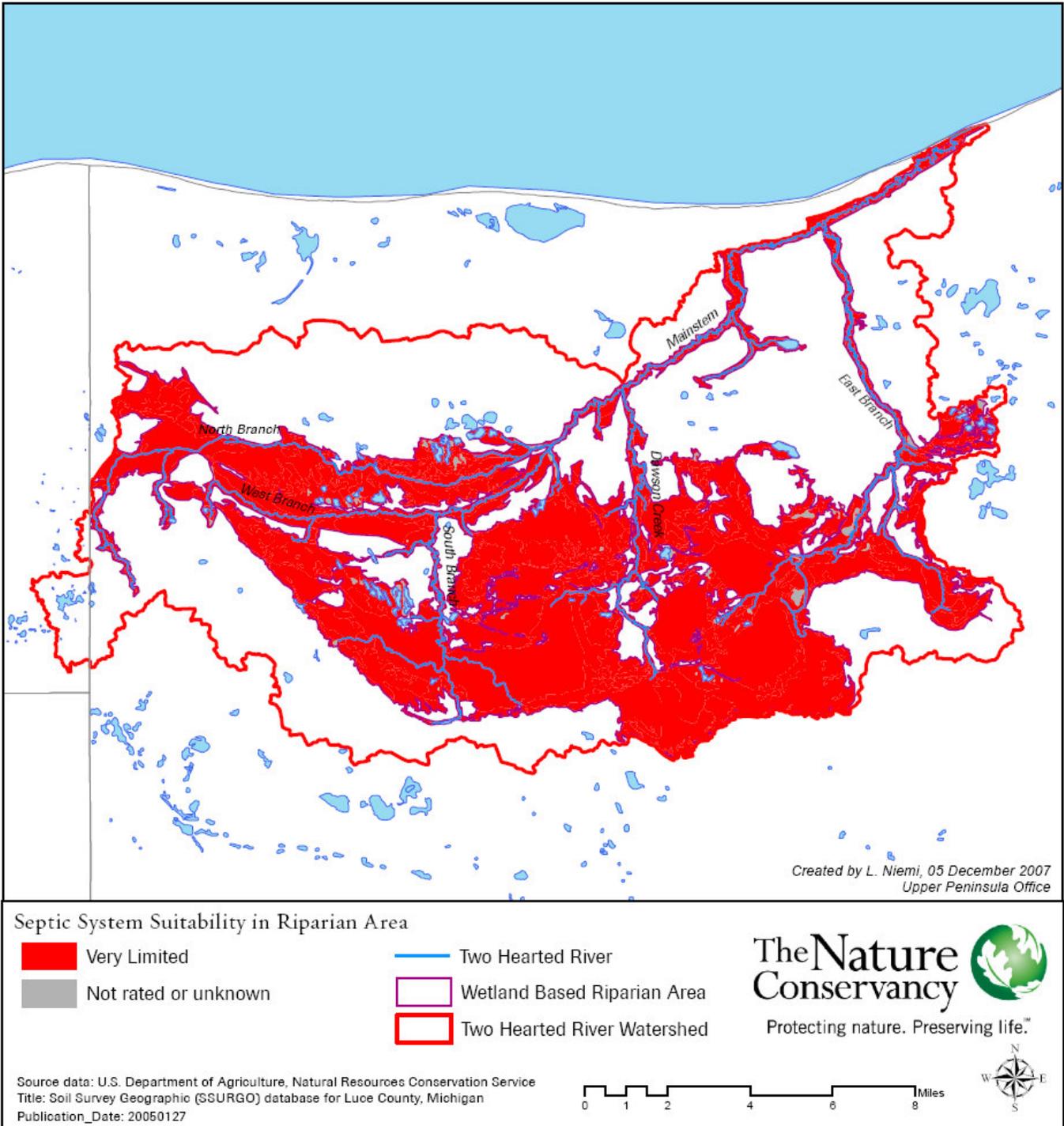


Figure 13. Suitability for Septic System

Comparison with Existing Regulations

The riparian areas identified in this analysis were compared with existing and proposed regulations pertaining to the Two Hearted River watershed. These include the voluntary riparian buffer widths recommended by MDEQ and MDNR, setbacks developed by the Natural Rivers program, and the proposed Luce County zoning ordinances. In some locations, the riparian area closely mimics the voluntary buffer recommendations and the Natural River District (see Figure 14); whereas in other locations, it is significantly more expansive than the existing regulations due to its inclusion of the adjacent wetland systems (see Figure 15). If buffers were created along the Two Hearted River utilizing the voluntary buffer widths laid out in the BMP manual (see Table 1), only 3,900 acres would be within this corridor. This represents approximately 7% of the area encompassed in the riparian area identified through this analysis.

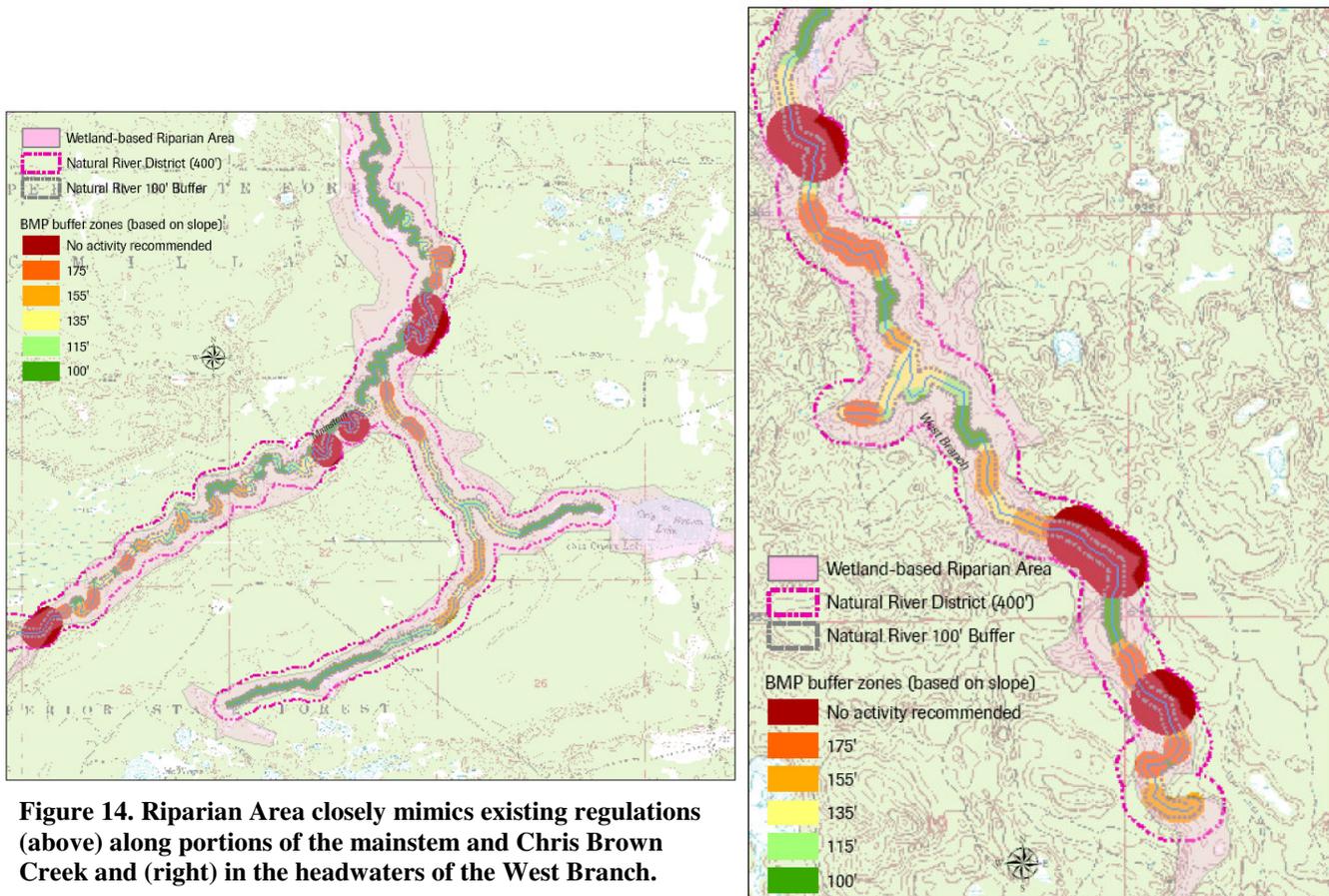


Figure 14. Riparian Area closely mimics existing regulations (above) along portions of the mainstem and Chris Brown Creek and (right) in the headwaters of the West Branch.

The narrowest portions of the riparian area are at least 300 feet wide, more than 100 feet greater than the minimum recommended buffer width in the BMPs. These occur in portions of the headwaters of the North Branch, the mainstem (just downstream from the confluence of the North and West Branches), and in the East Branch.

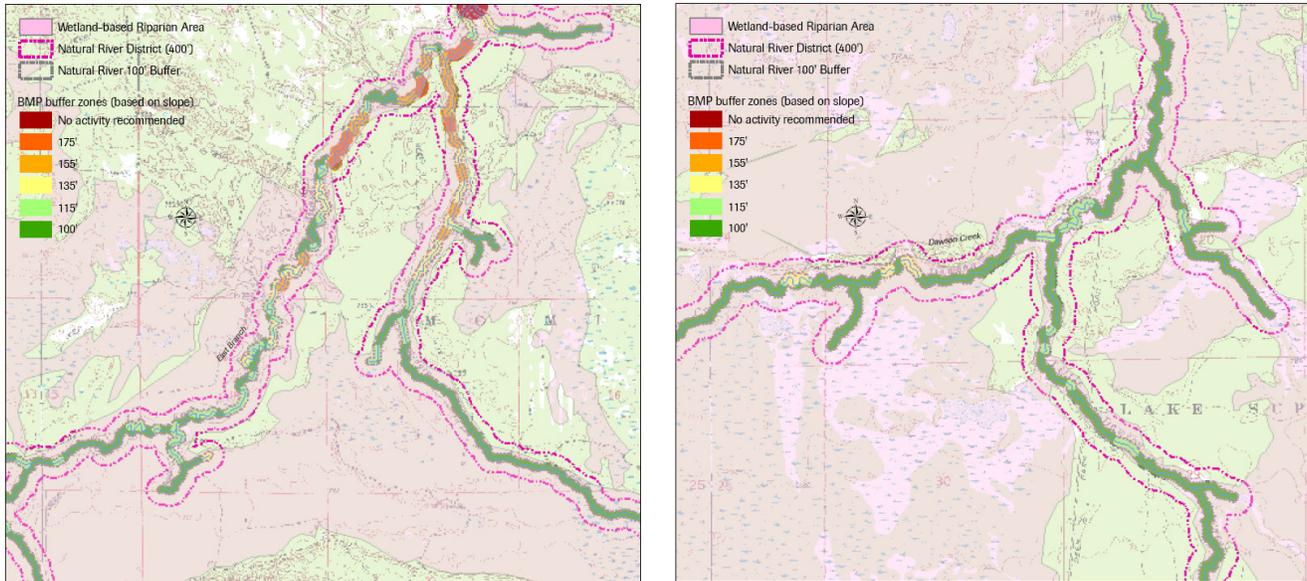


Figure 15. Riparian area extends well beyond the existing regulations on the Two Hearted River in locations dominated by wetlands, such as in the headwaters of the East Branch (left) and headwaters of Dawson Creek (right).

The riparian area strongly mimics the Environmentally Sensitive Areas (ESAs) identified in the Draft Luce County Zoning Ordinance of February 2006 (see Figure 16). In the draft ordinances, ESAs are identified as:

- sand dunes with slopes greater than 18 percent as measured on 2 foot contours,
- beach contiguous to a lake or stream,
- wetlands,
- area which is not accepted by the District Health Department for on-site sewage disposal unless an alternate system of sewage disposal is approved by the District Health Department,
- that part of a floodplain where flood waters are expected to have a destructive current,
- waterfront setback areas, and
- soil mapping units identified in the Luce County Soil Survey as having slopes 35% or greater (Specifically this includes soil mapping units 17F, 18F, 19F, 31F, 46F, 66F, 75F, 90F, 179F and 186F.)

Both methodologies include similar parameters such as wetlands, areas contiguous to streams, and certain soil parameters. One main difference is that the ESAs cover all lands in the County, not just those that are adjacent to the rivers and streams; therefore, there are areas within the Two Hearted River watershed that have been identified as an ESA but are not included in the riparian area identified in this analysis (see Inset in Figure 16). The ESA and its associated setbacks encompass approximately 62,500 acres, whereas the riparian area encompasses 58,000 acres.

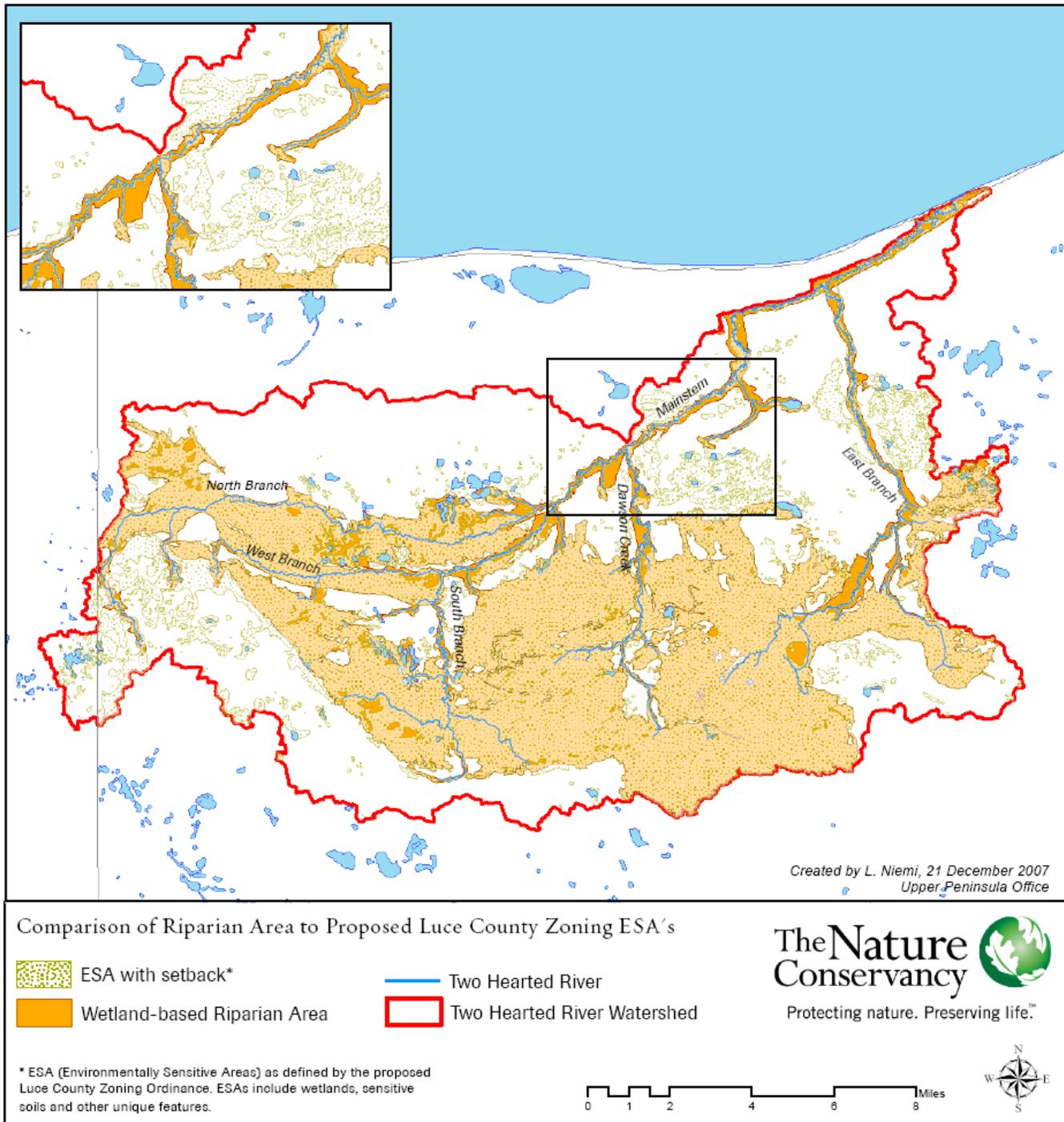


Figure 16. Comparison of Riparian Area with Luce County Proposed Zoning Ordinance's Environmentally Sensitive Areas. Inset provides one example of where the Riparian Area and ESAs differ in the watershed.

IV. Sensitive Areas

The main land use activity within the Two Hearted River watershed is forest management conducted by the State of Michigan, large forest product producers such as The Forestland Group, LLC and Plum Creek Timber, The Nature Conservancy, private hunt clubs, and other small private landowners. While a large portion of the watershed is undeveloped, there is further potential for residential development, especially along the rivers, tributaries, and lakes. Therefore, the goal of this analysis was to identify the riparian areas sensitive to development and/or forest management activities.

In this analysis, sensitive areas are defined as locations within the riparian area that, given their multiple attributes, create a unique area that if disturbed may affect the water quality of the Two Hearted River or its riparian area. A GIS analysis was conducted to identify these potentially sensitive areas, and was followed by limited field visits to monitor the accuracy of the data input. Characteristics such as physical distance from river, slope, soil erosion potential, presence of unique natural features, presence of wetlands, and other soil attributes related to building/ development conditions were utilized to identify these sensitive areas. Each portion of the riparian area was assigned a score for each of these characteristics (see Appendix D), and then the sum of all of these scores provided its overall rank. The ranking information may be analyzed in two ways, by breaking it out into categories (e.g. High, Medium, and Low) or by looking at the numerical ranks as a gradient of sensitivity to these activities. For illustration purposes, the entire riparian area was separated into five categories (using the equal interval classification) related to its sensitivity to development and to forest management activities. These categories (from *High* to *Low*) illustrate the varying degrees of sensitivity of the specific area. See Appendix D for technical information related to the GIS analysis.

Field monitoring was conducted to verify the accuracy of the input data for the GIS analysis, to gauge the general characteristics and condition of the riparian area within the Two Hearted River watershed, and to provide field verification of those sites identified as sensitive to develop and/or forestry through the analysis. In total, 30 sites were visited during the field seasons of 2006 and 2007. Overall, the input data for the GIS analysis was fairly representative of the on-the-ground characteristics. General topography was compared with the County Digital Elevation Models and land cover was compared with the IFMAP data. The vegetation composition identified through the field visits reflected the general land cover of the



Figure 17. Wetland complex at site #15 in Riparian Area.



Figure 18. Steep slope with large hemlock, white pine and sugar maple, at site #14.

riparian area with the majority of the sites being characterized as forested wetlands or lowland coniferous forests. There were sites characterized as scrub-shrub wetlands, patterned fens, White pine-red maple/blueberry-wild sarsaparilla habitat type, White pine-red maple/blueberry habitat type, and Sugar maple-Hemlock-American beech/Spinulose shield fern habitat type (see Figures 17 and 18). See Appendix E for the methodology utilized in the field data collection.

Sensitivity to Development

The riparian area was analyzed for its sensitivity to development utilizing the following parameters: nearness to river or stream, presence of wetlands, percent slope, ownership, soil suitability for septic, soil suitability for building construction

(without basement), soil erosion potential, and presence of unique natural features. Based on the classification utilized, equal interval, the majority of the riparian area within the watershed is considered to have a *moderate to low – moderate* sensitivity to development (see Table 11).

Table 11. Percent of Riparian Area by sensitivity categories

| Rank Category | Sum Rank | Acres | Percent |
|-----------------|----------|--------|---------|
| Low | 1 to 5 | 902 | 2% |
| Low - Moderate | 6 to 9 | 20,408 | 35% |
| Moderate | 10 to 14 | 32,532 | 56% |
| Moderate - High | 15 to 18 | 4,012 | 7% |
| High | 19 to 22 | 60 | <1 % |

The areas with the highest sensitivity to development include the Swamp Lakes area, due to the presence of a unique natural community, and other specific locations along the West Branch, Mainstem and Dawson Creek (see Figure 19). These latter areas all have a percent slope exceeding 30%; are under private ownership; have an erosion potential of *moderate to severe*; and most are within 100 feet of the river. The areas ranked *moderate- high*, which make up about 7% of the riparian area, are all located on soils considered *very limited* for septic suitability; most are located on soils with an erosion potential of *moderate – severe*; and the majority have a percent slope greater than 20%. There was not a strong correlation of this category to the property ownership or its nearness to the river. Approximately 2% of the riparian area ranked *low* in its sensitivity to development. In general, most of these locations were located at least 500 meters from the river or stream; are under public or a form of conservation ownership (ie. The Nature Conservancy); do not have limitations based on the soils (e.g. *slight* erosion potential and *not limited* for septic suitability); and have a percent slope of less than 10%. Some of these locations do overlap with unique natural features in the watershed and others are coincidental with lakes, such as the Two Hearted Lakes complex.

The sensitivity to development in the riparian area by subwatershed has a similar pattern to the watershed-wide perspective (see Table 12). Most of the riparian areas have a similar percentage of areas ranked *low* and *high*. The riparian area within the North and South Branches have a higher percentage of area within the *low-moderate* ranking, while the riparian area within the West and East Branches, the mainstem, and Dawson Creek all have a greater percentage of land with a *moderate* ranking. The riparian area within the mainstem, Dawson Creek, and the South Branch subwatersheds has a higher percentage ranked *moderate-high*. In the mainstem, this is likely due to the topography and erosion potential of the sandy soils, while in the South Branch and Dawson Creek subwatersheds, this is likely reflecting the extensive hydric soils limited for septic and construction suitability.

Table 12. Sensitivity to Development ranking by subwatersheds.

| Subwatershed | Percent within Ranking Categories per subwatershed | | | | |
|----------------|--|----------------|----------|-----------------|------|
| | Low | Low - Moderate | Moderate | Moderate - High | High |
| North Branch | 3% | 46% | 49% | 1% | 0% |
| West Branch | <1% | 35% | 61% | 3% | <1% |
| South Branch | 2% | 52% | 34% | 11% | 0% |
| Dawson Creek | <1% | 27% | 58% | 14% | <1% |
| East Branch | 0% | 26% | 68% | 5% | <1% |
| Mainstem | 2% | 20% | 61% | 18% | <1% |
| Watershed wide | 2% | 35% | 56% | 7% | <1% |

The field monitoring reflected the GIS analysis. The majority of the sites visited, 21 out of 30, represented the attributes of an area that would be sensitive to development.

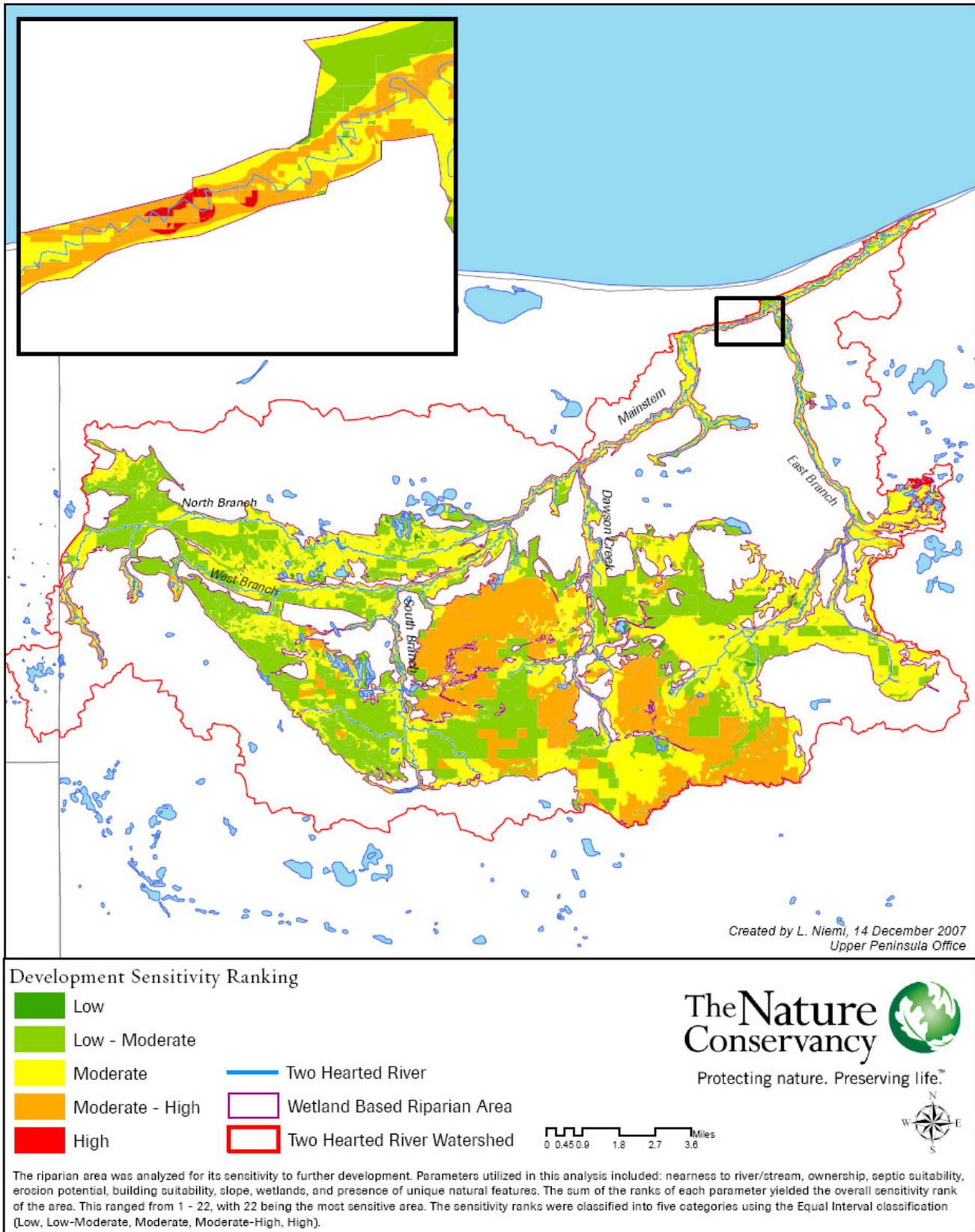


Figure 19. Development Sensitivity Ranking categories across the Two Hearted River watershed riparian area with an illustration of a location with *High* rating along the mainstem (inset).

Sensitivity to Forest Management

Through a similar process, the riparian area was analyzed for its sensitivity to forest management activities. The following parameters were utilized: nearness to river or stream, presence of wetlands, percent slope, soil erosion potential, and presence of unique natural features. The parameters based on the soil data include considerations such as seasonal limitations for equipment use. Based on the classification utilized, equal interval, the majority of the riparian area within the watershed is considered to have a *moderate* to *low – moderate* sensitivity to forest management (see Table 13). In comparison with the sensitivity to development, there is a greater percentage of land considered to have a *low* and *moderate – high* sensitivity to forest management.

Table 13. Percent of Riparian Area in 5 forestry sensitivity categories

| Rank | Sum Rank | Acres | Percent |
|-----------------|----------|--------|---------|
| Low | 1 to 4 | 11,102 | 19% |
| Low - Moderate | 5 to 7 | 20,524 | 35% |
| Moderate | 8 to 11 | 16,336 | 28% |
| Moderate - High | 12 to 14 | 9,883 | 17% |
| High | 15 to 17 | 57 | <1% |

The area with the highest sensitivity to forest management is the Swamp Lakes area, due to the presence of a globally rare natural community (see Figures 20 and 21). It represents less than one percent of the riparian area land base. As with potential development, this area is very sensitive to forest management and would be greatly impacted by such activity. Approximately 17% of the riparian area is considered to have a *moderate – high* sensitivity to forest management activities. About one-third of these areas include one or more unique natural features; the majority have a percent slope greater than 30% with an erosion potential rating of *severe*; and some are located within 100 feet of the river, while others are more than 500 meters from the river or stream. These lands are found within forested wetlands, but also on the uplands. Lands considered to have a *low* sensitivity to forest management (19% of the riparian area) are located mostly in the uplands; the majority have a slight slope of 0 to 10% with *slight* erosion potential rating; and the majority are located more than 100 feet from the river or stream. Some of these areas do support unique natural features and others have a *severe* erosion potential rating; however, these latter areas are located more than 500 meters from the river.

The sensitivity to forest management in the riparian area by subwatershed illustrates some similarities and deviations from the watershed-wide pattern (see Table 14). The only subwatershed with areas considered to be *high* sensitivity is the East Branch, where Swamp Lakes is located. The mainstem and the North Branch subwatersheds have less than 1% of their land base within the *moderate – high* category, greatly below the watershed-wide average of 17%. This deviation is most likely due to minimal amount of wetlands and hydric soils in the riparian areas of these two subwatersheds. Overall, the riparian areas within the North and West Branches are less sensitive to forest



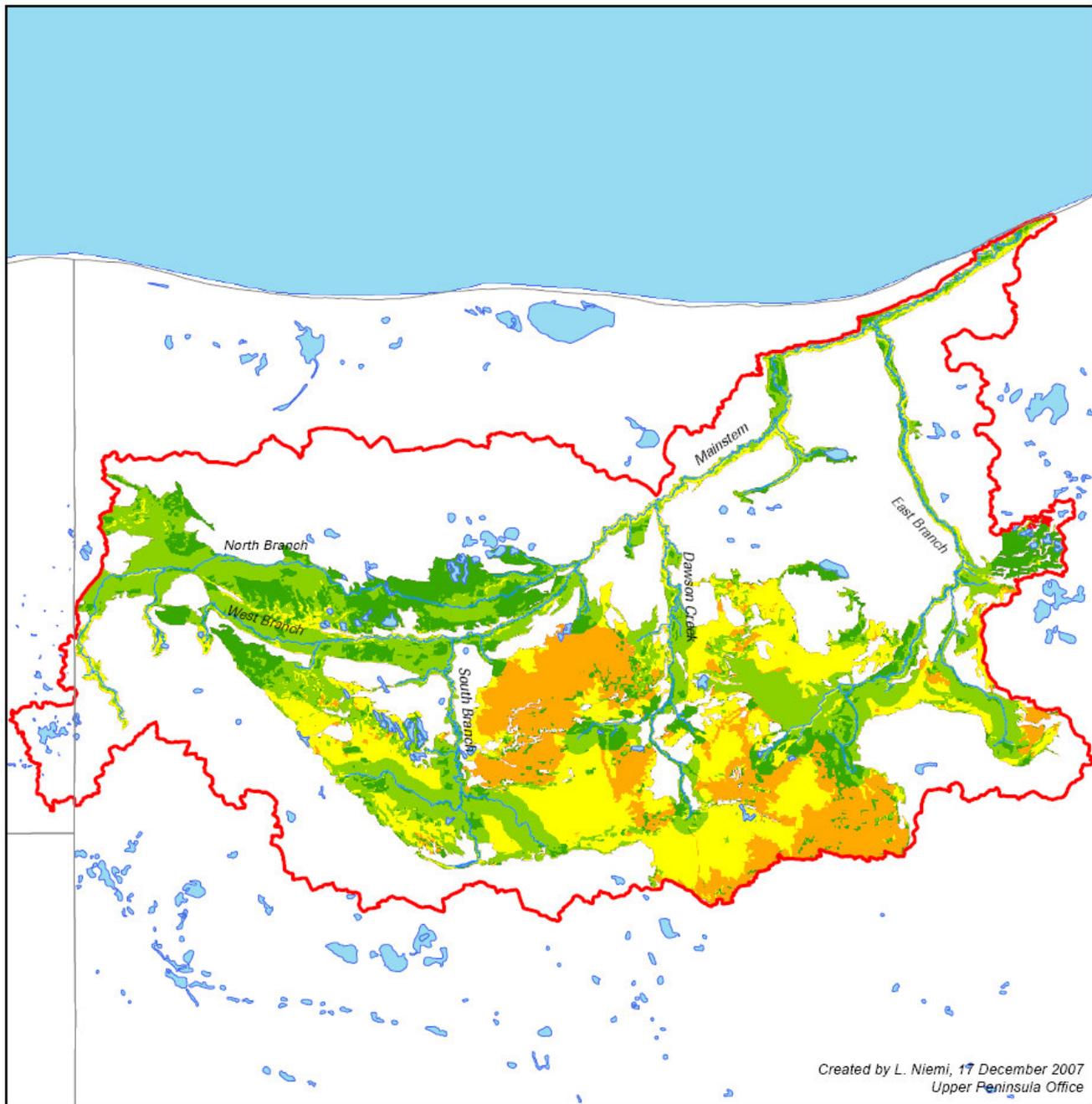
Figure 20. Swamp Lakes area, site #24.

management than the other subwatersheds. They both have a less percentage of land within the *moderate* sensitivity rating with higher percentages of land rated *low – moderate* and *low*.

Table 14. Ranking of Sensitivity to Forestry by subwatersheds.

| Subwatershed | Percent within Ranking Categories per Subwatershed | | | | |
|----------------|--|----------------|----------|-----------------|------|
| | Low | Low - Moderate | Moderate | Moderate - High | High |
| North Branch | 43% | 49% | 7% | <1% | 0% |
| West Branch | 23% | 40% | 10% | 27% | 0% |
| South Branch | 10% | 39% | 41% | 10% | 0% |
| Dawson Creek | 13% | 23% | 37% | 28% | 0% |
| East Branch | 15% | 30% | 33% | 22% | <1% |
| Mainstem | 17% | 48% | 35% | <1% | 0% |
| Watershed-wide | 19% | 35% | 28% | 17% | <1% |

The field monitoring reflected the GIS analysis conducted for areas sensitive to forest management activities. The majority of the sites visited, 24 out of 30, represented the attributes of an area that would be sensitive to forest management either due to the slope or soil characteristics. From the field work, it became clear that there is a great deal more wetlands on the landscape than what is represented in the GIS data. Most of these are less than one acre in size but still contribute to overall water quality and hydrologic connectivity within the riparian area. This stresses the need for on-the-ground field reconnaissance to identify these in order to ensure that they are protected if and when timber harvesting occurs.



Created by L. Niemi, 17 December 2007
Upper Peninsula Office

Forestry Sensitivity Ranking

- Low
- Low - Moderate
- Moderate
- Moderate - High
- High

- Two Hearted River
- Wetland Based Riparian Area
- Two Hearted River Watershed



Protecting nature. Preserving life.™



The riparian area was analyzed for its sensitivity to forest management activity. Parameters utilized in this analysis included: nearness to river/stream, erosion potential, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 17, with 17 being the most sensitive area. The sensitivity ranks were classified into five categories using the Equal Interval classification (Low, Low-Moderate, Moderate, Moderate-High, High).

Figure 21. Forest Management Sensitivity Ranking categories across the Two Hearted River watershed riparian area.

V. Management Recommendations

In assessing the areas identified through this analysis, there are a few items that need to be addressed. First, some of the GIS data utilized is at a coarse scale and may not accurately represent the on-the-ground characteristics at the exact locations. The purpose of the analysis is to provide a tool in landscape level planning, not necessarily in planning at the site specific scale. Therefore, a field reconnaissance is necessary to make decisions and recommendations at a particular site. Second, in the GIS analysis, the areas within 100 feet of the river or stream were not automatically rated as having a *High* sensitivity, even though this corridor is regulated under Michigan's Natural Rivers Program and is a mandatory vegetative buffer. Activities regarding timber harvesting and development are greatly restricted in this 100 foot buffer through the Natural Rivers Program, and these regulations should be adhered to in all instances.

Development

There are a few locations in the riparian area where the sensitivity to development ranked *High*. In these locations, further development should not be allowed unless a field reconnaissance illustrates a less vulnerable landscape from what the GIS analysis portrayed. The Swamp Lakes area is ranked *high* due to the presence of a globally rare natural community; therefore special precautions should be taken if and when further development is considered near this complex. The other sites that ranked *High*, were found to have severe slopes, high potential for erosion, and are located near the river; therefore, development is not suitable on or near these sites.

The areas ranked *moderate- high* are all located on soils considered *very limited* for septic suitability, and most are located on soils with an erosion potential of *moderate – severe*. In general, it is recommended that these areas remain undeveloped. Similarly to above, these areas should be assessed at a site specific level to determine the potential impact of development.

Overall, further development in the Two Hearted River riparian area should be limited to ensure the protection of the river's water quality and unique habitat. The majority of the riparian area is considered unsuitable for building (see Figure 12) and also is considered to be *very limited* for septic suitability (see Figure 13). In general, further development should be guided and concentrated in those areas of uplands following the existing regulations and the proposed Luce County Zoning Ordinances. In addition, further measures should be utilized to ensure long-term protection of the aquatic system, including the utilization of conservation easements. In those areas adjacent to the river, stream, and/or a unique natural community owned by private entities, the purchase or donation of conservation easements should be considered. For more information on conservation easements, see Appendix G. The terms of the conservation easement should be tailored to ensure the protection of the water resources at the site level, and they should be held by a qualified organization or agency dedicated to the long-term monitoring of these easements.

Forest Management

Similar to sensitivity to development, only a small percentage of the Two Hearted River riparian area is considered to have a *High* sensitivity to forest management. The Swamp Lakes complex is the only area that falls within this category, due to the presence of a globally rare natural community. Forest management within or near these complexes should be extremely limited, and conservation easements should be utilized to protect these resources for the long-term.

About 17% of the riparian area is considered to be in the *moderate – high* rating of sensitivity to forest management. The majority of these lands are considered to have a severe slope (>30%) with an erosion potential of *severe*. In general, forest management should be limited in these areas to enhance slope stability and prevent erosion. Further analysis of other factors that drove these areas into this category must be considered to develop additional recommendations. For example, about one-third of these areas include one or more unique natural features. Additional information on those natural features and the potential impacts of forest management should be considered prior to harvesting. In other areas, such as those located on hydric soils, forest management should be limited to the winter season with frozen conditions. This would minimize impacts to the soil and water resources of the riparian area.

Overall, the majority of the Two Hearted River riparian area is considered to be poorly suited for timber harvesting due to equipment limitations based on the soil characteristics (see Figure 11). This does not imply that all forest management should be restricted, rather that seasonal and/or conditional limitations for this activity are recommended. In general, forest management should be guided by existing regulations, the proposed Luce County Zoning Ordinances, and additional measures to ensure protection of the aquatic resources and unique habitat. Additional measures include conservation easements that recognize and limit forest management in areas that would negatively impact the aquatic resources and/or unique natural features, and better defined riparian management zones. The latter should be identified based on slope and soil characteristics and should exceed 100 feet from the waterbody. Activities that cause soil compaction should not be allowed within these areas, and native long-lived, larger trees should be promoted. The hydrology of the Two Hearted River watershed is complex due to the wetland-peatland complexes, and the groundwater flow is not well documented. To learn more about this function and the hydrology of the watershed, it is also recommended that demonstration areas are created to illustrate sustainable forestry practices in relation to the enhancement of water quality.

VI. References

- Bullock, M. James (2006). Plants. In William J. Sutherland (Eds.), *Ecological Census Techniques, A Handbook, Second Edition*. (pp. 186-213). Cambridge University Press.
- Burger, Timothy L. & John Kotar. (2003). *A guide to Forest communities and Habitat Types of Michigan*. Madison, WI: University of Wisconsin Madison Department of Forest Ecology and Management.
- Flaspohler, David J. et al. (2002). Temporal patterns in aquatic and avian communities following selective logging in the Upper Great Lakes Region. *Forest Science* 48 (2). pp. 339- 349.
- Goebel, P. Charles, Brian J. Palik & Kurt S. Pregitzer. (2003). Plant diversity contributions of riparian areas in watersheds of the northern Lake States, USA. *Ecological Applications*, 13(6). pp 1595-1609.
- Gove Associates, Inc. (2002). Comprehensive Plan, Luce County Michigan.
- Ilhardt, Bonnie L., Elon S. Verry, and Brian J. Palik. (2000) Defining Riparian Areas. In the *Forestry in the Riparian Zone* Conference Proceedings. (pp. 7 – 14). October 26, 2000.
- Luce County Zoning Ordinance, draft. (2006). pp. 1 – 134.
- Michigan Natural Features Inventory.
http://web4.msue.msu.edu/mnfi/data/MNFI_Natural_Communities.pdf, page 2 of 36. accessed September 28, 2007.
- Michigan Department of Natural Resources. 2002. *Two Hearted River Natural Rivers Plan*. pp. 1 – 37.
- Michigan Department of Natural Resources and Michigan Department of Environmental Quality. (1994). *Water Quality Management Practices on Forest Land*. pp. 1 – 51.
- Sabo, John L., et al. (2005). Riparian zones increase regional species richness by harboring different, not more, species. *Ecology*, 86(1). pp 56 – 62.
- The Nature Conservancy. *Conservation Blueprint for the Great Lakes*.
http://www.nature.org/wherework/northamerica/greatlakes/files/conservation_blprnt_final.pdf
accessed November 26, 2007.
- United States Department of Agriculture, Natural Resource Conservation Service and Forest Service. (1997). *Soil Survey of Iron County, Michigan*. pg. 162.

Appendix A

Maps

Riparian Area Comparisons

Riparian Area Comparison (500 meter vs. wetland based)

Riparian Area and Environmentally Sensitive Areas (draft Luce County Zoning Ordinance)

Riparian Area Characteristics (wetland-based riparian area)

Land Use/Land Cover (circa 2000)

Land Use Change (circa 1800 – circa 2000)

Land Ownership

Wetland Types

Groundwater Potential

Hydric Soils

Topography (percent Slope)

Soil Textures

Soils (septic suitability)

Soils (timber harvest potential)

Soils (Erosion potential)

Soils (Building w/out basement suitability)

Unique Natural Features

Sensitivity to Development

Riparian area by Sensitivity Rating Category

Riparian area by Sensitivity Ranking score

Dawson Creek watershed

East Branch watershed

Mainstem watershed

South Branch watershed

West Branch watershed

North Branch watershed

Sensitivity to Forest Management

Riparian area by Sensitivity Rating Category

Riparian area by Sensitivity Ranking score

Dawson Creek watershed

East Branch watershed

Mainstem watershed

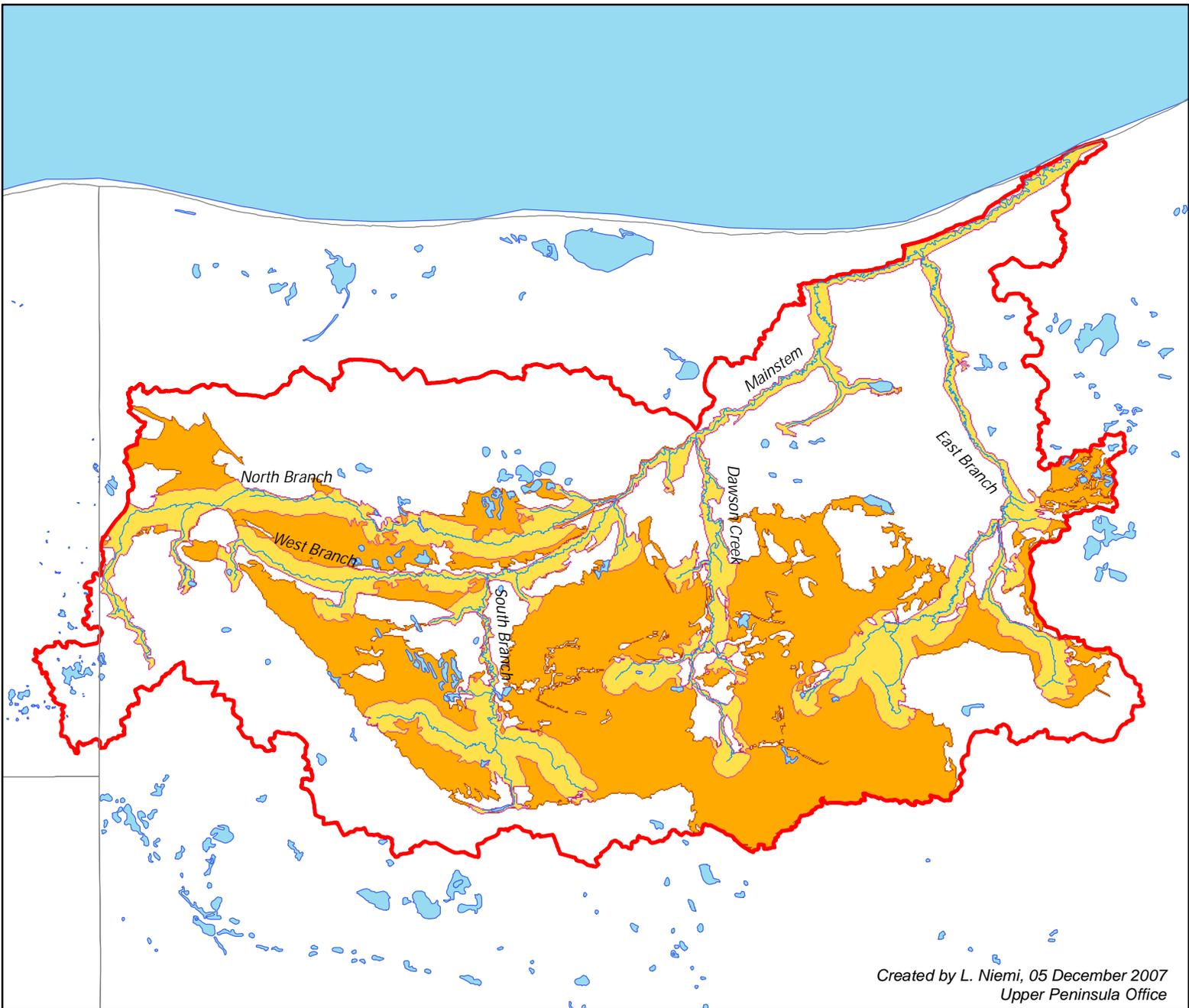
South Branch watershed

West Branch watershed

North Branch watershed

Other

Field Monitoring Sites



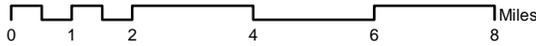
Created by L. Niemi, 05 December 2007
Upper Peninsula Office

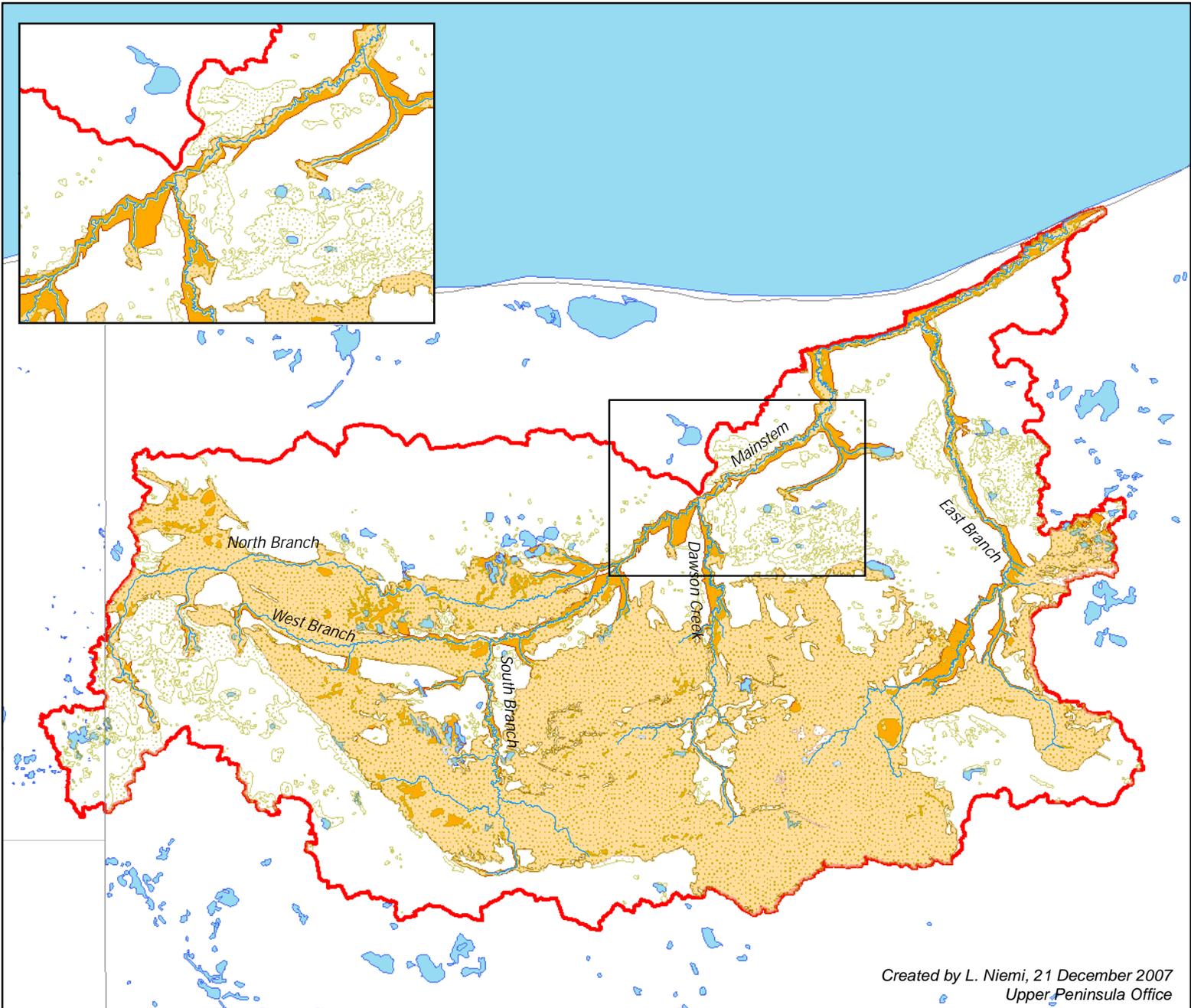
Comparison of Riparian Areas Identified

- 500 meter-based Riparian Area
- Wetland-based Riparian Area
- Two Hearted River
- Two Hearted River Watershed

The Nature Conservancy 
Protecting nature. Preserving life.™

Data utilized in analysis included: County Digital Elevation Model contours, National Wetland Inventory, County MI Geographic Framework data. Methodology derived from Ilhardt, Verry, and Palik.





Created by L. Niemi, 21 December 2007
Upper Peninsula Office

Comparison of Riparian Area to Proposed Luce County Zoning ESA's

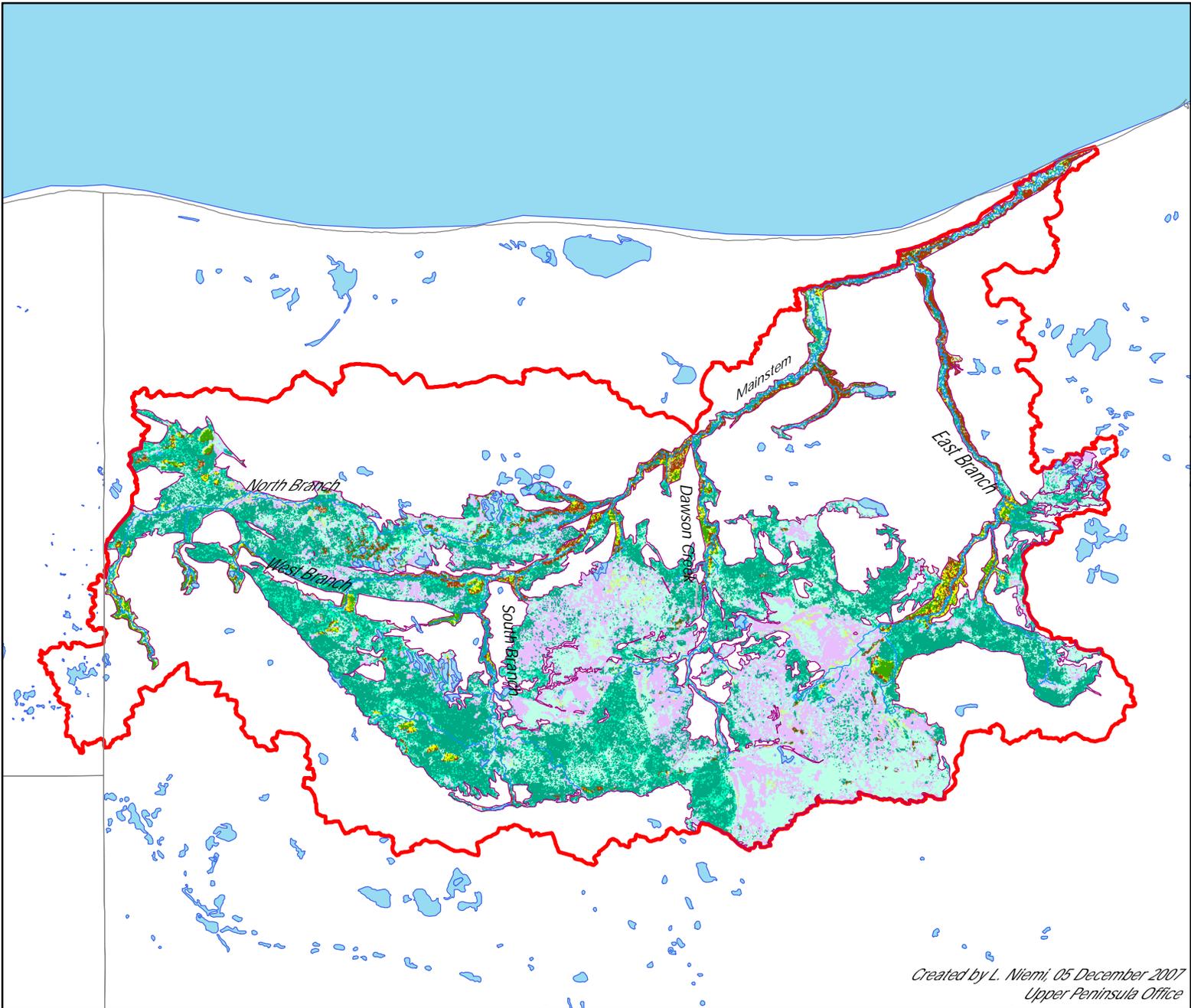
-  ESA with setback*
-  Wetland-based Riparian Area
-  Two Hearted River
-  Two Hearted River Watershed



Protecting nature. Preserving life.™

* ESA (Environmentally Sensitive Areas) as defined by the proposed Luce County Zoning Ordinance. ESAs include wetlands, sensitive soils and other unique features.





Created by L. Niemi, 05 December 2007
Upper Peninsula Office

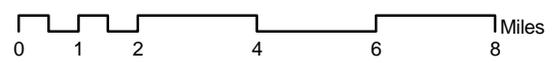
Land Use circa 2000

- | | |
|--|--|
|  <i>Aspen Association</i> |  <i>Mixed Non-Forest Wetland</i> |
|  <i>Mixed Upland Deciduous</i> |  <i>Lowland Shrub</i> |
|  <i>Northern Hardwood Association</i> |  <i>Lowland Mixed Forest</i> |
|  <i>Mixed Upland Conifers</i> |  <i>Lowland Coniferous Forest</i> |
|  <i>Upland Mixed Forest</i> |  <i>Herbaceous Openland</i> |
|  <i>Other Upland Conifers</i> |  <i>Floating Aquatic</i> |
|  <i>Pines</i> |  <i>Emergent Wetland</i> |
|  <i>Oak Association</i> |  <i>Sand / Soil</i> |
|  <i>Upland Shrub / Low-density trees</i> |  <i>Roads / Paved</i> |
|  <i>Water</i> | |

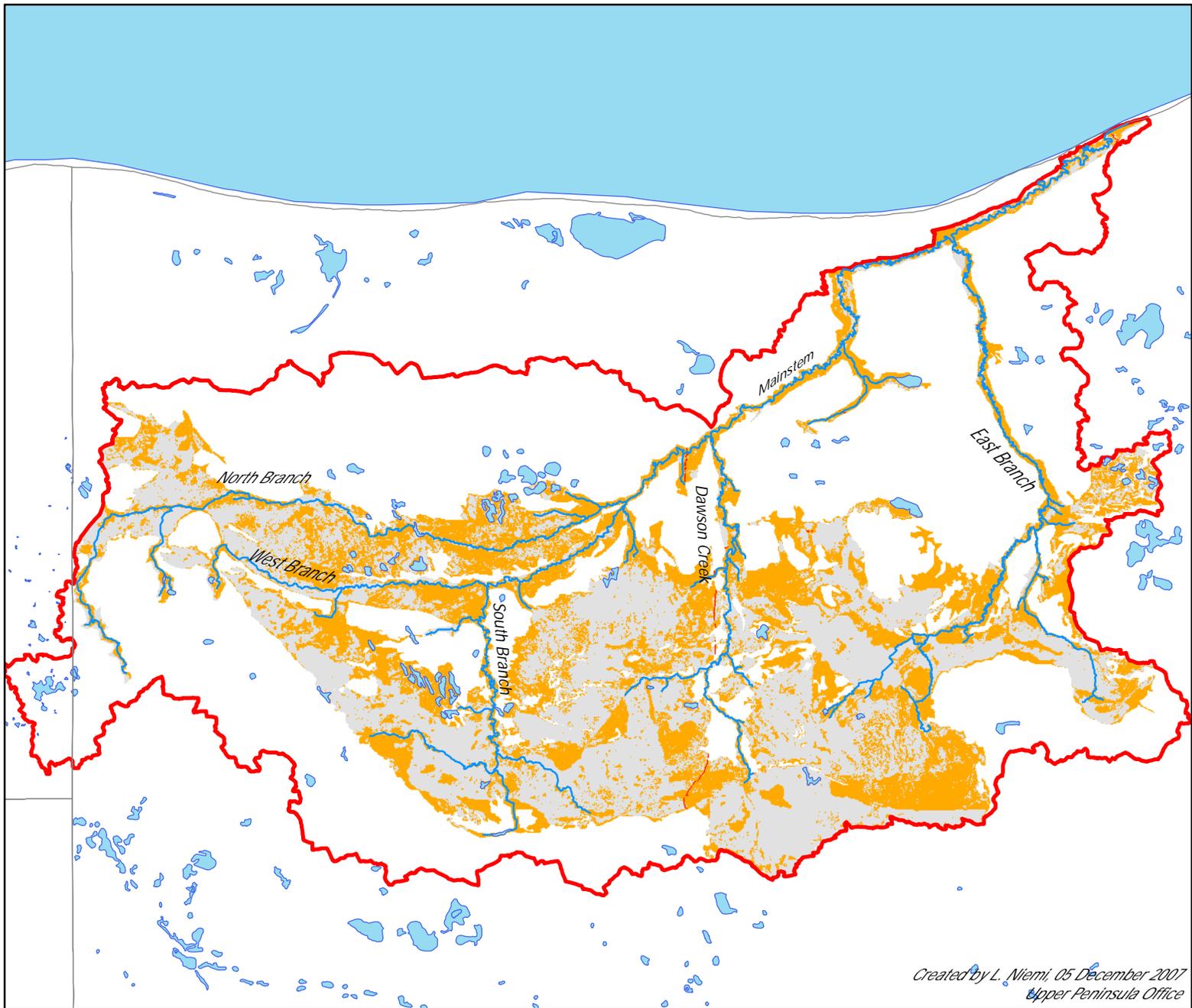


Protecting nature. Preserving life.™

-  *Two Hearted River*
-  *Two Hearted River Watershed*
-  *Wetland Based Riparian Area*



Source Data: MDNR, Forest, Mineral and Fire Management Division
Title: IFMAP/GAP Upper Peninsula Land Cover
Publication date: 20030401



Created by L. Niemi, 05 December 2007
Upper Peninsula Office

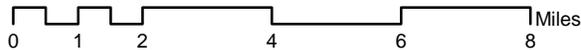
Land Use Change circa 1800 - circa 2000*

- Changed to Urban
- Other Change
- No change
- Two Hearted River
- Wetland Based Riparian Area
- Two Hearted River Watershed

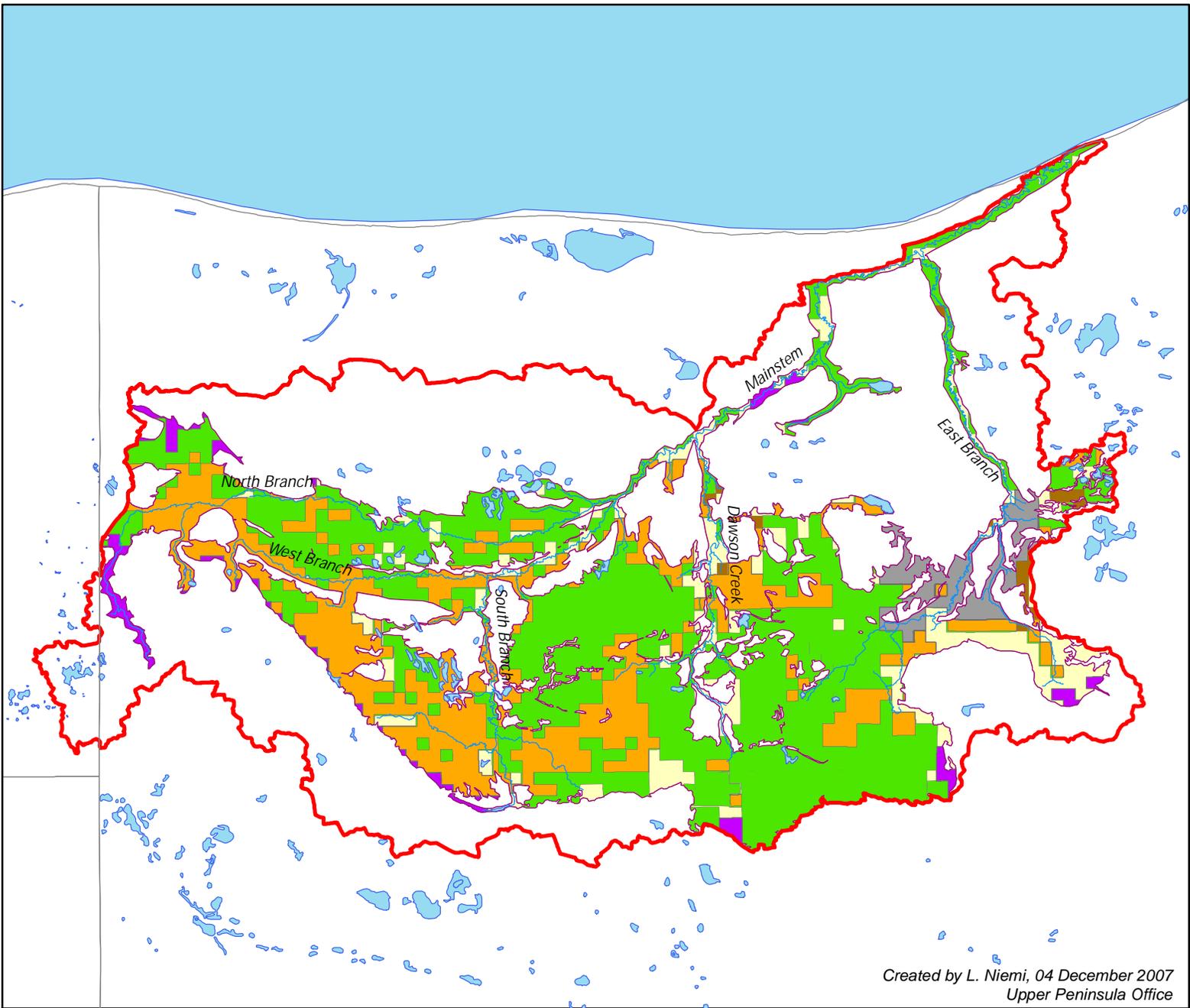


The Nature Conservancy

Protecting nature. Preserving life.™



*This dataset was created by Michigan Natural Features Inventory (MNFI) and compares land cover classes from circa 1800 to circa 2000 for the Upper peninsula of Michigan. Its purpose is for large scale ecological assessment, determining survey priorities, and comparison to other datasets. These data are intended for display and analysis at the state, region, or county level. No responsibility is assumed by the MNFI in the use of these data. No value of the quality of areas of unchanged vegetation should be inferred. Accuracy is dependent on the spatial and attribute accuracy of the original datasets. Source datasets: Vegetation circa 1800 of Michigan, MNFI, 1999; IFMAP, MDNR, 2003.

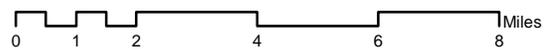


Created by L. Niemi, 04 December 2007
Upper Peninsula Office

Land Ownership in Riparian Area

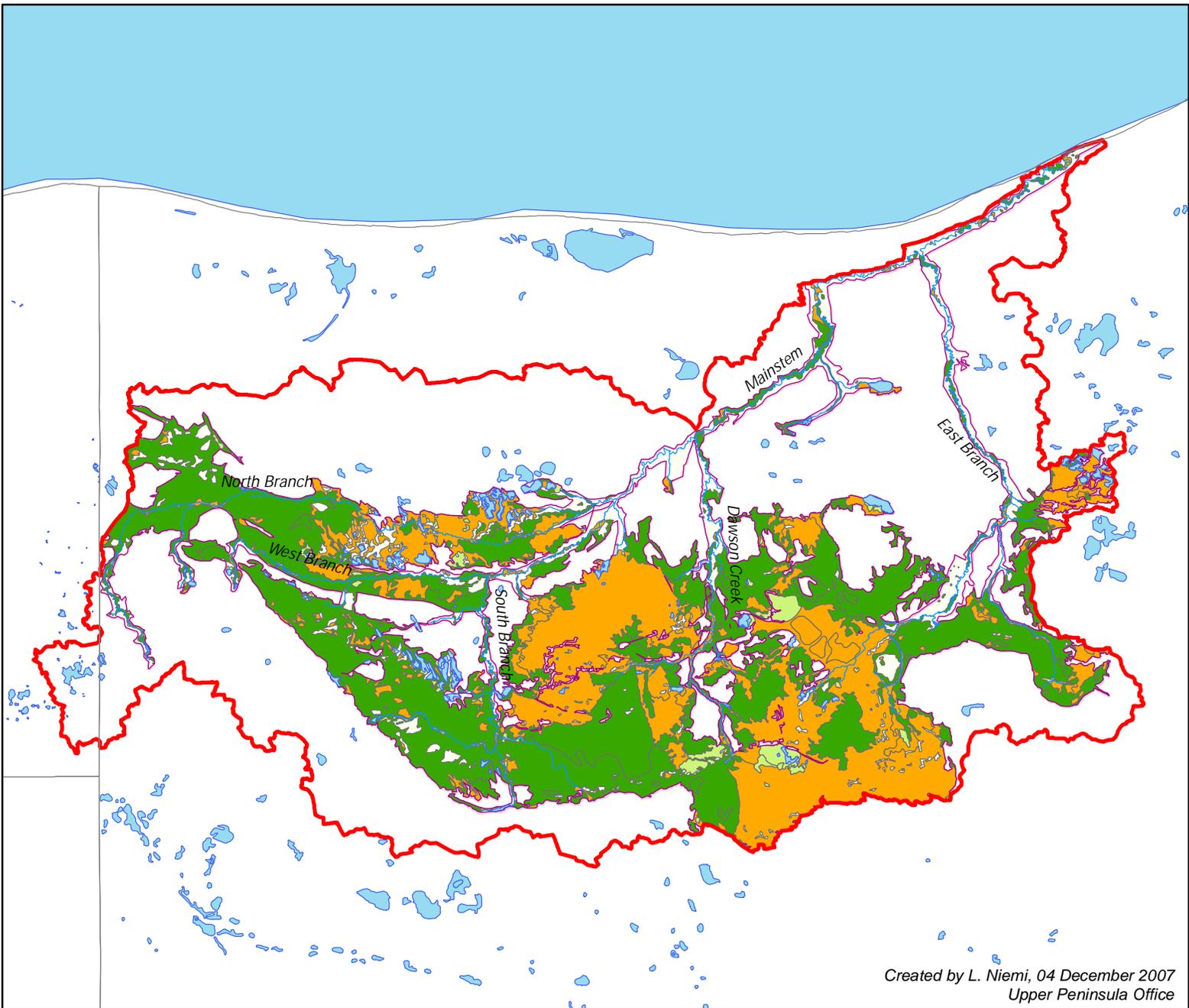
- State of Michigan
- The Nature Conservancy
- Forest Product Producer
- Forest Product Producer*
- Hunt Clubs
- Small Private
- Two Hearted River
- Wetland Based Riparian Area
- Two Hearted River Watershed

The Nature Conservancy 
Protecting nature. Preserving life.™



Source data: Ducks Unlimited, Inc.
Title: Conservation and Recreation Lands
Publication Date: June 4, 2007

* under Working Forest Conservation Easement, part of Northern Great Lakes Forest Project



Created by L. Niemi, 04 December 2007
Upper Peninsula Office

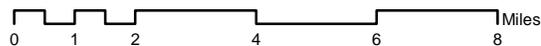
Wetland Types in Riparian Area

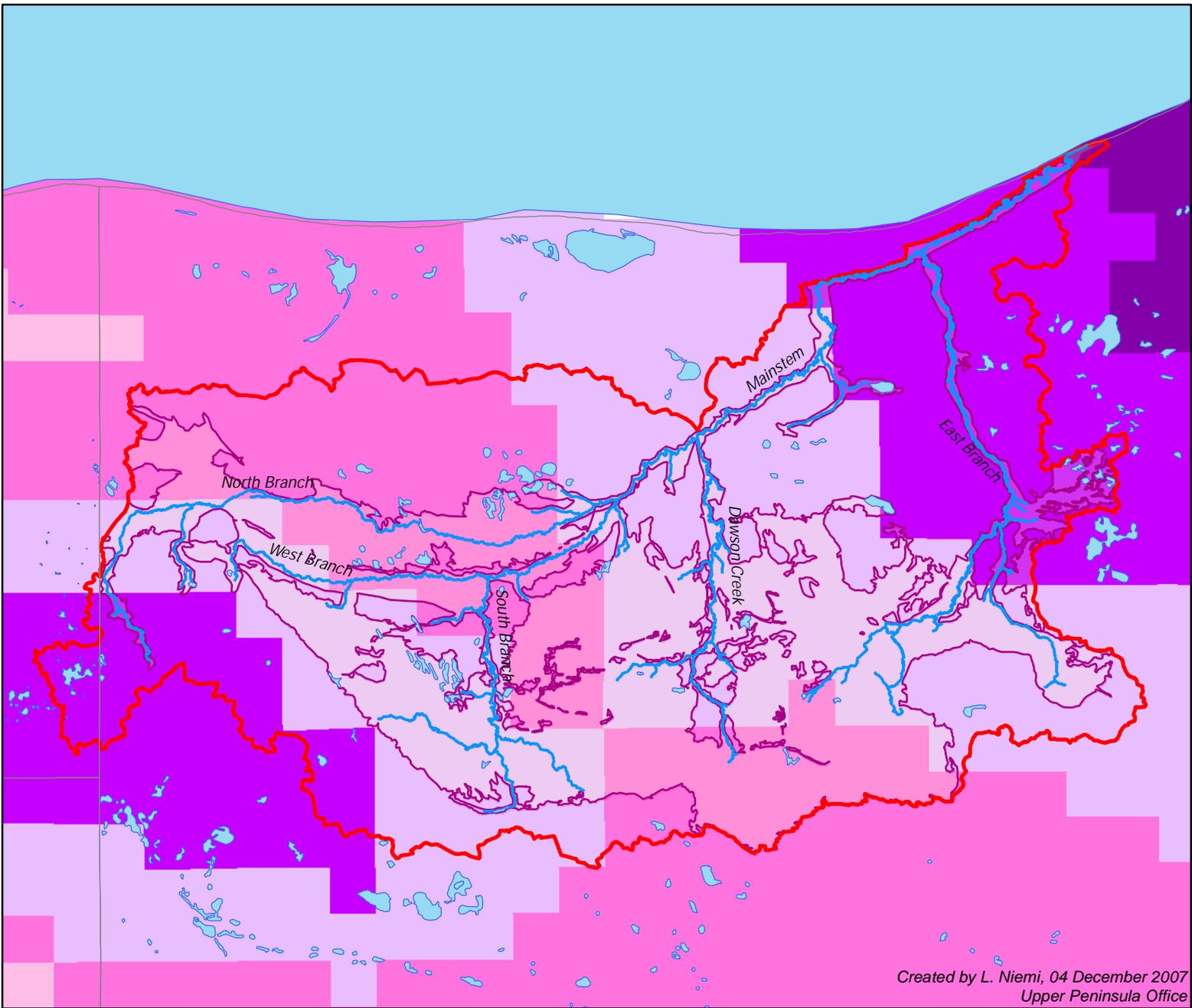
- | | |
|--|---|
|  Beach/Bar |  Two Hearted River |
|  Emergent |  Wetland Based Riparian Area |
|  Forested |  Two Hearted River Watershed |
|  Scrub-Shrub | |
|  Open Water/Unknown Bottom | |



Protecting nature. Preserving life.™

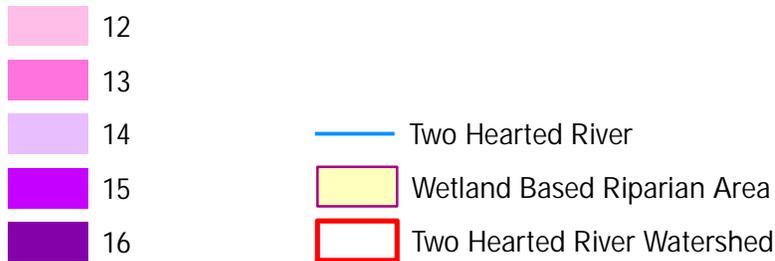
Source data: U.S. Fish & Wildlife Service, National Wetlands Inventory
Publication Date: 1979-1994
Title: Luce NWI; Alger NWI



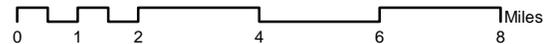


Created by L. Niemi, 04 December 2007
Upper Peninsula Office

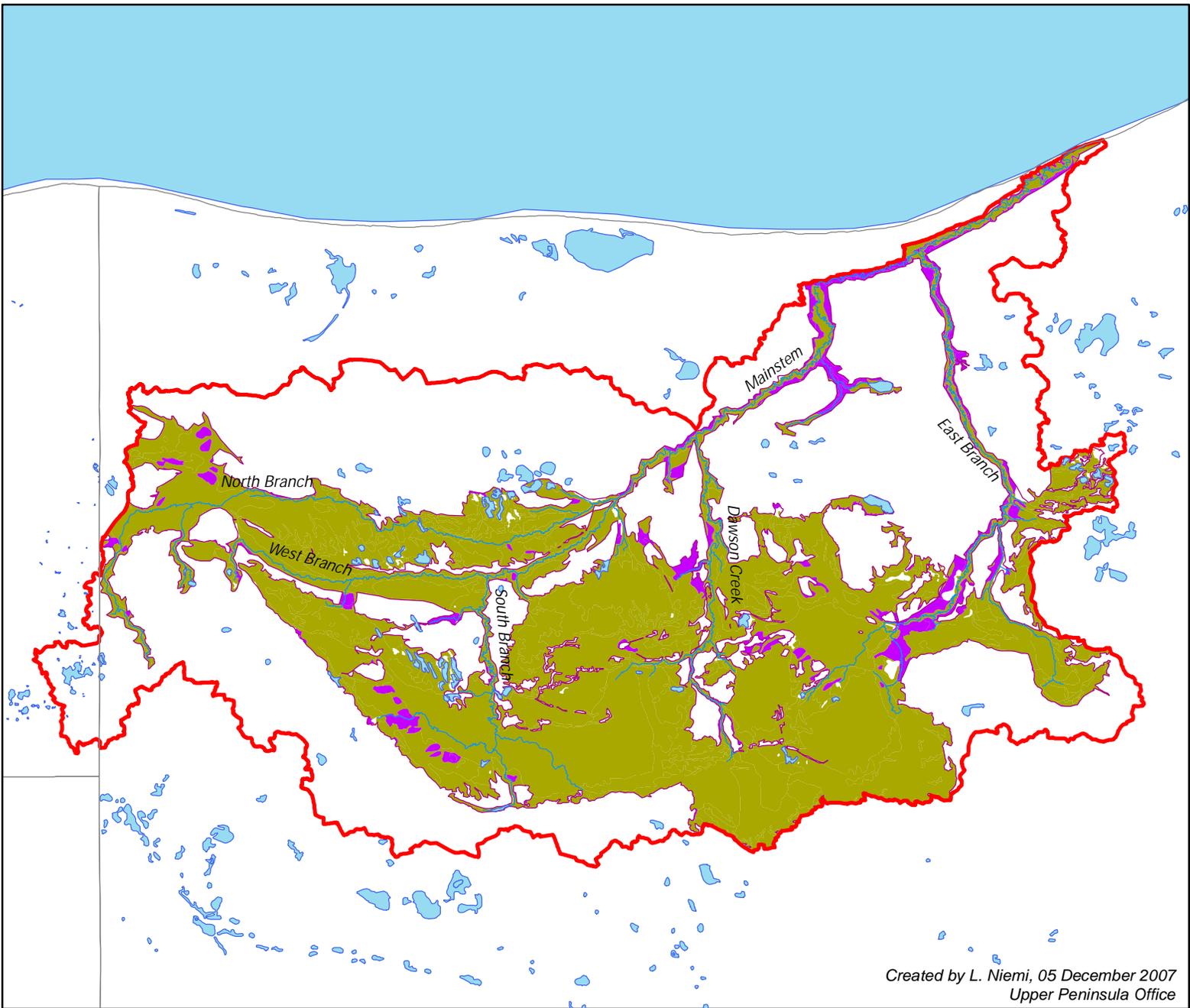
Estimate of Annual Groundwater Recharge (in/yr)*



The Nature Conservancy 
Protecting nature. Preserving life.™



*Groundwater Recharge Potential on a scale of 1 - 22 (inches/year). Groundwater Inventory and Mapping Project, a cooperative effort between the Water Bureau Michigan Department of Environmental Quality, USGS - Michigan Water Science Center and Michigan State University - Institute of Water Research, RS&GIS and Biosystems and Agricultural Engineering. This project was mandated by P.A.148 (Michigan Acts of 2003). Major funding was provided by MDEQ, supplemented with additional funds from the USGS Cooperative Water Program. Publication_Date: June 30th, 2005



Created by L. Niemi, 05 December 2007
Upper Peninsula Office

Hydric Soils in Riparian Area

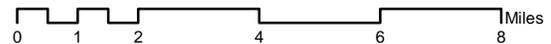
-  Hydric soil
-  Non-hydric soil

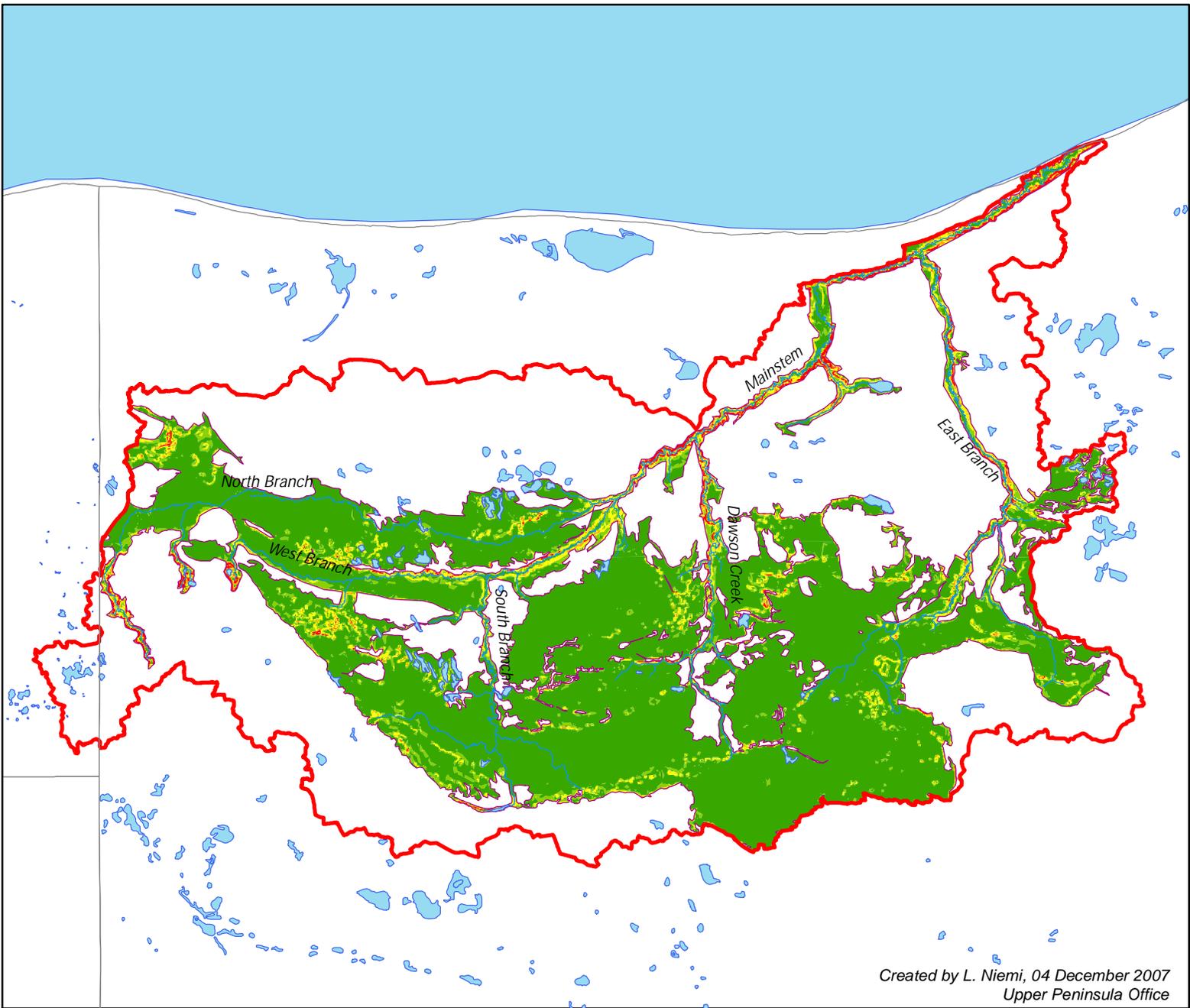
-  Two Hearted River
-  Wetland Based Riparian Area
-  Two Hearted River Watershed

The Nature Conservancy 

Protecting nature. Preserving life.™

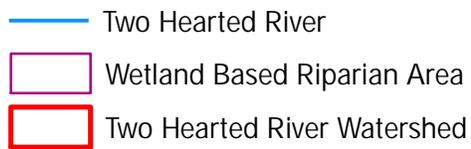
Source data: U.S. Department of Agriculture, Natural Resources Conservation Service
Title: Soil Survey Geographic (SSURGO) database for Luce County, Michigan
Publication_Date: 20050127





Created by L. Niemi, 04 December 2007
Upper Peninsula Office

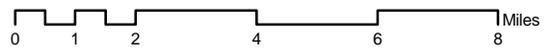
Percent Slope in Riparian Area

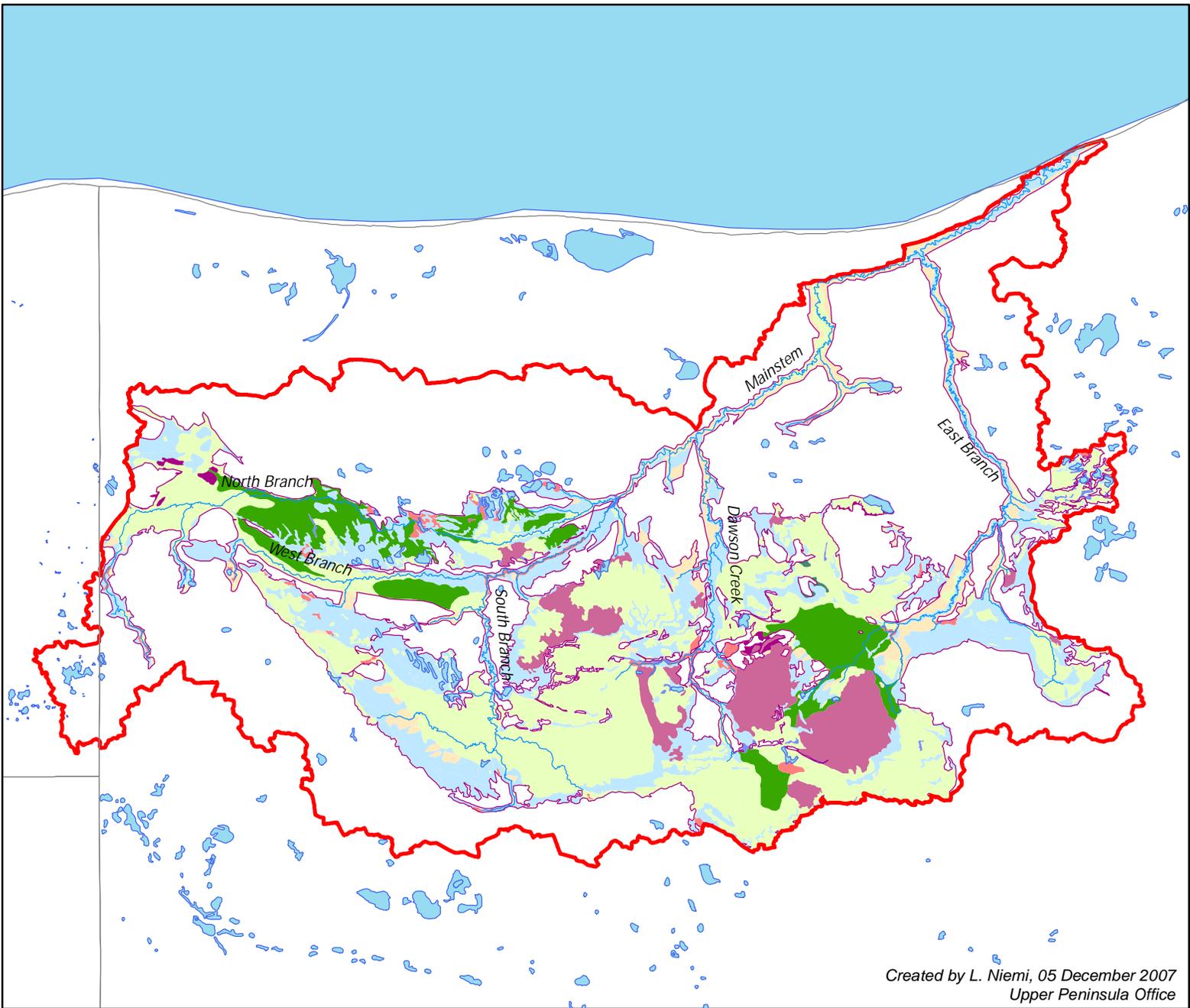


The Nature Conservancy 

Protecting nature. Preserving life.™

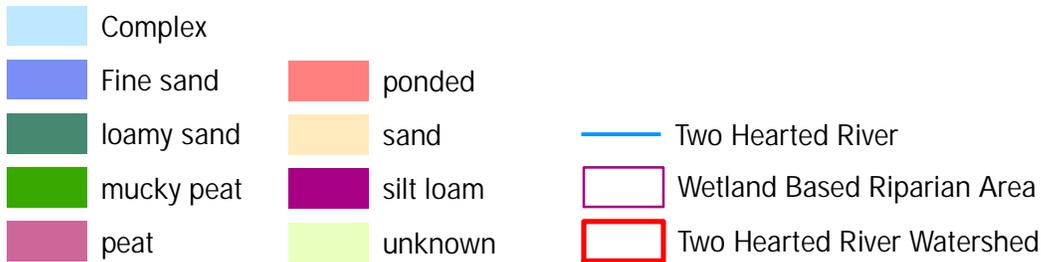
Source data: Michigan Geographic Database Library
Title: Digital Elevation Model by County (Alger, Luce)





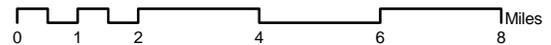
Created by L. Niemi, 05 December 2007
Upper Peninsula Office

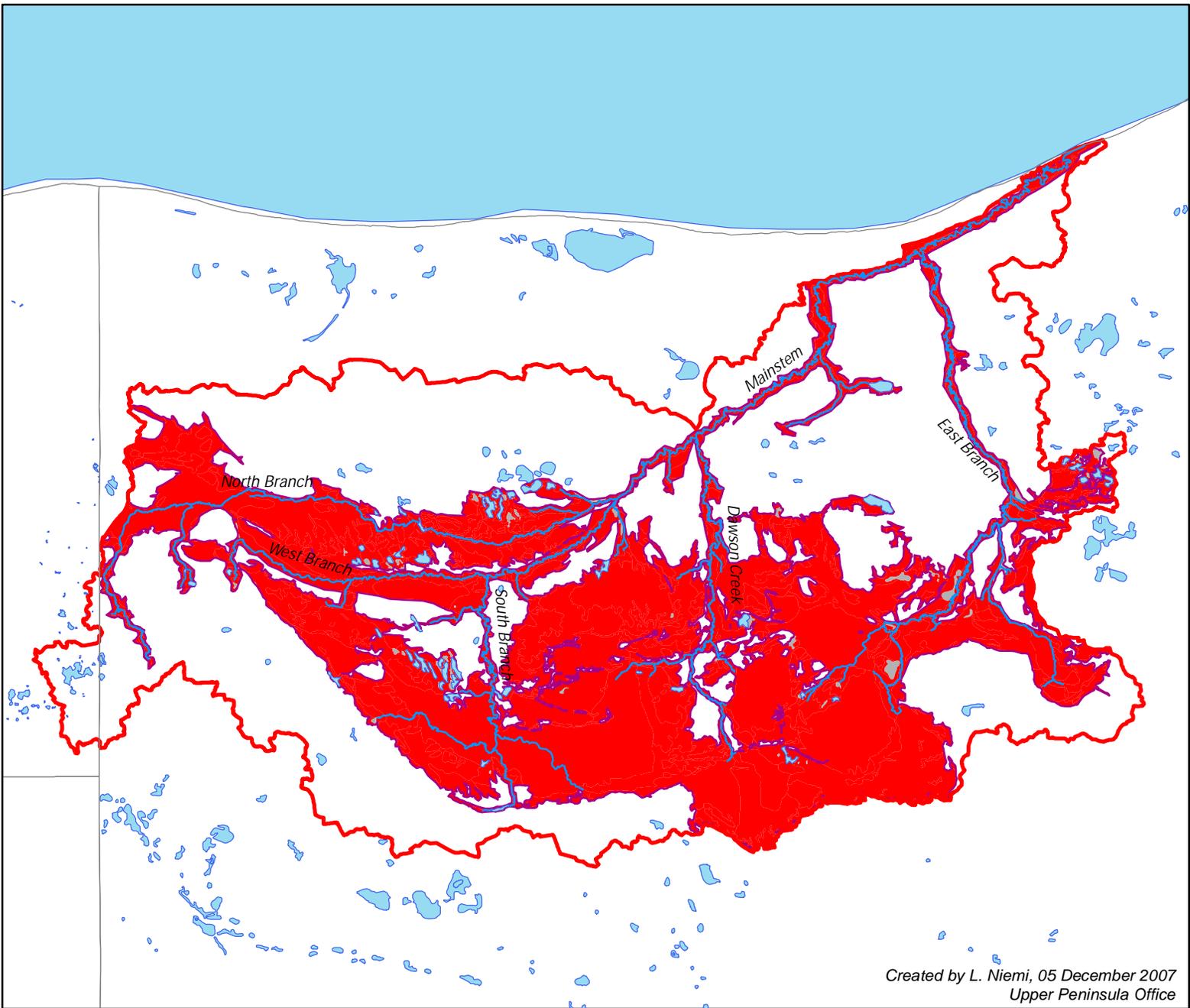
Soil Characteristics in Riparian Area



Protecting nature. Preserving life.™

Source data: U.S. Department of Agriculture, Natural Resources Conservation Service
Title: Soil Survey Geographic (SSURGO) database for Luce County, Michigan
Publication_Date: 20050127





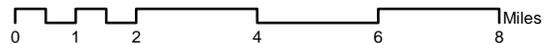
Created by L. Niemi, 05 December 2007
Upper Peninsula Office

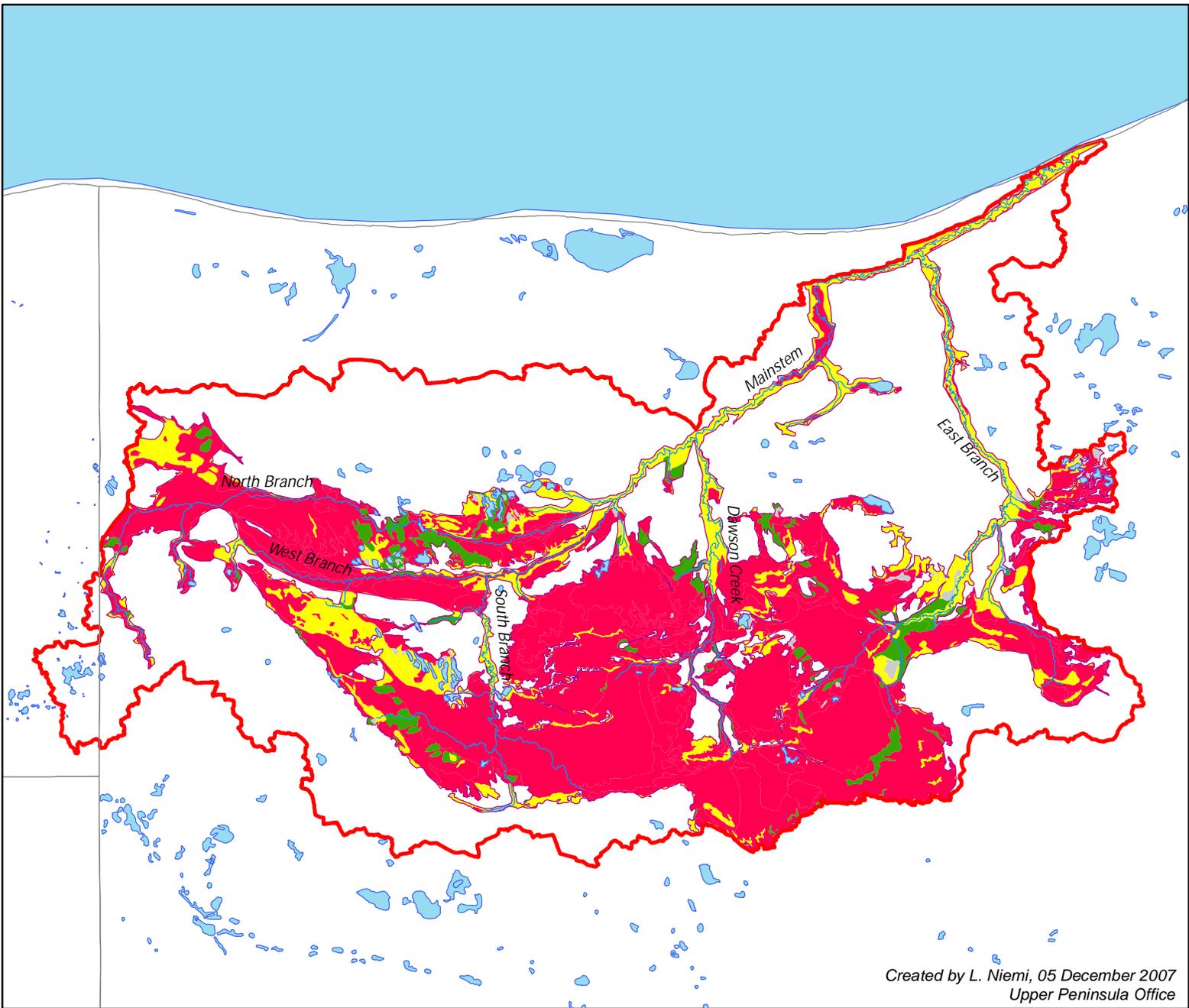
Septic System Suitability in Riparian Area

- Very Limited
- Not rated or unknown
- Two Hearted River
- Wetland Based Riparian Area
- Two Hearted River Watershed

The Nature Conservancy 
Protecting nature. Preserving life.™

Source data: U.S. Department of Agriculture, Natural Resources Conservation Service
Title: Soil Survey Geographic (SSURGO) database for Luce County, Michigan
Publication_Date: 20050127





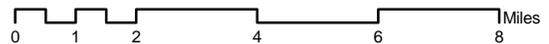
Created by L. Niemi, 05 December 2007
Upper Peninsula Office

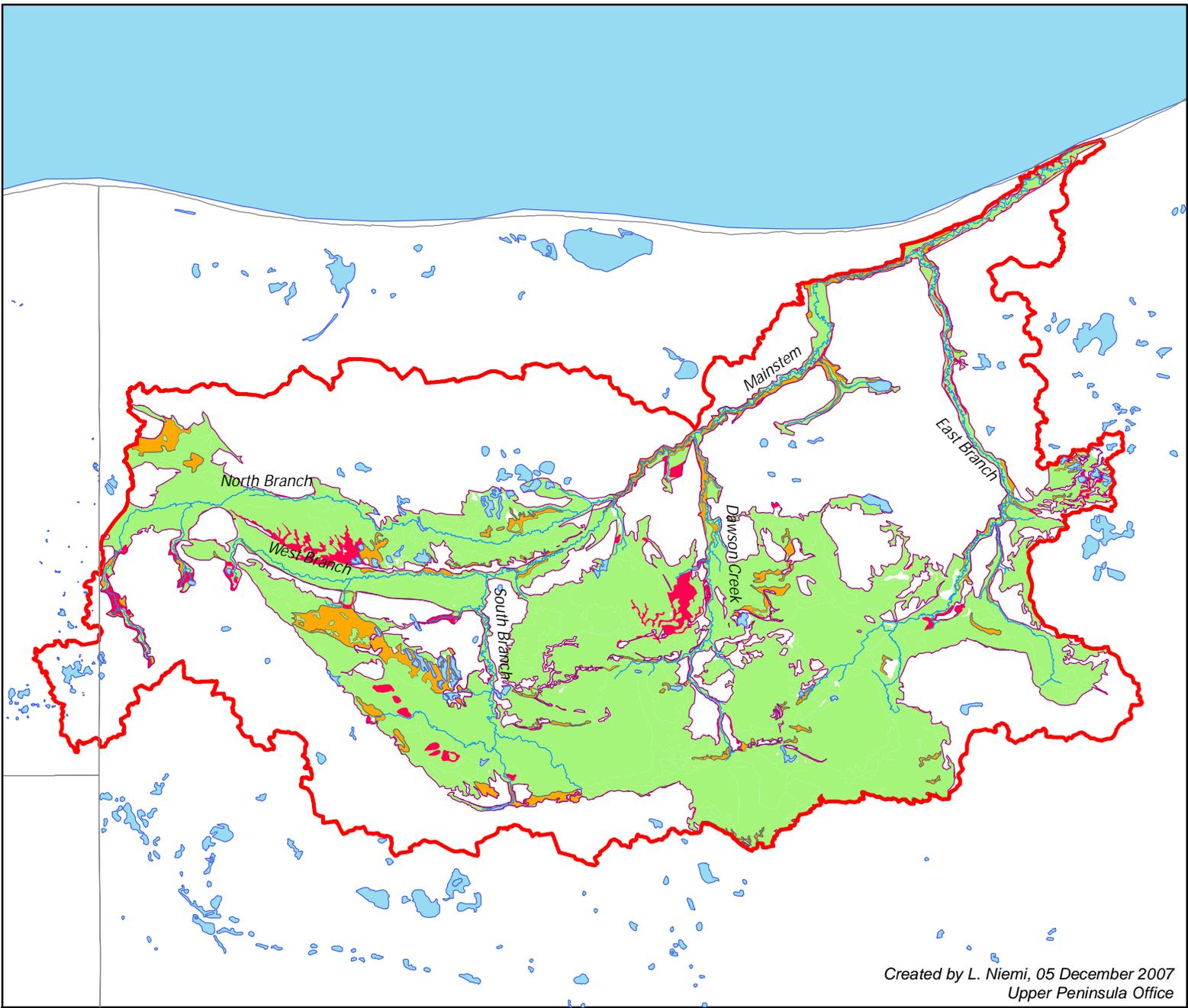
Harvest Potential in Riparian Area

- Poorly suited
- Moderately suited
- Well suited
- unknown
- Two Hearted River
- Wetland Based Riparian Area
- Two Hearted River Watershed

The Nature Conservancy 
Protecting nature. Preserving life.™

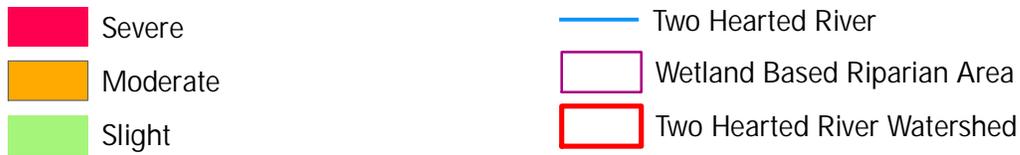
Source data: U.S. Department of Agriculture, Natural Resources Conservation Service
Title: Soil Survey Geographic (SSURGO) database for Luce County, Michigan
Publication_Date: 20050127





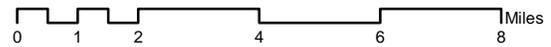
Created by L. Niemi, 05 December 2007
Upper Peninsula Office

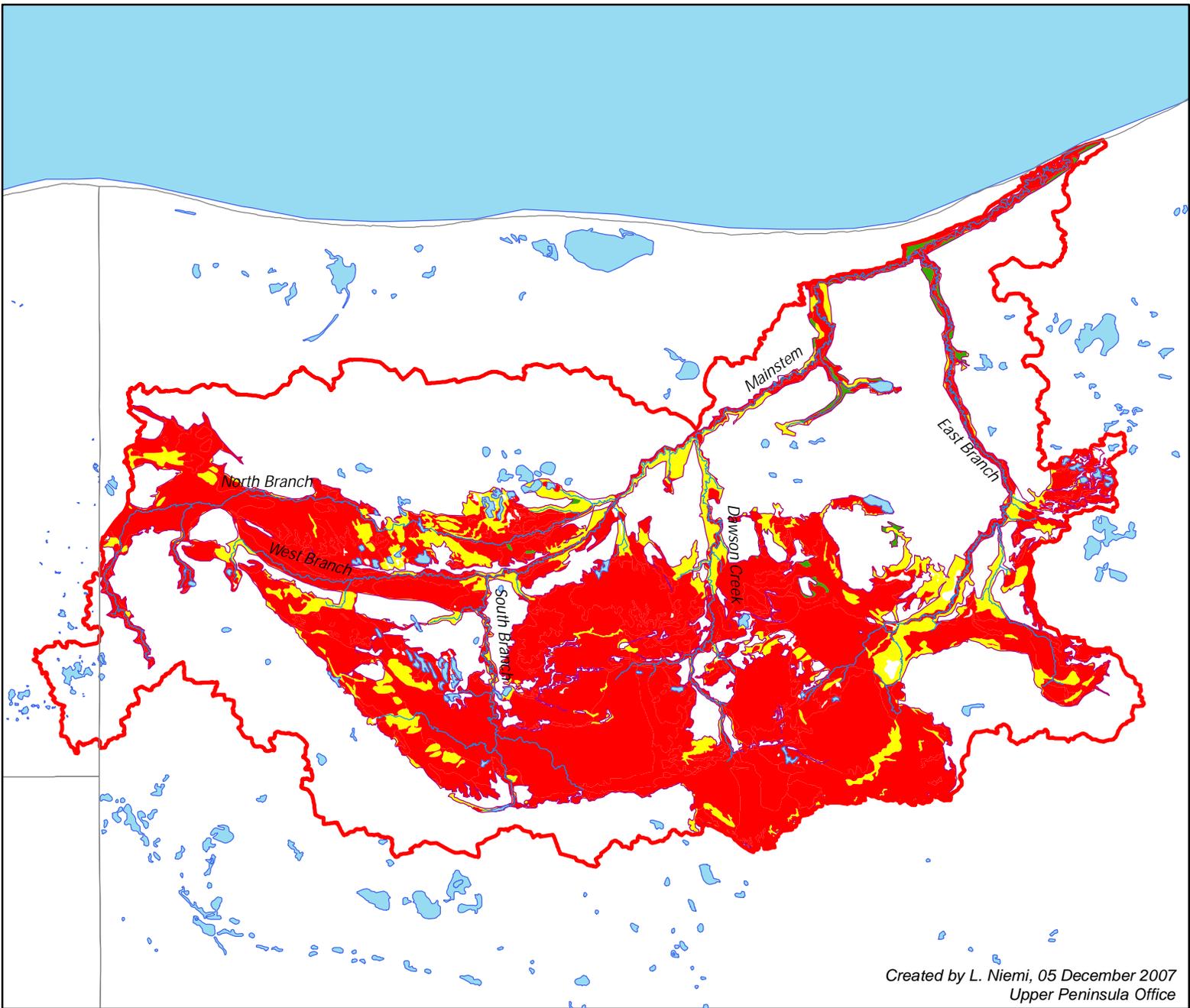
Erosion Potential in Riparian Area



The Nature Conservancy 
Protecting nature. Preserving life.™

Source data: U.S. Department of Agriculture, Natural Resources Conservation Service
Title: Soil Survey Geographic (SSURGO) database for Luce County, Michigan
Publication_Date: 20050127





Created by L. Niemi, 05 December 2007
Upper Peninsula Office

Suitability for Buildings (w/out basements)

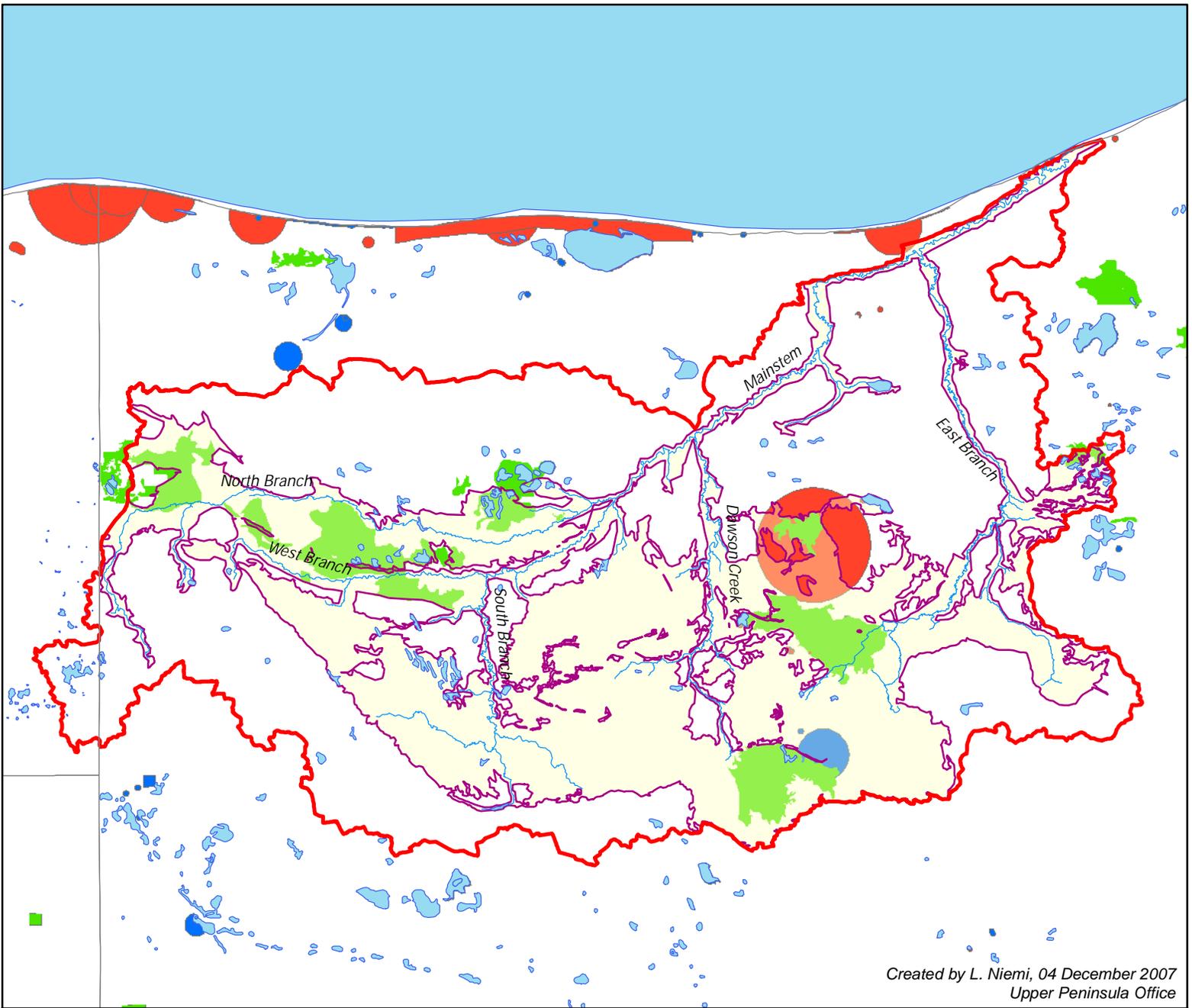
- | | | | |
|--|------------------|---|-----------------------------|
|  | Very limited |  | Two Hearted River |
|  | Somewhat limited |  | Wetland Based Riparian Area |
|  | Not limited |  | Two Hearted River Watershed |
|  | Not rated | | |

The Nature Conservancy 
Protecting nature. Preserving life.™

Source data: U.S. Department of Agriculture, Natural Resources Conservation Service
Title: Soil Survey Geographic (SSURGO) database for Luce County, Michigan
Publication_Date: 20050127

0 1 2 4 6 8 Miles





Created by L. Niemi, 04 December 2007
Upper Peninsula Office

Natural Features in Riparian Area

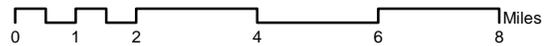
- Animal
- Community
- Plant
- Two Hearted River
- Wetland Based Riparian Area
- Two Hearted River Watershed

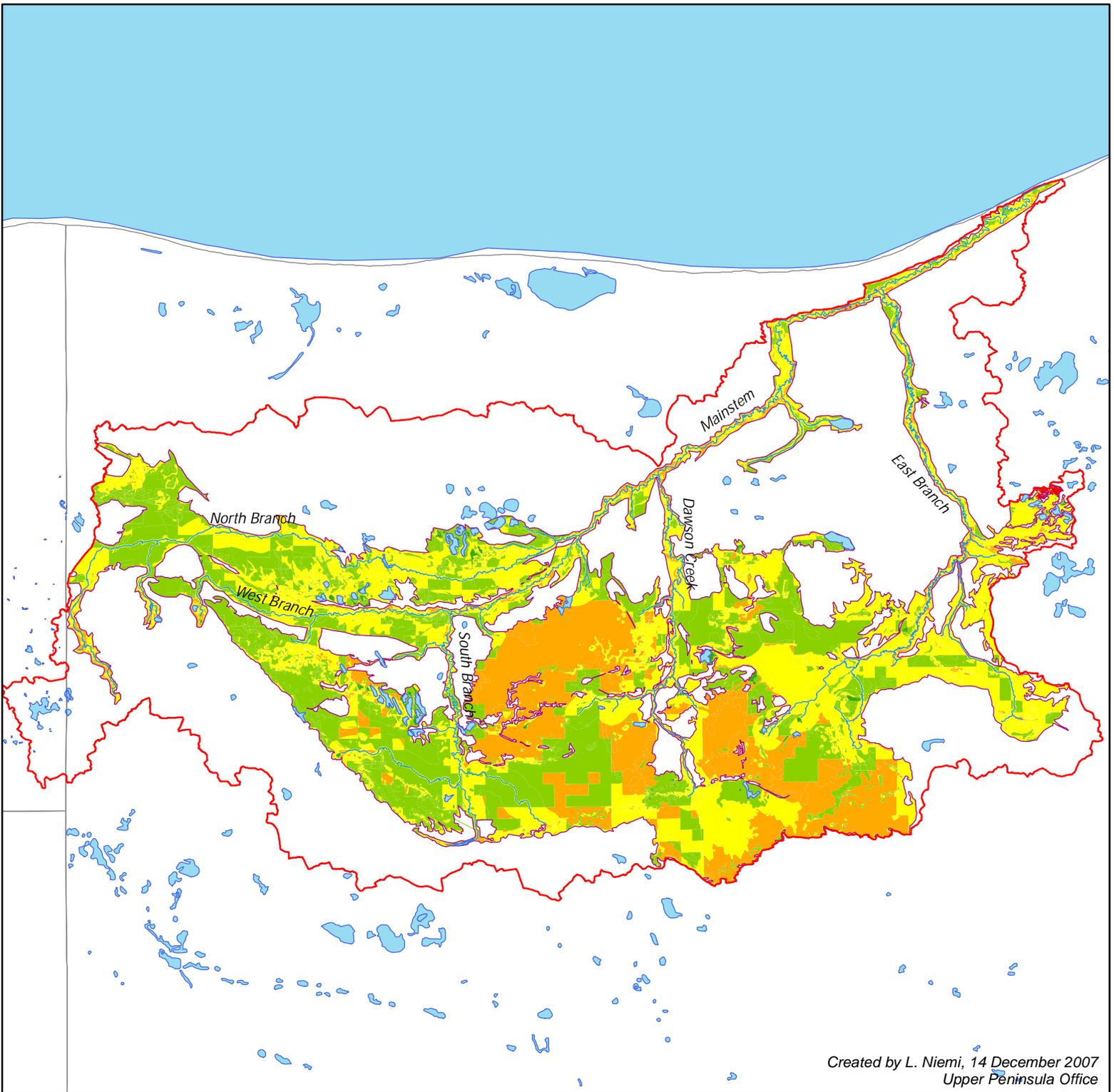


The Nature Conservancy

Protecting nature. Preserving life.™

Source data: Michigan Natural Features Inventory, Biotics database
Data from January 01, 2007





Created by L. Niemi, 14 December 2007
Upper Peninsula Office

Development Sensitivity Ranking

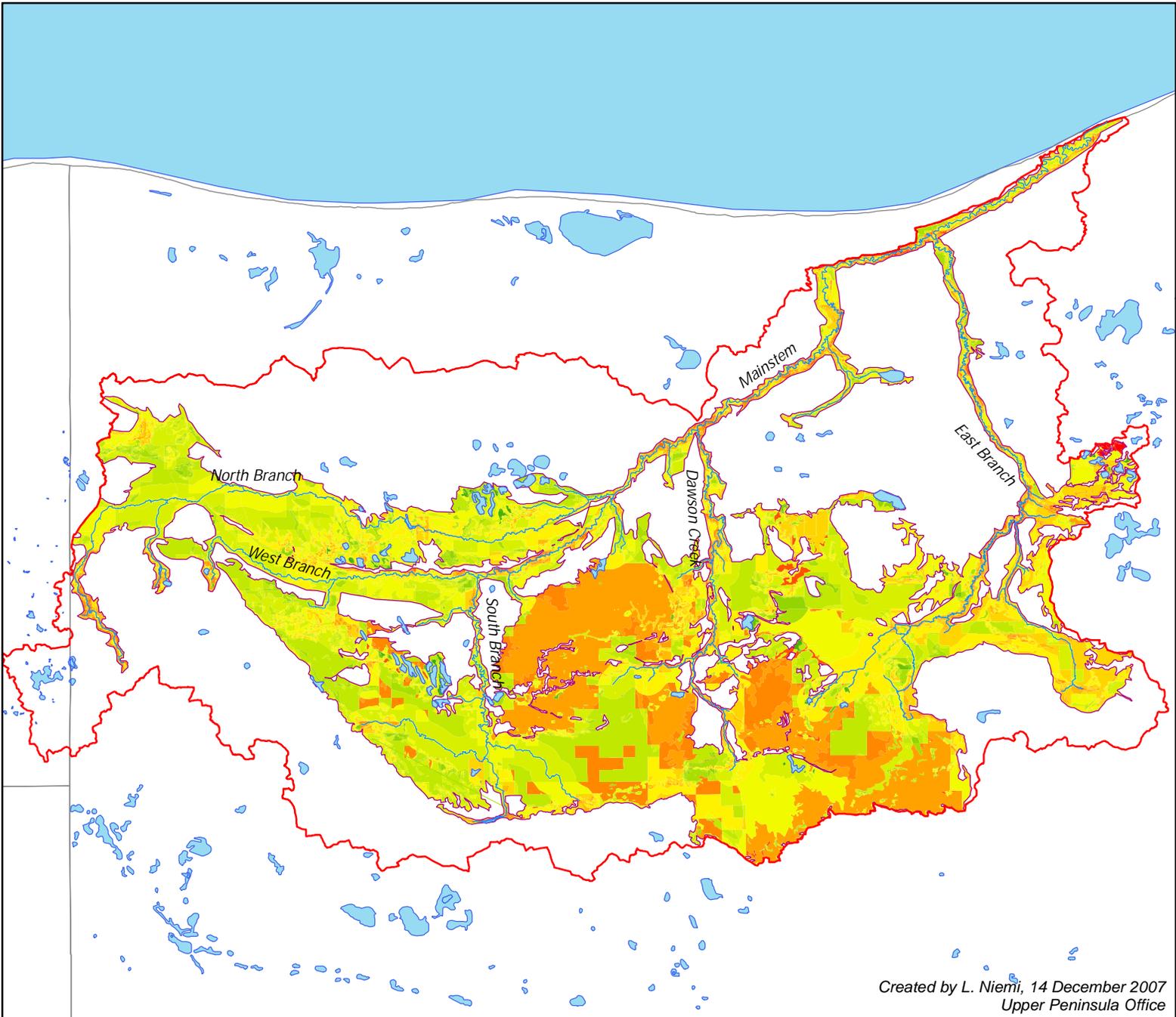


Protecting nature. Preserving life.™



The riparian area was analyzed for its sensitivity to further development. Parameters utilized in this analysis included: nearness to river/stream, ownership, septic suitability, erosion potential, building suitability, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 22, with 22 being the most sensitive area. The sensitivity ranks were classified into five categories using the Equal Interval classification (Low, Low-Moderate, Moderate, Moderate-High, High).



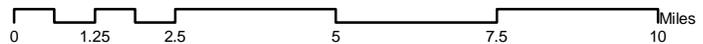


Created by L. Niemi, 14 December 2007
Upper Peninsula Office

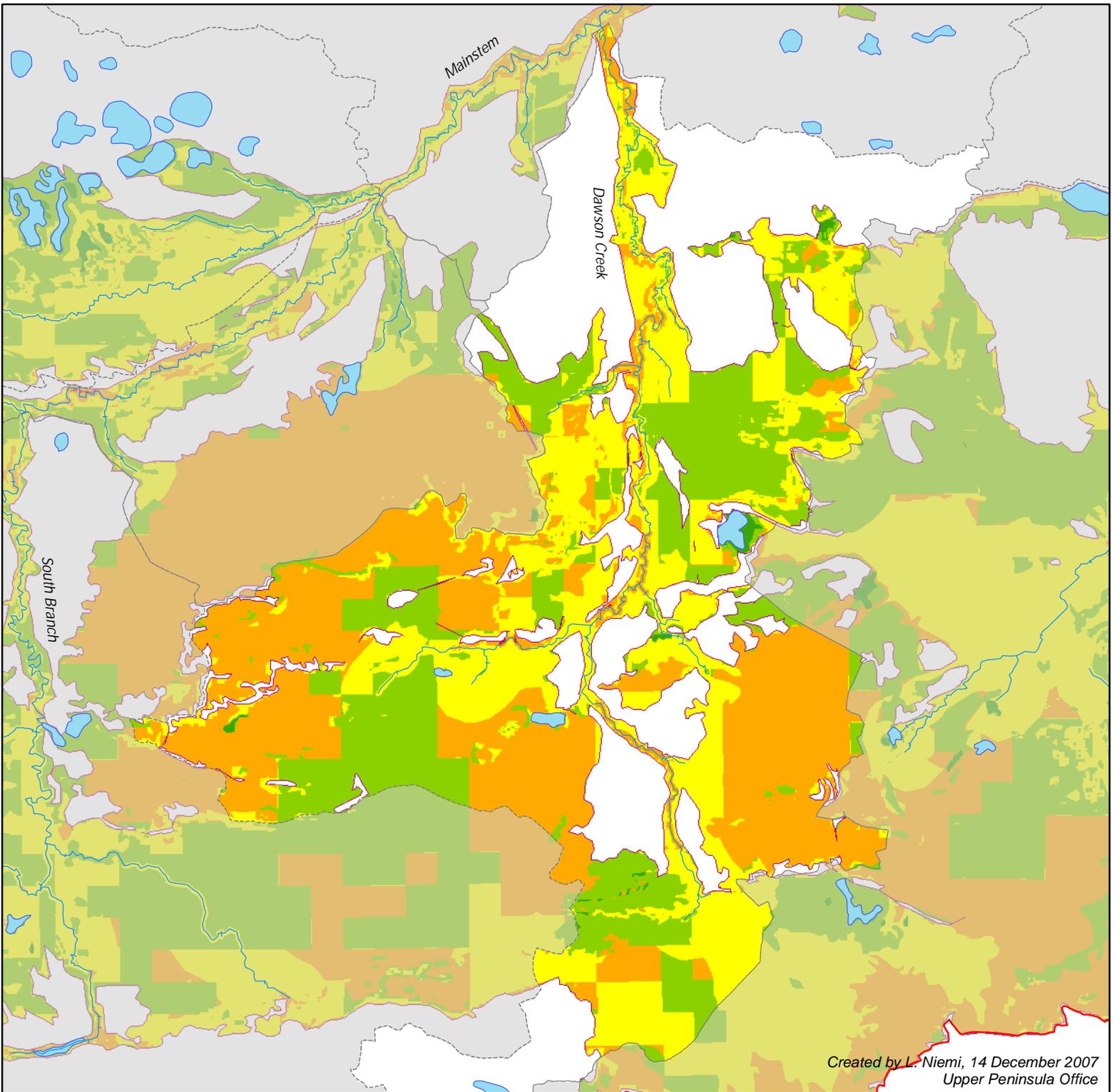
Development Sensitivity Ranking (attribute=RankSum2_0)



- Two Hearted River
- Wetland Based Riparian Area
- Two Hearted River Watershed



The riparian area was analyzed for its sensitivity to further development. Parameters utilized in this analysis included: nearness to river/stream, ownership, septic suitability, erosion potential, building suitability, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 22, with 22 being the most sensitive area.

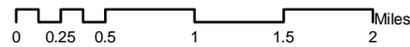


Created by L. Niemi, 14 December 2007
Upper Peninsula Office

Development Sensitivity Ranking - Dawson Creek

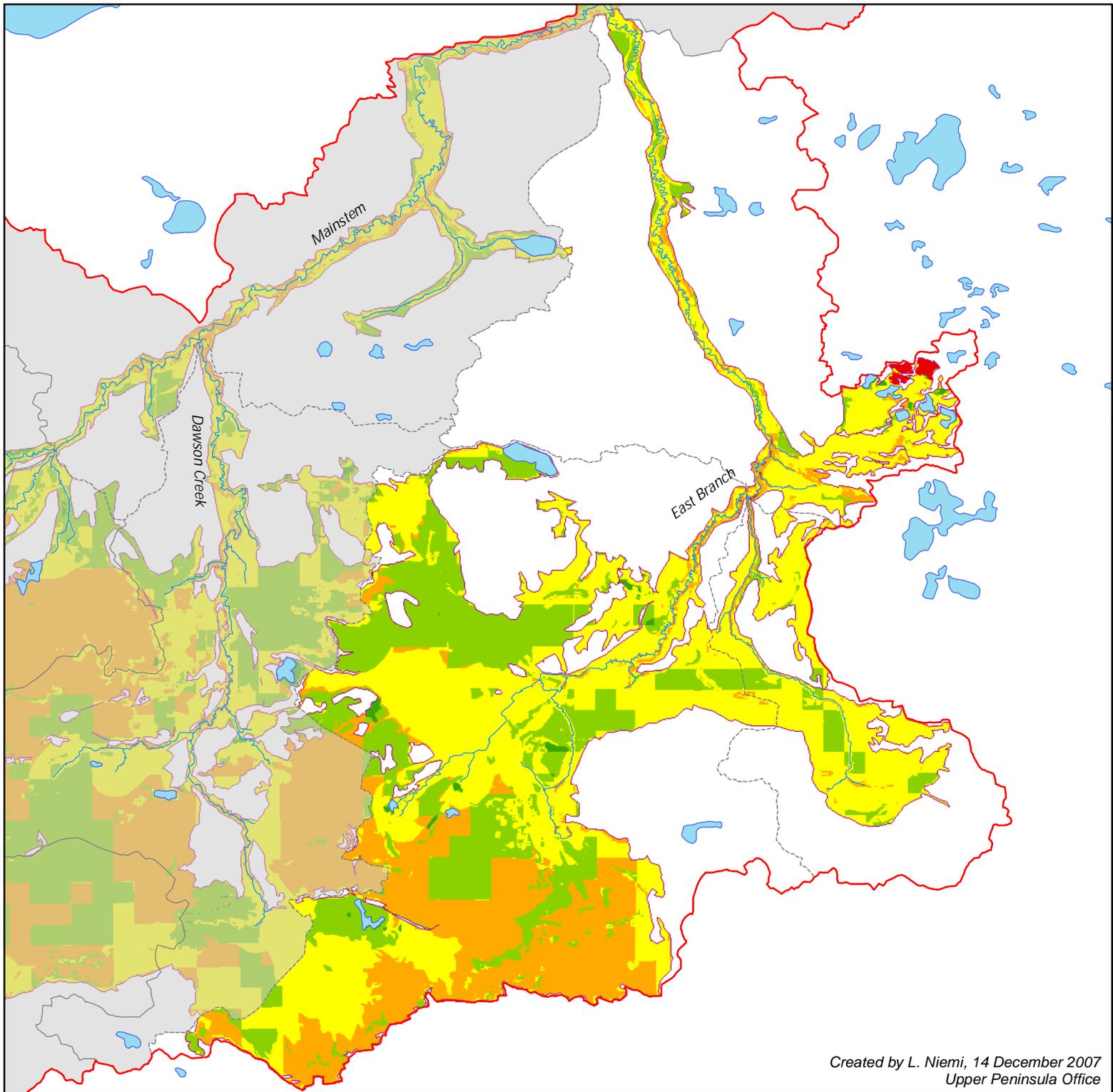


Protecting nature. Preserving life.™



The riparian area was analyzed for its sensitivity to further development. Parameters utilized in this analysis included: nearness to river/stream, ownership, septic suitability, erosion potential, building suitability, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 22, with 22 being the most sensitive area. The sensitivity ranks were classified into five categories using the Equal Interval classification (Low, Low-Moderate, Moderate, Moderate-High, High).



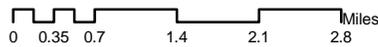


Created by L. Niemi, 14 December 2007
Upper Peninsula Office

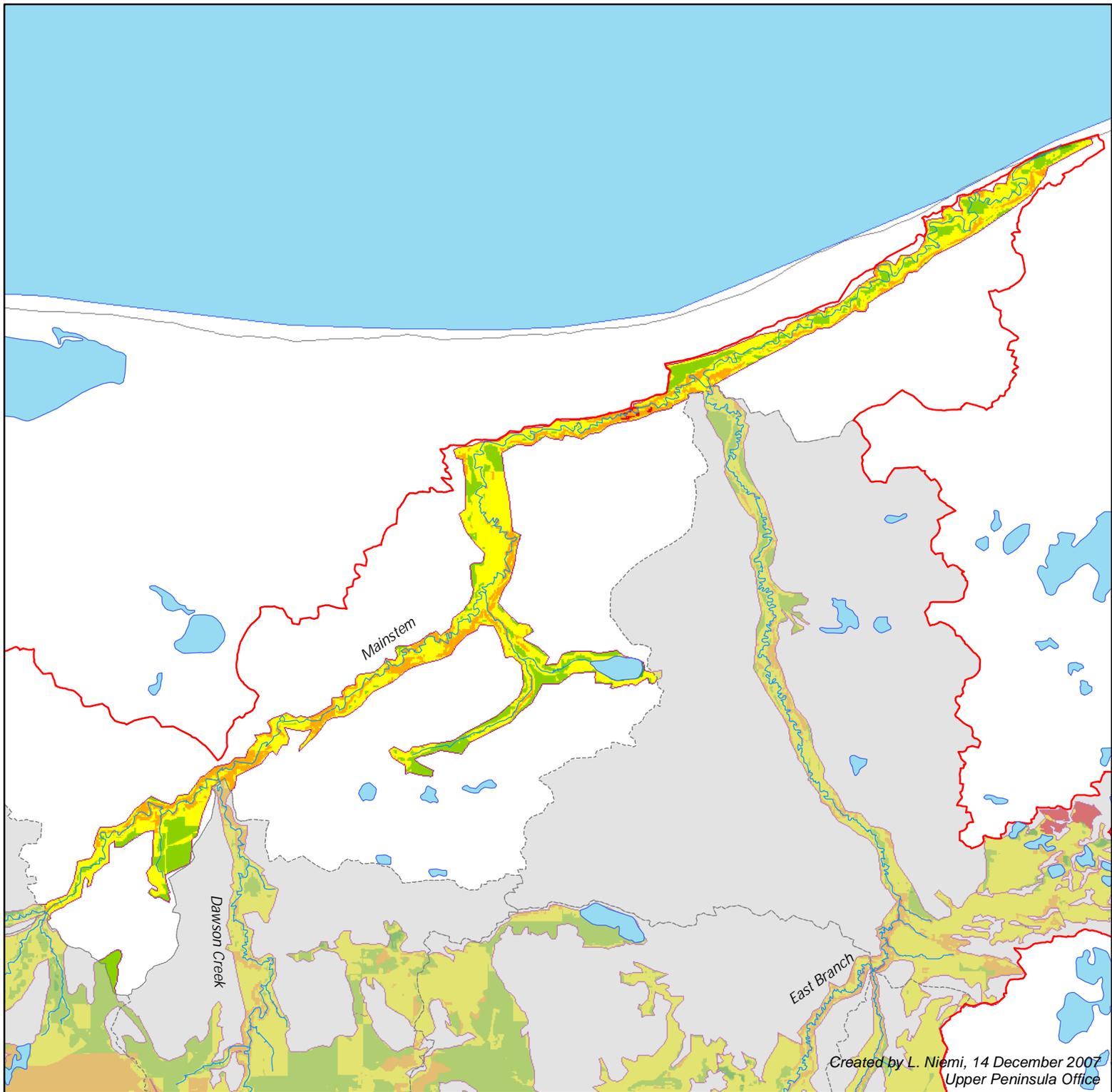
Development Sensitivity Ranking - East Branch Two Hearted River



Protecting nature. Preserving life.™



The riparian area was analyzed for its sensitivity to further development. Parameters utilized in this analysis included: nearness to river/stream, ownership, septic suitability, erosion potential, building suitability, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 22, with 22 being the most sensitive area. The sensitivity ranks were classified into five categories using the Equal Interval classification (Low, Low-Moderate, Moderate, Moderate-High, High).

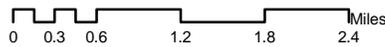


Created by L. Niemi, 14 December 2007
Upper Peninsula Office

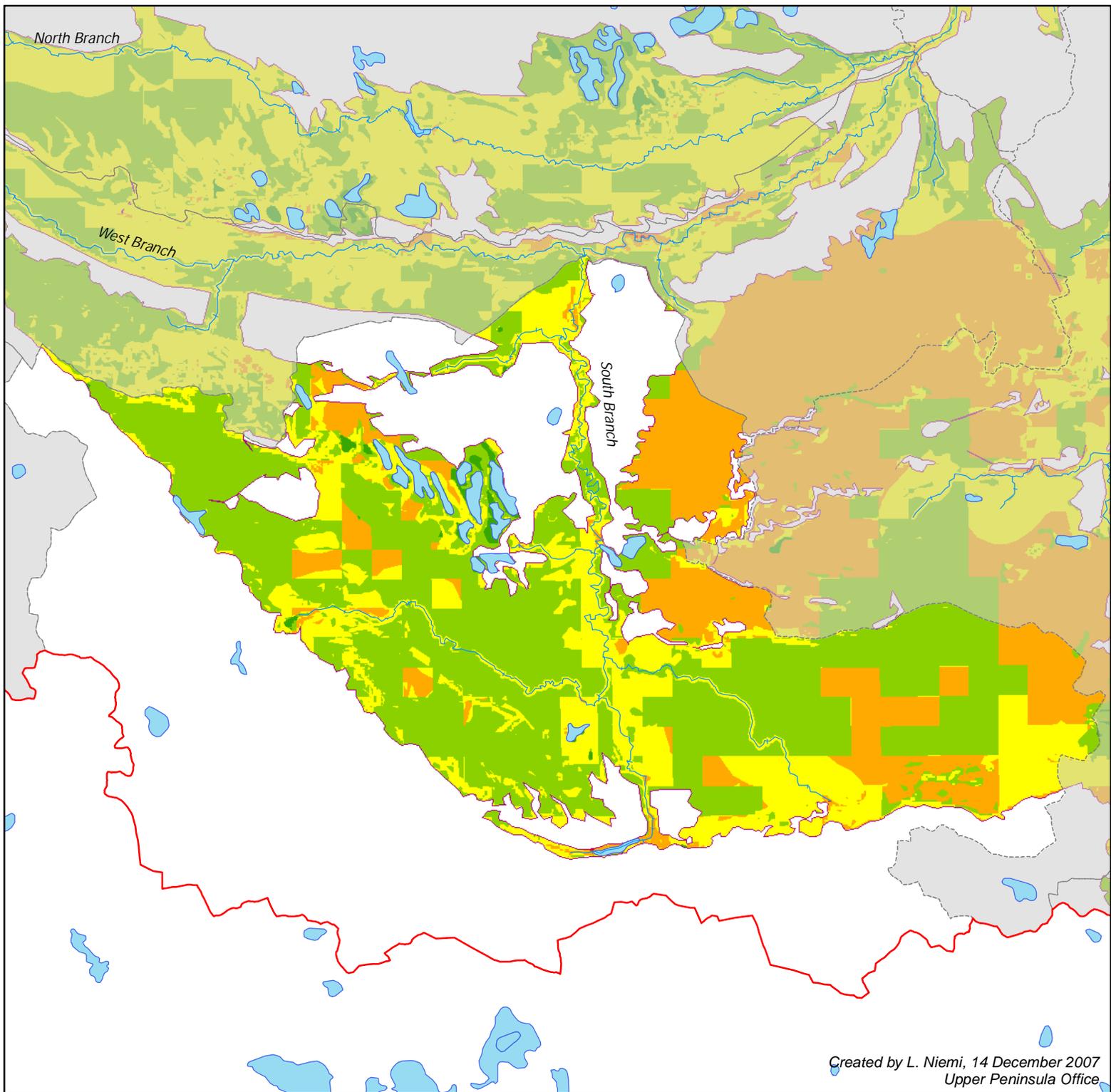
Development Sensitivity Ranking - mainstem Two Hearted River



Protecting nature. Preserving life.™



The riparian area was analyzed for its sensitivity to further development. Parameters utilized in this analysis included: nearness to river/stream, ownership, septic suitability, erosion potential, building suitability, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 22, with 22 being the most sensitive area. The sensitivity ranks were classified into five categories using the Equal Interval classification (Low, Low-Moderate, Moderate, Moderate-High, High).

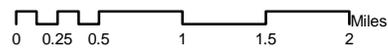


Created by L. Niemi, 14 December 2007
Upper Peninsula Office

Development Sensitivity Ranking -South Branch Two Hearted River

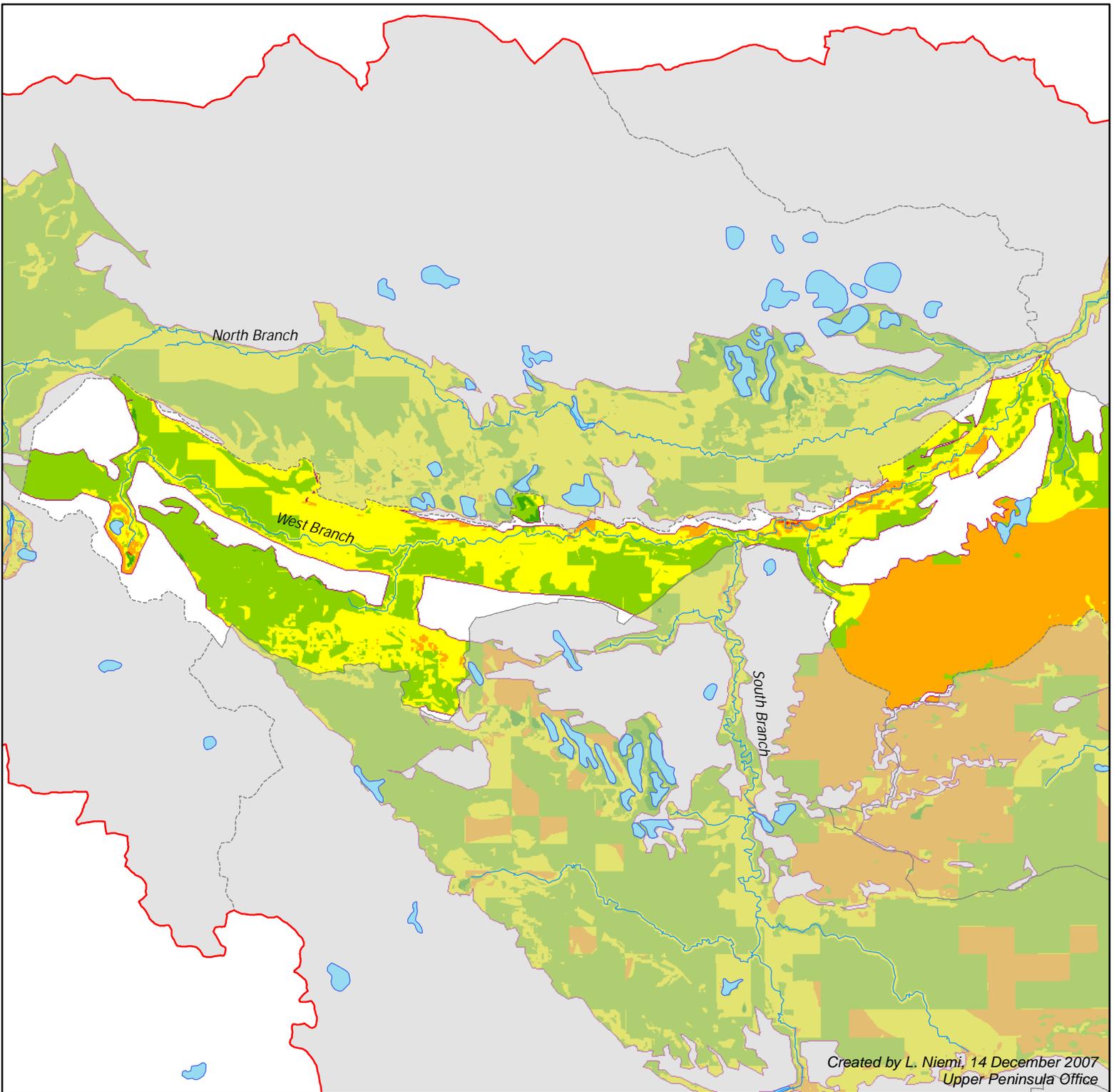


Protecting nature. Preserving life.™



The riparian area was analyzed for its sensitivity to further development. Parameters utilized in this analysis included: nearness to river/stream, ownership, septic suitability, erosion potential, building suitability, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 22, with 22 being the most sensitive area. The sensitivity ranks were classified into five categories using the Equal Interval classification (Low, Low-Moderate, Moderate, Moderate-High, High).



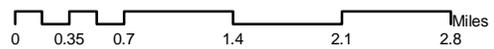


Development Sensitivity Ranking -West Branch Two Hearted River



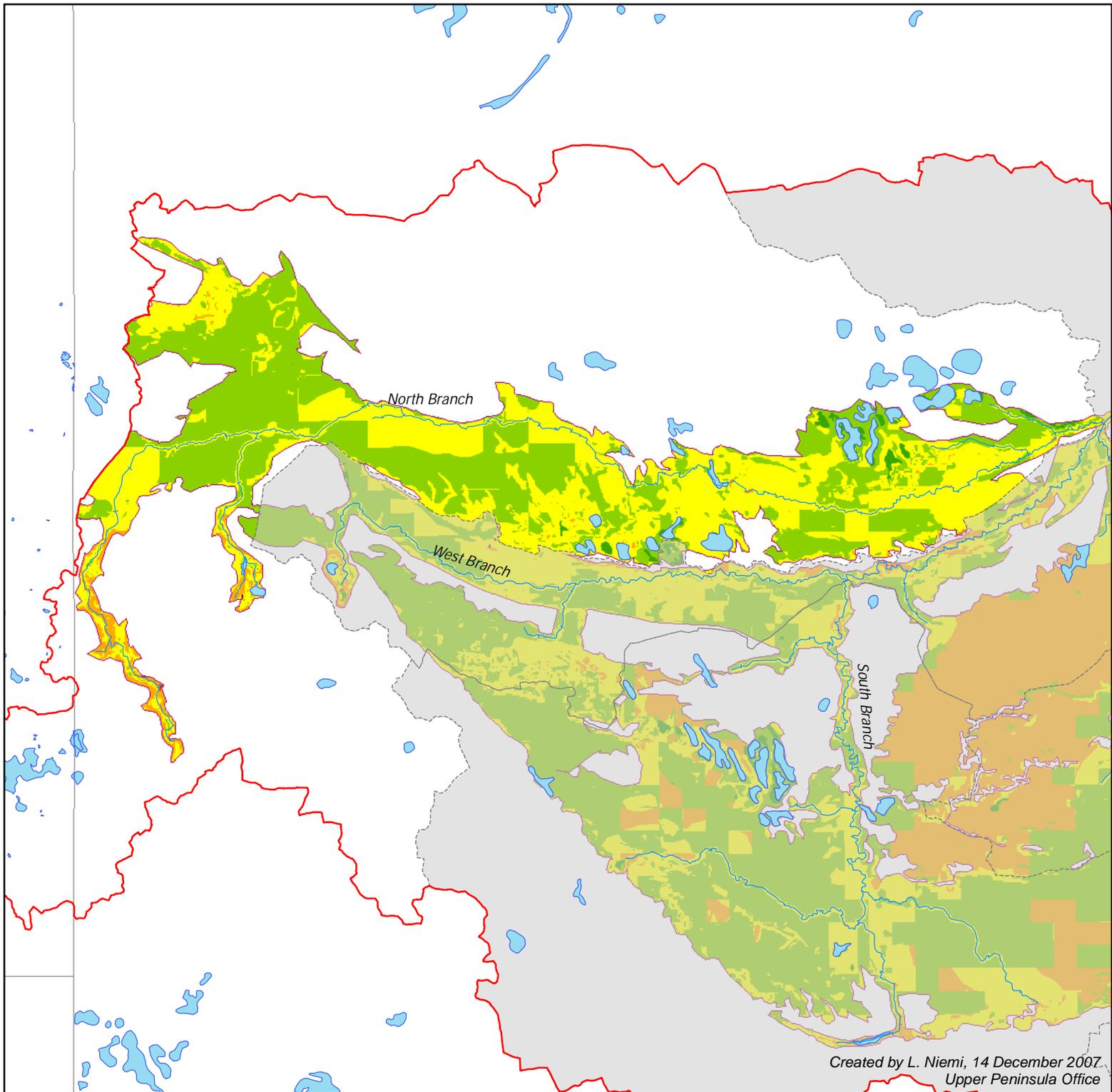
The Nature Conservancy 

Protecting nature. Preserving life.™



The riparian area was analyzed for its sensitivity to further development. Parameters utilized in this analysis included: nearness to river/stream, ownership, septic suitability, erosion potential, building suitability, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 22, with 22 being the most sensitive area. The sensitivity ranks were classified into five categories using the Equal Interval classification (Low, Low-Moderate, Moderate, Moderate-High, High).





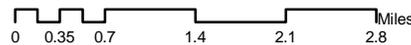
Created by L. Niemi, 14 December 2007
Upper Peninsula Office

Development Sensitivity Ranking -North Branch Two Hearted River



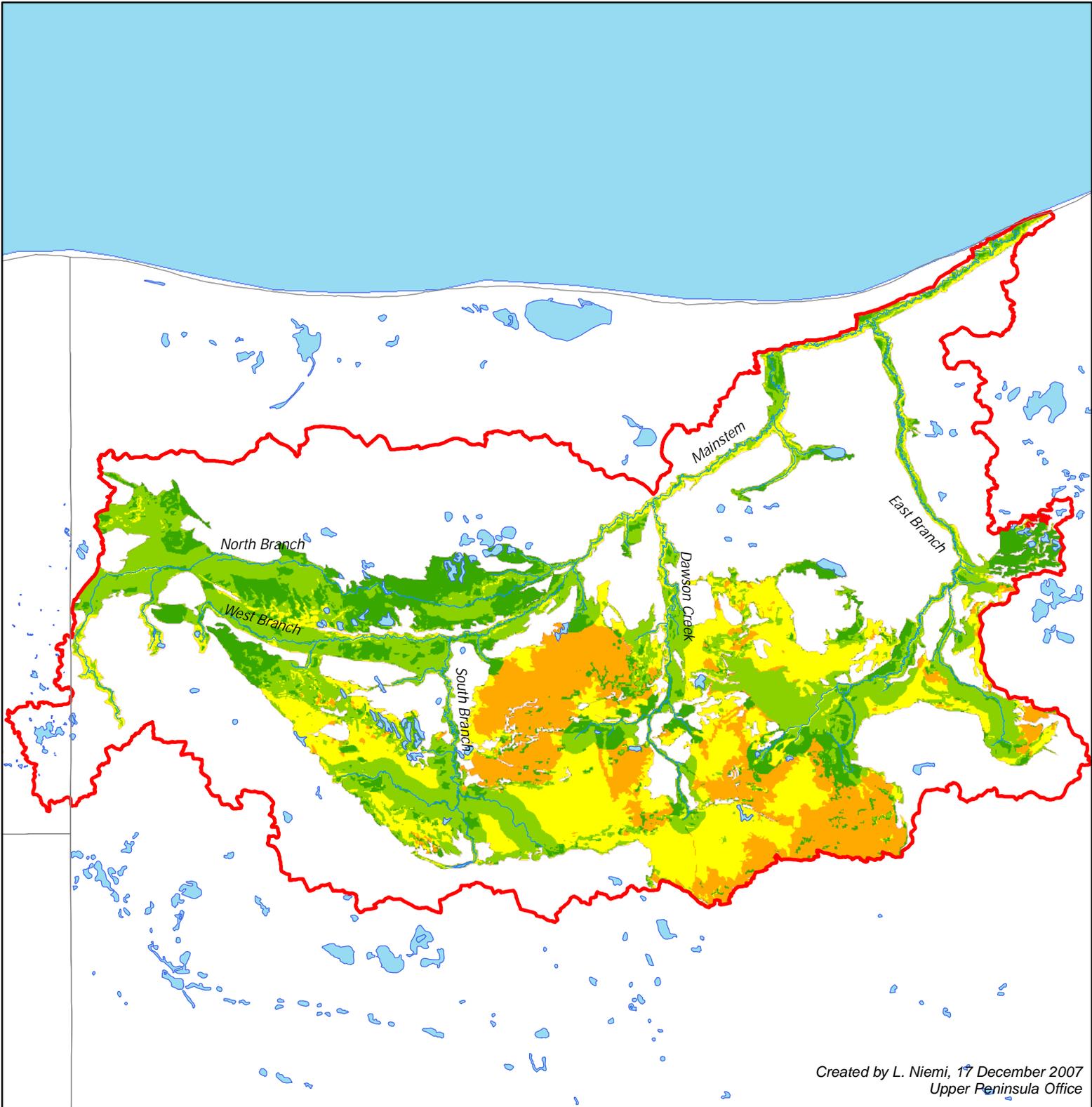
The Nature Conservancy 

Protecting nature. Preserving life.™



The riparian area was analyzed for its sensitivity to further development. Parameters utilized in this analysis included: nearness to river/stream, ownership, septic suitability, erosion potential, building suitability, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 22, with 22 being the most sensitive area. The sensitivity ranks were classified into five categories using the Equal Interval classification (Low, Low-Moderate, Moderate, Moderate-High, High).



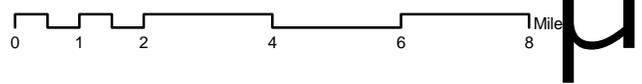


Created by L. Niemi, 17 December 2007
Upper Peninsula Office

Forestry Sensitivity Ranking

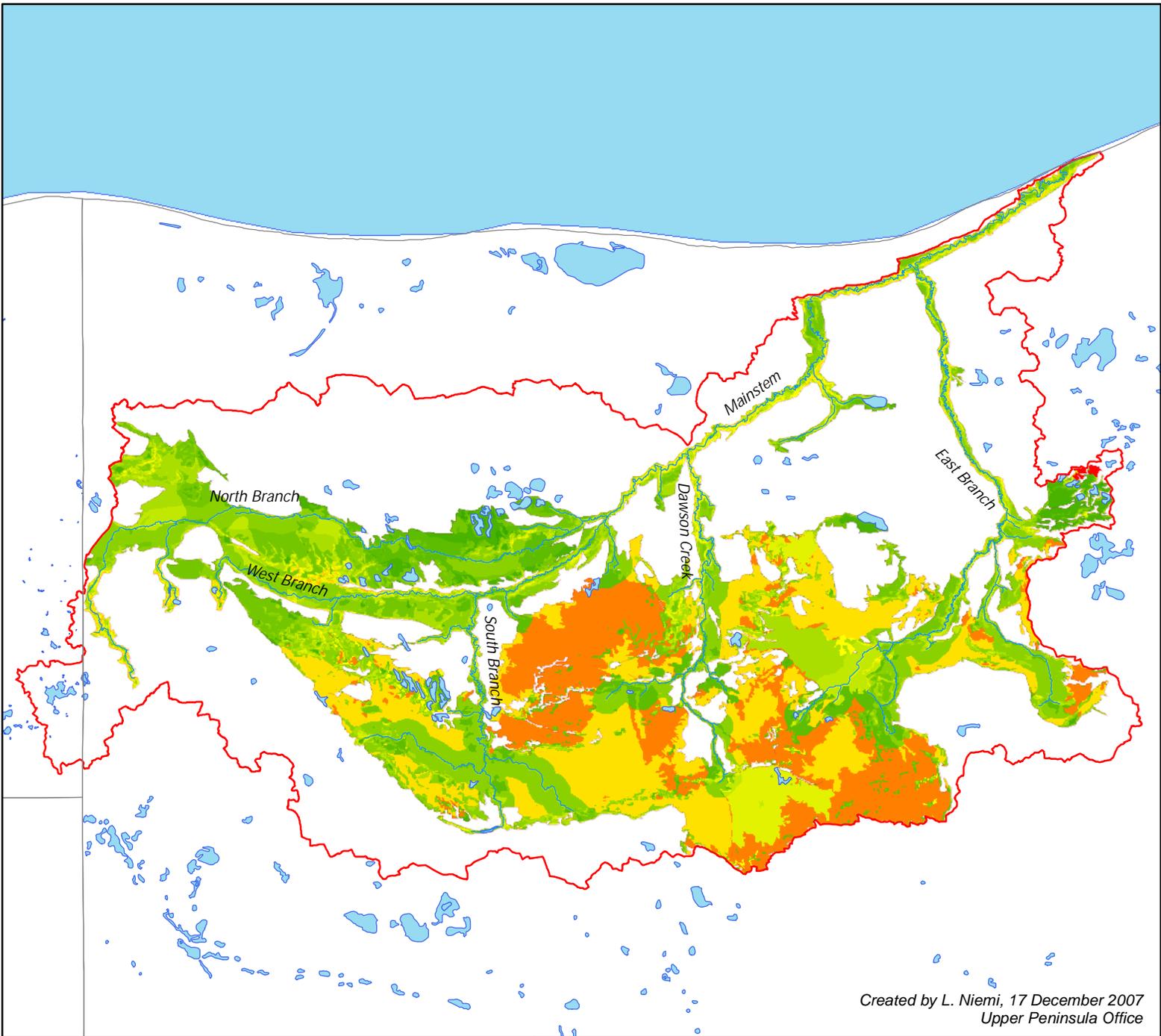
- Low
- Low - Moderate
- Moderate
- Moderate - High
- High

- Two Hearted River
- Wetland Based Riparian Area
- Two Hearted River Watershed



The Nature Conservancy 
Protecting nature. Preserving life.™

The riparian area was analyzed for its sensitivity to forest management activity. Parameters utilized in this analysis included: nearness to river/stream, erosion potential, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 17, with 17 being the most sensitive area. The sensitivity ranks were classified into five categories using the Equal Interval classification (Low, Low-Moderate, Moderate, Moderate-High, High).



Created by L. Niemi, 17 December 2007
Upper Peninsula Office

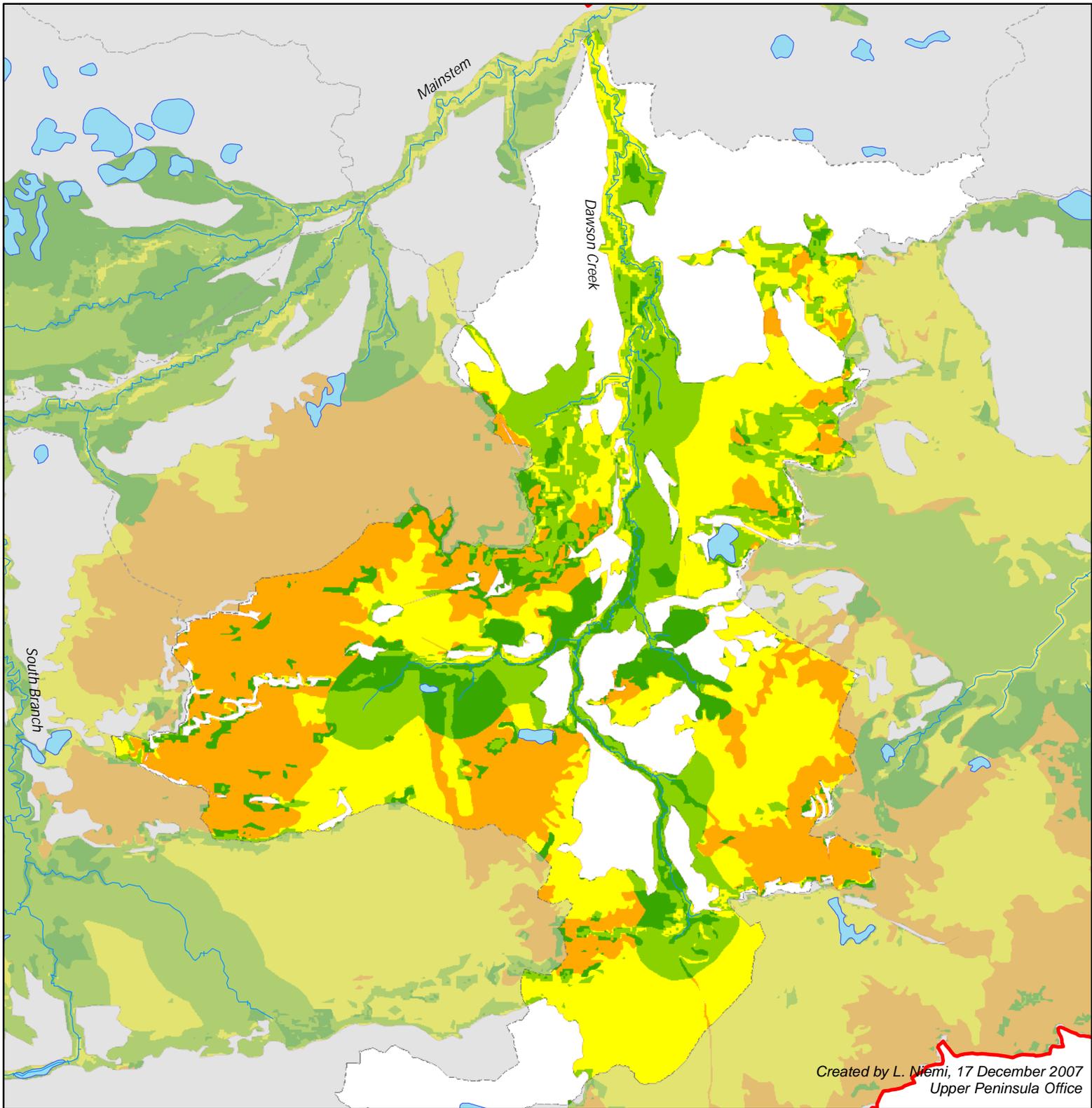
Forestry Sensitivity Ranking (attribute = RankSumFin)



Protecting nature. Preserving life.™



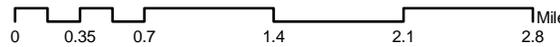
The riparian area was analyzed for its sensitivity to forest management activity. Parameters utilized in this analysis included: nearness to river/stream, erosion potential, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 17, with 17 being the most sensitive area.



Forestry Sensitivity Ranking -Dawson Creek

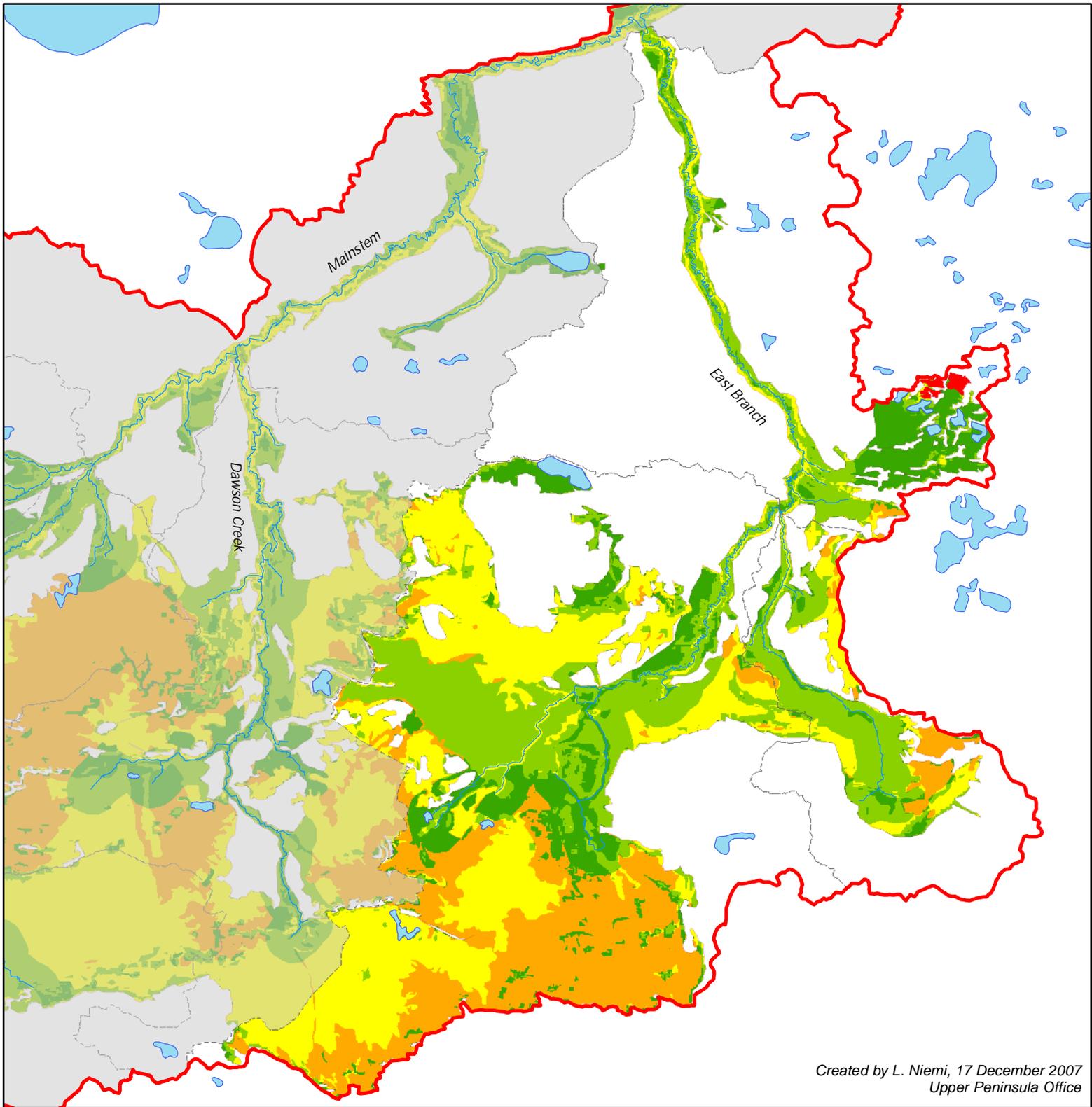
- Low
- Low - Moderate
- Moderate
- Moderate - High
- High

- Two Hearted River
- Wetland Based Riparian Area
- Two Hearted River Watershed



The Nature Conservancy 
Protecting nature. Preserving life.™

The riparian area was analyzed for its sensitivity to forest management activity. Parameters utilized in this analysis included: nearness to river/stream, erosion potential, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 17, with 17 being the most sensitive area. The sensitivity ranks were classified into five categories using the Equal Interval classification (Low, Low-Moderate, Moderate, Moderate-High, High).

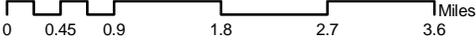


Created by L. Niemi, 17 December 2007
Upper Peninsula Office

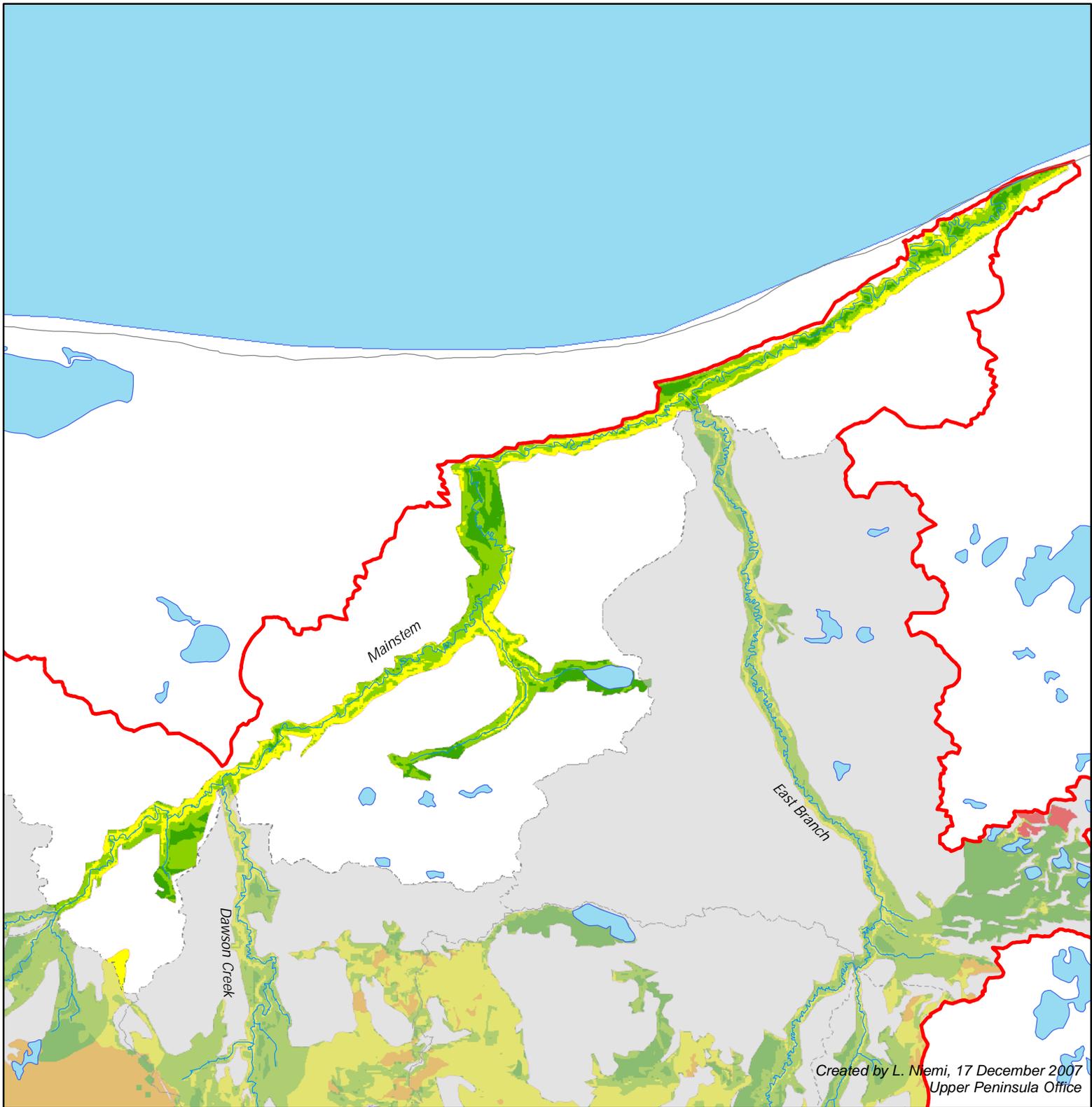
Forestry Sensitivity Ranking -East Branch Two Hearted River

- Low
- Low - Moderate
- Moderate
- Moderate - High
- High

- Two Hearted River
- Wetland Based Riparian Area
- Two Hearted River Watershed



The riparian area was analyzed for its sensitivity to forest management activity. Parameters utilized in this analysis included: nearness to river/stream, erosion potential, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 17, with 17 being the most sensitive area. The sensitivity ranks were classified into five categories using the Equal Interval classification (Low, Low-Moderate, Moderate, Moderate-High, High).



Forestry Sensitivity Ranking - Mainstem Two Hearted River

- Low
- Low - Moderate
- Moderate
- Moderate - High
- High

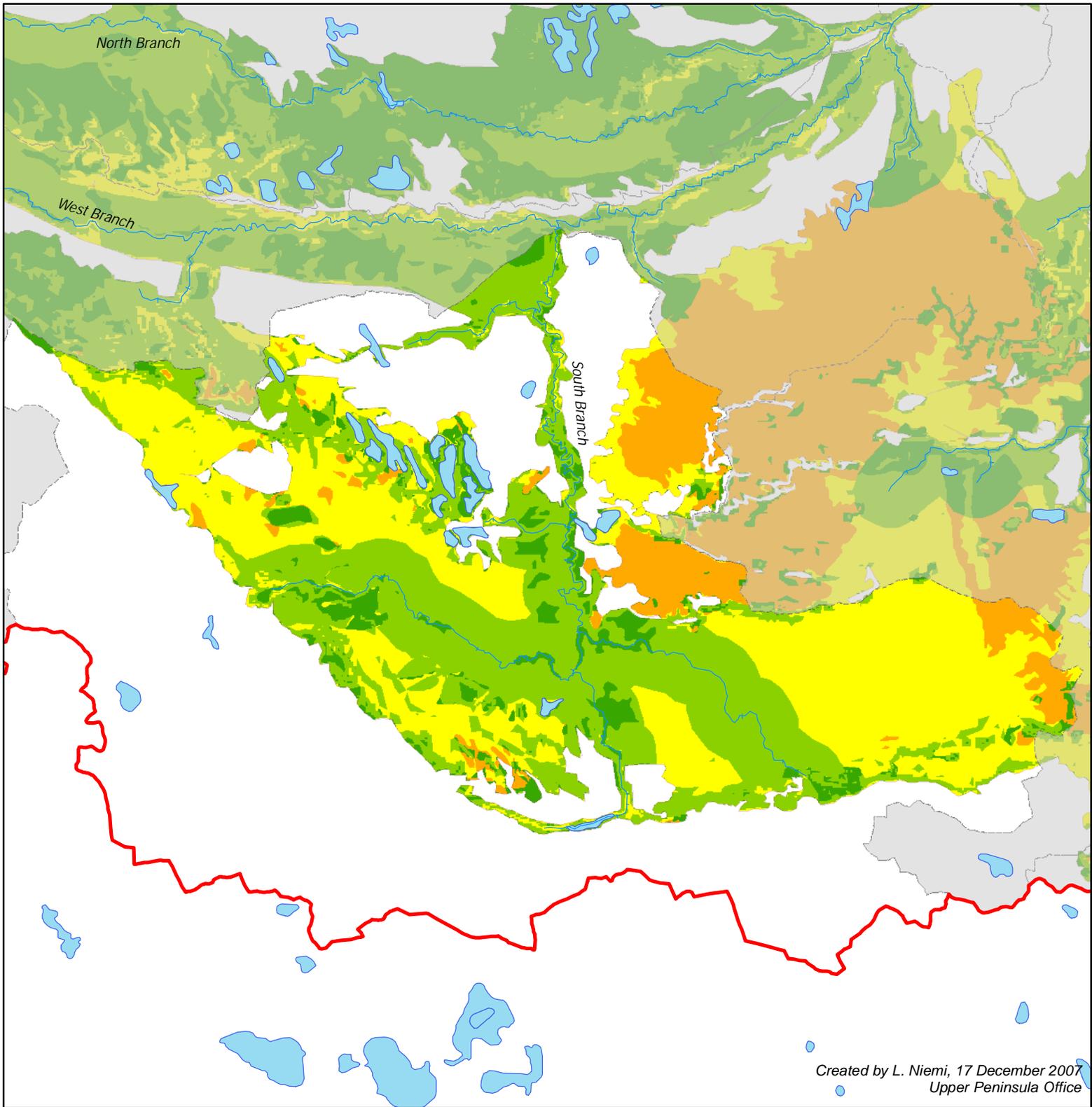
- Two Hearted River
- Wetland Based Riparian Area
- Two Hearted River Watershed



The Nature Conservancy 
 Protecting nature. Preserving life.™



The riparian area was analyzed for its sensitivity to forest management activity. Parameters utilized in this analysis included: nearness to river/stream, erosion potential, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 17, with 17 being the most sensitive area. The sensitivity ranks were classified into five categories using the Equal Interval classification (Low, Low-Moderate, Moderate, Moderate-High, High).



Created by L. Niemi, 17 December 2007
Upper Peninsula Office

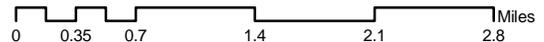
Forestry Sensitivity Ranking -South Branch Two Hearted River

- Low
- Low - Moderate
- Moderate
- Moderate - High
- High

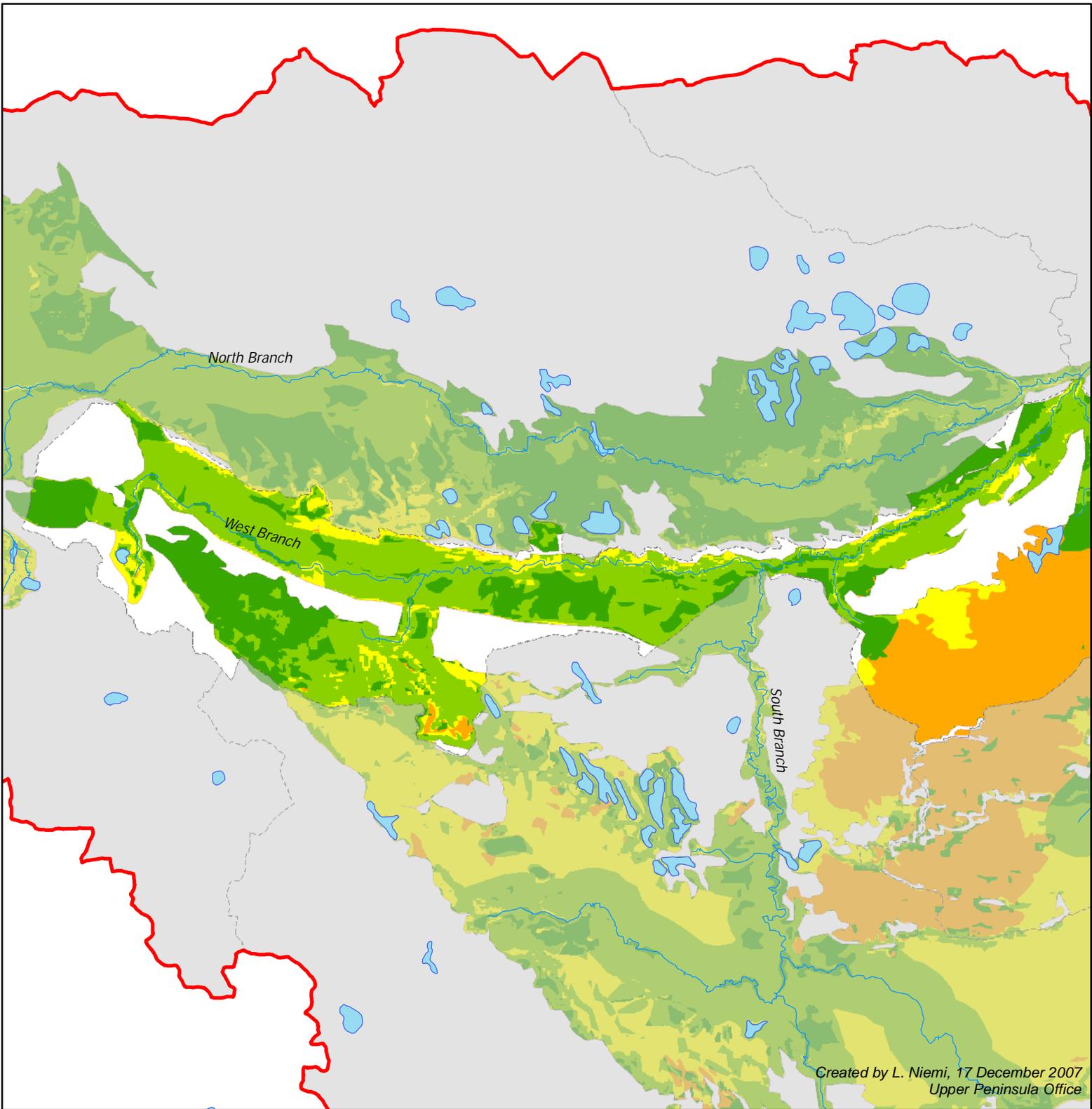
- Two Hearted River
- Wetland Based Riparian Area
- Two Hearted River Watershed



Protecting nature. Preserving life.™



The riparian area was analyzed for its sensitivity to forest management activity. Parameters utilized in this analysis included: nearness to river/stream, erosion potential, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 17, with 17 being the most sensitive area. The sensitivity ranks were classified into five categories using the Equal Interval classification (Low, Low-Moderate, Moderate, Moderate-High, High).



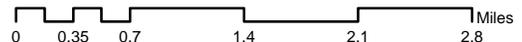
Forestry Sensitivity Ranking -West Branch Two Hearted River

- Low
- Low - Moderate
- Moderate
- Moderate - High
- High

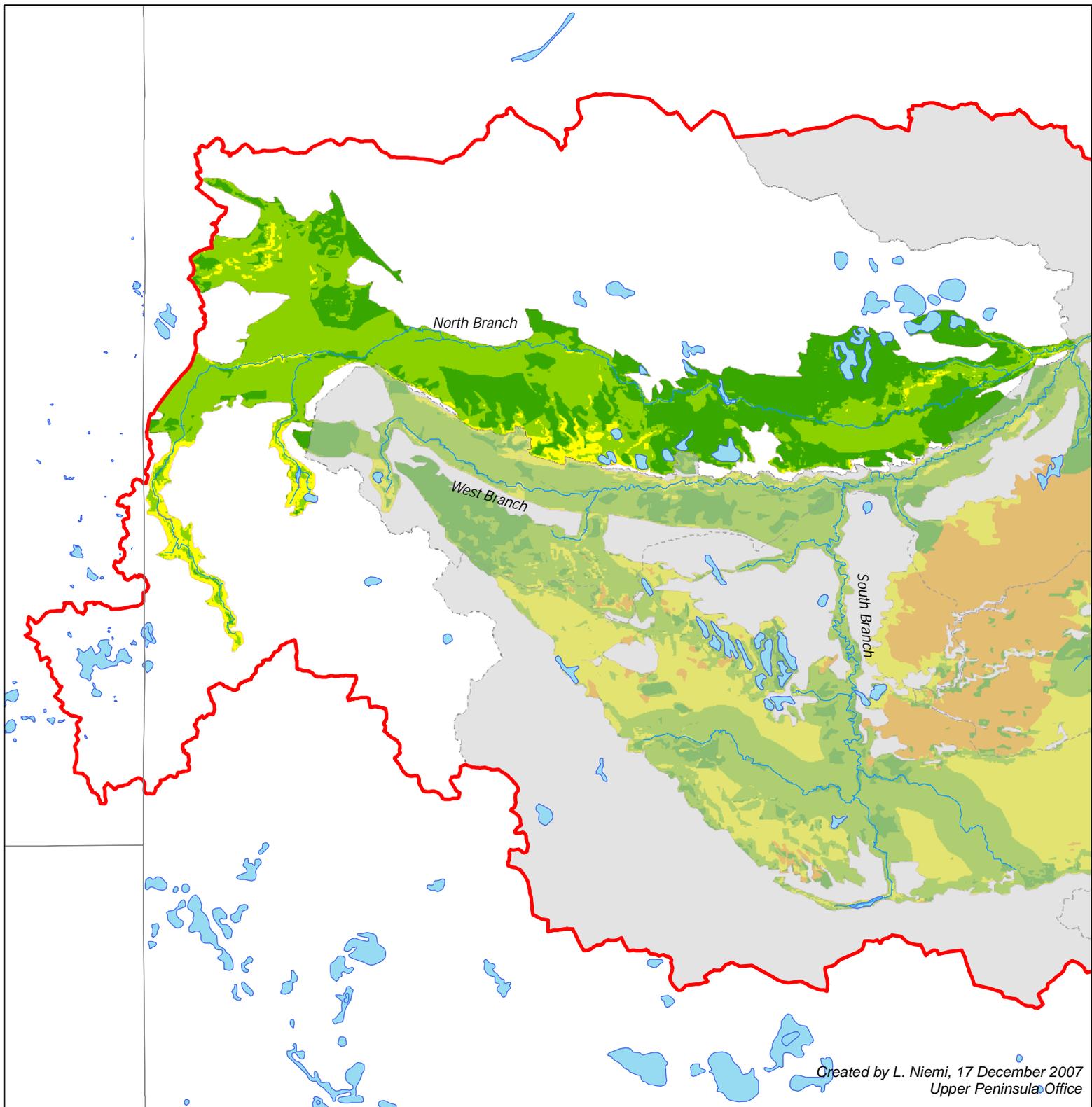
- Two Hearted River
- Wetland Based Riparian Area
- Two Hearted River Watershed



Protecting nature. Preserving life.™



The riparian area was analyzed for its sensitivity to forest management activity. Parameters utilized in this analysis included: nearness to river/stream, erosion potential, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 17, with 17 being the most sensitive area. The sensitivity ranks were classified into five categories using the Equal Interval classification (Low, Low-Moderate, Moderate, Moderate-High, High).

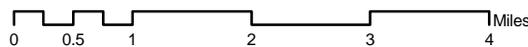


Created by L. Niemi, 17 December 2007
Upper Peninsula Office

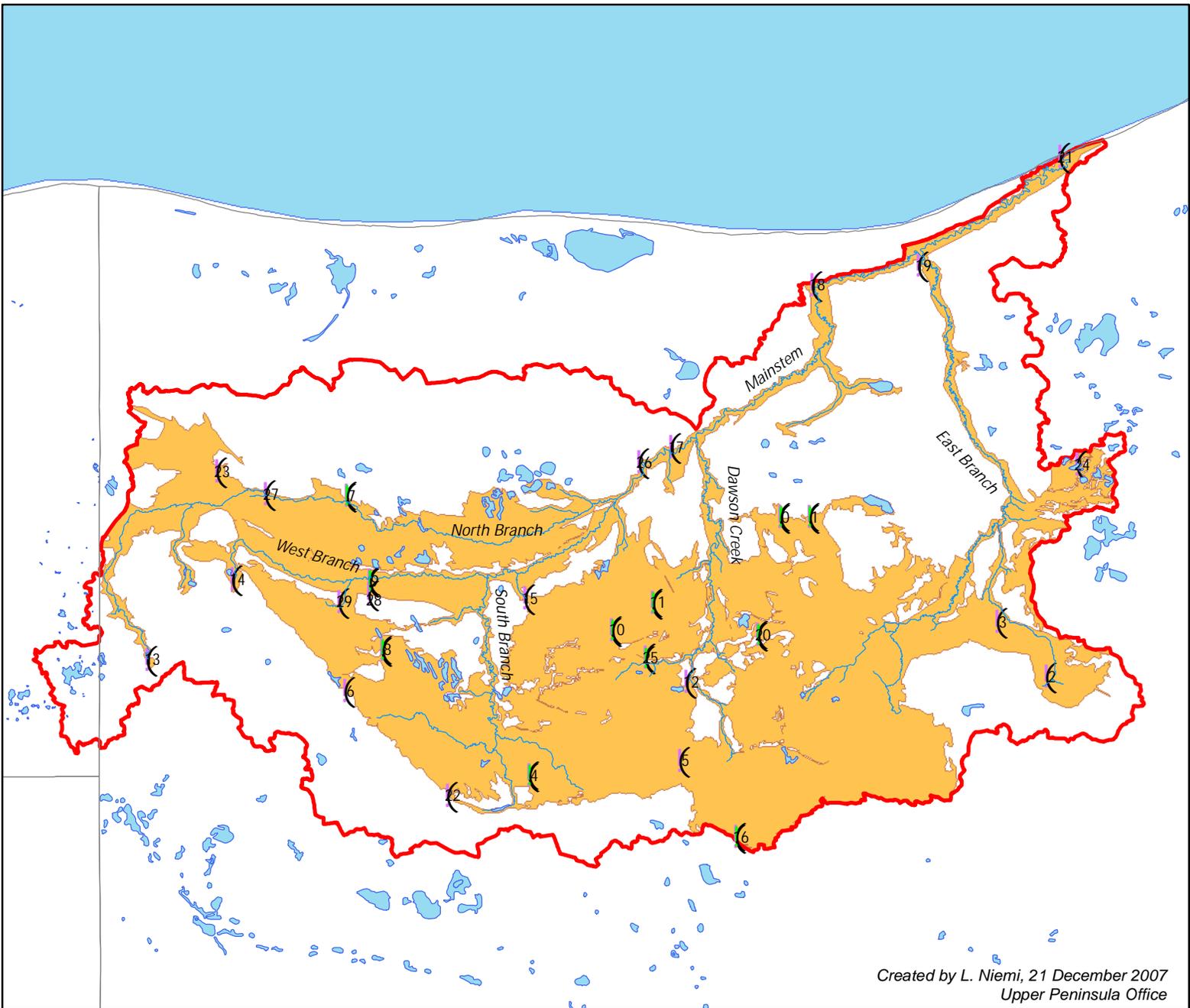
Forestry Sensitivity Ranking -North Branch Two Hearted River

- Low
- Low - Moderate
- Moderate
- Moderate - High
- High

- Two Hearted River
- Wetland Based Riparian Area
- Two Hearted River Watershed



The riparian area was analyzed for its sensitivity to forest management activity. Parameters utilized in this analysis included: nearness to river/stream, erosion potential, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 17, with 17 being the most sensitive area. The sensitivity ranks were classified into five categories using the Equal Interval classification (Low, Low-Moderate, Moderate, Moderate-High, High).



Created by L. Niemi, 21 December 2007
Upper Peninsula Office

Field Monitoring Points

(2007 Points

(2006 Points (by SCA crew)

Wetland-based Riparian Area

Two Hearted River

Two Hearted River Watershed

The Nature Conservancy 
Protecting nature. Preserving life.™

0 1 2 4 6 8 Miles



Appendix B

Summary of Riparian Area Characteristics

Wetlands

| Type of Wetland | Acres |
|-----------------|---------------|
| Beach | 10 |
| Emergent | 1,282 |
| Forested | 28,669 |
| Open Water | 1,159 |
| Scrub-Shrub | 19,325 |
| Total | 50,445 |

Percent Slope

| Percent Slope | Acres |
|---------------|--------|
| 0 to 5 | 46,493 |
| 5 to 10 | 3,712 |
| 10 to 20 | 1,181 |
| 20 to 30 | 1,163 |
| 30 to 100 | 5,354 |

Land Use/Land Cover

| Land Use Class Name | Acres | Percent of Riparian Area |
|----------------------------------|--------|--------------------------|
| Lowland Coniferous Forest | 20,810 | 36% |
| Lowland Shrub | 15,049 | 26% |
| Mixed Non-Forest Wetland | 10,707 | 19% |
| Lowland Mixed Forest | 4,101 | 7% |
| Pines | 2,301 | 4% |
| Aspen Association | 728 | 1% |
| Northern Hardwood Association | 716 | 1% |
| Water | 649 | 1% |
| Emergent Wetland | 571 | 1% |
| Floating Aquatic | 528 | <1% |
| Mixed Upland Conifers | 461 | <1% |
| Upland Mixed Forest | 406 | <1% |
| Other Upland Conifers | 399 | <1% |
| Herbaceous Openland | 191 | <1% |
| Mixed Upland Deciduous | 180 | <1% |
| Oak Association | 52 | <1% |
| Roads / Paved | 47 | <1% |
| Sand / Soil | 19 | <1% |
| Upland Shrub / Low-density trees | 8 | <1% |

Natural Features within Riparian Area

| Common Name | Scientific name | Protection Status | Global Rank* | State Rank* |
|---------------------------|-----------------------------------|-------------------|--------------|-------------|
| Bald Eagle | <i>Haliaeetus leucocephalus</i> | T | G4 | S4 |
| Common Loon | <i>Gavia immer</i> | T | G5 | S3S4 |
| Merlin | <i>Falco columbarius</i> | T | G5 | S1S2 |
| Yellow Rail | <i>Coturnicops noveboracensis</i> | T | G4 | S1S2 |
| Dry northern forest | | | G3? | S3 |
| Intermittent wetland | | | G2 | S3 |
| Patterned Fen | | | GU | S2 |
| Muskeg, Bog | | | G4 | S3 |
| Dry-mesic northern forest | | | G4 | S3 |
| Mesic northern forest | | | G4 | S3 |
| Rich conifer swamp | | | G4 | S3 |
| Hardwood-conifer swamp | | | G4 | S3 |
| Alga Pondweed | <i>Potamogeton confervoides</i> | SC | G4 | S3 |
| English Sundew | <i>Drosera anglica</i> | SC | G5 | S3 |
| Panicled Screw-stem | <i>Bartonia paniculata</i> | T | G5 | S2 |
| Wiegand's Sedge | <i>Carex wiegandii</i> | T | G3 | S2 |

Land Ownership

| Landowners | Acres | Percent of riparian area |
|---|--------|--------------------------|
| State of Michigan | 30,962 | 53% |
| The Nature Conservancy | 16,159 | 29% |
| Small Private landowners | 6,627 | 11% |
| Hunting Clubs | 2,169 | < 4% |
| Forest Product Producer (Working Forest Conservation Easement) | 1,496 | < 3% |
| Other Forest Product Producer | 491 | < 1% |

Erosion Potential

| Erosion Potential Rating | Acres |
|--------------------------|-----------|
| slight | 50,175.82 |
| moderate | 4,317.61 |
| severe | 2,178.88 |
| Unknown or open water | 1,230.47 |

Suitability for Harvesting

| Suitability for Harvesting | Acres | Percent of riparian area |
|----------------------------|--------|--------------------------|
| Well suited | 2,909 | 5% |
| Moderately Suited | 10,609 | 18% |
| Poorly suited | 43,154 | 75% |
| Unknown or open water | 1,230 | 2% |

Suitability for Building (without Basement)

| Suitability for Buildings* | Acres | Percent of riparian area |
|----------------------------|--------|--------------------------|
| Very Limited | 48,308 | 83% |
| Somewhat Limited | 7,873 | 14% |
| Not Limited | 480 | <1% |
| Not rated | 11 | <1% |
| Unknown or open water | 1,230 | 2% |

Suitability for Septic System

| Septic System Suitability | Acres | Percent of riparian area |
|---------------------------|--------|--------------------------|
| Very Limited | 56,661 | 98% |
| Not Rated | 11 | <1% |
| Unknown | 1,230 | 2% |

Sensitivity to Development within Riparian Area

| Rank Category | Sum Rank | Acres | Percent |
|-----------------|----------|--------|---------|
| Low | 1 to 5 | 902 | 2% |
| Low - Moderate | 6 to 9 | 20,408 | 35% |
| Moderate | 10 to 14 | 32,532 | 56% |
| Moderate - High | 15 to 18 | 4,012 | 7% |
| High | 19 to 22 | 60 | <1 % |

Sensitivity to Development by subwatershed

| Subwatershed | Percent within Ranking Categories per subwatershed | | | | |
|----------------|--|----------------|----------|-----------------|------|
| | Low | Low - Moderate | Moderate | Moderate - High | High |
| North Branch | 3% | 46% | 49% | 1% | 0% |
| West Branch | <1% | 35% | 61% | 3% | <1% |
| South Branch | 2% | 52% | 34% | 11% | 0% |
| Dawson Creek | <1% | 27% | 58% | 14% | <1% |
| East Branch | 0% | 26% | 68% | 5% | <1% |
| Mainstem | 2% | 20% | 61% | 18% | <1% |
| Watershed wide | 2% | 35% | 56% | 7% | <1% |

Sensitivity to Forest Management in Riparian Area

| Rank | Sum Rank | Acres | Percent |
|-----------------|----------|--------|---------|
| Low | 1 to 4 | 11,102 | 19% |
| Low - Moderate | 5 to 7 | 20,524 | 35% |
| Moderate | 8 to 11 | 16,336 | 28% |
| Moderate - High | 12 to 14 | 9,883 | 17% |
| High | 15 to 17 | 57 | <1% |

Sensitivity to Forest Management by subwatershed

| Percent within Ranking Categories per Subwatershed | | | | | |
|---|------------|-----------------------|-----------------|------------------------|-------------|
| Subwatershed | Low | Low - Moderate | Moderate | Moderate - High | High |
| North Branch | 43% | 49% | 7% | <1% | 0% |
| West Branch | 23% | 40% | 10% | 27% | 0% |
| South Branch | 10% | 39% | 41% | 10% | 0% |
| Dawson Creek | 13% | 23% | 37% | 28% | 0% |
| East Branch | 15% | 30% | 33% | 22% | <1% |
| Mainstem | 17% | 48% | 35% | <1% | 0% |
| Watershed-wide | 19% | 35% | 28% | 17% | <1% |

Appendix C

Methodology for Establishing Riparian Areas

Two riparian areas were initially designed, one with a defined maximum extent of 500 m from the river (500 m Based Riparian Area) and one without a defined maximum extent (Wetland Based Riparian Area). The 500 m based riparian area recognized the extensive wetlands in the area but did not include the full extent of these wetlands. The wetland based riparian area (WBRA) included the full extent of the wetlands adjacent to or near the river. Due to the nature of the watershed, a wetland-dominated system, the WBRA was utilized as the basis for the GIS analysis. The following describes the methodology utilized in establishing the riparian areas of the Two Hearted River:

1. Definitions of riparian area are based on *A Functional Definition and Identifying Functional Riparian Areas on the Ground* in the paper “Defining Riparian Areas” by Bonnie L. Ilhardt, Elon S. Verry, and Brian J. Palik. This work recognizes the following:
 - a. Riparian areas as three-dimensional ecotones of interaction including the terrestrial and aquatic ecosystems that extend into the groundwater, into the canopy and across the floodplain up the near-slopes that drain to the water
 - b. Riparian areas as having variable widths based on the above
 - c. Best way to identify the riparian area is through identification of the floodplain, the terrace, and the slope between the floodplain and terrace
 - d. Adjacent waterbodies (lake, stream, pond, wetland), and floodplains are always included.
 - e. For areas with a slope >5%, the riparian area should extend one tree length beyond the top of the slope
2. Shapefiles were obtained from Michigan’s Center for Geographic Information, and existing files in The Nature Conservancy Database.
3. Soils- Data was utilized from USDA SSURGO. The data was then clipped to the Two Hearted watershed. Information on the soil types was found in the Luce County Soil Survey.
 - a. Information was taken from the USDA Natural Resource Conservation Service’s Soil Data Mart: <http://soildatamart.nrcs.usda.gov/Default.aspx>
 - b. Selected Michigan, Luce County (MI095), selected all soils that appeared in a SSURGO shapefile and clipped to the watershed (watershed derived from Michigan Watershed Boundary data, MDEQ, 1998), then generated the following reports:
 - Acreage and Proportionate extent of soils
 - Camp areas, picnic areas and playgrounds
 - Dwellings and small commercial buildings
 - Equipment limitations on wetlands
 - Forestland erosion and windthrow hazard
 - Forestland productivity
 - Hydric soils
 - Paths, Trails, and Golf Fairways
 - Sewage Disposal

- c. Soil attributes were entered into an excel spreadsheet and joined to the SSURGO shapefile using ArcMap 9.2.

Note: at the date of this analysis, comparable soils data for Alger County was not available; therefore it is not included in the information provided.

All soil data compiled can be found: *SoilSurveyInfoCompiled.xls*

4. 500m Based Riparian Area GIS Rules

- a. The wetland is included if it is immediately adjacent to the river – *We acknowledge that the wetlands in the Two Hearted watershed are extensive, however for ease of analysis the maximum extents was defined as 500 m from the river or tributary.*
 - i. If the adjacent wetland extends beyond 500 m from the river, the riparian area is cut off at the 500 m boundary.
 - ii. Wetlands were utilized first to determine the cut off, and then contours were utilized.
- b. The floodplain, slope and terrace were determined using the contour lines from the County Digital Line Graph (DLG). When the riparian area boundary was determined by elevation, it depended on the floodplain percent slope and terrace (closeness of contours).
- c. Lakes are included in the riparian area if they are immediately adjacent to the river even if their entire surface area does not fall within 500m of the river.
- d. For areas with a percent slope > 5% the riparian area extends one tree length beyond the top of the slope. The height used was 36 m, the average height of a fourteen year old eastern white pine (*Pinus strobus*). (http://www.na.fs.fed.us/spfo/pubs/silvics_manual/volume_1/pinus/strobus.htm).
- e. Feature classes used and created in the Geodatabases used for making the 500 m based riparian area:
 - *FiveHndmeterRA* – riparian area determined by the above rules.
 - *WatershedWetlandNWI* (using the Class attribute) – National Wetlands Inventory to show wetland extent.
 - *contours* (using Elev_m attribute) were used to determine wetlands extent and percent slope (contour).
 - *Mriverbuffer* – 500 m buffer created around the river

5. Wetland Based Riparian Area GIS Rules

- a. All lakes and wetlands immediately adjacent to the river were included as part of the Riparian Area. *Note: a large acreage of forested wetlands is included in this area.*
- b. The floodplain, slope and terrace were determined using the contour lines from the County Digital Line Graph (DLG). When the riparian area boundary was determined by elevation, it depended on the floodplain percent slope and terrace (closeness of contours).
- c. Feature Classes from Geodatabases used:
 - *RAWetlandbasedFINAL* - is the final riparian area.

- *WBRASoilwithErosion* - is a clip of the SSURGO expanded data file explained above.
- *WatershedWetlandNWI* (using the Class attribute) – National Wetlands Inventory to show wetland extent.
- *contours (using Elev_m attribute)* - was used to determine wetlands and slope (contour).
- *WBRASoilwithErosion* - SSURGO soil data was used and the attribute table was expanded upon using soil data taken from the NRCS soil data mart. The following is the key for the “tree” attribute:

| | |
|--------------------------|----------------------------|
| AB- American Birch | NWC – Northern White Cedar |
| BA – Big Tooth Aspen | PB – Paper Birch |
| BC – Black Cherry | QA – Quaking Aspen |
| BF – Balsam Fir | RM – Red Maple |
| BS – Black Spruce | RP – Red Pine |
| EA – Eastern Arborvitae | SA- Speckled Alder |
| EH – Eastern Hemlock | SM- Sugar Maple |
| EWP – Eastern White Pine | T – Tamarack |
| JP – Jack Pine | YB – Yellow Birch |
| NRO – Northern Red Oak | WS – White Spruce |

6. Two Hearted Natural Rivers Plan

The Two Hearted Natural Rivers Plan identifies a 400 foot Natural River District along either side of the mainstem and major tributaries and a 100 foot natural vegetation strip along either side of the mainstem and major tributaries with restrictions on forestry activities and structures. These were digitized in the following feature classes:

- NatRiverDistrict400ft
- NatRiver100ftbuffer

7. Voluntary Best Management Practices (BMPs) Buffer widths

- The Michigan Department of Environmental Quality provides recommendations for buffer widths along waterbodies based on slope:

| Slope of land above water body or stream (%) | Minimum width of strip feet |
|--|---|
| 0 – 10 | 100 ft (30.48 m) |
| 10 – 20 | 115 ft (35.052 m) |
| 20 – 30 | 135 ft (41.148 m) |
| 30 – 40 | 155 ft (47.244 m) |
| 40 – 50 | 175 ft (53.34 m) |
| 50 + | Activity may not be advisable due to erosion potential. Extreme care must be taken to prevent movement of soil (10 ft, 3.048 m) |

- b. The above buffer widths were digitized in the following way:
- A 10 ft buffer was put around the river polyline (*2005DrawnTwoHeartedRiver.shp* – digitized using the 2005 NAIP County level orthophotos) to provide a better representation of the river width.
 - The percent slope polygon shapefile was clipped to the river buffer. Then the river was clipped into the percent slope categories (i.e. 0-10, 10-20, 20-30, 30-40, 40-50, 50+).
 - These buffers were merged together in a series of operations utilizing the XTools Pro/Layer Operations/Update Polygon Layer. This created a shapefile that maintained all of the attributes, but did not have overlapping polygons. Note: for the 50%+ slope category, we utilized a 400 foot buffer to represent these portions, although the DEQ does not provide a recommended buffer width in this instance.
 - The final buffer layer is *MerDEQupdate50allbuff.shp* and includes attributes that identify the buffer width, the associated percent slope category and the area (meters squared).

Appendix D

Methods for Identifying Sensitive Areas

1. The attributes of the riparian areas (outlined below) were used to create a ranking process for a) areas sensitive to development and b) areas sensitive to forest management.
2. Each shapefile was joined together using the Union Tool in ArcToolbox. This allowed for the joining of all the different polygon shapes while providing unique values with rank numbers for overlapping shapes. The rank numbers for each parameter were then summed for a final rank sum, thus creating a gradient of ranks according to sensitivity to each, development and forest management, across the riparian area.
3. The rank sum attribute was then broken down into 5 categories using the Equal Interval classification function in ArcMap. The following define the categories:
 - *High* – there is a very high potential that development and/or or certain timber harvesting activities will result in a negative impact on the River or its riparian area,
 - *Moderate – High* - there is a high potential that development and/or or certain timber harvesting activities will result in a negative impact on the River or its riparian area,
 - *Moderate* - there is moderate potential that development and/or or certain timber harvesting activities will result in a negative impact on the River or its riparian area,
 - *Low – Moderate* - there is minimum potential that development and/or or certain timber harvesting activities will result in a negative impact on the River or its riparian area,
 - *Low* - there is slight potential that development and/or or certain timber harvesting activities will result in a negative impact on the River or its riparian area.

Development

Eight parameters were used to conduct the analysis: nearness to river, ownership, septic suitability, erosion potential, building (without basement) suitability, slope, presence of wetlands and presence of unique natural features. When all parameter ranks were summed, each polygon within the riparian area was assigned a sum rank (from 1 to 22), representing a gradient of sensitivity to develop across the entire riparian area (see Figure D1.) This data can be found in *DevelopRankFinal.shp* (attribute – *SumRank2_0*). The sum ranks were broken down into the following categories (found in *DevelopRankFinal.shp* (attribute – *RankCatego*):

| <u>Rank Category</u> | <u>Sum Rank</u> |
|----------------------|-----------------|
| Low | 1 to 5 |
| Low- Moderate | 6 to 9 |
| Moderate | 10 to 14 |
| Moderate- High | 15 to 18 |
| High | 19 to 22 |

Below is a description of the parameters utilized and the ranks assigned to each parameter based on the attribute:

Physical Location - The Two Hearted Natural River Plan mandates a minimum of a 100 ft wide vegetation strip on each side of the river where selected removal of trees is permitted,

but must be approved by the zoning administrator and the forester. Feature class: *WatershedWideUnion*

| <u>Area</u> | <u>Rank Points</u> |
|------------------------------|--------------------|
| Within Wetland Riparian Area | 1 |
| Within 500 m Riparian Area | 2 |
| Within 100 ft River Buffer | 3 |

Ownership - Ownership provides information on the likelihood that the land will be developed in the future. Land owned by The Nature Conservancy (TNC) and the State are considered to have minimal potential for future development. Lands owned by forest product producers but that have a working forest conservation easement held by the State of MI have some potential for development. The Conservation and Recreation Lands databased from June 2007 was utilized to compile this data. Feature class: *ownerMerged_Union*

| <u>Owner</u> | <u>Rank Points</u> |
|--------------------------|--------------------|
| TNC Fee | 0 |
| State of Michigan Land | 0 |
| Working Forest Easement | 1 |
| Forest Product Producers | 2 |
| Small Private Owners | 3 |

Soil Data – Data obtained for Luce County from USDA.
Feature classes: *Septic_verylimited_Dissolve*, *ErosionWBRA*, and *WObasement_final*

| <u>Septic Suitability</u> | <u>Rank Points</u> |
|---------------------------|--------------------|
| Not Limited | 0 |
| Limited | 1 |
| Very Limited | 2 |

| <u>Erosion Potential</u> | <u>Rank Points</u> |
|--------------------------|--------------------|
| No information | 0 |
| Slight | 1 |
| Moderate | 2 |
| Severe | 3 |

| <u>Buildings without basements</u> | <u>Rank Points</u> |
|------------------------------------|--------------------|
| Not Rated | 0 |
| Not Limited | 0 |
| Somewhat Limited | 1 |
| Very Limited | 2 |

Slope – Percent slope based on the County Digital Elevation Models (Alger, Luce). Feature class: *Slopewithranking_cliptoWBRA*

| <u>Percent slope</u> | <u>Rank Points</u> |
|----------------------|--------------------|
| 0 -5 | 0 |
| 5 -10 | 1 |
| 10 - 20 | 2 |
| 20 - 30 | 3 |
| 30 -100 | 4 |

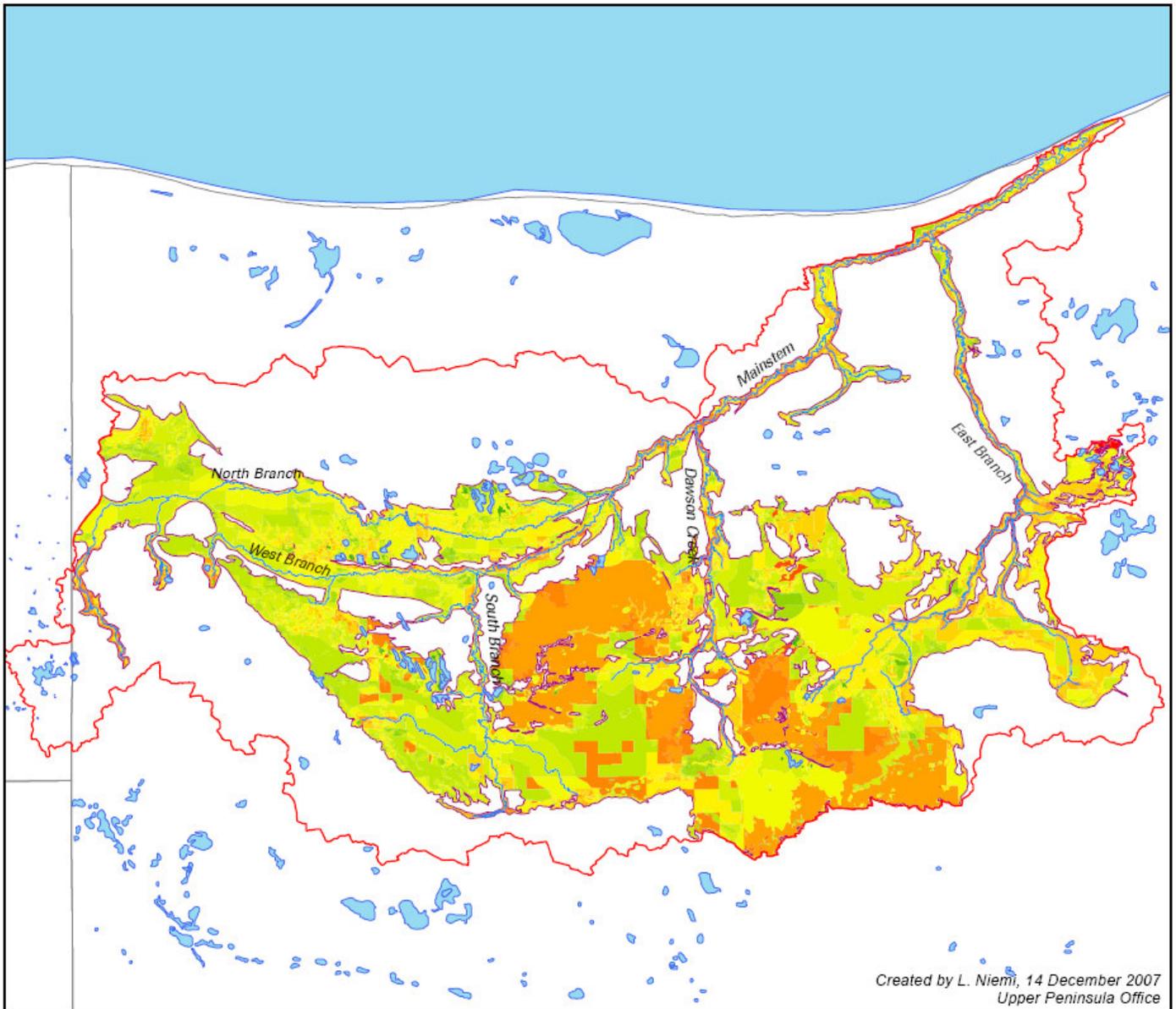
Wetlands - The National Wetlands Inventory map was utilized for this layer. Only uplands and wetlands classified as scrub-shrub or forested were considered for potential development. Emergent, open water and beach areas were not used and were considered to have a rank of 0 for this parameter. Feature class: *Wetlands_UpForSS*

| <u>Wetland Type</u> | <u>Rank Points</u> |
|---------------------|--------------------|
| Uplands | 1 |
| Forested | 2 |
| Scrub-shrub | 3 |

Unique Natural Features – Data derived from Michigan Natural Features Inventory (MNFI) January 2007 data. Natural communities rank points applied to the entire polygon of the occurrence; whereas for Plants and Animals, only the points were used to determine occurrence, and the polygons that contained these points were scored accordingly. The rank points are determined by the global and state status of the natural community, plant, or animal. For each Animal, Plant or Community, the G and S rank points were summed. If more than one unique natural feature occurred in one polygon, the points of all occurrences were summed. The Intermittent Wetland community occurrence produced an automatic “highest” ranking of 22 due to its Global Status (G2). GIS data is not provided due to confidentiality agreement between The Nature Conservancy and MNFI.

| <u>Status*</u> | <u>Rank Points</u> |
|----------------|--------------------|
| G2 | 6 |
| G3 | 3 |
| G4 | 0 |
| G5 | 0 |
| <u>GU</u> | <u>0</u> |
| S1 | 6 |
| S2 | 4 |
| S3 | 2 |
| S4 | 1 |

* status definitions may be found in Appendix F

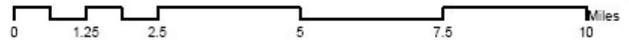


Created by L. Niemi, 14 December 2007
Upper Peninsula Office

Development Sensitivity Ranking (attribute=RankSum2_o)



- Two Hearted River
- Wetland Based Riparian Area
- Two Hearted River Watershed



The riparian area was analyzed for its sensitivity to further development. Parameters utilized in this analysis included: nearness to river/stream, ownership, septic suitability, erosion potential, building suitability, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 22, with 22 being the most sensitive area.

Figure D1. Development Sensitivity Ranking across the Two Hearted River watershed riparian area.

Forest Management

Five parameters were used to conduct the analysis: nearness to river, erosion potential, percent slope, and presence of wetlands, and presence of unique natural features. When all parameter ranks were summed, each polygon within the riparian area was assigned a sum rank (from 1 to 17), representing a gradient of sensitivity to develop across the entire riparian area (see Figure D2.) This data can be found in *ForestryRankFinal.shp* (attribute – *SumRank2_0*). The sum ranks were broken down into the following categories (found in *ForestryRankFinal.shp* (attribute – *RankCatego*):

| <u>Rank Category</u> | <u>Sum Rank</u> |
|----------------------|-----------------|
| Low | 1 to 4 |
| Low- Moderate | 5 to 7 |
| Moderate | 8 to 11 |
| Moderate- High | 12 to 14 |
| High | 15 to 17 |

Below is a description of the parameters utilized and the ranks assigned to each parameter based on the attribute:

Physical Location - The Two Hearted Natural River Plan mandates a minimum of a 100 ft wide vegetation strip on each side of the river where selected removal of trees is permitted, but must be approved by the zoning administrator and the forester. No active forest management or clear cutting is allowed within this buffer. Feature class: *WatershedWideUnion*

| <u>Area</u> | <u>Rank Points</u> |
|------------------------------|--------------------|
| Within Wetland Riparian Area | 1 |
| Within 500 m Riparian Area | 2 |
| Within 100 ft River Buffer | 3 |

Slope – Percent slope based on the County Digital Elevation Models (Alger, Luce). Feature class: *Slopewithranking_cliptoWBRA*

| <u>Percent slope</u> | <u>Rank Points</u> |
|----------------------|--------------------|
| 0 -5 | 0 |
| 5 -10 | 1 |
| 10 - 20 | 2 |
| 20 - 30 | 3 |
| 30 -100 | 4 |

Soil Data – Data obtained for Luce County from USDA.
Feature classes: *ErosionWBRA*

| <u>Erosion Potential</u> | <u>Rank Points</u> |
|--------------------------|--------------------|
| No information | 0 |
| Slight | 1 |
| Moderate | 2 |
| Severe | 3 |

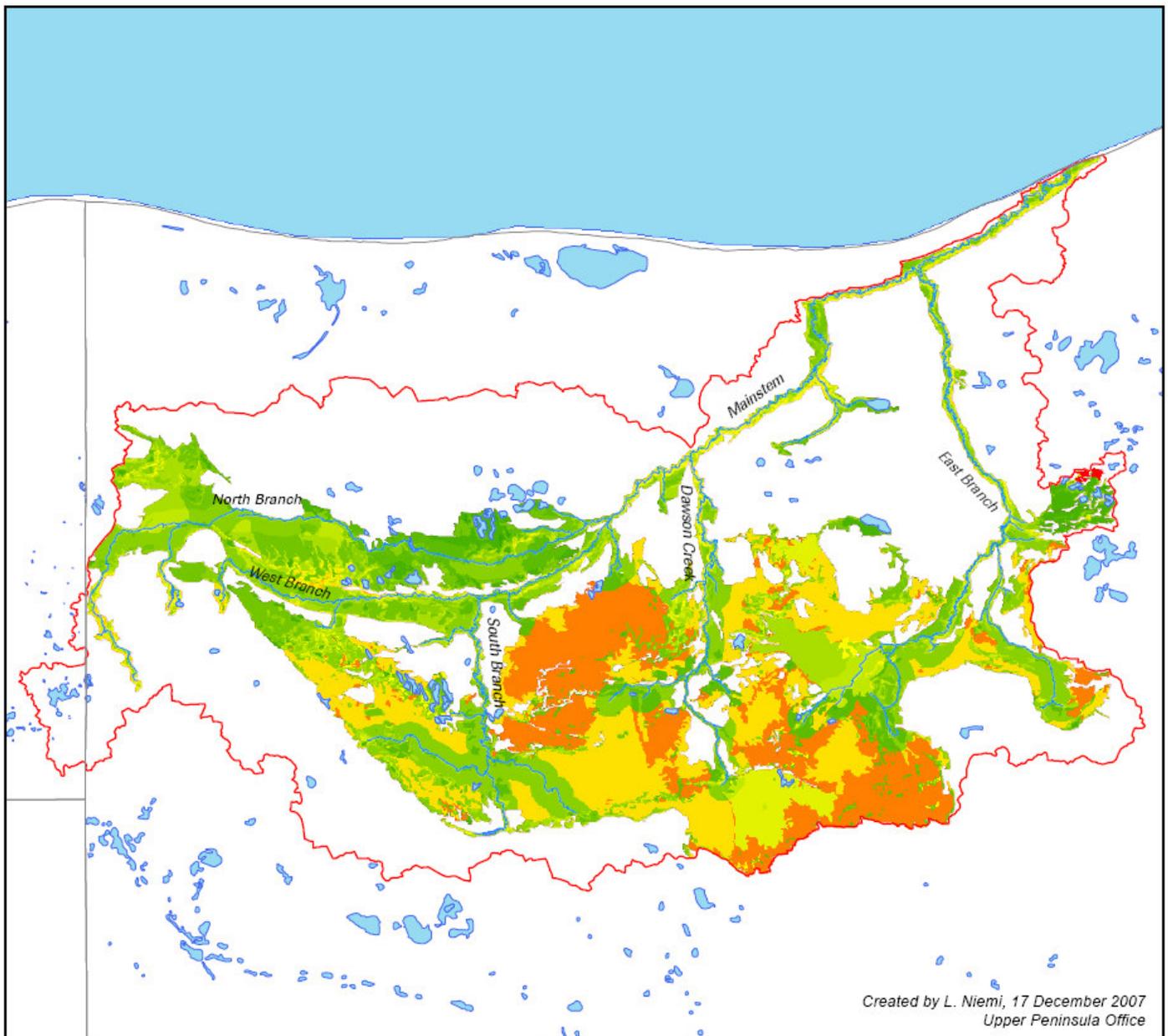
Wetlands - The National Wetlands Inventory map was utilized for this layer. Only uplands and forested wetlands were considered for potential forest management activities. Scrub-shrub, emergent, open water or beach areas were not used and were considered to have a rank of 0 for this parameter. Feature class: *PossibleTimberAreasWBRA*

| <u>Wetland Types</u> | <u>Rank Points</u> |
|----------------------|--------------------|
| Uplands | 1 |
| Forested | 2 |

Unique Natural Features – Data derived from Michigan Natural Features Inventory (MNFI) January 2007 data. Natural communities rank points applied to the entire polygon of the occurrence; whereas for Plants and Animals, only the points were used to determine occurrence, and the polygons that contained these points were scored accordingly. The rank points are determined by the global and state status of the natural community, plant, or animal. For each Animal, Plant or Community, the G and S rank points were summed. If more than one unique natural feature occurred in one polygon, the points of all occurrences were summed. The Intermittent Wetland community produced an automatic “highest” ranking of 22 due to its Global Status (G2). GIS data is not provided due to confidentiality agreement between The Nature Conservancy and MNFI.

| <u>Status*</u> | <u>Rank Points</u> |
|----------------|--------------------|
| G2 | 6 |
| G3 | 3 |
| G4 | 0 |
| G5 | 0 |
| GU | 0 |
| S1 | 6 |
| S2 | 4 |
| S3 | 2 |
| S4 | 1 |

* status definitions may be found in Appendix F



Created by L. Niemi, 17 December 2007
Upper Peninsula Office

Forestry Sensitivity Ranking (attribute = RankSumFin)



The riparian area was analyzed for its sensitivity to forest management activity. Parameters utilized in this analysis included: nearness to river/stream, erosion potential, slope, wetlands, and presence of unique natural features. The sum of the ranks of each parameter yielded the overall sensitivity rank of the area. This ranged from 1 - 17, with 17 being the most sensitive area.

Figure D2. Forest Management Sensitivity Ranking across the Two Hearted River watershed riparian area.

Appendix E

Methodology for Field Monitoring and Data Collection

The field monitoring was conducted to verify the accuracy of the input data for the GIS analysis, to gauge the general characteristics and condition of the riparian area within the Two Hearted River watershed, and to provide field verification of those sites identified as sensitive to develop and/or forestry through the analysis.

The proposed monitoring points were selected based on both the forestry and development sensitivity analyses. Those areas that rated *High* in one or both categories were given first priority, followed by those locations supporting unique natural features, those with a greater percent slope, and those located within the headwaters. Using satellite imagery from 2005, monitoring points were selected to represent these categories, and the sites were narrowed down based on ownership (namely lands under State or TNC land were utilized). Due to the Sleeper Lake Fire, proposed monitoring points within the fire area were eliminated since access to these locations was prohibited during the field season. In total, 30 points were identified for field monitoring.

Of the 30 original proposed sites, 11 were either unreachable due to the Sleeper Lake Fire road closures, had SCA (Student Conservation Association crew) plots near proposed points, or had road conditions too poor to reach the general area. The 11 sites that were not visited in 2007 were substituted by points that were monitored by the SCA crew during the summer of 2006. Data collection took place on September 6-21, 2007 for 19 of the points. The SCA data were collected between June 26 and August 29, 2006 (see Figure E1). The points are labeled 0-29 in the *FieldMonitoringPoints* feature class in the Geodatabase.

At each of the 19 locations monitored in 2007, the field data answered three basic questions: 1) what is the general topography? 2) what is the general habitat type?, and 3) what is the composition of the overstory, understory/groundcover?

1. Topography:

Percent slope was utilized to measure the general topography. At each site, the nearby slope was identified. One point was established at the base of the hill and a transect was run uphill perpendicular to the base of the hill. The percent slope was measured along this transect line using a Suunto PM5/SPC clinometer.

2. General Habitat Type:

At each location, forest community types were determined based on the data collected from the overstory, understory and groundcover using the Habitat Types in Michigan (Burger and Kotar, 2003). The Habitat types in the Eastern Upper Peninsula section include:

PVE – *Pinus strobus*/ *Vaccinium angustifolium* - *Epigaea repens*

PArV – *Pinus strobus* - *Acer rubrum*/ *Vaccinium angustifolium*

PArV-Ao - *Pinus strobus* - *Acer rubrum*/ *Vaccinium angustifolium* – *Apocynum* variant

PArVAa- *Pinus strobus* - *Acer rubrum*/ *Vaccinium angustifolium* - *Aralia nudicaulis*

ATFD – *Acer saccharum* – *Tsuga canadensis* – *Fagus grandifolia*/ *Dryopteris spinulosa*

AFPo – *Acer saccharum* – *Fagus grandifolia* / *Polygonatum pubescens*

AFOAs – *Acer saccharum* – *Fagus grandifolia* / *Osmohiza claytoni* – *Arisaema atrorubens*

Not all communities, such as wetlands, are identified by a specific Habitat Type; therefore, the wetland communities encountered were identified as the National Wetland class (forested wetland, scrub-shrub wetland) or as the MNFI community common name (muskeg, intermittent wetland, patterned fen, dry northern forest, mesic northern forest).

3. Vegetation Composition:

To determine the general composition of vegetation and condition at each site, the density and cover were measured in the understory and groundcover, whereas basal area was calculated for the overstory.

Overstory

The forest stand's basal area is the cross sectional area of the tree at diameter breast height (DBH~1.3 m) usually stated in meters squared per hectare (or feet squared per acre). This provides general information for foresters and other natural resource professionals on how well stocked the stand is. Basal area was collected using a wedge prism with a factor of 10. The measurement was taken at the main point as well as at the base of the slope, when the slope was less than 50%. When the percent slope exceeded 15%, as determined by a Suunto PM5/SPC clinometer, the following adjustments were made. The factor of the prism (10) was multiplied by the secant value, and then multiplied by the number of trees counted. The number of trees of each species was also noted to obtain species composition of the overstory. Point sampling and basal area calculations followed the The following sources were utilized for the basal area protocol: http://www.farmforestline.com.au/pages/6.3.1_stand_basal.html; <http://forestry.about.com/library/weekly/aa121398.htm>

Understory / Groundcover

The understory and groundcover is the layer of the natural community comprised of saplings (DBH <10cm), shrubs, and herbaceous plants. The understory and groundcover percent cover and density were taken within 6 quadrats along two transects at each monitoring site.

A transect line ran from the main point on a relatively flat terrain, either in a wetland or in the upland. The other transect line ran up the slope from the base of the hill toward the upland following a compass bearing. Three random numbers, representing meters along the transect, were generated and the three quadrats (1m x 1m) were placed at these measurements. The quadrat's center point was placed directly on the determine distance from the 0 meter of the transect line. Within each quadrat, the species were identified and the percent cover of each species was recorded, using the Braun Blanquet Cover Scale. The Braun Blanquet Scale includes the following percent cover categories: <1%, 1 -5%, 6-25%, 26-50%, 51-75%, and 76-100%. The protocol to determine percent cover followed techniques from Bullock (2006).

The SCA data (utilized at 11 sites) included general cover composition and cover percentages. Trees over 10 feet tall were counted as overstory. SCA data had no slope indication, though some plots included habitat types.

In addition to the data collected, four photographs were taken at each site to document the transect lines and the general characteristics (ie. condition, composition, and age of the forest or other natural community). The data collection form used in the field is included below.

All data from Field Data Collection is located in the excel file: *FinalMonitoringData.xls*

Actual Monitored points are in the *FieldMonitoringPoints* feature class in the Geodatabase.

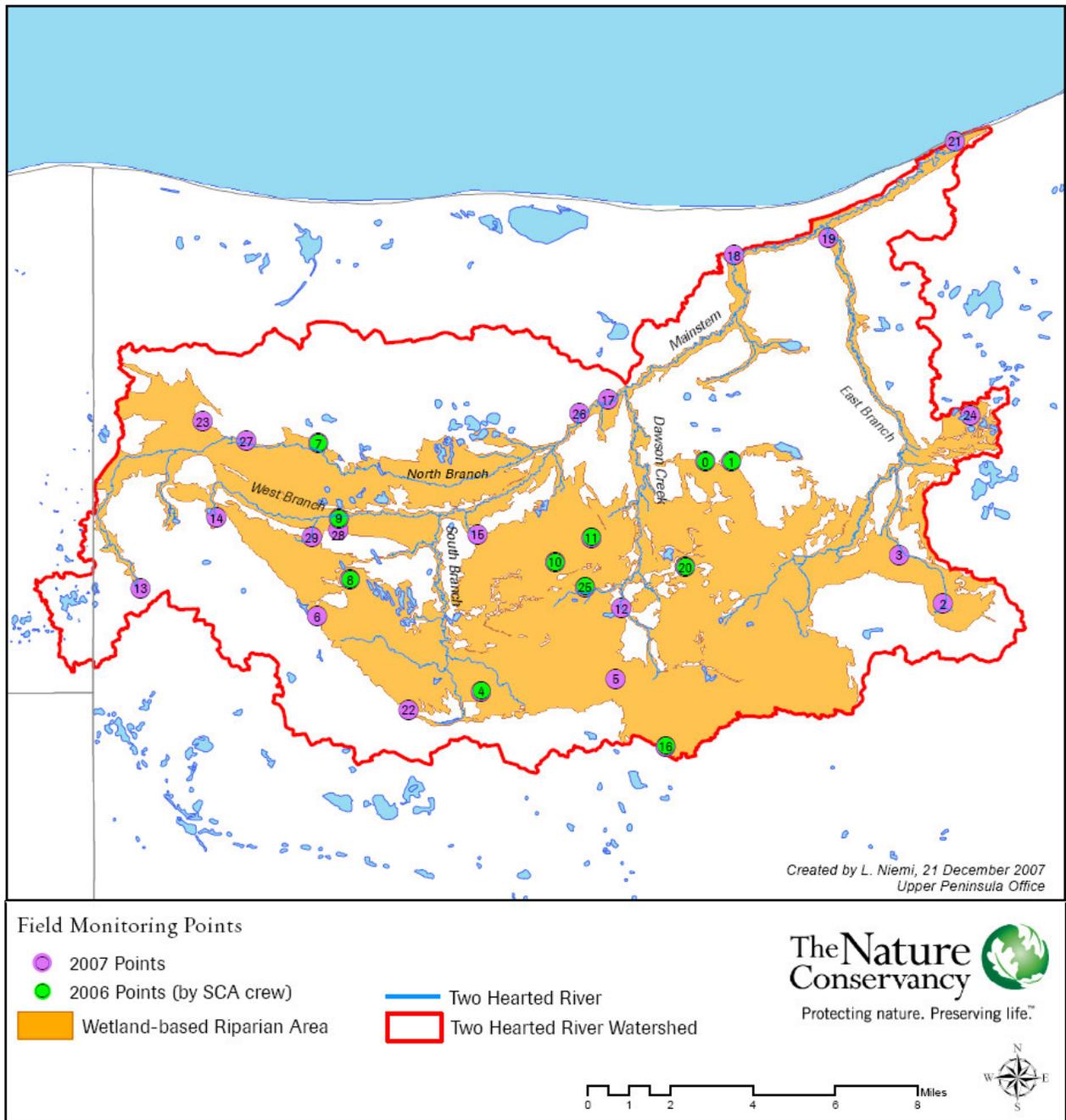


Figure E1. Field monitoring sites in Riparian Area.

Two Hearted River Analysis Field Monitoring Worksheet

Date: _____ **Conducted by:** _____

Point #: _____ **GPS Coordinates:** _____ N _____ W

Slope: Direction from Main Point: _____ Percent slope: _____

Notes:

Habitat type: PVE PArV PArV-Ao PArVAa ATFD AFPo AFOAs

Other: _____

Notes:

Main Point

Overstory

Picture 1 Direction: _____ Picture 2 Direction: _____

Species Found _____ # of individuals (density) _____

Using Prism:

of trees counted: _____

Basal Area: _____

Understory

Quadrat 1 Direction from Main Point: _____ Meters along transect: _____
Species Found _____ # of individuals (density) _____ Cover _____

Quadrat 2 Direction from Main Point: _____ Meters along transect: _____
Species Found _____ # of individuals (density) _____ Cover _____

Quadrat 3 Direction from Main Point: _____ Meters along transect: _____
Species Found _____ # of individuals (density) _____ Cover _____

Slope Point:

Overstory

Picture 1 Direction: _____ Picture 2 Direction: _____

Species Found _____ # of individuals (density) _____

Slope > 15%? No Yes - Secant: _____

of trees counted: _____

Basal Area: _____

Understory

Quadrat 1 Direction from Main Point: _____ Meters along transect: _____
Species Found _____ # of individuals (density) _____ Cover _____

Quadrat 2 Direction from Main Point: _____ Meters along transect: _____
Species Found _____ # of individuals (density) _____ Cover _____

Quadrat 3 Direction from Main Point: _____ Meters along transect: _____
Species Found _____ # of individuals (density) _____ Cover _____

Appendix F

Unique Natural Feature Occurrence Status and Ranks Defined (MNFI, 2007)

LEGEND

State Status

- E Endangered
- T Threatened
- SC Special concern

Federal Status

- LE Listed endangered
- LT Listed threatened
- LELT Partly listed endangered and partly listed threatened
- PDL Proposed delist
- E(S/A) Endangered based on similarities/appearance
- PS Partial status (federally listed in only part of its range)
- C Species being considered for federal status

Global Ranks

- G1 Critically imperiled globally because of extreme rarity (5 or fewer occurrences range-wide or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.
- G2 Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.
- G3 Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g. a single western state, a physiographic region in the East) or because of other factor(s) making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.
- G4 Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- G5 Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- GH Of historical occurrence throughout its range, i.e. formerly part of the established biota, with the expectation that it may be rediscovered (e.g. Bachman's Warbler).
- GU Possibly in peril range-wide, but status uncertain; need more information.
- GX Believed to be extinct throughout its range (e.g. Passenger Pigeon) with virtually no likelihood that it will be rediscovered.

State Ranks

- S1 Critically imperiled in the state because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation in the state.
- S2 Imperiled in state because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the state.
- S3 Rare or uncommon in state (on the order of 21 to 100 occurrences).
- S4 Apparently secure in state, with many occurrences.
- S5 Demonstrably secure in state and essentially ineradicable under present conditions.
- SA Accidental in state, including species (usually birds or butterflies) recorded once or twice or only at very great intervals, hundreds or even thousands of miles outside their usual range.
- SE An exotic established in the state; may be native elsewhere in North America (e.g. house finch or catalpa in eastern states).
- SH Of historical occurrence in state and suspected to be still extant.
- SN Regularly occurring, usually migratory and typically nonbreeding species.
- SR Reported from state, but without persuasive documentation which would provide a basis for either accepting or rejecting the report.
- SRF Reported falsely (in error) from state but this error persisting in the literature.
- SU Possibly in peril in state, but status uncertain; need more information.
- SX Apparently extirpated from state.

Appendix G
Conservation Easements



Conservation Easements

Conserving Land, Water and a Way of Life

Conservation easements are one of the most powerful, effective tools available for the conservation of private lands. Their use has successfully protected millions of acres of wildlife habitat and open space in the United States and in many countries.

A conservation easement is a restriction placed on a piece of property to protect its ecological or open-space values. It is a voluntary, legally binding agreement that limits certain types of uses or prevents development from taking place now and in the future. In a conservation easement, a landowner voluntarily agrees to donate or sell certain rights associated with his or her property, such as the right to subdivide, and a private organization or public agency agrees to hold the landowner's promise not to exercise those rights.

conservation easements benefit the public and the environment

- Conservation easements conserve watersheds and aquifers, helping ensure a clean supply of water for public use.
- Conservation easements buffer treasured national parks, from Yellowstone to Canyonlands, from development and human activity. Easement lands help protect migratory corridors for wide-ranging animals such as elk and bears, which do not confine their movements to the boundaries of a park. They are also used to buffer other public lands such as military bases and national forests.
- From Maine to California, conservation easements protect open space and enhance the quality of life in rapidly growing urban and suburban areas.
- Conservation easements preserve agricultural lands, from family farms to ranches to timberlands. And easement lands on which use is restricted to agriculture often generate more in local revenues than they require in community services.

conservation easements keep land in private hands and preserve traditional land uses

- Private property subject to a conservation easement remains privately owned, and landowners often continue to live on the property.
- The option to place conservation easements on private land is an important private property right that comes with land ownership in the United States.
- Conservation easements are individually tailored to protect targeted conservation values and to meet the landowner's needs.
- Many types of private land use, such as farming, ranching and timber harvesting, can continue under the terms of a conservation easement. The easement may require the landowner to take certain actions to protect land and water resources, such as fencing a stream to keep livestock out.



© Stuart Ruckman

Along the shores of Utah Lake near Orem, Utah, the ecologically important wetlands of Cherry Hill Farm are protected through several conservation easements, both donated by and purchased from the Taylor family, who homesteaded the property in the early 1900s. The conservation easements lowered the property's estate taxes when Paul Taylor died, allowing the fourth and fifth generations of Taylors to afford to keep the property in the family, as Paul intended.

- Land subject to a conservation easement can qualify the landowner for certain tax benefits. The market values land based on its “highest and best use,” which often means development. If a property’s development rights are forfeited through a conservation easement, then the land’s development potential no longer exists and the land’s value may be lowered — in turn, lowering taxes for a landowner. Tax savings from conservation easements can help keep land intact and in private hands.

conservation easements protect land for future generations

- Most conservation easements remain with the property, even if it is sold or passed on to heirs. Current and future landowners are bound to the easement’s restrictions in perpetuity.
- Landowners place conservation easements on their property because they want to protect it beyond their lifetimes. Easements help them fulfill their vision for the future of their lands and waters.
- Through conservation easements, landowners can more easily pass on land to their children and grandchildren. By removing the land’s development potential, an easement can result in lowered estate taxes. Such a tax reduction can make a critical difference in the ability of heirs to keep the land intact; the alternative has often been subdividing the land to pay heavy estate taxes.



© Jim Steinberg

Karl and Teri Rappold have sold several conservation easements to The Nature Conservancy on their working ranch on Montana’s Rocky Mountain Front. The easements protect important grizzly bear habitat and helped the Rappolds expand their cattle ranch.

conservation easements are gaining ground

- Conservation easements are one of the most popular conservation tools employed by the more than 1,260 land trusts in the United States.
- As of 2000, local and regional land trusts in the United States had protected nearly 2.6 million acres through conservation easements — almost a fivefold increase since 1990.
- As of January 1997, The Nature Conservancy had protected 645,000 acres through conservation easement acquisitions in the United States. By June 30, 2003, that figure had swelled to more than 2 million acres.
- Over the past decade, the use of conservation easements has been expanding into Latin America, Canada, the Caribbean, Australia and the Pacific.



© Stuart Ruckman

“We realize our land has surging economic value, but it has overwhelming ecological value as well. Our goal is to preserve the property for future family generations and for the many native plants and animals which call our farm home.”

— the late Paul Taylor (right), who chose conservation easements for his Cherry Hill Farm, in Utah, to give his descendants the means to keep the land in the family

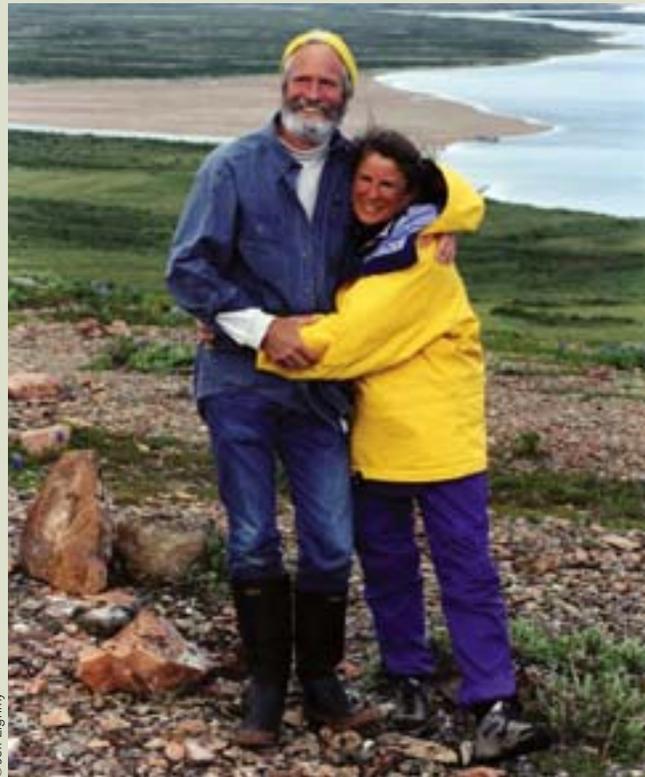
conservation easements protect landscapes efficiently and effectively

- Conservation easements extend conservation dollars by helping protect ecologically important private lands, freeing limited funds for other conservation projects.
- Conservation easements selectively target only those rights (e.g., subdivision) necessary to protect specific conservation values (e.g., migration routes).
- For more than four decades, The Nature Conservancy has been using conservation easements to protect more of a landscape from development than could be accomplished through outright purchase.
- In the Blackfoot Valley of Montana, for instance, the Conservancy accepted the state's first conservation easement on 1,800 acres in the mid-1970s. Today some 30,254 acres in the Blackfoot are covered by easements, and it is one of the most intact landscapes in all of Montana.

Since 1961, The Nature Conservancy has been engaged in the use of conservation easements that directly or indirectly protect the value of land and water as habitat for native plant and animal species.

For information on how you can place an easement on your land, or to learn how you can help support the use of conservation easements around the country and the world, contact your local office of The Nature Conservancy. A complete list of state chapter and country program offices can be found on the Conservancy's Website at nature.org/wherewework.

Cover photo: Rappold Ranch on the Rocky Mountain Front, near Choteau, Montana. ©Jim Steinberg



©Jeff Eighmy

Along the rapidly developing Front Range in Colorado, Jim and Audrey Benedict donated a conservation easement on their 484-acre Sawtooth Springs Ranch to The Nature Conservancy. Together with neighboring easements, some 1,180 acres of contiguous private land and important wildlife habitat have been protected in this part of Boulder County.

Bois Brule River, Wisconsin

In northwestern Wisconsin, the Bois Brule River flows north and drains into Lake Superior, its watershed blanketed by northern hardwoods and remnant stands of old-growth white and red pine. In the upper river region, habitat preservation and protection of the Brule's forests have been hallmarks of private property ownership for generations. Fifty years ago, private landowners banded together to form a corporation to purchase and hold a large parcel that was up for sale, to protect it from any future residential or commercial development

In the early 1980s, searching for a stronger means of protecting the river from development and increased recreational pressures, local landowners launched a conservation easement program with The Nature Conservancy. Today, conservation easements protect more than 90 percent of the privately owned riparian habitat along the upper stretch of the Brule. The Conservancy has negotiated 23 easements covering nearly 5,000 acres of the 8,320-acre Cedar Bog/Brule Spillway Conservation Area.

Appendix H

Geodatabase File List and Description

THRiparianAnalysis Geodatabase

| Feature Dataset | Feature Class | Description | Source |
|---|--------------------------------|--|--|
| Base Map Layers | 2005DrawnTwoHeartedRiver | Two Hearted River drawn by Emily Wessels; based on 2005 NAIP aerial photos | 2005 NAIP Luce County Aerial Photographs |
| | AlgerCoLakes | Lakes of Alger County | Michigan Geographic Framework v4b |
| | disslvthwatershed | Two Hearted River watershed | based on MDEQ 1998 Watershed Boundary data |
| | lakepoly_095v4b | Luce County lakes | Michigan Geographic Framework v4b |
| | twoheartedsubwatersheds | subwatersheds within Two Hearted River watershed | based on MDEQ 1998 Watershed Boundary data |
| Existing Regulations | ESAandsetbackarea | Environmentally Sensitive Area (according to Luce County Zoning Ordinance- draft) with recommended setback | digitized based on USDA SSURGO data, NWI, and 2005DrawnTwoHeartedRiver |
| | merDEQupdate50allbuff | Buffer widths on River according to MDNR/MDEQ voluntary BMPs | buffers created based on 2005DrawnTwoHeartedRiver |
| | NatRiver100ftbuffer | 100 foot buffer on River (mandatory natural vegetative buffer) | buffers created based on 2005DrawnTwoHeartedRiver |
| | NatRiverDistrict400ft | Natural River District | buffers created based on 2005DrawnTwoHeartedRiver |
| | Zoning1forbuffer | Environmentally Sensitive Area (according to Luce County Zoning Ordinance- draft) | digitized based on USDA SSURGO data, NWI, and 2005DrawnTwoHeartedRiver |
| Five Hundred meter Riparian Area | FiveHndMeterRA | 500 meter based Riparian Area of Two Hearted River | based on county Digital Elevation Models, NWI wetlands, and mriverbuffer |
| | mriverbuffer | 500 meter buffer created on River | buffers created based on 2005DrawnTwoHeartedRiver |
| Roads and Political Boundaries | ALGER_quarter_quarter_sections | Forty acre lines in Alger County | Michigan Geographic Gramwork |
| | allroads_003v3b | Roads in Alger County | Michigan Geographic Framework v3b |
| | allroads_095v3b | Roads in Luce County | Michigan Geographic Framework v3b |
| | LUCE_quarter_quarter_sections | Forty lines in Luce County | Michigan Geographic Gramwork |
| | namerds_003v3b | Roads in Alger County with their Names | Michigan Geographic Framework v3b |
| | namerds_095v3b | Roads in Luce County with their Names | Michigan Geographic Framework v3b |
| | Section_migeo | Section Lines in all of the UP | Michigan Geographic Gramwork |
| up_counties_only_miv3b | counties and outline of the UP | Michigan Geographic Framework v3b | |

| Feature Dataset | Feature Class | Description | Source |
|-----------------------------|-----------------------------|--|--|
| SensitiveArea Process | ErosionWBRA | Soil Erosion Potential for wetland Based Riparian Area | USDA NRCS SSURGO |
| | ownerMerged_Union | Owners in the wetland based Riparian area | Carl Database, TNC archives |
| | PossibleTimberAreasWBRA | wetlands (forested) in wetland based Riparian Area; used for forest management analysis | National Wetlands Inventory |
| | Septic_Verylimited_Dissolve | Very Limited soils for septic systems | USDA NRCS SSURGO |
| | Slopewithranking_CliptoWBRA | Slope from DEM within wetland based Riparian area | Digital Elevation Models |
| | WObasementFinal | Suitability of soil for building (without basement) construction within wetland based riparian area | USDA NRCS SSURGO |
| | WatershedWideUnion | Wetland based Riparian Area, 500 m based riparian area, 100 ft buffer and Two Hearted Watershed joined | based on 2005DrawnTwoHeartedRiver |
| | Wetlands_UpForSS | Wetlands used in development sensitivity ranking | National Wetlands Inventory |
| SensitiveAreas | DevelopRankFinal | final Development Sensitivity ranking | |
| | DevRankFinal_IINtsubsheds2 | Development Sensitivity Ranking by subwatershed | |
| | ForestryRank_Intsubsheds | final Forest Management Sensitivity Ranking | |
| | ForestryRankFinal | Forest Managmeent Sensitivity Ranking by subwatershed | |
| | | | |
| Watershed Wide | ContoursfromDEMs | contours of Alger and Luce Counties | based on County Digital Elevation Models |
| | SoilErosionwithRanking | Watershed wide soil data | USDA NRCS SSURGO |
| | WatershedWetlandsNWI | Watershed wide wetland data | NWI (National wetlands Inventory, by County) |
| | contours | contours of Luce county used to determine riparian areas | County Digital Line Graphs |
| | THWSSslope_final | Slope within watershed | Digital Elevation Models |
| Wetland Based Riparian Area | Esimated_GW_Recharge | Estimated Groundwater Recharge potential across UP | from Groundwater Inventory Mapping Project (MDEQ, USGS, MSU, and others) |
| | RAwetlandbasedFINAL | Wetland Based Riparian Area outline | derived from NWI, Digital Line Graphs, and 2005DrawnTwoHeartedRiver |
| | WBRAOwners | Land ownership within wetland based riparian area | derived from CARL databased, June 2007 and TNC archives |
| | WBRAslopePercent | percent slope within wetland based riparian area | based on County Digital Elevation Models |
| | WBRASoiliwithErosion | Soil data (harvest potential, erosion potential, septic suitability, building suitability, etc) within wetland based riparian area | USDA NRCS SSURGO |
| | WBRAWetlands | wetlands within wetland based riparian area | NWI (National wetlands Inventory, by County) |
| | FieldMonitoringPoints | Locations of areas where field monitoring was conducted | based on GPS points taken in field |

| Feature Dataset | Feature Class | Description | Source |
|------------------------|----------------------|--|---------------|
| Raster Files | ifmapclthrw1 | Land cover (circa 2000) of the watershed | IFMAP 2000 |
| | ifmapclwbra | Land cover (circa 2000) within the wetland based riparian area | IFMAP 2000 |
| | ifmapclWBRA1 | Use for legend of land cover | IFMAP 2000 |
| | mnfi1820clwra | Land cover change (circa 1800 - 2000) | MNFI |
| | mnfi1820clWRA1 | Use for legend for Land cover change (circa 1800 - 2000) | MNFI |