

Section IV

CHANGES TO THE 2003 10-YEAR ASSESSMENT

This section describes the changes made by ATC to certain planned, proposed and provisional transmission projects since the 2003 10-Year Assessment was issued. These changes are based on regulatory actions and updated information provided by the local distribution companies, the latest transmission service requirements, interconnection requests, recent analyses conducted by ATC, and input from various stakeholders at ATC-sponsored meetings.

New Generation Projects

In its 2003 10-Year Assessment, ATC utilized the following criteria to establish which proposed new generation would be included in the power flow analyses conducted:

Those generation projects for which, at the time the models were developed, (i) ATC has completed a generation interconnection study, a transmission service impact study and, if required, a transmission service facility study, and (ii) the generation developer or a customer of the developer has accepted the transmission service approved by ATC.

Since the 2003 10-Year Assessment, the following two new generation projects have met the criterion above and are included in the 2004 Assessment.

Fox Valley Generation

A new power plant is under construction near Kaukauna (Zone 4). This project was approved by the Wisconsin Public Service Commission for a total of 670 megawatts. By June 2005, the developer is currently projecting to install 350-400 megawatts of generating capacity. Interconnection studies have been completed for both the 350-400 megawatts of capacity in 2005 and the ultimate 670-megawatt development. A transmission service study for 235 megawatts of the plant output has been completed, and the requested service approved and accepted. The following transmission facilities will be constructed by ATC to support this new generation:

- A new 345 kV switchyard located at the power plant site to connect the two generators and to connect three 345 kV lines
- Loop the existing Point Beach-North Appleton 345 kV line into the new switchyard
- A new 11-mile, 345 kV line from the power plant site to Forest Junction substation, utilizing approximately 8 miles of unused 345 kV line on existing right-of-way between the plant site and Forest Junction.

Weston Power Plant Expansion

A new 500-megawatt generator (Weston 4) has been proposed at the existing Weston Power Plant site near Wausau (Zone 1). This generator is projected to be in service in 2008. ATC has conducted interconnection studies and transmission service studies to

determine the impact of the generator on the transmission system. The results indicate that a new 345 kV line from Weston is needed and that various lower voltage lines need to be upgraded. In addition, the study results indicate that the Arrowhead-Weston 345 kV line is needed in addition to the required reinforcements above. Additional details on the transmission requirements for this generator are provided later in this section.

Based on the results of the studies, ATC is proposing that the transmission projects listed below be constructed. Appropriate applications to the Wisconsin PSC will be developed and submitted during the next two years.

- ❑ Construct a new 345 kV line from the Gardner Park substation to a new substation, currently called Central Wisconsin, located near the midpoint of the proposed Morgan-Werner West 345 kV line. ATC is proposing to license, construct and put this line in service by December 2009.
- ❑ Upgrade the Weston-Kelly 115 kV line by 2009.

The scheduled in service date for the new Weston 500-megawatt generator is June 2008 and the projected in service date for the Gardner Park-Central Wisconsin 345 kV line is December 2009. Based on the 18-month in service date difference between the generator and 345 kV line project, additional studies were performed to determine if any feasible projects exist for delivery of all or a portion of the 500 megawatts prior to the in service date of the above 345 kV project. The interim transmission service and generator interconnection studies identified the following projects that will allow the generator to operate during this interim period under certain operating limitations and restrictions. Full generator operation will not be allowed until all necessary 345 kV lines are placed in service.

- ❑ Rebuild/reconductor Weston-Northpoint 115 kV line
- ❑ Upgrade Northpoint-Rocky Run 115 kV line
- ❑ Upgrade Weston-Sherman St. 115 kV line
- ❑ Upgrade Weston-Morrison Ave.-Sherman St. 115 kV line
- ❑ Upgrade Weston-Kelly 115 kV line
- ❑ Upgrade Kelly-Whitcomb 115 kV line
- ❑ Upgrade Whiting Avenue-Plover 115 kV line

Transmission Projects

Zone 1

Venus-Metonga-Laona 138 kV (operate at 115 kV) Line

This project was proposed in response to a request by WPS for new distribution (T-D) interconnections at Metonga and Laona. Based on further analysis by WPS, the in service date of Metonga has been deferred from 2005 to 2007. In addition, WPS has proposed to site the Metonga substation on the east side of Crandon and expand the substation to include two distribution transformers. This will provide the ability to serve both the

Crandon and Laona areas with a single distribution substation and allow the flexibility to withdraw the Laona substation T-D interconnection request.

Rocky Run-Northpoint 115 kV line uprate

This project is proposed to reduce the number of Transmission Loading Relief (TLR) incidents called during the outage of the Weston-Rocky Run 345 kV line by replacing substation equipment at Northpoint with higher-rated equipment. This line segment is one of the initial limiters consistently identified in system impact studies in response to requests for transmission service. Therefore, by replacing the disconnect switches, this project will allow for the approval of additional transmission service.

Eagle River-Cranberry/Three Lakes 115 kV line

This proposed project interconnects a new Eagle River Light and Water substation currently being called Eagle River. The in service year for this project has been deferred from 2005 to 2006 to reflect a more realistic in service date given the precertification activities that will be undertaken.

Clear Lake-Arnett Road 115 kV line

This proposed project interconnects a new WPS T-D substation, Arnett Road. The in service year for this project has been deferred from 2005 to 2007 due to the additional time and resources required to perform precertification work for this new line on new right-of-way.

Arrowhead-Weston construction plans

Gardner Park Substation

Two major projects to be interconnected at Weston (the planned Arrowhead-Weston 345 kV line and a proposed new 500-megawatt generator) will require that substation facilities at Weston be expanded. After extensive evaluation of the existing substation facilities at Weston, ATC has determined that a new 345/115 kV substation on the Weston power plant site is the most feasible course of action. This new substation will be tied to the existing 115 kV switchyard at Weston via two new 115 kV circuits.

The Arrowhead-Weston project will initially require the development of the following 345 kV substation facilities at the new Gardner Park substation:

- A new four-position 345 kV ring bus to accommodate the new Arrowhead-Weston 345 kV line
- The existing Weston-Rocky Run 345 kV line
- Two new 500 MVA, 345/115 kV transformers

The Arrowhead-Weston project also will require the installation of 115 kV substation facilities to accommodate the two 345/115 kV transformers, two 115 kV lines connecting the existing Weston 115 kV substation to the new Gardner Park substation, and one of the existing 115 kV lines currently terminated at the existing 115 kV Weston bus. Power flow studies have indicated that moving either the Weston-Kelly 115 kV line or the Weston-Blackbrook 115 kV line to the new Gardner Park substation provides the optimum network benefits. Physical line routing constraints around the existing Weston

substation will determine which of these two lines will be relocated to the Gardner Park substation.

The proposed 500-megawatt generator addition at the Weston Power Plant will require the expansion of the initial 345 kV substation facilities described above, including two new 345 kV bus positions to accommodate the 345 kV leads from the generator and a new 345 kV line to the Central Wisconsin substation (see below). To summarize, this substation will allow ATC to interconnect lines and generators in the most logical fashion in light of the major project additions.

Arrowhead-Weston reactive support

In the 2003 10-Year Assessment, ATC initially specified that the following capacitor banks would be needed to support the transfer capability target associated with the Arrowhead-Weston project:

- Two 25 MVAR capacitor banks at Arpin 138 kV
- Two 25 MVAR capacitor banks at Arpin 115 kV
- Two 40 MVAR capacitor banks at Weston 115 kV
- Three 52 MVAR capacitor banks at Rocky Run 115 kV
- One 65 MVAR capacitor bank at Arrowhead 230 kV

Since the release of the 2003 10-Year Assessment, ATC has revisited the reactive support for the Arrowhead-Weston line in an effort to optimize the capacitor requirements. Both steady state and voltage stability studies are ongoing with the preliminary results indicating a change in size and placement of the capacitors including:

- Six 34 MVAR capacitor banks at Gardner Park 115 kV
- One 40 MVAR capacitor banks at Arpin 138 kV
- Four 50 MVAR capacitor banks at Arrowhead 230 kV

The sizes and locations of these capacitor bank installations will change depending on whether the existing Stone Lake 161 kV substation is expanded to accommodate capacitor banks. Studies done to date indicate that locating capacitors at Stone Lake would be more effective, and thus reduce the overall reactive requirements at Arrowhead and Gardner Park.

Arrowhead-Weston midpoint substation

ATC is considering several potential applications for making temporary expansion of the Stone Lake substation permanent. As noted above, a 345/161 kV transformer will be installed at Stone Lake during construction of the northern portion of the Arrowhead-Weston line to support the system during the outage of the Stone Lake-Stinson 161 kV line. Other potential applications include installation of capacitor banks and an inductor bank for both switching and operating the Arrowhead-Weston line.

Whether the 345/161 kV transformer becomes permanent may be driven by either of two factors:

- The benefits of interconnection to the Xcel Energy and Dairyland Power Cooperative facilities at Stone Lake, and

- The benefits of installing 161 kV capacitor banks at Stone Lake, either with or without the interconnection to the Xcel Energy and Dairyland Power Cooperative facilities.

ATC believes there is considerable benefit to installing capacitor banks and inductor banks at Stone Lake. As noted above, installing capacitor banks at Stone Lake provides more effective reactive support than comparable amounts at Arrowhead and/or Gardner Park. Installing an inductor bank at Stone Lake is more beneficial for switching and operating Arrowhead-Weston than a comparable bank at Gardner Park.

ATC also believes there are benefits associated with an interconnection to Xcel Energy and Dairyland Power Cooperative, though the study work to confirm these potential benefits is ongoing.

Zone 2

Stiles-Plains double circuit 138 kV line

This proposed project addresses the most limiting transmission element to transferring power from Wisconsin to the Upper Peninsula of Michigan. Due to the critical nature of this line, it cannot be taken out of service to be uprated (rebuilt) without severely jeopardizing the ability to serve load in the Upper Peninsula. Various energized rebuild and reconductor options were evaluated. Based upon these analyses, ATC believes the most prudent method of uprating this line is a complete rebuild. Replacement of the structures and the use of larger conductors will improve the reliability and improve the emergency transfer capability and voltage stability transfer limits. The in service year was changed from 2004 to 2005 due to numerous complications encountered with planning the rebuild of the line while maintaining the Wisconsin to Upper Peninsula transfer capability. To minimize the risks associated with keeping the line energized during construction, a temporary line on the same right-of-way is planned on the northern most 21 miles (Plains-Amberg). On the southern 44 miles (Amberg-Stiles), obstructions along much of the right-of-way prevent the use of a temporary line, so ATC is planning to rebuild the existing Amberg-West Marinette 69 kV line and convert it to 138 kV. The Amberg-West Marinette 138 kV line would essentially form a bypass around Amberg-Stiles, allowing ATC to rebuild the Amberg-Stiles line segment conventionally, negating the need for an alternative energized rebuild method.

Nordic-Randville Substation -rebuild single circuit 69 kV to double circuit 69 kV

The opportunity for ATC to accelerate this work from 2005 to 2004 surfaced due to internal resource scheduling.

Zone 3

Rockdale to Boxelder 138 kV line

The scope of work is included in the Jefferson-Lake Mills-Stony Brook 138 kV line project since it is not required until this new network line is constructed and placed in

service. The year of need is tied directly to the in service of the new line; therefore, this work is being deferred from 2005 to 2007.

Jefferson-Lake Mills-Stony Brook 138 kV line

The in service year for this project has been deferred from 2006 to 2007 due to the additional time required to perform pre-certification work on the new right-of-way that will be required for this project.

Construct a new 138 kV line from Rubicon substation to Hustisford substation and rebuild the Hustisford to Horicon 69 kV line to 138 kV (new)

In the course of planning for the transmission needs in Dodge County, several projects have been contemplated. In the 2003 10-Year Assessment, conversion of 69 kV facilities from Columbus through Beaver Dam to 138 kV was considered the best short-term solution with conversion of the South Fond du Lac-Springbrook 69 kV line to 138 kV as a future reinforcement. Shortly after the 2003 10-Year Assessment was issued, ATC proposed swapping the timing of these projects. In the course of evaluating these two alternatives, ATC found that even if both projects were constructed, the system would still experience voltage problems within the next 10 years, and additional reinforcements would be warranted. As a result, additional alternatives have been evaluated.

Recently, ATC has initiated discussions with affected customers to evaluate transmission needs and alternatives while considering distribution needs in the area. Based on the discussions to date, ATC believes that a new alternative, the Rubicon-Horicon 138 kV line, represents the best overall project. This project would address reliability issues for a longer period of time than the two previously considered alternatives.

The Rubicon-Horicon project also will involve the conversion of Hustisford substation to 138 kV along with the installation of a new substation near Horicon with a 138/69 kV transformer. This project is needed to resolve voltage problems in Juneau and Horicon areas, and to address loading and voltage problems on the transmission system near Beaver Dam and Mayville. Since additional time is required to pre-certify, license and build the new 138 kV line from Rubicon to Hustisford, the planned in service date for this project is 2008, rather than the 2007 in service date indicated for the Beaver Dam reinforcement in the 2003 10-Year Assessment.

Brooklyn-Belleville 69 kV line (now Brooklyn-Sugar River)

Sugar River substation (new)

Sugar River-Southeast Fitchburg 138 kV line

These projects were proposed to address low voltages anticipated in the area by 2007. The Brooklyn to Belleville (changed to Sugar River) 69 kV line in service date has been moved up from 2009 to 2007, while the new line from Southeast Fitchburg to Sugar River will be deferred from 2007 until 2009. This deferral is being done to allow enough time for pre-certification activities and CPCN approval for this new 138 kV line on new right-of-way. Providing voltage support to this area requires the new Brooklyn to Sugar

River line be installed by 2007. Long-term needs are expected to require the addition of a new 138 kV line from Southeast Fitchburg.

Zone 4

Werner West-Clintonville 138 kV line

This proposed project relieves congested 138 kV facilities in the Green Bay area, reduces system losses, improves operating flexibility and interconnects with new 345 kV facilities that will be needed if the proposed Weston Unit 4 Power Plant is approved and constructed. Constructing that line to accommodate a 138 kV circuit from Werner West to Clintonville was originally proposed in ATC's 2002 Assessment, but could not be justified based on the 2003 10-Year Assessment analysis. Upon more detailed subsequent analysis, ATC has determined that a 138 kV line from Clintonville to Werner West, which could be strung primarily on the Morgan-Werner West 345 kV line structures, would provide significant system benefits and could be strung at the same time the Morgan-Werner West 345 kV line is constructed. Those benefits include reduced loading on the Highway V-Preble-Tower Drive 138 kV line, the North Appleton-Lawn Rd-White Clay 138 kV line, the Badger 138/115 kV transformer, the Badger-Caroline 115 kV line and facilitating a future de-energized rebuild of the Pulliam-Stiles double circuit 138 kV line, which would not be possible under current system conditions. In addition, the Clintonville-Werner West line will provide a second 138 kV source to the city of Clintonville. Therefore, ATC is proposing that the project be changed to include a new 138 kV circuit from Clintonville to Werner West.

Erdman-Howards Grove 138 kV line

ATC originally proposed constructing a 5-mile 138 kV line, on new right-of-way, from the existing Erdman substation to a new substation named Howards Grove in response to an Alliant T-D request. Since the 2003 10-Year Assessment, Alliant has proposed a location change for the Howards Grove substation site. In addition, ATC has determined that unused right-of-way from the new Howards Grove site to ATC's Forest Junction-Cedarsauk 138 kV line (approximately 2.3 miles) could be used. ATC is now proposing to construct a 2.3-mile double circuit 138 kV line on this existing unused right-of-way, to loop the Forest Junction-Charter Steel 138 kV line into the proposed Howards Grove substation.

Replace 400 Amp Current Transformer at South Fond du Lac 69 kV

This project had been proposed to address a potential overload on the South Fond du Lac-Willow Lawn 69 kV line. The current transformer had been determined to be the limiting element on this line. As a result of more detailed analysis, the current transformer was found to have a rating factor that enabled it to be operated at an ampacity greater than 400 amps and therefore the project was canceled.

Lodestar-Sheboygan Falls 138 kV line

In its 2002 Assessment, ATC identified that 138/69 kV transformers in and around Sheboygan were reaching their ratings. In the 2003 10-Year Assessment, ATC evaluated several alternatives and found that a new 138 kV line from Lodestar to Sheboygan Falls would adequately address these transformer issues. Since that time, ATC has continued to

evaluate various options. Based on this analysis, ATC now concludes that replacing four transformers (two at Edgewater, one at South Sheboygan Falls and one at Mullet River) performs better from a system perspective, is likely to be more cost-effective, can be implemented in a more timely fashion, and requires no new right-of-way.

Zone 5

Hartford 138 kV capacitor bank

This new project is proposed as a result of low voltages that were identified in the Hartford area. A 26 MVAR capacitor bank is scheduled to be installed in 2005.

Rockdale-Lannon Junction 345 kV line

This project was proposed as a result of numerous low bus voltages that were identified in eastern Jefferson, western Waukesha and southern Washington counties, all areas where load growth has been and continues to be high. In addition to improving voltage profiles, reducing loadings on parallel 138 kV circuits and reducing losses, the proposed reinforcements will improve ATC's existing east-west transfer capability. The project was initially proposed as follows:

- ❑ Construct a new 345/138 kV Lannon Junction substation at the intersection of Forest Junction-Arcadian 345 kV line, Arcadian-Granville 345 kV line, and Germantown-Bark River 138 kV and Sussex-Tamarack 138 kV lines and install a 500 MVA, 345/138 kV transformer at this substation
- ❑ Construct a second Germantown-Lannon Junction 138 kV line
- ❑ Rebuild Rockdale-Jefferson-Concord 138 kV line to double circuit 345/138 kV and install a 500 MVA, 345/138 kV transformer at Concord
- ❑ Convert the Bark River-Lannon Junction 138 kV line to 345 kV operation and install a 500 MVA, 345/138 kV transformer at Bark River
- ❑ Construct a new 345 kV line from Concord to Bark River

A more detailed analysis concluded that the second Germantown-Lannon Junction 138 kV line was no longer needed. The initial reasoning for the second Germantown-Lannon Junction line was to ensure stable operation under contingency. However, the stability situation was no longer an issue after the second breaker was installed on the Germantown-Bark River line.

Additionally, it was found that looping a second 345 kV line into the new Lannon Junction substation provides minimal initial benefit to the transmission system at an additional cost of \$3.6 million. Although the substation will be designed to ultimately accommodate future expansion, it is not cost-effective at this time to loop the Forest Junction-Arcadian 345 kV line into the proposed Lannon Junction substation.

System reinforcements for Elm Road generation

We Power submitted an application to the Wisconsin PSC proposing installation of 1950 megawatts of generation facilities at the existing Elm Road generation site in three phases of 650 megawatts each to be in service by June of 2007, 2009 and 2011.

The transmission facilities associated with the Elm Road generation project listed in the 2003 10-Year Assessment were required based on the results of thermal and stability studies conducted on these proposed generation facilities including the impacts of two competing interconnection requests. One request included the proposed connection of 1,194 megawatts on the Arcadian – Zion 345 kV line and the other request included the proposed connection of 375 megawatts on the Arcadian – Pleasant Prairie 345 kV line. Both of these requests have since been withdrawn. The PSCW order issued on the Elm Road generation application approved only two of the three phases with in-service dates of June 2009 and 2010. Following the issuance of the 2003 10-Year Assessment, stability restudies were conducted for the approved Elm Road generation facilities and with the withdrawal of the two interconnection requests. As a result of those studies, the in-service dates and required transmission facilities associated with the Elm Road generation project have been revised in this 2003 Update to reflect the latest findings. The affected projects are listed below:

- ❑ *Reconductor segment of the Oak Creek-Ramsey 138 kV line*
- ❑ *Reconductor underground segment of Ramsey-Harbor 138 kV line*
- ❑ *Reconductor Oak Creek-Allerton 138 kV line*

The in-service year for above three projects has been deferred from 2007 to 2009 because of the change in the in-service date of the first unit at Elm Road.

- ❑ *Construct an Oak Creek-Brookdale 345 kV line*
- ❑ *Construct a Brookdale-Granville 345 kV line*
- ❑ *Construct Oak Creek-St Martins 138 kV circuit*
- ❑ *Restring Bluemound-Butler 138 kV line on new 345 kV structures installed with Brookdale-Granville line*
- ❑ *Construct Butler-Tamarack (Carmen) 138 kV line on new 345 kV structures installed with Brookdale-Granville line*
- ❑ *Construct a 345/138 kV switchyard at Brookdale to accommodate two 345 kV lines, a 345/138 kV transformer and four 138 kV lines plus two 138/26.2 kV transformers*

The in-service year for the above six projects has been deferred from 2007 to 2010. This change is due in part to the change in the in-service date of the Elm Road generation, and in part to the results of the restudy conducted for Phases I and II, which shows the line is not required with the first 650-megawatt unit but is required with the installation of the second 650-megawatt unit (Phase II). The restudy also reflects a new connection configuration for the Elm Road generators.

- ❑ *Convert and reconductor Oak Creek-Bluemound 230 kV line to 345 kV*

This project is deleted from the list of 2007 projects and canceled because the restudy results show that the conversion of the line is not required for system stability purposes in Phases I, II or III of the proposed generation project at Elm Road without the competing generation in area.

- *Construct 345 kV Bluemound switchyard to accommodate one 345 kV line and a 345/138 kV transformer*

The in-service year for the above project has been deferred from 2007 to at least 2012. The restudy results of Phases I, II and III show that the construction of this substation is not required for system stability purposes unless Phase III of the Elm Road generation project is developed.

- *Expand Oak Creek 345 kV switchyard to interconnect one new generator*

The in-service year has been deferred from 2007 to 2009 because of the change in the in-service date of the first Elm Road unit from 2007 to 2009. In addition, a more detailed analysis in the restudy for Phase I of the Elm Road generation project suggests a revision to the switchyard project. It has been determined that both the existing Oak Creek 345 kV and 138 kV switchyards and associated facilities are to be replaced with a new switchyards in new locations. The only required expansion to the Oak Creek 345 kV switchyard in Phase I of the project is the interconnection of the one new generator. The expansion of the 138 kV switchyard to accommodate a new St. Martins line is deferred from 2007 to 2010 because the restudy results for Elm Road Phases I and II show the line is not required until Phase II of the Elm Road generation project and that the in-service date for the second unit has moved from 2009 to 2010.

- *Reconnect Oak Creek Unit 7 to 345 kV switchyard*

This project is deleted from the list of 2007 projects because the restudy results show that this system modification is not required for system stability purposes in Phases I, II or III of the Elm Road generation project.

- *Install two 345 kV series breakers at Pleasant Prairie on lines to Racine (L631) and Zion (L2221)*

The in service year for this project has been deferred from 2007 to 2009 because of the change in the in-service date of the first unit at Elm Road. Upon more detailed analysis in the restudy for Phase I of the Elm Road generation project, it has been determined that the most prudent method to provide delayed clearing times to meet stability criteria is to replace the existing circuit breakers with independent pole operation breakers that include redundant high-speed relaying, signal connection and DC battery supply. If there is insufficient space for an IPO breaker at either Pleasant Prairie position, then an alternative proposal is to install another line breaker in series with the existing line breaker at each position.

- *Replace seven 138 kV overdutied breakers at Bluemound*

The in-service year for this project has been deferred from 2007 to 2009 because of the change in the in-service date of the first unit at Elm Road. The short circuit restudy for Phase I of the Elm Road generation project is currently under way but has not yet been completed. The results of this restudy could possibly reduce the number of breakers needing replacement.

- ❑ *Uprate Kansas-Ramsey 138 kV line*
- ❑ *Uprate Oak Creek-Ramsey 138 kV line*

The in-service year for the above two projects has been deferred from 2008 to 2009 because of the change in the in-service date of the second Elm Road unit.

- ❑ *Install second 345/138 kV transformer at Oak Creek*

The in-service year for this project has been deferred from 2008 to 2009 because of the change in the in-service date of the second Elm Road unit.

- ❑ *Expand 345 kV switchyard at Oak Creek to interconnect one new generator, plus one new 345 kV line and 138 kV switchyard to accommodate new St. Martins line*

The in service year for this project has been deferred from 2009 to 2010 because of the change in the in-service date of the second Elm Road unit. The expansion of this project is due to the result of the restudy conducted for Elm Road Phases I and II and the deferral of a 345 kV and 138 kV line from Phase I to Phase II.

- ❑ *Expand Oak Creek 138 kV switchyard to reconnect Units 6 and 9*

The in-service year for this project has been deferred from 2011 to at least 2012 because of the uncertainty in the in-service date of a possible third Elm Road unit. Upon more detailed analysis in the restudy for Phase III of the Elm Road generation, this project is being revised as follows: Oak Creek Unit 6 would still be reconnected to the 138 kV switchyard as originally planned for Phase III. However, it has been determined from the results of the restudy that Oak Creek Unit 9 would remain connected at the Oak Creek 230 kV substation as it is today and would not be reconnected to the 138 kV bus in Phase III of Elm Road.

- ❑ *Expand 345 kV switchyard at Bluemound to accommodate three additional 345 kV lines and two additional 500 MVA 345/138 kV transformers*
- ❑ *Reconnect Oak Creek Unit 8 to 345 kV switchyard*
- ❑ *Reroute Brookdale-Granville 345 kV line into expanded Bluemound 345 kV switchyard*

These three projects are deleted from the list of 2011 projects and canceled because the restudy results show that this system modification is not required for system stability purposes for Phase III of the Elm Road generation.

- ❑ *Convert and reconductor Oak Creek-Bluemound 230 kV line to 345 kV and loop into Arcadian 345 kV substation*
- ❑ *Construct Oak Creek-Racine 345 kV line*

The in-service year for the above two projects has been deferred from 2011 to at least 2012 because of the uncertainty in the in-service date of a possible third Elm Road unit. The restudy results for three Elm Road units confirm that these projects are still required for system stability purposes.

- *Replace 22 overdutied 138 kV breakers at Harbor, Everett and Haymarket substations*

The in-service year for this project has been deferred from 2011 to 2012 because of the uncertainty in the in service date of a possible third Elm Road unit. The short circuit re-study for three Elm Road units has not yet been started. The results of this restudy could possibly reduce the number of breakers needing replacement.

- *Expand Oak Creek 345 kV switchyard to interconnect three new generators*

The in-service year for the above project has been deferred from 2011 to at least 2012 because of the uncertainty in the in-service date of a possible third Elm Road unit. Upon more detailed analysis in the restudy of three Elm Road units, this project is being revised. Expansion of the Oak Creek 345 kV switchyard to accommodate the three new units and the two 345 kV lines will still be required as originally planned. However, it has been determined from the results of the restudy that the installation of the eight 345 kV series breakers and the connection of Oak Creek Unit 8 will not be required with three Elm Road units and therefore can be eliminated from the project.

Umbrella Plans

As described in the 2003 10-Year Assessment, ATC has performed analyses that created a Northern Zones Umbrella Plan (Zones 1, 2 and 4) and a Southern Zones Umbrella Plan (Zones 3 and 5). These plans were developed to most efficiently and effectively address the combined issues and need drivers identified within the northern and southern portions of ATC's system. These umbrella-planning activities serve two primary purposes:

1. To evaluate the needs and address issues within the northern and southern portions of the ATC system and develop preliminary plans that adequately address those needs and issues, and
2. To evaluate and refine the preliminary plans based on analyses of various future scenarios.

Since the 2003 10-Year Assessment, ATC has conducted analyses and made numerous refinements to the first phase of its Northern Umbrella Plan. The first phase of the Northern Umbrella Plan is described below. No additional analyses have been conducted of its Southern Umbrella Plan since the 2003 10-Year Assessment, though several reinforcements that were part of that plan have been evaluated and refined.

During 2004, ATC intends to undertake extensive analyses focused on improving our customers' access to energy markets. These analyses will necessarily dovetail with the second phase of development and refinement of the Northern and Southern Umbrella Plans.

Northern Umbrella Plan (Phase 1)

Analyses of the first phase of the Northern Umbrella Plan have been done over the past year to define and refine the projects that comprise the plan. A key component in these activities has been the involvement of affected customers. ATC has met several times with these customers to discuss issues to be resolved, the findings of analyses of project alternatives and to obtain consensus.

The primary considerations in developing the first phase of the northern plan are (1) the chronic limitations to transferring power between Wisconsin and the Upper Peninsula of Michigan and (2) the vulnerability of the system to widespread outages. The northern plan was developed to address these two and other issues. The discussion below describes the pertinent issues, the components and the effects of the Northern Umbrella Plan. The plan is shown graphically in Figure IV-1.

Background

The most chronic problem plaguing day-to-day operation of ATC's transmission system is the limited transfer capability between Wisconsin and the Upper Peninsula of Michigan. Transfer capability becomes limited whenever an element in the transmission system reaches its thermal rating or when the voltage stability limit for transfers to the Upper Peninsula is reached. The resulting effects include:

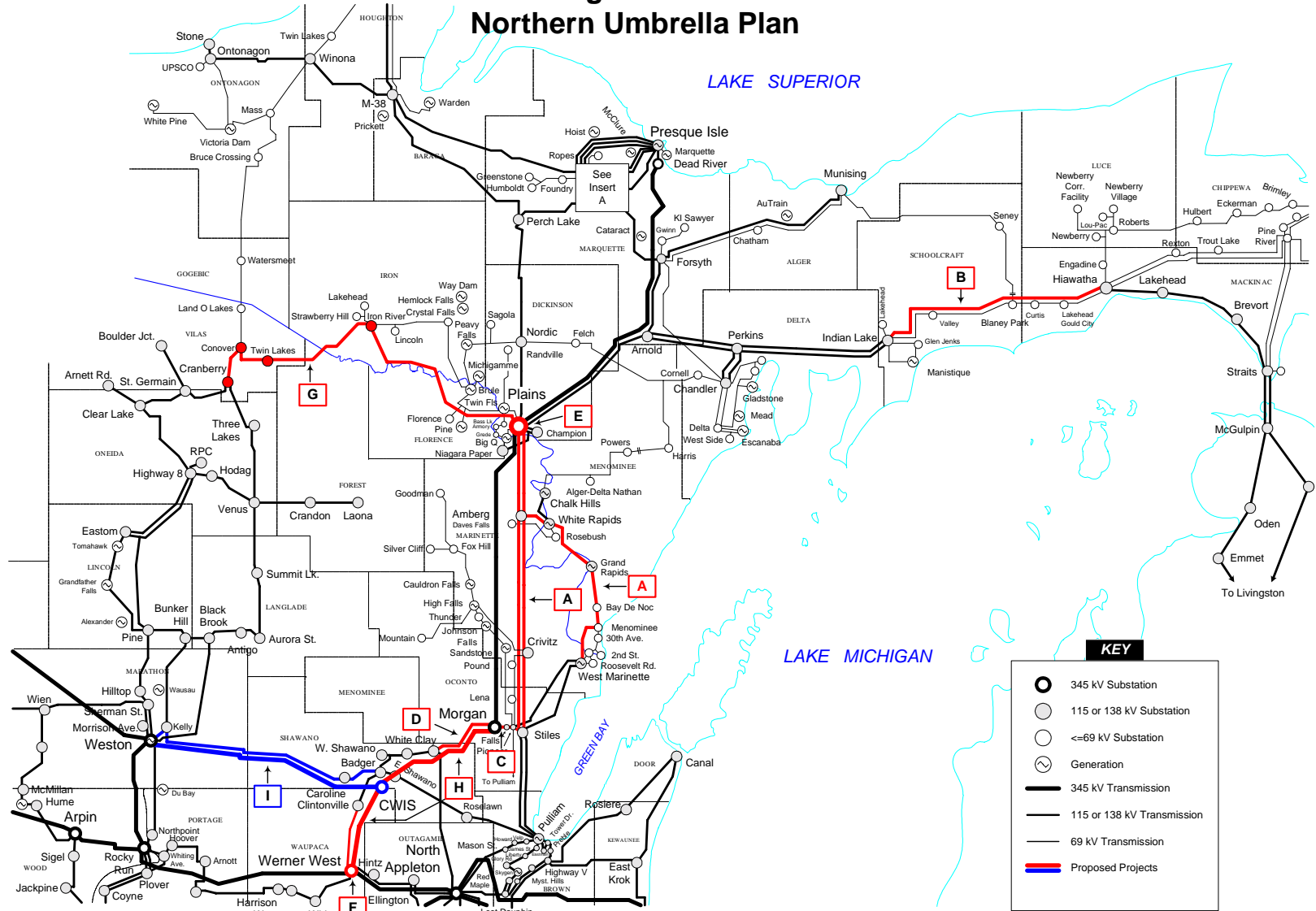
- ❑ Uneconomic dispatch of generation, costing ATC customers millions of dollars annually (over \$10 million from 2001 through 2003), which is expected to continue until limitations are resolved.
- ❑ Chronic interruption or curtailment of transmission service due to the need to invoke Transmission Loading Relief measures. These TLR events have increased from 80 days in 2001 to 230 days in 2003.
- ❑ Frequent reconfiguration of the system (opening the Hiawatha-Indian Lake 69 kV lines), resulting in reduced reliability of the system in Schoolcraft, Luce, Chippewa and Mackinac Counties.
- ❑ Operating near system security limits for extended periods of time, an undesirable operating situation. This situation is an indication that there is little cushion in the system to ride through forced and scheduled outages.
- ❑ Limited ability to schedule maintenance without invoking redispatch, system reconfiguration or other measures—all of which either add to system operation cost or reduced reliability, or both.

The nature of these system limitations changes seasonally. They surface on transmission facilities located in ATC Planning Zone 4 south of Green Bay to facilities located in ATC Planning Zone 2 covering the eastern Upper Peninsula. Given the dynamic nature of these limitations, resolving them will require that several system reinforcements be implemented in a closely coordinated fashion over the next several years.

The system limitations that surface at any given time depend on the following set of variables:

- ❑ system load,
- ❑ what generation is operating,
- ❑ which transmission facilities are out of service,
- ❑ how much power is being scheduled to the Upper Peninsula from Wisconsin, and
- ❑ network loop flows, which can add additional stress to the subject transmission facilities.

Figure IV-1 Northern Umbrella Plan



At various points in time, 21 separate system elements have limited transfer capability between Wisconsin and the Upper Peninsula. Fifteen different 138 kV lines, a 115 kV line, a 69 kV line, two different 345/138 kV transformers and two different 138 kV substations comprise those elements and are located from the Wisconsin/Michigan border to south of Appleton. Several of the facilities that show up as limitations also are well beyond their design life with the following three having more than 70 years in service:

- ❑ Plains-Amberg-Stiles 138 kV double circuit line (1925)
- ❑ Bay de Noc-Grand Rapids 69 kV (line conductor is 1922 vintage—poles were rebuilt in 1931—which is part of West Marinette-Amberg route)
- ❑ Twin Falls-Iron River 69 kV (built in 1912 with sections replaced in 1921)

ATC's goals in addressing these related issues are:

- ❑ to increase transfer capability between Wisconsin and the Upper Peninsula,
- ❑ minimize the impact on system operation while system reinforcements are being implemented,
- ❑ address facility condition issues to the extent practical,
- ❑ achieve greater reliability to reduce the risk of widespread outages in the Upper Peninsula, and
- ❑ achieve all of these benefits at the lowest reasonable cost.

As part of its Northern Umbrella Plan analyses, ATC evaluated 19 project alternatives in roughly 140 combinations to determine which alternatives performed best at meeting the above goals. In general, the combinations of alternatives involving certain projects tended to perform better from a network perspective. Those projects exhibiting superior performance were further evaluated in terms of capital cost, constructability, existing facility condition issues, potential environmental impacts, impacts on customers, and response to extreme conditions (varying load and generation in the Upper Peninsula). Based on the evaluations conducted, ATC has developed the following list of reinforcement projects, for which it plans to seek appropriate regulatory approvals. Italicized projects below have changed in scope from what was reported in ATC's 2003 10-Year Assessment.

- ❑ Rebuild Morgan-Stiles 138 kV line (in-service projection: 2005)
- ❑ Reconstructor Morgan-White Clay 138 kV line (2006)
- ❑ *Rebuild Plains-Stiles 138 kV line*
 - ❑ *Rebuild Plains-Amberg double circuit line while energized, which will require construction of a temporary bypass line during construction (2005)*
 - ❑ *Convert and rebuild 69 kV facilities from White Rapids substation to West Marinette substation and rebuild 138 kV facilities from White Rapids to Amberg (2005)*
 - ❑ *Rebuild Amberg-Stiles double-circuit line, which can be de-energized following completion of the Plains-Amberg and Amberg-West Marinette projects (2006)*
- ❑ Rebuild Hiawatha-Indian Lake 69 kV line for double-circuit 138 kV operation (2005)

- String one circuit and operate at 69 kV until 2009
- String second circuit in 2009
- Convert both circuits to 138 kV operation in 2009
- Construct new Werner West 345/138 kV substation (2006)
- Install second 345/138 kV transformer at Plains substation (2007)
- Construct new Cranberry-Conover 138 kV line (2008)
- Install 138/115 kV transformer at Cranberry substation (2008)
- Rebuild portions of the Plains-Conover 69 kV facilities for 138 kV operation (2008)
- Construct new Werner West-Morgan 345 kV line (2009)
 - This project could involve rebuilding portions or all of the Clintonville-Badger-White Clay-Morgan 138 kV line
 - String a new 138 kV line on the new structures from Clintonville substation to Werner West substation

In addition to the projects described above, ATC is considering other system reinforcements that would address emerging reliability issues to the Upper Peninsula. In particular, rebuilding the 69 kV line from White Rapids to Chandler and converting that line to 138 kV operation is being considered. A portion of the line would be rebuilt for double circuit 138 kV and 69 kV operation. This project would complete a fifth high voltage tie between Wisconsin and the Upper Peninsula, improving system reliability and transfer capability, address an emerging condition issue on the subject line and improve reliability locally. More information on this potential project will be included in the 2004 Assessment.

Transfer Capability Limitations

The transfer capability limitations from Wisconsin to the Upper Peninsula result in significant generation redispatch costs. These limitations vary depending on a variety of factors, but generally can be quantified as follows:

- Summer season: 220 megawatts, due to the thermal capability of the Plains-Stiles line
- Winter season: 250 megawatts, due to voltage stability at and north of Plains

If only the Plains-Stiles line thermal rating was increased, numerous other 138 kV lines, near their ratings under various conditions, would limit transfer capability to less than the existing voltage stability limit. The key to addressing this situation is to develop a plan that is timely, minimizes system impacts during the construction of reinforcements, provides flexibility in the operation of the system, and resolves the limitations for the foreseeable future.

The results of studies done by ATC indicate that by implementing the Northern Umbrella Plan projects, the Wisconsin to Upper Peninsula transfer capability could be at least doubled, with the voltage stability limitation nearly tripling. These increases will:

- allow ATC to accommodate a firm transmission request beginning in 2008 (135 megawatts, WPS to UPPCo),

- ❑ provide considerably more emergency operation and maintenance scheduling flexibility, and
- ❑ reduce the risk of widespread outages in the Upper Peninsula.

In the course of implementing the Northern Umbrella Plan projects, modest increases in transfer capability are expected until the Morgan-Werner West 345 kV project is in service. Figures IV-1-1 through IV-1-10 show existing limitations that are expected to surface during the implementation of the northern plan projects, along with limitations that are resolved as each project is implemented. In these figures, the red ‘stop signs’ show thermal limitations that exist up to the transfer limit dictated by voltage stability under contingency conditions (loss of the Morgan-Plains 345 kV line), which is shown in the red oval near the top of each figure. The larger stop signs indicate thermal limits well below the voltage stability limit. The smaller stop signs indicate thermal limits closer to the voltage stability limit.

As projects are implemented and limitations are relieved, the stop signs are shown in green. It is important to note that limitations below the voltage stability limit surface during the implementation of the Northern Umbrella Plan projects. This is in part due to the fact that the voltage stability limit is increasing by varying amounts with the completion of each project. In particular, completion of the Cranberry-Conover line and Conover-Plains rebuild/conversion increases the number of limitations closer to the voltage stability limit, but the voltage stability limit is expected to increase by over 80 megawatts with that project.

Figures IV-1-1 through IV-1-10 indicate the limitations and limitations relieved for the following sequence of Northern Umbrella Plan project implementation:

<i>Figure</i>	<i>Powerflow Case Utilized</i>	<i>Projects Included</i>
IV-1-1	2005 shoulder peak	❑ None (existing system)
IV-1-2	2005 shoulder peak	❑ Plains-Amberg 138 kV line rebuild and Amberg-West Marinette 69 kV line rebuild/conversion to 138 kV (Project A, Phase 1)
IV-1-3	2005 shoulder peak	❑ Project A, Phase 1 ❑ Hiawatha-Indian Lake 69 kV line rebuild (Project B)
IV-1-4	2006 shoulder peak	❑ Project A Phase 1 ❑ Project B ❑ Morgan-Stiles 138 kV line rebuild and Morgan-White Clay 138 kV line reconductor (Projects C and D)

<i>Figure</i>	<i>Powerflow Case Utilized</i>	<i>Projects Included</i>
IV-1-5	2006 shoulder peak	<ul style="list-style-type: none"> ❑ Project A (Phase 1) ❑ Projects B through D ❑ Amberg-Stiles 138 kV line out of service to rebuild (Project A, Phase 2 during construction outage)
IV-1-6	2006 shoulder peak (note voltage stability limit is now lower on 138/115 kV system west of Green Bay than in the UP)	<ul style="list-style-type: none"> ❑ Project A (Phase 1) ❑ Projects B through D ❑ Amberg-Stiles 138 kV line out of service to rebuild (Project A, Phase 2 in service)
IV-1-7	2007 shoulder peak	<ul style="list-style-type: none"> ❑ Project A (Phase 1 and 2) ❑ Projects B through D ❑ Plains 345/138 kV transformer and Werner West 345/138 kV substation (Projects E and F)
IV-1-8	2007 shoulder peak	<ul style="list-style-type: none"> ❑ Project A (Phase 1 and 2) ❑ Projects B through F ❑ Cranberry-Conover 138 kV line and Conover-Plains 69 kV line rebuild/conversion to 138 kV (Project G)
IV-1-9	2008 shoulder peak	<ul style="list-style-type: none"> ❑ Project A (Phase 1 and 2) ❑ Projects B through G ❑ Arrowhead-Weston 345 kV line (shown in blue)
IV-1-10	2009 shoulder peak	<ul style="list-style-type: none"> ❑ Project A (Phase 1 and 2) ❑ Projects B through G ❑ Morgan-Werner West 35 kV line and Clintonville-Werner-West 138 kV line (Project H) ❑ Arrowhead-Weston 345 kV line (shown in blue)

Figure IV-1-1: 2005 Existing System

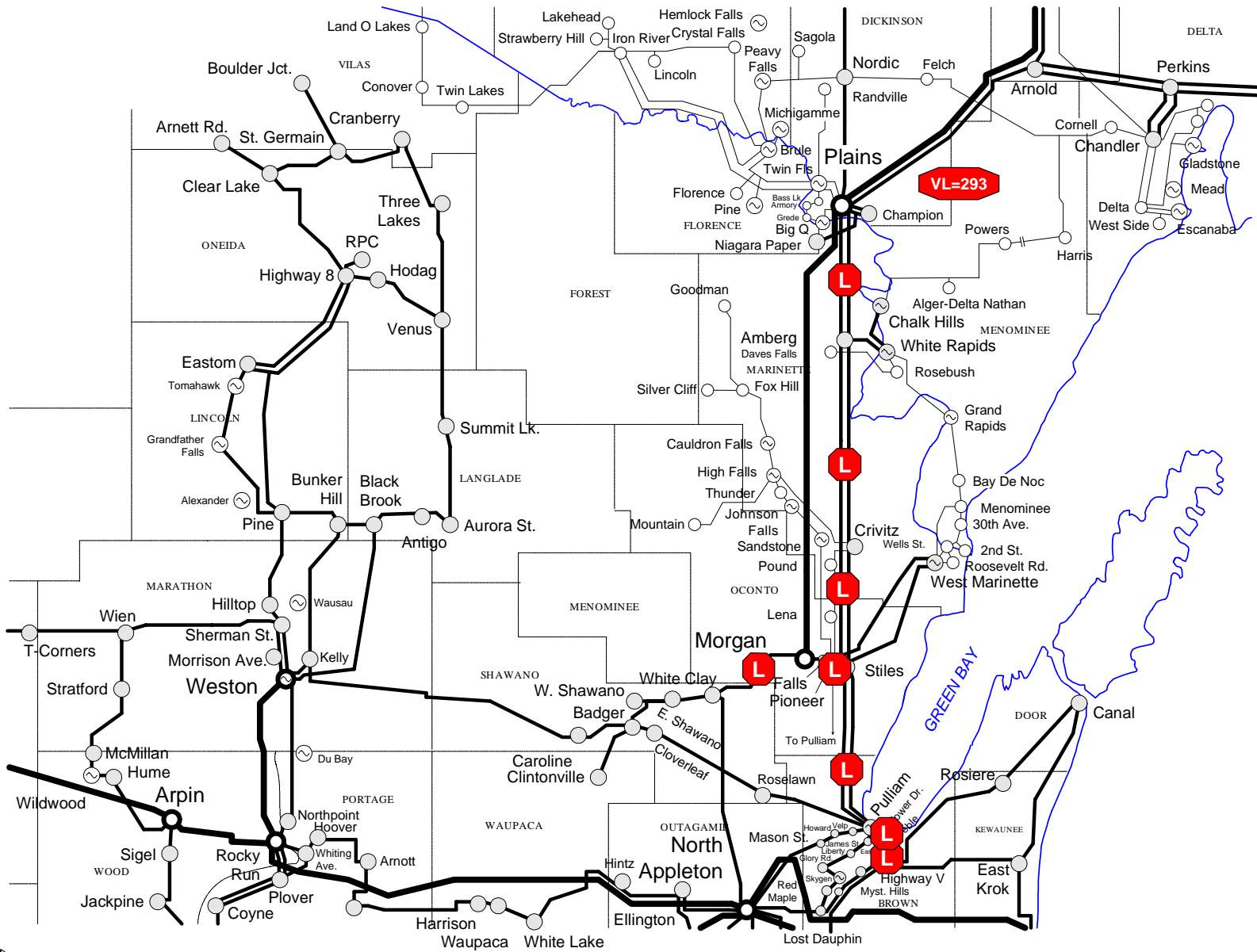


Figure IV-1-2: 2005 System
Add Project A - Phase 1: Plains-Amberg-W.Marinette 138 kV Rebuild

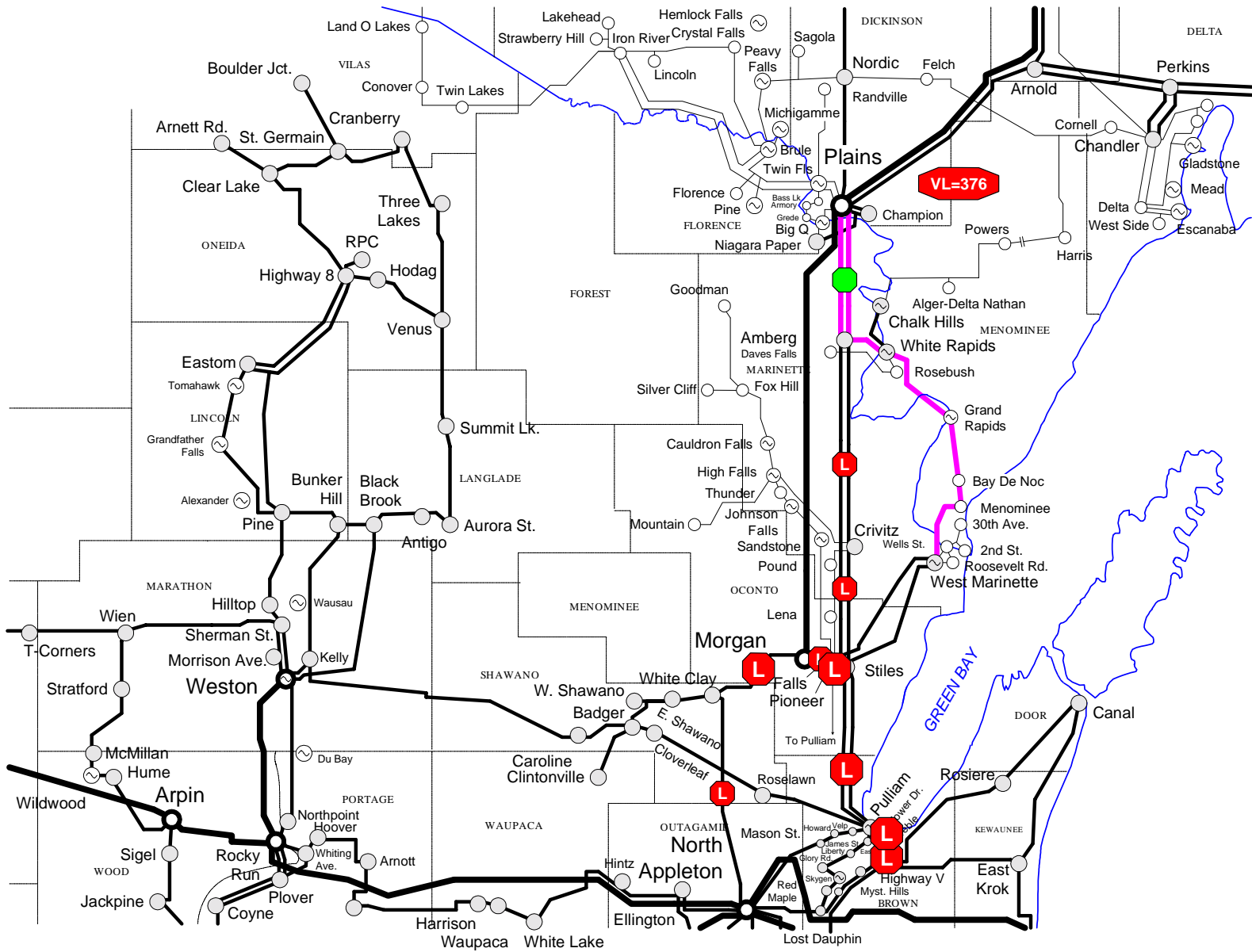


Figure IV-1-3: 2005 System With Project A - Phase 1
 Add Project B: Indian Lake-Hiawatha 69 kV

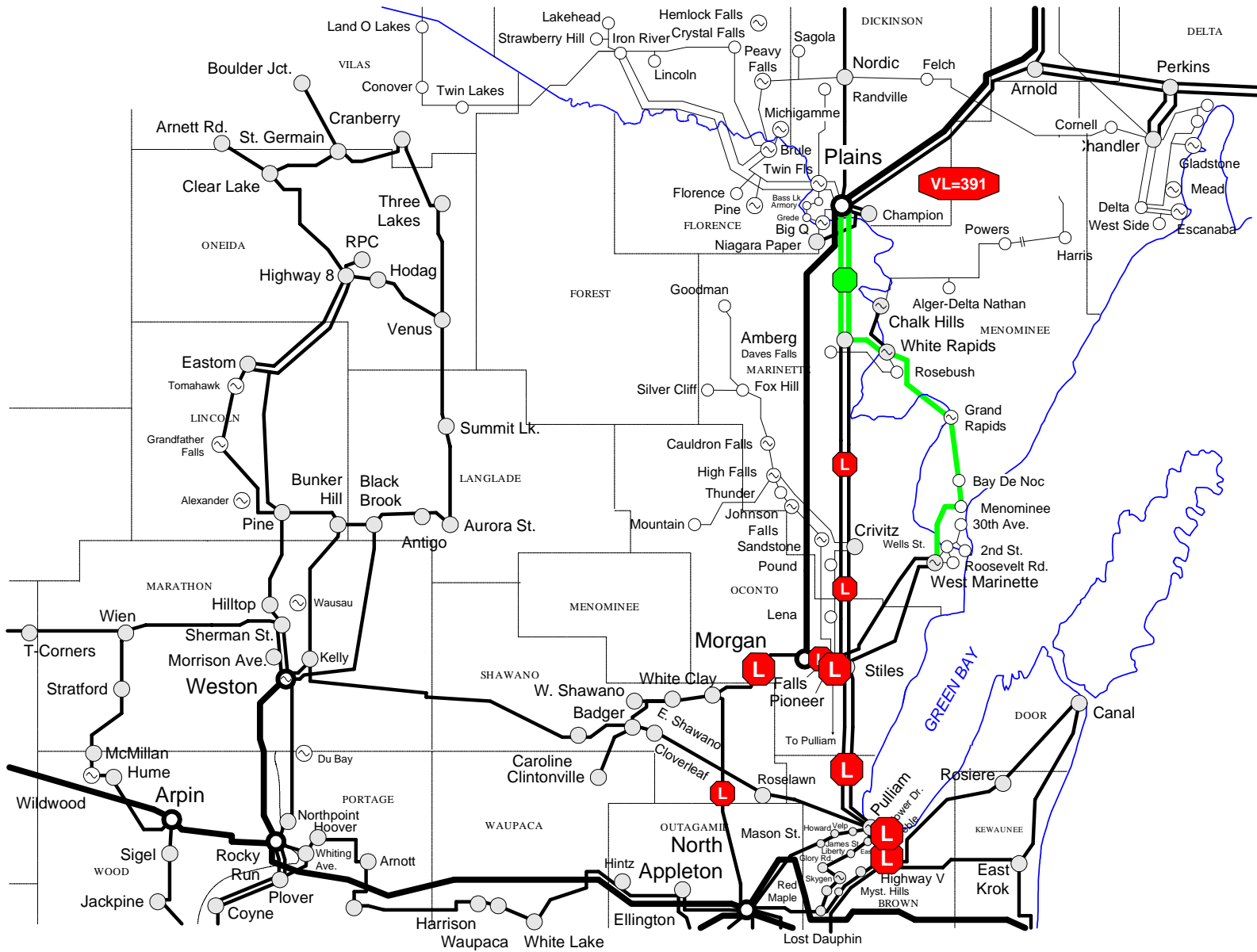


Figure IV-1-4: 2006 System With Projects A - Phase 1, B
Add Projects C + D: Morgan-Stiles 138 kV Rebuild + Morgan-White Clay 138 kV Reconductor

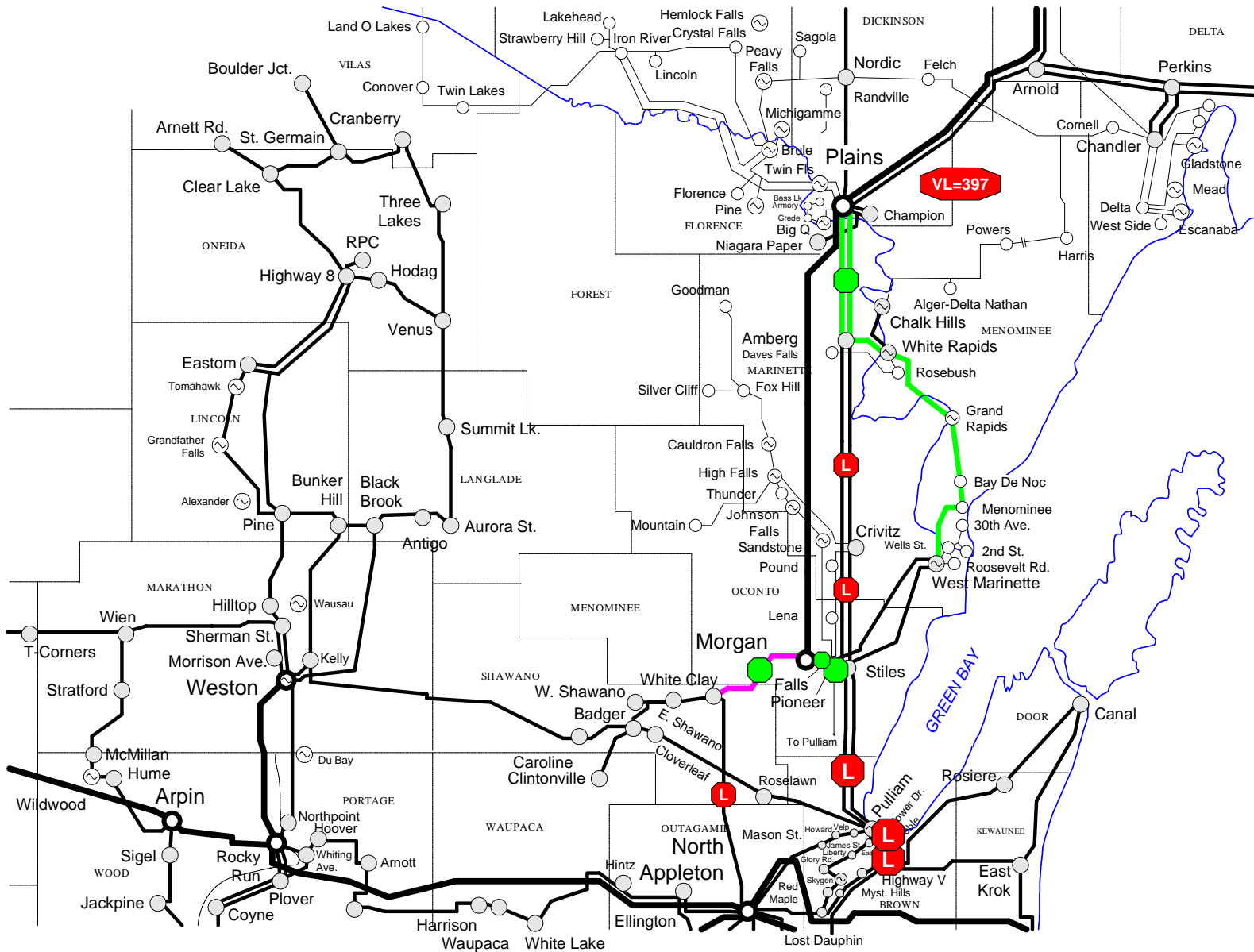


Figure IV-1-5: 2006 System With Projects A - Phase 1, B, C, D
 Amberg-Crivitz-Stiles 138 kV Out-Of-Service During Construction (Project A - Phase 2)

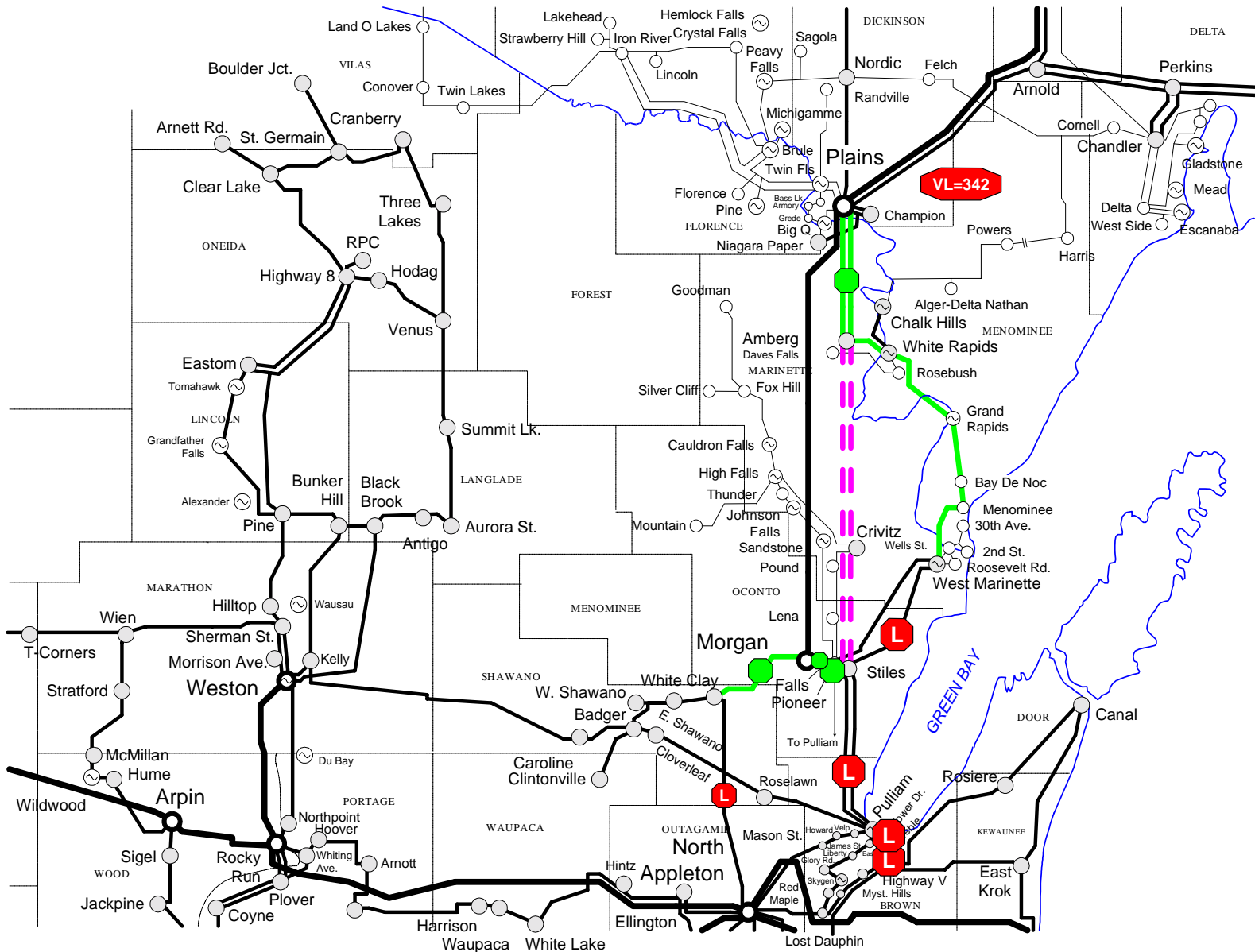


Figure IV-1-6: 2006 System With Projects A - Phase 1, B, C, D
Project A - Phase 2 Completed: Amberg-Crivitz-Stiles 138 kV Rebuild

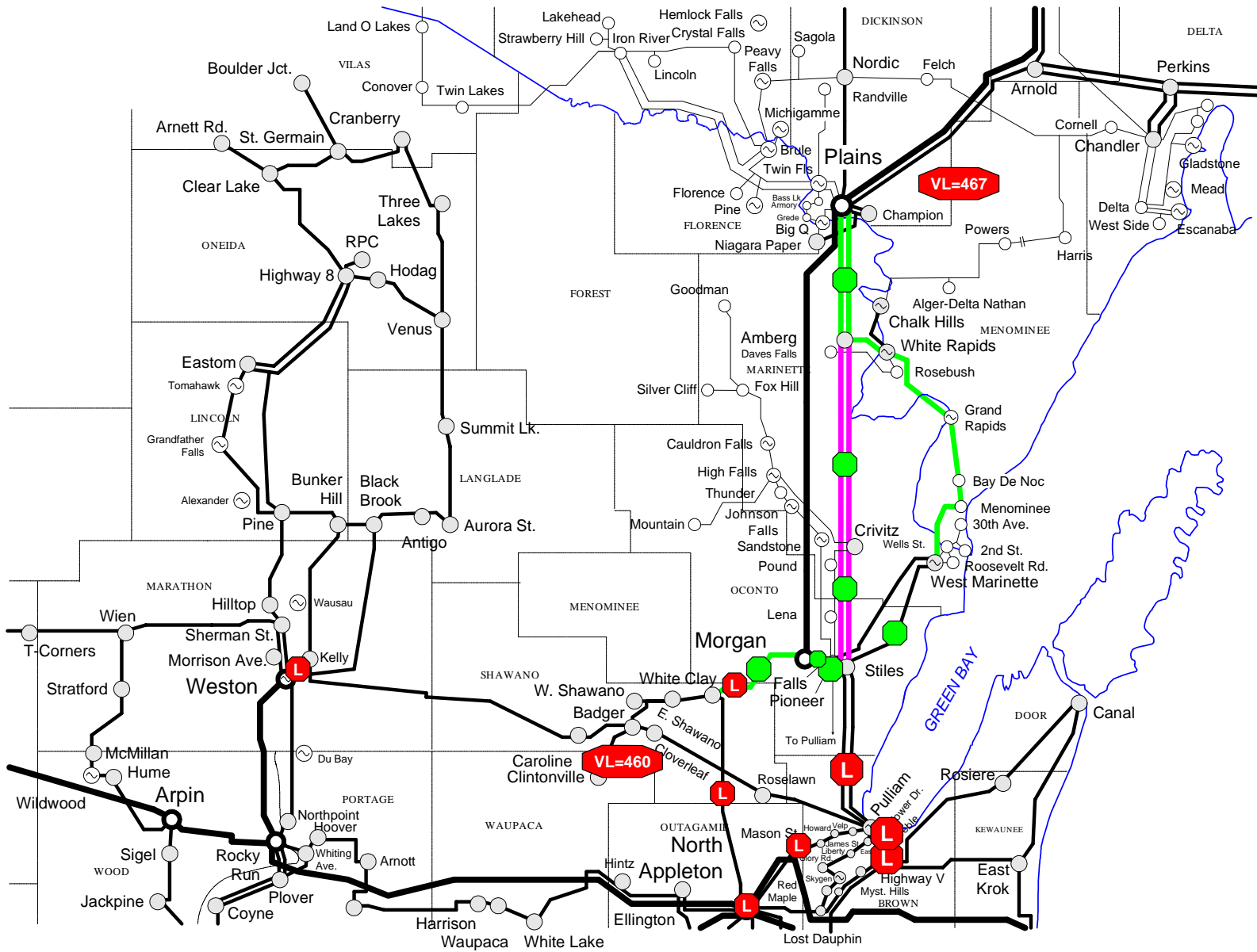


Figure IV-1-7: 2007 System With Projects A, B, C, D
 Add Projects E + F: Werner West & Plains 345/138 kV Transformations

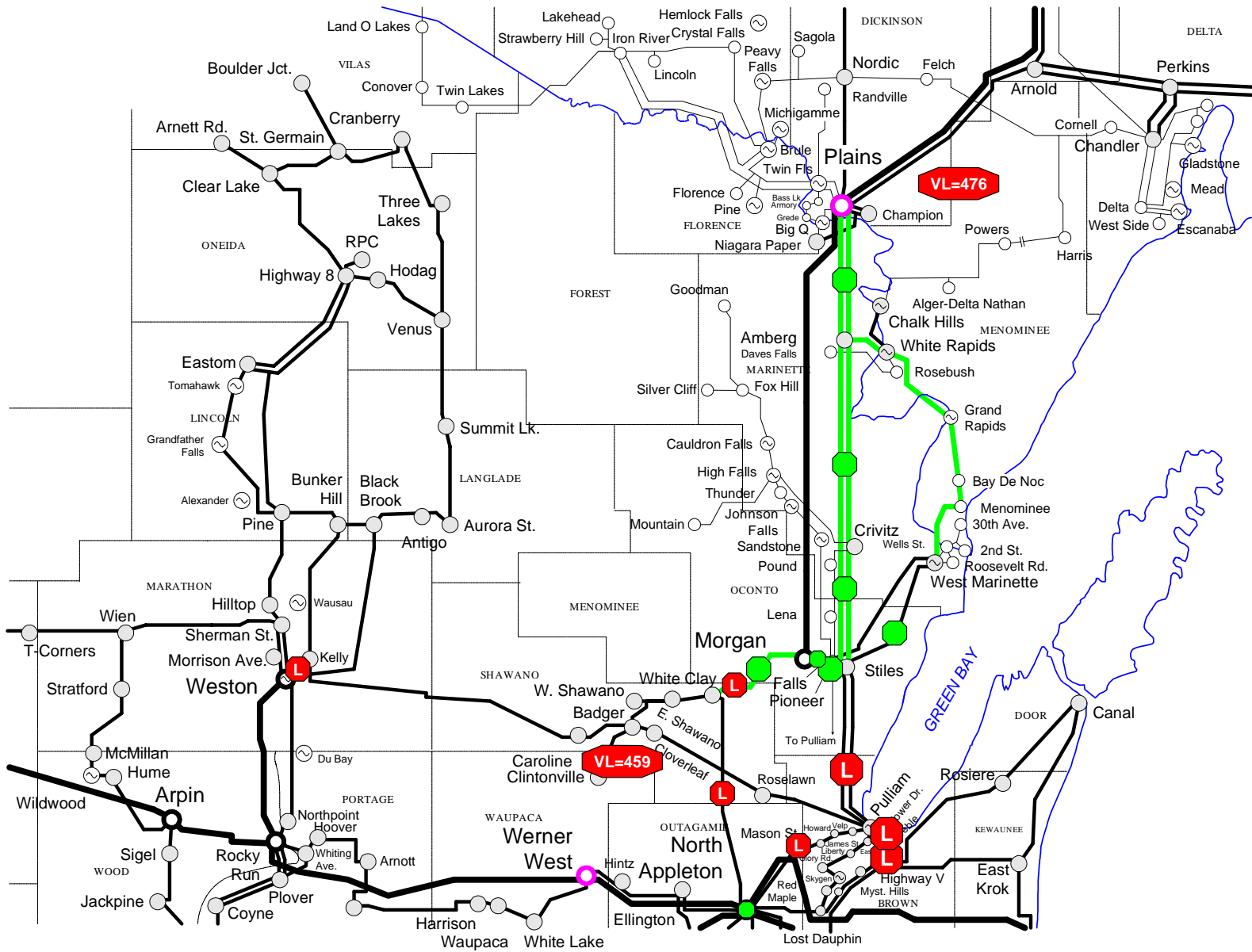


Figure IV-1-8: 2007 System With Projects A, B, C, D, E, F
 Add Project G: Plains-Iron River-Conover-Cranberry 138 kV

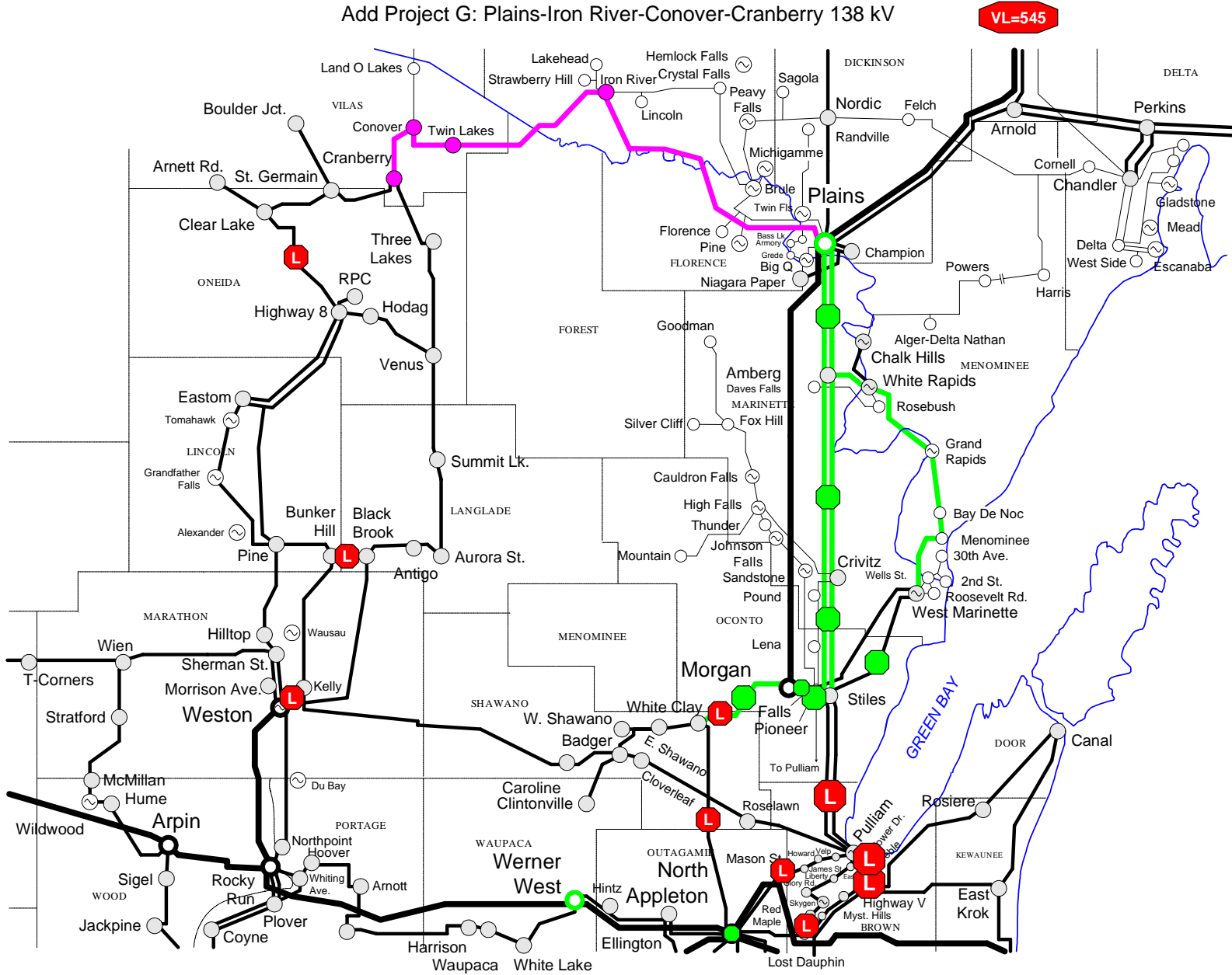


Figure IV-1-9: 2008 System With Projects A, B, C, D, E, F, G
 Add Arrowhead-Weston 345 kV

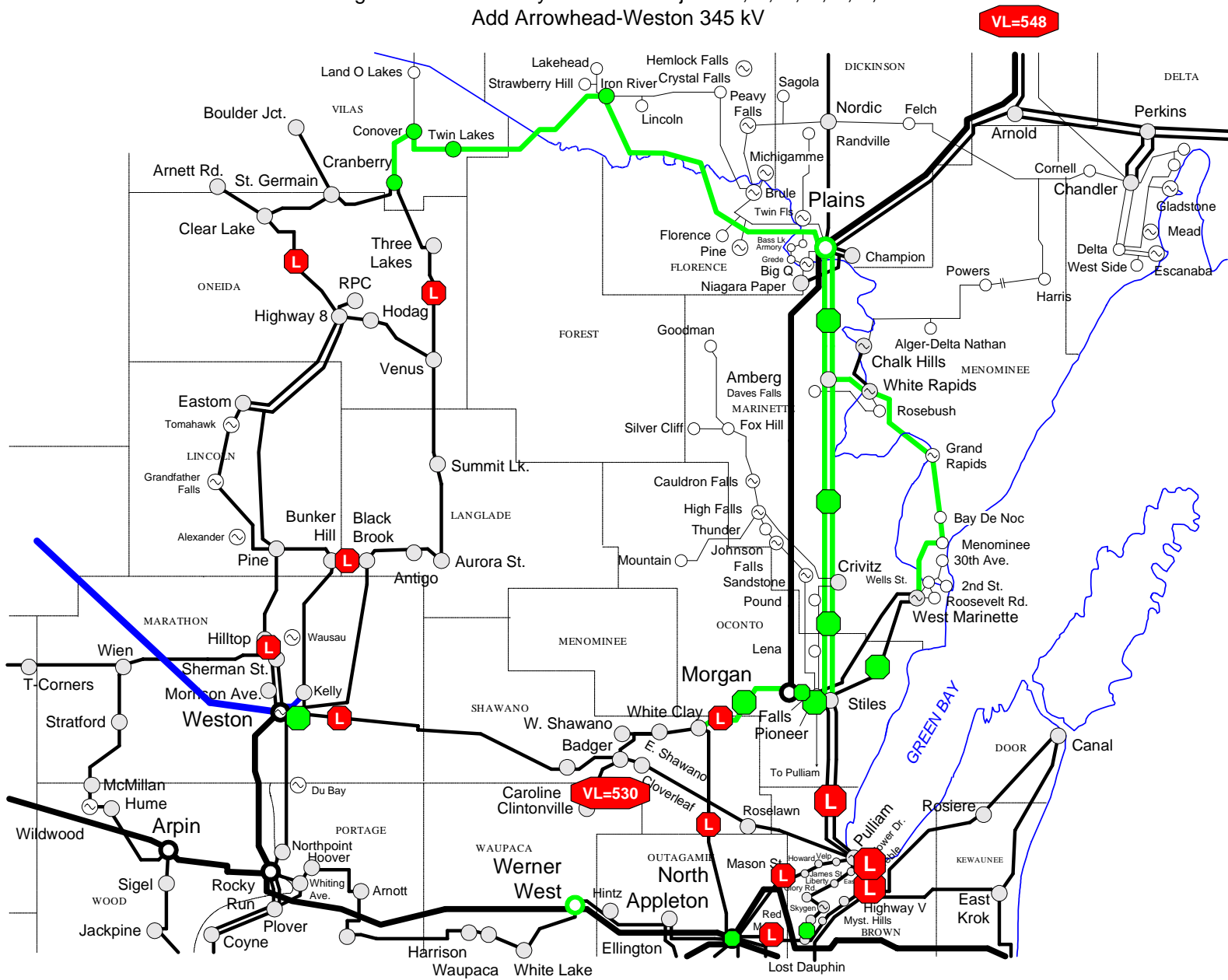


Figure IV-1-10: 2009 System With Projects A, B, C, D, E, F, G + Arrowhead-Weston 345 kV
Add Project H: Morgan-Werner West 345 kV + Clintonville-Werner West 138 kV

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