4 PROPOSED PROJECT

4.1 Project Description

The proposed Project is located entirely in Minnesota, in Hubbard, Becker and Wadena counties and is shown in **Figures 4-1A through 4-1C.**

Applicants propose to construct approximately 22.5 miles of new 115 kV transmission line between the existing Great River Energy Hubbard Substation and the proposed new Todd-Wadena Red Eye distribution substation; construct the proposed new Minnesota Power Straight River Substation and the proposed new Great River Energy Blueberry Substation; construct the proposed new Todd-Wadena Red Eye Substation to serve the proposed new MPL pump station; relocate the existing Todd-Wadena Menahga Substation to the new Blueberry Substation site and convert the voltage from 34.5 kV to 115 kV; and modify the existing Great River Energy Hubbard Substation and the Minnesota Power Pipeline Substation.

4.1.1 Transmission Line

Applicants are generally requesting approval of a 500-foot route width (250 feet either side of the transmission line in areas where the transmission line will be cross-country, or 250 feet either side of the centerline of road right-of-ways in areas where the transmission line follows a road), with the following exceptions (see detailed route maps in **Appendix G**):

- At the existing Hubbard Substation, an additional 150 by 650 feet north of the route width that encompasses the substation.

- In Section 26 of Straight River Township, a wider triangular route width is proposed to allow flexibility for the crossing of Minnesota Power's 230 kV "909" Line, although only a single alignment with an easement that is 50' on each side of the transmission line will be required in this area.

- Around the Straight River Substation, an area that accommodates the proposed location, plus an additional 650 feet to the west of the north-south alignment; and 500 feet north and 250 south of the road centerline is necessary to accommodate the transmission line.

- Around the Blueberry Substation, an additional route width of 100 feet to the north, 150 feet to the south, and 450 feet to the west of the substation is necessary to accommodate the transmission lines that will go in and out of the substation.

- Around the Red Eye Substation, an additional area of 400 feet by 750 north of the east-west alignment that extends into the substation (property owned by MPL) to allow flexibility in design and to minimize conflict with MPL and Todd-Wadena's facilities.

Figure 4-1A. Proposed Project-North

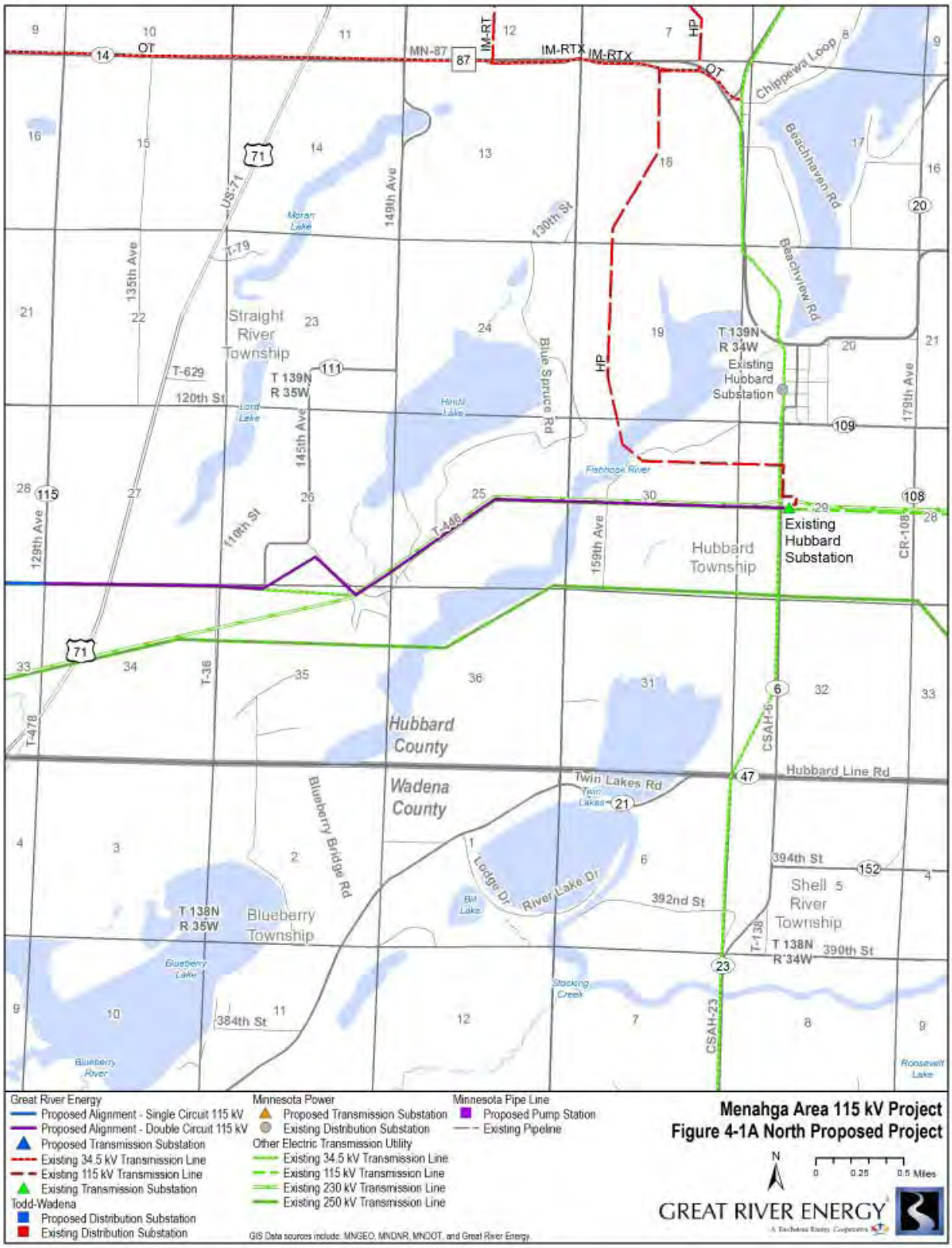

Figure 4-1B. Proposed Project-Central

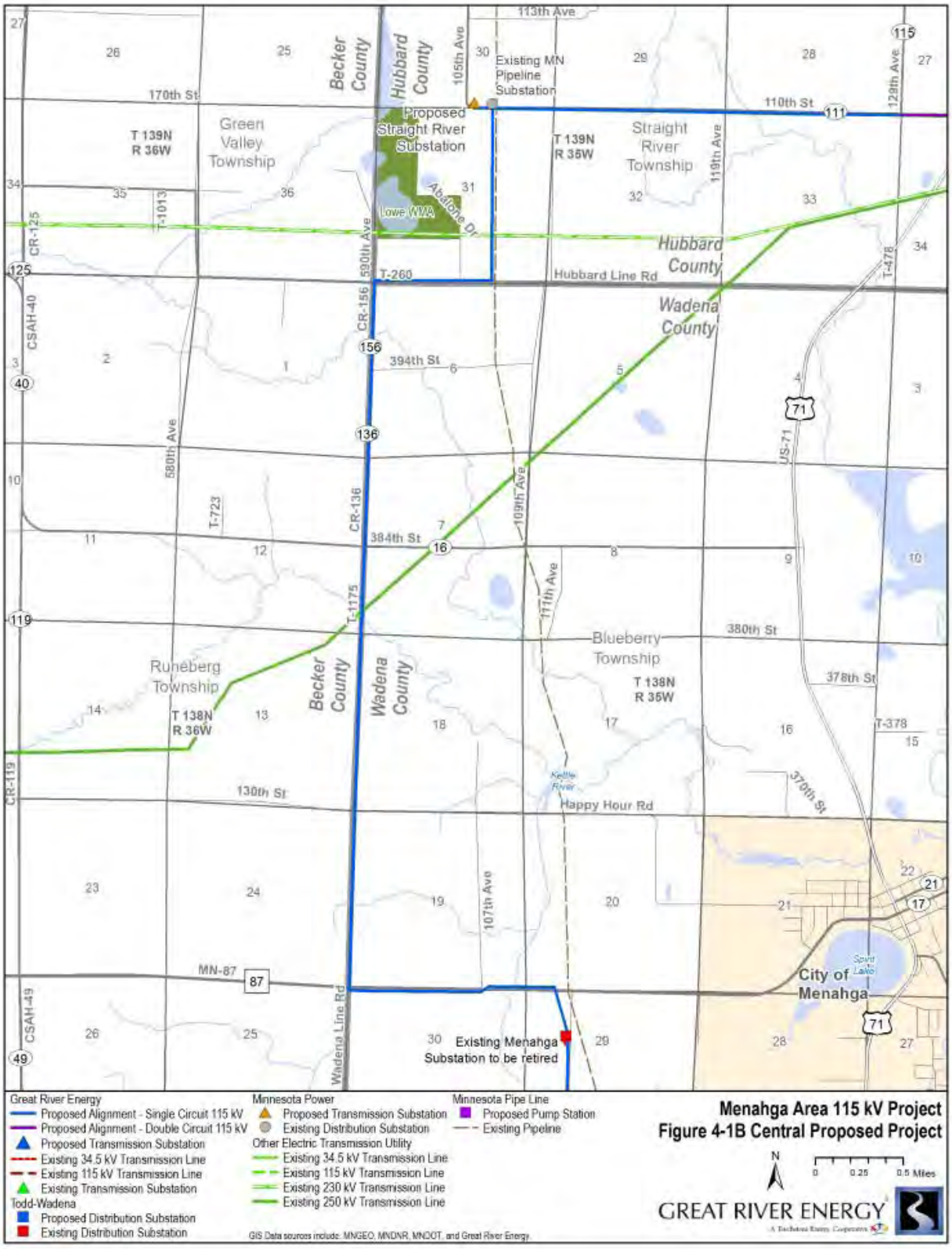

Figure 4-1C. Proposed Project-South

The Minnesota Power DC Line will need to be raised where the proposed 115 kV transmission line would cross under it in Section 7, T148, R35W. However, no additional right-of-way is anticipated to be needed to raise the line.

The proposed route is described below and detailed route maps (on aerial photo background) are included in **Appendix G.**

Proposed Route

The proposed route begins at Great River Energy's Hubbard Substation and heads westerly for approximately 7.0 miles to Minnesota Power's proposed new Straight River Substation. In this section of the Project the new 115 kV transmission line would replace Minnesota Power's 34.5 kV 522 feeder line. Because the 522 feeder line needs to remain energized during construction of the new 115 kV line, the 522 feeder line would not be removed until construction of the 115 kV line is complete. The first 4.5 miles of this section of the Project (from the existing Great River Energy Hubbard Substation west to CR 115) is proposed to be a double circuit 115 kV/115 kV line, as the second 115 kV circuit would be used for a future Great River Energy project to the north to address load-serving needs in the Osage area. Great River Energy is requesting that the second circuit be permitted as part of the Menahga Project so that the second circuit can be strung during construction of the Project, as it would be safer, more cost-effective, and would result in fewer environmental impacts (see additional discussion in **Sections 6.7 and 8.1.2**). A wider route is proposed in Section 26 of Hubbard Township to allow flexibility for the crossing of Minnesota Power's 230 kV "909" Line.

From the Straight River Substation, the line then turns southerly and will parallel the west side of MPL's pipelines for approximately 1.1 mile; it then turns westerly on the north side of Hubbard Line Road and continues for approximately 0.75 mile; it then turns southerly and runs along the west side of Wadena Line Road/County Road 156 for 4.0 miles to a crossing to the south side of TH 87; it then runs easterly along the south side of TH 87 for 0.75 mile, where it crosses to the north side of TH 87 and continues for 0.40 mile; it then turns in a south-southeasterly direction and angles to Great River Energy's existing TW-MET 34.5 kV line, where it will overtake the existing alignment for 0.5 mile to the proposed location of the new Blueberry Substation.

The line will exit the Blueberry Substation, turn west for 550 feet and cross to the westerly side of the Minnesota Energy natural gas pipeline, then turn southwesterly and continue along the west side of the Minnesota Energy pipeline for 0.25 mile; it then crosses 350th Street to the west side of 109th Avenue, where it continues for 1.5 miles to a proposed crossing of 109th Avenue to the southwest corner of the SW ¼ of the NW ¼ of Section 5 in Red Eye Township; the proposed line continues along the east side of 109th Avenue for approximately 0.75 mile to a crossing back to the west side near the southwest corner of the NW ¼ of the NW ¼ of Section 8, Red Eye Township; the proposed line continues along the west side of 109th Avenue for 0.75 mile to a crossing to the south side of CSAH 13, where it turns easterly and runs along the south side of CSAH 13 for 0.25 miles to a crossing to the north side of CSAH 13, where it continues easterly for 1.0 mile to a proposed crossing from the southeast corner of the SW ¼ of the SW ¼ of Section 9 to the northeast corner of the NW ¼ of the NW ¼ of Section 16; the proposed line then continues easterly for 0.75 mile along the south side CSAH 13, crosses TH 71, and continues easterly for 1.0 mile to the west side of 139th Avenue, where it turns south and continues along

the west side of 139th Avenue for about 1.5 miles to the Red Eye Substation in the SE ¼ of the NE ¼ in Section 22 of Red Eye Township.

Right-of-Way

Great River Energy has worked closely with the local, state and federal agencies and landowners regarding the Project. A 100-foot wide permanent ROW for the new transmission line (50 feet on each side of the transmission line centerline) will be acquired by Great River Energy. The easement may be slightly wider than 100 feet in some areas to accommodate guy wires and anchors. A portion of the easement may overtake/overlap with existing transmission or distribution line easements and/or road ROW where the line parallels a road.

A 100-foot wide ROW is Great River Energy's standard for a 115 kV transmission line to maintain proper clearances to objects within the ROW, and to ensure that the conductor will not blowout past the ROW during high wind events and that vegetation is sufficiently cleared to safely operate and maintain the line.

Structures

The majority of the new 115 kV line will consist of single circuit, single pole wood structures spaced approximately 275 to 400 feet apart. Spans for the double circuit portion of the Project will range from 350 to 450 feet. Transmission structures will typically range in height from 60 to 90 feet above ground, depending upon the terrain and environmental constraints (such as highway crossings, river and stream crossings, and required angle structures). The average diameter of the wood structures at ground level is 20 inches. Some sections of the new line will have distribution underbuild, which would be attached to new 115 kV transmission line structures spaced 250 to 300 feet apart.

H-Frame design structures may be used in areas with rugged topography and where longer spans are required to avoid or minimize impacts to wetlands or waterways. Span lengths average 600 to 800 feet, with 1,000-foot spans possible with certain topography. Structure heights typically range from 60 to 90 feet above ground with taller structures required for exceptionally long spans and in circumstances requiring additional vertical clearance exceeding the National Electrical Safety Code (NESC) and other agency requirements.

Typical 115 kV structure types (single circuit, single circuit with distribution underbuild, double circuit and H-Frame) are shown in **Figure 4-2** and **Figure 4-3**.

Conductors

The single circuit structures will have three single conductor phase wires and one shield wire. It is anticipated that the phase wires will be 477 thousand circular mil ACSR with seven steel core strands and 26 outer aluminum strands.

The shield wire will be 0.528 optical ground wire.

Figure 4-2. Typical Transmission Structure Types

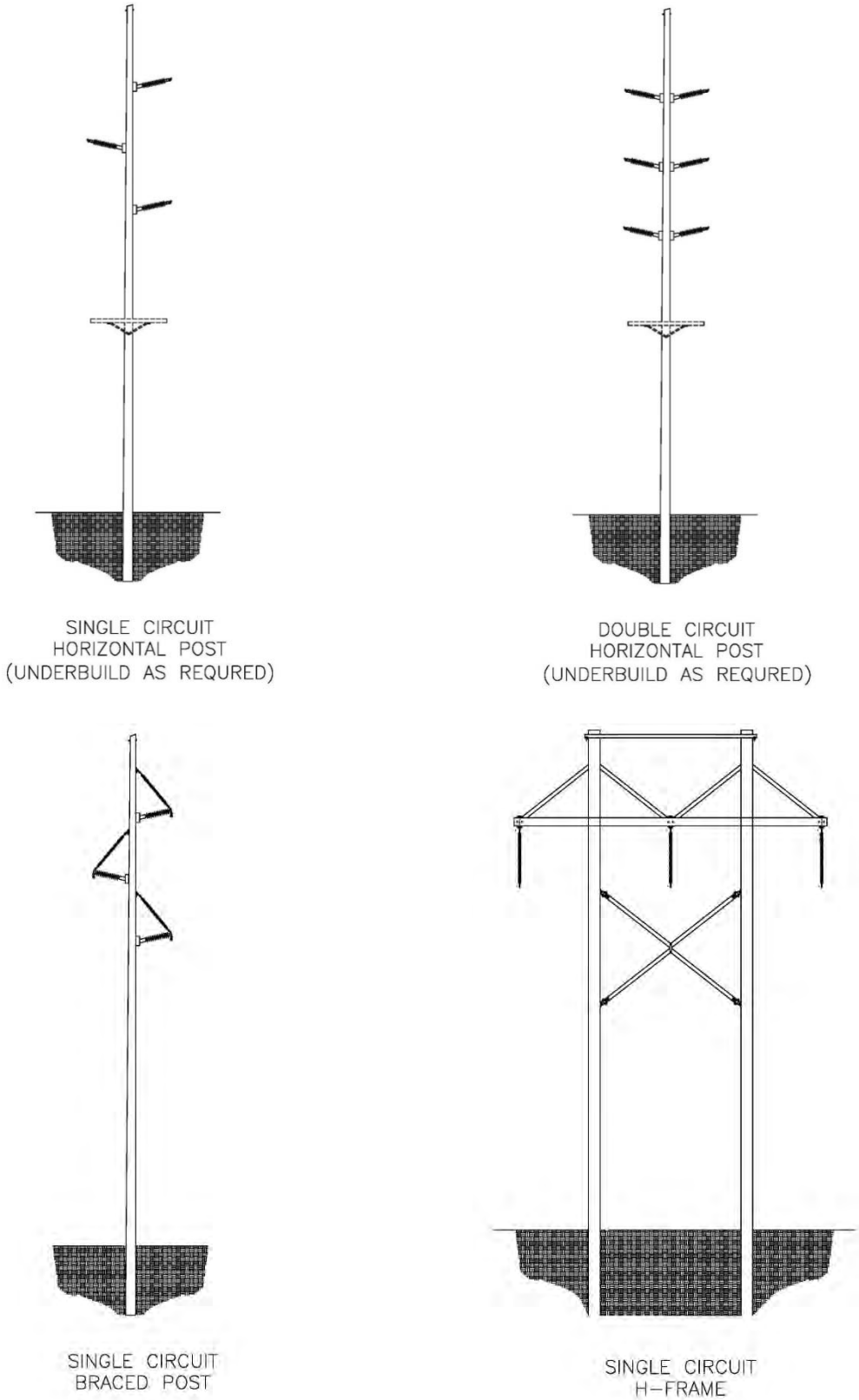

Figure 4-3. Photos of Typical 115 kV Transmission Structures

Typical Single Circuit Structure with Distribution Underbuild

Typical Double Circuit Structure

Typical Braced Post Structure

Typical H-Frame Structure

Service Life

The service life of a transmission line is approximately 40 years, although based on experience, it is quite possible that the line and structures will last longer than 40 years.

Annual Availability

An average new 115 kV transmission line is expected to be available approximately 99.9 percent of the year. Applicants expect that these lines should not be out of service for any extended period of time other than the rare times when scheduled maintenance is required or when a natural event, such as a tornado, thunderstorm, or ice storm causes an outage.

4.1.2 Associated Facilities

The proposed Project associated facilities include:

- The new Minnesota Power Straight River Substation in the vicinity of the existing Minnesota Power Pipeline Substation;
- The new Great River Energy Blueberry Substation;
- Relocation of the existing Todd-Wadena Menahga Substation to the new Blueberry Substation site and conversion of the voltage from 34.5 kV to 115 kV;
- The new Todd-Wadena Red Eye Substation to serve the proposed MPL pump station;
- Modifications to the existing Great River Energy Hubbard Substation and Minnesota Power Pipeline Substation.

Preliminary plot plans for the proposed new substations are provided in **Appendix H**.

Minnesota Power Straight River Substation

Minnesota Power proposes to construct the Straight River 115/34.5 kV Substation near the existing MPL Park Rapids Pump Station to re-establish 34.5 kV service to the Minnesota Power Pipeline Substation after removal of the 34.5 kV source from Hubbard. The 34.5 kV 522 feeder line from the Hubbard Substation to the Pipeline Substation will be removed to accommodate the interconnection and routing of the new 115 kV transmission line.

It is anticipated that the fenced area of the 115 kV substation will be approximately 115’ by 180’.

Facilities at the Straight River Substation will include:

- 115/34.5 kV transformer
- A 115 kV “transrupter” and a 34.5 kV recloser
- A 3-way 115 kV motor operated switch and tap line (approximately 700 feet)
- Structural steel, grounding
- 115 kV and 34.5 kV substation switches
- Communications and metering equipment

Great River Energy Blueberry Substation

Great River Energy proposes to construct the Blueberry115/34.5 kV Substation south of the existing Menahga distribution substation near Menahga, Minnesota. Great River Energy has an option to purchase 10 acres in the NW ¼ of the SW ¼ of Section 29 of Blueberry Township. It is anticipated that the fenced area of the 115 kV substation will be approximately 240' by 415'.

Facilities at the Blueberry Substation will include:

- Relocated 115/34.5 kV transformer from the Hubbard Substation
- A 115 kV breaker and a 34.5 kV breaker
- 115 kV switches
- Electrical Equipment Enclosure
- Structural steel
- Bus work and fittings
- SCADA/Relay/Control Equipment
- Conduit
- Grounding
- Fiber optic communication
- 115/12.47 kV distribution transformer
- Low side sectionalizing equipment

Todd-Wadena Menahga Substation

Todd-Wadena proposes to relocate the existing Menahga Substation to the new Blueberry Substation site and convert the voltage from 34.5 kV to 115 kV. The existing Menahga Substation will be completely retired, including all equipment, structures and fence. The Menahga Substation will occupy approximately 100' by 100' at the Blueberry site.

Facilities at the relocated Menahga Substation will include:

- 115/12.47 kV transformer
- Structural steel
- Meter building
- Bus work
- Low side sectionalizing equipment

Todd-Wadena Red Eye Substation

Todd-Wadena proposes to construct the Red Eye 115/4.16 kV Substation to support the motor loads for the MPL Sebeka pump station. Todd-Wadena plans to construct the proposed new substation on MPL's property in Section 22, T137N, R35W in Red Eye Township. It is anticipated that the fenced area of the 115 kV substation will be approximately 125' by 125'.

Facilities at the Red Eye Substation will include:

- 115/4.16 kV transformer
- Electrical Equipment Enclosure

- Structural steel
- Bus work and fittings
- Low side sectionalizing equipment
- Meter equipment
- Conduit, Grounding
- Fiber optic communication

Great River Energy Hubbard Substation

Great River Energy will modify the existing Hubbard Substation to accommodate the new 115 kV transmission line. One 115/34.5 kV transformer will be relocated to the proposed Blueberry Substation. The existing 34.5 kV breakers and foundations associated with the transformer will be retired. New equipment to be installed at the Hubbard Substation includes:

- A 115 kV breaker in the ring bus
- 115 kV switches
- Structural steel, bus work and fittings
- SCADA/Relay/Control Equipment
- Conduit, grounding
- Grounding
- Fiber optic communication

Minnesota Power Pipeline Substation

The existing Minnesota Power Pipeline 34.5/4.16 kV Substation, which provides a dedicated source to the MPL Park Rapids pump station, may need to be modified to accommodate the connection of a 34.5 kV feeder from the proposed new Straight River Substation. The extent of these modifications, if they are needed, will not be known until further engineering is completed on the Straight River Substation.

4.2 Estimated Costs

Total Project costs are estimated to be approximately $23 million dollars.

4.2.1 Great River Energy

Estimated costs for Great River Energy's portion of the proposed Project are divided into five phases. The tasks associated with each phase are outlined below and estimated costs for each phase are summarized in **Table 4-1**.

Planning
Siting and routing preliminary activities
Project presentation to the public
Certificate of Need and Route Permit development/state permitting process
Establishing centerline for survey

Land Acquisition/Miscellaneous Permits
Easements, ROW and environmental permits

Design
Line and structure design, survey and probes/soil borings

Procurement
Cost of all construction materials, i.e. poles, conductor and hardware

Construction
Staking for clearing and construction
ROW clearing and restoration
All construction labor and heavy equipment

Close Out
Remaining ROW restoration activities
Field verification surveys
Financial, engineering, and environmental close out activities

Table 4-1. Estimated Great River Energy Project Costs (2014 Dollars)

Project	Planning/ State Permitting	Land Acquisition/ Permits	Design	Procurement	Construction	Close Out	Total
Transmission Line	$553,682	$1,254,841	$587,317	$4,644,204	$5,701,116	$195,340	**$12,936,500**
Switches	$ 12,200	$ 10,200	$ 46,000	$ 146,000	$ 176,600	$ 9,000	**$ 400,000**
Meters	0	0	$ 39,200	$ 62,400	$ 53,600	$ 4,800	**$ 160,000**
Hubbard Substation	$ 11,160	$ 22,940	$ 86,800	$ 660,300	$ 441,440	$ 17,360	**$1,240,000**
Blueberry Substation	$ 27,000	$ 55,500	$210,000	$1,597,500	$1,068,000	$ 42,000	**$3,000,000**
Red Eye Substation	$ 13,500	$ 27,750	$105,000	$ 798,750	$534,000	$ 21,000	**$1,500,000**
Menahga Substation	$ 9,000	$ 18,500	$ 70,000	$ 532,500	$356,000	$ 14,000	**$1,000,000**
Total	**$626,542**	**$1,389,731**	**$1,144,317**	**$8,441,654**	**$8,330,756**	**$303,500**	**$20,236,500**

All capital costs for the proposed Blueberry Substation, modifications at the Hubbard Substation, and the approximately 22.5 miles of new 115 kV transmission line between the Hubbard Substation and the Red Eye Substation will be borne by Great River Energy. All capital costs for the Red Eye Substation and the relocated Menahga Substation will be borne by Todd-Wadena.

4.2.2 Minnesota Power

Estimated costs for Minnesota Power's portion of the proposed Project are summarized in **Table 4-2**.

Table 4-2. Estimated Minnesota Power Project Costs (2014 Dollars)

Component	Cost
Straight River Tap – Straight River 115 kV Line	$ 620,000
Straight River 115/34.5 kV Substation	$ 2,140,000
Straight River – Pipeline 34.5 kV Line	$ 50,000
Total	**$ 2,810,000**

All capital costs for the Straight River Substation (and associated facilities in the immediate area) and any modifications required at the Minnesota Power Pipeline Substation will be borne by Minnesota Power.

4.2.3 Transmission Line Construction Costs

Single pole construction costs are approximately $498,000 per mile. H-Frame construction costs are approximately $550,000 per mile and the double circuit construction costs are approximately $747,000 per mile.

There may be areas where construction is more difficult (e.g. where there are access issues or where greater span lengths must be employed to avoid sensitive features). In these areas the use of wooden mats, the Dura-Base Composite Mat System, or specialized construction vehicles to minimize environmental impacts during line construction may be required and could increase costs by $50,000 or more per mile.

4.2.4 Operation and Maintenance Costs

The estimated annual cost of ROW maintenance and operation and maintenance of Great River Energy's transmission lines (69 kV to 500 kV) in Minnesota currently average about $2,000 per mile. Storm restoration, annual inspections and ordinary replacement costs are included in these annual operating and maintenance costs.

4.3 Effect on Rates

The Commission's rules require an applicant to provide the annual revenue requirements to recover the costs of a proposed project. The Commission's Order of December 3, 2014, granting exemptions allowed the effect on rates to be described in the format set forth below.

Great River Energy has submitted the Hubbard to Blueberry area project for consideration as part of the 2014 MISO Transmission Expansion Plan (MTEP 14) and the Sebeka pump station area project for consideration as part of the 2015 MISO Transmission Expansion Plan (MTEP 15); Minnesota Power has submitted the Straight River Substation project for consideration as part of the MTEP 15 as well. The initial annual revenue requirement for both area projects is estimated

to be in the range of $2.7 million to $3.1 million. This is based off of a combined investment $14 to $16 million from both Minnesota Power and Great River Energy that may be included in MISO rates. Assuming a 10 MW increase in load associated with the Project, the effect on the zonal rate for the Minnesota Power pricing zone is estimated to be an increase in the range of a $0.11 to 0.13 per kW-month.

4.4 Project Schedule

Provided Applicants obtain a CON and a Route Permit by early 2016, Applicants plan to commence construction of the Project in late spring 2016 and complete it by spring 2017. Applicants anticipate that construction will take approximately 11 months and that the entire Project will be energized in April 2017.

4.5 Estimated Line Losses

When electrical energy is sent over a transmission line, some of it is lost through conversion into heat from the resistance in the conductor. The losses that occur are directly related to the square of the current flowing through the transmission line, the conductor size, and the length of the line. Additionally, transmission lines operated at higher voltages need less current to transfer the same amount of power than lower voltage lines. Therefore, the higher the operating voltage of a transmission network, the lower the amount of losses encountered for the same amount of power transferred, wire size, and line length. Also, because the current across a transmission line usually varies over time, losses are seldom constant from hour to hour, or from month to month.

Losses are a measure of the energy flow across the system that is converted into heat due to the resistance within the elements of the transmission system. It is necessary for utilities to provide enough generation to serve their respective system demands (plus reserves), taking into account the loss of the energy before it can be usefully consumed. By reducing and minimizing the amount of system losses, more efficient delivery of the electrical energy to the end user is achieved, which can help to defer the need to add more generation resources to a utility's portfolio. Therefore, system loss reduction results in monetary savings in the form of less fuel required to meet the system demand plus delayed capital investment in generating plant construction.

In determining the amount of losses associated with a particular project, it is not reasonable to consider only the project's transmission and calculate the losses directly from operation of that transmission. It is necessary to look at the total losses of the system that result with and without the proposed project. In its Exemption Order, the Commission authorized Applicants to provide line loss data for the system as a whole, rather than line loss data specific to the individual transmission lines. In this case Applicants considered a significantly larger area served by a number of utilities to determine the resulting effect of the Project's transmission upgrades.

Applicants calculated losses at peak demand based on the 2014 winter peak loadings. The results are summarized in **Table 4-3**.

Table 4-3. Summary of Line Losses

Scenario	System Losses (MW)
Existing System	154.3
System with Project Transmission	154.0
Difference	-0.3

Table 4-3 shows that the Project's proposed transmission infrastructure reduces the losses on the electrical system. Under winter peak demand conditions, the losses incurred are 0.3 MW less when the Project is energized as compared to the existing system configuration.

Because demand for electric power is not constant and losses are related to the square of current flowing through the transmission lines in the electric system, the losses will change over time, increasing as demand increases and decreasing as demand decreases. Because losses change over time, there is no precise method to calculate average annual loss reductions. One common method is to use the loss savings at peak demand to estimate the average annual loss savings in megawatt hours (MWh) based on the following formulas[1]:

$$\text{Loss Factor} = (0.3 \times \text{Load Factor}) + (0.7 \times \text{Load Factor}^2)$$

$$\text{Annual Loss Savings (MWh)} = (\text{Loss Factor} \times \text{Peak Loss Savings}) \times 8760 \text{ hours/year}$$

The average load factor for the Project area is 50.96 percent. Using the method described above and the calculated loss savings at peak demand (given in **Table 4-3**), the Project will reduce average transmission losses by an estimated 977.7 MWh annually.

4.6 Construction Practices

Applicants intend to employ normal practices in construction of the new substations and transmission line. No unusual or difficult features are expected along the route. Construction practices to be followed are described in more detail in **Section 8.4**.

4.7 Operation and Maintenance Practices

Great River Energy will periodically use its transmission line ROW to perform inspections, maintain equipment, and repair damage. Regular maintenance and inspections will be performed over the life of the facility to ensure a reliable system. Annual inspections will be done by foot, snowmobile, All-Terrain Vehicle, pickup truck, or by aerial means. These inspections will be limited to the acquired ROW and areas where obstructions or terrain require access off the easement. If problems are found during inspection, repairs will be performed and the landowners will be compensated for any losses incurred.

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[1] Gönen, Turan. *Electric Power Distribution System Engineering*. McGraw Hill, 1986. 55, 58-59.

Great River Energy's Transmission Construction & Maintenance Department will conduct vegetation surveys and remove undesired vegetation that will interfere with the safe operation of the transmission line. A three to seven year cycle of vegetation maintenance is desirable. ROW practices include a combination of mechanical and hand clearing, along with an application of herbicides where allowed.

4.8 Work Force Required

During construction, there will be positive impacts to community services, hotels and restaurants to support the utility personnel and contractors. It is estimated that 15 to 20 workers at a time will be employed during construction of the Project.

It is not expected that additional permanent jobs would be created by this Project. The construction activities would provide seasonal influx of additional revenue into the communities during the construction phase, and some materials may be purchased locally.