



## **Zone 2 Overview**

Zone 2 includes the counties of:

- Alger, Mich.
- Baraga, Mich.
- Chippewa, Mich.
- Delta, Mich.
- Dickinson, Mich.
- Florence, Wis.
- Forest, Wis. (northern portion)
- Gogebic, Mich. (eastern portion)
- Houghton, Mich.
- Iron, Mich.
- Keweenaw, Mich.
- Luce, Mich.
- Mackinac, Mich.
- Marinette, Wis. (northern portion)
- Marquette, Mich.
- Menominee, Mich. (northern portion)
- Ontonagon, Mich. (eastern portion)
- Schoolcraft, Mich.
- Vilas, Wis. (northern portion)

The physical boundaries of Zone 2 and transmission facilities located in Zone 2 are shown in Figure ZS-23.

Land use in Zone 2 is largely rural and heavily forested.

Zone 2 typically experiences peak electric demands during the winter months. Ore mining and paper mills are the largest electricity users in the zone.

### **Demographics**

#### *Historical and Projected Population*

The population of the counties in Zone 2 experienced slightly negative growth from 2001 to 2010. The highest growth rate of 0.2% per year and the largest increase in population of 1,100 occurred in Marquette County.

Population in Zone 2 is projected to grow on an annual basis of 0.2% between 2011 and 2020. For the same period, Vilas County is projected to realize the largest increase in population of about 1,300, as well as the highest growth rate (0.6%).



*Historical and Projected Employment*

During the same period, the annual employment also had a slightly negative growth rate was -0.4%. The highest growth rate and the highest increase in employment were in Marquette County (Michigan).

Employment in Zone 2 is projected to grow at 0.8% annually between 2011 and 2020. During this time period, Marquette County (Michigan) is projected to realize the largest increase in employment of over 3,800, while Luce County (Michigan) is projected to have the highest growth rate of 1.8%.

<b>Employment</b>			
Annual Growth Rate			
2001-2010		2011-2020	
Zone 2	-0.4	Zone 2	0.8
Marquette, MI	0.6	Luce, MI	1.8
Total Increase			
2001-2010		2011-2020	
Zone 2	-5,511	Zone 2	12,724
Marquette, MI	1,899	Marquette, MI	3,812

<b>Population</b>			
Annual Growth Rate			
2001-2010		2011-2020	
Zone 2	-0.3	Zone 2	0.2
Marquette, MI	0.2	Vilas, WI	0.6
Total Increase			
2001-2010		2011-2020	
Zone 2	-7,722	Zone 2	5,903
Marquette, MI	1,152	Vilas, WI	1,305

**Zone 2 environmental considerations**

Zone 2 includes a small part of the far northeast portion of Wisconsin and approximately the eastern two-thirds of the Upper Peninsula of Michigan. The Wisconsin portions of the zone fall into the Northeast Sands and North Central Forest ecological landscape regions. The portions of the zone located in Michigan are part of the Eastern Upper Peninsula eco-region. A description of the characteristics of the Eastern Upper Peninsula eco-region may



be found on the Michigan Department of Environmental Quality Web page at  
[http://www.michigan.gov/dnr/0,1607,7-153-10366\\_11865-31471--,00.html](http://www.michigan.gov/dnr/0,1607,7-153-10366_11865-31471--,00.html).

Large expanses of this zone are forested and there are large numbers of streams, lakes and wetlands throughout the zone. The Niagara Escarpment is situated in the Eastern Upper Peninsula. Lakes Superior, Huron and Michigan form the northern and eastern boundaries of the zone. Two Michigan State Natural Rivers (Fox and Two-Hearted) and nine National Wild and Scenic Rivers (Tahquamenon, Indian, Sturgeon, Whitefish, Yellow Dog, Ontonagon, Paint, Carp and North Sturgeon) are found in this zone. Portions of the Nicolet, Ottawa, and Hiawatha national forests, and numerous state forests and parks are found in this zone. Several Indian reservations are found in this zone. The Seney National Wildlife Area, Pictured Rocks National Lakeshore and numerous federal wilderness areas also are found in this zone.

### ***Zone 2 electricity demand and generation***

The coincident peak load forecasts for Zone 2 for 2012, 2016, 2021 and 2026 are shown in Table ZS-11. The table also shows existing generation, proposed generation based on projected in-service year, and resultant capacity margins (with and without the proposed generation).

This table shows that load in Zone 2 is projected to grow at roughly 0.59 percent annually from 2012 through 2021. Comparing load with generation (at maximum output) within the zone indicates that Zone 2 has more generation than peak load, though actual operating experience indicates that during most periods, Zone 2 is a net importer of power.

### ***Zone 2 transmission system issues***

Key transmission facilities in Zone 2 include:

- Morgan-Plains and Plains-Dead River 345-kV lines,
- Plains-Stiles 138-kV double-circuit line
- Conover-Plains 138-kV line, and
- 138-kV facilities tying the Upper Peninsula of Michigan to the Lower Peninsula.

### ***Transmission study drivers***

An overriding general characteristic of the Zone 2 transmission system is the fact that it consists of load islands dispersed over a broad area and numerous components are near limits. Both the local and interconnecting components of this network have been generally adequate by historic standards, however, modern performance requirements, coupled with load increases or generation reductions of "modest" magnitudes could result in reinforcement needs. Furthermore, the inability to immediately serve nominal growth or generation changes could emerge. This indicates the need for extensive Strategic Flexibility analysis which requires the inclusion of varied internal and external factors.



Please note that more information on the need drivers and preliminary solution development is presented fully in the ATC Energy Collaborative - Michigan section. This section presents a strategic flexibility approach to the multiple factors emerging across the U.P. and the status of current studies. The solution development process utilized in the ATC Energy Collaborative – Michigan, in addition to our ongoing studies, identified the area solutions to address various limitations based upon ATC's Planning criteria.

Key system performance issues in Zone 2 include:

- Connecting possible renewable generation sources,
- Serving possible point load increases,
- Anticipating possible generation retirements,
- Limited import and export capability,
- Aging 69-kV and 138-kV infrastructure throughout the Upper Peninsula,
- Generator stability in the central portion of Upper Peninsula,
- Parallel path flow around Lake Michigan that contributes to heavy loading on the 138-kV and 69-kV systems, and results in the need for transmission loading relief incidents and reconfiguration of the system,
- Record low Lake Superior water levels in previous years result in reduced available hydro generation output in the eastern U.P., magnifying reliability concerns in this area,
- High voltage concerns at lighter load periods for central and eastern Upper Peninsula,
- Low voltages, most pronounced in the western and eastern Upper Peninsula,
- Potential low voltages and overloads in the northwestern U.P. due to recent load increases, and
- Potential marginal voltages and overloads in the central U.P. due to potential load increases and generation reductions.
- Several provisional projects in past 10-Year Assessments found low voltage and thermal overload issues which did not appear in the 2011 TYA. The provisional project in-service dates were retained for now until it can be determined in future assessments that these voltage and thermal issues no longer exist.

Please refer to the ATC Energy Collaborative – Michigan for more information on the application of strategic flexibility planning to Zone 2.



## **Zone 2 - 2012 study results**

Refer to [Table ZS-1](#) and [Figure ZS-5](#)

### *Summary of key findings*

- Low voltages throughout the Newberry area under contingency necessitate a project to transfer load off of the Hiawatha-Roberts 69 kV line 6911 around 2012,
- Maintaining reliability of service to load in and around the greater Escanaba area requires that system reinforcements be implemented in the near term, and
- Power flows particularly through the eastern U.P. necessitate the need for system reinforcements in the near term.

There were facility overloads and several facilities near their emergency ratings in Zone 2 based on the 2012 analysis. Many projects are either planned or proposed to address these near-term thermal issues by 2014. Details regarding these projects are described in this section and in the [Zone 2 – 2016 study results](#) section.

### *Eastern U.P.*

High voltages have been experienced on an intact system in real time in the eastern U.P. The high voltages usually occur at lighter load levels. The primary sources are the Straits-McGulpin 138-kV submarine cables, which are significant reactive power sources (13 MVAR each) and act like capacitor banks which raise system voltages.

To mitigate this operating limitation in the near term, two 13.8-kV reactors (total 25 MVAR) were installed at the Straits Substation in 2010.

### *Escanaba area*

As part of the [ATC Energy Collaborative – Michigan](#), several projects were identified to address system issues in the Escanaba area by 2012.

- Install a second Chandler 138/69-kV transformer (2012),
- Install Delta 69-kV bus tie breaker (2012), and
- Replace five 69-kV breakers at Delta Substation (2012).

These Escanaba area projects were identified as a result of the analyses of several potential futures, which indicated low voltages and overloaded facilities throughout the 69-kV system in central Delta County. These projects also address many System Operations and Asset Renewal limitations. There are numerous System Operations needs associated with the Escanaba area driven by outage coordination issues that make maintenance work very difficult and/or expensive to perform. In addition, there are local issues associated with



the lack of generation availability and/or possible network transmission service additions. Additional projects to be installed by 2016 are identified in the 2016 Results section.

*Munising/Newberry area*

To address Munising area limitations, the following project has been proposed in the 2012 timeframe:

- Engadine load move project
  - A facility outage of the Hiawatha-Engadine 69-kV line situates the Engadine load at the end of a long radial feed and causes the voltage criteria on the Newberry area 69-kV buses to be exceeded, and
  - This project will address these low voltages under low generation and single contingency conditions.

*Western area*

No western area reinforcements are needed through 2012.

*Projects whose "Need date" precedes the "In-service date"*

- Large power flows through the eastern U.P. of Michigan result in inadequate loading performances and voltage, increased system losses, and high Locational Marginal Prices (LMPs) for local power purchases. Current measures taken to address the high flows include splitting the U.P. system almost all of the time to eliminate the flows through the U.P. and expensive generation redispatch to try to accommodate urgent maintenance outages in both the U.P. and northern lower peninsula. Please refer to the [Zone 2 - 2016 Study results](#) for further information and the solution to these issues

*Projects whose "In-service date" precedes the "Need date"*

- None

**Zone 2 - 2016 study results**

Refer to [Table ZS-2](#) and [Figure ZS-6](#)

*Summary of key findings*

- Maintaining reliability of service to load in and around the greater Escanaba area requires that system reinforcements be implemented in the near term, and
- Projects driven solely by the potential for the Kinross load addition in the eastern U.P. have been removed from the project list.



### *Escanaba area*

As part of the ATC Energy Collaborative – Michigan, several projects were identified to address system issues in the Escanaba area by 2016.

- Construct Chander-18<sup>th</sup> Road double-circuit 138-kV lines (2014), and
- Install Arnold 345/138-kV transformer (2015)

These Escanaba area projects were identified as a result of the analyses of several potential futures, which indicated low voltages and overloaded facilities throughout the 69-kV system in central Delta County. These projects also address many System Operations and Asset Renewal limitations. There are numerous System Operations needs associated with the Escanaba area driven by outage coordination issues that make maintenance work very difficult and/or expensive to perform. In addition, there are local issues associated with the lack of generation availability and/or possible network transmission service additions.

### *Eastern U.P.*

A new transmission-distribution interconnection, referred to as the Kinross load, was proposed as a load addition in Chippewa County south of Sault Ste. Marie. This load originally represented a significant addition to the existing load in the Sault Ste. Marie area, and created a sudden change in the load, generation, and transmission balance in the eastern U.P. Since the 2010 Assessment the net load proposed for this project has been greatly reduced to the point of not needing projects driven solely by the original load addition. The following projects are now needed without the large Kinross load.

- Rebuild Straits-Pine River lines 6904/5 for 138 kV and operate at 69 kV (2014), and
- Uprate Pine River-Nine Mile 69-kV line 6923 to 167 degrees F and minimum asset renewal (2016).

These projects will be required to improve the voltage profile and eliminate thermal limitations in the eastern U.P. during this timeframe.

In order to eliminate power flow limitations in the eastern U.P., ATC is proposing the addition of flow control technology in the area. The project chosen to address these issues is the installation of a back-to-back HVDC device with voltage source converter technology (VSC). The VSC will be connected in series with the Straits-McGulpin 138-kV lines (9901/9903) for installation as soon as possible around the year 2014.

Power flow control in the eastern U.P. will adjust flows to more manageable levels to preserve system reliability during maintenance and construction activities in the Upper and Lower Peninsula systems through a large variety of system conditions, as well as providing



improved local area power quality. It could also reduce system losses and allow more economic dispatch of market generation if used to eliminate congestion while maintaining local area reliability. Further study is required to determine the appropriate operational protocol using this new device.

In conjunction with the eastern U.P. power flow control, ATC expects to permanently energize a Hiawatha-Indian Lake line at 138 kV as soon as the VSC flow control is in service. The Hiawatha-Indian Lake 138-kV project will increase the effectiveness of the flow control project. It will enhance reliability by relieving voltage limitations and providing more reliable maintenance outage opportunities.

*Munising/Newberry area*

As part of the ATC Energy Collaborative – Michigan, an uprate of the Munising-Blanney Park 69-kV line was identified to address network system, asset renewal, and System Operations issues in 2014.

*Western area*

Project development following the ATC Energy Collaborative – Michigan, determined that a rebuild of the Atlantic69 line should be scheduled for completion in the 2013 timeframe. This project will address low voltages, overloaded facilities and facility condition throughout the Western area.

Several other projects were identified as near term solutions for the U.P. The solutions for the eastern U.P., Munising/Newberry and Escanaba areas for the years 2012-2016 are outlined in the Zone 2 – 2012 study results section.

No performance limits were exceeded for Category A conditions for all 2016 analysis except the high voltage at Munising, Alger, and Alger-Delta 138-kV buses and the Lakota Road 115-kV bus in the 2016 70% load model. The high voltage issues can be addressed by adjusting generation in the area.

The lead times necessary to implement the corrective plans that are scheduled for 2012 through 2016 were considered and taken into account prior to assigning an in-service date for each associated project. All of the projects scheduled for the near term planning horizon have an “In-service date” that matches the “Need date”, except the following projects:

*Projects whose “Need date” precedes the “In-service date”*

- None

*Projects whose “In-service date” precedes the “Need date”*

- None





## Zone 2 – 2021 study results

Refer to Table ZS-3 and Figure ZS-7

### *Summary of key findings*

- All longer term area needs were described and addressed in the Zone 2 – 2012 study results and Zone 2 – 2016 study results sections.

There was one thermal limitation and three area bus voltage limitations that appeared in Table ZS-3. All of these limitations are addressed by generation adjustments and/or the projects outlined in Zone 2 – 2012 study results and Zone 2 – 2016 study results. In addition, further explanation can be found in the ATC Energy Collaborative – Michigan section.

No performance limits were exceeded for Category A conditions for all 2021 analysis.

The lead times necessary to implement the corrective plans that are scheduled for 2017 through 2021 were considered and taken into account prior to assigning an in-service date for each associated project. All of the projects scheduled for the longer term planning horizon have an “In-service date” that matches the “Need date”, except the following projects:

### *Projects whose “Need date” precedes the “In-service date”*

- None

### *Projects whose “In-service date” precedes the “Need date”*

- None

## Zone 2 - 2026 study results

Refer to Table ZS-4 and Figure ZS-8

### *Summary of key findings*

- Limitations identified will be addressed in projects outlined in the 2012 and 2016 sections.

There are three thermal limitations and several voltage limitations listed in Table ZS-4. The voltage and thermal limitations occur in the Munising/Newberry, eastern U.P. and



# 10-Year Assessment

An annual report summarizing proposed additions and expansions to ensure electric system reliability.

# 2011

September 2011 10-Year Assessment  
[www.atc10yearplan.com](http://www.atc10yearplan.com)

Escanaba areas and will be mitigated by projects described in the 2012 and 2016 study results.

Please refer to the ATC Energy Collaborative – Michigan for further information.

*Projects whose “Need date” precedes the “In-service date”*

- None

*Projects whose “In-service date” precedes the “Need date”*

- None

### **Assessment of Steady State Compliance with NERC Standards**

The mitigation plans comprised of planned, proposed and provisional projects identified for Zone 2 in this Assessment will allow the ATC system in Zone 2 to meet the steady state portions of NERC standards TPL-001 and TPL-002 in each of the five years 2012-2016, and for the 2017-2021 planning horizon.

Table ZS-1  
2012 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2012 Summer Peak Case		2012 Minimum Load Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
1	Base case loading criteria exceeded	FALSE	--	FALSE	--	System Intact
1	Base case voltage criteria exceeded	--	FALSE	--	FALSE	System Intact
1	Council Creek 138-kV bus	--	89.1% - 89.2%	--	--	Council Creek - Petenwell 138-kV line ACEC Badger West - Saratoga 138 KV line ACEC Badger West - Petenwell 138 KV line Saratoga - Petenwell 138-KV line
1	Badger West 138-kV bus	--	89.3%	--	--	ACEC Badger West - Saratoga 138 KV line
1	Petenwell 138-kV bus	--	89.3%	--	--	ACEC Badger West - Saratoga 138 KV line ACEC Badger West - Petenwell 138 KV line Saratoga - Petenwell 138-KV line
2	Base case loading criteria exceeded	FALSE	--	FALSE	--	System Intact
2	Base case voltage criteria exceeded	--	FALSE	--	TRUE	System Intact
2	M38 – Atlantic 69-kV line	94.6%	--	--	--	M38 – Atlantic 138-kV line M38 – Atlantic 138-kV line <sup>5</sup>
2	Chandler – Lakehead Tap 69-kV line Masonville – Lakehead Tap 69-kV line Gladstone – North Bluff 69-kV line Madonville – Gladstone 69-kV line	108.5% 104.3% 97.3% 97.2%	--	--	--	Delta – Mead 69-kV line
2	Delta – Mead 69-kV line	97.3%	--	--	--	Chandler – Lakehead 69-kV line
2	Engadine, Newberry, LouPac, Newberry Hospital, Newberry Village, Roberts 69-kV buses	--	90.9 - 91.3%	--	--	Hiawatha – Engadine 69-kV line
2	North Bluff, Bay View, Mead, Gladstone, Masonville and Lakehead 69-kV buses	--	84.2 - 89.1%	--	--	Delta – Mead 69-kV line
2	Mead and Bay View 69-kV buses	--	--	--	90.4-91.0%	Delta – Mead 69-kV line
2	Alger Delta, Munising, Alger 69-kV buses	--	--	--	105.4-105.5%	System Intact
2	Atlantic 138-kV bus	--	--	--	113.7%	Atlantic – M38 138-kV line
3	Base Case Loading Criteria Exceeded	FALSE	--	FALSE	--	System Intact
3	Base Case Voltage Criteria Exceeded	--	FALSE	--	TRUE	System Intact
3	Royster – AGA Gas Tap 69-kV line	109.0%	--	--	--	Fitchburg – Syene 69-kV line
3	Royster – Sycamore 69-kV line	95.5%	--	--	--	Femrite 138/69-kV transformer
3	Darlington 138-kV bus	--	--	--	105.2%	System Intact
3	Huiskamp 138-kV bus	--	90.5%	--	114.8%	Huiskamp – North Madison 138-kV line
3	Verona 138-kV bus	--	90.9%	--	114.6%	Verona – Oak Ridge 138-kV line

Table ZS-1  
2012 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2012 Summer Peak Case		2012 Minimum Load Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
3	Hubbard and Hustisford 138-kV buses	--	87.5% 88.1% 88.1%	--	90.1% 90.2% 90.2%	Rubicon – Hustisford 138-kV line Hustisford – Hubbard 138-kV line Rubicon – Hustisford – Hubbard 138-kV line
4	Base case loading criteria exceeded	FALSE	--	FALSE	--	System Intact
4	Base case voltage criteria exceeded	--	FALSE	--	FALSE	System Intact
4	Sunset Point – Pearl Avenue 69-kV line	106.7% 106.4%	--	--	--	Ellinwood – 12th Avenue 69-kV line Ellinwood 138/69-kV transformer <sup>3</sup>
5	Base Case Loading Criteria Exceeded	FALSE	--	FALSE	--	System Intact
5	Base Case Voltage Criteria Exceeded	--	FALSE	--	TRUE	System Intact
5	Albers, Allerton, Hayes, Kenosha, Nicholson, Oak Creek, Pennsylvania, Racine, Ramsey, St. Rita, and Somers 138-kV buses	--	--	--	105-106.1%	System Intact
5	Maple and Germantown 138-kV buses	--	91.7% 91.2%	--	--	Maple – Saukville 138-kV line
5	Bain 345/138-kV transformer #5	108.3% 158.2%	--	--	--	Split Pleasant Prairie 345-kV bus 34 Split Pleasant Prairie 345-kV bus 23
5	Oak Creek 345/230-kV transformer T895	104% 100.1%	--	--	--	Split Oak Creek 230-kV bus 78 Split Oak Creek 230-kV bus 67
5	Arcadian4 – Waukesha1 138-kV line	98.8%	--	--	--	Arcadian6 – Waukesha3 138-kV line
5	Arcadian6 – Waukesha3 138-kV line	95.7%	--	--	--	Arcadian4 – Waukesha1 138-kV line Split Waukesha 138-kV bus 12
5	Harbor – Kansas 138-kV line	94.8%	--	--	--	Kansas – Norwich 138-kV line

Table ZS-2  
2016 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2016 Summer Peak Case		2016 70% Load Case		2016 90% Load Case		2016 105% Load Case		2016 65% High W-E Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
1	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
1	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	TRUE	--	FALSE	--	TRUE	System Intact
1	Council Creek 138-kV bus	--	104.9%	--	--	--	105.3%	--	--	--	105.4%	System Intact
1	Dartford 69-kV bus	--	91.2 - 91.4%	--	--	--	--	--	--	--	--	Ripon - Northwest Ripon Tap 69-KV line Metomen - Ripon 69-KV line
1	Petenwell 138/69 KV transformer	98.0 - 95.2%	--	--	--	--	--	98.1%	--	115.5%	--	Castle Rock - Quincy ACEC 69-KV line Hilltop - Buckhorn Tap 69-KV line Castle Rock - McKenna 69-kV line <sup>1</sup> McKenna - Quincy ACEC 69-KV line
1	ACEC Badger West - Saratoga 138-kV line	--	--	95.2 - 96.8%	--	--	--	--	--	95.8 - 100.9%	--	Arpin - Eau Claire 345-kV line King - Eau Claire - Arpin 345-kV line <sup>5</sup>
1	ACEC Badger West - Petenwell 138-kV line	--	--	98.2 - 99.8%	--	--	--	--	--	95.8 - 103.9%	--	Arpin - Eau Claire 345-kV line King - Eau Claire - Arpin 345-kV line <sup>5</sup>
2	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
2	Base case voltage criteria exceeded	--	FALSE	--	TRUE	--	FALSE	--	FALSE	--	FALSE	System Intact
2	Mead and Chandler 69-kV buses	--	--	--	--	--	--	--	--	--	95.1 - 95.9%	System Intact
2	Munising, Alger, Alger-Delta 69-kV buses	--	--	--	105-105.5%	--	--	--	--	--	--	System Intact
2	Lakota Road 115-kV bus	--	--	--	105.30%	--	--	--	--	--	--	System Intact
2	Indian Lake 69-kV bus	--	--	--	--	--	--	--	--	--	92.0% 91.1% 91.6% 91.7%	Pleasant Prairie – Zion 345-kV line Pleasant Prairie – Zion 345-kV line <sup>27</sup> Indian Lake 69-kV capacitor bank Perkins 138-kV capacitor bank
2	Indian Lake 138/69-kV transformer #1 Indian Lake 138/69-kV transformer #2	--	--	--	--	--	--	--	--	97.2-98.2%	--	Indian Lake 138/69-kV transformer #2 Indian Lake 138/69-kV transformer #1
2	Delta – Mead 69-kV line	102.3% 97.4% 97.1%	--	--	--	--	--	101.7% 96.8% 96.7%	--	--	--	Chandler – Lakehead Tap 69-kV line Masonville – Lakehead Tap 69-kV line Chandler - Lakehead - Masonville 69-kV line <sup>26</sup>
2	Chandler – Lakehead Tap 69-kV line Masonville – Gladstone 69-kV line Masonville – Lakehead Tap 69-kV line	112.8% 96.9% 108.5%	--	101.8% 90.7% 98.8%	--	108.6% 94.3% 104.7%	--	114.8% 97.9% 110.2%	--	103.9% 93.4% 101.1%	--	Delta – Mead 69-kV line
2	M38 – Atlantic 69-kV line	--	--	--	--	--	--	96.3% 96.5% 100%	--	--	--	M38 – Atlantic 138-kV line Atlantic 138/69-kV transformer M38 – Atlantic 69-kV line <sup>23</sup>
2	Engadine, Newberry, Newberry Hospital, Roberts, LouPac, Newberry Village, Hulbert and Eckerman 69-kV buses	--	90.3-90.7%	--	--	--	91.5-91.9%	--	91.3-91.7%	--	--	Hiawatha – Engadine 69-kV line
2	North Bluff, Bay View, Mead, Gladstone, Lakehead, Masonville 69-kV buses	--	84.7-91.8%	--	85.5-90.1%	--	84.9-89.6%	--	83.7-91.6%	--	82.3-90.5%	Delta – Mead 69-kV line
2	Empire - Presque Isle 138-kV line	--	--	--	--	--	--	--	--	100.6%	--	Split Empire 138-kV bus #23
2	Escanaba and West 69-kV buses	--	91.4-91.9%	--	--	--	--	--	--	--	--	Delta - West Tap 69-kV line
2	Nordic – Mountain 69-kV line	--	--	--	--	--	--	--	--	102.0% 110.5%	--	Empire – Forsyth 138-kV line Plains – Arnold 138-kV line

Table ZS-2  
2016 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2016 Summer Peak Case		2016 70% Load Case		2016 90% Load Case		2016 105% Load Case		2016 65% High W-E Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
3	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
3	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	System Intact
	Royster – Sycamore 69-kV line	98.2%	--	--	--	--	--	--	104.5%	--	--	Femrite 138/69-kV transformer
3	Verona 138-kV bus	--	89.4%	--	--	--	89.9%	--	88.8%	--	--	Verona – Oak Ridge 138-kV line
3	Huiskamp 138-kV bus	--	89.9%	--	91.7%	--	90.4%	--	89.9%	--	91.7%	Huiskamp – North Madison 138-kV line
3	Darlington – North Monroe 138-kV line	--	--	--	--	--	--	--	--	102.0 – 95%	--	Paddock 345/138-kV transformer Darlington 138/69-kV transformer Darlington – DPC Gratiot 69-kV line
3	Eden – Mineral Point 69-kV line	--	--	--	--	--	--	--	--	95.3%	--	Darlington – Lafayette Wind 138-kV line
3	South Monroe – Browntown 69-kV line	--	--	--	--	--	--	--	--	97.0%	--	Darlington – North Monroe 138-kV line
3	Concord 138-kV bus	--	--	--	--	--	--	--	96.0%	--	--	System Intact
3	Hubbard and Hustisford 138-kV buses	--	87.5% 88.2% 88.2%	--	87.1% 87.4% 87.4%	--	87.2% 86.5% 86.5%	--	--	--	87.2% 87.9% 87.9%	Rubicon – Hustisford 138-kV line Hustisford - Hubbard 138kV line Rubicon - Hustisford - Hubbard 138kV line
4	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
4	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	System Intact
4	Manrap – Custer 69-kV line	--	--	--	--	--	--	95.4%	--	--	--	Dewey – Lakefront 69-kV line
4	Lau Road – Elkhart Lake 138-kV line	--	--	--	--	--	--	--	--	95.6% 95.6% 95.6%	--	Sheboygan Energy Center – Grandville 345-kV line Point Beach – Sheboygan Energy Center 345-kV line Point Beach 345-kV bus tie 1 - 2
4	Elkhart Lake – Saukville 138-kV line	--	--	--	--	--	--	--	--	106.7% 106.7% 106.6% 103.4% 102.9% 101.9 – 95.0%	--	Point Beach 345-kV bus tie 1 - 2 Point Beach – Sheboygan Energy Center 345-kV line Sheboygan Energy Center – Grandville 345-kV line Cypress – Arcadian 345-kV line Edgewater – Cedarsauk 345-kV line Plus other less severe contingencies
4	Gravesville - Glenview 138-kV line	96.7% 96.7% 96.6% -- --	--	--	--	--	--	--	102.9% 102.9% 102.9% 96.0% 96.0%	--	--	Tecumseh Road 138/69 kV Transformer* Tecumseh Road 138/69 kV Transformer Tecumseh Road - Ford Drive tap 69-kV line Ford Drive tap - New Holstein 69-kV line Tecumseh Road - New Holstein 69-kV line*
4	Sunset Point – Pearl Avenue 69-kV line	107.9% 107.9%	--	--	--	97.0% 96.9%	--	113.6% 113.4%	--	--	--	Ellinwood – 12th Avenue 69-kV line Ellinwood 138/69-kV transformer*
5	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
5	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	System Intact
5	Bain 345/138-kV transformer #5	158.6% 111.4%	--	142.5% --	--	158.8% --	--	158.3% 106.4%	--	142.6% 127.1%	--	Split Pleasant Prairie 345-kV bus 34 Split Pleasant Prairie 345-kV bus 23
5	Oak Creek 345/230-kV transformer T895	104.2% 101.5%	--	--	--	104.4% --	--	104.3% 101.9%	--	--	--	Split Oak Creek 230-kV bus 78 Split Oak Creek 230-kV bus 67
5	Arcadian4 – Waukesha1 138-kV line	97.9%	--	114.1%	--	130.4%	--	98.5%	--	--	--	Arcadian6 – Waukesha3 138-kV line
5	Arcadian6 – Waukesha3 138-kV line	94.7% --	--	110.5% 100.4%	--	126.3% 112.7%	--	95.4% --	--	--	--	Arcadian4 – Waukesha1 138-kV line Split Waukesha 138-kV bus 12

Table ZS-2  
2016 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2016 Summer Peak Case		2016 70% Load Case		2016 90% Load Case		2016 105% Load Case		2016 65% High W-E Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
5	Arcadian 345/138-kV transformer #3	--	--	--	--	96.2% 99.6% 94.9%	--	--	--	--	--	Split Arcadian 345-kV bus 12 Arcadian 345-kV bus outage Arcadian 345/138-kV transformer #1
5	Bain – Kenosha 138-kV line	--	--	--	--	--	--	--	--	100.3%	--	Pleasant Prairie – Zion 345-kV line
5	Pleasant Prairie – Zion 345-kV line	--	--	--	--	--	--	--	--	96.8%	--	Zion – Arcadian 345-kV line <sup>27</sup>
5	Granville 345/138-kV transformer #1	--	--	--	--	108.2%	--	--	--	--	--	Split Granville 345-kV bus 23
5	Harbor – Kansas 138-kV line	--	--	110.4% 105.3% 102.5% 101.7%	--	100.0% -- -- --	--	--	--	--	--	Kansas – Norwich 138-kV line Dewey – Norwich 138-kV line Split Dewey 138-kV bus Dewey – Montana 138-kV line Plus Other Less Severe Outages
5	Albers – Kenosha 138-kV line	--	--	107.2%	--	105.6%	--	--	--	--	--	Albers – Bain 138-kV line
5	Edgewood – St. Martins 138-kV line	--	--	98.1%	--	--	--	--	--	--	--	Merrill Hills – Waukesha 138-kV line
5	Oak Creek – Ramsey 138-kV line Kansas – Ramsey 138-kV line Nicholson – Ramsey 138-kV line	--	--	--	--	101.0% 96.1% 95.1%	--	--	--	--	--	Oak Creek – Pennsylvania 138-kV line
5	Waukesha 138-kV bus 12	--	--	--	--	99.7%	--	--	--	--	--	Arcadian6 – Waukesha3 138-kV line
5	Kenosha – Lakeview 138-kV line	--	--	--	--	--	--	96.2%	--	126.9%	--	Pleasant Prairie – Zion 345-kV line
5	Lakeview – Zion 138-kV line	--	--	--	--	--	--	--	--	129.9%	--	Pleasant Prairie – Zion 345-kV line

Table ZS-3  
2021 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2021 Summer Peak Case		2021 Minimum Load Case		2021 70% Shoulder Case		2021 90% E-W Bias Case		2021 65% High W-E Bias Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
1	Base case loading criteria exceeded	TRUE	--	FALSE	--	FALSE	--	FALSE	--	TRUE	--	System Intact
1	Base case voltage criteria exceeded	--	FALSE	--	TRUE	--	FALSE	--	FALSE	--	FALSE	System Intact
1	Dartford, Ripon Industrial Park, Northwest Ripon and Ripon 69-kV buses	--	90.5 - 91.9% 90.6 - 91.9% 91.6%	--	--	--	--	--	--	--	--	Ripon - NW Ripon Tap 69-KV line Metomen - Ripon 69-KV line NW Ripon Tap - Dartford Tap 69-KV line
1	Winneconne, Omro and Omro Industrial Park 69-kV buses	--	90.8 - 91.4%	--	--	--	--	--	--	--	--	Winneconne - Sunset Point 69-kV line
1	Council Creek 161-kV bus	--	91.2%	--	--	--	--	--	--	--	--	Monroe County - La Crosse 161-kV line
1	Council Creek 138-kV bus	--	--	--	105.5%	--	--	--	--	--	--	System Intact
1	Metomen 138/69 KV transformer	95.6%	--	--	--	--	--	--	--	--	--	System Intact
1	Petenwell 138/69 KV transformer	101.7% 106.2% 104.1% 103.5% 101.4 - 103.3%	--	--	--	95.6 - 104.2%	--	--	--	119.2%	--	System Intact Castle Rock - Quincy ACEC 69-KV line Hilltop - Buckhorn Tap 69-KV line Castle Rock - McKenna 69-kV line <sup>14</sup> Plus other less severe contingencies
1	Castle Rock - ACEC Quincy 69-KV line	98.8% 98.8% 98.7%	--	--	--	--	--	--	--	--	--	Petenwell - Big Pond 69-KV line Petenwell 138/69-kV Transformer Necedah Tap - Big Pond 69-KV line
1	ACEC Badger West - Petenwell 138-kV line	--	--	--	--	96.9 - 135.9%	--	--	--	96.1 - 103.8%	--	Arpin - Eau Claire 345-kV line King - Eau Claire 345-kV line Arpin 345/138-kV transformer Arrowhead - Stone Lake 345-kV line Plus other less severe contingencies
1	ACEC Badger West - Saratoga 138-kV line	--	--	--	--	97.1 - 132.7%	--	--	--	100.5%	--	Arpin - Eau Claire 345-kV line King - Eau Claire 345-kV line Arpin 345/138-kV transformer Arrowhead - Stone Lake 345-kV line Plus other less severe contingencies
2	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
2	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	System Intact
2	Engadine, Newberry, Newberry Hospital, Roberts, LouPac, Newberry Village, Hulbert, Eckerman 69-kV buses	--	84.4-90.4% --	--	--	--	--	--	88.5-89.0% 89.5-89.8%	--	--	Hiawatha-Engadine 69-kV line Engadine-Newberry 69-kV line
3	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
3	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	System Intact
3	Darlington - North Monroe 138-kV line	--	--	--	--	--	--	--	--	118.8 - 98.8%	--	Paddock 345/138-kV transformer Darlington 138/69-kV transformer Darlington - DPC Gratiot 69-kV line Eden - Wyoming Valley 138-kV line Eden - Wyoming Valley - Spring Green 138-kV line plus other less severe contingencies
3	Eden - Mineral Point 69-kV line	--	--	--	--	--	--	--	--	111.3 - 98.5%	--	Darlington - Lafayette Wind 138-kV line
3	South Monroe - Browntown - Jennings Road - Wiote 69-kV line	--	--	--	--	--	--	--	--	110.8 - 101.2%	--	Darlington - North Monroe 138-kV line
3	Nelson Dewey 161/138-kV transformer	--	--	--	--	96.0%	--	--	--	--	--	System Intact
3	Nelson Dewey 161/138-kV transformer	--	--	--	--	103.1 - 99.4%	--	--	--	--	--	Nelson Dewey Unit 2 Pleasant Praire Unit 1 Pleasant Praire Unit 2 Edgewater Unit 5 plus other less severe contingencies
3	Royster - Sycamore 69-kV line	106.3%	--	--	--	--	--	96.3%	--	--	--	Femrite 138/69-kV transformer



Table ZS-3  
2021 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2021 Summer Peak Case		2021 Minimum Load Case		2021 70% Shoulder Case		2021 90% E-W Bias Case		2021 65% High W-E Bias Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
3	Westport – Wanakee Muni#2 69-kV line	98.1%	--	--	--	--	--	--	--	--	--	West Middleton – Pheasant Branch 69-kV line
3	Verona 138-kV bus	--	87.9%	--	--	--	90.8%	--	88.8%	--	91.4%	Verona – Oak Ridge 138-kV line Verona 138/69-kV transformer
3	Huiskamp 138-kV bus	--	89.4%	--	114.8%	--	90.1%	--	90.4%	--	91.4%	Huiskamp – North Madison 138-kV line
3	Hubbard and Hustisford 138-kV bus	--	87.5% 88.1% 88.1%	--	87.5% 87.6% 87.6%	--	86.9% 87.3% 87.3%	--	88.1% 88.1% 88.1%	--	87.2% 87.2% 87.1%	Rubicon – Hustisford 138-kV line Hustisford – Hubbard 138-kV line Rubicon – Hustisford – Hubbard 138-kV line
3	Paddock – Townline 138kV line	--	--	--	--	102.8% 101.8% 101.1%	--	--	--	--	--	NW Neloit – Paddock 138-kV line Paddock – NW Beloit – Blackhawk 138-kV line NW Beloit – Blackhawk 138-kV line
3	NW Beloit – Paddock 138kV line	--	--	--	--	96.9%	--	--	--	--	--	Paddock – Townline 138-kV line
4	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
4	Base case voltage criteria exceeded	--	FALSE	--	TRUE	--	FALSE	--	FALSE	--	FALSE	System Intact
4	Manrap – Custer 69-kV line	99.3%	--	--	--	--	--	--	--	--	--	Dewey – Lakefront 69-kV line
4	Glenview – Gravesville 69-kV line	103.7% 103.7% 103.7% 97.0% 97.0%	--	--	--	--	--	--	--	--	--	Tecumseh Road 138/69 kV Transformer* Tecumseh Road 138/69 kV Transformer Tecumseh Road - Ford Drive tap 69-kV line Ford Drive tap - New Holstein 69-kV line Tecumseh Road - New Holstein 69-kV line*
4	Sunset Point – Pearl Avenue 69-kV line	110.5% 110.4%	--	--	--	--	--	98.9% 98.9%	--	--	--	Ellinwood 138/69-kV transformer* Ellinwood – 12th Avenue 69-kV line
4	Morgan – Falls 138-kV line	--	--	--	--	101.8%	--	--	--	--	--	Morgan – Plains 345-kV line
4	Elkhart Lake – Saukville 138-kV line	--	--	--	--	--	--	--	--	97.9%	--	Barnhart – Cedarsauk 345-kV line
4	Kewaunee 138-kV bus	--	--	--	103.6%	--	--	--	--	--	--	System Intact
5	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
5	Base case voltage criteria exceeded	--	FALSE	--	TRUE	--	FALSE	--	FALSE	--	FALSE	System Intact
5	Oak Creek 345/230-kV transformer T895	104.3% 102.5%	--	--	--	--	--	104.4% 102.5%	--	102.7% 99.8%	--	Split Oak Creek 230-kV bus 78 Split Oak Creek 230-kV bus 67
5	Bain 345/138-kV transformer #5	158.4% 104.6%	--	--	--	--	--	--	--	--	--	Split Pleasant Prairie 345-kV bus 34 Split Pleasant Prairie 345-kV bus 23
5	Arcadian4 – Waukesha1 138-kV line	98.4%	--	--	--	110.2%	--	120.4%	--	--	--	Arcadian6 – Waukesha3 138-kV line
5	Arcadian6 – Waukesha3 138-kV line	95.3%	--	--	--	106.8% 95.8%	--	116.6% 102.0%	--	--	--	Arcadian4 – Waukesha1 138-kV line Split Waukesha 1-2 bus
5	Arcadian 345/138-kV transformer #3	--	--	--	--	--	--	95.9%	--	--	--	Arcadian 345/138-kV transformer #1
5	Pleasant Prairie – Zion 345-kV line	--	--	--	--	--	--	--	--	108.2% 101.1% 98.8%	--	Zion – Arcadian 345-kV line Zion - Arcadian 345-kV line <sup>14</sup> System Intact
5	Lakeview – Zion 138-kV line Arcadian – Zion 345-kV line Kenosha - Lakeview 138-kV line	96.8% -- 99.6%	--	--	--	--	--	--	--	144% 108.1% 141.9%	--	Pleasant Prairie – Zion 345-kV line
5	Bain – Kenosha 138-kV line	--	--	--	--	--	--	--	--	107.8%	--	Pleasant Prairie – Zion 345-kV line
5	Albers – Kenosha 138-kV line	--	--	--	--	100.4%	--	--	--	--	--	Albers – Bain 138-kV line
5	Maple and Germantown 138-kV buses	--	--	--	--	--	--	--	89.7-90.3%	--	--	Saukville – Maple 138-kV line

Table ZS-4  
2026 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2026 Summer Peak Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	
1	Base case loading criteria exceeded	TRUE	--	System Intact
1	Base case voltage criteria exceeded	--	TRUE	System Intact
1	Silver Lake, ACEC Spring Lake, Redgranite, Fountain Valley, River Run, Berlin and Fox River 69-kV buses	--	90.0 - 91.7% 91.0 - 91.2% 91.2 - 91.4% 91.8 - 91.9%	Wautoma – Silver Lake Tap 69-kV line Ripon - Northwest Ripon Tap 69-kV line Metomen – Ripon 69-kV line Silver Lake – ACEC Spring Lake 69-kV line
1	Dartford, Ripon Industrial Park, Northwest Ripon and Ripon 69-kV buses	--	96.4% 88.3 - 89.8% 88.5 - 89.9% 90.4 - 91.8%	System Intact Ripon - Northwest Ripon Tap 69-KV line Metomen – Ripon 69-kV line Northwest Ripon Tap - Dartford Tap 69-KV line
1	Winneconne, Omro and Omro Industrial Park 69-kV buses	--	89.4 - 90.0%	Winneconne – Sunset Point 69-kV line
1	Castle Rock – ACEC Quincy 69-kV line	101.1%	--	Necedah Tap – Big Pond 69-kV line Pettenwell – Big Pond 69-kV line Pettenwell 138/69-kV transformer
1	Metomen 138/69 KV transformer	100.5% 101.4% 100.0%	--	System Intact North Fond du Lac 138/69-kV transformer North Fond du Lac – Rosendale Tap 69-kV line
1	Pettenwell 138/69-kV transformer	106.2% 110.2% 107.9% 107.5% 107.3% 98.6 - 106.2%	--	System Intact Castle Rock – Quincy ACEC 69-kV line McKenna – Quincy ACEC 69-kV line Hilltop – Buckhorn Tap 69-kV line Castle Rock - McKenna 69-kV line <sup>25</sup> Plus other less severe contingencies
1	Wautoma - ACEC Wautoma Tap 69-kV line	96.9%	--	Harrison North - Harrison 69-kV line
2	Base case loading criteria exceeded	FALSE	--	System Intact
2	Base case voltage criteria exceeded	--	FALSE	System Intact
2	Hulbert, Eckermann, Lou-Pac, Newberry Village, Roberts, Talantino 69-kV buses	--	83.5 - 89.4% 88.1 - 91.5% 86.4 - 90.8% 86.7 - 91.2%	Engadine – Newberry 69-kV line Newberry – Newberry Hospital 69-kV line Newberry Hospital – Roberts 69-kV line Hiawatha – Roberts 69-kV line 6911 <sup>24</sup>
3	Base case loading criteria exceeded	FALSE	--	System Intact
3	Base case voltage criteria exceeded	--	FALSE	System Intact
3	Timberlane Tap – West Middleton 69-kV line	95.6%	--	Spring Green 138/69-kV transformer
3	West Middleton – Pheasant Branch 69-kV line	107.8 – 96.5%	--	Waunakee Switching – Waunakee Municipal 2 69-kV line Westport – Waunakee Municipal 2 69-kV line West Middleton 138/69-kV transformer
3	West Middleton 138/69-kV transformer	--	--	West Middleton 138/69-kV transformer
3	Westport – Waunakee Muni2 69-kV line	114.7%	--	West Middleton – Pheasant Branch 69-kV line
3	Waunakee Industrial Park – Huiskamp 69-kV line	95.7%	--	West Middleton – Pheasant Branch 69-kV line
3	Royster – Sycamore 69-kV line	115.0%	--	Femrite 138/69-kV transformer
3	Huiskamp 138-kV bus	--	88.7%	Huiskamp – North Madison 138-kV line
3	Verona 138-kV bus	--	86.0%	Verona – Oak Ridge 138-kV line
3	Hubbard and Hustisford 138-kV bus	--	87.0% 87.7% 87.7%	Rubicon – Hustisford 138-kV line Hustisford – Hubbard 138-kV line Rubicon – Hustisford – Hubbard 138-kV line
3	Alto 69-kV bus	--	96.8%	System Intact
4	Base case loading criteria exceeded	FALSE	--	System Intact
4	Base case voltage criteria exceeded	--	FALSE	System Intact
4	Manrap – Custer 69-kV line	106.2%	--	Dewey – Lakefront 69-kV line

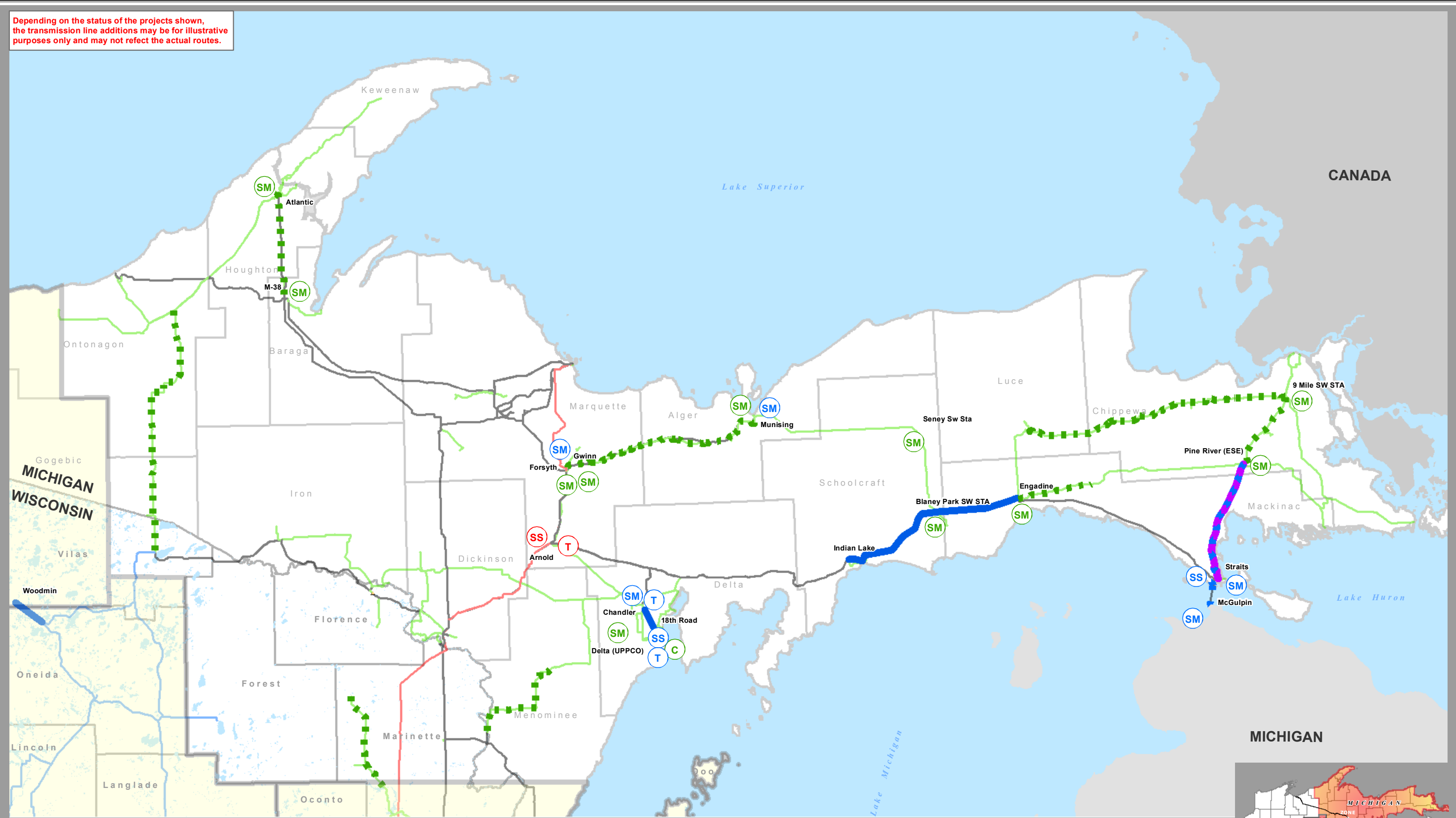
Table ZS-4  
2026 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2026 Summer Peak Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	
4	Glenview – Gravesville 69-kV line	101.5% 101.5% 101.5%	--	Tecumseh Road 138/69-kV transformer <sup>24</sup> Tecumseh Road 138/69-kV transformer Tecumseh Road – Ford Drive 69-kV
4	Sunset Point – Pearl Avenue 69-kV line	113.2% 112.9%	--	Ellinwood – 12th Avenue 69-kV line Ellinwood 138/69-kV transformer <sup>20</sup>
5	Base Case Loading Criteria Exceeded	FALSE	--	System Intact
5	Base Case Voltage Criteria Exceeded	--	FALSE	System Intact
5	Bluemound 230-kV buses #1, #2 and #3	--	95.8%	System Intact
5	Brookdale East, Allerton 138-kV buses	--	95.5 - 95.9%	System Intact
5	Bain 345/138-kV transformer #5	158.9% 99.5%	--	Split Pleasant Prairie 345-kV bus 34 Split Pleasant Prairie 345-kV bus 23
5	Oak Creek 345/230-kV transformer T895	102.4% 104.7%	--	Split Oak Creek 230-kV bus 67 Split Oak Creek 230-kV bus 78
5	Kenosha – Lakeview 138-kV line	103.0%	--	Pleasant Prairie – Zion 345-kV line
5	Lakeview – Zion 138-kV line	99.3%	--	Pleasant Prairie – Zion 345-kV line
5	Pennsylvania 138-kV bus	--	91.6%	Oak Creek – Pennsylvania 138-kV line
5	Arcadian – Waukesha 138-kV line	--	96.8%	Arcadian – Waukesha 138-kV line

*Table ZS-9  
Zone 2 Load and Generation*

Zone 2	2012	2016	2021	2026
Peak Forecast (megawatts)	844.3	867.6	890.5	913.7
Average Peak Load Growth	N/A	0.68%	0.52%	0.52%
Existing Generation Capacity (megawatts)	867.2	867.2	867.2	867.2
Existing Capacity Less Load (megawatts)	22.9	-0.4	-23.3	-46.5
Existing Generation Capacity plus Modeled Generating Capacity Additions (megawatts)	867.2	867.2	867.2	867.2
Modeled Capacity Less Load (megawatts)	22.9	-0.4	-23.3	-46.5

Depending on the status of the projects shown, the transmission line additions may be for illustrative purposes only and may not reflect the actual routes.



**2011 10-Year Assessment Projects  
PLANNING ZONE 2**

- New 69kV Transmission Line
- Rebuilt 69 kV Transmission Line
- New 115, 138 or 161 kV Transmission Line
- Rebuilt 115, 138 or 161 kV Transmission Line
- New 345 kV Transmission Line
- Rebuilt 345 kV Transmission Line
- Transmission Line Voltage Conversion

- New Substation
- Substation Modifications
- T-D Interconnection
- Capacitor Bank or Reactor
- Transformer

**Existing Transmission Facilities**

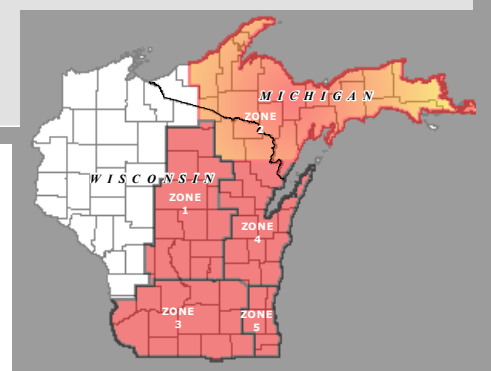
- ATC Substation, Switchyard or Terminal
  - Generation
  - Non-ATC Substation, Switchyard or Terminal
  - Non-ATC Transmission Line
- ATC Transmission Lines**
- 69 kV
  - 115 kV
  - 138 kV
  - 161 kV
  - 230 kV
  - 345 kV

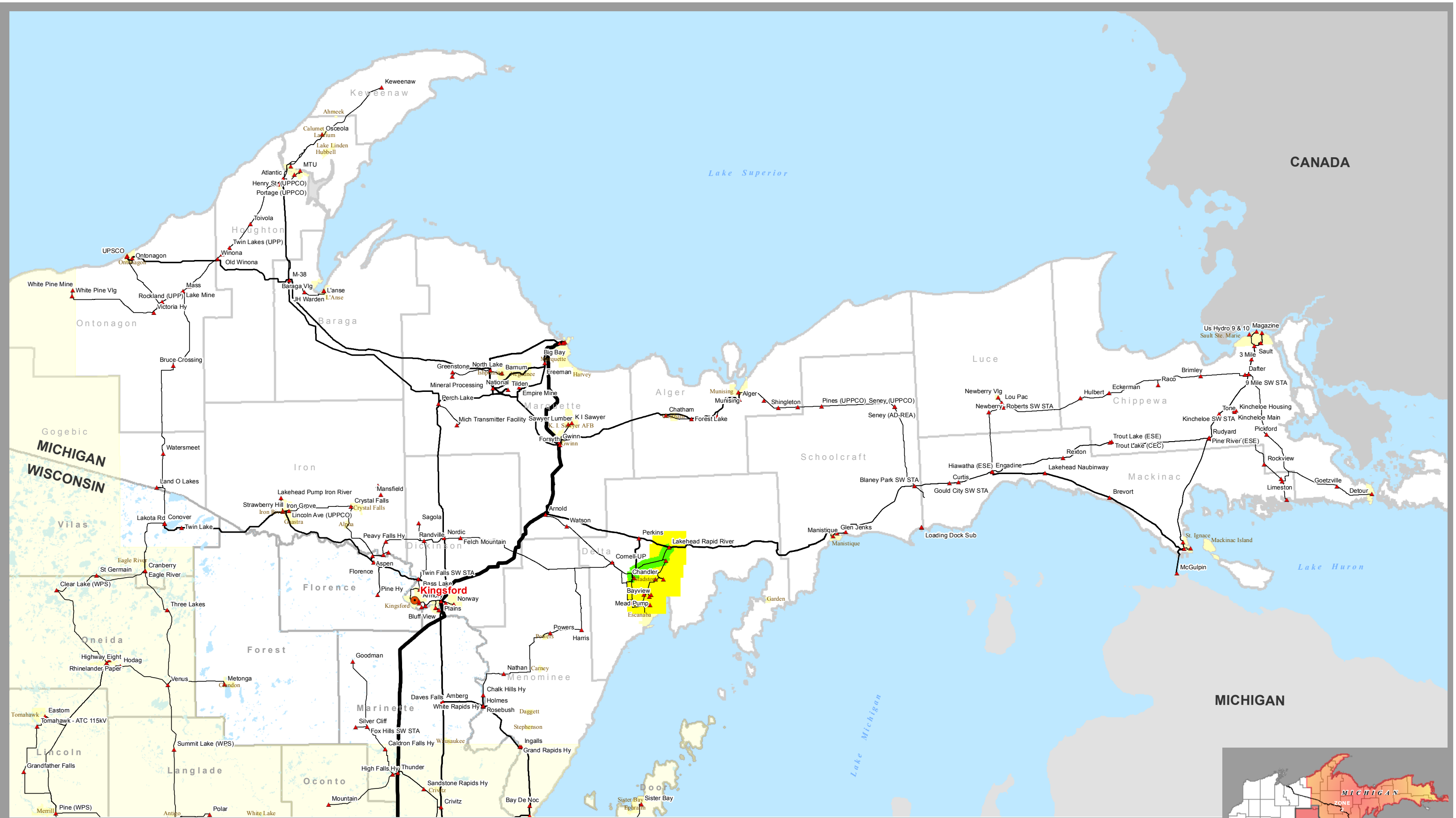
**ATC**  
AMERICAN TRANSMISSION COMPANY

Currently, ATC owns or operates transmission facilities in Wisconsin, Illinois, Minnesota, and the Upper Peninsula of Michigan. Facilities include:

- \* Approximately 9440 miles of transmission lines
- \* 96 wholly owned substations
- \* 419 jointly owned substations
- \* ATC offices in Madison, Cottage Grove, Pewaukee, DePere, and Kingsford, MI

The information presented in this map document is advisory and is intended for reference purposes only. American Transmission Company owned and operated facility locations are approximate.

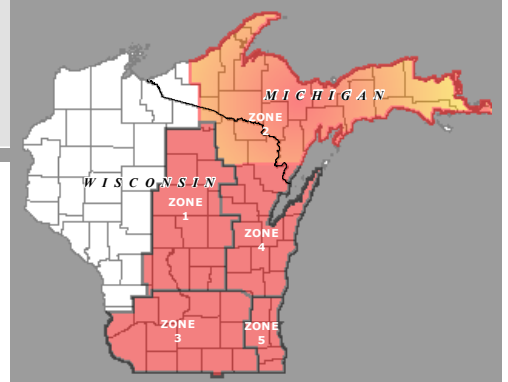




Performance Criteria Exceeded and Other Constraints (2011-2012)  
**PLANNING ZONE 2**

- High or Low Bus Voltage
- Overloaded Facility

- Existing Transmission Facilities**
- ATC Office Location
  - ▲ ATC Substation, Switchyard or Terminal
  - ⚡ Generation
  - ATC Transmission Line (width = voltage)

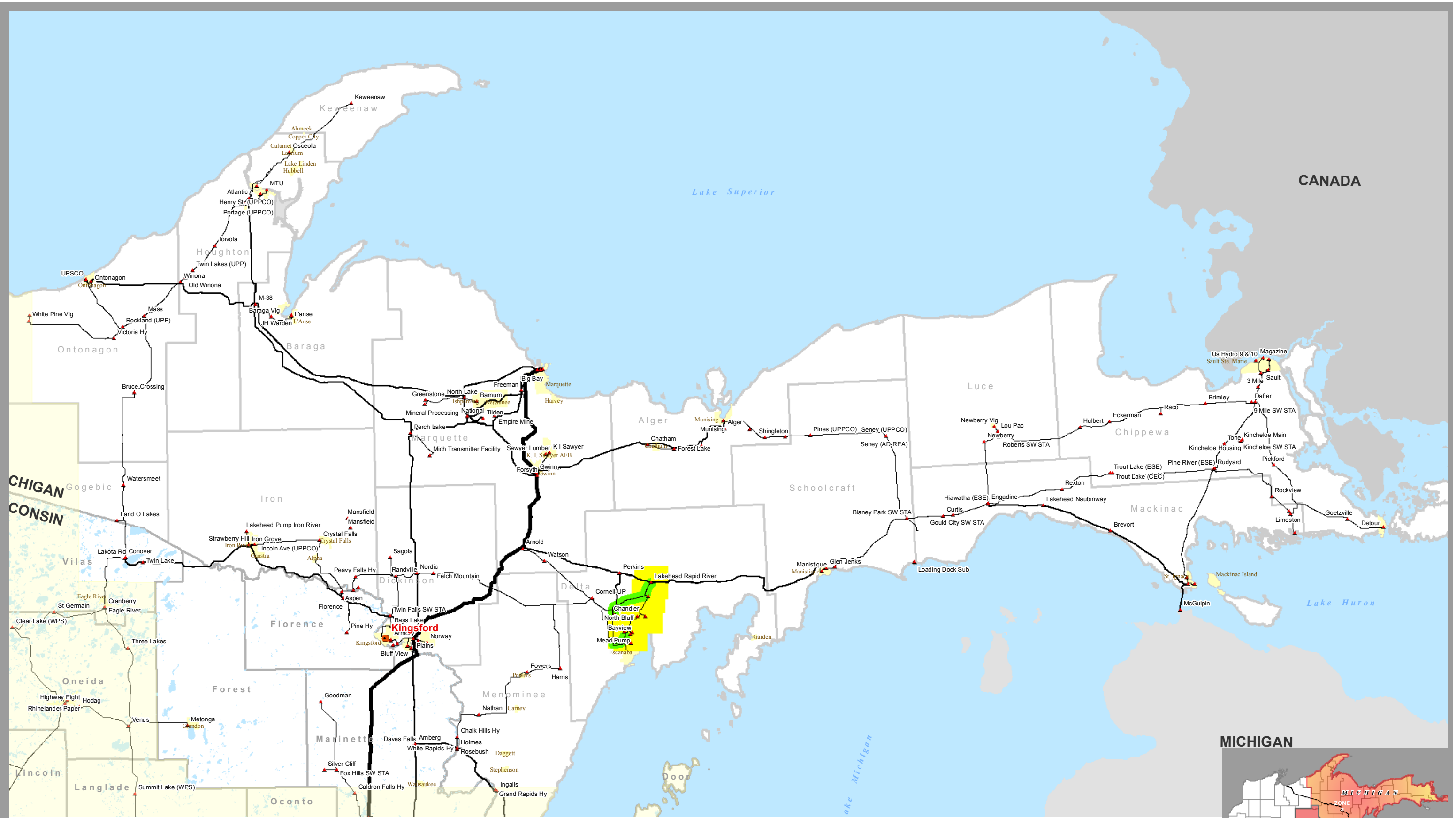


**ATC**  
AMERICAN TRANSMISSION COMPANY

Currently, ATC owns or operates transmission facilities in Wisconsin, Illinois, Minnesota, and the Upper Peninsula of Michigan. Facilities include:

- \* Approximately 9440 miles of transmission lines
- \* 96 wholly owned substations
- \* 419 jointly owned substations
- \* ATC offices in Madison, Cottage Grove, Pewaukee, DePere, and Kingsford, MI

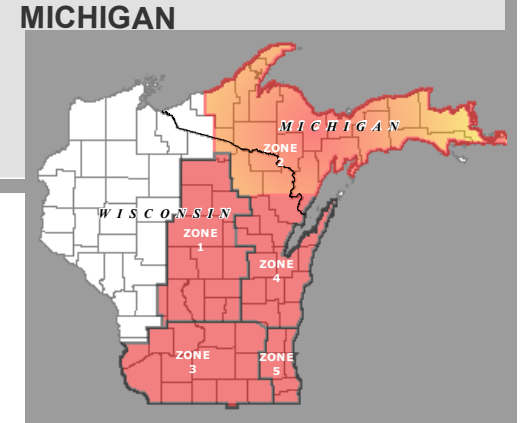
The information presented in this map document is advisory and is intended for reference purposes only. American Transmission Company owned and operated facility locations are approximate.



**Performance Criteria Exceeded and Other Constraints (2013-2016)**  
**PLANNING ZONE 2**

- High or Low Bus Voltage
- Overloaded Facility

- Existing Transmission Facilities**
- ATC Office Location
  - ▲ ATC Substation, Switchyard or Terminal
  - ☐ Generation
  - ATC Transmission Line (width = voltage)

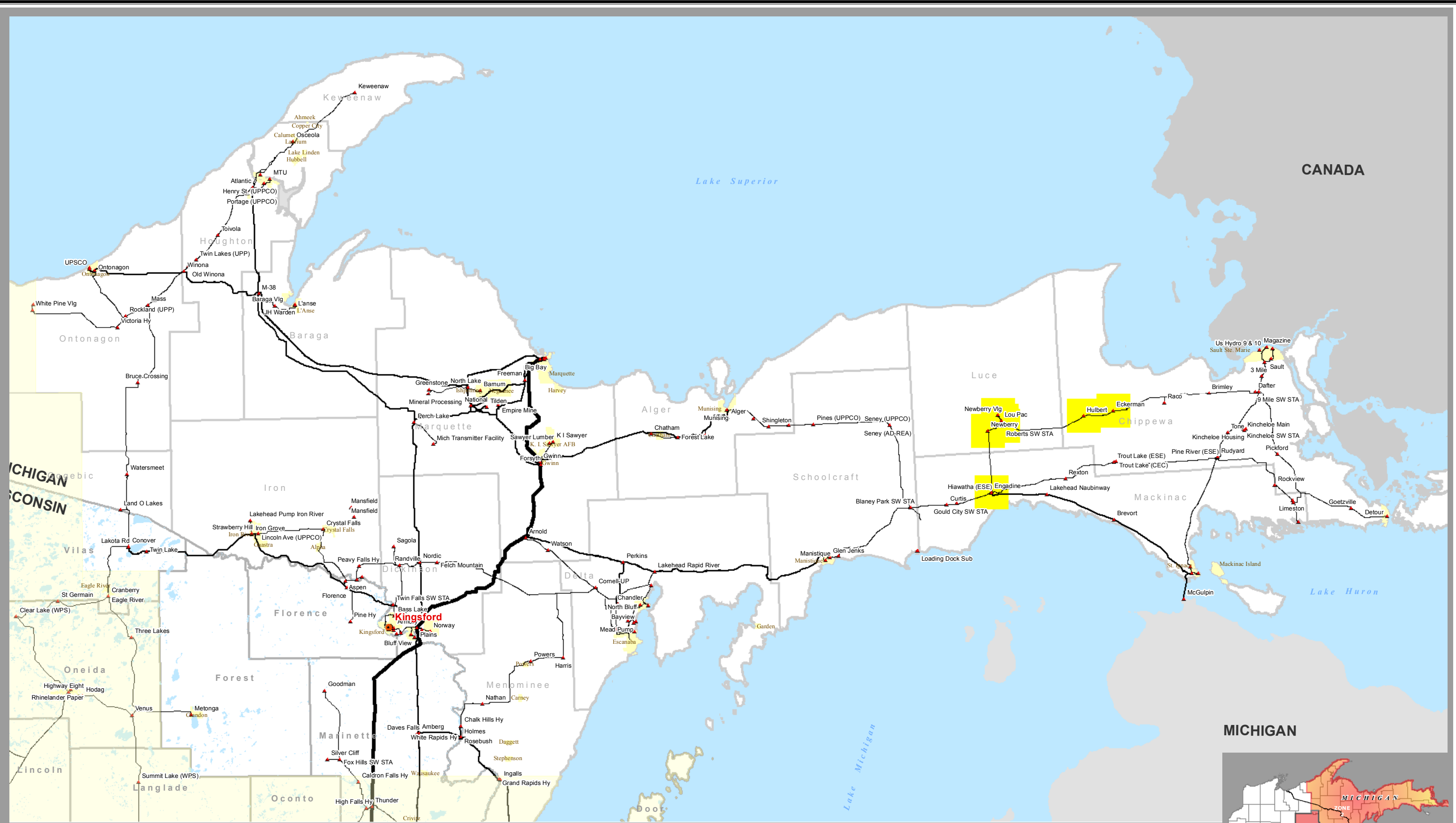


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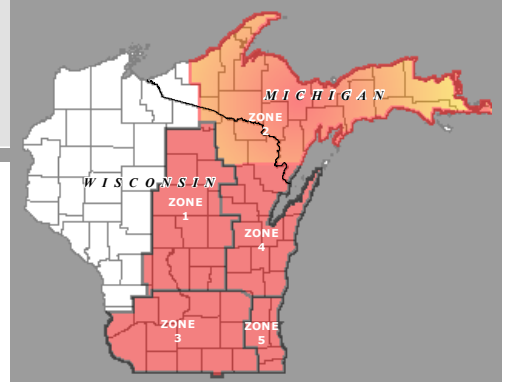
The information presented in this map document is advisory and is intended for reference purposes only. American Transmission Company owned and operated facility locations are approximate.



Performance Criteria Exceeded and Other Constraints (2017-2021)  
**PLANNING ZONE 2**

- High or Low Bus Voltage
- Overloaded Facility

- Existing Transmission Facilities**
- ATC Office Location
  - ▲ ATC Substation, Switchyard or Terminal
  - ⚡ Generation
  - ATC Transmission Line (width = voltage)



**ATC**  
 AMERICAN TRANSMISSION COMPANY

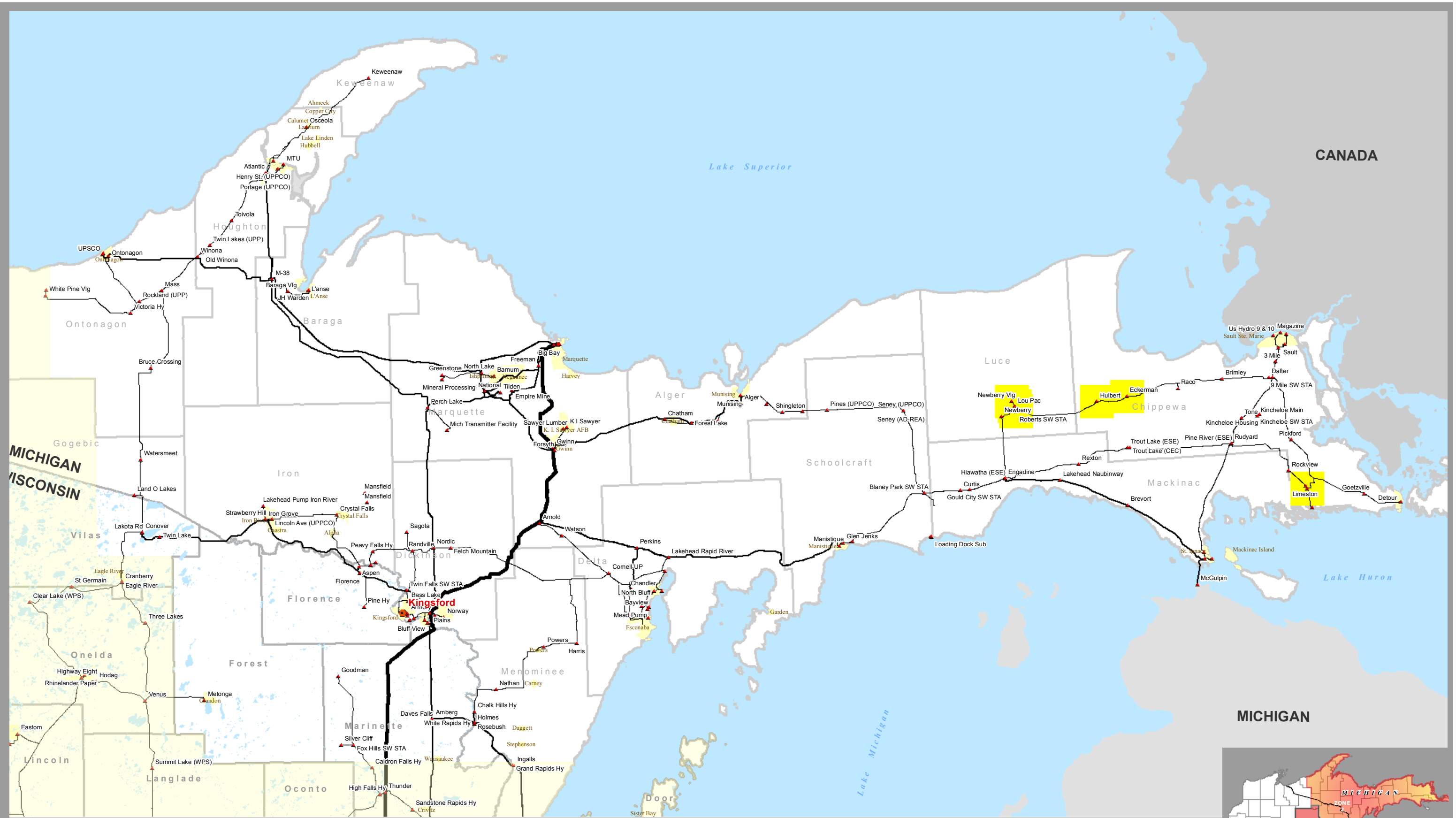
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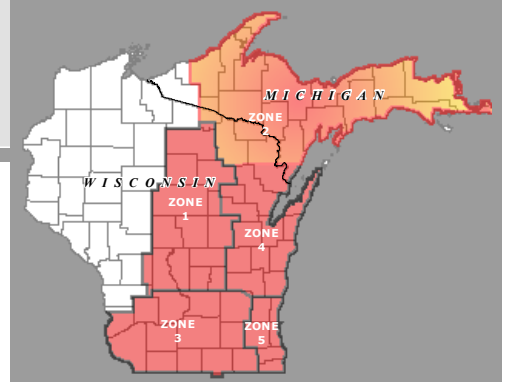
Figure ZS-8



**Performance Criteria Exceeded and Other Constraints (2012-2026)**  
**PLANNING ZONE 2**

- High or Low Bus Voltage
- Overloaded Facility

- Existing Transmission Facilities**
- ATC Office Location
  - ▲ ATC Substation, Switchyard or Terminal
  - ⚡ Generation
  - ATC Transmission Line (width = voltage)

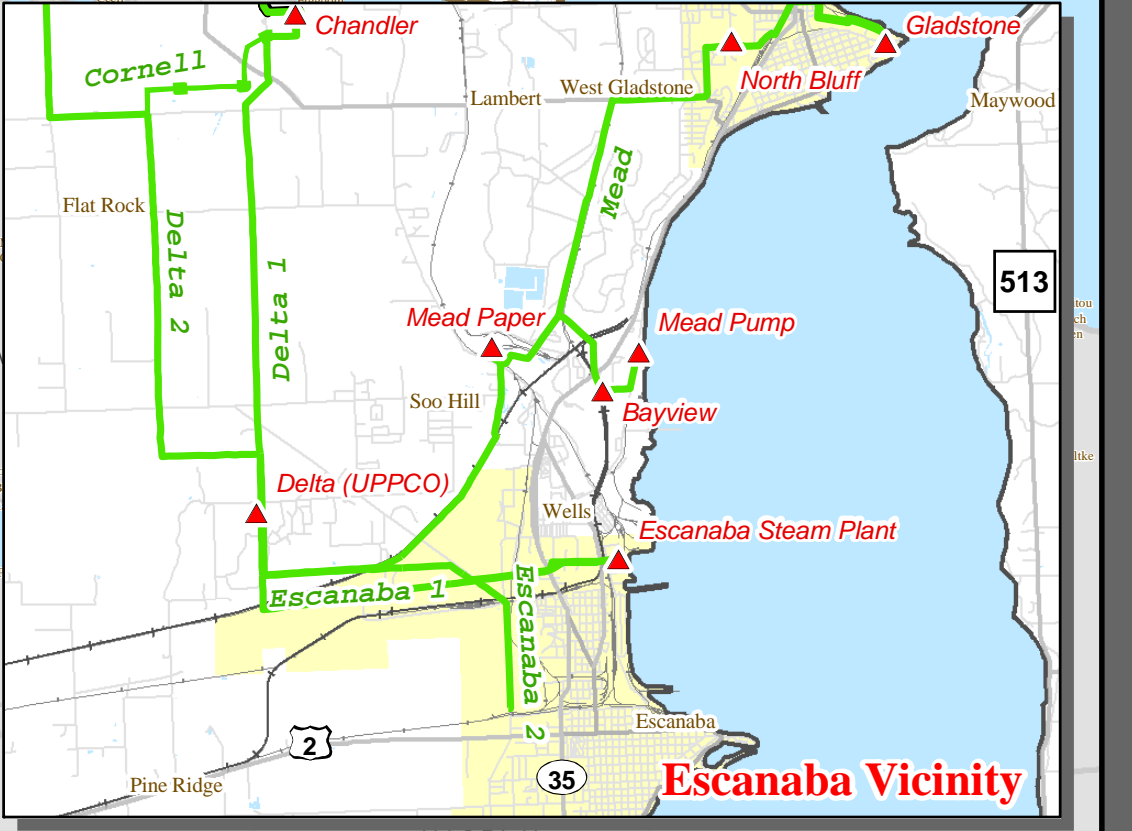
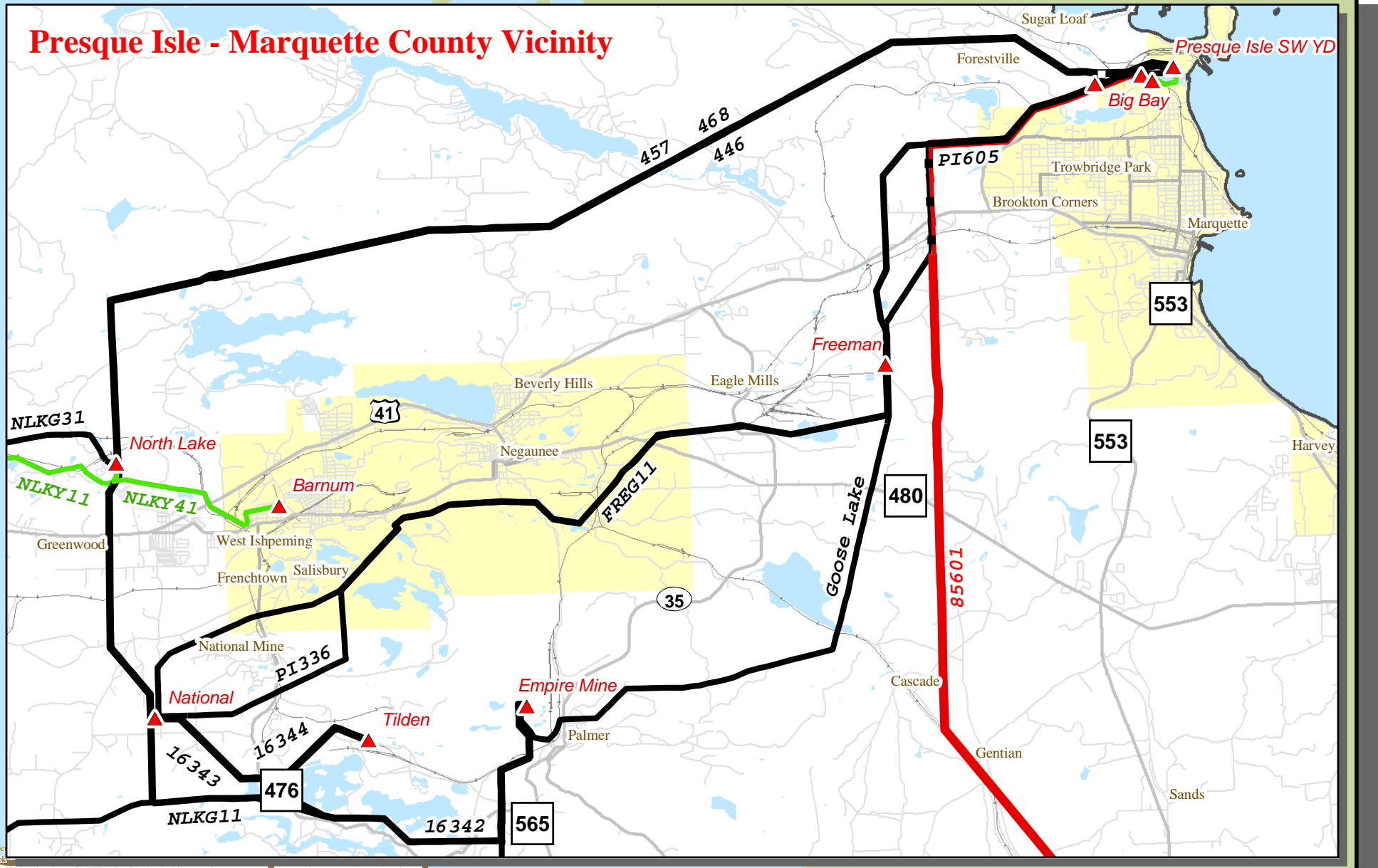
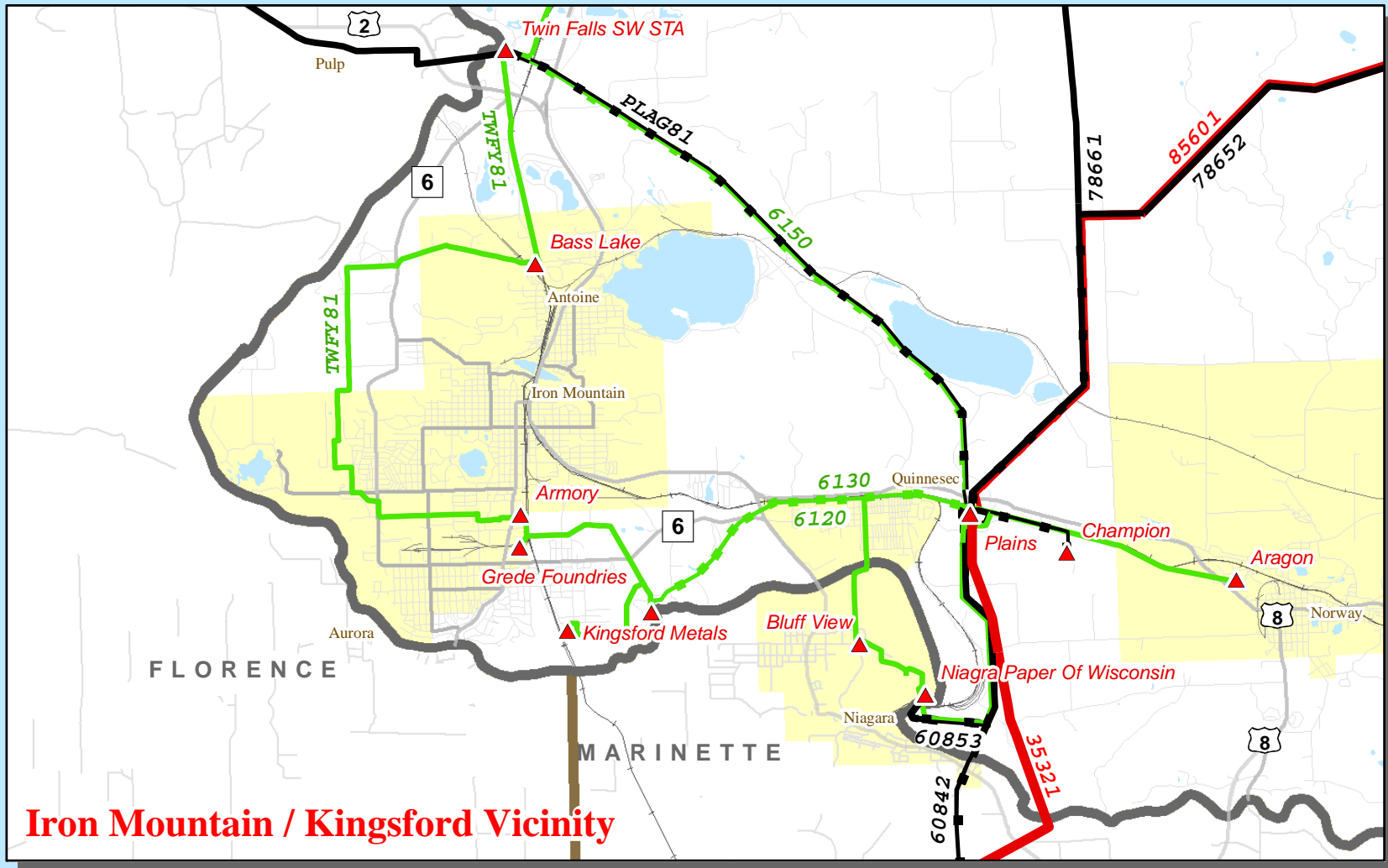
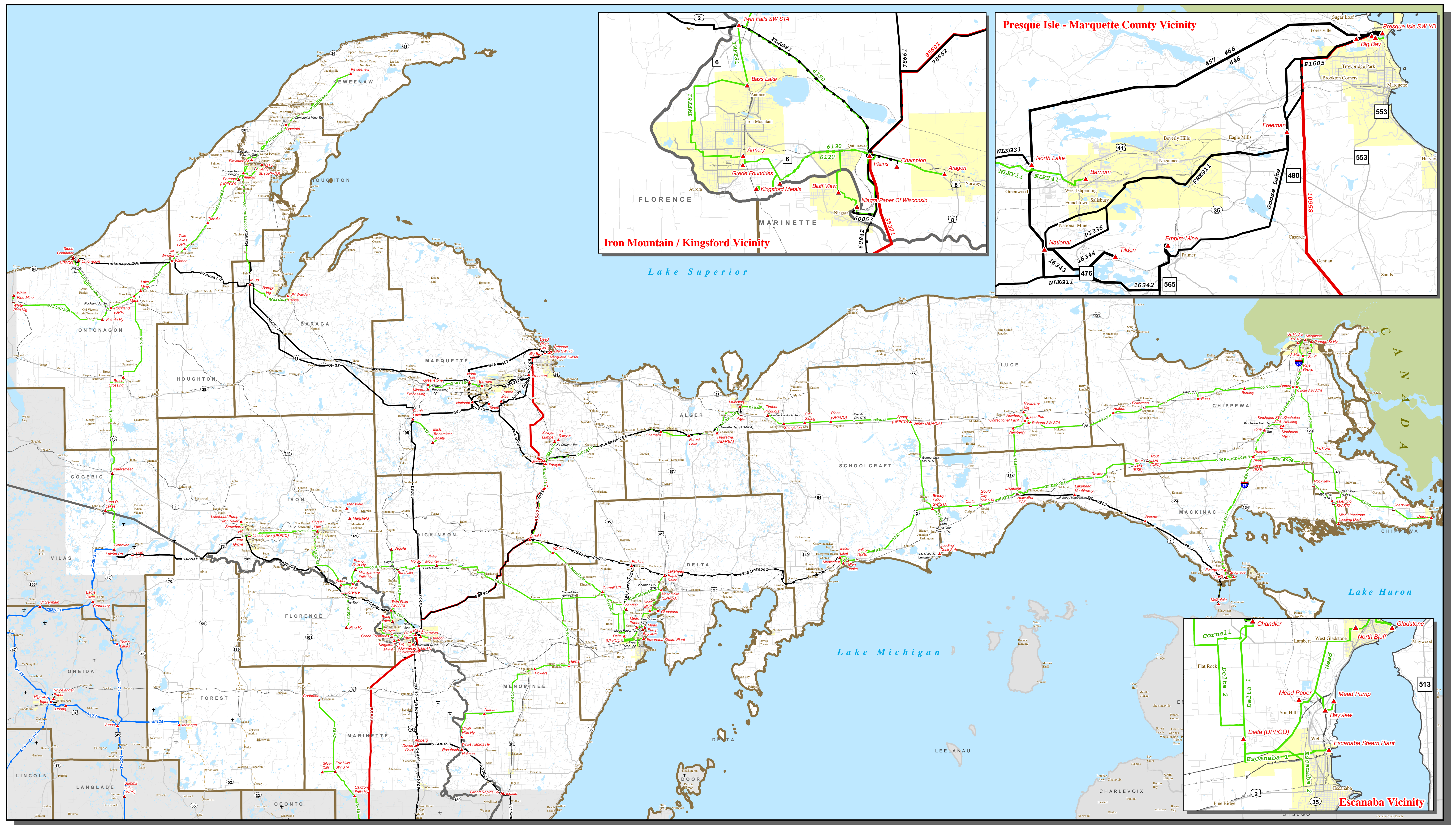


**ATC**  
 AMERICAN TRANSMISSION COMPANY

Currently, ATC owns or operates transmission facilities in Wisconsin, Illinois, Minnesota, and the Upper Peninsula of Michigan. Facilities include:

- \* Approximately 9440 miles of transmission lines
- \* 96 wholly owned substations
- \* 419 jointly owned substations
- \* ATC offices in Madison, Cottage Grove, Pewaukee, DePere, and Kingsford, MI

The information presented in this map document is advisory and is intended for reference purposes only. American Transmission Company owned and operated facility locations are approximate.



**Electrical Transmission and Related Facilities**

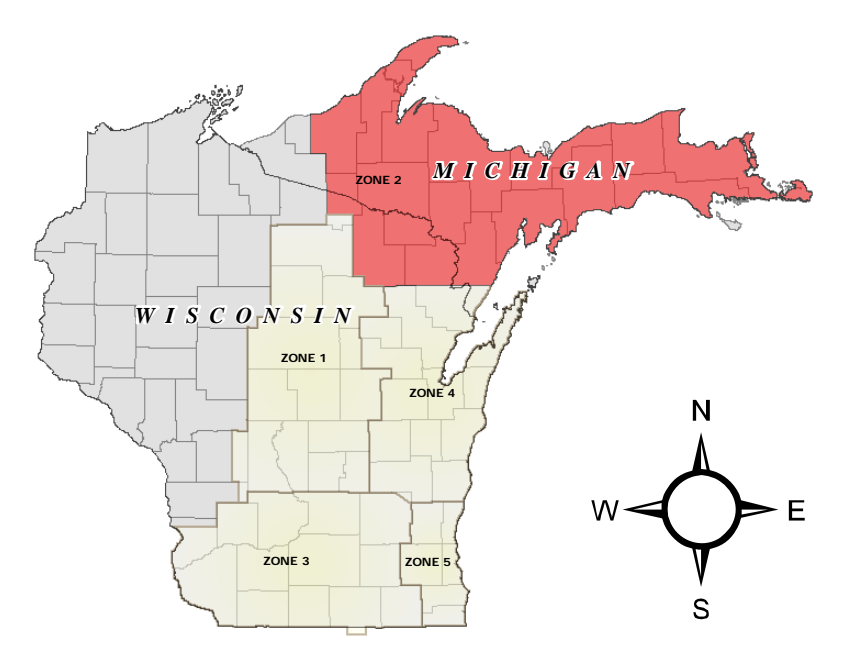
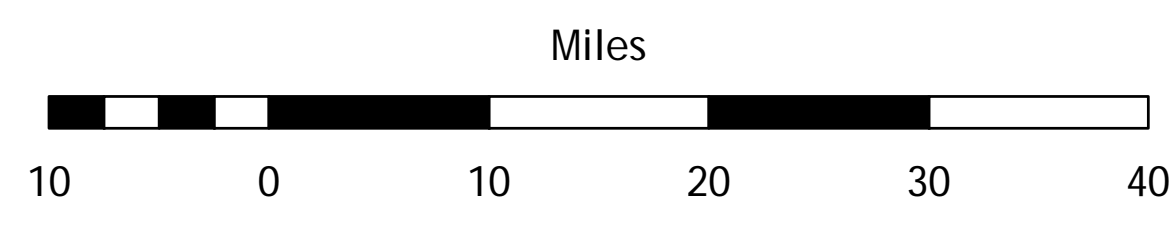
- Transmission Facilities**
- ▲ Substation or Switchyard
  - Tap or Switching Structure
  - Generation
  - ATC Office Location

- Transmission Line Voltage and Type**
- 69 kV
  - 115 kV
  - 138 kV
  - 345 kV
  - 69 kV Double Circuit
  - 115 kV Double Circuit
  - 138 kV Double Circuit
  - 345 kV Double Circuit
  - 69 kV Underground
  - 115 kV Underground
  - 138 kV Underground
  - MI Paved Airport or Airfield
  - MI Unpaved Airport or Airfield
  - WI Airport or Airfield

Mixed voltage double circuit lines drawn using line colors representative of voltage. Actual line configuration may be obscured due to map scale. Please notify ATC Real Estate/GIS of any errors or omissions found.

Transmission Network and Substations

# PLANNING ZONE 2



Currently, ATC owns or operates transmission facilities in 50 Wisconsin counties and in 15 Michigan counties. Facilities include:

- \* Approximately 9350 miles of transmission lines
- \* 96 wholly owned substations
- \* 410 jointly owned substations
- \* ATC offices in Madison, Cottage Grove, Pewaukee, De Pere, Wausau and Kingsford, WI

The information presented in this map document represents the most current and accurate georeferenced compilation of ATC owned and operated transmission facilities available - some facility locations may be approximate. This map is advisory and intended for reference purposes only. Please direct any revisions or corrections to ATC Asset Applications and GIS Group.

Base Map Information: ATC, PSCW, MDNR, WDNR