6 ALTERNATIVES TO THE PROJECT

6.1 Analysis of Alternatives

In any CON proceeding on a proposed transmission line project, an applicant is required to consider various alternatives to the proposed project. Minnesota Statutes Section 216B.243, subdivision 3(6) provides that in assessing need, the Commission will evaluate "possible alternatives for satisfying the energy demand or transmission needs." The Commission has also provided in its rules that an applicant for a CON must discuss in the application the possibility of a number of alternatives. Minnesota Rule 7849.0260 provides:

Each application for a proposed large high voltage transmission line (LHVTL) must include:

B. a discussion of the availability of alternatives to the facility, including but not limited to:

1. new generation of various technologies, sizes, and fuel types;
2. upgrading of existing transmission lines or existing generating facilities;
3. transmission lines with different design voltages or with different numbers, sizes, and types of conductors;
4. transmission lines with different terminals or substations;
5. double circuiting of existing transmission lines;
6. if the proposed facility is for DC (AC) transmission, an AC (DC) transmission line;
7. if the proposed facility is for overhead (underground) transmission, an underground (overhead) transmission line; and
8. any reasonable combinations of the alternatives listed in subitems (1) to (7).

Minnesota Rule 7849.0340 also requires an applicant to consider the option of not building the proposed facility.

In this section, the various alternatives to the proposed Project that were considered by Applicants are discussed. These alternatives include: 1) various generation options including peaking generation, distributed generation, and renewable (solar and wind) generation; 2) various transmission solutions, including upgrading other existing facilities, different voltage levels and different endpoints; and 3) a no-build alternative focusing on reactive power supply improvements and demand side management. Discussion of each alternative focuses on why that alternative is unacceptable or inferior to the Project.

6.2 Generation Alternative

6.2.1 Peaking Generation

Generation and distributed generation were considered as an alternative to the new transmission of the proposed Project. The type of small generators that could reasonably be considered for such an alternative (typically 1.5 or 2 MW diesel or natural gas-fueled generators) would not be sufficient to meet the need in the Hubbard-Verndale 34.5 kV system because the existing transformers and regulators are at full capacity on the Hubbard-Verndale 34.5 kV system. A rebuild of this system would be necessary if generation were added to the system.

The Project is proposed to address inadequacies in the 34.5 kV transmission in the Hubbard-Verndale system. The Project will provide approximately 11.38 MW of incremental load-serving capability beyond the 2017 load level. For comparison purposes, the generation solution must address the existing inadequacies of these systems and provide an equivalent level of load-serving capability.

A study was performed and showed that the equivalent load-serving capability could be achieved by operating multiple gas-fired or diesel generators for a total of 17 MW at the Sebeka Regulator Substation. The use of generation to address the needs this Project would address was not selected for the following reasons:

1. Operation of these generators to address system inadequacies at non-peak hours may be required, resulting in high operations costs.

2. Capital investment to install generation of this type is significant. With a typical estimate of $1,000/kW, installation of 17 MW of diesel generators is estimated to cost approximately $17 million.

3. Operation and maintenance costs associated with generation units are significantly higher than that of transmission systems.

4. Reliability of peak generation is less than that of transmission lines. Installation of redundant generation would be necessary to achieve equivalent reliability.

5. Addition of generation would not improve transmission system reliability of the aged infrastructure at issue in the Project area.

6.2.2 Distributed Generation

A distributed generation alternative was analyzed. Distributed generation, however, is not a viable alternative to address the proposed pump station load or the inadequacies identified in the existing transmission system. Due to the size of the pump station load, the affected load area and the performance achievable by the proposed Project, a large number of distributed generation units (1.5 to 2 MW each) would be required to address the load-serving performance achievable by the Project. This option was not selected for the following reasons:

1. Installation of the number of generators of this scale to address the pump station load and the inadequacies in the area and provide equivalent incremental load-serving capability is more costly than the proposed Project.

2. Operation and maintenance cost of these generators is high.

3. The area also serves industrial loads that consist of large motors. Motors such as these require a large amount of power at startup. Distributed generators are not capable of providing the large amount of power that may be needed by these motors.

4. Reliability of generators, in general, is less than that of transmission.

6.2.3 Renewable Generation

A system solution is needed that will provide reliable and effective power for the proposed pump station and the affected load area. Renewable generation is dependent on natural events, such as sunlight or wind speed. Neither wind generation nor solar generation is considered a reasonable alternative to the Project. Energy from these resources is not necessarily available at the times when they are most necessary to serve customers. Residential loads peak between 4 p.m. and 6 p.m., when people are returning to their homes after being away for the day. This is the time when energy for the pump station and in the affected load area is needed the most. Solar energy output and wind energy output typically decrease during these hours of the day.

This option was not selected for the following reasons:

1. Unpredictable sources of energy and inability to make use of resources when power is demanded for the pump station and within the affected load area.

2. Installation costs of both wind and solar generation resources are higher than those of the proposed Project.

6.3 Upgrade of Existing Facilities

The voltage of the existing transmission system in the area (34.5 kV) is not robust enough to serve the proposed pump station. Even if the 34.5 kV system was rebuilt with larger conductor to provide more capacity, the system voltage would go into violation upon contingency, and reactive power supplies (capacitor banks) are not feasible as the system has already reached its peak use of reactive power supplies.

Upgrading the existing facilities would involve rebuilding the transmission line from Hubbard to Verndale, which is 30 miles of line, costing about $11.5 million. The two 115/34.5 kV transformers at Verndale would need to be replaced to a higher capacity and the bus work at Verndale would need to be rebuilt to accommodate the new transformers with a higher rating, at an approximate cost of $4.5 million. Additionally the Sebeka regulators would need to be upgraded, costing about $500,000. The estimated total cost to upgrade the existing facilities is $16.5 million.

Even if the existing 34.5 kV facilities were upgraded, the system voltage would collapse on contingency. Simply stated, the 34.5 kV system cannot support a large industrial load such as the proposed pump station. Although the proposed Project is estimated to be $23 million and is more expensive than rebuilding the existing facilities, rebuilding the existing 34.5 kV system is not a feasible solution.

6.4 Alternative Voltages

Applicants are proposing to build a new 115 kV circuit from Hubbard-Blueberry-Red Eye to reliably serve the proposed MPL Sebeka pump station and the load growth in this area. However, Applicants considered the possibility of resolving the inadequacies in the Project area and affected load area by implementing a solution of a different voltage level, as discussed below.

6.4.1 Distribution Voltage

Using distribution voltage to address the system inadequacies was analyzed as an alternative to the Project. Transferring load between distribution systems is feasible to solve transmission issues when the receiving distribution system is served from an independent transmission network. Loads in the affected load area are from a single, and lengthy, 34.5 kV transmission system. Loads can only be transferred between distribution substations, but remain on the same 34.5 kV transmission network throughout the Hubbard-Verndale system. This will not improve loading or low voltage concerns on the Hubbard-Verndale system. Distribution substations served by a transmission system separate from the Hubbard-Verndale system are not located in close proximity. To use an independent distribution system to provide support to the Hubbard-Verndale system would require constructing lengthy distribution lines to transfer loads. This transfer would, overall, result in weaker voltage and increased loss on a high impedance distribution system. For these reasons, this alternative is not considered a reasonable alternative to the Project.

6.4.2 Higher Voltages

A higher voltage solution above 115 kV was not investigated at this time because Applicants determined that a 115 kV solution in the Project area would provide adequate and necessary support to the proposed pump station and the affected load area for the foreseeable planning horizon. Voltage solutions higher than 115 kV are typically implemented to facilitate the transfer of electricity over long distances. The Hubbard-Verndale system does not contain any 161 kV transmission lines, and construction of these facilities in this area would be non-standard. A 230 kV transmission system is not a load-serving system and was therefore not considered further as an alternative to the Project.

6.5 Different Conductor

The Hubbard-Verndale 34.5 kV system is mainly 3/0 ACSR and 336 ACSR conductor, which is a suitable size conductor for the 34.5 kV system. Rebuilding the 34.5 kV system with a conductor larger than 336 ACSR or a ACSS or composite conductor would provide more capacity on the system; however, the Verndale transformers and the Sebeka Regulator Station are still power flow-limiting elements. If the Hubbard-Verndale 34.5 kV system were rebuilt with a larger or different conductor, the amount of added capacity on the system would not be

enough to serve the proposed new MPL Sebeka pump station, and other pieces of equipment would need to be upgraded (Verndale transformers and Sebeka Regulator Station).

Great River Energy uses several types of conductors for system transmission lines. The standard bare aluminum overhead transmission conductors, ACSR and aluminum conductor steel supported (ACSS), offer known reliable power performance, operating at temperatures up to 100°C and 200°C, respectively. At these temperatures, for the 115 kV line proposed for the Project, ACSR would provide 196 MVA of capacity and ACSS would provide 315 MVA of capacity. ACSS typically costs approximately 10 percent more than ACSR conductor. Great River Energy is proposing to use 477 ACSR conductor for the Menahga Area 115 kV Project.

Two-composite conductor alternatives can offer substantial increases in capacity and the ability to span greater distances between poles by use of innovative modern composites, but at a significantly increased cost and lower efficiency. The modern materials and manufacturing process required for these composite conductors result in a material cost that is 300-500 percent higher compared to standard ACSR and ACSS. Composite conductors also experience higher losses because they are operated at higher temperatures. As a result, this type of conductor is used only in special circumstances, where long spans are required. Circumstances do not warrant use of this type of conductor for the Menahga Area 115 kV Project.

6.6 Alternative Endpoints

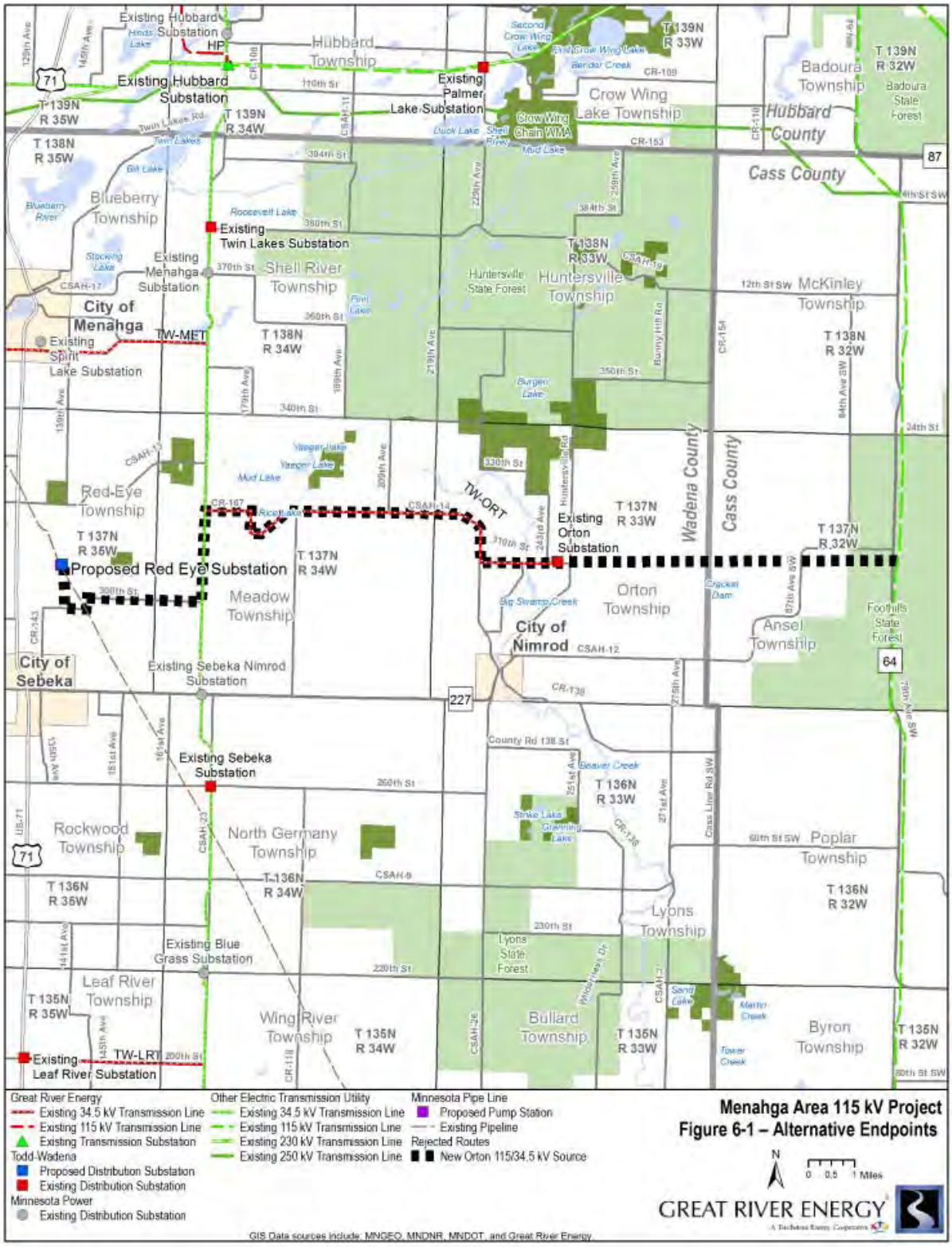
The proposed Project, with endpoints at the Hubbard Substation and the Red Eye Substation, was ultimately selected because it is the most robust solution addressing many system needs, not only in the affected load area but also in the Project area, which had experienced operational issues under certain contingencies. The endpoints of the Project were selected to facilitate serving the pump station and to provide additional incremental load-serving capability to serve future load growth in the affected load and Project areas.

However, during its analysis of how to address the pump station load and the operational concerns on the Hubbard-Verndale 34.5 kV system, Great River Energy did analyze one additional project with alternative endpoints. A discussion of this alternative project and why it was deemed inferior to the proposed Project is provided below.

6.6.1 New Orton 115/34.5 kV Source

Great River Energy analyzed whether adding a new 115/34.5 kV source to the Hubbard-Verndale 34.5 kV system sourced from a new tap off the Badoura – Dog Lake 115 kV line would address the pump station load and concerns identified in the affected load area. This alternative would be approximately 22.5 miles and include tapping the Badoura – Dog Lake 115 kV line and running a 115 kV transmission line west towards Orton, where a 115/34.5 kV substation would be located. The 115 kV line would continue south and westward towards the proposed Sebeka pump station. The point of interconnection for the new 115 kV line along the Badoura – Dog Lake 115 kV line would be near the intersection of County Road 20 and State Highway 64 (**Figure 6-1**). This alternative would address the pump station load and the transmission system thermal overload concerns on the transmission system serving the Hubbard-Verndale 34.5 kV system.

Figure 6-1. Alternative Endpoints



Although this alternative would be an effective solution for strengthening the system in the affected load area and provide service to the proposed pump station, and the cost of this alternative is estimated to be similar to the proposed Project (approximately $20.5 million – but could be higher because there are more wetlands in this alternative, which can increase permitting and construction costs), this alternative does not add redundancy to the largest load in the area (Menahga). This alternative also would not facilitate a planned Great River Energy project to the north that would address load-serving needs in the Osage area in the future. For these reasons, this alternative was considered inferior to the proposed Project.

6.7 Double Circuiting

Double circuiting is the construction of two separate circuits (three phases per circuit) on the same structures. Great River Energy has proposed double circuit construction to the greatest extent practical in the Project area.

The Menahga Project includes approximately 4.5 miles of double circuit 115 kV/115 kV line from the existing Great River Energy Hubbard Substation west to CR 115. Double circuiting in this area makes sense from a planning perspective, 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 **Section 8.1.2**).

Other opportunities for double circuit construction within the Project area were not identified.

6.8 Direct Current Alternative

High voltage direct current (HVDC) lines are typically proposed for transmitting large amounts of electricity over long distances because line losses are significantly less over long distances on a HVDC line than on an alternative current (AC) line. A HVDC line is not a reasonable alternative to the proposed Project. The Project is being proposed to serve a proposed pump station and for local load-serving purposes, whereas HVDC lines are typically proposed for regional transmission projects. The Project must be readily tapped now and in the future to serve customers in the Project area. HVDC lines require expensive conversion stations at each delivery point because the direct current (DC) power must be converted to AC power before it can be used by customers. Such conversion stations would add significantly to the cost of the Project. There is no justification – in terms of reliability, economy, performance, or otherwise – for a HVDC line in this case.

6.9 Undergrounding

Undergrounding is an alternative that is seldom used for high voltage transmission lines such as those proposed for the Project. One of the primary reasons underground high voltage transmission lines are seldom used is that they are significantly more expensive than overhead lines. The cost range depends on the design voltage, the type of underground cable required, the extent of underground obstructions such as rock formations, the thermal capability of the soil, the

number of river crossings, and other factors, but the construction cost of locating the entire length of the Project's proposed transmission underground is estimated to be as much as 8 to 10 times greater per mile than if it were to be constructed overhead as proposed. This cost does not include the large reactors that would likely be required at each substation to counteract the large line charging currents present on underground high voltage lines. In addition, there are increased line losses and additional maintenance expenses incurred throughout the useful life of an underground high voltage line that further increase the total additional cost of building an underground line instead of an overhead line.

A common argument in favor of implementing underground lines is that they will minimize the human and environmental impacts above ground. However, there are still human and environmental impacts both during and after construction. The predominant environmental impact from the construction, operation, and maintenance of underground transmission lines arises from the need to obtain and maintain completely cleared ROWs. While construction activities for overhead transmission lines are typically concentrated around the line's structures, leaving areas between structures relatively undisturbed apart from some vegetation removal, construction of underground transmission lines requires the entire ROW to be completely cleared and utilized for construction activities. This results in increased impact to wetland areas due to the likely need to install an access road capable of supporting the heavy construction equipment required for trenching activities, and cable installation. After construction, the ROW needs to be maintained free of woody vegetation to reduce soil moisture loss, because high voltage underground conductors make use of soil moisture for conductor cooling. A permanent road must also be maintained along the ROW for maintenance and repair.

Underground lines can also be more challenging to operate and maintain. While overhead lines are typically subject to more frequent outages than underground cables, service can usually be quickly restored. This is accomplished by automatic reclosing of circuit breakers, which results in only a momentary outage of the line. Because circuit breakers on underground lines are typically not reclosed until it can be verified that a fault has not occurred on the underground cable, the smaller number of outages is typically offset by their increased duration. A faulted underground line takes much longer to restore because of the difficulty in locating the fault and accessing the site to make repairs. If the fault is due to a failure in the cable, the segment of failed cable must typically be replaced. This usually involves completely replacing the failed cable between two man-hole splice points, which are ordinarily located every 1,500 to 2,000 feet along the line. To replace a failed cable, it must be possible to bring heavy equipment, including cable reels weighing 30,000 to 40,000 pounds, into the ROW during all seasons of the year. If the fault occurs in a wetland area where all-season roads are not maintained, restoration can be delayed due to the need to install wetland matting to gain access to the manholes involved in replacing the failed cable. Additionally, specialized equipment is often required to repair 115 kV underground transmission facilities and, as Great River Energy has no 115 kV underground facilities on its transmission system, this specialized equipment is not readily available in case of an outage.

Due to the construction, maintenance, reliability, and cost drawbacks of high voltage underground transmission lines, Applicants believe that undergrounding is not a viable alternative for any segment of the proposed Project.

6.10 No-Build Alternative

Before proposing a transmission or generation solution, Applicants considered the viability of managing the existing system such that building additional facilities could be avoided. As discussed in **Section 5.9**, a true "do-nothing" alternative would leave the transmission system in the affected load area and Project area strained by load growth and vulnerable to localized voltage collapses, and unable to serve the proposed pump station. Specifically, as shown in **Figure 5-11**, the affected load area peak demand already exceeds system capacity. The following discussion of the no-build alternative focuses on two different ways the pump station load might be served and inadequacies in the affected load area and Project area might be addressed without building new transmission or generation.

6.10.1 Demand Side Management and Conservation

As documented in **Section 5.8** and **Appendix I**, effective conservation measures in the affected load area have helped to defer the need for additional reliability improvements. However, the proposed Project is largely driven by the addition of a new large, high load factor electric load, in particular a proposed new pump station. This load is not only subject to modern energy efficiency standards for motors, but is typically designed to be as efficient as possible. Such an addition is also a clear target for enhanced efficiency due to its size and long run hours, so the ability to drive additional efficiency is limited. As such, conservation and energy efficiency is particularly inadequate in the Hubbard-Verndale system and Project area, where the addition of a highly efficient large industrial load is a large driver for the need for the Project. Additionally, peak demand in the affected load area already exceeds system capacity. Although conservation programs will continue to be implemented in the affected load area and the Project area to maximize efficient use of electricity, these programs are insufficient to mitigate the projected inadequacies in the transmission system.

6.10.2 Reactive Power Supply

The Hubbard-Verndale 34.5 kV system concerns are thermal overload rather than voltage issues. A reactive power supply is used to bolster voltage, which is not needed for this Project.

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