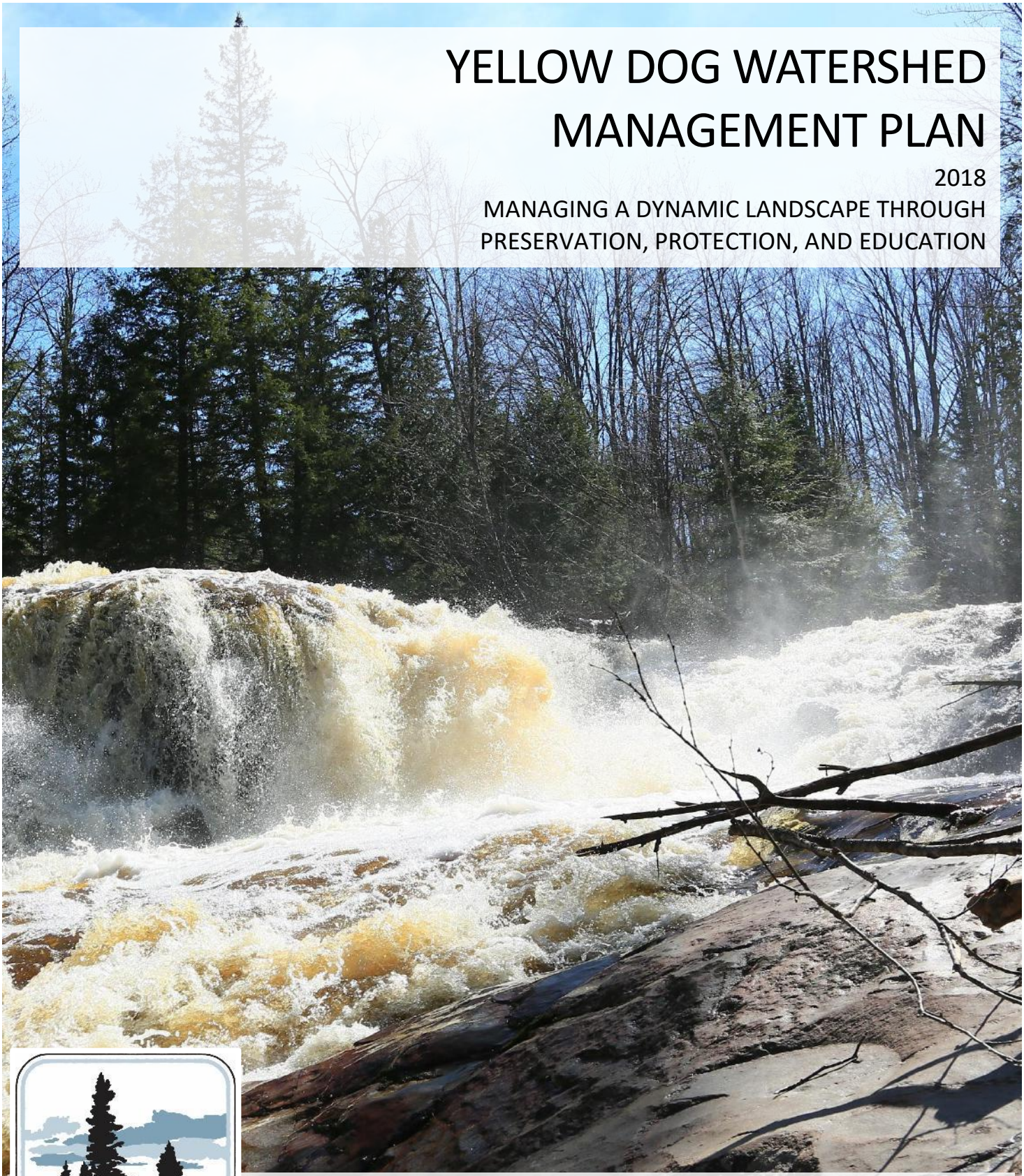
YELLOW DOG WATERSHED MANAGEMENT PLAN

2018

MANAGING A DYNAMIC LANDSCAPE THROUGH PRESERVATION, PROTECTION, AND EDUCATION



YELLOW DOG
Watershed Preserve

Provided by the
Yellow Dog Watershed Preserve
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Chapter 1 ABOUT THE PROJECT

EXECUTIVE SUMMARY

Watershed health is critical to the survival of native ecosystems and their inhabitants. In facilitating the creation of this document, the Yellow Dog Watershed Preserve (YDWP) has prioritized long-term health and management solutions over short term "quick fixes" to problems. YDWP has organized a diverse group of conservation professionals to represent the views of local and state agencies, individual and corporate landowners, and other interested parties to prioritize our concerns in a way that allows everyone to be heard.

Fifty-five percent of U.S. rivers are considered unsuitable to aquatic life according to the EPA National Rivers and Streams Assessment of 2008-2009 (U.S. Environmental Protection Agency, 2013). The report also states, "Biological condition is the most comprehensive indicator of water body health," and that healthy biology typically indicates good physical and chemical qualities as well. The Yellow Dog watershed is in good biological condition based on surveys conducted by the Yellow Dog Watershed Preserve over the past ten years and more. We will continue the planning process following the YDWP mission of *preserving and protecting the Yellow Dog Watershed, for now, and for the benefit of future generations*. Only an intact watershed system can maintain a wide range of uses, including those designated by the state.

The planning project is not a legal document. It is a set of goals, objectives, and preparatory plans created collaboratively by our community that serves as guidance for future action to protect the Yellow Dog Watershed. We hope you will consider taking part in the effort to protect this pristine area and restore areas of degradation or pollution for the long-term benefit of us all.

The Yellow Dog Watershed Preserve would like to especially thank Melinda Otto for leading this initiative and largely authoring this document. Her leadership and dedication to protecting the special places in the Upper Peninsula is admirable. Also, Ryan Leary played a significant role in revising and improving the document into completion. Both individuals deserve many congratulations and thanks.

Sincerely,

Chauncey Moran
Yellow Dog Watershed Preserve

PLAN DRVERS AND PURPOSE

The Yellow Dog Watershed Planning Project is an effort facilitated by the Yellow Dog Watershed Preserve (YDWP) out of Big Bay, MI with support and guidance provided from various stakeholders and steering committee members. The Yellow Dog Watershed Preserve was created by a group of local citizens concerned about unchecked logging and property division activities which threaten the health of the watershed. In 1995 YDWP obtained 501(c)3 status and officially became a non-profit organization, maintaining various conservation programs since: public advocacy, education, land acquisition, and water quality protection.

Due to the pressures of logging, mining, and high-impact recreational activities, the Yellow Dog watershed has been altered from its natural state. The purpose of the Yellow Dog Watershed Planning Project is to create a watershed management plan to analyze known and potential impacts and pollutants, determine their sources and causes within the watershed, create and prioritize solutions to these concerns, and formulate the necessary plans and budgets to execute them. This planning document will be used to implement our solutions, monitor, and evaluate implemented best management practices for the betterment of the Yellow Dog watershed.

The Yellow Dog Watershed Planning Project is community-based and guided by stakeholders and the help of a steering committee. Within the planning process, the steering committee has made public involvement a priority. The initial process of gathering concerns came from stakeholder input which was generated at stakeholder planning meetings. Additionally, the steering committee has provided input throughout the process through an online document sharing service called Wikispaces, via emails and phone calls, and during in-person meetings with individual organizations. This document and project development has been guided by stakeholder and steering committee suggestions and will continue to be as the document is reassessed every five years with improvements and changes being made as necessary.

YELLOW DOG WATERSHED MANAGEMENT TEAM

YELLOW DOG WATERSHED STEERING COMMITTEE:

Gene Champagne	Concerned Citizens of Big Bay
Mike Farrell	J.M. Longyear, L.L.C.
Tim Schneider	J.M. Longyear, L.L.C.
David Kallio	Landowner
Renee Leow	Marquette County Conservation District
George Madison	Michigan Department of Natural Resources, Fisheries Division
Geri Grant	Superior Watershed Partnership
Chris Burnett	Upper Peninsula Land Conservancy
David Allen	Upper Peninsula Environmental Coalition and the Sierra Club
George Lindquist	UP Whitetails of Marquette County
Chauncey Moran	Yellow Dog Watershed Preserve
Emily Whittaker	Yellow Dog Watershed Preserve

TECHNICAL SUPPORT TEAM:

Melinda Otto	Yellow Dog Watershed Preserve
Christina Spitz	Yellow Dog Watershed Preserve
Jessica Nelson	Independent Contractor
Cameron Feuss	Marquette County Equalization Department
Mitch Koetje	Michigan Department of Environmental Quality, Water Resources Division
Randy Swaty	LANDFIRE Team, The Nature Conservancy
Ryan Leary	Yellow Dog Watershed Preserve

STAKEHOLDERS:

Local residents and concerned citizens
Powell Township
Champion Township
Ishpeming Township
Michigamme Township
Concerned Citizens of Big Bay
J.M. Longyear, L.L.C.
Keweenaw Bay Indian Community
Marquette County Conservation District
Marquette County Planning and Zoning
Marquette County Road Commission
Michigan Department of Environmental Quality
U.S. Forest Service Ottawa National Forest
Plum Creek Timber
Save the Wild U.P.
Sierra Club
Superior Watershed Partnership
The Nature Conservancy
Trout Unlimited: Fred Waara Chapter
U.S. Fish and Wildlife Service
Upper Peninsula Environmental Coalition
Upper Peninsula Whitetails
USDA Natural Resources Conservation Service: Marquette Office
Yellow Dog Watershed Preserve

Chapter 2 THE NATURAL ENVIRONMENT

The following sections summarize the natural character and condition of the Yellow Dog watershed based on the results of past and recent inventories. Included are general descriptions of the location, hydrology, geology, glacial history, climate and precipitation, dams, topography, soils, vegetation, invasive species, wildlife, and natural features.

LOCATION

The Yellow Dog River is the largest river and subwatershed within the Iron River watershed. The Iron River watershed lies within the Lake Superior drainage, encompasses 62,832 acres (~98 square miles), and refers to all the land area that is drained by the Iron River (small outlet of the watershed that flows from Lake Independence to Lake Superior), including, but not limited to, the Yellow Dog River and Lake Independence (Figure 1). These watersheds are located in the central region of Michigan's Upper Peninsula in northwestern Marquette County and eastern Baraga County. The Yellow Dog River headwaters are located in the federally protected McCormick Wilderness Area of the Ottawa National Forest at a chain of interconnected lakes (Bulldog Lake, White Deer Lake, Lake Margaret and Island Lake), flows ~28 miles, and drops ~1108 feet in elevation before it reaches a wetland at the river's mouth and flows into Lake Independence. From here, water flows through Lake Independence and 3 miles down the Iron River before finally emptying into Lake Superior.

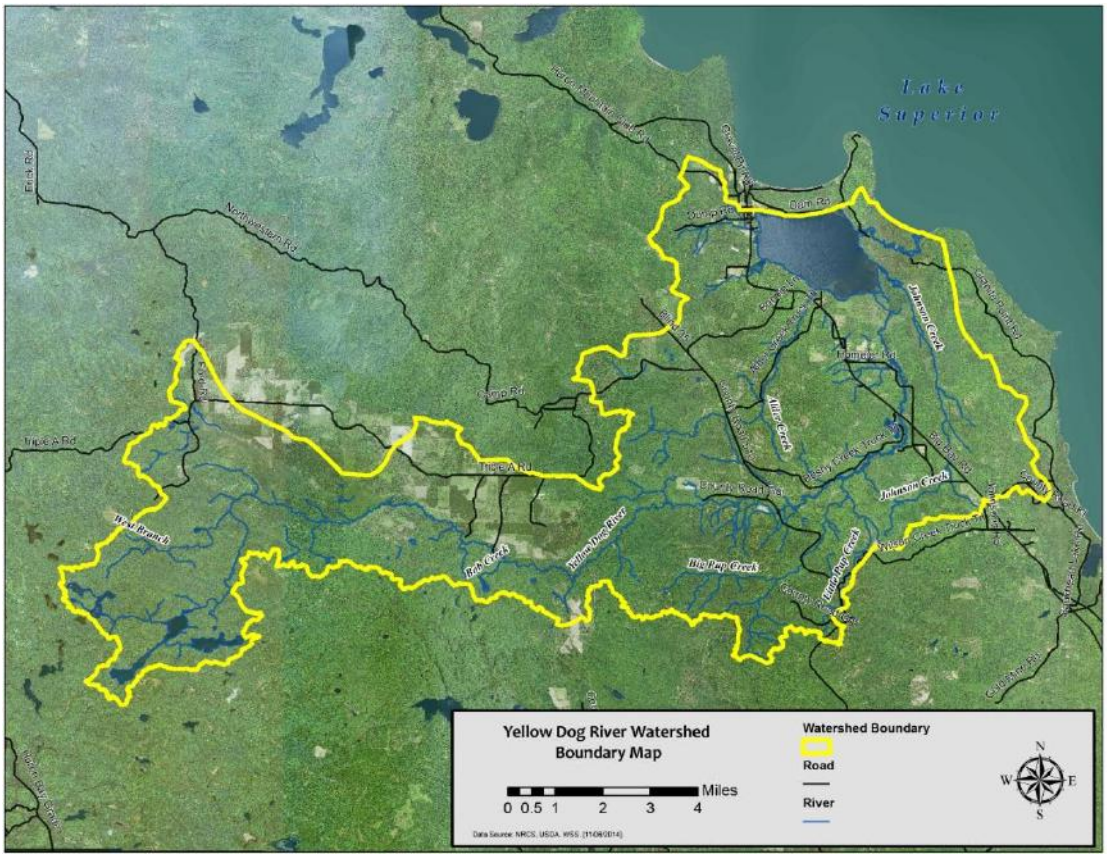


Figure 1 – Iron River watershed boundary. Map by Christina Spitz.

WATERSHED HYDROLOGY

BOUNDARIES AND WATERWAYS

The United States Geological Survey (USGS) has created a hierarchical system of 6 levels (region, subregion, basin, subbasin, watershed, and subwatershed) of hydrological units represented by hydrological unit codes (HUC) from 2 to 12 digits long. The Great Lakes Basin (HUC 04) is the first level (otherwise known as region) for the Yellow Dog River. The subregion is the Southern Lake Superior-Lake Superior (HUC 0402), the basin is Southcentral Lake Superior (HUC 040201), and the subbasin is Dead-Kelsey (HUC 04020105). The Iron River watershed is represented by HUC 0402010503 and is comprised of three subwatersheds (HUC 040201050301, 040201050302, and 040201050303), all of which consist of a portion of the Yellow Dog River.

The Iron River watershed consists of several main rivers and creeks: Yellow Dog River, Alder Creek, Johnson Creek, Bushy Creek, Big Pup Creek, Little Pup Creek, Lost Creek, Anderson Creek, and Bob Creek. Additionally, there are several lakes within the watershed with Lake Independence being the largest and most developed. Since the Yellow Dog River is the largest river and occupies the most land area within the Iron River watershed it earns the respect and concern of locals who refer to this area collectively as the Yellow Dog watershed, even though technically this collection of waterbodies comprise the Iron River watershed. The area of interest for this watershed management plan is all waters upstream from the outlet of the Iron River at Lake Superior with a focus on the Yellow Dog River; therefore, for the sake of consistency with terminology used at the local level, the Yellow Dog watershed will include all waters upstream from the Iron River outlet henceforth.

Figure 2 – Lake Independence by Jeremiah Eagle Eye.

Figure 3 – White Deer Lake in the McCormick Wilderness Area by Jeremiah Eagle Eye.

SURFACE WATER TEMPERATURE

The Yellow Dog River and its tributaries are designated trout streams based on the 2014 Fisheries Rule released by the Natural Resources Commission and the Michigan Department of Natural Resources (Michigan Department of Natural Resources, 2015). Water temperature data recorded by the U.S. Geological Survey and YDWP Volunteer Stream Monitoring Program verify that temperatures generally fluctuate between 0 and 21°C on all tributaries. Most top quality trout streams contain self-sustaining

populations of trout, and do not require fish stocking. The Yellow Dog River, stocked regularly, maintains a small population of native brook trout but the population is limited.

Tributary Name	Site ID	Location of Site	Min Temp (°C)	Max Temp (°C)
Iron River	IR1.0	N46.81327 W87.67608	8.4[1]	
Alder Creek	ADCR1.0	N46.79202 W87.70130	-1.5[1]	
Big Pup Creek	YDR5.2	N46°42'31.89" W87°42'39.14"	1.0	16.0
Little Pup Creek	YDR6.1	N46°44'30.84" W87°43'48.21"	0.7	15.5
Lost Creek	YDR6.0	N46.72892 W87.70951	2.7	13.66
Anderson Creek	YDR16.0	N46.73002 W87.94794	1.1	18.1
Bob Creek	YDR12.0	N46.71103 W87.83417	0.5	19.2

Figure 4 – Surface water temperatures recorded by YDWP volunteer stream monitoring program 2004 – 2014.

00010, Temperature, water, degrees Celsius,												
YEAR	Monthly mean in °C (Calculation Period: 2005-01-01 to 2013-09-30) [2] Calculation period restricted by USGS staff due to special conditions at/near site											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2005	0.00	0.00	0.03		11.08	18.70	19.39	18.34	15.65	9.24	2.49	
2006	0.12	0.00	0.22	5.93	11.24	16.95	19.73	17.90	13.08	5.84	2.35	0.03
2007	0.01	0.00	0.37	3.52	12.98	18.26	19.08	18.57	14.00	9.84	1.81	0.01
2008	0.02	0.00	0.01	1.87	9.95	15.97	18.15	17.47	14.06	7.70	2.47	
2009		0.00	0.16	3.04	11.15	15.70	16.14	16.77	14.94	5.50	3.40	0.11
2010	0.01	0.00	0.96	8.00	14.05	16.09	19.39	19.24	12.43	8.12	2.49	0.02
2011	0.00	0.00	0.15	2.78	10.89	15.62	20.40	18.87	13.69	8.80	2.03	0.01
2012	0.00	0.00	3.06	6.98	14.35	18.02		18.43	12.75	7.10	2.19	0.22
2013			0.00	0.41		15.99	18.59	17.35	14.05			
Mean of monthly Temperature, water	0.0	0.0	0.6	4.1	12.0	16.8	18.9	18.1	13.8	7.8	2.4	0.1

Figure 5 - USGS surface water monthly statistics for gage 04043275 in the Yellow Dog River near Big Bay, MI.

[1] New site in fall 2014 – there was not enough information to assess minimum and maximum.

[2] No incomplete data have been used for statistical calculation.

PEAK FLOW

A U.S. Geological Survey surface water gauge (No. 04043275) is located on the Yellow Dog River near Big Bay (Lat. 46°42'49", Long. 87°50'26" NAD27, at 1,370 feet above sea level). The gauge is located on the north bank adjacent to an unnamed road, 1.1 miles downstream from Wylie Falls, and 9.1 miles southwest of Big Bay. The drainage area represented by this gauge is 31.8 mi^2 (U.S. Geological Survey, 2013). The station contains a water-stage recorder and crest-stage gauge and the station has operated since 2004 in cooperation with the Keweenaw Bay Indian Community.

Figure 6 – Hills Falls on the Yellow Dog River at peak flow in May 2013.

04043275 YELLOW DOG RIVER NEAR BIG BAY, MI—Continued

SUMMARY STATISTICS

	Calendar Year 2011		Water Year 2012		Water Years 2005 - 2012	
Annual total	12,187.9		7,987.2			
Annual mean	33.4		21.8		26.8	
Highest annual mean					37.7	2006
Lowest annual mean					18.6	2009
Highest daily mean	290	Apr 11	124	Mar 19	486	Apr 22, 2008
Lowest daily mean	5.5	Aug 30	5.0	Sep 3	3.8	Aug 21, 2007
Annual seven-day minimum	5.7	Aug 26	5.4	Aug 29	3.9	Aug 21, 2007
Maximum peak flow			130	Mar 19	572	Apr 22, 2008
Maximum peak stage			4.89	Mar 19	6.61	Apr 22, 2008
Instantaneous low flow			4.8	Sep 3	3.5	Aug 28, 2007
Annual runoff (cfsm)	1.05		0.686		0.843	
Annual runoff (inches)	14.26		9.34		11.46	
10 percent exceeds	77		38		56	
50 percent exceeds	21		17		16	
90 percent exceeds	7.0		7.3		7.5	

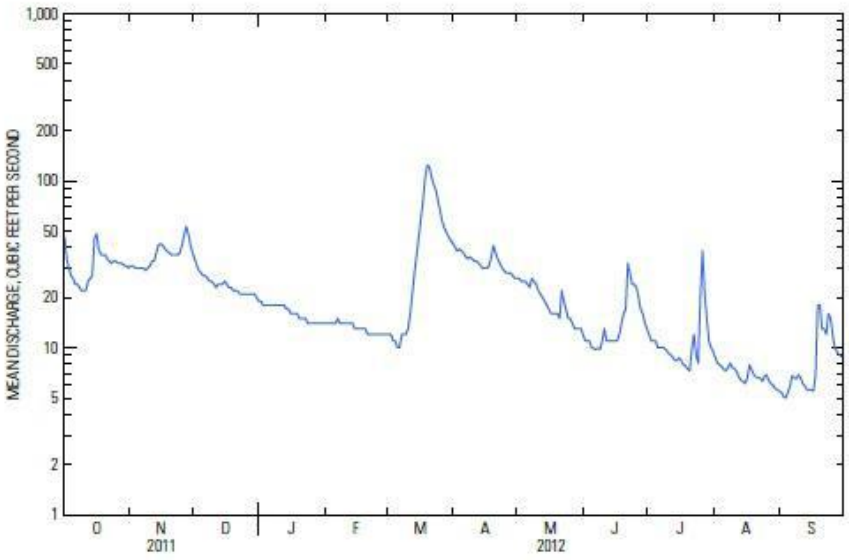


Figure 7 – Discharge in cubic feet per second for gage 04043275 in the Yellow Dog River near Big Bay, MI.

GROUNDWATER RECHARGE

Groundwater recharge is defined as inflow of water to a groundwater reservoir from the surface. One form of recharge is the infiltration of precipitation and its movement to the water table (U.S. Geological Survey, 2014). As shown in the map, recharge rates in the Yellow Dog Watershed are higher in the upland areas and lower as the topography slopes towards Lake Superior. The groundwater data used in this map was part of the Groundwater Inventory and Mapping Project, a cooperative effort between the Water Bureau (Michigan Department of Environmental Quality), Michigan Water Science Center (USGS) and Institute of Water Research (Michigan State University), and RS&GIS Biosystems and Agricultural Engineering. The project was mandated by P.A. 148 (Michigan Acts of 2003). Major funding was provided by Michigan Department of Environmentla Quality (MDEQ) and supplemented with additional funding from the USGS Cooperative Water Program.

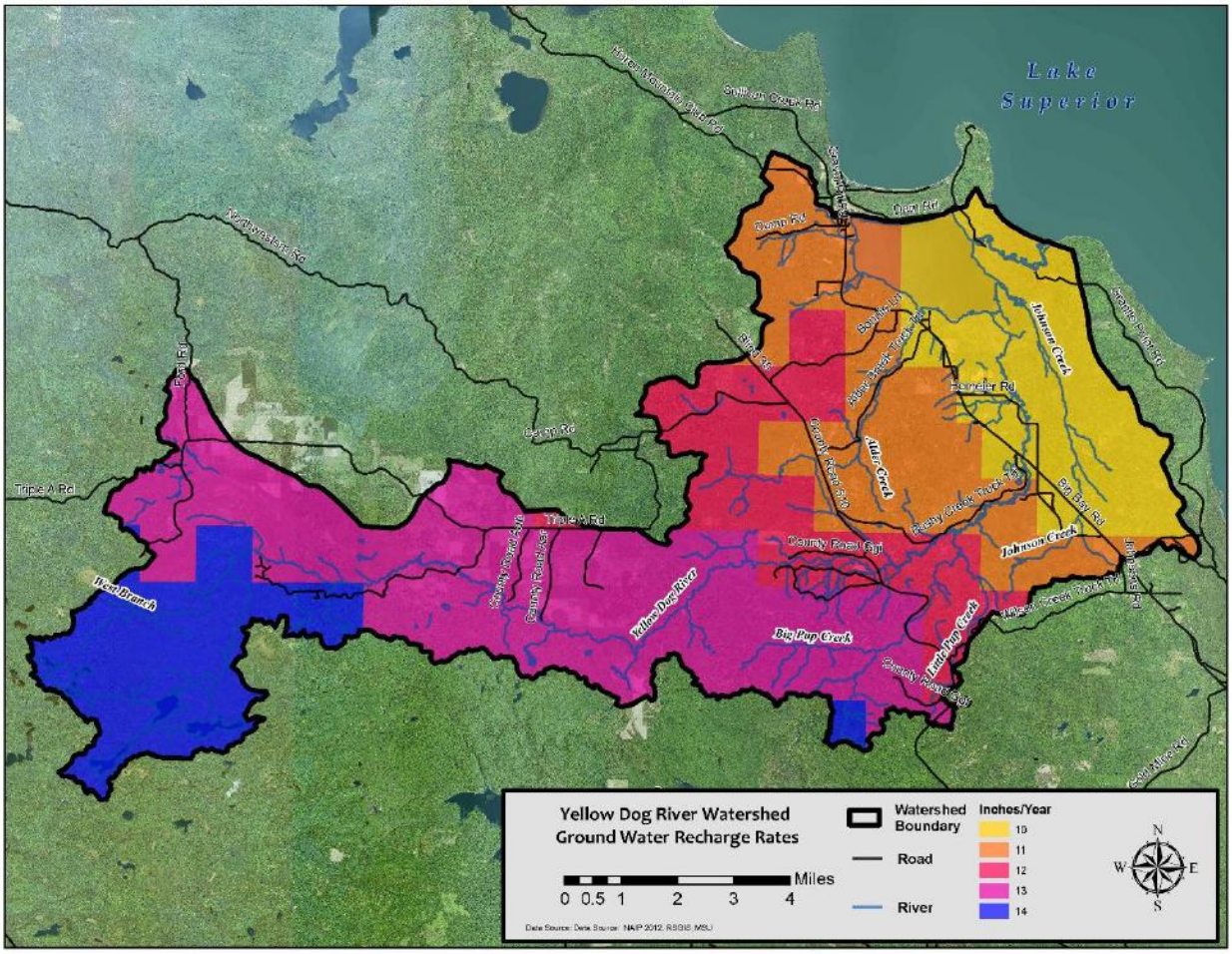


Figure 8 – Groundwater recharge rates within the Yellow Dog watershed. Map by Christina Spitz.

BEDROCK GEOLOGY

The watershed landscape began to take its current shape about 3.6 to 2.5 billion years ago during the development of the Great Lakes Tectonic Zone (Sims & Carter, 1993) a significant tectonic collision. Following this period, and after a period of crustal subsidence and sedimentation, seas filled the region. The sea life created sediments that eventually became banded iron formations. Fine grain sediments and organics settled and become shales that metamorphosed into slates (Mayer, Grubb, & Thiemann, 2004).

There are four major bedrock geology formations in the watershed: Jacobsville Sandstone, Archean Granite and Gneissic, Michigamme Formation, and a small part Archean Volcanic and Sedimentary. Jacobsville Sandstone is prominent along the southern Lake Superior shoreline. Where the sandstone is present along the south shore of the great lake, its thickness is about 1,000 feet on average (Olcott, 2009). In the Big Bay area, it is only about 100 feet thick (Hamblin, 1958).

Part of the watershed is composed of granites and gneisses. This formation contains fractures and faulting related to the Great Lakes Tectonic Zone and another tectonic collision called the Penokean Orogeny which created deformation of bedrock with folding, faulting and metamorphosis (Sims & Carter, 1993) (Mayer, Grubb, & Thiemann, 2004). Some exposed ridges of granite are found in this part of the watershed.

The Michigamme Formation lays below the outwash sands and jack-pine forests of the Yellow Dog Plains. The formation is composed of slates and low-grade banded iron formations (Mayer, Grubb, & Thiemann, 2004). It also contains dikes and faults which were formed during the Penokean Orogeny. Yellow Dog Peridotite was discovered in 1979; it is a dike within this formation, which formed like a wedge in an east-west direction. It is between 1.7 and 1.1 million years old (Klasner, Snider, Cannon, & Slack, 1979), and contains high grade copper-nickel ore deposits.

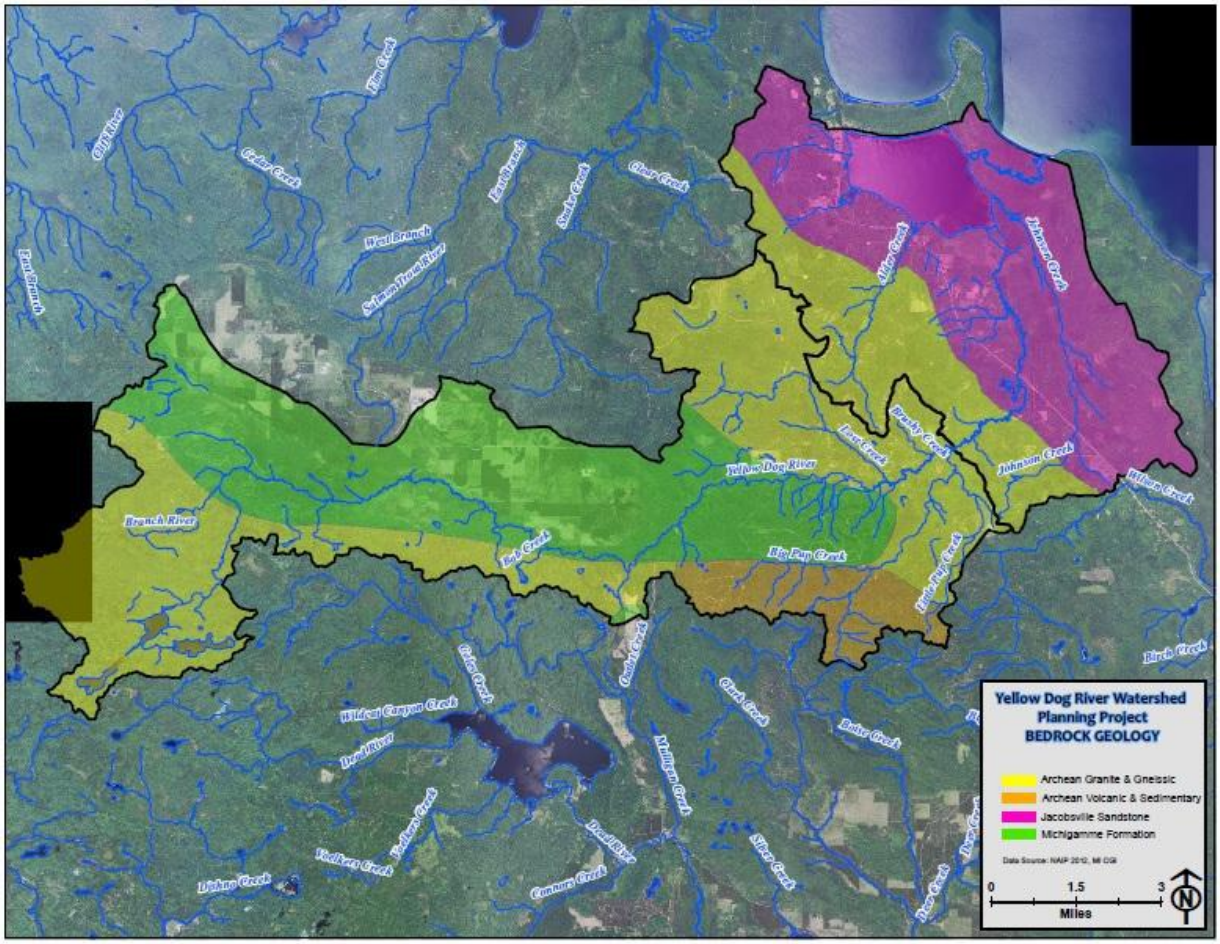


Figure 9 – Bedrock Geology within the Yellow Dog watershed. Map by Jessica Nelson.

GLACIAL HISTORY

The glacial features of the Yellow Dog watershed were specifically described in a 1964 U.S. Geological Survey research paper by Kenneth Segerstrom. In his paper, Segerstrom highlights several prominent features: the Negaunee moraine, kame-kettle topography, Yellow Dog Plains, and Pinnacle Falls.

The Negaunee moraine, a highly irregular escarpment and lowland, is a belt which extends from Marquette to Keweenaw Bay. By definition, the moraine was built by an accumulation of drift at the margin of a glacier (Flint, 1957). The Negaunee moraine lies within the Yellow Dog watershed and is composed of sand deposits, bedrock knobs, small kames, and small kettles (Segerstrom, 1964).


Figure 10 – Pinnacle Falls. Courtesy of Jeremiah Eagle Eye.

The Yellow Dog Plains is a terrace-like sandy area about 10 miles long and 2-3 miles wide. An escarpment drops to the north and a southern highland separates the river from the Mulligan watershed to the south. A glacier covered the valley immediately south of the Huron Mountains during the Mankato Stade. As it melted, the water and sediment spilled southward constructing the broad kame terrace that is known as the Yellow Dog Plains. Some of the water ponded and the water level increased until it passed a gap near Pinnacle Falls. The ancestral lake was emptied and a new path for the river began to form (Segerstrom, 1964).

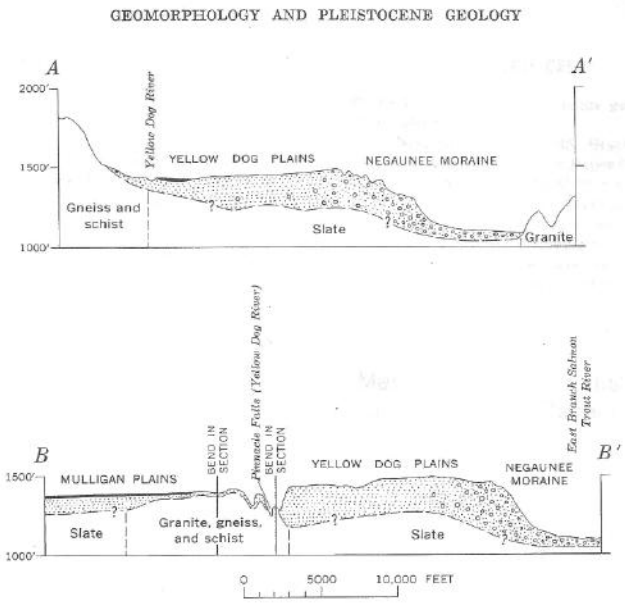


Figure 11 – Cross sections A-A' and B-B'. Swamp deposits shown as solid black. Vertical exaggeration about x 10 (Segerstrom, 1964).

period. The Lake Nipissing shoreline is now found at 640 feet above sea level which is about 35 feet higher than 5,000 years ago and isostatic rebound still continues (NRCS, 1996).

As the ice retreated north it left a variety of deposits on the surface of the bedrock. The thickness of glacial deposits in Marquette County ranges in depth; deposits range between 0 and 500+ feet (NRCS, 1996). Types of glacial deposits in Marquette County include till, outwash, lacustrine, and eolian.

Glacial deposits and formations in Marquette County were the result of the Greatlakean (formerly Valderan) advance which was the final sub-stage of the Wisconsinan glacial period. The Marquette advance, the final southern advance of the ice, created the most recent surface features such as glacial striations in the bedrock. This advance occurred 9,900 B.P. and spread onto the land surface of the northern fifth of the Upper Peninsula (Halsey, 1999). As the ice from the Marquette advance retreated north, water began to pool and flow into a rising water body.

Between 10,000 B.P. and 4,500 B.P. the lake level fluctuated drastically. As the weight of the ice retreated from the land surface isostatic rebound began and the land surface was uplifted. At 5,000 B.P. a water body that resembled Lake Superior was formed and is referred to as Lake Nipissing during this time

Figure 12 – Lake Superior.

CLIMATE / PRECIPITATION

The climate patterns in the Yellow Dog Watershed are affected by Lake Superior, which is in close proximity and has a moderating effect on temperatures in winter and summer. Near the lake, winters can be warmer and summers can be colder. The effect is also increased when the wind blows off the water and when land slopes face the lake (Minnesota Sea Grant, 2013).

Weather and climate is tracked by the National Climate Data Center at a tower in Big Bay, Michigan for a limited range of values. Due to the gaps in that data this report will refer to another tower in Negaunee for precipitation values. The National Weather Service and National Oceanic and Atmospheric Administration reported that the total annual precipitation averaged 33.75 inches between the years 2006 through the end of December 2013 at the KMQT Tower in Negaunee. Also, the WSO tower (5184) outside of Marquette has recorded an average maximum temperature of 52.2℃ and an average minimum temperature of 33.9℃ in 2010.

The Marquette area typically receives less annual snowfall than locations further inland. The record total annual snow depth for Marquette WSO (5184) was 296.2 inches in 2002.

CLIMATE CHANGE

Weather patterns are changing in many parts of the world, but not all parts of the world are experiencing the same change, or any change in some cases. According to the Centers for Disease Control and Prevention, "Climate change is any major change that has been occurring for at least 10 years in the temperature, precipitation, wind, and other weather patterns that we measure." As a result of climate change, extreme weather events are occurring more frequently, including: heat waves, floods, droughts, and tropical cyclones. For example, between 1880 and 2015 14 out of the last 15 years have been documented as the warmest on record (NOAA 2015).

According to the U.S. Global Change Research Program (U.S.G.C.R.P., 2009), the following issues are among key areas of concern for the Midwest and are highlighted in the vulnerabilities section in the Environmental Protection Agency (EPA) Region 5 Climate Change Adaptation Implementation Plan published May 30, 2014:

Figure 13 – Lake Independence. Photo courtesy of Mindy Otto.

- During the summer, public health and quality of life, especially in cities, will be negatively affected by: increasing heat waves, reduced air quality, and increasing insect and waterborne diseases. In the winter, warming will have mixed impacts.
- The likely increase in precipitation in winter and spring, more heavy downpours, and greater evaporation in summer would lead to more periods of both floods and water deficits.

- Increased storm intensity will lead to an increased risk of water pollution to the Great Lakes and Mississippi River basins from combined sewer overflows, sediments, and other threats to water quality.

- While the longer growing season provides the potential for increased crop yields, increases in heat waves, floods, droughts, insects, and weeds will present increasing challenges to managing crops, livestock, and forests.

- Native species and ecosystems are very likely to face increasing threats from rapidly changing climate conditions, including pests, diseases, and invasive species moving in from warmer regions.

Air quality can be impacted by many different types of pollutants: car and truck emissions, factories, and power plants. Marquette County is not (yet) experiencing ground-level ozone or fine particulate matter ($PM_{2.5}$) measures above National Ambient Air Quality Standards according to the Environmental Public Health Tracking Info by Location web tool (Centers for Disease Control and Prevention, 2014).

TOPOGRAPHY / ELEVATION

Topography varies throughout the Yellow Dog watershed with a low elevation of ~591 feet at Lake Superior and a high of over 1800 feet near the headwaters, providing a view of the wilderness, several rock outcrops, and Lake Superior. Along its course, the Yellow Dog River drops 1108 feet in elevation through rock outcrops, granite gorges, marshes, open plains, and hemlock forests to end in Lake Independence which sits at ~621 feet. From here, the Iron River flows from Lake Independence to Lake Superior with a drop in elevation of ~30 feet over its three mile course.

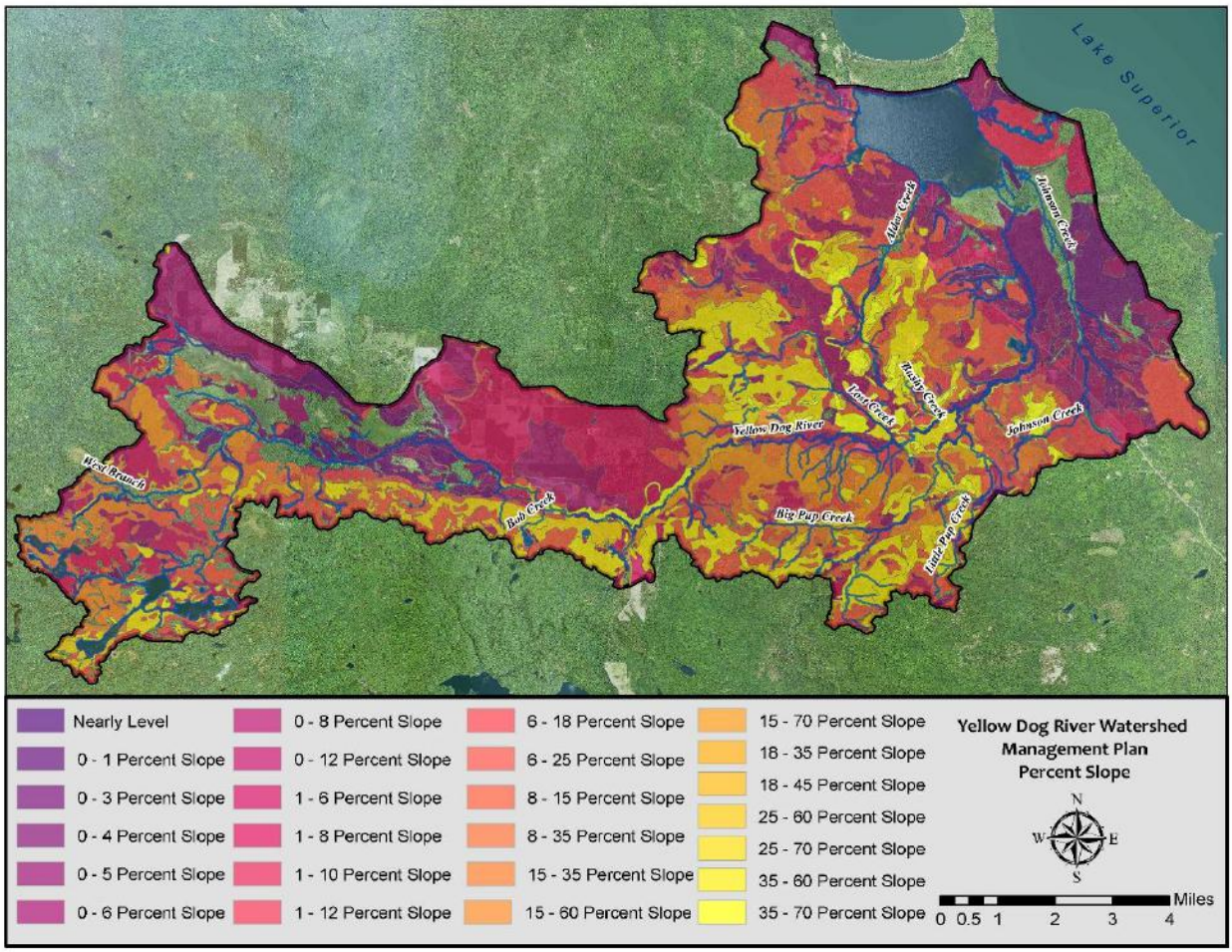


Figure 14 – Percent slope in the Yellow Dog watershed. Map by Christina Spitz.

Slope	Percent of Watershed	Acres
0 - 1 Percent Slope	0.21%	131.94
0 - 12 Percent Slope	0.58%	364.42
0 - 3 Percent Slope	6.86%	4310.18
0 - 4 Percent Slope	2.89%	1815.80
0 - 5 Percent Slope	1.02%	640.87
0 - 6 Percent Slope	12.12%	7615.07
0 - 8 Percent Slope	0.32%	201.06
1 - 10 Percent Slope	1.03%	647.16
1 - 12 Percent Slope	4.36%	2739.41
1 - 6 Percent Slope	10.51%	6603.50
1 - 8 Percent Slope	1.21%	760.25
15 - 35 Percent Slope	1.81%	1137.23
15 - 60 Percent Slope	3.77%	2368.71
15 - 70 Percent Slope	1.58%	992.72
18 - 35 Percent Slope	1.15%	722.55
25 - 60 Percent Slope	2.21%	1388.56
25 - 70 Percent Slope	10.50%	6597.21
35 - 60 Percent Slope	0.02%	12.57
35 - 70 Percent Slope	2.60%	1633.60

6 - 18 Percent Slope	9.14%	5742.72
6 - 25 Percent Slope	6.43%	4040.01
8 - 15 Percent Slope	0.98%	615.74
8 - 35 Percent Slope	5.48%	3443.12
Nearly Level	0%	0.00

Table 1 – Percent slope in the Yellow Dog Watershed.

SOILS

Soil types in the Yellow Dog Watershed vary from Amasa fine sand to Carbondale and Tacoosh Mucks. This variability has helped to sustain diverse ecosystems that are critical to providing habitat for a variety of flora and fauna species. All of the soil varieties are listed below in the table which was generated from the Natural Resources Conservation District Online Web Soil Survey.

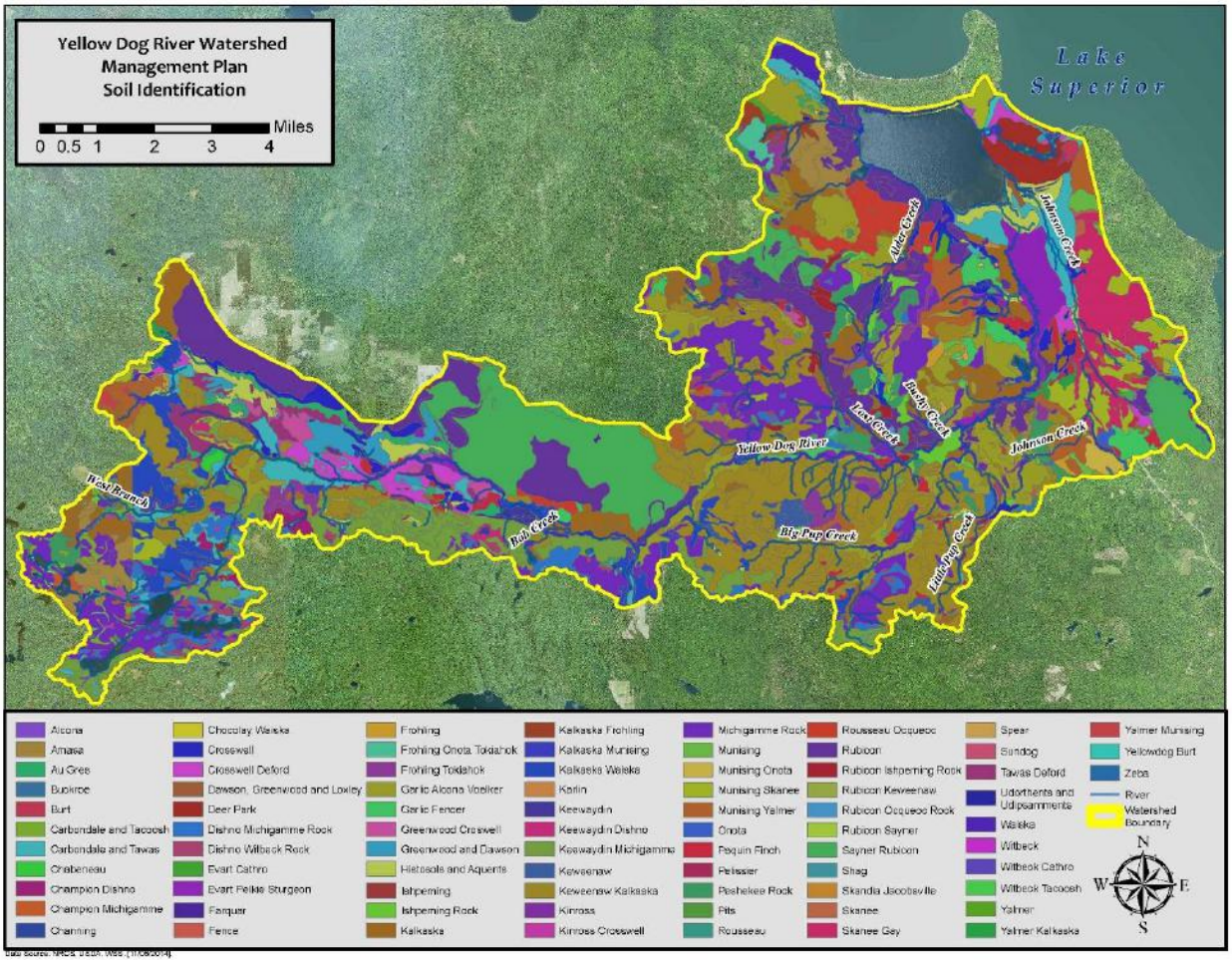


Figure 15 – Soil types in the Yellow Dog watershed.

Soil Type	Acres	Percent of Watershed
Alcona	15.4	0.02
Amasa	1113.4	1.77
Au Gres	584.2	0.93
Buckroe	5.6	0.01
Burt	49.9	0.08
Carbondale and Tacoosh	265.0	0.42
Carbondale and Tawas	2044.2	3.25
Chabeneau	68.9	0.11
Champion Dishno	174.4	0.28
Champion Michigamme	77.5	0.12
Channing	52.0	0.08
Chocolay Waiska	16.3	0.03
Crosswell	1051.6	1.67
Crosswell Deford	882.3	1.40
Dawson, Greenwood and Loxley	88.8	0.14
Deer Park	645.7	1.03
Dishno Michigamme Rock	1091.9	1.74
Dishno Witbeck Rock	363.5	0.58
Evart Cathro	232.7	0.37
Evart Pelkie Sturgeon	1806.8	2.88
Farquar	6.4	0.01
Fence	12.0	0.02
Frohling	135.6	0.22
Frohling Onota Tokiahok	171.7	0.27
Frohling Tokiahok	809.1	1.29
Garlic Alcona Voelker	3748.7	5.97
Garlic Fencer	729.0	1.16
Greenwood and Dawson	624.1	0.99
Greenwood Croswell	275.3	0.44
Histosols and Aquents	1142.1	1.82
Ishpeming	5.8	0.01
Ishpeming Rock	553.5	0.88
Kalkaska	3071.4	4.89
Kalkaska Frohling	218.1	0.35
Kalkaska Munising	28.4	0.05
Kalkaska Waiska	1830.8	2.91
Karlin	12.7	0.02
Keewaydin	141.1	0.22
Keewaydin Dishno	115.0	0.18
Keewaydin Michigamme	2687.2	4.28
Keweenaw	273.5	0.44
Keweenaw Kalkaska	8728.4	13.89
Kinross	93.4	0.15
Kinross Crosswell	31.1	0.05
Michigamme Rock	4630.8	7.37
Munising	212.9	0.34
Munising Onota	173.2	0.28
Munising Skanee	1331.1	2.12
Munising Yalmer	1363.6	2.17
Onota	44.4	0.07
Paquin Finch	639.6	1.02
Pelissier	16.0	0.03
Peshekee Rock	1287.2	2.05
Pits	9.7	0.02
Rousseau	47.1	0.07
Rousseau Ocqueoc	887.4	1.41
Rubicon	5454.3	8.68
Rubicon Ishpeming Rock	281.3	0.45
Rubicon Keweenaw	4.6	0.01
Rubicon Ocqueoc Rock	13.9	0.02
Rubicon Sayner	35.9	0.06
Sayner Rubicon	4176.7	6.65
Shag	5.2	0.01
Skandia Jacobsville	6.3	0.01
Skanee	78.0	0.12
Skanee Gay	1604.6	2.55
Spear	27.2	0.04
Sundog	14.3	0.02
Tawas Deford	920.0	1.46
Udorthents and Udipsamments	6.0	0.01
Waiska	253.9	0.40
Witbeck	16.4	0.03
Witbeck Cathro	64.2	0.10
Witbeck Tacoosh	39.8	0.06
Yalmer	72.5	0.12
Yalmer Kalkaska	164.8	0.26
Yalmer Munising	221.8	0.35
Yellow Dog Burt	54.6	0.09
Zeba	15.7	0.02
Undefined	2581.2	4.11

Table 2 – Soil types in the Yellow Dog watershed.

HYDRIC SOILS

Hydric soils are defined as soils that form under conditions of saturation, flooding, or ponding. The ponding must occur long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, July 13, 1994). During the growing season, these soils are saturated long enough to support the growth and reproduction of hydrophytic vegetation. Furthermore, there are three essential characteristics of wetlands, they include: hydrophytic vegetation, hydric soils, and wetland hydrology (Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979; United States Army Corps of Engineers, Environmental Laboratory 1987; National Research Council 1995; Tiner 1985). Criteria for all of these characteristics must be met for areas to be identified as wetlands. Hydric soil types in the Yellow Dog Watershed occur less frequently than non-hydric, and partially-hydric soils.

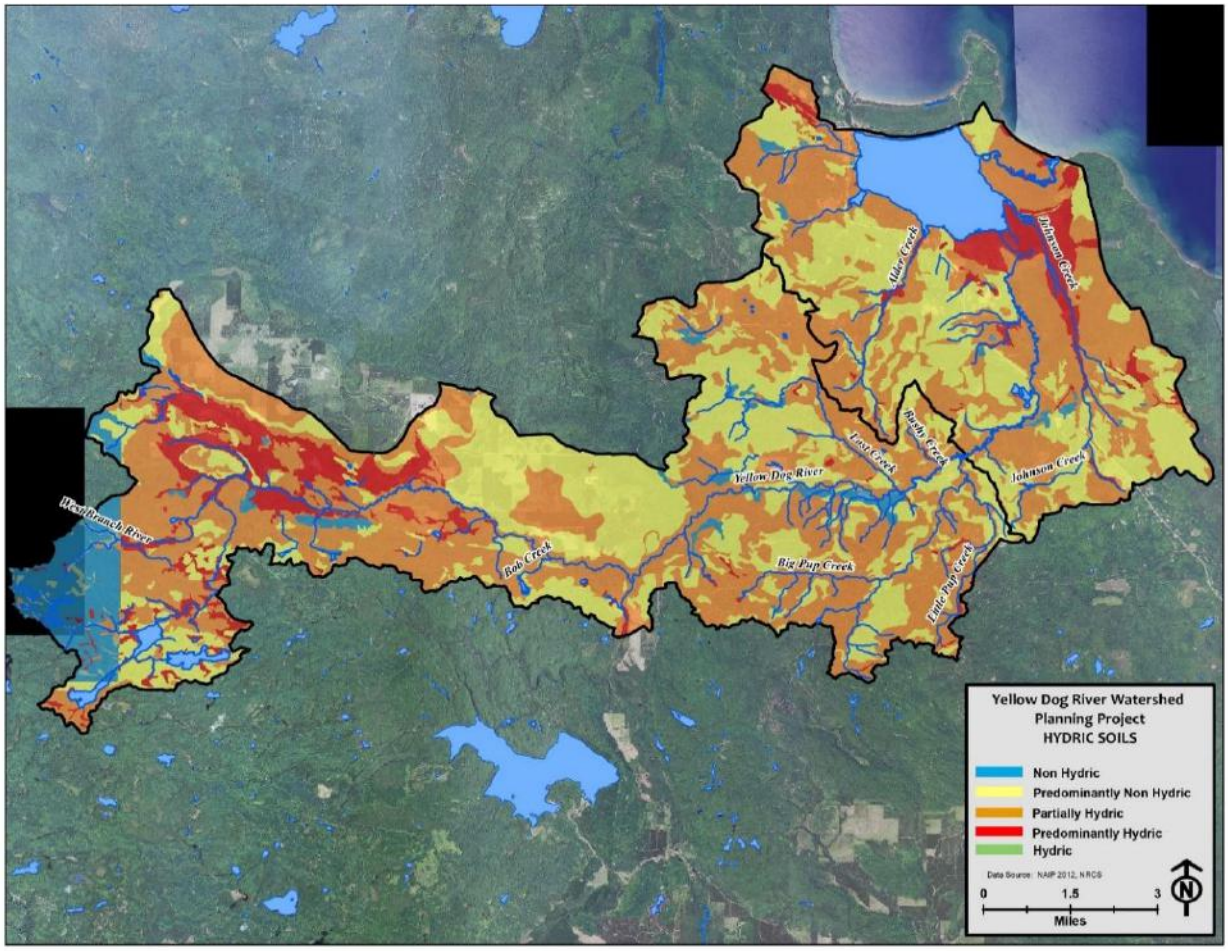


Figure 16 – Hydric soils in the Yellow Dog watershed.

EROSION POTENTIAL

Erosion potential is determined by a combination of percent slope, soil type, and soil particle size. Figure 17 shows the likelihood of soil loss after off-road and off-trail disturbances that expose the soil surface from logging, mining, trail building, recreation, agriculture, and grazing. A rating of 'Slight' indicates that erosion is unlikely under normal circumstances; a rating of 'Moderate' indicates that erosion is likely and some erosion-control may be necessary; a rating of 'Severe' indicates that erosion is very likely and that erosion-control measures are advised including re-vegetation; and, a rating of 'Very Severe' indicates that erosion-control is often so severe that it is often very expensive and impractical to control.

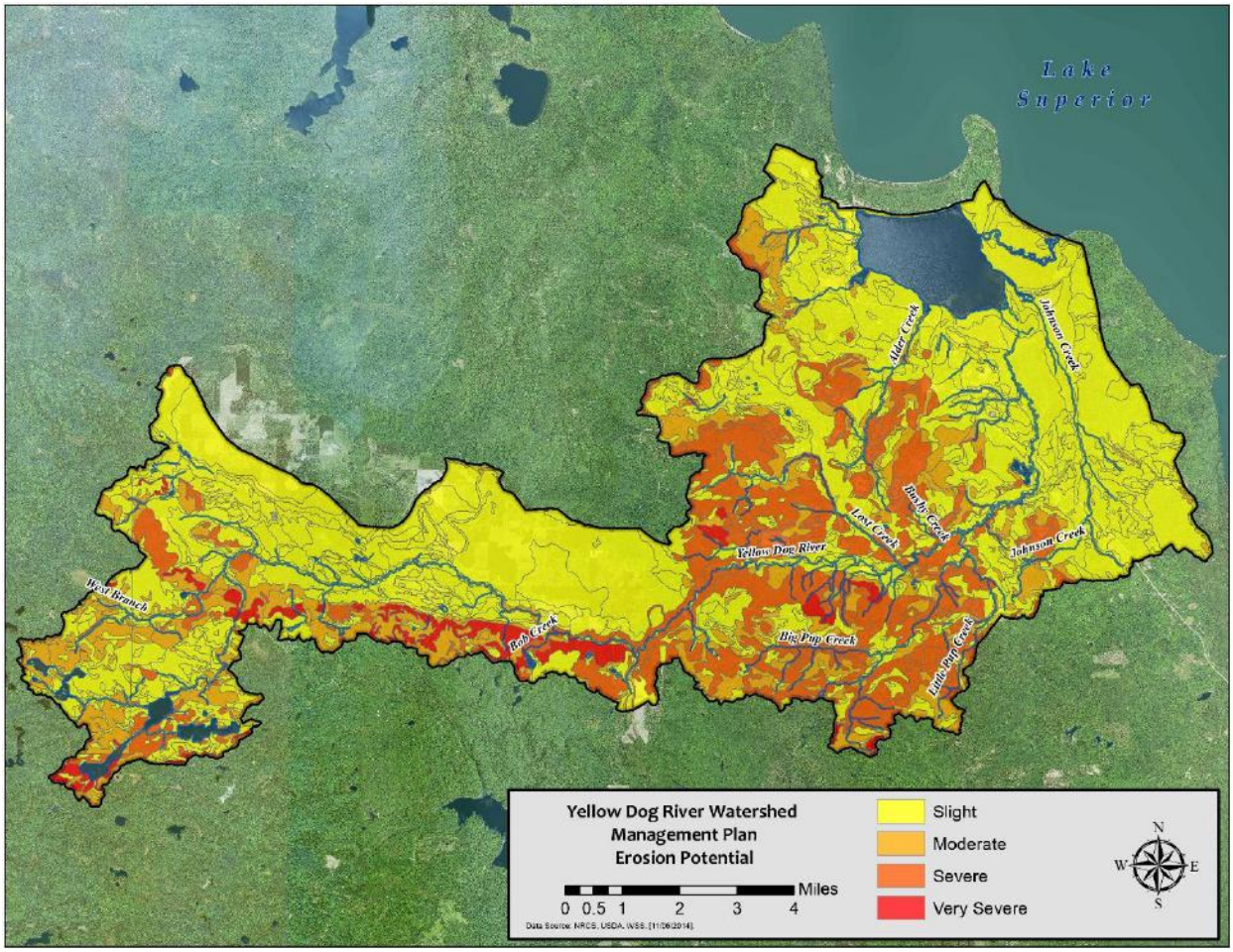


Figure 17 – Erosion potential in the Yellow Dog watershed.

Summary by Rating Value		
Rating	Acres in Watershed	Percent of Watershed
Slight	38,588.30	61.40%
Severe	11,486.90	18.30%
Moderate	8,548.20	13.60%
Very severe	1,603.10	2.60%
Null or Not Rated	2,604.10	4.10%

Table 3 – Erosion potential in the Yellow Dog watershed.

VEGETATION

The vegetation in the watershed is diverse, but some stand types occur more commonly than others. One of the most common tree species is sugar maple along with hemlock and yellow birch in partially hydric soils. In the Yellow Dog Plains area, the main forest type is jack pine plantations. In the upper reaches of the Yellow Dog River just south of the jack pine stands, the vegetation becomes more diverse with black spruce and tamarack. The watershed vegetation map below was created by Randy Swaty of The Nature Conservancy/LANDFIRE data team (www.landfire.gov). While LANDFIRE data is presented as 30m pixels, it is designed to be used at state or regional scales. It is valuable in providing landscape scale context and background information, but specific project or stand level management will need to be informed by locally developed datasets. Also this dataset was verified in the field on July 26, 2013 and was found to be consistent.

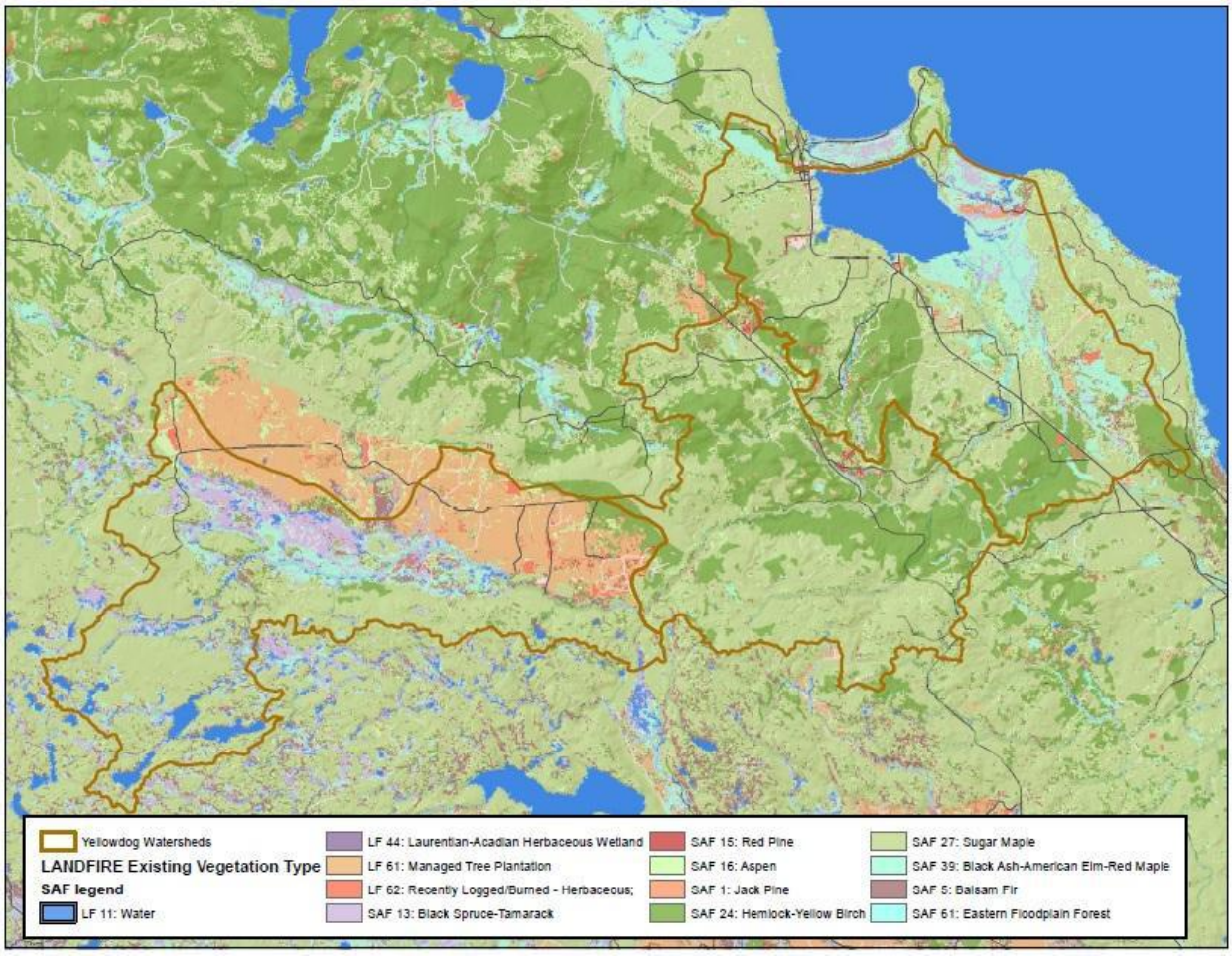


Figure 18 – LANDFIRE existing vegetation types in the Yellow Dog watershed. Map by Randy Swaty (LANDFIRE TEAM, The Nature Conservancy).

NON-NATIVE INVASIVE SPECIES

PLANTS

Non-native invasive species (NNIS) are a threat to Yellow Dog watershed ecosystems because of their ability to overcrowd native species from their natural habitats and are capable of causing economic or environmental harm or harm to human health. In 2009, a survey of the non-native invasive species in the McCormick Wilderness Area around the Yellow Dog River headwaters was undertaken by the Yellow Dog Watershed Preserve. This survey was funded by a grant from the National Forest Foundation. The McCormick Wilderness is a federally-owned and protected tract of rugged wilderness that is managed by the Ottawa National Forest. The survey found that the most common species of concern was the European swamp thistle aka marsh thistle, or *Cirsium palustre*, for its tendency to populate sensitive wetlands. Furthermore the European swamp thistle is ranked on the Ottawa National Forest list of priority species of concern.

EUROPEAN SWAMP THISTLE

In 2011 and 2013, YDWP and partners removed the thistle and seed heads by-hand throughout the McCormick Wilderness Area funded by the National Forest Foundation. The controls were focused on trails, wetlands, and some remote lakes. In 2013, YDWP noticed a reduction in the species occurrence in these areas since that initial survey in 2009. In 2014, YDWP again returned to the watershed to control and map the European swamp thistle funded through the National Fish and Wildlife Foundation via partnership with the Central Upper Peninsula Cooperative Weed Management Area (CUPCWMA). This time we also addressed infestations in other parts of the watershed near the river corridor, wetlands, and environmentally sensitive areas. In 2015, the efforts continued with a mini-grant through the Michigan Invasive Species Grant Program again via CUPCWMA.

Figure 19 – Circium palustre, non-native marsh thistle (Michigan State University, 2015).

CENTRAL UPPER PENINSULA COOPERATIVE WEED MANAGEMENT AREA

The Yellow Dog watershed lies within the area covered by the Central Upper Peninsula Cooperative Weed Management Area (CUPCWMA), one of five CWMAs in Michigan's Upper Peninsula. The CWMA covers four counties: Alger, Marquette, Delta and Schoolcraft. YDWP has participated in CUPCWMA invasive weed management efforts in our region for a few years. A list of Non-Native Invasive Plants in the CUPCWMA is included below. The information was found in the CUPCWMA Management Plan on 1/8/15.

CODE	Common Name	Scientific Name
ALPE4	Garlic mustard	*Alliaria petiolata*
ARMI2	Common burdock	*Arctium minus*
BETH	Japanese barberry	*Berberis thunbergii*
BRIN	Smooth brome	*Bromus inermis*
CEBI2	Spotted knapweed	*Centaurea biebersteinii*
CEDI3	White knapweed	*Centaurea diffusa*
CIAR4	Canada thistle	*Cirsium arvense*
CIPA6	Marsh thistle	*Cirsium palustre*
CIVU	Bull thistle	*Cirsium vulgare*
SEVA4	Purple crownvetch	*Securigera varia* (*Coronilla varia* (COVA2))
EUES	Leafy spurge	*Euphorbia esula*
FRAL4	Glossy buckthorn	*Frangula alnus*
HYPE	St. Johnswort	*Hypericum perforatum*
LOBE	Bell's honeysuckle	*Lonicera x bella*
LOJA	Japanese honeysuckle	*Lonicera japonica*
LOMO2	Morrow's honeysuckle	*Lonicera morrowii*
LOTA	Tartarian honeysuckle	*Lonicera tatarica*
LYSA2	Purple loosestrife	*Lythrum salicaria*
MEAL12	White sweet clover	*Melilotus alba (M. officinalis)*
MEOF	Yellow sweet clover	*Melilotus offinalis*
MYSP2	Eurasian watermilfoil	*Myriophyllum spicatum*
PASA2	Wild parsnip	*Pastinaca sativa*
PHAR2	Reed canarygrass	*Phalaris arundinacea*
PHAU7	Common reed	*Phragmites australis*
PISY	Scotch pine	*Pinus sylvestris*
RHCA3	Common buckthorn	*Rhamnus cathartica*
TAVU	Common tansy	*Tanacetum vulgare*
POCU6	Japanese knotweed	*Polygonum cuspidatum*
GYPA	Baby's breath	*Gypsophilla paniculata*
CYOF	Hounds tongue	*Cynoglossum officinale*
COMA2	Poison hemlock	*Conium maculatum*
HEMA17	Giant hogweed	*Heracleum mantegazzianum*

Table 4 – Non-native invasive plants found in the CUPCWMA.

AQUATIC NUISANCE SPECIES

The Michigan Deparment of Natural Resources (MDNR) Fisheries Division, local fisherman, and other watershed stakeholders have expressed concern about the invasive Rusty Crayfish. The species is suspected in Lake Independence, the Iron River, and the Yellow Dog River. It has been identified by local fisherman but has not yet been officially recorded by the state. The Rusty Crayfish outcompetes the native species and multiplies quickly. In late fall 2013, Lake Independence was part of a Michigan State University graduate student study of invasive species in Michigan's inland lakes and ponds. Surface water grab samples, and filtered samples were collected, frozen and shipped to East Lansing where they were tested for a variety of DNA. The tests came out negative or below the detection limit for all invasive species. Future testing will continue through this program. Any positive results will be reported to initiate management efforts.

Figure 20 – Rusty Crayfish - Orconectes rusticus (U.S. Geological Survey Florida Integrated Science Center., 2015)

Sample Collector: Melinda Otto
Date Collected: 11/18/2013
Lake Name: Lake Independence
Lake Location: Big Bay, MI (N46.81337, W87.72389)
Date Analyzed: 12/4/2013
eDNA Analysis By: Kronlein

Scientific Name	Common Name	Gene Targeted	Results
Cercopagis pengoi	**Fishhook Waterflea**	**COI**	**eDNA below detection limit**
Daphnia cristata	**Daphnia**	**hsp90**	**eDNA below detection limit**
Petromyzon marinus	**Sea Lamprey**	**18S rRNA and nd3**	**eDNA below detection limit**
Orconectes rusticus	**Rusty Crayfish**	**COI**	**eDNA below detection limit**
Limnoperna fortunei	**Golden Mussel**	**COI**	**eDNA below detection limit**
Dreissena bugensis	**Quagga Mussel**	**COI**	**eDNA below detection limit**
Bythotrephes longimanus	**Spiny Waterflea**	**COI**	**eDNA below detection limit**
Hydrilla verticillata	**Hydrilla**	**hvme1**	**eDNA below detection limit**
Dreissena polymorpha	**Zebra Mussel**	**COI**	**eDNA below detection limit**
Positive Control			
Zebra Mussel DNA Spiked in Reaction			**eDNA Detected**[3]

[3] In all tests, a positive control of zebra mussel eDNA was spiked into the sample to ensure the reaction was not being inhibited by a chemical or enzyme from the sample.

WILDLIFE

A wide variety of mammals, reptiles, and fish live in the Yellow Dog watershed due to its largely intact habitats and relative remoteness. It is home to: the white tailed deer, coyote, fox, rabbit, and other common fauna. Some of the more notable animal species include the grey wolf and the moose.

The grey wolf was nearly exterminated from the Upper Peninsula by the 1950's. After the federal listing of the animal on the endangered species list in the 1970's, a slow trickle of individuals eventually made their way back to the U.P. 1991 marked the first year a pair of wolves had mated and successfully produced pups in Michigan since the wolf's decline. During the 2004 census, 361 individual wolves inhabited the Upper Peninsula. Confirmed wolf packs in Marquette County include: Echo Lake, Ford Road, and Huron Mountain Club. Each pack generally stays within a 100 square mile territory and does not overlap. YDWP staff have documented wolf evidence including scat, tracks, and calls. The grey wolf became game species in 2013 and designated hunting areas were developed to manage wolf populations in specific areas. In 2015, a federal court ordered the U.S. Fish and Wildlife Service to return wolves in the Great Lakes region to the federal endangered species list, making it illegal for Michigan citizens to kill wolves. Under endangered species status, wolves may be killed only in the immediate defense of human life.

Figure 21 – Bull moose sighting near Big Pup Creek in 2012. Photo by Christy Budnick.

Moose were once found throughout the U.P. until the era of logging and mining came to its climax. By the early 1900's, moose sightings had dwindled to almost nothing. A reintroduction was tried in the 1940's but failed to repopulate the area, but in 1989, another attempt was more successful. MDNR transported Canadian moose to northwest Marquette County. Biologists have determined that the original number transplanted has grown but they do not know to what extent. Modeling and surveys have produced differing results and the MDNR did not achieve the 1000 moose population by the year 2000. Tracks and sightings are frequently found at the Yellow Dog North American Wetlands Conservation Act (NAWCA) wetland property and the Jean Farwell Wilderness near Lake Independence.

FISHERIES

Many local fishermen from the nearby towns of Big Bay, Marquette, Negaunee, and Ishpeming enjoy fishing in the Yellow Dog River and its tributaries, Lake Independence, and the Iron River. It is common for locals in the region to own a secondary, seasonally-accessed property in the woods, also known as a "camp," which is visited regularly for many weeks out of the year during hunting and fishing seasons. The Yellow Dog watershed contains many camps throughout the watershed allowing easier access to fishing opportunities.

YELLOW DOG RIVER

The popularity of fishing in this area has put pressure on the river's ability to naturally maintain fish populations, which have been restocked by the MDNR for many years (Madison, 2013).

Fish species that reside in the watershed include brown trout, rainbow trout, and brook trout. Between the mid-1930s through 1965 the stream was stocked regularly. After 1965 there was a break in fish stocking for twenty years until it was reinstated during the 1980s. The MDNR stocks fish at four main sites on the main branch of the Yellow Dog River: Clowry Bridge at Snowmobile Trail 5, Wylie Falls, the old ford, and Co Rd 510. Fish have also been stocked at the Bushy Creek Truck Trail in the past.

Figure 22 – Alex Ubbelohde fishing the Yellow Dog River near Bushy Creek Falls. Photo © Emily Whittaker.

An electrofishing survey was conducted on July 8, 2011 by MDNR Fisheries Research staff. The survey location started at the Co Rd 510 Bridge and continued upstream for 1,200 feet. During the survey some natural trout spawning was documented. Natural trout spawning was also documented in a 2002 MDNR survey. Other factors aside from angling which may impact natural fish spawning are: extreme spring flood flows, migration of fish to cold water refugia during hot weather when sampling is typically conducted, and high water temperatures.

From 2013-2019 the MDNR plans on annually stocking 3,000 yearling brook trout, 3,000 yearling brown trout, and 4,000 yearling rainbow trout across three sites in the Yellow Dog watershed. The total stocking density for each species of trout is approximately 75 per acre at all sites.

LAKE INDEPENDENCE

Lake Independence has a maximum depth of 30 feet in the center, and because it is relatively shallow it can be affected by seasonal storms which churn up water and sediment. The lake sediments are mainly sand with some patches of gravel on the eastern shore and organics near the shore in McKenzie Bay (Gunderman & MDNR, 2006 & 2012).

The lake is fed by the Yellow Dog River, Alder Creek, Johnson Creek, and two other tributaries. The Iron River connects the inland lake to Lake Superior, although upstream aquatic organism migration is blocked by a dam. Lake Independence supports a healthy pollution of walleye, northern pike, and smallmouth bass. Although most of the populations are self-sustaining, some fish stocking has occurred to maintain the walleye populations. Furthermore, the absence of yellow perch in the 2006 survey has led to some concern and a hold on walleye stocking.

FISH STOCKING IN LAKE INDEPENDENCE

- 1998 - Private plants: 1,000 fall fingerling walleye; 5,300 fall fingerling black crappie; 6,000 fall fingerling bluegill
- 1999 - 44,875 spring fingerling walleye
- 2004 - 15,000 spring fingerling walleye

In 1989, there was concern over the abundance of suckers in the lake which lead to removal efforts. When white suckers made up 94% of the biomass during the 2006 survey, removal efforts commenced again between May 5-15, 2006.

NATURAL FEATURES

The variety of unique species in the watershed have been documented and recorded in the Michigan Natural Features Inventory (MNFI). The MNFI maintains the state's largest database on the location of threatened, endangered, and species of special concern along with high-quality natural communities. The database is constantly updated and used widely by government agencies. In the table below, the information was extracted from the MNFI specifically for the Yellow Dog watershed. The state and global ranking criteria is listed below the table (Michigan Natural Features Inventory, 2014).

Scientific name	Common name	State status	State Rank	Global Rank
Haliaeetus leucocephalus	Bald eagle	Special Concern	S4	G5
Moehringia macrophylla	Big-leaf sandwort	Threatened	S1	G4
Elymus glaucus	Blue wild-rye	Special Concern	S3	G5
Gavia immer	Common loon	Threatened	S3S4	G5
	Granite Bedrock Glade		S2	
	Great Lakes Marsh		S3	
Coregonus artedi	Lake herring or Cisco	Threatened	S3	G5
Dryopteris filix-mas	Male fern	Special Concern	S3	G5
	Mesic Northern Forest		S3	
Gentiana linearis	Narrow-leaved gentian	Threatened	S2	G4G5
Pandion haliaetus	Osprey	Special Concern	S4	G5
	Wooded Dune and Swale Complex		S3	

Table 5 – Michigan natural features inventory data for the Yellow Dog Watershed.

State Ranking Criteria

S1 Critically imperiled in the state because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state.

S2 Imperiled in the state because of rarity due to very restricted range, very few occurrences (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state.

S3 Vulnerable in the state due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.

S4 Uncommon but not rare; some cause for long-term concern due to declines or other factors.

S5 Common and widespread in the state.

SX Community is presumed to be extirpated from the state. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.

S? Incomplete data.

Global Ranking Criteria

G2 Imperiled: at high risk of extinction due to very restricted range, very few occurrences (often 20 or fewer), steep declines, or other factors.

G3 Vulnerable: at moderate risk of extinction due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors.

G4 Apparently secure: uncommon but not rare; some cause for long-term concern due to declines or other factors.

G5 Secure: common; widespread.

GU Currently un-rankable due to lack of information or due to substantially conflicting information about status or trends.

G? Incomplete data

KIRTLAND'S WARBLER

The Kirtland's warbler is a state-listed endangered and legally protected species living in jack pine habitat in dry northern forest. The U.S. status is listed as endangered and the state and global ranks are critically imperiled (Michigan Natural Features Inventory, 2014); however, the Kirtland's warbler is not listed in the Michigan Natural Features Inventory for the Yellow Dog watershed. Regardless, in 2013 there was a sighting of the Kirtland's warbler in Marquette County, and there have been 6 recorded sightings in the county in total. The bulk of the breeding population 93% resides in the northern Lower Peninsula in Crawford, Ogemaw, Oscoda, Roscommon, and Alcona Counties. The Kirtland's warbler is best surveyed in early mornings throughout May and June. For over ten years, YDWP volunteers have been conducting annual U.S. Fish and Wildlife Service Singing Male Survey's on the Yellow Dog Plains in suitable Kirtland's warbler habitat: jack pine stands. In the summer of 2016 YDWP volunteers documented a singing male Kirtland's warbler. Potential habitat areas are ephemeral as the jack-pine stands age. Figure 24 shows jack pine stands of suitable age class for Kirtland's warbler.

Figure 23 – Kirtland's warbler on the Yellow Dog Plains. Photo by Chauncey Moran.

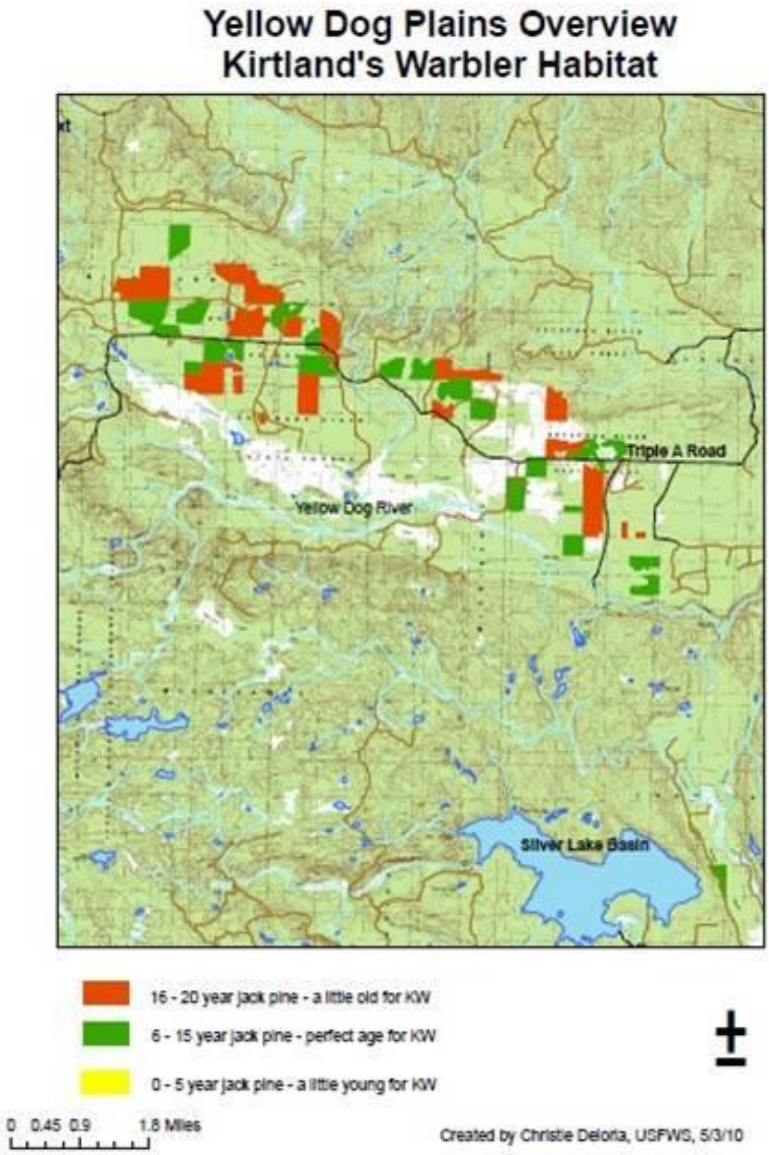


Figure 24 – Kirtland's warbler habitat in the Yellow Dog watershed.

Chapter 3 THE HUMAN ENVIRONMENT

LAND USE

The majority of the Yellow Dog watershed flows through corporately-owned logging parcels and is mostly devoid of residents. Most residents in the watershed live in or near Big Bay, MI (year round population 265) and Lake Independence. Additionally, there are seasonal residents and those that are scattered throughout the watershed. Four townships have jurisdiction over the zoning laws within the watershed: Powell, Michigamme, Champion, and Ishpeming. Watershed-wide discussions are a necessity to encourage a collaborative process that needs to take multiple priorities into account.

The Yellow Dog watershed is 71.75% forest, 2.39% urban, 0.07% cropland, 0.14% pastureland, 0.000027% feedlots, 5.06% water, and 20.59% other. These numbers were generated from the Spreadsheet Tool for Estimating Pollutant Load (STEPL) website based on data collected by the National Land Cover Database in 2006.

Big Bay is a small community founded by the local lumber industry. The region has been used for logging since the mid-18th century with the first European settlement and continues to be a major industry to this day.

Tourism plays an important role in the economic life of Big Bay today, and a large part of that is supported by the Yellow Dog River and Lake Independence. These waterbodies are a draw for fishermen, boaters, hikers, and wild berry-gatherers; many who recreate here are locals and others drive from out of town. Residents of Marquette (pop. 21,355 as of 2010), located 23 miles southeast of Big Bay, also utilize the recreation opportunities of the area on a frequent basis. Many of the privately-owned parcels dotted in-between public and timber lands are seasonal “camps” used as part-time dwellings by locals and downstate Michigan residents as recreational getaways.

A permit application for Eagle Mine, a copper and nickel extraction operation, was approved by the Michigan Department of Environmental Quality in 2007. Extraction and hauling of ore commenced in 2014. Many concerns over the mine's environmental impact were raised during the permitting process by local residents and groups. However, the state's permitting agency deemed Eagle Mine's operational plan safe for the environment. The mine is located in Michigamme Township on the Yellow Dog Plains and employs an estimated 400 people.

Mineral exploration continues to be an economic land use in the watershed, with the majority of exploration concentrated on the Yellow Dog Plains where Michigamme Formation bedrock is present.

Figure 25 – Aerial view of Big Bay, MI. Photo courtesy of Jeremiah Eagle Eye 5/7/2013.

FUTURE LAND USE CONSIDERATIONS

DEVELOPMENT

The four townships in the watershed each have unique zoning. These localized zoning ordinances do not all have the same setbacks from the water's edge in riparian areas. Private landowner development, specifically the construction of dwellings within riparian areas without a reasonable setback can be detrimental to the ecosystems as well as the landowner. Setbacks from waterways and lot size limitations are critical to maintaining properly functioning riparian areas within the Yellow Dog watershed. The removal of streamside vegetation for development purposes can lead to increased runoff and bank destabilization, causing unnatural sediment loading. Rivers naturally change course or alter the size of their bankfull width in a matter of years, and townships must keep this in mind when making zoning decisions. Poor placement of buildings can lead to flooding, erosion, or other property destruction.

FORESTRY

Michigan timber production is a $14.6 billion industry annually supporting the Michigan economy and makes up 10% of the state's manufacturing sector that produces many consumer goods (Michigan Forest Products Council, 2013). The Yellow Dog watershed is over 71% forest and a large portion of that forestland is part of the Michigan DNR Commercial Forest Reserve Program. Landowners whose property is part of this program receive tax incentives for retaining and managing their forest lands for long-term timber production.

Mining and logging is Michigan's smallest industry but employment in those areas grew 12.7% from 2009 to 2011 (Rourke, 2005).

MINING

As of January 20, 2015, there were over one hundred 40-acre parcels designated for development on the Yellow Dog Plains (Michigan Department of Natural Resources Forest Resources Division, 2015). Additionally, six more 40-acre parcels are designated for development with restrictions. In terms of ownership, the Michigan DNR currently owns the minerals and the surface for roughly 115 40-acre parcels in the entire Yellow Dog watershed (4,635 acres). Additionally, the DNR owns the minerals but not the surface for roughly 61 40-acre parcels in the Yellow Dog watershed. Also, other mineral ownership is mapped for some parcels. Given the mineral rich nature of the area, mining development may continue in the watershed into the foreseeable future.

TOURISM

The Michigan tourism industry earned $17.7 billion and generated $1 billion in state tax revenue in 2011. According to “Pure Michigan”, the 2012-2017 Michigan Tourism Strategic Plan, the industry is seeing record numbers (Nicholls Ph.D., 2012). Small towns on Lake Superior, like Big Bay, thrive on tourism throughout the year, especially during the summer and snowmobiling seasons.

DAMS

Currently, there are two man-made dams in the Yellow Dog Watershed: one is located at the outlet of Bulldog Lake in the McCormick Wilderness Area and the other is at the outlet of Lake Independence at the start of the Iron River. Each have interesting histories dating back to the early 1900s.

The Bulldog Lake dam in the McCormick Wilderness Area is part of the Ottawa National Forest. The U.S. Forest Service owns this dam, it was constructed in 1916, and it is listed on the National Inventory of Dams (NID); NID ID MI0087.

Figure 26 – Aerial photo of the Bulldog Lake dam. Photo by Jeremiah Eagle Eye 2014.

Figure 27 – Bulldog Lake dam. Photo courtesy of Ian Shackleford USFS 2009.

During an inspection on November 6, 2014, the dam was found to be in fair to poor condition, with cracks having been noted since the 1950s (Kenton Ranger District, (inspected September 8, 2005) written December 29, 2009). The dam is classified as a low hazard potential for developments downstream and is not considered a priority structure. A cost analysis of alternatives for the Bulldog Lake Dam was published in April 2006 by Sue Peterson, a Regional Dams Engineer. A statement in the November 2014 report concluded: "Unofficially, the Ottawa National Forest Leadership Team has decided to let the dam naturally attenuate (and simply continue with the ten (10) year inspection cycles per the FSM direction). This decision is based on this dam being located in a Congressionally Designated Wilderness Area, and on the fact that very little can be done to repair it without obtaining a variance (or a waiver) to violate the Wilderness rules" (Kenton Ranger District, (inspected November 6, 2014) written Jan 14, 2015).

The earliest record of a dam constructed in the watershed was in 1885, when Jim Redi built a dam and a sluiceway at the start of the Iron River. It was used by several early logging companies in the Big Bay area (Rydholm, 1989, p. 400). That first dam eventually failed. Another dam was constructed by the McAffee Bros. on the Lake Independence outlet to the Iron River in 1898; it is referred to as the Old Pole Dam (Tompkins, 1977). It was located about 100 feet west of the present dam. During high water in the spring of 1912 it washed out. That same year, the Lake Independence Lumber Co. (a subsidiary of the Brunswick Balke Collander Co.) started to build a new dam, with construction completed in 1913. The intention of the new dam was to raise the water level in Lake Independence by two feet. Then, a change in ownership occurred from Lake Independence Lumber Co. (Brunswick Balke) to Kerry and Hanson

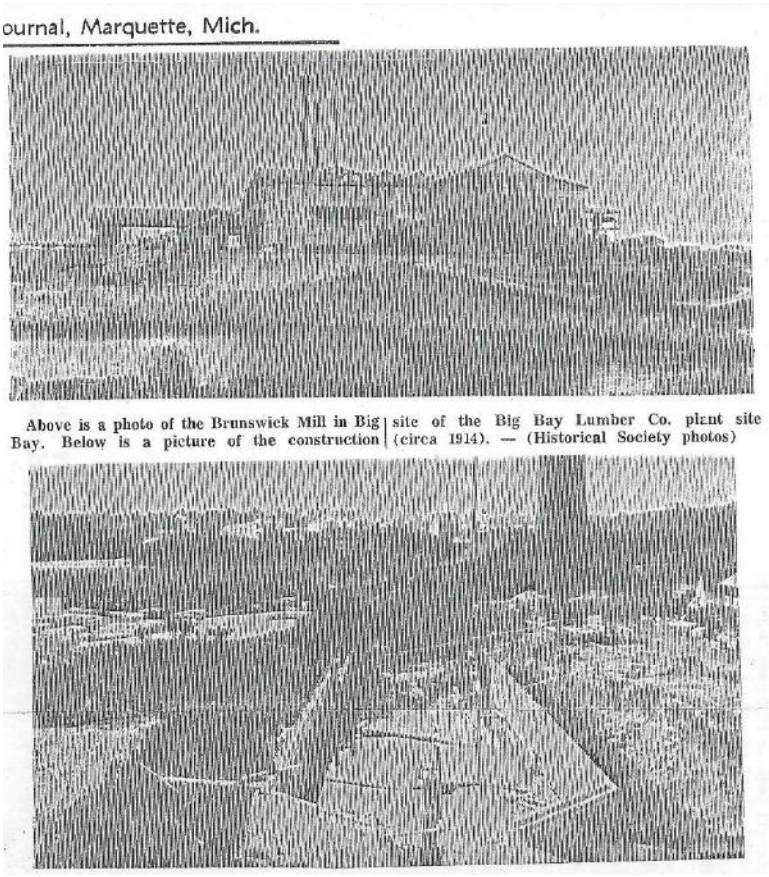
Flooring Co. to Ford Motor Co. The dam was re-constructed in the 1930s as a generator for hydroelectric power. Today, the Lake Independence Dam is maintained by the Marquette County Drain Commission with the intention of maintaining current lake water levels and preserving property values on the lake.

Figure 28 – Aerial photo of Lake Independence dam taken May 14, 2014 by Jeremiah Eagle Eye.

COMMUNITY HISTORY

The community has a rich history of settlers including: early explorers, fur traders, map makers and Native Americans. One journalist writes: "the finding of a 17th Century sword at the mouth of Lake Independence, and the discovery, three years ago this month of a skull, bones, flintlock musket, Hudson's Bay axe and other objects on an old Indian trail which crosses Squaw Beach Road and continues west across the Bay Cliffs property, indicate early travel: also Jesuit missionaries of the 1660s were familiar with that shore (The Mining Journal, 1959)." With the discovery of iron ore in the region in 1849, European settlers began to build homes on Lake Superior's southern shore which brought a surge of development to the timber and mining industries. The first European settler came to live in Big Bay during the 1860s and built a cabin at Squaw Beach according to Superior Heartland: A Backwoods History. He was technically a squatter, having no legal rights to his land. More settlers eventually arrived to the area, and timber harvest began in the Yellow Dog watershed.

One personal account preserved by the Marquette Regional History Center describes logging practices: "The specifications called for absolutely clear pine and all logs with knots were discarded […] getting the logs down the Yellow Dog, with no spring flood, was a difficult job, so many of them were hauled to Lake Independence over the trails. Many stacks were left in the woods in the hope that the following year there would be enough snow to get them out, and some of the timbers never did get removed. I was told a couple of years ago that in the Panorama Fire Tower area off the Triple A road, a few of these rotted timbers can still be seen" (E.B.B., 1957).


ournal, Marquette, Mich.

Above is a photo of the Brunswick Mill in Big Bay. Below is a picture of the construction site of the Big Bay Lumber Co. plant site (circa 1914). — (Historical Society photos)

Figure 29 – Big Bay mill circa 1914 (The Mining Journal, 1959).

By 1898, the first McAffee lumber mill was constructed and soon the Big Bay Lumber Co. was built on Lake Independence in 1901 which spurred activity in the village. When the mill burnt down in 1902, it was rebuilt in the same spot, but after a while, the village went through a period of stagnation when the timber market was poor and the mill closed. By 1909, a new company came into the village and bolstered the economy with 300 more logging jobs. This company was the Lake Independence Lumber Co. (a subsidiary of the Brunswick Balke Collander Co.) which was in operation until 1926. Between 1912 and 1932 they produced bowling pins.

The population of Big Bay grew to 400 by 1915, and over the previous three or four years many buildings were constructed. The hotel, several large homes, the store and the company office building were built during this time and the mill was once again operational (Rydholm, 1989, p. 467).

In 1925, the state of Michigan wanted to extend Highway M-35 across the Dead River in a northwest direction to Skanee and L'Anse. The road would provide a more direct route through the backwoods to L'Anse and clearing and grading began after the survey in 1926 eventually reaching the Salmon Trout River. Many citizens objected, Huron Mountain Club members were not in support, and Henry Ford who owned a lot of property in the area raised objections too. The Attorney General issued his opinion – stating that the road would not be constructed if 2/3 the property owners along the right of way objected to it. Mr. Ford's objection stopped the road as his property made up more than the required two thirds. Now, the road is still a dead end known locally as "Blind M-35."

The close of the Lake Independence Lumber Company left the village very quiet after a devastating fire in 1926 which was followed by the Great Depression in 1931. However, things started to pick up again in 1936 and lots where sold around Lake Independence, and the Kerry and Hanson Mill opened its bowling pin business again. By 1937, "pins coming from Michigan's Upper Peninsula and some from New York State provide[d] approximately 90 per cent of the nation's supply (The Mining Journal, 1937)."

Figure 30 – Big Bay sawmill and surrounding buildings from the water at Big Bay, Michigan, circa 1930. From the Collections of Henry Ford. Gift of Ford Motor Company.

Figure 31 – Big Bay 1944. From the Collections of Henry Ford.
Gift of Ford Motor Company

POLITICAL BOUNDARIES

Both Marquette and Baraga counties have land in the Yellow Dog watershed and ownership is a mixture of state, federal, and private properties, some of which are designated as commercial forest reserve lands. The mixed ownership creates a diversity of management strategies and goals, but much of the land is open to the public for access which allows for many recreation opportunities such as fishing, skiing, kayaking, hunting, and many more.

COMMERCIAL FOREST RESERVE

The Michigan Commercial Forest program is available to private landowners as an incentive to retain and manage their forest land for long-term timber production in support of the state's forest products industry in return for a property tax reduction. In 2015, 48.75% of the watershed within Marquette County was held in the Commercial Forest Reserve (CFR).

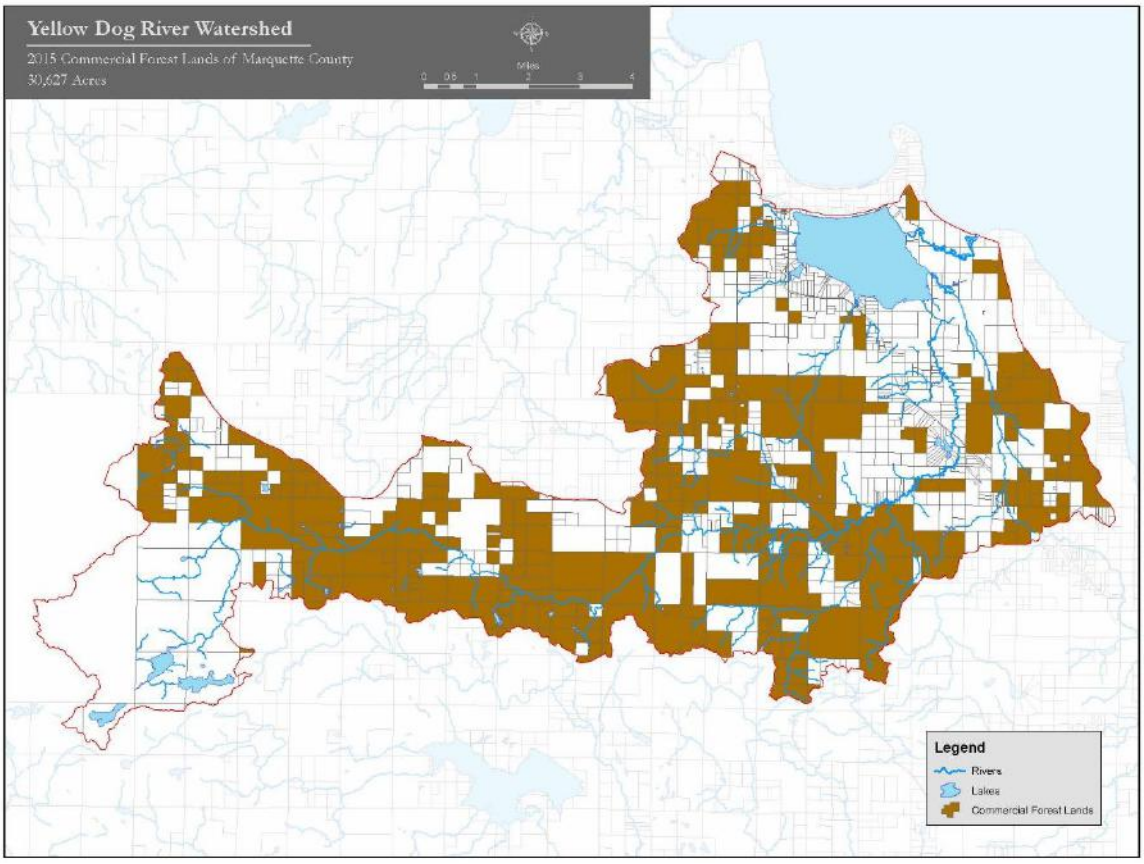


Figure 32 – Commercial forest reserve lands in the Yellow Dog watershed within Marquette County.

PRIVATE LANDS

Most of the private land in the watershed is designated as commercial forest and the landowners include major national timber companies, regional timber companies, and individuals. The remaining portion of private land in the watershed within Marquette County, 31.54% is mainly within the town of Big Bay and around Lake Independence.

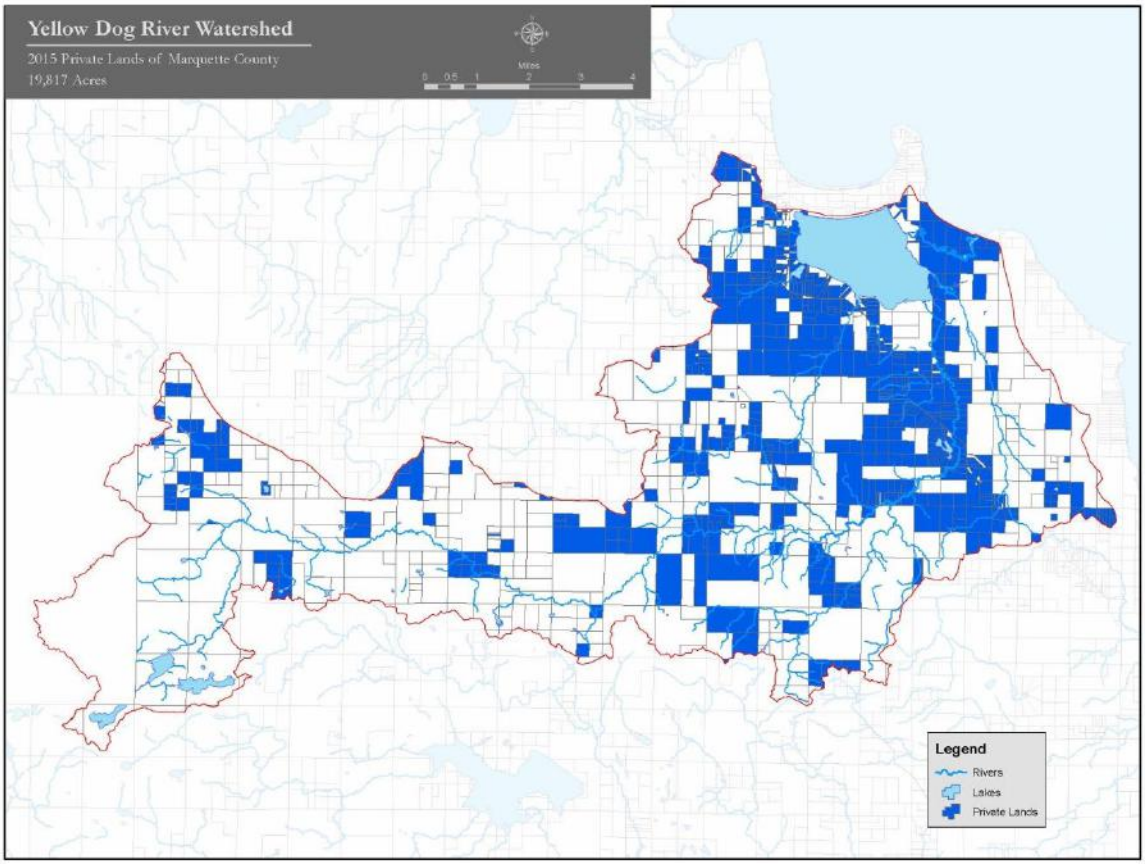


Figure 33 – Private lands within Marquette County in the Yellow Dog Watershed. Map created by Cameron Fuess.

FEDERAL LANDS

The McCormick Wilderness Area, part of the Ottawa National Forest, contains the headwater region of the Yellow Dog watershed. 4,936 acres of the total 17,000 within the McCormick are within the watershed and Marquette County, or about 7.85% of the watershed. Approximately, 2,815 acres of federal land within the McCormick are still part of the watershed, but are within Baraga County[4].

[4] An estimated amount.

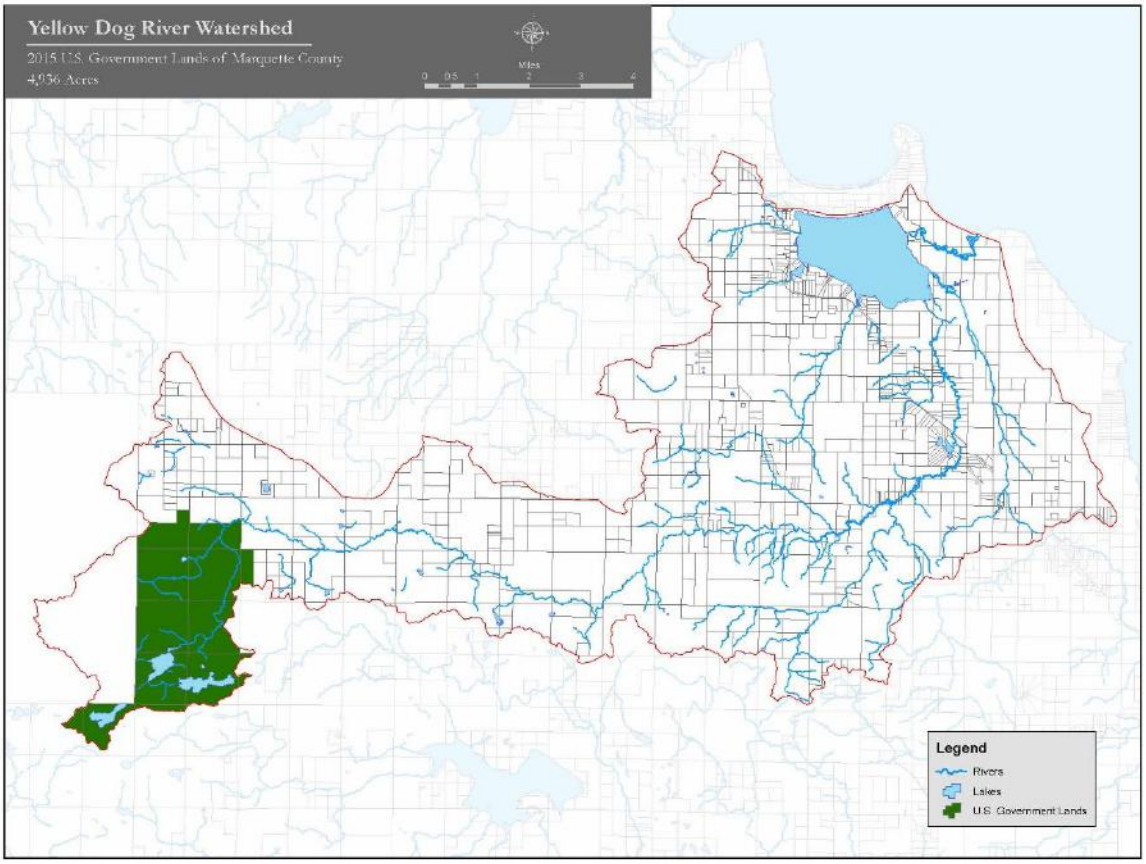


Figure 34 – Federal lands within Marquette County in the Yellow Dog Watershed. Map created by Cameron Fuess.

STATE LANDS

Land owned by the State of Michigan are scattered throughout the watershed and account for 7.37% of the land area in the Yellow Dog watershed.

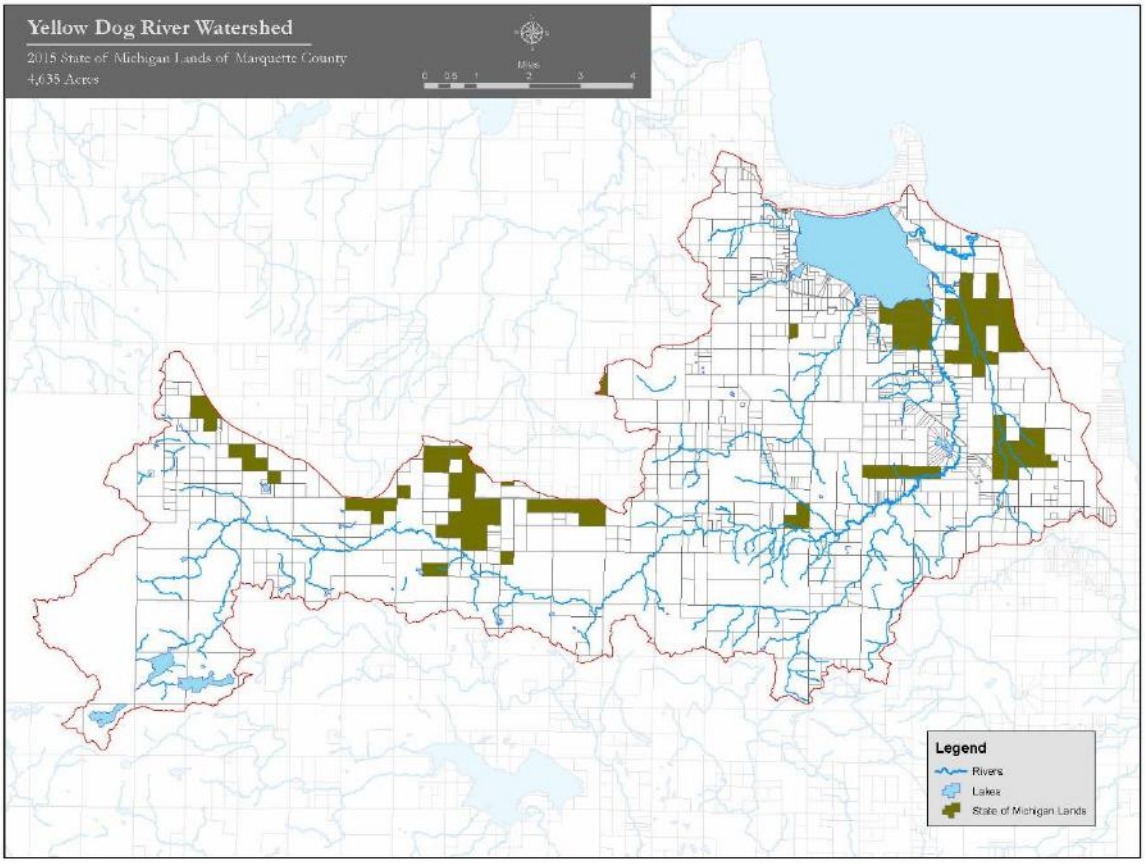


Figure 35 – State lands within Marquette County in the Yellow Dog watershed. Map created by Cameron Fuess.

TRIBAL LANDS

The entire watershed lies within the ceded territory of native tribes in Minnesota, Wisconsin, and Michigan who reserve hunting, fishing and gathering rights in the 1837, 1842, and 1854 treaties with the United States government.

TRANSPORTATION

Transportation to Big Bay has been through several stages of development throughout the towns history. In the very late 1800s, transportation from Marquette was either by boat or "a terrible wagon and sleigh road winding through the woods (The Mining Journal, 1959)." Most of the heavy construction materials that came into Big Bay, and the large timbers that were hauled out, came and went by boat on Lake Superior. Eventually, by December 1905, a branch of the Marquette and Southeastern Railroad finally reached Big Bay.

Today transportation is by County Road 550 aka "The Big Bay Road". On the south west side of Lake Independence Co. Rd. 550 intersects County Road 510, which starts in an east-west direction but eventually heads south to US-41 near Negaunee. County Road AAA (also known as Triple A Road) intersects Co. Rd. 510 where it turns to head south and Co. Rd. AAA continues west to the Yellow Dog Plains into jack pine country.

There are many intersecting and sometimes dead-end logging roads all over the watershed. The roads are used for timber harvest and often closed when projects are completed and access is blocked with large boulders. These roads are often native or dirt surfaced and used by heavy logging machinery.

In 2013, the Marquette County Road Commission announced the approval of a project that would widen and straighten Co. Rd. AAA, Co. Rd. 510 and resurface Co. Rd. 550 all the way to Marquette. The project was paid for by Rio Tinto before they sold the mining operation and the project was transferred to the Lundin Mining Company which committed to its completion.

POPULATION DEMOGRAPHICS

In 2010, Big Bay had a population of 319 people, up from 265 in 2000. According to usa.com, the population growth rate is much higher than the state average rate of -0.55% and is much higher than the national average rate of 9.71%.

Out of a total of 692 cities in Michigan containing survey data collected on population density, Big Bay is ranked #681 with #1 being the densest location. The population density of Big Bay is 53.7 people per square mile. This density is lower than the state average density of 102.20 people per square mile and is lower than the national average density of 81.32 people per square mile.

The majority of the population of Big Bay is Caucasian (94.67%). The average education level in Big Bay is higher than the state average and is higher than the national average (World Media Group, LLC, 2015).

Chapter 4 WATERSHED CONDITIONS

DESIGNATED USES AND POLLUTANTS OF CONCERN

The watershed planning process begins with evaluating current water quality conditions in the watershed. The main principle for assessing water quality conditions is whether or not the waterbody meets designated uses. Designated uses are recognized uses of water established by state and federal water quality programs. In Michigan, all surface waters of the state are protected by water quality standards for specific designated uses. These standards and designated uses are designed to 1) protect the public's health and welfare, 2) to enhance and maintain the quality of water, and 3) to protect Michigan's natural resources.

In Michigan, all surface waters of the state are designated for and shall be protected for all of the following uses:
1. **Total body contact recreation**[5]
2. **Partial body contact recreation**
3. **Navigation**
4. **Industrial water supply**
5. **Agriculture**
6. **Fish consumption**
7. **Warm water fishery (or cold water fishery)**[6] [7]
8. **Public water supply and the point of intake**[8]
9. **Other indigenous aquatic life and wildlife**

Table *6* – Designated uses for all surface waters of the state of Michigan. Citation: R323.1100 of Part 4, Part 31 of PA 451, 1994, revised 4/2/99.

DESIRED USES

Stakeholders in the Yellow Dog Watershed Planning Project identified many desired uses for the watershed (Tables 7 & 8). Desired uses are factors important to the watershed stakeholders and they reflect the way stakeholders want to use the watershed and how they would like it to exist in the future. Many of the stakeholders agreed that preservation of the watershed is a high priority. Stakeholders want to preserve natural aesthetic qualities and protect natural resources. They recommended several desired uses: protecting critical habitat for native species such as brook trout and Kirtland's warbler; maintaining accessibility to the public; limiting lot sizes; practicing sustainable and environmentally sound land use, recreation, and forest management to provide lasting protection of water quality; and conserving the riparian corridor and high biodiversity areas Additionally, stakeholders desired more education and outreach activities to provide more information to the public about the state of the watershed. These desired uses were defined specifically for the creation of a community forest in a specific part of the watershed.

[5] All surface waters of the state are designated and protected for total body contact recreation from May 1 to October 1 (R 323.1100[2]).
[6] Specific rivers and inland lakes as well as all Great Lakes and specific Great Lakes connecting waters are designated and protected as Cold Water Fisheries (R 323.1100[4]-[7]).
[7] Some areas are also protected for Fish Consumption.
[8] Several specific segments or areas of inland waters, Great Lakes, Great Lakes bays, and connecting channels are designated and protected as public water supply sources (R323.1100[8]).

Desired Use	Threat	Comment
Protecting native and endangered species	Non-native and invasive species, forest management without BMPs, excessive sedimentation, potential acid mine drainage, and climate change.	Improve or maintain brook trout population. Encourage management for Kirtland's warbler in jack pine areas.
Sustainable forestry	Improper BMPs, forest insects and diseases.	Limit harvest of hemlock, the establishment of monocultures, and harvesting without maintaining riparian buffers. Continued use for responsible, sustainable production of forest products following BMPs.
Cold water fishery	Inadequate or perched culverts, poor aquatic connectivity, poor road design, unstable banks, excessive sediment, salt/sand added to roads, climate change, timber harvesting in and near riparian areas, reduction in stream-side vegetation, and potential acid mine drainage.	Replace impaired culverts/road crossings. Stabilize banks that are impaired due to human impacts.
Maintain requirements for wild & scenic designation	Degradation of water quality, air quality, non-native and invasive species, and potential acid mine drainage.	Continuation of Wild & Scenic designation. Seek Wild & Scenic designation for the length of the river.
Canoeing & kayaking	Unimproved put-in sites.	Improve put-in sites with BMPs, incorporate signage to designate areas.
Swimming & drinking water	Excessive nutrients, toxins, heavy metals, acid rain, atmospheric deposition, potential acid mine drainage, mine exploration impacts to groundwater, groundwater recharge, and unprotected well heads.	Correct poorly maintained or outdated camp and home septic systems. Install stormwater protection infrastructure where applicable. Mining is presenting large drawdown and potential aquifer flow shifts. Monitor all mining activities and enforce laws and permit requirements. Ensure local protections for well heads in the watershed.
Hunting, trapping, and harvesting wild foods	Inappropriate use of State, CFA and other private lands; forest pathogens, invasive species, and climate change.	Potential impacts due to illegal uses and forest pathogens include loss or modification of habitat and loss of recreational opportunities
Trails and access for cross-country skiing, hiking, walking, running, snow shoeing	Few designated trails, conflicting uses for the same areas of access.	Designate areas for silent sports. Create and install signage.
Conserving riparian corridor and high biodiversity areas	Inadequate zoning, increased development in riparian corridor, potential acid mine drainage, and climate change.	Implement conservation easements where possible. Set aside undeveloped river corridor and other areas of high biodiversity. Improve

		forest management BMPs.
Watershed information/education	Limited accessible funding for watershed programming.	Reach out to community with educational workshops and public stakeholder meetings. Develop an outdoor education program for students. Include plant and animal studies, macro-invertebrates, watershed ecology, and more. Increase budget and outreach for educational programs.
Aesthetic appreciation, viewing, photography, painting	Incompatible recreational uses or lack of designated areas, poor forest management, forest insects and diseases, invasive species, illicit dumping, potential acid mine drainage, noise pollution and light pollution.	Manage for more of a natural area versus populated and industrialized.
Trails and access for ATVs/ORVs, mountain bikes, and horses	Inappropriate use on State, Commercial Forest Act and other private lands, illegal stream crossings.	Designate areas for trail riding. Create and install signage.
Equestrian pasturing	Inappropriate use on sensitive soil types, surface waters, and wetlands. Untreated animal waste in water supplies. Animal feed containing seeds of invasive species.	Improve local zoning regulations.

Table 7 – Desired uses and existing threats in the Yellow Dog watershed.

Desired Uses	Threats
Low impact public recreation	Unimproved boat access, inappropriate/conflicting recreational uses, building and development, limited recreational infrastructure (trails, parking, signage), erosion in high use areas
Community education	Limited infrastructure (trails, parking, signage), limited access
Biological diversity	Non-native invasive species, climate change, flora/fauna pathogens, monoculture, conversion to non-forest uses
High quality aquatic and terrestrial habitat	Improper forest management, erosion, poor aquatic connectivity, road impacts, resource extraction, altered hydrological flow patterns, conversion to non-forest uses
Artistic/cultural uses	Development, resource extraction, lack of designated areas, illicit dumping, noise/light pollution
Source/drinking water	Development and infrastructure, altered hydrological flow patterns, point source water withdrawals

Table 8 – Desired uses and threats relating to land acquisition and public sector stewardship.

IMPAIRED AND THREATENED DESIGNATED USES

The Michigan DEQ uses a rotating watershed cycle for surface water quality monitoring where each of the 58 major watersheds in the state are scheduled for monitoring at least once every five years. The Yellow Dog watershed was scheduled for monitoring in 2016 with the next sampling event scheduled for 2021. Data from this monitoring along with other readily available water quality data and information are used to assess surface water quality conditions. Each assessed waterbody is placed in at least one of five reporting categories. The waterbodies are evaluated in several ways: the degree of designated use support, how much is known about the waterbody's water quality status, and the type of impairment preventing designated use support.

If a body of water or stream reach is not meeting the water quality standards set for a specific designated use, then it is said to be in "nonattainment". An annually published listing of bodies of water and stream reaches in the state of Michigan that are supporting designated uses and those that are in nonattainment can be found in the Water Quality and Pollution Control in Michigan Secs. 303(d), 305(b), and 314 Integrated Report.

The table below shows the reported designated use attainment as defined in the state's Water Quality Standards (WQS) and the reported EPA national use divided by subwatershed (12-Digit Hydrologic Unit Code). According to the EPA, the status reported is based mainly on state uses. For each individual use for each assessment unit, if the state use attainment status is "fully supporting" without any indication that it is threatened, then the use status is "good". If the state use attainment status is "not supporting", "not attainable", or "partial support" then the state use status is "Impaired." If based on the above analysis, the use status is neither "impaired" nor "good", then the state use is examined to determine if the use has been flagged as "threatened". If so, the state use status is "threatened". If none of the above conditions are met, then for that designated use, the status is determined to be "not assessed" and is not included in any calculations for the report. Sizes from these assessment determinations are totaled and a percent for each status value is calculated.

Stream Reach/Water body	Designated Use										Overall Status
	Total Body Contact Recreation	Partial Body Contact Recreation	Navigation	Industrial Water Supply	Agriculture	Warm Water Fishery	Other Indigenous Aquatic Life and Wildlife	Public water supply and the point of intake	Cold Water Fishery	Fish Consumption	
040201050301-01 Bob Creek – Yellow Dog River	X	X	FS	FS	FS	X	NS	X	X	NS	Impaired TMDL needed
040201050301-02 Yellow Dog River	X	X	FS	FS	FS	X	NS	X	X	NS	Impaired TMDL needed
040201050302-01 Little Pup Creek – Yellow Dog River	X	X	FS	FS	FS	X	FS	X	X	X	Good
040201050302-02 Big Pup Creek	X	X	FS	FS	FS	X	FS	X	FS	FS	Good
040201050302-03 Yellow Dog River	X	X	FS	FS	FS	X	NS	X	X	NS	Impaired TMDL needed
040201050303-01 Yellow Dog River – Iron River	X	X	FS	FS	FS	X	FS	X	X	X	Good
040201050303-02 Lake Independence	X	X	FS	FS	FS	X	FS	X	X	NS	Impaired TMDL needed

X = Not Assessed, FS = Fully Supporting, NS = Not Supporting

Table 9 – Designated use attainment as defined In MDEQ water quality standards (WQS) and EPA Water Quality Assessment Report (U.S. Environmental Protection Agency, 2010).

In Michigan, site-specific water column and fish tissue data are used together to determine fish consumption designated use support. The water column mercury concentrations are compared to the Human Non-cancer Value (non-drinking water) Water Quality Standard (1.8 nanograms per liter [ng/L] or 1.8 parts per trillion); fish tissue mercury concentrations in edible portions are compared to Michigan's fish tissue value for mercury (0.35 milligrams per kilogram [mg/kg] wet weight or .35 parts per million) (Michigan Department of Environmental Quality , March 2014).

Cause of Impairment	Cause of Impairment Group	Designated Use(s)	State TMDL Development Status
Mercury in Water Column	Mercury	Fish Consumption, Other Indigenous Aquatic Life	TMDL Needed

Table 10 – Causes of impairment for reporting year 2010 (U.S. Environmental Protection Agency, 2010).

Probable Source	Probable Source Group	Cause(s) of Impairment
Atmospheric Deposition - Toxics	Atmospheric Deposition	Mercury in Water Column

Table 11 – Probable sources contributing to impairment for reporting year 2010 (U.S. Environmental Protection Agency, 2010).

According to this report, Big Pup Creek is the only portion of the watershed which fully supports the designated use as a cold water fishery, but the rest of the watershed has not been assessed for that designated use.

High levels of mercury have been recorded in the water column upstream of the County Road 510 Bridge and tributaries, as well as in the water column in Lake Independence and in some fish species. Mercury is not an uncommon impairment for other surface waters in Michigan's Upper Peninsula and remains a crucial pollutant of concern.

Threatened water bodies are defined as those that currently meet water quality standards but may not in the future. Potential pollutants, sources, and causes that threaten designated uses are discussed in later sections of this plan. The table below simply outlines threatened designated uses as defined by the Yellow Dog Watershed Planning Project Steering Committee.

Designated Uses	Status
Warm water fishery (or cold water fishery)	Threatened
Public water supply and the point of intake	Threatened
Other indigenous aquatic life and wildlife	Threatened
Fish consumption	Threatened

Table 12 – Designated uses that are potentially threatened in the Yellow Dog watershed as defined by the steering committee.

AVAILABLE MONITORING / RESOURCE DATA

USGS GAUGE STATION

A U.S. Geological Survey stream gage (No. 04043275) recorded daily minimums, maximums and means for stream discharge, water temperature, and specific conductance in the Yellow Dog River near Bob Creek. The site was discontinued in 2017. YDWP aims to replace the gauge station in conjunction with Northern Michigan University.

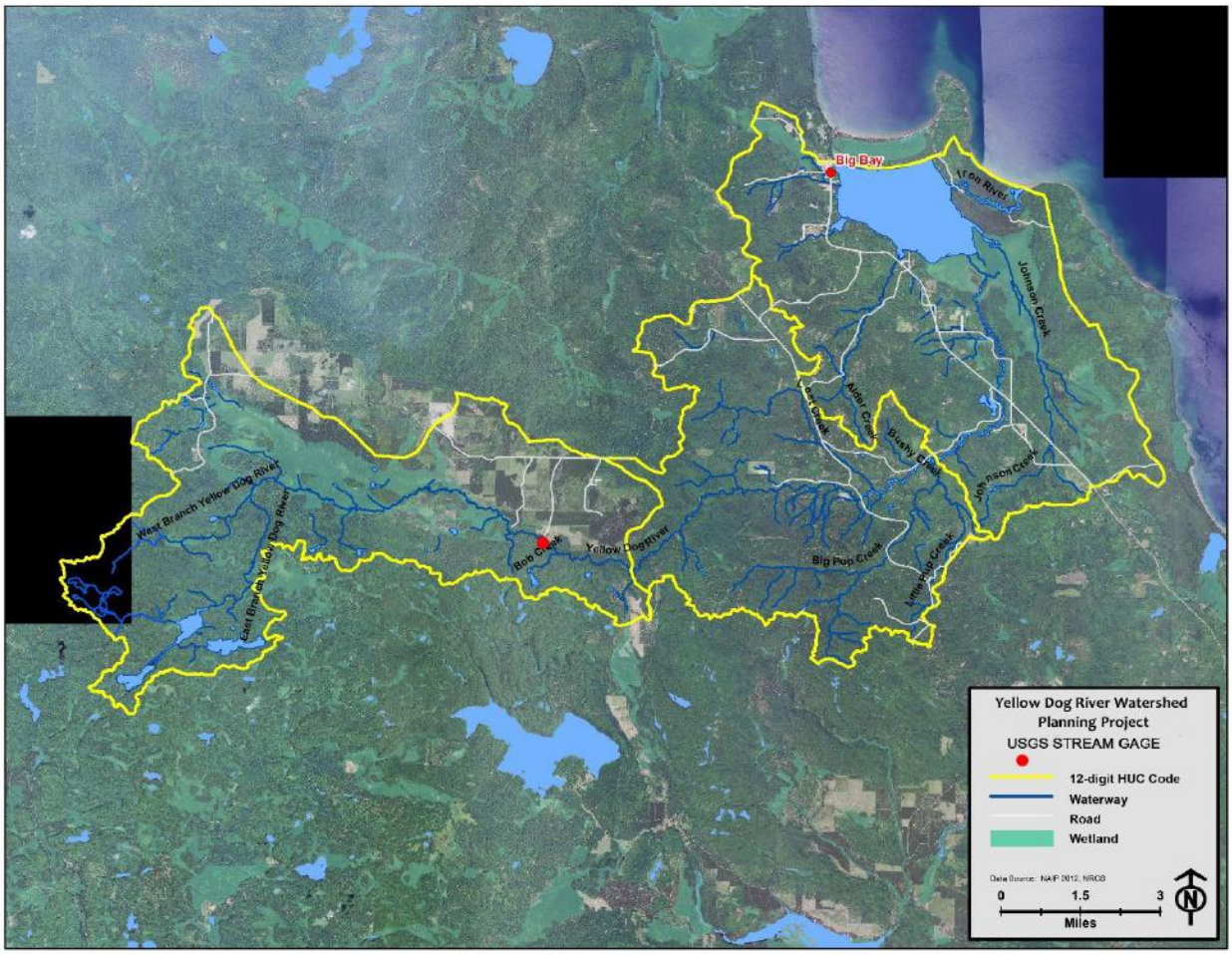


Figure 36 – USGS gage location in the Yellow Dog watershed.

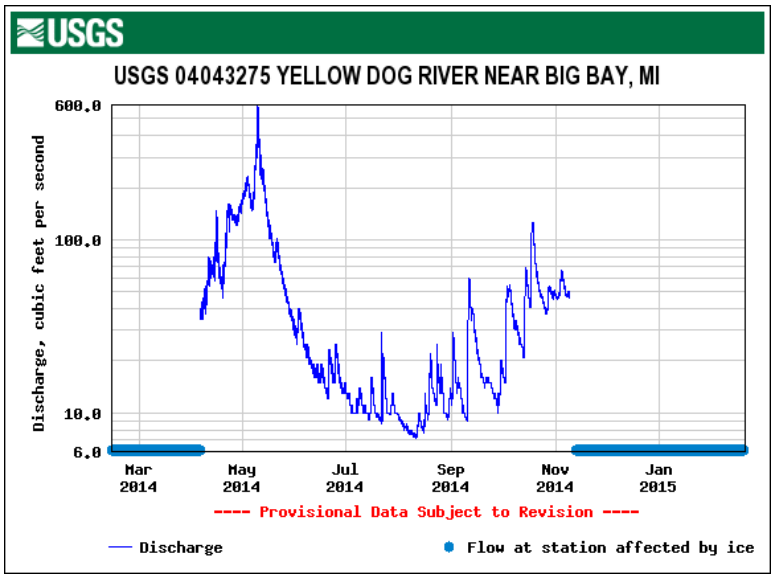


Figure 37 – Daily discharge reported from USGS stream gage 04043275.

Over the past year, the daily discharge fluctuated from 600 cubic feet per second in May 2014 during high water to 7 cubic feet per second in August 2014.

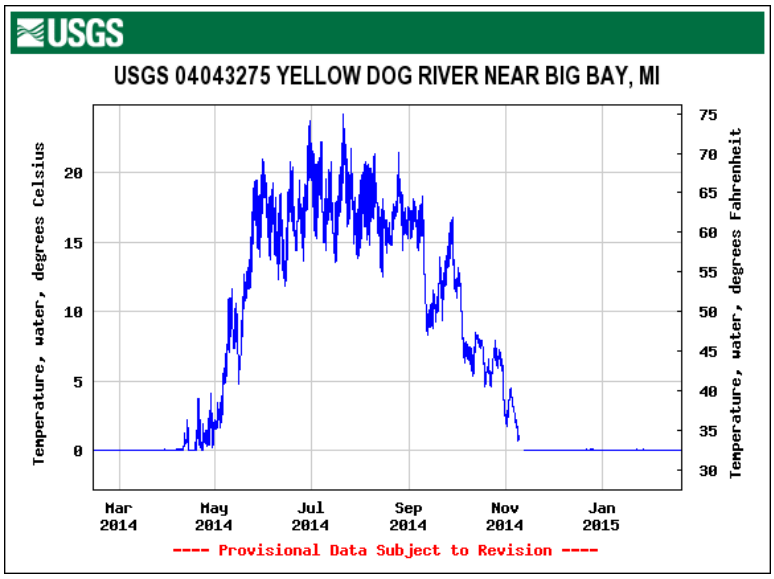


Figure 38 – Daily temperature reported from USGS stream gage 04043275.

The surface water temperature fluctuated from 0°Celsius in the winter to 24°Celsius in July and August 2014.

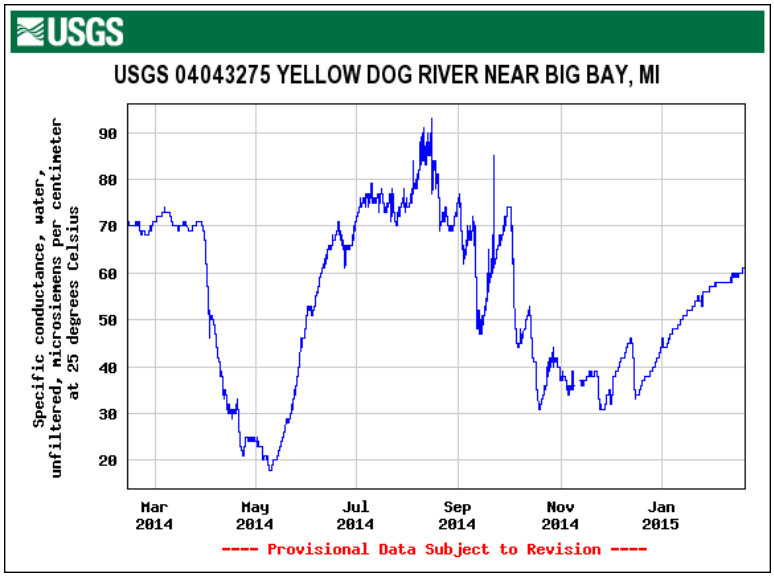


Figure 39 – Daily specific conductance at 25°C reported from USGS stream gage 04043275.

The daily specific conductance at 25°Celsius fluctuated from 15 microsiemens per centimeter to 93 microsiemens per centimeter

SURFACE WATER MONITORING ON THE YELLOW DOG PLAINS

Starting in 2004, Yellow Dog Watershed Preserve responded to mining development on the Yellow Dog Plains by beginning to establish a baseline surface water quality database for use as comparison to

changing conditions. The YDWP partnered with the Keweenaw Bay Indian Community to collect this information and made sure water samples were analyzed by EPA certified labs.

Multiple surface water stream sites within both the Yellow Dog and Salmon Trout River watersheds were tested by Dr. John Ejnik of the University of Wisconsin-Whitewater and others for trace metals, field parameters, and more. These baseline sites were generally tested three or four times each sampling season and sent to a certified lab for analysis.

Additionally, a total of 10 spring locations were sampled with Keweenaw Bay Indian Community about four times each year for a wide variety of surface water parameters such as chloride, total dissolved solids, and metals. These spring locations feed the headwaters of the East and Middle Branch Salmon Trout River and are critical locations for gathering baseline conditions for water resources in the area. Consultants were hired to conduct professional water chemistry sampling, package the samples, and send to an EPA certified lab for analysis. A total of 30-40 constituents were tested during each sampling session. The data that was collected at these sites has been compiled into a surface water monitoring database by the Yellow Dog Watershed Preserve. Three of the sites were inside the Yellow Dog watershed boundary (Table 13). See Appendix A for data collected at the three sites listed in Table 13.

Site ID	Description of Site	Latitude	Longitude
YDR001	South of Bentley Lake	46.729778N	-87.946917W
YDR002	Clowry Bridge at Snowmobile Trail 5	46.727278N	-87.872639W
YDR003	Wetland South of Eagle Rock	46.743111N	-87.883111W

Table 13 – Yellow Dog plains surface water monitoring location 2004-2012.

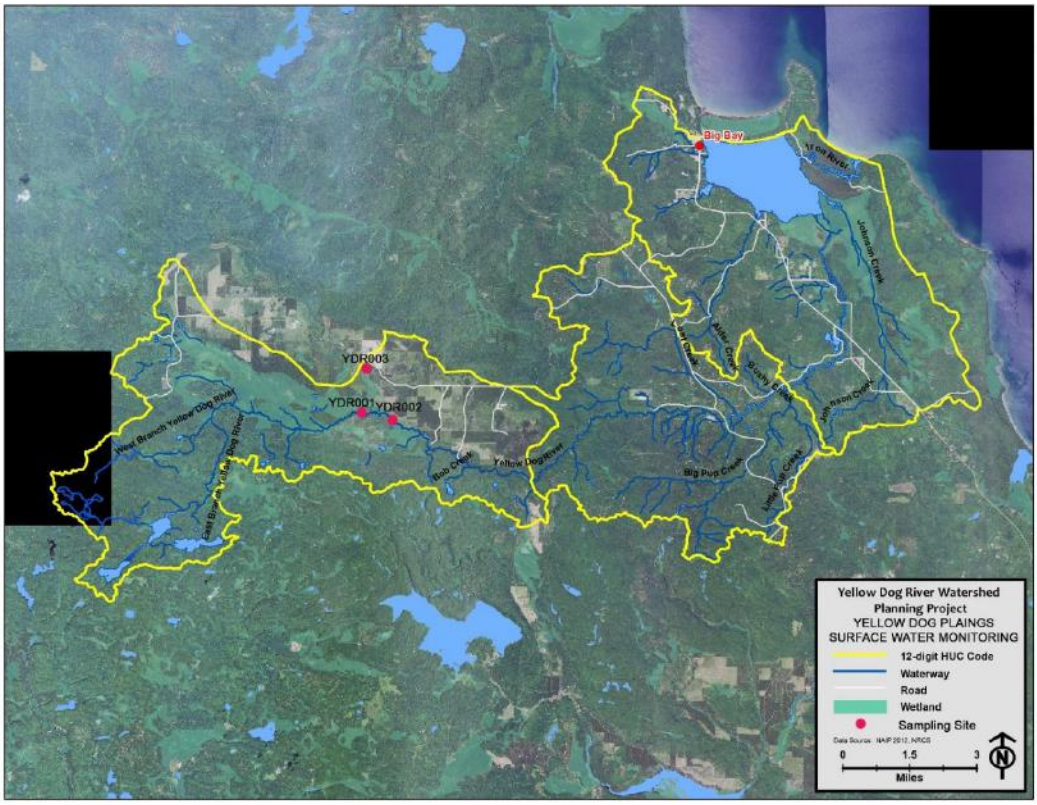


Figure 40 – YDWP/KBIC water chemistry sampling sites in the Yellow Dog watershed from 2004 to 2012.

U.S. GEOLOGICAL SURVEY COOPERATIVE WATER AGREEMENT

On April 18, 2013, the Keweenaw Bay Indian Community entered into a Cooperative Water Agreement with the U.S. Geological Survey to monitor surface waters on the Yellow Dog Plains for four years from 2013 to 2016 with a report of their findings to be reported in 2017. The USGS is a non-biased government agency that collects data using the highest quality science available.

Since the new agreement has been established, the results are public information available on the USGS website. Most spring and stream sites are located in the Salmon Trout Watershed, but one site in the Yellow Dog Watershed will continue to be monitored throughout the course of the study: YDR002 at the Clowry Bridge.

Figure 41 – USGS surface water data sampling at a Salmon Trout spring location near the mine site May 8, 2014. In the photo on left Hydrologic Technician Matt Holmio and Supv. Hydrologic Technician Neal Craig on right.

GREAT LAKES INDIAN FISH AND WILDLIFE COMMISSION (GLIFWC)

The Great Lakes Indian Fish and Wildlife Commission (GLIFWC) represents eleven Anishinaabeg[9] tribes in Minnesota, Wisconsin, and Michigan who reserved hunting, fishing and gathering rights in the 1837, 1842, and 1854 treaties with the United States government. GLIFWC provides natural resource management expertise, conservation enforcement, legal and policy analysis, and public information services in support of the exercise of treaty rights.

YDWP has partnered with GLIFWC Biological Services Division on a number of watershed monitoring initiatives. GLIFWC continues to manage a surface water monitoring project that is independent from the USGS monitoring project. The project includes surface water grab sampling and the placement and management of continuous conductivity loggers with YDWP partnership. There are a total of six (6) loggers placed in strategic spring and stream locations in the East and Middle Branches of the Salmon Trout River which may help to indicate the presence of heavy metals in surface waters.

EAGLE MINE MONITORING ON THE YELLOW DOG PLAINS

The Eagle Mine surface facilities are located on the watershed divide between the Salmon Trout and Yellow Dog Rivers. The Eagle Mine facility is required by the state of Michigan to maintain five permits: Air Quality, Groundwater Discharge, Part 632 Nonferrous Metallic Mineral Mining Permit, Land Use lease, and an Exploration lease. These state-level permits stipulate monitoring procedures and Maximum Daily Loads (MDLs) needed to remain in compliance. This list does not include permits required at the mill in Humboldt.

[9] It should be noted that the Ojibwa and Chippewa refer to the same group of people. For consistency in this paper the group will be referred to as the 'Anishinaabeg,' which means 'the original people' in the Anishinaabeg language. The Odawa, Ojibwa and Algonquin people all refer to themselves as the Anishinaabeg.

Starting in November 2002, Eagle Mine LLC hired North Jackson Company to monitor surface waters on the Yellow Dog Plains to begin the background water quality assessment for the Part 632 Nonferrous Metallic Mineral Mining Permit. Most of the surface water monitoring sites for the mine are located in the Salmon Trout watershed and one is located in the Yellow Dog at the Clowry Bridge. Groundwater quality monitoring has been conducted quarterly under the mine permit at 10 background (upgradient of potential impact from mining activities) and 14 compliance (downgradient of impact) monitoring locations beginning in 2012. The mine is also required to provide groundwater elevation data. Instruments were installed at 30 wells and provide hourly water elevation data, and in some cases water temperature data (Superior Watershed Partnership and North Jackson Company, 2015).

Baseline data were collected for the Groundwater Discharge Permit on a monthly basis from May through October 2008, and on a quarterly basis from January 2009 until October 2011. When the Wastewater Treatment Plant was fully constructed, operations monitoring of effluent began in October 2011. The area is monitored through a network of 7 hydraulically up gradient wells (background monitoring locations) and 8 hydraulically down gradient wells (compliance monitoring locations).

In 2012, the Superior Watershed Partnership created the Community Environmental Monitoring Program (CEMP). The program is funded by Eagle Mine LLC, and money is dispersed to the Marquette County Community Foundation then granted to Superior Watershed Partnership. In 2013, the CEMP began with data collection occurring at Eagle Mine, Humboldt Mill, and along transportation routes with monitoring efforts focusing on air quality, groundwater, surface water, wildlife, and plant life.

YDWP STREAM MONITORING

The Yellow Dog Watershed Preserve has been surveying the Yellow Dog River following the MiCorps Stream Monitoring protocol since 2004 when a start-up grant was received from the Michigan Department of Environmental Quality. The program is managed by trained YDWP staff and carried out by dedicated and trained volunteers. The program began with the establishment of 20 sites with each site 300 feet along the length of the stream, over half of which are extremely remote. YDWP has since reduced the bi-annually monitored sites to 10 total, in order to maintain consistent monitoring while dealing with budget constraints. These 10 sites are all on accessible roads to minimize access time and include sites on the Yellow Dog River, Alder Creek, and the Iron River.

Surveys include an assessment of aquatic habitats, erosion, land uses, and macroinvertebrate populations. The macroinvertebrate assessment can be used to accompany chemical analysis to ultimately provide a thorough evaluation of water quality.

Figure 42 – Stream width and depth measurements taken at the County Road 510 bridge as part of the volunteer stream monitoring program.

Figure 43 – Fall 2014 macroinvertebrate sampling through the volunteer stream monitoring program.

Yellow Dog Volunteer Stream Monitoring Program Results (Data collected from 2004 to 2014)				
Site ID	Location Description	Bi-Annual or 5-year	Avg. Total Benthic Score	Water Quality
IR 1.0	Iron River at Canoe Launch	Bi-annual	30.5[10]	-
AC 1.0	Alder Creek at CR550	Bi-annual	47.1[11]	-
YDR 1.0	Jean Farwell Wilderness	Bi-annual	46.93	Good
YDR 2.0	Old 550 Bridge/Antlers	Bi-annual	47.03	Good
YDR 3.0	Bear Lake Outlet	Bi-annual	45.45	Good
YDR 4.0	The Orchard	5-year	48.23	Excellent
YDR 5.0	Big Pup at Yellow Dog	5-year	46.10	Good
YDR 5.1	Big Pup at CR 510 Bridge	Bi-annual	42.64	Good
YDR 5.2	Big Pup at Section 29 Bridge	5-year	36.70	Good
YDR 5.3	Little Pup at Wilson Truck Trail	Bi-annual	38.44	Good
YDR 6.0	Lost Creek Inlet at YDR	5-year	45.18	Good
YDR 6.1	Lost Creek at CR 510	5-year	38.06	Good
YDR 7.0	CR 510 Bridge	Bi-annual	47.35	Good
YDR 8.0	Ford Crossing	Bi-annual	42.14	Good
YDR 9.0	Tawadina Creek	5-year	49.32	Excellent
YDR 10.0	Pinnacle Falls	5-year	47.13	Good
YDR 11.0	Section 20 Landslide	5-year	46.15	Good
YDR 12.0	Bob's Lake Creek at YDR	5-year	46.12	Good
YDR 13.0	Bob's Lake Crossing	5-year	49.37	Excellent
YDR 14.0	Clowry Bridge	Bi-annual	49.71	Excellent
YDR 15.0	YD Plains Discharge	5-year	51.23	Excellent
YDR 16.0	Anderson Creek	5-year	52.00	Excellent

Table 14 – Yellow Dog volunteer stream monitoring program results.

[10] [7] These sites were first monitored in fall 2014, there is not enough data in existence to make a conclusion about the water quality based on the Total Benthic Score.

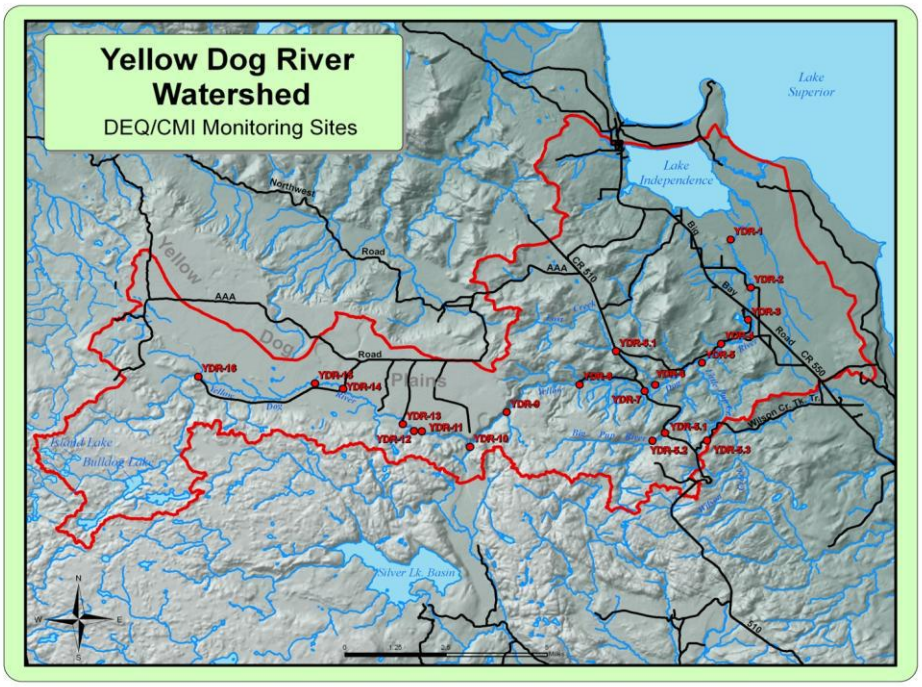


Figure 9 – Map of the original 20 sites initiated in 2004.

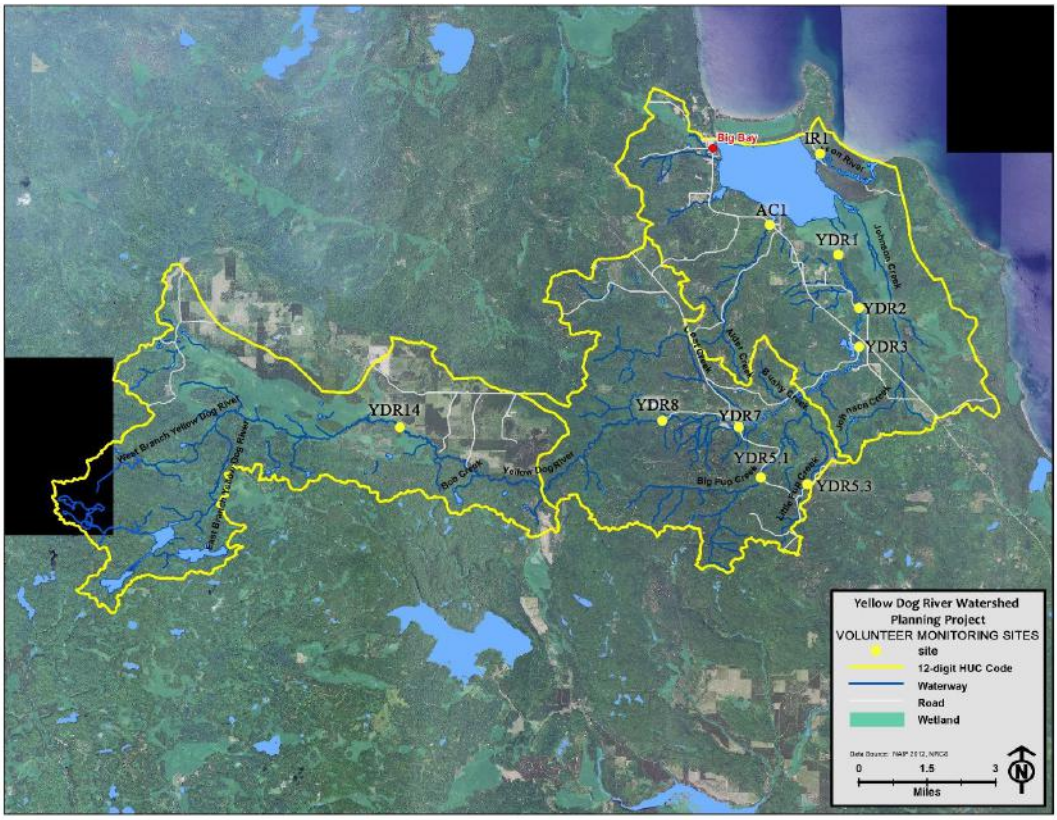


Figure 45 – Annual Yellow Dog volunteer stream monitoring sites 2015.

LAKE INDEPENDENCE WATER QUALITY AND CHARACTERISTICS

YDWP has been collecting data on Lake Independence since 2010 and has a historical record of lake water clarity data from 1977-1982. YDWP intends to continue collecting information about Lake Independence to monitor trends in water quality through the Cooperative Lake Monitoring Program indefinitely. This program is directed by a partnership between the MDEQ and the Michigan Lake and Stream Association. The goal is to provide water quality data for lakes in the state of Michigan in a cost-effective way. The data can be analyzed to observe long-term trends and will also be used to educate lake residents about lake ecology and potential threats to the health of their lake.

Figure 46 – Lake Independence monitoring from a sea kayak in 2012.

Volunteers from Marquette and Big Bay visit Lake Independence weekly to collect water quality data (total phosphorous, chlorophyll, water clarity, dissolved oxygen, and temperature) from May through September. Measurements and samples are collected following the state-wide program protocol in the same location, deepest part of the lake, during each sampling event. The program aims to track eutrophication, a natural aging process which occurs through the gradual accumulation of nutrients, increasing productivity, and a slow filling in of the lake basin with accumulated sediments, silt, and muck. The process occurs naturally in nature but humans can speed up the process.

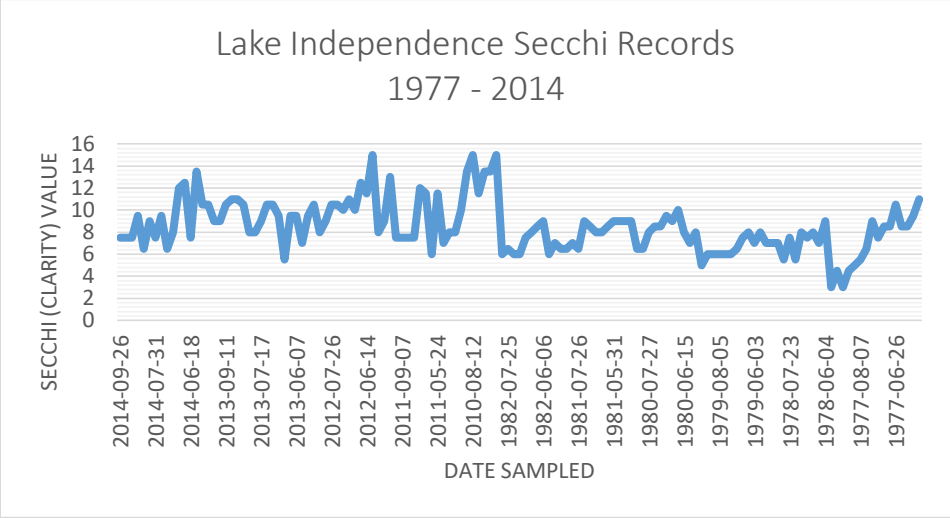


Figure 47 – Lake Independence secchi depth results from 1977-2014.

Lake Independence shows variable clarity measurements. Notice, there is a large gap in the data between 1982 and 2010.

While the lake remains classified as mesotrophic and healthy, YDWP is watching fluctuations in total phosphorus which have been variable. Phosphorus is a naturally occurring element in lake sediment, but can enter a lake through poorly maintained septic systems and lawn fertilizers. The excessive build up can start to damage a lake's natural ecology, dissolved oxygen levels, and fish habitat which are difficult and expensive to recover.

Figure 48 – Volunteer Jo Foley conducting the testing on Lake Independence.

Total phosphorus values have indicated no conclusive increasing trend according to the Department of Fisheries and Wildlife at Michigan State University. However, the program administrative experts emphasize continuing consistent annual monitoring to determine if an increase is truly occurring (Latimore Ph.D., 2014). Lake Independence has been classified as a "shallow mesotrophic lake that does not maintain summer stratification. Because the lake is so shallow, summer storms can drive wave energy into the deepest parts of the lake breaking up any stratification present and re-supplying the deep water with oxygen" (MiCorps 2013).

Samples are analyzed by a Michigan Department of Environmental Quality lab, and the annual report is released by the Michigan Clean Water Corps (MiCorps). Yellow Dog Watershed Preserve is looking into methods of educating lake residents about good lake stewardship.

Chapter 5 POLLUTANTS, SOURCES, AND CAUSES

Since 1995, the Yellow Dog Watershed Preserve (YDWP) has been recording chemical, biological, physical, and cultural data about the watershed through a variety of projects and ongoing programs. Over the years, YDWP has initiated and managed several data collection programs: macroinvertebrate surveys, baseline chemical analysis, road/stream crossing inventory data, field observations, land use analysis, and reconnaissance studies of flora and fauna. The group has consulted with watershed residents and experts, and the river has been monitored by many government and non-government agencies.

Sediment is the predominant known pollutant of concern in the Yellow Dog watershed. It is a naturally occurring material that is broken down by processes of weathering and erosion, and is transported by the action of wind, water, ice, or the force of gravity. Excessive sediment harms fish and other aquatic life by covering the gravel substrate they rely upon. It may also fill in stream channels, making them shallower and wider and more susceptible to changes in hydrologic flow and increases in water temperature. Sediment may enter the stream from many sources: failing road-stream crossings, fords, poor forest management practices, earth-moving, mining, development, recreational activities, or any other activity in which soil is disturbed and transported to nearby streams.

Many other types of pollutants are present in the watershed in some amount: heavy metals, nutrients, toxins (herbicides, pesticides, oils, gas, grease, salt/chloride, etc.), many of which will remain in the soil and water. Heavy metals, nutrients and toxins often attach to soil particles, which links them to sediment pollution.

Non-native invasive species have impacted the Yellow Dog watershed, where they continue to be present, posing current and future threats to the ecosystem. A non-native invasive species (NNIS) is defined as an organism that has been purposefully or accidentally introduced outside its original geographic range, and that is able to proliferate and aggressively alter its new environment, causing harm to the economy, environment, or human health (Executive Order 13112, February 3, 1999). NNIS are able to out-compete native species and are often transported by wind, waterways, human activity, and animals.

POLLUTANT SOURCE ASSESSMENT

The watershed contains a variety of pollutant sources that have been identified by watershed stakeholders. Some are known sources of pollution, while others have the potential to become a pollution source without proper management. First, these areas were identified as concepts to be assessed. Then, they were investigated further through field studies and reconnaissance, GIS data analysis, and research, or generally a combination of the three. Chapters 7 and 8 discuss efforts needed to manage these pollutant sources.

Threatened Designated Use	Pollutants	Sources	Causes
Cold water fishery, Other indigenous aquatic life and wildlife	Sediment (k)	Road stream crossings (k)	Poor design/construction/maintenance (k) Lack of erosion controls (k) Steep approaches (k) Culverts not aligned to stream bed (k)

			Undersized or perched culverts (k) Lack of crossing structure (k) Road grading operations (k)
		Road locations (k)	Poor design/construction/maintenance (k) Lack of erosion controls (k)
		Forest management practices (p)	Removal and/or lack of riparian buffers (p) Clearing by landowners (p) Equipment problems due to steep topography (p) Numerous crossings of small streams and drainages routes (p) Construction of roads (p)
		Mining activities (p)	Construction of industrial sites and roads(p) Exploration related activities (p)
		Development (k)	Removal and/or lack of riparian buffers (k) Clearing by landowners (k) Construction of secondary access roads (p)
		Recreation (k)	ATV/ORV crossings of streams (k) Streambank erosion from unauthorized or unimproved access points (k)
		Natural sources (k)	Natural river dynamics, high water storm events causing streambank erosion (k)
Cold water fishery, Other indigenous aquatic life and wildlife, Fish Consumption	Heavy metals (Mercury (k) and others (p))	Mining activities (p)	Leaching of storage ponds into surface and/or underground water supplies (p) Exploratory drilling (p)
		Atmospheric deposition (k)	Mercury in industrial air emissions (k) Nearby coal fired power plants (p) Extraction and/or transportation of underground deposits containing heavy metals (p) Extraction (p)
		Non-industry related combustion (p)	Forest fires (p) Use of burn barrels (p) Car engines (p)
Cold water fishery, Other indigenous aquatic life and wildlife	Nutrients (p)	Residential fertilizer use (p)	Improper application: amount, timing, frequency, location, method, chemical content (p)
		Septic systems (p)	Poorly designed or maintained systems (p) Unsuitable sites and/or soils (p)
Cold water fishery, Other indigenous aquatic life and wildlife	Toxins (herbicides, pesticides, oils, gas, grease, salt/chloride, etc.) (p)	Mining activities (p)	Leaching of storage ponds into surface and/or underground water supplies (p) Waste spills from heavy equipment (p) Air emissions (p)
		Forest management practices (p)	Improper application of herbicides and/or pesticides: amount, timing, frequency, location, method, chemical content (p) Waste spills from heavy equipment (p) Illicit dumping (p) Cleaning of forestry equipment (p)

		Atmospheric deposition (p)	Use of burn barrels (p) Industries (p)
		Winter road maintenance (p)	Salt use on roads (p)
		Application of herbicides/pesticides (p)	By private landowners (p) By MDARD certified applicants (p)
Warm and cold water fisheries, **Other indigenous aquatic life and wildlife**	Non-Native Invasive Species (k)	Recreation (p)	Unwashed boat hulls (p) Releasing unused bait into waterways (p) Seeds transported by attaching to hiking boots, pets, and clothing (p) ATV/ORV recreation (p) Fishing gear (i.e. waders and boots) (p)
		Movement of machinery (p)	Contaminated logging equipment (p) Seeds transported in gravel and contaminated seed mixes (p)

(k) = known, (p) = potential

Table 15 – Known and potential pollutants, sources, and causes in the Yellow Dog watershed.

NONPOINT SOURCES

STREAMBANK EROSION SITES

YDWP assessed the entire watershed for nonpoint sources of sedimentation from eroding streambanks and road stream crossings. Eroding streambanks were located in one of two ways: on-the-ground field assessment or using satellite imagery (i.e., Google Earth and/or imagery in GIS) from an office setting. In the field, information for streambanks was collected using the U.S. Department of Agriculture Natural Resources Conservation Service Technical Guide for Streambank Erosion (USDA NRCS). Staff members and qualified volunteers walked the river corridor to identify streambank erosion sites and collect information on soil texture (clay, silt, sand, gravel, loam, sandy loam, and gravelly loam), lateral recession rate, and dimensions (length and width) of the eroding area. This information was then used to calculate the amount of soil per year that is eroding into waterways using the Direct Volume Method following guidelines from the USDA National Resources Conservation Service technical guide. The equation used is as follows:

$$\frac{eroding\ area\ (ft^2)\ x\ lateral\ recession\ rate\ \left(\frac{ft}{year}\right)\ x\ soil\ density\ \left(\frac{lbs}{ft^3}\right)}{2000\frac{lbs}{year}} = erosion\ in\frac{tons}{year}$$

We calculated the minimum, maximum, and average erosion in tons per year at each site using the above formula. When a given attribute (see technical guide for values attributed to soil density and lateral recession rate) was provided as a range of values we used the minimum value when calculating the minimum erosion rate and the maximum value when calculating the maximum erosion rate. The average erosion rate was calculated by averaging the minimum and maximum erosion rates. After calculating average erosion rates, sites were prioritized into two categories: high priority for sites where erosion was determined to be human caused, and low priority for sites where erosion was determined to be naturally caused (Figure 49). Then, sites within each category were ranked from highest concern to those of lowest concern based on the amount of sediment each site was contributing to the system. See

Table 16 for summary of streambank erosion inventory and Appendix B for more details on each streambank erosion site.

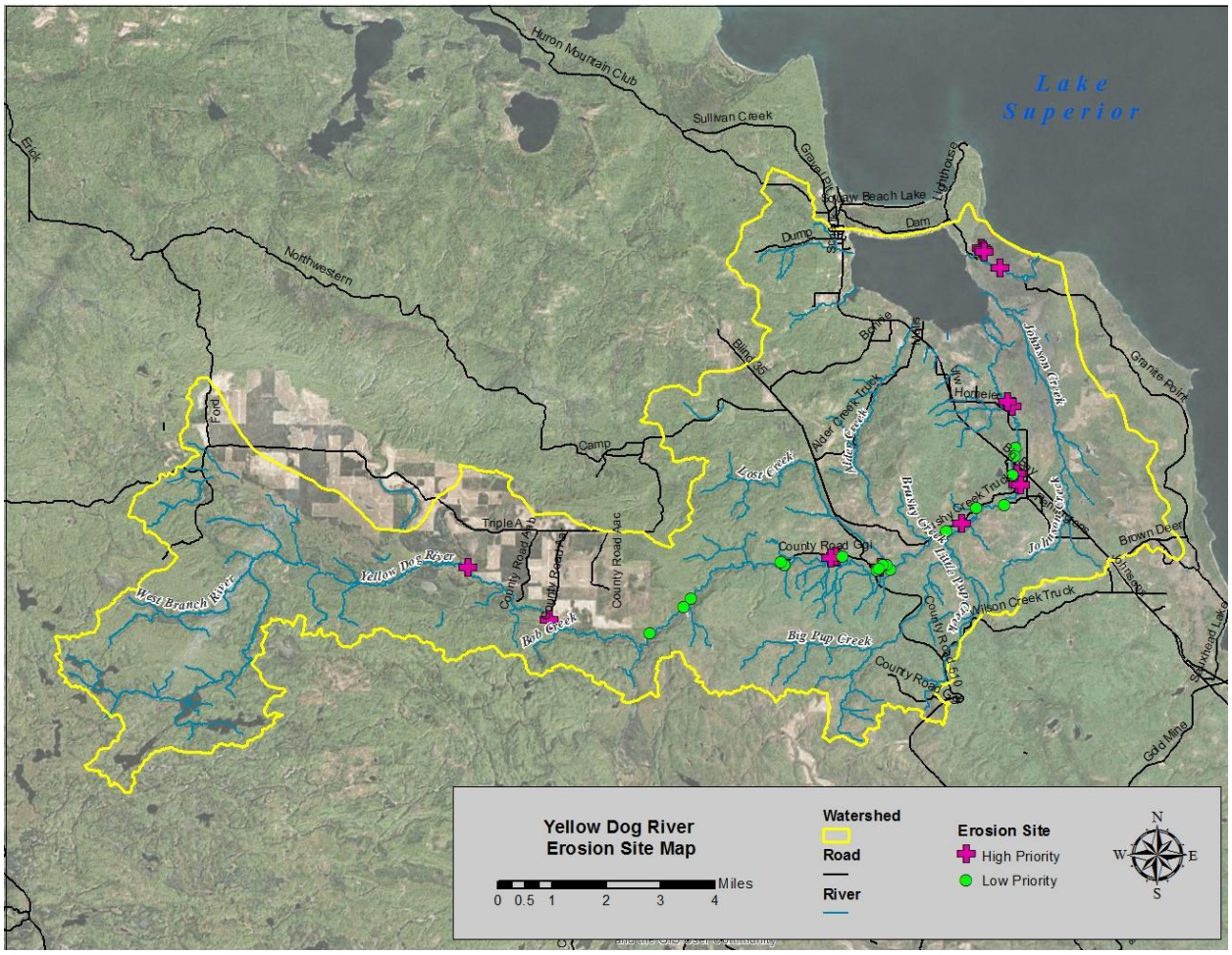


Figure 49 – Streambank erosion sites.

Cause of Erosion	Number of Sites	Total Average Annual Erosion (tons/year)
Anthropogenic	16	167.2
Development	6	140.6
Recreation	10	26.6
Natural	19	611.8
Total	**35**	**779**

Table 16 – Erosion summary for streambank erosion sites.

ROAD-STREAM CROSSING ANALYSIS

Throughout 2012 and 2013 the Yellow Dog Watershed Preserve conducted an analysis of 166 road-stream crossings in the watershed to assess aquatic connectivity, quantify erosion near the crossings, and determine functionality of structures (Figure 50 and Appendix C). The in-field surveys followed Great Lakes Road Stream Crossing Inventory guidelines and methodologies (see Appendix D for protocol

and data form). Most road stream crossings in the watershed were assessed; however, crossings located in construction zones or accessed only by private property were not assessed. See Appendix C for a list of the road stream crossing locations and some of the recorded attributes.

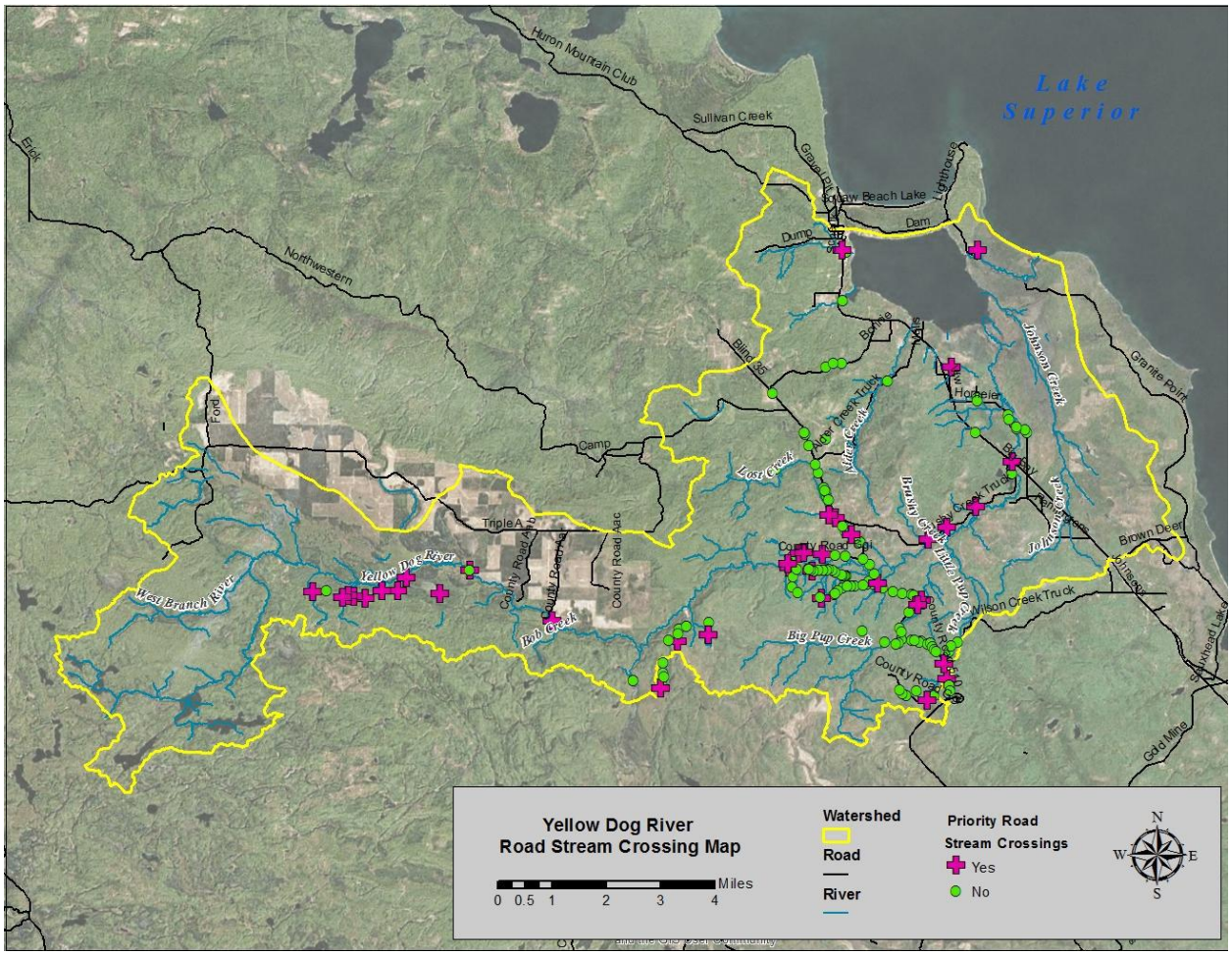


Figure 50 – Road-stream crossing sites.

Erosion Extent	Number of Sites	Erosion Volume (ft^3)
Minor	133	300
Moderate	15	1597
Severe	4	11,538
Blank on data form	14	0
Total	**166**	**13,435**

Table 17 – Erosion summary for road-stream crossing sites.

There are many benefits of improved road-stream crossings, inclucing social, environmental, and economic benefits (Table 18). Often, the cumulative benefit of replacement is overlooked, especially those that are more long-term.

Type of Benefit	Outcomes
Social	· Improved safety and mobility · Avoided physical and mental health impacts · Enhanced river-related recreation
Environmental	· Healthier populations of fish and wildlife · Improved river habitat for in-stream and river dependent species · Decreased erosion of stream banks - Improved water quality · Avoided water quality impacts from storm-related failure

Economic	· Avoided flood repair costs:
	  · Repair of damaged infrastructure
	  · Repair and replacement of damaged property
	  · Travel delays
	  · Lost business income from road closures
	· Local jobs for contractors
	· Avoided costs to repair environmental degradation (e.g., water quality)

Table 18 – Benefits of upgraded road-stream crossings (Levine, August 2013).

SEPTIC SYSTEMS

Using natural processes to treat and dispose of household wastewater onsite, a septic system is an underground, highly efficient wastewater treatment system which is relatively inexpensive to install and maintain. Information retrieved from the Spreadsheet Tool for Estimating Pollutant Load (STEPL) Input Data Server shows that, at time of data collection in 1998, there were 168 septic systems in the Yellow Dog Watershed with an average of two individuals per septic system and a failure rate of 1.14% (National Environmental Service Center, 1998). Properly functioning and maintained septic systems are important to limiting nutrient input into aquatic systems. When septic systems fail, there is risk of nutrient pollution loading that could threaten cold water fisheries, other aquatic life, and public water supplies.

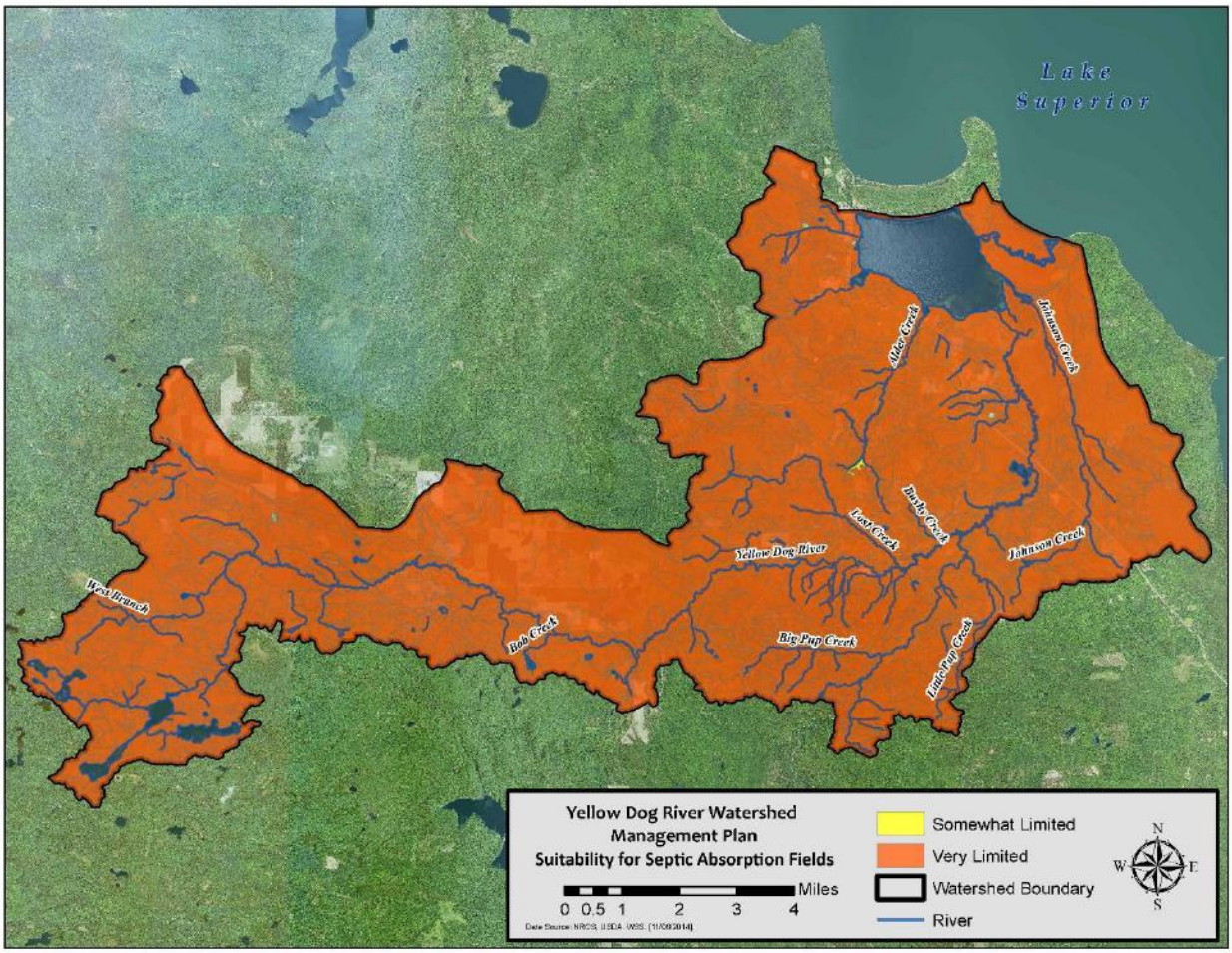


Figure 51 – Soil suitability for septic systems in the Yellow Dog watershed. Map by Christina Spitz.

Rating	Acres	Percent of Watershed
Very limited	60,211.00	95.80%
Somewhat limited	15.5	<1%
Null or Not Rated	2,604.10	4.10%

Table 19 – Table of soil suitability ratings and percentages for septic systems in the Yellow Dog watershed.

SUITABILITY OF BUILDINGS WITH BASEMENTS

Buildings with basements require specific soil types versus others to prevent design problems, expensive installation procedures, and high maintenance costs. For the purposes of this rating criteria, it is assumed that the buildings are single-family homes that are three stories or less with a spread footing foundation of reinforced concrete built on undisturbed soil at a depth of about 7 feet. This assumption was used to generate a soil suitability map showing where soils are not limited, somewhat limited, and very limited for buildings with basements.

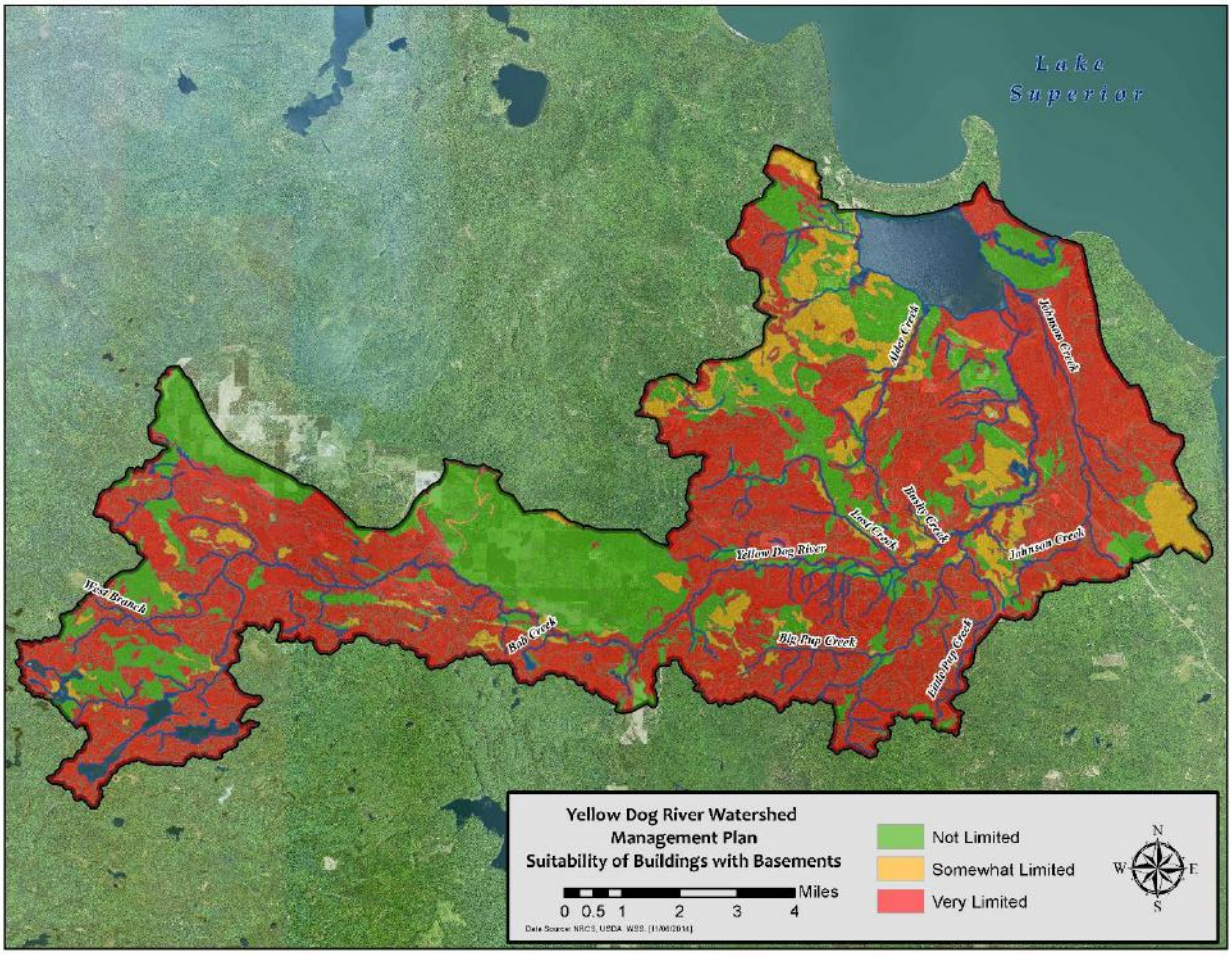


Figure 52 – Suitability of buildings with basements in the Yellow Dog watershed. Map by Christina Spitz.

Summary by Rating Value		
Rating	Acres in Yellow Dog watershed	Percent of Yellow Dog watershed
Very limited	39,208	62.40%
Not limited	15,002	23.90%
Somewhat limited	6,016	9.60%
Null or Not Rated	2,604	4.10%

Table 20 – Table of suitability for buildings with basements with percentage of area in Yellow Dog watershed.

According to the assessment of data provided by the Natural Resource Conservation Service Web Soil Survey, the majority of soil types in the watershed (62.4%) are very limited for buildings with basements.

ATMOSPHERIC DEPOSITION

As is the case in many water bodies across the state, atmospheric deposition is affecting the Yellow Dog Watershed. According to the 2014 MDEQ Water Resources Division Secs 303(d), 305(b), and 314 Integrated Report, "a statewide mercury-based fish consumption advisory applies to all of Michigan's inland lakes, reservoirs, and impoundments. The majority of Michigan's public access lakes have moderate or low nutrient levels; however, nutrient levels are high enough in several lakes to warrant

corrective action through the development and implementation of a TMDL" (Michigan Department of Environmental Quality , March 2014).

In Michigan, site-specific water column and fish tissue data are used together to determine fish consumption designated use support. The water column mercury concentrations are compared to the Human Non-cancer Value (non-drinking water) Water Quality Standard (1.8 nanograms per liter [ng/L] or 1.8 parts per trillion); fish tissue mercury concentrations in edible portions are compared to Michigan's fish tissue value for mercury (0.35 milligrams per kilogram [mg/kg] wet weight or .35 parts per million) (Michigan Department of Environmental Quality , March 2014).

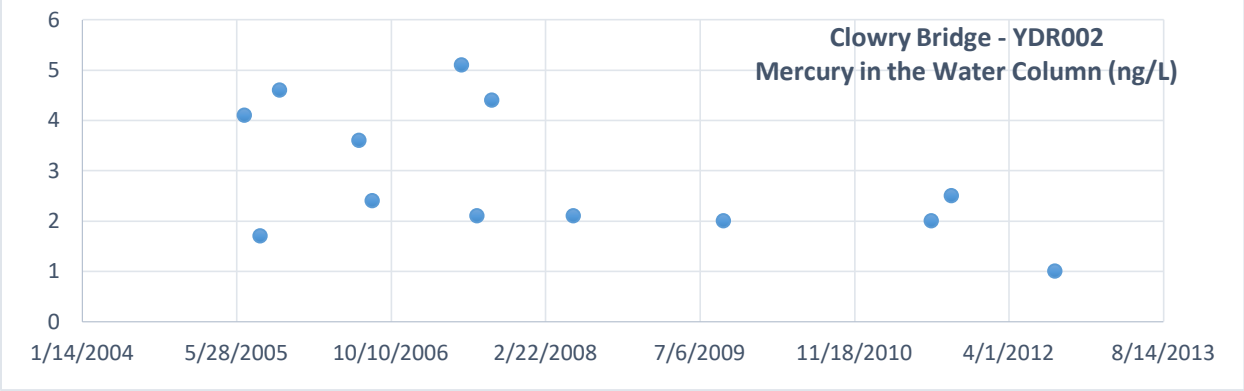


Figure 53 – Mercury in the water column at Clowry Bridge. Data analyzed from YDWP/KBIC surface water Yellow Dog Plains database and USGS Cooperative Water Agreement.

The portions of our watershed that are not supporting the established designated uses (fish consumption and other indigenous aquatic life and wildlife) are receiving a high concentration of mercury through the atmosphere due to anthropogenic activities like fossil fuel combustion, mining, and other industrial activities. The Michigan DEQ is working to establish a state-wide Total Maximum Daily Load (TMDL) for inland water bodies polluted by mercury emissions statewide. The purpose of the TMDL is to gather data, identify sources, and develop appropriate goals and reasonable assurance that will restore the designated uses to the water bodies. An 82% reduction of atmospheric mercury from anthropogenic sources is needed from 2001 levels (7.6 kg/day) to meet the allowable mercury load of 2.61 kg/day (Michigan Department of Environmental Quality, 2015).

According to the Michigan DNR Fisheries Division, the average mercury concentration in at least one fish species (N>= 5) in Lake Independence exceeds the acceptable concentration of 0.35 ppm. The concentration is not expected to pose a health concern to people consuming 15 grams of fish per day (VanDusen, 2009). In April 2005, Walleye averaged a concentration of 0.57 ppm Hg (N=9 legal). An update in 2009 lists Lake Independence as impaired for fish consumption due to elevated levels of mercury in northern pike.

ACID MINE DRAINAGE AND OTHER POLLUTION (ACTIVE & FUTURE MINING)

The emission of heavy metals into air and groundwater sources, particulate matter, and potential acid mine drainage created by sulfide-mining activity pose threats to human and environmental health and are serious concerns in the Yellow Dog watershed. Due to the severity of these pollutants they require thorough monitoring of all mining operations in which they pose a risk and frequent reporting where information is made publicly available. Any modifications to air quality and groundwater discharge permits (currently the Lundin Eagle Project is of specific interest) call for the attention of the public, and the detection of any parameters which exceed state or federal regulations must be reported and managed effectively.

Known nonpoint source pollutants connected to industrial mining-related operations have been outlined in the nonpoint source section. Mining activities where the extraction of underground mineral deposits containing sulfur or sulfide is commonly known as "Sulfide Mining." When the mineral or waste rock is brought to the surface and exposed to air, it oxidizes and creates sulfuric acid, commonly referred to as acid mine drainage. This acid can run off in rain or snow melt events and contaminate large areas of surface and ground water resulting in serious impacts to water quality and aquatic ecosystems. Contaminated groundwater also poses problems for private property owners that rely upon wells for their drinking water. Acid mine drainage poses a risk to human health and requires difficult and costly cleanup measures.

Threatened Designated Use	Pollutants	Sources	Causes
Industrial Water Supply **Cold Water Fishery** **Other indigenous aquatic life and wildlife** **Public water supply and the point of intake** **Fish Consumption**	Acid mine drainage (p)	Sulfide-based mining (p)	Extraction and/or transportation of underground deposits containing sulfur or sulfide (p)

Table 21 – Threatened designated uses in the Yellow Dog watershed.

Furthermore, this type of mining may impact water quality, air quality, and wildlife through many causes: air emissions from underground operations, off-site exploration, industrial site construction, truck traffic, heavy equipment operation, power generation, groundwater draw-down and treatment, fuel storage, chemical storage, aggregate contaminates, and acid rock storage. Underground mining operations at Lundin Eagle Mine in close proximity to the river corridor will be emitting pollutants from a single air vent known as the Main Ventilation Air Raise (MVAR). The chemicals present in the emissions include nitrogen oxides, carbon monoxide, volatile organic compounds, particulate matter, sulfur dioxide, greenhouse gases, lead, and other toxic air contaminants including arsenic, copper, nickel, and sulfuric acid.

Figure 54 – Aerial photo of the Eagle Mine facility by Jeremiah Eagle Eye 7-31-2014.

PRIORITY POLLUTANT RANKING

Pollutants in the watershed were ranked in priority based on how they most affect or have the potential to affect water quality and the watershed's designated uses. The Watershed Steering Committee desired a distinction between prioritizing known pollution (Tables 22 and 24) and prioritizing potential pollution (Tables 23 and 25), which is difficult to address but important to consider.

Sedimentation has the most known sources in the watershed of all the pollutants. This pollutant is the highest priority for this planning project. This type of nonpoint source pollution can be managed by replacing damaged culverts, implementing best management practices for logging, initiating riparian buffer ordinances, or improving zoning regulations. This pollutant can also be addressed by educating the public, and specifically informing landowners and recreational users and organizations. Sediment has the potential to negatively impact the ecology of the river and the potential to impact many of the designated and desired uses by stakeholders. Although sometimes caused by natural sources, human influence can accelerate the influx of sediment in the stream.

Non-native Invasive Species (NNIS) are the second-highest priority known pollutant and can be detrimental to natural habitats for native species. NNIS species can be addressed with consistent and rapid management techniques such as removal by-hand or herbicide treatment. Furthermore, the spread of NNIS species can be addressed by educating the community and encouraging their involvement in management of NNIS.

Parts of the water column in the Yellow Dog River are contaminated with mercury pollution due to several different sources: atmospheric deposition and air emissions. Control of this type of pollutant would start at the factories producing the pollution, and with the government agencies that regulate it. Mercury pollution could be addressed indirectly by educating the communities that create a demand for mercury-based or mercury-emissions-related products.

Known Nonpoint Source Pollutant	Priority Ranking
Sediment	1
Non-native invasive species	2
Heavy metals (mercury)	3

Table 22 – Priority ranking of known pollutants in the Yellow Dog watershed.

Potential Nonpoint Source Pollutant[13]	Priority Ranking
Sediment	1
Non-native invasive species	2
Nutrients	3
Heavy metals (other than mercury)	4
Toxins (Pesticides/herbicides, oils, gas, grease, salt/chloride, etc.)	5

Table 23 – Priority ranking of potential nonpoint source pollutants in the Yellow Dog watershed.

Pollutant	Source	Priority Ranking
Sediment	Road stream crossings Natural Sources	1 2 3 4
Non-native invasive species	Recreation Movement of machinery	1 2
Heavy metals (mercury)	Atmoshperic deposition	1

Table 24 – Priority ranking of known sources of pollutants in the Yellow Dog watershed.

Pollutant	Source	Priority Ranking
Sediment	Forest management practices Mining activities	1 2
Heavy metals (other than mercury)	Mining activities Non-industry related combustion	1 2
Nutrients	Septic systems Residential fertilizer use	1 2
Toxins (Pesticides/herbicides, oils, gas, grease, salt/chloride, etc.)	Forest management practices Mining activities Atmospheric deposition Winter road maintenance Application of herbicides/pesticides	1 2 3 4 5
Non-native invasive species	Recreation Movement of machinery	1 2

Table 25 – Priority ranking of potential sources of pollutants in the Yellow Dog watershed.

Chapter 6 WATERSHED GOALS AND OBJECTIVES

The overarching goal for the project aligns with the mission of the Yellow Dog Watershed Preserve: *to preserve and protect the Yellow Dog Watershed in its most natural state, for now, and for the benefit of future generations since 1995*. All activities on land have the potential to affect water quality, and the watershed planning process will facilitate the creation of a collaborative plan to protect the designated and desired uses of the stakeholders. The process of improving and protecting water quality will be carefully outlined in action plans that can be implemented to remove or reduce pollutants, sources, and causes in the watershed.

GOALS AND OBJECTIVES

The goals and objectives for the Yellow Dog watershed were created based on known and potential pollutants and threats to designated and desired uses of the stakeholder group. The goals and objectives establish the desired outcomes of the management planning process and will serve as a guide for future planning decisions.

Goals	Objectives	Threatened Designated Use Addressed	Desired Use Addressed	Pollutants Addressed
Goal #1. Landscape protection: Protect conservation values in the watershed through the use of land protection tools, including: ordinances, conservation easements, BMPs, and forestry management.	A. Limit development, reduce erosion, preserve habitat, and open more access to land for silent recreation.	Other indigenous aquatic life and wildlife; Public water supply and the point of intake; Warm and cold water fisheries; Fish consumption	Protecting native and endangered species; Sustainable forestry; Conserving riparian corridor and high biodiversity areas; Maintaining requirements for Wild & Scenic designation; Trails and access for ATV/ORVs, mountain biking, and horses; Hunting, trapping, and harvesting wild foods; Aesthetic appreciation, viewing, photography, painting	All
	B. Assist local units of government with master planning and zoning ordinances to protect and preserve terrestrial and aquatic habitats with special attention to areas of high biodiversity.			
Goal #2. Water quality and aquatic habitat protection: Maintain high-quality aquatic	A. Maintain or improve aquatic habitats, aquatic organism populations, and wetland and sensitive ecosystems.	Other indigenous aquatic life and wildlife; Public water supply and the point of intake; Warm and	Protecting native and endangered species; Conserving riparian corridor and high biodiversity areas; Cold water fishery; Maintaining requirements for Wild & Scenic	All

in-stream habitats, wetlands, and sensitive ecosystems by monitoring and implementing BMPs.	B. Reduce sediment being eroded into the river and tributaries from human disturbance with BMPs.	cold water fisheries; Fish consumption	designation; Watershed information/education; Swimming & drinking water; Canoeing & kayaking; Aesthetic appreciation, viewing, photography, painting	
	C. Participate in data collection, and analyze all available environmental data sources.			
Goal #3. Education: Increase awareness, stewardship, and involvement in conservation issues within the local and regional community.	A. Create information/education programs for the community that support watershed planning goals and objectives and increase stewardship.	Other indigenous aquatic life and wildlife; Public water supply and the point of intake; Warm and cold water fisheries; Fish consumption	Protecting native and endangered species; Sustainable forestry; Watershed information/education	All
	B. Emphasize citizen involvement in the WMP planning and implementation process.			
	C. Promote stakeholder awareness by distributing analyzed data results.			

Table 26 – Goals of the Yellow Dog Watershed Planning Project addressing threatened designated and desired uses.

Chapter 7 CRITICAL AREAS

We define 'Critical Areas' as areas that are both environmentally sensitive to changes within the ecosystem and those that have the potential to act as a conduit for increasing negative impacts within the watershed. The watershed as a whole will benefit from targeted efforts to restore, enhance, or protect these 'Critical Areas'.

CRITICAL AREAS FOR PROTECTION

RIPARIAN CORRIDOR

The riparian corridor is an environmentally sensitive area due to the many benefits it provides to aquatic and terrestrial ecosystems and its high level of biodiversity. The riparian corridor contains plants that trap sediment and absorb nutrients. Due to their beauty, these areas are attractive for land uses such as homebuilding and recreation. Development and associated infrastructure in the riparian corridor can have devastating and long lasting impacts on ecosystems as well as the infrastructure itself, especially in streams and rivers that move laterally in short time periods.

Figure 55 – Aerial photo of the Yellow Dog watershed.

Timber harvest within the riparian corridor has potential to cause sedimentation from increased surface runoff and streambank erosion, increase stream temperatures, and damage habitat for native species. Riparian areas should be conserved with buffer protections to maintain shaded aquatic habitat, regulate stream temperatures, reduce soil erosion, and reduce the pressure of human activity.

HEADWATERS

The headwaters of the Yellow Dog River starts as a chain of lakes in the McCormick Wilderness Area, with White Deer, Bulldog, and Margaret Lakes being the primary three. The headwaters are protected by the federal wilderness act of 1964 and are managed by the Ottawa National Forest. The wilderness area protects that part of the watershed from motorized vehicles and development. Yet, there is potential for impacts caused by atmospheric deposition, climate change, and recreational activities that may continue to spread invasive species that threaten natural habitat. Additionally, water pollution and/or contamination and invasive species have the potential to spread throughout the river as water flows to its source at Lake Superior.

Figure 56 – Bulldog Lake, the headwaters of the Yellow Dog River

WETLANDS

Wetlands, bogs, swamps, marshes, and bogs are sensitive to human activity and should be considered environmentally sensitive areas that should be preserved. They are biologically diverse, provide wildlife habitat, feed downstream waters, trap floodwaters, recharge groundwater, and filter pollution. Any impacts to wetland headwaters have the potential to cause damage downstream. Under the Clean Water Act, the term wetland means, "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas (U.S. Environmental Protection Agency, 1972)."

Figure 57 – Mouth of the Iron River. Courtesy of Jeremiah Eagle Eye

Wetlands are a key natural resource and vary widely in their characteristic soil types, topography, geology, climate, hydrology, water chemistry, and vegetation. This watershed contains a special type of wetland, unique to our region, known as the Great Lakes Marsh which is at the mouth of the Iron River on Lake Superior.

THE IRON RIVER

Where the Iron River reaches Lake Superior it is classified as a Great Lakes Marsh; a type of herbaceous wetland which only occurs along the Great Lakes and their connecting rivers (The Nature Conservancy: West Michigan Program, 2015). The Iron River is the final waterbody that connects the Yellow Dog River to Lake Superior. Coastal wetlands are known as critical habitat for the migration, feeding, and nesting of waterfowl, as well as home to a large variety of insects, fish, water birds, and mammals. In addition to being important ecologically, this relatively flat-water river is a very popular destination for river floating in canoes or kayaks. Ongoing and frequent recreational use of the river for small water crafts will require a boat launch and/or stairs to prevent erosion of the streambank. The mouth of the river is under private ownership, providing a low level of protection against future development and an opportunity for additional protection (i.e., land easements).

BUSHY CREEK TRUCK TRAIL RESIDENTIAL AREA

The area beginning where County Road 550 and the Yellow Dog River cross and ending where the Bushy Creek Truck Trail veers away from the river constitutes the Bushy Creek Truck Trail Residential Area. It has the highest concentration of development along the river which includes camps, homes, septic systems, and a road network that crosses waterways. With these sources of pollutants comes a corresponding concentration of road stream crossings and streambank erosion sites that are

contributing excessive sedimentation (see Table 16 and Figure 49 and 50). Many of these sites are listed in the in subsequent pages as both high and low priority for remediation or restoration.

JOHNSON CREEK AND YELLOW DOG RIVER OUTLETS

Johnson Creek and the Yellow Dog River flow into Lake Independence less than 1 mile apart. Often shown as single thread channels on maps, these waterbodies rather flow through a large, connected swamp with a single dinstinguishable channel often lacking. Known collectively as the "Yellow Dog Swamp" or SOSAWAGAMEE (Yellow Water), as it was known by the Anishinaabeg, this area consists predominantly of hydric soils and vegetation, and is an important wetland area for a diversity of plants and animals, as well as an important filtration system for water entering Lake Independence. The original wetland area has been reduced from ~3,500 acres before the oulet of Lake Independence was dammed to ~1,600 acres presently. These outlets and wetland area have been identified as a priority for protection by several agencies including the State of Michigan and the Yellow Dog Watershed Preserve; indicated by each owning land parcels near these locations.

WILD & SCENIC DESIGNATED AREAS

The Michigan Scenic Rivers Act of 1991 (P.L. 102-249) added segments of 14 Michigan rivers to the National Wild and Scenic Rivers System, including a portion of the Yellow Dog River. The first four miles of the Yellow Dog River, located in the federally protected McCormick Wilderness Area, are designated a National Wild and Scenic River (WSR). The protected portion begins near its origin at the outlet of Bulldog Lake and continues to the wilderness boundary (also the boundary of the Ottawa National Forest). The added protection for this section of river requires the administrative agency to create a Comprehensive River Management Plan (CRMP), with the most recent draft of the plan released by the U.S. Forest Service, Ottawa National Forest in 2007.

As defined by the National Wild and Scenic Rivers Act, a Wild and Scenic River must be maintained in a free-flowing condition and must have its water quality protected. In addition, the river must have at least one outstandingly remarkable scenic, recreational, geologic, fish, wildlife, historic, cultural, or other similar value. Outstandingly remarkable values (ORVs) are those values that are river-related, that owe their existence or location to the river, and that are rare, unique, or exemplary in character. Rivers may be added to the system by an Act of Congress or by order of the Secretary of the Interior upon official request by a State (U.S. Forest Service, Ottawa National Forest, 2007).

The outstandingly remarkable values designated by the CRMP for the WSR section of the Yellow Dog River include scenery, geology, and wildlife. This section of the river includes waterfalls such as the popular Yellow Dog Falls (which is a 2.4 mile hike from a trailhead at the north entrance of the McCormick Wilderness); varied topography with numerous rock outcrops, escarpments, hills, and bluffs; and relatively undisturbed stands of old growth forest. The abundance of conifer regeneration within the McCormick make it amenable to many rare species across the Ottawa National Forest. At least two wildlife species, moose and spruce grouse, are known here that are rare or absent across the rest of the Ottawa National Forest. The unique habitat, scenery, geology, and wildlife all contribute to the remarkable values of the Yellow Dog River.

RANKING OF PARCELS FOR LAND ACQUISITION

In order to best protect terrestrial and aquatic resources from known and potential threats, the YDWP intends on acquiring and protecting additional acreage in the watershed, with a focus on the critical areas identified in this plan.

CRITERIA FOR LAND ACQUISITION

A prioritized list of target areas has been identified and are discussed below. Methods to evaluate and determine which areas are of highest priority for land acquisition include a ranking system designed by the Yellow Dog Watershed Preserve. The ranking system is based on points for presence of aquatic and terrestrial attributes including riparian corridor, wetlands/lakes/ponds, upland/lowland forest, and cultural/recreational areas.

Land Parcel Characteristics	Points Possible	Points Awarded
Riparian Corridor Attributes		
River frontage	10	
Areas of surface water recharge	9	
Headwaters region	8	
Steep banks/severe topography	7	
Source water areas	6	
Connectivity with tributaries	5	
Waterfalls	5	
Sub-total Riparian Corridor Points		
Wetlands/Lakes/Ponds Attributes		
Direct hydrological connection to stream	8	
Entirely undeveloped	7	
Isolated	3	
Ephemeral	1	
Sub-total Wetlands/Lakes/Ponds Points		
Upland/Lowland Forest Attributes		
Rare/Threatened/Endangered Species	10	
Floristic Quality Index* of 35 or higher	8	
Adjacent to other protected area	6	
Connection between two protected areas	5	
Sub-Total Upland/Lowland Forest Points		
Cultural/Recreational Attributes		
Documented historical site	10	
Public access point	8	
Recreational opportunities	6	
Educational setting	4	
Food/medicine collection	3	
Sub-total Cultural/Recreational Points		
Total Score for Reviewed Parcel		

Table 27 – Ranking system used to evaluate priority targets for land acquisition.

PRIORITY TARGET AREAS FOR LAND ACQUISITION

The following list of specific areas are ranked accordingly to the criteria set above and ordered as highest priority to lowest priority. Other areas have significant value in addition to those listed here; however, these are the five highest scoring areas that have been evaluated.

1. **Yellow Dog River corridor near County Road 510 to County Road 550 -** This area ranks highest due to it meeting almost all criteria set in the above ranking system. It features aquatic significance, adjacent upland forest, scenic value, and numerous community benefits. Total score for this area- **93**
2. **Tawadina Gorge to Bob Lake Creek** - The "gorge," as it is called locally, features river corridor, waterfalls, upland forests, and recreational opportunities. It also is frequently subject to timber harvest. Total score for this area- **88**
3. **Downstream of National Wild and Scenic River Designation** - This area is a priority since it features wetlands, connectivity to designated areas, river corridor, and rare species habitat. Total score for this area- **79**
4. **Clowry Bridge Area** - Also known as the "Pine Camps" road, this area is a priority for several reasons. It has cultural significance due the historic location of lumber camps. Additionally, it is one of the few access points in the upper stretches of the river and is used frequently for recreational activities. It features river frontage, wetlands, upland forest, and rare species habitat. Total score for this area- **78**
5. **Upstream of Jean Farwell to KCH Road Bridge** - This area is important for maintaining hydrological flow patterns since it is a floodplain. Features include river frontage, wetlands, rare species habitat, recreational opportunities, and lowland forest. Total score for this area- **73**

PRIORITY SITES FOR NON POINT SOURCE POLLUTANT REDUCTIONS

STREAMBANK EROSION SITES

Areas that have the potential to release the largest amount of sediment into the watershed due to anthropogenic forces are considered critical areas for active management. Erosion is a natural process and should be expected, however, when erosion is accelerated by soil surface disturbance from actions such as recreation, forest management, development, or roads, the result is additional sediment being added to the stream ecosystem. Many times this additional sediment has deleterious consequences. Natural sources of sediment are difficult to manage but are prioritized here due to the large amounts of sediment they are contributing to the system. Three erosion sites from each anthropogenic and natural causes are prioritized for active management in the Yellow Dog watershed based on those contributing the largest amount of sediment.

ANTHROPOGENIC SOURCES

Site 23 – Private property near Bear Lake on the Yellow Dog River off the Bushy Creek Truck Trail is showing evidence of severe erosion. The eroding bank measures 300 feet in length and is 15 feet high contributing an annual average of ~112.5 tons of sediment per year. Development along the streambank has contributed to the bank erosion and now threatens the long term viability of human structures.

Figure 58 – Eroding streambank near Bear Lake at streambank erosion site 23.

Site 19 – Less than 30 feet from the Bushy Creek Truck Trail, this site allows easy access to the river for anglers. The eroding bank measures 107 feet in length and is 12 feet high contributing an annual average of ~26.3 tons of sediment per year.

Site 1 – Less than 300 feet from the Snowmobile Trail 5 Road, this site allows easy access to the river for anglers. The eroding bank measures 110 feet in length and is 6.5 feet high contributing an annual average of ~4.9 tons of sediment per year.

NATURAL SOURCES

Site 21 – Located 700 feet from County Road GGE along the river right bank of the Yellow Dog River, the eroding bank measures 183 feet in length and is 44 feet high contributing an annual average of ~165.1 tons of sediment per year.

Figure 61 – Streambank erosion at site 21.

Site 13 – This site is ~2,700 feet downstream from County Road 510 and ~600 feet downstream from the confluence of Lost Creek along the river right bank of the Yellow Dog River. The eroding bank measures 600 feet in length and is 11 feet high contributing an annual average of ~165 tons of sediment per year.

Figure 62 – Streambank erosion at site 13.

Site 15 – Located ~1.4 miles downstream from Pinnacle Falls in a steeper section of stream along the Yellow Dog River, the eroding bank measures 60 feet in length and is 60 feet high contributing an annual average of ~73.8 tons of sediment per year.

ROAD-STREAM CROSSING SITES

Areas that have the potential to release the largest amount of sediment into the watershed due to anthropogenic forces are considered critical areas for active management. Erosion is a natural process and should be expected, however, when erosion is accelerated by soil surface disturbance from actions such as recreation, forest management, development, or roads, the result is additional sediment being added to the stream ecosystem. Many times this additional sediment has deleterious consequences. Three road-stream crossing sites are prioritized for active management in the Yellow Dog watershed based on those contributing the largest amount of sediment.

Site 4 – Located where County Rd KD crosses the Iron River, ~1,700 feet downstream from the impassable dam at the outlet of Lake Independence, lies the only road crossing over the Iron River. This location sees lots of activity as a recreational spot for people looking to launch watercraft for floats down the river to Lake Superior and for fishing access. The area of erosion near this road-stream crossing is estimated to be ~7565 ft^3, the largest in the watershed. In addition, there are also a few other locations extending 1000 feet downstream where erosion appears to be of concern. The road parallels the river over this length and provides additional access to recreators.

Figure 64 – Road-stream crossing site 4, Co Rd KD over the Iron river.

Site 108 – Roads crossing waterways with no infrastructure, otherwise known as fords, are areas of concern, as it is with this site where the Bushy Creek Truck Trail crosses the Bushy Creek near its confluence with the Yellow Dog River. The right approach of the road to the stream is eroding/downcutting and washing into the stream due to the steep slope of the road. This road-stream crossing is also of concern due to the rivers steep gradient where erosive forces are highly active. This site is estimated to have contributed ~3,600 ft^3 of sediment into the stream.

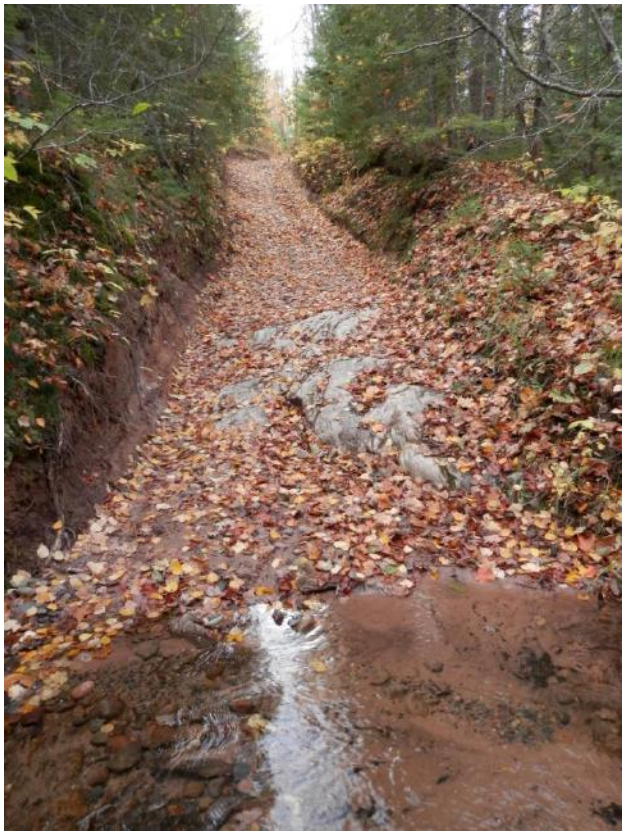


Figure 65 – Road-stream crossing site 108, Bushy Creek Truck Trail over Bushy Creek.

Site 1 – This site is located where County Road 510 crosses Lost Creek, ~500 ft south of where the Bushy Creek Truck Trail crosses County Road 510. It's estimated to have contributed ~500 ft^3 of sediment.

Figure 66 – Site 1 road-stream crossing, County Road 510 over Lost Creek.

PRIORITY SITES FOR AQUATIC ORGANISM PASSAGE (AOP)

Throughout 2012 and 2013 the Yellow Dog Watershed Preserve conducted an analysis of 166 road-stream crossings in the watershed to assess aquatic connectivity, quantify erosion near the crossings, and determine functionality of structures (Figure 50 and Appendix C). The in-field surveys followed Great Lakes Road Stream Crossing Inventory guidelines and methodologies (see Appendix D for protocol and data form). Most road stream crossings in the watershed were assessed; however, crossings located in construction zones or accessed only by private property were not assessed. See Appendix C for a list of the road stream crossing locations and some of the recorded attributes.

Matt Diebel of the Wisconsin DNR prioritized road-stream crossings for aquatic organism passage in an ArcInfo database for various monetary values. Diebel's prioritization is based on: (1) stream connectivity for stream-resident fishes, i.e. how many stream miles this culvert affects; (2) fish passage barriers: no barrier, partial barrier, and complete barrier; and, (3) cost of restoration. The passage ratings are described in detail below.

Passability = 0 (Most species and life stages cannot pass at most stream flows. These criteria do not apply to open bottom structures.) • The outlet of the structure is perched, or • The ratio of the structure water depth to the stream water depth is less than 0.1, or • The water velocity in the structure is greater than 3 ft/s during baseflow.
Passability = 0.5 (Some species and/or life stages cannot pass at most stream flows. These criteria do not apply to open bottom structures.) • The water depth in the structure is less than 0.2 feet, or • The water velocity in the structure is 2-3 ft/s during baseflow, or • The structure is longer than 30 ft and does not have natural substrate through its entire length.
Passability = 0.9 (Barrier at high flows.) • The constriction ratio (structure width/bankfull stream width) is less than 0.5, or • There is a scour pool below the structure.
Passability = 1 (No passage problem.) • None of the criteria above are met.

Table 28 – Road-stream passability ratings used in Wisconsin DNR assessment.

Site 76 – This site is located where an unnamed tributary of the Yellow Dog River is crossed by the J&R two-track. The tributary is forced to flow underground, briefly, as it passes under a sediment blocked wooden bridge and culvert. This road-stream crossing has been identified as a priority site for restoration during a Wisconsin DNR barrier assessment based on aquatic connectivity, sedimentation, and cost to repair. According to the Wisconsin DNR, this site is a barrier that would give the watershed a large amount of reconnected stream length for the investment. The cost to restore this site is estimated at $100,000.


Figure 67 – Road-stream crossing site 76 inlet (left) and oulet (right).

Site 88 – A tributary of the Yellow Dog River crosses County Road GGI near its confluence with the Yellow Dog River in this location. There are two culverts at this site, neither of which have natural substrate through the culvert bottom. The largest structure is 110 feet long, almost 5 feet wide, slightly perched with a freefall onto riprap. This road-stream crossing has been identified as a priority site for restoration during a Wisconsin DNR barrier assessment based on aquatic connectivity, sedimentation, and cost to repair. According to the Wisconsin DNR, this site is a barrier that would give the watershed a large amount of reconnected stream length for the investment. The cost to restore this site is estimated at $75,000.


Figure 68 – Road-stream crossing site 88 outlet.

Site 127 – A tributary of the Yellow Dog River crosses the J&R Zender Low Road, which is an older road that was used in recent years for logging, and subsequently closed off for vehicle traffic. The road is not heavily used, but could be opened up again for logging in the future. The culvert is slightly perched at its

outlet and lacks natural substrate through the culvert bottom. This road-stream crossing has been identified as a priority site for restoration during a Wisconsin DNR barrier assessment based on aquatic connectivity, sedimentation, and cost to repair. According to the Wisconsin DNR, this site is a barrier that would give the watershed a large amount of reconnected stream length for the investment. The cost to restore this site is estimated at $75,000.

Figure 69 – Road-stream crossing site 127 inlet (left) and outlet (right).

Site 106 – An unnamed tributary of the Yellow Dog River crosses the Bushy Creek Truck Trail near its confluence with the Yellow Dog River. The culvert is 15 feet in length and is perched at its outlet, creating a scour pool. This road-stream crossing has been identified as a priority site for restoration due to it being an impassable barrier for aquatic organism passage.

Figure 70 – Road-stream crossing site 106 inlet (left) and outlet (right).

Site 144 – An unnamed tributary of the Yellow Dog River crosses the Snowmobile Trail 5 Road in the upper reaches of the watershed. The culvert is 20 feet in length and is perched 14 inches at its outlet, creating a scour pool and eroding the surrounding banks. The inlet of this culvert is buried, with ~50% being plugged up. This road-stream crossing has been identified as a priority site for restoration due to it being an impassable barrier for aquatic organism passage and the erosion that is occurring at the culverts outlet.

Figure 71 – Road-stream crossing site 144 inlet (left) and outlet (right).

Chapter 8 MANAGEMENT STRATEGIES

A variety of management strategies will be necessary to acquire, maintain, or improve protections for priority areas of natural conservation value listed in Chapter 7. This section identifies existing management strategies and strategies that are needed to accomplish the watershed planning goals identified in previous chapters.

EXISTING MANAGEMENT STRATEGIES

Many management strategies have already been implemented, including both passive and active management actions. In the past, several active management projects have been conducted to restore critical areas of concern, including: streambank stabilization using Best Management Practices (BMPs), invasive species removal, replanting wetlands and trails with native seeds, and trail maintenance for erosion control. Passive management actions have included the use of conservation easements, designation of wilderness areas, and non-governmental protection of land through direct acquisition by nonprofits.

PASSIVE LAND MANAGEMENT ACTIONS

As stated in the Human Environment Chapter, land use in the watershed is made up largely of forestry activities, with secondary uses including suburban development, recreation, infrastructure, and mining. Currently, the Yellow Dog watershed (62,832 acres) has 13.2% of land considered protected through wilderness designation (7,751 acres), land acquisition by the YDWP (252 acres), and conservation easements through The Nature Conservancy (280 acres).

DESIGNATED FEDERAL WILDERNESS AREAS

The only designated area managed specifically for wilderness in the Yellow Dog watershed is the McCormick Wilderness Area. This acreage was donated to the federal government by the McCormick family in the late 1970s and is managed by the U.S. Forest Service. The wilderness area includes roughly 13,000 acres near the headwaters of the Yellow Dog River and 4 miles of protected river corridor.

Obtaining wilderness designation is a method of land management that results in the permanent protection of a given land area with removal of possible future development. These designations can be on a local, state, or federal level and vary in degree of approved uses. However, most all levels of wilderness designation are managed for preserving the natural environment and improving recreational access. While this tool has a long lasting result, it is very costly and time consuming to create these designations; sometimes even requiring passage of legislation from Congress. Management falls onto the governmental body that owns it; however, public groups assist in management in some situations.

NON-GOVERNMENTAL ORGANIZATION LAND OWNERSHIP

The Yellow Dog Watershed Preserve owns and manages 412 acres in total, 252 of which are in the Yellow Dog watershed (160 acres in the Salmon Trout watershed). The YDWP acquired the acreage, which is split between five separate preserves, for the purposes of protecting wildlife habitat,

recreational access, and river corridor protection. This includes roughly 1.5 miles of river corridor and 160 acres of wetlands.

CONSERVATION EASEMENTS

Two conservation easements held by The Nature Conservancy protect 280 acres in the Yellow Dog watershed. Both are on sections of the Yellow Dog River in areas with unique and rocky terrain. The Pinnacle Falls easement protects a 40-acre parcel containing a large noteworthy waterfall. The parcel is owned by the Yellow Dog Watershed Preserve and is a favorite hiking destination for waterfall enthusiasts.

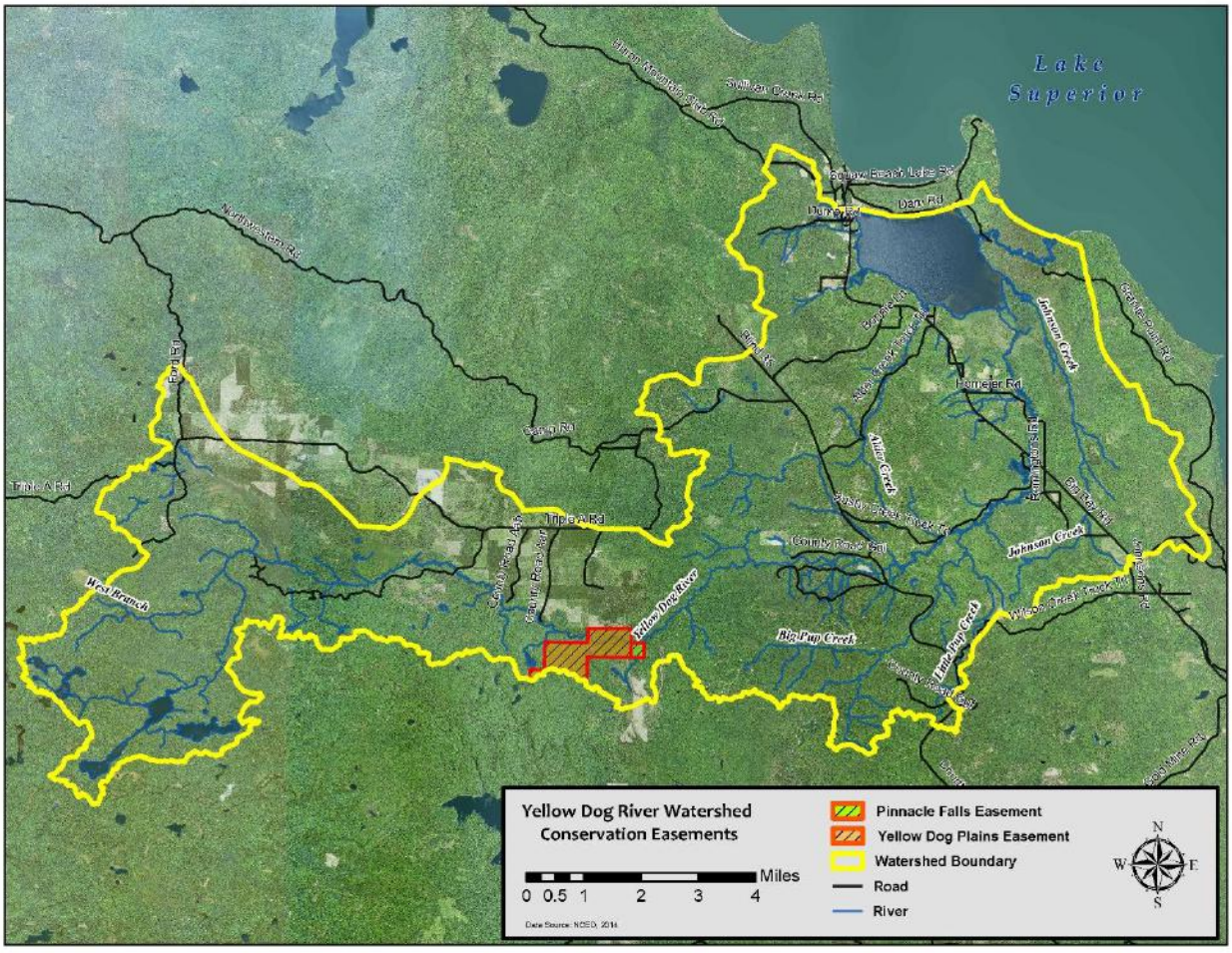


Figure 72 – Conservation easements in the Yellow Dog watershed. Map made by Christina Spitz.

LAND ACQUISITION AND PUBLIC SECTOR STEWARDSHIP

This strategy includes the fee simple purchase, conservation purchase, or donation of real property. Ideally, the property would meet the priority criteria established in this plan. However, property is occasionally donated and accepted even when not ranking high on the criteria list. Whichever method of acquiring land is utilized, the preference would be to have it in the hands of the public sector. This could mean ownership by governments of any level but also land trusts that keep their preserves open to the

public for recreation. This ensures that the community can be involved in the stewardship and care of these priority parcels.

PRIVATE LANDOWNER STEWARDSHIP

In addition to the above mentioned strategies, conservation stewardship by private landowners is a potential tool to be utilized at a relatively low cost. Reaching out to private landowners through education and public outreach will assist in the effort to actively manage land in a way that is congruent with this plan. There are numerous programs available that provide incentive to landowners for managing their property under certain guidelines.

One example of this is the existing Kirtland's Warbler (KIWA) Habitat Project on the Yellow Dog Plains. Plum Creek and the Michigan DNR worked with the U.S. Fish and Wildlife Service along with concerned citizens to establish potential KIWA nesting areas in jack-pine stands of similar age.

ZONING AND ORDINANCES

Zoning and ordinances are ways for local governments to regulate land use in their communities. In essence, ordinances and zoning are laws that restrict use and development in order to protect the surrounding natural environment and community. However, local regulation must comply with applicable state and federal laws. In Michigan, a great deal of local authority has been removed by the adoption of the Township Zoning Act of 2009. This act states that local governments may not enact ordinances that restrict timber harvest, mining, and other resource extraction endeavors. Nonetheless, other zoning and ordinances can still be very valuable in protecting aquatic and terrestrial ecosystems. The list of current zoning and ordinances that promote a healthy watershed are listed below arranged by township.

TOWNSHIP RIPARIAN-RELATED ZONING ORDINANCE

Township	Riparian-Related Zoning Ordinance
Powell Township	SECTION 402 ENVIRONMENTAL PROTECTION STRIPS A. A one hundred (100') foot wide environmental protection strip, measured from the high water mark, shall exist along each side of the following rivers: Yellow Dog, Big Garlic, Little Garlic, Alder, Wilson, Salmon Trout (Main Branch), Salmon Trout (East Branch), Salmon Trout will be maintained. B. A fifty (50') foot wide environmental protection strip, measured from the water's edge, shall exist along each side of all other non-intermittent streams and permanent bodies of water, exceeding five (5) acres in size, found in the districts established by this Ordinance. C. Selective cutting will be permitted within the environmental protection strip (Section 402, A and B) utilizing the following practices, and as a guide, The Water Quality Management Practices on Forest Land, May 1993, Michigan Department of Natural Resources, Forest Management Division, as amended. D. No mines, quarries, or gravel extraction, or removal of soil, sand, gravel, stone, or other earth materials shall be allowed within the environmental protection strips unless a Mineral Extraction Permit has been approved by the Planning Commission.
Champion Township	SECTION 1005 WATERFRONT DEVELOPMENT A. Setbacks from Water - All structures on lots abutting any body of water, as defined in Act 346 of the Public Acts of 1972, including inland lakes, rivers, streams, and impoundments, shall maintain a minimum setback of 75 feet as measured from the high water mark or lot line. All uses shall be subject to this setback except private bathing facilities, saunas, storage sheds, and associated facilities which shall maintain a minimum setback of 30 feet as measured from the high water mark

or lot line.

B. Shore and Bank Area Alterations - The part of any setback within 30 feet of the water edge shall be maintained in its natural condition. Trees and shrubs in a space 50 feet wide may be trimmed or pruned for a view of and for access to the fronting waters. No change shall be made in the natural grade. A lot shall be regarded in its natural condition when it has at least one tree or shrub at least 15 feet tall for each 75 square feet of area in wooded areas or sufficient natural ground cover in open areas.

C. Limitation of "Funnel Development" - Any development in any zoning district which shares a common lake front or stream area shall not permit more than one (1) family home, cottage, condominium or apartment unit to the use of each one hundred (100) feet of lake or stream frontage in such common lake-front or stream area as measured along the water's edge of normal high water mark of the lake or stream. This restriction is intended to limit the number of users of the lake or stream frontage to preserve the quality of the waters, avoid congestion, and preserve the quality of recreational use of waters and lands. This restriction shall apply regardless of whether access to the water shall be gained by easement, common fee ownership, single fee ownership or lease. This restriction shall not apply to an official public access site.

Ishpeming Township

SET BACK REQUIREMENTS

DISTRICT	FRONT SETBACK (FT)	SIDE SETBACK (FT)	REAR SETBACK (FT)	HEIGHT (FT)	LOT SIZE	LOT WIDTH (FT)
Single Family Residential R-1	30	10%	10	30 (23.7)	20,000 Ft^2	125
Two Family Residential R-2	30	10%	10	30	20,000 Ft^2	125
Multiple Residential R-3	30	10%	30	30	20,000 Ft^2	125
Mobile Home Park R-4	30	10%	30	30	20 Acres	None
Rural Residential RR-1	30	30	30	30	3 Acres	200
Rural Residential RR-2	30	30	30	30	10 Acres	300
Lakeshore & River LS/R	30	10%	30	30	20,000 Ft^2	100
Commercial C	30	5	20	30	None	None
Low Intensity Commercial C-1	30	30	30	30	3 Acres	200
Industrial I	40	5	20	SECTION 23.1	None	None
Public Area PL	None	None	None	None	None	None
Resource Production RP	30	30	30	30	10 Acres	300
Mineral Resource MR	None	None	None	None	None	None

SECTION 17 LAKESHORE AND RIVER DISTRICT LS/R

17.1 INTENT To establish and maintain for residential and recreational structures those areas with frontage on inland lakes and rivers which, because of their proximity to such inland lakes and rivers, are suitable for such development

17.2 PERMITTED PRINCIPAL USES Single family dwellings, recreational structures, and mobile homes.

17.3 CONDITIONAL USES None.

23.4 A garage not exceeding 16 feet in height may be located up to six feet of a side lot line and a storage or utility shed of less than 150 sq. ft. And not exceeding 10 feet in height may be located up to 6 ft of a side lot or rear lot line in residential and lakeshore and river (LS/R) districts. The boundary line of a utility easement, shown in a recorded plat, shall constitute the setback when such is a greater distance to a lot line than an otherwise required minimum set back distance.

Michigamme Township

SECTION 402 WATERFRONT DEVELOPMENT

There exists in Michigamme Township certain natural and scenic resources that should be protected and conserved to promote environmental quality and community character.

All waterfront properties, including streams, lakes or impoundment water, with adhere to the following:

1. All structures on lots abutting any body of water, as defined in Act No. 346 of the Public Acts of 1972, including but not limited to inland lakes, rivers, streams and impoundments, shall maintain a minimum setback of fifty (50) feet as measured horizontally from the normal high water mark. All uses shall be subject to this setback except private bathing facilities, saunas, storage sheds, and

	associated facilities which shall maintain a minimum setback of twenty (20) feet as measured horizontally from the normal high water mark. 2. Health Department permits and approval will be required for any water or septic systems necessary for any of these uses. 3. That part of the setback which lies within thirty (30) feet of the water's edge shall be maintained in its natural tree and shrub condition (native strip). Nothing in these requirements shall be interpreted to prohibit selective tree cutting in the native strip space to remove dangerous trees (windfall hazard) or other trees and shrubs that may prevent the native strip area from being retained in a healthful growth condition. From beyond 30 feet from the high water mark, the cutting of trees and shrubbery shall be the minimum amount required for the proposed permitted use. 4. Trees and shrubs may be trimmed, pruned, or removed for a maximum width of fifty (50) feet through the native strip, to provide access to a swimming area, boat dock or boat access. 5. If activities are conducted contrary to a Zoning Compliance Permit or without a permit where a permit is required, replacement of the removed or disturbed trees or vegetation shall be required. a. Clear cutting of waterfront lots is prohibited and is punishable under Section 1204 of this ordinance. b. The Township may have a Stop Work Order issued on the remaining portion of Construction whenever there is a failure to comply with the provisions of Section 402. c. The Township may perform any work necessary for compliance with Section 402. The expense of the work performed shall become a debt to the Township from the land owner and may be collected by any means in which indebtedness due the Township is collected. d. Tree Replacement Standards. 1) Replacement of trees shall be no less than one (1) tree in each 250 sq. ft. of area. 2) Replacement shall be no fewer than four species of trees such as those indigenous to the immediate area. 3) Replacement is limited to a maximum of twenty (20) trees per species for each 150 feet of water frontage. 4) The plan for replacement shall be approved by the Zoning Administrator in a written order signed by both parties. 5) Nothing in these requirements shall be interpreted to require the planting of shrubs or trees on agricultural lands or other parcels there a natural tree stand does not exist or cannot be grown. 6) Any excavating, filling, grading or other construction activity shall ensure that no silting will impact adjacent waters and that all banks, slopes and hillsides are stabilized to prevent soil erosion. 7) Any waterfront development shall be done in accordance with the State of Michigan Department of Environmental Quality (DEQ) and the Soil Erosion Department of the Marquette County Health Department. Owners are responsible for any and all permits that are required to be obtained from these agencies. 8) Limitations of "Funnel Development": Any development in any zoning district which shares a common lakefront or stream area may not permit more than one (1) single family dwelling or one (1) recreational structure; condominiums/apartments or co-op corporations (4 unit maximum, 2 bedrooms each) or an eight (8) unit motel; bed and breakfasts, inns and resorts are not to exceed eight (8) bedrooms each to the use of each one hundred fifty (150) feet of lake or stream frontage in such common lakefront or stream area as measured along the water's edge or normal high water mark of the lake or stream. This restriction is intended to limit the number of users of the lake or stream frontage to preserve the quality of recreational lands within the Township. This restriction shall apply to any parcel regardless of whether access to the water shall be gained by easement, common fee ownership, single fee ownership or lease.

Table 29 – Township riparian-related zoning ordinances.

TASKS & STRATEGIES NEEDED TO ACHIEVE GOALS

The information in this section details the active and passive management strategies needed to address the critical areas in the watershed. Some of these projects are already in development, or are part of ongoing programs established by the Yellow Dog Watershed Preserve. However, even in those cases, YDWP has outlined the tasks and milestones for the next 5-10 years.

TASK 1: CREATE COMMUNITY FOREST

Purchase parcels in the Yellow Dog River corridor from County Road 510 to County Road 550 and establish a community forest to protect land from the threat of development, reduce erosion, preserve habitat, and open more access to land for silent recreation.

Recommended Actions:

- Create and follow land management plans for each parcel or group of parcels
- Where applicable, manage working forest with sustainable practices
- Improve public access when necessary with limited infrastructure
- Address conflicting recreational uses with meetings, education/information, or signage
- Involve public and private entities in decision-making process

Goals Accomplished:
Landscape protection; water quality and aquatic habitat protection; education

Designated Uses Addressed:
Cold water fishery; other indigenous aquatic life and wildlife; total body contact recreation; partial body contact recreation; navigation; public water supply and the point of intake; fish consumption

Desired Uses Addressed:
Low impact public recreation; community education; biological diversity; high quality aquatic and terrestrial habitat; artistic/cultural uses; source/drinking water

Priority:
High

Timeline:
3 years

Work on establishing a Community Forest in the area of the watershed determined to be of highest priority has been occurring since 2012. The Yellow Dog Watershed Preserve successfully worked with the current landowner, J.M. Longyear LLC., to get an Option to Purchase. The group will work to acquire the capital needed to complete the purchase and will aim to have the Community Forest fully established by 2017.

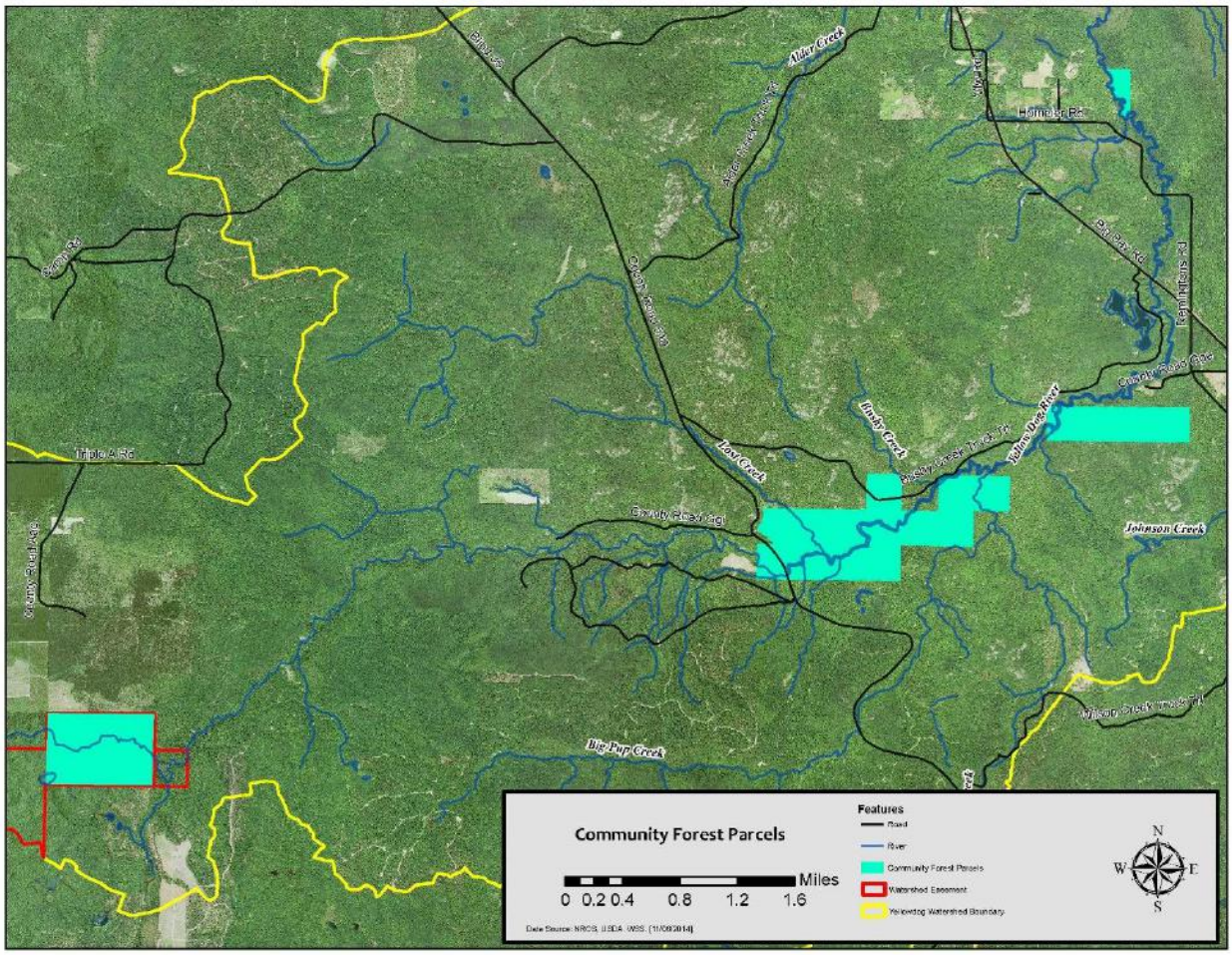


Figure 73 – Community forest parcels on the Yellow Dog River.

Milestones:

- Gather stakeholders and facilitate meetings for a Community Forest Stakeholder Group to gather input for the planning process. (Years 1-3)
- Secure 50% of the funding for purchase (Year 2)
- Secure 50% of the funding for purchase (Year 3)
- Secure ongoing funding for land management (Year 2-3)

Total Cost:
$1,200,000

Measurements:

- Number of acres preserved
- Number of partners participating
- Number of Community Forest Planning Meetings held
- Miles of river corridor protected
- Wetland ecosystems protected (acres)

Potential Partners: JM Longyear, LLC., Superior Watershed Partnership, The Nature Conservancy in Michigan, UP Whitetails, Trout Unlimited: Fred Waara Chapter, Marquette County Conservation District, Keweenaw Bay Indian Community, Marquette County Tourism Bureau, Ishpeming Township.

TASK 2: REDUCE SEDIMENTATION FROM ROAD-STREAM CROSSINGS

Reduce sedimentation caused by human-influenced erosion at road-stream crossings. Prioritize sites 1, 4, and 108 for initial project implementation. See Appendix C for list of additional sites.

Recommended Actions:

- Use natural contouring, native plants, and local materials (if possible)
- Install culverts or bridges where fords are used regularly
- Replace undersized, poorly aligned, and/or perched crossing structures
- Install culverts and bridges with natural stream bottoms
- Plant native vegetation on disturbed or bare soil areas
- Create diversion outlets and spillways to direct road runoff away from surface waters
- Consider climate change in road-stream crossing design

Goals Accomplished:
Landscape protection; water quality and aquatic habitat protection; education

Load Reduction Goal:
11,000 cubic feet per year (calculated by summation of top three priority sites)

Designated Uses Addressed:
Cold water fishery; other indigenous aquatic life and wildlife

Desired Uses Addressed:
Protecting native and endangered species; cold water fishery; conserving riparian corridor and high biodiversity areas; watershed information/education

Priority: High

Timeline: 10 years

Milestones:

- Secure funding for improvements
- Implement project at 1 site every three years on average (Years 1-10)
- Conduct pre and post BMP field evaluations (Years 1-10)

Total Cost: Stabalization projects at sites 1 and 4 are estimated to cost $10,000 each, while the stream ford at site 108 is estimated to cost much more due to the need for a culvert or bridge to be installed. The difficulty of estimating the cost for a project of this nature is above the expertise of YDWP staff and a professional estimate is needed. However, cost is expected to be $75,000 or greater.

Measurements:

- Number of sites improved for stream erosion

- Number of partners participating
- Quantity of sediment reduced — pre and post BMP field data (Year 10)
- Improved water quality ratings (annual stream monitoring)
- Photo documentation showing visual improvements in streamside vegetation

Potential Partners: JM Longyear, LLC, Plum Creek Timber Co., Michigan Department of Natural Resources, Natural Resources Conservation Service, Marquette County Conservation District, Superior Watershed Partnership, Marquette County Road Commission, and private land owners.

Permitting Agencies: Work planned for this task needs to ensure compliance with Michigan's primary environmental law NREPA, specifically Parts 301, 303, and 31. Permits will need to be sought and gained before work can progress. In addition, County permit 91 under the Soil and Sedimentation program will be needed.

TASK 3: REDUCE SEDIMENTATION BY STABILIZING ERODING STREAMBANKS

Reduce streambank erosion caused by anthropogenic and natural causes. Prioritize sites 1, 19, and 23 for sites impacted anthropogenicly and priotitize sites 13, 15, and 21 for sites where erosion is naturally occurring. See Appendix B for list of additional sites.

Recommended Actions:
- Use natural contouring, native plants, and local materials (if possible)
- Plant native vegetation on disturbed or bare soil areas
- Create diversion outlets and spillways to direct road runoff away from surface waters
- Consider climate change in road-stream crossing design
- Reduce slope on steep unstable banks, stabilize with BMPs, and re-plant streambank
- Install stairs or fishing access landings where needed

Goals Accomplished:
Landscape protection; water quality and aquatic habitat protection

Load Reduction Goal:
143.71 tons per year (calculated by summation of priority sites where erosion is caused by human interference)

Designated Uses Addressed:
Cold water fishery; other indigenous aquatic life and wildlife

Desired Uses Addressed:
Protecting native and endangered species; cold water fishery; conserving riparian corridor and high biodiversity areas; watershed information/education

Priority: High

Timeline: 10 years

Milestones:

- Secure funding for improvements
- Implement improvements at 2 sites every three years on average (Years 1-10)
- Conduct pre and post evaluations (site condition evaluation and stream monitoring) (Years 1-10)

Total Cost: $60,000 ($10,000 per site)

Measurements:

- Number of sites improved for stream erosion
- Number of partners participating
- Pre and post BMP field data (pebble counts, MiCorps scores, cross sectional and longitudinal profiles)
- Improved water quality ratings (annual stream monitoring)
- Photo documentation showing visual improvements in streamside vegetation

Potential Partners: JM Longyear, LLC, Plum Creek Timber Co., Michigan Department of Natural Resources, Natural Resources Conservation Service, Marquette County Conservation District, Superior Watershed Partnership, Marquette County Road Commission, and private land owners.

Permitting Agencies: Work planned for this task needs to ensure compliance with Michigan's primary environmental law NREPA, specifically Parts 301, 303, and 31. Permits will need to be sought and gained before work can progress. In addition, County permit 91 under the Soil and Sedimentation program will be needed.

TASK 4: EDUCATION AND INFORMATION PROJECTS

Create information/education projects for the community to promote shared leadership in project goals. These projects will be centered on environmental stewardship, natural shorelines, invasive species management, forest management, and watershed processes.

Recommended Actions:

- Design and distribute an environmental stewardship pledge.
- Hold workshops in the field and in the classroom to encourage awareness, participation, and nonpoint source pollution prevention
- Outdoor recreation opportunities, locations, and best practices for leave no trace stewardship.
- Watershed plan development website
- Distribute watershed-specific information and articles in the media
- River and creek clean up days
- Incorporate the public in trail maintenance
- Promote involvement in invasive species mapping and treatment projects
- Volunteer Stream Monitoring Program/ Cooperative Lake Monitoring Program

Goals Accomplished:
Landscape protection; water quality and aquatic habitat protection; education

Designated Uses Addressed:

All: warm and cold water fisheries; other indigenous aquatic life and wildlife; total body contact recreation; partial body contact recreation; navigation; industrial water supply; agriculture; fish consumption; public water supply and the point of intake

Desired Uses Addressed:
All: protecting native and endangered species; sustainable forestry; warm and cold water fisheries; maintain requirements for wild and scenic designation; canoeing & kayaking; swimming & drinking water; hunting, trapping, and harvesting wild foods; trails and access for cross-country skiing, hiking, walking, running, snow shoeing; conserving riparian corridor and high biodiversity areas; watershed information/education; aesthetic appreciation, viewing, photography, painting; trails and access for ATV/ORVs, mountain biking, and horses; equestrian pasturing

Priority: High

Timeline: ongoing

Milestones:
- Continue Volunteer Stream Monitoring Program 2 times each year (10 years)
- Continue Cooperative Lake Monitoring Program each year (10 years)
- Get 1,000 people to sign an environmental stewardship pledge (2 years)
- Clean up and reduce unnatural debris entering the Iron River by removing debris and tires and educating residents. (5 years)

Total Cost: $30,000

Measurements:
- Number of workshops held
- Number of stream locations monitored consistently
- Number of volunteer hours recorded spent working in the field or being educated
- Number of years of volunteer stream monitoring since 2004

Potential Partners: Marquette County Conservation District, Michigan Clean Water Corps, Powell Township School, Superior Watershed Partnership, Great Lakes Commission, Northern Michigan University.

TASK 5: INVASIVE SPECIES MANAGEMENT

Address priority non-native invasive species (NNIS) in the watershed with early detection, rapid complete and strategic management techniques to preserve and protect the native communities and prevent loss of habitat.

Recommended Actions:
- Inventory the watershed for invasive species, map locations
- Target infestations with best treatments recommended
- Use technology to track progress and meet milestones
- Educate and distribute detailed information about the threat of invasive species
- Inventory aquatic invasive species in inland lakes and streams

- Map selected sites after treatment to monitor progress
- Monitor new potential regional NNIS threats and report infestations to ensure rapid response from partnering agencies

Goals Accomplished:
Landscape protection; water quality and aquatic habitat protection; education

Designated Uses Addressed:
Warm and cold water fisheries; other indigenous aquatic life and wildlife

Desired Uses Addressed:
Protecting native and endangered species; cold water fishery; swimming & drinking water; hunting, trapping, and harvesting wild foods; conserving riparian corridor and high biodiversity areas; watershed information/education; aesthetic appreciation, viewing, photography, painting; equestrian pasturing

Priority: High

Timeline: ongoing

Milestones:
- Inventory Lake Independence for infestations of NNIS (2 years)
- Reduce total number of infested sites in watershed by 25% (3 years)
- Continue ongoing treatment of known infested areas (5 years)

Total Cost: $10,000

Measurements:
- Number of acres inventoried
- Number of acres treated
- Number of consecutive years treated
- Number of volunteer hours recorded spent working in the field or being educated

POTENTIAL PARTNERS: Central Upper Peninsula Cooperative Weed Management Area (CUPCWMA), Marquette County Conservation District, Alger Conservation District, Upper Peninsula Resource Conservation and Development Council, The Nature Conservancy, Ottawa National Forest, Michigan Clean Water Corps

TASK 6: ADDRESS INDUSTRY-RELATED MERCURY IMPAIRMENTS

Prevent further increase in mercury levels in the water column affecting and impairing habitat for aquatic life and fish consumption designated uses by educating and participating in the voluntary control component of the statewide Mercury (Draft) TMDL.

Recommended Actions:
- Distribute information about the proper ways to dispose of mercury containing items
- Distribute fish consumption guidelines for stakeholders and the public.
- Assist with mercury recycling efforts

- Encourage pollution prevention through education about mercury in antiques, renovations, and HVAC systems, thermostats and CFLs
- Participate in ongoing dialogue with the Environmental Protection Agency about emissions regulation

Goals Accomplished:
Landscape protection; water quality and aquatic habitat protection; education

Designated Uses Addressed:
Warm and cold water fisheries; other indigenous aquatic life and wildlife**;** fish consumption

Desired Uses Addressed:
Protecting native and endangered species; warm and cold water fisheries; swimming & drinking water; hunting, trapping, and harvesting wild foods; conserving riparian corridor and high biodiversity areas; watershed information/education

Priority: High

Timeline: ongoing

Milestones:
- Collaborate with mercury recycling centers to distribute information to 5,000 people (2 years)
- Collaborate with mercury recycling centers to distribute information to 10,000 people (5 years)
- Hold 3 workshop(s) on fish consumption guidelines, health risks, residential and industrial mercury pollution and prevention (5 years)

Total Cost: $2,500

Measurements:
- Number of people reached through media
- Number of people reached through education
- Rough quantity of recycled residential items containing mercury in Marquette County

Potential Partners: Michigan Energy Options, Superior Watershed Partnership, Marquette County Solid Waste Authority

TASK 7: ENCOURAGE IMPROVED LOCAL ZONING PROTECTIONS

Assist local units of government with master planning and zoning ordinances to protect and preserve terrestrial and aquatic habitats with special attention to high biodiversity areas through participation and suggestion of new ordinances.

Recommended Actions:
- Distribute information about mining exploration and impacts with the public
- Develop mining exploration ordinance through stakeholder collaboration
- Encourage stronger buffer protections in riparian areas

- Outline real case studies in the watershed related to buffer protection and exploration discussing impacts
- Coordinate project development with regional and national initiatives

Goals Accomplished:
Landscape protection; water quality and aquatic habitat protection; education

Designated Uses Addressed:
Warm and cold water fisheries; other indigenous aquatic life and wildlife**;** total body contact recreation; partial body contact recreation; navigation; industrial water supply; fish consumption; public water supply and the point of intake

Desired Uses Addressed:
All: protecting native and endangered species; sustainable forestry; warm and cold water fisheries; maintain requirements for wild and scenic designation; canoeing & kayaking; swimming & drinking water; hunting, trapping, and harvesting wild foods; trails and access for cross-country skiing, hiking, walking, running, snow shoeing; conserving riparian corridor and high biodiversity areas; watershed information/education; aesthetic appreciation, viewing, photography, painting; trails and access for ATV/ORVs, mountain biking, and horses; equestrian pasturing

Priority: High

Timeline: ongoing

Milestones:
- Distribute information to 5,000 people (2 years)
- Distribute information to 10,000 people (5 years)
- Propose draft mining exploration ordinance (2 years)
- Work with Ishpeming Township to increase setback to at least 50 feet in riparian areas (2 years)

Total Cost: $2,500

Measurements:
- Number of ordinances passed
- Number of people reached in the media
- Width of buffers in riparian areas
- Number of townships engaged

Potential Partners: Powell Township, Ishpeming Township, Champion Township, Michigamme Township, Marquette County Planning and Zoning, Private Landowners

TASK 8: IMPROVE ROAD-STREAM CROSSINGS FOR AQUATIC ORGANISM PASSAGE (AOP)

Improve AOP at five road-stream crossings. Prioritize sites 76, 88, 106, 127, and 144 for initial project implementation. See Appendix C for list of additional sites.

Recommended Actions:

- Use natural contouring, native plants, and local materials (if possible)
- Replace undersized, poorly aligned, and/or perched crossing structures
- Install culverts and bridges with natural stream bottoms
- Plant native vegetation on disturbed or bare soil areas
- Consider climate change in road-stream crossing design

Goals Accomplished:
Landscape protection; water quality and aquatic habitat protection

Designated Uses Addressed:
Warm and cold water fisheries; other indigenous aquatic life and wildlife

Desired Uses Addressed:
Protecting native and endangered species; cold water fishery; conserving riparian corridor and high biodiversity areas; watershed information/education; aesthetic appreciation, viewing, photography, painting

Priority: High

Timeline: 10 years

Milestones:
- Secure funding for improvements
- Implement project at 1 site every two years on average (Years 1-10)
- Conduct pre and post BMP field evaluations (Road-Stream crossing condition evaluation and volunteer stream monitoring) (Years 1-10)

Total Cost: $500,000

Measurements:
- Number of sites improved for aquatic organism passage
- Number of partners participating
- Number of miles of habitat opened up by improved stream passage
- Pre and post BMP field data (pebble counts, MiCorp scores, cross sectional and longitudinal profiles)
- Photo documentation showing visual improvements

Potential Partners: JM Longyear, LLC, Plum Creek Timber Co., Michigan Department of Natural Resources, Natural Resources Conservation Service, Marquette County Conservation District, Superior Watershed Partnership, Marquette County Road Commission, and private land owners.

Permitting Agencies: Work planned for this task needs to ensure compliance with Michigan's primary environmental law NREPA, specifically Parts 301, 303, and 31. Permits will need to be sought and gained before work can progress. In addition, County permit 91 under the Soil and Sedimentation program will be needed.

Chapter 9 IMPLEMENTATION PROGRAM DESIGN

This first draft of the Yellow Dog Watershed Management Plan is intended to outline 10 years of projects, and is scheduled for review, revision, and evaluation in 2022. The tasks and milestones are included for reference during funding acquisition and implementation stages. All monitoring activities will be conducted by YDWP staff who have been trained in the MiCorp Water Monitoring Program and follow the approved Quality Assurance Project Plan for the Yellow Dog River. Pebble counts, longitudinal surveys, and cross sectional profiles will be conducted by YDWP staff who have been trained by the U.S. Army Corps of Engineers.

SCHEDULE OF ACTIVITIES

Task 1	**Create Community Forest**	Timeline (years)									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Indicators to measure progress	Secure option to purchase (Year 1)	**x**									
	Conduct research and field reconnaissance for grant applications (Year 1)	**x**									
	Gather potential stakeholders, form committee, and facilitate meetings for a Community Forest Stakeholder Group to gather input for the planning process. (Year 1-3)	**x**	**x**	**x**							
	Secure 50% of the funding for purchase (Year 2)		**x**								
	Secure 50% of the funding for purchase (Year 2)		**x**								
	Secure ongoing funding for land management (Year 2-3)		**x**	**x**							

Task2	Reduce Sedimentation from Road-Stream Crossings	Timeline (years)									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Indicators to measure progress	Implement improvements at 1 site every three years on average (Years 1-10)				**x**			**x**			**x**
	Conduct pre and post evaluations to determine change in quantity of sediment being delivered to stream (site condition evaluation and stream monitoring) (Years 1-10)	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**

Task 3	Reduce Sedimentation by Stabilizing Eroding Streambanks	Timeline (years)									
		1	2	3	4	5	6	7	8	9	10
Indicators to measure progress	Implement improvements at 2 sites every three years on average (Years 1-10)				x			x			x
	Conduct pre and post evaluations to determine change in quantity of sediment being delivered to stream (site condition evaluation and stream monitoring) (Years 1-10)	x	x	x	x	x	x	x	x	x	x

Task 4	Education and Information Projects	Timeline (years)									
		1	2	3	4	5	6	7	8	9	10
Indicators to measure progress	Continue Volunteer Stream Monitoring Program 2 times each year (10 years)	x	x	x	x	x	x	x	x	x	x
	Continue Cooperative Lake Monitoring Program each year (10 years)	x	x	x	x	x	x	x	x	x	x
	Get 1,000 people to sign an environmental stewardship pledge (2 years)		x								
	Clean up and reduce unnatural debris entering the Iron River by removing debris and tires and educating residents. (5 years)					x					

Task 5	Invasive Species Management	Timeline (years)									
		1	2	3	4	5	6	7	8	9	10
Indicators to measure progress	Inventory Lake Independence for infestations of NNIS (2 years)		x								
	Reduce total number of infested sites in watershed by 25% (3 years)			x							
	Continue ongoing treatment of known infested areas (5 years)					x					

Task 6	Address Industry-Related Mercury Impairments	Timeline (years)									
		1	2	3	4	5	6	7	8	9	10
Indicators to measure progress	Collaborate with mercury recycling centers to distribute information to 5,000 people (2 years)		x								
	Collaborate with mercury recycling centers to distribute information to 10,000 people (5 years)					x					
	Hold 3 workshop(s) on fish consumption guidelines, health risks, residential and industrial mercury pollution and	x	x	x	x	x					

	prevention (5 years)										

Task 7	Encourage Improved Local Zoning Protections	Timeline (years)									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Indicators to measure progress	Distribute information to 5,000 people (2 years)		**x**								
	Distribute information to 10,000 people (5 years)					**x**					
	Propose draft mining exploration ordinance (2 years)		**x**								
	Work with Ishpeming Township to increase setback to at least 50 feet in riparian areas (2 years)		**x**								

Task 8	Improve Road-Stream Crossings for Aquatic Organism Passage (AOP)	Timeline (years)									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Indicators to measure progress	Implement improvements at 1 sites every two years on average (Years 1-10)		**x**		**x**		**x**		**x**		**x**
	Conduct pre and post evaluations (site condition evaluation and stream monitoring) (Years 1-10)	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**

Figure 74 – Implementation tasks and milestones.

POTENTIAL FUNDING SOURCES

The Yellow Dog Watershed Preserve projects have been supported by a variety of funding sources for 20 years since the organization was founded in 1995. Funding diversity is encouraged for the long-term sustainability of the work. Funding can come from federal, state, local and private funding sources, but this list is by no means exhaustive and can be adjusted and added to as necessary.

In addition to grant-seeking, YDWP also organizes and runs several fundraisers during the year, such as events, campaigns, and competitive online donation drives. These fundraisers often serve other purposes at the same time by promoting awareness, education, and involvement in projects. YDWP will use the already established membership and volunteer base to achieve watershed management planning tasks outlined in this project.

- Community Forest Program
- Clean Michigan Initiative - Nonpoint Source Pollution Control Grants
- EPA Environmental Education Grants
- Federal Clean Water Act, Section 319(h)
- Freshwater Future
- Great Lakes Commission: Michigan Clean Water Corps
- Great Lakes Sediment and Nutrient Reduction Program (formally known as the Great Lakes Basin Program for Soil Erosion and Sediment Control)
- Great Lakes Restoration Initiative
- Great Lakes Stewardship Initiative
- Healing Our Waters Coalition
- MDEQ Coastal Zone Management Program
- MDNR Aquatic Habitat Grant Program
- MDNR Michigan Invasive Species Grant Program
- Michigan Natural Resources Trust Fund
- National Fish and Wildlife Foundation
- National Oceanic and Atmospheric Administration
- National Wildlife Federation
- New Belgium Brewing Company
- North American Wetlands Conservation Act Small Grants Program
- Patagonia
- Superior Health Foundation
- Sustain Our Great Lakes
- Woollam Foundation
- Other Private Foundations
- Donations

Chapter 10 EVALUATION FRAMEWORK

Changes to the watershed planning tasks can be anticipated when external factors affect watershed conditions or planning resources. There may be changes in funding sources, new developments that may shift priorities, and even implemented projects that may not produce the desired effect. It is critically important to continue to evaluate progress and identify where change is necessary.

An annual evaluation of the Yellow Dog Watershed Planning Project will be carried out by the watershed steering committee with input requested from the stakeholder group. The components of this annual evaluation are outlined below.

ANNUAL ASSESSMENT QUESTIONS

- Is monitoring complete for the year? Explain.
- Have any new trends been discovered in the data? Explain.
- Have there been any suggested changes for the goals, objectives, or tasks? Do you suggest changes now? Explain.
- Have these changes been made? Explain.
- Which recommended actions have been completed or addressed? Explain.
- Are the completed actions following the timeline? Explain.
- How is progress being measured? Explain.
- Is the most essential, relevant and useful datasheet being used to collect monitoring data? Do we need to update it? Explain.
- Do we need more partners in the planning process? Explain.

QUANTITATIVE METHODS

- Volunteer Stream Monitoring Results (biological and physical characteristics)
- USGS chemical monitoring of the surface waters (pH, dissolved oxygen, heavy metals)
- USGS stream flow monitoring
- Sediment monitoring
- Number of new ordinances
- Number of acres protected
- Number of tasks completed

QUALITATIVE METHODS

- Stakeholder meeting and public workshop evaluations.
- Level of public understanding of watershed concerns.
- Volunteer and partner participation in watershed projects including annual evaluation.
- Stories of cooperation between participating agencies.

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APPENDICES

APPENDIX A: SURFACE WATER QUALITY ON THE YELLOW DOG PLAINS

YDWP/KBIC Plains Monitoring					
Site ID:	YDR001	Start Date:	8/1/2004		
Site Description:	South of Bentley Lake	End Date:	10/18/2012		
Location:	46.729778N	87.946917W			
Constituent	pH	SPC (uS/cm)	C (uS/cm)	Temp (celsius)	DO (mg/L)
Mean	6.62	55.74	43.16	12.71	8.76
Median	6.50	51.70	42.50	12.95	8.50
Min	6.20	36.60	27.20	0.90	6.05
Max	7.18	81.00	65.30	20.00	12.70
Std Dev (S)	0.33	14.73	14.17	4.89	1.81
Constituent	Alkalinity (mg/L)	Ammonia (mg/L)	Aluminum (mg/L)	Arsenic (ug/L)	Barium (ug/L)
Mean	24.74	0.05	0.09	0.80	12.01
Median	24.00	0.04	0.09	0.88	7.20
Min	12.00	0.03	0.08	0.42	5.30
Max	36.00	0.13	0.09	0.99	100.00
Std Dev (S)	7.79	0.03	0.00	0.22	21.33
Constituent	Beryllium (ug/L)	Boron (ug/L)	Cadmium (ug/L)	Calcium (mg/L)	Chromium (ug/L)
Mean	0.01	0.00	0.04	8.25	0.27
Median	0.01	0.00	0.02	8.20	0.24
Min	0.01	0.00	0.01	5.00	0.10
Max	0.01	0.00	0.13	12.00	0.70
Std Dev (S)	0.00	0.00	0.04	2.13	0.20
Constituent	Chloride (mg/L)	Cobalt (ug/L)	COD (mg/L)	Copper (ug/L)	Cyanide (mg/L)
Mean	0.00	0.12	22.33	0.43	0.01
Median	0.00	0.11	20.50	0.41	0.01
Min	0.00	0.08	14.00	0.25	0.01
Max	0.00	0.15	35.00	0.87	0.01
Std Dev (S)	0.00	0.03	6.24	0.22	0.00
Constituent	Hardness (mg/L)	Iron (mg/L)	Lead (ug/L)	Lithium (ug/L)	Magnesium (mg/L)
Mean	29.64	0.42	0.12	4.30	1.80
Median	28.00	0.41	0.11	4.30	1.90
Min	19.00	0.16	0.09	4.30	1.10
Max	39.00	0.72	0.16	4.30	2.40
Std Dev (S)	6.96	0.14	0.03	0.00	0.43
Constituent	Manganese (ug/L)	Mercury (ng/L)	Nickel (ug/L)	Nitrite+Nitrate (mg/L)	Phosphorus (mg/L)
Mean	35.32	2.82	1.07	0.05	0.02
Median	31.00	2.70	0.58	0.06	0.02
Min	14.00	1.50	0.50	0.03	0.01
Max	83.00	4.50	4.00	0.11	0.02
Std Dev (S)	17.16	1.02	1.29	0.02	0.01
Constituent	Potassium (mg/L)	Selenium (ug/L)	Silver (ug/L)	Sodium (mg/L)	Sulfate (mg/L)

Mean	0.44	0.30	0.00	1.24	3.59
Median	0.44	0.30	0.00	0.81	3.75
Min	0.26	0.30	0.00	0.67	2.50
Max	0.63	0.30	0.00	8.10	5.20
Std Dev (S)	0.10	0.00	0.00	1.67	0.84
Constituent	Sulfide	TDS (mg/L)	Thallium (ug/L)	TOC (mg/L)	Turbidity (NTU)
Mean	2.00	13.00	0.01	7.39	4.95
Median	2.00	13.00	0.01	7.40	1.30
Min	2.00	13.00	0.01	3.80	0.79
Max	2.00	13.00	0.01	13.00	63.00
Std Dev (S)	0.00	0.00	0.00	2.81	14.96
Constituent	Vanadium (ug/L)	Zinc (ug/L)			
Mean	0.80	1.85			
Median	0.72	1.23			
Min	0.67	0.61			
Max	1.10	5.50			
Std Dev (S)	0.17	1.68			

YDWP/KBIC Plains Monitoring (Includes some USGS Surface Water Data)					
Site ID:	YDR002	Start Date:	7/30/2004		
Site Description:	Clowry Bridge	End Date:	8/6/2013		
Location:	46.727278N	87.872639W			
Constituent	pH	SPC (uS/cm)	C (uS/cm)	Discharge (cfs)	Temp (celsius)
Mean	6.63	64.68	52.70	16.62	13.59
Median	6.64	64.00	54.80	12.60	14.10
Min	5.80	34.00	12.40	0.24	1.50
Max	7.24	95.00	78.00	47.70	19.50
Std Dev (S)	0.36	18.81	23.43	14.94	4.71
Constituent	DO (mg/L)	Alkalinity (mg/L)	Aluminum (mg/L)	Ammonia (mg/L)	Arsenic (ug/L)
Mean	8.63	30.21	0.06	0.04	1.04
Median	8.02	32.00	0.07	0.04	1.11
Min	6.96	13.00	0.03	0.03	0.63
Max	11.93	43.00	0.09	0.09	1.29
Std Dev (S)	1.44	8.28	0.03	0.02	0.25
Constituent	Barium (ug/L)	Beryllium (ug/L)	Boron (mg/L)	Cadmium (ug/L)	Calcium (mg/L)
Mean	9.17	0.01	0.00	0.02	9.92
Median	9.30	0.01	0.00	0.02	9.60
Min	6.70	0.01	0.00	0.01	6.00
Max	11.00	0.01	0.00	0.03	13.00
Std Dev (S)	1.19	0.00	0.00	0.01	2.52
Constituent	Chromium (ug/L)	Chloride (mg/L)	Cobalt (ug/L)	COD (mg/L)	Copper (ug/L)
Mean	0.32	0.00	0.12	27.28	0.43
Median	0.34	0.00	0.11	29.00	0.47
Min	0.19	0.00	0.08	12.00	0.23
Max	0.46	0.00	0.17	44.00	0.65
Std Dev (S)	0.09	0.00	0.03	9.37	0.17

Constituent	Cyanide (mg/L)	Hardness (mg/L)	Iron (mg/L)	Lead (ug/L)	Lithium (ug/L)
Mean	0.01	35.08	0.86	0.10	4.30
Median	0.01	34.50	0.86	0.11	4.30
Min	0.01	22.00	0.14	0.00	4.30
Max	0.01	45.00	1.60	0.21	4.30
Std Dev (S)	0.00	8.46	0.35	0.08	0.00
Constituent	Magnesium (mg/L)	Manganese (ug/L)	Mercury (ng/L)	Nickel (ug/L)	Nitrite+Nitrate (mg/L)
Mean	2.04	30.73	2.89	0.54	0.11
Median	2.10	28.20	2.40	0.54	0.05
Min	1.20	14.00	1.00	0.37	0.03
Max	2.80	70.00	5.10	0.84	0.65
Std Dev (S)	0.51	12.42	1.30	0.15	0.18
Constituent	Phosphorus(mg/L)	Potassium (mg/L)	Selenium (ug/L)	Silver (ug/L)	Sodium (mg/L)
Mean	0.02	0.46	0.30	0.00	0.91
Median	0.01	0.45	0.30	0.00	0.84
Min	0.01	0.26	0.30	0.00	0.69
Max	0.02	0.72	0.30	0.01	1.20
Std Dev (S)	0.01	0.11	0.00	0.00	0.15
Constituent	TDS (mg/L)	Sulfate (mg/L)	Sulfide	Thallium (ug/L)	TOC (mg/L)
Mean	40.50	3.62	2.00	0.01	8.97
Median	40.50	3.10	2.00	0.01	8.35
Min	27.00	2.34	2.00	0.01	3.40
Max	54.00	7.70	2.00	0.01	17.00
Std Dev (S)	19.09	1.44	0.00	0.00	3.97
Constituent	Turbidity (NTU)	Vanadium (ug/L)	Zinc (ug/L)		
Mean	2.56	1.15	1.27		
Median	2.40	1.10	1.09		
Min	0.96	0.67	0.51		
Max	8.80	2.50	2.24		
Std Dev (S)	1.67	0.51	0.74		

YDWP/KBIC Plains Monitoring (Includes some USGS Surface Water Data)					
Site ID:	YDR003	Start Date:	8/1/2004		
Site Description:	Wetland south of Eagle Rock	End Date:	5/24/2011		
Location:	46.743111N	87.883111W			
Constituent	pH	SPC (uS/cm)	Temp\e (celsius)	DO (mg/L)	Alkalinity (mg/L)
Mean	3.51	34.01	14.09	5.68	0.00
Median	3.61	34.30	15.40	5.50	0.00
Min	2.80	28.00	1.30	4.80	0.00
Max	3.99	44.30	25.50	6.95	0.00
Std Dev (S)	0.40	5.00	6.65	0.85	0.00
Constituent	Ammonia (mg/L)	Arsenic (ug/L)	Barium (ug/L)	Beryllium (ug/L)	Cadmium (ug/L)

Mean	0.03	0.79	20.00	0.02	0.10
Median	0.03	0.79	20.00	0.02	0.10
Min	0.03	0.79	15.00	0.02	0.10
Max	0.03	0.79	25.00	0.02	0.10
Std Dev (S)	0.00	0.00	7.07	0.00	0.00
Constituent	Calcium (mg/L)	Chromium (ug/L)	Chloride (mg/L)	Cobalt (ug/L)	COD (mg/L)
Mean	1.10	0.64	0.00	0.40	185.50
Median	1.10	0.64	0.00	0.40	185.50
Min	0.89	0.64	0.00	0.40	91.00
Max	1.30	0.64	0.00	0.40	280.00
Std Dev (S)	0.29	0.00	0.00	0.00	133.64
Constituent	Copper (ug/L)	Cyanide (mg/L)	Hardness (mg/L)	Iron (mg/L)	Lead (ug/L)
Mean	1.17	0.01	4.00	0.23	2.02
Median	1.17	0.01	4.00	0.23	2.02
Min	1.17	0.01	4.00	0.23	2.02
Max	1.17	0.01	4.00	0.23	2.02
Std Dev (S)	0.00	0.00	0.00	0.00	0.00
Constituent	Lithium (ug/L)	Magnesium (mg/L)	Manganese (ug/L)	Nickel (ug/L)	Nitrite+Nitrate (mg/L)
Mean	4.30	0.32	29.00	0.61	0.06
Median	4.30	0.32	29.00	0.61	0.06
Min	4.30	0.25	11.00	0.61	0.03
Max	4.30	0.38	47.00	0.61	0.09
Std Dev (S)	0.00	0.09	25.46	0.00	0.04
Constituent	Potassium (mg/L)	Selenium (ug/L)	Silver (ug/L)	Sodium (mg/L)	Sulfate (mg/L)
Mean	0.00	0.30	0.01	0.36	0.00
Median	0.00	0.30	0.01	0.36	0.00
Min	0.00	0.30	0.01	0.18	0.00
Max	0.00	0.30	0.01	0.53	0.00
Std Dev (S)	0.00	0.00	0.00	0.25	0.00
Constituent	Sulfide	Thallium (ug/L)	TOC (mg/L)	Turbidity (NTU)	Vanadium (ug/L)
Mean	2.00	0.02	33.00	8.43	2.45
Median	2.00	0.02	33.00	8.43	2.45
Min	2.00	0.02	30.00	0.86	1.50
Max	2.00	0.02	36.00	16.00	3.40
Std Dev (S)	0.00	0.00	4.24	10.71	1.34
Constituent	Zinc (ug/L)				
Mean	5.77				
Median	5.77				
Min	5.77				
Max	5.77				
Std Dev (S)	0.00				

APPENDIX B: STREAMBANK EROSION INVENTORY

Site	Latitude	Longitude	Stream Name (River Left/River Right)	Soil Texture	Volume - Weight (pcf)	Lateral Recession Rate (ft/yr)	Erosion Area (ft^2)	Annual Erosion (tons/year) MIN	Annual Erosion (tons/year) MAX	Average Annual Erosion (tons/year)	Cause of Erosion	Priority Category	Ranking within Priority Category
23	46.750748	-87.65959	YDR (RL)	Sand	90-110	very severe (0.5+)	4500	101.25	123.75	112.5	anthropogenic	high	1
19	46.740284	-87.68113	YDR (RL)	Sand	90-110	severe (0.3 to 0.5)	1284	17.334	35.31	26.322	anthropogenic	high	2
1	46.727200	-87.87260	YDR (RL)	Sand	90-110	moderate (.06 to .2)	715	1.9305	7.865	4.89775	anthropogenic	high	3
2	46.713320	-87.84091	YDR (RL)	Sand and Rock	90-110	moderate (.06 to .2)	648	1.7496	7.128	4.4388	anthropogenic	high	4
32	46.813579	-87.67436	Iron River (RL)	Sand	90-110	moderate (.06 to .2)	630	1.701	6.93	4.3155	anthropogenic	high	5
33	46.813197	-87.67382	Iron River (RL)	Sand	90-110	moderate (.06 to .2)	430	1.161	4.73	2.9455	anthropogenic	high	6
34	46.812570	-87.67332	Iron River (RL)	Sand	90-110	moderate (.06 to .2)	400	1.08	4.4	2.74	anthropogenic	high	7
10	46.728210	-87.71259	YDR (RR)	Sand and Rock	90-110	moderate (.06 to .2)	360	0.972	3.96	2.466	anthropogenic	high	8

Site	Latitude	Longitude	Stream Name (River Left/River Right)	Soil Texture	Volume - Weight (pcf)	Lateral Recession Rate (ft/yr)	Erosion Area (ft^2)	Annual Erosion (tons/year) MIN	Annual Erosion (tons/year) MAX	Average Annual Erosion (tons/year)	Cause of Erosion	Priority Category	Ranking within Priority Category
7	46.730950	-87.72948	YDR (RL)	Sand and Rock	90-110	moderate (.06 to .2)	350	0.945	3.85	2.3975	anthropogenic	high	9
6	46.731100	-87.72997	YDR (RL)	Sand and Rock	90-110	moderate (.06 to .2)	350	0.945	3.85	2.3975	anthropogenic	high	10
24	46.753563	-87.65980	YDR (RR)	Sand	90-110	slight (0.01 - 0.05)	533	0.0405	1.46575	0.753125	anthropogenic	high	11
22	46.750503	-87.65841	YDR (RR)	Sand	90-110	moderate (.06 to .2)	100	0.27	1.1	0.685	anthropogenic	high	12
28	46.771413	-87.66204	YDR (RR)	Sand	90-110	slight (0.01 - 0.05)	132	0.0594	0.363	0.2112	anthropogenic	high	13
29	46.772799	-87.66376	YDR (RR)	Sand	90-110	slight (0.01 - 0.05)	66	0.0297	0.1815	0.1056	anthropogenic	high	14
31	46.730667	-87.73190	YDR (RL)								anthropogenic?	high	Need field visit
35	46.808490	-87.66711	Iron River (RL)								anthropogenic?	high	Need field visit
21	46.745210	-87.66453	YDR (RR)	Sand	90	severe (0.3 to 0.5)	8052	108.702	221.43	165.066	natural	low	1
13	46.727780	-87.70860	YDR (RR)	Sand	90	very severe (0.5+)	6600	148.5	181.5	165	natural	low	2

Site	Latitude	Longitude	Stream Name (River Left/River Right)	Soil Texture	Volume - Weight (pcf)	Lateral Recession Rate (ft/yr)	Erosion Area (ft^2)	Annual Erosion (tons/year) MIN	Annual Erosion (tons/year) MAX	Average Annual Erosion (tons/year)	Cause of Erosion	Priority Category	Ranking within Priority Category
15	46.719560	-87.78593	YDR (RL)	Sand	90	severe (0.3 to 0.5)	3600	48.6	99	73.8	natural	low	3
30	46.710142	-87.80176	YDR (RL)	Sand	90	moderate (.06 to .2)	6400	17.28	70.4	43.84	natural	low	4
12	46.729110	-87.71028	YDR (RL)	Sand	90	very severe (0.5+)	1350	30.375	37.125	33.75	natural	low	5
11	46.728980	-87.71147	YDR (RL)	Sand	90	severe (0.3 to 0.5)	1050	14.175	28.875	21.525	natural	low	6
4	46.728890	-87.74964	YDR	Sand and Rock	90	very severe (0.5+)	780	17.55	21.45	19.5	natural	low	7
18	46.738277	-87.68691	YDR (RL)	Sand	90	moderate (.06 to .2)	2548	6.8796	28.028	17.4538	natural	low	8
5	46.728890	-87.74964	YDR	Sand and Rock	90	very severe (0.5+)	660	14.85	18.15	16.5	natural	low	9
3	46.728890	-87.74964	YDR	Sand and Rock	90	very severe (0.5+)	630	14.175	17.325	15.75	natural	low	10
20	46.744518	-87.67560	YDR (RL)	Sand	90	slight (0.01 - 0.05)	5688	2.5596	15.642	9.1008	natural	low	11

Site	Latitude	Longitude	Stream Name (River Left/River Right)	Soil Texture	Volume - Weight (pcf)	Lateral Recession Rate (ft/yr)	Erosion Area (ft^2)	Annual Erosion (tons/year) MIN	Annual Erosion (tons/year) MAX	Average Annual Erosion (tons/year)	Cause of Erosion	Priority Category	Ranking within Priority Category
27	46.760642	-87.66053	YDR (RL)	Sand	90	moderate (.06 to .2)	1175	3.1725	12.925	8.04875	natural	low	12
8	46.727630	-87.71384	YDR (RR)	Sand	90	severe (0.3 to 0.5)	360	4.86	9.9	7.38	natural	low	13
14	46.717240	-87.78864	YDR (RL)	Sand	90	moderate (.06 to .2)	900	2.43	9.9	6.165	natural	low	14
9	46.727970	-87.71308	YDR (RL)	Sand	90	severe (0.3 to 0.5)	180	2.43	4.95	3.69	natural	low	15
17	46.731261	-87.72725	YDR (RL)	Sand	90	moderate (.06 to .2)	395	1.0665	4.345	2.70575	natural	low	16
16	46.729421	-87.75105	YDR (RL)	Sand	90	moderate (.06 to .2)	280	0.76	3.08	1.918	natural	low	17
25	46.753249	-87.66135	YDR (RL)	Sand	90	slight (0.01 - 0.05)	230	0.1035	0.6325	0.368	natural	low	18
26	46.758329	-87.66058	YDR (RL)	Sand	90	slight (0.01 - 0.05)	165	0.07425	0.45375	0.264	natural	low	19

APPENDIX C: ROAD STREAM CROSSING INVENTORY

ID	Stream Name	Road Name	Latitude	Longitude	Perch Culvert	Erosion Extent	Erosion Volume ft^3	Priority Site (Erosion)	Priority Site (AOP)	Priority Site
1	Lost Creek	CR 510	46.741338	-87.730098	No	Moderate	500	yes		yes
2	Yellow Dog	CR GGI	46.731806	-87.744405	Yes	Minor	10	yes	yes	yes
3	Yellow Dog	Off GGI	46.729013	-87.748708	NA	Minor	0			Yes
4	Iron River	CR KD	46.813251	-87.676068	NA	Severe	7565	yes		Yes
5	Yellow Dog Trib.	CR 550	46.764792	-87.5622	No	Minor	0			no
6	Yellow Dog Trib.	Off KCG	46.773656	-87.675522	No	Minor	0			no
7	Yellow Dog Trib.	KCG1	46.772867	-87.675333	NA	Minor	0			no
8	Yellow Dog Trib.	KCE	46.781897	-87.685815	No	Minor	0	yes		Yes
9	Yellow Dog River	CR 550	46.756875	-87.661936	NA	Minor	180	yes		Yes
10	Yellow Dog Trib.	KCH	46.764615	-87.655963	Yes	Minor	0		yes	no
11	Yellow Dog Trib.	KCH	46.765287	-87.656645	No	Minor	0			No
12	Yellow Dog River	KCH	46.76593	-87.65995	NA	Minor	0			no
13	Yellow Dog Trib.	KCG	46.769196	-87.66332	No	Minor	0			No
14	Yellow Dog Trib.	KCG	46.768062	-87.663198	No	Minor	0			no
15	Yellow Dog Trib.	Bushy Creek TT	46.75347	-87.66165	No	Minor	0			no
16	Yellow Dog River	CR 510	46.726498	-87.714625	NA	Minor	0			no
17	Yellow Dog Trib.	CR 510	46.724123	-87.713831	NA	Moderate	36	yes		Yes
18	Yellow Dog Trib.	CR 510	46.723339	-87.712825	No	Minor	0			no
19	Yellow Dog Trib.	CR 510	46.722845	-87.711416	No	Minor	0			no
20	Yellow Dog Trib.	CR 510	46.721722	-87.707417	Yes	Minor	0		yes	no
21	Yellow Dog Trib.	CR 510	46.721444	-87.703944	No	Minor	0			no
22	Yellow Dog Trib.	CR 510	46.72106	-87.700152	No	Minor	0			no
23	Yellow Dog Trib.	CR 510	46.720905	-87.699509	No	Minor	0			no
24	Big Pup Trib.	CR 510	46.719533	-87.696613	No	Minor	0			Yes
25	Big Pup Trib.	CR 510	46.718286	-87.69788	No	Minor	0			Yes
26	Big Pup Trib.	CR 510	46.716276	-87.70127	No	Moderate	0			No
27	Big Pup Trib.	CR 510	46.712123	-87.704988	Yes	Minor	0		yes	No

28	Big Pup	CR510	46.711183	-87.704188	NA	Minor	0			No
29	Big Pup Trib.	Big Pup TT	46.709095	-87.704213	Yes	Minor	0		yes	No
30	Big Pup Trib.	Big Pup TT	46.708171	-87.705297	No	Minor	0			No
31	Big Pup	Big Pup TT	46.707953	-87.70616	No	Minor	0			No
32	Big Pup Trib.	Big Pup TT	46.708178	-87.791015	Yes	Minor	25	yes	yes	Yes
33	Big Pup	Big Pup TT	46.708235	-87.710611	NA	Minor	0			No
34	Big Pup Trib.	CR 510	46.708978	-87.70011	No	Minor	0			No
35	Big Pup Trib.	CR 510	46.708868	-87.699043	No	Minor	0			No
36	Little Pup Trib.	CR 510	46.708511	-87.697268	No	Minor	5	yes		no
37	Little Pup Trib.	CR 510	46.708633	-87.696345	Yes	Minor	0		yes	No
38	Little Pup Trib.	CR 510	46.70785	-87.694003	No	Minor	0			No
39	Little Pup Trib.	CR 510	46.708315	-87.692955	No	Minor	0			No
40	Little Pup Trib.	CR 510	46.707121	-87.692052	No	Minor	0			No
41	Little Pup Trib.	CR 510	46.706493	-87.691325	No	Minor	0			no
42	Little Pup Trib.	CR 510	46.705968	-87.690615	No	Minor	0			no
43	Little Pup Trib.	CR 510	46.702754	-87.687697	Yes	Minor	0		yes	Yes
44	Little Pup	Wilson Creek TT	46.706056	-87.6855	NA	Minor	0			no
45	Little Pup	Wilson Creek TT	46.707611	-87.684944	NA		0			no
46	Little Pup	Wilson Creek TT	46.708611	-87.682278	NA	Minor	0			no
47	Little Pup	CR 510	46.698833	-87.686611	Yes	Minor	3	yes	yes	Yes
48	Little Pup Trib.	CR 510	46.697028	-87.685556	No		0			no
49	Little Pup Trib.	CR 510	46.696083	-87.684889	Yes		0		yes	No
50	Little Pup Trib.	CR 510	46.695444	-87.684889	No		0			no
51	Yellow Dog River	Bob Lk Rd./AAR	46.713306	-87.839833	NA	Moderate	328	yes		Yes
52	Yellow Dog Trib.	J & R Two Track	46.723889	-87.715278	No	Minor	0			No
53	Yellow Dog Trib.	J & R Two Track	46.723667	-87.717556	No	Minor	0			no
54	Yellow Dog Trib.	J & R Two Track	46.7235	-87.719167	No		0			no
55	Yellow Dog Trib.	J & R Two Track	46.723333	-87.72225	No	Minor	0			No
56	Yellow Dog Trib.	J & R Two Track	46.723167	-87.723806	No	Minor	0			No
57	Yellow Dog Trib.	J & R Two Track	46.72317	-87.724667	Yes	Minor	0		yes	No
58	Yellow Dog Trib.	J & R Two Track	46.723111	-87.725222	No	Minor	0			no

59	Little Pup Trib.	Lookout Tower Rd.	46.694185	-87.691333	No	Minor	0			no
60	Little Pup	Lookout Tower Rd.	46.69297	-87.69417	No	Minor	0			Yes
61	Little Pup	GGF	46.69418	-87.70204	No	Minor	0			No
62	Little Pup Trib.	GGF	46.69467	-87.70342	No	Minor	0			No
63	Little Pup Trib.	GGF	46.69553	-87.70442	No		0			No
64	Little Pup Trib.	GGF	46.69533	-87.69802	No	Moderate	0			No
65	Yellow Dog Trib.	J & R Two Track	46.72261	-87.72713	Yes	Minor	0		yes	No
66	Yellow Dog Trib.	J & R Two Track	46.72183	-87.72907	Yes	Minor	0		yes	No
67	Yellow Dog Trib.	J & R Two Track	46.7211	-87.72994	Yes		0		yes	No
68	Yellow Dog Trib.	J & R Two Track	46.72106	-87.73039	Yes	Minor	0		yes	No
69	Unnamed Trib.	J & R Two Track	46.72814	-87.74899	NA	Minor	0			
70	Unnamed Trib.	J & R Two Track	46.72778	-87.75123	NA		0			
71	Unnamed Trib.	J & R Two Track	46.72754	-87.75225	NA		0			
72	Yellow Dog Trib.	J & R Two Track	46.71986	-87.73523	No	Moderate	9	yes		Yes
73	Yellow Dog Trib.	J & R Two Track	46.72018	-87.73561	No		0			No
74	Yellow Dog Trib.	J & R Two Track	46.72272	-87.74662	Yes	Minor	0		yes	No
75	Yellow Dog Trib.	J & R Two Track	46.72565	-87.74649	no	Minor	0			No
76	Yellow Dog Trib.	J & R Two Track	46.72803	-87.74835	No	Moderate	0		yes	Yes
77	Yellow Dog Trib.	J & R Two Track	46.72133	-87.74434	No	Minor	0			No
78	Yellow Dog Trib.	CR 510	46.72895	-87.7167	No	Minor	0			No
79	Yellow Dog Trib.	CR 510	46.73048	-87.71912	No	Minor	0			No
80	Lost Creek Trib.	CR 510	46.73501	-87.72047	No	Minor	0			No
81	Lost Creek Trib.	CR 510	46.73591	-87.72233	No	Minor	0			No
82	Lost Creek Trib.	CR 510	46.73769	-87.72611	No	Minor	0			No
83	Lost Creek Trib.	CR 510	46.73913	-87.7272	No	Minor	0			No
84	Yellow Dog Trib.	GGI	46.731111	-87.725972	No	Minor	0			No
85	Yellow Dog Trib.	GGI	46.7315	-87.730056	No	Minor	0			No
86	Yellow Dog Trib.	GGI	46.731667	-87.73528	No	Moderate	0	yes		Yes
87	Yellow Dog Trib.	GGI	46.732139	-87.742444	No	Moderate	0	yes		Yes
88	Yellow Dog Trib.	GGI	46.730778	-87.746944	Yes	Moderate	0		yes	No
89	Lost Creek Trib.	CR 510	46.737028	-87.724111	No	Minor	0			Yes

90	Lost Creek Trib.	CR 510	46.746139	-87.732722	NA	Minor	0			No
91	Lost Creek Trib.	CR 510	46.747167	-87.733444	No	Minor	0			No
92	Lost Creek Trib.	CR 510	46.748361	-87.734	No	Minor	0			No
93	Lost Creek Trib.	CR 510	46.749389	-87.734639	No	Minor	0			No
94	Lost Creek Trib.	CR 510	46.748713	-87.734199	No	Minor	0			No
95	Unnamed Trib.	CR 510	46.753389	-87.736833	No	Minor	0			No
96	Unnamed Trib.	CR 510	46.755472	-87.738222	No	Minor	0			No
97	Lost Creek Trib.	CR 510	46.760472	-87.74075	No	Minor	0			No
98	Lost Creek Trib.	CR 510	46.762444	-87.734333	No	Minor	0			No
99	Lost Creek Trib.	CR 510	46.763444	-87.742333	No	Minor	0			No
100	Lost Creek Trib.	CR 510	46.763972	-87.742611	No	Minor	0			No
101	Unnamed Trib.	CR 510	46.774472	-87.755056	NA	Minor	0			no
102	Unnamed Trib.	CR 510	46.781639	-87.734361	No	Moderate	0			No
103	Unnamed Trib.	CR 510	46.782583	-87.731417	No		0			No
104	Unnamed Trib.	Thomas Rock	46.782722	-87.728361	No	Minor	0			No
105	Unnamed Trib.	CR 510	46.799306	-87.728056	No	Minor	0			No
106	Yellow Dog Trib.	Bushy Creek TT	46.744861	-87.675972	Yes	Minor	0		yes	Yes
107	Yellow Dog Trib.	Bushy Creek TT	46.739139	-87.687028	Yes	Moderate	104	yes	yes	Yes
108	Bushy Creek	Bushy Creek TT	46.735889	-87.694222	NA	Severe	3600	yes		Yes
109	Yellow Dog Trib.	CR 550/Yamaha Trail	46.764528	-87.676083	No	Minor	0			No
110	Yellow Dog River	Snowmobile Trail 5	46.726472	-87.872111	NA	Minor	0			No
111	Lost Creek	Unnamed Road	46.742028	-87.732944	NA	Severe	363	yes		yes
112	Big Pup Trib.	Big Pup Truck Trail	46.713028	-87.778833	No	Minor	0			No
113	Yellow Dog Trib.	Big Pup Truck Trail	46.709889	-87.779194	NA	Minor	13	yes		Yes
114	Yellow Dog Trib.	Big Pup Truck Trail	46.712167	-87.787583	NA	Minor	0			No
115	Yellow Dog Trib.	Big Pup Truck Trail	46.712167	-87.787583	No	Minor	0			No
116	Yellow Dog Trib.	Big Pup Truck Trail	46.711417	-87.790333	No	Minor	0			No
117	Yellow Dog Trib.	Big Pup Truck Trail	46.710083	-87.790806	NA	Minor	0			No
118	Yellow Dog Trib.	Big Pup Truck Trail	46.70825	-87.79425	NA	Minor	0			No
119	Yellow Dog Trib.	Big Pup Truck Trail	46.702278	-87.796417	No	Minor	0			No
120	Yellow Dog Trib.	Big Pup Truck Trail	46.6995	-87.796306	No	Minor	0			No

121	Yellow Dog Trib.	Big Pup Truck Trail	46.698528	-87.796139	No	Minor	0			No
122	Yellow Dog Trib.	Big Pup Truck Trail	46.696583	-87.796611	Yes	Minor	0		yes	No
123	Yellow Dog Trib.	Big Pup Truck Trail	46.695472	-87.797333	No	Moderate	0	yes	yes	Yes
124	Yellow Dog Trib.	Big Pup Truck Trail	46.697389	-87.808139	NA	Minor	0			No
125	Big Pub	Unnamed Road	46.697389	-87.808139	NA	Minor	0			No
126	Big Pup Trib.	Candy Land Logging Rd.	46.71125	-87.719222	No		0			No
127	Yellow Dog Trib.	J & R Low Road	46.72444	-87.71632	Yes	Minor	0		yes	No
128	Yellow Dog Trib.	J & R Low Road	46.72461	-87.71698	No	Minor	0			No
129	Yellow Dog Trib.	J & R Low Road	46.726	-87.72553	No	Minor	0			No
130	Yellow Dog Trib.	J & R Low Road	46.72593	-87.72602	No	Minor	0			No
131	Yellow Dog Trib.	J & R Low Road	46.72594	-87.72659	No	Minor	0			No
132	Yellow Dog Trib.	J & R Low Road	46.72607	-87.72698	No	Minor	0			No
133	Yellow Dog Trib.	J & R Low Road	46.72625	-87.72756	No	Minor	0			No
134	Yellow Dog Trib.	J & R Low Road	46.72696	-87.73003	No	Minor	0			No
135	Yellow Dog Trib.	J & R Low Road	46.72732	-87.73128	No	Minor	0			No
136	Yellow Dog Trib.	J & R Low Road	46.72777	-87.73267	No	Minor	0			No
137	Yellow Dog Trib.	J & R Low Road	46.7275	-87.73331	No	Minor	0			No
138	Yellow Dog Trib.	J & R Low Road	46.72731	-87.74599	Yes	Minor	0		yes	No
139	Yellow Dog Trib.	J & R Low Road	46.72763	-87.74492	No	Minor	0			No
140	Yellow Dog Trib.	J & R Low Road	46.72771	-87.74049	Yes	Minor	0		yes	No
141	Yellow Dog Trib.	Snowmobile Trail 5	46.72431	-87.89649	No	Minor	0			Yes
142	Yellow Dog Trib.	Snowmobile Trail 5	46.72071	-87.89973	No	Minor	0			Yes
143	Yellow Dog Trib.	Snowmobile Trail 5	46.72071	-87.90601	No	Minor	0			Yes
144	Yellow Dog Trib.	Snowmobile Trail 5	46.71872	-87.91261	Yes	Severe	10	yes	yes	Yes
145	Yellow Dog Trib.	Snowmobile Trail 5	46.7191	-87.91684	No	Minor	0			Yes
146	Yellow Dog Trib.	Snowmobile Trail 5	46.71936	-87.91904	No	Minor	0			Yes
147	Yellow Dog Trib.	Snowmobile Trail 5	46.71894	-87.92106	NA	Minor	64	yes		yes
148	Yellow Dog Trib.	Snowmobile Trail 5	46.72041	-87.92759	No	Minor	0			No
149	Yellow Dog Trib.	Unnamed	46.72018	-87.88364	NA	Minor	0			Yes
150	Yellow Dog Trib.	J & R Low Road	46.72744	-87.73483	No	Minor	0			No
151	Yellow Dog Trib.	J & R Low Road	46.72744	-87.73483	Yes		0		yes	No

152	Yellow Dog Trib.	J & R Low Road	46.72741	-87.73492	No	Minor	0			No
153	Yellow Dog Trib.	J & R Low Road	46.7275	-87.73646	No	Minor	0			No
154	Yellow Dog Trib.	J & R Low Road	46.72719	-87.73791	Yes	Minor	0		yes	No
155	Yellow Dog Trib.	J & R Low Road	46.72707	-87.73843	No	Minor	0			No
156	Yellow Dog Trib.	J & R Low Road	46.72725	-87.73902	Yes	Minor	0		yes	Yes
157	Yellow Dog Trib.	J & R Low Road	46.72733	-87.73954	No	Minor	0			No
158	Yellow Dog Trib.	J & R Low Road	46.72751	-87.74024	No	Minor	0			No
159	Lost Creek Trib.	Red Roof Inn Road	46.7542	-87.75339	No	Minor	0			No
160	Tributary to Lake Independence		46.81234	-87.72675	yes		0		yes	No
161	Tributary to Lake Independence	CR 550	46.81271	-87.72861	no	moderate	420	yes		yes
162	Tributary to Alder Creek	Alder Creek Truck Trail	46.76543	-87.66012	no	minor	0			no
163	Tributary to Alder Creek	Alder Creek Truck Trail	46.27821	-87.70979	no	Minor	0			no
164	Tributary to Alder Creek	Alder Creek Truck Trail	46.778	-87.71051	yes	minor	0		yes	no
165	Yellow Dog Trib.	private road	46.72645	-87.87209	Yes	Minor	0		yes	Yes
166	Yellow Dog Trib.	private road	46.7201	-87.9327	yes	Moderate	200	yes	yes	Yes

Great Lakes Road Stream Crossing Inventory Instructions

5/6/2011

This protocol was developed, reviewed, and tested by the following organizations: U.S. Forest Service, U.S. Fish & Wildlife Service, Michigan DNR, Wisconsin DNR, Huron Pines, Conservation Resource Alliance, Michigan Technological University, and road commissions.

Funding for development and testing was provided by the U.S. Forest Service, U.S. Fish & Wildlife Service, and The Nature Conservancy.

Stream Crossing Data Sheet

Site ID: _____

General Information

Stream Name: _____ Road Name: _____

Name of Observer(s): _____ Date: _____

GPS Waypoint: _____ GPS Lat/Long: _____

County: _____ Township: _____ Range: _____ Sec: _____

Adjacent Landowner Information: _____ Additional Comments: _____

Crossing Information

Crossing Type: Culvert(s) no.: _____ Bridge Ford Dam Other: _____

Structure Shape: Round Square/Rectangle Open Bottom Square/Rectangle Pipe Arch Open Bottom Arch Ellipse

Inlet Type: Projecting Mitered Headwall Apron Wingwall 10-30° or 30-70° Trash Rack Other

Outlet Type: At Stream Grade Cascade over Riprap Freefall into Pool Freefall onto Riprap Outlet Apron Other

Structure Material: Metal Concrete Plastic Wood

Substrate in Structure: None Sand Gravel Rock Mixture

General Condition: New Good Fair Poor

Plugged: _____ % Inlet Outlet In Pipe

Crushed: _____ % Inlet Outlet In Pipe

Rusted Through? Yes No Structure Interior: Smooth Corrugated

Multiple Culverts/Spans

Number the culverts/spans left to right, facing downstream. Include #s in site sketch on back page

Culvert/ Span #	Width (ft)	Length (ft)	Height (ft)	Material

Structure Length (ft):[1] _____ Structure Width (ft):[1] _____ Structure Height (ft):[1] _____

Structure Water Depth (ft):[1] inlet _____ outlet _____ Perch Height (ft):[1] _____ or NA

Embedded Depth of Structure (ft):[1] inlet _____ outlet _____

Structure Water Velocity (ft/sec):[1] inlet _____ outlet _____

Structure Water Velocity Measured: At Surface or _____ ft Below Surface Measured With: Meter or Float Test

Stream Information

Stream Flow: None < ½ Bankfull < Bankfull = Bankfull > Bankfull

Scour Pool (if present) Length: ____ Width: ____ Depth: ____ Upstream Pond (if present) Length: ____ Width: ____

Riffle Information (measured in a riffle outside of zone of influence of crossing)

Water Depth (ft): _____ Bankfull Width (ft): _____ Wetted Width (ft): _____ Water Velocity (ft/sec): _____

Dominant Substrate: Cobble Gravel Sand Organics Clay Bedrock Silt Measured With: Meter or Float Test

Road Information

Type: Federal State County Town Tribal Private Other:

Road Surface: Paved Gravel Sand Native Surface Condition: Good Fair Poor

Road Width at Culvert (ft): _____ Location of Low Point: At Stream Other Runoff Path: Roadway Ditch

Embankment: Upstream Fill Depth (ft): _____ Slope: Vertical 1:1.5 1:2 >1:2

Downstream Fill Depth (ft): _____ Slope: Vertical 1:1.5 1:2 >1:2

Left Approach: Length (ft): _____ Slope: 0% 1-5% 6-10% >10% Ditch Vegetation: None Partial Heavy

Right Approach: Length (ft): _____ Slope: 0% 1-5% 6-10% >10% Ditch Vegetation: None Partial Heavy

[1] - Fill out for primary culvert (culvert #1). If multiple culverts are used, number each and use embedded table. Form Date: February 28, 2011

APPENDIX E: LAKE INDEPENDENCE MONITORING DATA

Micorps Data Exchange Network Secchi Records

Lake Independence

Site ID 520149

Latitude	Longitude	Date Sampled	Time Sampled	Secchi Depth	Weather Conditions	Unusual Conditions	Bottom Measurement
46.808337	-87.711393	2014-09-26	10:45:00	7.5	Sunny	NA	N
46.808337	-87.711393	2014-09-08	10:35:00	7.5	Partly Cloudy	NA	N
46.808337	-87.711393	2014-08-31	13:20:00	7.5	Partly Cloudy	NA	N
46.808337	-87.711393	2014-08-28	10:35:00	9.5	Sunny	NA	N
46.808337	-87.711393	2014-08-14	12:00:00	6.5	Sunny	NA	N
46.808337	-87.711393	2014-08-06	11:10:00	9	Sunny	NA	N
46.808337	-87.711393	2014-07-31	11:30:00	7.5	Sunny	NA	N
46.808337	-87.711393	2014-07-23	10:20:00	9.5	Sunny	NA	N
46.808337	-87.711393	2014-07-16	10:50:00	6.5	Partly Cloudy	NA	N
46.808337	-87.711393	2014-07-09	10:50:00	8	Partly Cloudy	NA	N
46.808337	-87.711393	2014-07-03	10:40:00	12	Sunny	NA	N
46.808337	-87.711393	2014-06-25	10:40:00	12.5	Partly Cloudy	NA	N
46.808337	-87.711393	2014-06-18	10:51:00	7.5	Cloudy	NA	N
46.808337	-87.711393	2014-06-11	10:59:00	13.5	Sunny	NA	N
46.808337	-87.711393	2014-06-04	11:30:00	10.5	Sunny	NA	N
46.808337	-87.711393	2014-05-29	11:00:00	10.5	Sunny	NA	N
46.808337	-87.711393	2014-05-23	11:30:00	9	Sunny	NA	N
46.808337	-87.711393	2013-09-16	14:45:00	9	Sunny		
46.808337	-87.711393	2013-09-11	11:20:00	10.5	Sunny		
46.808337	-87.711393	2013-09-05	11:45:00	11	Sunny		
46.808337	-87.711393	2013-08-29	11:40:00	11	Sunny		
46.808337	-87.711393	2013-08-23	10:35:00	10.5	Sunny		
46.808337	-87.711393	2013-08-14	14:40:00	8	Sunny		
46.808337	-87.711393	2013-08-04	14:33:00	8	Sunny		
46.808337	-87.711393	2013-07-17	12:37:00	9	Sunny	n/a	Y
46.808337	-87.711393	2013-07-11	11:15:00	10.5	Sunny, warm	n/a	
46.808337	-87.711393	2013-07-03	01:35:00	10.5	Sunny, warm	n/a	Y
46.808337	-87.711393	2013-06-27	15:50:00	9.5	Sunny, warm	n/a	Y
46.808337	-87.711393	2013-06-18	14:00:00	5.5	Sunny, light wind, warm	n/a	Y
46.808337	-87.711393	2013-06-15	10:15:00	9.5	Sunny, light wind, warm	n/a	Y
46.808337	-87.711393	2013-06-07	15:40:00	9.5	Sunny, warm	n/a	Y
46.808337	-87.711393	2013-05-13	14:22:00	7	Sunny, Windy15mph	n/a	Y
46.808337	-87.711393	2012-09-07	16:00:00	9.5	Sunny, Partly Cloudy	Recent heavy rain	N
46.808337	-87.711393	2012-08-27	12:15:00	10.5	Sunny, Windy		N
46.808337	-87.711393	2012-08-09	15:35:00	8	Cloudy, Windy		N
46.808337	-87.711393	2012-08-02	14:50:00	9	Partly Cloudy, Windy	Recent heavy rain	N
46.808337	-87.711393	2012-07-26	15:40:00	10.5	Sunny, Partly Cloudy		N
46.808337	-87.711393	2012-07-19	15:40:00	10.5	Sunny, Partly		N

					Cloudy, Windy		
46.808337	-87.711393	2012-07-12	15:10:00	10	Sunny		N
46.808337	-87.711393	2012-07-05	15:15:00	11	Sunny, Windy		N
46.808337	-87.711393	2012-06-28	14:55:00	10	Cloudy, Windy		N
46.808337	-87.711393	2012-06-22	13:45:00	12.5	Sunny		N
46.808337	-87.711393	2012-06-14	14:35:00	11.5	Cloudy		N
46.808337	-87.711393	2012-06-07	14:55:00	15	Sunny		N
46.808337	-87.711393	2012-05-31	14:10:00	8	Sunny		N
46.808337	-87.711393	2012-05-24	14:50:00	9	Sunny, Windy		N
46.808337	-87.711393	2012-05-17	13:18:00	13	Sunny		N
46.808337	-87.711393	2011-09-12	11:12:00	7.5	Sunny		N
46.808337	-87.711393	2011-09-07	11:40:00	7.5	Sunny		N
46.808337	-87.711393	2011-08-03	12:57:00	7.5	Sunny		N
46.808337	-87.711393	2011-07-19	10:30:00	7.5	Sunny		N
46.808337	-87.711393	2011-07-05	13:44:00	12	Sunny, Windy		N
46.808337	-87.711393	2011-06-21	11:30:00	11.5	Partly Cloudy, Windy		N
46.808337	-87.711393	2011-06-14	14:00:00	6	Rainy, Windy	Aborted early, very wavy conditions for a tandem kayak.	N
46.808337	-87.711393	2011-05-24	14:40:00	11.5	Partly Cloudy		N
46.808337	-87.711393	2011-05-17	14:25:00	7	Sunny		N
46.808337	-87.711393	2010-09-16	10:00:00	8	Cloudy, Rainy	steady rain	
46.808337	-87.711393	2010-09-09	12:00:00	8	Partly Cloudy		
46.808337	-87.711393	2010-09-02	11:00:00	10	Cloudy, Rainy		
46.808337	-87.711393	2010-08-26	12:30:00	13.5	Partly Cloudy		
46.808337	-87.711393	2010-08-12	10:30:00	15	Sunny		
46.808337	-87.711393	2010-08-05	11:00:00	11.5	Cloudy, Rainy		
46.808337	-87.711393	2010-07-15	10:18:00	13.5	Sunny, Windy	Recent rain	
46.808337	-87.711393	2010-07-08	10:20:00	13.5	Sunny	Rained the night before	
46.808337	-87.711393	2010-07-01	10:00:00	15	Sunny		
46.808337	-87.711393	1982-08-01	12:00:00	6			
46.808337	-87.711393	1982-07-25	12:00:00	6.5			
46.808337	-87.711393	1982-07-18	12:00:00	6			
46.808337	-87.711393	1982-07-11	12:00:00	6			
46.808337	-87.711393	1982-07-04	12:00:00	7.5			
46.808337	-87.711393	1982-06-27	12:00:00	8			
46.808337	-87.711393	1982-06-20	12:00:00	8.5			
46.808337	-87.711393	1982-06-06	12:00:00	9			
46.808337	-87.711393	1981-09-13	12:00:00	6			
46.808337	-87.711393	1981-08-30	12:00:00	7			
46.808337	-87.711393	1981-08-23	12:00:00	6.5			
46.808337	-87.711393	1981-08-09	12:00:00	6.5			
46.808337	-87.711393	1981-08-02	12:00:00	7			
46.808337	-87.711393	1981-07-26	12:00:00	6.5			
46.808337	-87.711393	1981-07-12	12:00:00	9			

46.808337	-87.711393	1981-07-05	12:00:00	8.5			
46.808337	-87.711393	1981-06-21	12:00:00	8			
46.808337	-87.711393	1981-06-14	12:00:00	8			
46.808337	-87.711393	1981-06-07	12:00:00	8.5			
46.808337	-87.711393	1981-05-31	12:00:00	9			
46.808337	-87.711393	1981-05-24	12:00:00	9			
46.808337	-87.711393	1981-05-17	12:00:00	9			
46.808337	-87.711393	1981-05-10	12:00:00	9			
46.808337	-87.711393	1980-08-10	12:00:00	6.5			
46.808337	-87.711393	1980-08-03	12:00:00	6.5			
46.808337	-87.711393	1980-07-27	12:00:00	8			
46.808337	-87.711393	1980-07-20	12:00:00	8.5			
46.808337	-87.711393	1980-07-13	12:00:00	8.5			
46.808337	-87.711393	1980-07-06	12:00:00	9.5			
46.808337	-87.711393	1980-06-29	12:00:00	9			
46.808337	-87.711393	1980-06-22	12:00:00	10			
46.808337	-87.711393	1980-06-15	12:00:00	8			
46.808337	-87.711393	1980-06-08	12:00:00	7			
46.808337	-87.711393	1980-06-01	12:00:00	8			
46.808337	-87.711393	1979-08-26	12:00:00	5			
46.808337	-87.711393	1979-08-19	12:00:00	6			
46.808337	-87.711393	1979-08-12	12:00:00	6			
46.808337	-87.711393	1979-08-05	12:00:00	6			
46.808337	-87.711393	1979-07-29	12:00:00	6			
46.808337	-87.711393	1979-07-08	12:00:00	6			
46.808337	-87.711393	1979-06-24	12:00:00	6.5			
46.808337	-87.711393	1979-06-17	12:00:00	7.5			
46.808337	-87.711393	1979-06-10	12:00:00	8			
46.808337	-87.711393	1979-06-03	12:00:00	7			
46.808337	-87.711393	1979-05-27	12:00:00	8			
46.808337	-87.711393	1979-05-13	12:00:00	7			
46.808337	-87.711393	1979-05-06	12:00:00	7			
46.808337	-87.711393	1979-04-29	12:00:00	7			
46.808337	-87.711393	1978-08-06	12:00:00	5.5			
46.808337	-87.711393	1978-07-23	12:00:00	7.5			
46.808337	-87.711393	1978-07-16	12:00:00	5.5			
46.808337	-87.711393	1978-07-02	12:00:00	8			
46.808337	-87.711393	1978-06-25	12:00:00	7.5			
46.808337	-87.711393	1978-06-18	12:00:00	8			
46.808337	-87.711393	1978-06-11	12:00:00	7			
46.808337	-87.711393	1978-06-04	12:00:00	9			
46.808337	-87.711393	1977-09-11	12:00:00	3			
46.808337	-87.711393	1977-09-04	12:00:00	4.5			
46.808337	-87.711393	1977-08-28	12:00:00	3			
46.808337	-87.711393	1977-08-21	12:00:00	4.5			
46.808337	-87.711393	1977-08-14	12:00:00	5			
46.808337	-87.711393	1977-08-07	12:00:00	5.5			
46.808337	-87.711393	1977-07-31	12:00:00	6.5			

46.808337	-87.711393	1977-07-24	12:00:00	9			
46.808337	-87.711393	1977-07-17	12:00:00	7.5			
46.808337	-87.711393	1977-07-10	12:00:00	8.5			
46.808337	-87.711393	1977-07-03	12:00:00	8.5			
46.808337	-87.711393	1977-06-26	12:00:00	10.5			
46.808337	-87.711393	1977-06-12	12:00:00	8.5			
46.808337	-87.711393	1977-06-05	12:00:00	8.5			
46.808337	-87.711393	1977-05-29	12:00:00	9.5			
46.808337	-87.711393	1977-05-22	12:00:00	11			

Micorps Data Exchange Network Total Phosphorus Records

Lake Independence

Site ID 520149

Latitude	Longitude	Date Sampled	Time Sampled	Spring Overturn/Late Summer	Date Ice-Out	Weather Conditions	Turn In Date	Phosphorus (ug P/L)	REP (ug P/L)	Lab Comments
46.808337	-87.711393	2014-08-31	13:30:00	Late Summer	0000-00-00	Partly Cloudy	2014-09-02			
46.808337	-87.711393	2014-08-31	13:30:00	Late Summer	0000-00-00	Partly Cloudy	2014-09-02	9	11	
46.808337	-87.711393	2014-05-23	11:30:00	Spring Overturn	2014-05-15	Sunny, Windy	2014-05-27			
46.808337	-87.711393	2014-05-23	11:30:00	Spring Overturn	2014-05-15	Sunny, Windy	2014-05-27	7		
46.808337	-87.711393	2013-08-23	10:40:00	Late Summer	0000-00-00	Sunny, Calm, warm	2013-08-26	15	11	Recommended laboratory holding time was exceeded.
46.808337	-87.711393	2013-05-13	14:30:00	Spring Overturn	2013-05-10	Sunny, Windy	2013-05-14	14	10	
46.808337	-87.711393	2012-08-27	12:30:00	Late Summer	0000-00-00	Sunny, Windy	0000-00-00	12		
46.808337	-87.711393	2012-04-29	15:14:00	Spring Overturn	2012-00-00	Sunny, Calm	2012-05-01	9	8	
46.808337	-87.711393	2010-08-26	12:30:00	Late Summer	0000-00-00	Partly Cloudy	2010-08-31	9	10	

Micorps Data Exchange Network Chlorophyll Records

Lake Independence

Site ID 520149

Latitude	Longitude	Date Sampled	Time Sampled	Event #	Secchi Depth (feet)	Composite Sample Depth (feet)	Weather Conditions	Chlorophyll (mg/L)	REP (ug P/L)	Lab Comments
46.808337	-87.711393	2014-08-28	11:00:00	5	9.5	14.5	Sunny	2.1		
46.808337	-87.711393	2014-08-14	12:25:00	4	6.5	13	Sunny	2.2		
46.808337	-87.711393	2014-07-16	11:00:00	3	6.5	13	Sunny	2.1		

46.808337	-87.711393	2014-06-11	10:59:00	2	13.5	27	Sunny	< 1.0	< 1.0	Sample value was less than laboratory quantification limit (1 ug/l).
46.808337	-87.711393	2014-05-23	11:30:00	1	9	18	Sunny, Windy	3.1		
46.808337	-87.711393	2013-08-23	10:35:00	5	10.5	21	Sunny, Warm, Calm	1.9		
46.808337	-87.711393	2013-08-14	14:45:00	4	8	16	Sunny	2.6		
46.808337	-87.711393	2013-07-17	12:45:00	3	9	18	Sunny hot, calm	3.4		
46.808337	-87.711393	2013-06-18	14:15:00	2	5.5	11	Sunny,Windy light wind, warm	2.1		
46.808337	-87.711393	2012-08-27	12:30:00	5	10.5	21		2.4		
46.808337	-87.711393	2012-07-12	15:00:00	3	10	20		< 1.0		Sample value was less than laboratory quantification limit (1 ug/l).
46.808337	-87.711393	2012-05-17	13:18:00	1	13	26		1.4		
46.808337	-87.711393	2011-07-19	10:45:00	3	7.5	14				
46.808337	-87.711393	2011-06-21	12:00:00	2	11.5	23				

Micorps Data Exchange Network Dissolved Oxygen Records											
Lake Independence											
Site ID 520149											
Latitude	**Longitude**	**Date Sampled**	**Time Sampled**	**Weather Conditions**	**Sampling Depth (feet)**	**Calibration DO (% air saturation)**	**Calibration Temp (°C)**	**Lake Altitude Value**	**Depth (feet)**	**Temp (°C)**	**DO Level (mg/l)**
46.808337	-87.711393	2014-09-26	10:45:00	Sunny	29.3	96.1	19.5	6	1	14.8	10.48
46.808337	-87.711393	2014-09-26	10:45:00	Sunny	29.3	96.1	19.5	6	5	14.6	10.43
46.808337	-87.711393	2014-09-26	10:45:00	Sunny	29.3	96.1	19.5	6	10	14.4	10.32
46.808337	-87.711393	2014-09-26	10:45:00	Sunny	29.3	96.1	19.5	6	15	13.9	10.05
46.808337	-87.711393	2014-09-26	10:45:00	Sunny	29.3	96.1	19.5	6	17.5	13.8	9.86
46.808337	-87.711393	2014-09-26	10:45:00	Sunny	29.3	96.1	19.5	6	20	13.6	9.83
46.808337	-87.711393	2014-09-26	10:45:00	Sunny	29.3	96.1	19.5	6	22.5	13.5	9.62
46.808337	-87.711393	2014-09-26	10:45:00	Sunny	29.3	96.1	19.5	6	25	13.3	9.14
46.808337	-87.711393	2014-09-26	10:45:00	Sunny	29.3	96.1	19.5	6	27.5	13.3	8.64
46.808337	-87.711393	2014-09-08	10:35:00	Partly Cloudy	29.7	96.7	23.6	6	1	18.8	9.08
46.808337	-87.711393	2014-09-08	10:35:00	Partly Cloudy	29.7	96.7	23.6	6	5	18.6	9.05
46.808337	-87.711393	2014-09-08	10:35:00	Partly Cloudy	29.7	96.7	23.6	6	10	18.5	9.02
46.808337	-87.711393	2014-09-08	10:35:00	Partly Cloudy	29.7	96.7	23.6	6	15	18.5	8.99
46.808337	-87.711393	2014-09-08	10:35:00	Partly Cloudy	29.7	96.7	23.6	6	17.5	18.4	8.95
46.808337	-87.711393	2014-09-08	10:35:00	Partly Cloudy	29.7	96.7	23.6	6	20	18.4	8.9
46.808337	-87.711393	2014-09-08	10:35:00	Partly Cloudy	29.7	96.7	23.6	6	22.5	18.3	8.81
46.808337	-87.711393	2014-09-08	10:35:00	Partly Cloudy	29.7	96.7	23.6	6	25	18.3	8.63
46.808337	-87.711393	2014-09-08	10:35:00	Partly Cloudy	29.7	96.7	23.6	6	27.5	18.2	8.29
46.808337	-87.711393	2014-08-28	10:40:00	Sunny	29.2	94.5	20.4	6	1	19.8	8.35
46.808337	-87.711393	2014-08-28	10:40:00	Sunny	29.2	94.5	20.4	6	5	19.7	8.34
46.808337	-87.711393	2014-08-28	10:40:00	Sunny	29.2	94.5	20.4	6	10	19.6	8.31
46.808337	-87.711393	2014-08-28	10:40:00	Sunny	29.2	94.5	20.4	6	15	19.6	8.24
46.808337	-87.711393	2014-08-28	10:40:00	Sunny	29.2	94.5	20.4	6	17.5	19.6	8.23
46.808337	-87.711393	2014-08-28	10:40:00	Sunny	29.2	94.5	20.4	6	20	19.6	8.24
46.808337	-87.711393	2014-08-28	10:40:00	Sunny	29.2	94.5	20.4	6	22.5	19.6	8.11

46.808337	-87.711393	2014-08-28	10:40:00	Sunny	29.2	94.5	20.4	6	25	19.4	7.79
46.808337	-87.711393	2014-08-28	10:40:00	Sunny	29.2	94.5	20.4	6	27.5	19.1	7.02
46.808337	-87.711393	2014-08-14	12:00:00	Sunny	27.1	95.7	19.7	6	1	19.9	8.26
46.808337	-87.711393	2014-08-14	12:00:00	Sunny	27.1	95.7	19.7	6	5	19.8	8.27
46.808337	-87.711393	2014-08-14	12:00:00	Sunny	27.1	95.7	19.7	6	10	19.7	8.28
46.808337	-87.711393	2014-08-14	12:00:00	Sunny	27.1	95.7	19.7	6	15	19.6	8.21
46.808337	-87.711393	2014-08-14	12:00:00	Sunny	27.1	95.7	19.7	6	17.5	19.6	8.3
46.808337	-87.711393	2014-08-14	12:00:00	Sunny	27.1	95.7	19.7	6	20	19.5	8.31
46.808337	-87.711393	2014-08-14	12:00:00	Sunny	27.1	95.7	19.7	6	22.5	19.5	8.38
46.808337	-87.711393	2014-08-14	12:00:00	Sunny	27.1	95.7	19.7	6	25	19.4	8.35
46.808337	-87.711393	2014-07-31	11:30:00	Sunny	26.1	98	21.3	6	1	19.8	8.55
46.808337	-87.711393	2014-07-31	11:30:00	Sunny	26.1	98	21.3	6	5	19.7	8.58
46.808337	-87.711393	2014-07-31	11:30:00	Sunny	26.1	98	21.3	6	10	19.6	8.56
46.808337	-87.711393	2014-07-31	11:30:00	Sunny	26.1	98	21.3	6	15	19.5	8.52
46.808337	-87.711393	2014-07-31	11:30:00	Sunny	26.1	98	21.3	6	17.5	19.5	8.49
46.808337	-87.711393	2014-07-31	11:30:00	Sunny	26.1	98	21.3	6	20	19.5	8.51
46.808337	-87.711393	2014-07-31	11:30:00	Sunny	26.1	98	21.3	6	22.5	19.4	8.49
46.808337	-87.711393	2014-07-31	11:30:00	Sunny	26.1	98	21.3	6	25	19.3	8.22
46.808337	-87.711393	2014-07-16	10:45:00	Partly Cloudy	28.9	97.9	17.6	6	1	18.6	8.75
46.808337	-87.711393	2014-07-16	10:45:00	Partly Cloudy	28.9	97.9	17.6	6	5	18.6	8.74
46.808337	-87.711393	2014-07-16	10:45:00	Partly Cloudy	28.9	97.9	17.6	6	10	18.5	8.73
46.808337	-87.711393	2014-07-16	10:45:00	Partly Cloudy	28.9	97.9	17.6	6	15	18.3	8.73
46.808337	-87.711393	2014-07-16	10:45:00	Partly Cloudy	28.9	97.9	17.6	6	17.5	18.5	8.71
46.808337	-87.711393	2014-07-16	10:45:00	Partly Cloudy	28.9	97.9	17.6	6	20	18.4	8.69
46.808337	-87.711393	2014-07-16	10:45:00	Partly Cloudy	28.9	97.9	17.6	6	22.5	18.4	8.66
46.808337	-87.711393	2014-07-16	10:45:00	Partly Cloudy	28.9	97.9	17.6	6	25	18.4	8.62
46.808337	-87.711393	2014-07-16	10:45:00	Partly Cloudy	28.9	97.9	17.6	6	27.5	18.4	8.59
46.808337	-87.711393	2014-06-18	10:53:00	Cloudy	27.5	97.8	20.2	6	1	18.6	99.3
46.808337	-87.711393	2014-06-18	10:53:00	Cloudy	27.5	97.8	20.2	6	5	18.4	98.9

46.808337	-87.711393	2014-06-18	10:53:00	Cloudy	27.5	97.8	20.2	6	10	18.1	98.2
46.808337	-87.711393	2014-06-18	10:53:00	Cloudy	27.5	97.8	20.2	6	15	17	95.5
46.808337	-87.711393	2014-06-18	10:53:00	Cloudy	27.5	97.8	20.2	6	17.5	16.9	94.5
46.808337	-87.711393	2014-06-18	10:53:00	Cloudy	27.5	97.8	20.2	6	20	16.5	93.4
46.808337	-87.711393	2014-06-18	10:53:00	Cloudy	27.5	97.8	20.2	6	22.5	16	90.4
46.808337	-87.711393	2014-06-18	10:53:00	Cloudy	27.5	97.8	20.2	6	25	15.7	89
46.808337	-87.711393	2014-06-18	10:53:00	Cloudy	27.5	97.8	20.2	6	27.5	15.6	87
46.808337	-87.711393	2014-06-04	11:30:00	Sunny	30	97.8	24.2	6	1	17.7	9.5
46.808337	-87.711393	2014-06-04	11:30:00	Sunny	30	97.8	24.2	6	5	16.9	9.55
46.808337	-87.711393	2014-06-04	11:30:00	Sunny	30	97.8	24.2	6	10	16.4	9.6
46.808337	-87.711393	2014-06-04	11:30:00	Sunny	30	97.8	24.2	6	15	16.1	9.71
46.808337	-87.711393	2014-06-04	11:30:00	Sunny	30	97.8	24.2	6	17.5	15.5	9.55
46.808337	-87.711393	2014-06-04	11:30:00	Sunny	30	97.8	24.2	6	20	15	9.58
46.808337	-87.711393	2014-06-04	11:30:00	Sunny	30	97.8	24.2	6	22.5	13.7	9.59
46.808337	-87.711393	2014-06-04	11:30:00	Sunny	30	97.8	24.2	6	25	12.8	9.42
46.808337	-87.711393	2014-06-04	11:30:00	Sunny	30	97.8	24.2	6	27.5	12	9.17
46.808337	-87.711393	2014-05-29	11:10:00	Sunny	29.5	97.8	19.2	6	1	18.1	0.01
46.808337	-87.711393	2014-05-29	11:10:00	Sunny	29.5	97.8	19.2	6	5	17.7	0.01
46.808337	-87.711393	2014-05-29	11:10:00	Sunny	29.5	97.8	19.2	6	10	13.8	0.01
46.808337	-87.711393	2014-05-29	11:10:00	Sunny	29.5	97.8	19.2	6	15	11.5	0.01
46.808337	-87.711393	2014-05-29	11:10:00	Sunny	29.5	97.8	19.2	6	17.5	11	0.01
46.808337	-87.711393	2014-05-29	11:10:00	Sunny	29.5	97.8	19.2	6	20	10.7	0.01
46.808337	-87.711393	2014-05-29	11:10:00	Sunny	29.5	97.8	19.2	6	22.5	10.5	0.01
46.808337	-87.711393	2014-05-29	11:10:00	Sunny	29.5	97.8	19.2	6	25	10.4	0.01
46.808337	-87.711393	2014-05-29	11:10:00	Sunny	29.5	97.8	19.2	6	27.5	10.3	0.01
46.808337	-87.711393	2014-04-03	10:40:00	Sunny	30	97.8	19.2	6	1	19.8	8.36
46.808337	-87.711393	2014-04-03	10:40:00	Sunny	30	97.8	19.2	6	5	19.8	8.35
46.808337	-87.711393	2014-04-03	10:40:00	Sunny	30	97.8	19.2	6	10	19.7	8.33
46.808337	-87.711393	2014-04-03	10:40:00	Sunny	30	97.8	19.2	6	15	19.6	8.26

46.808337	-87.711393	2014-04-03	10:40:00	Sunny	30	97.8	19.2	6	17.5	19.6	8.24
46.808337	-87.711393	2014-04-03	10:40:00	Sunny	30	97.8	19.2	6	20	19.6	8.23
46.808337	-87.711393	2014-04-03	10:40:00	Sunny	30	97.8	19.2	6	22.5	19.4	8.23
46.808337	-87.711393	2014-04-03	10:40:00	Sunny	30	97.8	19.2	6	25	18.6	7.34
46.808337	-87.711393	2014-04-03	10:40:00	Sunny	30	97.8	19.2	6	27.5	17.7	5.85
46.808337	-87.711393	2013-09-11	11:00:00	Sunny	32.6	97.8	22.2	6	1	19.4	8.7
46.808337	-87.711393	2013-09-11	11:00:00	Sunny	32.6	97.8	22.2	6	5	19.3	8.63
46.808337	-87.711393	2013-09-11	11:00:00	Sunny	32.6	97.8	22.2	6	10	19.1	8.58
46.808337	-87.711393	2013-09-11	11:00:00	Sunny	32.6	97.8	22.2	6	15	19	8.51
46.808337	-87.711393	2013-09-11	11:00:00	Sunny	32.6	97.8	22.2	6	17.5	19	8.47
46.808337	-87.711393	2013-09-11	11:00:00	Sunny	32.6	97.8	22.2	6	20	19	8.46
46.808337	-87.711393	2013-09-11	11:00:00	Sunny	32.6	97.8	22.2	6	22.5	18.8	7.69
46.808337	-87.711393	2013-09-11	11:00:00	Sunny	32.6	97.8	22.2	6	25	18.7	7.4
46.808337	-87.711393	2013-09-11	11:00:00	Sunny	32.6	97.8	22.2	6	27.5	18.6	7.34
46.808337	-87.711393	2013-09-05	11:40:00	Sunny	31.8	97.8	21.2	6	1	19.8	8.65
46.808337	-87.711393	2013-09-05	11:40:00	Sunny	31.8	97.8	21.2	6	5	19.5	8.61
46.808337	-87.711393	2013-09-05	11:40:00	Sunny	31.8	97.8	21.2	6	10	19.5	8.5
46.808337	-87.711393	2013-09-05	11:40:00	Sunny	31.8	97.8	21.2	6	15	19.4	8.5
46.808337	-87.711393	2013-09-05	11:40:00	Sunny	31.8	97.8	21.2	6	17.5	19.4	8.48
46.808337	-87.711393	2013-09-05	11:40:00	Sunny	31.8	97.8	21.2	6	20	19.4	8.46
46.808337	-87.711393	2013-09-05	11:40:00	Sunny	31.8	97.8	21.2	6	22.5	19.4	8.4
46.808337	-87.711393	2013-09-05	11:40:00	Sunny	31.8	97.8	21.2	6	25	19.3	8.22
46.808337	-87.711393	2013-09-05	11:40:00	Sunny	31.8	97.8	21.2	6	27.5	19.1	8
46.808337	-87.711393	2013-08-29	11:20:00	Sunny	31.5	97.8	27.3	6	1	24.1	8.54
46.808337	-87.711393	2013-08-29	11:20:00	Sunny	31.5	97.8	27.3	6	5	23.7	8.52
46.808337	-87.711393	2013-08-29	11:20:00	Sunny	31.5	97.8	27.3	6	10	22	8.39
46.808337	-87.711393	2013-08-29	11:20:00	Sunny	31.5	97.8	27.3	6	15	21.4	8
46.808337	-87.711393	2013-08-29	11:20:00	Sunny	31.5	97.8	27.3	6	17.5	21.2	7.85
46.808337	-87.711393	2013-08-29	11:20:00	Sunny	31.5	97.8	27.3	6	20	21	7.56

46.808337	-87.711393	2013-08-29	11:20:00	Sunny	31.5	97.8	27.3	6	22.5	20.9	7.28
46.808337	-87.711393	2013-08-29	11:20:00	Sunny	31.5	97.8	27.3	6	25	20.8	6.8
46.808337	-87.711393	2013-08-29	11:20:00	Sunny	31.5	97.8	27.3	6	27.5	20.7	6.55
46.808337	-87.711393	2013-08-14	14:40:00	Sunny	29.1	97.8	26.6	6	1	19.1	8.73
46.808337	-87.711393	2013-08-14	14:40:00	Sunny	29.1	97.8	26.6	6	5	18.9	8.7
46.808337	-87.711393	2013-08-14	14:40:00	Sunny	29.1	97.8	26.6	6	10	18.7	8.59
46.808337	-87.711393	2013-08-14	14:40:00	Sunny	29.1	97.8	26.6	6	15	18.5	8.46
46.808337	-87.711393	2013-08-14	14:40:00	Sunny	29.1	97.8	26.6	6	17.5	18.4	8.42
46.808337	-87.711393	2013-08-14	14:40:00	Sunny	29.1	97.8	26.6	6	20	18.4	8.4
46.808337	-87.711393	2013-08-14	14:40:00	Sunny	29.1	97.8	26.6	6	22.5	18.4	8.35
46.808337	-87.711393	2013-08-14	14:40:00	Sunny	29.1	97.8	26.6	6	25	18.3	8.34
46.808337	-87.711393	2013-08-14	14:40:00	Sunny	29.1	97.8	26.6	6	27.5	18.2	8.32
46.808337	-87.711393	2013-07-29	15:40:00	Sunny	32.9	95.5	24.5	6	1	19.1	8.66
46.808337	-87.711393	2013-07-29	15:40:00	Sunny	32.9	95.5	24.5	6	5	18.7	8.6
46.808337	-87.711393	2013-07-29	15:40:00	Sunny	32.9	95.5	24.5	6	10	18.5	8.55
46.808337	-87.711393	2013-07-29	15:40:00	Sunny	32.9	95.5	24.5	6	15	18.3	8.45
46.808337	-87.711393	2013-07-29	15:40:00	Sunny	32.9	95.5	24.5	6	17.5	18	8.36
46.808337	-87.711393	2013-07-29	15:40:00	Sunny	32.9	95.5	24.5	6	20	17.8	8.36
46.808337	-87.711393	2013-07-29	15:40:00	Sunny	32.9	95.5	24.5	6	22.5	17.7	8.36
46.808337	-87.711393	2013-07-29	15:40:00	Sunny	32.9	95.5	24.5	6	25	17.7	8.37
46.808337	-87.711393	2013-07-29	15:40:00	Sunny	32.9	95.5	24.5	6	27.5	17.6	8.39
46.808337	-87.711393	2013-07-17	12:45:00	Sunny hot, calm	29.5	97.7	38.1	6	1	25.1	7.89
46.808337	-87.711393	2013-07-17	12:45:00	Sunny hot, calm	29.5	97.7	38.1	6	5	24.1	7.7
46.808337	-87.711393	2013-07-17	12:45:00	Sunny hot, calm	29.5	97.7	38.1	6	10	22.8	7.53
46.808337	-87.711393	2013-07-17	12:45:00	Sunny hot, calm	29.5	97.7	38.1	6	15	21.1	6.88
46.808337	-87.711393	2013-07-17	12:45:00	Sunny hot, calm	29.5	97.7	38.1	6	17.5	20.8	6.59
46.808337	-87.711393	2013-07-17	12:45:00	Sunny hot, calm	29.5	97.7	38.1	6	20	20.5	6.4
46.808337	-87.711393	2013-07-17	12:45:00	Sunny hot, calm	29.5	97.7	38.1	6	22.5	20.4	6.08
46.808337	-87.711393	2013-07-17	12:45:00	Sunny hot, calm	29.5	97.7	38.1	6	25	19.9	3.51

46.808337	-87.711393	2013-07-17	12:45:00	Sunny hot, calm	29.5	97.7	38.1	6	27.5	19.4	4.7
46.808337	-87.711393	2013-07-03	13:07:00	Sunny	29	97.7	33.3	6	1	21.8	8.01
46.808337	-87.711393	2013-07-03	13:07:00	Sunny	29	97.7	33.3	6	5	21.5	7.98
46.808337	-87.711393	2013-07-03	13:07:00	Sunny	29	97.7	33.3	6	10	20.8	7.92
46.808337	-87.711393	2013-07-03	13:07:00	Sunny	29	97.7	33.3	6	15	19.4	7.22
46.808337	-87.711393	2013-07-03	13:07:00	Sunny	29	97.7	33.3	6	17.5	18.6	6.67
46.808337	-87.711393	2013-07-03	13:07:00	Sunny	29	97.7	33.3	6	20	18.5	6.5
46.808337	-87.711393	2013-07-03	13:07:00	Sunny	29	97.7	33.3	6	22.5	18.4	6.3
46.808337	-87.711393	2013-07-03	13:07:00	Sunny	29	97.7	33.3	6	25	16.5	4.7
46.808337	-87.711393	2013-07-03	13:07:00	Sunny	29	97.7	33.3	6	27.5	14.9	3.6
46.808337	-87.711393	2013-06-18	13:50:00	Sunny	30.4	98.7	18.2	6	1	18.2	8.55
46.808337	-87.711393	2013-06-18	13:50:00	Sunny	30.4	98.7	18.2	6	5	17.8	8.43
46.808337	-87.711393	2013-06-18	13:50:00	Sunny	30.4	98.7	18.2	6	10	17.1	8.32
46.808337	-87.711393	2013-06-18	13:50:00	Sunny	30.4	98.7	18.2	6	15	16.9	8.15
46.808337	-87.711393	2013-06-18	13:50:00	Sunny	30.4	98.7	18.2	6	17.5	16.7	8
46.808337	-87.711393	2013-06-18	13:50:00	Sunny	30.4	98.7	18.2	6	20	16.4	7.81
46.808337	-87.711393	2013-06-18	13:50:00	Sunny	30.4	98.7	18.2	6	22.5	15	6.71
46.808337	-87.711393	2013-06-18	13:50:00	Sunny	30.4	98.7	18.2	6	25	14.3	6.29
46.808337	-87.711393	2013-06-18	13:50:00	Sunny	30.4	98.7	18.2	6	27.5	13.3	4.7
46.808337	-87.711393	2013-06-07	15:47:00	Sunny	28.1	97.7	28.1	6	1	15.4	8.51
46.808337	-87.711393	2013-06-07	15:47:00	Sunny	28.1	97.7	28.1	6	5	14.2	8.23
46.808337	-87.711393	2013-06-07	15:47:00	Sunny	28.1	97.7	28.1	6	10	13.9	8.18
46.808337	-87.711393	2013-06-07	15:47:00	Sunny	28.1	97.7	28.1	6	15	13.7	8.11
46.808337	-87.711393	2013-06-07	15:47:00	Sunny	28.1	97.7	28.1	6	17.5	13.5	8.01
46.808337	-87.711393	2013-06-07	15:47:00	Sunny	28.1	97.7	28.1	6	20	13.3	7.7
46.808337	-87.711393	2013-06-07	15:47:00	Sunny	28.1	97.7	28.1	6	22.5	12.8	7
46.808337	-87.711393	2013-06-07	15:47:00	Sunny	28.1	97.7	28.1	6	25	12.5	6.68
46.808337	-87.711393	2013-06-07	15:47:00	Sunny	28.1	97.7	28.1	6	27.5	12	5.53
46.808337	-87.711393	2013-05-17	15:45:00	Sunny cool	28.1	97.8	16.1	6	1	9.6	6.18

46.808337	-87.711393	2013-05-17	15:45:00	Sunny cool	28.1	97.8	16.1	6	5	9.3	6.12
46.808337	-87.711393	2013-05-17	15:45:00	Sunny cool	28.1	97.8	16.1	6	10	9	6.22
46.808337	-87.711393	2013-05-17	15:45:00	Sunny cool	28.1	97.8	16.1	6	15	8.7	6.27
46.808337	-87.711393	2013-05-17	15:45:00	Sunny cool	28.1	97.8	16.1	6	17.5	8.7	6.33
46.808337	-87.711393	2013-05-17	15:45:00	Sunny cool	28.1	97.8	16.1	6	20	8.6	6.38
46.808337	-87.711393	2013-05-17	15:45:00	Sunny cool	28.1	97.8	16.1	6	22.5	8.3	6.39
46.808337	-87.711393	2013-05-17	15:45:00	Sunny cool	28.1	97.8	16.1	6	25	7.8	6.3
46.808337	-87.711393	2013-05-17	15:45:00	Sunny cool	28.1	97.8	16.1	6	27.5	7.7	6.27
46.808337	-87.711393	2013-05-13	14:47:00	Sunny,Windy	30.1	97.8	15	6	1	5.9	9.73
46.808337	-87.711393	2013-05-13	14:47:00	Sunny,Windy	30.1	97.8	15	6	5	5.8	9.73
46.808337	-87.711393	2013-05-13	14:47:00	Sunny,Windy	30.1	97.8	15	6	10	5.9	10.13
46.808337	-87.711393	2013-05-13	14:47:00	Sunny,Windy	30.1	97.8	15	6	15	5.8	11.61
46.808337	-87.711393	2013-05-13	14:47:00	Sunny,Windy	30.1	97.8	15	6	17.5	5.7	11.95
46.808337	-87.711393	2013-05-13	14:47:00	Sunny,Windy	30.1	97.8	15	6	20	5.7	12.62
46.808337	-87.711393	2013-05-13	14:47:00	Sunny,Windy	30.1	97.8	15	6	22.5	5.7	12.65
46.808337	-87.711393	2013-05-13	14:47:00	Sunny,Windy	30.1	97.8	15	6	25	5.7	12.86
46.808337	-87.711393	2012-08-27	12:40:00	Sunny,Windy	31	97.8	25.4	6	1	21.8	8.8
46.808337	-87.711393	2012-08-27	12:40:00	Sunny,Windy	31	97.8	25.4	6	5	21.8	8.78
46.808337	-87.711393	2012-08-27	12:40:00	Sunny,Windy	31	97.8	25.4	6	10	21.7	8.74
46.808337	-87.711393	2012-08-27	12:40:00	Sunny,Windy	31	97.8	25.4	6	15	21.6	8.64
46.808337	-87.711393	2012-08-27	12:40:00	Sunny,Windy	31	97.8	25.4	6	17.5	21.5	8.49
46.808337	-87.711393	2012-08-27	12:40:00	Sunny,Windy	31	97.8	25.4	6	20	21.3	8.51
46.808337	-87.711393	2012-08-27	12:40:00	Sunny,Windy	31	97.8	25.4	6	22.5	21.1	8.2
46.808337	-87.711393	2012-08-27	12:40:00	Sunny,Windy	31	97.8	25.4	6	25	20.8	7.12
46.808337	-87.711393	2012-08-27	12:40:00	Sunny,Windy	31	97.8	25.4	6	27.5	20.8	6.78
46.808337	-87.711393	2012-08-09	15:40:00	Cloudy,Windy Very windy	31	99.1	22.2	6	1	23	8.16
46.808337	-87.711393	2012-08-09	15:40:00	Cloudy,Windy Very windy	31	99.1	22.2	6	5	23	8.15
46.808337	-87.711393	2012-08-09	15:40:00	Cloudy,Windy Very windy	31	99.1	22.2	6	10	23	8.14
46.808337	-87.711393	2012-08-09	15:40:00	Cloudy,Windy Very windy	31	99.1	22.2	6	15	23	8.11

46.808337	-87.711393	2012-08-09	15:40:00	Cloudy,Windy Very windy	31	99.1	22.2	6	17.5	23	8.12
46.808337	-87.711393	2012-08-09	15:40:00	Cloudy,Windy Very windy	31	99.1	22.2	6	20	23	8.12
46.808337	-87.711393	2012-08-09	15:40:00	Cloudy,Windy Very windy	31	99.1	22.2	6	22.5	23	8.12
46.808337	-87.711393	2012-08-09	15:40:00	Cloudy,Windy Very windy	31	99.1	22.2	6	25	22.9	8.11
46.808337	-87.711393	2012-08-09	15:40:00	Cloudy,Windy Very windy	31	99.1	22.2	6	27.5	22.8	7.99
46.808337	-87.711393	2012-07-26	15:40:00	Sunny,Partly Cloudy	31	98	25.5	6	1	25.1	7.82
46.808337	-87.711393	2012-07-26	15:40:00	Sunny,Partly Cloudy	31	98	25.5	6	5	25.1	7.76
46.808337	-87.711393	2012-07-26	15:40:00	Sunny,Partly Cloudy	31	98	25.5	6	10	24.9	7.63
46.808337	-87.711393	2012-07-26	15:40:00	Sunny,Partly Cloudy	31	98	25.5	6	15	24.9	7.6
46.808337	-87.711393	2012-07-26	15:40:00	Sunny,Partly Cloudy	31	98	25.5	6	17.5	24.8	7.62
46.808337	-87.711393	2012-07-26	15:40:00	Sunny,Partly Cloudy	31	98	25.5	6	20	24.7	7.4
46.808337	-87.711393	2012-07-26	15:40:00	Sunny,Partly Cloudy	31	98	25.5	6	22.5	24.5	7.07
46.808337	-87.711393	2012-07-26	15:40:00	Sunny,Partly Cloudy	31	98	25.5	6	25	24.5	7.02
46.808337	-87.711393	2012-07-26	15:40:00	Sunny,Partly Cloudy	31	98	25.5	6	27.5	24.3	6.4
46.808337	-87.711393	2012-07-12	15:30:00	Sunny,Partly Cloudy	30.5	96.8	29.9	6	1	26.2	8.08
46.808337	-87.711393	2012-07-12	15:30:00	Sunny,Partly Cloudy	30.5	96.8	29.9	6	5	25.6	8.11
46.808337	-87.711393	2012-07-12	15:30:00	Sunny,Partly Cloudy	30.5	96.8	29.9	6	10	25.1	8
46.808337	-87.711393	2012-07-12	15:30:00	Sunny,Partly Cloudy	30.5	96.8	29.9	6	15	25	7.95
46.808337	-87.711393	2012-07-12	15:30:00	Sunny,Partly Cloudy	30.5	96.8	29.9	6	17.5	24.7	7.39
46.808337	-87.711393	2012-07-12	15:30:00	Sunny,Partly Cloudy	30.5	96.8	29.9	6	20	24.5	7.22
46.808337	-87.711393	2012-07-12	15:30:00	Sunny,Partly Cloudy	30.5	96.8	29.9	6	22.5	23.9	5.95
46.808337	-87.711393	2012-07-12	15:30:00	Sunny,Partly Cloudy	30.5	96.8	29.9	6	25	22.5	1.9
46.808337	-87.711393	2012-07-12	15:30:00	Sunny,Partly Cloudy	30.5	96.8	29.9	6	27.5	22.2	0.91
46.808337	-87.711393	2012-06-28	14:25:00	Cloudy	27	95.7	25.6	6	1	23.6	9.05
46.808337	-87.711393	2012-06-28	14:25:00	Cloudy	27	95.7	25.6	6	5	23.5	9.07
46.808337	-87.711393	2012-06-28	14:25:00	Cloudy	27	95.7	25.6	6	10	23.3	9.02
46.808337	-87.711393	2012-06-28	14:25:00	Cloudy	27	95.7	25.6	6	15	22.2	8.66
46.808337	-87.711393	2012-06-28	14:25:00	Cloudy	27	95.7	25.6	6	17.5	21.9	8.47
46.808337	-87.711393	2012-06-28	14:25:00	Cloudy	27	95.7	25.6	6	20	21.4	7.74

46.808337	-87.711393	2012-06-28	14:25:00	Cloudy	27	95.7	25.6	6	22.5	21.1	6.94
46.808337	-87.711393	2012-06-28	14:25:00	Cloudy	27	95.7	25.6	6	25	20.9	5.77
46.808337	-87.711393	2012-06-14	14:30:00	Sunny,Windy	0	99.2	21.4	6	1	19.9	8.52
46.808337	-87.711393	2012-06-14	14:30:00	Sunny,Windy	0	99.2	21.4	6	5	19.9	8.5
46.808337	-87.711393	2012-06-14	14:30:00	Sunny,Windy	0	99.2	21.4	6	10	19.9	8.49
46.808337	-87.711393	2012-06-14	14:30:00	Sunny,Windy	0	99.2	21.4	6	15	19.8	8.49
46.808337	-87.711393	2012-06-14	14:30:00	Sunny,Windy	0	99.2	21.4	6	17.5	19.8	8.47
46.808337	-87.711393	2012-06-14	14:30:00	Sunny,Windy	0	99.2	21.4	6	20	19.8	8.41
46.808337	-87.711393	2012-06-14	14:30:00	Sunny,Windy	0	99.2	21.4	6	22.5	19.7	8.27
46.808337	-87.711393	2012-06-14	14:30:00	Sunny,Windy	0	99.2	21.4	6	25	18.7	6.08
46.808337	-87.711393	2012-06-14	14:30:00	Sunny,Windy	0	99.2	21.4	6	27.5	18.2	4.87
46.808337	-87.711393	2012-05-31	14:15:00	Sunny	27.5	95.2	17.1	6	1	17.9	8.79
46.808337	-87.711393	2012-05-31	14:15:00	Sunny	27.5	95.2	17.1	6	5	17.8	8.78
46.808337	-87.711393	2012-05-31	14:15:00	Sunny	27.5	95.2	17.1	6	10	17.6	8.77
46.808337	-87.711393	2012-05-31	14:15:00	Sunny	27.5	95.2	17.1	6	15	17.5	8.76
46.808337	-87.711393	2012-05-31	14:15:00	Sunny	27.5	95.2	17.1	6	17.5	17.4	8.76
46.808337	-87.711393	2012-05-31	14:15:00	Sunny	27.5	95.2	17.1	6	20	17.4	8.72
46.808337	-87.711393	2012-05-31	14:15:00	Sunny	27.5	95.2	17.1	6	22.5	17.2	8.67
46.808337	-87.711393	2012-05-31	14:15:00	Sunny	27.5	95.2	17.1	6	25	17.1	8.6
46.808337	-87.711393	2011-09-12	11:28:00	Sunny	29.03	97.7	24.1	6	1	19.9	10.71
46.808337	-87.711393	2011-09-12	11:28:00	Sunny	29.03	97.7	24.1	6	5	19.6	10.29
46.808337	-87.711393	2011-09-12	11:28:00	Sunny	29.03	97.7	24.1	6	10	19.4	9.72
46.808337	-87.711393	2011-09-12	11:28:00	Sunny	29.03	97.7	24.1	6	15	19.1	9.31
46.808337	-87.711393	2011-09-12	11:28:00	Sunny	29.03	97.7	24.1	6	17.5	19.1	9.2
46.808337	-87.711393	2011-09-12	11:28:00	Sunny	29.03	97.7	24.1	6	20	19	9.08
46.808337	-87.711393	2011-09-12	11:28:00	Sunny	29.03	97.7	24.1	6	22.5	18.9	8.68
46.808337	-87.711393	2011-09-12	11:28:00	Sunny	29.03	97.7	24.1	6	25	18.7	7.87
46.808337	-87.711393	2011-09-12	11:28:00	Sunny	29.03	97.7	24.1	6	27.5	18.3	5.78
46.808337	-87.711393	2011-09-07	12:05:00	Sunny	27.5	97.7	19.6	6	1	19	10.02

46.808337	-87.711393	2011-09-07	12:05:00	Sunny	27.5	97.7	19.6	6	5	18.7	9.6
46.808337	-87.711393	2011-09-07	12:05:00	Sunny	27.5	97.7	19.6	6	10	18.6	9.25
46.808337	-87.711393	2011-09-07	12:05:00	Sunny	27.5	97.7	19.6	6	15	18.4	8.97
46.808337	-87.711393	2011-09-07	12:05:00	Sunny	27.5	97.7	19.6	6	17.5	18.4	8.85
46.808337	-87.711393	2011-09-07	12:05:00	Sunny	27.5	97.7	19.6	6	20	18.3	8.27
46.808337	-87.711393	2011-09-07	12:05:00	Sunny	27.5	97.7	19.6	6	22.5	17.8	7.62
46.808337	-87.711393	2011-09-07	12:05:00	Sunny	27.5	97.7	19.6	6	25	17.8	7.48
46.808337	-87.711393	2011-09-07	12:05:00	Sunny	27.5	97.7	19.6	6	27.5	17.8	7.36
46.808337	-87.711393	2011-08-03	12:57:00	Sunny	27.5	97.8	24.6	6	1	23.4	8.2
46.808337	-87.711393	2011-08-03	12:57:00	Sunny	27.5	97.8	24.6	6	5	23.3	8.1
46.808337	-87.711393	2011-08-03	12:57:00	Sunny	27.5	97.8	24.6	6	10	23.2	8.02
46.808337	-87.711393	2011-08-03	12:57:00	Sunny	27.5	97.8	24.6	6	15	23.2	7.94
46.808337	-87.711393	2011-08-03	12:57:00	Sunny	27.5	97.8	24.6	6	17.5	23.1	7.84
46.808337	-87.711393	2011-08-03	12:57:00	Sunny	27.5	97.8	24.6	6	20	22.5	6.6
46.808337	-87.711393	2011-08-03	12:57:00	Sunny	27.5	97.8	24.6	6	22.5	21.8	5.54
46.808337	-87.711393	2011-08-03	12:57:00	Sunny	27.5	97.8	24.6	6	25	20.9	2.48
46.808337	-87.711393	2011-08-03	12:57:00	Sunny	27.5	97.8	24.6	6	27.5	20.1	0.94
46.808337	-87.711393	2011-07-19	10:00:00	Sunny	25	97.6	25.7	6	1	24.7	9.19
46.808337	-87.711393	2011-07-19	10:00:00	Sunny	25	97.6	25.7	6	5	24.6	9.04
46.808337	-87.711393	2011-07-19	10:00:00	Sunny	25	97.6	25.7	6	10	23.1	8.67
46.808337	-87.711393	2011-07-19	10:00:00	Sunny	25	97.6	25.7	6	15	21.5	8.02
46.808337	-87.711393	2011-07-19	10:00:00	Sunny	25	97.6	25.7	6	17.5	20.8	6.93
46.808337	-87.711393	2011-07-19	10:00:00	Sunny	25	97.6	25.7	6	20	20.6	6.34
46.808337	-87.711393	2011-07-19	10:00:00	Sunny	25	97.6	25.7	6	22.5	19.7	4.83
46.808337	-87.711393	2011-07-19	10:00:00	Sunny	25	97.6	25.7	6	25	19.1	3.34
46.808337	-87.711393	2011-07-05	13:00:00	Sunny,Windy	25	98.3	23.5	6	1	21.3	10.14
46.808337	-87.711393	2011-07-05	13:00:00	Sunny,Windy	25	98.3	23.5	6	5	21.2	9.82
46.808337	-87.711393	2011-07-05	13:00:00	Sunny,Windy	25	98.3	23.5	6	10	21.1	9.58
46.808337	-87.711393	2011-07-05	13:00:00	Sunny,Windy	25	98.3	23.5	6	15	19.1	8.92

46.808337	-87.711393	2011-07-05	13:00:00	Sunny,Windy	25	98.3	23.5	6	17.5	18.8	8.67
46.808337	-87.711393	2011-07-05	13:00:00	Sunny,Windy	25	98.3	23.5	6	20	18.3	8
46.808337	-87.711393	2011-07-05	13:00:00	Sunny,Windy	25	98.3	23.5	6	22.5	17.8	7.25
46.808337	-87.711393	2011-07-05	13:00:00	Sunny,Windy	25	98.3	23.5	6	25	17.6	6.84
46.808337	-87.711393	2011-06-21	13:00:00	Cloudy	27.5	100	18.4	6	1	17.5	9.31
46.808337	-87.711393	2011-06-21	13:00:00	Cloudy	27.5	100	18.4	6	5	17.5	9.17
46.808337	-87.711393	2011-06-21	13:00:00	Cloudy	27.5	100	18.4	6	10	17.5	9.11
46.808337	-87.711393	2011-06-21	13:00:00	Cloudy	27.5	100	18.4	6	15	17.4	8.63
46.808337	-87.711393	2011-06-21	13:00:00	Cloudy	27.5	100	18.4	6	17.5	17.3	8.76
46.808337	-87.711393	2011-06-21	13:00:00	Cloudy	27.5	100	18.4	6	20	17.1	8.61
46.808337	-87.711393	2011-06-21	13:00:00	Cloudy	27.5	100	18.4	6	22.5	16.9	7.65
46.808337	-87.711393	2011-06-21	13:00:00	Cloudy	27.5	100	18.4	6	25	16.6	6.34
46.808337	-87.711393	2011-06-21	13:00:00	Cloudy	27.5	100	18.4	6	27.5	16.5	5.52
46.808337	-87.711393	2011-05-17	14:30:00	Sunny	30.6	97.8	22.1	6	1	11.7	10.33
46.808337	-87.711393	2011-05-17	14:30:00	Sunny	30.6	97.8	22.1	6	5	10.9	10.15
46.808337	-87.711393	2011-05-17	14:30:00	Sunny	30.6	97.8	22.1	6	10	10.6	10.08
46.808337	-87.711393	2011-05-17	14:30:00	Sunny	30.6	97.8	22.1	6	15	10.5	9.97
46.808337	-87.711393	2011-05-17	14:30:00	Sunny	30.6	97.8	22.1	6	17.5	10.5	9.88
46.808337	-87.711393	2011-05-17	14:30:00	Sunny	30.6	97.8	22.1	6	20	10.5	9.84
46.808337	-87.711393	2011-05-17	14:30:00	Sunny	30.6	97.8	22.1	6	22.5	10.04	9.79
46.808337	-87.711393	2011-05-17	14:30:00	Sunny	30.6	97.8	22.1	6	25	10.2	9.69
46.808337	-87.711393	2011-05-17	14:30:00	Sunny	30.6	97.8	22.1	6	27.5	10.2	9.63