Xcel Energy

NORTHERN STATES POWER COMPANY
APPLICATION TO THE
MINNESOTA PUBLIC UTILITIES COMMISSION
FOR A CERTIFICATE OF NEED
FOR TWO 115 KV HIGH VOLTAGE TRANSMISSION LINES IN THE MIDTOWN AREA OF SOUTH MINNEAPOLIS, HENNEPIN COUNTY

HIAWATHA PROJECT

MPUC Docket No. E002/CN-10-694

November 29, 2010

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CONTENT REQUIREMENTS COMPLETENESS CHECKLIST

Authority	Required Information	Where
Minn. R. 7849.0200, Subp. 2	Title Page	Title Page
Minn. R. 7849.0200, Subp. 2	Table of Contents	Pages i-viii
Minn. R. 7849.0200, Subp. 4	Cover Letter	Cover Letter
Minn. R. 7849.0220, Subp. 3	Joint Ownership and Multiparty Use	Section 1.4
Minn. R. 7849.0240	Need Summary and Additional Considerations	–
Subp. 1	Summary of the major factors that justify the need for the proposed facility	Section 1.3
Subp. 2	Relationship of the proposed facility to the following socioeconomic considerations:	–
A.	Socially beneficial uses of the output of the facility	Sections 1.3 and 4.0
B	Promotional activities that may have given rise to the demand for the facility	Sections 1.3 and 4.0
C.	Effects of the facility in inducing future development	Section 1.3
Minn. R. 7849.0260	Proposed LHVTL and Alternatives	–
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(1)	Design voltage	Sections 1.1 and 2.1.2; Appendix A.1
(2)	Number, sizes and types of conductors	Sections 1.1 2.1.2, 5.1.4; Appendix A.1
(3)	Expected losses under projected maximum loading and under projected average loading in the length of the line and at terminals or substations	Section 4.8; Appendix A.1 at Section 6; and Appendix F; Appendix A.2 at Section 9.1
(4)	Approximate length of the proposed line	Sections 1.1 and 2.1.2

Authority	Required Information	Where
(5)	Approximate locations of DC terminals or AC substations on a map	Figures 2 and 3; Appendix D
(6)	List of likely affected counties	Sections 1.1 and 8.2
B.	Discussion of the available alternatives including:	–
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(2)	Upgrading existing transmission lines	Section 1.3; Appendix A.1
(3)	Transmission lines with different voltages or conductor arrays	Sections 4.8, 5.1.1 and 5.1.2
(4)	Transmission lines with different terminals or substations	Sections 4.6, 4.7 and 4.8
(5)	Double circuiting of existing transmission lines	Section 4.9; Appendix A.2
(6)	If facility for DC (AC) transmission, an AC (DC) transmission line	Section 5.1.3
(7)	If proposed facility is for overhead (underground) transmission, an underground (overhead) transmission line	Section 5.2
(8)	Any reasonable combination of alternatives (1) – (7)	Chapters 4.0 and 5.0
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(2)	Service life	Sections 5.3.1 and 5.6.4
(3)	Estimated average annual availability	Section 5.3.1
(4)	Estimated annual O&M costs in current dollars	Sections 5.7.4 and 5.8.4
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Authority	Required Information	Where
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Abbreviation	Meaning
AC	Alternating Current
ACSR	Aluminum Conductor Steel Reinforced
ACSS	Aluminum Conductor Steel Supported
ALJ	Administrative Law Judge
ANSI	American National Standards Institute
APE	Area of Potential Effect
C-BED	Community-Based Energy Development
Commission	Minnesota Public Utilities Commission
CRFS	City Requested Facilities Surcharge Rider
dBA	A-weighted sound level in decibels
DC	Direct current
EFs	Electric fields
EIS	Environmental Impact Statement
ELF	Extremely low frequency
EMF	Electromagnetic fields
FEIS	Final Environmental Impact Statement
HCRRA	Hennepin County Regional Railroad Authority
HDD	Horizontal directional drilling
HPC	Historic Preservation Commission
HVED	High voltage extruded dielectric
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEEE	Institute of Electrical and Electronic Engineers
kcmil	Thousand circular mils
kV/m	Kilovolts per meter
kV	Kilovolts
LTC	Load Trap Changer

MAAQS	Minnesota Ambient Air Quality Standards
MCWD	Minnehaha Creek Watershed District
MFs	Magnetic fields
mG	Milligauss
Mn/DOT	Minnesota Department of Transportation
MnDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
NAAQS	National Ambient Air Quality Standards
NAC	Noise area classification
NERC	North American Electric Reliability Corporation
NESC	National Electric Safety Code
NIEHS	National Institute of Environmental Health Sciences
NO_2	Nitrogen dioxide
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
OES	Minnesota Department of Commerce, Office of Energy Security
PSC	Public Service Commission of Wisconsin
PVC	Polyvinyl chloride
RES	Renewable Energy Standard
RPA	Route Permit Application
S&L	Sergeant & Lundy, LLC
SDS	State Disposal System
WHO	World Health Organization

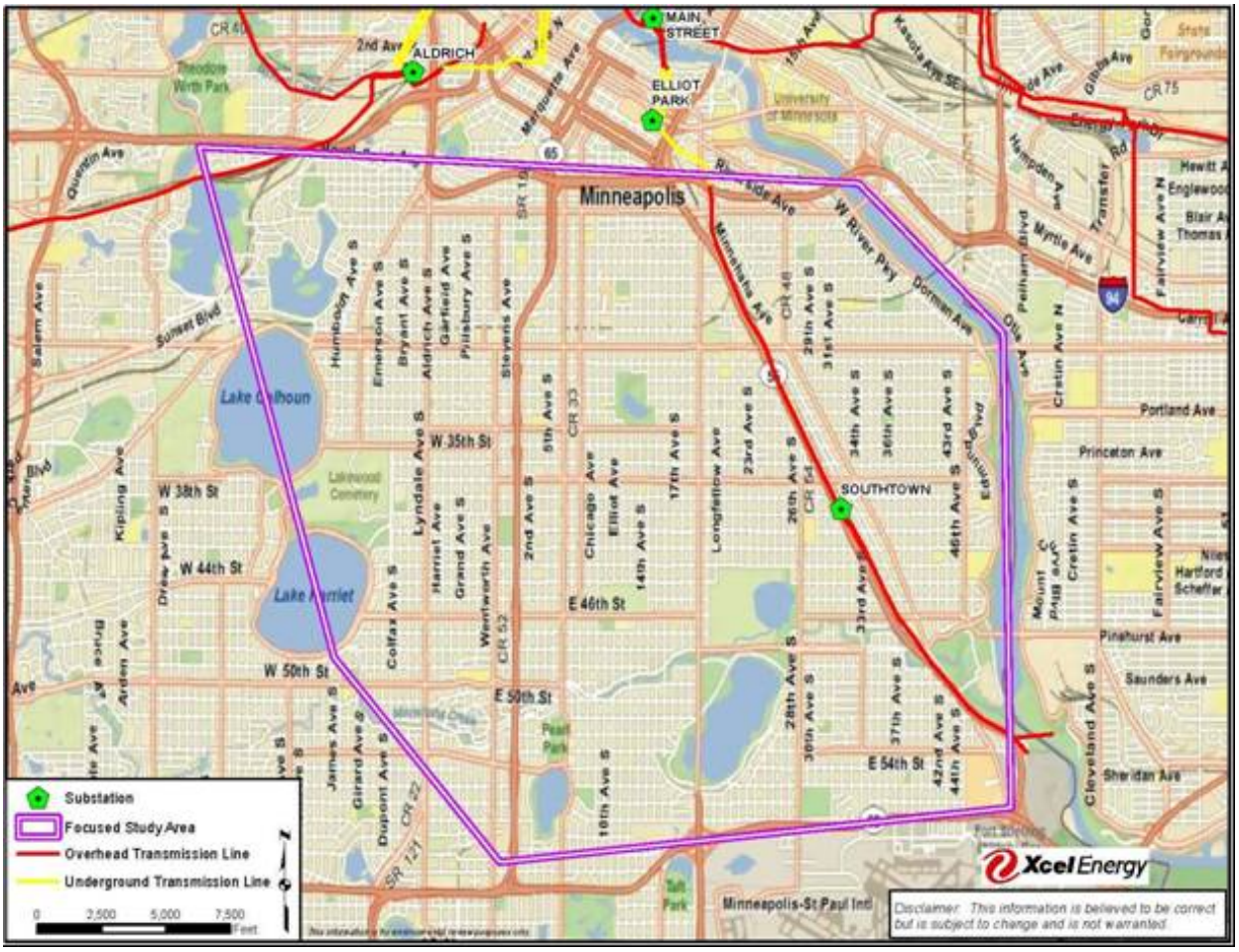
1.0 INTRODUCTION & SUMMARY

1.1 APPLICANT AND PROPOSAL

Northern States Power Company, a Minnesota corporation ("Xcel Energy", "Company" or "Applicant"), submits this application to the Minnesota Public Utilities Commission ("Commission") for a Certificate of Need to construct two 115 kV transmission lines and two new distribution substations in the Midtown area of South Minneapolis ("Hiawatha Project" or "Project"). This application is made pursuant to Minnesota Statutes Section 216B.243, 2010 Minnesota Law, Chapter 361, Article 5, Section 19, and Minnesota Rules Chapter 7849. An introduction and overview of the proposal are provided in this summary chapter.

The Hiawatha Project is designed to meet the distribution needs of Xcel Energy's customers in south Minneapolis, Hennepin County, Minnesota. The demand for power has increased beyond the capability of the system due to population growth, higher load density, and recent successful urban revitalization efforts, particularly in the areas along Lake Street, Hiawatha Avenue, and the Chicago and Park Avenue corridors. Additional electrical infrastructure is required to address overload conditions on the distribution system and to improve the reliability of the power supply to residences and businesses. Without new infrastructure, electrical conditions will worsen with time. A map of the Project area ("Project Area" or "Focused Study Area") is shown in Figure 1.

Figure 1: Project Area



Xcel Energy proposes to construct the following facilities:

- A new 115 kV distribution substation near Hiawatha Avenue and 28th Street ("Hiawatha Substation"),
- A new 115 kV distribution substation near Oakland Avenue South and 29th Street, including the site of the former Oakland Substation ("Midtown Substation"), and
- Two 115 kV transmission lines between the two new substations. The routes for the transmission lines total approximately 1.4 to 3.8 miles depending on the final route selected.

The proposed transmission lines can be constructed overhead or underground. Xcel Energy evaluated both options and, from an engineering perspective, believes that both the overhead or underground design would provide the performance required to meet the identified distribution needs. Xcel Energy is prepared to build either design as directed by the Commission.

For overhead designs, Xcel Energy proposes to use single or double circuit steel poles 75 to 110 feet tall. Spans would be 500 feet on average. The right-of-way would be up to 50 feet.

For underground transmission facilities, a double circuit design is proposed. Underground vaults with manhole access would be spaced approximately 1,500 feet apart. The right-of-way would be approximately 30 feet.

The estimated cost for construction of the Project, depending on final design (overhead or underground) and route, is between $30 million and $43 million if constructed on the preferred substation sites (Hiawatha West and Midtown North). Construction is expected to commence the second quarter of 2012 and be completed by second/third quarter 2013. Details about the design and costs are included in Chapter 2.

1.2 COMMISSION APPROVALS REQUIRED

Xcel Energy must obtain a Route Permit and a Certificate of Need before constructing the Project.

1.2.1 ROUTE PERMIT PROCEEDING

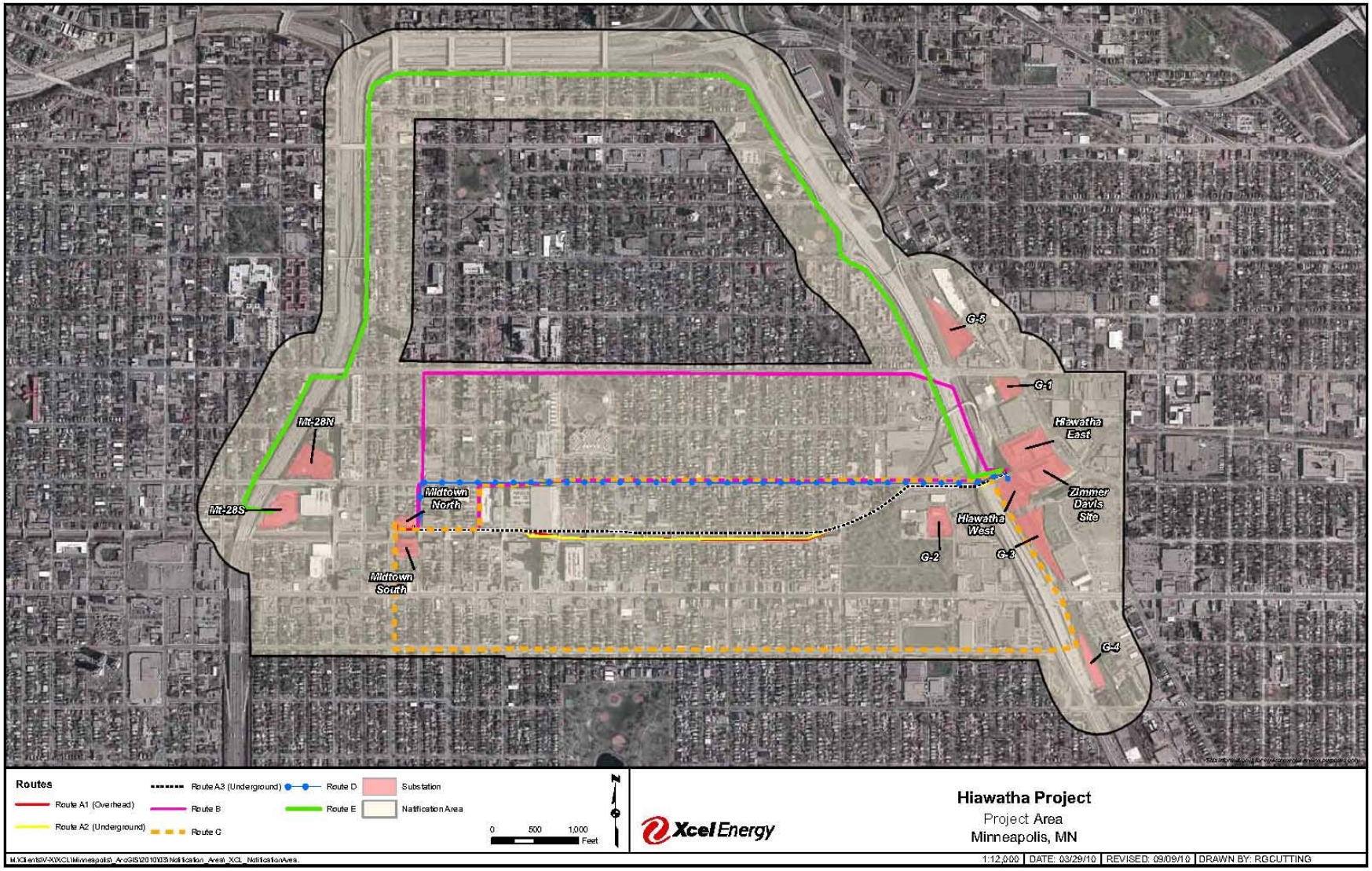
In April 2009, Xcel Energy filed an application with the Commission for a Route Permit ("Route Permit Application" or "RPA"). *In the Matter of the Route Permit Application for a High Voltage Transmission Line Route Permit for the Hiawatha Transmission Project*, Docket No. E002/TL-09-38; OAH Docket No. 15-2500-20599-2 (April 24, 2009). Under then-existing law, a Route Permit was the only Commission approval required to construct the Hiawatha Project.

In the Route Permit Application, Xcel Energy proposed four routes, A – D, between a new Midtown Substation at Oakland Avenue South and 29th Street ("Midtown North") and a new Hiawatha Substation near Hiawatha Avenue and 28th Street ("Hiawatha West"). Xcel Energy also proposed two transmission line design options (overhead and underground). A brief description of routes A – D between the Hiawatha and Midtown substations follows:

- Route A parallels the Midtown Greenway for 1.4 miles and includes three alignments. The overhead design alignment follows 29th Street. One underground design alignment, Alignment A2, also follows 29th Street. A second underground alignment, Alignment A3, is located along the north side of the Midtown Greenway, under the bike/walking path.
- Route B is a street route for two single circuit overhead lines. One of the transmission lines would follow 26th Street for 1.8 miles. The second line would follow East 28th Street for 1.5 miles.
- Route C is also a street route for two single circuit overhead lines. One of the transmission lines would follow East 28th Street for 1.5 miles. The second line would follow 31st Street for 2.3 miles.
- Route D is for a double circuit underground design along East 28th Street for 1.5 miles.

In the Route Permit Application, Xcel Energy also proposed three additional substation sites, one for the Midtown Substation and two for the Hiawatha Substation. The route proceeding evaluated these routes and substation sites as well as a fifth route recommended by the Advisory Task Force (Route E2), two alternative sites for the Midtown Substation and five alternative sites for the Hiawatha Substation. The route and substation site alternatives are shown on Figure 2 below. This Application for a Certificate of Need ("Application") will focus on the Company's proposed routes (A – D) and Xcel Energy's preferred substation sites (Midtown North and Hiawatha West).

Figure 2: Routes and Substation Sites



Administrative Law Judge ("ALJ") Beverly Heydinger held two days of public hearings and 13 days of evidentiary hearings in April 2010 regarding the Route Permit Application. ALJ Heydinger issued her Findings, Recommendations and Conclusions ("ALJ Report") on October 8, 2010. *In the Matter of the Application for a Route Permit for the Hiawatha Transmission Project*, Findings of Fact, Recommendations and Conclusions, Docket No. E002/09-38 (October 8, 2010). The ALJ recommended that the Midtown North and Hiawatha West sites be approved for the substations. The ALJ also concluded that, based on an evaluation of the State criteria and factors and the unique circumstances of the Project Area, Route D (underground on 28th) was the best alternative in the record for the transmission lines. *Id.* at Conclusion 9. The ALJ further found that routes B, C and E2 were not feasible and prudent alternatives. *Id.* at Conclusion 8. The Commission will not make its route decision until the Certificate of Need decision has been made.

1.2.2 CERTIFICATE OF NEED REQUIRED

In the 2010 Minnesota State Legislative session, the Legislature enacted a new Certificate of Need provision that applies to the Hiawatha Project. The new law requires a Certificate of Need for transmission lines of this size and length if located in an area with high population density and if the lines are within one-half mile of and parallel a below-grade bike and pedestrian path that connects with other bike paths along a river. 2010 Minn. Laws, ch. 361, art. 5, sec. 19 Effective Date: May 18, 2010. A copy of this law is included in Appendix F.

As a result of this legislation, the Hiawatha Project requires a Certificate of Need from the Commission.

1.3 NEED SUMMARY

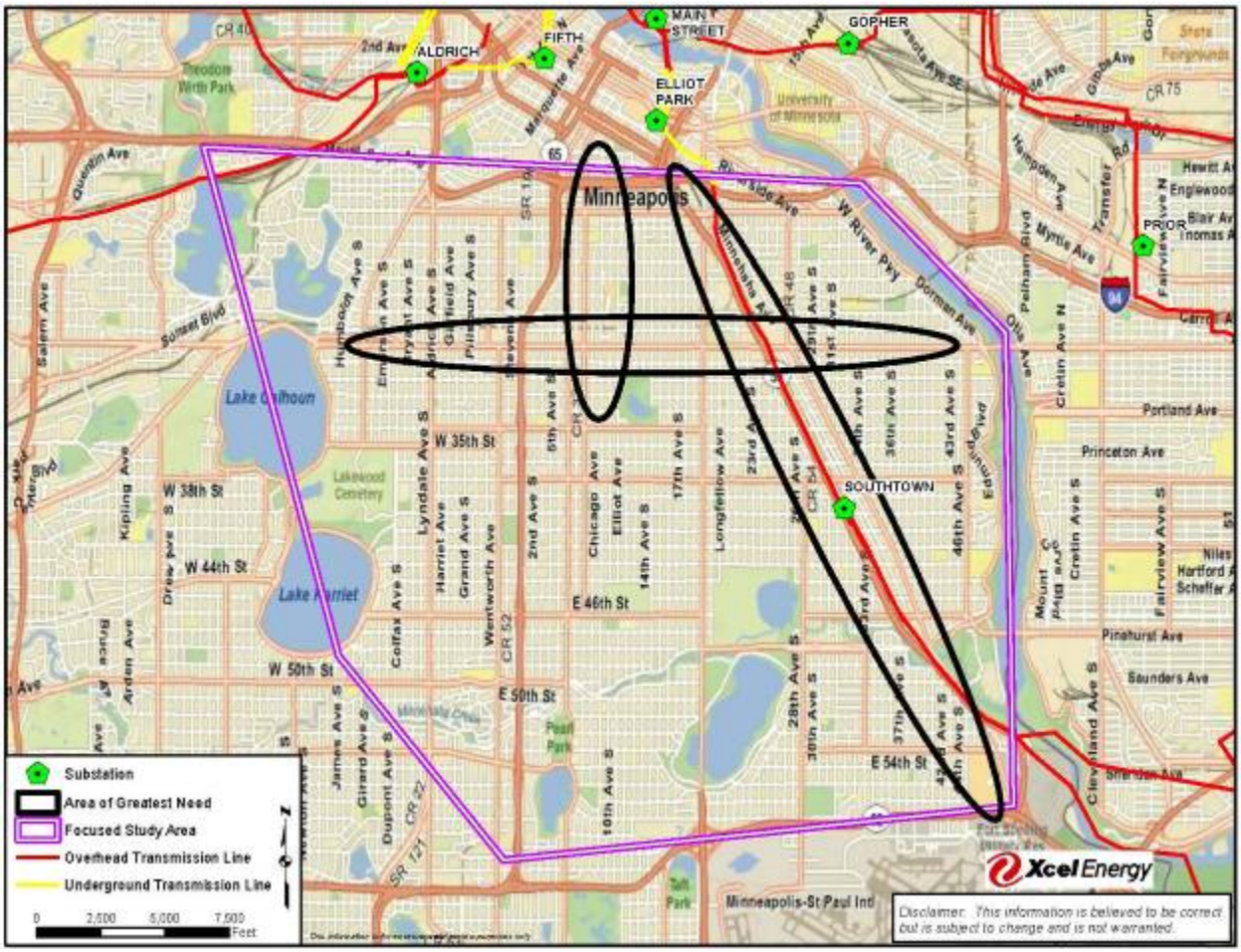
Xcel Energy has been monitoring the growing customer electrical demand in the south Minneapolis area for more than 50 years. Over the past 10 years, the area has experienced increasing feeder circuit overloads. The load density in this area is due in part to various redevelopment projects that have been implemented in recent years. The City of Minneapolis is several years into a redevelopment initiative demonstrated by the Sears Building redevelopment as the Midtown Exchange with new high density residential, hotel, and surrounding buildings. The installation of light rail along Hiawatha Avenue is complemented by City of Minneapolis and contractor high density residential projects. Recent improvements along the Chicago Avenue corridor by Abbott Northwestern and Children's Hospitals and redevelopment north and south of these large hospitals have also contributed to historical and continuing electrical load growth in the area.

From 2001 to 2008, the Company implemented an array of distribution level solutions in the Focused Study Area to meet growing demand. The Company reinforced feeder circuits, added capacitor banks, converted three 4 kV substations to 13.8 kV, targeted overloaded customer transformers and rearranged no fewer than nine feeder circuits by moving increased customer demand from an overloaded feeder to an adjacent feeder circuit with capacity in the Focused Study Area. In addition, the Company replaced six feeder circuits and replaced more than 120 cables of overloaded and damaged feeder equipment with new equipment capable of delivering equal or higher capacity. The Company added four feeder circuits at the Southtown Substation and added two feeder circuits at the Elliot Park Substation to increase feeder circuit capacity from those substations to customers and to relieve feeder circuit overloads under system intact (N-0) and first contingency (N-1) conditions.

As described in more detail in Chapter 4, the demand for power in the south Minneapolis area exceeds the capacity of the distribution system and typical distribution mitigation strategies of distribution equipment and feeder upgrades to address overload conditions have been exhausted. Consequently, the area has experienced overload conditions, brown outs, and disruption of and damage to sensitive electronic components.

To assess the system deficiencies and identify potential solutions, the Company conducted a study of the south Minneapolis distribution delivery system, including 39 feeders and associated transformers, that serves the area of south Minneapolis experiencing the most overloaded conditions. *South Minneapolis Electric Distribution Delivery System Long-Term Study* ("Distribution Study"), Appendix A.1. The 39 feeders serve a 22-square mile area of south Minneapolis area bounded roughly by Interstate 94 on the north, Lake Harriet and Lake Calhoun on the west, the Mississippi River on the east and Highway 62 on the south ("Focused Study Area"). When evaluating the existing demands on the system in the Focused Study Area, the Company found that there were three areas that had the highest loads, these three areas are along Lake Street, Hiawatha Avenue, and Chicago Avenue and Park Avenue corridors. A diagram of the Focused Study Area including the three concentrated load areas is shown in Figure 3.

Figure 3: Focused Study Area



As part of the analysis, the Company, in 2009, examined historical peak loads on the 39 feeders (2008 and prior years) and forecast peak loads (2009 and beyond). The highest peak occurred in 2006, when load in the Focused Study Area reached 331 megawatts ("MW"). This peak exceeded the capability of the distribution system under contingency conditions by 55 MW.

Demand in the Focused Study Area declined in 2007 and 2008, but in 2009 and 2010, despite the continuing economic downturn, demand on the distribution system increased. Indeed, at 5 p.m. on July 27, 2010, a hot 90 plus degree humid day, Xcel Energy set a demand record in its Upper Midwest service territory of 9,132 MW.

This upward demand trend in the affected area is expected to persist as commercial, residential, and industrial growth continues consistent with development plans for the area. There are several small area plans, which are subsets of the City of Minneapolis's comprehensive plan, which articulate future land use plans. Examples

of such plans include (1) the Midtown Greenway Land Use and Development Plan; (2) the Midtown Minneapolis Land Use and Development Plan; (3) the Phillips West Master Land Use Plan; (4) the Seward Longfellow Greenway Area Land Use and Predevelopment Study; and (5) the Hiawatha/Lake Street Station Area Master Plan. All five land use plans call for new and intensified development along the Midtown Greenway and in the surrounding area.

To address the capacity deficit and to identify sources of additional capacity to serve anticipated load growth, the Company developed and analyzed several transmission and distribution alternatives to increase capacity in the areas experiencing the most severe overload operating conditions. *See* Distribution Study, Appendix A.1 and *South Minneapolis Interconnection Study* ("Interconnection Study"), Appendix A.2. The Company also considered other alternatives, including generation and demand side management. Ultimately, the Company concluded that the option that best addressed both the immediate and long-term needs for electricity in the south Minneapolis area includes the addition of two new distribution substations in the Hiawatha and Midtown areas, with both new substations tapped off the Elliot Park – Southtown 115 kV transmission line, and two new looped 115 kV transmission lines connecting the two new substations.

The proposed Project is designed to alleviate the current 55 MW deficit identified in the Distribution Study (Appendix A.1) and address future load growth in the area. This is achieved by providing approximately 120 MW of additional load serving capability through the combination of the proposed Midtown and Hiawatha substations. This additional capacity will meet the immediate distribution system needs and provide support for further demand growth in the area.

Of the increase in distribution supply capacity provided by the Project, 90% of this will directly serve load in the three concentrated load areas along Lake Street, Chicago Avenue, and Hiawatha Avenue shown in Figure 3. However, there is also a broader improved reliability benefit as a result of the Project. The proposed new transmission lines, associated substations, and feeder circuits will enhance reliability and voltage levels of the power supply to residences and businesses by relieving distribution system overloads in the entire south Minneapolis Focused Study Area. As demand for power grows, the capacity of the system can be further expanded by adding transformers and feeder circuits at the two proposed substations.

1.4 Ownership of Project

Xcel Energy will construct, own, operate, and maintain the proposed Hiawatha and Midtown substations and the two new proposed 115 kV transmission lines connecting the new substations.

1.5 Costs and Rate Impact

The total cost of the Project with the Midtown North and Hiawatha West substation sites ranges from $30 to $43 million depending on the route and transmission line design. If different substation sites were selected, the costs could reach approximately $51 million.

There has been stakeholder interest in undergrounding the transmission lines. The transmission line estimated costs range from $2.8 million to $5.7 million for overhead design and $12.7 million to $15.5 million for underground designs.

If the cost of the entire Project were assigned to all ratepayers, there would be a rate impact of approximately $0.000117 – $0.000195 per kWh which yields $0.09 – $0.15 per month for a typical residential customer. Alternatively, the Commission could determine a portion of the cost to mitigate impacts, such as placing the line underground, should be borne by local customers. Additional information regarding cost allocation and potential rate impact scenarios is contained in Chapter 2.

1.6 Environmental Land Use Inventory and Permitting

The Hiawatha Project is Xcel Energy's first high voltage transmission project in some time to be proposed in an urban area in Minnesota with as high a population density (about 8,000 people per square mile) as the Project Area and consequently presents numerous unique challenges and considerations. Among these challenges is the significant built-up infrastructure in the immediate area, including multi-family housing and businesses, which limits the space available to add infrastructure, such as the proposed transmission lines.

The area is also one of the most culturally diverse areas of the State and includes several historical resources, including the Chicago, Milwaukee & St. Paul Railroad Grade Separation historic district ("CM&St.P Historic District") which is located along a portion of the Midtown Greenway. The Midtown Greenway is owned by the Hennepin County Regional Railroad Authority ("HCRRA") which acquired the corridor for future rail use.

Chapter 8 contains a summary inventory of the natural environment and land use features in the area where the Project would be constructed. The evaluation includes a comprehensive review of potential impacts to human settlement and historical resources and mitigation techniques. Whiles these issues are notable, the Company believes any impact to human settlement and or historic resources can be mitigated and thus would not prevent the proposed transmission lines from being constructed.

A thorough analysis of potential impacts by route was also undertaken in the Route Permit proceeding. Route specific information can be found in the Final Environmental Impact Statement ("EIS") prepared by the Minnesota Department of Commerce, Office of Energy Security ("OES"). *In the Matter of the Route Permit Application for a High Voltage Transmission Line Route Permit for the Hiawatha Transmission Project*, Docket No. E002/TL-09-38, Hiawatha Transmission Line Project Final Environmental Impact Statement *prepared by* OES (June 7, 2010) *available at* http://energyfacilities.puc.state.mn.us/resource.html?Id=28369 ("FEIS"). The OES will also prepare an environmental document for the Certificate of Need proceeding.

1.7 CERTIFICATE OF NEED CRITERIA

1.7.1 RULE AND STATUTORY REQUIREMENTS

The Commission will apply a four-part standard when deciding whether a proposed project is needed. Minn. R. 7849.0120. The standard is as follows:

> A. the probable result of denial would be an adverse effect upon the future adequacy, reliability, or efficiency of energy supply to the applicant, to the applicant's customers, or to the people of Minnesota and neighboring states, . . . ;
>
> B. a more reasonable and prudent alternative to the proposed facility has not been demonstrated by a preponderance of the evidence on the record, . . . ;
>
> C. by a preponderance of the evidence of the record, the proposed facility, or a suitable modification of the facility, will provide benefits to society in a manner compatible with protecting the natural and socioeconomic environments, including human health, . . . ; and
>
> D. the record does not demonstrate that the design, construction, or operation of the proposed facility, or a suitable modification of the facility, will fail to comply with relevant policies, rules, and regulations of other state and federal agencies and local governments.

Additional Certificate of Need criteria are also found in several other statutes: Minnesota Statutes Sections 216B.1612, subdivision 5; 216B.1691; 216B.2422, subdivision 4; 216B.2426; 216B.243, subdivision 3a; and 216H.03, subdivision 3. Several of these statutes, Minnesota Statutes Sections 216B.2422, subdivision 4; 216B.243, subdivision 3a; and 216H.03, subdivision 3 pertain to transmission lines

proposed to transmit electricity generated from non-renewable sources. Because the Project is independent of any specific generator, these statutes do not apply. *See In the Matter of the Application of Great River Energy, Northern States Power Company (d/b/a Xcel Energy) and others for Certificates of Need for the Cap X 345 kV Transmission Projects*, Docket No. ET-2, E-002, et al./CN-06-1115, Order Granting Certificates of Need with Conditions (*adopting* ALJ's Findings of Fact, Conclusions and Recommendation at Findings 474-479) (May 22, 2009 as modified August 9, 2009).

Minnesota Statutes Section 216B.243, subdivision 3(10) states that the Commission shall evaluate whether the applicant is in compliance with the applicable provisions of sections 216B.1691 (the Renewable Energy Standard ("RES")) and 216B.2425, subdivision 7. The RES requires Minnesota utilities to acquire an ever growing share of their retail electric sales from renewable sources, including Community-Based Energy Development ("C-BED") discussed in Minnesota Statues Section 216B.1612, eventually reaching a 25% share by the year 2025. Minn. Stat. § 216B.1691, subd. 2a (the statute states that Xcel Energy must reach 30% of its retail electric sales by 2025). Minnesota Statutes Section 216B.2425, subdivision 7 requires that "transmission upgrades to support development of the renewable energy resources required to meet" the RES must be identified.

Minnesota Statutes Section 216B.1612, subdivision 5(c) states that "the Commission shall consider the efforts and activities of a utility to purchase energy from C-BED projects when evaluating its good faith effort towards meeting the renewable energy objective under section 216B.1691."

Minnesota Statutes Section 216B.2426 provides that the Commission shall ensure that opportunities for the installation of distributed generation are considered in any Certificate of Need proceeding.

1.7.2 SATISFACTION OF CRITERIA

The information in this Application demonstrates that the Project satisfies each of the applicable criteria.

Minn. Rule 7849.0120

- Denial of a Certificate of Need for the Project would result in worsening overload conditions in south Minneapolis. The Midtown area is already experiencing low voltage conditions and service interruptions. Absent additional facilities, conditions will worsen with time.
- The proposed transmission lines will provide benefits to society in a manner compatible with protecting the natural and socioeconomic environments by

ensuring reliable electric service to residences and businesses. The Project does not result from any promotion of the use of electricity but rather from the need to maintain and improve reliability. There also is no indication that additional transmission capacity will serve as an inducement for future development, but the added load serving capacity is necessary for anticipated growth to occur.

- A more reasonable and prudent alternative to the proposed Project has not been identified. The Distribution Study and Interconnection Study considered costs, system losses, technical performance, and other factors. The proposed transmission upgrade was identified as the best performing option among alternatives reviewed.
- Xcel Energy has not found any rule or regulation at any level of government affecting the design, construction or operation the Project that cannot be complied with.

The four additional statutory criteria applicable to this transmission line Project are also satisfied. In its most recent Integrated Resource Plan filing in August 2010, Xcel Energy outlined its plans to secure the renewable energy resources needed to comply with RES. *See In the Matter of Xcel Energy's 2010 Resource Plan*, Resource Plan, Docket No. E002/RP-10-825 (August 2, 2010). A portion of these renewable energy resources needed to comply with RES include more than 100 MW of C-BED wind generation projects in operation and a total of about 220 MW under contract. In 2009 Xcel Energy published the Southwest Twin Cities – Granite Falls Transmission Upgrade and MN RES Update Studies to identify transmission facilities necessary to support the RES. Thus, both Minnesota Statutes Sections 216B.243, subdivision 3(10) and 216B.1612, subdivision 5(c) are met.

As part of the engineering analysis supporting the Project, Xcel Energy considered the use of generation, including distributed generation, to meet the identified need. Xcel Energy concluded that new generation at multiple locations will not correct the distribution feeder circuit overloads experienced in the Project Area. Accordingly, Minnesota Statutes Section 216B.2426 is satisfied.

1.8 APPLICANT'S REQUEST

Xcel Energy respectfully requests that the Commission grant a Certificate of Need for the Hiawatha Project presented in this Application.

Any correspondence concerning this Application can be directed to:

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(612) 330-7592
paul.lehman@xcelenergy.com

2.0 PROJECT DESCRIPTION

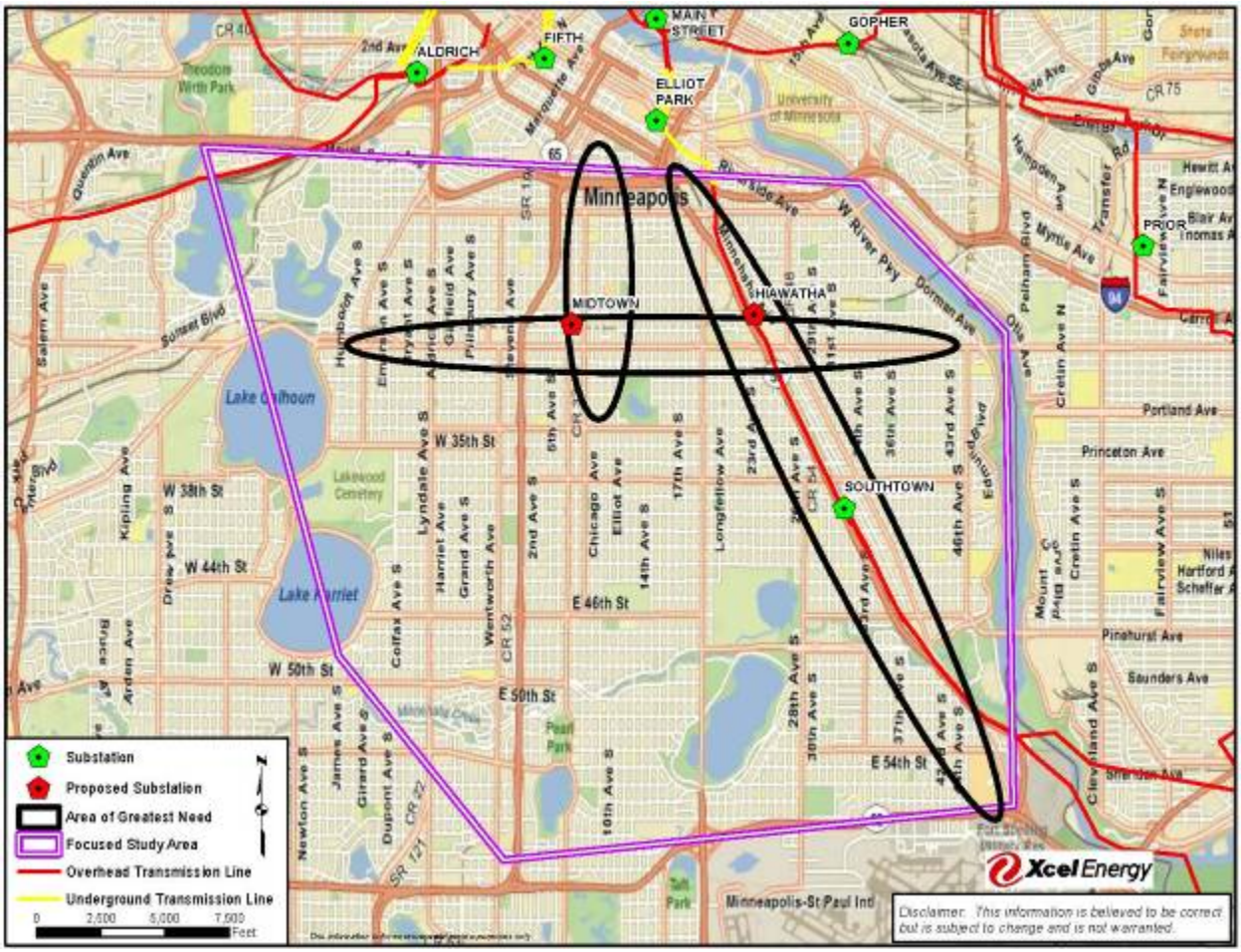
The Project includes two new substations, a Midtown Substation and a Hiawatha Substation, and two 115 kV transmission line connections between the two substations. Xcel Energy's proposal is to construct the transmission lines along Route A, build the Midtown Substation at the Midtown North site and the Hiawatha Substation at the Hiawatha West location. This double circuit design maximizes efficiencies and reduces overall right-of-way requirements. Detailed descriptions of the Project components and transmission line characteristics are provided in this chapter. This chapter also includes information regarding schedule, costs and rate impact.

2.1 FACILITIES TO BE CONSTRUCTED

2.1.1 SUBSTATIONS

The Company identified a need for additional sources in the Project Area, specifically in the areas of high load concentrations along Hiawatha Avenue, Lake Street and along Chicago Avenue and Park Avenue corridors. To address this need the two new substations are proposed to be located in the concentrated load areas, as shown in Figure 4.

Figure 4: Substation Locations Within Concentrated Load Areas



On the west end, the Midtown Substation is proposed to be located on the northwest corner of the intersection of Oakland Avenue and the Midtown Greenway. It is proposed to be a high profile design of approximately three quarters of an acre. Equipment at the substation would include:

> Two 115 kV transmission line steel box structures and related substation equipment and structures;
>
> One 70 MVA, 118-14.4 kV, LTC distribution transformer; and
>
> One electrical equipment enclosure containing 13.8 kV distribution feeder equipment, electrical controls, protective relaying, and auxiliary equipment for the operation of the substation.

The Midtown Substation alternatives will be surrounded by an architecturally-designed, decorative wall which will aid in mitigating noise generated by the operation of the substation. In addition, the Company plans to install lower noise transformers, sound absorbing materials for the transformer fire walls and rubber matting under the substation transformers.

A new Hiawatha Substation is proposed on the east end of the Project. The Hiawatha Substation is proposed as a low profile design, approximately two (2) acres in size. The Hiawatha Substation would initially consist of the following equipment:

> 115 kV transmission line dead-end structures and related substation equipment and structures.
>
> One 13.8 kV transformer termination structure;
>
> One 50 MVA, 118-14.4 kV, Load Tap Changer ("LTC") distribution transformer;
>
> One switchgear enclosure containing 13.8 kV distribution equipment; and
>
> One electrical equipment enclosure containing electrical controls, protective relaying, and auxiliary equipment for the operation of the substation.

Conceptual layouts for the Midtown Substation and the Hiawatha Substation are provided in Appendix D.

2.1.2 TRANSMISSION LINES

2.1.2.1 ROUTE A

Xcel Energy proposes to construct two 115 kV transmission lines along Route A. There are three potential alignments along Route A. Alignment A1 follows 29th Street and consists of two overhead 115 kV transmission lines on double circuit structures. Alignment A2 is an underground design along 29th Street, parallel to the Midtown Greenway. Alignment A3 is an underground design on an alignment under the bike/walking path along the north edge of the Midtown Greenway.

For Route A—Alignment A1, Xcel Energy proposes to use galvanized, self-weathering/rust-colored steel double circuit structures with davit arms. For areas where the Project will cross existing and future light rail, auto, and pedestrian paths, custom designed structures will be used.

The right-of-way required would be 50 feet, 25 feet on each side of the pole, and located in public streets and the Midtown Greenway. Average spans between structures will be approximately 500 feet. However, span lengths may vary between structures from as short as 300 feet to as long as 1,000 feet to accommodate future plans for the area, such as future transit within the Midtown Greenway. The proposed conductor is 795 kcmil Aluminum Conductor Steel Reinforced ("ACSR") 26/7 or conductor of comparable capacity per phase ("kcmil" is a unit of measure representing "thousand circular mils").

The poles would be approximately 75-feet tall. Depictions of typical tangent and dead-end double circuit structures are shown in Figure 5 and Figure 6. At several locations the lines would cross existing and future light rail, auto and pedestrian paths. There will be custom designed structures for the current and future light rail corridors based on the field requirements at each location. These custom structures would be similar to the dead end structures depicted below with an additional arm to support crossings eliminating the need for an additional structure. These structures have not been designed at the time of filing, but will be designed once Commission approvals are obtained.

Figure 5: Double Circuit Tangent Structure

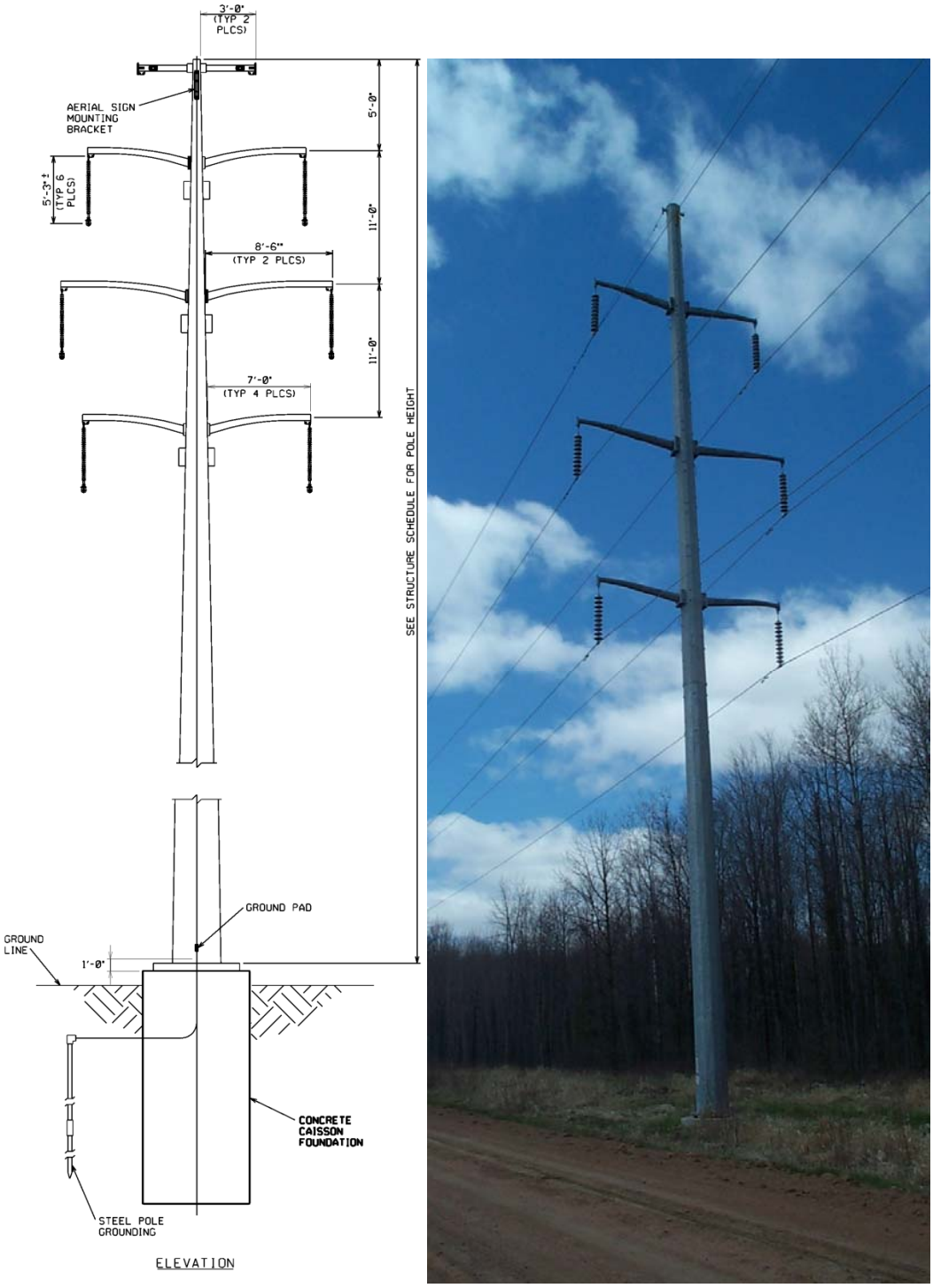


Figure 6: Double Circuit Dead-End Structure

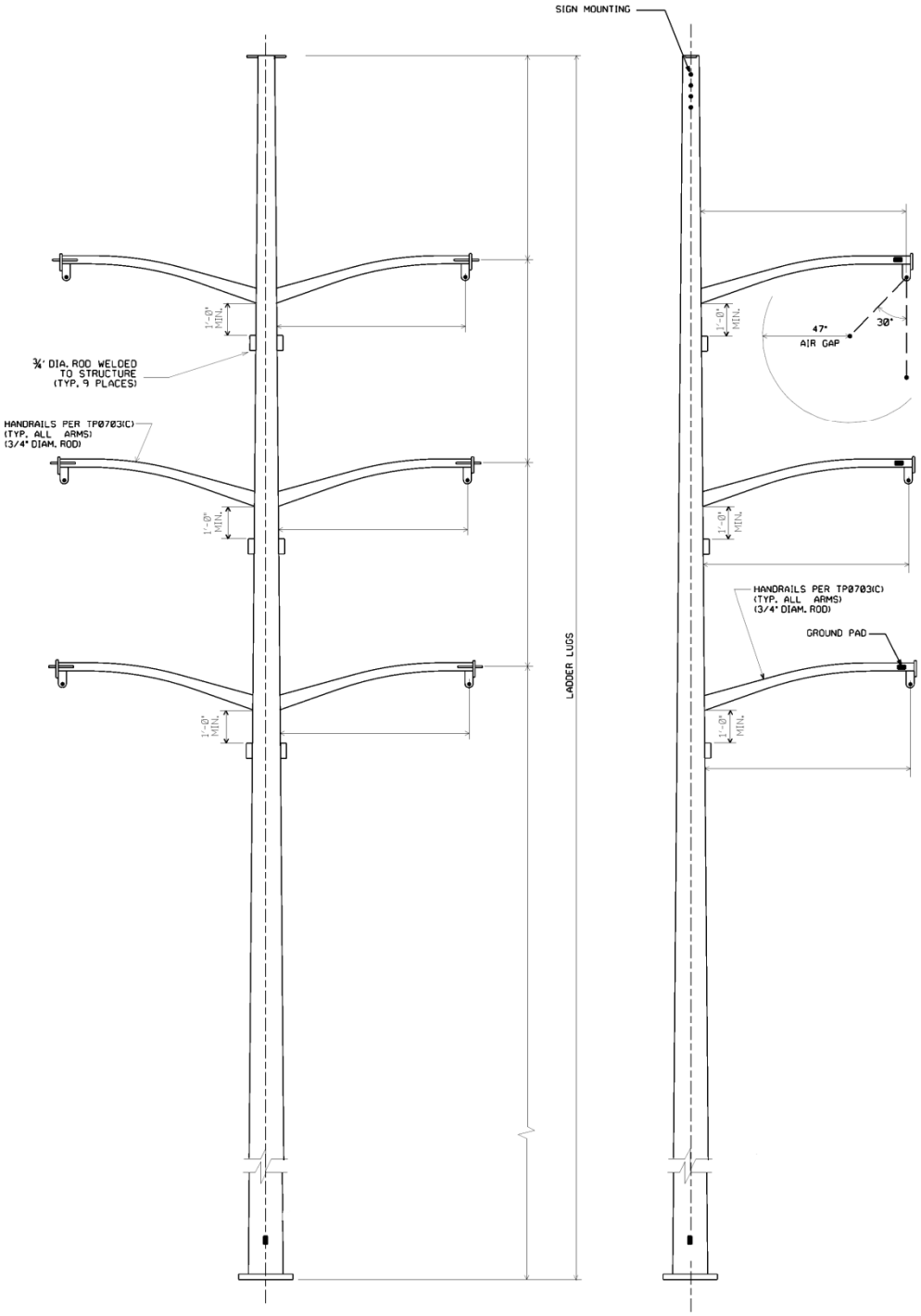


Figure 7 summarizes the structure designs and foundation for Route A.

Figure 7: Route A—Alignment 1 Double Circuit Structure Design Summary

Project Component	Line Voltage	Structure Type	Pole Type	Conductor	Foundation	Average Span Length	Average Height	Maximum Height
Tangent	115 kV	Typical	Steel	795 kcmil 26/7 ACSR	Drilled Pier	500 feet	75 feet	110 feet
Dead-End	115 kV	Crossing	Steel	795 kcmil 26/7 ACSR	Drilled Pier and/or Driven Pile	500 feet	80 feet	115 feet

For the underground alignments on Route A—Alignment A2 and Alignment A3, Xcel Energy proposes to install two identical concrete duct banks containing four 6-inch polyvinyl chloride ("PVC") conduits for the transmission circuits, and two 2-inch PVC conduits for ground continuity and communication needs. The duct banks are anticipated to be installed adjacent to each other in the same trench unless a different design is dictated by the physical limitations of the route. Cable vaults with manhole access will be required approximately every 1,500 feet and at major changes in direction in the route to facilitate the installation of the cable as well as for future inspection and repairs. The amount of right-of-way required for the underground design for Route A—Alignment A2 and Alignment A3 is 30 feet, or 15 feet on each side of the transmission line centerline.

The proposed cable is a high voltage extruded dielectric ("HVED") cable, 3000 kcmil. HVED cable consists of stranded copper conductor surrounded by a solid electrostatic conductor shield and insulation. The outermost layers consist of an insulation shield and moisture block and cable shield covered by a layer of polyethylene protective jacket.

Figure 8 and Figure 9 illustrate underground ducts and vaults.

Figure 8: Underground Duct Section

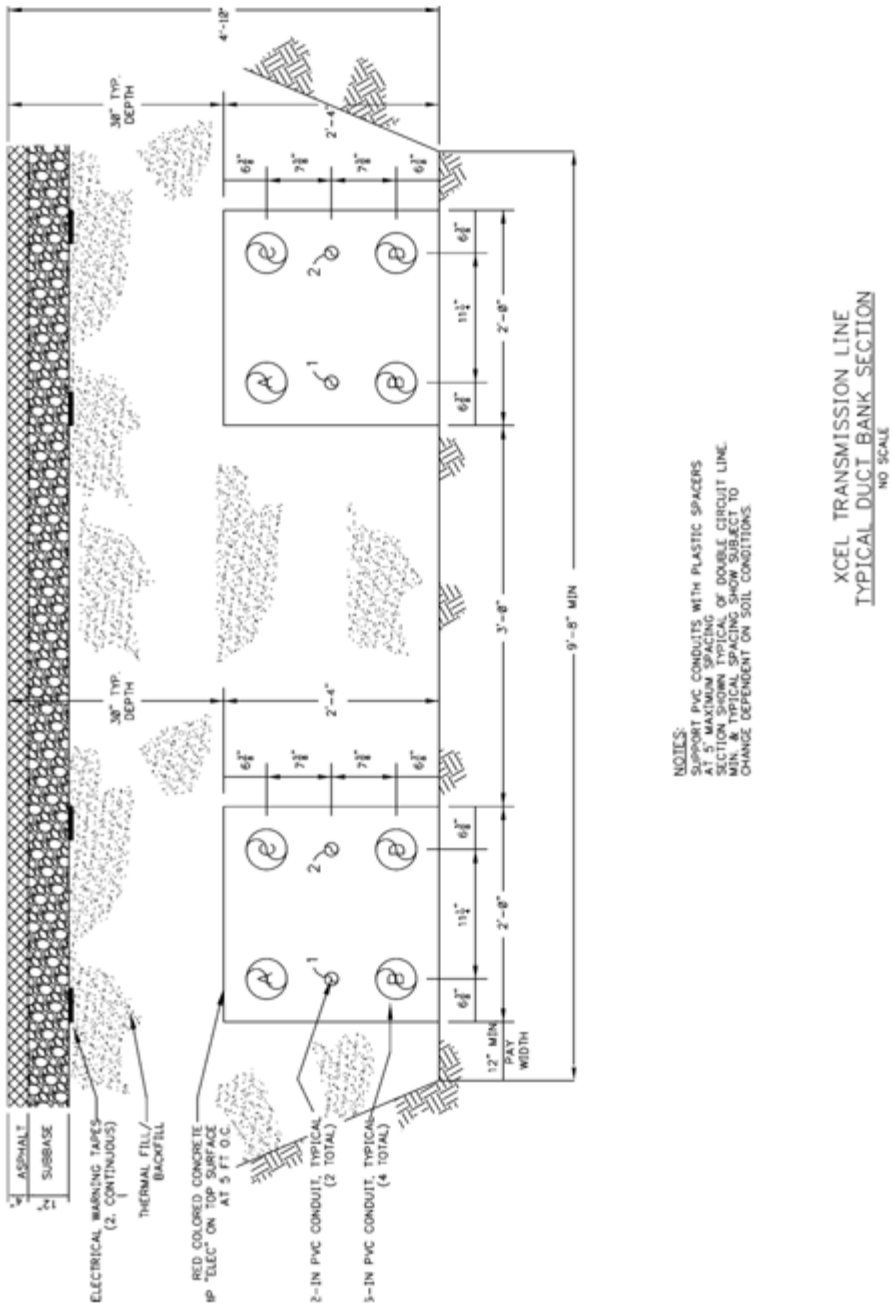
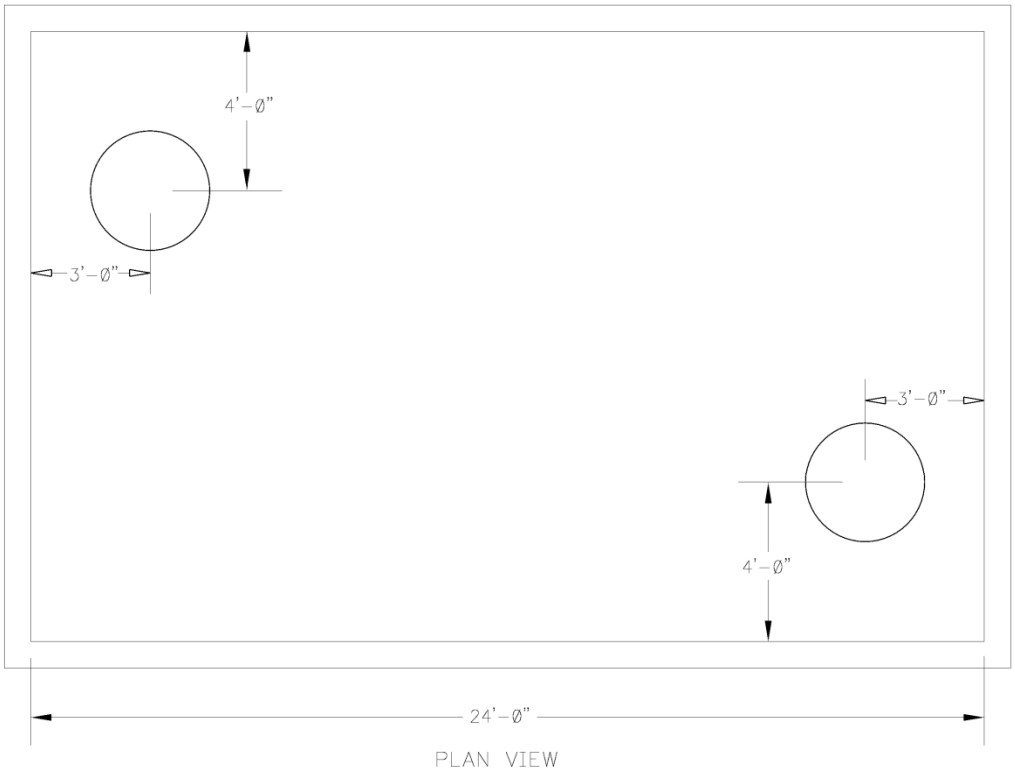


Figure 9: Underground Cable Vault



STREET MANHOLE
(14' WIDE X 24' LONG X 7'-6" HIGH)
NO SCALE

Details regarding construction techniques for underground transmission facilities are provided in Chapter 6.

2.1.2.2 OTHER ROUTES EVALUATED IN ROUTE PERMIT PROCEEDING

Overhead Design Single Circuit Route B and Route C

Routes B and C are street routes for two single circuit overhead 115 kV transmission lines. Route B follows 26th Street (1.8 miles) and 28th Street (1.5 miles). Route C follows 28th Street (1.5 miles) and 31st Street (2.3 miles). The same transmission line design for the facilities is proposed along both routes.

For Route B or Route C, a cantilever design is proposed. This design would require the installation of a single pole transmission structure with all davit arms and conductors installed on the side of the pole overhanging the public road or public

right-of-way. The National Electric Safety Code ("NESC") clearance requirements dictate a 25-foot right-of-way clearance on the side of the pole with the installed davit arms. There is no NESC safety clearance minimum required for the side of the pole without the cantilevered arms and conductors. Xcel Energy will seek 25-feet of right-of-way on the street side and may seek to acquire a right-of-way on the non-arm side of the poles for access and maintenance of the structures up to 25 feet where feasible. Xcel Energy will work to minimize the right-of-way needed from private landowners to the extent possible.

The poles would be approximately 75-feet tall and typical spans will be 500 feet. The proposed conductor is 795 kcmil, 26/7 ACSR, or conductor of similar capacity.

Figure 10: Single Circuit Tangent Structure

(Also depicts direct embedded steel pole installation)

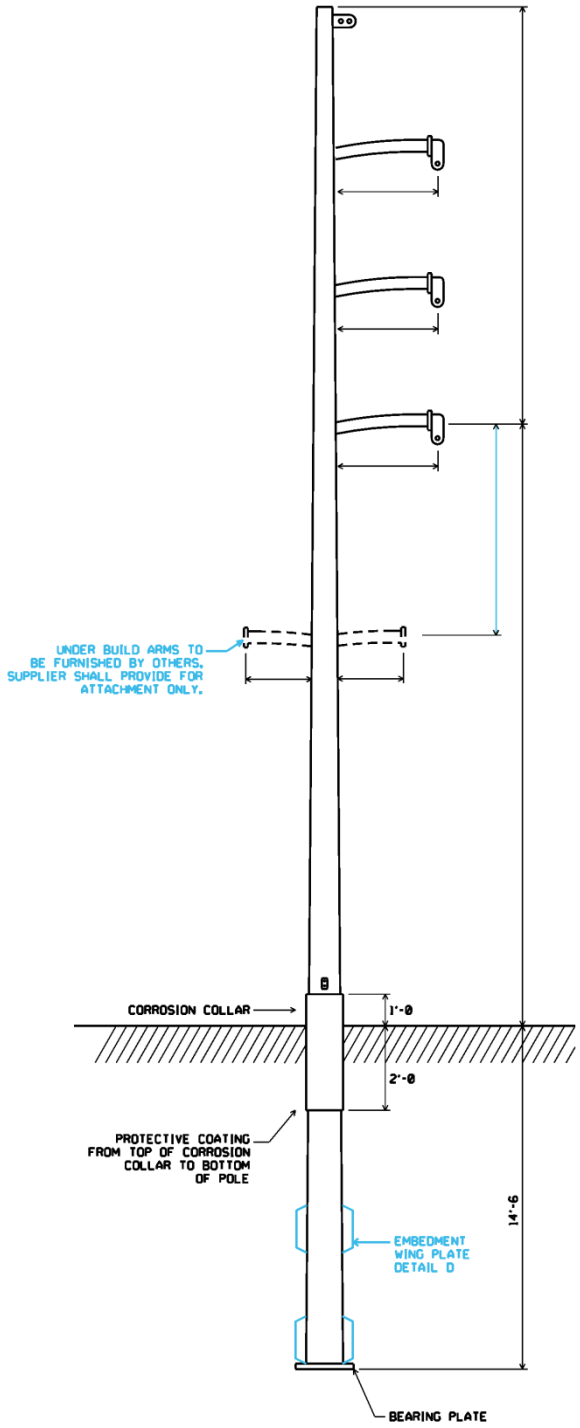


Figure 11: Single Circuit Dead-End 90 Degree Corner Structure

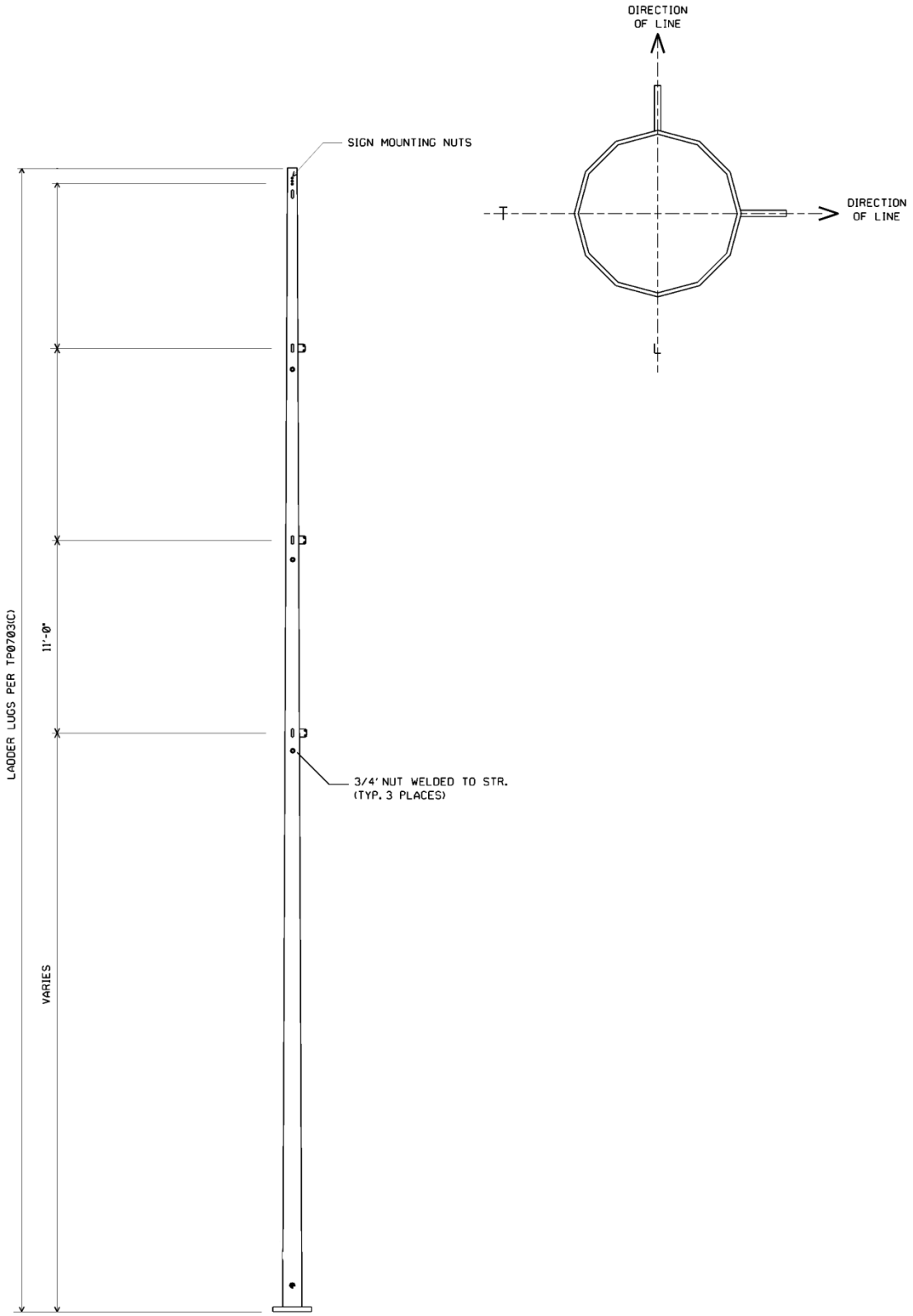


Figure 12: Subgrade Foundation

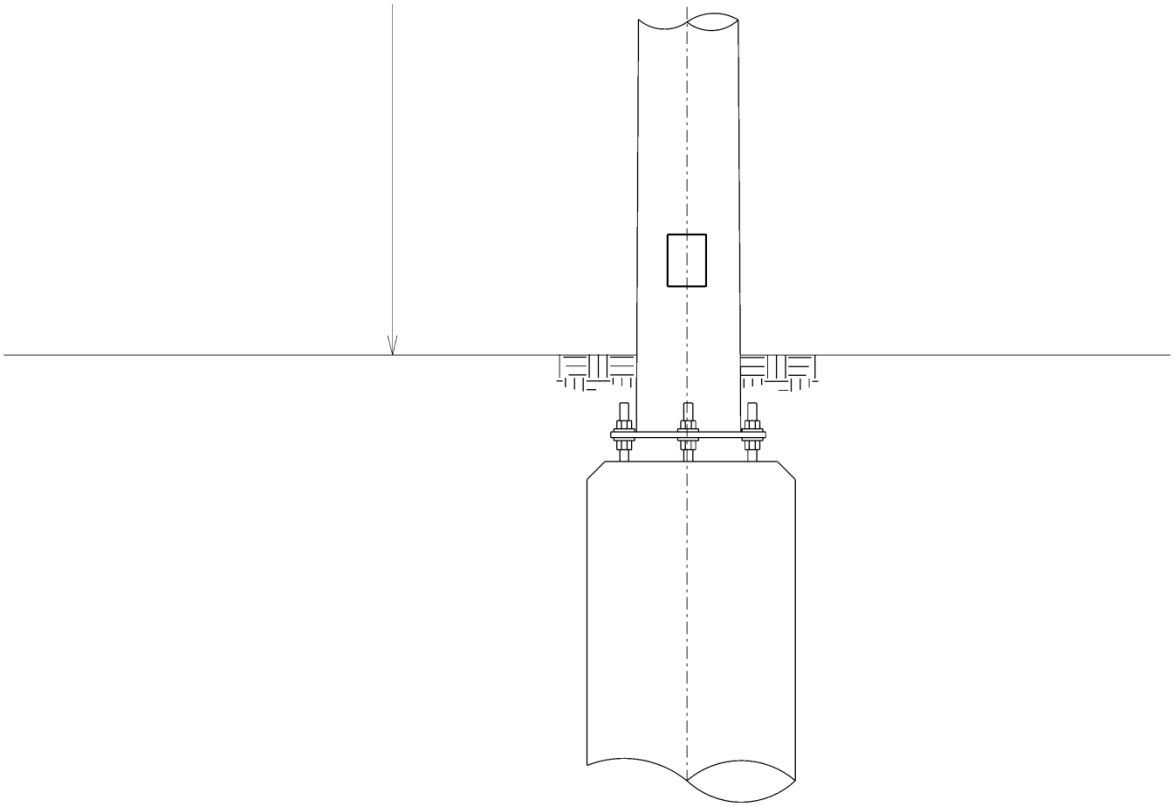


Figure 13 summarizes the structure and foundation designs for the line if constructed along Route B or Route C:

Figure 13: Route B and Route C, Single Circuit Structure Design Summary

Project Component	Line Voltage	Structure Type	Pole Type	Conductor	Foundation	Average Span Length	Average Height
Tangent	115 kV	Typical	Steel	795 kcmil 26/7 ACSR	Drilled Pier or Direct Imbed	500 feet	75 feet
Dead-End	115 kV	Crossing	Steel	795 kcmil 26/7 ACSR	Drilled Pier	500 feet	100 – 110 feet

Underground Design Route D

Route D would be located along 28th Street between the Midtown Substation and the Hiawatha Substation. If constructed along Route D, the facilities would utilize the same design and have the same right-of-way requirements as Route A—Alignment A2 and Route A—Alignment A3, as described above.

2.2 SCHEDULE

The Project has a target in-service date of second/third quarter 2013. The schedule for construction of the Project is shown in Figure 14 below:

Figure 14: Construction Schedule

Task	Timing
Permitting Process	4th Quarter 2011
Preconstruction Activities (survey, ROW acquisition, equipment/materials acquisition)	1st-2nd Quarter 2012
Construction	2nd Quarter 2012 – 2nd Quarter 2013
Project Completion	2nd Quarter 2013 – 3rd Quarter 2013

This schedule is based on the best information available as of the date of this filing and upon planning assumptions that balance the timing of implementation with the availability of crews, materials, and other practical considerations. This schedule may be subject to adjustment and revision as further information is developed.

2.3 CAPITAL COSTS/RATE IMPACT

2.3.1 ESTIMATED PROJECT COSTS

The cost of the Project includes materials, construction, right-of-way acquisition and Project management. The estimated cost of the Project varies depending on the route selected and ultimate design (overhead or underground).

The substation cost estimates are based on construction at the Hiawatha West and Midtown North sites. For the Hiawatha West site, the estimate ($2010) is $15.8 million and is based on a low-profile design and includes $900,000 in private land acquisition costs and $625,000 in estimated relocation costs (fiber optic and rail spur). This estimate does not include acquisition costs for Minnesota Department of Transportation ("Mn/DOT")-owned property. For the Midtown North site, the

substation cost estimate is $11.8 million based on a high profile design and includes $700,000 estimates for land acquisition.

The total cost of the Project ranges from $30 to $43 million (using Midtown North and Hiawatha West sites). The Project costs, by route and design for the Hiawatha West and Midtown North substation sites are provided in

Figure 15. Additional cost estimates for other substation locations proposed by Xcel Energy are provided in Appendix C.1.

Figure 15: Project Costs ($2010 millions)

Route Alternative	Hiawatha Substation Costs (Hiawatha West)	Midtown Substation Costs (Midtown North)	115 kV Transmission Line Costs	Total Cost
Route A—Alignment 1 (double circuit)	$15.8	$11.8	$2.8	$30.4
Route A—Alignment 2 (underground)	$15.8	$11.8	$13.6	$41.2
Route A—Alignment 3 (underground)	$15.8	$11.8	$12.7	$40.3
Route B (two single circuits)	$15.8	$11.8	$4.6	$32.2
Route C (two single circuits)	$15.8	$11.8	$5.7	$33.3
Route D (underground)	$15.8	$11.8	$15.5	$43.1

2.3.2 TARIFF PROVISIONS

The means of cost recovery for the Project, and resultant rate impact, is dependent on the total cost of the Project and the facilities' classification under the Tariff as "Standard Facilities" or "Special Facilities." The costs associated with Standard Facilities are recovered from all customers collectively through rates specified in the Company's standard service tariffs. However, in those cases where a customer or group of customers wants the Company to provide Special Facilities at higher costs than that of Standard Facilities, the terms and conditions of the Company's General Rules and Regulations apply. Generally, if a facility is a Special Facility, the difference in costs between the Standard Facility and the Special Facility ("Excess Expenditure") is borne by the customer or group of customers who requested or required the Company to incur the Excess Expenditure.

Standard Facilities, in general, are those facilities constructed in conformance with Xcel Energy's standard practice, considering all of the surrounding circumstances. Tariff, Section 6, Rule 5.3 (A)(5) Sheet 6-27.1. This Tariff provision provides flexibility to assess and determine whether a particular facility is a Standard Facility based on the unique facts and circumstances surrounding the individual installation. Special Facilities are defined as "non-standard facilities or the non-standard design or location of facilities as provided in Section 5.3(B)" of the Tariff. Tariff, Section 6, Rule 5.3 (A)(6), Sheet 6-27.1. "Excess Expenditure" is generally defined as the incremental costs of Special Facilities over the costs of Standard Facilities. Tariff, Section 6, Rule 5.3 (A)(7), Sheet 6-27.1.

The Tariff provides that when Special Facilities (distribution or transmission) are requested "by a customer, group of customers, developer, or Municipality [including a county, city, a township or other unit of local government] to provide types of service that result in an expenditure in excess of the Company designated standard service installation" the requesting party is responsible for the Excess Expenditure. Tariff, Section 6, Rule 5.3 (B)(1), Sheet 6-27.2.

The Tariff further provides that when "Special Facilities are requested or ordered by a Municipality which is not a city, or in circumstances other than those addressed in Section 5.3(E)(3) [described below]", and the municipality does not make or arrange payment for the Excess Expenditure, then "the Company may seek approval of the Commission to allow the Excess Expenditure to be the responsibility of the Company's customers residing within the Municipality and may seek approval by the Commission pursuant to Minnesota Statutes Chapter 216B to allow recovery of such expenditures from those customers through a rate surcharge or other method." Tariff, Section 6, Rule 5.3(E)(2), Sheet 6-29.1.

In the case of a City order for undergrounding of distribution facilities as a Special Facility, then Rule 5.3(E)(3) applies. Rule 5.3(E)(3) provides that when a City requires undergrounding and payment for the excess expenditure is not made or arranged, then the excess expenditure will be recovered by Xcel Energy from Xcel Energy customers located in the municipality through a City Requested Facilities Surcharge over a period of 36 to 60 months. City Requested Facilities Surcharge Rider ("CRFS") (Tariff, Section 6, Rule 5.3 (E)(3), Sheet 6-29.2 and Section 5, Sheet 5-131).

2.3.3 POTENTIAL RATE IMPACTS

If the Project were constructed along Route A—Alignment A1, overhead, the costs would likely be treated as standard and allocated across all Xcel Energy customers. If the transmission lines are constructed underground on one of the

Route A alignments or Route D, then the Commission will assess what costs should be considered Excess Expenditures and how Xcel Energy should recover those costs.

The estimated overall cost of the Project ranges from $30 to $43 million for the Midtown North and Hiawatha West substation sites and up to approximately $51 million for alternate substation sites. If all facilities were determined to be Standard Facilities, the rate impact of the combined substation and transmission line costs would be $0.000117 – $0.000195 per kWh which yields $0.09 – $0.15 per month for a typical Minnesota residential customer.

If some or all of the facilities were designated by the Commission as Special Facilities the rate impact would vary depending on how the Excess Expenditures were defined and allocated. As part of the Route Permit proceeding, Xcel Energy was asked by Commission Staff to calculate how the incremental costs of undergrounding the Hiawatha transmission line would be recovered based on the CRFS rider as a model and assessed across several customer bases including the City of Minneapolis, Hennepin County, the seven-county metropolitan area and Xcel Energy's entire service territory over a three- and five-year time frame. The difference in transmission line costs between the double circuit overhead design along Route A—Alignment A1 and the underground alternatives, Route A—Alignment A2, Route A—Alignment A3 and Route D, are shown below in Figure 16. Xcel Energy's response to the information request is included in Appendix C.2.

Figure 16: Transmission Line Cost Differential by Design ($2010 millions)

Underground Design	Underground Design Costs	Overhead Design, Route A—Alignment A1	Cost Difference
Route A—Alignment A2	$13.6	$2.8	$10.8
Route A—Alignment A3	$12.7	$2.8	$9.9
Route D	$15.5	$2.8	$12.7

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3.0 ELECTRICAL SYSTEM OVERVIEW

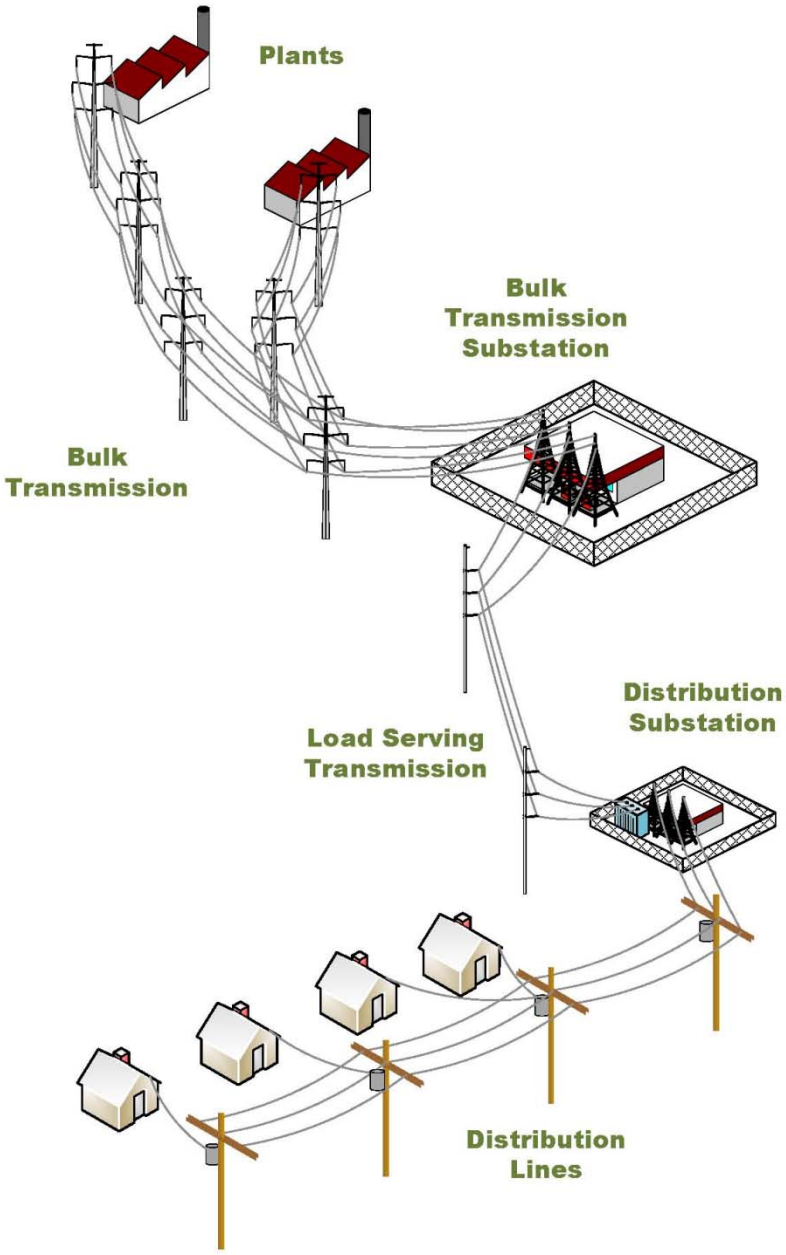
When a customer turns on a light switch, a circuit is completed that connects the light with the wires that serve the customer's building. The building wires are connected to a transformer and a distribution line outside of the building. The distribution lines, in turn, are connected to substations and through larger transformers to transmission lines, which are connected to the bulk-power system that carries electricity from electric generating plants to the areas where the electricity is needed.

Electricity is produced at both large and small generating plants. Electricity can be generated using a variety of sources or fuels, including solar, wind, and hydro; internal and external combustion of biomass, biofuels, natural gas, and coal; and heat and steam created through nuclear fission. Regardless of the fuel used, electricity is produced by converting the fuel's energy into electric energy through the use of a generator that converts mechanical energy into electric energy. Electric energy is generated at a specific voltage and frequency. For it to be useful, electricity must be transmitted from the generation source to consumers. Unlike other products or services, electricity must be generated simultaneously with its consumption, so generators connected to the system must instantaneously adjust their electric output to respond to changes in customer demand. The transmission system must also be able to accommodate changes in both generation and consumption.

Typically, the voltage of electricity generated in a power plant is increased (stepped-up) by transformers installed close to the generating plant. The electricity is then transported over transmission lines, often at voltages in excess of one hundred thousand volts (e.g., 115 kV, 230 kV, 345 kV). One kilovolt equals 1,000 volts. The reason for stepping up the voltage is that it is more efficient to move electricity over longer distances at higher voltages because the system experiences fewer electrical losses. Once the electricity reaches the locality where it will be consumed, the transmission voltage (e.g., 115 kV and higher) is reduced (stepped-down) to voltages appropriate for distribution to end use customers by transformers at a distribution substation facility. The electricity is then further transformed and distributed at distribution "primary" voltages (e.g., 13.8 kV) within communities by the distribution system which delivers power for individual customer use.

A diagram showing the transfer of electricity from generator to consumer is shown below in Figure 17.

Figure 17: Electrical System



Note: Figure 17 is an artistic portrayal of an electrical system and is not a true representation of all actual electrical system components.

3.1 TRANSMISSION SYSTEM OVERVIEW

The transmission system is made up of high voltage transmission lines which can carry electricity long distances. The transmission system is designed to be an integrated system that is able to withstand the outage of a single transmission line without major disruption to the overall power supply. The majority of the bulk transmission facilities consist of transmission lines and bulk transformers at 100 kV and above.

3.1.1 HIGH VOLTAGE TRANSMISSION LINES

Transmission lines are made up of conductors, which are bundled groups of wires usually made from copper or aluminum, that are usually held up by poles or towers that are made from wood or steel.

Transmission lines carry electricity from the generation source to the area where the power is needed. Electricity is simply the movement of electrons within a conductor (the wire). The rate at which electricity moves through a wire is called current and is measured in amperes (or amps). The force that moves the electricity through the wire is called voltage. Voltage is measured in terms of volts or kilovolts ("kV"). The wire conducting the current offers resistance to its movement. This resistance is measured in a unit called ohms. Some materials are better conductors than others, i.e., they offer less resistance. The wires used by utilities to conduct electricity are usually made of copper or aluminum, which conduct electricity with relatively little resistance.

3.1.2 TRANSMISSION SUBSTATIONS

Substations contain equipment that allows transmission lines to connect with one another, or allow power to be transformed to a lower voltage for distribution, typically below 69 kV. The equipment inside a substation includes breakers, transformers, switches, buses, and relays. Breakers protect lines by stopping power from flowing down a line when the line experiences a fault (such as one caused by a lightning strike). Transformers increase voltage to move power over longer distances more efficiently or decrease voltage for consumer use. Switches isolate pieces of equipment in a substation to allow for maintenance or to configure the power system. A bus is a substation conductor, usually aluminum or copper, that moves the power through the substation among the lines that connect within the substation. Relays are programmed to sense the flows within the substation and on the lines that connect to the substation. Relays are capable of detecting system conditions that are abnormal and opening lines to respond. New substations are generally designed to have room

for future growth, and substation equipment is generally designed so as not to limit the capacity of any transmission lines on the system.

3.2 DISTRIBUTION SYSTEM OVERVIEW

The distribution system is made up of substations which house transformers and distribution feeder circuits that provide the path for delivering electrical energy from the distribution substation to the distribution customer transformer. Distribution feeder circuits for standard service to customers are designed as radial circuits, so the failure of any single critical element of the feeder circuit can cause a customer outage, which is the standard of service for a distribution system unlike for a transmission system. Generally, the distribution system is planned to facilitate single-contingency switching to restore outages within approximately one hour. Feeders are designed to facilitate restoration of main line capacity and restoration of service to most customers with simple manual field switching with some exceptions. A description of distribution substations and feeder circuits is provided below.

3.2.1 DISTRIBUTION SUBSTATIONS

Distribution substations transform transmission line voltages (typically 69 kV and above) to distribution voltage for delivery across a distribution system. The main distribution substation elements are switches, bus, breakers, and distribution substation transformers. Various other equipment is installed for purposes including load monitoring, remote control, electrical problem detection, electrical problem isolation, voltage regulation, and security.

Switches are used to route or reroute flow of electric energy and to isolate substation equipment for safe construction, maintenance, and inspection. Typically distribution feeder switches are operated when electrical load is turned off. Switches are used to reconfigure the electric delivery system for maintenance and during contingency operation.

Buses are electrical conductor(s) that provide both a path for electrical energy flow and multiple connection points for electrical devices including switches, transformers, and breakers. They provide the multiple paths for electrical energy flow to support normal and contingency operations.

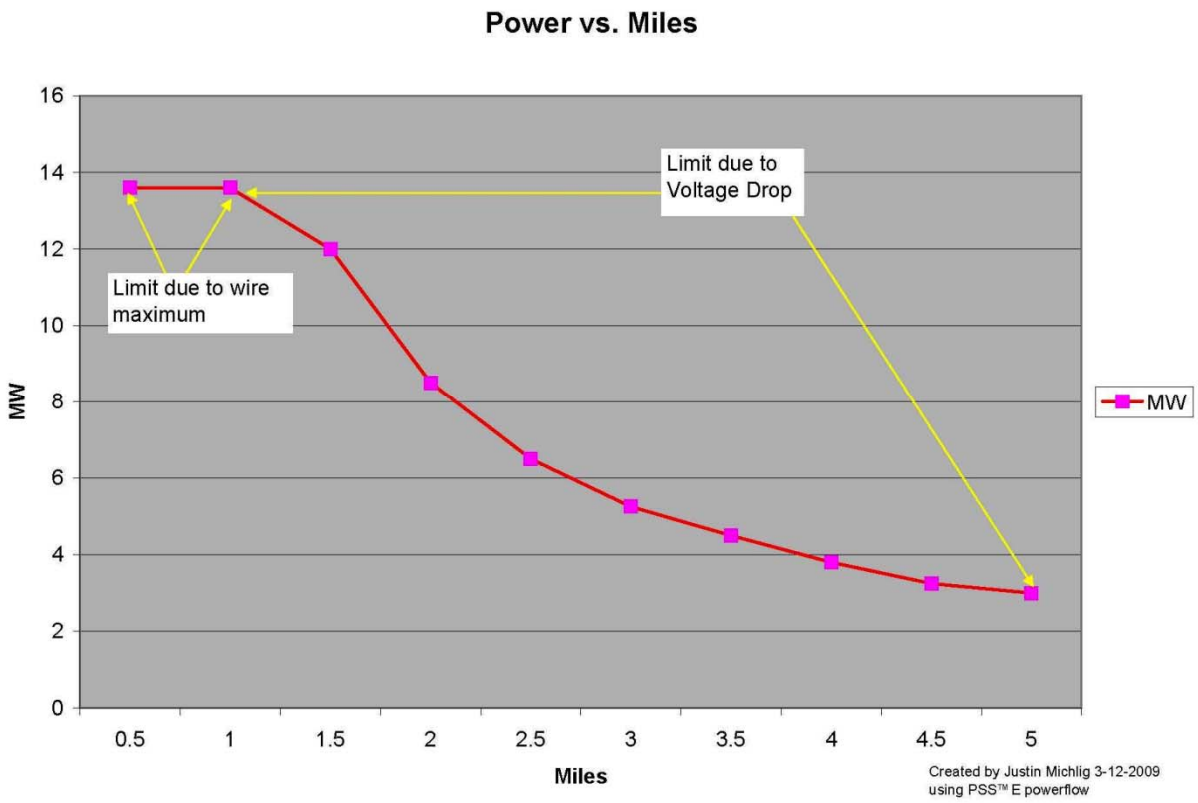
A breaker is a switching device designed to interrupt electrical energy flow between energized elements. Breakers interrupt and quickly isolate electrical energy flow from transmission lines to distribution substation transformers (transformer breakers) and from distribution substation transformers to distribution feeder circuits (feeder breakers).

Distribution substation transformers are the key distribution substation elements used by the Company when developing plans and options to electrically serve an area of distribution customer load. Other substation equipment is selected and installed based on the transformer quantity and size planned in the ultimate substation design. The maximum number and size of substation transformers in the ultimate substation design are the primary limiting factors for the amount of electrical energy that a substation can deliver.

Xcel Energy plans and constructs distribution substations with a physical footprint sized for the ultimate substation design. The maximum ultimate design capacity established in Xcel Energy planning criteria is three transformers at the same distribution voltage (there is one exception to this criterion. In downtown Minneapolis, the Fifth Street Substation houses four transformers to serve the significant amount of load there). This maximum size balances substation and feeder circuit costs with customer service considerations including limitations of feeder circuit routes emanating from substations, circuit exposure of long feeder circuits, ease of operation, cost of operation, customer outage restoration, and the electrical losses. Transformers and feeder circuits are incrementally added within the established footprint until the substation is built to ultimate design capacity.

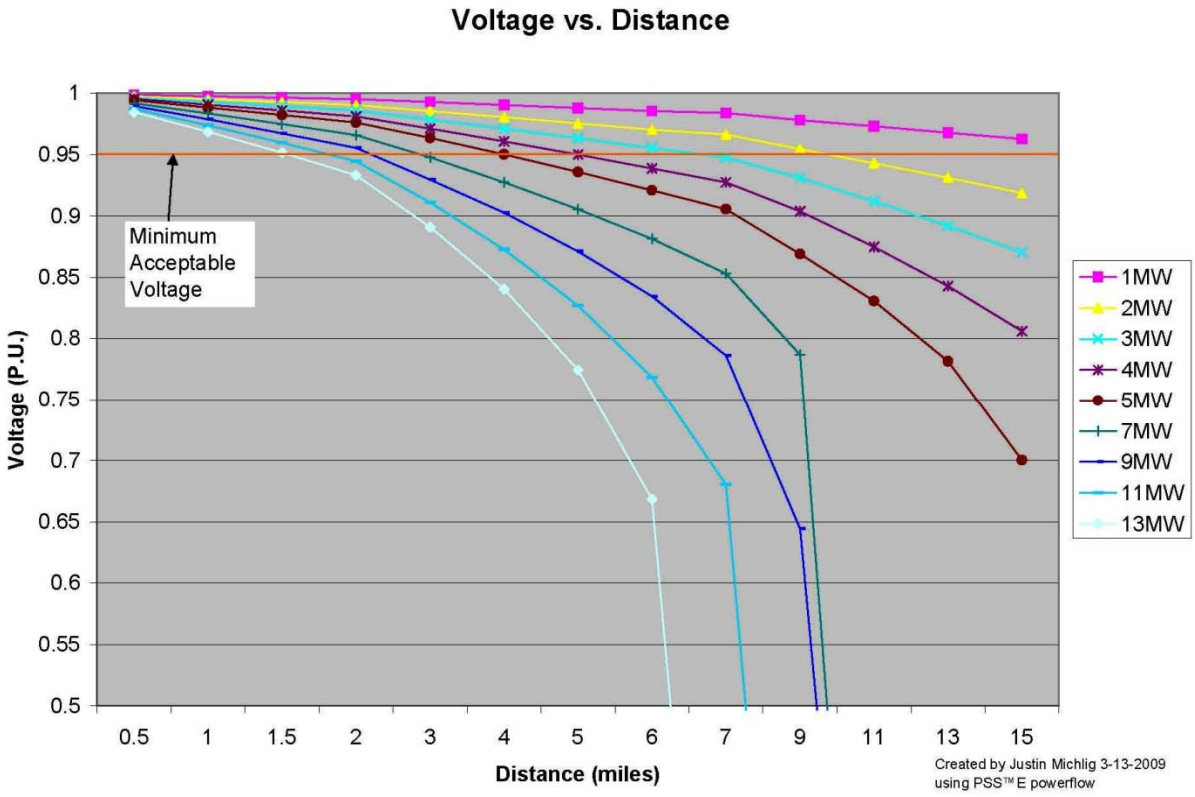
Generally, distribution substations are located as close to the area of heaviest load or electrical usage, as possible. This is because the farther a substation is from the load being served, the longer the feeder circuits are that emanate from the distribution substation, which impacts the amount of load a feeder circuit can efficiently carry to customers while maintaining required voltage levels. Figure 18 illustrates how the ability of a distribution feeder line to adequately serve customer load decreases as the load is farther from the substation along the feeder circuit. This capacity reduction is caused by a reduction in voltage—as the line length increases, the voltage at the end of the line decreases. This is due to electrical and physical properties in the power system. Closest to the substation, a feeder circuit's limit is the maximum amount of current the circuit can carry. At points along the feeder circuit farther away from the substation, the limit becomes the maximum amount of allowable voltage drop. For example, at 2.5 miles from the transformer, the capacity of a feeder at an adequate voltage is reduced by half. By analogy, a person generally can hold greater weight closer to the person's body and as the weight moves further from the body, the amount of weight that a person can hold straight out decreases. Therefore, when planning the electric distribution delivery system, the Company tries to locate distribution substations as close to the major load areas as possible, which decreases the lengths of the feeder circuits serving that load and consequently maintains the ability of those feeder circuits to carry load efficiently.

Figure 18: Relationship Between Feeder Circuit Load and Length



When feeders circuits traverse a long distance from their sources (i.e., distribution substation transformers) and serve load the entire length of their lines, then those feeders may experience excessive voltage drop, which can result in unsatisfactory operation of and damage to electrical equipment. Figure 19 shows the relationship between distance and voltage drop on a typical feeder conductor. Each line represents increasing levels of load served by the feeder.

Figure 19: Relationship Between Voltage and Distance From Substation Transformer



3.2.2 DISTRIBUTION FEEDER CIRCUITS

The primary voltage distribution feeder circuit elements are the feeder breaker, the feeder circuit main line and the feeder circuit taps.

A feeder breaker is both part of the distribution substation and the beginning of the distribution feeder. The feeder breaker is a piece of equipment located at a substation which, in combination with associated measurement equipment, is capable of detecting, switching, and interrupting the electrical power on a particular feeder under predetermined conditions.

A distribution feeder main line typically begins at the feeder breaker and radially feeds segments of overhead wire or underground cable with switch connections to adjacent feeder circuit main lines. The main line feeder circuit is typically comprised of electrical equipment including overhead wire, underground cable, voltage regulation equipment, and overhead and underground switching devices. The typical feeder circuit main line is capable of delivering all of the electric

energy from the feeder breaker to an average of 1,000 mixed use distribution customers.

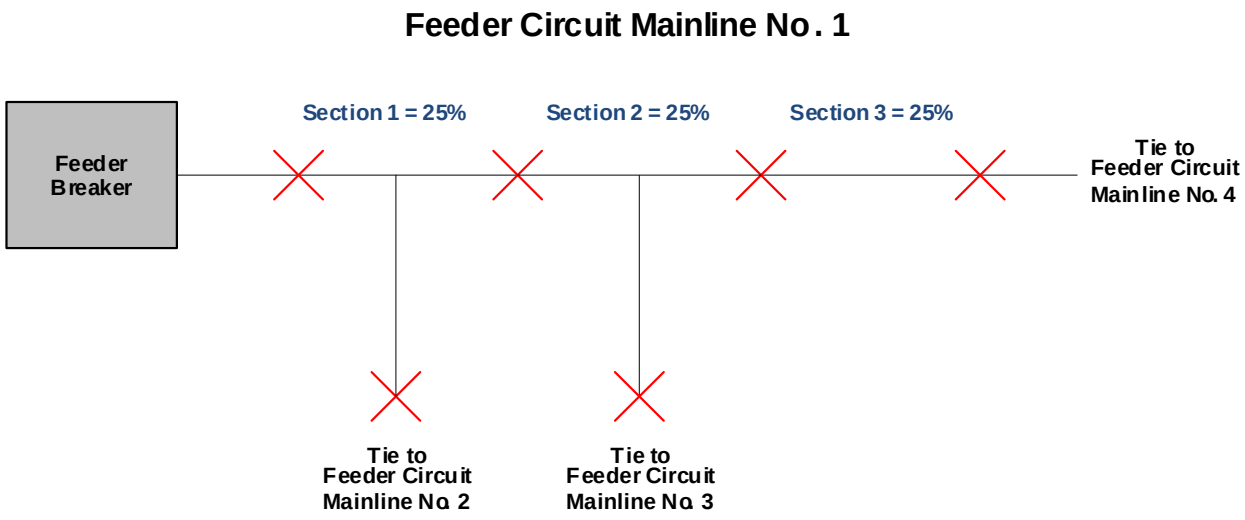
A distribution main feeder is generally composed of three equal sections that should serve no more than 25% of the total capacity of the main feeder. As a result, during system intact conditions, a feeder circuit with three sections should be loaded to no more than 75% of capacity (also known as utilization rate), which reserves 25% of the capacity to be used to meet the load of an adjacent feeder circuit in the event of a failure.

Main line feeder sections are separated by switches so that sections can be isolated from each other and from the substation breaker to facilitate maintenance of individual pieces of equipment while continuing uninterrupted electric service to distribution customers. Each section is connected to an adjacent feeder so that the entire feeder may be restored by conducting a minimum number of switching operations for rapid restoration of a worst case failure, an outage of the head end element of the feeder circuit.

Feeder circuit taps are fuse connected segments of overhead wire or underground cable fed from the feeder main line that deliver electrical energy to distribution transformers adjacent to customer locations. Tap fuses, which separate the tap from the main line, operate when an electrical problem occurs downstream of the fuse to isolate the problem from the main line and keep the largest possible number of customers in service at all times.

Figure 20 depicts a feeder circuit, including the breaker, and the three sections of the main feeder, which are separated by switches, each represented by an "X".

Figure 20: Typical Distribution Feeder Circuit Main Line With Three Sections Capable Of System Intact N-0 and First Contingency N-1 Operations



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4.0 DISTRIBUTION LOAD SERVING NEED ANALYSIS

Customer electricity usage has grown significantly over the past decade in south Minneapolis and the Company's distribution system as a whole reached a new system peak in Summer 2010. The growth in south Minneapolis has been most significant along and around Lake Street, Chicago, Park and Hiawatha Avenues due to successful revitalization and redevelopment efforts. This area includes several hospitals, Anderson Open Elementary School, Midtown Medical office/clinic building, a hotel, condominiums, commercial and industrial buildings and a shopping center.

The need for the Project is not the result of any promotional activities. Rather, the need for the Project is driven by a continuing increase in demand for power and anticipated increasing demand. Planning reports issued by the City of Minneapolis planning department describe City plans to facilitate continued large-scale redevelopment in the south Minneapolis area over the next several years. Current and future redevelopment is concentrated along Lake Street and the Hiawatha Light Rail Transit corridors and in areas adjacent to those corridors (*e.g.*, Midtown Exchange, Abbott Northwestern Hospital, and Minneapolis Children's Hospital).

In response to growing power demands, the Company conducted a study of the south Minneapolis distribution delivery system. The Company determined that the demand on the distribution system serving the south Minneapolis area exceeded capacity by 55 MW beginning in 2006. The typical distribution mitigation strategies that have been implemented previously in the Project Area, such as extending feeder circuits, reconfiguring feeder circuits, and adding new feeder circuits, are no longer effective to address capacity deficits and voltage problems. The Company also determined that existing distribution substations in south Minneapolis are at design capacity and cannot be expanded to alleviate the overload conditions. Therefore, new transmission sources are required to meet load serving requirements.

The Company developed and analyzed several alternatives to provide additional capacity in the south Minneapolis areas experiencing the most severe overload operating conditions. The Company determined that the option that best addressed both the immediate and long-term needs for electricity included the addition of two new distribution substations in the Hiawatha and Midtown areas, each initially housing a single substation transformer, with both new substations tapped off of the Elliot Park – Southtown 115 kV transmission line and two new 115 kV transmission lines connecting the two new substations. The proposed Project is not expected to encourage further development, but will allow planned development to occur in the area and improve electrical service to customers in the Focused Study Area.

This chapter summarizes the Company's analysis and conclusions. The Distribution Study and Transmission Interconnection Study are included in Appendix A.1 and Appendix A.2

4.1 Study Areas

To assess deficiencies, the Company identified a "Focused Study Area" and a "Greater Study Area" for analysis. The Focused Study Area is an approximately 22-square mile area in south Minneapolis containing 39 feeder circuits that are experiencing the most significant overloading conditions. The Greater Study Area is a larger geographic area served by 15 substation transformers and 110 feeder circuits. Diagrams of the Focused Study Area and the Greater Study Area are shown in Figure 21 and Figure 22, respectively.

Figure 21: Focused Study Area

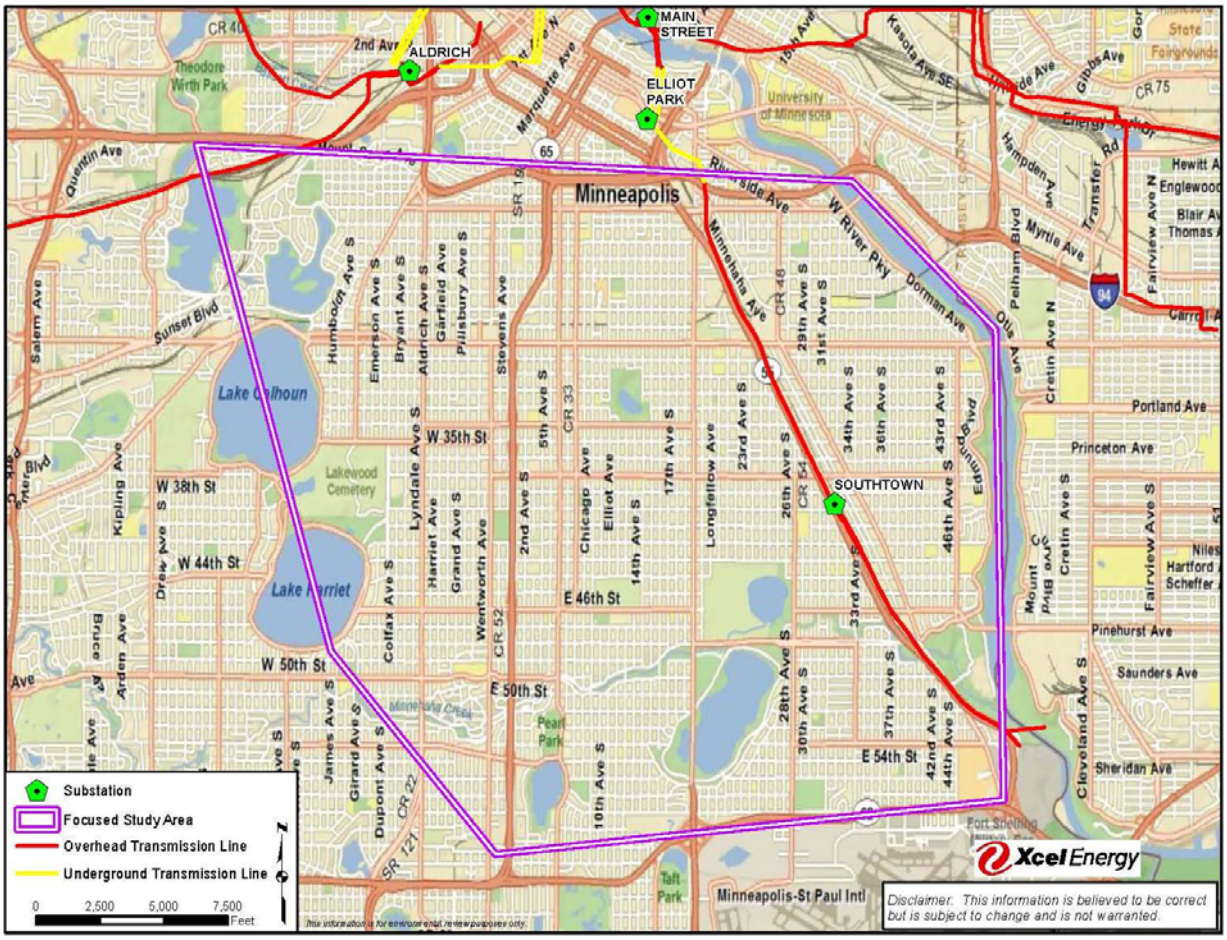
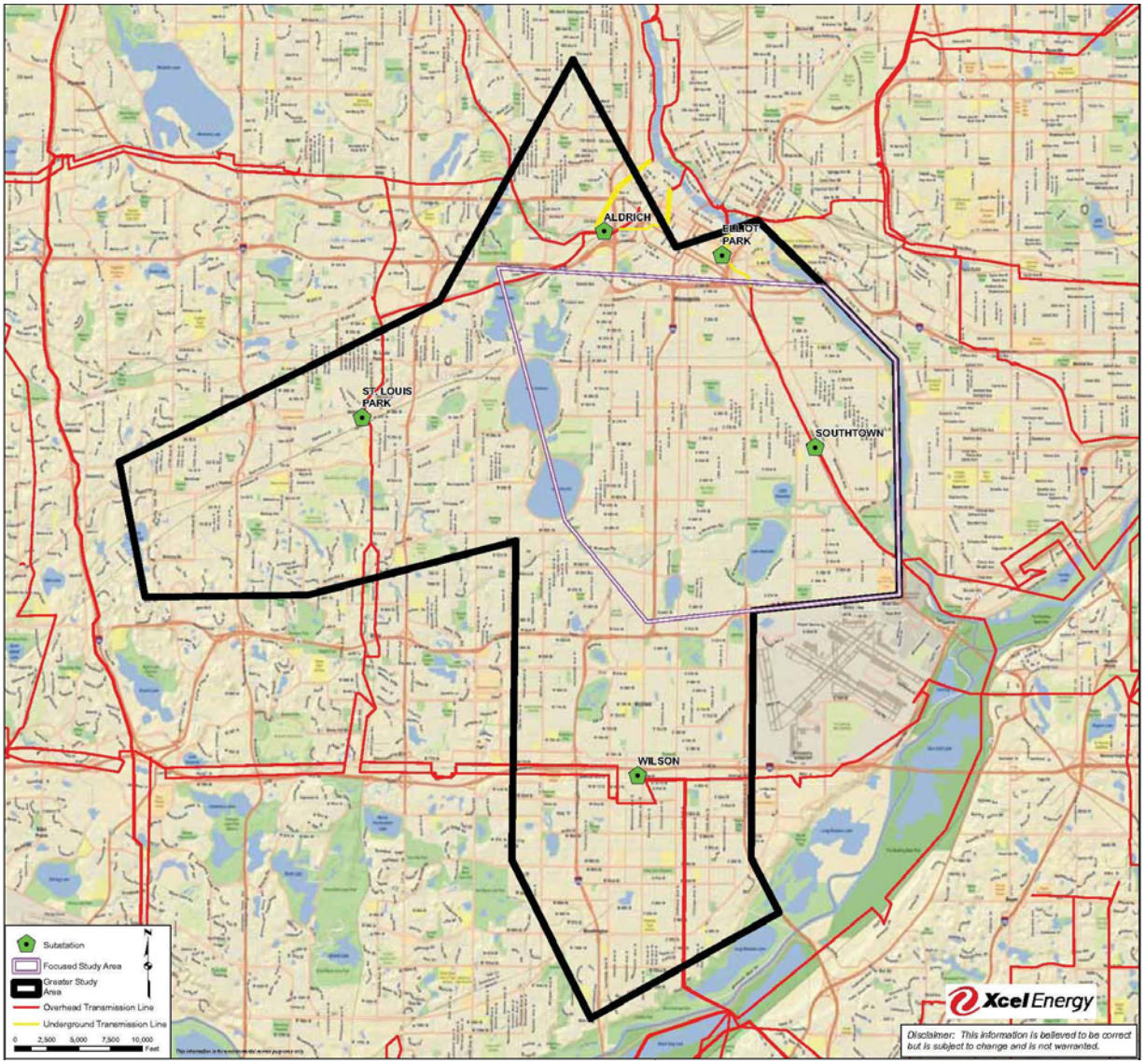


Figure 22: Greater Study Area



4.2 Distribution Planning Criteria

Xcel Energy is committed to and obligated by Minnesota law to provide safe, adequate, efficient, and reliable electrical service at just and reasonable rates. To meet these objectives, Xcel Energy's distribution system load is planned, measured, and forecasted on an annual basis with the goal to reliably serve all customer electric load under system intact and first contingency operating conditions.

Normal operation (also called "system intact" or "N-0" operation) is the condition under which all electric infrastructure equipment is fully functional. First contingency operation (also called single contingency operation or "N-1") is the

condition under which a single element (feeder circuit or distribution substation transformer) is out of service. A distribution delivery system that has adequate first contingency capacity is one in which all customer load can be restored through distribution system reconfiguration, e.g., electrical switching. Xcel Energy uses distribution planning criteria to achieve uniform development of Xcel Energy's distribution systems. These planning criteria are described below.

4.2.1 FEEDER CIRCUITS

Under system intact operating conditions, typical feeder circuits should be loaded to less than 75% of capacity. Xcel Energy developed this indicator to help ensure that service to customers can be maintained under single contingency operating conditions. If feeder circuits were loaded to their maximum capacity and an outage occurred, the remaining system components would not be able to make up for the loss because adding load to the remaining feeder circuits would cause them to overload. By targeting a 75% loading level, there is generally sufficient remaining capacity on the system (25% per feeder) to cover an outage of an adjacent feeder with minimal service interruptions. A typical feeder circuit capable of delivering 12 MVA, for example, is normally loaded to less than 9 MVA. During contingency conditions, it can be loaded up to 12 MVA.

4.2.2 SUBSTATION TRANSFORMERS

Under system intact operating conditions, substation transformers should be loaded at 75% of normal rating or lower. Substation transformer utilization rates below 75% are indicative of a robust distribution system that has multiple restoration options in the event of a substation transformer becoming unavailable because of an equipment failure or required maintenance and construction. The higher the transformer utilization rate (i.e., greater than 75% of capacity is being used under normal system conditions), the higher the risk that customer electrical service will be interrupted in the event of a transformer or feeder outage.

4.3 FEEDER CIRCUITS HISTORICAL AND FORECAST LOADS

4.3.1 HISTORICAL LOADS

Feeder circuit peak loading in the south Minneapolis area occurs during the summer. Measured peak loads fluctuate from year to year due to the duration and intensity of hot weather. In the 2009 study, the Company evaluated historical peak loads from 2000 to 2008. In the Focused Study Area, the measured peak load for feeders increased an average of 1.7% per year over those eight years, resulting in a

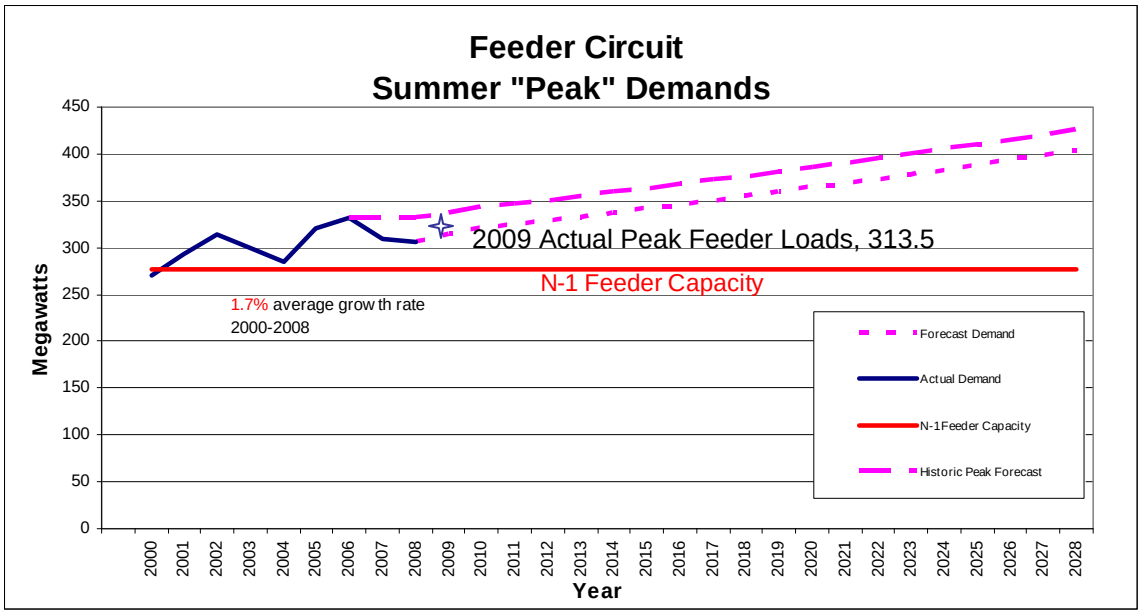
peak load growth of approximately 37 MW. Feeder circuit load peaks were experienced in 2002 and 2006 (331 MW). Load declined in 2007 and 2008.

In 2009, the upward trend returned. The peak loading on the 39 feeder circuits reached 313 MW, representing a 1.6% increase over 2008 when the peak was 307 MW. In 2010, demand again increased over the prior year. While 2010 feeder loading data has not yet been compiled, levels are expected to have increased over 2009 reflective of the increase in total system peak reached in August 2010.

4.3.2 FORECAST LOADS.

As part of the Distribution Study, the Company identified a 1.7% historical peak load growth rate from 2000 to 2008 and then created two future load forecasts from 2009 to 2020 for the Focused Study Area. Both forecasts applied a 1.3% annual growth rate (as shown in Figure 24), which reflects a more conservative growth rate than the historic growth rate. The Company first applied the 1.3% from the 2006 peak load level of 331 MW. The Company then applied the same 1.3% conservative forecast from the 2008 peak of 307 MW. Figure 23 shows the historical peak load and two forecasts for the Focused Study Area. Figure 23 also shows that actual loading in 2009 was within the range of the two forecasts.

Figure 23: Feeder Circuit Peak Summer Demand



4.4 FEEDER CIRCUITS OVERLOADING

Xcel Energy aims to maintain utilization rates at or below 75% on distribution feeder circuits to help ensure a robust distribution system capable of providing electrical service under first contingency N-1 conditions. (Operating the feeder system at levels >75% results in equipment overloads during first contingency conditions (N-1); operating the feeder system at levels >100% means that the equipment overloads during system intact conditions (N-0)).

Therefore, to assess the robustness of the system in the Focused Study Area over time, the Company analyzed the historical utilization rates and projected utilization rates based on forecast demand. This analysis revealed utilization rates of feeder circuits above 75% in the Focused Study Area despite the addition of six new feeder circuits between 2000 and 2008. Current average utilization rates remain above desired 75% levels. Forecasted average utilization rates will exceed 90% by approximately 2015 unless system improvements are made. As a result of the 90% loading level, multiple first contingency conditions will exist for which segments of customers will be exposed to extended outages as a result of contingency operations (equipment outages, required switching, etc.). This loading level may also result in severe overloads and possible rolling customer blackouts.

The Distribution Study concluded that the feeder circuit and substation transformer equipment overloads are widespread in the Focused Study Area. Under 2006 peak loading conditions, during system intact (N-0) conditions (i.e., all 39 circuits are fully operational), 12 of the 39 circuits exceed equipment maximum limits by a total of 12.2 MW and four of the 12 overloaded feeder circuits exceed 115% of maximum limits. Under 2006 peak loading and first contingency (N-1) conditions (i.e., any one of the 39 circuits are out of operation and switched to adjacent feeder circuits), 24 of the 39 feeder circuits exceed equipment maximum limits by a total of 55 MW. Figure 24 shows historical feeder circuit utilization and overloads.

Figure 24: Historical Feeder Circuit Utilization and Overloads

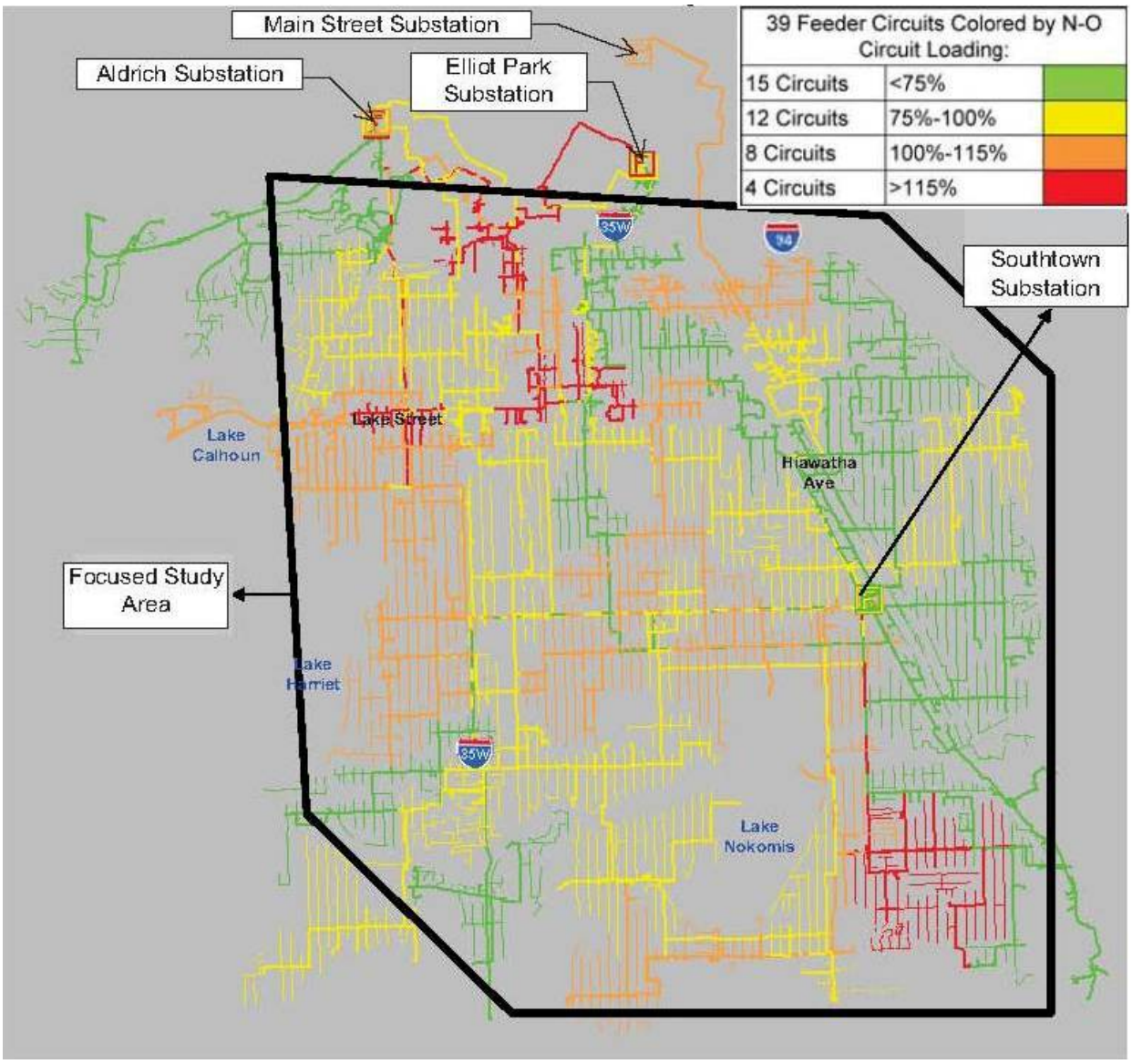
Historical Feeder Circuit Utilization and Overloads And Forecast Using Trending Method									
	2000	**2004**	**2006**	**2008**	**2009**	**2013**	**2018**	**2023**	**2028**
# of Circuits	33	36	39	39	39	39	39	39	39
MW Capacity	<327	<362	<402	402	402	402	402	402	402
Feeder Actual	2000-2008 Average								
% Growth	1.7%								
% Utilization	>83%	>79%	>83%	76%					
Forecast					2009-2018 Average			2019-2028 Average	
% Growth					1.28%			1.25%	
% Utilization					78%	83%	88%	94%	100%
N-0 Overloads									
# Severe >115%	5	6	4	2	4	4	8	12	15
# of Circuits	10	10	12	6	7	13	16	18	22
MW > 100%	15.8	17.0	12.2	7.6	9.2	14.1	24.3	37.2	52.6
N-1 Conditions									
# Circuits > 75%	21	21	24	24	25	27	27	28	31
MW > 75%	47.3	51.0	54.7	38.7	46.4	58.3	73.9	94.1	113.8

To better illustrate the number, concentration and location of the historical and forecasted overloads, the Company developed distribution system maps depicting the overloaded feeders in N-0 system intact and N-1 first contingency operating conditions for loads above 75% of capacity limits in 2006 and future forecast years 2009 through 2028. These distribution system maps are contained in the Distribution Study, Appendix A.1. Two of those maps for 2006 are depicted in Figure 25 and Figure 26, respectively. The underlying data for the two diagrams are contained in

Appendix A.1, appendix B, page 76 under 2006 n-0 and 2006 n-1 respectively. The color codes in the distribution system maps represent rows in Figure 21 as follows:

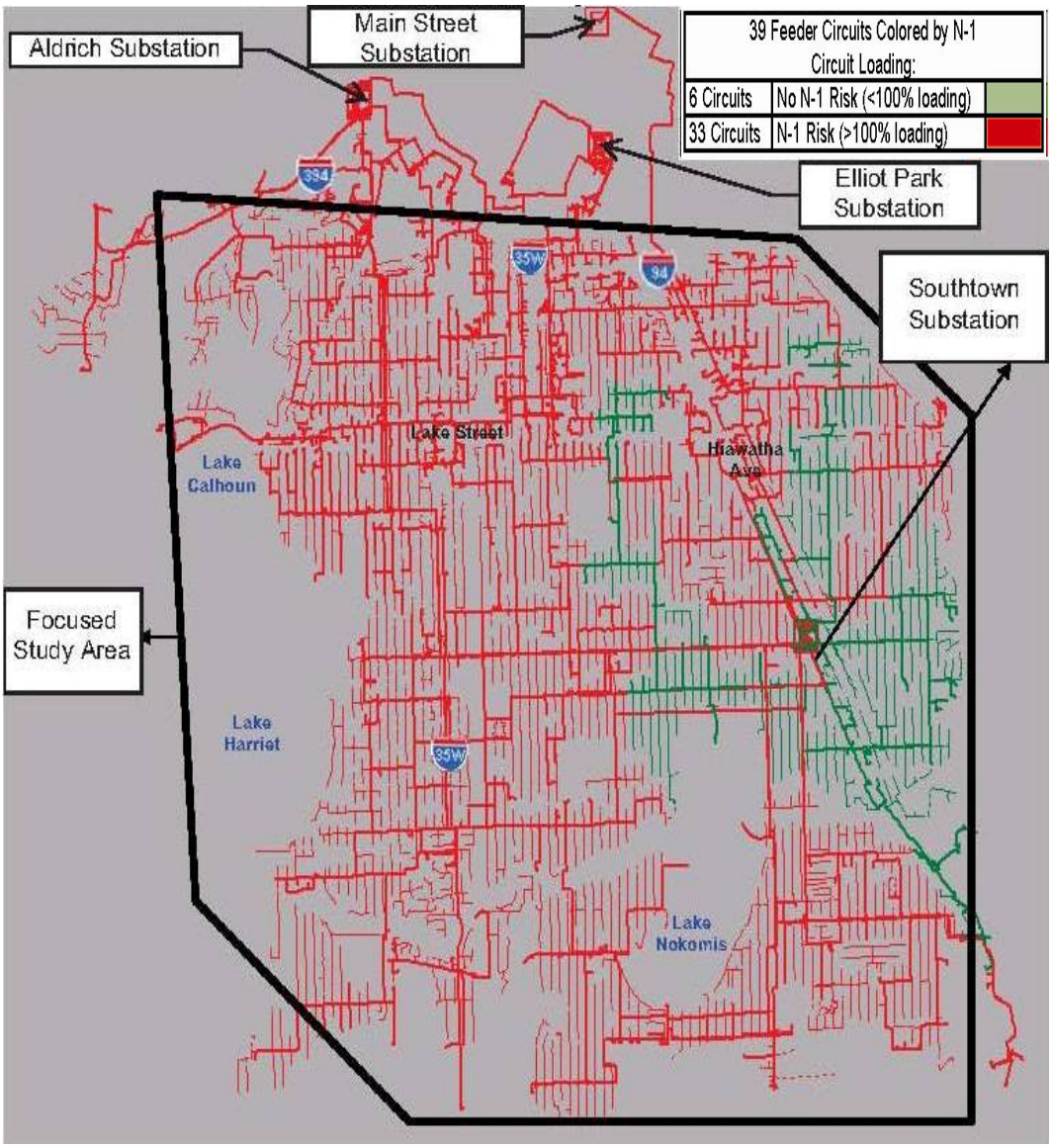
> # Severe > 115%, N-0 Overloads: The quantity of feeder circuits that are severely overloaded under system intact conditions are identified as shown in red.
>
> # of Circuits, N-0 Overloads: The quantity of feeder circuits that are overloaded under system intact conditions are identified as shown in orange and red depending on the severity of the overload with red feeder circuits having the most severe overloads.
>
> MW > 100%, N-0 Overloads: The sum of the system intact overloads, in MW for the number of circuits that are identified as overloaded and shown in orange and red.
>
> # Circuits > 75%, N-1 Conditions: The quantity of feeder circuits that are loaded above 75% capacity indicating first contingency overload conditions are identified as shown in yellow, orange, and red. Yellow circuits are feeder circuits with first contingency overloads.
>
> MW > 75%, N-1 Conditions: The sum of the first contingency overloads, in MW for the number of circuits that are identified as overloaded and shown in yellow, orange, and red.

Figure 25: Focused Study Area System Intact Loading 2006



Feeder circuit loads greater than 100% of equipment limits that are shown in orange and red are overloaded. Overloading equipment results in equipment damage and shortens the life of the equipment. Orange circuits represent overloads up to 115% of equipment limits and red circuits represent "severe" overloads greater than 115% of equipment limits.

Figure 26: Focused Study Area System First Contingency Loading 2006



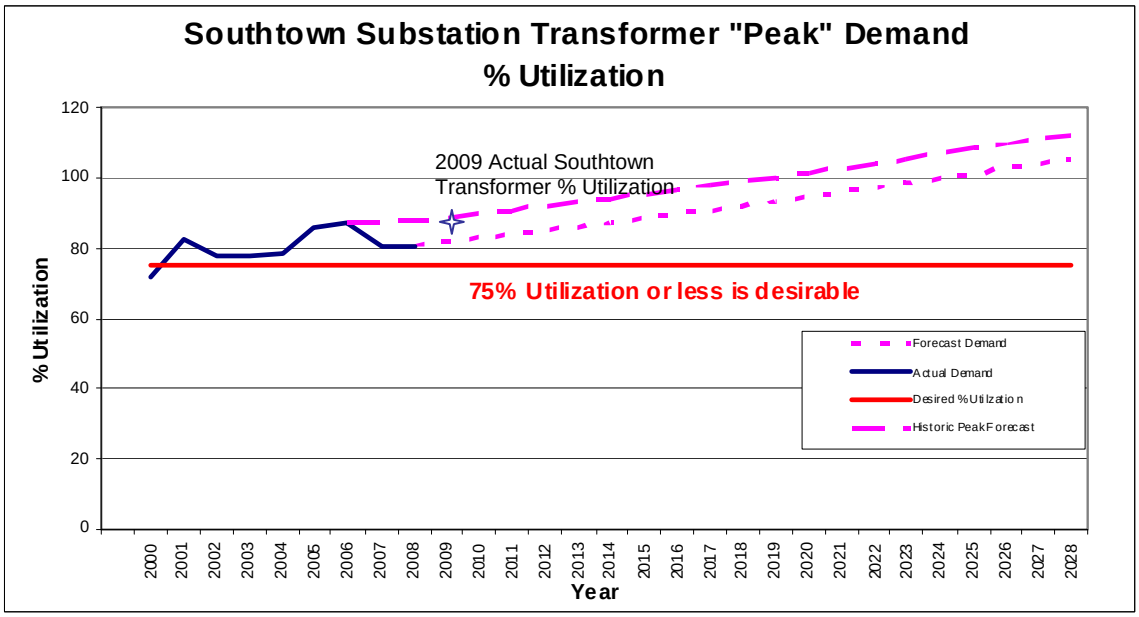
4.5 TRANSFORMER OVERLOADING

After examining feeder circuit peak demands, the Company looked at the loading levels for the three transformers housed at the Southtown Substation. Southtown Substation is the only substation that is located in the Focused Study Area and is completely dedicated to serving Focused Study Area load.

Again, the Company reviewed historical loading on the transformers and forecasted future demand. Southtown Substation transformer historical and forecasted load levels are similar to those for the 39 feeder circuits. Substation

transformers are loaded above maximum equipment limits during all first contingency configurations (N-1 or one substation transformer out of service). The growth rate from 2000 to 2008 was 1.7%. To forecast loading in future years, this growth rate was applied to the 2006 peak load levels and the lower 2008 peak. Figure 27 shows the historical and forecast peak demand utilization.

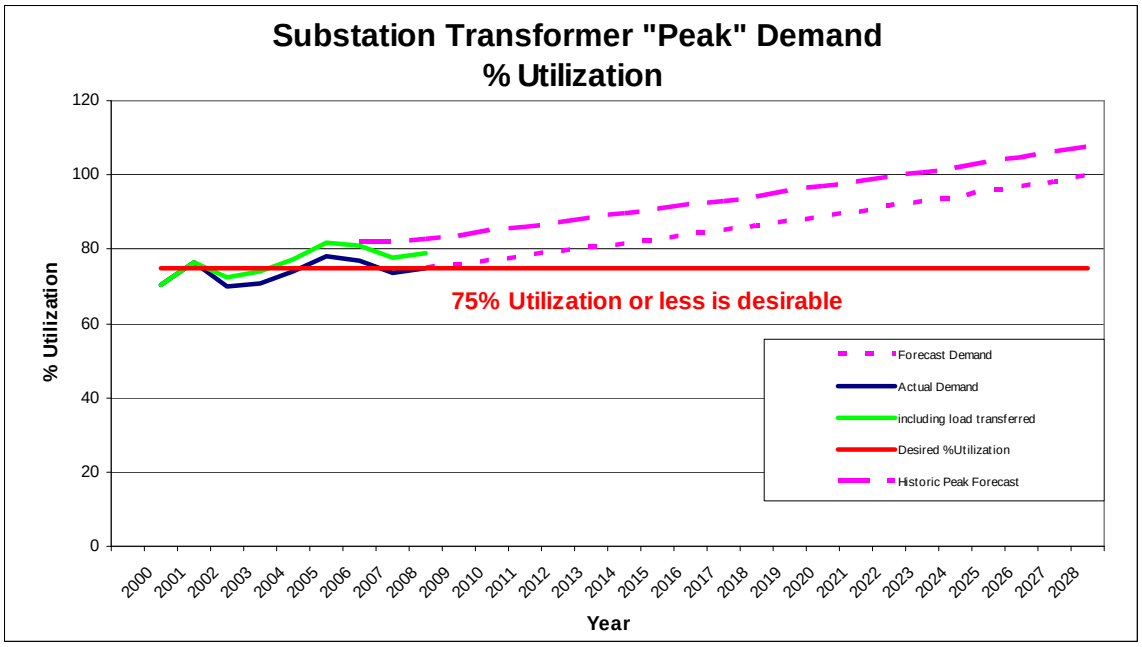
Figure 27: Southtown Transformer Peak Demand % Utilization



The Company compiled the transformer loading and utilization data for the 15 substation transformers in the Greater Study Area and found that utilization rates began exceeding 75% beginning in 2001 and increased to 77% in 2006. Greater Study Area transformer N-1 overloads have increased both in number and duration since that time.

To address this problem, the Company began transferring some of the load in the Greater Study Area to other distribution substations outside of the area. Figure 28 shows the resultant transformer utilization following these steps.

Figure 28: Greater Study Area – Substation Transformer Bank Utilization Percentage with Load Transfers



As shown in Figure 28, the Greater Study Area substation transformer peak utilization percentage first exceeded 75% during 2001 peak loading. Despite load transfers of more than 52 MW from 2000 through 2008 to new West River Road and Cedar Lake substation transformers, average peak utilization percentage has still exceeded 75% since 2004.

4.6 EXISTING SUBSTATION ALTERNATIVES

After identifying system deficiencies, the Company identified potential solutions to provide necessary additional capacity to the Focused Study Area. The Company first considered distribution level alternatives that would not require construction of a new substation including adding feeders, extending feeders, and expanding existing substations.

The Company first reviewed whether the surrounding substations in the Greater Study Area, Aldrich, Elliot Park, Southtown, St. Louis Park, and Wilson, could be expanded to meet demands. The Company determined that these substations were either already built to the ultimate design capacity of the substation or had capacity that was already designated to serve load in other areas. The fully developed layout of the substations, lack of additional locations for additional feeder circuits and the unavailability of routes to build additional duct lines across physical

barriers including freeways and the Lowry Hill tunnel preclude the expansion of existing substations.

The Company concluded that new distribution sources would be needed to provide the additional required capacity.

4.7 New Facilities Alternatives, Distribution Study

Once it was determined that expansion of existing feeder circuits and substations were not viable options to correct the overloading conditions in the area, the Company developed four electrical system alternatives that would provide additional loading capacity in the Project area to meet current and help address future needs.

The four alternatives are as follows:

- New Source Alternative 1 ("A1" or "Hiawatha Project"): Hiawatha and Midtown 115/13.8 kV distribution substations and two looped 115 kV transmission lines (Midtown located east of Interstate 35)
- New Source Alternative 2 ("A2"): Hiawatha Substation and West Midtown Substation 115/13.8 kV distribution substations and two looped 115 kV transmission lines (Midtown located west of Interstate 35)
- New Source Alternative 3 ("A3" or "Super Hiawatha"): Hiawatha Substation 13.8 kV distribution substation.
- New Source Alternative 4 ("A4"): Hiawatha 13.8 kV distribution and 34.5 kV sub-transmission with three substations in Midtown for 13.8 kV distribution)

Alternatives A1 and A2 are considered standard installation. Alternatives A3 and A4 are considered non-standard installation because they involve using multiple distribution voltage feeder circuits at 13.8 kV or 34.5 kV to move power from a distant substation transformer location instead of using a 115 kV transmission line to transmit power.

To evaluate the effectiveness of the four alternatives, the Company compared the alternatives with respect to system performance, operability, future growth, costs and losses. The Company further evaluated the alternatives based on the cost of adding distribution equipment at both substations to address N-0 and N-1 overloads in the Focused Study Area as load grows to the ultimate design in 2023 that would be required.

The assumed facilities and estimated costs are included in the Distribution Study, Appendix A.1, Section 6.2.2.

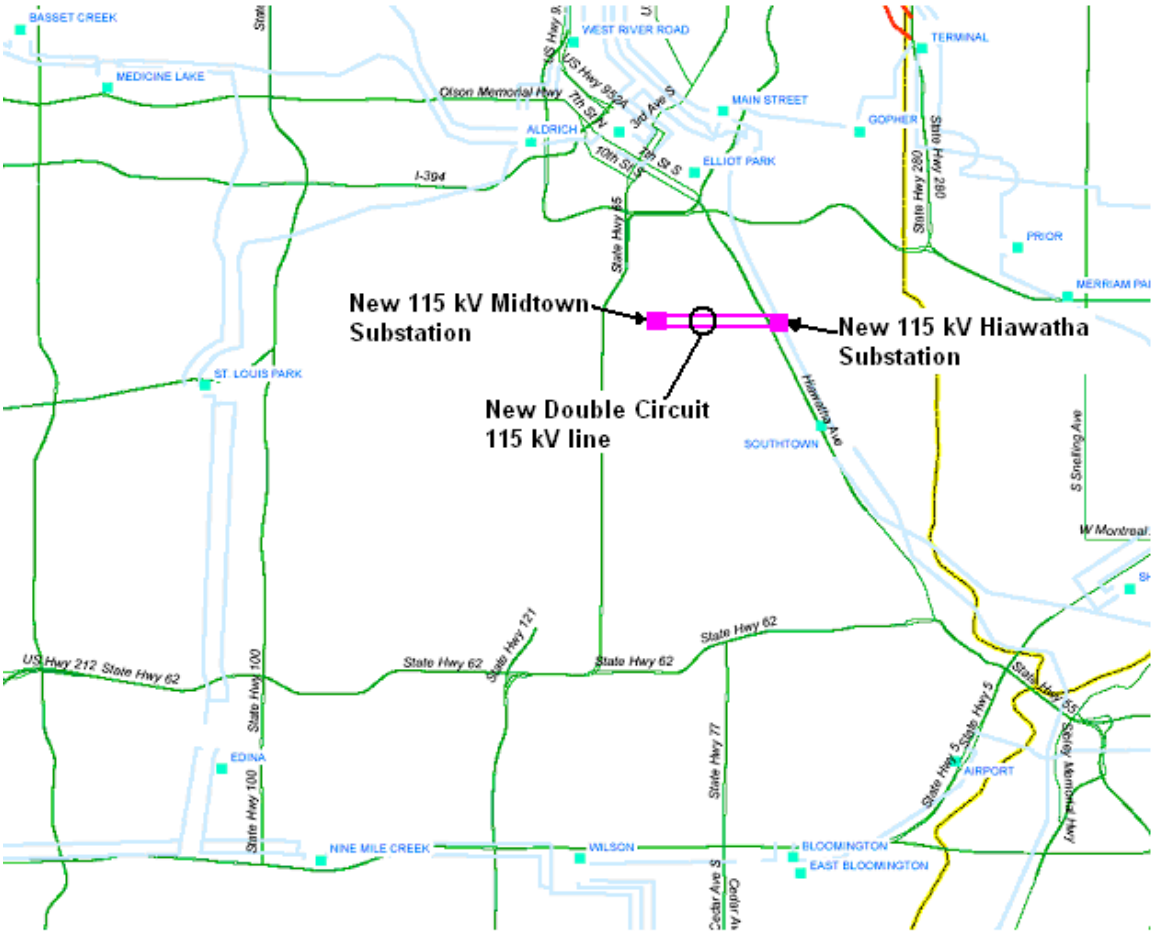
A summary of the assumed initial and 2028 buildout costs are shown in Figure 29. The cost estimates provided in Figure 29 include estimated costs for additional distribution ducts and feeder circuits needed for the Project.

Figure 29: Study Alternatives Cost Estimates ($millions)

	Initial Buildout	Ultimate Design (2023)	Present Worth
Hiawatha Project	$33.4	$55.9	$53.0
Alternative A2	$42.4	$60.6	$61.8
Alternative A3	$21.8	$60.0	$54.4
Alternative A4	$61.1	$122	$113.4

The Hiawatha Project was found to best satisfy the Company's criteria. This option includes an ultimate design capacity of five distribution substation transformers with a total of 30 feeder circuits located at two new substation locations. The initial configuration is shown in Figure 30.

Figure 30: Hiawatha Project – Hiawatha and Midtown 115/13.8 kV Distribution Substations and Looped Transmission Lines



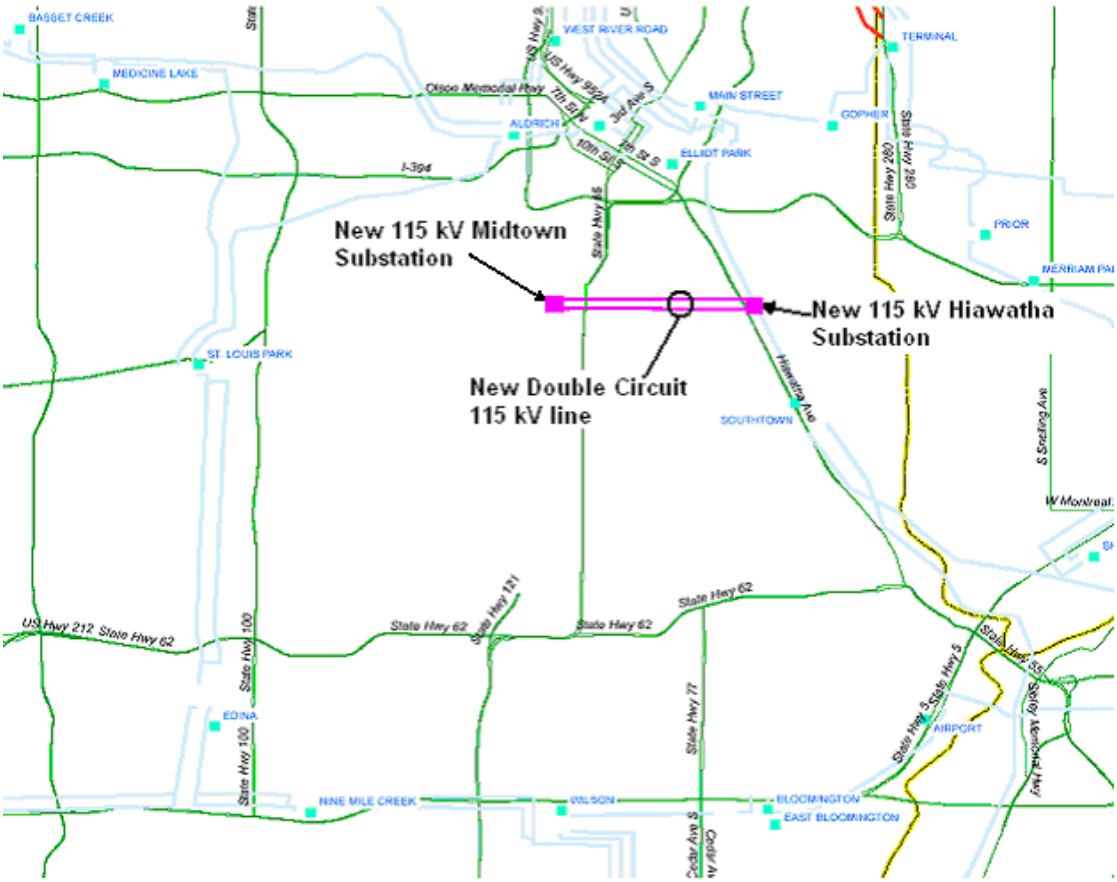
With respect to system performance, the Hiawatha Project includes substation transformer capacity at two new substations at or near the identified load centers in the Focused Study Area. As a result, the Hiawatha Project requires shorter feeder circuits to serve load from these two new substations. Shorter feeder circuits consist of less equipment, have fewer elements that can fail, and have less exposure to external factors that increase the chance of feeder outages. The Hiawatha Project is capable of maintaining adequate voltage on feeder circuits. The Project also has the best operability over the other alternatives. The Hiawatha Project is an extension of the distribution system and provides for a large number of standard options that could be quickly implemented under contingency conditions. With respect to future growth, the Hiawatha Project provides possibilities for future capacity additions in an area expected to experience significant growth in electricity demand.

As described in more detail below, the Company further found that A3, was not a viable alternative because it does not meet system performance requirements. The two remaining alternatives, A2 and A4, are inferior to the Hiawatha Project.

Alternative A2

A2 would locate a new Midtown Substation on the west side of Interstate 35. This alternative is shown in Figure 31.

Figure 31: Hiawatha and West Midtown 115/13.8 kV Distribution Substations and Looped 115 kV Transmission Lines



A2 meets the various criteria by which the Company compared each alternative. With respect to system performance, A2 installs additional substation transformer capacity at two new substations, one of which would be located west of Interstate 35W in the Midtown area, a greater distance than the substations under A1 from the identified load centers in the Focused Study Area. As a result, A2 requires slightly longer feeder circuits than A1 to serve load, and therefore, is subject to slightly greater exposure to conditions that could lead to line failures. With respect to operability, similar to A1, A2 is an extension of the distribution system and provides for a large number of standard options that could be quickly implemented under

contingency conditions. With respect to future growth, A2 provides possibilities for future capacity additions in an area expected to experience significant growth in electricity demand, but requires more infrastructure than A1 at a higher cost. A2 addresses future load serving needs.

Alternative A3

A3 does not include new transmission facilities. It includes an ultimate design capacity of six distribution substation transformers with a total of 30 feeder circuits located at one new substation location.

Three of the substation transformers at 115/13.8 kV serve fifteen 13.8 kV feeder circuits that serve customer loads directly from the substation location.

Three of the substation transformers serve 15 feeder circuits that are express circuits installed in duct banks from the Hiawatha Substation site to the nexus of the 13.8 kV feeder circuits located near the former Oakland Substation in the Midtown area.

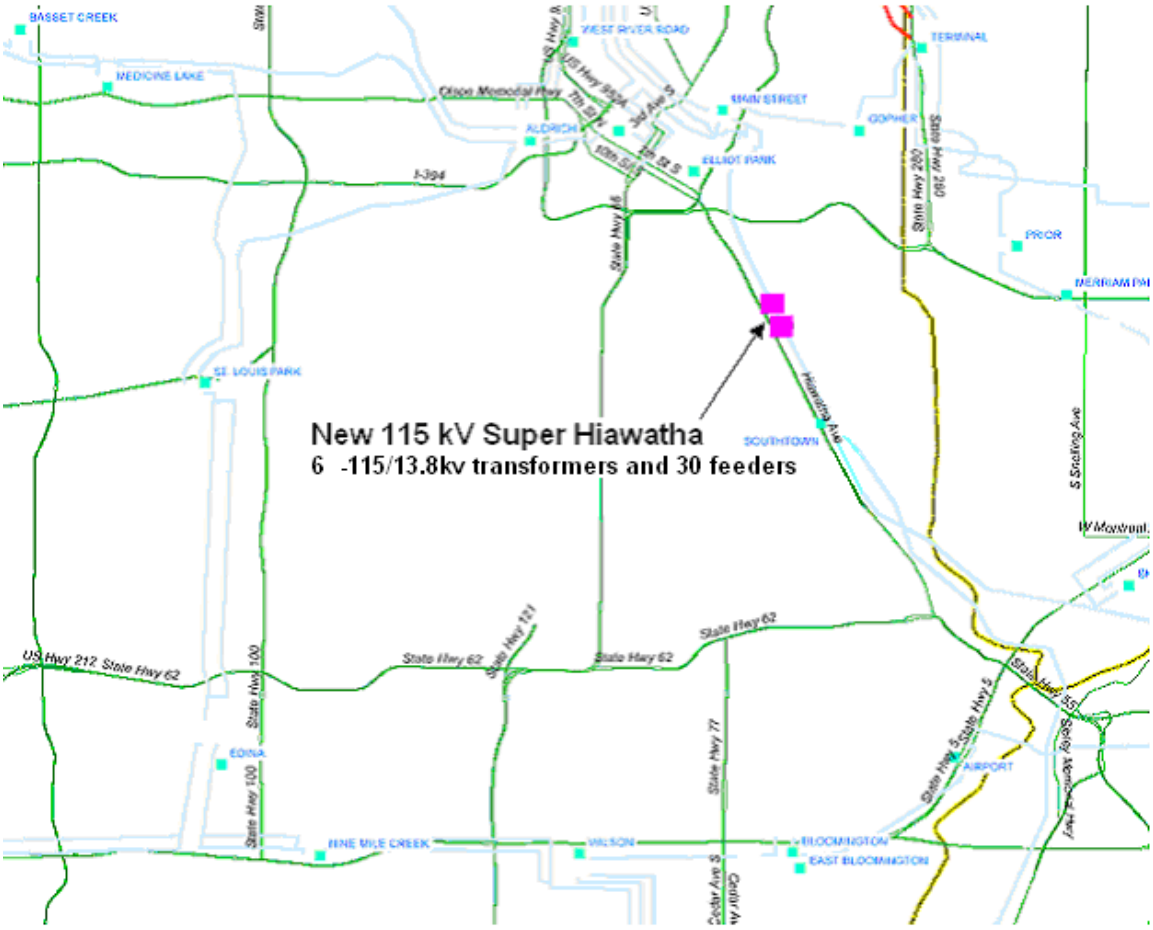
A distribution substation with an ultimate capacity of six distribution transformers and 30 feeder circuits of which 15 are express feeder circuits instead of a 115 kV transmission line is a non-standard installation.

A single substation would be located near the site of the former Hiawatha Substation which requires a short transmission line extension to tap the Elliot Park – Southtown 115 kV transmission line into the substation site and more extensive 115 kV equipment installation in the substation to enable the installation of six substation transformers. The proposed site requires a larger physical size than the substation considered in A1 or A2.

The initial installation includes two substation transformers and ten associated feeder circuits at one substation site. The first 115/13.8 kV transformer with five associated feeder circuits would serve distribution customer load directly from the substation location. The second 115/13.8 kV transformer, also installed in the same substation site has five 13.8 kV express feeders installed in at least 12,000 feet long manhole and duct bank(s) installed from Hiawatha Substation site to the nexus of feeder circuits at the former Oakland Substation site near Oakland Avenue and 29th Street in the Midtown area. The length of the duct line and express feeders will be determined by the exact location of the Hiawatha Substation. The five 13.8 kV feeder circuits are connected to existing feeders at the former Oakland Substation site.

Figure 32 illustrates the A3 configuration.

Figure 32: A3 – Large Hiawatha 115/13.8 kV Distribution Substation and 13.8 kV Express Feeders



With respect to system performance, A3 does not meet voltage requirements. A load flow run on the system model configured for A3 indicated system-intact N-0 voltage problems on two of the express feeders constructed to serve customer load west of the load center. These heavily loaded feeders would serve loads as far as four miles from the distribution substation, and the feeders do not maintain voltages that comply with the tolerances for voltage at the customer meter (±5% of 120 volt nominal) as stated in American National Standards Institute ("ANSI") Standard C84.1 entitled Electric Power Systems and Equipment – Voltage Ratings (60 Hertz). A3 feeder circuits also do not meet minimum voltage requirements under N-1, first contingency conditions. A3 has the longest feeder circuits of the four alternatives and has the highest system losses. Longer feeder circuits consist of more equipment, have more elements that can fail, and have more exposure to external factors that increase the chance of feeder outages. A3 does not meet the threshold system performance requirements.

With respect to operability, A3 uses standard distribution delivery components in a non-standard way, making A3 more vulnerable during overload and outage conditions. A3 also uses long express feeder circuits that require many more components to keep in running order and fully operational during all possible conditions.

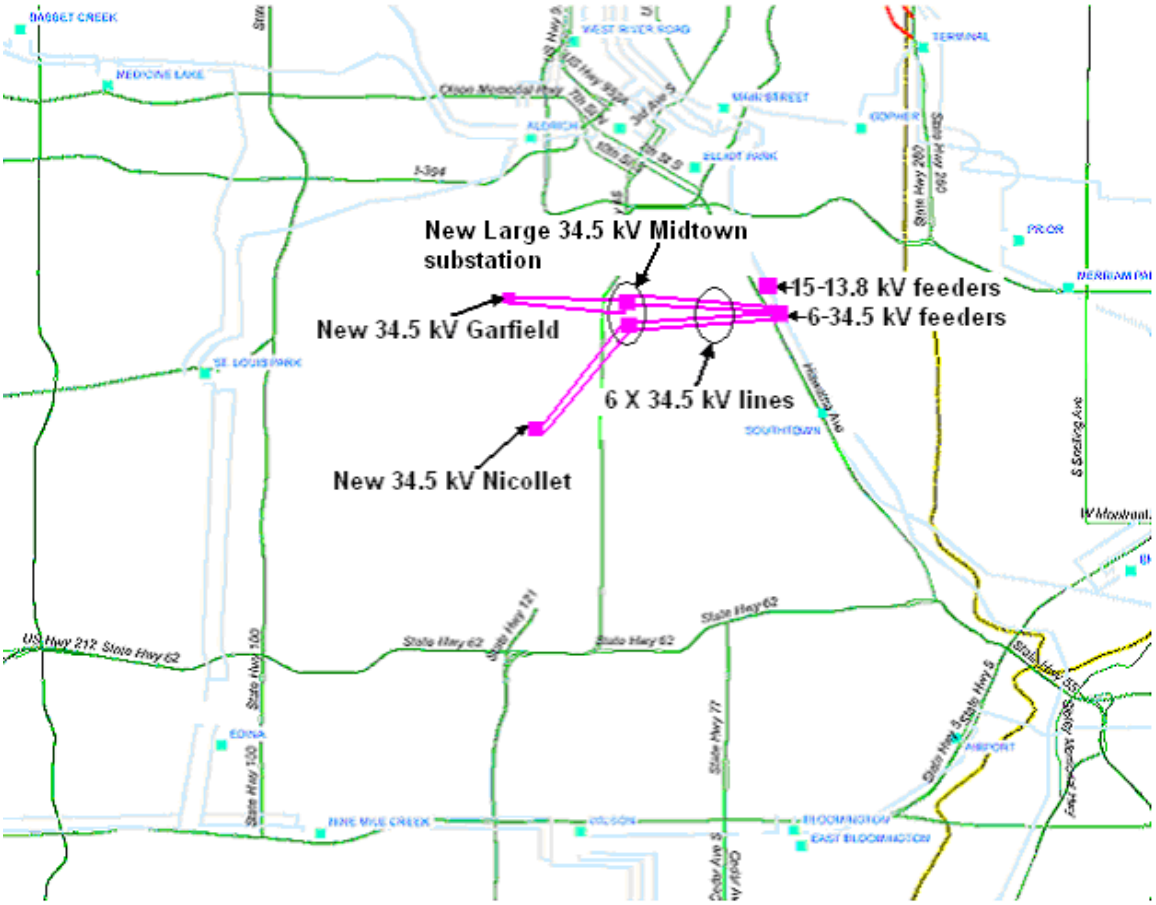
With respect to future growth, A3 provides roughly equal possibilities for future capacity additions as do A1 and A2 in an area expected to experience significant growth in electricity demand. A3 addresses future load serving needs.

Alternative A4

Alternative 4 includes an ultimate design capacity of 14 distribution substation transformers with a total of 37 feeder circuits located at four new substation locations.

Figure 33 illustrates the initial configuration of A4.

Figure 33: A4 – Large Hiawatha 115/13.8 kV Distribution Substation with 34.5 kV Sub-transmission and Three 13.8 kV Distribution Substations



With respect to system performance, A4, which installs four substations and uses 34.5 kV as sub-transmission to transmit power, has more exposure to line failures than A1 or A2 due to adding 34.5 kV circuits between the substation and the customer. A4 is capable of maintaining adequate voltage on feeder circuits but is the most complex of the alternatives and requires the most equipment. With respect to operability, A4 is the worst alternative based on this criterion because it introduces a new distribution voltage and adds another level of transformation at additional 34.5/13.8 kV substations, making operations more difficult and complex.

With respect to future growth, A4 would be difficult to integrate into the distribution delivery system and so would require additional 34.5 kV infrastructure to assist in serving future load, which is possible, but more challenging than Alternative A1 and Alternative A2.

4.8 New Facilities Alternatives, Transmission Interconnection Study

The Company also evaluated the four alternatives from a transmission performance perspective. Each alternative consists of incremental installation plans from initial installation through the option's full design capacity. Specifically, with respect to each option, the Company evaluated power system performance (system intact, contingent loadings and voltages), associated losses on the transmission system, costs, practicality (logistics of construction and operation), and ability to address the distribution capacity deficiency.

In addition to the four alternatives studied as distribution solutions, the Company evaluated three alternative transmission options that would provide capacity to the substation in the Midtown area from the Elliot Park Substation, the Aldrich Substation or the Wilson Substation. The three additional options are as follows:

Option 1: Hiawatha – Midtown – Wilson = 8.5 miles

Option 2: Elliot Park – Midtown – Wilson = 10 miles

Option 3: Hiawatha – Midtown – Aldrich = 4 miles

The Company determined that all three options would require more transmission facilities to be constructed. This would directly increase the cost of the proposed Hiawatha Project. In addition, the Company concluded that these options were not reasonable alternatives because of the potential to exacerbate a fault current condition on the Twin Cities metro area electrical system (within approximately the 345 kV loop). Xcel Energy and Great River Energy are currently studying metro area fault currents and developing a comprehensive plan to address the issue.

Fault current is the current that flows during a short circuit. When fault current becomes too great, devices that are meant to stop the current flowing to a fault can fail. On the transmission system, larger breakers (the size of a small bedroom) are used to stop fault current from flowing. These devices have a maximum amount of fault current that they can interrupt.

The maximum amount of fault current that Xcel Energy has designed for is 63 kA. Some Xcel Energy substations are near this limit. The Company has evaluated planned projects for the next 10 years and determined that there would be no resultant fault currents exceeding 63 kA. If a Hiawatha – Midtown – Wilson 115 kV line (Option 1) were constructed, fault currents would exceed 63 kA at some substations, including the Riverside Substation. Breakers would not be able to interrupt faults which would require additional system enhancements to address. Therefore, the Company determined that Option 1 was not a reasonable alternative. The Company also determined that fault current levels would be exceeded if Option 2 were selected and likely exceeded if Option 3 were selected.

The Company also evaluated system losses. Losses are power that dissipates in electric conductors due to resistance. All options would provide significant efficiency improvements because they would deliver the needed power at a higher voltage than distribution (115 kV v. 13.8 kV). The impact of the proposed Hiawatha Project on the transmission system would be less than 1 MW difference under average and maximum loading conditions due to the short length and its radial nature.

The Company determined that the Hiawatha Project offered the best overall results based on the following criteria:

- Power system performance (system intact and contingent loadings and voltages)
- Operability (logistics of construction and operation)
- Price (cumulative present worth cost)
- Distribution system losses
- Ability to serve existing and anticipated distribution load in the Midtown area

4.9 Double Circuit Considerations

The Company considered whether a double circuit design would be appropriate for the Hiawatha Project. Double circuiting is the construction of two separate circuits on the same overhead structures or underground in the same or

adjacent trenches. Double circuiting is employed, for example, in situations where two circuits serve different functions or where high capacity is required. The analysis of double circuiting can involve review of the existing system—to determine if another circuit can be added to an existing line or building the new line with two circuits.

First, the Company considered whether the new lines could be co-located with existing electrical facilities. Because there are no transmission facilities in the Focused Study Area, this option was not available.

Second, the Company considered whether it would be appropriate to put both new 115 kV transmission lines on a single set of poles. In typical transmission line Certificate of Need cases, the application of the North American Electric Reliability Corporation ("NERC") planning requirements are applied to determine if the loss of a common tower would adversely affect the reliability of the transmission system.

NERC planning requirements apply to the Bulk Electric System which is generally defined as electrical generation resources, transmission lines, interconnections with neighboring systems, and associated equipment, generally operated at voltages of 100 kV or higher. Radial transmission facilities serving only load are generally not included in this definition.

NERC requires that the Bulk Electric System be designed so that under system intact conditions and single contingency conditions, e.g., when a single transmission line, generator or transformer is out of service, operators are able to reliably operate the system and serve all connected loads without any ongoing overloads or voltage problems. The standards require affected entities, including the Company, to continuously keep the system in a secure state, able to withstand the next contingency, even after one or more contingencies have already occurred. NERC defines different types of system events and groups them into four different categories:

Category A – All facilities in service (no contingencies)

Category B – Event resulting in loss of a single element

Category C – Event(s) resulting in the loss of two or more (multiple) elements

Category D – Extreme event resulting in two or more (multiple) elements removed or cascading out of service

The proposed Hiawatha Project includes two 115 kV lines that would serve load from a single source – the Hiawatha Substation. Because the lines are radial, that

is, only one end at the Hiawatha Substation is connected to the transmission system, they are not subject to NERC planning criteria.

Nevertheless, when developing the Hiawatha Project, the Company considered the potential impact on the transmission system and distribution system if both lines were simultaneously lost. The Company determined that the loss of the radial lines would have no adverse impact on the transmission system, therefore, a double circuit configuration is a reasonable alternative.

The Company also assessed the impacts of the potential loss of both overhead transmission lines. The Company identified the need for two transmission lines to provide flexibility in serving the load during planned and unplanned outages of one of the lines. The most likely cause of a double line outage would be the failure or malfunction of a breaker. In the case of the Hiawatha Project, this risk will be eliminated by using the one-and-a-half breaker design and the configuration of transmission lines in the substation which will separate the lines so that if a breaker fails at the Hiawatha Substation, at least one of the two lines will still be operational.

In the unlikely event the overhead double circuit line were to fail, it would affect a limited number of customers and be expected to take only a couple of days to repair and restore service. Meanwhile, the distribution system would be available to serve load. Given the high density nature of the Project Area which provides limited routing opportunities, and the ability to repair overhead lines generally within a matter of days, the Company determined that a double circuit design would adequately address distribution needs and would be an appropriate alternative for routing of the transmission lines. In addition, when comparing overhead options, the double circuit alternative is also a lower cost alternative.

5.0 OTHER ALTERNATIVES

As part of the study process that resulted in the proposal to construct the Hiawatha project, Xcel Energy considered a number of alternatives including (i) size alternatives (different voltages or conductor arrays, alternating current ("AC")/direct current ("DC"), and single circuit); (ii) generation alternatives; and (iii) no build (including Demand Side Management). In this chapter, Xcel Energy describes the analysis of these alternatives and its conclusion that none is a more reasonable alternative to the Hiawatha Project.

5.1 SIZE AND TYPE ALTERNATIVES

5.1.1 DIFFERENT VOLTAGES

The Company evaluated the availability of different line voltages and alternative types of conductors as part of their analysis of the appropriate electrical facilities to meet the identified need. The Company concluded that the 115 kV voltage was the only appropriate voltage for the facilities based on the capacity deficit and the south Minneapolis location of the proposed facilities.

When new facilities are required to increase capacity in an area, a key consideration when identifying alternatives is the characteristics of the existing electrical system that serves the load. In the Twin Cities metro area, the distribution system is generally served by a 115 kV transmission system initially developed in the early 1900s. the Company designed a ring of 115 kV lines around the Twin Cities to reliably deliver electrical power to growing city populations using power generated from smaller local power plants such as Black Dog (then 267 MW). New 115 kV facilities were added to the system over the next 50 years. By the 1950s and 1960s, the 115 kV system had become strained and a 345 kV bulk transmission ring was constructed around the Twin Cities to deliver larger amounts of power from more remote generators such as the Allen S. King Plant (529 MW).

Today, the metro distribution system continues to be served off of a 115 kV system, fed through the 345 kV loop. This 115 kV system is interconnected to substations that are specifically designed to accommodate the 115 kV voltages. The standard equipment at substations includes 115 kV/13.8 kV transformers to step down the 115 kV voltage to distribution voltage, 13.8 kV.

The Company first identified potential 115 kV sources as the appropriate voltage because it would integrate well into the 115 kV transmission system within the Twin Cities. In addition, the 115 kV voltage fully provides the capacity needs of the distribution system.

A higher voltage transmission alternative such as a 161 kV, 230 kV or 345 kV could provide additional capacity, but it is not anticipated that this capacity would be needed within the next 20 years based on current forecasting analyses. In addition, a higher voltage would require an additional transformer or new type of transformer that would add cost and complexity to the electrical system. For example, if a 161 kV transmission line were constructed, a 115 kV/161 kV transformer would be required at Hiawatha to "step up" the voltage from the Elliot Park – Southtown 115 kV transmission line. If the line from the Midtown Substation were to continue on, it would either need to be converted to 115 kV at Midtown or at the new connection point. There would also be additional costs associated with a higher voltage.

As part of the higher voltage analysis, the Company also considered whether the transmission line between the proposed substations should be constructed so that it would be capable of operating at a higher voltage in the future. The Company determined that 161 kV and 230 kV alternatives would not be appropriate because they would not fit well with the 115 kV/345 kV system serving the Twin Cities. Facilities that would be capable of operation at 345 kV would fit within the standard system, but it is unlikely any additional load serving benefit would be achieved in the future. The 345 kV system is designed to carry large amounts of power to the 115 kV system. A 345 kV voltage would not be advantageous here because it would be a radial line into the Midtown Substation. The proposed 115 kV lines will provide adequate power to the Midtown area for the identified needs.

The Company also determined that a lower voltage 69 kV transmission line was not a reasonable alternative to meet the identified need. Like higher voltages, a 69 kV line would be a non-standard facility for the Twin Cities. In addition, a 69 kV alternative would provide less than half the capacity of the 115 kV option. Each of the two proposed 115 kV transmission lines with 795 ACSR can provide up to 230 MVA. The maximum capacity of an Xcel Energy standard 69 kV transmission line with 477 ACSR is 100 MVA. Therefore, the 115 kV option is better suited to address the near-term and future capacity needs in the Focused Study Area. Moreover, the 115 kV option is more efficient than the 69 kV option because it has a lower losses profile.

Another voltage option was a 34.5 kV alternative. This alternative includes four new substations in and around the Midtown area. This alternative was rejected because it would add a non-standard, subtransmission system, require two more distribution substations than the 115 kV transmission line alternative, require additional 115 kV/34.5 kV transformations and has an estimated installed cost of $122 million. In addition, this option would be the least efficient option because of increased distribution system losses.

5.1.2 ONE TRANSMISSION LINE

In determining that the Hiawatha Project should consist of two 115 kV transmission lines, the Company assessed how a single circuit option would perform in the immediate term and longer term.

One significant factor in proposing two circuits is the anticipated need for a second transformer at the Midtown Substation shortly after the installation of the first one, by 2016 or approximately three years after the proposed Hiawatha Project in-service date. Prior to then, the existing distribution system along with the new substation Hiawatha substation, would be able to adequately serve the load in the Focused Study Area during the loss of the single Midtown transformer. With forecasted load levels expected in 2016, the distribution system would be able to back up the loss of the single Midtown transformer, or a single transmission supply to that substation, under light loading conditions, but would not be able to serve all load in the Focused Study Area during peak times. Thus, a second transmission line will be needed along with the installation of the second transformer to ensure continued reliable service to the load in the Focused Study Area. Installing a second transmission line to the Midtown Substation as part of the Hiawatha Project results in overall lower costs for the two transmission lines – mobilization costs account for approximately 30 percent of construction costs. Just as importantly, installing a second line along with the first avoids a second set of transmission line construction impacts to the affected neighborhoods, reducing overall disruption. This configuration also results in timing efficiencies. If the second transmission line were in place, a second transformer installation would take only approximately a few months and would not require a route permit or other state approval. In contrast, a second transmission line would require Commission approvals and take approximately 10 months to construct if an overhead design were used and between 9 to 27 months for underground construction depending on whether a second duct bank were initially installed.

The Company also considered operational and maintenance concerns. The two lines provide redundancy to ensure continuous service. In the event one transmission line were unavailable due to an outage event, the second line would provide the capacity in the immediate and longer term necessary to continue serving the load. Two transmission line sources also provide flexibility for maintenance, allowing one line to be taken out of service for required maintenance without affecting distribution service.

In addition, the two line proposal provides flexibility for further expansion of the system. The two lines could be bifurcated in the future to free up a termination

position for a future 115 kV connection at the Midtown Substation if conditions warrant.

5.1.3 AC/DC

Xcel Energy further considered the alternative of a DC line in place of the proposed facilities. DC transmission lines have been built throughout the world, with two in service in the upper Midwest and two in Manitoba. DC transmission lines normally consist of two current-carrying conductors instead of the three associated with an AC configuration.

A DC transmission line's primary intended purpose is to deliver electricity from a distant generation location (several hundred miles away) to a load center. Such lines do not have the capability to provide community load serving support to an AC system because there are no intermediate substation connections. Rather, there are converter stations at each end of the line. This characteristic of a DC line makes it unsuitable for the needs sought to be addressed by the lines proposed in this Application.

5.1.4 CONDUCTOR CHOICE

5.1.4.1 OVERHEAD DESIGN

Xcel Energy uses several types of conductors for its 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. For each of the 115 kV lines proposed here, ACSR would provide 230 MVA of capacity and ACSS would provide 361 MVA of capacity. ACSS typically costs approximately 10% more than ACSR conductor. ACSR conductor is proposed for the Hiawatha Project because a major constraint is the right-of-way width and ACSR provides the required capacity and can be pulled tight to narrow the right-of-way required.

If the Project is constructed overhead, the use of composite conductors may be appropriate in some areas. 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% 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. In the case of

the Hiawatha Project, there may be some long spans, such as across Highway 55, where composite conductor would be beneficial.

5.1.4.2 UNDERGROUND DESIGN

In assessing the appropriate HVED conductor for underground construction, the Company evaluated both 1250 kcmil and 3000 kcmil. To provide the necessary capacity, either two cables per phase of 1250 kcmil conductors or one cable per phase of 3000 kcmil conductors would be required. The 3000 kcmil is proposed because it meets the capacity requirements and requires fewer cables, which provides additional flexibility in conductor placement and reduces installation costs. The 3000 kcmil conductor is also preferred because the Company has recent experience with the conductor – it is being installed this year (2010) on the underground segment of the Chisago – Apple River 161 kV Project.

The heat loss experienced by underground conductors varies with the load on the conductor. At 138 amps, the average anticipating loading on the lines when placed in service, the loss per circuit would be approximately 0.42 W/ft. Therefore, the total heat released for the double circuit 115 kV underground would only be approximately 1 W/ft at 138 amps (average loading conditions). If the cables were operated at full load (1560 amps), the loss per circuit would be 38 W/ft.

5.2 SUBSTATION DESIGN, OVERHEAD/UNDERGROUND

As detailed in Chapter 2, the transmission lines can be constructed using an overhead or underground design. In the Route Permit proceeding, Xcel Energy, at the request of the Department of Commerce, Office of Energy Security, also reviewed an underground design for the Hiawatha Substation. The Company engaged Sergeant & Lundy LLC ("S&L") to perform a cost study for the transmission and distribution facilities to be built at the Hiawatha Substation West site. S&L was directed to provide an estimate of the costs, assuming that the substation could be constructed, within a 40% margin of error. S&L prepared a Hiawatha Underground Substation Study Paper and estimated that the cost for this installation would be approximately $86 million. Therefore, the range of cost based on the margin of error is between $51.6 million and $120 million. No feasibility study has been undertaken and the Company believes an underground substation is not a reasonable alternative to the standard above-ground design. There is only one substation on Xcel Energy's system that is underground, the 5th Street Substation in downtown Minneapolis.

5.3 GENERATION

5.3.1 PEAKING GENERATORS

In evaluating generation alternatives to the proposed 115 kV transmission project, the Company studied the availability of traditional peaking generation sources (e.g., diesel generation) to meet the load serving need and determined that generation is not a reasonable alternative.

To analyze the appropriateness of generation as an alternative for load serving capacity, the first step is to identify the level of the deficiency. In the case of the Focused Study Area, the current deficit is 55 MW and is predicted to grow in future years.

Once the deficiency is identified, the second step is to identify reasonable generation technologies that could satisfy the deficiency. The need for the proposed facilities arise under peak conditions. To address that deficiency with generation, it would be appropriate to consider the costs of a peaking unit, single cycle generator.

Transmission lines have the ability to operate more than 99% of the time. This reliability level is one of the benefits of constructing transmission lines. For comparison purposes, peaking generation cannot be assumed to be available to operate more than 95% of the necessary hours. Consequently, to replicate the 99% reliability found in transmission, redundant generation would need to be installed. For example, to achieve the necessary reliability of generation to address the 55 MW deficit identified in the Focused Study Area using simple cycle combustion turbines, four units would be required, each with a generation output of 20 MW. At any point in time, three of the four units must be available to provide at least 55 MW of output. Additional generators would be required as load grows beyond 55 MW.

Generation is not a reasonable alternative for the Project. New generation at multiple locations will not correct the distribution feeder circuit overloads. The more than 30 feeder circuit overloads operate as radial circuits and each has a smaller capacity than any of the contemplated generators. Generation also would not obviate the need for new facilities. If only generation were installed, the generators would have to connect to the Southtown Substation, which would require expansion of the substation (and possible relocation of adjacent businesses), a step up transformer and a transmission line to connect to the substation. Permitting generation would also be challenging in the Project Area. A local generation proposal by District Energy was previously proposed and rejected in 2008.

Even if generation could satisfy the identified needs, it would not be a reasonable alternative because of the associated cost. Applying single cycle equipment-only prices from Gas Turbine World ("2010 GTW Handbook") and assuming typical industry costs of approximately an additional 50% for site and plant engineering, labor, and contractor costs, the generation required to achieve comparable reliability to transmission would require a roughly $86 million investment ($2010) (four 20 MW plants at $21.5 million each). These costs do not include the cost of installation of gas lines, the fuel necessary to operate the units, site acquisition costs or annual operating labor and maintenance costs.

Also, in response to an information request from the Department of Commerce, Office of Energy Security, the Company gathered information regarding a typical waste-wood burning power plant. A copy of the OES Information Request and the Company's response are included in Appendix C.4.

In addition to the extra capital investment that would be required to install redundant generation to serve the same need as transmission, additional costs would have to be taken into account for the higher operations and maintenance of generators when compared to such expenses for transmission. Once constructed, transmission lines require relatively modest ongoing operations and maintenance costs. Peaking generators, by contrast, require much more costs for ongoing operations and maintenance. Generators also generally have a shorter expected service life than transmission facilities (30 years for generators versus 40-plus years for transmission facilities).

5.3.2 DISTRIBUTED GENERATION

The Company also considered distributed generation as an alternative. Distributed generation is generally considered to be small generation sources, usually less than 10 MW, located close to the ultimate users. However, in some cases generators larger than 10 MW are considered to be distributed generation as well. If distributed generation had similar operating characteristics to the peaking plant scenarios discussed in the prior section, adding such generation would not satisfy the identified customer service needs in a cost-effective manner.

The most likely fuel for dispatchable distributed generation would be diesel. A large number of diesel generators, which are typically in the 1.5 to 2 MW range, would be required to generate the amount of capacity necessary to address the shortfalls currently projected. Diesel fired generators like those under consideration here are generally used on a standby basis, and fired up when conditions, such as a contingency situation when a line or transformer is taken out of service, require operation of the generator. Diesel generators are not generally operated continually.

That provides two concerns in this situation. First, if a contingency arises, such as a storm event, there could be a period of time when power was not available while the plant was placed into operation. Second, as the demand for power continues to grow in the critical areas, the time these generators were in operation would continue to expand, making for expensive generation. Third, there are generally limits on the operation of diesel generators due to emissions limits.

5.3.3 WIND GENERATION

Because of the theoretical possibility that generation could potentially address community reliability needs, the Company analyzed whether the addition of small and dispersed wind generation projects could eliminate the need for the Project. The analysis concluded that sufficient wind generation cannot be installed to offset the community service reliability deficiencies in the affected area. This is due to the variability of wind, City of Minneapolis ordinances, and cost.

Wind generation is a "variable" resource that is dependent on the availability of wind to operate. While a wind turbine may have a stated nameplate capacity, its average net operating output may range from 10% to 40% of its nameplate capacity throughout the year. A wind turbine is a "nondispatchable" resource and cannot be relied on to produce power in the same way as a conventional power plant. A traditional power plant (e.g., natural gas, nuclear, hydro, coal) is "dispatchable", meaning it can be relied upon to produce power when power is needed. Power needs to be created and used in equal amounts for each instant of time. Power typically cannot be created one day and used the next without introducing an energy storage system such as batteries to store power until it is needed.

As a result, wind generation is generally relied upon as a source of energy but does not provide the type of capacity that is required to ensure reliable customer service for those times when the wind is not blowing. As a result, wind generation is typically integrated into the transmission system along with dispatchable resources such as natural gas peaking plants and hydro, which are capable of generating power during those hours when customer demand is high but the wind is not blowing.

This operating characteristic creates two separate issues, each of which can be alleviated by transmission. First, the system must be capable of importing power to the affected community during those hours when sufficient wind power is not being generated to satisfy the entire need (*i.e.*, high demand/low wind scenario). Second, the system must be capable of exporting power from the affected community during those hours when more wind energy is being generated than can be used by the local community (*i.e.*, low demand/high wind scenario).

Because the electric system must be designed to meet all customer requirements during all hours of the year, the addition of local wind energy generators will not eliminate the need for additional transmission. To the extent that wind generation projects might be able to meet local community service reliability needs, that ability is limited and therefore the electricity delivery system must still be designed to cover the deficiencies identified. Moreover, additional infrastructure needs to be constructed to export that wind-generated power to the transmission system at times when wind-generated power exceeds community load levels. Therefore, dispersed wind projects are not a reasonable alternative to the proposed transmission alternative for local community service reliability needs.

Even if wind generation could provide the needed capacity, it is not a feasible option here. Minneapolis ordinances require at least one acre of land for wind turbine siting (Minneapolis Code § 535.730) and limit the heights of wind turbines to 60 feet on lots between one to five acres in residence, office residence, and commercial districts (Minneapolis Code § 535.740). To install wind turbines in the densely populated south Minneapolis area, they would need to be placed on residential lots. If a one-acre residential lot were available for wind turbine placement, the height of the wind turbine would likely exceed Minneapolis City Ordinance height restrictions of 60 feet. The turbines would also be expected to generate noise at decibel levels which violate Minneapolis ordinance noise limit levels of 60-65 dBA during the day and 50-55 dBA during the night in industrial/residential mix areas (*see* Minneapolis Ordinance § 389.210).

Even if the turbines could be installed in compliance with Minneapolis ordinances, the alternative is not practical. The largest turbine that can be installed on a home without major wiring changes is 20 kW. If the assumption is made that wind could provide the needed capacity, 6,000 turbines would need to be installed to create the 120 MW capacity that would be provided by the Hiawatha Project.

$$\frac{120 Megawatts}{20 Kilowatts / turbine} = 6000 turbines$$

The costs associated with new turbines are also a relevant consideration. Using turbine costs provided by ReDriven (www.redriven.net), a manufacturer of wind turbines and towers, the cost for a 20 kW unit is $61,628 ($47,737 for turbine and $13,891 for tower). Without considering shipping and installation, charges that are not included, the cost would be $370 million (6000 * $61,628).

5.3.4 SOLAR GENERATION

In addition to wind generation as an alternative, the Company considered distributed solar generation (photovoltaics) as an alternative.

Solar installations generally require significant space and are limited in capacity. For example, Xcel Energy is partnering with the City of Minneapolis and Westwood Professional Services to install the largest solar voltaic array in the upper Midwest Region. When completed in December 2010, the 600 kW project will include more than 2,600 panels installed on the roof of the Minneapolis Convention Center. All of the electricity produced annually by the panels will be used on-site. The $3 million project received a $2 million grant from the Xcel Energy Renewable Development Fund.

For purposes of the analysis for this Application, it was assumed that solar panels will be able to output nameplate rating when demand is needed, that each panel would require 400 sq. ft of space, and that residential infrastructure capable of holding the weight (*i.e.*, structural requirements are met) of a solar array would be used.

Using the above assumptions, the largest array solar that can be placed on a home is approximately 4.6 kW. To create 120 MW of capacity, units would have to be installed on 21,739 homes. (http://www.wholesalesolar.com/gridtie.html).

$$26{,}087 arrays = \frac{120 Megawatts}{4.6 Kilowatts / array}$$

The cost of the equipment, excluding shipping and installation, would be approximately $26,000 per array. (http://www.wholesalesolar.com/gridtie.html). The total cost for 120 MW would be $670 million, which is based on the need for a minimum of 26,087 arrays at a cost of $26,000 per array.

Solar system output reaches its maximum output during the noonday period and falls off as the afternoon progresses. Residential load, however, typically reaches its peak later in the day and usually occurs between 4 and 6 p.m. as people return home from work and school for the day. This means that the energy output of the system has peaked prior to the load on the system peaking. This poses significant challenges to efforts to use photovoltaic systems to displace or defer investments in distribution system equipment designed primarily to serve residential customers. In order to do that, either extremely large systems requiring hundreds of acres or unrealistic photovoltaic saturation would be needed to defer investments.

5.4 NO BUILD/CONSERVATION AND LOAD MANAGEMENT

No large energy facility can be certified by the Commission for construction unless the applicant can show that "demand for electricity cannot be met more cost effectively through energy conservation and load-management measures." Minn. Stat. § 216B.243, subd. 3. The Commission, in assessing need, shall consider "any feasible combination of energy conservation improvements, required under section 216B.241, that can . . . (i) replace part or all of the energy to be provided by the proposed facility, and (ii) compete with it economically." Minn. Stat. § 216B.243. The statutory requirements set forth in sections 216B.243, subdivisions 3 and 3(8) are reflected in Minnesota Rule 7849.0120(A)(2), that requires the Commission to consider "the effects of the applicant's existing or expected conservation programs and state and federal conservation programs." Each electric and gas utility has an annual energy savings goal equivalent to 1.5% of gross annual retail energy sales. Minn. Stat. § 216B.2401.

In accordance with this statutory mandate, the Company considered whether an increase in customer participation in Xcel Energy's conservation and load management programs (collectively, "DSM") in the Focused Study Area could adequately address the capacity needs identified for that area and determined that these programs could not. Customer conservation is a personal choice. Xcel Energy offers a number of effective energy conservation programs and strongly encourages its customers to participate. Energy conservation is the best way to reduce individual customer load. Xcel Energy provides a broad spectrum of no cost and low cost options to customers to help them reduce their energy usage. Information about these programs is provided periodically in monthly billing inserts and on the Company's website. Residential customers can call Xcel Energy's Customer Contact Center at (800) 895-4999 to learn more about Xcel Energy's other conservation programs. Xcel Energy's business customers can work with their Xcel Energy account manager or the Business Solutions Center at (800) 481-4700.

Xcel Energy is committed to DSM programs throughout its service territory. *See* Appendix G. The Company offers an extensive portfolio of load management and demand side management programs designed to address the Minnesota statutory energy savings mandate of 1.5%. In general, these programs can be categorized as direct or indirect. Further, the direct programs can be categorized as prescriptive or custom.

Direct programs result in quantifiable energy savings. The Lighting Efficiency program, for example, offers rebates for the installation of energy efficient lighting within our business customer segment. Prescriptive programs use technical assumptions based on stipulated or deemed-technical assumptions that are assigned to

measures in order to calculate gross energy and demand savings. The rebates and savings are predetermined based on the deemed-technical assumptions. Custom programs use technical assumptions to calculate the energy and demand savings. The rebates and savings vary with the measure. Further, direct programs can be categorized as conservation or load management programs. Load management programs are specifically designed to manage peak load.

At this time, indirect programs, which are largely information-based and are intended to create customer awareness of and change behavioral patterns about using energy efficiently, do not result in quantifiable energy savings. Xcel Energy takes a proactive approach to meeting with communities and providing information on what conservation programs are available to customers. These efforts in the Project Area include a March 17, 2009 meeting with community representatives to discuss what conservation programs were available and which were currently in use in the area. On September 14, 2010, Xcel Energy joined members of the Green Institute to present a workshop in the Phillips neighborhood at Ventura Flats to educate the community on various ways they could reduce daily energy usage and communicate the value of programs like Home Electric Savings, Home Energy Audit, and Windsource. Xcel Energy also advertises available residential conservation through various forums in the Project Area such as displays during National Night Out (held August 3, 2010) and advertisements created specifically for the Nice Ride bike kiosks located in the Phillips neighborhood.

The Company also offers load management programs. The Saver's Switch Program, for example, requires customers to sign up for the program and have a device installed on the air-conditioning unit that allows Xcel Energy to cycle the air conditioners on and off during periods of high demand. An additional load management program is available to customers with loads greater than 50 kW. The Interruptible Rate Program is used during periods of high demand to reduce system load and customers must volunteer to participate in this program.

In the Phillips Neighborhood, the Home Electric Savings Program and Savers Switch Program are the most utilized programs. Figure 34 shows the level of participation in the Phillips Neighborhood and the associated demand savings (in kW).

Figure 34: Customer Program Participation and Associated Demand Savings

Program	Participation	kW/Unit	Program Total (kW)
Central Air Conditioning	29	0.63	
Lighting	3	0.0096	
Savers Switch	203	1.272	
Home Electric Savings Programs:	125	–	130.3

Correcting overloads measured during 2006 peak loading levels without adding feeder circuit infrastructure would require load reductions equivalent to more than 50,000 residential customers, more than 12 hospital complexes, or 16 Midtown Exchange equivalents in the Focused Study Area. The historical data used in the forecasting includes DSM impacts, so a significant number of additional customers would need to be willing and eligible to participate in the conservation and load management programs to decrease load levels and, even then, any realistic decrease would be insufficient to address the existing 55 MW deficit or anticipated larger capacity deficits in the future. Therefore, DSM is not a reasonable alternative to the Project.

5.5 Combination of Generation and Conservation

Based on the generation and no build alternative analysis detailed above, the Company concluded that a combination of generation and DSM could not address the identified needs. Even if a conservation rate of 2 percent of energy sales were achieved, a rate that is above the statutory objective of 1.5 percent, and even if that energy savings translated into the same percentage of demand savings (each percent of energy saved equals a percent of peak demand savings), this would result in meeting only 6.5 megawatts of the need (.02 * 331 MW of peak load). Therefore, load management programs would not provide significant additional relief – a 49 MW existing deficit would remain. Generation is not a reasonable alternative to meet this deficit for the reasons set forth in Section 5.3 and 5.4.

5.6 Consequence of Delay

Minnesota Rule 7849.0340(B) further requires the applicant to discuss the impact on existing facilities under a no-facility analysis, specifically their impact on:

(1) the amount of land required; (2) induced traffic; (3) fuel requirements; (4) airborne emissions; (5) water appropriation and conservation; (6) discharges to water; (7) reject heat; (8) radioactive releases; (9) solid waste production; (10) audible noise; and (11) labor requirements (the "Section B Requirements"). There would be little if any impact on existing generation and transmission facilities under a no-facility alternative. The likely consequence of a no-facility scenario would be service interruptions. Similarly, the Section B Requirements are not impacted in any significant manner under a no-build scenario. Additionally, since the Section B Requirements would not be significantly impacted, no equipment or measures need be used to mitigate such impacts pursuant to Section C of the Rule.

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6.0 ENGINEERING DESIGN, CONSTRUCTION AND RIGHT-OF-WAY ACQUISITION

6.1 OVERHEAD TRANSMISSION FACILITIES, ROUTES A, B AND C

6.1.1 RIGHT-OF-WAY EVALUATION AND ACQUISITION

Right-of-way will be required for the new transmission lines and the proposed substations. It is anticipated that the transmission lines would be constructed primarily on public right-of-way. Substations may be constructed on public, private and Company property.

For those portions of the Project that will be constructed on public land, Xcel Energy will coordinate with the appropriate agency to obtain the necessary approvals to construct the facilities. Xcel Energy anticipates working closely with the City of Minneapolis, the HCRRA, and Mn/DOT throughout this permitting process and after a Certificate of Need and Route Permit are issued.

Where private land rights need to be acquired, the right-of-way acquisition process begins early in the detailed design process. For transmission lines, utilities typically acquire easement rights across the parcels to accommodate the facilities. For substations, Xcel Energy typically acquires a fee interest. The evaluation and acquisition process includes initial owner contacts, survey work, document preparation, negotiation, and purchase of the easement. Each of these activities, particularly as it applies to easements for transmission line facilities, is described in more detail below.

After owners are identified, a right-of-way representative personally contacts each property owner or the property owner's representative. The right-of-way agent describes the need for the transmission facilities and how the specific project may affect each parcel. The right-of-way agent also seeks information from the landowner about any specific construction concerns. Also, at this contact, the right-of-way representative will request permission for survey and soil boring information to be performed on the property in order to design the facility and prepare plans for the landowner. Surveys are conducted to locate the right-of-way corridors, natural features, man-made features, and associated elevations for use during the detailed engineering of the line. The soil analysis is performed by an experienced geotechnical testing laboratory. This contact is typically made after a route permit is issued for a project, but may occur earlier in some instances.

The right-of-way agent then negotiates with the property owner(s) to acquire the easement rights necessary to build, operate, and maintain the transmission

facilities. The agent will also provide maps of the transmission line route or site, provide maps showing the landowner's parcel, and offer compensation for the transmission line easement. During the negotiation process, the location of the proposed transmission line can be staked.

At a minimum, the monetary offer made by the utility's representative(s) must compensate for any diminution in value of the fair market value of the property due to the encumbrance of the transmission line easement. The landowner is allowed a reasonable amount of time in which to consider the offer and to present any material that the owner believes is relevant to determining the easement's value.

In nearly all cases, Xcel Energy is able to work with the landowners to address their concerns and an agreement is reached for the utilities' purchase of land rights. The right-of-way agent prepares all of the documents required to complete each transaction and will take care of all title issues and document filing.

In rare instances, a negotiated settlement cannot be reached and the landowner chooses to have an independent third party determine the value of the rights taken. Such valuation is made through the utility's exercise of the right of eminent domain pursuant to Minnesota Statutes Chapter 117. The process of exercising the right of eminent domain is called condemnation.

Before commencing a condemnation proceeding, the Company must obtain at least one appraisal for the property proposed to be acquired and a copy of that appraisal must be provided to the property owner. Minn. Stat. § 117.036, subd. 2(a). The property owner may also obtain another appraisal and the Company must reimburse the property owner for the cost of the appraisal according to the limits and process set forth in Minnesota Statutes Section 117.036, subdivision 2(b). The property owner may be reimbursed for reasonable appraisal costs up to $1,500 for single-family and two-family residential properties; $1,500 for property with an acquisition value of $10,000 or less; and $5,000 for other types of properties.

To start the formal condemnation process, a utility files a Petition in the district court where the property is located and serves that Petition on all owners of the property. If the court grants the Petition, the court then appoints a three-person condemnation commission that will determine the compensation for the easement. The three people must be knowledgeable of applicable real estate issues. Once appointed, the condemnation commissioners schedule a viewing of the property over and across which the transmission line easement is to be located. Next, the commissioner schedules a valuation hearing where the utility and landowners can testify as to the fair market value of the easement or fee. The commission then makes an award as to the value of the property acquired and files it with the court. Each

party has 40 days from the filing of the award to appeal to the district court for a jury trial. In the event of an appeal, the jury hears land value evidence and renders a verdict. At any point in this process, the case can be dismissed if the parties reach a settlement.

Once right-of-way is acquired and prior to construction, the right-of-way agent will again contact the owner of each parcel to discuss the construction schedule and construction requirements. To ensure safe construction of the line, special consideration may be needed for fences or other personal property issues. For instance, fences may need to be moved or certain features protected. In each case the right-of-way agent coordinates these processes with the landowner.

6.1.2 Overhead Transmission Construction Procedures

Construction will begin after all regulatory approvals are obtained, property and rights-of-way are acquired, soil conditions are established and final design is complete. The precise timing of construction will take into account various requirements that may be in place due to permit conditions, system loading issues and available workforce.

The actual construction will follow standard construction and mitigation practices that were developed from experience with past projects. These best practices address right-of-way clearance, staging, erecting transmission line structures and stringing transmission lines. Construction and mitigation practices to minimize impacts will be developed based on the proposed schedule for activities, permit requirements, prohibitions, maintenance guidelines, inspection procedures, terrain, and other practices. In some cases, these activities, such as schedules, are modified to minimize impacts to sensitive environments.

Transmission line structures are generally designed for installation at grade. Typically, structure sites with 10% or less slope will not be graded or leveled. Sites with more than 10% slope will have working areas graded level or fill brought in for working pads. If the landowner permits, it is preferred to leave the leveled areas and working pads in place for use in future maintenance activities, if any. If permission is not obtained, the site is graded back to its original condition as much as possible and all imported fill is removed from the site.

Typical construction equipment used on a project consists of tree removal equipment, mowers, cranes, backhoes, digger-derrick line trucks, track-mounted drill rigs, dump trucks, front end loaders, bucket trucks, bulldozers, flatbed tractor-trailers, flatbed trucks, pickup trucks, concrete trucks, and various trailers. Many types of excavation equipment are set on wheel or track-driven vehicles. Steel poles are

transported on tractor-trailers. It is anticipated that the poles may be erected aerially due to space limitations.

Staging areas are usually established for a project. Staging involves delivering the equipment and materials necessary to construct the new transmission line facilities. Construction of the Project would likely include one or two staging areas. The materials are stored at staging areas until they are needed for the Project.

Temporary lay down areas may be required for additional space for storage during construction. These areas will be selected for their location, access, security, and ability to efficiently and safely warehouse supplies. The areas are chosen to minimize excavation and grading. The temporary lay down areas outside of the transmission line right-of-way will be obtained from affected landowners through rental agreements.

Access to the transmission line right-of-way corridor is made directly from existing roads that run parallel or perpendicular to the transmission line right-of-way. Depending upon the type of construction method used, roads would be closed during road crossings one lane at a time, with several days of road closures anticipated at each structure location. Road closures would require a permit from the appropriate governing agency. Depending on the route permitted, construction may impact use of the Midtown Greenway on a very temporary basis. The Company will work with stakeholders to minimize impacts when feasible.

When it is time to install the poles, structures are moved from the staging areas and delivered to the staked location. The structures are placed within the right-of-way until the structure is set. Insulators and other hardware are attached while the steel pole is on the ground. The pole is then lifted, placed, and secured on the foundation using a crane, or set aerially.

Typical tangent and angle structures will be installed by direct embedding them into the ground for the single circuit alternatives. This method typically involves digging a hole for each pole, placement of a corrugated metal culvert for soil support which is partially filled with crushed rock and then setting the pole on top of the rock base. The area around the pole is then backfilled with crushed rock and/or soil. The proposed double circuit poles would be placed on concrete or drilled pier foundations. Structures that are considered medium angle, heavy angle or dead-end structures will be supported by concrete drilled pier foundations. In those cases, excavations will need to be drilled in preparation for the concrete. Drilled pier foundations may vary from five to seven feet in diameter and 20 or more feet in depth, depending on soil conditions. Rubber tire mixers will transport the concrete to each site from a local concrete batch plant.

Environmentally sensitive areas may also require special construction techniques in some circumstances. These may include additional erosion control measures to protect steep slopes, matting to minimize soil disturbance/compaction, and/or remediation associated with unanticipated contaminated soils.

In addition, potential vibration levels will be evaluated and monitored to minimize any potential impacts to historic structures.

It is anticipated that overhead construction along Route A—Alignment A1 will require 3,000 civil engineering man hours and 6,800 electrical engineering man hours. Up to 15 to 25 construction workers will be used at any one time to construct the double circuit overhead transmission line.

6.1.3 OVERHEAD TRANSMISSION RESTORATION PROCEDURES

During construction, crews will attempt to limit ground disturbance wherever possible. However, areas are disturbed during the normal course of work, which can take several weeks in any one location. As construction on each parcel is completed, disturbed areas are restored to their original condition to the maximum extent practicable. The right-of-way agent contacts each property owner after construction is completed to see if any remaining damage as a result of the project needs to be repaired. If non-repairable damage has occurred to the property, the Company will fairly reimburse the landowner for the damages sustained. In some cases, the Company may engage an outside contractor to restore the damaged property as near as possible to its original condition. Portions of vegetation that are disturbed or removed during construction of transmission lines will naturally reestablish to pre-disturbance conditions. Resilient species of common grasses and shrubs typically reestablish with few problems after disturbance. Areas with significant soil compaction and disturbance from construction activities along the proposed transmission line corridor will require assistance in reestablishing the vegetation stratum and controlling soil erosion. Commonly used methods to control soil erosion and assist in reestablishing vegetation include, but are not limited to:

- Erosion control blankets with embedded seeds
- Silt fences
- Matting
- Hay bales

These erosion control and vegetation establishment practices are regularly used in construction projects and are referenced in the construction permit plans. Long-term impacts are minimized by utilizing these construction techniques.

6.1.4 Overhead Transmission Maintenance Procedures

Transmission lines and substations are designed to operate for decades and require only moderate maintenance, particularly in the first few years of operation.

The estimated service life of the proposed transmission line for accounting purposes is approximately 40 years. However, practically speaking, high voltage transmission lines are seldom completely retired. Transmission infrastructure has very few mechanical elements and is built to withstand weather extremes that are not normally encountered. With the exception of severe weather such as tornadoes and heavy ice storms, transmission lines rarely experience structural and/or electrical failures. Transmission lines are automatically taken out of service by the operation of protective relaying equipment when a fault is sensed on the system. Such interruptions are usually only momentary. Scheduled maintenance outages are also infrequent. As a result, the average annual availability of transmission infrastructure is very high, in excess of 99%.

The principal operating and maintenance cost for transmission facilities is the cost of inspections, done every other year by ground inspection in metro areas. Annual operating and maintenance costs for transmission lines in Minnesota and the surrounding states vary. For voltages from 115 kV through 345 kV, Company experience shows that costs are approximately $300 to $500 per mile. Actual line-specific maintenance costs depend on the setting, the amount of vegetation management necessary, storm damage occurrences, structure types, materials used, and the age of the line.

6.2 Underground Transmission Facilities, Routes A and D

Two underground transmission construction designs are presented in this Application (*i.e.*, Route A and Route D).

High voltage underground cable requires significant study to determine the cable design criteria according to power transfer, reactive compensation, heat transfer, emergency loading, fault capacity, redundancy, and environment. Design of underground lines requires soil sampling and testing to determine the thermal conductivity of the earth and ability to trench/bore in the prospective right-of-way.

Technologies for construction of underground lines include surface-cut open trenching, horizontal boring, and horizontal directional drilling ("HDD"). Trenching

is preferred because it is easily controlled and the most cost effective method for construction, even though mitigation efforts may be necessary to shore up the trench for worker safety, dewater to keep the trench dry, backfill with selective materials to improve heat transfer, and landscape/re-vegetate disturbed areas. Horizontal boring and directional drilling, while more expensive than trenching, are most often used to pass the cables, pipes, and conduits below existing objects that are very difficult to open up for a trench such as deep ravines, railroad crossings, major roads, rivers, and other obstacles. Figure 35 shows an underground single circuit 115 kV facility being built using the trenching method. The trench for a double circuit 115 kV would be at least twice the size of that shown in the photograph.

Underground transmission lines require the installation of a duct system. The diameter of high voltage underground cables is determined by the conductor which carries the load current, the insulation thickness required for the power system line-to-ground voltage, and the cable's electrostatic shield system. Generally, the conductor of an underground transmission line will be twice the size of an equivalent overhead transmission line. This is a result of the limited heat dissipation due to cable insulation and below grade encasement.

Figure 35: Underground 115 kV Single Circuit Construction Trench Bracing

If one of the two underground designs, Route A (Alignment A2 or A3) or Route D, were selected, the majority of the underground facilities would consist of two identical concrete duct banks containing four (4) 6-inch PVC conduits for the transmission circuits, and two (2) 2-inch PVC conduits for ground continuity, and communication needs. The layout would have the duct banks installed adjacent to each other in the same trench. The duct banks may also be installed in separate trenches as dictated by physical limitation of the route (for example, running parallel on opposite sides of a surface street). Two HDD crossings will likely be required near Hiawatha Avenue. The conductor would be HVED cable, 3000 kcmil copper cross-linked polyethylene type or similar design. Cable vaults with manhole access will be required approximately every 1,500 feet and at any major changes in direction in the route to facilitate the installation of the cable as well as for future inspection and repair. A typical vault with manhole access would be approximately 24 - 25 feet in length by 14 feet in width by seven to 10 feet in height. It is anticipated that the majority of the transmission facilities would be constructed by installation of a concrete encased duct bank raceway system in an open cut trench. Open cut trenching is used to install most duct systems in city streets today and has been used since underground installation of electrical facilities began in the early 1900s. It is the method of choice for most installations because it is readily adaptable to most conditions found in the field, as long as sufficient space exists to conduct the open cut trenching operation.

Probably the greatest advantage of using the open cut method is that excavation contractors with the level of experience needed to successfully use the methodology are available in most locations. The system used is similar to that used to install most subsurface infrastructure. In most cases, the open cut trenching can accommodate high water tables by using normal dewatering methods, provided the work complies with National Pollutant Discharge Elimination System ("NPDES") permits and other local requirements.

In most urban locations, the concrete encased duct bank is the preferred method of underground installation. Duct installation of underground cable systems can be economical when many circuits are to be installed in a confined area. Spare ducts are sometimes included to allow future installation of additional cable circuits. This Project includes construction of two duct banks with one circuit in each bank. There will also be an extra duct in each bank to allow a conductor to be installed in the future if conditions require. The duct system provides supplemental dig-in protection for the cables, minimizes the probability of concurrent failures of adjacent cables or circuits, and minimizes the length of trench open at any one time. The cables are pulled into the ducts after the backfilling operation has been completed.

Vaults with manholes access are installed along the duct line at spacing not exceeding maximum cable pulling lengths. These pulling lengths are limited by maximum permissible cable pulling tensions and maximum sidewall pressures. Maximum reel sizes may limit cable-pulling lengths in some cases. Additional vaults may be required at sharp bends along the duct route. When cable faults occur in duct systems, the faulted cable section is pulled out and replaced between adjacent manholes. At the ends of the underground line, termination poles or structures are used to transition from underground to overhead construction as necessary.

A different method of installation is anticipated at the crossings of Hiawatha Avenue and the Metro Transit Hiawatha Light Rail Line. At these locations, HDD would be used. Initially used in the 1970s, directional crossings are a marriage of conventional road boring and directional drilling of oil wells. Pipelines have been installed for carrying oil, natural gas, water, and other products using HDD. Ducts have been installed to carry electric and fiber optic cables. Besides crossing under rivers and waterways, HDD installations have been made crossing under highways, railroads, airport runways, shore approaches, islands, areas congested with buildings, pipeline corridors and future water channels. Although directional drilling was originally used primarily on the U.S. Gulf Coast through alluvial soils, more crossings have been undertaken through gravel, cobble, glacial till and hard rock. Adequate space must be available to allow rigs to set up for the duration of the installation.

HDD installations have the least environmental impact of any underground installation method. The technology also offers maximum depth of cover under the obstacle, thereby affording maximum protection and minimizing maintenance costs. HDD installations have a reasonably predictable and short construction schedule. Directional drilling may minimize social impacts such as extensive highway closures and traffic congestion under the right conditions. Perhaps the most significant advantage is that HDD installations are, in select cases, less expensive than tunnel boring methods. However, HDD installations are more costly than open trenched crossings.

6.2.1 UNDERGROUND TRANSMISSION RIGHT-OF-WAY EVALUATION AND ACQUISITION

The underground lines would require a 30-foot wide right-of-way with 15 feet on each side of the transmission line centerline. The identified routes for both the overhead and underground scenarios are located primarily within public street right-of-way or the HCRRA corridor. It is anticipated that easement acquisition from private landowners will be limited to ensure adequate clearances for safe operation of the facilities. Underground line right-of-way evaluation and acquisition would

proceed in a manner similar to that of overhead lines. The right-of-way evaluation and acquisition process is described in section 6.1.1.

6.2.2 UNDERGROUND TRANSMISSION CONSTRUCTION PROCEDURES

Construction will begin after federal, state and local approvals are obtained, property and rights-of-way are acquired, soil conditions are established, and final design is completed. The precise timing of construction will take into account various requirements that may be in place due to permit conditions, system loading issues, and available workforce.

The actual construction will follow standard construction and mitigation practices that were developed from experience with past projects. These best practices address right-of-way clearance, staging, construction of subsurface structures and conductor pulling techniques. Construction and mitigation practices to minimize impacts will be developed based on the proposed schedule for activities, permit requirements, prohibitions, maintenance guidelines, inspection procedures, terrain, and other practices. In some cases these activities, such as schedules, are modified to minimize impacts to sensitive environments. During all stages of the construction activities, a safety barrier would enclose the work area to prevent unauthorized access to the area.

For underground transmission line construction, the construction of the initial duct banks would proceed at a rate of about 200 feet per day assuming normal conditions are encountered. Once the initial duct banks are installed, the transmission cables would be pulled through and spliced at each of the maintenance entrances.

Double circuit underground lines can be installed either horizontally or vertically. Horizontal installation would place the circuits at approximately the same depth in the trench and would require an approximately 15-foot-wide and six-foot-deep construction trench. Vertical installation would place one circuit on top of the other and would require an approximately five-foot-wide and 12-foot-deep construction trench. The exact size of the trench may vary based upon conditions encountered during construction.

Typical construction equipment used on a project consists of tree removal equipment, mowers, cranes, backhoes, digger-derrick line trucks, track-mounted drill rigs, dump trucks, front end-loaders, bucket trucks, bulldozers, flatbed tractor-trailers, flatbed trucks, pickup trucks, concrete trucks, and various trailers. Many types of excavation equipment are set on wheel or track-driven vehicles.

Staging areas are usually established for the project. Staging involves delivering the equipment and materials necessary to construct the new transmission line facilities. Construction of the Project may include one or two staging areas near the substation locations. The materials are stored at staging areas until they are needed for the Project.

Temporary lay down areas may be required for additional space for storage during construction. These areas will be selected for their location, access, security, and ability to efficiently and safely warehouse supplies. The areas are chosen to minimize excavation and grading. The temporary lay down areas outside of the transmission line right-of-way will be obtained from affected landowners through rental agreements.

Access to the transmission line right-of-way corridor is made directly from existing roads that run parallel or perpendicular to the transmission line right-of-way. Depending upon the type of construction method used, roads would be closed during road crossings one lane at a time, with several days of road closures anticipated at each structural location. Road closures would require a permit from the appropriate governing agency. The proposed route runs along and crosses the Midtown Greenway. If a closure of the bike path is needed for construction, it will be temporary in nature and the Company will work with stakeholders to minimize impacts when feasible.

Environmentally sensitive areas may also require special construction techniques in some circumstances. These may include additional erosion control measures to protect steep slopes and/or remediation associated with unanticipated contaminated soils.

It is anticipated that underground construction along Route A—Alignment A2 or Alignment A3 will require 10,000 civil engineering man hours and 3,000 electrical engineering man hours. Up to 20 workers may be used during the peak construction period for the underground transmission line. These include crews building the duct banks, installing the vaults, doing excavation work, setting pipe, pulling cable, and terminating.

6.2.3 UNDERGROUND TRANSMISSION RESTORATION PROCEDURES

During construction, crews will attempt to limit excess ground disturbance wherever possible. However, underground transmission installation requires such disturbance through creation of a trench along the entire route, with the exception of areas where the line is being installed using HDD methods. Construction can take several weeks in any one location. As construction on each parcel is completed,

disturbed areas are restored to their original condition to the maximum extent practicable.

The right-of-way agent contacts each property owner after construction is completed to see if any damage remains as a result of the project. If non-repairable damage has occurred to the property, Xcel Energy will fairly reimburse the landowner for the damages sustained. In some cases, Xcel Energy may engage an outside contractor to restore the damaged property as nearly as possible to its original condition. Portions of vegetation that are disturbed or removed during construction of transmission lines will naturally reestablish to pre-disturbance conditions. Resilient species of common grasses and shrubs typically reestablish with few problems after disturbance.

Underground transmission installation would require clearing of all vegetation along the right-of-way. The cleared areas would be revegetated with compatible shallow rooted species. During construction, extensive use of erosion control measures would be required along the length of the line, as compared to overhead construction, where erosion control measures are only required in the vicinity of the structure locations.

During construction, soils would be stockpiled in the vicinity of the construction activities and returned to the trench once construction is complete, with the exception of certain contaminated soils. Depending upon soil and transmission line type, off-site fill may be required for heat dissipation purposes. In this case, the excess soil from the trench would be appropriately disposed of once construction is complete.

6.2.4 UNDERGROUND TRANSMISSION MAINTENANCE PROCEDURES

Underground transmission lines present challenging service issues. While they are subject to fewer outages, the outages are typically longer in duration because underground cables do not have temporary faults such as branches falling or ice breakage and are not subjected to reclosing operations. As a result, the down time associated with an underground transmission line fault will be longer in duration than the equivalent overhead line failure. Typical overhead line outages are repaired and back in service 10 – 24 hours after the outage event. In contrast, typical underground line outages are repaired and the line placed back in service two to three weeks after the outage event.

If the underground alternative is selected, it is not expected that there will be any operating and maintenance costs because it is not possible to physically inspect

the facilities. Routine inspections on the underground transmission line would not be completed unless a maintenance and/or repair need is identified.

6.3 SUBSTATION FACILITIES

6.3.1 SUBSTATION CONSTRUCTION PROCEDURES

Construction of the Hiawatha and Midtown substations is planned to begin once required approvals are obtained and property acquisition is complete. A detailed construction schedule will be developed based upon the availability of crews, weather conditions, spring load restrictions on roads, and any specific area restrictions in place to minimize construction impacts. Between 12 – 15 construction workers will be present at each substation site will be used to construct the two substations during the peak period of construction. These include electrical construction crews, electrical testers, civil crews, and physical construction crews.

Once the substation sites are graded, a perimeter fence will be erected to secure the sites. Concrete foundations will be poured to support the substation equipment and the control house. After grading, fencing, and foundation work have been completed, the substation and control house erection will commence. Applicants will also construct permanent access roads to provide for ingress and egress for its substation operating personnel and equipment maintenance. Erosion control methods will be implemented to minimize runoff during construction. Applicant will comply with all local, state, NESC, and internal standards regarding clearance to ground, clearance to other utilities in the area, clearance to buildings, and other applicable standards.

6.3.2 SUBSTATION MAINTENANCE PROCEDURES

Substations require a certain amount of maintenance to keep them functioning in accordance with accepted operating parameters and the NESC and NERC requirements. Transformers, circuit breakers, batteries, protective relays, and other equipment need to be serviced periodically in accordance with the manufacturer's recommendation. The site itself must be kept free of vegetation and drainage maintained.

7.0 TRANSMISSION LINE OPERATING CHARACTERISTICS

7.1 OZONE AND NITROGEN OXIDE EMISSIONS

Currently, both state and federal governments have regulations regarding permissible concentrations of ozone and nitrogen dioxide ("NO_2"). The National Ambient Air Quality Standards ("NAAQS") and Minnesota Ambient Air Quality Standards ("MAAQS") for these compounds are presented in Figure 36.

Figure 36: National and Minnesota Ambient Air Quality Standards

Pollutant	Level	Averaging Time
Nitrogen Dioxide	0.053 ppm	Annual (Arithmetic Mean)
Ozone	0.075 ppm	8-hour

Source: EPA, 2009a

The only potential air emissions for the Project would be associated with overhead designs and are limited. Corona consists of the breakdown or ionization of air in a few centimeters or less immediately surrounding conductors, and can produce ozone and oxides of nitrogen in the air surrounding the conductor. For a 115 kV transmission line, the conductor gradient surface is usually below the air breakdown level. Typically, some imperfection such as a scratch on the conductor or a water droplet is necessary to cause corona. Ozone is not only produced by corona, but also forms naturally in the lower atmosphere from lightning discharges and from reactions between solar ultraviolet radiation and air pollutants such as hydrocarbons from auto emissions. The natural production rate of ozone is directly proportional to temperature and sunlight and inversely proportional to humidity. Thus, humidity (or moisture), the same factor that increases corona discharges from transmission lines, inhibits the production of ozone. Ozone is a very reactive form of oxygen and combines readily with other elements and compounds in the atmosphere. Because of its reactivity, it is relatively short-lived. All portions of the Project Area are designated as in attainment for the NAAQS and MAAQS.

For the overhead design on Route A, the predicted Ozone concentration is 0.00003 ppm. The corona loss estimate is 0.1 W/m. The single circuit designs would be below these limits.

During construction of the proposed transmission line, there will be limited emissions from vehicles and other construction equipment and fugitive dust from right-of-way clearing. Temporary air quality impacts caused by construction-related emissions may occur during this phase of activity.

The magnitude of the construction emissions is influenced heavily by weather conditions and the specific construction activity occurring. Exhaust emissions, primarily from diesel equipment, will vary according to the phase of construction, but will be minimal and temporary. Adverse impacts to the surrounding environment will be minimal because of the short and intermittent nature of the emission and dust-producing construction phases.

7.2 AUDIBLE NOISE

Overhead transmission conductors produce noise under certain conditions. The level of noise depends on conductor conditions, voltage level and weather conditions. Generally, activity-related noise levels during the operation and maintenance of substations and transmission lines are minimal.

Noise emission from a transmission line occurs during certain weather conditions. In foggy, damp, or rainy weather, power lines can create a crackling sound due to the small amount of electricity ionizing the moist air near the wires. During heavy rain, the background noise level of the rain is usually greater than the noise from the transmission line. As a result, people do not normally hear noise from a transmission line during heavy rain. During light rain, dense fog, snow, and other times when there is moisture in the air, transmission lines can produce noise. Noise levels produced by a 115 kV transmission line are generally less than outdoor background levels and are therefore not usually audible. At substations, the source for noise is primarily the transformers which can create a humming noise.

Since human hearing is not equally sensitive to all frequencies of sound, the most noticeable frequencies of sound are given more "weight" in most measurement schemes. The A-weighted scale corresponds to the sensitivity range for human hearing. Noise levels capable of being heard by humans are measured in A-weighted decibels ("dBA"). A noise level change of 3 dBA is barely perceptible to human hearing. A 5 dBA change in noise level, however, is clearly noticeable. A 10 dBA change in noise level is perceived as a doubling of noise loudness, while a 20 dBA change is considered a dramatic change in loudness. Figure 37 shows noise levels associated with common, everyday sources.

Figure 37: Common Noise Sources and Levels

Sound Pressure Level (dB)	Typical Sources
120	Jet aircraft takeoff at 100 feet
110	Same aircraft at 400 feet
90	Motorcycle at 25 feet
80	Garbage disposal
70	City street corner
60	Conversational speech
50	Typical office
40	Living room (without TV)
30	Quiet bedroom at night

Source: Environmental Impact Analysis Handbook, ed. by Rau and Wooten, 1980

In Minnesota, statistical sound levels (L Level Descriptors) are used to evaluate noise levels and identify noise impacts. The L_5 is defined as the noise level exceeded 5% of the time, or for three minutes in an hour. The L_{50} is the noise level exceeded 50% of the time, or for 30 minutes in an hour.

The Minnesota Pollution Control Agency ("MPCA") noise standards are consistent with speech, sleep, annoyance and conversation requirements for receivers based on the present knowledge for preservation of public health and welfare. Similar land uses have been grouped and classified using the State's noise area classification ("NAC") system. Residential areas, churches, and similar type land use activities are included in NAC 1; commercial-type land use activities are included in NAC 2; and industrial-type land use activities are included in NAC 3.

Figure 38 identifies the established daytime and nighttime noise standards by NAC. The standards are expressed as a range of permissible dBA within a one hour period; L_{50} is the dBA that may be exceeded 50% of the time within an hour, while L_{10} is the dBA that may be exceeded 10% of the time within the hour.

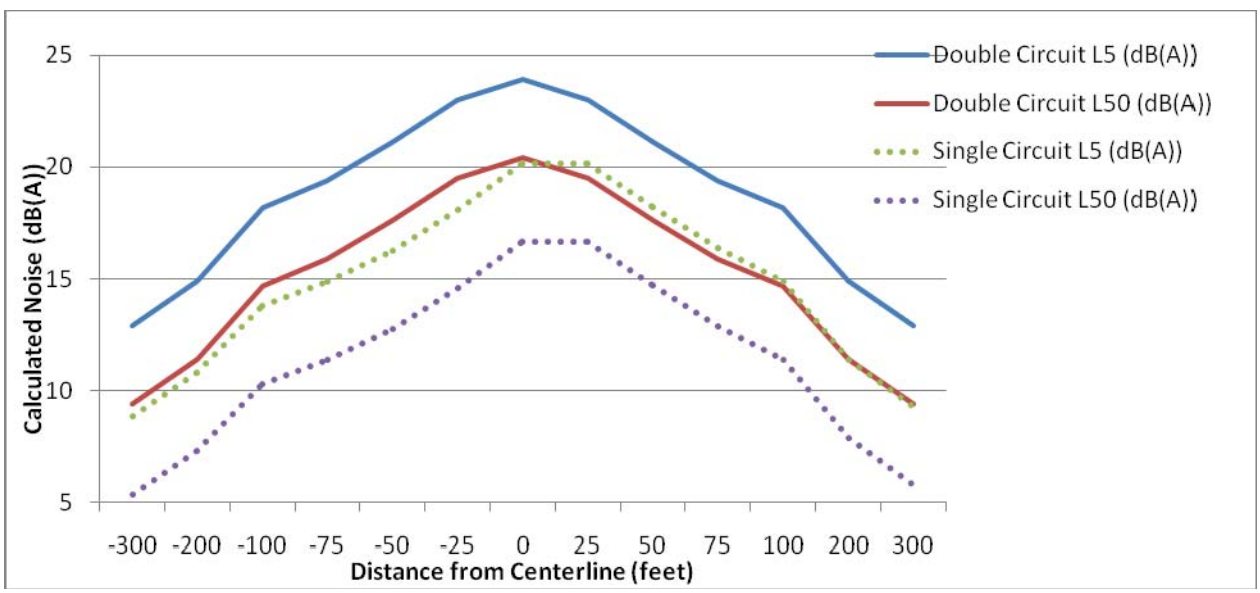
Figure 38: Noise Standards by Noise Area Classification

(Units in dBA)

Noise Area Classification	Daytime		Nighttime	
	L_{50}	L_{10}	L_{50}	L_{10}
1	60	65	50	55
2	65	70	65	70
3	75	80	75	80

The potentially affected residences fall within NAC 1. The noise generated from the transmission lines is not expected to exceed the background noise levels and would therefore not be audible at any receptor location. Figure 39 below shows the noise calculations for the proposed transmission lines under rainfall conditions when the noise level is expected to be the greatest. In addition, noise levels would be well below the noise standards established for NAC 1, as shown in Table 4 above.

Figure 39: Transmission Line Noise Calculations for Double Circuit Structures



A noise assessment conducted by Xcel Energy determined the existing ambient sound levels in the vicinity of the proposed Midtown North site and assessed the potential noise impacts on the surrounding residential area and the Midtown Greenway when the substation is operational. Potential impacts were assessed with

respect to the MPCA nighttime noise standards and the existing ambient sound level. This study concluded that based on an assessment of existing and predicted sound levels in the vicinity of the proposed Midtown North site, the noise levels from the substation will be in compliance with the State of Minnesota noise standards and will have a minimum impact on existing sound levels. To further reduce noise impacts, the Company proposes to install a sound buffering wall and low noise transformers.

The Hiawatha Substation will be located in an area zoned as a light industrial district (NAC 3). The Midtown Substation will be located in an area zoned as a high density residence district (NAC 1). The nearest occupied home to the proposed Hiawatha Substation is greater than 200 feet away, and the nearest home to the proposed Midtown Substation is approximately 20 feet away.

The potentially affected residences fall within NAC 1. The noise generated from the transmission lines is not expected to exceed the background noise levels and would therefore not be audible at any receptor location. In addition, noise levels would be well below the noise standards established for NAC 1, as shown in Figure 38 above.

The City of Minneapolis has established noise ordinances under its Code of Ordinances Title 15, Chapter 389.60. Besides incorporating by reference the MPCA's noise standards, the City of Minneapolis ordinances prohibit activities which generate sound, regardless of frequency, that is more than 10 dBA above the ambient noise level when measured within any dwelling unit during the daytime or five (5) dBA or more above the ambient noise level during the nighttime when measured within any dwelling unit. The noise ordinance also provides maximum permitted sound levels in decibels by octave band frequency, which apply to the boundary of a residence or business district. The Company will ensure that the noise at the substations does not exceed the levels established in the noise ordinances.

In addition to the noise ordinances presented above, the City of Minneapolis prohibits the operation of construction equipment within the city between the hours of 6:00 p.m. and 7:00 a.m. on weekdays or during any hours on Saturdays, Sundays and federal holidays, except as allowed by permit for a specific project. Depending upon the alternative chosen, the Company may request a permit for after-hours construction for specific activities, such as road crossings.

7.3 Radio and Television Interference

Corona from transmission line conductors can generate electromagnetic "noise" at the same frequencies that radio and television signals are transmitted. This noise can cause interference with the reception of these signals depending on the

frequency and strength of the radio and television signal. Tightening loose hardware on the transmission line usually resolves the problem.

If radio interference from transmission line corona does occur, satisfactory reception from AM radio stations presently providing good reception can be obtained by appropriate modification of (or addition to) the receiving antenna system. Moreover, AM radio frequency interference typically occurs immediately under a transmission line and dissipates rapidly within the right-of-way to either side.

FM radio receivers usually do not pick up interference from transmission lines because:

- Corona-generated radio frequency noise currents decrease in magnitude with increasing frequency and are quite small in the FM broadcast band (88 – 108 Megahertz), also
- The excellent interference rejection properties inherent in FM radio systems make them virtually immune to amplitude type disturbances.

A two-way mobile radio located immediately adjacent to and behind a large metallic structure (such as a steel tower) may experience interference because of signal-blocking effects. Movement of either mobile unit so that the metallic structure is not immediately between the two units should restore communications. This would generally require a movement of less than 50 feet by the mobile unit adjacent to a metallic tower.

Television interference is rare but may occur when a large transmission structure is aligned between the receiver and a weak distant signal, creating a shadow effect. Loose and/or damaged hardware may also cause television interference. If television or radio interference is caused by or from the operation of the proposed facilities in those areas where good reception is presently obtained, the Company will inspect and repair any loose or damaged hardware in the transmission line, or take other necessary action to restore reception to the present level, including the appropriate modification of receiving antenna systems if deemed necessary.

7.4 SAFETY

The proposed transmission lines and substation upgrades will be designed to meet or surpass all relevant state codes and the NESC. Appropriate standards will be met for construction and installation, and all applicable safety procedures will be followed during and after installation. The proposed transmission lines will be equipped with protective devices to safeguard the public from the transmission line if

an accident occurs and a structure or conductor falls to the ground. The protective equipment would de-energize the line when such an event occurs. In addition, the substation facilities will be fenced and access limited to authorized personnel.

7.5 ELECTRIC AND MAGNETIC FIELDS

The term electromagnetic field ("EMF") refers to electric and magnetic fields that are coupled together such as in high frequency radiating fields. For the lower frequencies associated with power lines (referred to as "extremely low frequencies" ("ELF")), EMF should be separated into electric fields ("EFs") and magnetic fields ("MFs"), measured in kilovolts per meter ("kV/m") and milligauss ("mG"), respectively. These fields are dependent on the voltage of a transmission line (EFs) and current carried by a transmission line (MFs). The intensity of the EF is proportional to the voltage of the line, and the intensity of the MF is proportional to the current flow through the conductors. Transmission lines operate at a power frequency of 60 hertz (cycles per second).

7.5.1 ELECTRIC FIELDS

There is no federal standard for transmission line electric fields. The Commission, however, has imposed a maximum electric field limit of 8 kV/meter measured at one meter above the ground. *In the Matter of the Route Permit Application for a 345 kV Transmission Line from Brookings County, South Dakota to Hampton, Minnesota,* Docket No. ET-2/TL-08-1474, Order Granting Route Permit (*adopting* ALJ Findings of Fact, Conclusions and Recommendation at Finding 194 (April 22, 2010 and amended April 30, 2010)) (September 14, 2010). The standard was designed to prevent serious hazards from shocks when touching large objects parked under AC transmission lines of 500 kV or greater. The maximum electric field, measured at one meter above ground, associated with Xcel Energy's proposed Project is calculated to be 1.12 kV/m.

The calculated electric fields for the Project are provided in Figure 40.

Figure 40: Calculated Electric Fields (kV/m) for Proposed 115 kV Transmission Line Designs (1 Meter or 3.28 feet above ground)

Routes	Structure Type	Nominal Voltage (kV)	Distance to Proposed Centerline								
			-200'	-100'	-50'	-25'	0'	25'	50'	100'	200'
B & C	Horizontal Post 115 kV Single circuit	121	0.02	0.05	0.05	0.13	1.12	1.09	0.09	0.08	0.03
A	Davit Arm 115 kV/115 kV Steel Pole Double circuit	121	0.01	0.02	0.15	1.00	0.56	1.00	0.15	0.02	0.01
A & D	Transmission Duct Bank 115 kV/115 kV Underground Double circuit	121	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

7.5.2 MAGNETIC FIELDS

There are presently no Minnesota regulations pertaining to MF exposure. The Company provides information to the public, interested customers, and employees so they can make informed decisions about MFs. Such information includes the availability for measurements to be conducted for customers and employees upon request.

The calculated magnetic fields for the Project are shown on Figure 41.

Figure 41: Calculated Magnetic Flux Density (milligauss) for Proposed 115 kV Transmission Line Designs (1 meter or 3.28 feet above ground)

Route	Structure Type	System Condition	Current (Amps)	Distance to Proposed Centerline										
				-200'	-100'	-75'	-50'	-25'	0'	25'	50'	75'	100'	200'
B & C	Horizontal Post 115kV Single Circuit	Peak	230	0.67	2.24	3.50	6.07	12.11	26.16	26.25	12.18	6.10	3.51	0.86
		Average	138	0.42	1.41	2.20	3.82	7.63	16.49	16.54	7.68	3.84	2.21	0.54
A	Davit Arm 115kV/115kV Steel Pole Double Circuit	Peak	230	0.22	1.49	3.13	7.88	23.03	38.44	22.77	7.73	3.05	1.44	0.21
		Average	138	0.13	0.90	1.79	4.73	13.82	23.06	13.66	4.64	1.72	0.87	0.13
A & D (3000 kcmil)	Transmission Duct Bank 115kV/115kV Under ground Double Circuit	Peak	230	0.00	0.01	0.03	0.11	0.84	13.08	0.85	0.11	0.03	0.01	0.00
		Average	138	0.00	0.01	0.02	0.07	0.51	7.85	0.51	0.07	0.02	0.01	0.00
A & D (1250 kcmil)	Transmission Duct Bank 115kV/115kV Under ground Double Circuit	Peak	230	0.00	0.01	0.02	0.05	0.37	19.67	0.37	0.05	0.01	0.01	0.00
		Average	138	0.00	0.00	0.01	0.03	0.22	11.80	0.22	0.03	0.01	0.00	0.00

Considerable research has been conducted throughout the past three decades to determine whether exposure to power-frequency (60 hertz) MFs causes biological responses and health effects. Epidemiological and toxicological studies have shown no statistically significant association or weak associations between MF exposure and health risks. The possible impact of exposure to EMFs upon human health has also been investigated by public health professionals for the past several decades. While the general consensus is that EFs pose no risk to humans, the question of whether exposure to MFs can cause biological responses or health effects continues to be debated.

In 1999, the National Institute of Environmental Health Sciences ("NIEHS") issued its final report on "Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields" in response to the Energy Policy Act of 1992. NIEHS concluded that the scientific evidence linking MF exposure with health risks is weak and that this finding does not warrant aggressive regulatory concern. However, because of the weak scientific evidence that supports some association between MFs and health effects, passive regulatory action, such as providing public education on reducing exposures, is warranted.

In 2007, the World Health Organization ("WHO") concluded a review of the health implications of electromagnetic fields. In this report, WHO stated:

> Uncertainties in the hazard assessment [of epidemiological studies] include the role that control selection bias and exposure misclassification might have on the observed relationship between magnetic fields and childhood leukemia. In addition, virtually all of the laboratory evidence and the mechanistic evidence fail to support a relationship between low-level [extremely low frequency] magnetic fields and changes in biological function or disease status. Thus, on balance, the evidence is not strong enough to be considered causal, but sufficiently strong to remain a concern. (WHO, 2007 at p. 12).

Also, regarding disease outcomes, aside from childhood leukemia, WHO stated:

> A number of other diseases have been investigated for possible association with ELF magnetic field exposure. These include cancers in both children and adults, depression, suicide, reproductive dysfunction, developmental disorders, immunological modifications and

> neurological disease. The scientific evidence supporting a linkage between ELF magnetic fields and any of these diseases is much weaker than for childhood leukemia and in some cases (for example, for cardiovascular disease or breast cancer) the evidence is sufficient to give confidence that magnetic fields do not cause the disease. (*Id.* at p. 12.)

Furthermore, in its "Summary and Recommendations for Further Study" WHO emphasized that "the limit values in [ELF-MF] exposure guidelines [should not] be reduced to some arbitrary level in the name of precaution. Such practice undermines the scientific foundation on which the limits are based and is likely to be an expensive and not necessarily effective way of providing protection." *Id.* at p. 12.

Although WHO recognized epidemiological studies indicated an association on the range of three to four mG, WHO did not recommend these levels as an exposure limit but instead provided: "The best source of guidance for both exposure levels and the principles of scientific review are the international guidelines." *Id.* at pp. 12-13. The international guidelines referred to by WHO are the International Commission on Non-Ionizing Radiation Protection ("ICNIRP") and the Institute of Electrical and Electronic Engineers ("IEEE") exposure limit guidelines to protect against acute effects. *Id.* at p. 12. The ICNIRP – 1998 continuous general public exposure guideline is 833 mG and the IEEE continuous general public exposure guideline is 9,040 mG. In addition, WHO determined that "the evidence for a causal relationship [between ELF-MF and childhood leukemia] is limited, therefore exposure limits based on epidemiological evidence is not recommended, but some precautionary measures are warranted." *Id.* at 355-56.

WHO concluded that:

> given the weakness of the evidence for a link between exposure to ELF magnetic fields and childhood leukemia and the limited impact on public health, the benefits of exposure reduction on health are unclear and thus the costs of precautionary measures should be very low. . . . Provided that the health, social and economic benefits of electric power are not compromised, implementing very low-cost precautionary procedures to reduce exposure is reasonable and warranted. (*Id.* at p. 372).

Wisconsin, Minnesota and California have all conducted literature reviews or research to examine this issue. In 2002, Minnesota formed an Interagency Working Group ("Working Group") to evaluate the body of research and develop policy

recommendations to protect the public health from any potential problems resulting from HVTL MF effects. The Working Group consisted of staff from various state agencies and published its findings in a White Paper on Electric and Magnetic Field (EMF) Policy and Mitigation Options in September 2002, (Minnesota Department of Health, 2002). The report summarized the findings of the Working Group as follows:

> Research on the health effects of [MF] has been carried out since the 1970s. Epidemiological studies have mixed results – some have shown no statistically significant association between exposure to [MF] and health effects, some have shown a weak association. More recently, laboratory studies have failed to show such an association, or to establish a biological mechanism for how magnetic fields may cause cancer. A number of scientific panels convened by national and international health agencies and the United States Congress have reviewed the research carried out to date. Most researchers concluded that there is insufficient evidence to prove an association between [MF] and health effects; however, many of them also concluded that there is insufficient evidence to prove that [MF] exposure is safe. (*Id.* at p. 1.)

The Public Service Commission of Wisconsin ("PSC") has periodically reviewed the science on MFs since 1989 and held hearings to consider the topic of MF and human health effects. The most recent hearings on MF were held in July 1998. In January 2008, the PSC published a fact sheet regarding MFs. In this fact sheet the PSC noted that:

> Many scientists believe the potential for health risks for exposure to [MFs] is very small. This is supported, in part, by weak epidemiological evidence and the lack of a plausible biological mechanism that explains how exposure to [MFs] could cause disease. The [MFs] produced by electricity are weak and do not have enough energy to break chemical bonds or to cause mutations in DNA. Without a mechanism, scientists have no idea what kind of exposure, if any, might be harmful. In addition, whole animal studies investigating long-term exposure to power frequency [MF] have shown no connection between exposure and cancer of any kind. (PSC, 2008).

The Minnesota Public Utilities Commission, based on the Working Group and World Health Organization findings, has repeatedly found that "there is insufficient evidence to demonstrate a causal relationship between MF exposure and any adverse human health effects." *In the Matter of the Application of Xcel Energy for a Route Permit for the Lake Yankton to Marshall Transmission Line Project in Lyon County*, Docket No. E-002/TL-07-1407, Findings of Fact, Conclusions of Law and Order Issuing a Route Permit to Xcel Energy for the Lake Yankton to Marshall Transmission Project at pp. 7-8 (August 29, 2008); *see also, In the Matter of the Application for a HVTL Route Permit for the Tower Transmission Line Project*, Docket No. ET2, E015/TL-06-1624, Findings of Fact, Conclusions of Law and Order Issuing a Route Permit to Minnesota Power and Great River Energy for the Tower Transmission Line Project and Associated Facilities at p. 23 (August 1, 2007) ("Currently, there is insufficient evidence to demonstrate a causal relationship between EMF exposure and any adverse human health effects.").

The Commission again confirmed its conclusion regarding health effects and MFs in the Brookings County – Hampton 345 kV Route Permit proceeding ("Brookings Project"). In the Brookings Project Route Permit proceeding, Applicants Great River Energy and Xcel Energy and one of the intervening parties provided expert evidence on the potential impacts of electric and magnetic fields on human health. The ALJ in that proceeding evaluated written submissions and a day-and-a-half of testimony from these two expert witnesses. The ALJ concluded: "there is no demonstrated impact on human health and safety that is not adequately addressed by the existing State standards for [EF or MF] exposure." *In the Matter of the Route Permit Application by Great River Energy and Xcel Energy for a 345 kV Transmission Line from Brookings County, South Dakota to Hampton, Minnesota*, Docket No. ET-2/TL-08-1474, ALJ Findings of Fact, Conclusions and Recommendation at Finding 216 (April 22, 2010 and amended April 30, 2010).

The Commission adopted this finding on July 15, 2010. *In the Matter of the Route Permit Application by Great River Energy and Xcel Energy for a 345 kV Transmission Line from Brookings County, South Dakota to Hampton, Minnesota*, Docket No. ET-2/TL-08-1474, Order Granting Route Permit (September 14, 2010).

8.0 ENVIRONMENTAL ANALYSIS

8.1 ENVIRONMENTAL INFORMATION

This section provides a description of the environmental setting, potential impacts and mitigative measures the Company has proposed, where appropriate, to minimize the impacts of siting, constructing and operating the Project. If the 115 kV transmission lines were removed in the future, the land could be restored to its prior condition and/or put to a different use. The majority of the measures proposed are part of the standard construction practices at the Company. Unless otherwise identified in the following text, the costs of the mitigative measures proposed are considered nominal.

The environmental information provided herein contains a greater level of detail than is typically provided in Certificate of Need applications. Ordinarily, general environmental information is provided in the Certificate of Need proceeding and then greater detail is provided in the subsequent route permit when actual placement of the transmission line is determined.

In the case of the Hiawatha Project, the Route Permit proceeding preceded the Certificate of Need application and therefore route specific information already has been compiled. Accordingly, this section provides general information the Certificate of Need rules require as well as some additional detailed data. Further environmental information can be found in the FEIS prepared by the OES in the Route Permit proceeding.

8.2 GEOMORPHOLOGY AND PHYSIOGRAPHY

The Project would be located in the City of Minneapolis in Hennepin County. The area surrounding the Hiawatha Substation sites is mainly commercial and industrial on both the eastern and western sides of Hiawatha Avenue. The Metro Transit Hiawatha Light Rail Line and other major transportation corridors are located in close proximity to the proposed Hiawatha Substation. The nearest residential structures to the proposed Hiawatha Substation is Hiawatha Commons, a mixed-use residential and commercial building located at 2740 Minnehaha Avenue. The area surrounding the Midtown Substation site is light industrial, single and multi-unit residential, and commercial.

The area surrounding the transmission line alternatives varies in use from primarily residential to commercial, light and medium industrial, parks, and major transportation corridors. The Project Area is located within the Minnesota Department of Natural Resources ("MnDNR") Anoka Sand Plain Ecological

Subsection within the MnDNR's Ecological Classification section. The Anoka Sand Plain was formed from sand deposited by glacial meltwater. However, the land features in the Project Area have been largely shaped by human activity (MnDNR, 2009a). The Project Area is not located within a FEMA-designated floodplain.

The topography of the Project Area is relatively level land ranging in elevation between 850 to 870 feet above mean sea level. Bedrock is typically overlain by 50 to 150 feet of either terrace deposits associated with the Mississippi River or glacial outwash. Soils are typically well-drained sands and gravels and in areas may be overlain by artificial fill (Hennepin County Geologic Atlas, 1989).

Presettlement vegetation consisted primarily of prairie, savanna, oak and aspen woodlands (MnDNR, 2009a). The present-day use of the land varies from single and multi-unit residential to commercial and industrial.

8.3 HYDROLOGIC FEATURES

No water bodies are located within the Project Area. The water body nearest to the Project Area is Powderhorn Lake, located approximately 0.2 miles south of the 31st Street portion of Route C. There are no National Wetlands Inventory wetlands located within the Project Area. Direct impacts to the surface water resources are not anticipated as a result of the Project.

During construction there is the possibility of sediment reaching the Minneapolis storm water sewer system as construction activities disturb the ground. Once the Project is complete substations may contribute to stormwater runoff directed to the stormwater sewer system.

The Project Area is located within the Minnehaha Creek Watershed District ("MCWD").

Mitigative Measures

The Company will follow standard erosion control measures identified in the MPCA's Stormwater Best Management Practices Manual, such as using silt fencing to minimize impacts to water resources.

As the Project Area is greater than one acre it is subject to the requirements of the NPDES/State Disposal System ("SDS") Construction Stormwater General Permit ("General Permit"). The Company will obtain a General Permit from the MPCA and comply with all applicable requirements.

The Project Area will also disturb greater than 5,000 square feet of top soil and is, therefore, subject to the City of Minneapolis Erosion and Sediment Control for Land Disturbance Activities Ordinance and the MCWD Rule B. The Company will obtain an Erosion and Sediment Control Permit from the City of Minneapolis and prepare an Erosion and Sediment Control Plan for review by the City of Minneapolis. The Company will also obtain an Erosion Control Permit from the MCWD and comply with all applicable requirements.

8.4 VEGETATION AND WILDLIFE

8.4.1 VEGETATION

Because the majority of the routes are located within public rights-of-way, impacts to vegetation will be minor. Impacts to trees will likely occur based upon the transmission alternative that is selected. For the overhead route alternatives, trees may need to be removed depending upon the placement of the transmission structures. Most trees beneath the transmission line currently have been trimmed down because of existing overhead distribution lines, with the exception of Route C, which would require the removal of three mature American elm trees. Additional trimming may be required to ensure that tree growth does not interfere with the transmission lines. A small number of trees may be removed along the transmission lines where it seems likely that the tree, due to age or health, may fall on to the transmission facilities. For the underground route alternatives, trees within the construction trench right-of-way would be removed or significantly impacted prior to construction. Tree impacts for underground design were conservatively estimated to include potential impacts to trees near sidewalks, to account for all potential impacts.

While the Hiawatha West site is currently vacant land owned, for the most part, by Mn/DOT, in recent years, community groups have planted trees and shrubs on this site and have identified this site as potential greenspace along the Midtown Greenway bike/pedestrian path. Some of these trees and shrubs will need to be removed if the Hiawatha West site is selected.

Mitigative Measures

To minimize impacts to trees in the Project Area, the Company will only remove trees located in the right-of-way for the transmission line, or those that would impact the safe operation of the facility. Trees outside the right-of-way that would need to be removed include trees that are unstable and could potentially fall into the transmission facilities. The Company would work with affected landowners to replace removed trees with other, more suitable trees and shrubs, regardless of what route is selected.

8.4.2 WILDLIFE

Because the Project is located within a highly developed urban area, the fauna generally present within the Project Area are adapted to high levels of anthropogenic disturbance. Therefore, it is unlikely that the construction, operation, and maintenance of the Project would have an effect on fauna present in the Project Area. Wildlife that inhabit trees that may be removed for the Project will likely be temporarily displaced. Comparable habitat is adjacent to the routes, and it is likely that these organisms would only be displaced a short distance.

Raptors, waterfowl, and other bird species may be affected by the construction and placement of the transmission lines. Avian collisions are a possibility after the completion of the transmission line in areas where there are wetlands and open water. The nearest open water is Powderhorn Lake, approximately 0.2 miles south of the 31st Street portion of Route C.

Additionally, the electrocution of large birds, such as raptors, can be a concern with transmission lines. Electrocution occurs when birds with large wingspans come in contact with two conductors or a conductor and a grounding device. The Company transmission line design standards provide adequate spacing to eliminate the risk of raptor electrocution, so there are no concerns about avian electrocution as a result of the proposed Project.

Mitigative Measures

Displacement of fauna is anticipated to be minor and temporary in nature. No long-term population-level effects are anticipated; therefore, no mitigation is proposed.

8.4.3 THREATENED AND ENDANGERED SPECIES

The MnDNR Natural Heritage Database in the Project Area was consulted to identify any rare or unique resources identified within the Project Area. Nine known occurrences of rare species or special communities have been identified within one mile of Routes A – D (MnDNR Natural Heritage Database, 2009b).

No known occurrences of rare or unique resources were identified within the Project Area. With the exception of the Blanding's Turtle, all rare or unique resources are located along the Mississippi River located approximately one mile to the north and east of the Project Area. Due to the distance of these resources from the Project Area, the construction of the proposed Project would not impact these resources.

The Blanding's Turtle was last observed on May 14, 1986 approximately one-half block south of the Project Area in a city park. No subsequent sightings of this species have been recorded. Blanding's Turtles need both wetland and upland habitats to complete their life cycle (MnDNR, 2009k).

The 31st Street portion of Route C would travel closest to the recorded occurrence of the Blanding's Turtle (compared to Routes A – D). However, because the transmission line would be located on the north side of 31st Street, the construction activities would not occur within areas of potential Blanding's Turtle habitat. As such the construction activities are unlikely to have an impact on the Blanding's Turtle.

Mitigative Measures

No impacts are anticipated. Therefore, no mitigative measures are proposed.

8.5 Land Use and Human Settlement

8.5.1 Commercial, Industrial, Residential Land Use

Current Land Use

All routes would cross various differing land uses as identified by the City of Minneapolis Community Planning and Economic Development Department. The zones crossed by each route alternative are presented in Figure 42.

Figure 42: Land Use Designations

Route Alternative/Substation Site	Route Portion	Zoning Code	Zoning District
Route A (29th Street/HCRRA Overhead & Underground Route)	N/A	R4	Multiple-family (medium density)
		R5	Multiple-family (high density)
		I1	Light Industrial
		R6	Multiple-family (high density)
		OR3	Institutional Office Residence
		R2B	Two-family (low density)
		OR2	High Density Office Residence
		I2	Medium Industrial

Route Alternative/Substation Site	Route Portion	Zoning Code	Zoning District
		R1A	Single-family
		R3	Multiple-family (medium density, mixed unit types)
		C3A	Community Activity Center
Route B (26th Street/28th Street Overhead Route)	26th Street	I1	Light Industrial
		R2B	Two-family (low density)
		R4	Multiple-family (medium density)
		OR1	Neighborhood Office Residence
		OR3	Institutional Office Residence
		OR2	High Density Office Residence
		C1	Neighborhood Commercial
		C4	General Commercial
		I2	Medium Industrial
	28th Street	I1	Light Industrial
		R6	Multiple-family (high density)
		R5	Multiple-family (high density)
		R1A	Single-family
		OR3	Institutional Office Residence
		R2B	Two-family (low density)
		C1	Neighborhood Commercial
		I2	Medium Industrial
Route C (28th Street/31st Street Overhead Route)	28th Street	See Above	
	31st Street	C1	Neighborhood Commercial
		C3S	Community Shopping Center
		I1	Light Industrial

Route Alternative/Substation Site	Route Portion	Zoning Code	Zoning District
		R4	Multiple-family (medium density)
		R3	Multiple-family (medium density, mixed unit types)
		C2	Neighborhood Corridor Commercial
		OR1	Neighborhood Office Residence
		R2B	Two-family (low density)
		C1	Neighborhood Commercial
		R5	Multiple-family (high density)
		R6	Multiple-family (high density)
		OR2	High Density Office Residence
		C3A	Community Activity Center
Route D (28th Street Underground Route)	N/A	I1	Light Industrial
		R6	Multiple-family (high density)
		R5	Multiple-family (high density)
		R4	Multiple-family (medium density)
		OR3	Institutional Office Residence
		R2B	Two-family (low density)
		C1	Neighborhood Commercial
		I2	Medium Industrial
Hiawatha Substation, West, East, and Zimmer Davis	N/A	I1	Light Industrial
		R1A	Single-family
Midtown Substation, North	N/A	R5	Multiple-family (high density)
Midtown Substation, South	N/A	R4	Multi-family (medium density)

Source: Minneapolis Zoning Code Maps, Website Accessed September 2010

The Hiawatha Substation and the Midtown Substation sites were zoned as I1 by the City of Minneapolis when the Route Permit Application was filed in April 2009. In April 2010, the City of Minneapolis rezoned much of South Minneapolis.

Under the new zoning classifications the Hiawatha West, East and Zimmer Davis sites remained zoned as Light Industrial while the Midtown North site is now zoned R5 and Midtown South is zoned R4.

The area surrounding the Hiawatha Substation sites is currently comprised of light to medium industry and commercial shopping areas. The area surrounding the Midtown Substation sites is light industry and multiple-family residential, both high and low density. The Midtown North site is consistent with the prior use of, at least a portion of, this site as the former Oakland Substation.

Route A is not located within 200 feet of any places of worship or schools; Route B is located within 200 feet of two places of worship and one school; Route C would be located within 200 feet of eight places of worship and one school; and Route D is located within 200 feet of one place of worship. The construction and operation of the proposed transmission line would not impact these structures or their existing uses.

Mitigative Measures

The Hiawatha Substation sites are within areas zoned as light industrial. Architecturally-designed, decorative walls will be constructed around the Hiawatha Substation. The walls will be designed to complement the surrounding structures.

The Midtown Substation sites are within areas zoned multi-family and the proposed substation at the Midtown North site would be high-profile design, would be landscaped on the south, east, and west sides as practicable and walled on four sides by 20 foot walls. A portion of the Midtown North site is consistent with the prior use of this site as the former Oakland Substation. The Midtown South site would likely be a low-profile substation with an average height of approximately 45 feet. The Midtown South site would have approximately 10 feet of landscaping on the east and west sides and would be walled on four sides with an architecturally pleasing design and a graffiti-resistant surface. In addition, a substation at either these two sites is consistent with the industrial uses that are present along the Midtown Greenway.

Population Density

The area has a high population density. For instance, for Route A, there are approximately 8,000 people located within 500 feet of the route. Figure 43 below provides census information for all tracts located within 500 feet of the route alignments (United States Census Bureau, 2000).

Figure 43: Population of U.S. Census Tract within 500 feet of Transmission Line Routes

Xcel Energy - Hiawatha Project Population of U.S. Census Tract within 500 feet of Transmission Line Routes		
Transmission Line Route	**U.S. Census Tract ID**	**Number of Persons in Tract**
Route A	107500	2,019
	007302	2,332
	007900	1,604
	007802	2,050
	Total Census Pop.	**8,005**
Route B	107500	2,019
	007302	2,332
	007301	1,815
	107200	2,514
	107100	2,721
	007802	2,050
	007900	1,604
	Total Census Pop.	**13,036**
Route C	107500	2,019
	007302	2,332
	007900	1,604
	007802	2,050
	008400	2,760
	008500	4,501

Xcel Energy - Hiawatha Project Population of U.S. Census Tract within 500 feet of Transmission Line Routes		
Transmission Line Route	**U.S. Census Tract ID**	**Number of Persons in Tract**
	108600	3,087
	108700	3,550
	108800	3,813
	Total Census Pop.	**25,716**
Route D (Center of Street)	107400	1,1713
	107500	2,019
	007302	2,332
	007900	1,604
	007802	2,050
	Total Census Pop.	**19,718**
Route D (North Sidewalk)	107400	1,713
	107500	2,019
	007302	2,332
	007900	1,604
	007802	2,050

8.5.2 HUMAN SETTLEMENT

8.5.2.1 DISPLACEMENT

Adequate right-of-way must be acquired for safe operation of a transmission line. Displacement can be required when a residence or business is located within the required right-of-way. The amount of right-of-way required is dependent on NESC clearance requirements plus the area needed by the Company for access and maintenance of the line. NESC clearance requirements are dependent on the type of

structure, structure arm lengths, conductor blowout, and a specified NESC clearance requirement amount. Displacement is not anticipated as a result of construction of Routes A – D.

The construction of the substations could potentially require removal of existing structures and displacement. Hiawatha West will not require the removal and relocation of an existing business. The Hiawatha West site is currently open land that is owned by Mn/DOT. Mn/DOT indicated in its March 10, 2010 comment letter on the Draft EIS and in live testimony during the Route Permit proceeding that it considers this land to be surplus property and would be willing to sell this land for use as a substation site. The property contains a rail spur that is currently used by the Metropolitan Council for light rail deliveries. If the Hiawatha West site were selected, this rail spur would be relocated. The Hiawatha East site will require the removal of the warehouse complex owned by Crew2. The Hiawatha Zimmer Davis site will require removal of the central distribution hub for Primary Surgical, Inc. d/b/a Zimmer Davis, an orthopedic implant sales and distribution business.

If the Midtown North site is selected, a condemned triplex will need to be removed. The Midtown South site includes two properties owned and occupied by Brown Campbell Enterprises and would require removal of multiple building structures.

Mitigative Measures

Xcel Energy will work with the landowners subject to displacement and provide just compensation for the property and all required relocation benefits.

8.5.2.2 AESTHETICS

Overhead Transmission

The proposed structures for the 115 kV lines from the Midtown Substation to the Hiawatha Substation will be either single or double circuit construction, depending upon which route is chosen. The single circuit structures will be similar to the existing single circuit transmission lines located on the east side of Hiawatha Avenue. Both the double circuit and single circuit structures will be between 75 and 80 feet in height, although some will reach 100 to 115 feet in height where the line crosses transportation corridors. The poles will have an average span of approximately 500 feet between the structures, although spans can be made as short as 300 feet and as long as 1,000 feet to minimize direct aesthetic impacts (*i.e.*, avoid placement of poles directly in front of buildings). The Company will minimize direct impacts where practical.

The Midtown District is characterized by industrial and transportation associations, so overhead transmission structures would not be entirely out of character. Still, the transmission structures would introduce modern features to the Midtown Greenway of a taller size and larger scale than buildings and distribution lines in the area. The majority of the building structures in the Project Area range from one to three stories; however, taller commercial and residential buildings are present. The tallest building in the Project Area is the central tower of the Midtown Exchange building, which is 16 stories (approximately 210 feet) in height.

To mitigate the aesthetic impacts to historic resources, the Company can construct the proposed transmission lines on rust colored steel structures as opposed to galvanized steel pole structures. In addition, if Route A—Alignment A1 were selected, the Company would re-locate the distribution lines along 29th Street and place them underground.

Underground Transmission

The construction of the underground transmission line would cause temporary ground disturbance to the Project Area. This disturbance would be limited to the construction period. Once the transmission lines were in operation, the underground design would have less of an aesthetic impact on the Project Area than an overhead design. However, if the underground transmission lines and duct system would have to be relocated at a future date to accommodate new development, the resulting relocation would create additional aesthetic impacts to the Project Area and would be costly.

Substations

The Hiawatha Substation will be located in an area characterized by light industry, major transportation corridors such as Hiawatha Avenue and commercial retail development. The substation will be visible from these features.

If a substation at the Hiawatha West site is constructed as a high-profile design, Xcel Energy proposes to build the substation with 20-foot walls on all sides. Xcel Energy also studied a low-profile design for the Hiawatha West site which would be constructed with a 12-foot wall on all sides.

The Hiawatha East Substation would be a low-profile substation. The Hiawatha East Substation would be surrounded on three sides (north, west, and east) with a 12-foot prefabricated concrete, architecturally-designed wall with a graffiti resistant design appropriate to the area.

The Hiawatha Substation at the Zimmer Davis site would be a low-profile substation with an average height of approximately 20 feet. The substation would be surrounded on four sides with a 12-foot high architecturally-designed wall with a graffiti resistant design appropriate to the area and a 20-foot wide chain-link gate would allow for maintenance access on one side of the site.

Regardless of which of the Hiawatha Substation sites is selected, transmission equipment of an industrial character and approximate height of 40 feet would extend above the substation walls. The Hiawatha substation wall footprint and architectural treatment would be comparable to the light industrial and retail buildings in the area. The transmission equipment visible above the wall would have a more industrial character than the adjacent light industrial buildings.

The Midtown North site would be a high-profile substation with an average height of approximately 45 feet. The walls of the substation would be approximately 20-feet high. The Midtown North site would be landscaped on the south, east, and west sides as practical and walled on four sides with an architecturally pleasing design and will use graffiti-resistant surface. The majority of the property proposed for the preferred Midtown North site was historically a substation. Therefore, the Midtown North Substation will not significantly change the character of the site. However, the Midtown Substation will be larger than the former Oakland Substation and will be visible by nearby properties.

The Midtown South site would likely be a low-profile substation with an average height of approximately 45 feet. The Midtown South site would have approximately 10 feet of landscaping on the east and west sides and would be walled on four sides with an architecturally pleasing design and a graffiti-resistant surface.

Mitigative Measures

Although an overhead line would be a contrast to some current surrounding land uses, the Company has identified route alternatives that utilize existing corridors and to avoid direct impacts sensitive cultural and institutional resources to the greatest extent practicable. The Company has also offered to reduce aesthetic impacts to historic resources by using a weathering steel structures over galvanized steel.

To mitigate visual impacts of the proposed transmission lines, the Company would re-locate the existing distribution lines along the 29th Street/HCRRA corridor and place them underground if Route A—Alignment A1 is selected. If either Route B or Route C were selected, the Company would remove select distribution structures along the selected route and support the distribution lines on the proposed transmission structures.

To mitigate visual impacts of the Hiawatha and Midtown substations, the Company will construct decorative walls around the substations. The walls will be architecturally-designed to complement the character of the Project Area.

8.5.2.3 PUBLIC SERVICES

The City of Minneapolis provides typical public infrastructure (water, sewer, and storm water management) to the community. It is not anticipated that the Project will affect these public services.

Temporary road closings will be required during the construction phase of the Project. The duration and details of the road closings will be based upon the route selected and conditions encountered in the field. The Company will continue to work with the City of Minneapolis to minimize conflicts as plans become more defined.

The proposed routes run adjacent to or cross the HCRRA/Midtown Greenway. Hennepin County indicated that its near term plan (0-5 years) for the Midtown Greenway is to continue allowing the City of Minneapolis to operate a commuter bicycle and pedestrian trail and to preserve this area for future transit use (more than 5 years). At this time, Hennepin County has neither determined the form of this future transit (rapid bus, light rail, or street car transit) nor the specific time frame for transit implementation.

The Company has reviewed publicly available plans for the corridor and has determined that Xcel Energy will be able to construct the proposed transmission lines, overhead or underground, in such a manner that they do not interfere with future transit use within the Midtown Greenway. For instance, Route A—Alignment A1 and Route A—Alignment A2 are primarily located outside of the trench area, where Hennepin County is expected to construct any transit facilities. Route A—Alignment A3 is located along the bottom of the Midtown Greenway, generally north of the paved bike/pedestrian path. Given that all of the studies to date place future transit to the south of the bike/pedestrian path to maintain usability of the path, the Company believes it is highly unlikely that the underground proposed lines would interfere with future transit. Indeed, in the Route Permit proceeding, Hennepin County stated that Route D or Route A, underground design, are the most appropriate for the facilities.

There are a few cases where the proposed transmission structures may be adjacent to the future light rail electrical wires, this will not interfere with or prevent operation of the light rail cars. The current 115 kV line along Hiawatha Avenue parallels the light rail corridor and both facilities have been operating without known conflict.

While the Hiawatha West site is currently vacant land owned, for the most part, by Mn/DOT, in recent years, community groups have planted trees and shrubs on this site and have identified this site as potential greenspace along the Midtown Greenway bike/pedestrian path. Mn/DOT has indicated it considers this land to be surplus property and would be willing to sell this land for use as a substation site. Initially, Xcel Energy proposed to build a low-profile substation at the Hiawatha West site but in response to requests from community groups during the Route Permit proceeding for increased green space around the substation, the Company analyzed a high-profile design.

Mitigative Measures

It is not anticipated the Project will impact any public services. The Company will minimize road closings by closing as few lanes at a time as possible.

The Company has committed to work with Hennepin County to reduce the risk that overhead or underground transmission facilities will need to be relocated to accommodate new transit facilities. The more detailed information that can be provided by Hennepin County during the design phase of this Project about the expected method and location of future transit, the less likelihood there is for future conflict. Even if transit plans change in the future after the transmission facilities are constructed, the new transit facilities could be constructed around the existing transmission facilities; relocation of the transmission facilities is also an option.

8.5.3 RECREATION

Minneapolis Park and Recreation Board has 15 properties within 0.5 miles of the Project Area. Recreational opportunities within the Project Area include Stewart Park, 2529 13th Ave South Property, Cedar Avenue Field, and Powderhorn Park (Minneapolis Park and Recreation Board, 2009).

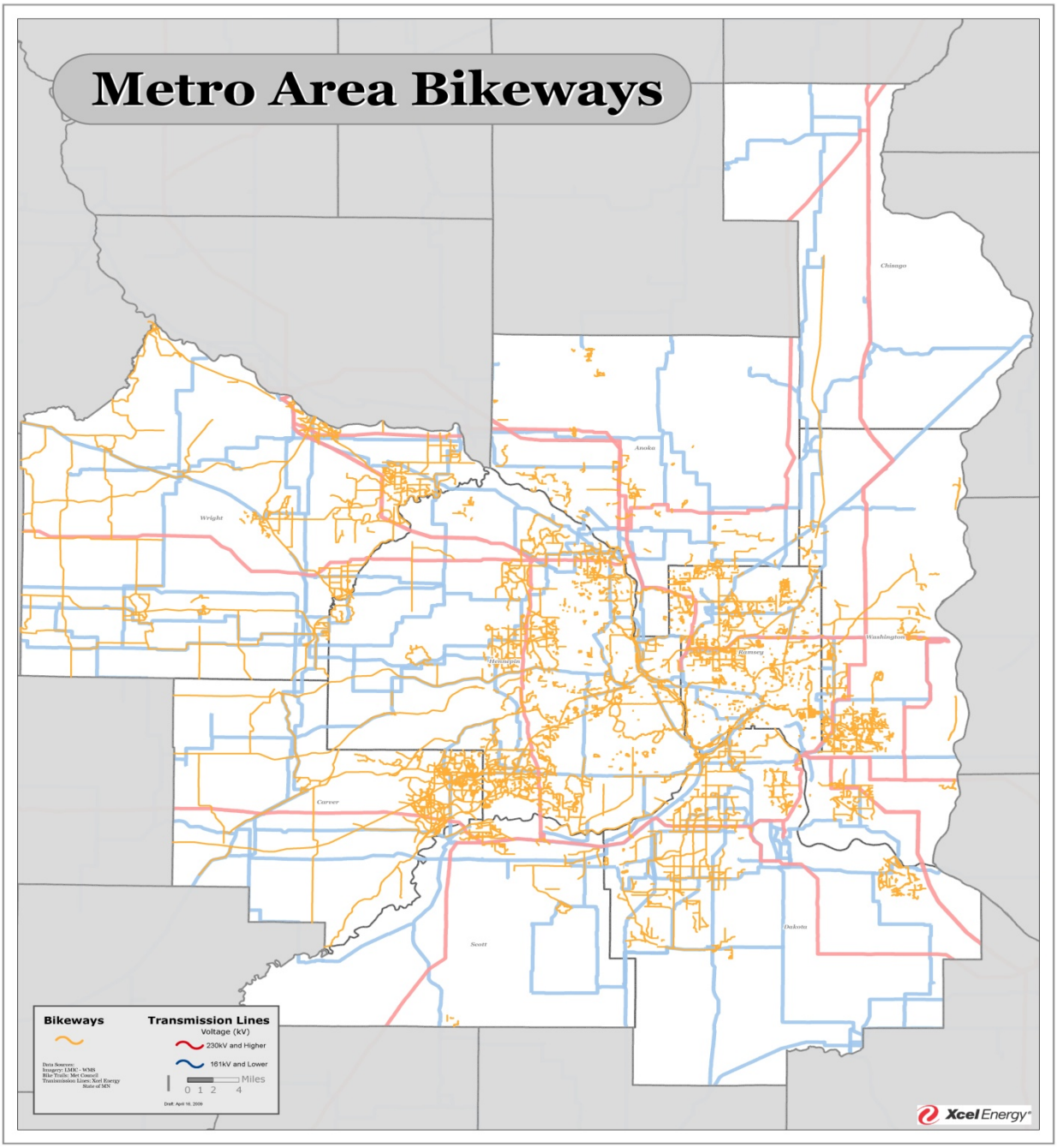
Amenities at Stewart Park include a playground, baseball and softball fields, wading pool, and recreation center. Cedar Avenue Field provides picnic and playground activities. The 2529 13th Ave South Property includes the White Neighborhood House, a playground and gardens. Powderhorn Park is the largest park in the neighborhood covering 65 acres of land and holds several events each year including the annual 4th of July Celebration, May Day Festival and the Powderhorn Arts Festival. Powderhorn Park also offers many amenities including a bandstand, several athletic fields and courts, fishing dock, garden, ice rink, picnic area, playground, wading pool, walking path, and recreation center.

The Midtown Greenway, located within HCRRA property, crosses through the Project Area. The Midtown Greenway is currently used as a 5.7-mile shared bicycle and pedestrian corridor that travels through the City of Minneapolis from the St. Louis Park city limits in the west to West River Parkway near the Mississippi River in the east. Average daily bicycle trips during 2007 and 2008 in the vicinity of the Project ranged from 143 to 3,129 (Midtown Greenway Count Report, July 2008).

Facilities constructed along Route A, whether overhead or underground design, would not be visible from or located adjacent to any parks. However, the majority of transmission lines would be located on or adjacent to HCRRA property and the Midtown Greenway. The proposed alignment for Route A—Alignments A1 and A2 is along the top slope of the HCRRA property. The majority of the Route A—Alignment A3 is located along the Midtown Greenway, at the bottom of the railroad bed.

If overhead construction were used, much of the line along Route A—Alignment A1 will be visible from the Midtown Greenway. Xcel Energy understands there are concerns in the community about aesthetic impacts on recreation, especially along the Midtown Greenway. While the Company understands the concern, bicycle paths adjacent to transmission facilities are not uncommon. Figure 44 shows an overview map of bicycle paths and transmission facilities in the seven county metropolitan area.

Figure 44: Bicycle Paths and Transmission Facilities in the 7-County Metropolitan Area



If underground construction were used along either Route A—Alignment A2 or A3, use of the Midtown Greenway would be impacted during construction activities. All construction closures and relocations would be temporary in nature and the Company would work with stakeholders to minimize impacts through trail relocations or other measures when feasible. For Route A—Alignment A3, such

disruptions or closures would be minimized by creating an alternate path for bicyclists or pedestrians using the Midtown Greenway during these times. This alternate path would most likely be on the southern portion of the Midtown Greenway. Post-construction, periodic closures or reroutes of pedestrian or bicycle traffic along the Midtown Greenway will be necessary for required maintenance and repairs

Portions of Route B are adjacent to Stewart Park and the 2529 13th Avenue Property. The facilities would likely be visible from Cedar Avenue Field. Transmission facilities constructed on portions of Route C would likely be visible from Powderhorn Park. The Hiawatha Project will not disturb areas within parks, interfere with existing uses, or otherwise directly impact these resources.

Mitigative Measures

The Company does not believe any impacts to recreation exist. Therefore, no mitigative measures are proposed.

8.5.4 AGRICULTURE, FORESTRY AND MINING

As the Project is located in a highly developed, urban area, there are no forestry or mining activities that occur within the Project Area. No commercial agriculture occurs within the Project Area. There are several community gardens within the Project Area. These community gardens include Prairie Oaks Community Garden at 2600 Oakland Avenue South, 12th and 13th Avenue Block Club Garden, Shalom Garden and Walker Church Community Garden 3104 16th Avenue South.

Route A is not located adjacent to any community gardens. Route B is located adjacent to the Prairie Oaks Community Garden. Route C is located adjacent to the Walker Church Community Garden, which incorporates youth programming, education, food production and individual garden plots. Route D is not located adjacent to any community gardens.

The Project will not disturb areas within community gardens or directly impact these resources.

Mitigative Measures

No impacts are anticipated and therefore no mitigative measures are proposed.

8.6 Archaeological and Historic Resources

8.6.1 Historic Resources

Prior to submitting the Route Permit Application, the Company completed a Cultural Resources Assessment for the Project to determine the potential for impacts to cultural resources within the various route alternatives. *See* Appendix E.1. The purpose of the Cultural Resources Assessment was to identify known cultural resource properties within the Project Area and the potential for previously unidentified cultural resource properties that may be significant to inform the route selection process.

Figure 45 presents the known cultural resource properties that may be aesthetically impacted by the various route and substation alternatives of the Project. This table includes properties listed or potentially eligible for the National Register of Historic Places ("NRHP") as well as properties listed on the Historic Preservation Commission's ("HPC's") 800 List.

Figure 45: Cultural Resources Potentially Impacted by Route and Substation Alternatives

Name	NRHP Listed	NRHP Eligible	HPC Designated	800 List
Route A—Alignment A1	8	4	3	3
Route A—Alignment A2	8	4	3	3
Route A—Alignment A3	8	4	3	3
Route B	9	5	3	11
Route C	7	5	1	9
Route D	0	0	0	0
Hiawatha Substation Sites	0	0	0	0
Midtown Substation Sites	3	1	0	0

Source: Cultural Resources Assessment, January 2009

In addition to the Cultural Resources Assessment, a "Cultural Resources Analysis of Effects for the Xcel Energy Hiawatha Project" ("Effects Study") was conducted by Xcel Energy during the Route Permit proceeding to assess the potential effects that construction of the Project along Route A may have on historic architectural resources and archaeological resources. A copy of the Effects Study is included in Appendix E.2.

For purposes of the Effects Study, historic properties were determined to be known properties listed on the NRHP, properties eligible for listing on the NRHP, properties locally designated by the Minneapolis Heritage Preservation Council or those identified on the City of Minneapolis's 800 List. A total of seven properties in the Area of Potential Effect met these criteria including: the South Side Destructor, the Sears, Roebuck Company building ("Sears Building"), the Zinsmaster Baking Company ("Zinsmaster") building, the Avalon Theater, the Minneapolis Pioneers and Soldiers Cemetery ("Layman's Cemetery"), a house at 2812-2814 11th Avenue South, and the CM&St.P Historic District.

Effects to historic properties can occur in a wide variety of forms, but are broadly placed in two categories: direct and indirect. For direct effects, think of something that would have a physical impact to a property, such as destruction, damage or alterations. Indirect effects may include such effects as changes to the property's setting, the introduction of visual, atmospheric or audible elements, changes in ownership or changes in access.

The most commonly used criteria for assessing effects to historic resources are those used for undertakings within Section 106 of the National Historic Preservation Act of 1966 (36 CFR Part 800). In those guidelines, an action may have an "adverse effect" when an undertaking may alter, directly or indirectly, the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the property's integrity.

With respect to visual effects, generally construction of a facility will not cause a visual adverse effect except where visual setting or visual elements are character-defining features of a historic property.

The Effects Study determined Route A—Alignment A1 would have adverse visual and aesthetic impacts on the CM&St.P Historic District. These adverse visual and aesthetic impacts are the result of size and scale of the transmission structures compared to existing and historical utility lines. These potential adverse visual effects could be mitigated by using different materials or finishes for the transmission

structures such as wood, laminate wood, or weathering steel materials. For Route A—Alignments A2 and A3, the Effects Study determined that these underground alignments have the potential to cause adverse effects from vibrations created during construction on the historic bridges of the CM&St.P Historic District, the Sears building, and the Zinsmaster building. The Company will take appropriate measures to monitor these vibrations so that impacts to historic resources are minimized.

Route A—Alignment A2 may also have a direct effect to historic retaining walls east of the 10th Avenue bridge, where the line transitions from 29th Street to the base of the trench, and to the retaining walls west of the 18th Avenue bridge, where the line transitions from the trench to the 29th Street grade. Xcel Energy has committed to avoiding destruction or removal of these historic retaining walls if Route A—Alignment A2 were selected.

The Cultural Resources Assessment concluded that Route B will likely result in an adverse effect on the American Swedish Institute as this route will likely result in the placement of a transmission structure on the northwest corner of the property and transmission lines along two sides of the property.

Hiawatha Substation Sites

The proposed and alternative Hiawatha substation sites are to be located in an area that has been significantly redeveloped in recent years. It does not appear to contain historic properties or to be proximate to historically significant properties.

Midtown Substation Sites

The Midtown North and Midtown South sites are adjacent to the CM&StP Railroad Grade Separation historic district on its north or south sides. As additional space will likely be needed to accommodate all of the required substation equipment at the Midtown North site, a retaining wall and possibly a transmission structure may need to be constructed within the CM&St.P Historic District. The design of this retaining wall has not yet been determined nor has the placement of the pole been determined. The construction of this retaining wall will change the embankment on the CM&St.P Historic District. However, unlike other projects that attempted to alter or demolish the historic retaining walls currently located within the CM&St.P Historic District, the construction of a retaining wall at the Midtown North site construction will not affect historic retaining walls.

8.6.2 ARCHAEOLOGICAL RESOURCES

Because the Project Area does not exhibit any topographically prominent features and is located at a considerable distance from any water sources or wetlands

and the proposed routes would be sited in areas documented as previously disturbed, it is considered to have low potential for containing precontact archaeological resources.

Significant, intact historical archeological resources, such as street car lines and sewers, are also unlikely within the Project Area. Given that the Project Area was primarily developed in the 1890s, it is unlikely that any archeologically significant sewer systems would have existed in the Project Area. With regard to streetcar tracks, the possibility of encountering intact streetcar tracks along Routes A – D is remote. This is because all of the streets along these routes have been resurfaced, upgraded and improved over the last century. Moreover, even if intact streetcar tracks were discovered, the archeological value of streetcar tracks in this area is very low because these particular streetcar lines have been well documented and are largely understood.

Mitigative Measures

If human remains should be inadvertently encountered during the excavation and construction, the Company will appropriately handle such a discovery in a manner compliant with Minnesota's Private Cemeteries Act. Minn. Stat. § 307.08. No impacts to street car lines and sewers are anticipated and therefore no mitigative measures are proposed.

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