

# Iron River – Iron County, Michigan

## Channel Assessment Report



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## **BACKGROUND**

During a canoe trip on the Iron River in 2008 to assess areas for habitat enhancement, it became apparent the river had frequent and seemingly evenly spaced deposits of sand and fines in the bed of the upper reaches. This was in contrast to an area beginning roughly below the City of Iron River, MI where the stream bed is composed of gravels and boulders down to its confluence with the Brule. The regular occurrence of the sand slugs in the upper reaches, coupled with the barely visible tops of boulders (relic riffle areas), lead to the hypothesis that the sand had filled historic pools and riffles along the upper portion of the river. Without active point sources of sand apparent in the upper watershed, it was further hypothesized that this sand may be a relic of late 19th century logging operations. The determination of whether sand and fines in the channel is natural or human induced holds significant implications for restoration approaches within the Iron River system.

A grant proposal was submitted to the Menominee Enhancement Fund to determine if the sand in the Iron River was in fact a natural component of the river system or a relic of historic watershed activities. The grant was approved and work commenced in the summer of 2010, focused on creating maps of the bed elevation, substrate composition, and approximate depth of sediment deposition along the Iron River from its headwaters to the confluence with the Brule. The grant was accepted with the condition that the investigation focus on restorative actions and management in response to this perceived impact of fine sediment in the channel. The following report summarizes the investigation and synthesis of field data and existing reports on the river.

## **WATERSHED CONDITIONS**

### *Hydrology*

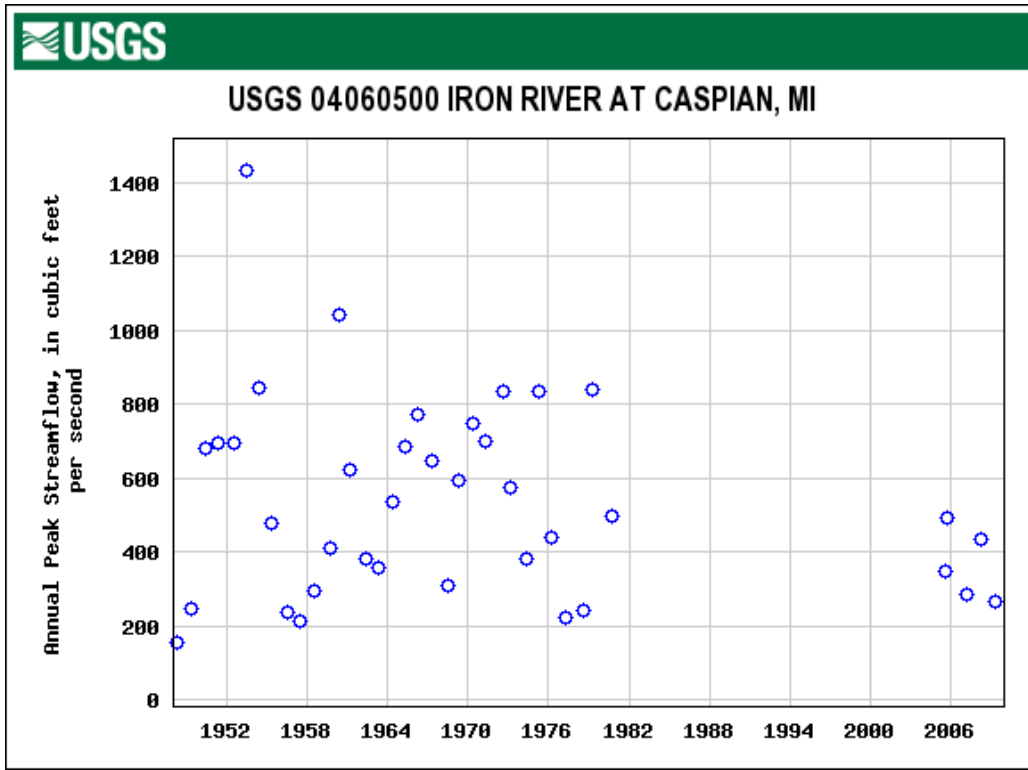
The entire watershed comprises 96 square miles, located largely within Iron County, MI. Due to the coarse glacial deposits in the watershed (see surface geology section below), rainfall tends to infiltrate readily in the basin creating a stream that is very stable with what might be considered minor increases in stage associated with flood events. This stability translates into low stream power, small sediment loads, as well as minimal delivery of sediment to the river, and a less dynamic system. A large amount of groundwater inflow keeps water temperatures low. Given these characteristics, the Iron River above the City of Iron River, can be called a baseflow system. Through the cities of Iron River and Caspian, the impacts of urban stormwater and large scale channel manipulation are present, but the channel doesn't appear to manifest these impacts through the systemic bed incision and erosion, typical of most urban streams. This is likely due in part to the extensive growth of

vegetation along the banks, comprised mainly of tag alder, as well as the presence of several grade control dams and bridge crossings that maintain bed control. Below Caspian, the river enters a steeper gradient section that does not bear a noticeable signature of any large scale human impacts.

The USGS operates a gage at the HWY 424 Bridge in Caspian (USGS# 04060500). The gage contains a period of record from 1948-1980 and has been reinstated in 2005 to present. Significant changes to the basin which would affect hydrology are assumed to be minor during the period of 1980 to 2005, making the historical data appropriate for prediction purposes. A graph of peak flows (Figure 1) along with a table (Table 1) of predicted recurrence intervals are presented. The USGS Report for water year 2009 is included in Appendix C for reference.

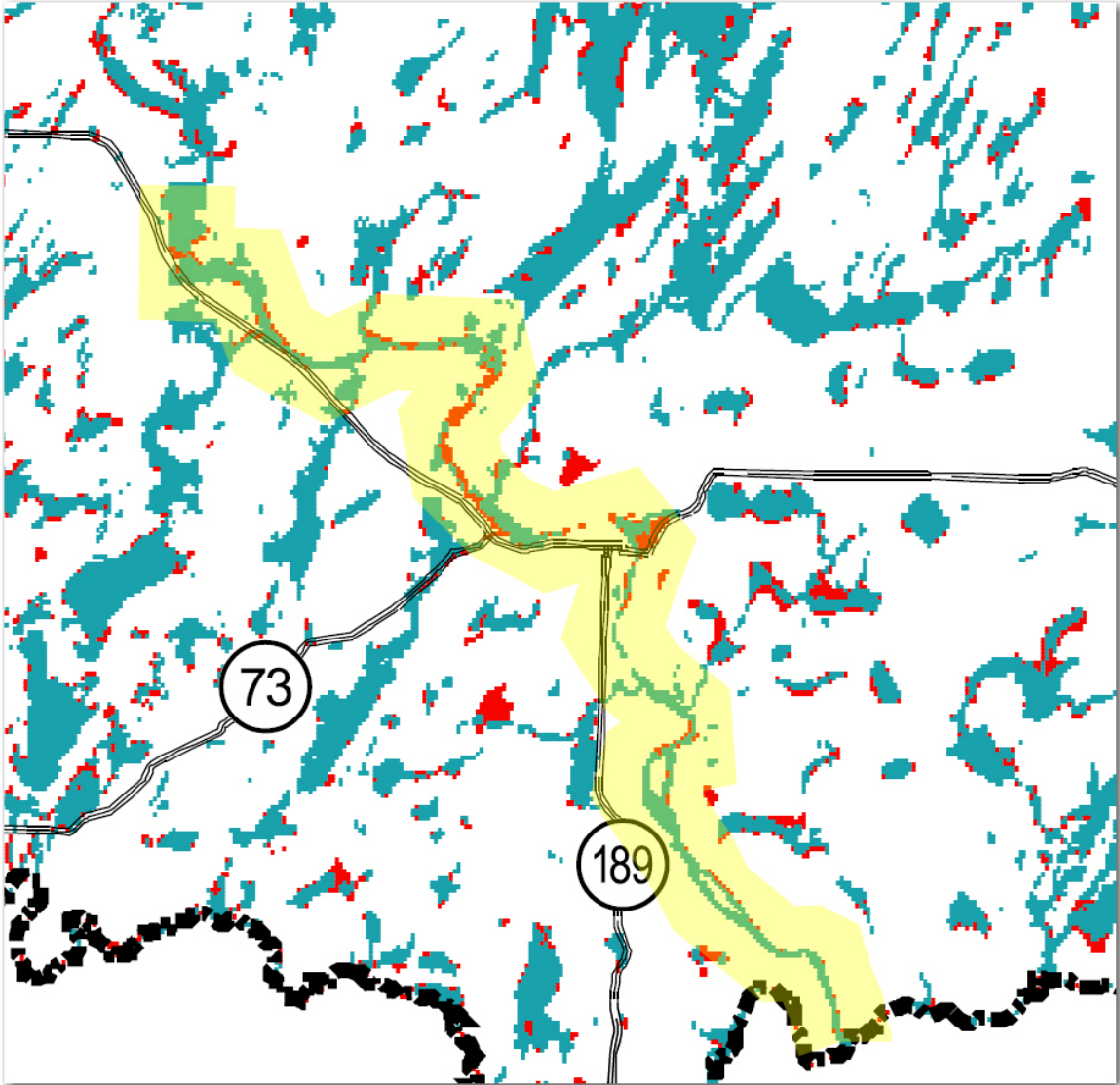
**Table 1:** Frequency analysis of USGS gage data at Caspian, MI

DISTRIBUTION	Flood Recurrence Interval					
	Q <sub>100</sub>	Q <sub>50</sub>	Q <sub>25</sub>	Q <sub>10</sub>	Q <sub>5</sub>	Q <sub>2</sub>
<i>Normal</i>	1073	1009	939	830	728	532
<i>Log Normal</i>	1517	1324	1139	902	725	477
<i>Gamma 3</i>	1099	1029	951	833	726	526
<i>Gumbel</i>	1262	1135	1007	835	699	494
<i>Log Pearson III</i>	1452	1283	1116	896	727	482
<b><i>Average</i></b>	<b>1280</b>	<b>1156</b>	<b>1031</b>	<b>859</b>	<b>721</b>	<b>502</b>



**Figure 1: Peak flows for the Iron River at Caspian**

Based on the watershed report compiled in 2001 by the Iron County Conservation District, the Iron River Watershed comprises approximately 96 square miles within Iron County. Today the cities of Iron River, Stambaugh, Caspian, and Gaastra lie completely within the watershed, accounting for most of the 16% urban landuse. Other landuse in the watershed is 57% forested, 12% agricultural, 7% wetland, and 8% “other” which likely includes most mining areas within the watershed. Wetland losses within the watershed appear to be minor based on a comparison made by the Michigan Natural Features Inventory between 1980 and 1800 wetland locations (Figure 2). An inspection of the GLO maps indicates that wetland hydrology has likely changed significantly with the addition of roads and rail lines running parallel to the Iron River for much of its length.



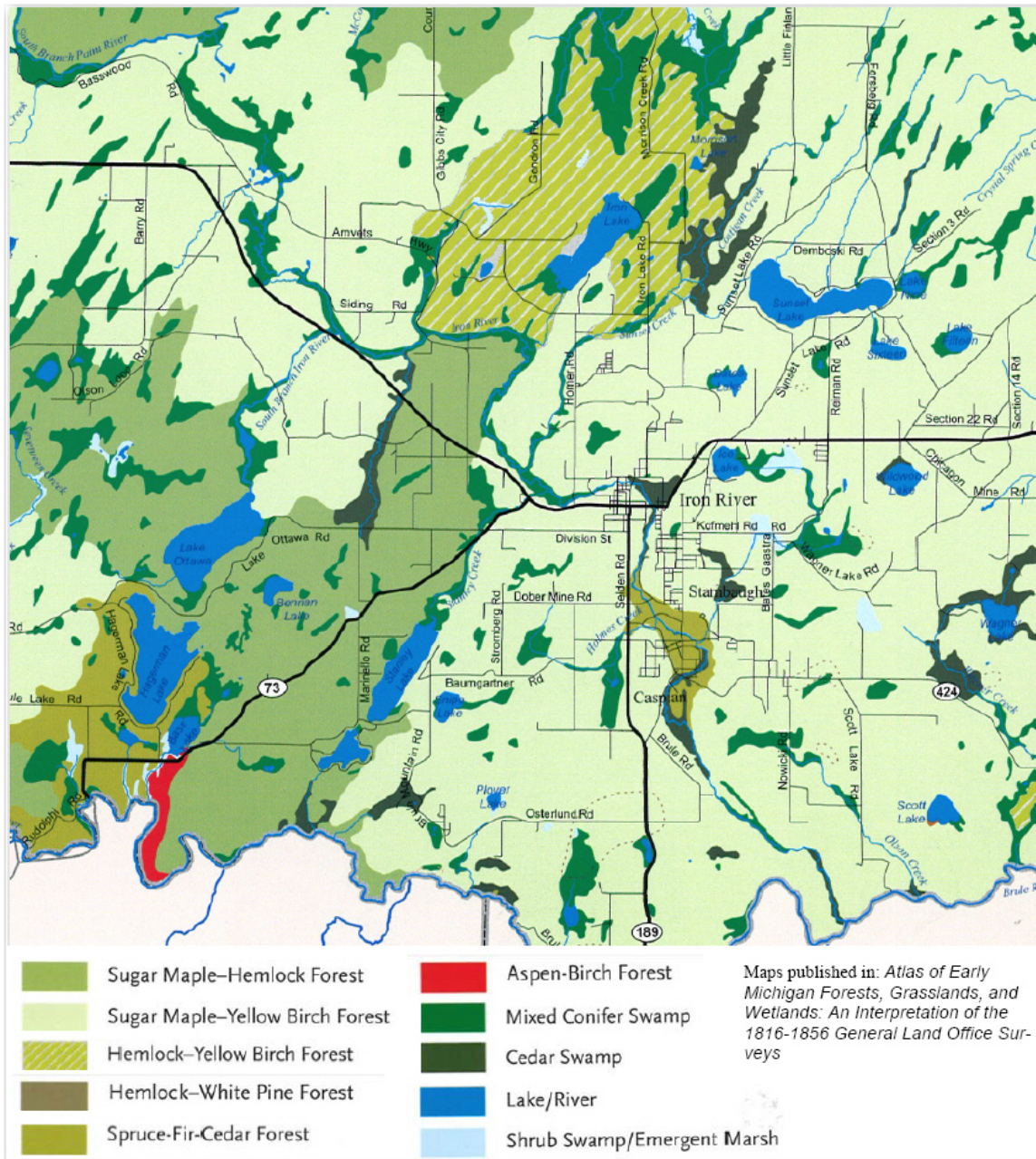
**Figure 2:** Wetland changes between 1800 and 1980 within the greater Iron River watershed. Red indicates wetland loss, the mainstem of the Iron River is highlighted. *Source: Michigan Natural Features Inventory*

### *Historic Landscape*

The Iron County Conservation District produced a comprehensive report on the Iron River watershed, focusing largely on the urban, agricultural, and mining impacts along the river. This report presented a wealth of information and outlined a number of projects, largely focused on mitigating the impact that development (urban, mining etc.) away from the historic forested landscape has had on the river. The focus of this report differs, in that it concentrates largely on the physical, in-channel characteristics and processes that affect and persist within the river today.

Historically the area was a mixture of forests and swamps (Figure 3). Prior to 1870, the area within the Iron River watershed was largely undeveloped. The river, then called the Maple River, was home to a few Ojibway Indians and settlers. Concurrently in the 1870s both mining and logging booms came to the area. Logging in Iron County proceeded in two phases, the first was the complete removal of the white pine forests, which were exhausted by 1898. Following this, the remaining timber industry focused harvest on the lesser softwoods and the extensive hardwood forests in the area. This industry continues today. At about the same time, the mining of iron ore, begun in earnest in the 1880s fell on hard times, and most mines closed in the 1890s. It was during this period that locals turned to agriculture for subsistence and much of the cleared, flat ground, was put into production of food crops which persist today. A second, and larger, mining boom occurred in the early 1900s and lasted until the Great Depression of the 1930s. Considered the most prosperous time in Iron County history, the 1900-1930 boom saw a population explosion and associated economic growth. A second brief resurgence of mining occurred during World War II, but was not sustained and most mining in the county dwindled and ceased by the end of the 1970s.

It is important to understand this early history because the effects on the landscape, particularly within the Iron River are still present today. Early methods of agriculture, timber harvest, and mining were devastating to the natural environment. Concepts of erosion control, stormwater management, water pollution, and sustainability were absent from these industries until the late 1940s and ultimately not until the passage of the Clean Water Act in 1972 were practices enforced that abated the severe impacts to streams and rivers. Thus, the pre-1870 Iron River, was physically and functionally much different than what is observed today. This departure from what might be called the “pristine” Iron River is what river restoration attempts to discern and correct.

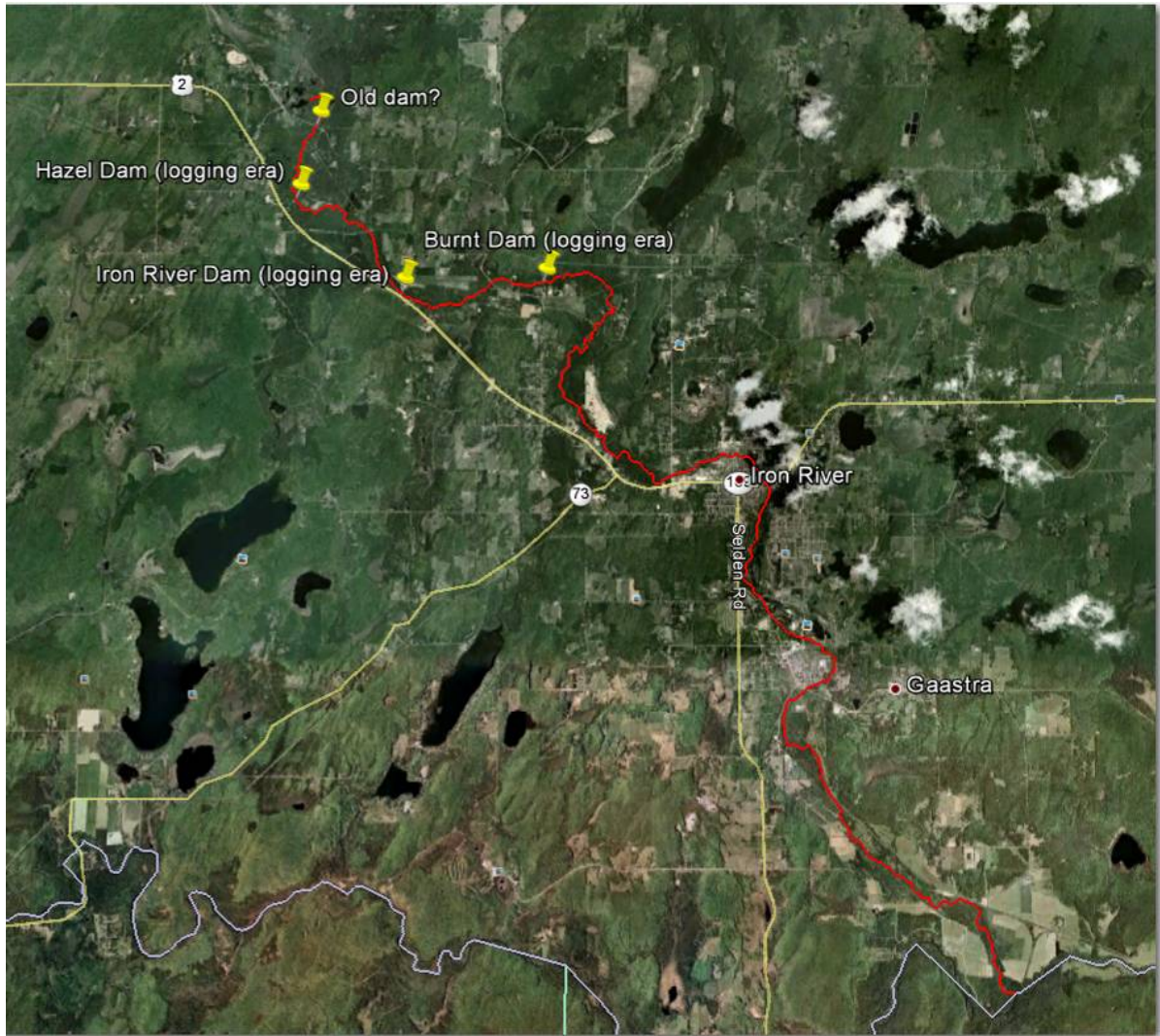


**Figure 3:** Pre-logging era land cover map of the Iron River compiled from the GLO survey

### *Logging*

Logging had a significant impact on the northern forests, as nearly all of the white pine timber was clearcut from the landscape in a short period of time, leaving a landscape void of trees and roots to hold the soil. In Iron County, this process began in the 1880's and by 1898 the dense forests of white pine and other softwoods were exhausted. The initial impact to the rivers of the northern forest came from the use of the waterways to float the buoyant soft wood logs down to mills located on the Menominee River. River banks were frequently used as stockpile areas for logs cut in the

winter, awaiting spring floods to facilitate their transport down the river. In headwater locations where the volume of water was small, timber dams were built to pond a sufficient volume of water that would be released to create a significant flood to carry the logs downstream. Three old timber dam locations have been identified along the Iron River, noted in Figure 4. A fourth dam is suspected to have been located just above AmVets Highway, but there is no documentation in the literature to support this. The Iron River Dam and Hazel Dam appear in the 1898 USGS topographic map (Appendix F)



**Figure 4:** Locations of 3 known and 1 suspected logging era dams along the river

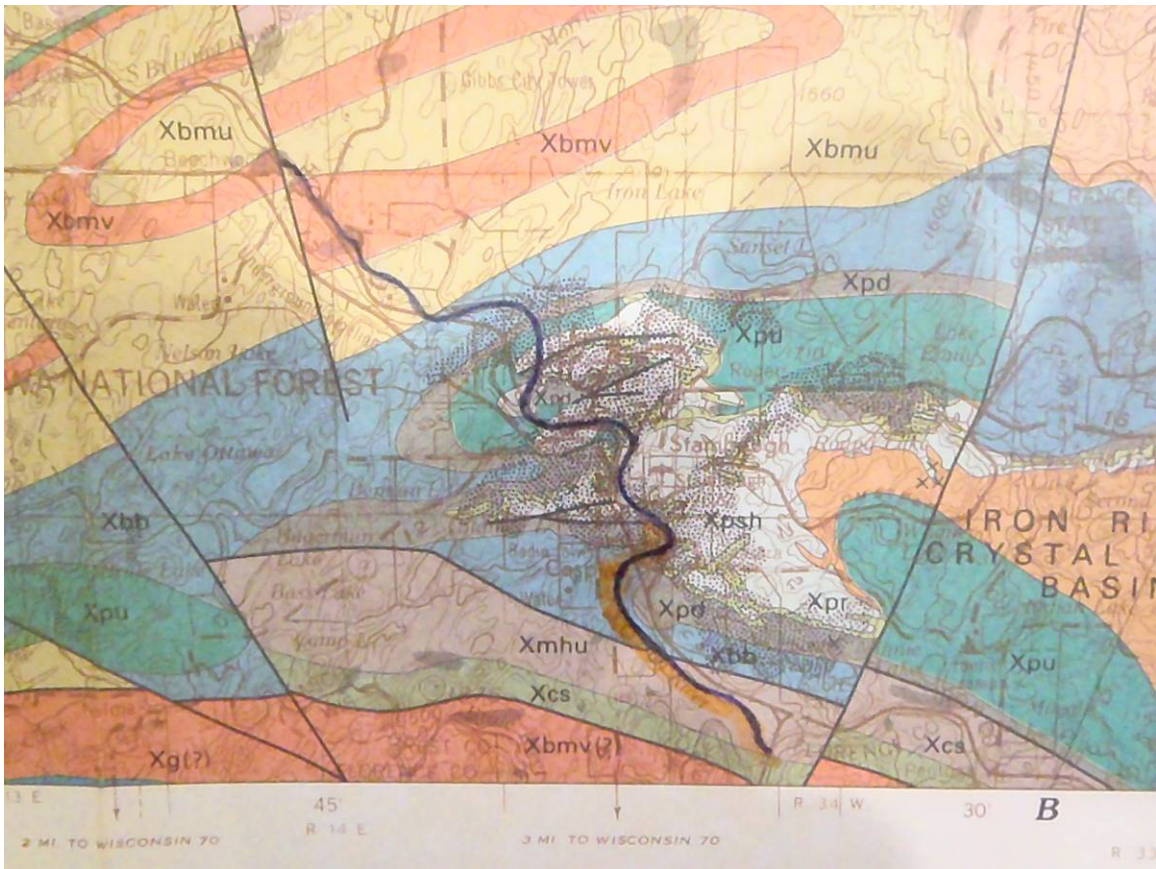
Though others likely existed, the effects of these timber dam locations persist today as the river continues to recover from their effects over 100 years ago. Once the forests were cut in an area and the loggers moved on, the landscape was left devoid of trees, exposing the soil to the erosive elements of rain and wind and causing eroded soil to migrate from uplands down into valley bottoms

and often into rivers. Regrowth of the protective overstory was slow, due in large part to massive wildfires immediately following the clearcut propagated on the slash left from the initial logging. The fires killed young trees that had grown from the seed stock left behind by the mature forests. The removal of this stock and the lack of sources for new seed stock prolonged the recolonization of the landscape and continued to leave soils vulnerable to erosion. As logging transitioned from white pine to the hard woods of the area, rivers were no longer useful routes for transportation and the network of railroads built to move ore from the mines was used to transport these new lumber products. This eliminated the physical impact of log transport on the river, but the exposed soils and logging roads on the uplands likely maintained an influx of sediment to the river until natural re-vegetation was able to protect these bare soils.

The specific impact on the Iron River from logging is difficult to assess. Based on the historic vegetation of the watershed (Figure 3) there were few monocultures of white pine forest within the watershed, though stands of other soft woods were prevalent, the area may have experienced a lighter impact from the initial harvest that focused on white pine. Stands of soft woods are noted within the riparian area of the Iron River in Figure 3. These were likely harvested and floated downstream, requiring the need for the log dams noted in Figure 4. Channel changes for log transport within the riparian area would have a significant impact on the Iron River, and may be the source of the wide, shallow, sand covered portions of the stream noted today, as the protective bank vegetation, likely similar to the tag alders we see today, was removed so logs for the mill would float freely down the river during a flood release. Unvegetated banks would have been subject to active scour from logs and contributed to an influx of sand from the margins of the channel. Although logging made much of the sediment in the uplands available for transport, the pathways (tributaries) for that sediment to enter the Iron River do not appear to exist. In fact, most tributaries to the Iron River mainstem are noted as swamps, which are low gradient streams, making it difficult to transport large volumes of sediment into the Iron River. In addition, sediment (sands and fines) seen in the Iron River today is likely derived from logging roads, railroad construction, and from the scour of the river itself into its vulnerable banks during the log drives of the late 1800s. Contemporary roads that were unpaved in the early part of the last century likely had a significant input of sediment as well. Further discussion of this is found in the channel assessment discussion below.

### *Mining*

Most mining along the Iron River occurred between the town of Iron River on the upstream side and the town of Caspian on the downstream end (Figure 5). The area from Iron River down to the confluence with the Brule would be within a downstream zone of influence from this mining.



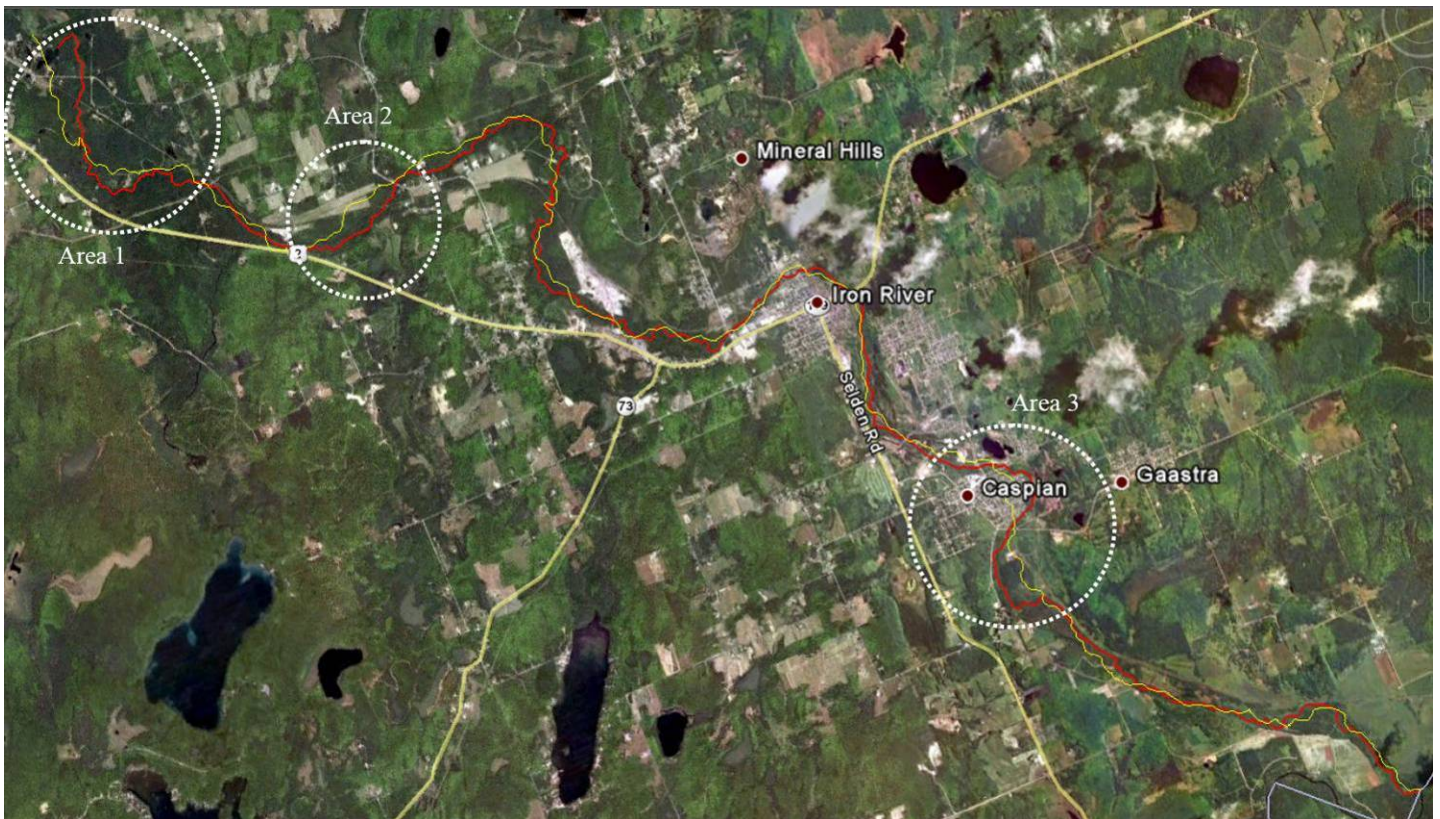
**Figure 5:** Bedrock geology map of the Iron River area. Note all of the black "dots" near the river are bore holes for mine exploration (Map by W.F. Cannon, USGS 1986, in conjunction with Michigan DNR)

Mining impacts to the Iron River include both direct and indirect effects. The influx of sediment from tailings, the water pollution associated with acid mine runoff, and the physical manipulation (channelization and straightening) of the river encompass direct impacts, many of those that persist are mentioned in the 2001 watershed report. Indirect effects are associated with the rapid urbanization of the cities of Iron River, Stambaugh, and Caspian within the Iron River corridor that likely contributed copious amounts of sediment and pollution to the river before more mitigative stormwater measures were installed later in the 20<sup>th</sup> century. Direct effects are well documented along the Iron, particularly with the Dober Mine which caused a massive fish kill along the Iron River and into the Brule River in the early 1970s. Evidence of river straightening is obvious in modern aerial photos. Aerial photos from 1938-39 (Appendix D) are available of the Iron River from Stambaugh up to the headwaters. A review of these indicate major channel manipulations had been accomplished by this time. The historic channel was slightly more sinuous, particularly through Iron River, Stambaugh, and Caspian. Effects of early mining beginning in the 1880s are unknown. Ore was extracted from both surficial deposits and subsurface veins, placed on railcars and shipped to smelting factories located along Lake Michigan. The railroad may have represented some of the most

dramatic impacts to the river, as its pathway closely follows the length of the river, used today as an ORV trail. As mechanization increased in the early 1900s the volume of ore mined and shipped grew exponentially. Mine tailings, the unusable portion of mined material, were usually stored near the mine, and although today tailings are recognized as a significant threat to waterways, they were seldom managed historically and placed adjacent to the Iron River in many instances. Because mining areas through Iron River and down to Caspian occurred on a steeper section of the river, it is reasonable that sediment which entered the river in these areas, has already washed downstream to the Brule.

#### *GLO Maps*

The Government Land Office (GLO) conducted surveys of Iron County during a period from roughly 1846-1851. These surveys provide a unique look at the relatively virgin landscape within Iron County prior to extensive European settlement. The original maps can be found in Appendix E. Notes were recorded on rivers, streams, vegetation and general landscape features. Planform locations of streams are drawn in as approximate, but in many instances are strikingly accurate, and most accurate where they cross section lines.

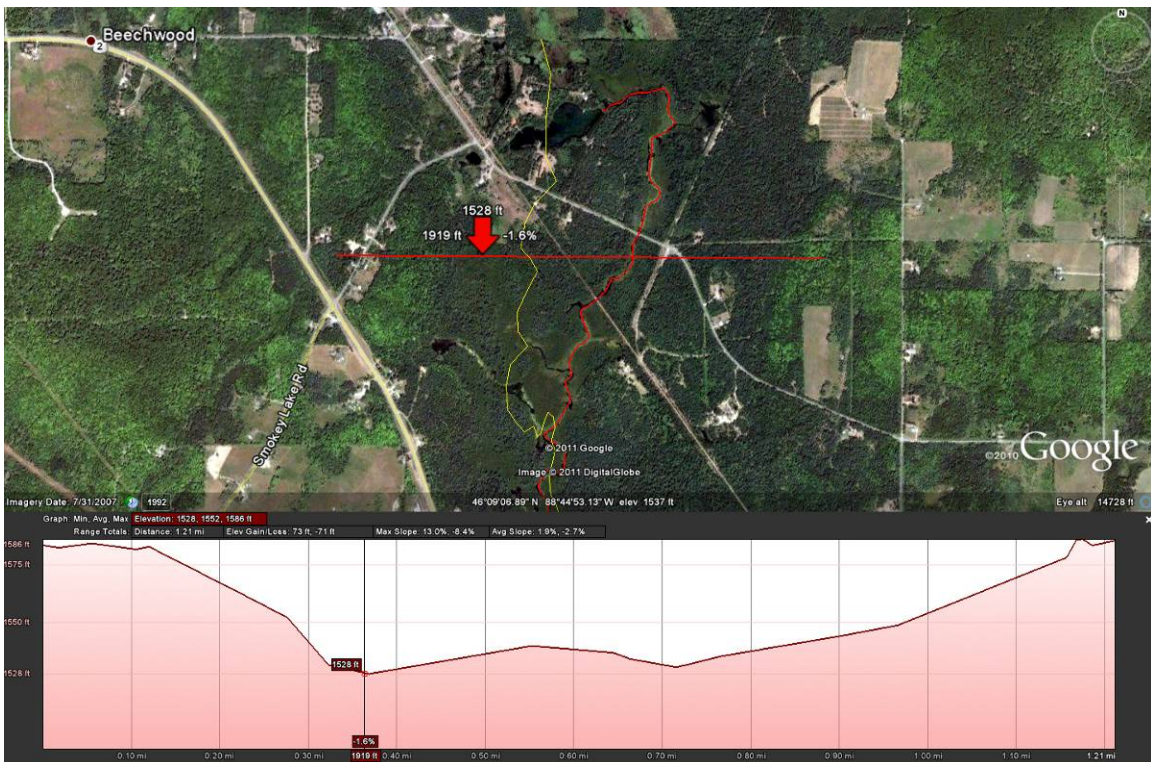


**Figure 6:** Comparison of GLO channel centerline (yellow) and modern aerial centerline (red)

A comparison of the Iron River channel centerline from the GLO maps was compared to the present day centerline, traced on a recent aerial photo. Minor deviations between the lines are likely the result of the semi-approximate methods of the GLO, but major deviations may indicate a human induced change over historic conditions. Three major deviations exist along the length of the Iron River, investigated further below.

*Area 1*

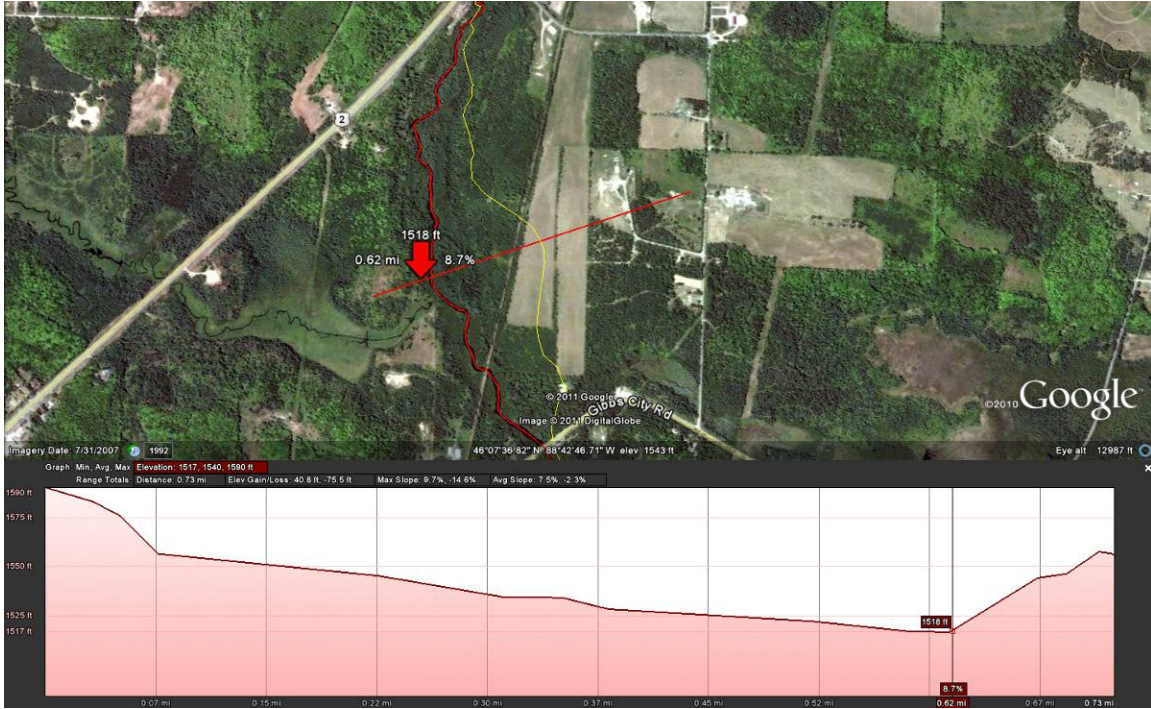
This area lies at the headwaters of the Iron River. The pond in the upper part of the aerial, is a former aquaculture facility and historic channel manipulation in this location is evident. A comparison of the valley cross section using Google earth lends evidence that that historic channel may have been moved to the east as the low point of the valley actually lies at the red arrow, closest to the yellow line which is the channel location noted in the GLO survey. Another possibility is that two channels historically flowed through this area and the hydrology was manipulated to favor one channel over the other. Evidence suggests a dam may have been located just upstream of present day AmVets Highway as well.



**Figure 7:** Red (present) and Yellow (1850s) lines mark the center of the Iron River. The 1850s GLO maps show the river splitting here and evidence from the valley cross section indicates this was likely true.

### Area 2

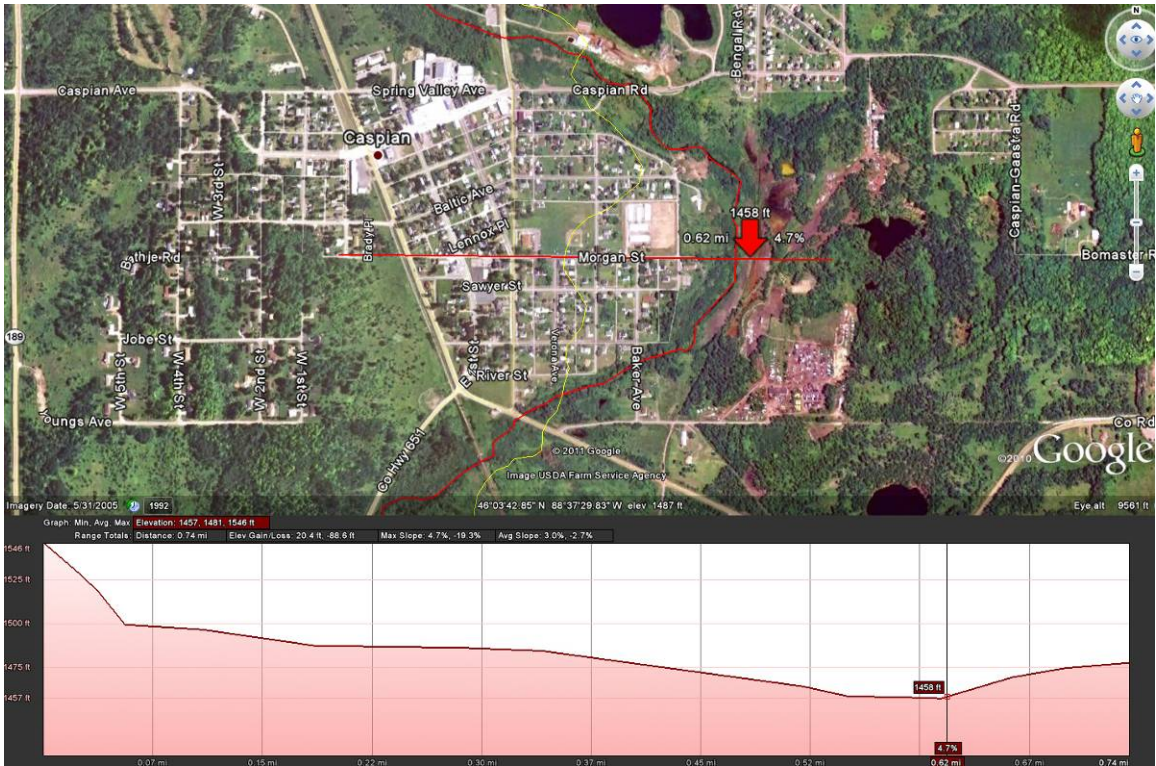
Area 2 is located just upstream of the Gibbs City Rd crossing. The GLO survey indicates the channel may have been shifted to the south in this location. However, the valley cross section from Google Earth indicates that the current channel location is consistent with the low point in the valley, and the discrepancy is likely due to the approximate methods of the GLO survey.



**Figure 8:** Red (present) and Yellow (1850s) lines mark the center of the Iron River. The 1850s GLO maps show the river splitting here and evidence from the valley cross section indicates the low point of the valley is in the location of the present day river and was not in fact along the Yellow alignment depicted in the 1850s maps.

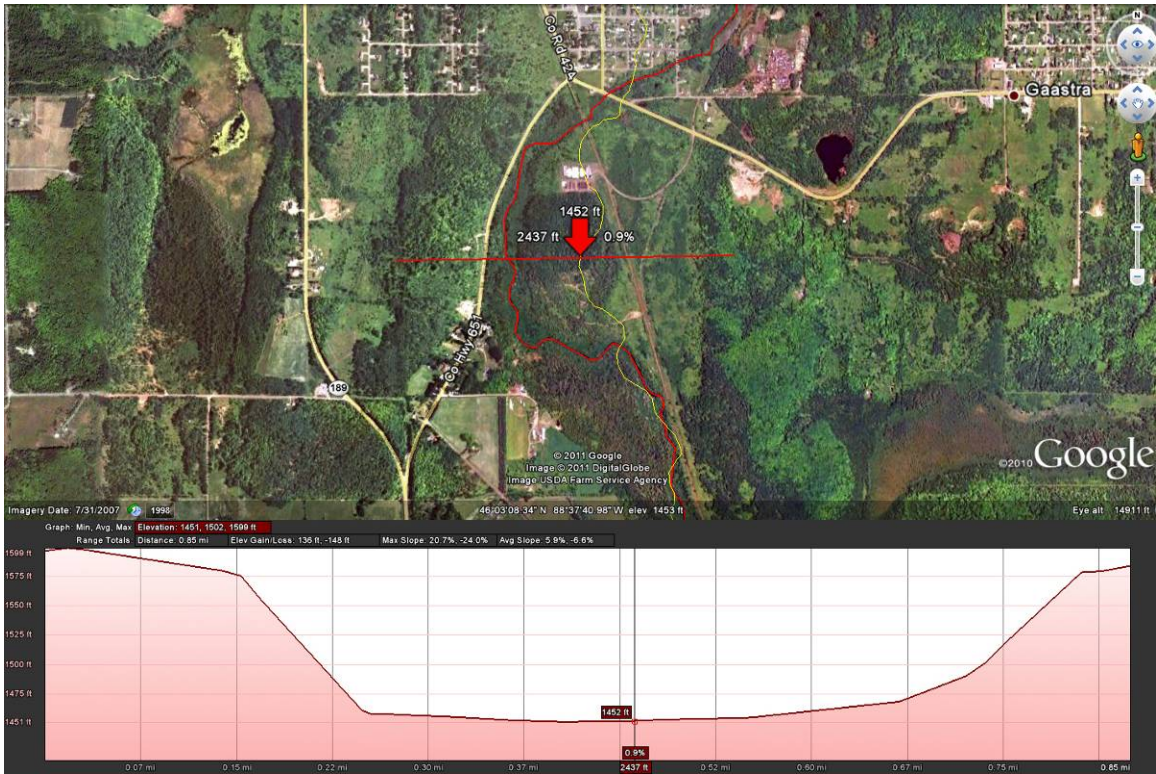
### Area 3

Area 3 encompasses an area through the City of Caspian and just downstream. The river today has two very distinct bends in this location, both of which are shown to be absent on the GLO maps. By looking at the valley cross section in Google Earth at the upstream bend, running through Caspian, it is clear that the location of the river today is in fact at the lowest elevation of the valley, indicating that either major earth moving occurred to increase the elevation in the current location of the town of Caspian, or the approximate methods of the GLO surveyors misrepresented the actual channel location.



**Figure 9:** Red (present) and Yellow (1850s) lines mark the center of the Iron River. The 1850s GLO maps show the river flowed further west than present day. Evidence from the valley cross section indicates the low point of the valley is in the location of the present day river and this old alignment is likely mistaken.

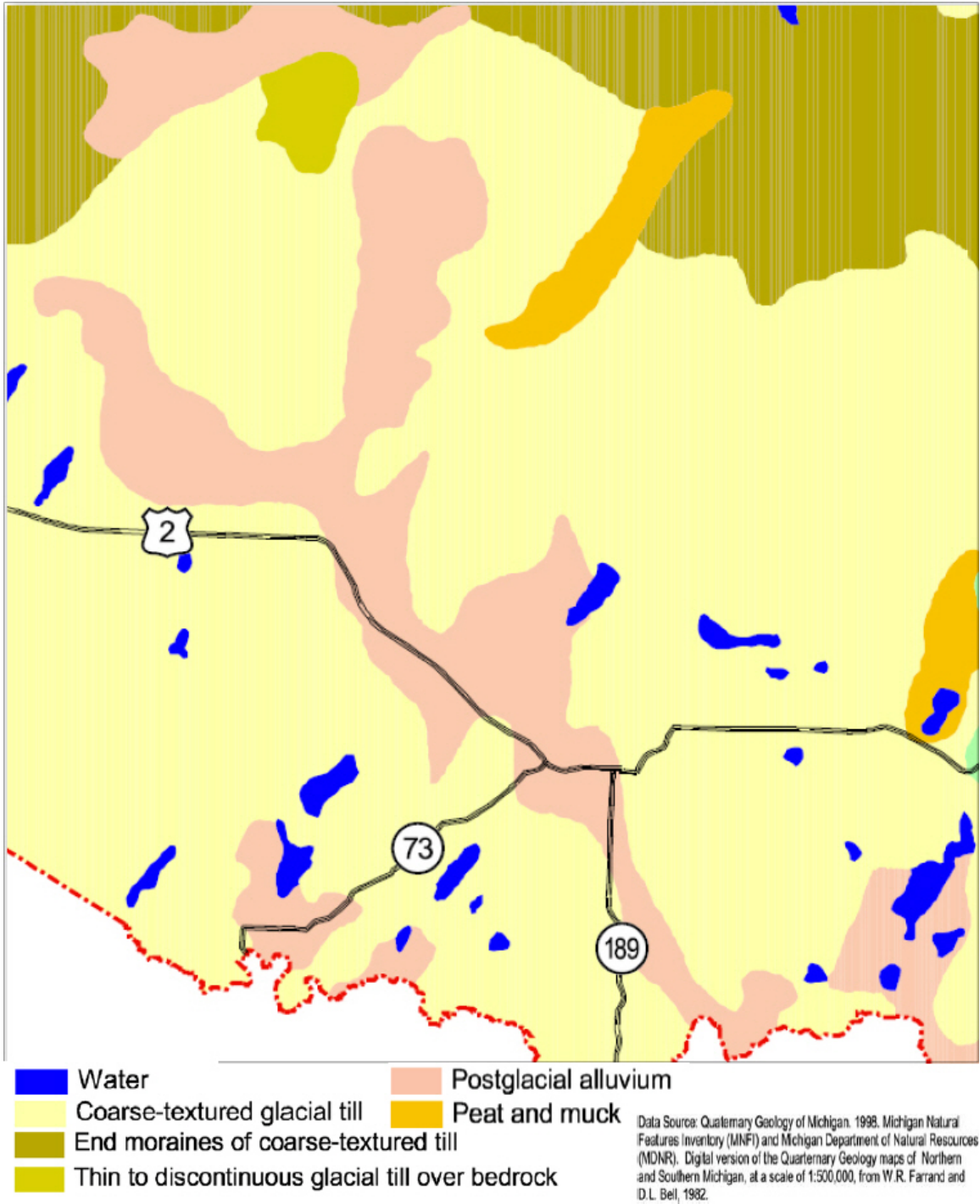
The area downstream of Caspian also illustrates a significant departure from the GLO survey. Looking at the valley section here, the current location of the river is not in fact at the low point of the valley and was likely moved historically. The presence of the old railroad, now the ORV trail, near the GLO location of the channel may be further evidence that the river has been moved.



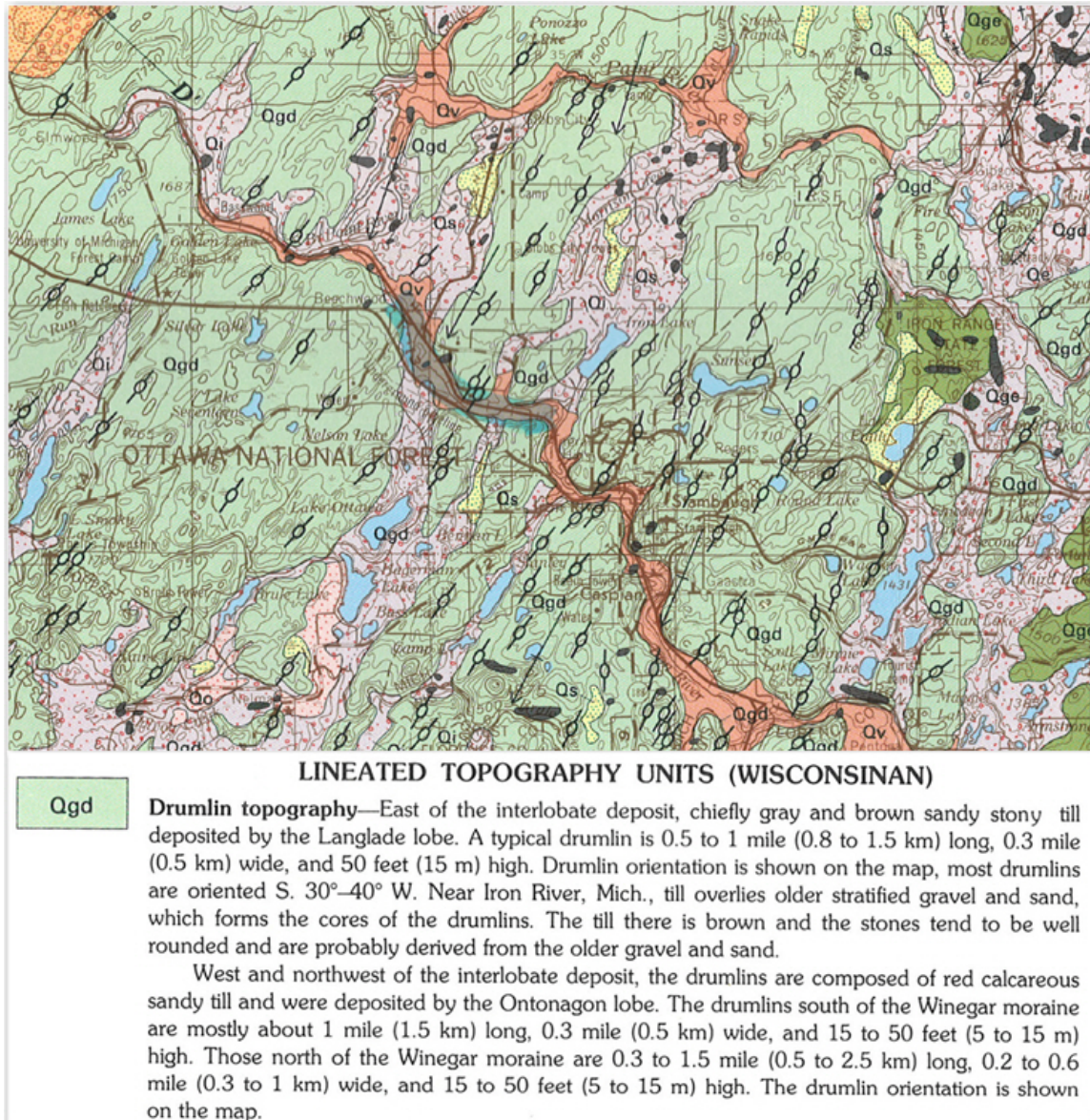
**Figure 10:** Red (present) and Yellow (1850s) lines mark the center of the Iron River. The 1850s GLO maps show the river further east here than present day. Investigating the valley cross section indicates that the river likely was moved to the east as the low point of the valley intersects the 1850 map location.

### *Surface Geology*

The geologic landscape of the Iron River Watershed is wholly influenced by glacial advance and retreat and the deposits left in their wake. End moraines running roughly east to west as well as drumlins oriented northeast to southwest are prominent within the watershed (Figure 12). Bedrock is usually buried deep below outwash and till deposits of coarse sand and gravel left from the glaciers. This lithology is consistent with the high level of surface water infiltration in the watershed and the considerable groundwater interaction within river itself. Figure 11 below is a quaternary geology map of the extended watershed area. The footprint of the Iron River can clearly be seen outlined by the depositional boundaries of various materials. Figure 12 provides a more detailed map of surface geologic features in the watershed.



**Figure 11:** Quaternary geology of the Iron River



**Figure 12:** Surface geology of the Iron River watershed showing drumlin locations, an important feature along the channel.

This lithology is important in understanding the sources of bed materials found in the Iron River. The glacial tributary to the Brule River ran in a strong north to south direction, cutting nearly perpendicular to the moraines and eroding through these features and their extensive component of coarse (sand and gravels to boulders) tills to reconnect with the Brule. As glacial melt ceased and the river occupied a character more similar to what is seen today, the parent material through which it flowed would have likely been composed largely of coarser material (large gravel / boulder bed) resistant to transport by the lower flood magnitudes associated with the onset of vegetation and more stable climate patterns. It is hypothesized by this author that smaller amounts of sand were

likely in the channel as well at this time (pre-logging), but would have been limited and derived largely from relic alluvial deposits laid down during floods of the glacial Iron River. This reasoning is the source for investigating the deposits of sand in the bed of the river upstream of the City of Iron River.

## **FIELD SURVEY AND DISCUSSION**

The length of survey conducted in early July 2010, included over 20 miles of the river from its outlet into the Brule River to its headwaters above the AmVets Highway. Bed elevations were collected using a survey grade GPS unit and the type and extent of bed material was noted. In areas of predominantly sand or fine bed material, a rod was used to estimate the depth of this material in an attempt to determine if historic pools had been filled in with fine sediment. Photographs and field notes were collected throughout the entire 8 day survey of the river. The output of this effort is included as the discussion below and the attached maps in the various appendices. Discussions are referenced to the river station, noted in feet, on the aerials in Appendix A and B, beginning at station 0.0 Ft. where the Iron River enters the Brule River and proceeding up to the beginning of the survey just above AmVets Highway at station 108,100 ft.

### *Bed Slope and Channel Segments*

Three distinct bed slopes (Table 2) are apparent within the river, categorized here as Flat, Mild, and Steep. Each of the three roughly follow a specific bed material type and can be used in a number of ways to discuss the physical aspects of the Iron River documented in the paragraphs below.

**Table 2: Bed slope categories for the Iron River**

Slope Category	Bed Slope Range	Largest Bed Material
FLAT	<.05%	Fines - Sand
MILD	<.05% x <.10%	Gravel - Cobble
STEEP	>.10%	Cobble - Boulder

The Iron River can be broadly broken into 3 segments when characterized by the slope of the channel bed. The “upper” segment is delineated roughly from station 108,100 ft. to station 59,700 ft. This segment is characterized by long lengths (approximately 1 mile) of flat to mild channel slopes interspersed by short sections of steep transition where the bed elevation drops considerably down to the next flat elevation. The flat areas are dominated by fine sand and organic material and the steeper transition areas are composed of coarse material; boulders, cobbles or gravel.

The second, “middle” segment is bounded on the upstream side by station 59,700 ft. and on the downstream side by station 41,000 ft., near Museum Dr. This section is a transition reach where bed slope varies among steep, mild, and flat slopes, without an apparent pattern. Flat sections decrease in frequency and length through this reach, replaced by mild sections. Steep sections maintain their proportion in this reach. This segment encompasses all of the City of Iron River and the associated impacts from infrastructure and adjacent inputs of sediment and stormwater.

**Table 3:** Delineations of slope categories along the surveyed length of the Iron River, MI. These are also noted on the Profile Overview Maps in Appendix A.

US Station	US Elev	DS Station	DS Elev	Bed Slope	Slope Type	Distance (mi)	Segment
108,500	1518.6	102,700	1518.2	0.007%	FLAT	1.1	Upper Segment Length = 9 Miles
102,700	1518.2	100,000	1508.1	0.373%	STEEP	0.5	
100,000	1508.1	96,800	1507.4	0.022%	FLAT	0.6	
96,800	1507.4	91,000	1502.8	0.079%	MILD	1.1	
90,650	1500.7	84,400	1499.9	0.012%	FLAT	1.2	
84,400	1499.9	82,000	1492.2	0.322%	STEEP	0.5	
82,000	1492.2	77,400	1490.1	0.047%	FLAT	0.9	
77,400	1490.1	73,700	1486.9	0.085%	MILD	0.7	
73,700	1486.9	71,600	1483.4	0.166%	STEEP	0.4	
71,600	1483.4	66,400	1482.1	0.025%	FLAT	1.0	
66,400	1482.1	64,300	1478.7	0.162%	STEEP	0.4	
64,300	1478.7	59,700	1477.4	0.028%	FLAT	0.9	Middle Segment Length = 4 miles
59,700	1477.4	57,500	1475.9	0.070%	MILD	0.4	
57,500	1475.9	49,000	1471.0	0.058%	MILD	1.6	
49,000	1471.0	48,500	1465.8	1.034%	STEEP	0.1	
48,500	1465.8	46,200	1466.1	-0.012%	FLAT	0.4	
46,200	1466.1	42,900	1455.5	0.322%	STEEP	0.6	
42,900	1455.5	41,000	1456.1	-0.032%	FLAT	0.4	Lower Segment Length = 8 miles
41,000	1456.1	37,000	1451.9	0.104%	STEEP	0.8	
37,000	1451.9	36,350	1447.9	0.617%	STEEP	0.1	
36,350	1447.9	32,100	1443.5	0.103%	STEEP	0.8	
32,100	1443.5	17,200	1414.0	0.198%	STEEP	2.8	
17,200	1414.0	10,800	1404.2	0.153%	STEEP	1.2	
10,800	1404.2	6,100	1400.4	0.081%	MILD	0.9	
6,100	1400.4	420	1391.0	0.165%	STEEP	1.1	

20.4

The “lower” segment is from station 41,000 to the confluence with the Brule River at station 0.0. This section is a steep section characterized by swift moving water and a gravel/cobble bed interspersed with boulders. This final reach is a transport reach, moving all sands and fines through the reach and eventually to the Brule River. All three of these segments will be discussed in greater detail below.

**Table 4: Bed slope category by segment**

Slope Category	% Slope Category by Segment		
	Upper Segment	Middle Segment	Lower Segment
FLAT	61%	22%	0%
MILD	20%	57%	12%
STEEP	19%	20%	88%
Sum (mi)	9.2	3.5	7.7

**Table 5: Road crossings and other structures are prolific on the river. This table lists the crossings and the potential impact. Each is discussed in detail below and included in the profile maps. A full page view of this table is included in Appendix G.**

STATION	DESCRIPTION	INVERT / CREST ELEV**	TYPE	IMPACT	SEGMENT
108500	AMVETS HWY	NOT TAKEN	CULVERT	BACKWATERING UPSTREAM (UNKNOWN EXTENT)	Upper Segment
107410	ORV TRAIL	N/A	TIMBER BRIDGE	NO IMPACT	
102500	HAZEL DAM	N/A	OLD LOGGING DAM	SIGNIFICANT CHANNEL WIDENING / SOLAR IMPACT	
95700	POWERLINE ROW	N/A	BURIED / OVERHEAD LINE	STREAM NARROWED / IMPOUNDS WATER SLIGHTLY	
91000	WILD RIVER RD / IRON RIVER DAM	1502.5	CULVERT / OLD LOGGING DAM	ELEVATION IS CAUSING DEPOSITION UPSTREAM	
85400	ORV TRAIL	1501.7 (BEAVER DAM)	TIMBER BRIDGE	BEAVER DAM CONTROLS WATER TO WILD RIVER RD	
84100	GIBBS CITY RD	1500.1	CULVERTS	CULVERT ELEVATION IS CAUSING DEPOSITION UPSTREAM	
82820	PRIVATE BRIDGE	N/A	TIMBER BRIDGE	NO IMPACT	
80790	BURNT DAM	1491.5	OLD LOGGING DAM	CHANNEL NARROWING / WIDENING. WATER CONTROL INFLUENCE	
75600	UTILITY ROW	N/A	BURIED / OVERHEAD LINE	NO IMPACT	
70350	ORV TRAIL	N/A	TIMBER BRIDGE	NO IMPACT	Middle Segment
60900	MOTTES RD	N/A	BOTTOMLESS ARCH	NO IMPACT	
53700	16TH AVE	1473.5	BRIDGE	SUPER-ELEVATED, DEPOSITING SEDIMENT UPSTREAM (SED TRAP?)	
52300	MINCKLER AVE / 14TH ST	N/A	BRIDGE	UNKNOWN	
52050	ORV TRAIL	N/A	BRIDGE	NO IMPACT	
50100	7TH AVE	1472.2	BRIDGE	SUPER-ELEVATED, DEPOSITING SEDIMENT UPSTREAM (SED TRAP?)	
49400	DAM / 5TH AVE	1472.5	BRIDGE / DAM	FISH BARRIER / INDUCING MINOR DEPOSITION UPSTREAM	
48700	4TH AVE / SEWER LINE	1471.1	BRIDGE	FISH BARRIER / INDUCING MINOR DEPOSITION UPSTREAM	
46400	ADAMS ST / HWY 2	N/A	BRIDGE	NO IMPACT	
46000	GENESEE ST	N/A	BRIDGE	NO IMPACT	
43700	PEDESTRIAN TRAIL BRIDGE	N/A	BRIDGE	NO IMPACT	Lower Segment
41050	ORV TRAIL	N/A	BRIDGE	BED IS SUPER-ELEVATED INDUCING DEPOSITION UPSTREAM	
38450	ORV TRAIL	N/A	BRIDGE	NO IMPACT	
38200	19TH ST	N/A	BRIDGE	NO IMPACT	
37700	DAM	1457	CONTEMPORARY DAM	FISH PASSAGE / SEDIMENT TRANSPORT BARRIER	
37000	MUSEUM DR	N/A	BRIDGE	NO IMPACT	
34300	BRADY AVE	N/A	BRIDGE	NO IMPACT	
33100	CASPIAN RD	N/A	BRIDGE	NO IMPACT	
29800	BAKER AVE	N/A	BRIDGE	NO IMPACT	
28800	CR 424	N/A	BRIDGE	NO IMPACT	
28300	ORV TRAIL	N/A	BRIDGE	NO IMPACT	

\*\*RELATIVE ELEVATION ON PROJECT DATUM

**Upper Segment – approximately AmVets Hwy. to Mottes Rd.**

Reach Descriptions

The section begins at the culvert under AmVets Highway. This culvert is passable to fish, though is still acting as a dam for sediment transport, causing deposition upstream. Its location in the upper part of the watershed would make it a lower priority for replacement. The stream just above AmVets Highway appears to have been altered in some way as a water control structure and associated berm still exist. The layout and aerial footprint of the vegetation is very similar to a logging-era dam, but no dam has been identified historically in this area. The area was not surveyed in detail, but the control structure at this location is likely maintaining a higher than normal water elevation for some distance upstream. A known logging era dam did exist, the Hazel Dam, at station

102,500. Its effects are still present, manifest as the pool created near the old dam where sediment was removed to build the berm. Depending on the height of the dam and the length of time in place, the impoundment area may have been substantial upstream. If sediment were being mobilized during this period, the impoundment would have trapped a considerable volume of this material.

Habitat from the AmVets Highway to the Powerline ROW at station 95,700 is consistent with headwater sections of streams. The channel width and depth varies considerably as the stream meanders through flat slope areas with characteristics similar to beaver impoundments, and transitions between these areas which are steeper, noted by faster water movement and narrowing of the channel width and depth. As noted on the profile, this pattern of flat and mild slopes with steep transitions between continues throughout the Upper segment, becoming less defined in the downstream direction as flat sections become shorter and less frequent. Flat sections as well as some mild sections of bed slope tend to collect sediment as the transport capacity of the stream is reduced in these sections. This is confirmed by field observations of fines and sand composing the bed material in these locations and can be seen in the Appendix A maps. Sediment will move through these reaches, but only over long periods of time, unless flood hydrology becomes more severe. In these sections the DOR (depth of refusal) was considerable, particularly within the flat sections, indicating an accumulation of fine sediment. In mild slope sections within the reach there is some evidence, though largely qualitative, that sediment has occupied old pools in these locations and may be the result of years of persistent transport out of flat reach areas. Again, assuming a significant amount of sediment influx occurred during the logging era, these impacts may remain today.

The Hazel Dam (station 102,500) an old logging dam, is long gone, but the impacts to the channel in the vicinity of the dam are still present. Upstream of this location there is a long section of flat slope up to AmVets Highway which may have been augmented with fine material accumulated because of the dam. It is difficult to determine if this section of the river was always flat, wide and more wetland than stream or if the condition seen today is due to historic impacts. Recall, as noted earlier in the report that the river flow in this location may have been manipulated between an eastern and western channel pathway.

The channel is extremely straight between the Powerline ROW at station 95,700 and Wild River Rd at station 91,000. The historic GLO maps show the channel in a meandering pattern through this reach and not in the current location. This section was not investigated in detail in the field to determine whether a historic channel existed in the rough locations shown in the in the GLO maps but should be done to continue piecing together the history of what appears to be a highly manipulated reach. If the historic channel is present in its old form, the consequences of re-occupying this channel as a restorative action should be considered.

A second logging dam was located at the current Wild River Rd. crossing. This dam persisted until the early 2000's in some form until it was removed. The culvert under Wild River Rd still maintains the river in a heightened condition and thus induces sediment deposition upstream for some distance. The river above this location is characterized as a mild slope and includes a number of boulders interspersed in the bed, though the bed material is composed of fines and sand. This section upstream of the road crossing (about 2000' to station 93,000) maintains characteristics of dewatered impoundments seen following dam removals. The channel includes a large volume of sediment, noted by the mid channel bars and multiple channel pathways typical of rivers cutting through a large sediment deposit. Above station 93,000, boulders become present in the river, first only the tops buried in the sediment are noted, then gradually increasing in height moving upstream. This may be indicative of sediment accumulation induced by the logging era dam, impacts from log drives in this area, or the numerous beaver dams located in this stretch, both acting to stop sediment transport and cause sand and fine material to deposit in the bed over the boulders.

The reach below Wild River Rd. is a long flat reach. Water elevations are controlled by a beaver dam located at the ORV crossing (station 85,400) and Gibbs City Rd culverts (station 84,100). The top of the beaver dam elevation at the ORV trail is approximately 1501.7'. This single structure is controlling the water surface elevation upstream to a point just below Wild River Rd, a distance of nearly one mile. Historically beaver may have created and maintained dams in this reach, but this structure is being aided by the ORV pilings and is unnatural. The river includes good habitat but harbors a large amount of fines and sands in this reach. Pools and riffles are present in the reach, but highly embedded. Large wood is absent, though an excellent example of the habitat provided by large wood was noted at station 89,900 on the right bank. Boulders, much like those observed above the road crossing, are present, though do not compose a majority of the bed material except in locations noted. It appears this section has some potential if the slope of the channel can be restored with changes at both Wild River Rd, the ORV trail, and Gibbs City Rd., allowing the channel to gain slope and a more natural condition.

The steep section immediately below Gibbs City Rd is one of the best examples of pool riffle habitat on the river. Large boulders occupy the stream, clean gravels compose the bed for about 1000'. At station 83,300, a large amount of wood is present in the stream, along with a large amount of fines. The valley wall comes very close to the river channel here and it appears this may have been a log staging area along the bank. Given the location of the Burnt dam, an old logging dam located a few thousand feet downstream, this may have been a logical use. The habitat here, even with the relic wood, is poor and the river nearly doubles in width. This section is short however, and soon after the river returns to a steep boulder cascade consistent with the character seen upstream. At station 82,200, the channel changes abruptly to a lower gradient stretch. The boulders are gone and a blanket

of sand is present from bank to bank in the channel, approximately 0.2' deep. Gravel underlies this sand. Burnt dam is located at station 80,790. The dam is gone but the embankment material persists and the channel is only 15' wide through the opening. On the downstream side, an over widened, deep pool is in the river filled with fine material, and could act as a good sediment trap. Returning the channel to more natural dimensions at this location would be beneficial, as this location is still acting as a hydraulic control at flood stage. Below the dam the river moves slightly faster with a gravel bed and weak development of pools and riffles. Beavers are in this reach. A large slug of sand was abruptly encountered at station 79,300 without an apparent source. The material was occupied by rooted macrophytes adding to its stability. At station 78,800, the tops of boulders become visible in the channel bed, embedded by fine material and the channel has widened considerably, but only at this location. Again, these boulders may indicate a historic riffle section in the channel. It appears some historic manipulation has occurred in this area, but it is not apparent what that was. Shortly below, the river steepens considerably and flows through a series of well developed pool-riffle-run sequences to station 75,400. Here the river abruptly changes character again. The channel widens considerably and deposited fines and sands cover the bed. The deposited material is vegetated and appears resistant to transport by the river. The valley walls appear to narrow considerably on both sides of the river at station 74,600. Coupled with the obvious widening in the channel apparent in the aerial photos, it appears that there may have been some relic logging activities in this section (74,600 – 74,200) that contribute to river character seen during the survey. A splash dam would have been simple to build at this location, though no record exists of such a structure. From station 74,200 to 72,500 the river includes several large gravel deposits, noted in the survey, as well as large boulders, buried in the bed. This steep section appears to have some geologic context and may be the result of the river cutting through or around a drumlin feature. The planform of the river has a few tight meanders in this location, which are not noted elsewhere on the river. The bed material is composed of gravels and boulders as well as sand and fines in the margins. Where there is sand and fine material it is vegetated.

From station 72,500 down to 68,300 the river varies considerably in width between narrow sections characterized by more coarse material in the bed and wider sections with fines and sand deposition composing the bed. The channel encounters mature riparian forest at several locations along this reach which will eventually provide inputs of large wood. Beavers are noted in the reach, and perhaps historic beaver activity has some connection to the narrow – wide pattern observed. From station 68,300 to 63,800 the river forms one long run section with a largely coarse bed alternating from cobbles and boulders to gravels. Fines are located along the reach, but do not predominate. This section likely has a geologic control as well that maintains the river slope and form in this area.

Station 63,800 to Mottes Rd at station 60,900 includes a similar form seen upstream where the river alternates between narrow and wide sections, though the consistency is weak here. What may be relic riffles appear in the bed at several locations, noted by the buried tops of boulders. The riparian area is mature along this stretch, and there is some input of large wood to the channel, though not in volumes consistent to affect habitat.

#### Management of the Upper Segment

It appears that the Upper segment from roughly the Burnt Dam at station 80,790 to the section above AmVets Highway may have been manipulated heavily during the logging era. Modern aerial photos illustrate the possible outline of old reservoirs at many of the known historic dam locations, evidenced by vegetation patterns. This same pattern exists at other locations in this section as well where dams have not been documented, but perhaps did occur. In these reaches the amount of sand accumulated in the channel is considerable, evidenced by the DOR information in the profile survey. Immediate restorative action on the river should focus primarily on removing the last few man-made controls on the river. Though not surveyed, the removal of the control structure above AmVets Highway would be the most upstream point to begin. A more detailed investigation of this area would inform restoration expectations as well. Working downstream, the replacement of the Wild River road crossing as well as the Gibbs City Rd crossing with a bridge or bottomless arch culvert that is a minimum of 1.2x bankfull channel width would be next. The historic dam locations should be returned to more natural channel dimensions, eliminating any backwater or pooling affect. Dam locations are also important to the history of the river and may present a unique interpretative opportunity to document the historic use and location of these structures. Local landowner projects can also build momentum for the overall effort, but must be couched within a larger effort and plan to ensure realistic expectations are promoted.

The beaver dam at the ORV crossing upstream of Gibbs City Rd should be removed. Note, the removal of all beaver dams is not advocated, particularly in the headwaters of the Upper segment, as beavers are a natural part of this system. Beaver management should focus instead on control of the number of dams within some pre-established capacity, consistent with historic conditions. These projects should be done with an understanding that they will likely mobilize sand and fine material from upstream as the elevation controls are removed, and should be built in conjunction with sediment control measures to reduce or eliminate the downstream transport of these materials, particularly at the Gibbs City Rd crossing. Sediment traps, temporary weirs and other means are effective at this. These controls should be left in place and maintained (excavated) until upstream evacuation of sediment is complete and may require many years to accomplish.

After the road crossings are addressed and several years or floods have been allowed for channel adjustment, the lack of large wood habitat should be addressed. Before any large wood work is done on the river, a plan should be in place for the management of tree stock in existing riparian areas (both existing and future plantings) as well as the management of trees and log jams placed or recruited into the river. Goals for log densities (logs/500' or jams/500') should be established within sections of the river. Historic accounts do not provide specific guidance for this, so a variety of densities should be employed within similar reaches, then monitored to determine adjustment. As a beginning point, densities should be lowest in steep sections where the river bed is coarse and scour will be limited and highest in mild sections, particularly where it appears sand and fines have gathered in an unnatural fashion. In areas where fines and sand have accumulated and appear to have done so over the native gravel or boulder material, the use of wood to narrow the channel and induce scour and transport of these materials is an appropriate measure to take. This type of reach level mobility of material will require a large input of wood to be effective. Given limited financial resources, it is better to add logs within a small reach of river at the densities desired, rather than place logs at half or less of the density desired over a larger area. Working within a small area also allows the technique to be observed and adjusted before being applied to longer reaches of the river.

Given that the river is a highly paddled river, recreational access should be maintained. Published guidelines for the width of canoe passage around trees and jams will ensure that both habitat and paddling access is preserved. Large wood creates scour in areas of flowing water, mobilizing fine sediment and uncovering coarse resistance material in the bed. Trees should be introduced into areas of steep or mild slopes, and accomplished working in the downstream direction. Currently flat slope sections controlled by the road crossings mentioned above, may present great opportunities once the downstream control is eliminated and these transition into more "mild" slope sections. Flat slope sections such as those above and below AmVets Highway will not adjust and historically have probably always been wetland sections, an important habitat area themselves. Trees can also be important in these sections but habitat value will be targeted at amphibians and piscivorous bird perches, rather than scour holes for fish. Still the latter are important areas to be included in the overall plan. Trees placed in the channel should mimic natural features and should be configured as single logs, multiple logs and debris jams using a variety of tree sizes and lengths. Because the Iron is a baseflow river, mobilization of these logs can easily be reduced by those familiar with the use of this habitat technique.

More localized projects such as landowner mis-management of the riparian zone should be considered as well. These types of impacts are localized without broad reaching effects on the river and although important in the overall restoration, should be considered projects to be accomplished when resources allow.

As mentioned, the river appears to have natural processes in place for recovery once the hydraulic controls are removed, but the expected form of recovery and the potential for the river to reach this on its own should be understood. If the channel is in fact highly manipulated from relic logging era structures, more aggressive techniques of sediment removal and restoration may need to be employed ahead of the use of large wood and other measures. This effort could require significant resources if deemed appropriate and should be considered carefully. Typical approaches have been the use of small mobile dredges that can remove material and deposit it in overbank areas. A photo of such a device is below.



**Figure 13:** A portable hydraulic dredge may be necessary to remove accumulated sand from the channel.

*Photos of the Upper Segment*



**Figure 14:** Relic water control structure upstream of AmVets Highway. The survey began below this point so elevation information was not gathered.



**Figure 15:** Station 108,000. Typical wide section of river characteristic of the flat bed slope sections of the stream.



**Figure 16:** Station 102,000. Example of higher gradient transition section between flat sections in the upper segment. Note the mature trees close to the stream and the narrow channel as the stream enters this section



**Figure 17:** Example of steep section of stream at station 101,800. Second, perhaps third growth forest abuts the channel edge. Eventually these trees will die and fall into the river inducing scour pools and fish habitat. Note vegetation growing in the channel, indicating high stability.



**Figure 18:** Relic bridge crossing for the Christiansen Trail, located at station 96,500. This historic nature of this feature is unknown.



**Figure 19:** Boulders in the river bed at station 93,700 indicate some geologic control. The river does not have the power to move these boulders. They are exposed (not covered by fines) and thus the bed elevation at this location is likely an original bed elevation.



**Figure 20:** Upstream of Wild River Rd, near station 92,000, the river appears to be recovering from an impounded condition with a large volume of sediment in the river and extended valley bottom.



**Figure 21:** Excellent example of large wood habitat in the river (station 89,900), note the submerged log, deep scour pool, and undercut bank. This habitat is lacking throughout the river.



**Figure 22:** Groundwater upwelling in the river bed at station 89,300, noted by the circles of clean sand. These areas are important to Brook Trout spawning, and may be mapped using a thermometer probed in the bed along the entire profile of the Upper Segment.



**Figure 23:** Beaver dam at ORV trail above Gibbs City Rd. This dam is controlling the water elevation up to Wild River Rd. and should be removed and maintained in a removed state.



**Figure 24:** Three culverts at Gibbs City Rd. Note the slack water and presence of aquatic vegetation occupying sediment deposits in the channel.



**Figure 25:** Section immediately below Gibbs City Rd, one of the best examples of steep gradient, riffle pool sequences on the river. Preservation of this reach should be a priority.



**Figure 26:** Gravel underlies sand at station 82,100 at the beginning of the transition from the steep reach above to a mild slope. Perhaps a relic deposit from Burnt Dam, a logging era structure on the river, located at station 80,790 downstream.



**Figure 27:** Sediment slug encountered on the river at station 79,300. Note the rooted macrophytes that add to the stability of the material and make it difficult for the river to transport. A contemporary source for this material was not apparent and it may be logging-era derived sediment.



**Figure 28:** Old birch tree located on the bank of the river near station 77,200. This is an obvious sign of stability at this location of the river.



**Figure 29:** Mid-channel bar, formed at station 74,900. The bed is composed of fine well vegetated sand. The channel widens considerably here and may be a natural feature or perhaps the result of some historic manipulation.



**Figure 30:** Example of long run section around station 66,400. Note the dead trees along the riparian area that will provide wood habitat. The bed in this section is largely composed of coarse materials, though fines are deposited along the margins. The addition of large wood habitat in this reach would increase habitat complexity considerably.



**Figure 31:** Station 66,600, here the wide section includes deposited sand which has been vegetated. In the background, note the river narrowing its width. Good habitat in this reach, though the abundance of sand and fine material may or may not be a natural feature here.



**Figure 32:** The Mottes Rd culvert, a great example of a bottomless road crossing that does not act as a bed control on the stream slope and passes aquatic species easily. This crossing does cause a flow constriction and ideally should have been sized for slightly wider than a bankfull width, but the impact is minor.

***Middle Segment – Mottes Rd. to Museum Drive\*\****

*\*\*This segment description extends slightly further downstream than stated in Table 3. Due to the extensive channel adjustments upstream of Museum Drive, it seemed appropriate to include these in the same description, even though the geomorphic slope break is likely upstream of here.*

Reach Descriptions

The Middle segment extends from Mottes Rd to a point just below Iron River. The shortest segment at only 4 miles, it is a transition reach between the steeper Lower segment and the varied slopes of the Upper segment discussed above. This reach is the most heavily impacted by human development in the form of urbanization and mining. A number of contemporary impacts related to these two developments have been identified and addressed in the *Iron River Watershed Comprehensive Management Plan*, completed in 2001. This report will focus largely on the in-channel habitat and geomorphic features of this segment.

Just below Mottes Rd, the channel is composed of sand, gravel, and even cobbles in spots and includes very good habitat, specifically the segment between stations 59,800 and 54,500. Some

large wood is present, but this reach in particular could be augmented in areas to increase habitat diversity. At station 54,500 a tributary enters from the west that is contributing a significant amount of sand and gravel to the channel. The source of this material was not investigated. From this point to the bridge at 16<sup>th</sup> street, the channel widens and sediment deposition is present in the bed. The survey data indicates the channel bed under 16<sup>th</sup> St. is significantly higher and acting as a hydraulic control upstream, collecting material coming downstream from the tributary at station 54,500. This may be a useful tool to trap material coming in from upstream if cleaned out regularly. Once sediment input from upstream returns to normal levels, this elevation control should be reduced to restore sediment continuity within the reach.

Below 16<sup>th</sup> St the channel narrows and deepens and is full of fine material, possibly deposited due to a similar elevation control that appears to be located below 14<sup>th</sup> St bridge and upstream of the ORV trail bridge. This control is at an elevation of 1472' and the DOR data upstream in the profile indicates it is trapping sediment, again perhaps a good thing, if this was the intended purpose of this feature. It may simply be the tailout riffle (deposition) from a former bridge at 14<sup>th</sup>St, as the current bridge does not appear to back water and cause scour. The deposition of fine material continues below the ORV trail and the channel is lacking complexity and habitat in this reach. The loss of the native riparian zone is first noted in this reach about station 50,300, as backyards begin to occupy the river bank. The power of the river, being a baseflow channel, is muted and the lack of root structure from vegetation in the banks does not appear to be causing significant erosion.

Three more significant hydraulic controls are present between 7<sup>th</sup> Ave. and just below 4<sup>th</sup> Ave. Each are apparent in the profile survey. The first is a riffle structure located at 7<sup>th</sup> Ave. The second is a low head dam located at 5<sup>th</sup> Ave. The last is an exposed sewer crossing located at the 4<sup>th</sup> Ave crossing. The last two are both fish barriers. All three of these features should be lowered to increase the energy grade of the river in this reach. The dam should be removed and replaced with a riffle as it is a barrier to fish passage. The sewer line crossing should be reset or the riffle made more substantial to better facilitate fish passage. It appears from the profile that the reach from 7<sup>th</sup> Ave, and perhaps even upstream, down to about station 48,500 was a higher gradient section of the river and these controls have been built at some point in time to protect infrastructure or perhaps calm the flow of the river. The habitat provided by some of the riffles is good, but their impact on overall stream function is not favorable. Still, given the urban nature of this section, these types of measures may be irreplaceable if they in fact provide some protection for the community. They should be redesigned however, to better serve both purposes.

At station 47,400, a significant cold water tributary enters the river. The GLO survey indicates this area to the east was an extensive cedar swamp, and likely represents a significant

groundwater inflow location from the adjacent valley wall. These types of inputs are extremely important to the maintaining the health of the cold water river. Habitat through this area down to about station 42,000 is very good for an urban river system. There are a number of stormwater improvements that can and have been made in this reach, many detailed in the 2001 watershed management plan, but overall the river appears to be healthy with an intact riparian area.

Station 42,000 marks the beginning of historic mining impacts that, although addressed in part, continue to impact the river channel downstream to station 36,000. The riparian area in this reach is largely gone, replaced by a monoculture of alder. The ORV trail is paved in mine tailings or a similar product and contributes a heavy red suspended sediment to the river when it rains. Tailings piles are still present within the river valley and the banks of the river are composed of mine waste in many locations. The channel has been straightened significantly through most of the reach as well. Some remediation work has been done and the dam at station 37,700 is part of a plan to maintain a stable water surface elevation upstream to provide mitigation for mine waste. The dam has a fish ladder included on the right side of the river but it appears to be inoperable and its efficacy at passing fish is suspect. The dam acts as both a fish and sediment barrier and should be removed and replaced with a series of riffles that maintain water elevations required by the upstream project. Overall this stretch of just over a mile should be completely restored, including remeandering, the planting and preservation of a native riparian area, BMPs constructed to eliminate runoff from the ORV trail etc. This is a significant undertaking within the context of what appear to be contaminated soils throughout the project area.

#### *Management of the Middle Segment*

The Middle segment is surprisingly intact and in reasonable condition. Major issues are the numerous grade controls through the upper end of the town Iron River which appear to be holding back the transport of fine material and sand, though taken as a whole, this impact is relatively minor. A redesign of what appears to be a steep section between 16<sup>th</sup> ave (station 53,700) to around 4<sup>th</sup> Ave (station 48,700) could improve habitat in this reach with more numerous riffles and pools that would not fill in with sediment. This effort should be planned to coincide with redevelopment of the infrastructure at 6<sup>th</sup> Ave and 4<sup>th</sup> Ave. The second area of major concern is the mining impacted area. Given its locale through a well-used portion of town there is significant benefit to be had here in terms of community investment in the river. The downside is that the area is filled with contaminated materials and would require significant planning and cost to affect restoration of the river corridor. Improvements can be made with better management and planting of the riparian area and addressing the runoff from the tailings and ORV trail. Instream work associated with re-meandering, habitat construction (pools, riffle, large wood) can be done, but this type of effort requires disturbing

assumed contaminated soils and will be expensive. The restoration of this reach should be included in long term plans and might be accomplished in segments to manage costs. A redesign of the water control dam at station 37,700 into a series of passable riffles for fish and sediment can likely be done with minimal sediment disturbance.

The segment from Mottes Rd down to 16<sup>th</sup> Ave includes excellent habitat and could likely be improved further with the addition of large wood habitat in areas where scour could be affected. The density of this would be critical to affect improvement, as discussed previously in the Upper segment. A plan for this type of approach should be drawn up to include both recreational and habitat needs for in-channel wood as well as management of the stock of existing riparian trees for future input. Where fine material is expected to be mobilized, maintenance of a sediment trap, perhaps at 16<sup>th</sup> Ave, would mitigate the movement of this material downstream. Wood could be added through some segments in town, but given the large number of road crossings and the presence of homes etc. within the floodplain, it may prove to be less appropriate, and more rigid structures such as boulder clusters may better induce scour and bed heterogeneity. Habitat through town is in reasonable condition, so this type of approach may not result in significant benefits.

*Photos of the Middle Segment*



**Figure 33:** Typical view of some excellent habitat located below Mottes Rd.



**Figure 34:** Photo of tributary contributing sand and gravel to the Iron River at station 54,400.



**Figure 35:** Riffle controlling elevation at 16th St bridge



**Figure 36:** Station 50,300, the riparian zone begins to be influenced by residences within Iron River



**Figure 37:** The dam at 5th Ave. A fish passage barrier it should be removed and if necessary replaced with a riffle.



**Figure 38:** Sewer or stormwater pipe crossing at 4th Ave. This crossing is a fish barrier and should be retrofitted or removed to accommodate fish.



**Figure 39:** Steep section below 4th Ave. This is one of the steepest sections on the river at 1%, but only lasts through the park before the slope becomes mild.



**Figure 40:** Typical view of habitat around station 47,000. This reach through town has wood in the channel, a coarse bed and good habitat for an urban channel



**Figure 41:** Minor stormwater issues persist in the urban section of the river, but many appear to have been remediated as well



**Figure 42:** Habitat through town is consistently good. Here low banks provide easy access to the floodplain and the river moves across coarse sediments with relatively little embedded fines



**Figure 43:** A beaver dam at station 42,500



**Figure 44:** Several low bridges, relic RR crossings now used for the ORV trail are within the reach. These don't appear to have an impact at normal flows, but likely back up water during flood flows. The condition of these bridges indicates they are near the end of their design life. Replacement structures should be built within a restoration context of the reach and ensure little impact on river transport and fish passage.



**Figure 45:** Runoff from the ORV trail contributes suspended sediment to the adjacent river



**Figure 46:** Mine tailings are still prominent features within the river corridor



**Figure 47:** The dam at station 37,700 is blocking fish passage but is an integral part of a wetland remediation project upstream. The dam should be removed and could be replaced with a series of riffles to accomplish the same purpose and improve habitat.



**Figure 48:** Straightened condition of the river through the mining impact area.

***Lower Segment - Approximately Museum Dr. to the mouth at the Brule River***

*Reach Descriptions*

The Lower segment is characterized best as a transport reach. The bed material throughout most of the segment is coarse, with gravel, cobble, and boulders. The river is steep through this section and sand and fine material deposition is nearly absent. In several areas the river intercepts the valley wall, where cut banks are contributing some sediment (a normal river process), but otherwise, sources of fines from upstream are stopped by the dam at station 37,700 (Middle segment) and are likely only coming from stormwater inputs and winter road applications both of which have limited access to the river.

Long riffles or boulder cascades are present in the reach. In many areas mature trees abut the river and in others tag alders compose the majority of the riparian vegetation. Stream widths varies through the reach, between thirty and fifty feet, likely a result of a long history of beaver activity and dams in the river. A debris dam is present at station 13,000 that appears to be natural.

In short, this stretch of river likely had some historic impacts from logging and the construction of the railroad through the valley but because of the power of the river and the steep slopes, signs of these impacts are largely erased. There does appear to be a lack of wood in the river, but given the extensive intact riparian area, the management plan here should focus on recruitment of the natural stock that is returning and adding wood, if desired, should be limited to areas with good access and existing pools where wood will provide overhead cover.

*Management*

There is no management need for this stretch of river. A plan for management and recruitment of wood should be established, but as noted above, should focus on the long term preservation of the riparian area.

*Photos of the Lower Segment*



**Figure 49:** Brady Ave crossing, showing some armoring of the stream bank with sheet pile.



**Figure 50:** Long riffle at station 32,100. The riffle extends to station 31,450



**Figure 51:** Wide section at station 27,700, still good habitat and depth



**Figure 52:** large beaver dam at station 24,500, impounding water behind. Fish passage at these structures is unknown, but beavers are a natural part of the system and these are temporary obstructions.

\*\*Photos of the Lower Segment below station 22,000 are sparse due to the submergence of the digital camera about 4 miles upstream of the mouth.

## **SUMMARY**

The Middle segment, although the most heavily impacted from urbanization and mining, also includes areas of intact channel with good habitat. The effort to restore this section of the river is substantial and would require significant resources and time to accomplish, but nevertheless can be accomplished with planning and careful phasing of the effort. This section has the greatest potential to grow ownership in the river among the communities through which it flows.

The river in its present form in the Upper and Lower Segments flows through an intact watershed that is recovering, in the case of the Upper, from assumed historic manipulations due to logging. The natural processes that move both water and sediment through this landscape are in place and functioning (though function is limited by hydraulic controls as noted), although the rate at which change is affected from these processes, in terms of a return to a pre-logging channel condition, are slow and beyond the lifetime of most people working in the watershed. The baseflow characteristics of the channel which even at flood flows does not exhibit strong forces moving large volumes of material, maintaining a slow but steady rate of change. This fact dictates a long term approach for implementing, observing results of any restorative actions, and adjusting the approach. Many tribes in the Upper Midwest promote a “seventh generation” approach to the management of their resources, assessing the consequences of their efforts today to the seventh generation to come. A similar approach is appropriate here, as the river changes over the coming decades, plans should be in place to avoid retarding the natural progression toward restoration of function and process.

Impacts to the channel have been noted above, as well as priorities among these to focus efforts in each segment. A downstream approach has been advocated in all situations that would mobilize sediment. Above all, a restoration plan with elements addressing present and future road crossings, in-channel sediment management, the management of large wood, and finally the implementation, monitoring, and adjustment of restoration actions, is imperative in ensuring the long term success of the restoration and in some cases, preservation of the Iron River.

The impetus of this effort was to define whether sediment in the Iron River, particularly in the Upper Segment was natural or derived from some historic impact, assumed to be logging. The investigation has yielded valuable information with respect to the existing condition of the Iron River and associated physical controls, or lack of controls. The Upper Segment of the river harbors a large volume of fine sediment overlying coarse material, even boulders in many areas. The Upper segment has undergone significant manipulation both historically from logging-era dams and due to existing crossings acting as hydraulic controls. Although definitive evidence to determine that this sediment

load is in fact unnatural was not gathered, the observations indicate that this segment in particular has deviated from its natural condition.

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## **APPENDICES**

- A – Profile Overview Maps
- B – Detailed Profile Maps
- C – USGS Water Year 2009 Report for Caspian Gage
- D - 1939 Aerial maps
- E - Government Land Office ca. 1850 Maps
- F - 1898 USGS Topographic Map
- G - Table of Hydraulic Structures and Controls