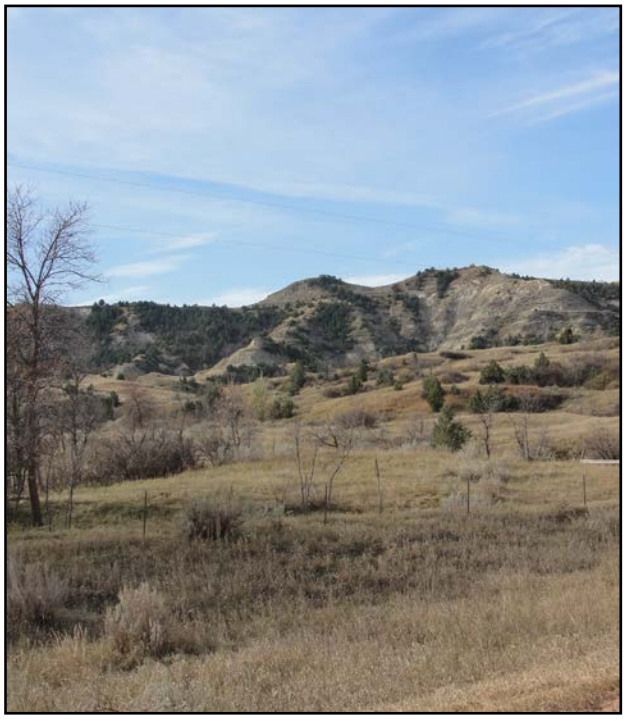
Application to the North Dakota Public Service Commission:

Consolidated Certificate of Corridor Compatibility & Route Permit

Volume I



Basin Electric Power Cooperative

North Killdeer Loop Phase I
345-kV Transmission Project

November 2014

Application to the North Dakota Public Service Commission:

Consolidated Certificate of Corridor Compatibility & Route Permit

for the

North Killdeer Loop Phase 1 345-kV Transmission Project

Basin Electric Power Cooperative

November 2014

prepared by

Burns & McDonnell Engineering Company, Inc.
Kansas City, Missouri

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APPLICATION FOR Consolidated Certificate of Corridor Compatibility & Route Permit

Section A: Description

A.1 Type

Basin Electric Power Cooperative (Basin Electric) proposes to construct, operate, and maintain Phase I of the North Killdeer Loop Project (NKL Project), which is approximately 28 miles of new 345 kilovolt (kV) AC electrical transmission line, connecting the proposed Patent Gate 345-kV Substation and the proposed Kummer Ridge 345-kV Substation. Another substation, the Roundup Substation, is being proposed along the AVS to Neset 345-kV transmission line. Approximately 28 miles of new 345-kV transmission line and three new 345/115-kV substations (Roundup Substation, Kummer Ridge Substation, and Patent Gate Substation) would need to be constructed.

Starting from Basin Electric's proposed Patent Gate 345/115-kV Substation, which is adjacent to the AVS to Neset 345-kV Transmission Project (PU-11-696) 28 miles of new 345-kV transmission line would extend generally eastward to Basin Electric's proposed Kummer Ridge Substation located northeast of Watford City. The new 345-kV transmission line would include new construction in new right-of-way (ROW) except for approximately one mile of line extending east from the Patent Gate Substation, which would be double circuited within existing Basin Electric easement with the AVS to Neset Line, currently under construction. The Roundup 345/115-kV Substation is located near Killdeer, ND, and also interconnects with the AVS to Neset 345-kV Transmission Project (PU-11-696). Phase II of the NKL Project will interconnect the Kummer Ridge and Roundup Substations. A Siting application for Phase II of the NKL Project is anticipated to be submitted in 2015.

A.2 Product

A new 345-kV transmission line from the Alexander area to the 115-kV system in the Watford City area and two new 345/115-kV Substations that would connect into the AVS to Neset transmission line (Case No. PU-11-696) and would increase the load-serving capacity to accommodate the projected load growth and maintain acceptable reliability of the regional transmission system.

A.3 Size and Design

The Project consists of 28.1 miles of new 345-kV electric transmission line connecting the proposed Patent Gate 345/115-kV Substation to the proposed Kummer Ridge 345-kV Substation (Figure 1.2-1). The line would be single-circuit for approximately 27 miles and double circuit for approximately 1 mile of new line. New ROW would be required with the exception of where approximately one mile of line would be double-circuited within existing Basin Electric easement with the existing AVS to Neset line, extending east from Patent Gate Substation.

The proposed 345-kV transmission lines would be constructed using either single-pole or H-frame self-supporting structures. All segments would be constructed within a 150-foot-wide ROW. The Project would require construction of three new substations (Roundup, Kummer Ridge, and Patent Gate).

A.4 Location

Refer to Section 4.1, General Corridor/Route Description, in the Application for Consolidated Certificate of Corridor Compatibility and Route Permit.

A.5 Geographical Service Area

The Study Corridor for the transmission Project encompasses parts of McKenzie County in North Dakota. The proposed substations are located in Dunn and McKenzie Counties in North Dakota. The general area to be served by this Project is west-central North Dakota.

A.6 Time Schedule

The Project would be expected to start construction in 2nd quarter 2015. Construction is scheduled to take 18 months, with commercial operation planned for December 2016. Permitting efforts, including the corridor and route selection processes, are underway. The Project requires various state, federal, and local permits prior to initiating construction. An overview of the Project schedule is provided in Table A.

Table A: Project Schedule

Activity	Timeframe
Submittal of Application for Certificate of Corridor Compatibility and Route Permit	October 2014
Certificate of Corridor Compatibility and Route Permit	Anticipated 2015
Right-of-way acquisition complete	April 2015
Construction start	April 2015
Construction complete	October 2016
Test operations	November 2016
In-service date	December 2016

A.7 Future Plans

Basin Electric has proposed Phase II of the NKL Project, which will connect the Roundup Substation to the Kummer Ridge Substation by a 345-kV transmission line approximately 32 miles in length. This additional transmission segment (Phase II) would provide the redundancy and reliability for the electrical transmission system servicing the region. Because additional time was required to define the final Corridor/Route in the Phase II segment of the NKL Project, this segment was removed from this application. An application for Phase II is anticipated to be submitted in 2015. However, should future load growth in the area dictate the construction of additional facilities, Basin Electric would report the identified facilities in its Ten-Year Plan.

Section B: Need for Facility.

B.1 Analysis of Need

Refer to Section 2.1 of this Application for Consolidated Certificate of Corridor Compatibility and Route Permit for the NKL Project Phase I 345-kV Transmission Project.

B.2 Alternative Methods

Refer to Section 2.2 of this Application for Consolidated Certificate of Corridor Compatibility and Route Permit for the NKL Project Phase I 345 kV-kV Transmission Project.

B.3 Deviation from Ten-Year Plan

The description of the proposed Project corresponds with information provided in the most recent Ten-Year Plan, which was submitted to the North Dakota Public Service Commission by Basin Electric in June 2014. There are no deviations between the planned Project described in the Ten-Year Plan and the proposed Project described in this Application.

Section C: Cost

Construction costs for the NKL Project Phase I 345-kV Transmission Project are estimated at $135 million dollars.

Section D: Waiver Request

D.1 Provisions Requested to be Waived and Minimal Adverse Effect

(a) Pursuant to North Dakota Century Code (NDCC) Section 49-22-07.2, Basin Electric requests permission to submit a consolidated Application for a Certificate of Corridor Compatibility and Application for a Route Permit and, therefore, requests that the Public Service Commission waive the provisions of Section 49-22-08 NDCC, Section 49-22-08.1 NDCC, Chapter 69-06004 North Dakota Administrative Code (NDAC), and Chapter 69-06-05 NDAC, which require separate filings of said applications.

Basin Electric would comply with all the requirements in the laws and regulations relating to the content of Applications for a Certificate of Corridor Compatibility and Route Permit. However, due to the urgent need for the proposed facilities, Basin Electric believes the reduction of time achieved by the processing of a consolidated application is warranted.

(b) Pursuant to Section 49-22-07.2 NDCC, Basin Electric also requests that the Public Service Commission holds a combined hearing on the Certificate of Corridor Compatibility and Route Permit and waives those provisions of Section 49-22-13 NDCC and Section 69-06-01-02 NDAC, which may require separate hearings.

The reason for this request is also to reduce the time needed to obtain the Certificate of Corridor Compatibility and Route Permit.

(c) Basin Electric's methodology for identification of the preferred corridor and route, as explained in Section 2.2 of the Application for a Consolidated Certificate of Corridor Compatibility and Route Permit, was developed through the careful examination of relevant corridor and route criteria to minimize adverse impacts.

As discussed in Section 5.14 (Summary of Route Impacts) of the Application for a Consolidated Certificate of Corridor Compatibility and Route Permit, Basin Electric

identifies possible impacts and describes mitigation measures that would be taken to minimize adverse impacts.

D.2 Emergency Situation

Basin Electric is not, at this time, requesting immediate authority to construct the proposed facility. However, the continued expansion of the oil and gas development activity in northwestern North Dakota is causing accelerated growth in the demand for electric power delivery to the region. As identified in Section 2.2 of the Application for a Consolidated Certificate of Corridor Compatibility and Route Permit, the proposed NKL Project Phase I 345-kV Transmission Project is necessary to meet the local projected loads, enhance transmission system reliability, and serve regional needs. Without the Project, the existing regional transmission systems will be subject to overload, resulting in non-compliance with North American Electric Reliability Corporation (NERC) requirements.

Application to the North Dakota Public Service Commission:

Waiver of Procedures &Time Schedules and a Consolidated Certificate of Corridor Compatibility & Route Permit

prepared for

Basin Electric Power Cooperative
North Killdeer Loop Phase I
345-kV Transmission Project

November 2014

prepared by

Burns & McDonnell Engineering Company, Inc.
Kansas City, Missouri

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Detailed Project Route Maps: Selection Criteria Volume II

LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
Act	North Dakota Energy Conversion and Transmission Facility Siting Act
AES	Alternatives Evaluation Study
APE	Area of potential effects
AVS	Antelope Valley Station
BA	Biological Assessment
BART	Best Available Retrofit Technology
Basin Electric	Basin Electric Power Cooperative
BGEPA	Bald and Golden Eagle Protection Act
BMcD	Burns & McDonnell
BMPs	Best Management Practices
BN	Burlington Northern
CAA	Clean Air Act
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
Commission	North Dakota Public Service Commission
CUP	Conditional Use Permit
CRP	Conservation Reserve Program
CWA	Clean Water Act
dB	Decibels
dBA	A-weighted decibels

Abbreviation	Term/Phrase/Name
DEIS	Draft Environmental Impact Statement
EIA	Energy Information Administration
EIS	Environmental Impact Study
EMF	Electric and Magnetic Field
EO	Executive Order
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
ERO	Electric Reliability Organization
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
HUD	Department of Housing and Urban Development
Hz	Hertz
IAP	Instrument Approach Procedures
IPCC	Intergovernmental Panel on Climate Change
IS	Integrated System
kV	kilovolt
kV/m	Kilovolts per meter
LCS	Lonesome Creek Station
LMNG	Little Missouri National Grassland
L_x	Exceedance sound level

Abbreviation	Term/Phrase/Name
MAC	Metcalf Archaeological Consultants, Inc.
MBTA	Migratory Bird Treaty Act
MCS	Macro-Corridor Study
mG	milligauss
MIS	Management Indicator Species
MRO	Midwest Reliability Organization
MVMT	Million Vehicle Miles Traveled
MW	Megawatts
MWEC	Mountrail-Williams Electric Cooperative
N_2O	Nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NERC	North American Electric Reliability Corporation
NESC	National Electrical Safety Code
NDAC	North Dakota Administrative Code
NDCC	North Dakota Century Code
NDCRS	North Dakota Cultural Resource Survey
NDDOH	North Dakota Department of Health
NDDOT	North Dakota Department of Transportation
NDPA	North Dakota Pipeline Authority
NDSWC	North Dakota State Water Commission
NESHAP	National Emission Standards for Hazardous Air Pollutants

Abbreviation	Term/Phrase/Name
NHI	Natural Heritage Inventory
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NKL	North Killdeer Loop
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSPS	New Source Performance Standards
NWI	National Wetland Inventory
O_3	Ozone
OAQPS	Office of Air Quality Planning and Standards
OHGW	Overhead Groundwire
OPGW	Optical Groundwire
Pb	Lead
PGS	Pioneer Generating Station
PLOTS	Private Land Open to Sportsmen
PM	Particulate matter
PM_{10}	Particulate matter with aerodynamic diameter less than or equal to 10 microns

Abbreviation	Term/Phrase/Name
$PM_{2.5}$	Particulate matter with aerodynamic diameter less than or equal to 2.5 microns
PSD	Prevention of Significant Deterioration
PUD	Planned Unit Development
RC	Reliability Coordinators
ROW	Right-of-way
ROD	Record of Decision
RSF	Resource Selection Function
RUS	Rural Utilities Service
SHPO	State Historic Preservation Officer
SHSND	State Historical Society of North Dakota
SIL	Scenic Integrity Level
SIO	Scenic Integrity Objective
SO_2	Sulfur dioxide
SUP	Special Use Permit
SWG	State Wildlife Grants
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load
TRNP	Theodore Roosevelt National Park
TVI	Television Interference
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service

Abbreviation	Term/Phrase/Name
USFWS	U.S. Fish & Wildlife Service
VMT	Vehicle Miles Traveled
Western	Western Area Power Administration
WMA	Wildlife Management Area
WRP	Wetlands Reserve Program
WTP	Water Treatment Plant

1.0 INTRODUCTION

Basin Electric Power Cooperative (Basin Electric) submits this application for a Consolidated Certificate of Corridor Compatibility and Route Permit for Phase I (Figure 1.0-1) of Phase I of the North Killdeer Loop (NKL) 345 kilovolt (kV) Transmission Project (Project).

Basin Electric is a regional wholesale electric generation and transmission cooperative owned and controlled by the 137 member cooperatives it serves. It was created in May 1961 as a result of regional efforts by electric distribution cooperatives. Basin Electric serves approximately 2.8 million customers in 540,000 square miles covering portions of nine states: Colorado, Iowa, Minnesota, Montana, Nebraska, New Mexico, North Dakota, South Dakota, and Wyoming.

Portions of Basin Electric's system operate within the Integrated System (IS) that consists of Western, Basin Electric, and Heartland Consumers Power District. The IS oversees the high-voltage transmission system grid in eastern Montana, North Dakota, and South Dakota.

The IS transmission facilities consist of approximately 9,200 miles of interconnected high-voltage transmission lines, of which approximately 1,340 miles are owned by Basin Electric. The IS transmission system provides for delivery of power from federal hydroelectric facilities and thermal generation plants owned by Basin Electric and Heartland Consumers Power District. The IS provides open-access transmission service to customers in the region.

The Basin Electric service area in northwestern North Dakota is experiencing a rapid increase in development as a result of the activities associated with oil and gas extraction from the Bakken shale formation, currently concentrated in McKenzie, Mountrail and Williams counties. The level of development that has occurred and is planned for the future will require numerous infrastructure upgrades throughout the region, including an increase in electrical transmission capacity and reliability. Studies of power supply for the region and the upper Midwest (IS, 2011) indicate that a new 345-kV transmission line and associated substation additions and upgrades are needed to increase capacity to distribute electricity to serve the long-term needs of northwestern North Dakota. In addition, the Project is expected to help maintain the reliability of the delivery system.

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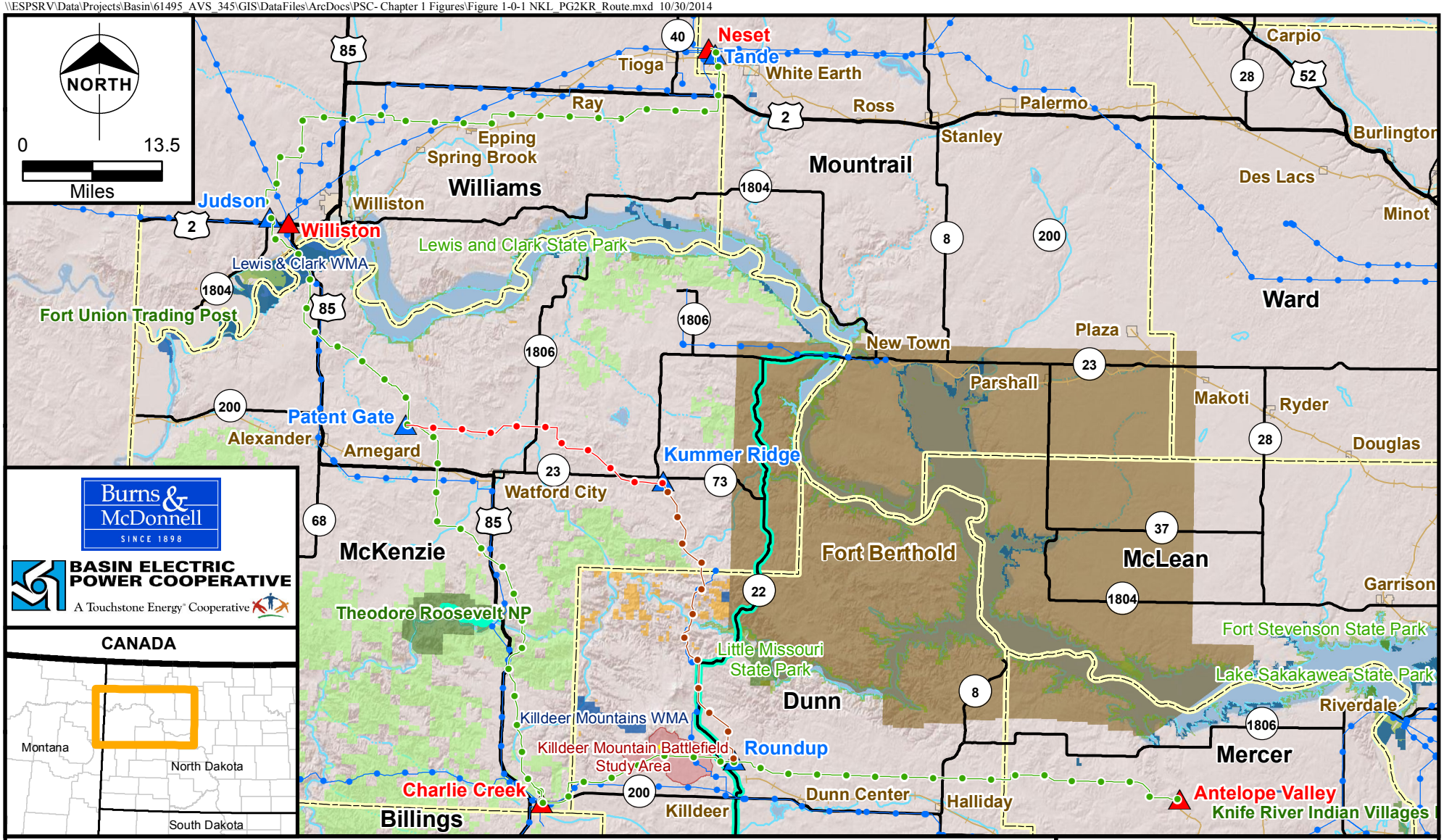

Figure 1.0-1
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
NW North Dakota 345-kV
System Improvements

Source: North Dakota GIS; Esri; Basin Electric; Burns & McDonnell.

Revised October 30, 2014

On April 23, 2014, the North Dakota Public Service Commission (Commission) adopted the Finding of Fact and Conclusions of Law and Order for Basin Electric's March 2013 Application (PU-11-696) granting a waiver of procedures and time schedules in issuing Corridor Certificate No. 152 and Route Permit No. 164 to Basin Electric.[1] This Corridor Certificate and Route Permit authorize:

- Construction by Basin Electric of approximately 197 miles of 345-kV and 230-kV electric transmission line and associated facilities extending from the Antelope Valley Station (AVS) near Beulah, North Dakota, to the Neset Substation near Tioga, North Dakota;
- Upgrades at the AVS and Charlie Creek Substations; and
- Construction of two new substations, Judson Substation near Williston, North Dakota, and Tande Substation near Tioga.

These AVS to Neset facilities address the most critical system improvements identified as part of the IS 2011 study. Additional facilities were also identified as part of this study, following Basin Electric's March 2013 Application. These additional facilities were identified to the Commission in the Amendment to the March 2013 Application, filed by Basin Electric in July 2014, and include:

- NKL 345-kV transmission line; and
- New 345/115-kV load-serving substations: Roundup Substation near Killdeer, North Dakota; Kummer Ridge Substation north of Killdeer and east of Watford City, North Dakota; and Patent Gate Substation east of Alexander, North Dakota.

A portion of these additional NKL facilities (Phase I) are the subject of this Application. Both these additional facilities, other future facilities, and the facilities previously approved by the Commission as part of Corridor Certificate No. 152 and Route Permit No. 164 were the subject of a Rural Utilities Service (RUS) Environmental Impact Study (EIS) and were approved in the RUS Record of Decision (ROD) issued September 13, 2014, and as part of Appendix A.

For this Application, Basin Electric proposes to construct, operate, and maintain approximately 28 miles of new 345-kV transmission line and three new 345/115-kV load-serving substations in North Dakota (Roundup Substation, Kummer Ridge Substation, and Patent Gate Substation). Starting from Basin Electric's proposed Patent Gate Substation northeast of Alexander, the new 345-kV transmission line would extend eastward and terminate at Basin Electric's proposed Kummer Ridge Substation site located

[1] Subsequent to the issuance of Corridor Certificate No. 152 and Route Permit No. 164, Basin Electric filed an Amendment to its Application in Case No. PU-11-696 identifying four minor route alignment revisions. This Amendment was filed in July 2014 and, at the time of preparation of this document, was still under consideration by the Commission.

east of Watford City, North Dakota. The Roundup Substation would also be part of the Project and would be located north of the City of Killdeer. The new 345-kV transmission line would include new construction in new right-of-way (ROW) with the exception that approximately one mile of line would be constructed double circuit within existing Basin Electric easement east from the Patent Gate Substation. The overall Project area encompasses parts of Dunn and McKenzie Counties in North Dakota. An approximately six mile wide Study Corridor was identified between the Patent Gate and Kummer Ridge Substation sites. This Study Corridor was used to assess constraints between the proposed substations and to identify potential Corridor/Route alternatives.

1.1 Compliance with the Energy Conversion and Transmission Facility Siting Act

The North Dakota Energy Conversion and Transmission Facility Siting Act (Act) requires an application for a Certificate of Corridor Compatibility and a Route Permit to meet the criteria set forth in the North Dakota Century Code (NDCC Chapter 49-22). Within this application, Basin Electric presents the information required by the Act. In addition, Basin Electric discusses in this application its consideration of the exclusion areas, the avoidance areas, the selection criteria, and the policy criteria set forth in North Dakota Administrative Code (NDAC) Section 69-06-08-02.

1.1.1 Rural Utilities Service and Western Area Power Administration and U.S. Forest Service Planning Documents

The RUS electric program provides capital loans to electric cooperatives for the upgrade, expansion, maintenance, and replacement of the electric infrastructure in rural areas. Basin Electric is requesting financing assistance from RUS for this proposed 345-kV transmission Project in Dunn and McKenzie Counties. Prior to providing financing assistance, RUS must comply with the National Environmental Policy Act (NEPA) and has prepared an EIS[2].

The Western Area Power Administration's (Western) role as the administrator of the Western/Basin Electric/Heartland Consumers Power District IS requires that Western coordinate with the IS partners to operate and maintain a reliable transmission system that serves the needs of its network customers, including unplanned network load growth. Transmission system planning studies identified the need for additional 345-kV transmission line and substation facilities. Western participated in the RUS NEPA process for this Project as part of its administrative role in the IS system.

[2] The EIS was prepared with Western and U.S. Forest Service participating as cooperating agencies. The EIS addressed both the AVS to Neset facilities and the North Killdeer Loop facilities.

As part of the NEPA process, a Macro-Corridor and Alternatives Report was prepared to define the proposed Project and conduct scoping for the proposed Project. This report, reviewed by RUS, contained an Alternatives Evaluation Study (AES) and a Macro-Corridor Study (MCS). The AES was used to determine which system alternative(s) would be appropriate for serving the purpose and need for the proposed Project. The Macro-Corridor Study defined the proposed Project study area, identified Project-related opportunities and constraints within the study area, and developed macro-corridors suitable for the routing of a transmission line within the study area.

Following public and agency review of the Macro-Corridor and Alternatives Report, RUS held public and agency scoping meetings to gain input on opportunities and constraints within the Project study area, and particularly within the identified macro-corridors. Public scoping meetings were held at two Project area locations to provide the public with information regarding the proposed Project and to identify concerns regarding potential impacts from the proposed Project. An agency scoping meeting was held in Bismarck to provide federal, state, and local agencies with information about the proposed Project and to identify compliance, permitting, and other issues related to the proposed Project.

Public and agency scoping meetings provided the attendees the opportunity to ask questions about the Project, learn about the federal review process, and provide feedback on the resources potentially affected by the proposed Project. Maps of the Project area and macro-corridor alternatives were also available for agency and public review and comment. Preliminary potential route alignments were presented on maps to provide agencies and the public with an idea of the possible locations of Project alignment alternatives within the macro-corridors.

A Scoping Report for the proposed Project was developed. This report summarized the scoping process and agency consultations regarding the macro-corridors for the Project. Based upon the scoping process, the Scoping Report identified relevant issues to be evaluated in the EIS.

RUS issued a Draft Environmental Impact Statement (DEIS) in December 2012 and a SDEIS in December 2103 for the Project (Appendix B). As noted earlier, Western requested to serve as a cooperating agency for the NEPA environmental review of the proposed Project. Although the NKL Phase I Project does not cross U.S. Forest Service (USFS) lands, USFS lands are located with the macro-corridor for this line. USFS was a cooperating agency on the RUS EIS because other facilities considered in the EIS (AVS to Neset 345-kV line) would cross USFS lands. The USFS Supervisor of the Dakota Prairie Grasslands will issue a Special Use Permit with terms and conditions to determine if facilities addressed in the overall EIS process are compatible with current USFS land management plans for the

Little Missouri National Grasslands. The DEIS and SDEIS evaluated 1,000-foot corridor routes and addressed the impacts associated with 150-foot-wide Project alignment and ROW within the 1,000-foot corridor related to construction, operation, and maintenance of the proposed Project. The DEIS also included a detailed evaluation and comparison of route alternatives and a no action alternative. The Final EIS was issued in May 2014. The USFS and RUS issued their individual RODs in September 2014. Western's ROD is expected n the fourth quarter of 2014.

1.1.2 Certificate of Corridor Compatibility

Certificate of Corridor Compatibility Table 1.1-1 outlines the information required to fulfill the requirements to obtain a Certificate of Corridor Compatibility from the Commission, using the Commission's Guidelines and identifying where these requirements are addressed in this application.

Table 1.1-1: Certificate of Corridor Compatibility Completion Checklist

State Authority	Description From the Guidelines	Application Section
Chapter 49-22	Commission Guidelines: Energy Conversion and Transmission Facility Siting	1.1
Section A	Description	1.2, 4.2
1.	Type: Describe the type of transmission facility addressed in this application. The description shall include the purpose of the facility and the technology to be employed.	1.0, 1.2, 2.1, 4.2.1
2.	Product: Describe the type, source, and final destination of the product to be transmitted by the proposed facility.	1.2.2
3.	Size and Design:	4.0
3.a.	Provide a description of the size and design of the Electrical facility including, but not limited to, the following:	4.2.1, 4.2.2, 4.2.3
3.a.1.	Width of ROW;	4.2.1
3.a.2.	Estimated span lengths;	4.2.1
3.a.3.	Anticipated type of structure;	4.2.1
3.a.4.	Approximate length of facility	1.0, 1.2, 4.1
3.a.5.	Voltage; and	4.2.1
3.a.6.	The requirement for a general location of any new associated facilities.	4.2.2
3.b.	Provide a description of the size and design of the pipeline facility including, but not limited to, the following:	N/A
4.	Time Schedule: Provide the anticipated time schedule for the accomplishment of the following events:	1.3
4.a.	Certificate of Corridor Compatibility;	1.3
4.b.	Route Application;	1.3

4.c.	Route Permit;	1.3
4.d.	Construction start date;	1.3
4.e.	Construction complete; and	1.3
4.f.	In-service date.	1.3
Section B	Studies	Appendices
--	Provide a copy of any evaluative studies or assessments of the environmental impact of the proposed facility submitted to any federal, regional, state or local agency.	Appendices
Section C	Need for Facility	2.0
1.	An analysis of the need for the proposed facility based on present and projected demand for the product to be transmitted by the facility, including the most recent system studies supporting the analysis of the need.	2.1
2.	A description of any feasible alternative methods of serving the need.	2.2
3.	A statement justifying any deviations from the most recent Ten-Year Plan which the proposed facility may present.	2.3
Section D	Location	Figures, 4.1
1.	Select a study area, which includes the proposed corridor, of sufficient width to enable the Commission to evaluate the factors addressed in Section 49-22-09, NDCC	1.2.1
2.	Identify and map the criteria that led to the proposed corridor location within the study area.	Figures, 1.2.1, 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6 Volume II
3.	Discuss the relative value of each criteria and how the proposed corridor location was selected giving consideration to all criteria.	1.2.1, 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6
4.	The criteria to be evaluated shall include at a minimum all of the following which are within the study area:	3.0
4.a.	Exclusion areas;	3.1
4.b.	Avoidance areas;	3.2
4.c.	Selection criteria;	3.3
4.d.	Policy criteria;	3.4
4.e.	Design and construction limitations; and	3.5
4.f.	Economic considerations.	3.6
5.	Discuss the general mitigative measures that would be taken to minimize adverse impacts which result from a route location in the proposed corridor.	5.1.3, 5.2.3, 5.3.3, 5.4.3, 5.5.3, 5.6.3, 5.7.3, 5.8.3, 5.9.3, 5.10.3, 5.11.3, 5.12.3, 5.13.3
6.	List the qualifications of the people in the various disciplines that contributed to the corridor location study	9.0

7.	Maps	Figures and Volume II
7.a.	Map the criteria within the study area showing the proposed corridor. Several different criteria may be shown on each map, depending on the map scale and the density and nature of the criteria. Minimum map scale shall be ½ inch = 1 mile. All maps shall be at the same scale unless otherwise specified.	Volume II
7.b.	Furnish one set of Mylar maps, separate from the application, of the same scale as the criteria maps and showing the same basic features as the criteria maps, including the study area, but not the proposed facility location.	Figures. GIS-based maps are included with this Application in lieu of Mylar maps.
Chapter 49-22-09	Factors to be considered in evaluating applications and designation of sites, corridors, and routes.	8.0
1.	Available research and investigations relating to the effects of the location, construction, and operation of the proposed facility on public health and welfare, natural resources, and the environment.	8.1
2.	The effects of new energy conversion and transmission technologies and systems designated to minimize adverse environmental effects.	8.2
3.	The potential for beneficial uses of waste energy from a proposed energy conversion facility.	8.3
4.	Adverse direct and indirect environmental effects which cannot be avoided should the proposed site or route be designated.	8.4
5.	Alternatives to the proposed site, corridor, or route which are developed during the hearing process and which minimize adverse effects.	8.5
6.	Irreversible and irretrievable commitments of natural resources should the proposed site, corridor, or route be designated.	8.6
7.	The direct and indirect economic impacts of the proposed facility.	8.7
8.	Existing plans of the state, local government, and private entities for other developments at or in the vicinity of the proposed site, corridor, or route.	8.8
9.	The effect of the proposed site or route on existing scenic areas, historic sites and structures, and paleontological or archaeological sites.	8.9
10.	The effect of the proposed site or route on areas which are unique because of biological wealth or because they are habitats for rare and endangered species.	8.10
11.	Problems raised by federal agencies, other state agencies, and local entities.	8.11

1.1.3 Route Permit

Table 1.1-2 outlines the information required to fulfill the requirements to obtain a Route Permit from the Commission using the Commission's Guidelines for Energy Conversion and Transmission Facility Siting (November 1979) and identifies where these requirements are addressed in this application.

Table 1.1-2: Route Permit Completion Checklist

State Authority	Description From the Guidelines	Application Section
Chapter 49-22	Commission Guidelines: Energy Conversion and Transmission Facility Siting	1.1
Section A	Description	1.2, 4.2
1.	Type: Describe the type of transmission facility proposed.	1.0, 1.2, 4.2
2.	Product: Describe the product or products to be transmitted.	1.2.2
3.	Size and Design: Provide a general description of the proposed size and design, and any alternate size or design, which was considered. Provide one (1) copy of the design data report, separate from the application, for the proposed facility and any associated facilities.	4.0, Appendix C
4.	Time Schedule: Provide the anticipated time schedule for the accomplishment of major events including, at a minimum, the following:	1.3
4.a.	Route Permit;	1.3
4.b.	ROW acquisition complete;	1.3
4.c.	Construction start date;	1.3
4.d.	Construction complete;	1.3
4.e.	Test operations; and	1.3
4.f.	In-service date.	1.3
Section B	Location	Figures, 4.0
1.	Discuss the utility's policies and commitments to limit the environmental impacts of its facilities, including copies of board resolutions and management directives.	3.4
2.	Discuss the factors listed in Section 49-22-09, NDCC to aid the Commission's evaluation of the proposed route.	8.0
2.a.	Available research and investigations relating to the effects of the location, construction, and operation of the proposed facility on public health and welfare, natural resources, and the environment.	8.1
2.b.	The effects of new energy conversion and transmission technologies and systems designated to minimize adverse environmental effects.	8.2
2.c.	The potential for beneficial uses of waste energy from a proposed energy conversion facility.	8.3

State Authority	Description From the Guidelines	Application Section
2.d.	Adverse direct and indirect environmental effects which cannot be avoided should the proposed site or route be designated.	8.4
2.e.	Alternatives to the proposed site, corridor, or route which are developed during the hearing process and which minimize adverse effects.	8.5
2.f.	Irreversible and irretrievable commitments of natural resources should the proposed site, corridor, or route be designated.	8.6
2.g.	The direct and indirect economic impacts of the proposed facility.	8.7
2.h.	Existing plans of the state, local government, and private entities for other developments at or in the vicinity of the proposed site, corridor, or route.	8.8
2.i.	The effect of the proposed site or route on existing scenic areas, historic sites and structures, and paleontological or archaeological sites.	8.9
2.j.	The effect of the proposed site or route on areas which are unique because of biological wealth or because they are habitats for rare and endangered species.	8.10
2.k.	Problems raised by federal agencies, other state agencies, and local entities.	8.11
3.	Identify and map the criteria that led to the proposed route location within the designated corridor.	Figures, 1.2.1, 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, Volume II
4.	Discuss in detail the relative value of each criteria and how the location, construction, and operation of the facility would affect each criteria.	1.2.1, 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6
5.	The criteria to be evaluated shall include at a minimum all of the following which are within the designated corridor:	3.0
5.a.	Exclusion areas;	3.1
5.b.	Avoidance areas;	3.2
5.c.	Selection criteria;	3.3
5.d.	Policy criteria;	3.4
5.e.	Design and construction limitations; and	3.5
5.f.	Economic considerations.	3.6
6.	Discuss the mitigative measures that would be taken to minimize adverse impacts which result from the location, construction, and operation of the facility.	5.1.3, 5.2.3, 5.3.3, 5.4.3, 5.5.3, 5.6.3, 5.7.3, 5.8.3, 5.9.3, 5.10.3, 5.11.3, 5.12.3, 5.13.3
7.	List the qualifications of the people in the various disciplines that contributed to the facility route location study	9.0
8.	Maps	Figures

State Authority	Description From the Guidelines	Application Section
8.a.	Map the criteria within the designated corridor showing the proposed route and location of any new associated facilities. Several different criteria may be shown on each map, depending on the map scale and the density and nature of the criteria. Minimum map scale shall be ½ inch = 1 mile. All maps shall be at the same scale unless otherwise specified.	Volume II
8.b.	Furnish one (1) set of Mylar maps, separate from the application, of the same scale as the criteria maps and showing the same basic features as the criteria maps, including the designated corridor, but not the proposed route or location of any new associated facilities.	Figures. GIS-based maps are included with this Application in lieu of Mylar maps
8.c.	Furnish one (1) set of uncontrolled 9x9 inch stereo-pair aerial photographs, separate from the application, with acceptable resolution showing the designated corridor, proposed route and location of any new associated facilities, and Section, Township and Range numbers, at a scale of 1 inch = 2,000 feet, together with a flight map at a scale of ½ inch = 1 mile showing each flight line and the beginning and ending photo number of each flight line. Photo mosaic strip maps would also be acceptable. If the applicant can demonstrate that because of the limited size and scope of the Project, aerial photographs would not be practical, this requirement may be waived.	Figures. GIS-based maps are included with this Application

1.2 Project Summary

The Project includes three 345/115-kV load-serving substations to tie the local 115-kV system to the new AVS to Neset 345-kV line. These substations include the Roundup Substation and the Patent Gate Substation located along the AVS to Neset line. An additional substation, Kummer Ridge, and approximately 28 miles of new 345-kV electric transmission line to connect the proposed Patent Gate 345-kV Substation to the proposed Kummer Ridge 345-kV Substation are also included (Figure 1.2-1). The 345-kV line would be single-circuit for approximately 27 miles on new ROW. Approximately 1 mile would be double circuit on existing AVS to Neset ROW. The proposed 345-kV transmission lines would be constructed using steel, single-pole or H-frame self-supporting structures. All 345-kV line would be constructed within a 150-foot wide ROW.

1.2.1 Study Area, Project Corridor, and Route Development Summary

During the initial route development process in the development of the DEIS, two potential Project alternatives were identified that could provide a transmission line from the AVS Substation to Judson Substation to Neset Substation, with Williston Substation and Charlie Creek Substation connections identified as necessary to solve the system concerns identified in the IS 2011 study.

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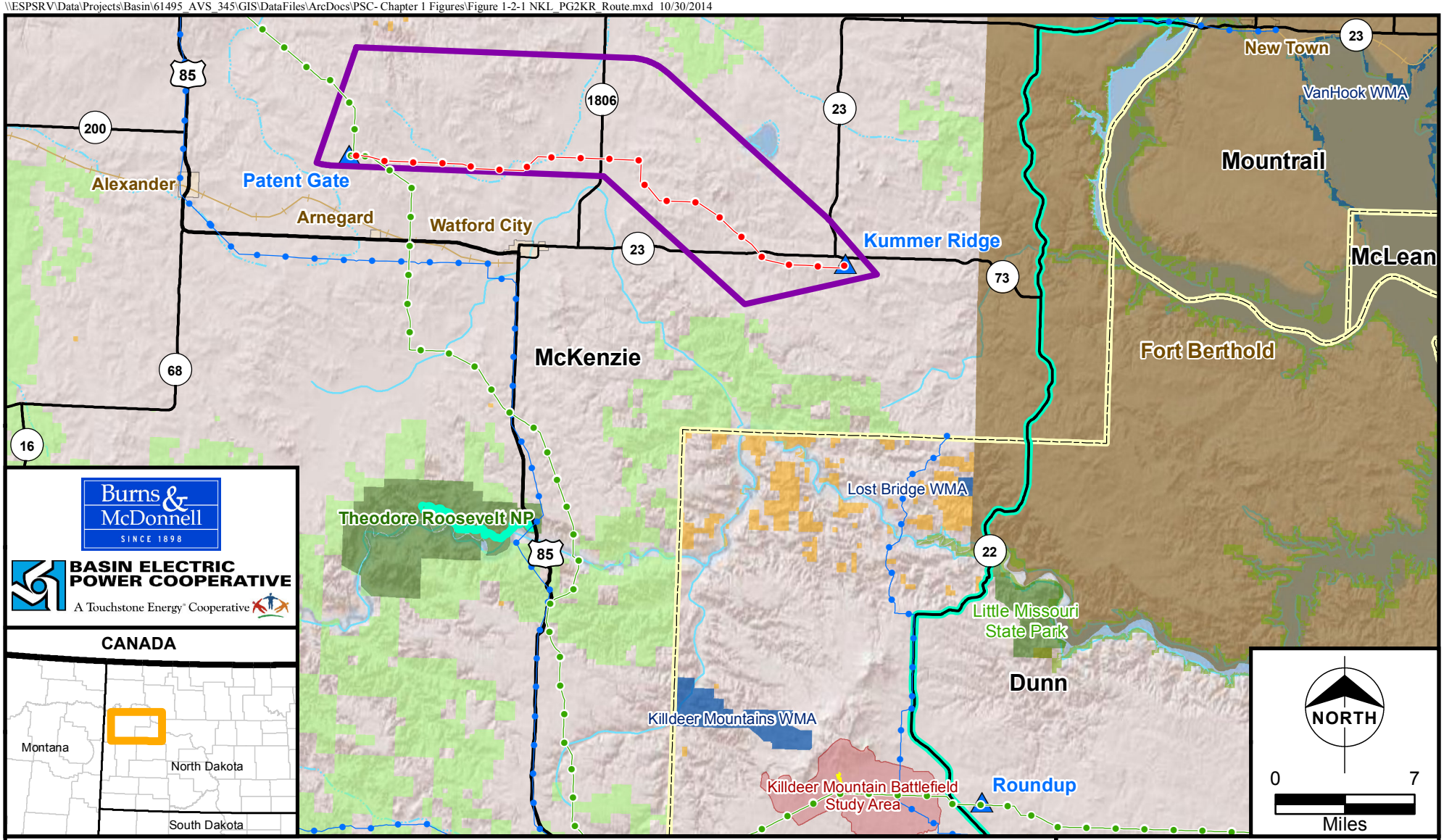

Figure 1.2-1
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Overall Proposed Study Corridor
and Proposed Corridor/Route

Source: North Dakota GIS; Esri; Basin Electric; Burns & McDonnell.

Revised October 30, 2014

One alternative involved a transmission line extending from the AVS Substation directly to the Charlie Creek Substation, then on to the proposed Judson Substation with an interconnection to the Williston Substation, and then on to the proposed Tande Substation with an interconnection to the Neset Substation. The other alternative involved a transmission line extending from the AVS Substation to a new substation near Killdeer (the currently proposed Roundup Substation) with an interconnection from the new Roundup Substation to the Charlie Creek Substation, then extending from the Roundup Substation on to the Judson Substation with an interconnection to the Williston Substation, and then to the Tande Substation with an interconnection to the Neset Substation. Established for the Project was a study area suitable for development of several corridors that encompassed parts of Mercer, Dunn, McKenzie, Williams, and Mountrail Counties in North Dakota. Macro-corridors, approximately 6 miles wide, were developed within the study area that:

- Provided an area to investigate route corridors to connect the above-mentioned Project endpoints.
- Provided flexibility to identify multiple route corridors for a transmission line within the macro-corridors.
- Minimized impacts to important natural and human resources identified within the macro-corridors.

An investigation of the human and natural attributes within the study area was conducted to identify resources that would present issues or concerns for either Project alternative. Human resources include municipal and other populated areas, public lands, roads, transmission lines, railroads, and other utilities. Natural attributes include wildlife, vegetation, wetlands, special status species, topography, and cultural resources. High level screening of the initial macro-corridors was conducted to avoid placing transmission lines and substations in the following:

- Communities and other developed areas within the study area
- Theodore Roosevelt National Park (TRNP)
- Little Missouri National Grasslands (LMNG)
- Little Missouri River
- Areas of rough and steep terrain around the Little Missouri River

Potential route corridors were developed within the 6-mile-wide macro-corridors identified for the proposed Project. Route corridors consisted of approximately 1,000-foot wide corridor segments that could be combined to connect the Project end points. The objective was to identify potential route corridors that minimize impacts on natural and human resources and provided cost-effective Project options. Routing principles used to develop the route corridors included:

- Minimize length
- Minimize number of heavy angles (angles over 30 degrees)
- Follow existing ROW and land divisions (electric lines, roads, property boundaries, fence rows, field borders), as appropriate
- Minimize visual contrast with natural landscape
- Minimize conflict with current and planned uses of land
- Minimize impacts to natural resources such as wetlands, woodlands, and wildlife
- Minimize impacts to human resources such as residences and cultural resources
- Avoid densely populated residential areas and maintain as much distance as practicable from individual homes and public facilities (e.g., churches, schools, etc.)
- Avoid crossing back and forth across waterways and roads
- Maximize distance from airports, landing strips and other aviation facilities
- Avoid crossing major roads in the vicinity of intersections and interchanges

Within the macro-corridor identified for the NKL Phase I Project (one of two macro-corridors evaluated), generally two individual 1,000-foot wide route corridor segments were developed within the six-mile-wide macro-corridors to avoid constraints and take advantage of opportunity areas while considering public and agency comments (Figure 1.2-2). The alternative route corridor segments were evaluated based on social and natural resources present within the macro-corridors; engineering and constructability consideration; and concerns expressed by federal, state, and local agencies and the public. Following the development of route corridor segments and route corridors, a screening process was used to identify those segments and route corridors that provided the best opportunity for the routing of a transmission line while avoiding areas of constraint and minimizing impacts on the natural and human resources within the macro-corridor.

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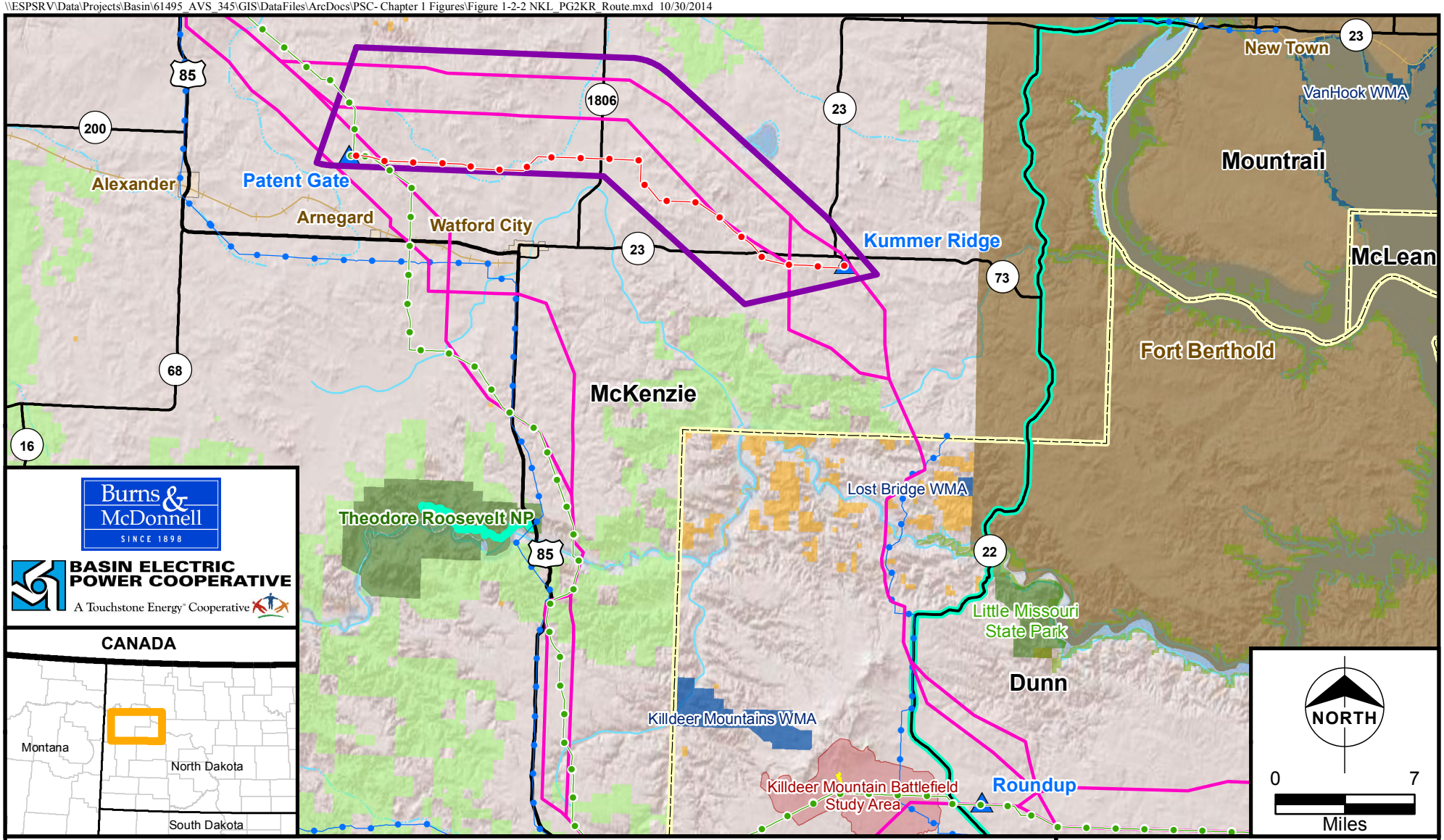


Figure 1.2-2
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Route Corridor Segment Network

Source: North Dakota GIS; Esri; Basin Electric; Burns & McDonnell.

Revised October 30, 2014

Subsequent to the screening process and through detailed discussions with landowners, Basin Electric identified a 1,000-foot wide route corridor alternative within the NKL Phase I Project macro-corridor. A representative 150-foot-wide route alignment ROW was created within the 1,000-foot wide route corridor alternative for evaluation of potential impacts of constructing and operating the Project for this application.

Subsequent to the identification of the two route corridor alternatives (AVS to Neset and NKL) evaluated in the November 2012 Draft EIS and Basin Electric's filing of its Application in March 2013 for one of these route corridor alternatives, new load forecasts showed nearly a 50 percent increase over previous projections (Kardmas, Lee & Jackson, Inc., 2012). These projections required construction of additional facilities beyond those proposed and evaluated in the Draft EIS and Application. As a result, a Supplemental Draft EIS was prepared that considered additional alternatives, including the construction and operation of the facilities approved by the Commission as part of Corridor Certificate No. 152 and Route Permit 164 in combination with several new load-serving substations (Roundup, Kummer Ridge, Patent Gate) and additional 345-kV transmission line (NKL). Based on this route analysis and subsequent environmental studies and agency and public input, the Project Corridor/Route (150-foot-wide ROW alignment within the 1,000-foot NKL corridor) presented in this Application, and already presented and evaluated in the RUS Supplemental EIS and Final EIS, was selected as the owner's preferred alternative for a route for the NKL Project, including Phase I and Phase II segments. The factors addressed in NDCC Section 49-22-09 were considered in identification of the Corridor/Route. All exclusion areas, avoidance areas, selection criteria, and policy criteria set forth in NDAC Section 69-06-08-02 were considered in selection of the Corridor/Route.

1.2.2 Product

A new 345-kV transmission line from the Alexander area east to the Watford City area (NKL Phase I Project) would connect into the AVS to Neset transmission line to increase the load-serving capacity, accommodate the near term projected load growth, and maintain acceptable reliability of the regional transmission system. When completed, the NKL Phase II Project would provide the needed redundancy for long term load growth and acceptable reliability.

1.3 Project Schedule

The Project is expected to start construction in mid-2015. An 18-month construction phase is anticipated with in-service expected in late 2016. Permitting efforts, including the corridor and route selection processes, are underway. The RUS ROD (Appendix A) for the EIS addressing this Project was issued in

September 2014, USFS's ROD was issued in October 2014. Western's ROD is expected in the fourth quarter of 2014. The Project requires various state, federal, and local permits prior to initiating construction. An overview of the Project schedule is provided in Table 1.3-1.

Table 1.3-1: Project Schedule

Activity	Timeframe
Corridor Certificate/Route Permit application	November 2014
Corridor Certificate/Route Permit	Anticipated 2015
Right-of-way acquisition complete	April 2015
Construction start date	April 2015
Construction complete	October 2016
Test operations	November 2016
In-service date	December 2016

1.4 Future Associated Facilities

Construction and operation of the proposed Corridor/Route would facilitate development of additional electricity transmission facilities within the Project area. These facilities will include construction of a new 345-kV transmission line between the Roundup Substation and the Kummer Ridge Substation, referred to as Phase II of the NKL Loop Project. These facilities will be the subject of a future application by Basin Electric to the Commission for review and approval once a Corridor/Route for this line has been finalized.

In addition, due to increasing load growth in Northwest North Dakota, Basin Electric is looking to expand both the Pioneer Generating Station and the Lonesome Creek Generating Station in 2015. It is anticipated that Energy Conversion Siting Permit applications for both Projects will be submitted to the ND PSC in the fourth Quarter 2014.

2.0 NEED FOR FACILITY

2.1 Needs Analysis

Basin Electric has identified the need for additional electric transmission capacity in northwestern North Dakota as a result of increased demand and to meet reliability and system stability requirements for the region.

2.1.1 System Reliability Issues

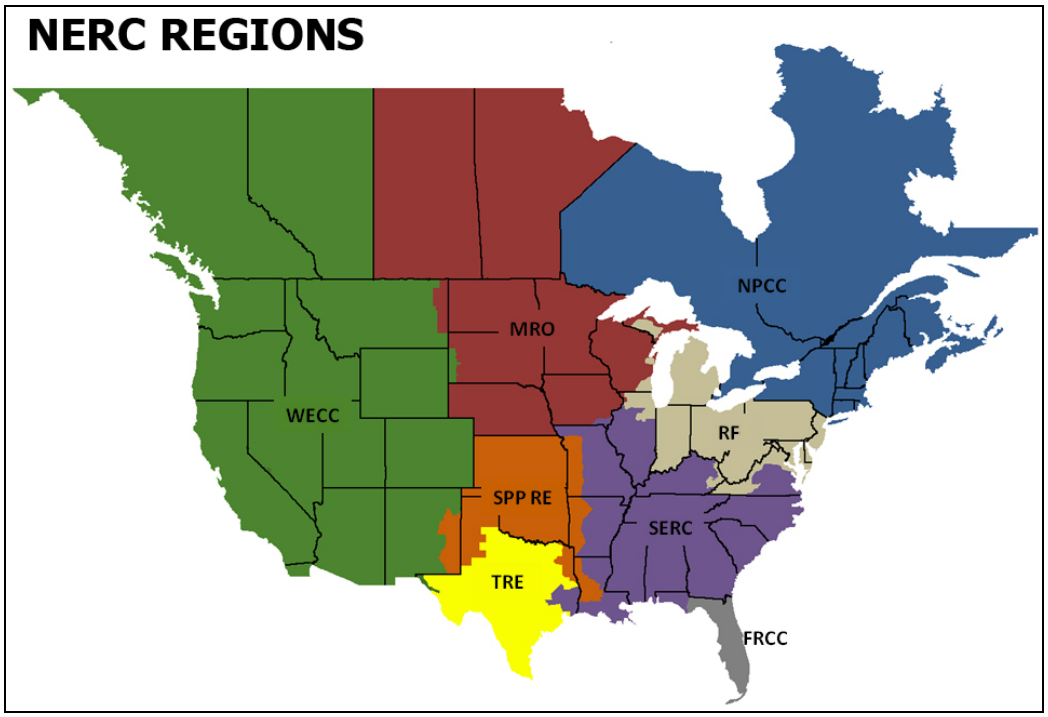
The Federal Energy Regulatory Commission (FERC) has the authority to develop and enforce reliability standards. These standards are in place to increase system reliability, which is defined by the U.S. Department of Energy's Energy Information Administration (EIA) as "a measure of the ability of the system to continue operation while some lines or generators are out of service. Reliability deals with the performance of the system under stress" (EIA, 2012). The system load-serving capacity is the amount of load that can be accommodated without violating reliability criteria. The term "system" as it is used here refers to both generation and transmission components. However, it does not include the low-voltage distribution lines that deliver electricity to consumers.

Section 215 of the Energy Policy Act of 2005 (Public Law, 109-58) requires the creation of an Electric Reliability Organization (ERO) with authority to establish, approve and enforce mandatory electricity reliability standards, subject to review and approval by FERC. In 2006, the FERC established rules for certification of the ERO and procedures for establishment, approval and enforcement of reliability standards.

In 2006, the North American Electric Reliability Corporation (NERC), a pre-existing voluntary reliability organization, was certified as the ERO in the U.S. The authority and certification granted to NERC also included a provision for the newly certified ERO to delegate certain authority to regional entities, as shown in Figure 2.1-1, for the purpose of proposing and enforcing reliability standards in particular regions of North America (FERC, 2006).

NERC Reliability Standards define the reliability requirements for planning and operating the North American Bulk-Power System and are focused on performance, risk management, and entity capabilities. NERC reliability standards apply to all owners, users and operators of the bulk power system, which includes the electric generation and transmission system in North America. The reliability standards developed by NERC have been approved by FERC. Among the many reliability standards NERC has developed are sets of standards for transmission operations and transmission planning.

Figure 2.1-1: NERC Reliability Regions



Source: NERC, 2013

2.1.2 The Midwest Reliability Organization (MRO)

The Midwest Reliability Organization's (MRO's) current primary function is to monitor and enforce the NERC Reliability Standards (MRO, 2010). The MRO has delegated much of its transmission reliability responsibility to two Reliability Coordinators (RCs). NERC guidelines require that each regional reliability organization establish one or more RCs to "continuously assess transmission reliability and coordinate emergency operations among the operating entities within the region and across the regional boundaries" (MRO, 2010). For the Basin Electric service area in northwestern North Dakota, the RC is the Midcontinent Independent System Operator known as MISO.

2.1.3 Project Area Reliability Issues

The existing high voltage system in the Williston/Tioga region consists of 230-kV and 115-kV systems that connect to Saskatchewan, Canada; eastern Montana; central North Dakota; and western North Dakota. An IS study was completed in 2011 that evaluated and identified system additions needed in this region. In part, the study evaluated the unexpected network load growth because of increasing oil development. The IS study focused on eastern Montana and western North Dakota (the Williston Load Pocket) as the area with the most rapidly changing and increasing demand and the greatest potential for outage issues. In conducting the analysis and to maintain consistency, various demand and outage scenarios were utilized that other MRO service providers and reviewing authorities had previously

approved. The IS analysis identified serious short- and long-term overload and low voltage NERC criteria violations (IS, 2011) in scenarios with modeled high load growth. Should the load level exceed transmission system capacity, outages could cause low voltage criteria violations, overload adjacent transmission lines in the Williston/Tioga region, and, therefore, be in violation of NERC reliability standards.

2.1.4 Load Forecast

The power load forecast indicates growth in the northwestern North Dakota area is accelerating over the next several years primarily due to the development of the Bakken Formation. Based on the projected load growth of increases of approximately 15 percent in 2014 and 2015, the timeliness of Project completion is critical. Much of the short-term load growth in this area is associated with provision of electrical service to support the rapid expansion of facilities for oil production and support infrastructure and services. As a follow-up to previous Basin Electric load forecasts, a third-party study undertaken in 2012 (Kardmas, Lee & Jackson, Inc., 2012) confirms the load projections in northwestern North Dakota due to rapidly expanding electrical service in this region (Appendix P).

While there are 17 oil-producing counties in North Dakota, all of which are located in the western third of the state, the top producing counties in 2012 included Mountrail, McKenzie, Dunn, and Williams in northwestern North Dakota. Oil production in North Dakota increased from 62.8 million barrels of oil in 2008 to 2.9 billion barrels in 2013 (a 361 percent increase) (North Dakota Industrial Commission, 2014). Production is expected to continue to increase with the development of an estimated 1,100 to 2,700 new wells per year in western North Dakota and 40,000 to 45,000 new wells over the next 20-plus years (Bangsund and Hodur, 2013). Electric transmission lines, including the proposed Project and other lower voltage lines and natural gas simple cycle generation facilities, have recently been constructed or are in development in western North Dakota to support expanding development and supporting infrastructure.

Table 2.1-1 shows for northwestern North Dakota in the Williston/Tioga region the load forecasts that were developed during 2011 compared with the forecast that was released in 2013. The load forecast completed in 2013 showed a significant increase over the forecast published in 2011, ranging from a 25 percent increase in the 2013-2014 winter season to nearly 50 percent by 2016-2017. In addition, it is likely that similar trends are occurring in the regions adjacent to the Williston/Tioga area.

Initially Basin Electric and IS load forecasts determined that one 345-kV transmission line would be sufficient to meet future growth and delivery requirements in the Williston/Tioga Region, and this was the basis for the AVS to Neset Transmission Project. However, the significant change in the load forecast led

to a reevaluation of solutions to meet the Project need. Basin Electric concluded that to meet the current load forecasts and system delivery requirements, the AVS to Neset Transmission Project would need to include an additional 345-kV line in the McKenzie County area and provide additional load-serving substations to connect with the transmission system in the area. This additional 345-kV line is the proposed North Killdeer Loop Project.

The originally proposed Project, as evaluated in the DEIS published in November 2012 and approved by the Commission in April 2014 (Case No. PU-11-696), was designed to increase transmission line capacity to meet the expected increase in load of 538 megawatts (MW) in 2016. However, the new load forecasts show the load increasing beyond the original forecast by nearly 50 percent. Therefore, the original Project as described in the DEIS would not achieve the increased capacity needs or reliability standards. The FEIS identified a preferred alternative that would meet both the capacity needs (forecasted load of 909 MW expected to occur by 2018-2019 winter season) and the reliability standards (adequacy and security). This preferred alternative included the combination of the AVS to Neset Project and the North Killdeer Loop Project.[3]

Table 2.1-1: Basin Electric Member Load Forecast for Transmission Lines in the Williston/Tioga Region

Winter Peak	2011 Forecast Load (MW)[1]	2013 Forecast Load (MW)[2]	Percentage Change in Load Forecast Between 2011 and 2013	Annual Percentage Increase in Load (2013 Forecast)
2013-2014	454	568	25	--
2014-2015	481	660	37	16
2015-2016	509	752	48	14
2016-2017	538	804	49	7
2017-2018		863		7
2018-2019		909		5

[1]Basin Electric, 2011
[2]Basin Electric, 2013
MW = megawatts

2.2 Alternatives

A Macro-Corridor and Alternatives Report was prepared as part of the process to define the proposed Project and conduct scoping for the proposed Project. This document, reviewed by RUS, contained an

[3] The AVS to Neset Project was approved by the Commission as part of Route Corridor Certificate No. 152 and Route Permit 164. The North Killdeer Loop Project is the subject of this Application. Both Projects were part of the RUS EIS and approved in the RUS ROD in September 2014.

AES and MCS. The AES was used to determine which system alternative(s) would be appropriate for serving the purpose and need for the proposed Project. The Macro-Corridor Study defined the proposed Project study area, identified Project-related opportunities and constraints within the study area, and developed macro-corridors suitable for the routing of a transmission line within the study area. A summary of the system alternatives considered for the proposed Project is provided below.

2.2.1 System Upgrades

The electrical transmission line network in North Dakota is part of a regional electrical system. The IS is operated and administered by Western. The common use transmission system is in the eastern interconnection of the IS service area. The IS transmission reliability study group performed an evaluation study titled *Eastern Montana/Western North Dakota Load Serving Study Facility Additions Justification - August 2011* (IS, 2011). The IS 2011 study was based on the load forecasts supplied in early 2011. With the rapidly evolving oil development in this region, the load forecast may develop earlier than initially planned. With potential unanticipated load growth, additional system improvements may be required at an accelerated timeline.

Numerous operating scenarios were developed and evaluated as well as facility upgrades that did not include new line construction. These operating scenarios were modeled with different line ratings, line carrying capacities, and system contingencies. Modeling of the facility upgrades included replacement of existing transformers with higher-capacity units and the installation of capacitors at various locations throughout the system. Under all scenarios investigated, system reliability on some lines would be only temporarily improved. However, even with implementation of all investigated upgrades, significant system failures, including considerable voltage drops or even voltage collapse, would result in numerous lines exceeding their emergency ratings throughout the system. These considerable system limitations could occur as early as 2014.

2.2.2 Additional 115-kV Lines

In order to mitigate the system limitations identified, construction of several new alternatives for 115-kV lines were investigated. It was anticipated by the study that these lines would be constructed and made operational by 2014 by Basin Electric and our member distribution cooperatives. Generally, these lines would serve specific loads and would not be operated as part of the overall regional electricity transmission network. Additional 115-kV lines currently in the planning and evaluation stages or under construction include:

- Mountrail-Williams Electric Cooperative (MWEC) 115-kV lines to serve the Tioga and Blaisdell areas
- Central Power 115-kV line between the Minot and Roseglen areas
- MWEC 115-kV line between Watford City and Swenson
- 115-kV line connection between Snake Creek Pumping Station and Parshall with an interconnection at Roseglen
- 115-kV line between Blaisdell and Berthold Substations
- McKenzie Electric - Patent Gate 115-kV Substation to proposed Lonesome Creek Switchyard
- McKenzie Electric - Numerous 115-kV Projects throughout its service territory

Construction and operation by the member cooperatives of these 115-kV facilities was found to mitigate many of the system limitations identified through 2014. However, as early as 2015, many of the current system limitations would again result, even with the proposed upgrades and 115-kV line constructions. Potentially, the load forecasts for the IS territory would not be met with the evaluated system improvements. The IS Study was based on predicted load growth; should the actual load growth be larger than what was predicted, additional system improvements may be required.

2.2.3 Additional 345-kV Lines

The IS study included further long-term analysis to identify potential solutions to address the inability of the system to meet projected load forecasts beyond the 2014-2016 time period. These alternatives included construction of various 345-kV lines in addition to the 115-kV lines previously noted. Initial Project development efforts identified the region north of the existing AVS 345-kV Substation as providing a direct path towards a connection to the existing Neset 230-kV Substation near Tioga.

The two big impediments to developing a new transmission line directly from AVS to Tioga are the Fort Berthold Reservation and Lake Sakakawea, both north of the existing AVS 345-kV Substation. Crossing Fort Berthold was not considered a viable alternative because it would involve tribal lands, which could complicate the approval process. Crossing Lake Sakakawea was investigated at a conceptual level, and it was determined that the logistics and costs associated with placement of a submarine cable in the lake made the Project infeasible. Furthermore, system planning analysis determined that a connection to the Charlie Creek Substation and a connection to Western's Williston Substation would be needed to satisfy the purpose and need for the Project and the long-term needs of the system. For these reasons, the above-mentioned alternatives were not carried forward as alternatives for the proposed Project.

Based on the IS study previously mentioned, two general 345-kV transmission line configurations were recommended for consideration as Project alternatives:

AVS to Charlie Creek Substation to Judson to Tande to Neset with interconnection with Williston alternative. This alternative would include a 65-mile 345-kV line from the AVS to the existing Charlie Creek 345-kV Substation. The existing Charlie Creek 345-kV Substation would be connected by a 70-mile segment to the proposed Judson 345-kV Substation near Williston. The proposed Judson 345-kV Substation would then interconnect with the proposed Tande 345-kV Substation by a 56-mile line segment, and a 2-mile 230-kV transmission line would interconnect the proposed Judson 345-kV Substation to Western's existing Williston 230-kV Substation. Finally, the proposed Tande 345-kV Substation would interconnect with the existing Neset 230-kV Substation by a 1-mile 230-kV line segment.

AVS to Killdeer to Judson to Tande to Neset 345-kV line with interconnection with Williston and a Killdeer to Charlie Creek Substation interconnection alternative. This alternative would include construction of approximately 40 miles of 345-kV line from AVS to a proposed 345-kV switchyard near Killdeer. An additional 85-mile 345-kV transmission line would extend from the proposed Killdeer 345-kV Switchyard to the proposed Judson 345-kV Substation, and a 25-mile 345-kV line segment would extend from the proposed Killdeer 345-kV Switchyard to the existing Charlie Creek 345-kV Substation, located near Grassy Butte. The proposed Judson 345-kV Substation would then interconnect with the proposed Tande 345-kV Substation by a 56-mile line segment. The Williston Tie Project that was previously approved by the PSC (Case PU-11-692) consists of a 2-mile 230-kV transmission line that would interconnect the proposed Judson 345-kV Substation to Western's nearby existing Williston 230-kV Substation. Finally, the proposed Tande 345-kV Substation would interconnect with the existing Neset 230-kV Substation by a 1-mile 230-kV line segment.

2.2.4 No Action Alternative

Under the No Action Alternative, the Project would not be constructed. No land would be used for transmission facilities or substations, and there would be no Project-related changes to the existing environment within the study area. Under the No Action Alternative, load growth would increase beyond the load-serving capacity of the existing system for the Williston/Tioga region, including the Watford City area by 2016, resulting in transmission system reliability issues and exceeding the criteria recommended by NERC for transmission reliability in the region. A No Action Alternative was evaluated in the EIS in accordance with the Council on Environmental Quality NEPA regulations (40 CFR 1502.14) requiring review of a no-action alternative.

2.2.5 Recommended System Alternatives

Based on the IS study, construction of new 345-kV transmission line facilities would be required to meet the projected load for the eastern Montana and western/central North Dakota areas, including the identified Williston Load Pocket. Construction of a 345-kV line from AVS to Charlie Creek, Williston and Tioga areas was, based on this initial IS study, the only alternative identified capable of meeting the long-term system load capacity and reliability criteria.

There was initial discussion of delivering power to the Judson/Williston/Neset Substations without a Charlie Creek 345-kV Substation connection. Future conditions evaluated with and without a Charlie Creek 345-kV Substation connection were found to maintain system reliability requirements and serve projected load forecasted through 2020. However, the future condition including the Charlie Creek 345-kV Substation connection provided a more robust support of the Western IS system and better support of future planning for growth in western North Dakota. Therefore, it is determined that the construction and operation of the AVS-to-Charlie Creek-to-Judson-to-Tande-to-Neset by a 345-kV transmission line, with associated substation interconnections, would better satisfy the Project's Purpose and Need and was recommended by the IS study (IS, 2011).

However, as noted above, subsequent studies (Kardmas, Lee & Jackson, Inc., 2012) identified the need for load serving capacity that would exceed the capacity provided by this system alternative, alone. While the AVS-to-Charlie Creek-to-Judson-to-Tande-to-Neset 345-kV transmission line would still provide the foundation for the overall solution to the system needs, additional facilities were determined necessary to meet the additional needs for the Project. As a result, the North Killdeer Loop Project - including the construction, operation, and interconnection of the Roundup, Kummer Ridge and Patent Gate substations by new 345-kV line facilities along with associated interconnection to the AVS to Neset 345-kV line and local 115-kV system, was identified and proposed to address the regional transmission system needs.

2.3 New Generation

In order to meet the need for voltage support to areas in northwestern North Dakota, Basin Electric has recently constructed two simple-cycle combustion turbine projects. The need for these projects was identified as areas for concern with the current load demands and the existing transmission infrastructure. The two projects are the Pioneer Generating Station (PGS) and the Lonesome Creek Station (LCS).

PGS is located in western Williams County, northwest of Williston. PGS Phase I and Phase II projects consist of three LM 6000 PC SPRINT simple-cycle combustion turbines with a nominal output rating of 45 MW each. PGS Unit 1 incorporated a clutch attached to isolate the combustion turbine from the

generator set. With the clutch engaged, the generator acts similar to a synchronous condenser, thus providing much needed voltage support to the local transmission system during times that generation is not required. Commercial operation of all three PGS units began in December 2013. The Basin Electric Board recently identified and approved the PGS Phase III project that consist of 12 reciprocating engines each rated at 9.3 MW nominal. A ND PSC Siting application is currently being prepared and is scheduled to be filed with the ND PSC in November 2014.

LCS is located in northern McKenzie County, near Alexander. LCS Phase I and II consist of three LM 6000 PC SPRINT simple-cycle combustion turbines with a nominal output rating of 45 MW each. LCS Unit 1 also incorporated a clutch attached to isolate the combustion turbine from the generator set. With the clutch engaged, the generator acts similar to a synchronous condenser, thus providing much needed voltage support to the local transmission system during times that generation is not required. Construction on the LCS Phase I began on July 3, 2012 and commercial operation began in August 2013. Construction of LCS Phase II began in May of 2014 with commercial operation expected to begin in early 2015. Basin Electric Board recently identified and approved the LCS Phase III project that consist of 3 additional 45-MW simple cycle LM 6000 PC SPRINT combustion turbines. A ND PSC Siting application is currently being prepared and is scheduled to be filed with the ND PSC in November 2014.

2.4 Ten-Year Plan

Basin Electric filed a Ten-Year Plan with the Commission on June 2014. This Project is consistent with the Ten-Year Plan on file with the Commission.

3.0 TRANSMISSION FACILITY CORRIDOR AND ROUTE CRITERIA

The Project Corridor/Route selection process included an inventory and suitability analysis of criteria listed in NDAC Section 69-06-08-02, including exclusion and avoidance area criteria; selection criteria that relate to minimizing potential land use and environmental impacts; policy criteria that relate to maximizing public benefits; and design and construction limitations. Basin Electric also included economic considerations as part of the analysis.

For purposes of this Project, the Corridor/Route is the 150-foot-wide area in which the transmission line facility would be constructed. As the Corridor and the Route are the same alignment, all the criteria evaluation and analysis required for both corridors and routes has been applied to the 150-foot-wide ROW. Volume II of this document includes detailed maps that illustrate the exclusion, avoidance and selection criteria in relation to the Project Corridor/Route.

3.1 Exclusion Areas

Per Section 69-06-08-02(1), the geographical areas listed in Table 3.1-1 shall be excluded in the consideration of a corridor or route for a transmission facility, and the corridor or route shall include a buffer zone of reasonable width to protect the integrity of the area. Exclusion areas are mapped for the Project Corridor/Route, as shown in Volume II.

Table 3.1-1: Exclusion Areas

Geographic Area	Present within Corridor/Route	Proposed Buffer	Section Addressed
Designated or registered national: parks; memorial parks; historic sites and landmarks; natural landmarks; monuments; and wilderness areas	Not present within Corridor/Route	No impacts are anticipated and no buffer is proposed	5.2, 5.8, 5.9
Designated or registered state: parks; historic sites; monuments; historical markers; archaeological sites; and nature preserves	Not present within Corridor/Route	No impacts are anticipated and no buffer is proposed	5.2, 5.8, 5.9
County parks and recreational areas; municipal parks; and parks owned or administered by other governmental subdivisions	Not present within Corridor/Route	No impacts are anticipated and no buffer is proposed	5.2, 5.9

Geographic Area	Present within Corridor/Route	Proposed Buffer	Section Addressed
Areas critical to the life stages of threatened or endangered animal or plant species	Not present within Corridor/Route	ESA Section 7 consultation has been initiated with the USFWS so that the Project would not jeopardize the continued existence of any listed species or adversely modify critical habitats Whooping crane: The Project would be designed to meet requirements for the protection of avian species from electrocution and line strikes Sprague's pipit and Dakota skipper: Potential temporary disturbance to grassland habitat within Corridor/Route; grassland habitat would be re-established upon completion of construction	5.13
Areas where animal or plant species that are unique or rare to this state will be irreversibly damaged	Not present within Corridor/Route	Potential temporary disturbance to native grassland habitat within Corridor/Route; grassland habitat to be re-established upon completion of construction	5.13

3.2 Avoidance Areas

Per Section 69-06-08-02(2), the geographical areas listed in Table 3.2-1 shall not be considered in the routing of a transmission facility unless the applicant shows that, under the circumstances, there is no reasonable alternative. In determining whether an avoidance area should be designated for a facility, the Commission may consider, among other things, the proposed management of adverse impacts; the orderly siting of facilities; system reliability and integrity; the efficient use of resources; and alternative routes. Avoidance areas are mapped for the Project Corridor/Route, as shown in Volume II.

Table 3.2-1: Avoidance Areas

Avoidance Area	Present within Project Corridor/Route	Proposed Buffer	Section Addressed
Designated or registered national: historic districts; wildlife areas; wild, scenic or recreational rivers; wildlife refuges; and grasslands	Not present within Corridor/Route	No impacts are anticipated and no buffer is proposed	5.2, 5.8, 5.9
Designated or registered state: wild, scenic, or recreational rivers; game refuges; game management areas; management areas; forests; forest management lands; and grasslands	Not present within Corridor/Route	Vegetation removal and replacement will be conducted according to requirements in the Public Service Commission's Woody Species Replacement Plan (Appendix Q)	5.2, 5.9
Historical resources which are not specifically designated as exclusion or avoidance areas	Based on the Class I cultural resources investigation conducted for the Project, known sites have been avoided; a large portion of the Corridor/Route has been surveyed at the Class III level. The remainder would be surveyed prior to construction and any eligible cultural resource sites would be avoided.	Section 106 consultation has been completed with the implementation of a Programmatic Agreement (PA) for the Project and will address the need for Class II and/or Class III cultural resource inventories Known archaeological sites within the Corridor/Route would be spanned and protected from disturbance during construction	5.8

Avoidance Area	Present within Project Corridor/Route	Proposed Buffer	Section Addressed
Areas which are geologically unstable	Corridor/Route would cross approximately 148 feet of terrain in T150N R96W Section 20 near an intermittent tributary of Northfork Creek (0.5 acres within the Corridor/Route) where landslides have occurred previously Corridor/Route does not cross terrain with greater than 10 percent slope	A majority of the identified landslide areas would be spanned by the transmission line, with no structures placed within susceptible landslide areas; geotechnical assessments would be conducted at structure locations to minimize the potential development of landslides in susceptible areas during construction	5.11
Within 500 feet of a residence, school, or place of business	No residences are located within 500 feet of the Corridor/Route No schools or business within 500 feet of the Corridor/Route	The transmission line was routed to minimize impacts to residences, and the Project would not result in any displacement of residences	5.1
Reservoirs and municipal water supplies	Not present within Corridor/Route	No impacts are anticipated and no buffer is proposed	5.12
Water sources for organized rural water districts	Not present within Corridor/Route	No impacts are anticipated and no buffer is proposed	5.12
Irrigated land	Not present within the Corridor/Route	No impacts are anticipated and no buffer is proposed	5.2, 5.10

Avoidance Area	Present within Project Corridor/Route	Proposed Buffer	Section Addressed
Areas of recreational significance which are not designated as exclusion areas	No known designated recreation lands are present within the Corridor/Route. Corridor/Route would cross approximately 4 North Dakota School Trust Land parcels, for a total of approximately 36.4 acres within the Corridor/Route. While these lands are open to public recreation , they are not designated as recreation areas and primarily used for agriculture.	Basin Electric would obtain an easement from the North Dakota Department of Trust Lands to cross these parcels and is coordinating with the Department so that the Project does not impact the ability to continue to develop the Trust Lands per their planning.	5.2, 5.7, 5.9

3.3 Selection Criteria

Per Section 69-06-08-02(3), a corridor or route shall be designated only when it is demonstrated to the Commission by the applicant that any significant adverse effects resulting from the location, construction, and maintenance of the facility, as they relate to the following, will be at an acceptable minimum, or that those effects will be managed and maintained at an acceptable minimum (Table 3.3-1). Selection criteria are mapped for the Project Corridor/Route, as shown in Volume II.

Table 3.3-1: Selection Criteria

Selection Criteria	Potential Adverse Effects	Section Addressed
Agricultural production	141.0 acres of cultivated cropland and 6.4 acres of pasture/hayland within the Corridor/Route. An additional 282.5 acres of grassland potentially available for grazing or hay production also occurs within the Corridor/Route. Current agricultural production would be maintained for most of the Corridor/Route. The only land unavailable for agriculture would be the area occupied by structures for a total of 0.1 acres (0.0009-acre per structure). There would be approximately 165 structures for the Corridor/Route. Landowners would be compensated for crop and forage loss that occurs as a result of construction and maintenance activities, and damage to soils would be redressed. At the proposed Roundup, Kummer Ridge, and Patent Gate substation sites, the agricultural land within the approximately 12-acre sites would be permanently converted to utility use. (36 acres total)	5.2, 5.10
Family farms and ranches	No family farms would be displaced due to construction of the Corridor/Route. Basin Electric would work with landowners to minimize impacts to their land and agricultural operations.	5.2, 5.10
Land which the owner can demonstrate has soil, topography, drainage, and an available water supply that cause the land to be economically suitable for irrigation	No irrigated land was identified within or adjacent to the Corridor/Route. No owner has expressed concerns related to economically suitable irrigation on their land.	5.2, 5.10

Selection Criteria	Potential Adverse Effects	Section Addressed
Surface drainage patterns and groundwater flow patterns	No impacts to surface drainage patterns or groundwater flow patterns are anticipated. The Corridor/Route would cross two perennial waterways and numerous intermittent streams. All stream crossings would be spanned by the Project, and no transmission structures would be placed in a streambed. All FEMA-designated floodplain areas within the Corridor/Route would be spanned, and no impacts to these areas are expected during construction or operation of the Project. Best Management Practices (BMPs) would be utilized to prevent soil erosion and sedimentation.	5.12
Noise-sensitive land uses	The Corridor/Route and proposed substations would not be located within 500 feet of sensitive noise receptors.	5.6
The visual effect on the adjacent area	Project would introduce a new manmade feature into the viewsheds of the Project counties. Project would not adversely affect the scenic integrity of resources because existing transmission lines, roadways, communications towers, and oil and gas development facilities are already present in the visual landscape where the Corridor/Route crosses these resources.	5.7
Extractive and storage resources	One oil and gas well was identified within 500 feet of the Corridor/Route; Project would not directly affect any wells or drill rigs since the Corridor/Route has been designed to avoid these areas, span collector systems, and provide sufficient clearance for well maintenance and operation	5.11
Wetlands, woodlands, and wooded areas	No effect. All 7.9 acres of wetlands within the Corridor/Route would be spanned. No structures would be placed in wetlands, and no wetland vegetation would be cleared. Approximately 5.5 acres of woodland would be removed within the Corridor/Route.	5.13
Radio and television reception, and other communication or electronic control facilities	No impacts to radio and television reception, and other communication or electronic control facilities are expected There would be six Federal Communication Commission (FCC) towers within 1 mile of the Corridor/Route.	5.4 5.3

Selection Criteria	Potential Adverse Effects	Section Addressed
Human health and safety	During construction, Project may add an additional temporary burden on public health and safety services such as police, fire, ambulance, and hospital services Basin Electric conducted an electric and magnetic field (EMF) analysis for the Project (Appendix I). Results of the analysis indicate that the maximum predicted EMF value at the edge of the Corridor/Route would be far less than recommended levels identified for protection of the general public. Therefore, no adverse effects from Project-induced electric fields would occur Accidents involving direct contact with energized transmission line would be avoided by transmission line design features	5.4
Plant life	Approximately 5.5 acres of woodland would be removed within the Corridor/Route. A total of approximately one tenth of an acre of vegetation permanently removed within Corridor/Route at structure locations. Potential introduction of noxious weeds within Corridor/Route would be avoided by weed mitigation measures Removal of all vegetation within the fenced area of the proposed Roundup, Kummer Ridge, and Patent Gate substations (approx. 42 acres total)	5.13

3.4 Policy Criteria

Per Section 69-06-08-02(4), the Commission may give preference to an applicant that will maximize benefits that result from the adoption of the following policies and practices, and in a proper case may require the adoption of such policies and practices (Table 3.4-1).

Table 3.4-1: Policy Criteria

Policy Criteria	Suitable Policy or Practice of Applicant	Section Addressed
Location and design	Basin Electric's policy is to locate and design projects to minimize environmental impacts and utilize existing corridors.	1.1, 1.2.1
Training and utilization of available labor in this state for the general and	Basin Electric would use local labor to the extent practicable.	5.1

Policy Criteria	Suitable Policy or Practice of Applicant	Section Addressed
specialized skills required		
Economies of construction and operation	The Project creates economies of construction and operation by locating the Roundup and Patent Gate substations at interconnection locations along the AVS to Neset Line to avoid alignment or additional line construction for the AVS to Neset Line. Additionally, approximately one mile of the Project would be constructed double circuit within existing Basin Electric easement for the AVS to Neset line, currently under construction.	4.2
Use of citizen coordinating committees	Several public participation activities were conducted for the Project. The use of citizen coordinating committees is not expected for this Project.	6.0
A commitment of a portion of the transmitted product for use in this state	The Project would meet the need for additional electric transmission capacity as a result of increased demand in northwestern North Dakota and would meet reliability and system stability requirements for the region.	1.0, 2.1
Labor relations	No labor relations would be negatively affected by the Project.	5.1
The coordination of facilities	The Project is being considered by Western in coordination with the Western/ Basin Electric Power Cooperative/ Heartland Consumers Power District IS to maintain a reliable transmission system. Interconnections to the local 115-kV system would be coordinated with Basin Electric's local member cooperatives.	4.2
Monitoring of impacts	Basin Electric would utilize BMPs during construction to minimize environmental impacts and would monitor construction compliance with the commitments made in this application and applicable permit conditions, including the Commission's Order.	5.1.3, 5.2.3, 5.3.3, 5.4.3, 5.5.3, 5.6.3, 5.7.3, 5.8.3, 5.9.3, 5.10.3, 5.11.3, 5.12.3, 5.13.3
Utilization of existing and proposed ROW and corridors	The Project follows half- and quarter-section lines to the extent practicable.	4.2

Policy Criteria	Suitable Policy or Practice of Applicant	Section Addressed
Other existing or proposed transmission facilities	The Project creates economies of construction and operation by locating the Roundup and Patent Gate substations at interconnection locations along the AVS to Neset Line to avoid alignment or additional line construction for the AVS to Neset Line. Additionally, approximately one mile of the Project would be constructed double circuit within existing Basin Electric easement for the AVS to Neset line, currently under construction.	4.2

3.5 Design and Construction Limitations

The Project Corridor/Route is the most direct route that also minimizes impacts to the criteria identified in NDAC 69-06-08-02. Constraints present within the Project area include communities and developed areas. The Corridor/Route was routed to minimize impacts to these areas to the extent possible. Basin Electric intends to span all streams and associated wetlands, and no structures would be placed in streambeds or wetlands.

Basin Electric and/or its contractors have performed initial surveys on lands for which access for survey permissions were given. When survey permissions are acquired on the remainder of the route, the required surveys would be performed prior to construction of the transmission line. These surveys would consist of centerline location, profile, access, cultural, wetland delineations, and in some cases biological surveys.

Geotechnical studies also would be conducted along the transmission line route to determine engineering requirements for structures. Following geotechnical exploration, it may become necessary to utilize special structures or materials to avoid sensitive environmental features or to accommodate poor soil conditions or other design limitations.

3.6 Economic Considerations

Basin Electric identified the need for additional electric transmission capacity in northwestern North Dakota as a result of increased demand and to meet system reliability requirements for the region. Investigations and analysis conducted for the overall power delivery system found that without improvements, the flow along the existing lines may result in local line overloads, especially in the Williston/Tioga region. The Project would meet the electrical demands in the region. Without construction of the Project, the load growth would be capped at the projected 2015 load level, no new load growth could be accommodated, and transmission systems reliability would be severely impacted.

This would limit the future potential development activities related to the expanding oil and gas industry in the region, and impact the existing infrastructure in the Bakken oil field and any other load requirements in this service region.

There are many economic considerations in the design and routing of a transmission line. In general, minimizing the length of the route and minimizing the number of angle structures decreases the cost of the transmission line by minimizing the material, construction, and ROW costs. The Corridor/Route effectively balances the economic considerations of the overall length of the line and the required number of angle structures with the potential impacts on the environment, agricultural lands, and landowners.

The selection of materials and structure types also affects the cost of a transmission line. Basin Electric proposes to use steel, single-pole or H-frame self-supporting structures, depending on the terrain and land use characteristics at specific locations along the Project.

4.0 ENGINEERING AND OPERATIONAL DESIGN

Engineering design data is presented in Appendix C, and plan and profiles are provided in Appendix E. A legal description for the Project Corridor/Route is provided in Appendix F.

4.1 General Corridor/Route Description

The Corridor/Route would exit the Patent Gate Substation to the east, extending approximately one mile, double-circuit with the existing AVS to Neset 345-kV line. The single circuit Corridor/Route would then continue east, crossing Tobacco Garden Creek, for approximately 4.0 miles along section lines then angle southeast for approximately 0.6 mile. It would extend east, again crossing Tobacco Garden Creek, for 2.4 miles. It would angle northeast for approximately 1.0 mile. It would cross Tobacco Garden Creek again, then turn east. The Corridor/Route would extend for 5.2 miles along the half section lines and cross Tobacco Garden Creek and State Highway 1806. It would then turn south for approximately 1.0 mile.

The Corridor/Route would angle southeast for 1.4 miles then turn east and continue for 1.9 miles along the half section lines. It would extend generally southeast for 5.7 miles and cross State Highway 23. It would then extend eastward for 1.4 miles along half section lines, extending southeast for 0.5 miles. The Corridor/Route would turn east and extend for approximately 1.0 mile to connect with the Kummer Ridge Substation. Description of Proposed Facilities

Basin Electric is proposing the construction of three new 345/115-kV substations. Two of these substations, Roundup and Patent Gate, would be located along the AVS to Neset 345-kV line. The proposed Kummer Ridge Substation would be located east of Patent Gate and connected to it by a new 345-kV electric transmission line. This proposed line was identified as the result of a systematic evaluation of alternatives that could meet the Project need. A description of the proposed Project is presented below.

4.1.1 Transmission Line Characteristics

The proposed Project includes:

- New Roundup (approximately 14 acres), Kummer Ridge (approximately 11 acres), and Patent Gate (approximately 17 acres) 345/115-kV substations
- A double circuit 345-kV transmission line connection from the proposed Patent Gate Substation to a point one mile eastward co-located with the AVS to Neset 345-kV Transmission line, currently under construction

- A single circuit 345-kV transmission line connection just east of Patent Gate Substation to the proposed Kummer Ridge 345-kV Substation

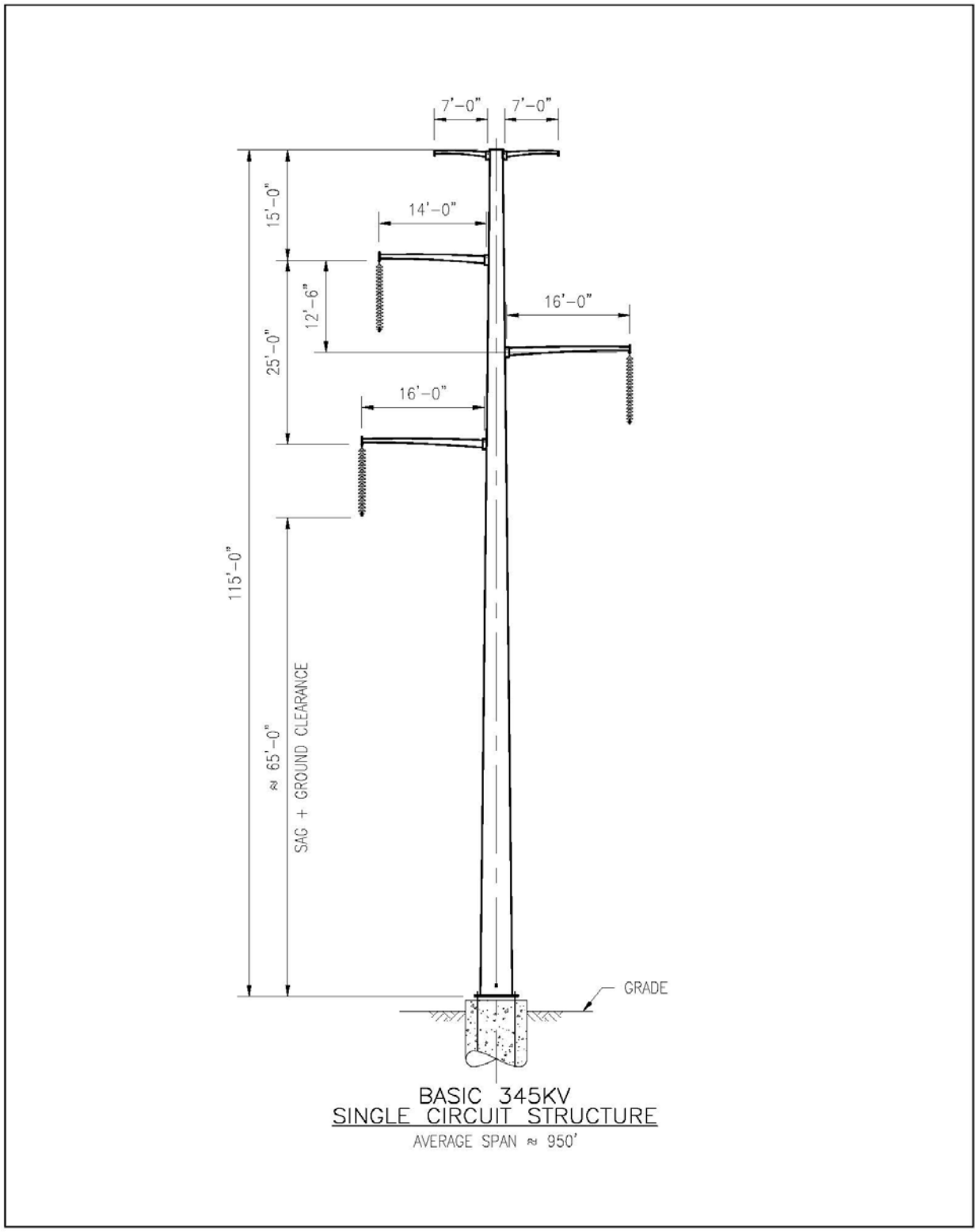
The proposed 345-kV transmission line would be constructed using steel, single-pole or H-frame self-supporting structures within a 150-foot-wide ROW. Detailed construction access considerations and construction techniques are described further in the following sections. Various transmission line structure types would be necessary to address the differing number of circuits and terrain variations in different components of the proposed Project. Structures proposed for this Project by Basin Electric are shown in Figure 4.1-1, Figure 4.1-2, and Figure 4.1-3. A summary of Basin Electric's proposed structure characteristics for each of these structure types is provided in Table 4.1-1.

Table 4.1-1: North Killdeer Loop 345-kV Transmission Project Typical Structure Design Characteristics

Description of Design Component	345-kV (Fig 4.2-1)	345-kV H-Frame (Figure 4.2-3)	345-kV/345-kV (Fig 4.2-2)
Conductor size (inches)	1.8	1.8	1.8
ROW width (feet)	150	150	150
Typical minimum and maximum span distance between structures (feet) [1]	650-1,100	900-1,000	650-1000
Average span (feet)	950	1,000	900
Minimum and maximum structure height (feet)	100-130	80-100	100-155
Average height of structures (feet)	115	90	130
Average number of structures per mile	6	5.5	6
Temporary disturbance per structure (acre) [2]	0.4	0.4	0.4
Permanent disturbance per structure (acre)	0.0003	0.0004	0.0003
Minimum conductor-to-ground clearance to agricultural lands, rural roads and paved highways at 100 deg C (feet)	30	30	30
Minimum conductor-to-ground clearance to railroads at 100 deg C (feet)	As required by specific railroad		
Circuit configuration[3]	Figure 4.1-1	Figure 4.1-2	Figure 4.1-3

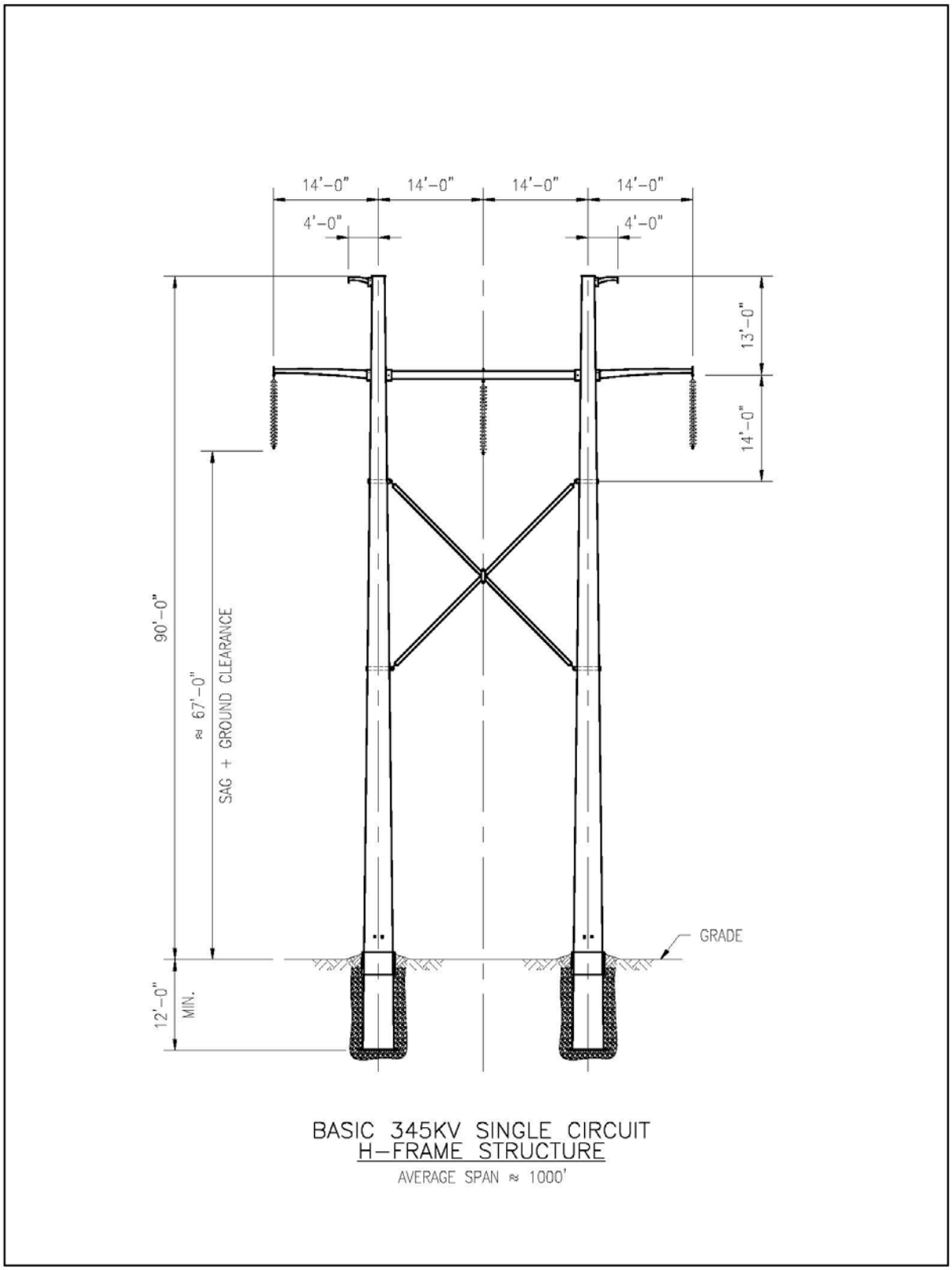
[1]Actual span distance would vary depending on topography.
[2]Angle and dead-end structures (for longitudinal stability) would be constructed with concrete foundations. Guy wires would not typically be required.
[3]Single pole tangent structures would be freestanding on concrete foundations or directly embedded. H-frame tangent structures would likely be directly embedded into the ground.

Figure 4.1-1: 345-kV Single Circuit Structure



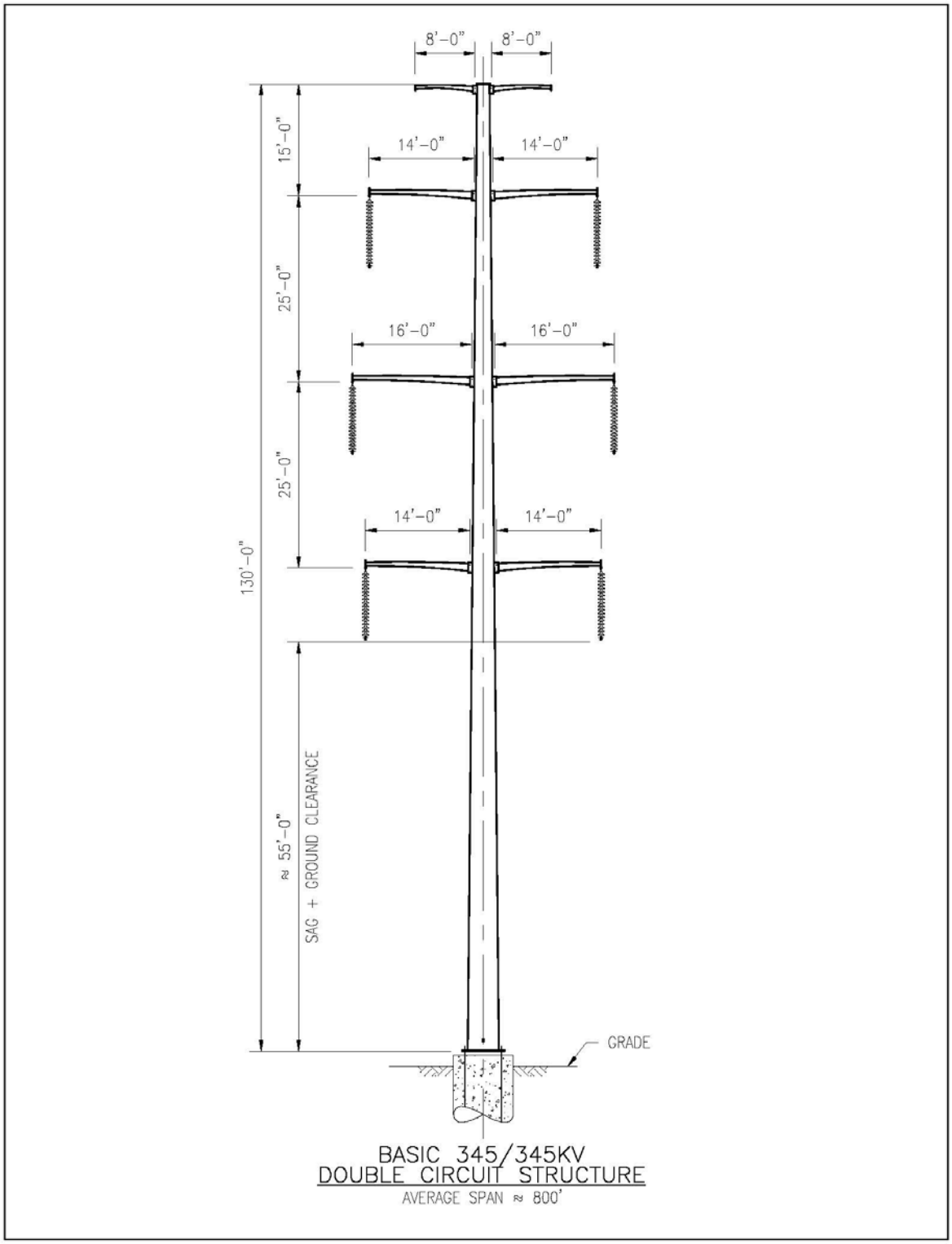
Source: Basin Electric, 2013

Figure 4.1-2: 345-kV Single Circuit H-Frame Structure



Source: Basin Electric, 2013

Figure 4.1-3: 345-kV/345kV Double Circuit Structure



Source: Basin Electric, 2013

Project construction and design would meet the requirements of the National Electrical Safety Code-Heavy Loading District, RUS design criteria (USDA, 2009), and other applicable local or national building codes (Institute of Electrical and Electronics Engineers Standards Association, 2012). The Heavy Loading District refers to those areas (including North Dakota) that are subject to severe ice and wind loading. Minimum conductor clearance is measured at the point where conductor sag is in closest proximity to the ground. The proposed transmission line would be constructed with clearances that exceed standards set by the National Electrical Safety Code.

4.1.2 Associated Facilities and Project Components

The proposed overall Project would require the following associated facilities and Project components:

- **Roundup 345-kV Substation.** The proposed Roundup 345/115-kV Substation near Killdeer would be approximately 14 acres in size on the 50 acre parcel Basin Electirc owns and would require the installation of a 345-kV/115-kV transformer, and the necessary bus, circuit breakers, disconnect switches, grounding switches, and protection and control equipment to support the 345-kV interconnection.
- **Kummer Ridge 345-kV Substation.** The proposed 11-acre Kummer Ridge 345-kV Substation within the 41 acre Basin Electric owned parcel east of Watford City, would require the initial installation of a 345-kV/115-kV transformer with a possible second transformer installation in the future, and the necessary bus, disconnect switches, circuit breakers, grounding switches, and protection and control equipment to support the 345-kV interconnection.
- **Patent Gate 345-kV Substation.** The proposed 17-acre Patent Gate 345/115-kV Substation located on a 118 acre Basin Electric owned parcel, located northeast of Alexander, would require the installation of two 345-kV/115-kV transformers, and the necessary bus, disconnect switches, circuit breakers, grounding switches, and protection and control equipment to support the 345-kV interconnections.

4.1.3 Construction Techniques

The proposed 345-kV, single-circuit transmission line would be constructed using single-pole or H-frame self-supporting structures within a 150-foot-wide ROW. Detailed construction access considerations and construction techniques are described further in the following sections.

4.1.3.1 Pre-Construction Activities

Basin Electric and/or its contractors would perform engineering surveys prior to construction of the transmission line. These surveys would consist of centerline location, profile, and access surveys. Pre-construction surveys would likely coincide with other pre-construction activities.

Geotechnical studies would be conducted along the transmission line route to determine engineering requirements for structures and foundations. Truck-mounted augers would be transported to selected locations to drill small-diameter boreholes, and borehole cuttings would be analyzed to determine specific soil characteristics. These activities would be conducted after harvest to minimize impacts on agricultural fields. Minimal land disturbance (approximately 400 square feet) would be anticipated for each geotechnical boring site. Additionally, small access trails may be required for some of the boring locations.

Two temporary construction material and equipment laydown areas, would be used for the duration of construction. Both the Patent Gate and Kummer Ridge properties yards would be utilized. The Patent Gate yard was previously developed and permitted to help support construction of the AVS to Neset Project. Figure 4.1-4 shows the location of the two laydown areas. Both laydown areas would be approximately five acres in size.

To avoid or minimize impacts on sensitive resources, construction laydown areas are typically located at previously disturbed or developed locations, such as vacant lots, existing utility yards, or parking lots. Where existing yard locations are not available, preferred locations for yards are undeveloped areas, such as grazing land or cropland that are cleared and flat; have all-weather access; and do not contain streams, wetlands, or other environmentally sensitive resources. Laydown yards consist of flat or gently sloping lands where construction material would be placed on pallets or cribbing. No topsoil would be removed and minimal, if any, grading or re-grading is expected to take place at these facilities. Laydown areas would be returned to pre-construction conditions upon completion of the Project. Vegetation removal within the ROW is anticipated to be minimal throughout a large portion of the Project, especially in rangeland and cropland areas. In more forested portions of the ROW, trees and shrubs would be removed if they interfered with construction activities or the safe and reliable operation of the transmission line. Woody vegetation would be removed at ground level to provide access to the ROW.

Disposal of trees and shrubs would be consistent with the landowner's wishes and all state waste management regulations. It is expected that the woody species removed would be replaced at a 2:1 ratio post-construction. Final replacement requirements would be dependent on the final regulatory

\\ESPSRV\Data\Projects\Basin\61495_AVS_345\GIS\DataFiles\ArcDocs\PSC - Chapter 4 Figures - Project Route\Figure 4-1-4 NKL_PG2KR_Route.mxd 11/3/2014

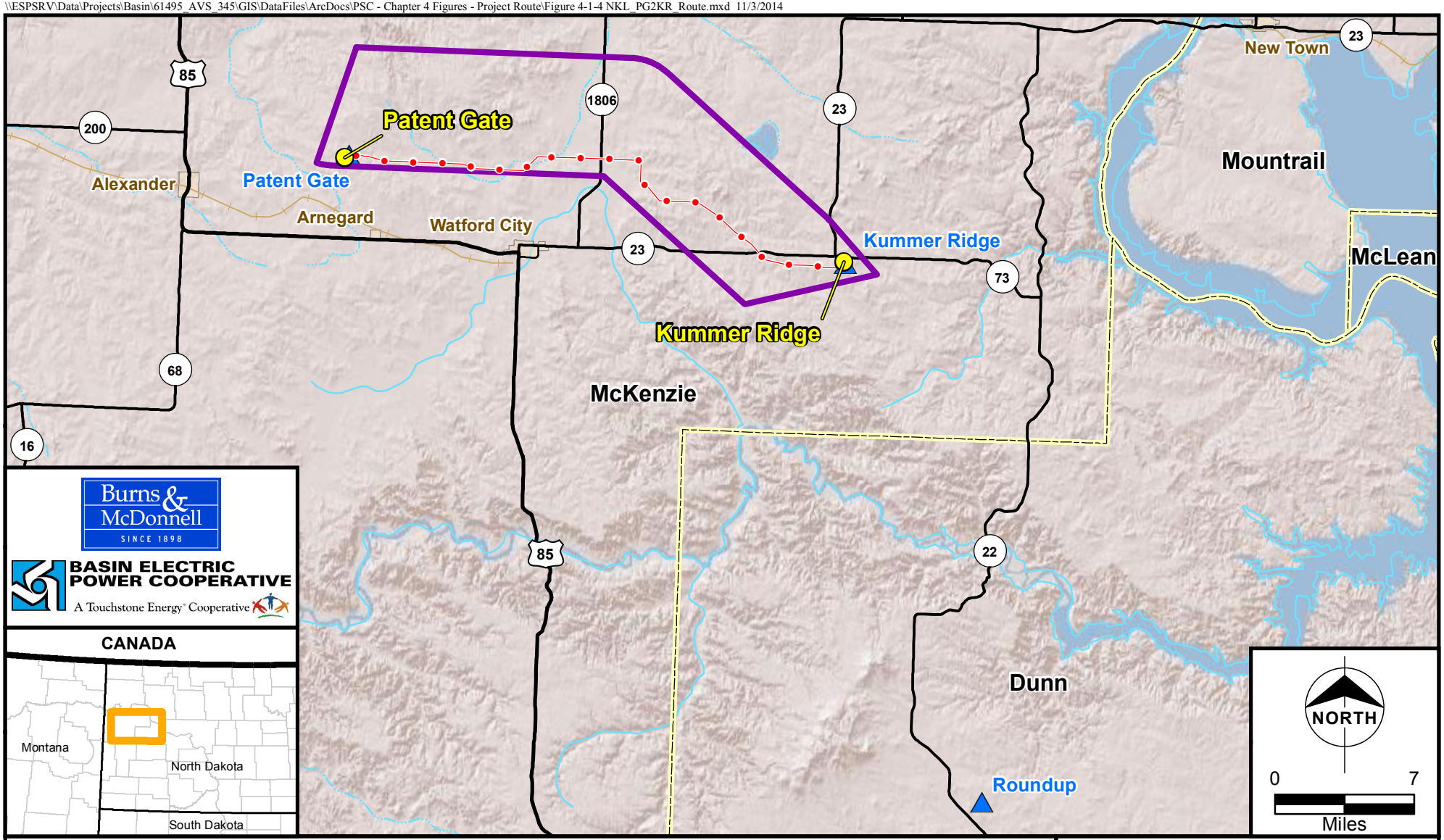


Figure 4.1-4
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Temporary Construction Material
and Equipment Laydown Areas

Source: North Dakota GIS; Esri; Basin Electric; Burns & McDonnell.

Revised November 03, 2014

requirements stipulated for the Project through the Commission's siting process. A copy of the Commission's Tree and Shrub Replacement Plan is included in Appendix Q.

4.1.3.2 Transmission Structure Site Preparation

Transmission structure site clearing is expected to be minimal over a large portion of the Project, due to much of the Corridor/Route being located across rangeland, grasslands, or agricultural areas. In these areas, site leveling is expected to be minimal or unnecessary. In areas of difficult terrain, structure location sites may require more extensive leveling using bulldozers or front-end loaders to allow for the safe operation of equipment. In the limited areas where access is extremely difficult, structure placement may be performed through the use of helicopters. All blading and leveling would occur within the boundary of the ROW throughout the length of the Project. Soil removed during leveling of structure sites would be stockpiled nearby and replaced following construction. Disturbed ground would be re-graded to as close to pre-construction condition as appropriate for stabilization and re-vegetated or approved for tillage, depending on pre-construction land use.

Structure holes would be drilled by truck-mounted auger or power auger at appropriate locations along the length of the Corridor/Route. Total land disturbance at each structure location would vary depending on location (i.e., level terrain versus steep, rugged terrain) and structure type. All disturbances related to the boring of structure holes would be confined to the ROW.

Structures used for the Project would be either directly imbedded into the ground or would be bolted on reinforced poured concrete foundations. Whether a structure would be directly imbedded into the ground or would require a foundation would depend on available access due to terrain and soil conditions. Screw anchors may be used in certain locations based on terrain and soil conditions; the helix on the anchor would cut through the soil, resulting in minimal soil disturbance. An estimated 165 structures would be used for the proposed Project, with an average of approximately one structure every 900 feet.

4.1.3.3 Structure Assembly and Erection

Structure components, such as pole segments, davit arms, hardware, and insulators, would be brought to the structure site via truck and assembled onsite. Davit arms, insulators, and other components would be attached to the structure while on the ground. The structure would be placed into the borehole and backfilled or bolted onto reinforced foundations using cranes or large boom trucks. In areas of very rough terrain that have limited accessibility or are even inaccessible, aerial placement of structures by helicopter may be required. If helicopters are used, the upper sections of the structure would then be bolted onto the lower section. Structure setting activities would be done within the boundaries of the ROW. Conductor

pulling may require some work outside of the permanent 150-foot wide ROW, for which an additional construction easement would be obtained.

4.1.3.4 Stringing and Tensioning of Conductors

Following structure construction, crews would install the conductor wires, overhead groundwire (OHGW) and an optical groundwire (OPGW) using conductor stringing sheave blocks and line pulling and tensioning equipment. The conductor, OHGW and OPGW are kept under tension during the stringing process to keep the conductor clear of energized circuits, the ground, and obstacles that could damage the conductor, OHGW, and OPGW surfaces.

Pulling and tensioning sites are typically located at 8,000- to 9,000-foot intervals and at angle point structures. Sites along tangent structures are located within the construction ROW; those at angle points typically are located partially outside of the ROW. Stringing equipment generally consists of wire pullers; tensioners; conductor, OHGW, and OPGW reels; and sheave blocks. After the conductors, OHGW, and OPGW are pulled for a section of line, they are tightened or sagged to the required design tension in compliance with the National Electrical Safety Code (NESC). The process is repeated until the OPGW, OHGW, and conductors are pulled through all sheaves. Conductor stringing also requires access to each structure once final line sag is established for securing the conductor to the insulators and OHGW or OPGW to each structure.

For public safety and property protection, temporary wooden guard structures would be used to provide temporary support when stringing conductors, OHGW, and OPGW across existing power lines, roads, highways, railroads, and other linear obstacles. The structures would be removed when stringing is complete; the guard structure holes would be backfilled, and the sites would be reclaimed. All temporary wooden guard structures would be installed within the transmission line ROW. Pipeline crossings would be identified on construction plans and may be visibly marked in the field. Matting would be installed across pipeline ROW as necessary to allow equipment safely to cross these areas. Following construction, matting would be removed and the area restored.

4.1.3.5 Structure Site Access and Traffic

Construction crews would gain access to the ROW from public roads and section line trails, as well as within the ROW itself in areas with no public access. Access for line construction would be by truck within the ROW. Structures located along section lines would be accessed from section line roads and trails where possible. For most existing access roads and trails, no additional widening, surfacing, culverts, or other improvements would be necessary. New surface access roads are not anticipated for a

majority of the line; however, they may be required in certain areas with no access. In areas with steep or rugged terrain, , access would likely be gained using helicopters and would not require additional new roads. Existing roads and trails used for construction access would be restored after construction to achieve comparable or better conditions relative to prior to construction activities. New roads would be restored to the natural condition of the surrounding area.

Project construction could affect fences and gates. Gates installed to facilitate access and to keep livestock from roaming onsite during the construction process would be left in place, with landowner concurrence, following construction of the line. Fences and gates removed during the construction process would be replaced or rebuilt following completion of construction.

Temporary overland access would be used in areas not accessible by local roadways or section line trails. If possible, access through cultivated fields would be done during the non-growing season. If crop damage were to occur, landowners would be compensated for loss of crops. Temporary overland access routes would result in temporary disturbance and compaction of soil and vegetation. Vegetation along these routes would be expected to recover quickly, as no grading would be required. Landowners would be compensated for temporary overland access routes.

4.1.3.6 Substation Construction Procedures

Construction procedures for the Roundup, Kummer Ridge, and Patent Gate Substations would be essentially the same, except for the specific equipment installed. The substation sites range from 11 acres to 17 acres, although additional area around each substation would be acquired for buffer with adjacent lands and to provide space for transmission line connections. Following survey and staking of the site, erosion control BMPs would be followed. Site access would be prepared, including installation of culverts, in road drainage, to install a gravel driveway. No clearing of forested areas is anticipated for the Kummer Ridge or Patent Gate Substations. The Roundup Substation requires removal of several hundred feet of a single-row shelterbelt. The sites would be graded and fenced. Concrete pads and footing for equipment would be installed. Aggregate would be spread throughout the fenced area. Equipment would be delivered to the sites and generally stored inside the fenced area, although some materials may need to be stored on the property outside the fence due to size or safety considerations. Equipment such as circuit breakers, bus work, capacitors, and dead-ends, would be assembled and installed. Transformers would be delivered to the sites and installed. Substation control houses and supervisory control and data acquisition equipment would be installed. Upon completion of construction activities, disturbed areas outside the fence would be restored and erosion control measures removed.

4.1.3.7 Transmission Line Maintenance and Operation

Following construction, continued access to the transmission line ROW would be needed to conduct periodic inspections, perform routine maintenance and vegetation management, and repair any damage to the transmission line or structures. Maintenance activities would be limited to the ROW, where possible, and would be in accordance with all local, state, and federal regulations and permits. Landowners would be compensated for any damages occurring during routine maintenance, inspections, or repairs.

4.1.3.8 Substation Maintenance

Substations and switching stations would be subject to regular inspections to check that equipment is in good working order and the area is neat and tidy. Faulty or worn equipment would be repaired or replaced. Trash would be collected and properly disposed of offsite. Fluid levels in transformers are monitored remotely by system operators, and the fluid levels would be regularly checked and transformers would be inspected for leaks. Batteries for emergency back-up operations would be inspected, fluid levels checked, and replaced as necessary. In the event of system disturbances, equipment would be inspected and reset as necessary. Any potential security concerns, such as damage to the fence, exterior lighting, or locks, would be addressed. The control house would be kept clean and in good structural and visual condition. All maintenance and operations activities would occur within the fenced area of the substation.

4.1.3.9 Construction Schedule and Projected Workforce

Although construction would occur over 18 months (only 12 months for the 345-kV line), individual crews may be required for only a few months in a particular construction area before moving out to another area on a subsequent phase of the Project. Additionally, construction would not be confined to one area or community, but workers would be spread out over 28 miles in four crews (one for each substation and one for the line) of approximately 20 workers each, for a total of 80 workers.

4.1.3.10 Procedures for Minimizing Environmental Impact during Construction

To protect environmental and human resources, numerous BMPs and mitigation measures have been incorporated into the development and construction of the proposed Project. These measures are varied and may be intended to address specific resource concerns, be more general in nature, or address multiple areas of concern for different resources. Minimizing measures range from avoiding sensitive resources during Project and route development to conditions for restoring the Project ROW following construction. BMPs that would be implemented as part of the Project are discussed in Appendix G. In addition, Basin Electric would comply with the conditions of any permits obtained for the Project (Appendix S). In

Section 5 of this document, other mitigation measures specific to each resource are discussed in conjunction with the analysis of Project-related impacts to the various human and natural resources.

4.1.3.10.1 Waste Management

Waste materials resulting from Project construction would be removed from the sites and disposed of in appropriate landfills. Sanitary waste would be removed from the site and disposed of according to local sanitary waste ordinances. Hazardous waste such as oil, gasoline, solvents, paint, and cleaning chemicals would be stored and disposed of in accordance with local, state, and federal regulations.

4.1.3.10.2 Reclamation

To minimize erosion following construction, disturbed areas would be graded and/or leveled to their approximate preconstruction conditions. Compacted agricultural soils would be disked or plowed to loosen the soil. Disturbed areas include temporary overland access trails, staging areas, the transmission ROW, and any other areas disturbed by Project construction activities. Reclamation activities include the removal of all temporary facilities and construction debris, completion and removal of proper erosion control measures, and re-seeding of disturbed ground. Grassland areas would be re-seeded with native species based on either the county Natural Resources Conservation Service (NRCS) recommendations or the appropriate federal agency's recommendations.

4.1.3.11 ROW and Property Issues

Basin Electric Property and Right-of-Way Division would be responsible for acquiring easements for the Project. Initially, landowners would be contacted to request their permission for property boundary surveys, biological surveys, terrain mapping, and archeological surveys. A survey permit form is not an easement, and not all properties would require all types of surveys. When a final route is approved, land values would be determined, and landowners would be contacted to start the easement process. Basin Electric staff would give the landowners ample time to review and comment on the ROW alignment and easement terms. Landowners would be compensated for the easement, for any damages to existing crops or other property features, and for potential future years of agricultural impacts from the transmission ROW and transmission structures on the property.

5.0 ENVIRONMENTAL ANALYSIS

This section describes the environmental setting as it relates to the Corridor/Route and discusses potential impacts associated with the construction and operation of the proposed Project. For this application, the Corridor/Route consists of a 150-foot wide ROW for 28.1 miles from the Patent Gate Substation to Kummer Ridge Substation. The analysis has been conducted on this ROW and, where appropriate, to the areas adjacent to the ROW. NDCC 49-22-09 lists factors to be considered in evaluating the application and designation of sites, corridors, and routes. The Commission shall be guided by, but is not limited to, the following considerations, where applicable, to aid in the evaluation and designation of sites, corridors and routes:

1. Available research and investigations relating to the effects of the location, construction, and operation of the proposed facility on public health and welfare, natural resources, and the environment;
2. The effects of new energy conversion and transmission technologies and systems designed to minimize adverse environmental effects;
3. The potential for beneficial uses of waste energy from a proposed energy conversion facility;
4. Adverse direct and indirect environmental effects which cannot be avoided should the proposed site or route be designated;
5. Alternatives to the proposed site, corridor, or route which are developed during the hearing process and which minimize adverse effects;
6. Irreversible and irretrievable commitments of natural resources should the proposed site, corridor, or route be designated;
7. The direct and indirect economic impacts of the proposed facility;
8. Existing plans of the state, local government, and private entities for other developments at or in the vicinity of the proposed site, corridor, or route;
9. The effect of the proposed site or route on existing scenic areas, historic sites and structures, and paleontological or archaeological sites;
10. The effect of the proposed site or route on areas which are unique because of biological wealth or because they are habitats for rare and endangered species;
11. Problems raised by federal agencies, other state agencies, and local entities.

For each resource, a general description of the resource is provided, followed by a discussion of potential impacts and potential mitigation measures. The impact discussion subsections describe the potential effects on each resource resulting from the Project. Based on the Corridor/Route alignment, a 150-foot-wide ROW was established to quantify the nature and extent of the impacts. For many of the resources discussed, such as vegetation and soils, impacts would be limited to this 150-foot-wide ROW. For other resources such as wildlife, recreation, and visibility, impacts may extend outside the ROW.

In addition to impacts associated with construction and operation of the proposed Project within a 150-foot-wide ROW, other potential impacts would result from construction-related facilities and activities. These would occur during the establishment of laydown and staging yards and during the development of access roads to structure locations. Impacts from these activities are discussed in general terms, as some of these details would not be known until later in the process when field survey and final design are completed and as coordination with landowners progresses.

The mitigation discussion subsections provide potential measures to reduce or eliminate anticipated adverse impacts identified. Standard mitigation measures have been incorporated into the development and construction of the proposed Project. These mitigation measures are designed to reduce or eliminate anticipated impacts resulting from the construction and/or operation of the proposed Project. They include BMPs such as spanning wetlands, using silt fencing, and applying other erosion-control measures, as well as using existing corridors where feasible for locating and constructing the transmission line. These standard mitigation measures are included in Appendix G, Standard Mitigation Measures.

5.1 Demographics

5.1.1 Description of Resources

5.1.1.1 Regional Setting

There has been an oil and gas development boom in the Bakken region that has influenced socioeconomic trends in the region over the past several years. Oil and gas development activities have occurred in the region since the 1950s. After a brief boom in the 1970s, however, the region's oil and gas activity decreased dramatically. The population of the area generally decreased between 1990 and 2000. Technology advances after the year 2000 led to population growth, especially between 2008 and the present, as oil and gas development-related workers moved into the region to take advantage of new jobs. As a result, the Bakken formation has seen rapid development due to the implementation of hydraulic fracturing processes that can access previously untapped oil-bearing features in the region.

The oil and gas industry has provided increasing employment opportunities. As a result, unemployment rates have been very low in the Project counties. Poverty rates, which were above 13 percent for the Project counties in 2000, dropped to 10.7 percent in McKenzie County and 8.0 percent in Dunn County in 2012 (U.S. Census Bureau, 2000, 2012a). The housing characteristics of the region are also influenced by the oil and gas development boom. While the majority of housing consists of owner-occupied, single family residences, the Project counties have a high percentage of mobile homes, which could be reflective of the larger transient population and of housing shortages in the region in recent years. Some cities, such as Williston, are experiencing a surplus of jobs and a housing shortage which increases the need for transient housing (Bakken Dispatch, 2011.)

5.1.1.2 Population

The Corridor/Route extends through McKenzie County in North Dakota. The three proposed substations are located in both Dunn and McKenzie Counties. The populations of these counties are shown in Table 5.1-1. These counties are predominantly rural with small populations, as compared to the State as a whole.

The population of both Project counties declined between 1990 and 2000, while the population of North Dakota as a whole remained relatively constant. As a result of the oil and gas development boom in recent years, population growth trends in the Project counties have reversed. McKenzie County experienced relatively high growth rates between 2000 and 2012, with much of this growth occurring since 2008. Dunn County experienced slower rates of population growth compared to McKenzie County.

Table 5.1-1: Population of the Region

	1990 Population	2000 Population	2012 Population	% change 1990-2000	% change 2000-2011
North Dakota	638,800	642,200	676,253	0.5%	5.3%
Dunn	4,005	3,600	3,648	-10.1%	1.3%
McKenzie	6,383	5,737	6,692	-10.1%	16.6%

Source: U.S. Census Bureau, 1990, 2000, 2012a

The Corridor/Route does not extend through any cities or towns, although there are several nearby communities. The populations of communities within the Project vicinity are shown in Table 5.1-2. In terms of population, the largest town is Watford City, followed by Killdeer and Alexander.

Table 5.1-2: Populations of Towns in the Region

Town	2012 Population Estimate
Alexander	293

Town	2012 Population Estimate
Arnegard	184
Dunn Center	133
Killdeer	965
Watford City	2,088

Source: U.S. Census Bureau 2012c

The population in the Bakken region is expected to continue rapidly increasing in the future, concurrent with the continued expansion of oil and gas development activities. Estimates indicate that the population of the State of North Dakota increased by 34,053 people between 2010 and 2012 (U.S. Census Bureau, 2012a). In addition to the permanent population of the Project counties, the region also has a high transient population, which includes drilling rig-related workers and construction workers. Official population estimates may not include these temporary workers who consider their home residence in another state. The increasing numbers of temporary workers moving to the region has heavily impacted the region's cities and towns, such as Watford City. After including the transient population, the effective population of Watford City was likely closer to 6,500 in 2010 (Smith, 2011; Ruggles, 2011). Growth in the surrounding area is predicted to be substantial over the coming years as well. Estimates indicate that the population of Williston, which is approximately 20 miles north of the Corridor/Route, could reach 25,000 by the year 2015 and reach as high as 50,000 by the year 2030 (City of Williston, 2011).

5.1.1.3 Housing

The total number of housing units within the Project counties and the State of North Dakota as a whole are displayed in Table 5.1-3 along with various characteristics of housing in the Project counties. The percent of housing that is owner-occupied is higher in the Project counties as compared to the State, with Dunn County having the highest rates. Vacancy rates are relatively low throughout the Project counties and the State as a whole, with the lowest rates occurring in McKenzie County which had a vacancy rate of less than 1 percent in 2012. Housing is of similar age throughout the Project area and the State.

Table 5.1-3: Housing Characteristics in the Region

	North Dakota	Dunn County	McKenzie County
Number Housing Units	319,468	2,201	3,125
Percent Owner-Occupied	66.4%	82.7%	69.6%
Vacancy Rate (Homeowner/Rental)	1.4% / 5.9%	2.1% / 7.4%	0.8% / 0.0%
Median Year Built	1974	1974	1974
Percent Single Family	66.8%	69.4%	81.2%

	North Dakota	Dunn County	McKenzie County
Percent Multi-Family	25.7%	5.0%	7.2%
Percent Mobile Homes, RVs, etc.	7.6%	25.6%	11.6%
Median Value	$123,900	$88,300	$104,400
Median Rent	$610	$448	$470

Source: U.S. Census Bureau 2012b

Single family housing accounts for the majority of housing in North Dakota as well as the Project counties, with McKenzie County having the highest percentage of single family housing. There is a lower percentage of multi-family housing in the Project counties compared to the State as a whole. McKenzie County has a higher percentage of multi-family housing than Dunn County. Mobile homes comprise a larger percentage of housing units in the Project counties compared to the State as a whole. In addition to permanent housing in the Project counties, an increasing amount of transient housing has been constructed and utilized in the region in the last several years. Transient housing may include man camps, recreational vehicles (RV) parks, informal RV parking, and hotels. Housing construction in the region has increased in the past several years as communities struggle to keep up with demand.

Housing values are lower on average in the Project counties as compared to the State, with median values lower in Dunn County compared to McKenzie County. Rents are also lower in the Project counties than in the State as a whole, with Dunn County having a lower median rent than McKenzie County. High demand for housing has increased rent costs and housing affordability has become an issue in heavily impacted communities, such as Watford City (Ondracek et al., 2010).

5.1.1.4 Income

Between 2000 and 2012, median household incomes increased considerably in the Project counties as well as in the State as a whole (Table 5.1-4). Poverty rates decreased slightly in North Dakota over this time period and poverty rates in the Project counties dropped as well.

In 2012, median household incomes in the Project counties were higher than the median household income for the State as a whole, with the highest incomes in McKenzie County. County poverty rates were higher than the State rate.

Table 5.1-4: Income in the Region

	Median Household Income (2000)	Median Household Income (2012)	Percent Below Poverty (2000)	Percent Below Poverty (2012)
North Dakota	$34,604	$51,641	11.9%	7.5%

Dunn County	$30,015	$54,539	17.5%	8.0%
McKenzie County	$29,342	$61,893	17.2%	10.7%

Source: U.S. Census Bureau 2000, 2012a

5.1.1.5 Employment

The labor force in the State of North Dakota increased slightly each year between 2002 and 2013 (Table 5.1-5). In the Project counties, the size of the labor force fluctuated over this time period. Between 2010 and 2013, however, the size of the labor force increased dramatically in Dunn and McKenzie Counties, increasing by 91.5 percent and 102.4 percent, respectively.

Table 5.1-5: Unemployment Rates in the Region (Labor Force/Annual Unemployment Rate)

Year	North Dakota		Dunn County		McKenzie County	
	Labor Force	Unemployment Rate (%)	Labor Force	Unemployment Rate (%)	Labor Force	Unemployment Rate (%)
2002	345,836	3.5	1,775	3.8	2,692	3.7
2003	348,929	3.6	1,818	3.6	2,747	3.7
2004	351,801	3.5	1,712	3.6	2,739	3.5
2005	355,874	3.4	1,732	3.4	2,694	3.7
2006	360,913	3.2	1,730	3.3	2,809	3.2
2007	366,467	3.1	1,688	3.9	2,922	3.1
2008	370,270	3.1	1,750	3.1	3,107	2.4
2009	372,748	4.1	1,793	4.2	2,930	3.2
2010	377,516	3.8	2,130	3.2	3,518	2.2
2011	384,691	3.4	2,914	2.0	4,433	1.7
2012	394,987	3.0	3,666	1.4	5,883	1.5
2013	400,588	2.9	4,080	1.3	7,122	1.4

Source: Bureau of Labor Statistics, 2014

Unemployment rates in North Dakota and within the Project counties were relatively low between 2002 and 2013. The State's annual unemployment rate was below 4 percent for all years in this time frame except 2009, as was also the case for Dunn County. In McKenzie County, the unemployment rate was below 4 percent for all years between 2002 and 2013.

In conjunction with the increased oil and gas development activities in the region, monthly unemployment rates have varied in the Project counties between June 2013 and June 2014 (Table 5.1-6). McKenzie County saw a decrease in September and October 2013 to 1.1 percent unemployment, which rose to 1.7 percent in June 2014. Dunn County also saw a decrease in unemployment in October 2013

when the unemployment rate dropped to 0.9 percent. The unemployment rate of Dunn County was 1.2 percent in June 2014.

Table 5.1-6: Monthly Unemployment Rates in the Region

Month	Unemployment Rate (%)		
	North Dakota	Dunn County	McKenzie County
June 2013	1.2	1.4	1.7
July 2013	1.2	1.2	1.4
August 2013	1.0	1.2	1.2
September 2013	0.9	1.0	1.1
October 2013	1.0	0.9	1.1
November 2013	1.3	1.0	1.2
December 2013	1.3	1.3	1.4
January 2014	1.3	1.3	1.7
February 2014	1.5	1.5	1.7
March 2014	1.4	1.4	1.9
April 2014	1.1	1.1	1.5
May 2014	1.0	1.0	1.5
June 2014	1.2	1.2	1.7

Source: Bureau of Labor Statistics, 2014

The top three industries in terms of employment for the State and Project counties include educational services; retail trade; and agriculture, forestry, fishing and hunting, and mining (Table 5.1-7).

Table 5.1-7: Employment by Industry in the Region

Industry	Employment by Industry (%)		
	North Dakota	Dunn County	McKenzie County
Agriculture, forestry, fishing and hunting, and mining	8.8	30.7	25.6
Construction	7.1	10.3	6.0
Manufacturing	7.2	5.7	4.7
Wholesale trade	3.3	2.3	1.5
Retail trade	12.3	10.0	7.6
Transportation and warehousing, and utilities	5.4	6.2	7.3
Information	1.6	1.0	0.6
Finance and insurance, and real estate and rental and leasing	5.9	1.8	4.7
Professional, scientific, and management, and administrative and waste management services	6.6	3.4	4.5

Industry	Employment by Industry (%)		
	North Dakota	Dunn County	McKenzie County
Educational services, health care and social assistance	24.6	18.1	17.1
Arts, entertainment, and recreation, and accommodation and food services	7.9	5.2	8.6
Other services, except public administration	4.6	2.3	4.2
Public administration	4.9%	3.0%	7.6%

Source: U.S. Census Bureau 2012a

5.1.1.6 Racial and Ethnic Characteristics

In the State of North Dakota, the majority of the population is white (Table 5.1-8). The largest minority group in the State is American Indian. Compared to the State, Dunn and McKenzie Counties have lower percentages of white residents and higher percentages of American Indian residents. The Fort Berthold Reservation extends through portions of the Project counties, and this could explain the higher percentages of American Indian residents. Other minority groups, including Asian, Hawaiian or Pacific Islander, and Hispanic, comprise similar percentages of the population in all of the Project counties as compared to the State as a whole.

Table 5.1-8: Population by Race and Ethnicity in the Region

	2012 Population	Race or Ethnicity							
		White	Black	American Indian	Asian	Hawaiian / Pacific Islander	Other	Two or more races	Hispanic or Latino of Any Race
North Dakota	676,253	90.0%	1.2%	5.3%	1.0%	0.1%	0.7%	1.7%	2.1%
Dunn County	3,648	85.3%	0.3%	8.8%	1.4%	0.1%	1.6%	3.3%	2.1%
McKenzie County	6,692	76.6%	0.2%	20.4%	0.6%	0.0%	0.9%	1.6%	2.7%

Source: U.S. Census Bureau 2012b

5.1.1.7 Property Valuation and Taxation

Local and state governments generate a portion of their tax revenues by assessing and taxing certain categories of property. In North Dakota, property taxes are levied on real property owned by a corporation, partnership, individual, estate, or trust. Taxation is based on the value of the object that is taxed. Table 5.1-9 presents property tax revenue for Project counties and the State (Fong, 2010).

Table 5.1-9: Property Tax Revenue in the Region, Payable 2008-2012

	Total Property Tax Revenue				
	2008	**2009**	**2010**	**2010**	**2011**
Dunn County	$4,257,953	$4,273,671	$3,587,498	$43,693,032	$4,029,511
McKenzie County	$3,808,607	$4,002,063	$3,310,266	$3,667,888	$4,261,718
Project Counties Total	$8,066,560	$8,275,734	$6,897,764	$47,360,920	$8,291,229
North Dakota	$740,540,738	$776,398,475	$678,749,378	$721,988,243	$757,769,003

Source: Fong, 2012

The primary laws that determine how transmission lines are taxed in North Dakota are in Chapter 57-33.2 and 57-06-17.3 of North Dakota's Century Code. Chapter 57-33.2 applies only to lines whose voltage is 40.6-kV or more, and 57-06-17.3 applies only to lines whose voltage is 230-kV or more. Transmission lines that are taxable under 57-33.2 pay a rate ranging from $50 to $600 per mile, depending on the voltage of the line. If the line was placed in service after January 1, 2009, however, it is exempt from taxes during its first year. Its taxes are reduced by 75 percent the second year, 50 percent the third year, and 25 percent the fourth year, after which the standard rates are applied.

Transmission lines are not taxable under Chapter 57-33.2 if they were placed in service after October 1, 2002, and are of 230-kV or greater. They are taxable under Chapter 57-06-17.3, at a rate of $300 per mile. These lines also are exempt from taxes during their first year, followed by a 75 percent reduction in their second year, 50 percent in their third year, and 25 percent in their fourth year of operation.

Transmission line tax revenues accounted for less than 1 percent of the total property tax revenue in North Dakota in 2013. Total property tax revenues levied in 2012 (payable in 2013) were $918,715,410, of which electric generation, distribution, and transmission taxes statewide accounted for 0.88 percent of this total, or $8,050,056 (Fong, 2013). The share of this figure accounted for specifically by transmission lines was not available for the taxes levied in 2012. However, this share was available for the taxes levied in 2011 (payable in 2012). In 2011, transmission line taxes accounted for $1,360,977 of $8,111,292 of total electric generation, distribution, and transmission taxes levied, or approximately 16.8 percent (Fong, 2013). Due to the similarity of the total revenue generated in each year, it is likely that transmission line taxes levied in 2012 accounted for a similar share of the total electric generation, distribution, and transmission tax revenue for that year.

5.1.2 Impacts

Socioeconomic resources include elements of the human environment such as population characteristics, employment and other economic factors, public services, and human health and safety. These resources are characterized, measured, and tracked at levels such as census block groups and tracts, counties, and the State as a whole. The effects of the proposed Project on these types of factors are typically not limited to the ROW itself but measured by the effects that would result to the wider geographic areas for which indicators in these areas are recorded. Effects typically are limited to the county or census block levels, as the influence of the Project on social and economic trends in the State would generally be temporary, short-term, and inconsequential when compared to all the activities at the broader state level.

Construction and operation of the proposed Project would result in both direct and indirect socioeconomic impacts. Potential socioeconomic impacts include:

- Improved electric reliability and increased capacity for existing, developing, and future customers
- Temporary increase in population as a result of the influx of construction workers
- Temporary increase in demand for temporary lodging facilities as a result of the influx of construction workers
- Temporary increase in demand and spending for local goods, services, and construction materials from construction of the proposed Project
- Potential changes to property values
- Proximity of the new line to existing residences

5.1.2.1 Regional Economy

As discussed above, the regional economy of northwest North Dakota is heavily influenced by the rapid and widespread oil and gas development associated with the Bakken oil shale fields. The level of development that has occurred and is planned for the future in the Bakken region likely requires increased infrastructure throughout the region, including an increase in electrical transmission capacity and reliability. As a vital component to provide power for heating, lighting, and machinery for commercial and industrial development, the continued reliable electric service to the region is necessary to serve the needs of business and enable the economy of the area to continue to develop.

Under the proposed Project, construction of a new 345-kV transmission line through McKenzie County and the load serving substations in McKenzie and Dunn Counties that connects directly to the 115-kV system would provide an increase in the load-serving capacity to accommodate the long-term electrical needs of northwest North Dakota. The Project would accommodate load growth and the reliability of the

regional transmission system would be maintained, continuing to serve the electricity needs of the area and make the region attractive for additional growth and development opportunities.

In addition to electrical support for the economy of the area, Project construction would itself generate a certain amount of economic activity in and around the area of transmission line construction.

The Project would require approximately 80 temporary construction workers to construct the transmission line and the proposed Patent Gate, Kummer Ridge, and Roundup substations. These workforce numbers are based on the assumption that the proposed Project would require four construction crews, each with a 20-person crew, for construction of the three separate substations and the transmission line route.

While minimal when compared to the current sales throughout the region, the presence of approximately 80 additional construction workers over an 18-month period (only 12 months for the line crew) would generate additional sales of food, fuel, lodging, and services (primarily vehicle and equipment repairs). Construction workers would introduce an additional approximately $5.1 million into the local economy in the two Project counties over the 18 months of construction (GSA, 2014).[4] Construction activities would also require concrete, aggregate, lumber, and hardware items. These materials likely would be purchased locally, contributing further to local sales. Most material comprising the structures themselves and the conductor would be shipped from manufacturers outside the region. However, many of these materials may be subject to sales and subsequent property taxes payable to local jurisdictions, which would benefit local public facilities like roads and schools.

5.1.2.2 Population

The Project region has seen a dramatic increase in population over the past several years as a result of the economic activity and availability of jobs in the area. Table 5.1-1 shows a population increase in both Project counties between 2000 and 2010, amounting to over 1,000 new permanent residents. A considerable number of additional individuals moving to the area are temporary or semi-permanent, relocating to the area for short-term financial incentive or until work assignments are expended. Construction of the proposed Project would provide similar types of population changes. Transmission line construction generally requires specialized equipment, contractors, and labor. As such, line construction contractors and workers would temporarily relocate to the Project area. Construction would include clearing, foundation construction, structure erection, line stringing, and restoration work. Although construction would occur over 18 months, individual crews may be required for only a few

[4] Conservatively estimated based on IRS 2014 North Dakota Standard Per Diem rate of $129 per day for 80 workers at total of 365 days plus an additional 182 days for 60 workers. As per diem would be dollars spent on lodging and food it is reasonably assumed to be spent locally as opposed to sent home or saved.

months before moving out of the area when construction moves on to the next phase of Project development. Because of the short-term residency, most workers would not relocate their families.

Additionally, construction would not be confined to one area or community. Workers would be spread out over nearly 28 miles in four crews of approximately 20 workers each, for a total of 80 workers. Temporary housing for workers would likely include available facilities at several towns throughout the area as well as at man camps and RV parks in more remote locations. The larger towns of Williston, Beulah, Watford City, and Tioga would likely be most impacted by this temporary population increase as workers would seek to take advantage of amenities offered in these towns. Population changes in local communities would be negligible (only 80 people Project-wide), particularly compared to the current population and growth in the area (Table 5.1-1 and Table 5.1-2). Because this is a transmission line project, no additional permanent jobs requiring permanent staff that would add to the local population are anticipated as a result of this Project.

5.1.2.3 Housing

The construction workforce required for the Project would have an impact on the availability of temporary housing in the Project area. Many of the construction workers would seek temporary housing for varying time periods based on their individual roles in the proposed Project. The construction contractor may establish longer-term housing, with crews rotating in and out, as their assignments begin and are completed. Dunn and McKenzie Counties have a very limited supply of temporary housing units available for use by construction workers relocating to the area on a temporary basis. Short-term housing is likely to experience the largest increase in demand due to the transient nature of construction workers and their limited duration in the Project area. Generally, housing options for construction crews would consist of area hotels, existing man camps, or RV camps. No centralized housing locations would be established during construction of the proposed Project, as construction would likely involve multiple construction crews based in different locations along the Project route.

It is not anticipated that permanent employees would be required for the proposed Project. No additional requirements for permanent housing would occur in the Project areas following completion of construction activities.

5.1.2.4 Employment and Income

Project-related construction jobs would provide a short-term influx of income to the area and may result in a small positive economic impact to the region. Basin Electric would use local labor to the extent practicable. However, the specialized workforce skills required for the Project may limit the number of

workers that would be hired locally, and permanent jobs are not anticipated to be added to the area. Expenditures of wages, approximately $5.1 million total in per diem, by workers temporarily relocating to the area would benefit businesses in the local communities, but any changes would be minimal compared to existing salary and wage expenditures in the area. Wages for Project construction workers would be approximately $8.6 million.[5] This would represent only a little more than 1 percent of the salaries and wages paid within the Project counties in 2012, which were reported by the U.S. Bureau of Economic Analysis to have exceeded $714.3 million (BEA, 2012). Any benefits to local businesses as a result of spending associated with this Project would not be substantial enough to require hiring additional staff.

Short-term indirect positive economic impacts would also result from construction of the proposed Project, as revenue would likely increase for some local businesses, such as hotels, restaurants, gas stations, and grocery stores, due to increased spending from construction workers. The spending would create minimal socioeconomic impacts to the overall region due to the small number (up to a maximum of 80) of construction workers, the short term temporary nature of Project construction, and construction activity being dispersed across two counties.

The proposed Project would induce positive socioeconomic impacts as a result of increasing transmission capacity and reliability. Additional capacity would provide electricity for the expanding Bakken oil field development activities and other future potential development activities in the region. A reliable supply of electricity would continue to support the expanding economy of the region, indirectly supporting the creation of new jobs and existing jobs.

5.1.2.5 Property Values

New ROW for the construction and maintenance of the new transmission line would be required for the Project. Existing access roads would be used where possible, but additional access road easements would likely be acquired. Basin Electric would pay market value to non-federal landowners, as established through the land evaluation process, for any new land rights required for the proposed Project. The process takes many factors affecting property value into consideration, including the impact of transmission lines on property value. The appraisals may reference studies conducted on similar properties to support their conclusions. The strength of any appraisal depends on the individual analysis of the property, using neighborhood-specific market data in order to determine market value.

[5] Conservatively estimated using an average salary for transmission line construction workers of $25/hour, working 10 hour days, 6 days per week for 18 months for a construction work force of up to 80.

The impact of introducing new ROW for transmission structures and lines can vary dramatically, depending on the placement of the ROW in relation to a property's size and shape and the location of existing improvements. A transmission line may diminish the utility of a portion of property if the line effectively severs an area from the remaining property. These factors, as well as other elements unique to the property, are taken into consideration to determine any loss in value within the easement area, as well as outside the easement area in cases of severance.

A common concern when land uses change is what effect the change may have on property values nearby. The question of whether nearby transmission lines can affect residential property values has been studied extensively in the U.S. and Canada over the last 20 years with mixed conclusions. In general, the impacts are difficult to measure, vary among individual properties, and are influenced by a number of interplaying factors, including:

- Proximity of residential properties to transmission line structures;
- Type and size of high-voltage transmission line structures;
- Appearance of easement landscaping; and
- Surrounding topography (Jackson, 2010).

Jackson and Pitts (2007) summarize the following conclusions on the impacts of high-voltage transmission lines:

- When negative impacts are present, studies report an average decline of prices from 1 to 10 percent
- Value diminution is attributable to the visual unattractiveness of the lines, potential health hazards, disturbing sounds, and safety concerns
- Where property value impacts were present, the effect dissipated with time and distance
- Impacts diminish as the distance between the high-voltage transmission lines and the affected properties increase, and generally disappear completely at a distance of 200 feet from the lines
- Where views of transmission lines and towers are completely unobstructed, negative impacts can extend up to 0.25 mile
- If high-voltage transmission-line structures are at least partially screened from view by trees, landscaping, or topography, any negative effects are reduced considerably
- Value diminution attributed to high-voltage transmission-line proximity is temporary and usually decreases over time, disappearing completely in 4 to 10 years

A recent study of sales of rural land parcels in central Wisconsin during the period 2002 through 2008 found small but not statistically significant negative price effects on the sale of properties encumbered by a transmission line easement (Jackson, 2010). A study by J.A. Chalmers analyzed nearly 600 miles of a 500-kV line stretching across Montana, extending from Colstrip in the southeast corner to the state border near Taft (Chalmers, 2012a, 2012b, 2012c). Chalmers' research reports on sales dynamics involving properties that sold between 2000 and 2010 within 500 feet of the centerline of the Colstrip-Bonneville Power Administration line.

With regard to the circumstances that may affect vulnerability to transmission line impacts in rural settings, Chalmers suggests three general principles based on his study of this line:

- When a property's sole use is residential, its vulnerability to price impacts from a transmission line increases
- As property size increases, vulnerability to negative market impacts from a transmission line decreases
- If substitutes are available, vulnerability to price impacts and marketing delays can increase

To varying extents, price impacts and market delays associated with the 500-kV line on small rural residential parcels are clearly noted in the Chalmers study. The same report did not find evidence of transmission line impact on sales involving production agricultural properties. Based on a small number of case studies, the research found no impact on the sales of recreationally influenced agricultural lands due to the presence of the Colstrip-Bonneville Power Administration line.

Studies of impacts during periods of physical change, such as new transmission line construction or structural rebuilds, generally reveal greater short-term impacts than long-term effects. However, most studies have concluded that other factors (e.g., general location, size of property or structure, improvements, irrigation potential, condition, amenities, and supply and demand factors in a specific market area) are far more important criteria than the presence or absence of transmission lines in determining the value of residential real estate.

Some impacts on property values (and salability) might occur on an individual basis as a result of the new transmission line. There are low adverse effects expected to property values near the transmission line, and these impacts would be highly variable, individualized, and unpredictable. Additionally, reductions in property values associated with reduced agricultural production would be mitigated with compensation for fair market value losses. Most of these losses would be temporary in nature.

5.1.2.6 Property Taxes

The construction, operation, and maintenance of the transmission line would generate additional property taxes to counties where the line would be located. Table 5.1-10 summarizes these tax receipts to local governments association with the 28.1 miles of transmission line. Additionally, there would be property taxes collected from the substation properties.

Table 5.1-10: Property Tax Revenues to McKenzie County Associated with the Corridor/Route*

	Corridor/Route (miles)	Year 2	Year 3	Year 4	Years 5-45
McKenzie County	21.8	$1,635	$3,270	$4,905	$6,540

Source: Staff calculations based on North Dakota Title 57, Taxation, n.d.
* - Tax revenues would also be collected for the Patent Gate and Kummer Ridge Substations in McKenzie County, and the Roundup Substation in Dunn County.

5.1.2.7 Impacts to Residences

Short-term impacts to nearby residents as a result of the proposed Project would include temporary disruptions during construction. These would include increased noise from construction activities and equipment, the visual presence of construction equipment, and potential traffic disruptions and congestion resulting from construction trucks and equipment accessing the ROW, using local roads, and potential short-term road closures during conductor stringing. Long-term impacts to nearby residents as a result of operation of the proposed Project would include minor, infrequent disturbance during any maintenance or repair activities.

The transmission line was routed to minimize impacts to residences, and the Project would not result in any displacement of residences. Due to the fast-paced expansion of oil and gas development in the region and the associated expansion of housing development, additional temporary residences may be constructed in the vicinity of the Project. Basin would continue to monitor this development and identify potential effects of the Project on new residences.

5.1.3 Mitigation

- The construction contractor, after assessing utilization of existing housing availability, should plan to establish its own housing in the form of man camps and/or RVs brought in from outside the region to a number of locations secured by the contractor.

- Basin Electric and its contractors would work with agricultural producers to minimize disruptions during the harvest season and to limit the impact on the farmers' ability to maneuver equipment in the vicinity of the immediately affected area.
- Basin Electric and its contractors would work with individual landowners to try to coordinate the timing of construction to minimize short-term impacts on agriculture.
- Basin Electric and its contractors would initiate discussions with local fire and police districts prior to construction and work with the districts and other appropriate emergency response providers to develop fire and emergency response plans.

5.2 Land Use

5.2.1 Description of Resources

5.2.1.1 Regional Setting

The Corridor/Route extends through portions of McKenzie County in northwestern North Dakota. Watford City, located in McKenzie County, is the largest city in the Project vicinity. Several other small towns are scattered throughout the area. State and federal properties managed by various agencies are located within the Project vicinity, and include the LMNG and USFWS conservation easement lands, as well as state wildlife management areas (WMA) and school trust lands.

5.2.1.2 Existing Land Use

The Project counties contain large expanses of rural, undeveloped areas with scattered rural residences and farmsteads interspersed throughout. Land use within the Project area consists of a mixture of grassland and rangeland, with smaller areas of woodland, cropland, and developed lands. Numerous oil and gas wells are scattered throughout the area.

5.2.1.3 Zoning

The Project requires Conditional Use Permits (CUP) from McKenzie and Dunn Counties. The proposed substations require zoning changes from agricultural use to industrial use in both Dunn and McKenzie Counties. Copies of these approvals would be filed to the Commission docket separately. A CUP for Kummer Ridge and Patent Gate substations and the 345-kV line connecting them would be filed in McKenzie County. A CUP for Roundup Substation would be filed in Dunn County.

5.2.1.3.1 Dunn County Zoning

The Dunn County Land Development Code, adopted March 7, 2012, regulates development in the areas of Dunn County that are outside the jurisdiction of the Bureau of Indian Affairs and the municipalities of

Dodge, Dunn Center, Halliday, and Killdeer (Dunn County Planning Commission, 2012). There are three zoning districts established by the development code, which include Rural Preservation, Rural Development, and Municipal Development. Transmission lines are a permitted use in all three zoning districts. The development code also includes regulations for a Floodplain Overlay District.

5.2.1.3.2 McKenzie County Zoning

The McKenzie County Zoning Ordinance, adopted in March 2013, applies to all unincorporated areas of the county, except those townships that have not relinquished zoning power to the county (McKenzie County Commission, 2013a). The county is divided into seven zoning districts, which include Agricultural, Low Density Residential (R-1), Medium Density Residential (R-2), High Density Residential (R-3), Recreational, Commercial, and Industrial. Electric transmission lines and associated facilities are specified as a conditionally allowed use in the Agricultural and Industrial Districts. Transmission lines are a conditionally allowed use in the Recreational District. Public utilities, which include facilities for electricity by definition, are a conditionally allowed use in the R-1, R-2, and R-3 Districts. Transmission towers are listed as a conditionally allowed use in the Commercial District. The Ordinance also establishes two overlay districts, including Planned Unit Development (PUD) Overlay and Floodplain Overlay.

5.2.1.4 Comprehensive Plans

The Dunn County Comprehensive Plan, adopted October 12, 2011, establishes a vision for future development of the county (Dunn County Planning Commission, 2011). The primary vision described in the comprehensive plan is to maintain the existing quality of life for Dunn County residents while taking advantage of opportunities created as a result of the expanding oil and gas development industry. The plan includes general goals and objectives for land use, transportation, housing, economic development, public services, infrastructure, natural resources, intergovernmental cooperation, and planning.

The McKenzie County Comprehensive Plan, approved in January 2013, provides goals, objectives, and implementation strategies for the county, as it confronts growth and development issues in the agriculture and energy sectors (McKenzie County Commission, 2013b). Areas addressed by the plan include economic development, government, natural resources, land use, public facilities and services, transportation, recreation, and housing.

5.2.1.5 State and Federal Properties

The Project counties include portions of the following state and federal lands (Figure 5.2-1).

5.2.1.5.1 USFS Lands

The LMNG includes nearly 1.3 million acres of publicly owned lands administered by the USFS (USFS, 2010). There are no USFS lands within the Study Corridor. The LMNG is located throughout portions of McKenzie County. In addition to providing recreational opportunities, these lands also support livestock grazing and oil and gas production. Portions of the LMNG are designated as Inventoried Roadless Areas, or areas identified as lands without existing roads that could be suitable for conservation as a wilderness area. Many of the Roadless Areas are associated with badland areas adjacent to the Little Missouri River and TRNP. The Corridor/Route does not cross the LMNG or any special management areas designated as Roadless Areas within the LMNG.

5.2.1.5.2 USACE Lands

The USACE oversees management of Lake Sakakawea and the public lands surrounding the lake. USACE partners with various federal, tribal, state, and local entities for management of various parks and recreational facilities and WMAs on these lands (USACE, 2007). A small portion of the USACE land around Lake Sakakawea is within the Project area. There are no UASCE lands within the Study Corridor.

5.2.1.5.3 North Dakota School Trust Lands

School trust lands, which are managed by the North Dakota State Land Department, are scattered throughout the Project area. School trust lands are leased for the purpose of generating income for the schools and designated trust funds of the State (N.D. State Land Department, 2011). The majority of the lands are leased for grazing. These lands are also open to the public for walk-in recreational uses such as hunting, fishing, hiking, and bird watching.

5.2.1.5.4 North Dakota Game and Fish Department Lands

The NDGFD manages state WMAs in the Project counties. There are no WMAs within the Study Corridor, but several throughout the Project counties. In McKenzie County there are three WMAs managed by the NDGFD: Och's Point WMA, Neu's Point WMA, and Sullivan WMA. In Dunn County there are two WMAs: Killdeer Mountains and Lost Bridge.

5.2.1.5.5 Bureau of Land Management Lands

While there are no BLM lands within the Study Corridor, BLM land does exist within the Project counties. McKenzie County BLM parcels are sparse and scattered throughout the county. In Dunn County, BLM lands are primarily located in the northwest corner of the county near the McKenzie County line. There is over 15,000 acres of BLM land in Dunn County. There is slightly more than 5,500 acres of BLM land in McKenzie County.

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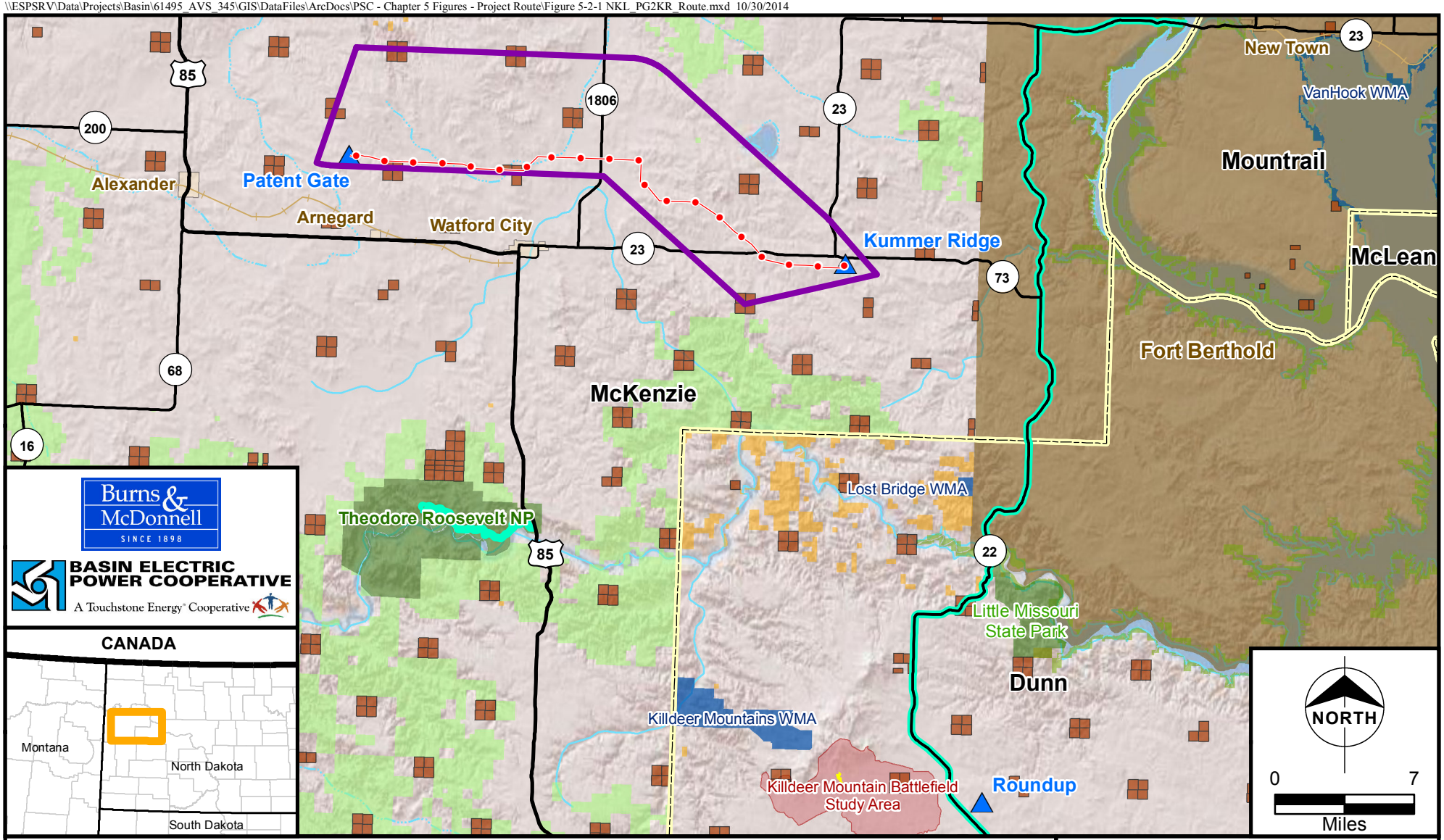

Figure 5.2-1
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Federal and State-Owned Lands

Source: North Dakota GIS; Esri; Basin Electric; Burns & McDonnell.

Revised October 30, 2014

5.2.2 Impacts

A land use impact is one that restricts the future use of land or conflicts with an existing use. Transmission lines tend to restrict certain activities but may or may not change the land use.

Construction and operation of the proposed Project would result in both direct and indirect impacts to land use. Potential impacts to land use include:

- Temporary and permanent land use changes
- Restrictions on activities within the ROW
- Inconsistency with local land use plans and zoning
- Removal of land from future development
- Potential use restrictions or conflicts with school trust lands

5.2.2.1 Agricultural Land Use Impacts

The majority of the land crossed by the proposed Project is grassland and cropland. Long-term land use impacts to grassland, cropland, and pasture would be primarily the result of structure placement, ROW maintenance, and access roads. Current agricultural practices would be maintained for most of the ROW. Areas of cropland within the ROW could continue to be farmed. The only land that would be unavailable for agriculture would be the area occupied by structures located within tillable areas. This area is estimated to be an area of about 7 feet in diameter, which is equivalent to 38.5 square feet or 0.0009 acres per structure, or approximately 0.1 acres overall. There would be approximately 165 structures for the Corridor/Route. This land would be removed from production, and structures would present obstacles that would need to be avoided. Impacts on pastureland would also be negligible, because grazing could continue within the ROW. Structures would remove small areas of land from forage production, and structures would present obstacles to haying equipment. Overall, however the line would result in approximately 0.1 acres of reduction in agricultural production or land available for agricultural activities.

Easements would be obtained from landowners along the Corridor/Route for the purpose of constructing and maintaining the transmission line. The landowner would maintain ownership of the property and continue to pay taxes on the property, but Basin Electric would acquire an easement allowing them to construct and maintain a transmission line ROW in exchange for a monetary payment to the landowner. The easement agreement between the landowner and Basin Electric would outline any use restrictions applying to the easement. The easement agreement would include certain restrictions on the continued use of the ROW, such as prohibiting permanent structures and establishment of certain types of vegetation

within the ROW that could affect access to the line or safe and reliable operation. The land could still be used for agriculture.

During construction and maintenance activities, agricultural lands would be subject to temporary impacts. Depending on the time of year, access for construction could result in damage to crops, compaction and rutting of soil, restrictions on access to the ROW, and restrictions on general agricultural practices in and around the ROW (such as prescribed burning of grassland pasture). Landowners would be compensated for crop and forage loss, and any damage to soils would be redressed. Cattle may need to be re-located or confined away from the ROW areas of pasture during construction. Following completion of construction, disturbance and disruption to agricultural activities would largely cease. Periodic maintenance activities and emergency repairs would result in impacts similar to those for construction. However, these activities would be infrequent over the life of the Project. Landowners would be compensated for any damage, and the ROW would be restored to previous conditions.

In addition to the ROW for the transmission line and substations locations, two temporary construction material and equipment laydown areas would be necessary for the duration of construction. The Patent Gate Laydown Yard was identified and developed to support the AVS to Neset 345-kV Transmission Project (PU-11-696). This laydown yard will also serve the NKL Phase I Project. In addition, the Kummer Ridge parcel will be utilized as a material laydown yard. In total, approximately 511.2 acres of ROW would be required for the Project. These lands would be restricted from various types of future development but agricultural uses could continue. Table 5.2-1 shows the acreages of each land use type within the Corridor/Route. The majority of the Corridor/Route consists of grassland and cultivated cropland, with a small percentage consisting of pasture/hay land, developed lands, and woodland. Impacts to all land use types would include the temporary loss of use for landowners within the Corridor/Route to allow for line construction. Temporary disturbance from heavy equipment within the ROW may result in the loss of some crops during construction.

Table 5.2-1: Acres of Land Affected within Corridor/Route

Land Use (acres)	Project Corridor/Route
Grassland	282.5
Cultivated cropland	141.0
Pasture/hay	6.4
Developed lands	25.4
Barren Lands	2.8
Emergent Wetland	0.95

Land Use (acres)	Project Corridor/Route
Shrub/Scrub	46.7
Woodland	5.5
Total	**511.2**

Source: NLCD

Three new substations would also be constructed as part of the Project. Construction would take place on approximately 42 acres of land. Substation construction would result in the permanent conversion of approximately 42 acres from agricultural land to utility land use.

5.2.2.2 Zoning and Land Use Plans

Local zoning ordinances and comprehensive plans were examined for potential conflicts between the proposed Project and current land uses and future development plans. The Corridor/Route would extend through Dunn and McKenzie Counties. Transmission lines and substations are a permitted or conditional use in these counties. As the Corridor/Route would extend across organized townships that have specific land use requirements, applicable county and township zoning and land use approvals would be obtained for the proposed Project prior to construction.

The Project would be consistent with the identified zoning ordinances or comprehensive plans because transmission lines and substations are a permitted or conditional use in all these jurisdictions. Therefore, the Project would not be anticipated to conflict with zoning and land use plans. Applicable zoning and land use approvals would be obtained prior to construction.

5.2.2.3 State and Federal Properties

The proposed Corridor/Route would not cross any federal property; however, it would cross lands owned by state agencies. Within the proposed Project area, school trust land parcels consist of approximately 36.4 acres. These lands are used to generate revenue for schools from grazing and agricultural uses and the extraction of mineral resources such as aggregate and oil and gas production. The Corridor/Route would cross four school trust land parcels, for a total of approximately 36.4 acres within the ROW. Of the 36.4 ROW acres, 33.1 acres are grassland, 0.0 acres are in cultivated crops, 0.0 acres are wetlands, 0.0 acres are woodland, 2.6 acres are shrub/scrub, 0.6 acres are developed, and 0.0 acres is barren land. Shrub/scrub areas would be permanently converted to cleared ROW suitable for agricultural activities. No permanent changes in land use, inconsistent with the current school land requirements within these parcels are anticipated as a result of the proposed Project. Temporary impacts would be expected during construction, with permanent impacts to grasslands and cultivated cropland occurring only at structure

locations. An easement to cross these public lands would be needed from the North Dakota Department of Trust Lands for these portions of the route. Basin Electric has been in communications with the Department to determine if the Project would impact the ability of the Department of Trust Lands to continue to develop the school trust lands per its planning.

During construction, public use of lands within and adjacent to the proposed ROW would be restricted for security and safety of the line, construction workers, and the public. Following construction, these lands would be available for public use.

5.2.3 Mitigation

- Basin Electric and its contractors would coordinate with landowners for potential measures to minimize Project impacts on uses on specific properties.
- Basin Electric and its contractors would coordinate with appropriate state land management agencies to obtain appropriate permits and easements for portions of the Corridor/Route traversing public lands.
- Basin Electric and its contractors would obtain the appropriate permits as necessary to comply with county and township zoning ordinances.
- Basin Electric and its contractors would plan and conduct construction activities to minimize temporary disturbance, displacement of crops, and interference with agricultural activities.
- Basin Electric and its contractors would restore compacted cropland soils as close as possible to pre-construction conditions using tillage.
- Basin Electric and its contractors would compensate landowners for any new land rights required for ROW or access road easements.
- Basin Electric and its contractors would compensate landowners at market value for any new land rights required for ROW easements or acquired for new temporary or permanent access roads on private lands. This should include compensation at market values for agricultural production lost during the construction period.

5.3 Infrastructure/Transportation

5.3.1 Description of Resources

5.3.1.1 Regional Setting

Northwestern North Dakota is currently experiencing a rapid increase in development as a result of the activities associated with the extraction of oil from the Bakken shale. In North Dakota, Bakken shale

development is currently concentrated in McKenzie, Mountrail and Williams Counties. The level of development that has occurred and is planned for the future will require an increase in electrical transmission capacity and reliability, associated substations, pipelines, roadways, water supply, and wastewater treatment.

Historically, northwestern North Dakota has had minimal infrastructure compared to more populated regions of the United States. This area consisted of small communities and rural farmsteads, with agricultural activities, along with past and current oil development, as the primary factors in defining most infrastructure needs. Populations, until recently, were steady or declining, and new infrastructure projects were not as necessary as they are presently.

Infrastructure development related to the recent expanding oil and gas industry activity in the region includes pipelines, rail, natural gas plants, roads, and transmission/distribution line development. Pipeline infrastructure is under development to transport crude oil out of the Bakken oil field to refinery and marketing hubs, such as the U.S. Gulf Coast, as well as to transport natural gas, fracking water, and salt water. Crude oil is being transported by rail out of the Bakken oil field, and expansion of rail infrastructure and associated loading and unloading facilities is under development. Natural gas plants are expanding to process natural gas for consumer use. Local transmission lines for distribution have recently been constructed or are in development in western North Dakota to support the expanding drilling activity and supporting infrastructure. Existing roadways often require expansion and more frequent maintenance due to increased industrial activity in the region, and new roadway projects are being developed for the region. Further discussion regarding utility infrastructure and transportation infrastructure in the region is found in the following sections. Figure 5.3-1 shows some of the existing utility and transportation infrastructure within the Project area.

5.3.1.2 Utility Infrastructure

5.3.1.2.1 Pipelines

Numerous existing pipelines are located within the Project area, with additional pipelines currently being constructed or planned for construction in the near future. Increasing oil and gas industry activity has facilitated the construction of numerous crude oil and natural gas pipelines. More pipelines occur west of the Project area due to that region's more favorable location for oil and gas activity. Natural gas pipelines typically consist of a network of gathering pipelines, which transport natural gas to refining gas plants, and a network of transmission pipelines, which transport treated natural gas to markets both within and out of state. There are also numerous crude oil pipelines that occur within the Project counties, and one

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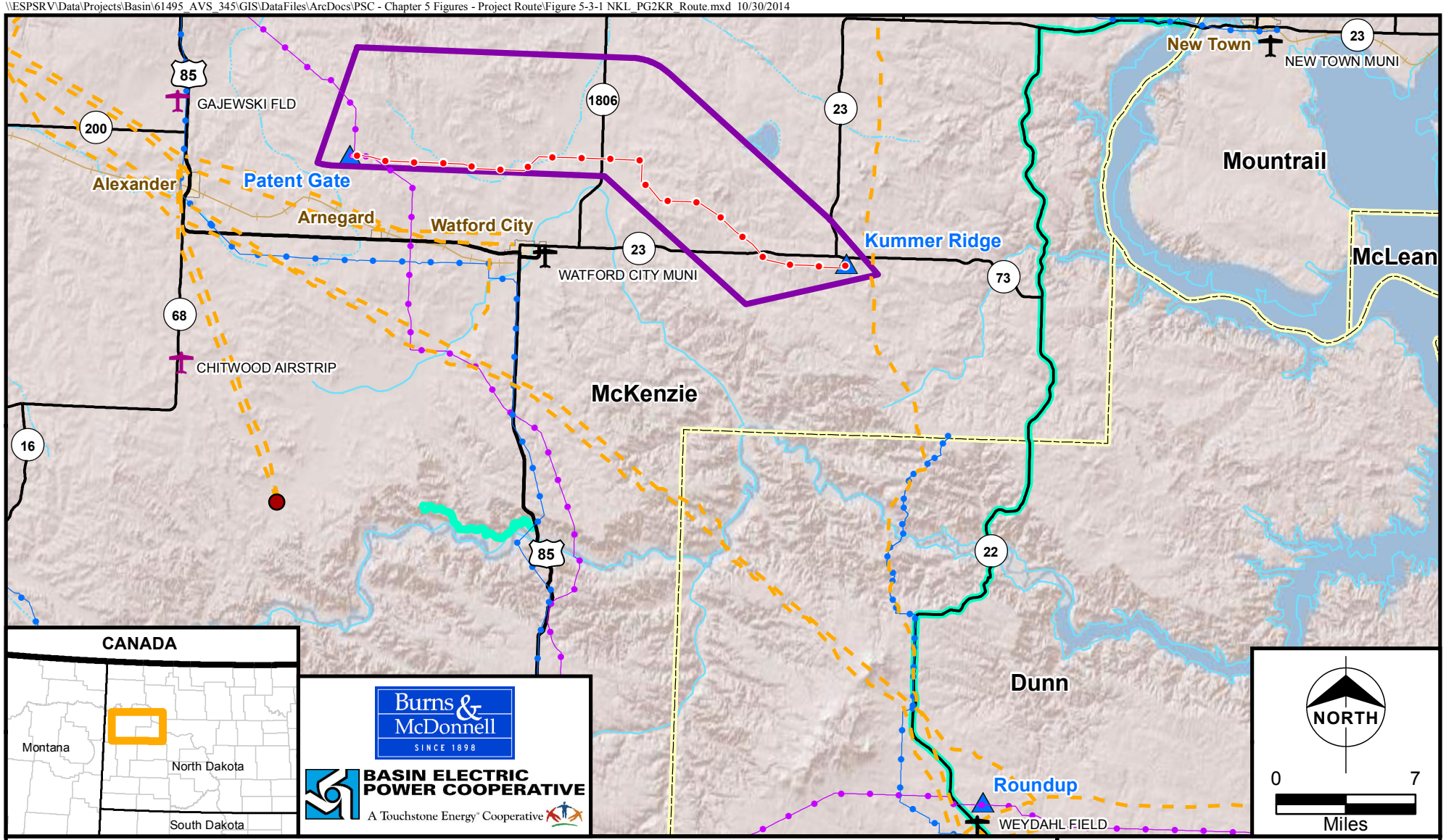


Figure 5.3-1
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Transportation and Utilities

Source: North Dakota GIS; Esri; Basin Electric; Burns & McDonnell.

Revised October 30, 2014

existing carbon dioxide (CO_2) pipeline, extending from Antelope Valley Station to the Canadian border, that is within the Study Corridor.

Natural gas processing plants associated with the oil and gas industry also occur within the Project counties. According to GIS data available on the North Dakota Pipeline Authority (NDPA) website, the Garden Creek gas plant is located within the Study Corridor near Watford City. There are five additional gas processing plants within McKenzie County. Dunn County currently has no gas plants (NDPA, 2014).

In addition to the numerous pipelines associated with increasing oil and gas activity, there are water and sewer pipelines occurring within the Project counties. Most of these pipelines are associated with the small communities located in the vicinity, but there are other water lines occurring within the Project counties that are associated with agricultural purposes, such as center-pivot irrigation systems. There are no known center pivot irrigation systems within the Study Corridor.

5.3.1.2.2 Electrical Transmission Lines

Several transmission lines (115-kV or greater) are present within the Project counties. Basin Electric's existing Charlie Creek to Antelope Valley Station 345-kV transmission line extends east to west through Dunn County to the southeast corner of McKenzie County. The Charlie Creek to Belfield 345-kV line extends east and then south from the Charlie Creek Substation in Dunn and McKenzie Counties. The Charlie Creek to Squaw Gap 115-kV line is located in the southern portion of McKenzie County, extending west from the Charlie Creek Substation toward the state line. There are a number of 115-kV transmission lines within the Project counties as well. Basin Electric, McKenzie Electric, Montana Dakota Utilities, and Western own these lines.

Numerous smaller transmission and distribution lines occur throughout the Project counties to provide electrical service to communities, rural residences, and businesses. Distribution lines are generally located along area roadways. Transmission lines more commonly extend cross-country following section, quarter-section, or fence lines. Increasing oil and gas activities have resulted in additional need for distribution lines to serve oil pump sites and drill rigs, and to serve the increasing worker populations living in temporary housing camps.

5.3.1.2.3 Electrical Substations

There are numerous transmission substations located within the Project counties. Some of these substations are owned and operated by utilities not involved with the proposed Project. Transmission substations transform voltage from higher to lower, and increase or decrease current levels depending on

the type of transformers installed within the substation. Existing substations outside the Project area, but associated with the Project, are Basin Electric's existing Antelope Valley Station 345-kV Substation, Charlie Creek 345-kV Substation, Neset 230-kV Substation, and Western's Williston and Cherry Creek 230-kV substations.

5.3.1.2.4 Power Supply/Generation

Basin Electric owns all or portions of 13 existing energy conversion facilities located in North Dakota, South Dakota, Montana, Wyoming, and Iowa. Four of these facilities are in North Dakota. Two are coal-fired facilities: Antelope Valley Station near Beulah and Leland Olds Station near Stanton. Two are wind projects: Prairie Winds I and Minot Wind Project, both near Minot. Two generation facilities that consist of natural gas-fired 45-MW simple-cycle combustion turbines are currently or have recently been constructed in northwest North Dakota. Other generation resources are located in Montana, South Dakota, Wyoming and Iowa.

Basin Electric purchases all or portions of the output from eight Waste Heat Recovery Units. Three waste Heat recovery units are located in North Dakota, three in South Dakota, one in Montana, and one in Minnesota.

Basin Electric purchases all or portions of the output of seven wind projects in North Dakota, South Dakota, and Minnesota. Basin Electric also purchases all or portions of the generation from numerous coal, gas, and liquid fuel generation facilities throughout its service territory in South Dakota and Iowa. One of these generation facilities, Lonesome Creek, is located within McKenzie County.

Project Need

In the Williston/Tioga region, the preliminary load forecast for Williston Load pocket prepared for Basin Electric is noted in Table 5.3-1. It is projected that the load is increasing in the regions adjacent to Williston/Tioga in a similar manner.

Table 5.3-1: Load Forecast for Transmission Lines in the Williston/Tioga Region

Year	Load (MW*)	Annual Increase (%)
2011	280	--
2012	390	39
2013	454	16
2014	481	6

Year	Load (MW*)	Annual Increase (%)
2015	509	6
2016	538	6

*MW = mega watts
Source: Basin Electric

An analysis of transmission line capacity indicates by the year 2016 the load will have increased beyond the load-serving capacity of the existing system for the Williston/Tioga region, and new transmission line and substation facilities will be required to provide additional capacity and system reliability. The nearest transmission system infrastructure that is capable of supporting this load growth is at the existing Antelope Valley Station, which is located near Beulah (see Figure 5.3-1). This system operates at 115-kV, 230-kV, and 345-kV and extends west, south, and east from Beulah.

5.3.1.2.5 Reliability Issues

The existing high voltage system in the Williston/Tioga region consists of 230-kV and 115-kV systems that connect to the following regions: Saskatchewan, Canada; eastern Montana; central North Dakota; and western North Dakota. Outage of any of these paths could cause low voltage criteria violations and overload adjacent transmission lines in the Williston/Tioga region.

5.3.1.2.6 Federal Communication Commission Towers

There are six Federal Communication Commission (FCC) towers within 1 mile of the Corridor/Route. These towers include an ASR tower, two cellular towers, and three private LM towers (FCC, 2012).

5.3.1.2.7 Water Supply and Treatment

Much of rural northwestern North Dakota, including the Project counties, relies primarily on groundwater for its water supply, through wells or rural water districts. Communities located near the Missouri River/Lake Sakakawea appropriate surface water to support their needs. Table 5.3-2 provides a listing of all municipal and industrial water treatment plants (WTP) within Dunn and McKenzie Counties. This information was provided by the North Dakota Department of Health (NDDOH).

As the oil and gas industry continues to grow in this area, increasing amounts of water will be needed to support drilling efforts and a growing population and workforce. Efforts are currently underway to develop further water supply systems that will utilize Missouri River water to help with the increasing demand for water in the region (North Dakota State Water Commission, 2010).

Table 5.3-2: Water Treatment Plants in Project Area Counties

County	Public Water System Name	Contact	Address	Address	City	State	Zip
Dunn	City of Killdeer	Dawn Marquardt	165 RR St SE	PO Box 270	Killdeer	ND	58640-0270
McKenzie	City of Alexander	Anne Mrachek	112 Manning Ave W	PO Box 336	Alexander	ND	58831-0336
McKenzie	McKenzie County Rural Water	Kristy Roles	201 5th St NW, Ste 1456	--	Watford City	ND	58854
McKenzie	Watford City	Laura Anderson	213 2nd St NE	PO Box 494	Watford City	ND	58854

Source: NDDOH, 2012

A wastewater treatment plant had been proposed west of the City of Killdeer. In January 2014, however, the Killdeer City Commission denied the application for the plant, which had been approved by the Dunn County Commission. The city had concerns about the plant due to the proposed location's proximity to the city, as well as its proximity to the Wellhead Protection Area. Both commissions met in February 2014 and agreed to deny the wastewater treatment plant (Ratliff, 2014).

5.3.1.3 Transportation Infrastructure

5.3.1.3.1 Roadways

Primary roadways within the Project counties include U.S. Highway 85, North Dakota State Route 8, North Dakota State Route 16, North Dakota State Route 22, North Dakota State Route 23, North Dakota State Route 68, North Dakota State Route 73, North Dakota State Route 200, and North Dakota State Route 1806. The proposed Roundup 345-kV Substation would be constructed near North Dakota State Highway 200, approximately 2.5 miles north of the community of Killdeer. The proposed Kummer Ridge Substation would be constructed near the intersection of State Highway 23 and State Highway 73. The proposed Patent Gate Substation would be constructed approximately 5 miles north of U.S. Highway 85, northwest of Arnegard.

Several paved county routes exist within the Project counties, along with numerous smaller paved and unpaved roads. Oil and gas well access roads are also common in portions of the Project area, although these are generally private, dead-end gravel roads terminating at an oil well or drill rig. Many areas within the proposed Project are remote with little to no access via public roads, especially in areas near the Little Missouri River.

5.3.1.3.2 Rail

There are no rail lines within the Project area. There are two abandoned Burlington Northern (BN) rail lines in the Project counties; one south near Killdeer that extends east toward Beulah, and the other extending from west of Alexander to Watford City.

5.3.1.3.3 Airports/Airstrips

Data on airports within the Project counties were obtained from the National Flight Data Center (FAA, 2011) and North Dakota GIS (2011). There are several public and private airports and airstrips located within the Project counties. Private airstrips generally consist of small airstrips or grass strips and are often associated with private ranches within the Project area. Public airports are generally larger and can accommodate commercial or freight flights. Two public airports, Weydahl Field and Watford City

Municipal Airport, are located within the Project counties. Weydahl Field is located northwest of the community of Killdeer. Watford City Municipal Airport is located in Watford City.

The Weydahl Field located near the community of Killdeer was closed due to the inability of Killdeer and Dunn County to maintain the facilities. The FAA advised pilots to land at their own risk after the closure. Over the past several years, however, the airport, although still officially closed, has seen increased traffic. An expansion project is currently underway to improve the facilities (Holdman, 2012). The project began construction activities in June 2014. The runway will be expanded to 60 by 4,200 feet, with the potential to expand to 75 by 5,000 feet in the future (Lymn, 2014). Basin Electric would coordinate with this facility to determine any necessary precautions for Project construction and operation.

5.3.1.3.4 Proposed Roadway Improvements

The rapid increase in oil and gas development activities within the Project counties has added a significant amount of traffic to the local road system. Much of the increase in traffic can be attributed to the increase in heavy-haul trucks and associated equipment traveling to and from oil rigs and well sites. Improvements and repairs to existing roadways not designed for heavy-haul traffic will likely be initiated in the coming years to account for the rapid increase in vehicle traffic over these roadways. The North Dakota Department of Transportation (NDDOT) has divided North Dakota into eight districts, two of which occur within the Project area. Below are listings of ongoing or proposed road projects associated with roadways occurring near the Project area. These projects are not necessarily a result of the increase in vehicle traffic, as some of these projects are routine maintenance projects. It is reasonable to assume that additional improvements to local roadways would be needed in the future to address the growing oil and gas exploration and development industry in the region. The following is a list of key current or proposed roadway improvement projects within the Project counties for District 5 and District 7.

5.3.1.3.5 NDDOT District 5 Current Projects

- Widening, hot bituminous pavement, and turn lanes on ND State Route 22 from the portion of highway north of Dickinson to Manning
- Widening, hot bituminous pavement, and turn lanes on ND State Route 22 from Lost Bridge north to the junction of ND 73

5.3.1.3.6 NDDOT District 7 Current and Future Projects

Current Projects:

- Widening U.S. Highway 85 to a four-lane roadway from the west edge of Watford City to U.S. Highway 2, east of Williston

- Watford City and Alexander By-Passes
- Preventative maintenance on ND State Route 1806 north of Watford City
- Preventative maintenance on ND State Route 23 and ND State Route 73 east of Watford City (NDDOT, 2013).

Future Projects:

- Replacement of the Lewis & Clark Bridge over the Missouri River near Williston
- Resurfacing and widening of ND State Route 40 north of Tioga (possible construction in 2015)

5.3.1.3.7 Scenic Highways

One state-designated scenic highway occurs within the Study Corridor. The Killdeer Mountain Four Bears Scenic Byway incorporates approximately 64 miles of ND State Route 22, and passes through the central portion of the Project area in a north-south direction (Figure 5.3-2). The Theodore Roosevelt National Park North Unit Scenic Byway is located in McKenzie County outside the Study Corridor.

Figure 5.3-2: Killdeer Mountain Four Bears Scenic Byway

5.3.2 Impacts

Northwestern North Dakota is experiencing a rapid increase in development as a result of activities associated with the extraction of oil from the Bakken shale. The level of current and future development will require increases in transmission capacity, pipelines, rail, roads, gas, refineries, and other

infrastructure needs. This section discusses the potential impacts to current utility and transportation infrastructure resulting from construction and operation of the proposed Project.

Direct impacts to existing utility and transportation infrastructure resulting from the construction and operation of the proposed Project are anticipated to be minor. Impacts would include:

- Temporary power service interruptions during construction and stringing of conductors across existing lines.
- Delays, detours, or temporary road closures during line construction.
- Road congestion near construction areas.
- Road deterioration from heavy equipment used for construction.

5.3.2.1 Utility Infrastructure

Temporary impacts to existing utilities during construction of the transmission line may include short-term power service interruptions on existing transmission and distribution lines for safety reasons during construction. Basin Electric would identify all utility lines to be crossed by the Project (electric, gas, oil, telephone, water, sewer) and coordinate with the owner to protect these facilities and to coordinate construction safety procedures during utility crossings. Impacts to utilities such as water, sewer, and wastewater are not anticipated, as efforts would be made to locate transmission structures away from these existing utilities and protect them at Project crossings.

The Corridor/Route would include no crossings of existing transmission lines but would likely cross distribution lines. Potential impacts to these existing lines are expected to be temporary, such as taking these lines out of service for short time periods for safety reasons during stringing of conductors across an existing line. Such outages would be scheduled during off-peak use times to avoid or minimize any outages to customers. The Corridor/Route would not cross any known oil, natural gas, or CO_2 pipelines. However, with the rapid oil and gas development in the area, it is likely pipeline facilities for oil and/or gas collection and transport would be crossed. No impacts to pipelines are anticipated. If any previously unidentified pipelines were discovered during route survey activities, Basin Electric would locate the pipelines on design and construction drawings and all transmission structures would be placed outside of pipeline ROWs. Basin Electric would coordinate with the pipeline owner. Appropriate measures would be taken to protect them should equipment be required to use or cross pipeline ROWs.

5.3.2.2 Transportation Infrastructure

Temporary impacts to local roads and highways may also occur during the construction phase of the proposed Project. The Corridor/Route has 23 road crossings, and construction at road crossings may result in occasional short-term traffic delays during the stringing of conductors across the roadway. Traffic would likely be detoured or temporarily halted as conductors are pulled across the road.

Transportation concerns include delays or detours on local roadways when stringing conductors across these roads, and general traffic increases and congestion along roads near the proposed Project due to construction-related vehicles and equipment. These effects would be minor and temporary as construction would occur at several locations along the line, reducing the amount and intensity of construction at any particular location. Construction crews would only be at a particular location for several days during the various stages of construction, so any construction-related delays or congestion at any specific location along the line would occur for only a short time. Most of the roads that would be crossed by the Project have low levels of vehicle traffic, and the grid of section line roads in the area provides numerous opportunities for traffic to detour around construction areas with only minimal delay and inconvenience to motorists.

Temporary lane closures, flaggers, or pilot vehicles for traffic flow would be implemented for traffic control and motorist and construction crew safety. However, any lane or partial road closures would likely only last a few hours, with any complete stoppage of traffic only anticipated for a few minutes. While such activities would likely create considerable congestion along these highways, they would only occur for a short time during the actual stringing across the road. Once accomplished, traffic flow patterns would be restored to normal. Additionally, stringing across these roads could be conducted during off-peak travel hours to reduce the number of motorists exposed. Stringing across these roadways would only be expected to take several hours, minimizing the period of inconvenience to motorists.

Construction equipment would be required to operate over local roadways, contributing incrementally to the wear and tear of roads. Overall, construction vehicles would be similar to current vehicle and semi-trailer traffic and would not result in a significant increase in average daily traffic on major thoroughfares or contribute significantly to road wear. On more local roadways, heavy construction vehicles would be similar to agricultural and oil field traffic, although the level of vehicle use would likely increase in the areas along the line during construction. Such increases could contribute to road deterioration. Basin Electric would coordinate with the counties and NDDOT to redress any road damage related to construction of the Project.

Following completion of construction, impacts to transportation and infrastructure would largely cease. Infrequent and short-term congestion and road closures may be necessary for maintenance and repair activities. Road crossing permits would be acquired from the affected counties as part of the requirements for construction of the Project.

5.3.2.3 Railroads

The Corridor/Route does not cross active railroad tracks.

5.3.2.4 Airports and Airstrips

Several public and private airport and airstrips occur in the Project counties. Under Title 14 Code of Federal Regulations Part 77 (Part 77) the sponsor of a proposed Project with the potential to affect navigable airspace is required to notify the FAA 45 days prior to construction. This provides the FAA time to determine if the structure would be a hazard to airport operations. The FAA has established standards to identify a proposed or existing structure that would be an obstruction to the navigable airspace surrounding public airports. These standards are defined in Part 77 by imaginary surfaces that extend above and beyond the physical surface of the runway and are based on the dimensions, composition, and type of approach available or planned for the runway. The imaginary surfaces include:

- A horizontal surface 150 feet above the runway elevation that extends outward from the runway from 5,000 to 10,000 feet; and
- A conical surface that begins at the outer edge of the horizontal surface and extends outward and upward at a 20:1 slope for an additional 4,000 feet; and
- An approach surface that extends outward and upward from the runway end for 5,000 to 50,000 feet at a slope determined by the category of runway, and transition surfaces between the various surfaces.

Weydahl Field in Dunn County is the only public or private airstrip within 5 miles of the Corridor/Route. Public airports with published instrument approach procedures (IAP) could potentially be affected by transmission structures that will be within the final approach portion of the IAP. The final approach portion typically begins at a point located within 50,000 feet from the IAP runway end and must begin within 10 nautical miles (60,760 feet) of the runway end. Based on this maximum distance, the Corridor/Route would not be within 10 nautical miles of any airports with published IAPs.

The Corridor/Route would be approximately 23,500 feet north of the Watford City Municipal Airport and possibly within an IAP area. Public airports with no published or planned IAP's could be affected by transmission structures that exceed a Part 77 imaginary surface. Transmission structures that exceed an

imaginary surface would require a study by the FAA to determine the effect they could have on air navigation. An Obstruction Analysis was submitted to the FAA in the area of Weydahl Field Airport in Dunn County in November 2012 (Obstruction Analysis 2012-AGL-11085 thru 2012-AGL-11097) to determine any impacts of the AVS to Neset Project at the Airport. The FAA in their Obstruction Analysis provided a Determination of No Hazard to Air Navigation for the structures near the Weydahl Field. Only the Roundup Substation component of the NKL Phase I Project would be in the vicinity of Weydahl Field. When the final substation plan and profile is available, further screening using the FAA Obstruction Analysis would be performed and if required Obstruction Anaylsis data would be submitted for evaluation with the FAA.

Basin Electric would coordinate with the FAA to determine if the proposed Project would have any impact to local aircraft facilities. Further consultation with the FAA would be required to determine specific impacts and potential mitigation measures to address any impacts to aviation safety and the operation of the airports and airstrips in proximity to the Corridor/Route.

5.3.2.5 Substation Impacts

Impacts to existing utility and transportation infrastructure resulting from the construction and operation of the proposed Roundup, Kummer Ridge, and Patent Gate substations are anticipated to be minor. Temporary impacts to existing utilities and transportation infrastructure during construction of the substations may include short-term line outages on existing transmission lines for safety reasons during construction and interconnection to the substations, minimal (if any) service outage to electricity customers, delays or detours on local roadways during construction, and general increases in traffic along roads in construction areas due to construction-related vehicles and equipment. Substation sites are generally located along roadways but are large enough to allow equipment to pull off and park off the roadways, reducing road congestion.

5.3.3 Mitigation

- Basin Electric and its contractors would time conductor stringing across North Dakota State Highway 1806 and ND State Highway 23 to avoid peak traffic, in consultation with NDDOT.
- Basin Electric and its contractors would mark a detour route, if required by NDDOT, and provide traffic information to motorists in advance of the detour, consistent with the Manual on Uniform Traffic Control Devices (Federal Highway Administration, 2012).
- Basin Electric and its contractors would coordinate with townships, counties, and NDDOT to redress any road damage related to construction of the Project.

- Basin Electric and its contractors would coordinate with FAA to avoid or minimize impacts on local aircraft facilities.
- Basin Electric and its contractors would identify existing utilities and coordinate with the owners to implement appropriate measures to protect both facilities and construction workers during crossings.

5.4 Public Health and Safety

5.4.1 Description of Resources

The Project area is located in rural, agricultural areas with low population density. Historically, the predominant activities are farm-related and include row crop production, livestock production, grazing, and hay production. However, oil and gas development activities have increased dramatically within the Project area in recent years, resulting in an increase in population and industrial activity. This has placed stress on the current level of public health and safety's resources. Public health and safety within the Project area depends on the potential for the public to encounter hazards and risk. Occupational hazards include risks associated with farming and farm-related implements and equipment. Construction hazards include risks associated with construction equipment, installation of equipment, and transportation of heavy equipment.

5.4.1.1 Traffic Accidents

One of the public hazards that has resulted from the rapid development in the area includes the increased traffic volume on local roadways due to construction vehicles and the use of local roadways to transport equipment when the roadways were designed for lighter traffic. According to the State of North Dakota, the statewide accident rate is 181.87 per 100 million vehicle miles traveled (VMT). Dunn County had a rate of 0.99 per million VMT for 2012 and McKenzie County had a rate of 1.08 per million VMT in 2012 (NDDOT, 2012; see Infrastructure section for additional transportation discussion).

5.4.1.2 Law Enforcement

Local law enforcement or emergency response agencies located in nearby communities provide public safety within the Project area. The Killdeer Police Department and the Dunn County Sheriff's Office provide law enforcement services to the portions of Dunn County that are within the Project area. The McKenzie County Sheriff's Office and the Watford City Police Department are the law enforcement agencies located within the Project area in McKenzie County.

The increase in oil development activities in the area has brought an influx of people to the region, resulting in the need for increased law enforcement presence in the area. With the influx of people, there has been an increase in local crime rates. The Watford City Police Department continues to add personnel and equipment each year to keep up with the increase in crime, adding one new officer and three new patrol cars in 2012 (Billing, 2013). The outlying areas of Williams County, patrolled by the Williams County Sheriff's Department, have seen an increase in the number of calls coming from all over the county, sometimes requiring up to 40 minutes for a deputy to respond (Domaskin, 2011). Crimes such as oil site thefts, burglary, alcohol-related offenses, prostitution, and assault are rising in the vicinity of the Project. In Williston, for example, thefts at residences and retail shops have risen steadily, with police responding to approximately 40 percent more burglar alarms in 2011 as compared to 2010. Assault and battery charges increased by 171 percent in Williston in one year, and police departments in many of the towns within the Project area are encountering increases in night club violence and domestic violence, as well (Domaskin, 2011; Ellis, 2011).

5.4.1.3 Ambulance Districts

Two ambulance districts serve the Project area: Killdeer Area Ambulance Service in Killdeer and McKenzie County Ambulance Service in Watford City (NDDOH, 2005). These districts provide ground-based life support services. The increase in the oil-related activity has required the ambulance districts to expand their staffing and level of service. The majority of the ambulance districts operate on a voluntary or part-time basis.

5.4.1.4 Fire Departments

Fire services within the Project vicinity are provided by volunteer fire departments, rural fire departments, and fire protection districts. The Halliday Rural Fire Protection District and West Dunn First District are located in Dunn County. The Alexander Volunteer Fire Department and Watford City Volunteer Fire Department are located in McKenzie County. The oil-related activity has required the fire departments to expand their staffing and services provided.

5.4.1.5 Hospitals

The McKenzie County Memorial Hospital and Healthcare Systems, located in Watford City, is the only hospital near the Project. McKenzie County Memorial Hospital is currently undergoing a $59 million expansion to support the growing need for medical services in the community. The new complex will add 10 emergency room bays, 18 primary care patient rooms, and 12 specialty care rooms (Dalrymple, 2014). Larger cities such as Williston and Dickinson, located outside of the Project area, offer more and larger health care facilities.

5.4.2 Impacts

As discussed above, the proposed Project would be located primarily in rural, agricultural areas with low population density. However, oil and gas development activities have increased dramatically within northwestern North Dakota in recent years, resulting in an increase in population and industrial activity and placing stress on the current level of public health and safety resources. This section discusses potential impacts to existing health and safety resources resulting from construction and operation of the proposed Project, as well as potential health and safety impacts directly related to the construction and operation of the line.

Construction-related impacts would be temporary, while potential impacts from Project operations would remain as long as the line is in service. Potential and permanent impacts resulting from construction and operation of the proposed Project would include:

- Added stress on existing public health and safety services
- Increased likelihood of traffic accidents as a result of increased number of large construction vehicles on local roadways
- Potential health effects from electric and magnetic fields (EMF) once the line is energized
- Safety concerns from potential stray voltage or direct contact with energized lines

A more detailed discussion of temporary and permanent potential health and safety impacts from the Project is provided below.

5.4.2.1 Construction Impacts

Impacts related to the construction phase of the Project would be temporary and would cease once the line is in service. Existing public health and safety services such as police, fire, ambulance, and hospital services are already experiencing some deficiencies and personnel shortages in the area due to the rapid growth in the region, especially in smaller communities unaccustomed to rapid increases in population. This, coupled with the inherent potential for accidents and injuries associated with industrial development, has increased the need for health services. Additional workers moving into the region during construction of the proposed Project, if only temporarily, may add an additional burden on some or all of the existing public service resources.

The addition of construction-related vehicles on highways and local roads would contribute to an already-increasing traffic congestion issue in northwestern North Dakota. Increased traffic congestion by itself can pose safety issues, and the large size of many of the construction vehicles using these roads would

potentially increase the likelihood for serious car accidents involving large construction vehicles (see Section 5.3 for existing traffic data and crash reports for northwestern North Dakota). Additionally, large construction vehicles repeatedly using the same stretches of roadway during construction could cause road surface damage such as ruts and potholes, which would serve as potential obstacles and safety hazards to motorists. Generally, however, the additional traffic generated by Project construction would be minimal. Basin Electric would coordinate with local road jurisdictions to redress construction-related issues along area roads and would comply with current load limitations that are in place at the time of the construction activity.

5.4.2.2 Operational Impacts

A number of potential safety concerns are associated with high-voltage electricity transmission lines, as discussed below.

5.4.2.2.1 Electric and Magnetic Fields

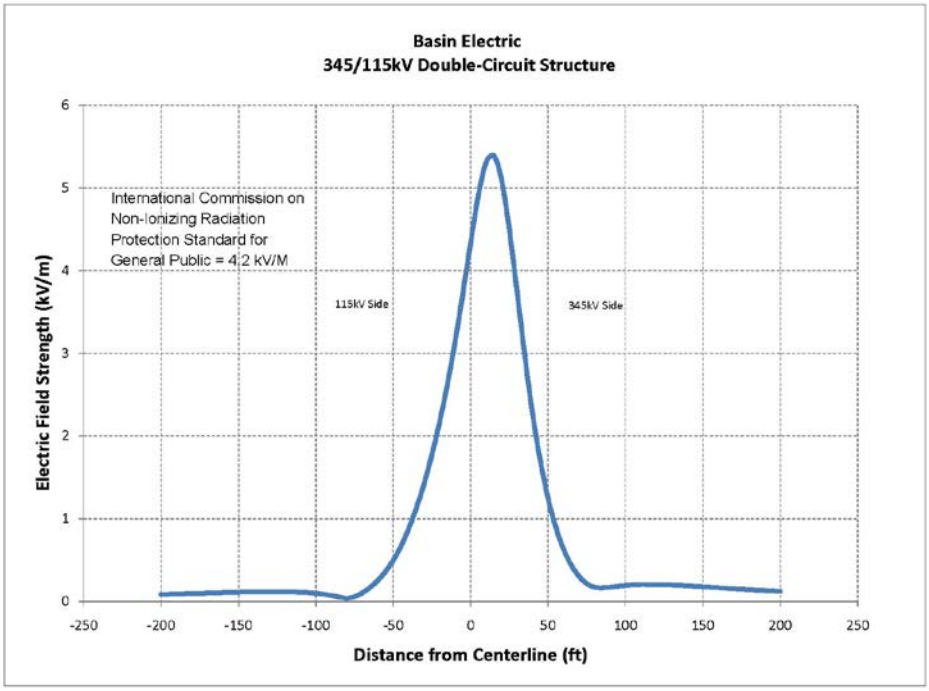
Operation of the transmission line produces electric fields and magnetic fields. These fields exist whenever the transmission line is energized. Electric fields are produced by voltage and are measured in kilovolts per meter (kV/m). Electric fields are generally easily shielded or blocked by objects such as buildings and trees. Electric fields also decrease as the distance from the source increases. Magnetic fields, however, are produced by current. They are measured in milligauss (mG) and are not easily blocked by most materials. Magnetic fields also decrease in strength as the distance from the source increases.

The potential health effects from EMF associated with high-voltage transmission lines are often a subject of discussion because no definitive answers have been found, despite decades of scientific research. Overall, research suggests that electric fields pose little, if any, health risk to humans due to objects easily shielding the fields and the significant reduction in the fields over distance from the source. Some scientific studies have suggested a weak statistical association between magnetic fields and childhood leukemia, while other studies suggest no such link, and no scientific support for a link has been found in studies using laboratory animals. The National Institute of Environmental Health Sciences (NIEHS) (Appendix H) concluded that there is very little evidence to support a link between EMF exposure and health risks. As such, no federal guidelines exist for EMF at this time.

To assess potential concerns for EMF exposure from the proposed Project, an analysis for predicted EMF conditions was conducted for a double-circuit 345/115-kV transmission line.[6] The analysis used the selected input variables to calculate the approximate EMF levels using a computer program that is based on the equations and calculation methods developed by the Bonneville Power Administration. The output from these calculations was used to plot the electric and magnetic field profiles across distances from the centerline of the transmission line (Appendix I). Figure 5.4-1 illustrates the electric field values in-kV/m from the centerline of the Project to well beyond the edge of the ROW. The maximum predicted value at the edge of the proposed Project ROW would be 0.214-kV/m. This value would be far less than the 4.2-kV/m level identified for protection of the general public (ICNIRP, 2010). Therefore, no adverse effects from Project-induced electric fields are expected to occur.

Figure 5.4-2 illustrates the magnetic field values in milligaus (mG). At a distance of 75 feet from the centerline, the maximum predicted value is 94 mG, which is far less than the 2,000 mG standard identified for the protection of the general public (ICNIRP, 2010). No residences are located within 500 feet of the Corridor/Route, and it is anticipated that there would be no potential issues with increased EMF exposure as a result of the construction or operation of the proposed Project.

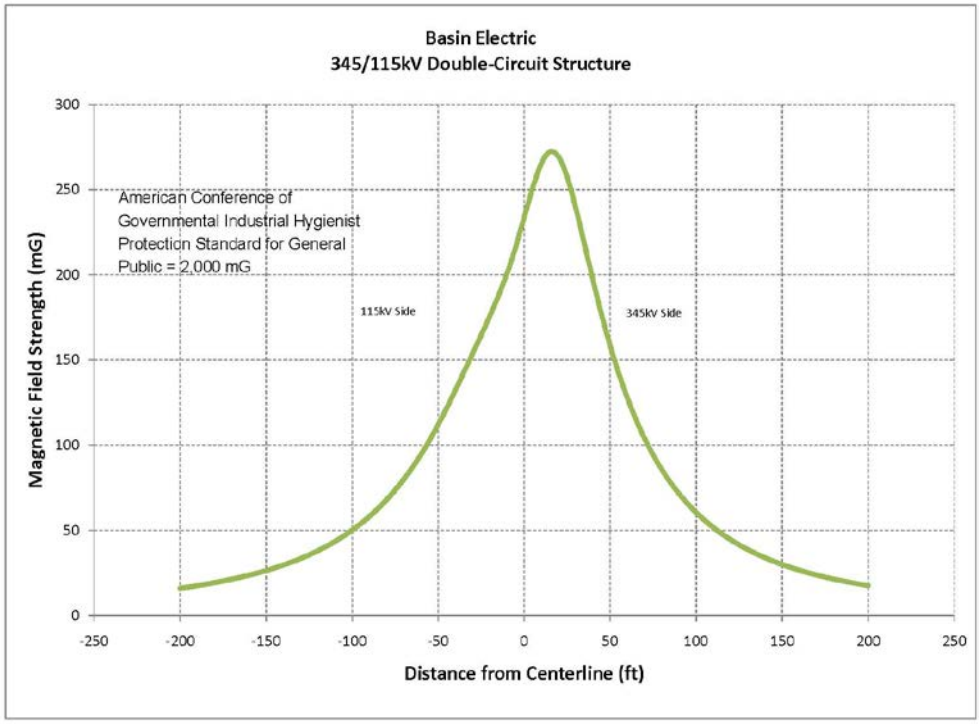
Figure 5.4-1: Electric Field Strength



Source: BMcD, 2013

[6] Basin Electric is proposing to construct 345, 345/115, 230/115, and 230-kV transmission line configurations for the proposed Project. The 345/115kV configuration was selected for the EMF analysis because this configuration would have the potential to generate the highest levels of EMF exposure.

Figure 5.4-2: Magnetic Field Strength



Source: BMcD, 2013

5.4.2.2.2 Radio and Television Interference

For high-voltage and extra-high-voltage transmission lines, the electric field attains its maximum strength at the surface of the conductors. The electric field in a transmission line is concentrated wherever surface irregularities occur. These irregularities include dirt, insects, bird droppings, water droplets, loose hardware, scrapes, and nicks. At these concentrated locations, the field strength may be great enough that the air becomes ionized and a partial spark discharge between the conductor and the surrounding air takes place. This phenomenon is called “corona.” The greatest corona activity occurs during rain when each clinging raindrop acts as an individual corona source.

Radio Interference and Television Interference (TVI) can occur, usually during periods of rainy weather. Usually the residences affected by interference are those that are in very close proximity to the transmission line. The AM broadcast band on the radio is affected more by corona-generated electromagnetic interference than the FM band or TV reception. This is because radio noise due to corona decreases at higher frequencies to a very low level. The FM band is rarely a problem due to its higher frequency and signal modulation method that makes it less affected by impulse-type noise associated with corona. Television systems are rarely a problem because they operate at much higher frequencies and especially when there is a good signal quality in the area before the transmission line is built. “Corona-caused TVI occurs during foul weather and is generally of concern for transmission lines with voltages of

345-kV or above, and only for conventional receivers within about 600 feet (183 meters) of a line" (T. Dan Bracken, Inc., 2001). Television systems that operate at higher frequencies, such as satellite receivers, are not affected by interference. Similarly, cable television systems are unaffected.

5.4.2.2.3 Implantable Medical Devices

Devices such as pacemakers and defibrillators could experience interference from strong EMF. The majority of research on the effects of EMF on implantable medical devices has focused on the interference of EMF on pacemakers. A 2004 Electric Power Research Institute (EPRI) report concluded that implantable medical devices may be more susceptible to interference from electric fields as opposed to magnetic fields (EPRI, 2004). Persons with pacemakers may experience temporary interference when exposed to high electric fields, but would resume normal function as they move away from the source of interference. The EPRI report suggests that persons with implantable medical devices such as pacemakers may experience some interference from electric fields while in close proximity to a high-voltage transmission line; however, beyond the boundary of the proposed ROW the electric fields are anticipated to be at ambient levels. Therefore, if there is any potential for implantable medical devices to be affected, it would only occur if the individual remained within the ROW and under the line for an extended period. In practice, most occurrences would take place while driving or passing under the transmission line for a brief moment. Such exposure would not contribute to more than an instantaneous interruption in the function of the equipment and is not anticipated to jeopardize health under normal everyday life conditions.

5.4.2.2.4 Stray Voltage

Operation of the proposed Project may cause "stray voltage," which can occur from a maintenance issue or from improperly grounded equipment underneath the transmission line and on the electric service entrances to structures from distribution lines. Transmission lines can induce stray voltage on distribution lines in circumstances where the transmission line is parallel to and directly over the distribution line. If such configurations are created by construction of the Project, some farm equipment (barns, fences, gates, etc.) may be subject to developing small electric charges that could be transferred to humans or livestock upon contact with the equipment, structures, or facilities. However, no anticipated stray voltage impacts are expected as a result of the operation of Project because appropriate measures would be taken to prevent stray voltage issues in instances where the proposed Project would parallel or cross existing distribution, and by proper grounding of metal objects near to the proposed Project. Should stray voltage concerns be identified following construction, Basin Electric would promptly work to correct the circumstances creating the stray voltage and eliminate the problem.

5.4.2.2.5 Direct Contact with Lines and Structures

Direct contact between an object on the ground and an energized conductor poses the most serious risk of injury or death from a high-voltage transmission line. Direct contact with an energized line is not anticipated during the construction phase of the proposed Project, as the line would not yet be energized. However, construction of the Project would require numerous crossings of existing energized lines. Care would be taken to protect construction workers and the Project from contact with or damage to these facilities. Basin Electric would identify all electrical line crossings and coordinate closely with the owning utility to schedule line outages or implement appropriate measures for the safe construction of the line.

The Project would be designed to meet or exceed appropriate NESC standards, providing for appropriate clearances for the safe and reliable operation of the Project. During operation, the height of the energized conductors (approximately 30 feet) would protect activities below and around the line from direct contact. Care would need to be taken by others during future activities adjacent to the line to maintain appropriate clearance from the line to avoid contact.

The Project would require the installation of several hundred structures to support the current-carrying conductors. Many of these structures would be located in or adjacent to agricultural fields and would create an obstacle for equipment. This would be particularly true of structures in crop fields where farmers would be preparing soil, planting, and harvesting crops in a manner that minimizes the loss of productive area from the structure. Operation of farm equipment in proximity to structures would create the potential for contact with structures, potentially resulting in damage to equipment and/or the structure and injury to equipment operators. During Project design and negotiations with landowners, Basin Electric would work to locate structures to minimize health and safety concerns related to farming operations.

5.4.2.2.6 Fallen Lines

High-voltage transmission lines are designed to trip automatically, or become de-energized, if they fall or come in contact with trees. Distribution lines, conversely, generally do not automatically become de-energized upon falling. Potential safety issues would occur if a high-voltage transmission line were to fall on a distribution line, resulting in an energized distribution line being on the ground and presenting a safety hazard. However, high-voltage transmission lines typically do not fall down unless subject to extreme weather conditions, such as a tornado or excessive ice, or possibly being struck by a large vehicle. As discussed in Section 4, the Project would be designed for severe ice and wind conditions.

Therefore, impacts associated with fallen lines are not anticipated to occur as a result of the operation of the proposed Project.

Proposed Substations and Switchyards

Construction of the proposed Roundup, Kummer Ridge, and Patent Gate substations may cause temporary impacts to public health and safety resources near the construction sites similar to those experienced during construction of the transmission line. Potential health and safety impacts during operation of the substations would be limited to direct contact with energized equipment within the substation or switchyard fence, and with potential EMF issues associated with high-voltage transmission lines connecting to the substations or the switchyard. According to the NIEHS, EMF levels produced by substation equipment beyond the substation fence are typically indistinguishable from background levels and therefore have not been evaluated for this Project.

5.4.3 Mitigation

- Prepare a construction plan in accordance with the National Electrical Safety Code and the Occupational Safety and Health Administration's regulations, as required by federal law, to coordinate safety procedures for construction workers. This would also identify procedures should a spill occur or hazardous materials be discovered.
- Construct the proposed Project with materials designed to contain electric currents and meet high safety standards.
- Employ standardized agency procedures should the transmission line need maintenance or repairs. Standardized agency procedures can help increase the safety of both workers and those in the surrounding area.
- Additional measures, such as those identified in Appendix G, are designed so that Basin Electric's operational procedures adhere to a high standard of safety for workers and others close to the construction and operation of the proposed Project.

5.5 Air Quality

5.5.1 Description of Resources

5.5.1.1 Regional Setting

Existing sources of air emissions in the Project counties include the gas-fired LCS, oil and natural gas processing plants, other infrastructure associated with the oil and gas industry, automobiles, trucks, farm equipment, and emissions resulting from wood burning stoves in residential areas. Vehicle traffic in the

Project area is responsible for tailpipe emissions including nitrogen oxides (NO_x), carbon monoxide (CO), and sulfur dioxide (SO_2). The primary pollutant produced by farm equipment is NO_x from the combustion of fuel. Farming and ranching activities and vehicles using unpaved roads are sources of fugitive dust. Oil and gas activities within the Project area generate emissions, particularly from the manufacturing, construction, operation, and maintenance of oil and gas development-related facilities in the Bakken formation. The oil and gas industry is experiencing a noticeable increase in the number of wells developed in the past few years and the associated deliveries of water, material, and supplies that are required to support the current oil expansion.

North Dakota is characterized by cold winters and moderate summers. The average annual temperature varies between 37 degrees Fahrenheit (°F) in the northeast to 43°F in the southern portion of the state. During the summer, temperatures can reach 100°F during the day (usually just a few days each year) with lows in the lower 70s. July, typically the warmest month, has average temperatures between 67°F and 73°F. January, the coldest month, has average temperatures between 2°F and 17°F. Lows below 32°F can be expected between 180 to 210 days each year, depending on location in the State. Sub-zero temperatures occur between 35 and 65 days each year, mostly in December, January, and February.

Annual rainfall in the State ranges from 13 inches in the northwest to approximately 20 inches in the southeast and the Red River Valley. The majority of the precipitation occurs in June as rain, with a monthly average between 3 and 4 inches throughout the State. North Dakota averages between 26 and 32 inches of snow each year, with the most snowfall occurring in the belt that stretches diagonally across the State from the northeast corner to the southwest. Winds generally come from the north-northwest direction during the majority of the year.

5.5.1.2 NAAQS/Attainment

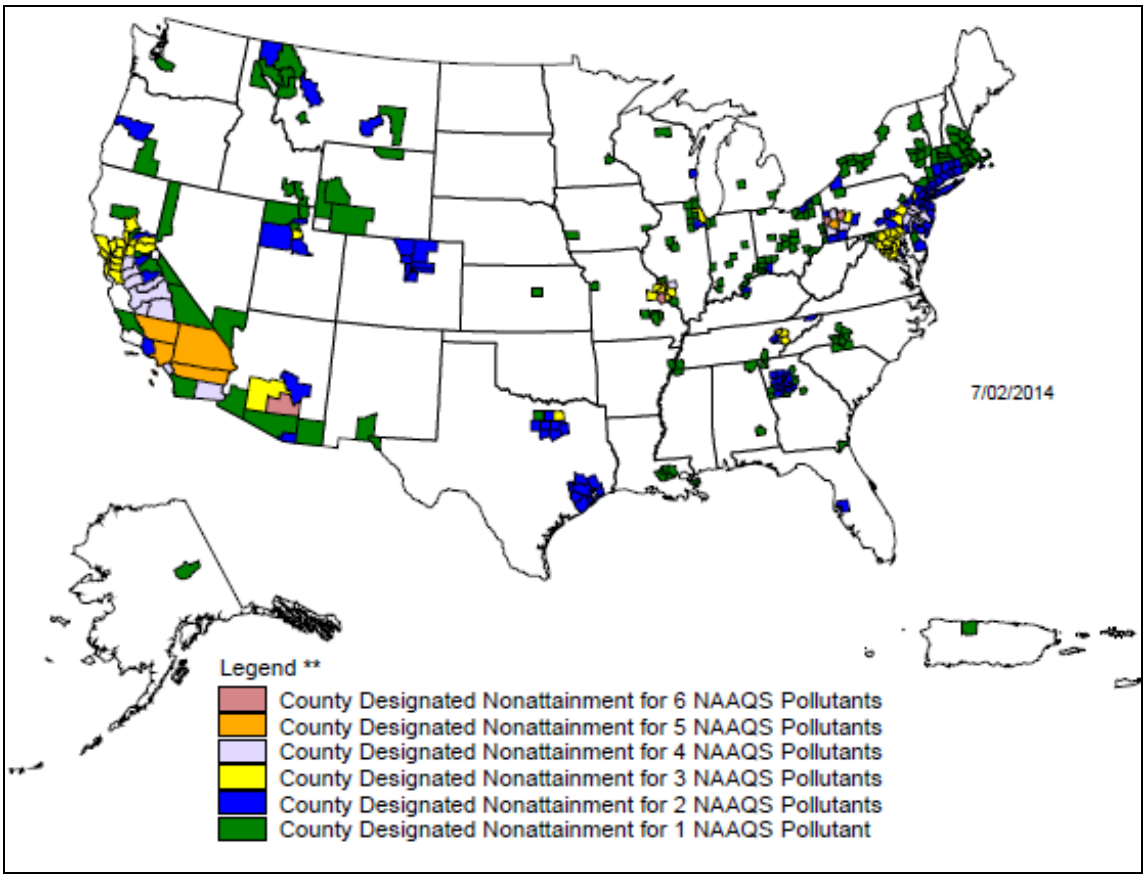
The Clean Air Act (CAA), which was last amended in 1990, requires the Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The CAA established two types of national air quality standards. Primary standards set limits to protect public health, including the health of “sensitive” populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

The EPA, Office of Air Quality Planning and Standards (OAQPS) has set NAAQS for six principal pollutants, which are called “criteria pollutants”: SO_2, CO, ozone (O_3), nitrogen dioxide (NO_2), lead (Pb)

and particulate matter (PM). All counties in North Dakota are currently in attainment for all NAAQS, meaning that these counties meet the standards for public health and welfare concerning levels of the above-referenced criteria pollutants (Figure 5.5-1).

In 2010, 1-hour standards for NO_2 and SO_2 were promulgated. The state of North Dakota is currently in attainment with these 1-hour standards. Therefore, the entire state of North Dakota is expected to remain in attainment or unclassifiable for all criteria pollutants.

Figure 5.5-1: Counties Designated "Nonattainment" for NAAQS



Source: EPA, 2014

Outside of the nonattainment areas, the CAA had enacted programs to maintain the air quality in attainment areas and ensure that new sources of criteria pollutants do not detrimentally affect the air quality. These programs include: New Source Performance Standards (NSPS), National Emission Standards for Hazardous Air Pollutants (NESHAP), Prevention of Significant Deterioration (PSD), and Title V Operating Permits. Of these programs, the PSD applies to this Project because in the CAA, Congress set aside special land classifications for PSD purposes. These lands where existing good air quality conditions are especially important to maintain—like National Parks, National Forests, and

wilderness areas—have been defined as Class I areas. All other areas are designated as Class II areas. There are two Class I areas in North Dakota (TNRP and Lostwood Fish and Wildlife Service Area). Neither of these Class I areas are in the Study Corridor. The U.L. Bend Wildlife Area is in Montana and approximately 200 miles west of the Corridor/Route, and Medicine Lake Wildlife Area is approximately 51 miles northwest of the Corridor/Route.

PSD increments were established for Class I and Class II areas to monitor air quality in attainment areas to determine if it is maintained. If a Project is subject to PSD, the ground level air concentrations from the Project must be below these increment values in attainment areas. In addition, all facilities must meet the NAAQS, with an appropriate background value added to the source impact concentration.

5.5.1.3 Greenhouse Gases

Climate change refers to changes in the long-term trends of many climatic factors such as temperature, precipitation, or wind. Climate change may be the result of:

- Natural factors such as solar and orbital variations.
- Natural processes and cycles within the climate system (e.g., ocean circulation changes).
- Human activities that change the atmosphere's composition (e.g., land use changes, burning fossil fuels) and the land surface.

Greenhouse gases (GHGs) are gases that trap heat in the earth's atmosphere by absorbing and re-emitting solar radiation. GHGs, such as water vapor and CO_2, occur naturally and are emitted to the atmosphere through natural processes as well as human activities. The Intergovernmental Panel on Climate Change (IPCC) estimates that water vapor is responsible for 60 to 80 percent of the world's greenhouse effect (IPCC, 2007). Other GHGs, such as fluorocarbons, are created and emitted solely through human activities. The principal GHGs are CO_2, methane (CH_4), nitrous oxide (N_2O), and fluorocarbon gases (EPA, 2009).

CO_2 enters the atmosphere through the burning of solid waste, wood, and fossil fuels (oil, natural gas, and coal), and also as a result of other chemical reactions (e.g., manufacture of cement). Most CO_2 that is naturally produced through respiration and decomposition is taken up by photosynthesis of plants on land and in the oceans. CO_2 emitted by combustion of fossil fuels and industrial processes is causing CO_2 concentrations to increase in the atmosphere (IPCC 2007). CO_2 accounts for approximately 70 percent of global manmade GHG emissions (EPA, 2006).

CH_4 is emitted during the production and transport of coal, natural gas, and oil. CH_4 is also emitted from livestock, agricultural processes, and organic waste decay. These emissions amount to about 24 billion metric tons annually in the U.S. Natural CH_4 emissions globally are from wetlands, oceans, hydrates, and fires. CH_4 accounts for approximately 15 percent of global manmade GHG emissions (EPA, 2006).

N_2O emissions are emitted during the combustion of fossil fuels and solid wastes, as well as during agricultural and industrial activities. N_2O accounts for approximately 8 percent of global manmade GHG emissions (EPA, 2006).

Fluorocarbon gases such as perfluorocarbons, hydrofluorocarbons, and sulfur hexafluoride are emitted from a variety of industrial processes. They are 7 percent of global GHG emissions. They are not naturally produced (EPA, 2006).

In 2010, the EPA promulgated the Greenhouse Gas Tailoring Rule, which made greenhouse gases a criteria pollutant subject to regulation under the CAA. In June 2014, the U.S. Supreme Court said that EPA may not treat greenhouse gases as an air pollutant for purposes of determining whether a source is a major source required to obtain a PSD or Title V permit. The Court also said that PSD permits that are otherwise required (based on emissions of other pollutants) may continue to require limitations on greenhouse gases emissions based on the application of Best Available Control Technology (BACT). At the time of preparation of this document, EPA was evaluating the implications of the Court's decision and awaiting further action by the U.S. Courts.

5.5.1.4 Regional Haze

The Regional Haze Rule (40 CFR Part 51, subpart P) was intended to protect and improve visibility in areas of the country known as Federal Class I areas. Several facilities in North Dakota were subject to a regional haze analysis per 40CFR Part 51.308, known as the Best Available Retrofit Technology (BART) analyses. These analyses applied to facilities in 26 source categories (mainly power plants) that were constructed between approximately 1962 and 1977 (years prior to the Clean Air Act Amendments of 1977). Utilities are the most common facilities that met the requirements under the BART rules. The analyses include modeling sources for contribution to haze (visibility impairment) in Class I areas. At the time of preparation of this document, North Dakota was in the process of updating their State Implementation Plan (SIP) to include controls and emission limits required by the BART analyses to improve visibility in Class I areas. North Dakota has submitted several iterations and amendments to the original SIP sent to EPA for approval. The EPA is reviewing the information submitted and will respond to North Dakota with approval or questions on the SIP.

5.5.2 Impacts

The EPA OAQPS has set NAAQS for six criteria pollutants: SO_2, CO, ozone, NO_2, lead (Pb), particulate matter with aerodynamic diameter less than or equal to 10 microns (PM_{10}), and particulate matter with aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$). All counties in North Dakota are currently in attainment for all NAAQS, meaning that these counties meet the standards for public health and welfare concerning levels of the above-referenced criteria pollutants. This section discusses potential impacts to air quality resulting from construction and operation of the proposed Project.

Impacts resulting from construction activities are anticipated to be temporary and minor. Impacts resulting from the operation of the proposed Project are anticipated to be negligible. Potential impacts to air quality as a result of the construction and operation of the proposed Project would include:

- Increases in fugitive dust caused by construction activity, vehicles, and equipment
- Emissions from the combustion of fuel in the construction vehicles and equipment
- Potential impairments to Federal Class 1 Area visibility
- Potential contribution of greenhouse gas emissions

5.5.2.1 Construction Impacts on Air Quality

Potential impacts on air quality as a result of construction include increases in fugitive dust caused by construction activity and emissions from the tailpipes of construction vehicles and equipment. The primary construction impact on air quality comes from fugitive dust. The footprint of the proposed Project is primarily on open ranges, undeveloped land, or agricultural land, with transportation occurring primarily on dirt or gravel roads. Increases in traffic on these roads from construction-related workers, equipment, earthmoving activities, and wind action on disturbed areas would all lead to increases in the production of fugitive dust. Site-preparation for the proposed Project would require earthmoving and grading activities, exposing soils and increasing the potential for wind erosion. In addition, the transportation of soil and other construction debris in uncovered trucks could also contribute to fugitive dust. The primary concern with fugitive dust would occur during the warmer, drier months when soils are not as compacted and are more prone to dust generation. Impacts from fugitive dust would be expected to be short-term and only occurring during the construction period. Based on the relatively small size of the affected area, minimal surface disturbance, and current air quality conditions, it is expected that this Project would result in low impacts from fugitive dust on air quality.

Other impacts on air quality as a result of construction activities come from emissions from construction vehicles and heavy equipment used in the construction process. These vehicles and equipment would emit

hydrocarbons, particulate matter, and CO_2. Emissions resulting from construction activities would be highly localized in the immediate Project area and ROW and would be similar to or less than those created by agricultural activities taking place in a majority of the Project area. Air emissions from construction are expected to be minimal, as these activities are temporary and would involve limited equipment. Estimated emissions are listed in Table 5.5-1. As shown in the table, expected emissions would be below applicable thresholds. Therefore, emissions stemming from the construction of the Project would not substantially reduce air quality in the Project area, would not exceed EPA *de minimis* thresholds, and would not affect the current attainment status of North Dakota. Rather, the Project would result in short-term, low impacts.

Table 5.5-1: Transmission Line and Substations Construction Emissions Estimates and General Conformity *De Minimis* Thresholds

Pollutant	Maximum Yearly Emissions (tons/year)	General Conformity *De Minimis* Threshold (tons/year)
NO_x	52.3	100
Volatile organic compounds	52.3	100
$PM_{2.5}$	16.5	100
SO_2	83.0	100
CO	47.4	100

Source: EPA's AP-42 emission factors and New Source Performance Standards (40 CFR Part 60) for Mobile Engines.

5.5.2.2 Operational Impacts on Air Quality

Emissions potentially impacting air quality during operation of the transmission line, substation, and switchyard would only occur as a result of atmospheric interactions with the energized conductors. These minor emissions consist of ozone and NO_x and occur near the conductor due to the development of a corona. These emissions would be negligible relative to NAAQS and would not approach current *de minimis* levels of air emissions. Project operations would result in low impacts on air quality.

5.5.2.3 Impacts to Class I Areas

A potential area of concern regarding proposed air quality impacts associated with the Corridor/Route is the proximity of the proposed transmission line to the TRNP-North Unit, a Federal Class I area. The proposed transmission line would be approximately 14 miles from the TRNP. Class I areas are sensitive areas with important visual qualities and are protected from air pollutants that can potentially cause visibility impairments. Visibility can be affected by several air pollutants including PM_{10}, $PM_{2.5}$, sulfates, nitrates, and sulfuric acid mist. Project-related construction activities could emit particulate matter (PM_{10}

and $PM_{2.5}$), which could impact visibility. However, construction-related emissions would be limited, highly localized, and short-term nature. In addition, the implementation of management practices to control emissions and fugitive dust would further control construction emissions such that they would not cause visibility impairments to the Class I area.

5.5.2.4 Greenhouse Gas Emissions

GHG emissions resulting from the Corridor/Route were calculated for two types of activities that produce GHG emissions: construction of the transmission line and ongoing annual operations and maintenance for its estimated 50-year-long operational life. GHG emissions associated with construction activities would occur over a period of approximately 18 months. Based on existing data, it was assumed that an average of 80 workers (20 workers in each of four crews) located throughout the Project area would work on the Project daily during peak construction (including foundation and structure installation) and non-peak construction (including installing and removing BMP measures and staging areas, site preparation and restoration work, and equipment and materials moving). The transportation components of GHG emissions were estimated based on the approximate number of vehicles that would be used during project construction and the approximate distance those vehicles would travel. The number of round trips was conservatively estimated using the following assumptions.

- All workers would travel in separate vehicles to and within the Project area each day.
- The maximum number of workers (80) would be required to construct the Project.
- The round trip distance in the Study Corridor is approximately 50 miles, depending on the exact location of workers within the Study Corridor.
- Fuel consumption is based on the average fuel economy for standard pickup trucks of 18 miles per gallon. This is likely an overestimate, as more efficient vehicles may be occasionally used. Average helicopter fuel mileage is anticipated to be around 1 mile per gallon.

Fuel consumption and GHG emissions would also result from operation of onsite heavy construction equipment. Heavy construction equipment may include augers, bulldozers, excavators, graders, heavy-duty trucks, and front-end loaders. It is also expected that the majority of heavy construction equipment use would occur during peak construction. Assumptions included a maximum of 50 equipment machines would be in operation during peak construction and 25 equipment machines during off-peak. It was also assumed that the average size of equipment would not exceed 600 horsepower, with most of the equipment less than 300 horsepower, and would operate at max power for 8 hours per day 5 days a week, which is a significant overestimation because equipment commonly operate in idle or reduced power.

Development of the Project would require the permanent removal of trees and other vegetation as part of ROW clearing. Although permanent tree removal would not immediately emit GHGs, it would reduce the level of solid carbon storage in the area. Tree growth and future carbon sequestration rates are highly variable and dependent on several factors, including the species of the tree, the age of the tree, climate, forest density, and soil conditions. In the North Central Region, the average carbon storage associated with forest is 160,000 pounds per acre (USFS, 1992). As a result of the Project, a total of approximately 5.5 acres of forested area would be removed.

During operation and maintenance of the transmission line, it is expected that routine patrols, maintenance of roads and structures, and aerial inspections by helicopter would occur once per year and emergency maintenance and natural resource review would occur on average once every 4 years, with all activities estimated to incur 50 miles round trip. Operation and maintenance emissions are estimated for the 50-year life span of the transmission line.

Based on the above assumptions, the Project would result in an estimated total of approximately 118,320 metric tons of carbon dioxide equivalent (CO_2e) emissions during construction and a total of an estimated 50 metric tons of CO_2e emissions for ongoing operations and maintenance activities over the 50-year lifespan of the line. On an annual basis, construction CO2e emissions would be approximately half of the total emissions at around 60,000 metric tons per year (or 65,000 short tons per year). To provide context for this, when the EPA set the Prevention of Significant Deterioration (PSD) Tailoring Rule for Greenhouse Gases threshold for major source permitting, they set the level at 100,000 tons (short tons) per year for PSD and Title V programs. On an annual basis, this is less than the estimated maximum construction emissions for this site. During normal operation and maintenance of the transmission line, the greenhouse gas emissions will be very low when compared to the major source thresholds set by EPA.

It is expected that approximately 5.5 forested acres would be removed for the Corridor/Route. Assuming each affected acre contains the average carbon content for the North Central Region, the net carbon footprint associated with the removal of forested area would be an estimated 400 metric tons of CO_2e. Given this estimate, the impact of vegetation removal on GHG emissions would be well below the EPA threshold of 25,000 metric tons and also well below the major source permitting thresholds of 100,000 tons (short tons) per year.

5.5.3 Mitigation

- Basin Electric and its contractors would use water on roads and disturbed areas to minimize dust.

- Basin Electric and its contractors would re-seed vegetation in disturbed areas outside of the substation/switchyard to prevent wind-blown dust from areas devoid of vegetation.
- Basin Electric and its contractors would implement vehicle idling and equipment emissions requirements, such as establishing operating policies that limit idling time and mechanical modifications to the vehicles that restrict the amount of idle time.
- Basin Electric and its contractors would encourage carpooling and the use of shuttle vans among construction workers to minimize construction-related traffic and associated emissions.
- Basin Electric and its contractors would locate staging areas as close to construction sites as practicable to minimize driving distances.
- Basin Electric and its contractors would locate, where possible, staging areas in previously disturbed or graveled areas to minimize new soil and vegetation disturbance where practicable.
- Basin Electric and its contractors would encourage the use of proper size equipment to maximize energy efficiency.
- Basin Electric and its contractors would use alternative fuels, such as propane or solar, for generators at construction sites or use electrical power, where practicable.
- Basin Electric and its contractors would recycle or salvage non-hazardous construction and demolition debris where practicable.
- Basin Electric and its contractors would dispose of wood debris (burning) in the local area where practicable.
- Basin Electric and its contractors would use local rock sources for road construction where practicable.

5.6 Noise

5.6.1 Description of Resources

5.6.1.1 Definitions

Sound is caused by the vibration of air molecules and is measured on a logarithmic scale with units of decibels (dB). Sound is composed of various frequencies, which are measured in Hertz (Hz), or the number of cycles per second. The typical human ear can hear frequencies ranging from approximately 20 Hz to 20,000 Hz. Typically, the human ear is most sensitive to sounds in the middle frequencies (1,000 to 8,000 Hz) and is less sensitive to sounds in the low and high frequencies. As such, the A-weighted scale was developed to simulate the frequency response of the human ear to sounds at typical environmental levels. The A-weighted scale emphasizes sounds in the middle frequencies and de-

emphasizes sounds in the low and high frequencies. Any sound level to which the A-weighted scale has been applied is expressed in A-weighted decibels (dBA). For reference, the A-weighted sound pressure level and subjective loudness associated with some common noise sources are listed in Table 5.6-1.

It has been found that the A-scale weighting best approximates the frequency response of the human ear. The human ear responds to noises in the audible frequencies in a similar manner in most individuals. Most humans perceive the change in a noise level as follows:

- 3 to 5 dBA change - Barely perceptible change.
- 6 dBA change - Readily perceptible change.
- 10 dBA change - Doubling (or halving, if the sound is decreasing) of the apparent loudness.

Table 5.6-1: Typical Sound Pressure Levels Associated with Common Noise Sources

Sound Pressure Level (dBA)	Subjective Evaluation	Outdoor Environment	Indoor Environment
140	Deafening	Jet aircraft at 75 feet	
130	Threshold of pain	Jet aircraft during takeoff at a distance of 300 feet	
120	Threshold of feeling	Elevated train	Hard rock band
110		Jet flyover at 1000 feet	Inside propeller plane
100	Very loud	Power mower, motorcycle at 25 feet, auto horn at 10 feet, crowd noise at football game	
90		Propeller plane flyover at 1000 feet, noisy urban street	Full symphony or band, food blender, noisy factory
80	Moderately loud	Diesel truck (40 mph) at 50 feet	Inside auto at high speed, garbage disposal, dishwasher
70	Loud	B-757 cabin during flight	Close conversation, vacuum cleaner, electric typewriter
60	Moderate	Air-conditioner condenser at 15 feet, near highway traffic	General office
50	Quiet		Private office
40		Farm field with light breeze, birdcalls	Soft stereo music in residence

Sound Pressure Level (dBA)	Subjective Evaluation	Outdoor Environment	Indoor Environment
30	Very quiet	Quiet residential neighborhood	Bedroom, average residence (without TV and stereo)
20		Rustling leaves	Quiet theater, whisper
10	Just audible		Human breathing
0	Threshold of hearing		

Source: Adapted from Egan 1988 and Ramsey and Sleeper 1994

There are also objective factors to consider when determining the noise and how people may be affected by the noise. Noise in the environment is constantly fluctuating, such as when a car drives by, a dog barks, or a plane passes overhead. Therefore, noise metrics have been developed to quantify fluctuating environmental noise levels. These metrics include the exceedance sound level (L_x). The L_x is the sound level exceeded "X" percent of the sampling period and is referred to as a statistical sound level. The most common L_x values are L_{eq}, L_{90}, L_{50}, and L_{10}. L_{eq} is the level of a constant sound over a specific time period that has the same sound energy as the actual sound over the same period. L_{dn} is another common noise metric, which applies a 10-dB penalty to nighttime noise levels.

5.6.1.2 Ambient Conditions

Ambient sound levels are highly variable and are based on sound sources in the immediate area. For much of the Project area, which is mostly open fields, agricultural, and rural residential areas, L_{dn} sound levels will typically vary between 40 and 45 dB.[7]. The several communities in the Project area would typically have higher ambient noise levels. Areas adjacent to North Dakota state highways and numerous county and local roads would have higher ambient noise levels as well, due to vehicle traffic. Land with restricted access, such as around the Little Missouri River, could be quieter than the general Project area. The development of numerous oil wells across the Project area has introduced isolated pockets of noise during construction and during operation from the well flares, pumping activities, and truck traffic.

There are no State, county, or city specific regulations for noise in the Project area.

5.6.2 Impacts

As mentioned above, much of the proposed Project area consists of open fields, agricultural areas, and rural residential areas. Ambient noise levels in these areas typically are expected to vary between 40 and 45 dB, which is generally considered quiet. The several communities located near the proposed Project would have higher noise levels, as would areas adjacent to local roadways and highways. This section

[7] Figure 4 from http://www.nonoise.org/library/envarticle/index.htm accessed on 12/8/2011

provides a discussion of the potential noise impacts to the area as a result of construction and operation of the proposed Project.

Noise impacts resulting from construction activities are anticipated to be temporary and minor. Noise impacts during operation of the proposed Project are anticipated to be negligible. Potential noise impacts as a result of construction and operation of the proposed Project would include:

- Temporary increases in noise levels along the Corridor/Route from construction vehicles and equipment
- Temporary increases in noise levels for nearby residences during construction of the proposed substations
- Potential increase in ambient noise levels as a result of the operation of the transmission line or proposed substations

5.6.2.1 Corridor/Route Noise Impacts

While construction noise would occur along the entire line, noise increases would only be a concern if sensitive noise receptors (such as residences, schools, churches, libraries) were located in proximity to the construction area so as to experience increases in noise exposure. Temporary and highly localized noise increases would be generated from construction vehicles and equipment. Increased traffic along roadways near construction areas would lead to a temporary increase in noise levels adjacent to these roads. However, no sensitive noise receptors are located along the vast majority of these areas due to the rural nature of the area. Construction-related noise impacts would be temporary and would only occur along small sections of the line where construction activities would actually be taking place. Only certain areas along the length of the route would experience increases in noise at any one time, with the most noise occurring during ROW clearing (which would be minimal) and the erection of transmission structures. Construction-related noise impacts would occur during normal construction hours, mainly during daylight hours. Increases in noise levels related to construction activities would cease upon completion of construction.

Noise generated from the operation of the Project is expected to be negligible. The primary source of noise as a result of operation of the transmission line would be the corona effect, which is a type of electrical conduction that generally occurs in the atmosphere near the conductor. Local atmospheric pressure changes that occur with corona may result in a hissing and cracking sound that may be audible from directly under the transmission line to within a few feet of the ROW, depending on local atmospheric conditions. For other projects double circuited with a 345-kV and 115-kV, the L_{50} noise

levels were predicted to be 50 dBA at 300 feet (Basin Electric, 2012). Therefore, for this Project, the L_{50} noise level would be even less at 500 feet (the location of the nearest residence) and less because the Project would only be a single circuit. The transmission line would be far enough away so as not to be heard above the ambient noise produced by other sources in the area.

5.6.2.2 Proposed Substations Noise Impacts

Increases in noise levels resulting from the construction of the proposed Roundup, Kummer Ridge, and Patent Gate substations are anticipated to be similar to impacts associated with the construction of the proposed transmission line, with the exception that construction would occur over a more extended period of time in a specific area. Potential impacts during site construction would include temporary increases in noise levels from construction vehicles and equipment onsite and on the surrounding roads. The potential increases in sound due to construction would be temporary in nature and sound levels would return to the existing ambient levels after construction is complete.

Future sound levels in areas directly adjacent to the three proposed substations would potentially be impacted by operation of new substation facilities, particularly noise generated by transformers. The sound commonly associated with a transformer is described as a hum. This hum is created by the expansion and contraction of the core when the unit is energized (known as magnetostriction). The expansion and contraction occurs roughly twice per alternating current cycle. The cycle for the proposed transformers is 60 times per second, or 60 Hz. The transformers would therefore oscillate at a frequency of approximately 120 Hz. Historical field work has demonstrated that transformer noise mostly occurs in the 1st, 3rd, 5th, and 7th harmonics (120, 360, 600, and 840 Hz).

In addition, the transformers would have cooling fans that would create noise at various times. These fans create noise two ways: 1) the motors' mechanical noise, and 2) by the blades disrupting the air. Predictive modeling was conducted to determine potential noise levels generated by substation operations.

The CadnaA noise model was used to analyze the sound levels from the three proposed substations. Due to the absence of local noise regulations, the overriding design goal for noise generated by the proposed substations will be an L_{dn} of 55 dBA, per the EPA Noise Guidelines.

Table 5.6-2 shows the equipment that would be installed at the Kummer Ridge, and Patent Gate, and Roundup substations.

Table 5.6-2: Substation Equipment

Proposed Substation	Substation Type
Kummer Ridge	One 333 MVA transformer, one 25 MVAR reactor
Patent Gate	Two 333 MVA transformers, one 50 MVAR reactor
Roundup	One 333 MVA transformer, one 25 MVAR reactor

The sound profile for the transformers was calculated using the National Electric Manufacturers Association (NEMA) rating system for an unquieted 333 MVA transformer. Vendor data for a reactor similar to those at the proposed substations was used. The expected sound-power profiles for the transformers and reactors are shown below in Table 5.6-3.

Table 5.6-3: Expected Transformer Sound Profiles

Equipment	Transformer Sound Power Level (Lw) at Octave Band Frequency (Hz) (dBA)									Normalized Value (dBA)
	31.5	63	125	250	500	1000	2000	4000	8000	
Transformer	103	109	111	106	106	100	95	90	83	115
Reactor	26	66	86	60	17	17	17	17	17	86

The modeled sound-pressure levels for each of the substations did not exceed an L_{dn} of 55 dBA at any current residences in the area. Therefore, it is not expected that operation of the Patent Gate, Kummer Ridge, and Roundup substations would cause sound levels that exceed the EPA Guidelines at any current residences, provided Basin Electric install transformers rated at the modeled noise level of 90 dBA or lower for IEEE distances. This noise level would be well within the range of noise levels for such equipment. Once specific equipment for the substations has been identified, further assessment of noise levels could be conducted to determine if EPA guidelines would actually be exceeded at these residences (see Appendix J, Substation Preliminary Noise Analysis Memo, September 2014).

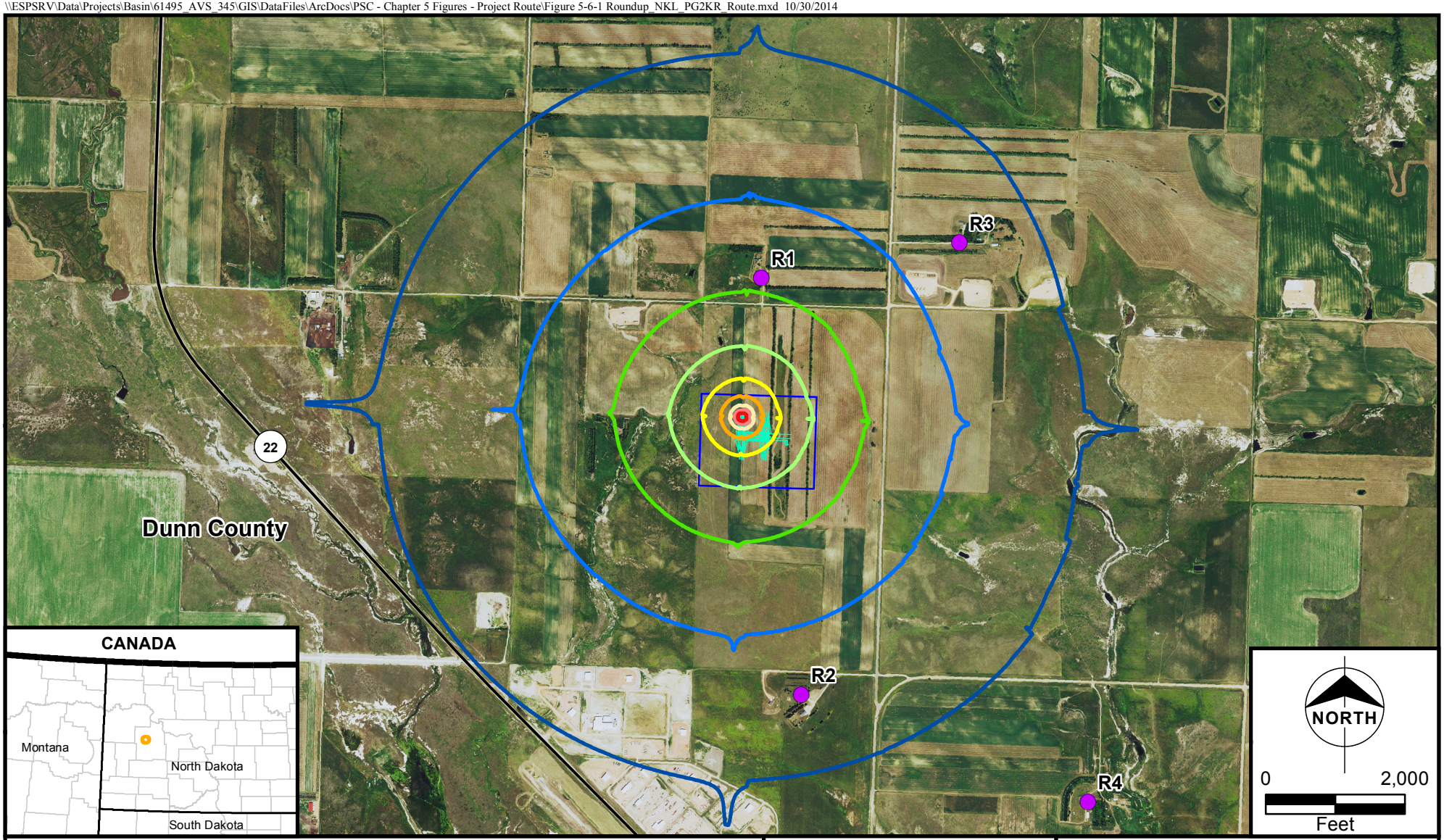
5.6.3 Mitigation

- Basin Electric and its contractors would use equipment with sound-control devices no less effective than those provided on the original equipment.
- Basin Electric and its contractors would not use equipment with an un-muffled exhaust.
- Basin Electric and its contractors would not conduct noise-generating construction activity within 1,000 feet of a residential structure between the hours of 10 p.m. and 7 a.m.
- Basin Electric and its contractors would take measures to restore the reception to a quality as good as or better than before the interference if the proposed transmission line is found to be the

source of radio or television interference in areas with reasonably good previous reception during operation.

- Basin Electric would purchase transformers with a noise rating of 90 dBA or less, based on IEEE distance specifications.
- Basin Electric would investigate any complaints of substation noise from nearby residences and work to determine if EPA guidelines are exceeded. If exceedances are determined, Basin Electric would work to reduce noise exposure at these residences.

\\ESPSRV\Data\Projects\Basin\61495_AVS_345\GIS\DataFiles\ArcDocs\PSC - Chapter 5 Figures - Project Route\Figure 5-6-1 Roundup_NKL_PG2KR_Route.mxd 10/30/2014



Substation Property Boundary
Substation Equipment
Residences

Sound Levels (dBA)

45 60 75
50 65 80
55 70 85

Burns & McDonnell SINCE 1898

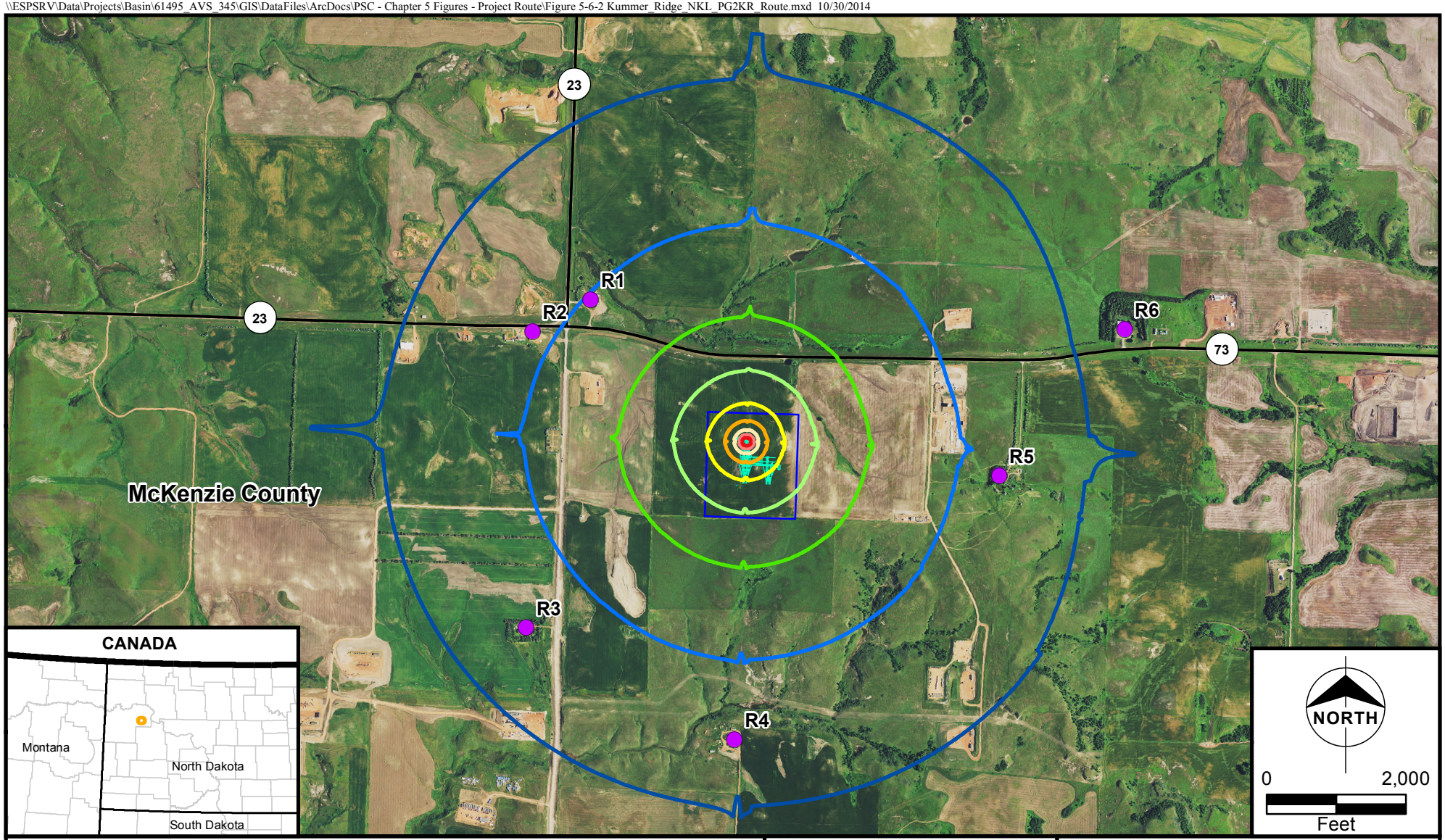
BASIN ELECTRIC POWER COOPERATIVE
A Touchstone Energy® Cooperative

Figure 5.6-1
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Ldn Sound Contours
Roundup Substation

Source: USDA NAIP 2014 Aerial Photography; North Dakota GIS; Basin Electric; Burns & McDonnell.

Revised October 30, 2014

\\ESPSRV\Data\Projects\Basin\61495_AVS_345\GIS\DataFiles\ArcDocs\PSC - Chapter 5 Figures - Project Route\Figure 5-6-2 Kummer_Ridge_NKL_PG2KR_Route.mxd 10/30/2014



Substation Property Boundary
Substation Equipment
Residences

Sound Levels (dBA)

45 60 75
50 65 80
55 70 85

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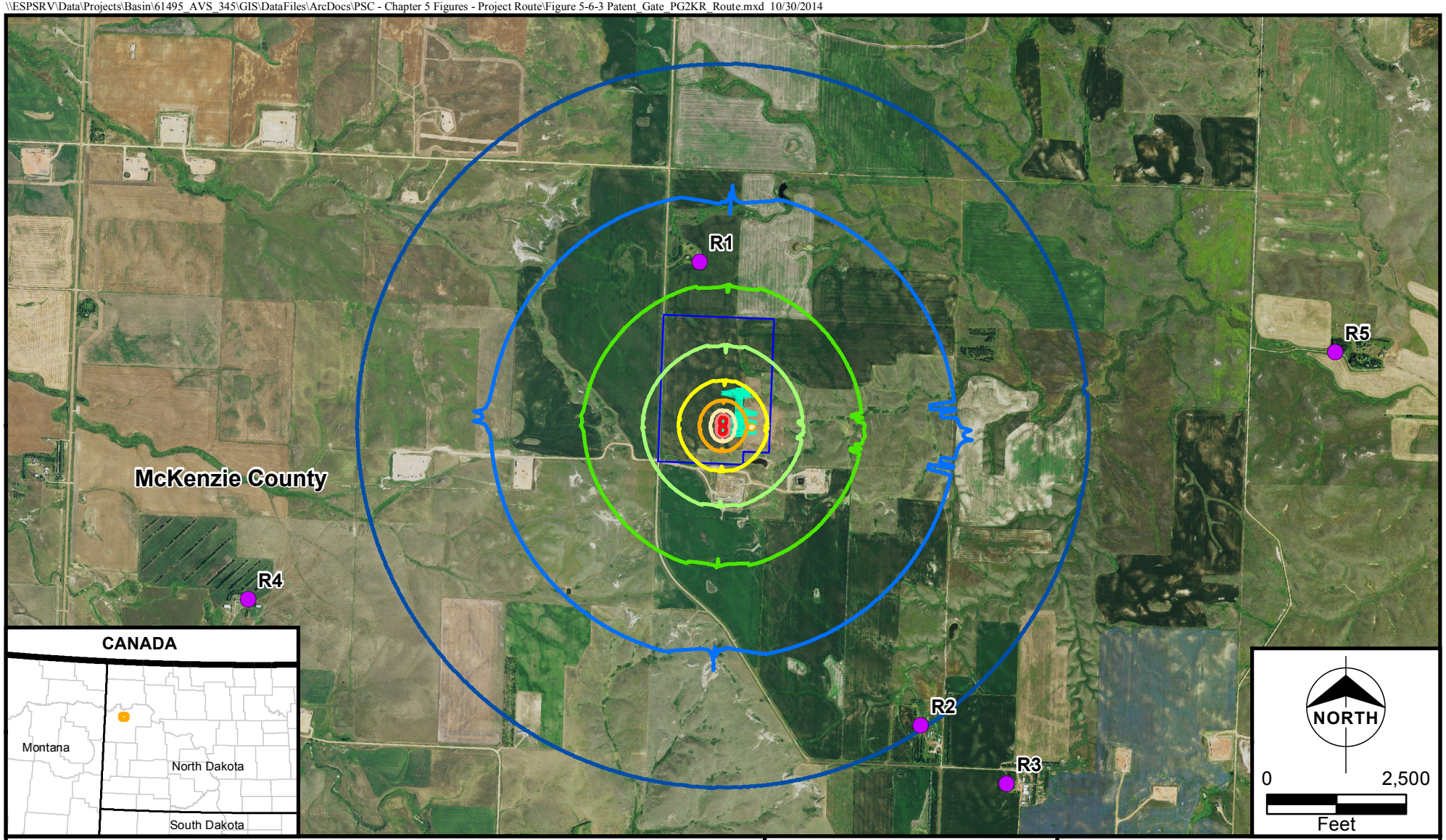
BASIN ELECTRIC POWER COOPERATIVE
A Touchstone Energy® Cooperative

Figure 5.6-2
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Ldn Sound Contours
Kummer Ridge Substation

Source: USDA NAIP 2014 Aerial Photography; North Dakota GIS; Basin Electric; Burns & McDonnell.

Revised October 30, 2014

\\ESPSRV\Data\Projects\Basin\61495_AVS_345\GIS\DataFiles\ArcDocs\PSC - Chapter 5 Figures - Project Route\Figure 5-6-3 Patent_Gate_PG2KR_Route.mxd 10/30/2014



Substation Property Boundary
Substation Equipment
Residences

Sound Levels (dBA)

45	60	75
50	65	80
55	70	85

Burns & McDonnell SINCE 1898

BASIN ELECTRIC POWER COOPERATIVE
A Touchstone Energy® Cooperative

Figure 5.6-3
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Ldn Sound Contours
Patent Gate Substation

Source: USDA NAIP 2014 Aerial Photography; North Dakota GIS; Basin Electric; Burns & McDonnell.

Revised October 30, 2014

5.7 Visual Impacts

5.7.1 Description of Resources

5.7.1.1 Regional Setting

This section describes existing visual resources within the Project counties. Scenic quality is based on the evaluation of the overall character and diversity of the terrain, vegetation type, water, and cultural features of a particular landscape in relation to a viewer's sensitivity. Landowners within the Project area would have a different sensitivity level to changes in the landscape than would motorists or tourists who view the area for a limited period of time.

The Project counties are within the Northwestern Great Plains Ecoregion. Within this major ecoregion, there are numerous smaller physiographic ecoregions (see Geology and Landforms section for further descriptions). The Northwestern Great Plains Ecoregion encompasses the area south of Lake Sakakawea (Bryce et al., 1998). The Project area contains a diversity of topographic features and associated visual landscapes.

5.7.1.2 Natural Features

The Project area counties contain a broad range of topography and elevation, with ranges of approximately 1,300 to 3,300 feet above mean sea level (amsl). Rural homesteads are interspersed throughout the area (Figure 5.7-1). The Project area exhibits generally rolling terrain. Wide viewsheds are available in this region, particularly from higher vantage points. Few trees obstruct views from local roads and points throughout the Project area. However, greater changes in elevation and increased topographic relief lend to greater screening of objects in the landscape.

Fewer agricultural fields occur near the Little Missouri River and Lake Sakakawea, with cattle grazing being more common. Large tracts of timber are uncommon within the Project counties, although wooded fencerows and shelterbelts are common, especially near farms and rural residences.

Within the Project counties, TRNP and the LMNG offer designated scenic trails and views within their boundaries. Additionally, the Killdeer Mountain Four Bears Scenic Byway (North Dakota State Route 22) and the TRNP North Unit Scenic Byway (located off of U.S. Highway 85) provide scenic views of the rural landscape in the central section of the Project area.

Figure 5.7-1: Cropland and Rolling Prairie with Farmstead and Oil Development

The USFS Scenery Management System provides a tool for managing scenic resources and is incorporated into forest plans to determine the relative value and importance of scenery on National Forest System lands. The process involves classifying landscapes, and setting goals and objectives for maintaining, enhancing, restoring, and monitoring scenic integrity. Under the administration of USFS, discrete units of the National Grasslands have been assigned scenic integrity objectives (SIOs) under the Northern Great Plains Management Plans Revision. SIOs guide the amount, degree, intensity, and distribution of management activities needed to achieve desired scenic conditions. SIO classifications range from very high to unacceptably low. These SIOs are the management objectives adopted through the approval of the Forest Land and Resource Management Plan.[8]

The LMNG, located in McKenzie County, is part of the larger Dakota Prairie National Grasslands. These lands, administered by the USFS, have SIOs. The LMNG areas within the Project area are mostly classified as having low SIOs, although there are areas with both moderate and high SIOs (USFS, 2001). National Grassland areas within the Project area with moderate and high SIOs are primarily found adjacent to or near TRNP North Unit, outside the Project area.

[8] Scenic integrity levels (SILs) are the proposed management objectives presented in the alternatives development of the DEIS. SILs become SIOs when the preferred alternative is selected. The SILs define the degrees of acceptable deviation in form, line, color, and texture that may occur at any given time. SILs ranging from high to low are assigned to all management areas. Usually they are described at the management prescription level. A high SIL means human activity is not scenically evident, a moderate SIL describes a valued landscape character that is slightly altered, and a low SIL indicates that a landscape is moderately altered.

5.7.1.3 Built Environment

Rural homesteads are visible throughout the Project counties. Incorporated towns and unincorporated communities also occur as part of the manmade environment within the Project counties. Many of these towns and small communities are experiencing rapid residential and commercial growth to support oil and gas development activities in the region, particularly the Watford City area.

U.S. and state highways, county roads, and unpaved roads also traverse the Project counties as part of the built environment. Numerous overhead transmission and distribution lines also occur within the Project area.

Recent increases in oil and gas production within the Project area have led to an increase in the number of oil and gas wells and drill rigs that are visible on the landscape (Figure 5.7-2). Each oil well pad site incorporates as much as 10 acres of surrounding land and typically includes a drill rig, pump jack, storage tanks, and gas flaring equipment on a gravel pad and containment berms (Figure 5.7-3). New oil well storage tank facilities, oil and natural gas pipelines, and associated industrial facilities have also been constructed within the Project counties, with more of these currently under construction and projected to be built in the future to support the oil and gas industry. Oil and gas production activities have also led to the widespread development of temporary employee housing, which generally consists of clusters of mobile home or trailer units (Figure 5.7-4). These housing clusters are increasingly visible on the landscape as well, mainly on the outskirts of established communities. Temporary housing is currently giving way to more permanent apartment and other multi-family type housing, particularly in and around rural communities where access to utilities is available. Such growth and development is expanding into more rural areas, converting the visual character from undeveloped landscapes to a more suburban-type environment.

Figure 5.7-2: Typical Oil and Gas Development Activities Visible on the Landscape within the Project Counties

Figure 5.7-3: Typical Oil Well Pad Site with Pump Jack, Gas Flaring Equipment, and Storage Tanks

Figure 5.7-4: Typical Temporary Employee Housing Camps in Project Area

5.7.2 Impacts

As discussed above, the proposed Project counties contain a diversity of visual resources and viewsheds, particularly with respect to LMNG, Lewis & Clark National Historic Trail, and the ND State Route 22 scenic byway. Visual changes would be noticeable for landowners who live near the proposed Project or residents who use roads or highways located within the viewshed of the proposed Project. This section discusses potential visual impacts to resources resulting from construction and operation of the proposed Project.

5.7.2.1 Corridor/Route Visual Impacts

Construction and operation of the Project would introduce another feature into the visual landscape throughout the Project area. Potential visual impacts to individuals or resources as a result of the proposed Project would include:

- Proximity of the transmission line and/or structures to residences and residential areas
- Changes to the visual landscape within or near recreational areas such as public lands
- Reduction in the visual quality of scenic byways or trails crossed by the proposed Project

New transmission structures, conductors, and cleared ROW areas would change the visual characteristics in the vicinity and the viewshed of the proposed Project. However, the proposed Project would not differ

from other transmission lines common throughout the region and Project area. For residences located near the transmission line and local residents traveling area roads in the Project area, a new manmade feature would be present in the landscape. However, the topography and woody vegetation in shelterbelts and windbreaks serve to reduce line visibility down to momentary glimpses of a generally small section of line.

Residents of homes along the line would be most prone to changes in the visual environment around their homes. However, the visual sensitivity to the line would be highly dependent on the orientation of the line to the home (e.g., in front, behind, or alongside), any screening between the home and the line (e.g., trees or topography), distance, other visual components (e.g., existing lines, radio towers), and the general sensitivity of the occupants to the Project.

Based on the visual integrity objectives identified in the Northern Great Plains Management Plans Revision (2001), the two small LMNG tracts within the Study Corridor appear to have a scenic integrity level (SIL) of low. Neither tract is crossed by the Corridor/Route. A low SIL is described as a landscape appearing heavily fragmented, with human activities strongly dominating the natural landscape. Using these tracts for comparison due to their proximity, the proposed Project would be consistent with this SIL and not contribute to adverse changes in the visual setting throughout the majority of the Study Corridor. The following discusses specific areas or resources of visual interest potentially impacted along the Corridor/Route.

The Project would be constructed through varying types of terrain. Distance from the line, terrain, topographical features in the area, differences in elevation, manmade features and natural features such as forest cover would all influence the level of potential impact at specific locations throughout the Project area. The Corridor/Route would have 23 road crossings along the length of the route. Many, if not most, of these roads are county section-line gravel roads that receive only very light local traffic. However, the Project would introduce a new visual element to the surrounding area for motorists at each road crossing. This addition would likely be more pronounced at road crossings of larger, well-traveled roads or at crossings where there is no existing transmission or distribution lines within view of the road.

The Corridor/Route would not be located within 500 feet of any residences. The impacts to residences farther than 500 feet of the proposed Project would be similar to those generally discussed previously. Throughout the majority of the Project area, except in specific areas discussed below, adverse visual changes would be minimal as the transmission line is located along existing transmission lines, roads, railroads, or in areas that contain other manmade visual elements such as oil and gas facilities or

communications towers. The overall low scenic integrity of the area through which the Corridor/Route would extend would not be adversely changed through the presence of the proposed line.

5.7.2.2 Substation Visual Impacts

Visual impacts resulting from the construction and operation of the proposed Roundup, Kummer Ridge, and Patent Gate substations would have similar impacts associated with the construction and operation of the proposed Project. Each new substation would be an added visual element in the existing landscape.

The proposed Roundup Substation would be constructed approximately 2.4 miles north of the City of Killdeer. No residences would be located within 500 feet of the proposed substation site, but several would likely be within sight of the substation. The land cover on the site is a mix of cultivated crops and grassland. The Roundup Substation would be considered a compatible component of the visual landscape due to its location along the AVS to Neset line and utility and oil development in the area.

The proposed Kummer Ridge Substation would be constructed approximately 0.6 miles south of the intersection of ND State Highway 23 and ND State Highway 73. No residences would be located within 500 feet of the proposed substation site, but several would likely be within sight of the substation. The land cover in this site is currently scrub/shrub. The Kummer Ridge Substation would be considered a compatible component of the visual landscape due to utility and oil development in the area.

The proposed Patent Gate Substation would be located approximately 4 miles northwest of Arnegard. No residences would be located within 500 feet of the proposed substation. This site is currently being used for agricultural purposes. The Patent Gate Substation would be considered compatible with the current visual setting of the area due to its location along the AVS to Neset line and utility and oil development in the area.

5.7.3 Mitigation

- Basin Electric and its contractors would leave (where possible) plants smaller than 8 feet in height within the 150-foot wide ROW to help reduce the effect of the ROW on visual and aesthetic resources.
- Basin Electric and its contractors would remove construction debris and other litter from the ROW to minimize visual intrusion to the surrounding landscape.
- Basin Electric and its contractors would re-vegetate disturbed non-cropland areas of the ROW promptly following construction to reduce visual contrast of ROW within adjacent areas.

5.8 Cultural Resources

5.8.1 Description of Resources

Because RUS would provide funds for the Project, the agency is required to comply with Section 106 of the National Historic Preservation Act (NHPA), Public Law 89-665 as amended, and its implementing regulation 36 CFR Part 800. As the lead agency, RUS coordinated with Western concerning compliance requirements associated with Section 106 and NEPA. As such, both agencies are using studies and analyses conducted to comply with NEPA to comply with Section 106 as appropriate. Pursuant to 36 CFR Part 800.2(d) (3), RUS has used its NEPA procedures to meet its requirements for public involvement under Section 106.[9] A programmatic agreement for cultural resources has been executed for this Project and is included in Appendix T.

5.8.1.1 Project Area of Potential Effects

Pursuant to 36 CFR Part 800.16(d), the undertaking area of potential effects (APE) is defined as the area within which the proposed Project has the potential, either directly or indirectly, to affect historic properties. Historic properties are defined as "…any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places [NRHP]" (36 CFR 800.16(l)(1). For purposes of complying with Section 106, the Project APE had been defined as a 150-foot wide corridor based on the centerline of the Corridor/Route and associated access roads. The APE also includes proposed substations and laydown yards. Compliance also requires that the visual impacts of the undertaking on historic properties be addressed. Given the height of the proposed structures and the requirement to maintain a ROW cleared of vegetation, the proposed Project could alter the integrity of historic properties, especially historic standing structures, with respect to their location, design, setting, materials, workmanship, feeling, and/or association. For purposes of compliance with Section 106, RUS and Western have defined the APE for visual impacts as a corridor 0.5-mile on either side of the Corridor/Route centerline, a total corridor width of 1.0 mile.

The Section 106 consultation process for the Project is ongoing. Basin Electric has participated in consultations between RUS, Western, and the North Dakota State Historic Preservation Officer (SHPO). The USFS and the USACE have also been consulted for those portions of the Corridor/Route[10] that would

[9] Completion of the NEPA process for this Project included the preparation of an EIS that included the AVS to Neset Project and the NKL Phase I and Phase II Projects. RUS was the lead agency for the EIS, with Western and USFS serving as cooperating agencies.

[10] Here, Corridor/Route refers to the AVS to Neset Project included in the EIS and Section 106 process, which crosses lands administered by the USFS and the USACE. The NKL Phase I Project does not cross any lands administered by these agencies.

cross lands they administer. Other federal and state permitting agencies were invited to participate in Section 106 consultation.

Section 106 and 36 CFR Part 800 requires that federal agencies such as RUS and Western must consult with federally recognized Indian tribes, as appropriate, as part of the compliance process. Western has undertaken consultation with the following tribes.

- Flandreau Santee Sioux
- Santee Sioux Nation
- Fort Peck Assiniboine and Sioux Tribes
- Spirit Lake Tribe
- Fort Belknap Indian Community
- Standing Rock Sioux
- Leech Lake Band of Ojibwe
- Three Affiliated Tribes
- Lower Sioux Indian Community
- Turtle Mountain Chippewa
- Minnesota Chippewa Tribe
- Upper Sioux Indian Community
- Prairie Island Indian Community
- White Earth Nation

5.8.1.2 Class I File Search

The *North Dakota Comprehensive Plan for Historic Preservation: Archaeological Component*, (ND SHPO, 2008) divides the state into a series of study units centered on the major drainages in the state. The plan summarizes the archaeological record for each unit, the types of cultural resources likely to be encountered, and the investigations that have occurred. The plan also is a tool whereby the necessary level of inventory for a project within a study unit can be evaluated. The NKL Phase I Project Corridor crosses the Little Missouri Study Unit (Unit #1), and the Garrison Study Unit (Unit #6). The Little Missouri and Garrison study units have experienced more cultural resource investigations than other study units, primarily because of oil development.

As part of the NEPA process for the Project, Metcalf Archaeological Consultants, Inc. (MAC) staff prepared a Class I review (Appendix K) for the Project EIS in late 2011 and early 2012, the results of

which are documented in the EIS. The Class I review of the NKL (Phase I and Phase II[11]) Corridor was periodically updated, once in the fall of 2013 and again in late summer 2014. The review involved a search of the State Historical Society of North Dakota (SHSND) site and manuscripts files. The objective was to identify the cultural resources, such as buildings, structures, sites, objects, or districts, or properties of traditional religious and cultural importance to Native Americans, that have been recorded and the cultural resource investigations that have been conducted within the transmission line planning area. The search area encompassed a 6-mile wide corridor along the Project[12] evaluated in the EIS. Identification of cultural resources also included, to the extent possible, establishing whether the resource has been determined eligible for inclusion or is already included in the NRHP. Both designations are considered to be historic properties (36CFR800.16[l][1]) and afford the same considerations and protections under NHPA.

A total of 13 cultural resources were identified within one-quarter mile of the NKL Phase I Corridor/Route. The cultural resources included 2 archaeological sites, 2 archaeological isolated finds, 3 historic sites, and 3 architectural resources. A total of 13 cultural resource investigations have occurred within or adjacent to the Corridor/Route, including the Basin Electric Roundup, Kummer Ridge and Patent Gate substations (Bluemle 2014). All of these investigations are cultural resource inventories. The majority of the inventories are associated with energy and infrastructure development. None encompassed the NKL Phase I Corridor/Route.

The data sets from the files search were organized for use in consultation with and between Basin, RUS, Western, the SHPO, and tribes. These consultations addressed the need for a Class II and/or Class III cultural resource inventory. The anticipation was that some areas along the Corridor/Route may only require a Class II reconnaissance while others a Class III intensive inventory. The consultation also addressed the effects of the construction of the Project on cultural resources, specifically those that are included in or eligible for the NRHP or those for which eligibility has not been determined, and how to minimize adverse effects.

5.8.1.3 Class III Inventory

MAC archaeologists began the Class III cultural resource inventory of the NKL (Phase I and Phase II) Corridor/Route and access roads during the 2014 field season. The inventory will be completed during the 2014-2015 field seasons before construction begins. The inventory methodology conforms to *North*

[11] At the time of the Class I File Search and the Class III Inventory, both the NKL Phase I and Phase II Corridor/Routes were included. Subsequently, as noted in Section 1.4, the alignment for NKL Phase II is under further development. Once finalized, cultural resource investigations of Phase II may require updating.
[12] AVS to Neset Project and North Killdeer Loop Project, Phases I and II Projects.

Dakota SHPO Guidelines Manual for Cultural Resource Inventory Projects (SHSND, 2012). The field inventory activities will be in the 150-foot-wide Corridor/Route or access road centerlines, for the entire length of the Corridor/Route.

Prior to field work on the NKL Phase I Project, MAC noted 10 cultural resources within one-quarter mile of the Corridor/Route that had been recorded prior to the inventory. During the 2014 field season, MAC updated one of these resources. Prehistoric feature site, 32MZ2351, which was expanded significantly, now crosses the Corridor/Route. Avoidance of this site by spanning the feature is recommended. Additionally, MAC archaeologists recorded two cultural resources using the appropriate North Dakota Cultural Resource Survey (NDCRS) archaeological, historic, and/or architectural form. The first cultural resource, a cairn, lies outside of the project corridor, and was recorded as a site lead, since access to fully record it was not possible. The second cultural resource, a historic roadbed, is not eligible for the NRHP. Official site numbers for these sites will be forthcoming from the North Dakota SHPO.

Resources were recorded according to the three classes the SHPO recognizes: site, isolated find, or site lead. *Sites* are defined as "…a location of past human activity that took place over 50 years ago and which left physical traces of that activity in the form of (1) an intact cultural feature, (2) six or more artifacts found within about 60 meters of each other, and/or (3) an intact subsurface cultural deposit regardless of the number of artifacts." *Isolated finds* are defined as "[a] location with five or fewer artifacts and identified by the archeologist(s) as representing an area of very limited past activity." *Site leads* consist of "…locations reported by a landowner or other non-professional as containing cultural resources" or "…a location with five or fewer surface visible artifacts may, in the professional judgment [sic] of the archeologist(s), be only a limited surface expression of a former occupation area where most of the artifacts are not visible (i.e., still buried)" (SHSND, 2012:17).

MAC staff is completing the NDCRS forms for the resources encountered during the 2014 inventory . The final report will be submitted to Basin in 2015, provided field investigations are completed. Western will use this report to initiate Project-specific tribal consultations. The report will include assessments of the resources as to whether they qualify as "historic properties." Avoidance will be recommended for those resources that are determined to be historic properties or for which survey data are insufficient to determine whether they qualify. If a resource that qualifies as a historic property cannot be avoided, a mitigation plan would have to be developed and executed before construction can impact the resource. If survey data are insufficient to determine whether the resource qualifies as a historic property and that resource cannot be avoided, the resource would have to be evaluated to determine if it qualifies and, if so, mitigated before construction can impact the resource.

5.8.1.4 Visual Assessment

As part of the compliance process, the visual impacts of the Project on historic properties were to be assessed. Accordingly, MAC is conducting a visual assessment of the impacts of the NKL Phase I Project on historic standing structures. Following Western guidelines, the Visual APE consisted of 0.5-mile on either side of the centerline. The assessment involved driving the route, and photographing and recording standing structures/structure complexes. The report documenting the results will be submitted upon completion of the fieldwork.

5.8.1.5 Traditional Cultural Properties

Traditional cultural properties (TCPs) are historic properties that are of "…traditional religious and cultural importance to an Indian tribe…" (36CFR800.16[l][1]). Many TCPs are associated with places (LeBeau, 2009). None of the resources recorded during the inventory have been specifically identified as TCPs. A number of stone features, including stone circles and cairns, were recorded. Many Native Americans consider stone circles and cairns to be TCPs as they interpret them as prayer circles. Cairns are known to have served a variety of functions, including trail markers, burials, buffalo drives, among others. Tribal consultations would need to address whether such features are considered to be TCPs and, if so, the appropriate avoidance or mitigation measure(s). Tribal surveys were completed in October 2015 on the NKL Phase I segment including the three substation locations.

5.8.1.6 Substation Sites

In 2013, Metcalf conducted a Class III cultural resource inventory of three substations included in the NKL Phase I Project. Metcalf found one cultural resource within the land parcel owned by Basin Electric. The Patent Gate Substation was developed with the cultural resource site outside of the substation and construction disturbance boundary. At the Kummer Ridge Substation, Metcalf recorded one isolated find which is recommended *not eligible* for the National Register of Historic Places. Metcalf inventory of the Roundup Substation location encountered seven cultural resources including four prehistoric isolated finds and three prehistoric lithic scatters. NDSHPO concurred with the finding of No Historic Properties Affected for all three substations, provided that the potentially significant resources found within the Roundup Station be avoided (ND SHPO March 13, 2014; Appendix U). Basin subsequently determined the cultural resources within the Roundup Substation could not be avoided, and further archaeological investigations were necessary. In the summer of 2014, Basin requested that MAC conduct evaluative testing of the three sites located within the proposed Roundup Substation (Metcalf, forthcoming). The sites and isolated finds were recommended as *not eligible* for the National Register of Historic Places and

no further work is necessary. MAC recommended a finding of *No Historic Properties Affected* for all three substation locations. This determination is currently awaiting NDSHPO review and concurrence.

5.8.2 Impacts

The construction of Project facilities could affect recorded and as yet unrecorded cultural resources - archaeological, historic and/or architectural – and TCPs. The Project, with its pole installation and substation construction and/or modifications, has the potential to disturb cultural resources and TCPs. Construction could alter the integrity of location, design, setting, materials, workmanship, feeling, and/or association of cultural resources or TCPs. In areas not previously disturbed and where the potential for cultural resources or TCPs is considered high (such as near large lakes and river crossings or areas having a good viewshed), resources or TCPs – both recorded and unrecorded - may be affected during construction of transmission structures, substations, or access roads. The viewshed for resources, especially historic buildings, or TCPs, also may be impacted through the intrusion of modern transmission structures. Archeological resources could be impacted by 1) subsurface excavations to install structures; 2) disturbance to surface soils by the operation of heavy construction equipment; and 3) disturbance to surface soils through site grading and preparation.

Impacts to cultural resources would be considered significant if they adversely affect historic properties - those cultural resources eligible for listing or included on the NRHP (36 CFR Part 60.4). If a cultural resource is identified as an historic property, the eligibility of the property is determined by evaluating whether it meets one or more of the NRHP criteria (36 CFR 800.4 (c)(1)). A cultural resource that meets one or more of the criteria is considered a historic property and is entitled to consideration afforded under Section 106 of the NHPA and its implementing regulations (36 CFR 800). Potential impacts to historic property are evaluated on an individual basis. Evaluation is in terms of the effect of the Project on the eligibility criteria (36 CFR Part 60.4) applicable to the resource.

It is possible that the vertical height of the proposed Project may diminish the integrity of an historic property by altering its setting and feeling, when those aspects are applicable. New transmission lines would result in a change in the existing viewshed of a historic property or could be seen from that property. Mitigation for visual impacts is discussed in greater detail in Section 5.7, Visual Impacts.

5.8.3 Mitigation

- Basin Electric and its contractors would comply with the conditions of the Programmatic Agreement (Appendix T).

- Basin Electric and its contractors would finish the Class III cultural resource inventory of the Project APE prior to construction and develop mitigation measures where required, in compliance with the Programmatic Agreement.
- Basin Electric and its contractors would span and protect known eligible archaeological sites within the Corridor/Route from disturbance during construction.
- Basin Electric and its contractors would develop protocol to reduce opportunities for construction workers to collect or disturb discovered cultural resources.
- Basin Electric and its contractors would follow the Project's Unanticipated Discovery Plan to provide guidance on how to proceed if a previously unknown archaeological or historic resource or human remains are encountered during construction or operation of the Project, including contact of the SHPO, participating tribes as appropriate, and designated representatives of Western and RUS for further evaluation (Appendix D).

5.9 Recreational Resources

5.9.1 Description of Resources

5.9.1.1 Regional Setting

The area consists of rolling prairies, agricultural lands, steep and rough terrain, lakes, rivers, and streams. Various outdoor recreational facilities and opportunities, such as hunting, fishing, hiking, and camping, are available throughout the Project counties.

5.9.1.2 Facilities

5.9.1.2.1 Lake Sakakawea

Lake Sakakawea is a large, manmade impoundment of the Missouri River located in west-central North Dakota. Lake Sakakawea's headwaters initially start as the Missouri River crosses U.S. Highway 85 near Williston. The southern boundary of Lake Sakakawea from west to east is McKenzie, Dunn, and Mercer Counties. Lake Sakakawea is the largest USACE reservoir in the United States. The USACE oversees the management of the public lands and water of Lake Sakakawea, which is 178 miles long with 1,884 miles of shoreline at normal pool elevation. Lake Sakakawea is 14 miles wide at its widest point, with a normal pool storage capacity of nearly 23 million acre-feet of water (USACE, 2011).

Lake Sakakawea and its surrounding public lands, predominately operated by the USACE, provide the public with fishing, boating, hunting, and camping opportunities. Thirty-five recreational areas are located around Lake Sakakawea to provide these outdoor recreational opportunities (see Figure 5.9-1). Many of

these recreational areas offer campsites, water, restroom facilities, boat ramps, and electricity hookups. The lake also provides irrigation, flood damage reduction, municipal and industrial water supply, and hydropower for the area. The proposed Project does not cross the Missouri River or Lake Sakakawea.

5.9.1.2.2 Little Missouri River

Similar outdoor recreational opportunities exist on and near the Little Missouri River, which passes through the Project area in McKenzie and Dunn Counties and empties into Lake Sakakawea.

5.9.1.2.3 TRNP

The TRNP North Unit, managed by the National Park Service (NPS), is located in McKenzie County, south of Watford City and west of U.S. Highway 85. The North Unit of this national park encompasses roughly 24,000 acres of wilderness and provides numerous outdoor activities such as camping, canoeing, fishing, horseback riding, and hiking (NPS, 2011). A variety of wildlife species occur within the park boundaries, making it a popular wildlife viewing area. The TRNP is outside the Study Corridor for the Project.

5.9.1.2.4 LMNG

Another area popular for outdoor recreation within the Project counties is the LMNG, which is comprised of numerous blocks of natural grasslands in North Dakota. These grasslands are administered by the USFS and consist of over 1 million acres of grassland, making it the largest grassland in the United States. These grasslands provide opportunities for hiking, hunting, wildlife viewing, camping, and horseback riding (USFS, 2010). The many tracts of the LMNG are divided into smaller management planning units that are managed for a particular emphasis. These management planning areas can consist of very small to very large acreages, with each area containing specific guidelines and standards for that area. Each management area is assigned a rating from one of six categories, with a Category 1 rating being the most land-use restrictive and generally assigned to wilderness areas and backcountry settings. Category 6 ratings are the least restrictive and are managed to meet a variety of ecological and human needs (USFS, 2001).

5.9.1.2.5 WMAs

Much of the hunting within the Project area is done on private tracts of land, although there are numerous WMAs occurring within North Dakota that provide opportunities for hunting and fishing on public land. WMAs are managed by the North Dakota Game and Fish Department (NDGFD) and are generally managed for various types of hunting, fishing, and nature viewing.

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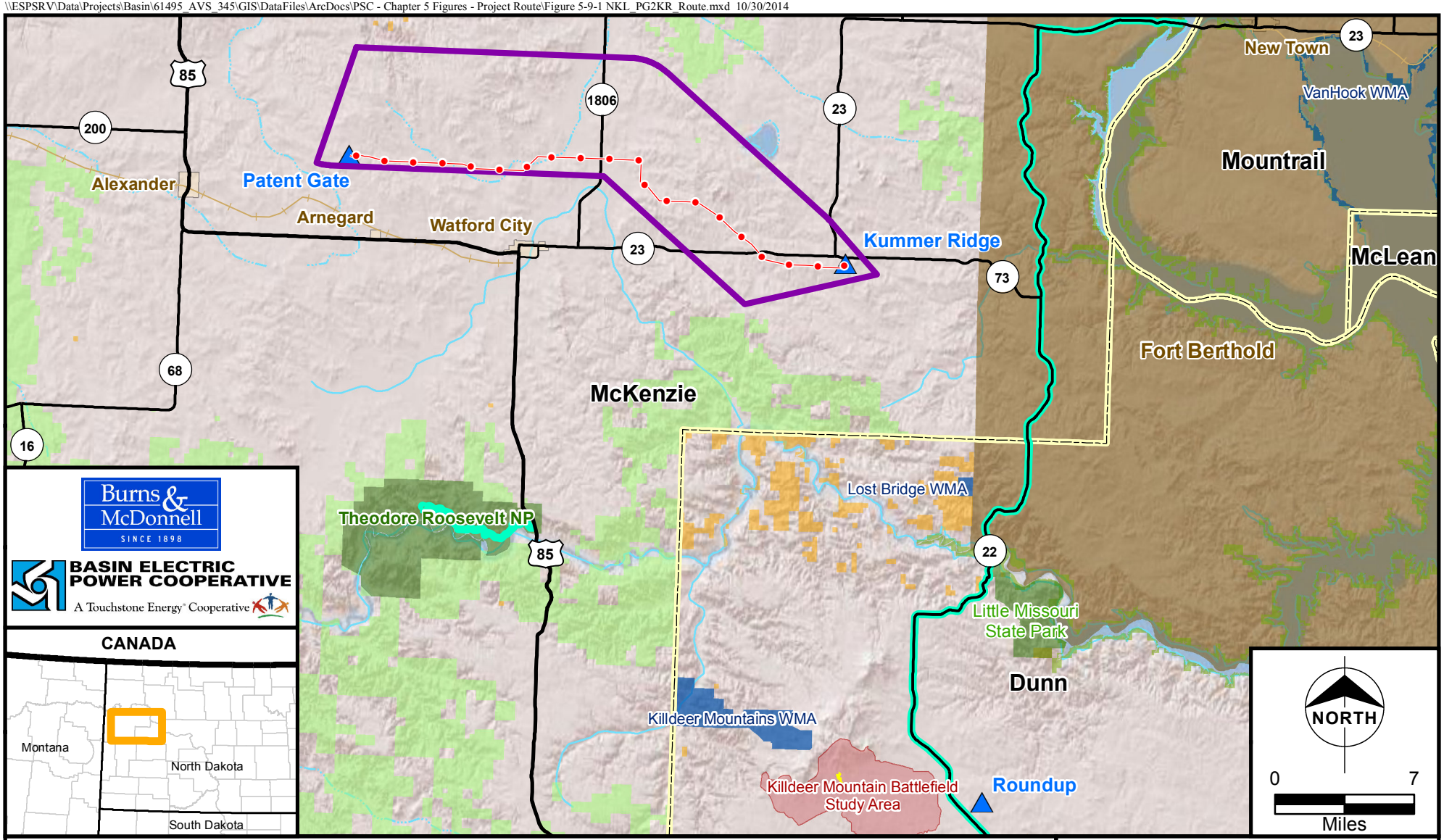


Figure 5.9-1
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Recreation Areas

Source: North Dakota GIS; Esri; Basin Electric; Burns & McDonnell.

Revised October 30, 2014

5.9.1.2.6 Private Lands Open to the Public

In addition to public WMAs, NDGFD manages many privately owned tracts of land open to public hunting under the Private Land Open to Sportsmen (PLOTS) program. Several of these tracts of privately owned land occur within the Project counties and serve as walk-in hunting areas for sportsmen (NDGFD, 2011).

5.9.1.2.7 Other Recreational Facilities

Other recreational opportunities exist in the Project counties. Many nearby communities offer recreational and cultural opportunities such as golfing, shopping, and dining. Additionally, many of these communities maintain city parks that provide outdoor recreational opportunities and maintain complexes to host leagues for team sports such as softball, baseball, football, and soccer.

5.9.1.3 Hunting and Fishing

Outdoor recreational opportunities such as hunting and fishing are very popular within the Project counties and provide a substantial source of revenue for these counties. Prior to recent oil and gas development activities, hunting and fishing were significant, if not primary, sources of income for many residents within the Project counties. Many out-of-state hunters and fishermen visit western North Dakota every year to take advantage of hunting and fishing seasons, and the communities within the Project counties benefit financially from these activities. According to the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation for North Dakota, there were 128,000 resident and nonresident hunters in North Dakota in 2006, and these hunters spent nearly $130 million in activities related to hunting (USFWS, 2008).

Species such as deer, pronghorn, moose, and elk are found within the Project area and provide big game hunting opportunities. Hunting for various species of waterfowl is also popular for resident and non-resident hunters alike. Pheasant hunting is also very popular throughout the Project counties, attracting numerous non-resident hunters and providing an additional source of revenue for many landowners during the pheasant-hunting season each year.

Fishing is also a popular outdoor recreational opportunity within the Project counties and provides revenue for the Project counties and the State of North Dakota as well. In 2006, 106,000 resident and non-resident anglers spent nearly $94 million on fishing within the State. Lake Sakakawea provides opportunities for fishing for numerous species of game fish, such as northern pike, walleye, smallmouth bass, yellow perch, and lake trout (NDGFD, 2010a). In McKenzie County, Sather Dam (37 acres) is located approximately 25 miles southwest of Watford City. The Missouri, Little Missouri, Knife, and

Little Muddy rivers also provide opportunities for fishing, as do numerous smaller lakes, ponds, and streams located throughout the region.

5.9.2 Impacts

As discussed above, the proposed Project area consists of rolling prairies, badland areas with steep and rough terrain, lakes, rivers, and streams. These areas provide various outdoor recreational activities such as hunting, fishing, hiking, and camping. State and federally owned lands including WMAs, USFS grasslands, school trust lands, and a national park are present within the proposed Project counties and offer a variety of recreational opportunities. Recreational opportunities generally found near or within municipal areas include parks, golf courses, and sports complexes. This section discusses potential impacts to these resources resulting from construction and operation of the proposed Project.

5.9.2.1 Corridor/Route Impacts to Recreational Resources

Direct impacts to recreational activities resulting from the construction and operation of the Project are anticipated to be minor and primarily temporary. Potential impacts to recreation would occur from construction workers engaging in recreational activities and using recreational facilities as well as construction activities restricting recreational use or diminishing the recreational experience on lands along and adjacent to the Project. These impacts would include:

- Diminishment of scenic resources within and from recreational areas by the addition of manmade elements to the natural landscape
- Introduction of noise/air pollution to recreational areas
- Disturbance and inconvenience to individuals recreating on lands adjacent to the Project
- Potential for loss of natural areas and game species habitat
- Restrictions on access to recreational lands and waters during construction
- Reduction in availability of water and woodland resources used for recreation
- Temporary increases in campground and RV park use
- Temporary increases in local hunting and fishing pressure
- Temporary increased use of outdoor recreational areas (e.g., state and national parks)

Impacts from additional use of recreational facilities such as golf courses, municipal parks, and other developed recreational facilities would be minor and temporary, and would result from the increase in worker population during construction of the transmission line. Although additional construction workers would be present, they would typically have limited available time for recreational activities, limiting the increases in use of recreational resources in the area.

Lands within and adjacent to the Corridor/Route would be disturbed and restricted from use for safety and security reasons during Project construction. To the extent that these areas are used for hunting and other outdoor recreational activities, they could be temporarily restricted. Such restrictions would occur on both public and private lands affected by the construction of the transmission line due to the operation of heavy equipment, removal of vegetation within the ROW, access requirements, and other construction activity. These restrictions may also diminish the recreational experience for users in proximity to the Project due to visual disturbance along the ROW, construction noise and activity, and access restrictions. Following completion of construction, these impacts would largely cease, and lands within and adjacent to the ROW would again be available for recreational activities. There could be a greater demand for recreational use on other areas should previous uses of the lands within and along the Corridor/Route no longer be found attractive by some for recreational use. However, such increases in demand would be minor due to the generally low density of recreational users and abundance of recreational lands and opportunities in the area.

Implementation of the Project would have minor impacts on recreational activities. Impacts resulting from the construction of the Corridor/Route would include the potential clearing of trees and other vegetation within the transmission ROW, thus reducing suitable habitat for game species utilizing these areas, possibly causing these species to re-locate, and reducing opportunities for hunting these species in these areas. Direct impacts to fishing, boating, or other water-related activities are expected to be minimal and temporary, since construction and operation of the Project would not prevent access to lakes or rivers.

The Corridor/Route would cross approximately 36.4 acres of state-owned property, school trust lands. While not designated or managed for recreation, they are open to the public and may be used for hunting or other outdoor activities. The Corridor/Route does not cross any federally owned property. Permanent impacts to recreation within these lands would most likely be aesthetic in nature, since the construction of a transmission line would add a new, manmade element into a natural area that already contains existing manmade elements such as transmission and distribution lines, oil and gas facilities, and roads. Temporary impacts such as increased noise levels from construction, increased construction traffic, and land use restrictions for safety reasons during construction may occur within state-owned recreational properties impacted by the Project.

5.9.2.2 Substation Impacts to Recreational Resources

Construction and operation of the proposed Roundup, Kummer Ridge, and Patent Gate substations would potentially result in minor impacts to recreation. Construction of substations would convert land from agricultural, grassland, or scrub/shrub to industrial use, limiting future recreational use of the area.

However, as the proposed substations are located in privately owned agricultural, grassland, and scrub/shrub areas, recreation at these locations is likely limited. During construction, noise, ground disturbance, access restrictions, and human activity may impede hunting activities around the substation sites. However, following completion of construction, these disturbances would cease and game species would likely return to the area, which would allow hunting opportunities on these adjacent lands to return. Only the cumulative approximately 42 acres developed for all the substations would be lost for future recreational activity.

5.9.3 Mitigation

- Impacts on recreation would largely be associated with changes in viewsheds and general recreational experiences from the presence of the Project. Mitigation measures for viewsheds are described under Aesthetics and Visual Resources.
- Recreation would be impacted in the short term by noise and dust from construction activities, equipment, and vehicles; construction-related traffic; and the presence of construction crews. Mitigation measures for these impacts are described under Geology and Soils; Infrastructure and Transportation; and Noise.

5.10 Soils and Farmlands

5.10.1 Description of Resources

5.10.1.1 Soils

The dominant soil order in this area is Mollisols, which developed under grassland vegetation, and tends to be classified as prime farmland. Area soils have a soil temperature regime reflecting their northern location, a soil moisture regime reflecting a moist climate, and mixed mineralogy (USDA-NRCS, 2006). They generally are very deep, well drained to very poorly drained, or loamy with mixed or smectitic mineralogy.

The soils in the Project counties are comprised of three main groups based on their geological history: loess (wind-blown sediment derived from finely ground rocks associated with glaciers) that lies on the ridge-tops, residual material that formed in glacial plains and moraines, and alluvial material that lies in stream terraces and glacial outwash plains. Some soil types in the Project area are hydric, meaning that they contain standing water or are saturated most of the year; the hydric soils are associated with swales/potholes, floodplains, and outwashes. However, these soil types also contain drier areas and are

extensively used for agriculture. Table 5.10-1 shows the soil orders and soil series found near the Project, by county.

Table 5.10-1: Soil Orders and Series within the Project Area

	McKenzie County	Dunn County
Soil Order	Mollisols, Entisols, Aridisols, Vertisols, Inceptisols	Mollisols, Entisols, Aridisols, Vertisols, Inceptisols
Soil Series	Sansarc, Opal, Bullock, Cabba, Amor, Flasher, Vebar, Temvik, Mandan, Cherry, Chama, Zahl, Lallie, McKeen, Williams, Rhoades, Belfield, Reeder, Regent, Parshall, Glova	Sansarc, Opal, Bullock, Cabba, Amor, Flasher, Vebar, Temvik, Mandan, Cherry, Chama, Zahl, Lallie, McKeen, Williams, Rhoades, Belfield, Reeder, Regent, Parshall, Glova

Source: Bryce et al. 1998

More than one-half of the Study Corridor supports native grasses and shrubs that are grazed. About one-third of the Study Corridor is used for dry-farmed small grains such as wheat, barley, oats, rye, and flax. There are some localized areas of irrigation for crop production in the northern portions of the Project counties with the pre-dominate locations on the bottomland along the Missouri River. Major soil resource concerns are wind erosion, water erosion, maintenance of the content of organic matter and productivity of the soils, and management of soil moisture. Conservation practices on cropland generally include systems of crop residue management, especially no-till or other conservation tillage systems that conserve moisture and contribute to soil quality. Other practices include terraces, vegetative wind barriers, grass waterways, nutrient management, and wind strip cropping (Brady, 1996).

5.10.1.2 Farmland

Based on the 2012 Census of Agriculture, 86.8 percent (nearly 39.3 million acres) of the total land area in the State of North Dakota is farmland, with an average farm size of 1,268 acres (USDA, 2012a). North Dakota ranked 11th in the U.S. in total value of agricultural products sold ($10.9 billion), with crop sales accounting for 88 percent and livestock sales accounting for 12 percent. The top crops in terms of acreage in North Dakota include wheat for grain (over 7.7 million acres), spring wheat for grain (over 5.7 million acres), soybeans (over 4.7 million acres), and corn (over 3.4 million acres). The top livestock items in terms of inventory in North Dakota include cattle and calves (1.8 million), turkeys (over 419,000), colonies of bees (over 370,000), hogs and pigs (over 133,000), and chickens (specifically layers; over 92,700). Land enrolled in the Conservation Reserve Program (CRP), including the Wetlands Reserve Program, Farmable Wetlands Program, and Conservation Reserve Enhancement Program, in North Dakota totaled over 2.1 million acres in 2012, or 5.5 percent of farmland in North Dakota.

Compared to the State as a whole, the Project counties have a lower percentage of land in farms, with Dunn County having the lower percentage (Table 5.10-2). Average farm sizes in the Project counties were larger than the State average. In terms of the total value of agricultural products sold, Dunn County had a higher total value than McKenzie County. In the State as a whole and in the Project counties, crop sales comprised a majority of the total value of agricultural products sold.

Table 5.10-2: Characteristics of Agriculture in Project Area Counties

	Dunn	McKenzie
Land area in farms (percentage of total land area in county)	1,031,359 acres (56.3%)	1,064,191 acres (79.9%)
Average farm size	1,642 acres	1,854 acres
Total value of agricultural products sold (crop sales / livestock sales)	$124,788,000 (61% / 39%)	$114,448,000 (69% / 31%)
Top crops in terms of acreage	Wheat for grain (153,934) Forage (117,304) Spring wheat for grain (112,139) Winter wheat for grain (21,029)	Wheat for grain (203,519) Spring wheat for grain (111,317) Durum wheat for grain (79,379) Forage (76,131)
Land enrolled in CRP (percentage of farmland in county)	12,075 acres (1.2%)	17,130 acres (1.6%)

Source: USDA, 2012b; USDA, 2012c

Wheat was the top crop in terms of acreage in the Project counties as well as in the State as a whole. Spring wheat, winter wheat, durum wheat, and forage were also top crops in the Project counties. The top livestock inventory item was cattle (as calves) for both the Project counties and the State. The Project counties differed from the State in that horses and ponies were also a top livestock inventory item in the Project counties but not in the State as a whole. The Project counties all had lower percentages of farmland enrolled in CRP as compared to the State.

5.10.1.3 Prime Farmland

Prime farmland, as defined by the U.S. Department of Agriculture (USDA), is land that has been determined to have the best combination of physical and chemical properties for agricultural production and is available for farming (USDA-NRCS, 2011d). In addition to prime farmland, land may be classified as prime farmland if drained, prime farmland if irrigated, or farmland of statewide importance, as determined by the state.

In McKenzie County, one soil is classified as prime farmland, one soil is prime farmland if drained, and 65 soils are classified as farmland of statewide importance. In Dunn County, eight soils are classified as prime farmland, one soil is prime farmland if drained, and 57 soils are classified as farmland of statewide importance.

Dunn County contains 376,903 acres of prime and important farmland and McKenzie County contains 306,703 acres of prime and important farmland. Table 5.10-3 shows a breakdown of the total important farmland acres by classification, by county. Figure 5.10-1 visually illustrates important farmland soils found within the Study Corridor and surrounding areas.

Table 5.10-3: Prime and Important Farmland by County

County	Farmland Classification	Acres
Dunn	All areas are prime farmland	54,170
	Farmland of statewide importance	322,261
	Prime farmland if drained	472
	Dunn County Total	**376,903**
McKenzie	All areas are prime farmland	1,763
	Farmland of statewide importance	304,244
	Prime farmland if drained	697
	McKenzie County Total	**306,704**

Source: USDA-NRCS 2011e

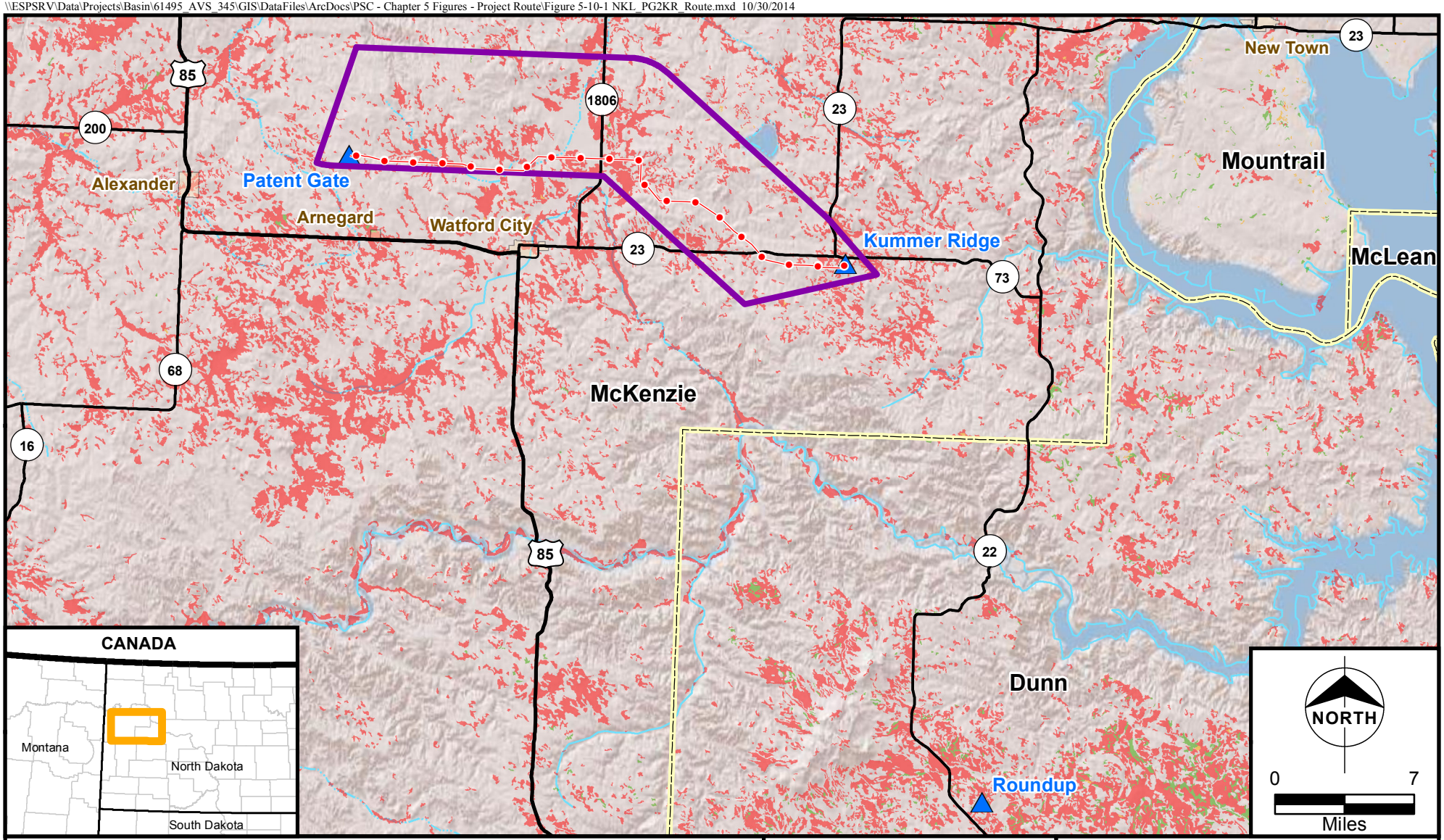
5.10.2 Impacts

Most of the soils within the Study Corridor were developed under grassland vegetation, and many are classified as prime farmland. Agricultural activities are common throughout the proposed Project area, and soil resource concerns include wind and water erosion. This section discusses potential impacts to these resources resulting from construction and operation of the proposed Project.

Potential effects on soils and farmlands from the Project would include:

- Soil movement and displacement
- Soil erosion and compaction
- Loss of farmland due to structure placement
- Interference with agricultural activities
- Prime farmland taken out of production

\\ESPSRV\Data\Projects\Basin\61495_AVS_345\GIS\DataFiles\ArcDocs\PSC - Chapter 5 Figures - Project Route\Figure 5-10-1 NKL_PG2KR_Route.mxd 10/30/2014



Study Corridor
Project Corridor/Route
Proposed Substation
County Boundary
Municipal Areas
Prime Farmland
Farmland of Statewide Importance
Prime Farmland if Drained

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Figure 5.10-1
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Prime and Important Farmland

Source: North Dakota GIS; Esri; Basin Electric; Burns & McDonnell.

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5.10.2.1 Soils

Construction activities along the Corridor/Route and at the substation locations would cause disturbance to soils. Potential impacts include soil erosion, soil compaction and rutting, and the introduction of noxious weeds on the soil surface. Construction activities such as vegetation clearing, excavating, grading, topsoil segregation, and back-filling may also increase erosion potential by destabilizing the soil surface. Soil compaction and rutting can result from the movement of heavy construction vehicles along the Corridor/Route. The degree of compaction and rutting would depend on the moisture content and texture of the soil. These impacts would be short-term in nature and minimized as much as possible.

For the transmission structures, construction activities would be confined to the ROW and around structure locations. Any topsoil removed during any required leveling of structure sites would be stockpiled nearby and replaced following construction. Disturbed ground would be re-graded to as close to pre-construction condition as appropriate for stabilization and re-vegetated or approved for tillage depending on pre-construction land use.

The construction laydown area required for the proposed Project would be located at the Patent Gate laydown yard previously developed for the AVS to Neset Project. Construction materials would be placed on pallets or cribbing within the designated laydown areas. No topsoil would be removed and no re-grading is expected to take place. The laydown area would be returned to pre-construction condition upon completion of the construction of the Project.

Stormwater runoff and erosion control BMPs would be developed for the proposed Project under National Pollutant Discharge Elimination System (NPDES) stormwater pollution prevention plan (SWPPP) permit requirements for construction activities. Typical BMPs that would be part of a SWPPP include, but are not limited to, silt fencing, dust control measures, check dams, erosion control blankets, and seeding of exposed soil surfaces to minimize the potential for wind and water erosion.

Approximately 511.2 total acres of surface soil would be incorporated into the Corridor/Route, although the acreage that would be disturbed would be far less. Permanent impacts to soils would include the disturbance of approximately 0.1 total acres of soil where the approximately 165 transmission structures would be placed. As much as approximately 5.5 acres of woodland occur within the Corridor/Route, and the clearing of trees would disturb the soil within these acres and expose it to erosional forces. Some of the Corridor/Route would also likely be located along areas of steeper slopes, and would incorporate approximately 0.5 acres of land that has experienced landslides in the past, making these areas especially susceptible to soil erosion. The development of access roads during construction would potentially disturb

areas of soil as well, although these areas are anticipated to be minimal since most access to the ROW would occur at locations where the ROW crosses existing roads and by utilizing the ROW itself for access along the line.

5.10.2.2 Farmland

Construction and operation of the proposed Project would result in both temporary and long-term impacts to agricultural land. During construction, potential temporary impacts within the Corridor/Route would include crop damages (depending on the time of year of construction across specific fields), soil disturbance, and potential loss of production for one growing season. These impacts would potentially result from construction activities and the transport of construction equipment and vehicles restricting or preventing planting of lands within or adjacent to the ROW.

Some minimal long-term, direct loss of agricultural land would occur as a result of transmission line structure placement. After construction is complete, however, landowners would be able to resume farming activities around the transmission line structures. Basin Electric has a policy of allowing agricultural practices within its ROW as long as they do not interfere with, or jeopardize, the operation of its lines. Indirect impacts to agriculture as a result of the proposed Project would include interference with certain agricultural activities, such as interference with the movement of machinery and equipment, obstacles for aerial spraying, or interference with the movement of cattle or other livestock for grazing. At the proposed Roundup, Kummer Ridge, and Patent Gate substation sites, agricultural land would be permanently converted to utility use**.**

Approximately 141.0 acres of cultivated cropland would be incorporated into the Corridor/Route. It is likely that impacts would not occur across the entire 141.0 acres, with most impacts being limited to the immediate area around structure locations and the narrow construction travel trail between structures. These impacts would be temporary and occurring during construction. Permanent impacts, requiring the removal of cropland from production, would occur only at the structure locations. The remaining acreage within the ROW would be allowed to return to cropland upon completion of construction. Approximately 289 combined acres of grassland, pasture, or hayland occur within the Corridor/Route, and construction activities would have a temporary impact on cattle grazing activities. Cattle may need to be moved temporarily during construction in areas where the ROW would cross grass, pasture or hayland. Additionally, cattle would need to be restricted from grazing within the ROW upon completion of construction until the re-establishment of vegetation within the ROW was complete.

At the proposed Roundup, Kummer Ridge, and Patent Gate substation sites, any agricultural land within the approximately 36 acres of these substations would be permanently converted to utility use.

5.10.2.3 Prime Farmland

The construction activities associated with the proposed Project would potentially have short-term effects on prime farmland soils, depending upon the time of year that construction takes place. Portions of these soils within the Corridor/Route would be temporarily lost to production for one or two growing seasons due to the nature of the construction activity and the ingress and egress of construction equipment and vehicles. However, after construction is complete, these soils would be returned to production. Prime and important farmland soils would only be permanently lost to agricultural practices as a result of transmission line structures being placed within the ROW.

The Corridor/Route would traverse areas containing prime or other important farmland soils. Approximately 21.5 percent of the Corridor/Route is farmland of statewide importance (Table 5.10-4). However, only a minimal amount of prime farmland would be taken out of production permanently due to the placement of transmission line structures within the ROW and the lack of prime farmland in the Study Corridor. Alternatively, areas cleared within the ROW on prime farmland could be converted to agricultural use. The reduction in farmland of statewide importance availability would represent less than 1 percent of over 18,500 acres of farmland of statewide importance within the Study Corridor. Based on this, it is expected that alternatives would not need to be considered under the Farmland Protection Policy Act. However, the Farmland Conversion Impact Rating for Corridor Type Projects documentation (Form NRCS-CPA-106) would be completed and coordinated with the NRCS.

Table 5.10-4: Acres of Prime Farmland within Corridor/Route

Farmland Classification	Acres in Corridor/Route
Not prime farmland	401.0
All areas are prime farmland	0.0
Farmland of statewide importance	110.2
Prime farmland if drained	0.0
Prime farmland if irrigated	0.0
Total	**511.2**

Source: USDA SSURGO Data, 2011

For construction of the proposed Roundup, Kummer Ridge, and Patent Gate substations, no prime farmland would be permanently taken out of production.

5.10.3 Mitigation

5.10.3.1 Mitigation for Impacts to Soils

- Basin Electric and its contractors would confine construction activities to the Corridor/Route and around structure locations for placement of the transmission structures.
- Basin Electric and its contractors would stockpile any topsoil removed during any required leveling of structure sites nearby and replace it following construction.
- Basin Electric and its contractors would re-grade disturbed ground to as close to pre-construction condition as appropriate for stabilization and re-vegetated or approved for tillage depending on pre-construction land use.
- Basin Electric and its contractors would locate the construction laydown areas required for the proposed Project at previously disturbed or developed locations, such as vacant lots or agricultural lands, where feasible.
- Basin Electric and its contractors would place construction materials on pallets or cribbing within the designated laydown areas.
- Basin Electric and its contractors would return laydown areas to pre-construction condition upon completion of the Project.

5.10.3.2 Mitigation for Impacts to Farmland

- Compensate landowners for crop damage that may occur as a result of construction and operation of the proposed Project.
- Redress compaction or other construction-related issues that could affect soil productivity and agricultural operations.

5.11 Geology and Landforms

5.11.1 Description of Resources

5.11.1.1 Regional Setting

The Project lies within the interface of the Northwestern Glaciated Plains and Northwestern Great Plains ecoregions within the Great Plains Province (Bryce et al., 1998). The Northwestern Glaciated Plains encompasses the westernmost extent of continental glaciation, with high concentrations of wetlands. The Northwestern Great Plains encompasses the Missouri Plateau section of the Great Plains, and is a semi-arid region with rolling plains, buttes, and badlands.

The Northwestern Glaciated Plains and Northwestern Great Plains are further divided into smaller ecoregions with specific geologic, topographic, or soil features. The Project area contains two of these unique ecoregions, and these are discussed further in the General Geology section. The Project area is also located in the Union Formation which is underlain by calcareous shales, siltstones, and sandstones which are nearly all covered in glacial till plains. Kettle holes, kames, moraines, and small glacial lakes occur within the Project counties as well.

5.11.1.2 Terrain

A majority of the Project counties was unglaciated, but east and north of the Project area was glaciated. The area is on an old, moderately dissected, rolling plain with badlands, buttes, and isolated hills. Terraces are adjacent to broad flood plains along most of the major drainages. Relief is considerably low for most of the area. Elevation ranges from approximately 600 feet in river bottoms to approximately 750 feet in the Study Corridor (USDA-NRCS 2011d).

5.11.1.3 General Geology

South of Lake Sakakawea, the Study Corridor is within the River Breaks and Missouri Plateau ecoregions (Figure 5.11-1). The Missouri Plateau is unglaciated and consists of Tertiary sandstone, shale, and coal. The River Breaks, located adjacent to Lake Sakakawea, the Missouri River, and its tributaries, contain broken terraces and uplands with dissected topography. These areas were unglaciated and consist of Tertiary sandstone and shale.

5.11.1.4 Oil Shale

Oil and gas development activities have been occurring in the region since the 1950s. Early oil production consisted of deep vertical drilling and peaked in the late 1970s and early 1980s. Shortly thereafter, the region's oil and gas activity decreased dramatically. After a stagnant oil production period between 1990 and 2000, the region again experienced an increase in oil and gas production in the mid-2000s, as oil companies began to take advantage of newly developed technology advances in drilling and extraction techniques. As a result, the region has seen rapid oil and gas development due to the implementation of horizontal hydraulic fracturing processes that are able to access a previously untapped oil bearing feature of the Bakken Formation.

The Bakken Formation is a thin, widespread geologic formation consisting of oil-generating shale and sandstone layers that extends through portions of Montana, North Dakota, and the Canadian Provinces of Saskatchewan and Manitoba (USGS, 2008). Figure 5.11-2 depicts the extent of the Bakken Formation, and Figure 5.11-3 illustrates where the formation occurs within the State of North Dakota.

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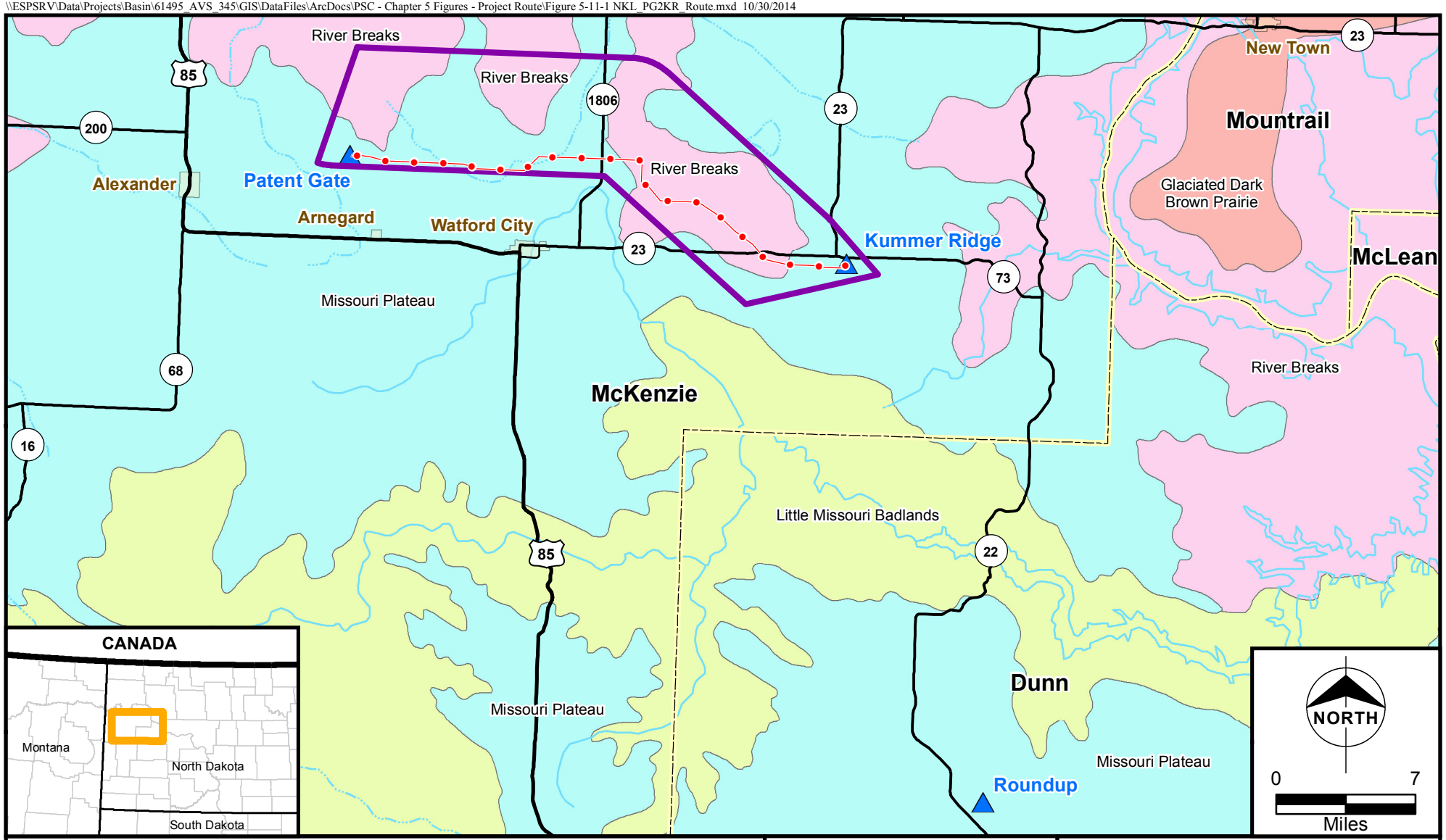

Study Corridor
Project Corridor/Route
Proposed Substation
County Boundary
Municipal Areas

Ecoregions

Glaciated Dark Brown Prairie
Little Missouri Badlands
Missouri Plateau
River Breaks

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Figure 5.11-1
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Ecoregions within the Study Corridor

Source: North Dakota GIS; Esri; Basin Electric; Burns & McDonnell.

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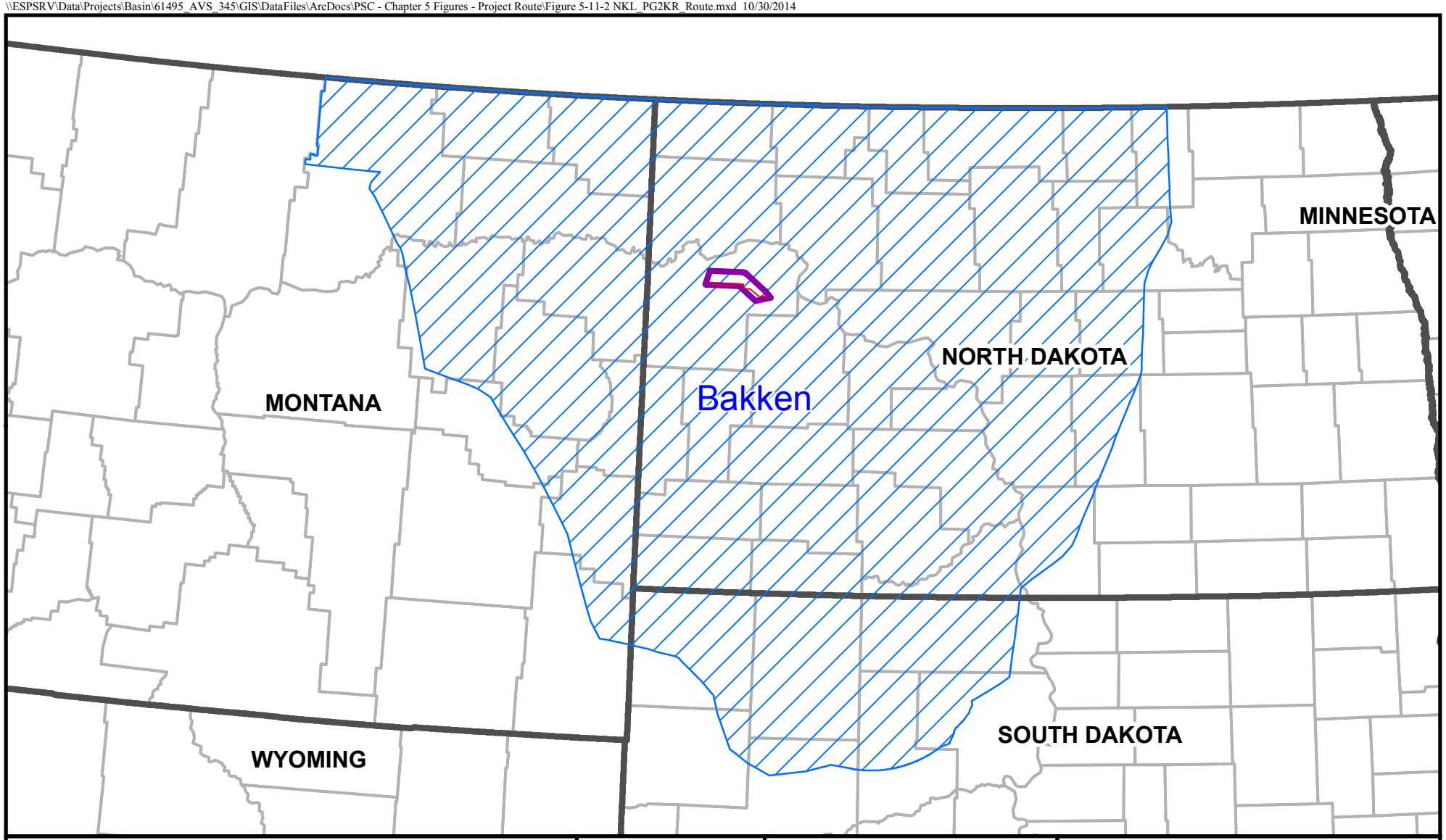

Study Corridor
Project Corridor/Route
Bakken Shale Formation
State Boundary
County Boundary

NORTH

0 60
Miles

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Figure 5.11-2
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Bakken Shale Formation
in the U.S.

Source: North Dakota GIS; Esri; Basin Electric; Burns & McDonnell.

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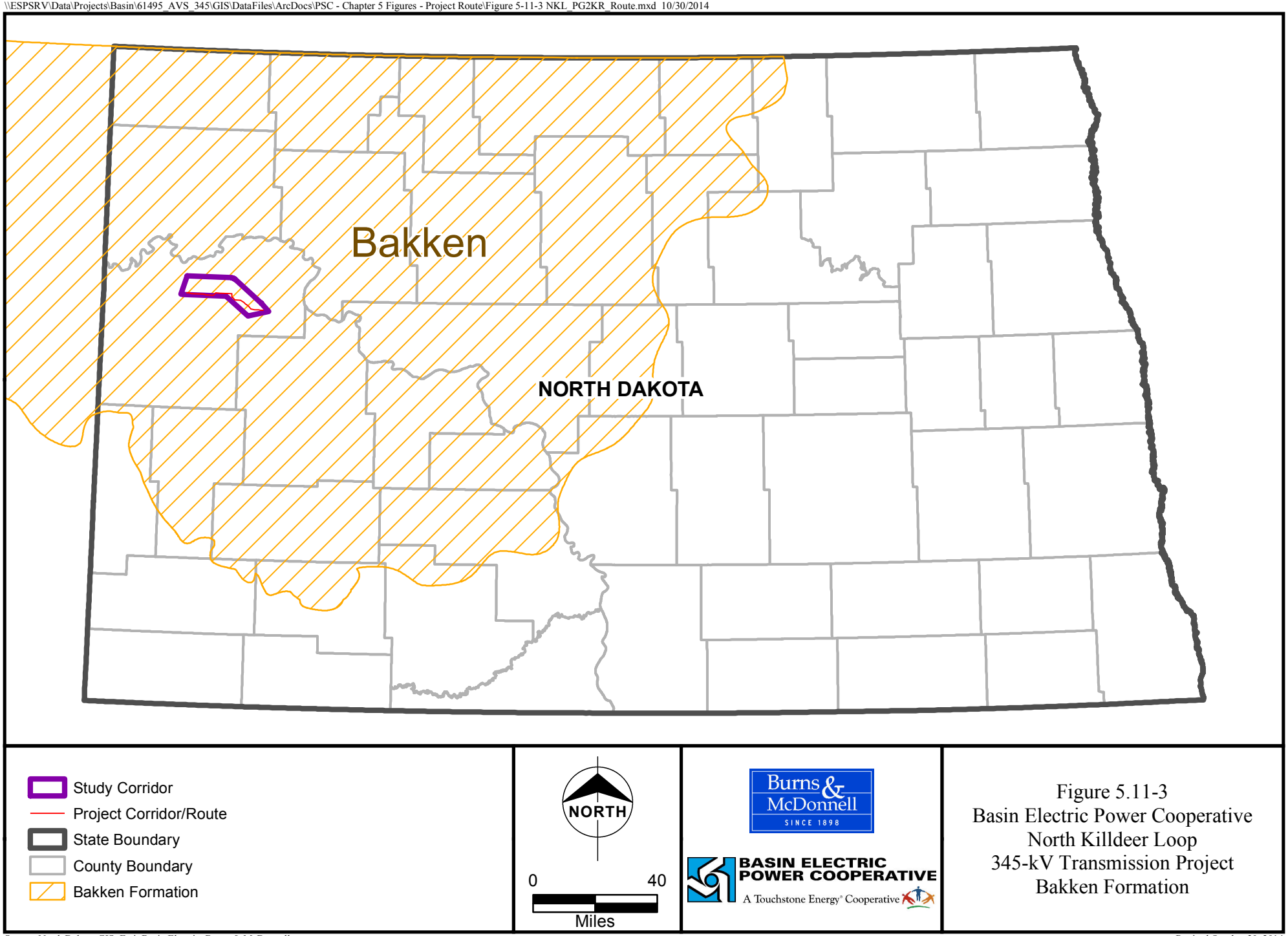

Figure 5.11-3
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Bakken Formation

Source: North Dakota GIS; Esri; Basin Electric; Burns & McDonnell.

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The formation consists of three members: (1) lower shale member, (2) middle sandstone member, and (3) upper shale member. Each succeeding member is of greater geographic extent than the underlying member. Both the upper and lower shale members are organic-rich marine shale of fairly consistent lithology; they are the petroleum source rocks and part of the continuous reservoir for hydrocarbons produced from the Bakken Formation (USGS, 2008). The middle sandstone member varies in thickness, lithology, and petrophysical properties, and local development of matrix porosity enhances oil production in both continuous and conventional Bakken reservoirs.

According to the North Dakota Petroleum Council (2014), there are 17 oil-producing counties in North Dakota, all of which are located in the western third of the state. North Dakota currently is the second largest oil producing state in the U.S. and is the 19th largest oil producer in the world. Top-producing counties within North Dakota for 2014 were McKenzie County and Mountrail. Over 1.1 million barrels of oil was produced every day in North Dakota in July 2014 and over 1.2 million barrels of natural gas was produced per day in July 2014 (NDPC, 2014). Annual oil production has seen a 686 percent increase since 2006 in the region. Production is expected to continue to increase in the region with an estimated 1,100 to 2,700 new wells expected per year and 26,000 new wells expected over the next 10 to 20 years (NDDMR, 2011). Using a geology-based assessment methodology, the U.S. Geological Survey estimated mean undiscovered volumes of 3.65 billion barrels of oil, 1.85 trillion cubic feet of associated/dissolved natural gas, and 148 million barrels of natural gas liquids in the Bakken Formation of the Williston Basin Province within Montana and North Dakota.

5.11.1.5 Mineral Resources

Several mineral resources are mined in the region. Bedrock clays can be found from silty clay in the lower part of the Golden Valley Formation near Hebron, west of the Project counties. Lignite coals can be found mainly in the Tertiary, Bullion Creek and Sentinel Butte Formations in western North Dakota.

Salts in the region consist of three main types of deposits within the Williston Basin of North Dakota: halite, potash, and Glauber salt or mirabolite. Halite (sodium chloride or table salt) and potash occur in thick deposits in the deep subsurface in the western part of the basin, while Glauber salt occurs at or within 70 feet of the surface throughout North Dakota.

Sand and gravel deposits, which are formed from glacial deposits, contain sand and gravel as either outwash or as isolated lenses of sand and gravel within till. Beach ridges and deltas that formed along glacial lakes Agassiz and Souris are also important sources of sand and gravel. Pliocene to Holocene-age sand and gravel deposits also occur as terrace deposits, and less commonly as pediments, in the western

part of the state. Sand and gravel is the third largest mineral industry found in the region, trailing only oil and gas and lignite (NDGS, 2011).

The largest single deposit of lignite known in the world is found in western North Dakota, at an estimated 351 billion tons. North Dakota also contains an estimated 25 billion tons of economically mineable coal found within the lower Fort Union Group in western and central North Dakota. Mining within the Project counties dates back to the late 1800s, and by 1920 there were approximately 250 mines operating within North Dakota. These mines consisted of underground mines and surface strip mines. Eventually, surface strip mining became more profitable, and the last underground mine closed in 1966. Currently, there are six operations that mine approximately 32 million tons of coal annually within western North Dakota. Four of these operations mine coal to feed electric generating plants in North Dakota, and two operations mine lignite that is used in soil stabilization and as drilling fluid additive (NDGS, 2011).

5.11.2 Impacts

Northwestern North Dakota's unique geology has resulted in rapid increases in activities associated with the extraction of oil from the Bakken shale. Oil and gas wells and associated equipment, as well as unique surface landforms within the proposed Project counties, may present obstacles during the construction and operation of the proposed Project. This section discusses potential impacts to the geology and landforms within the region as a direct result of the construction and operation of the proposed Project. Figure 5.11-4 illustrates oil fields and coal deposits present within the Study Corridor and surrounding areas.

5.11.2.1 Landslides

The North Dakota Geologic Survey (2011) has identified landslide areas within the Project area. These areas have experienced landslides in the past, or may be subject to landslide activity due to geologic shifting or unstable soils. Within the Project area, landslide-prone areas are small and highly localized. These areas typically exhibit steep terrain and exposed soils, which contribute to landslide activity (Figure 5.11-5).

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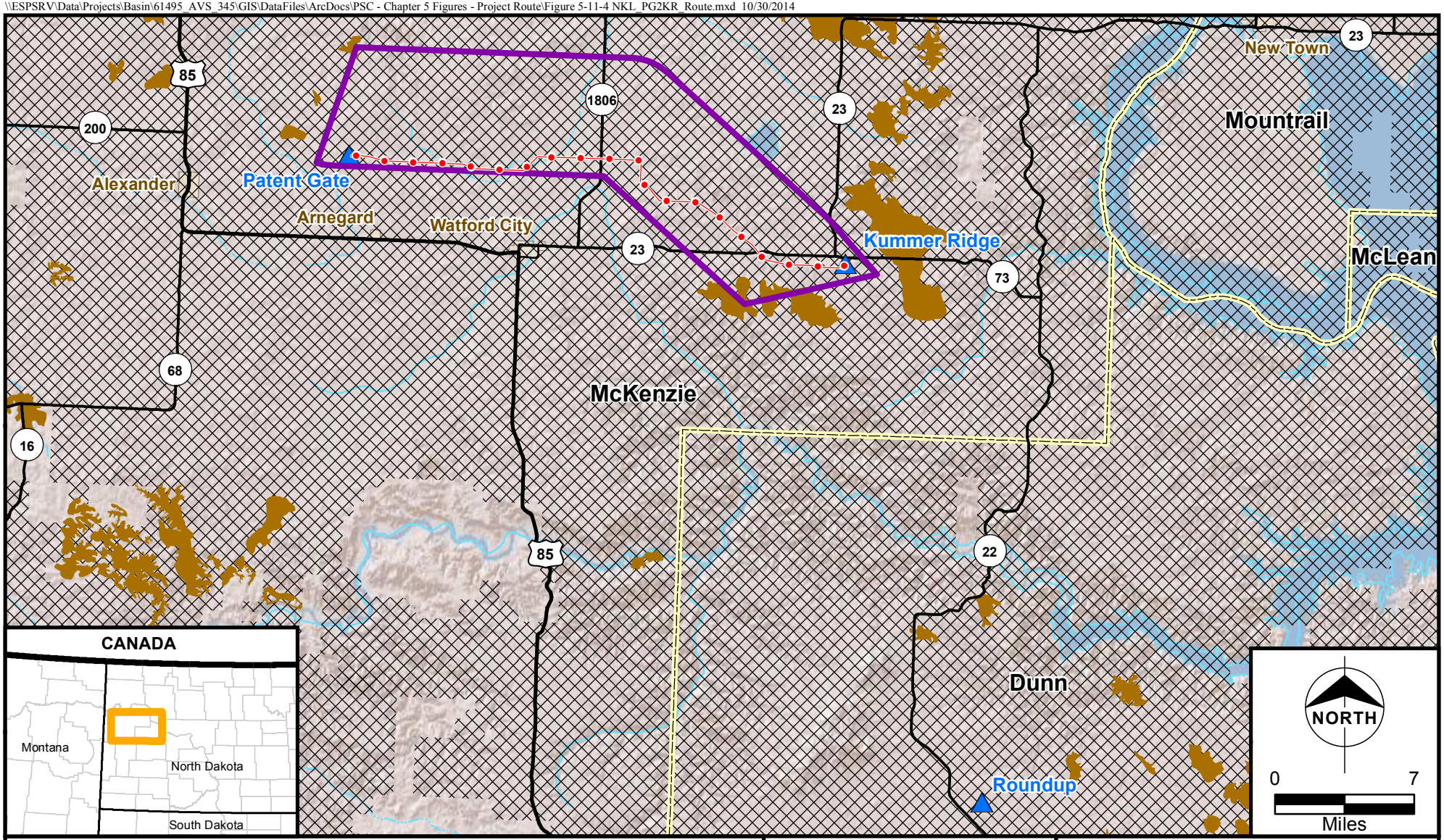

Study Corridor
Project Corridor/Route
Proposed Substation
County Boundary
Municipal Areas
Coal Fields
Oil Fields

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Figure 5.11-4
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Oilfields and Coal Deposits

Source: North Dakota GIS; Esri; Basin Electric; Burns & McDonnell.

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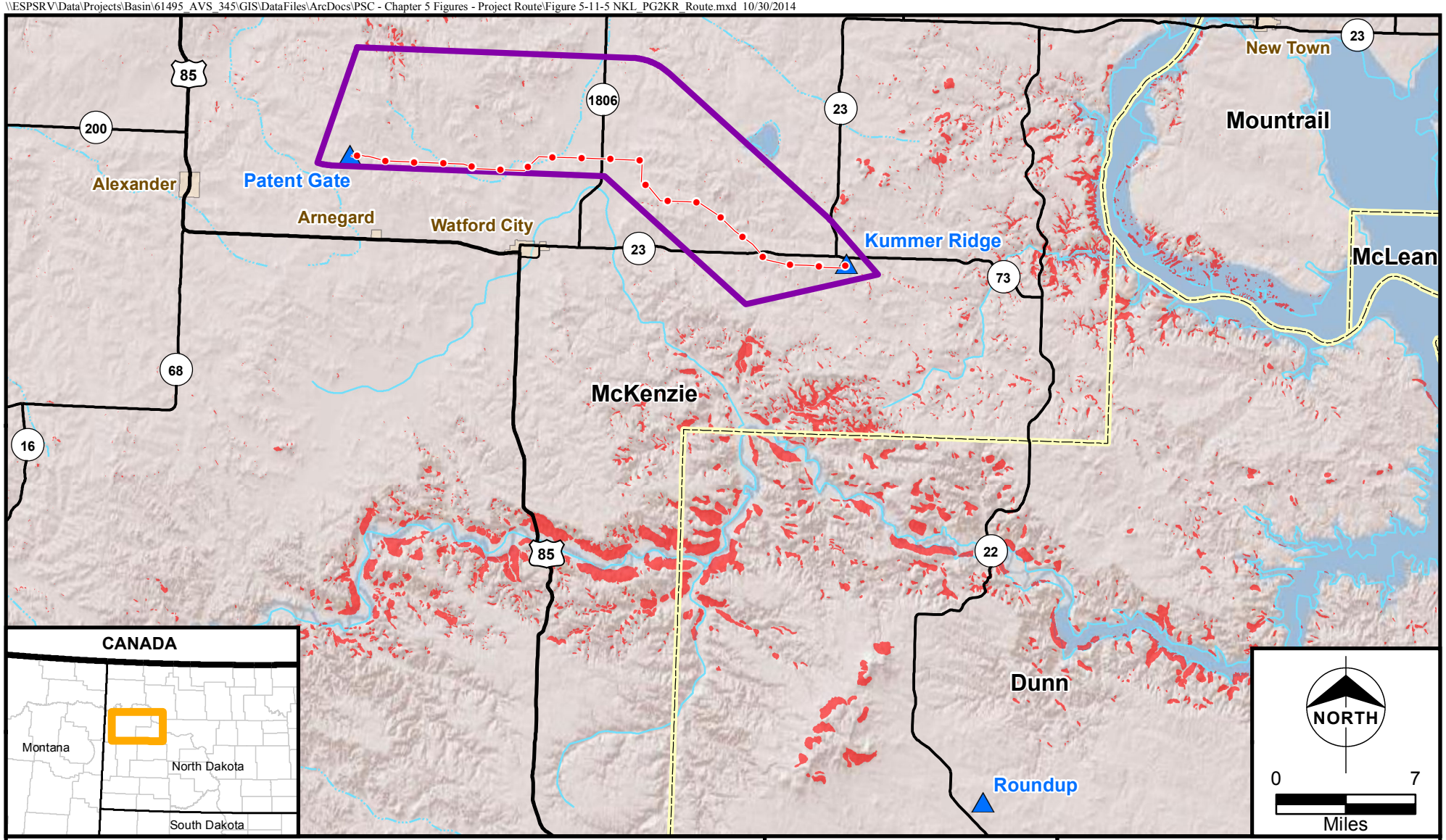

Study Corridor
Project Corridor/Route
Proposed Substation
County Boundary
Municipal Areas
Landslide Deposits

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Figure 5.11-5
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Landslide Areas

Source: North Dakota GIS; Esri; Basin Electric; Burns & McDonnell.

Revised October 30, 2014

Project construction would require little surface soil disturbance and would be neither large enough nor deep enough to have an effect on geologic formations throughout the region. Soil impacts would be limited to the sites for structure erection, with geologic impacts limited to minimal disturbance to subsurface rock during drilling and use of augers to prepare foundation holes. Potential impacts include:

- Disturbance, conflicts, or restrictions to existing oil and gas activity in the area
- Displacement of soil and rock during construction activities
- Alteration of geologic features due to earth-moving activities during construction
- Increased likelihood of landslide caused by construction activities in areas of steep terrain and unstable soils
- Increased erosion potential
- Support for long-term electricity needs of the oil and gas industry in the region

The overall impact of the Project on geology, geologic resources, and surface landforms within the proposed Project area would be minor. The Corridor/Route is located within 500 feet of one existing oil and gas well along the length of the route, but it is probable that this number would increase over time due to the continuing development of oil and gas development activities in the area. However, it is anticipated that the Project would not directly affect any wells or drill rigs since the final design and placement of structures along the Corridor/Route would be designed to avoid these areas, span collector systems, and provide sufficient clearance for well maintenance and operation. Basin Electric would coordinate with well developers around the Project to design future wells to co-exist without conflicting with the Project.

The Corridor/Route would not cross any active mines and would not be anticipated to impact future mining operations. Direct impacts resulting from the construction of the Project would consist of the displacement of soil and rock during construction of structure foundations. Borings for structure foundations would extend approximately 25 to 30 feet below the surface and would be approximately 8 feet in diameter, resulting in a maximum volume of displaced soil and rock of approximately 1,500 cubic feet per structure location.

With approximately 165 structures used for the construction of the Corridor/Route, a total of approximately 247,500 cubic feet of displaced soil and/or rock would be anticipated. This displaced soil and rock would be used for backfilling around structure foundations with excess material removed from the site to locations directed by the landowner or disposed of at another location.

The Project would not affect the overall geology of the area. However, the various geologic characteristics of the area would need to be considered during construction to provide for a safe and reliable Project. Erosion and the potential for landslides would be possible in select areas along the length of the Corridor/Route, primarily during the construction phase of the Project until restoration of disturbed areas could be completed. The Corridor/Route would cross approximately 148.3 linear feet of terrain (0.5 acres within the Corridor/Route) where landslides have occurred previously (as mapped by the North Dakota Geological Survey). A majority of these areas would be spanned by the Project, with no structures placed within susceptible landslide areas. The exact locations of the structures would be selected to avoid construction in the landslide areas based on additional geotechnical studies. Care would be taken to minimize disturbance in these areas both to reduce landslide potential and to protect construction workers and equipment from slides and falls. In some specific areas, Basin Electric may use helicopter construction to minimize ground disturbance. The Corridor/Route would not cross terrain with a slope greater than 10 percent. Increased erosion could lead to increased landslide potential in these areas if crossed.

Impacts to geologic features, resources, or surface landforms resulting from the construction and operation of the proposed Roundup, Kummer Ridge, and Patent Gate substations are anticipated to be negligible. The substation sites are located on terrain with little slope, and impacts to geological resources related to construction and operation of these substations are not anticipated. Some surface grading and subsurface excavation and trenching would be necessary but would be relatively shallow and not expected to encounter significant bedrock.

5.11.3 Mitigation

- Basin Electric and its contractors would conduct geotechnical assessments at structure locations to develop a process or approach to minimize the potential development of landslides in susceptible areas during construction.
- Basin Electric and its contractors would span identified landslide areas and avoid placing structures within susceptible landslide areas.
- Prior to construction, Basin Electric and its contractors would prepare a SWPPP for construction activities.

5.12 Water Resources

5.12.1 Description of Resources

5.12.1.1 Regional Setting

The Project counties contain several major surface water and groundwater features. Surface waters located within the Project counties include the Knife River, Spring Creek, Little Missouri River, Lake Sakakawea (Upper Missouri River), and Little Muddy River. Isolated wetlands, smaller creeks and tributaries, and unnamed intermittent and ephemeral streams also occur within the Project counties. Groundwater resources within the Project counties and surrounding area include Paleozoic aquifers, lower and upper Cretaceous aquifers, lower Tertiary aquifers, and unconsolidated-deposit aquifers.

5.12.1.2 Surface Water

Lake Sakakawea is a major water feature in the Project Counties and surrounding area and was formed by the construction of the Garrison Dam on the Missouri River near the community of Pick City. Lake Sakakawea generally flows from northwest to southeast. Major drainage sub-basins near the Project are depicted in Figure 5.12-1 and are discussed in further detail below.

The Upper Missouri/Lake Sakakawea Basin drains the extreme northern portions of Dunn County and the northern half of McKenzie County. The Knife River Basin drains the southern portion of Dunn County. The Knife River flows generally from west to east and empties into the Missouri River below Lake Sakakawea. Spring Creek is a tributary of the Knife River, and it too travels in a generally west to east direction before joining the Knife River near the town of Zap. Both the Knife River and Spring Creek are located outside the Study Corridor to the south.

The Little Missouri River Basin drains the central portion of Dunn County and also the southern portion of McKenzie County (USGS, 2009). The Little Missouri River flows generally north to south and then turns easterly. The Little Missouri River flows into Lake Sakakawea.

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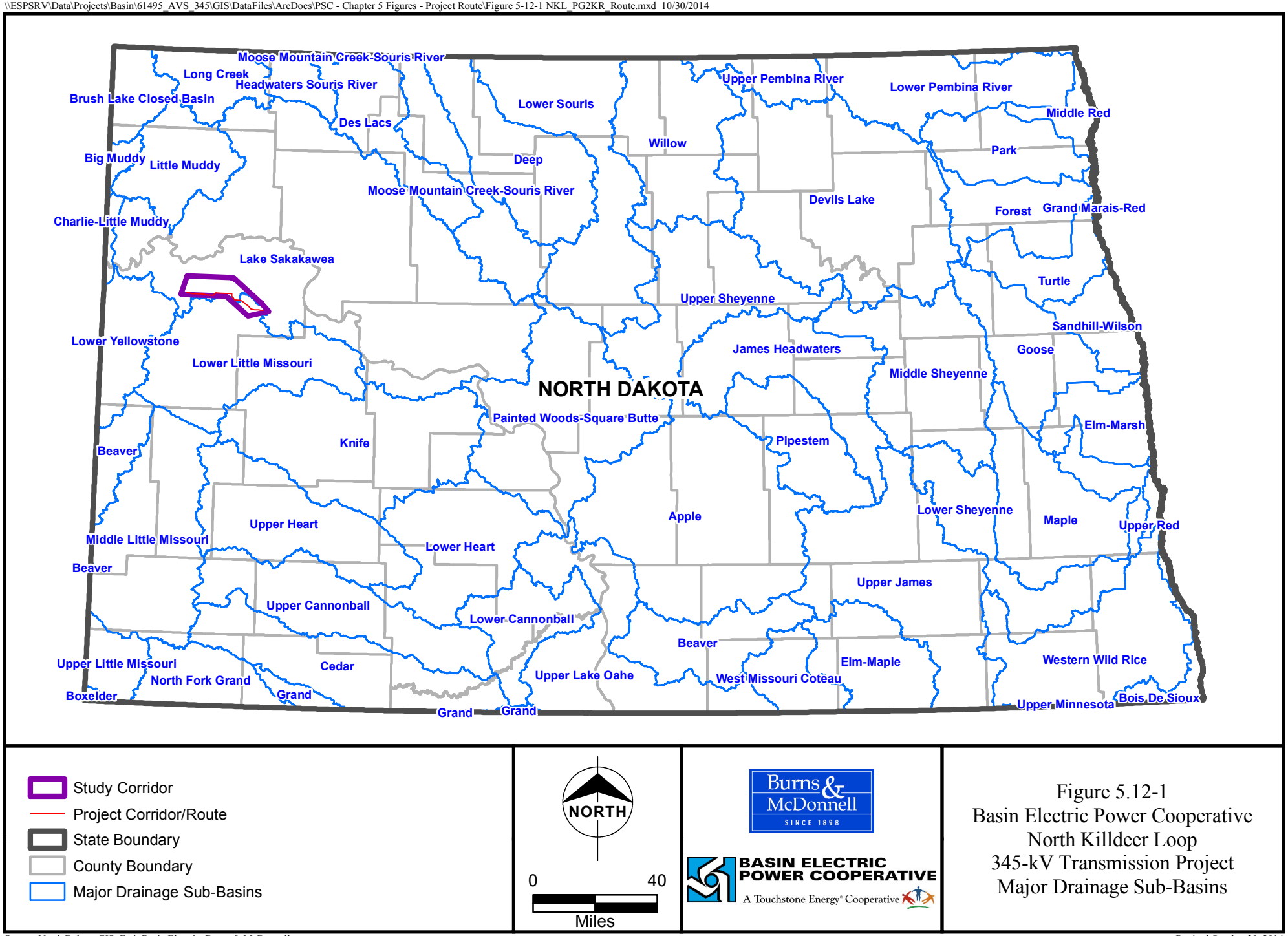

Study Corridor
Project Corridor/Route
State Boundary
County Boundary
Major Drainage Sub-Basins

NORTH

0 40
Miles

Burns & McDonnell
SINCE 1898

BASIN ELECTRIC POWER COOPERATIVE
A Touchstone Energy® Cooperative

Figure 5.12-1
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Major Drainage Sub-Basins

Source: North Dakota GIS; Esri; Basin Electric; Burns & McDonnell.

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As required under section 303(d) of the federal Clean Water Act (CWA), the EPA has identified and created a list of impaired water bodies that require the development of Total Maximum Daily Load (TMDLs). A TMDL is the amount of pollution a water body can receive and still maintain water quality standards established by the EPA. The main cause of impairment within the three river basins draining the Project area is fecal coliform, resulting mostly from livestock operations and grazing near riparian areas. Impaired rivers and lakes within the Knife, Little Missouri, and Upper Missouri/Lake Sakakawea basins include portions of the Knife River, Little Missouri River, and Lake Sakakawea (EPA, 2011).

5.12.1.3 Floodplains

Dunn County participates in the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program, which allows residents to purchase special insurance at subsidized rates. Flood data derived from FEMA Flood Insurance Rate Maps (FIRM) were used to identify areas within the Project area that are designated as 100-year floodplains. Designated 100-year floodplains are not mapped countywide, but include those areas near communities or other populated areas (FEMA, 1984). McKenzie County has preliminary FIRMs available for the county. Designated 100-year floodplain is not mapped countywide, but includes populated areas such as Watford City, Arnegard, and Alexander (FEMA, 2013). FEMA floodplains identified within the Project area portions of Spring Creek located approximately two miles northeast of the community of Killdeer in Dunn County. Additional floodplain areas not listed on FIRMs are likely present within the Project area. These areas include, but are not limited to, the Knife River, Little Missouri River, Little Muddy River, and associated tributaries.

5.12.1.4 Groundwater

Deep Paleozoic aquifers extend throughout the Project area, but generally contain highly mineralized water due to their depth. Cretaceous aquifers are found throughout the Project counties, and provide a valuable source of water for farms, ranches, and communities. Lower Tertiary aquifers are found closer to the surface, are composed primarily of sandstone and lignite, and provide a source of water for various uses (Whitehead, 1996). Aquifers comprised of unconsolidated rocks are generally very productive, but are smaller and more scattered throughout the Project counties, occurring primarily around river valleys and lakes. Figure 5.12-2 shows the distribution of bedrock formations and associated aquifers within North Dakota. These formations and associated aquifers are further discussed in the following section.

5.12.1.5 Hydrogeology Formations

Figure 5.12-2 shows where the various formations occur (crop out or sub crop) at land surface. The geologic section further discusses their occurrence beneath the land surface. A large number of individual

bedrock formations have been formally identified and described in North Dakota, but for the purpose of defining bedrock aquifers, these formations can be grouped into four major units, which are labeled A to D in descending order. The relationship of the bedrock formations to the aquifer units is given in Table 5.12-1.

Table 5.12-1: Relationship of Bedrock Formations to Aquifer Units

Geologic Age	Bedrock Formations	Thickness (feet)	Aquifer Units
Tertiary	White River Group Golden Valley Formation Fort Union Formation	250 300 2,300	A
Cretaceous	Hell Creek Formation Fox Hills Sandstone Undifferentiated rocks Dakota Sandstone	600 400 3,000 400	B C
Jurassic	--	1,000	--
Triassic	--	600	--
Paleozoic	--	7,000	D

Unit A, the uppermost unit, includes a series of aquifers composed of sandstone and lignite beds that occur mainly in the Fort Union Formation in the western half of the State. These aquifers are quite variable in horizontal extent and thickness. Consequently, the aquifers in unit A are less reliable sources for development than the deeper aquifers. Nevertheless, most farms and ranches and many small communities are able to obtain sufficient quantities of water for most purposes from these aquifers. Water in unit A, although commonly more mineralized than desirable, is used for most purposes except for irrigation.

Unit B is an extensive sandstone aquifer that underlies the western two-thirds of the State. The aquifer is a relatively dependable source of water because of its wide extent and uniform character. It supplies water to many farms and ranches and several small cities in central and western North Dakota. Water from unit B is similar in quality to that of unit A and generally is used for the same purposes.

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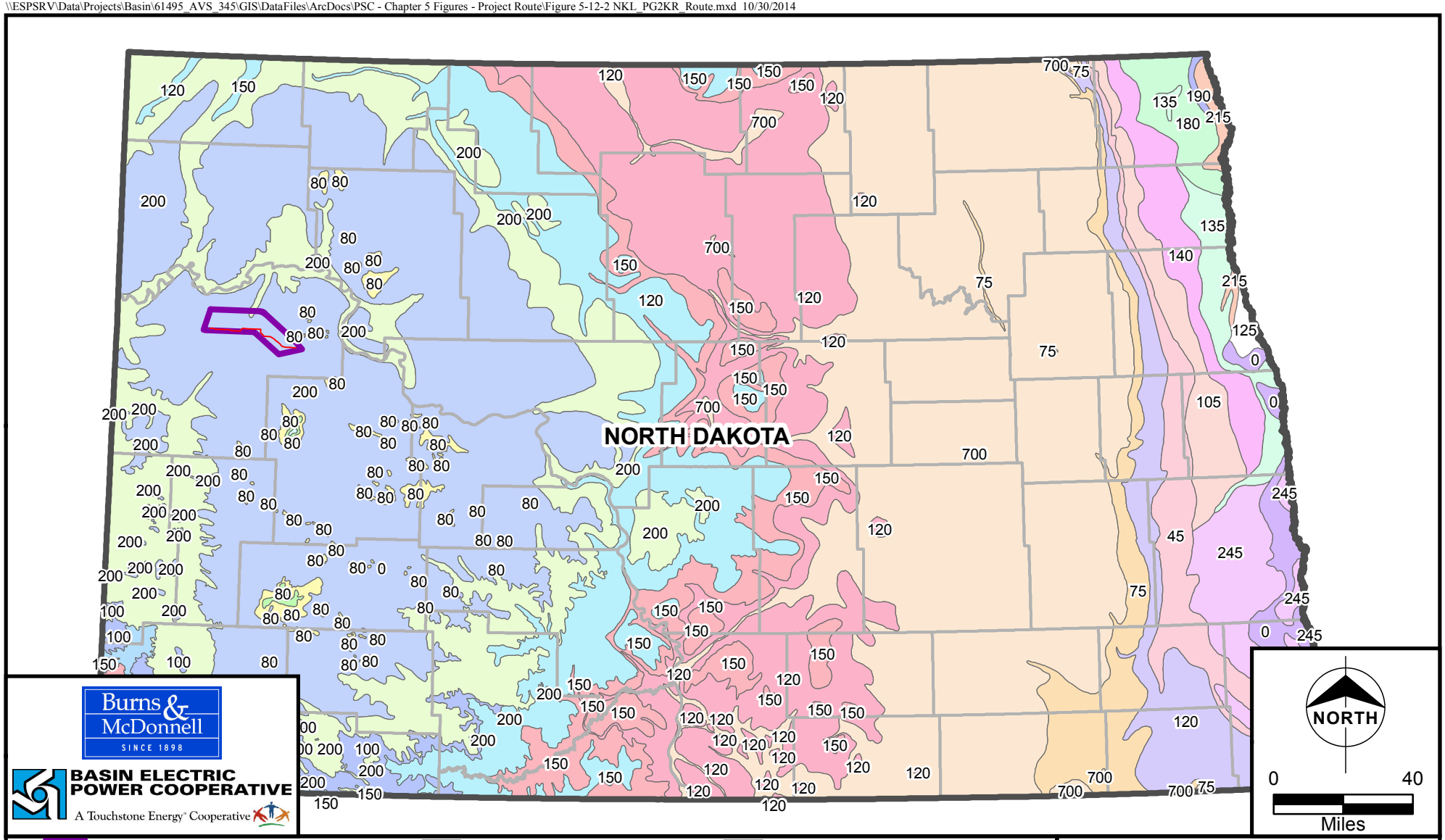

Figure 5.12-2
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Bedrock Formations

Source: North Dakota GIS; Esri; Basin Electric; Burns & McDonnell.

Revised October 30, 2014

Unit C, which underlies most of the State, consists of several sandstone layers that are commonly referred to as the Dakota Sandstone aquifer, or simply the Dakota aquifer. The availability of a free-flowing water supply may have made the Dakota Sandstone such an attractive source. It is likely that it was not the water quality, which generally is unsuitable for many uses because of salinity. However, in many areas it was the only readily available source. Water from the Dakota was particularly valued, and still is, for watering livestock during the winter because of the relatively warm temperature of the water. In western North Dakota, the aquifer is used both as a source and a sink in connection with oil-field operations. Water is pumped from the aquifer for use in re-pressurizing depleted oil reservoirs, and waste brine from the reservoirs is injected into the aquifer.

Unit D, the deepest and thickest of the aquifer units, underlies the entire State except a small area near the North Dakota-Minnesota boundary. The top of this unit is only a few hundred feet below land surface near the eastern edge of the State, and from there it slopes westward to depths of about 9,000 feet. Very little is known about the water-bearing properties of the rocks in this unit. In most parts of North Dakota, it would not be practical to drill wells this deep to obtain water. In addition, data from oil wells completed in rocks of this unit indicate that the water is saline and not usable for most purposes (USGS, 1983).

5.12.1.6 Missouri River Basin Water Supply and Water Use Information

The Project fits wholly within the northwestern portion of the Missouri River Basin, which includes seven major sub-basins. The Project counties fit mostly within the Lake Sakakawea, Little Muddy River, Lower Little Missouri River, and Knife River sub-basins.

5.12.1.6.1 Water Use

Based on a 2005 report issued by the ND State Water Commission (NDSWC), 85 percent of the water used in the Basin is used for industry, 11 for percent irrigation, 2 for percent municipal, and the remaining 2 percent is distributed among livestock, rural domestic, rural water systems, and other uses. Of the groundwater being used, 69 percent is for irrigation, 14 percent for livestock, 7 percent for industrial, 6 percent for municipal, 3 percent for rural domestic, and 1 percent for rural water systems and other uses. Of the available groundwater being pumped, 69 percent was used for irrigation; 90 percent of the surface water pumped was used for industrial purposes (NDSWC, 2005).

Concerns highlighted by the North Dakota State Water Commission (NDSWC) within the Missouri River Basin included:

- Declining reservoir levels on Lake Sakakawea during years of prolonged drought have caused problems for municipal and industrial water supply intakes;

- periodic flooding of agricultural land and some communities (communities most seriously affected are located outside the Study Corridor);
- Expected growth in electrical generation facilities fueled by lignite coal would require large amounts of water for processing, and
- Cooling purposes.

Some water users have an inadequate supply of good quality water to meet municipal, rural domestic, irrigation and livestock needs. In 2004, 45 communities exceeded secondary water quality standards. Expansion of rural water systems would improve water quality and quantity for many cities and farms. Agriculture, real estate development, and recreational uses are often at odds in the Missouri River corridor. In order to encourage coordinated water and related land resource management and development along the Missouri River, a coalition comprised of local governments and residents of the counties bordering the river has been formed (NDSWC, 2005).

5.12.1.6.2 Water Supply Development Initiatives within the Project Area

In December 2010, the NDSWC completed the *2011-2013 North Dakota Water Development Report*, providing an update to the 2009 State Water Management Plan. In this report, the NDSWC discusses Regional Water System development and funding sources. Figure 5.12-3 shows the locations and labels for the various state water systems (NDSWC, 2011).

As the oil industry continues to grow in the northwest portion of North Dakota, so does the need for water development projects to support that growth both for drilling processes and a growing workforce. Even with current drilling activity in that region, existing water supplies are stretched. The strain on water supplies is expected to intensify in the coming years due to drilling expansion. This is particularly true of areas that rely heavily on groundwater resources. For that reason, developments of water supply systems that utilize abundant Missouri River water have become a priority in the region.

The Western Area Water Supply project is a collaborative effort among Williston, Williams Rural Water District, McKenzie Water Resource District, and R&T Water Supply Association (including the communities of Ray, Tioga, and Stanley). Its focus has been to develop a regional water supply system that will deliver Missouri River water from the Williston Regional Water Treatment plant to areas throughout the northwest, oil-producing region of the State. The total estimated cost of this project is approximately $150 million, with $25 million budgeted as a grant from the State, through the NDSWC. The remaining balance will come from local project sponsors, likely through bond proceeds.

5.12.2 Impacts

As discussed above, the Project counties contain several major surface water and groundwater features. Surface waters potentially affected by the proposed Project include smaller creeks, tributaries, and unnamed intermittent and ephemeral streams. Groundwater sources include Paleozoic aquifers, lower and upper Cretaceous aquifers, lower Tertiary aquifers, and unconsolidated-deposit aquifers. This section discusses potential impacts to these resources resulting from construction and operation of the Project.

Impacts to water resources resulting from the construction or operation of the proposed Project would include:

- Possible disruption of floodwaters due to structures in floodplain areas
- Increased sedimentation into surface waters from stormwater runoff
- Increased sedimentation into EPA-classified Impaired Waters from stormwater runoff or construction activities
- Possible introduction of contaminants into surface and groundwater resources

The Corridor/Route contains no FEMA-designated floodplain along the length of the route. No impacts to these areas are expected during construction or operation of the proposed Project. The Corridor/Route would cross two perennial waterways and numerous intermittent streams. All stream crossings would be spanned by the Project, and no transmission structures would be placed in the streambed. Because of the use of standard BMPs, no impacts to water resources during operation of the proposed Project are anticipated.

No impacts to water resources resulting from the construction and operation of the proposed Roundup, Kummer Ridge, or Patent Gate substations are expected because BMPs would be used to prevent soil erosion and sedimentation. No streams or other water bodies are present within any of the substation sites, and the substation sites would not be located within FEMA-designated floodplains.

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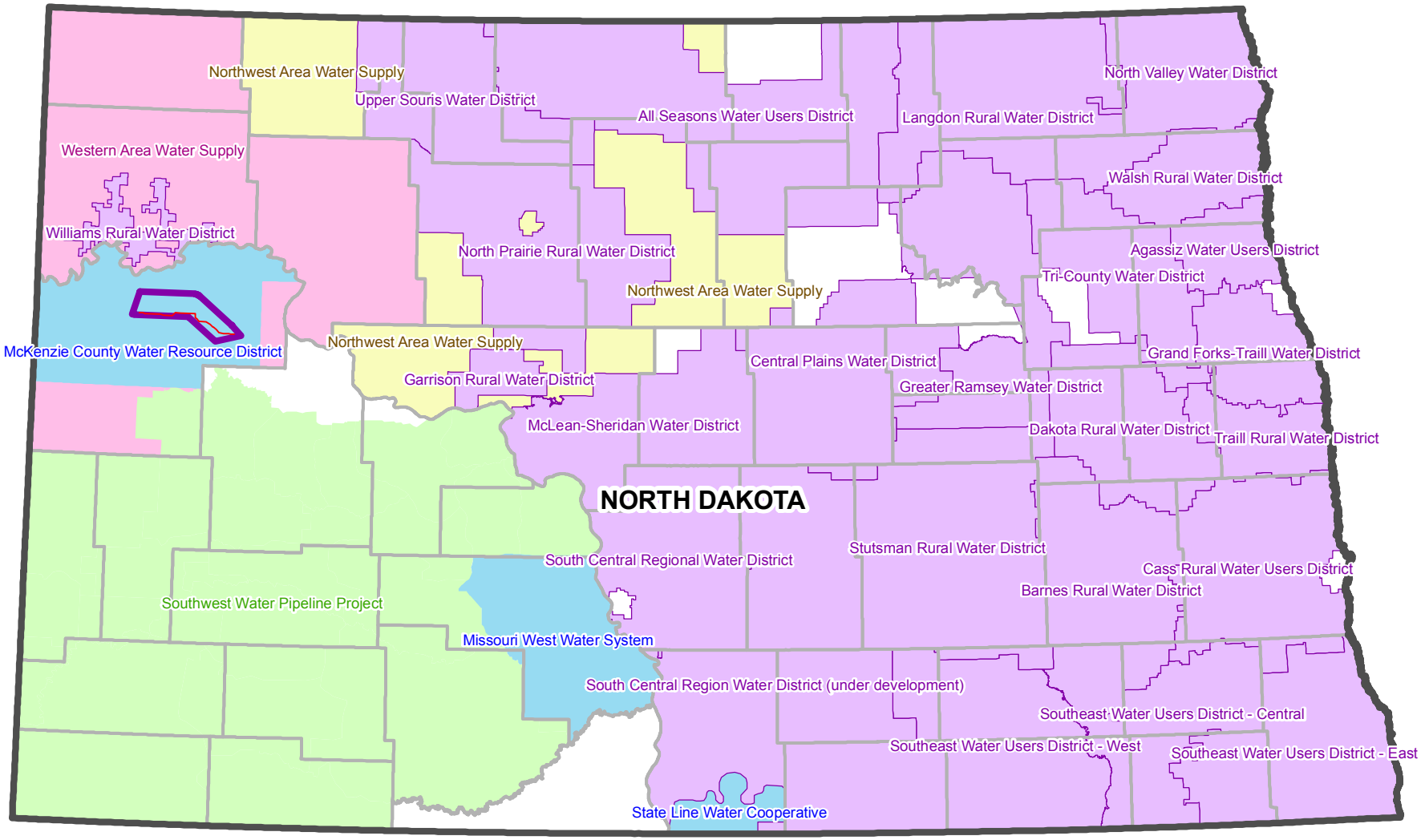

Study Corridor
Project Corridor/Route
State Boundary
County Boundary

Rural Water Districts
Rural Water Associations
Northwest Area Water Supply
Southwest Water Pipeline Project
Western Area Water Supply

NORTH

0 40
Miles

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BASIN ELECTRIC POWER COOPERATIVE
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Figure 5.12-3
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Regional Water Systems

Source: North Dakota GIS; Esri; Basin Electric; Burns & McDonnell.

Revised October 30, 2014

5.12.3 Mitigation

- Basin Electric and its contractors would clean up any spills or equipment leaks promptly to prevent materials from entering surface water.
- Basin Electric and its contractors would appropriately contain and store materials such as fuel, lubricants, and solvents.
- Basin Electric and its contractors would span floodplains to the extent possible to avoid potential impacts.
- Basin Electric and its contractors would plant or seed non-agricultural areas that were disturbed during construction; use native seed mixes from the indigenous plants, and plant indigenous species located in the immediate disturbed soil area; coordinate seeding and/or plantings efforts at a time congruent with seeding and growth of the area, not during a time that would preclude germination or rooting.
- Basin Electric and its contractors would remove excavated material and other debris from flood-prone areas to maintain storage volumes and prevent introduction of debris that may lead to clogged culverts or bridges, resulting in changes to water flow and flood patterns.
- Basin Electric and its contractors would locate structures and disturbed areas away from rivers and lakes, where practicable.
- Basin Electric and its contractors would install sediment control measures prior to construction in accordance with plans and permits including: mulch produced through the chipping of removed trees; soil berms; and partially burying logs along the ROW.
- Basin Electric and its contractors would use wastewater and stormwater control measures to meet the effluent limits prior to discharging from construction sites to surface waters.
- Basin Electric and its contractors would avoid the use of fertilizers, pesticides, or herbicides in or near surface waterbodies.
- Basin Electric and its contractors would fuel construction vehicles away from surface waterbodies and use appropriate spill prevention and containment procedures.
- Equipment washing, storage of petroleum products, lubricants, solvents and hazardous materials, structure sites, and other disturbed areas would be located at least 100 feet from rivers, streams (including ephemeral streams), ponds, lakes, and reservoirs, where practical, by Basin Electric and its contractors. This includes construction vehicles and heavy equipment when parked overnight or longer.
- ROW access roads would be located at least 100 feet from rivers, ponds, lakes, and reservoirs, where practical, by Basin Electric and its contractors.

- If the banks of ephemeral stream crossings are sufficiently high and steep that breaking them down for a crossing will cause excessive disturbance, culverts would be installed by Basin Electric and its contractors using the same measures as for culverts on perennial streams.

5.13 Biological Resources

5.13.1 Description of Resources

5.13.1.1 Regional Setting

The Corridor/Route extends across two physiographic ecoregions: Missouri Plateau and River Breaks (Bryce et al., 1998). Physiographic regions generally characterize areas by their topography and geologic features. The River Breaks ecoregion encompasses the area immediately adjacent to the Missouri River/ Lake Sakakawea and its tributaries. The Missouri Plateau ecoregion occur south of the Missouri River/Lake Sakakawea (see Geology and Landforms section for further discussion of these ecoregions).

The Project counties contain a variety of biological resources within diverse landscapes consisting of rolling prairies, badland areas, cultivated farmlands, and riparian areas. These landscapes contain diverse vegetative communities that serve as habitat to many species of wildlife. Riparian areas and wetlands within the Project counties also provide habitat for plant and animal species dependent on these areas. Additionally, several special status species are known to utilize selected habitats found within the Project counties. The following is a discussion of the vegetative, wildlife, wetland, and special status species resources found within the Project counties. Figure 5.13-1 through Figure 5.13-4 illustrates the various types of landscapes in the area that support vegetation and wildlife.

Figure 5.13-1: Typical Prairie

Figure 5.13-2: Typical Badland Area

Figure 5.13-3: Cultivated Farmland

Figure 5.13-4: Wetland/Riparian Area

5.13.1.2 Vegetation

Natural vegetation within areas of rolling topography in the Missouri Plateau ecoregion consists of shortgrass prairie plants, including blue grama (*Bouteloua gracilis*), needleleaf sedge (*Carex duriuscula*), threadleaf sedge (*Carex filifolia*), needle-and-thread (*Hesperostipa comate*) wheatgrass (*Elymus smithii*), little bluestem (*Schizachyrium scoparium*), big sagebrush (*Artemisia tridentata*), buffalograss (*Bouteloua dactyloides*), and prairie sandreed (*Calamolvilfa longifolia*). Forbs include white wild onion (*Allium textile*), buffalo-bean (*Thermopsis* spp.), silverleaf (*Astragalus* spp.), moss phlox (*Phlox subulata*), white beardtongue (*Penstemon* spp.), and fringed sage (*Artemesia frigida*) (Western, 2010).

Spring wheat, barley, sunflowers, alfalfa, lentils, peas, and silage corn are common crops in cultivated areas (Bryce et al., 1998). Land that is not cultivated is often managed for pasture or rangeland for grazing by cattle or horses. Most pasture forage is native, especially blue grama grass, western wheatgrass, big sagebrush, green needlegrass (*Nassella viridula*), and prairie junegrass (*Koeleria macrantha*).

North Dakota state law requires all landowners to make every effort to control the spread of noxious weeds on their property. Federal agencies are also directed to prevent the introduction of invasive species and avoid actions that are likely to cause or promote the introduction or spread of invasive species (USDA, 2011). Noxious weeds can be detrimental for a number of reasons. They threaten wildlife by replacing natural vegetation and nesting habitat, threaten native plant species, reduce crop productivity, and increase soil erosion (NDDOA, 2003).

North Dakota has a state-level noxious weeds list that includes all counties and cities within the state. Table 5.13-1 shows those species appearing on the state list. In addition, individual counties have the option of including additional species to their respective county lists. Within the Project area, only McKenzie County has a list different form the state. It has added black henbane (*Hyoscyamus niger*), common burdock (*Arctium minus*), houndstongue (*Cynoglossum officinale*), halogeton (*Halogeton glomeratus*), and baby's breath (*Gypsophila* spp.) to its noxious weeds list (NDDOA, 2003). Dunn County utilizes the state-listed noxious weeds list.

Table 5.13-1: North Dakota State-Listed Noxious Weeds

Common Name	Scientific Name
Absinth wormwood	*Artemisia absinthium*
Canada thistle	*Cirsium arvense*
Diffuse knapweed	*Centaurea diffusa*

Common Name	Scientific Name
Leafy spurge	*Euphorbia esula*
Musk thistle	*Carduus nutans*
Purple loosestrife	*Lythrum salicaria*
Russian knapweed	*Acroptilon repens*
Spotted knapweed	*Centaurea stoebe* spp. *Micranthos*
Yellow toadflax	*Linaria vulgaris*
Dalmatian toadflax	*Linaria genistifolia* spp. *Dalmatica*
Saltcedar	*Tamarix* spp.

Source: North Dakota Department of Agriculture, 2014; Retrieved September 2014

5.13.1.3 Wildlife

The Project counties are within the Great Plains-Palouse Dry Steppe Province and the Great Plains Steppe Province, which are similar to physiographic ecoregions but include biological characteristics (Bailey, 1995). These regions are characterized by rolling plains, valleys, canyons, and buttes, with the more gently rolling plains found north of the Missouri River and Lake Sakakawea outside the Study Corridor. The diverse landscape is home to many species of wildlife. The primary habitat types that occur in the Project counties are short and mixed-grass prairie, badland areas, shelterbelt woodland areas, agricultural lands (rangeland and cropland), wetlands, and riparian areas. Appendix L includes a representative list of some of the birds, mammals, reptiles, fish, and amphibians that may occur near or within the Project counties. The following is a discussion of common wildlife species that may be found within the Project counties.

5.13.1.3.1 Big Game

Several species of big game are known to occur within the Project counties. Whitetail deer (*Odocoileus virginianus*) are found throughout the area, while mule deer (*Odocoileus hemionus*) are less common. Mule deer occur primarily in the western portion of McKenzie County, although they are occasionally found further east in the badland areas along the Little Missouri River.

Pronghorn antelope (*Antilocapra americana*) are found primarily in open prairie habitat, but have been known to occur throughout the Project counties. The pronghorn antelope wintering range occurs primarily south and west of the Corridor/Route. Recent harsh winters have contributed to a decline in current populations of pronghorn antelope. Hunting for pronghorn antelope was not allowed from 2009 to 2014 due to the decline in populations. A limited hunting season for this species was allowed in 2014 and 250 licenses were available (NDGFD, 2014).

5.13.1.3.2 Mammals

Coyote (*Canis latrans*), mountain lion (*Felis concolor*), porcupine (*Erethizon dorsatum*), badger (*Taxidea taxus*), striped skunk (*Mephitis mephitis*), and bobcat (*Felis rufus*) are some of the larger mammals known to occur within the Project counties. These mammals use a variety of habitats including mixed-grass prairie, pastureland, forested areas, and riparian areas (USGS-NPWRC, 2006). Mountain lions are generally found in more isolated areas, mainly within the badland areas associated with the Little Missouri River, although they have been found throughout the Project counties. Many smaller mammals, including several species of mice, voles, squirrels, bats, and rabbits, are found within the Project counties (see Appendix L).

5.13.1.3.3 Migratory and Resident Birds

Migratory and resident birds occur within the Project counties. Typical migrant bird species that may occur within the Project area include western meadowlark (*Sturnella neglecta*), yellow warbler (*Dendroica petechial*), black-headed grosbeak (*Pheucticus melanocephalus*), chipping sparrow (*Spizella passerine*), grasshopper sparrow (*Ammodramus savannarum*), northern oriole (*Icterus galbula*), loggerhead shrike (*Lanius ludovicianus*), brown thrasher (*Toxostoma rufum*), bobolink (*Dolichonyx oryziv*), upland sandpiper (*Bartramia longicauda*), western kingbird (*Tyrannus verticalis*), American robin (*Turdus migratorius*), and mourning dove (*Zenaida macroura*). Typical resident bird species that may occur within the Project area include horned lark (*Eremophila alpestris*), black-capped chickadee (*Parus atricapillus*), white-breasted nuthatch (*Sitta carolinensis*), blue jay (*Cyanocitta cristata*), American crow (*Corvus brachyrhynchos*), and American goldfinch (*Carduelis tristis*) (NDGFD, 2010c). All of the birds listed above, as well as hundreds more, are migratory birds and are protected by the Migratory Bird Treaty Act (MBTA), which makes it illegal to kill, harass, or possess migratory birds. Executive Order (EO) 13186 was enacted so that federal departments and agencies take actions to study the effects of federal actions on migratory birds in environmental evaluations.

5.13.1.3.4 Raptors

Some of the raptor species that may occur within the Project counties include bald eagle (*Haliaeetus leucocophalus*), golden eagle (*Aquila chrysaetos*), red-tailed hawk (*Buteo Jamaicensis*), American kestrel (*Falco sparvenius*), prairie falcon (*Falco mexicanus*), great horned owl (*Bubo virginianus*), northern harrier (*Circus cyaneus*), and other birds of prey including the turkey vulture (*Cathartes aura*) (NDGFD, 2010c). These species range over large areas when foraging for food. Many of these species also breed within the Project counties. Raptors are protected under the MBTA. Bald and golden eagles also are protected by the Bald and Golden Eagle Protection Act (BGEPA). The BGEPA prohibits anyone, without

a permit issued by the Secretary of the Interior, from taking bald or golden eagles, including their parts, nests, or eggs. The BGEPA defines "take" as pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb.

5.13.1.3.5 Game Birds, Waterfowl, and Shorebirds

Game birds, waterfowl, and shorebirds are known to occur within the Project counties. Common upland game birds found within the Project area include ring-necked pheasant (*Phasianus colchicus*), gray partridge (*Perdix perdix*), sharp-tailed grouse (*Tympanuchus phasianellus*), and wild turkey (*Meleagris gallopavo*). Upland game bird species are not protected under MBTA but are regulated by state game laws. Many species of waterfowl can also be found during the breeding season within the Project counties. These species include mallard (*Anas platyrhynchos*), gadwall (*Anas strepera*), Canada goose (*Branta canadensis*), northern shoveler (*Anas clypeata*), and blue-winged teal (*Anas discors*), among others. In addition, various species of shorebirds are found near wetland areas and riparian corridors within the Project counties. Some of these species include great blue heron (*Ardea herodias*), American bittern (*Botaurus lentiginosus*), American coot (*Fulica americana*), killdeer (*Charadrius vociferous*), common tern (*Sterna hirundo*), and spotted sandpiper (*Actitis macularia*) (see Appendix L).

5.13.1.3.6 Reptiles and Amphibians

Several species of reptiles and amphibians can be found within the counties affected by the proposed Project. Lizards and snakes are found in various habitats in the region, while amphibians are more likely to be found in wetland areas or near riparian corridors associated with rivers, lakes, and streams. Reptiles and amphibians that may be found within the Project counties include common garter snake (*Thamnophis sirtalis*), plains garter snake (*Thamnophis radix*), smooth green snake (*Opheodrys vernalis*), sagebrush lizard (*Sceloporus graciosus*), short-horned lizard (*Phrynosoma douglassi*), common snapping turtle (*Chelydra serpentina*), bullsnake (*Pituophis catenifer*), prairie rattlesnake (*Crotalus viridis*), plains spadefoot toad (*Scaphiopus bombifrons*), northern leopard frog (*Rana pipiens*), and tiger salamander (*Ambystoma tigrinum*) (Hoberg and Gause, 2006).

5.13.1.3.7 Native and Introduced Game Fish Species

Rivers and lakes within the Project counties provide habitat for various species of fish. Game fish species that may be found within the Project counties include walleye (*Sander vitreus*), northern pike (*Esox lucius*), bluegill (*Lepomis macrochirus*), white crappie (*Pomoxis annularis*), smallmouth bass (*Micropterus dolomieu*), and rainbow trout (*Oncorhynchus mykiss*) (NDGFD, 2010a). Smallmouth bass and rainbow trout are introduced species, but have greatly increased recreational fishing opportunities

within the Project area. Numerous nongame fish species also occur within the Project counties (see Appendix L).

5.13.1.4 Wetlands

Wetlands are scattered throughout much of northwestern North Dakota, including the Project counties. These natural communities provide filtration of sediments and pollutants from surface water runoff, floodwater retention, erosion control, resting, foraging, and nesting habitat for waterfowl and mammals, fish spawning and nursery, and amphibian habitat.

Wetlands are defined, for regulatory purposes, in the Clean Water Act. This definition is used by the EPA and the USACE to administer the permit program outlined in Section 404 of the Act. Wetlands under USACE jurisdiction are defined as follows:

> Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (Environmental Laboratory, 1987). Wetlands generally include swamps, bogs and similar areas (40 CFR 230.3 and 33 CFR 328.3).

In order to be classified as a wetland, a site must possess three characteristics: hydric soils, a dominance of hydrophytic vegetation, and wetland hydrology.

Wetlands found within the Project counties are generally classified in three categories based on the vegetation occurring in the area: forested, scrub/shrub, and emergent. Most of the wetlands within and near the Project consist of small prairie potholes or other small ponds. Larger, forested and shrub/scrub wetland areas are typically associated with riparian corridors within the Project counties. National Wetland Inventory (NWI) digital data of the Project counties were reviewed to provide information on existing conditions within the area. Figure 5.13-5 shows existing wetland areas within the Study Corridor and surrounding areas, as determined by NWI digital data.

Forested wetlands are characterized by woody vegetation that is greater than 6.0 meters tall (Cowardin et al., 1979). The dominant trees found in forested wetlands within the Project counties are eastern cottonwood (*Populus deltoides*), Missouri River willow (*Salix eriocephala*), American elm (*Ulmus americana*), balsam poplar (*Populus balsamifera*), water birch (*Betula occidentalis*), and boxelder (*Acer negundo*) (USDA-NRCS, 2011a). These wetlands occur along the major river systems and their tributaries within the Project counties, primarily Little Missouri River tributaries. Additionally, these wetlands are often only seasonally flooded during the spring and during heavy runoff periods.

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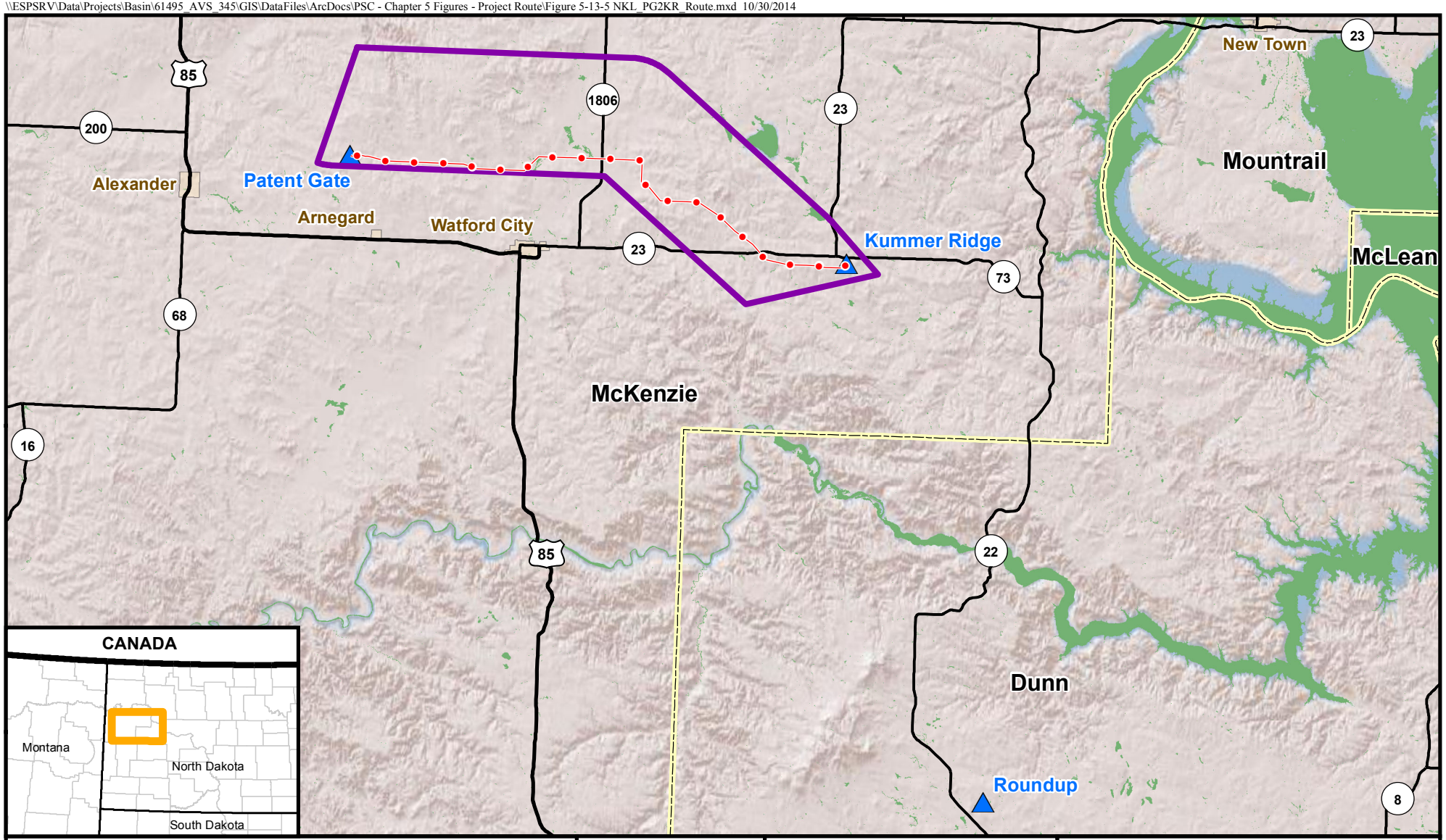

Study Corridor
Project Corridor/Route
Proposed Substation
County Boundary
Municipal Areas
NWI Wetlands

NORTH

0 7
Miles

Burns & McDonnell SINCE 1898

BASIN ELECTRIC POWER COOPERATIVE
A Touchstone Energy® Cooperative

Figure 5.13-5
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
NWI Wetlands

Source: USFWS NWI Wetlands; North Dakota GIS; Esri; Basin Electric; Burns & McDonnell.

Revised October 30, 2014

Scrub/shrub wetlands are characterized by woody vegetation less than 6.0 meters in height. These wetlands consist of a mixture of shrubs and small trees and are also associated with rivers and tributaries within the Project counties. Common species found in scrub/shrub wetlands include Bebb willow (*Salix bebbiana*), Missouri River willow (*Salix eriocephala*), saltcedar (*Tamarix ramosissima*), prairie willow (*Salix humilis*), Russian olive (*Elaeagnus angustifolia*), silverberry (*Elaeagnus commutata*), and skunkbush sumac (*Rhus trilobata*).

Emergent wetlands found within the Project counties include wet meadows, prairie potholes, and aquatic bed wetlands. Common species found in emergent wetlands include reed canarygrass (*Phalaris arundinacea*), prairie cordgrass (*Spartina pectinata*), bald spikerush (*Eleocharis erythropoda*), American vetch (*Vicia americana*), quill sedge (*Carex tenera*), Sartwell's sedge (*Carex sartwellii*), broadleaf cattail (*Typha latifolia*), bog yellowcress (*Rorippa palustris*), and smooth horsetail (*Equisetum laevigatum*).

The NRCS oversees the Wetlands Reserve Program (WRP), which is a voluntary program that provides financial incentives and technical assistance for landowners who wish to protect, restore, and enhance wetlands on their property while helping to achieve the national goal of no net loss of wetlands. Landowners participating in the program either sell a conservation easement (30 years) or enter into a cost-share restoration agreement (10 years) with the USDA to protect and restore wetlands (USDA-NRCS, 2011b). The WRP is gaining popularity with landowners in North Dakota, as participation in this program increased from 109 easements totaling over 24,000 acres in 2009 to 205 easements totaling 33,625 acres in 2010 (USDA-NRCS, 2011c). Within the Project area, McKenzie County has 1,464 acres enrolled in WRP. No WRP enrolled acres were reported for Dunn County (Hagel, 2011).

5.13.1.5 Special Status Species

5.13.1.5.1 Endangered Species Act Species and Critical Habitat

County lists from the USFWS were used to determine which protected species have the potential to occur in the Project counties (USFWS, 2011a, Towner, 2011). According to the USFWS, the Project counties may contain suitable habitat for, or have known occurrences of five federally listed endangered animal species: the whooping crane (*Grus americana*), interior least tern (*Sterna antillarum*), pallid sturgeon (*Scaphirhynchus albus*), black-footed ferret (*Mustela nigripes*), and gray wolf (*Canis lupus*). USFWS indicates that the Project counties also include one federally listed threatened species, the piping plover (*Charadrius melodus*), and two candidate species, the Sprague's pipit (*Anthus spragueii*) and Dakota skipper (*Hesperia dacotae*). These species, along with their federal designations and counties of possible occurrence, are shown in Table 5.13-2. Suitable habitats for the interior least tern, pallid sturgeon, and

piping plover within the Study Corridor and surrounding areas are illustrated on Figure 5.13-6, along with the whooping crane migration corridor through North Dakota. No federally listed endangered or threatened plant species are known to occur within the Project area.

Table 5.13-2: Federally Listed Threatened, Endangered, and Candidate Species

Name	Scientific Name	Dunn County	McKenzie County
Whooping Crane (E)	*Grus americana*	X	X
Piping Plover (T)	*Charadrius melodus*	X	X
Interior Least Tern (E)	*Sterna antillarum*	X	X
Sprague's Pipit (C)	*Anthus spragueii*	X	X
Pallid Sturgeon (E)	*Scaphirhynchus albus*	X	X
Dakota Skipper (C)	*Hesperia dacotae*	X	X
Black-footed Ferret (E)	*Mustela nigripes*	X	X
Gray Wolf (E)	*Canis lupus*	X	X

E – Endangered, T – Threatened, C – Candidate
Source: USFWS, 2011a; Towner, 2011

Black-Footed Ferret

Black-footed ferrets are a federally listed endangered species that depend on prairie dog (*Cynomys* spp.) colonies as a source of food and shelter (USFWS, 1989). The black-footed ferret historically inhabited black-tail and white-tailed prairie dog colonies throughout the Great Plains, but were thought to be extirpated in the wild from 1987 until 1991. In 1991, 49 captive animals were reintroduced into the wild in Wyoming. Since then, ferrets have been reintroduced into Montana, South Dakota, Colorado, and Arizona and are reproducing in the wild. Unconfirmed sightings from other areas continue to be reported. In North Dakota, the majority of the reports come from the southwest part of the state (USFWS, 2011b). There has been a confirmed sighting of black-footed ferrets in south-central North Dakota within the last two years that came for a re-introduction site in South Dakota (K. Shelley, 2013).

The black-footed ferret inhabits short grass prairies, always within close proximity to prairie dog towns. Black-footed ferrets are sexually mature at 1 year of age, and breeding usually takes place between March and May, with three to four young per litter. Juvenile male ferret mortality rates are high as a result of their dispersing to new areas. Life expectancies for black-footed ferrets are considered to be less than 5 years. Prairie dogs comprise 90 percent of the diet of black-footed ferrets. Ferrets also utilize prairie dog burrows for shelter and raising young (USFWS, 2011b).

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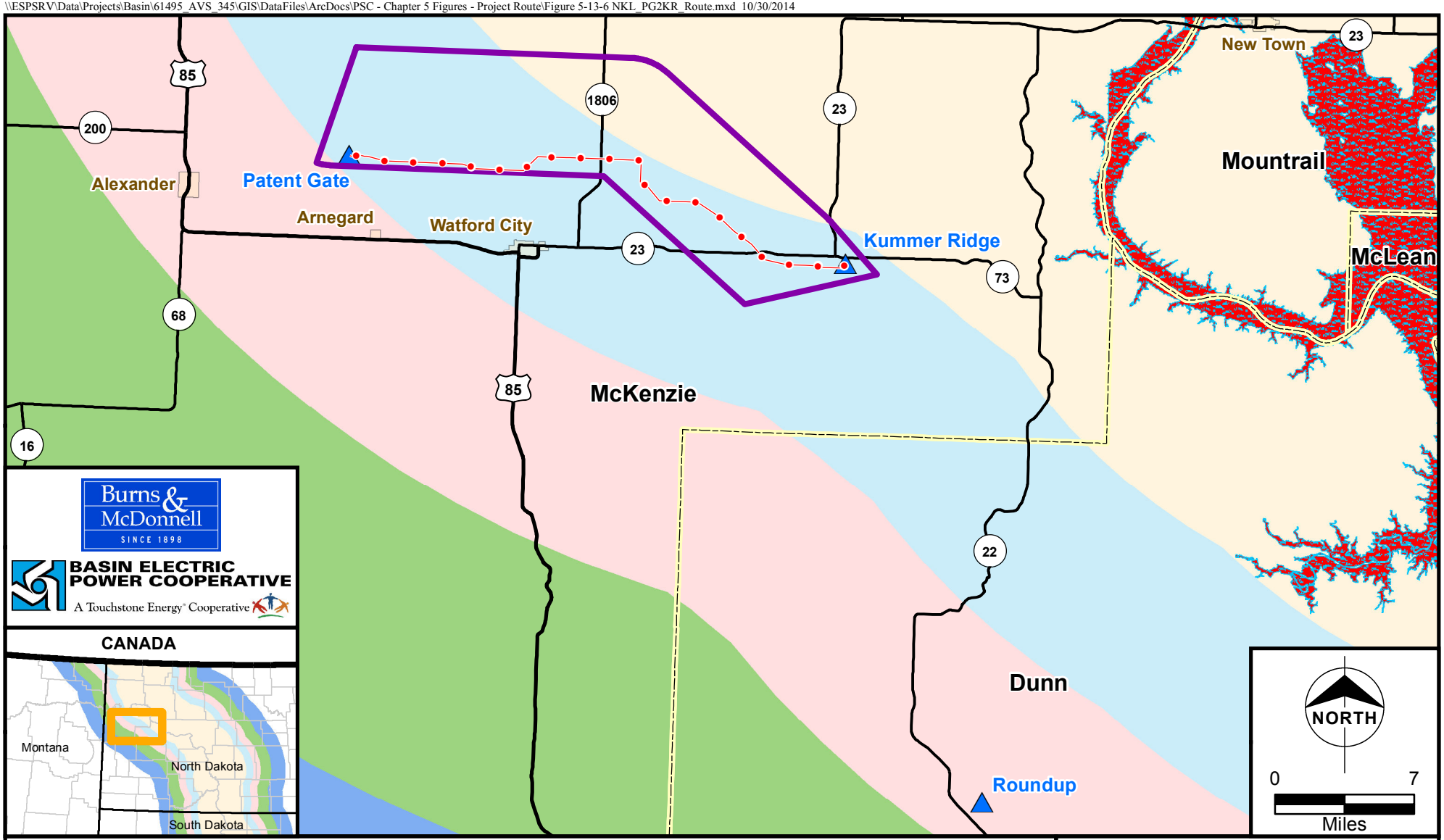

Figure 5.13-6
Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Important Threatened and Endangered Species Habitat

Source: USFWS NWI Wetlands; North Dakota GIS; Esri; Basin Electric; Burns & McDonnell.

Revised October 30, 2014

Black-footed ferrets are typically 20 to 24 inches long and weigh up to 2.5 pounds. They have a yellowish-brown body with a distinctive black mask across the face and black on the feet and the tip of the tail. The decline of black-footed ferrets has been linked to the eradication of prairie dogs, which now occupy less than 1 percent of their historic range. Black-footed ferrets are also susceptible to predation by golden eagles, great-horned owls, and coyotes (USFWS, 2011b).

Dakota Skipper

The Dakota skipper is a small butterfly with a 1-inch wingspan. Dakota skippers historically range from southern Saskatchewan across the Dakotas and Minnesota to Iowa and Illinois. Dakota skippers now occur no further east than western Minnesota and are believed to be extirpated in Illinois and Iowa. They occur in scattered remnants of native prairie, with their population distribution straddling the border between tall-grass prairie ecoregions to the east and mixed-grass prairie ecoregions to the west. The most significant remaining populations of Dakota skippers occur in western Minnesota, northeastern South Dakota, and north-central and southeastern North Dakota (USFWS, 2014a). Despite native prairie conservation efforts, the species still faces many threats to its habitat including over-grazing, conversion to cultivated agriculture, inappropriate fire management and herbicide use, woody plant invasion, road construction, gravel mining, invasive plant species, and in some areas, historically high water levels (USFWS, 2014a). The Dakota skipper is a candidate species for listing under ESA. Review of the listing petition for the Dakota Skipper has been ongoing since 2003 (USFWS, 2011c). USFWS released its Dakota Skipper Conservation Guidelines in September 2007 (USFWS, 2007a).

Dakota skippers have four basic life stages: egg, larva, pupa, and adult. During the brief adult period in June and July, female Dakota skippers lay eggs on the underside of leaves close to the ground. These eggs take about 10 days to hatch into larvae. The larvae build shelters at or below the ground surface and emerge at night to feed on grass until late summer or early fall when they become dormant. They overwinter as mid-stage larvae in shelters at or just below ground level, typically in the bases of native bunchgrasses. The larvae emerge the following spring and continue development. Pupation occurs primarily in June and takes about 10 days. Males emerge as adults about 5 days before females. The maximum life span as adults is about 3 weeks and represents the entire reproductive period of the individual (USFWS, 2014a).

The Dakota skipper occurs in two types of habitat. The first is relatively flat and moist native bluestem prairie in which three species of wildflowers are usually present and flowering when Dakota skippers are in their adult (flight) stage: wood lily (*Lilium philadelphicum*), harebell (*Campanula rotundifolia*), and smooth camas (*Zygadenus elegans*). The second habitat type is upland (dry) prairie that is often on ridges

and hillsides. Bluestem grasses and needlegrasses dominate these upland habitats, and three wildflowers are typically present: pale purple (*Echinacea pallida*), upright coneflowers (*E. angustifolia*), and blanketflower (*Gaillardia sp.*) (USFWS, 2002). Of the 38 existing or possibly existing sites in North Dakota, 19 occur within 2 complexes: Towner-Karlsruhe in McHenry County (13 sites) and Sheyenne Grasslands (6 sites) in Ransom County. The other 19 sites that are presumed to exist are isolated. The largest complex in North Dakota is located within McHenry County (USFWS, 2002). According to USFWS, Dakota skipper may be found within both Dunn and McKenzie Counties.

Gray Wolf

Historically, the gray wolf occurred throughout the lower 48 states except for the Southeast and the deserts of the Southwest (USFWS, 2011d). Today, sustainable populations can be found in habitats with low road and human densities in the following states: Minnesota, Michigan, Wisconsin, Idaho, Montana, and Wyoming (USFWS, 2011d). The gray wolf was listed as endangered on March 9, 1978, in the lower 48 states (except Minnesota) (USFWS, 1987). In North Dakota, the gray wolf has been recently de-listed in the region east of the Missouri River from the South Dakota border to Lake Sakakawea and east of the centerline of U.S. Highway 83 to the Canadian border. Gray wolves west of this area, however, are still federally endangered (USFWS, 2012a). The closest wolf pack to North Dakota is in northwestern Minnesota (Licht and Fritts, 1998). Wolves seen in North Dakota are likely animals dispersing from established populations in Minnesota and Canada (USFWS, 2012a).

Gray wolves live in packs consisting of a breeding pair, their young, and other non-breeding adults. The average size litter of five pups is born in late spring, and young reach adult size in 8 months. Once reaching sexual maturity in 2 to 3 years, young wolves may leave the pack in search of a mate to establish a new pack. The average life span of the gray wolf is 10 years (USFWS, 2011d). The diet of the gray wolf consists mainly of large ungulates such as deer and elk. However, they are opportunistic and will take smaller animals and domestic livestock. They usually hunt in packs but can make kills of large prey on their own (Montana Natural Heritage Program and Montana Fish, Wildlife and Parks, 2012).

Due to the lack of a known breeding population in North Dakota, it is unlikely that gray wolves will be encountered in the Project counties. Although dispersing gray wolves may be spotted anywhere in North Dakota, they are most likely to be seen in the forested areas of north-central and northeast North Dakota, as these areas provide better cover and hunting (USFWS, 2012a).

Interior Least Tern

Historically, the least tern was found on the Atlantic, Gulf of Mexico, and California coasts and on the Mississippi, Missouri, and Rio Grande River systems. It was found throughout the Missouri River system in North Dakota. The interior population of the least tern presently breeds in the Mississippi, Missouri, and Rio Grande river systems. The birds usually stay in close proximity to the rivers. Decline of the interior population of the least tern is due to loss of habitat from dam construction and river channelization on major rivers throughout these river systems. Dams allow for river flows to be managed in a fashion that is not conducive to the creation and maintenance of sandbars with sparse vegetation, which is needed by the interior least tern for nesting (USFWS, 2011e).

The interior population of least terns was listed as endangered on June 27, 1985 (USFWS, 1990). The population estimate for the interior least tern at that time was approximately 5,000 individuals (USFWS, 1990). Almost 17,600 adult least terns were recorded during a 2005 range-wide census of the interior least tern population (Lott, 2006). The majority (11,281) of individuals were observed on the lower Mississippi River, while 2,044 individuals were recorded on the Missouri River (Lott, 2006). USFWS states that approximately 100 pairs breed in North Dakota (USFWS, 2011e).

Nesting least terns mainly utilize sandbars within the free-flowing sections of the Missouri and Yellowstone rivers in North Dakota, and to a lesser extent islands and shorelines of both Missouri River reservoirs (Lake Sakakawea and Lake Oahe) in North Dakota (USFWS, 1990, 2011a). Nests are built on sand or small rocky substrate that is devoid of vegetation (USFWS, 1990, 2012a). Breeding least terns will utilize the river and wetlands adjacent to the nest for foraging (USFWS, 2011a).

Interior least terns begin arriving at nesting sites as early as late April, with peak nesting occurring from mid-June to mid-July (USFWS, 1990, 2012a). Least terns are colonial to semicolonial nesters, and may be found at times with piping plovers, with their nests occurring in shallow depressions in sandy/pebbly substrate.

In the Project counties, habitat for this species is limited to the Missouri River, outside of the Study Corridor. Suitable habitat for the interior least tern has not been identified in the Study Corridor.

Pallid Sturgeon

The historic range of the pallid sturgeon included the Missouri River from Fort Benton, Montana, to St. Louis, Missouri; the Mississippi River from above St. Louis to the Gulf; the lower reaches of other large tributaries, such as the Yellowstone, Platte, Kansas, Ohio, Arkansas, Red, and Sunflower; and the first 60 miles of the Atchafalaya River (USFWS, 2011f). The pallid sturgeon was considered uncommon, and

historic population estimates on the upper Missouri River were unknown (USFWS, 1993). The pallid sturgeon was listed as endangered on September 6, 1990 (USFWS, 1993). In 2004, there were an estimated 158 wild adult pallid sturgeon in the Fork Peck and Yellowstone reaches of the species' range (Klungle and Baxter, 2005). Due to ongoing stocking efforts, populations have been increasing on the lower Missouri River (Missouri River Recovery Program, 2010).

Adult pallid sturgeon typically utilize the bottom of large, turbid, fast flowing rivers. However, their life cycle requires a wide array of aquatic habitats from floodplain backwaters to main river channels (USFWS, 1993). Pallid sturgeon is a long lived species (up to 40 years), with estimated sexual maturity at 7 to 9 years for males and 15 to 20 years for females (USFWS, 1993). Females may spawn every 3 to 10 years (USFWS, 1993). Overall, the life history of pallid sturgeon is not well-understood. Spawning is thought to occur between June and August and historically in the upper reaches of the range, coinciding with an increase in river flow from mountain runoff. The feeding ecology of pallid sturgeon is not well-understood. It is thought that the diet of young fish is mainly aquatic invertebrates, with an increase in small fish consumption as pallid sturgeon age (USFWS, 1993).

Habitat for this species is limited to the Missouri River outside the Study Corridor.

Piping Plover

The piping plover is small shorebird that historically was widely distributed across the Great Plains. The piping plover was listed as threatened across its range in 1985, except in the Great Lakes region where it is listed as endangered (50 Federal Register 50733; December 11, 1985). In the Great Plains, piping plovers inhabit barren sand and gravel shores of rivers and lakes and the shores of alkali wetlands and lakes. Plovers avoid dense vegetation. Habitat destruction and poor breeding success are major reasons for the population decline (USFW, 2012b).

North Dakota is a very important state in the Great Plains region for nesting piping plovers. The state's population of piping plovers decreased from 496 breeding pairs in 1991 to 399 breeding pairs in 1996. More than three-fourths of piping plovers in North Dakota nest on prairie alkali lakes, while the remainder use the Missouri River. Almost all natural lakes used by piping plovers in North Dakota are alkaline and have salt-encrusted, white beaches with sparse vegetation. Beaches used by piping plovers generally are 10 to 40 yards wide. Piping plovers also use barren river sandbars. In North Dakota, barren river sand bars are found on the Missouri and Yellowstone rivers (USFWS, 2012b).

The breeding season in North Dakota extends from mid-April through August. Pairs are territorial and defend their nest area from other piping plovers. A four-egg clutch is laid in a shallow depression in open,

sand/gravel substrate. Both sexes share in incubation, which lasts about 28 days. Plover chicks can walk and feed within hours of hatching and can fly in about 21 days. Piping plovers feed in open beach areas on insects and crustaceans (USFWS, 2012b).

Habitat for this species includes any beach areas associated with alkaline lakes. No critical habitat has been designated in the Study Corridor. However, potential habitat comprised of wetland greater than 3 hectares, is present.

Sprague's Pipit

The Sprague's pipit is a small, grassland bird. It migrates from breeding grounds in the northern prairies of southern Canada and northern United States to the wintering grounds in southern United States and northern Mexico. The Sprague's pipit was designated as a candidate for listing under ESA on September 15, 2010 (Federal Register, 2010). Historically, Sprague's pipit was found throughout the native mid- to short native prairie grasslands of North America; now they are only common in large remnant grassland patches in the northern mixed-grass native prairie of North America.

Native grassland is used extensively by Sprague's pipits throughout their life cycle. Typical nest sites are dominated by native grasses and sedges, with forbs and shrubs, litter, and bare ground present in lesser amounts. Larger tracts of native grassland in landscapes dominated by grasslands are thought to influence the abundance of Sprague's pipits on their breeding grounds. Sprague's pipits have not been documented nesting in Conservation Reserve Program grasslands, dense nesting cover (waterfowl nesting habitat), or cropland (USFWS, 2010). Large tracts of grassland are also preferred habitat of wintering Sprague's pipits, but they may use non-native grasslands to a greater extent. Little if any data is available for habitat preferences during migration.

Sprague's pipits breed in the historic prairie regions of the northern United States, including central and western North Dakota, and Canada. They winter from central Texas south into central Mexico. They arrive on the breeding grounds from mid-April to mid-May with nest initiation anywhere from the second week of May to early August. Four to five eggs are laid on the ground in a cup-shaped nest made of grass. The nest may also be covered with a grass canopy. Incubation is usually 12 to 14 days and mostly done by the female. Generally, Sprague's pipits leave the breeding grounds in late September and arrive on their wintering grounds by early November. The diet of Sprague's pipits consists mostly of arthropods throughout the year (Jones, 2010).

Habitat for Sprague's pipit occurs within the Project counties in areas of large tracts of native grasslands. Occurrence of Sprague's pipit in the area has only been found on grassland tracts 72 acres or larger. Nesting is only known to occur on grasslands that are 358 acres or larger.

Whooping Crane

Whooping cranes are the tallest North American bird. They are omnivorous, nest in marshes, and make long winter and spring migrations from their breeding areas in and around Wood Buffalo National Park in Canada to their winter grounds in and around the Aransas National Wildlife Refuge (USFWS, 2007b). They were listed as threatened with extinction in 1967 and endangered in 1970, then listed as federally endangered under the ESA. They are also listed as endangered in Canada. The natural population of whooping cranes came to an all-time low of 15 individuals in 1941. Since then, the wild population of whooping cranes (of which only one is known to exist) has grown steadily to 279 individuals in 2011 (USFWS, 2012c). The total population of wild and captive whooping cranes, as of 2011, was 437 (USFWS, 2012c).

There is no designated critical habitat for whooping cranes in North Dakota (USFWS, 2014b). Whooping cranes feed and roost in wetlands, riparian areas, and croplands (USFWS, n.d.). Habitat for whooping crane in the form of various-sized wetlands for roosting and agricultural lands for foraging are found throughout much of the Project counties, with the exception of the badlands area north and south of the Little Missouri River crossing. The whooping crane migration corridor does traverse through North Dakota, and the Corridor/Route is within the 80 percent migration corridor (Figure 5.13-6).

5.13.1.5.2 USFS Sensitive and Management Indicator Species

There are 19 animal species known to occur in the Dakota Prairie National Grasslands (Little Missouri, Sheyenne, Cedar River, and Grand River National Grasslands) that are considered by USFS to be sensitive species in North Dakota. In addition, there are 38 sensitive/watch plant species identified for LMNG. Only limited LMNG lands occur in the Study Corridor reducing the likelihood that any of these species would be present. USFS Sensitive Species are provided in Table 5.13-3. The plains sharp-tailed grouse (*Tympanuchus phasianellus jamesii*) is identified as a Management Indicator Species (MIS) in the Land and Resource Management Plan for the Dakota Prairie National Grasslands Northern Region 2001 (USFS, 2001) and was addressed in the EIS for this Project at the request of USFS (USFS, 2012a).

Table 5.13-3: USFS Sensitive and Management Indicator Species

Species Common Name	Scientific Name	Type
Baird's Sparrow	*Ammodramus bairdii*	USFS Sensitive Species
Bald Eagle	*Haliaeetus leucocephalus*	USFS Sensitive Species

Species Common Name	Scientific Name	Type
Burrowing Owl	*Athene cunicularia hypugaea*	USFS Sensitive Species
Greater Prairie-Chicken	*Tympanuchus cupido*	USFS Sensitive Species
Plains Sharp-Tailed Grouse	*Tympanuchus phasianellus*	USFS Sensitive Species; Management Indicator Species
Greater Sage-Grouse	*Centrocercus urophasianus*	USFS Sensitive Species
Loggerhead Shrike	*Lanius ludovicianus*	USFS Sensitive Species
Long-Billed Curlew	*Numenius americanus*	USFS Sensitive Species
Sprague's Pipit	*Anthus spragueii*	USFS Sensitive Species
Black-Tailed Prairie Dog	*Cynomys ludovicianus*	USFS Sensitive Species
Bighorn Sheep	*Ovis canadensis*	USFS Sensitive Species
Arogos Skipper	*Atryone arogos iowa*	USFS Sensitive Species
Broad-winged skipper	*Poanes viator*	USFS Sensitive Species
Dakota skipper	*Hesperia dacotae*	USFS Sensitive Species
Dion skipper	*Euphyes dion*	USFS Sensitive Species
Mulberry wing	*Poanes massasoit*	USFS Sensitive Species
Ottoe skipper	*Hesperia ottoe*	USFS Sensitive Species
Powesheik skipper	*Oarisma powesheik*	USFS Sensitive Species
Regal Fritillary	*Speyeria idalia*	USFS Sensitive Species
Tawny Crescent	*Phycoides batessi*	USFS Sensitive Species

Source: USFS

5.13.1.5.3 North Dakota Species of Conservation Priority

The State of North Dakota does not have an endangered species law but has categorized 100 fish and wildlife species into 3 levels of conservation priority (NDGFD, 2005). The North Dakota State Wildlife Grants (SWG) program provides federal money for wildlife conservation and restoration programs for species of conservation priority. The following categories have been developed to describe the conservation needs for North Dakota species of conservation priority:

- **Level I:** Species with a high level of priority due to the declining status in North Dakota or across the range or high rate of occurrence in North Dakota, constituting the core of the species breeding range but are at-risk range wide, and non-SWG funding is not readily available to them.
- **Level II:** Species with a moderate level of priority or species with a high level of priority but a substantial level of non-SWG funding.
- **Level III:** Species with a moderate level of priority but are believed to be peripheral or non-breeding in North Dakota.

A complete listing of the 100 species of conservation priority for North Dakota is provided in Appendix N.

5.13.2 Impacts

The Project counties contain a variety of diverse landscapes consisting of rolling prairies, badland areas, cultivated farmlands, and riparian areas. These landscapes contain diverse vegetative communities that serve as habitat to many species of wildlife. Riparian areas and wetlands within the proposed Project counties provide habitat for plant and animal species dependent on these areas. Additionally, several special status species are known to utilize selected habitats found within the proposed Project counties. This section discusses potential impacts to vegetation, wildlife, wetlands, and special status species resources resulting from construction and operation of the proposed Project.

The proposed Project would encompass a wide variety of terrain, vegetative communities, and habitat types used by a variety of wildlife. Construction and operation of the proposed Project would have impacts on vegetation, wetlands, and wildlife. Using appropriate mitigation measures, there would likely be no significant impacts to special status species. Potential impacts would include:

- Disturbances or changes to vegetative communities as a result of construction activities within the ROW
- Introduction and spread of noxious weeds during construction of the line
- Sedimentation within wetland areas caused by construction activities
- Removal of wetland vegetation within the ROW during construction
- Removal of wildlife habitat within the ROW
- Temporary disturbance to wildlife from human presence and disruption to habitat
- Disturbance to aquatic habitats from construction activities
- Impacts to special status species or their habitats

5.13.2.1 Vegetation

Potential impacts to vegetation would include temporary and permanent effects. Impacts would include localized disturbance to vegetative communities caused by construction equipment and vehicles during site preparation, such as damage to vegetation from vehicle tires, excavation, grading, and soil stockpiling. Woody vegetation would be cleared within the ROW and in areas where access roads are required. Construction through forested areas would require the removal of any trees or large shrubs that could interfere with line safety, equipment access, or operation.

Vegetation would be permanently removed at each structure foundation location, and woody vegetation would be cleared within currently forested areas of the ROW. Only temporary impacts to vegetation are anticipated within the ROW in grassland, cropland, and hayland areas, as these vegetation types would be

restored within the ROW upon completion of construction. Permanent impacts to vegetation would be limited to conversion of woodland to non-woodland habitat and any loss of vegetation resulting from permanent conversion of new, undeveloped areas, particularly for substation sites.

In total, approximately 511.2 acres of ROW would be required for the Project, of which 435.4 acres are considered vegetated. Very little of this area would actually be subject to disturbance during construction. Table 5.13-4 presents the potential number of acres impacted within the Project Corridor/Route for each vegetation type.

Table 5.13-4: Vegetation Types within Corridor/Route

Vegetation Type	Project Corridor/Route (acres)
Woodland	5.5
Grassland	282.5
Pasture/Hayland	6.4
Cultivated Cropland	141.0

Source: National Land Cover Dataset

5.13.2.1.1 Corridor/Route Temporary Impacts to Vegetation

Temporary impacts associated with the construction of the Project would include the disturbance of vegetation along temporary access roads, as well as temporary disturbance of vegetation within the ROW boundary for access during construction.

Grassland vegetation comprises the largest amount of acreage within the Corridor/Route. Grassland vegetation would be temporarily impacted during construction, but because grassland vegetation is low to the ground, removal of only minimal grassland vegetation is anticipated within the ROW, except at structure locations. Grassland vegetation would be expected to recover upon the completion of construction and restoration efforts. Vegetation used for pasture or hay production would be temporarily impacted, as well, primarily during structure erection and pulling of conductors. In agricultural areas, cropland would be temporarily disturbed within the ROW during construction, but would be re-planted following completion of construction.

5.13.2.1.2 Corridor/Route Permanent Impacts to Vegetation

Permanent vegetative impacts associated with the Project would include the removal of vegetation at each structure foundation location, resulting in a permanent loss of vegetation of approximately 0.1 acres over the length of the Corridor/Route.

Approximately 5.5 acres of woodland is located within the Corridor/Route. Typically, trees would be cleared to maintain access to the ROW and appropriate clearance for the safe and reliable operation of the line. Depending on the type of vegetation adjacent to these wooded areas, cleared woodland areas would likely be converted to grassland or pasture similar to other grassland or pastures throughout the Project areas.

In addition, though not categorized as woodland, treed windbreaks, shelterbelts, and fencerows would be crossed by the Project. Trees within the ROW at these locations would be cleared and the areas converted to similar vegetative cover that is adjacent to the cleared areas.

Periodic trimming and clearing of the ROW would be anticipated to keep the transmission lines clear of any vegetation obstructions during line operation. Herbicides may be used periodically within the ROW to prevent the growth and spread of any noxious weeds, control woody vegetation, and prevent stump sprouting. These activities are not anticipated to have any permanent impacts to vegetation outside of the transmission ROW along the length of the Corridor/Route. However, it may occasionally be necessary to trim or remove trees adjacent to the ROW that pose a hazard (danger trees) to the safe and reliable operation of the line. Management of danger trees would be very infrequent and have little, if any, effect on adjacent vegetative communities.

5.13.2.1.3 Substation Impacts to Vegetation

The proposed Roundup, Kummer Ridge, and Patent Gate substations would require the removal of all vegetation within the fenced area of the site (approximately 36 total acres), as each site would be converted to utility use. These substation sites are located in grassland, cropland, or scrub/shrub, thereby avoiding the clearing of woodland vegetation. Impacts to vegetation within the substation boundaries would be permanent.

5.13.2.1.4 Noxious Weeds

The introduction and spread of noxious weeds as a result of construction of the proposed Project would be possible through ground disturbance and transfer by equipment. North Dakota law (NDCC § 4.1-47-02) requires “that every person do all things necessary and proper to control the spread of noxious weeds.” Currently, Dunn and McKenzie Counties have county-level Weed Boards, which oversee and control efforts to eliminate the introduction and spread of noxious weeds. Precautions would be needed during construction to prevent the introduction and spread of noxious weeds, such as re-seeding of disturbed areas with certified seed that contains no viable noxious weed seeds, as well as the use of standard BMPs related to construction and re-vegetation practices within disturbed areas.

5.13.2.2 Wetlands

EO 11990, Protection of Wetlands, requires federal agencies to minimize the destruction, loss, or degradation of wetlands when providing federally undertaken, financed, or assisted construction and improvements, as well as other activities. Each agency shall avoid new construction located in wetlands unless "the agency finds (1) that there is no practicable alternative to such construction, and (2) that the Proposal includes all practicable measures to minimize harm to wetlands which may result from such use."

5.13.2.2.1 Corridor/Route Impacts to Wetlands

Impacts to NWI wetland areas associated with the proposed Project are not anticipated.

Table 5.13-5 displays potential wetland types and acreages within the Corridor/Route. Wetland data was determined using available NWI data. Prior to construction, wetland areas within the Corridor/Route would be delineated to minimize the Project's impacts to the wetland areas.

Table 5.13-5: NWI Wetland Acres within Corridor/Route

Wetland Type	Wetland Acres in Corridor/Route
PEM	7.2
PSS	0.3
Lake	0.0
Pond	0.4
Riverine	0.0
PUS	0.0
Total	**7.9**

PEM = palustrine emergent, PSS = palustrine scrub/shrub
PUS = palustrine unconsolidated shore
Source: NWI Geographic Information System (GIS) data layer

No structures would be placed within any wetlands within the Corridor/Route, and no clearing of wetland vegetation is anticipated within the ROW. BMPs would be employed to minimize impacts to wetlands within the ROW during construction. Basin Electric would coordinate with the USACE to determine any permitting requirements and conditions necessary for construction involving wetlands within the Corridor/Route. No impacts to wetlands are anticipated during operation of the proposed Project.

5.13.2.2.2 Substation Impacts to Wetlands

No impacts to wetlands are expected from the construction of the proposed Roundup, Kummer Ridge, or Patent Gate substations. No NWI wetlands are located within the boundaries of either substation site, and

no wetlands would need to be crossed for access to either site for construction. BMPs would be used to minimize soil erosion and runoff during construction to prevent sedimentation into any nearby wetlands.

5.13.2.3 Wildlife

The Corridor/Route would cross a variety of different habitat areas used by a diverse assemblage of wildlife species. Although construction would result in minor changes in habitat composition for lands within the ROW, Project-related impacts would largely be temporary and short-term, limited to the construction period and times when workers and equipment are regularly present. Potential impacts relevant to wildlife during the construction phase of the proposed Project may include:

- Temporary disturbance to wildlife within and near the transmission ROW during construction due to human intrusion, noise, and construction activity
- During ROW clearing, disturbance or removal of vegetation that is used as food, shelter, or cover for wildlife species
- Introduction of sediment into aquatic ecosystems during construction
- Potential exposure to contaminants, such as fuels and chemicals, used during construction
- Permanent loss of habitat, particularly wooded areas, shelterbelts, windbreaks, and fencerows

Potential impacts, both temporary and permanent, are discussed for specific wildlife types in the following sections.

5.13.2.3.1 Big Game

Species such as mule and white-tailed deer, elk, pronghorn antelope, and bighorn sheep would experience a potential loss of forage due to the clearing and disturbance of vegetation within the Corridor/Route. In most instances, this loss would be insignificant, and available habitat and forage adjacent to the ROW would be abundant and sufficient for these species until construction was completed and vegetation within the ROW became re-established. Increased human activity and noise associated with the construction of the proposed Project would temporarily displace big game species in the ROW area; however, during breaks in construction efforts (such as between structure placement and conductor stringing) and upon completion of construction, these species would be expected to move back into the ROW and adjacent areas.

Specific, sensitive areas used by certain big game species, such as lambing areas for bighorn sheep, are located within areas of the Little Missouri River badlands within the LMNG and adjacent private lands. However, these areas are outside the Study Corridor. Although habitat within the ROW may be changed

or modified from its current condition, big game calving and lambing activities would not be adversely impacted by construction. Following construction, the ROW would provide habitat not dissimilar to that currently present in the area and within existing utility ROWs. No changes in big game use of the area are anticipated.

5.13.2.3.2 Nongame Species

Potential impacts to nongame species, such as small mammals, reptiles, and amphibians, resulting from construction of the proposed Project would include temporary loss of habitat within the ROW in grassland and agricultural areas.

Permanent impacts to existing habitat would occur in areas where woodland would be cleared within the ROW. Additionally, some mortality of less-mobile or burrowing species may occur from construction vehicles or equipment within the ROW during construction. Although some nongame species would be temporarily displaced during construction of the transmission line, permanent displacement of these species is not anticipated, except potentially in cleared forest areas, which may no longer provide suitable habitat for some species. Suitable forest habitat would be available in other areas near or adjacent to the Corridor/Route, and any loss of woodland would be minimal, with abundant woodland areas still available along the line for refuge during construction and as habitat during Project operation.

Long-term habitat fragmentation is not anticipated due to the relatively open terrain and limited large-tract forested areas. Generally, only a 150-foot wide ROW would be cleared in forested areas and that would not create a barrier to forest-dwelling species.

5.13.2.3.3 Birds

The MBTA (16 USC 703-712), makes it unlawful to take, kill, or possess migratory birds. The MBTA defines “take” as

> “to pursue, hunt, take, capture, kill, attempt to take, capture, or kill, possess, offer for sale, sell, offer to barter, barter, offer to purchase, purchase, deliver for shipment, ship, export, import, cause to be shipped, exported, or imported, deliver for transportation, transport or cause to be transported, carry or cause to be carried, or receive for shipment, transportation, carriage, or export, any migratory bird, any part, nest, or eggs of any such bird, or any product, whether or not manufactured, which consists, or is composed in whole or part, of any such bird or any part, nest, or egg thereof.”

Habitat disturbance or alteration, human disturbance, and collisions with transmission lines may result in impacts to migratory species.

Raptors, waterfowl, and other bird species may be impacted by the construction and operation of the proposed Project. Temporary impacts to raptors and waterfowl species may occur during construction of the proposed Project. Foraging areas for these species would be temporarily disturbed during ROW clearing and general construction activities. Golden eagles, protected under the BGEPA, commonly use native grassland within the proposed Project area for foraging and nesting. An aerial survey was done in April 2013 and 2014 in accordance with the guidance provided in the USFWS Eagle Conservation Plan Guidance (USFWS, 2013) and the USFWS Inventory and Monitoring Protocols (Pagel et al, 2010). The survey included the Project and the area within 1 mile of either side of the Corridor/Route. Historic nest locations provided by the NDGFD were surveyed for nest status and condition. A total of 144 raptor nests were recorded during this survey which covered the entire AVS-Neset Project, representing eight species of raptors. Of these nests, only eight nests were within 1 mile of Phase I of the Project. There were two unoccupied, inactive golden eagle nests. One nest was in good condition and the other nest was in excellent condition. Five nests were made by an unknown raptor species. These five nests were unoccupied, inactive, and in good condition. The final nest was occupied by a red-tailed hawk and was in good condition. The full raptor nest survey is located in Appendix M. In coordination with the USFWS, Basin Electric would develop and implement a plan to protect any identified active nests from adverse effects during construction.

ROW clearing would occur outside of nesting season or, if during nesting season, additional nesting surveys would be completed. If nests are identified during the nesting survey work, an appropriate buffer for clearing and construction activities would be set in accordance with the protection measures identified in the Biological Assessment (BA; Appendix O) and the Biological Opinion (Appendix R).

Upon completion of construction, grassland species would be expected to return to the area as grassland is restored and construction disturbance ceases. Forest-dwelling species would move into neighboring forested areas adjacent to the ROW during construction and operation of the line. Species dependent on woodland habitat would experience a minor loss of habitat within the ROW. Any loss would be minimal compared to the areas of adjacent woodland and the minimal amount of clearing (approximately 5.5 acres of woodland along over 28 miles) that would be required.

The Project could result in avian collisions with the transmission line, particularly for larger, less maneuverable species and in areas of dense bird congregations. Under various conditions, including high wind, fog, or poor light conditions, avian collisions with the line may occur, generally with the overhead shield wire which is smaller and less visible than is the actual conductor. Migratory waterfowl would be especially susceptible to transmission line collisions where the proposed transmission line will be located

between agricultural areas (feeding) and wetland areas (roosting). Additionally, the Corridor/Route would be located entirely within the whooping crane migration corridor. Specific impacts to whooping cranes are discussed further in the Special Status Species section. All but 21.6 miles of the entire project will have the shield wire marked to reduce whooping crane and therefore other species potential collision risk.

Electrocutions would pose an additional concern for bird species, particularly for raptors which commonly use transmission structures for perching while searching for prey, feeding, resting, or even nesting. However, the likelihood of electrocution from the proposed Project is minimal. Transmission lines are generally not responsible for bird electrocutions as the conductors are separated far enough apart to prevent birds with outstretched wings from enabling the current to arch between lines through the bird, resulting in an electrocution. Additionally, Basin Electric would design the proposed Project to meet the requirements for the protection of avian species from electrocution and line strikes according to the guidelines in the Avian Power Line Interaction Committee's "Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2012" (APLIC, 2012).

5.13.2.3.4 Aquatic Species

Since no transmission structures would be placed in any body of water along the course of the Corridor/Route, direct construction-related impacts to fish and other aquatic species would not occur. BMPs would be used to prevent soil erosion and runoff, sedimentation, water quality changes, and contamination of water from herbicides, fuels, and other spills. In some instances, culverts would be installed across intermittent streams to provide access to the ROW for construction vehicles. Clearing of vegetation along stream banks may cause a local increase in water temperature due to increased levels of sunlight warming the water, potentially changing the aquatic habitat in these areas.

5.13.2.3.5 Substation Impacts to Wildlife

Construction of the proposed Roundup, Kummer Ridge, and Patent Gate substations would require the removal of all vegetation within the fenced boundary of the sites. Impacts to wildlife during construction would be similar to those incurred during construction of the transmission line. Loss of vegetation in these fenced areas would be permanent, and any available wildlife habitat would be converted to utility use. The proposed substation sites would range from approximately 11 to 17 acres in size. These sites currently consist of grassland habitat, scrub/shrub, and cultivated crops. Land use in these areas is a mixture of grassland and tillable cropland. Wildlife species using any available habitat on the proposed substation sites would be displaced to available habitat adjacent to these sites.

5.13.2.4 Special Status Species

The Project area may contain habitat for, or has known occurrences of, federally endangered, threatened, and candidate species; USFS sensitive and MIS species; and North Dakota Species of Conservation Priority. These species are cumulatively referred to in this report as special status species.

According to the USFWS, the proposed Project counties may contain suitable habitat for, or has known occurrences of, five federally listed endangered animal species (the whooping crane, interior least tern, pallid sturgeon, black-footed ferret, and gray wolf); one federally listed threatened species (the piping plover); and four candidate or proposed species (the Sprague's pipit, Dakota skipper, northern long-eared bat, and Ruffa red knot). No federally listed endangered or threatened plant species are known to occur within the Corridor/Route, and no designated critical habitat is crossed.

USFS has identified 19 sensitive animal species in North Dakota that are known to occur in the Dakota Plains National Grasslands, which includes the LMNG. These include eight birds (Baird's sparrow, bald eagle, burrowing owl, greater prairie-chicken, greater sage grouse, loggerhead shrike, long-billed curlew, and Sprague's pipit); two mammals (black-tailed prairie dog and bighorn sheep); and nine species of butterfly (Arogos skipper, broad-winged skipper, Dakota skipper, mulberry wing, Ottoe skipper, Powesheik skipper, regal fritillary, and tawny crescent). USFS has also identified 38 sensitive / watch plants species in the LMNG. In addition, USFS requested that the EIS for the Project address two MIS species for LMNG: the black-tailed prairie dog and the plains sharp-tailed grouse.

Table 5.13-6 presents the Project considerations for federally listed special status species. Project-specific mitigation measures were developed as part of detailed species-specific evaluation in the BA for the Project (Appendix O), in consultation with USFWS.

Table 5.13-6: Potential Project Considerations for Federally Listed Special Status Species

Species	Potential Habitat in Corridor/Route	Comment
Endangered		
Whooping crane	Approximately 28.1 miles (entire length of Corridor/Route) of new line within migration corridor (Table 5.13-7)	Collisions with transmission lines pose highest potential risk, especially where line is located between wetland roosting areas and agricultural areas used for foraging. Habitat locations would be identified in the Project areas as a result of surveys to be completed for suitable habitat locations. Project-specific mitigation measures developed as part of detailed species-specific evaluation in the BA, in consultation with USFWS.
Interior least tern	None	Suitable habitat not crossed by Project.

Species	Potential Habitat in Corridor/Route	Comment
Pallid sturgeon	None	Suitable habitat not crossed by Project.
Black-footed ferret	None	No populations known to exist in counties crossed by the project (USFWS, 2011a, K. Shelley, USFWS, pers. comm.); surveys for prairie dog towns would be conducted prior to construction to identify potential habitat for black-footed ferret.
Gray wolf	None	No populations known to exist within the Project area
Threatened		
Piping plover	None	Suitable habitat not crossed by Project. No populations known to exist within the Project area
Candidate and Proposed		
Sprague's pipit (also a USFS sensitive species)	Approximately 282.5 acres of potential grassland habitat within Corridor/Route	Potential temporary disturbance to grassland habitat within ROW; grassland habitat re-established upon completion of construction. Project-specific mitigation measures developed as part of detailed species-specific evaluation in the BA, in consultation with USFWS.
Dakota skipper (also a USFS sensitive species)	Approximately 282.5 acres of potential grassland habitat within Corridor/Route	Potential temporary disturbance to native grassland habitat within ROW; grassland habitat to be re-established upon completion of construction. Project-specific mitigation measures developed as part of detailed species-specific evaluation in the BA, in consultation with USFWS.
Northern long-eared bat	None	Potential collisions with overhead lines, permanent loss of habitat through clearing of woodland. Project-specific mitigation measure developed as part of detail species-specific evaluation in the BA, in consultation with USFWS.
Rufa red knot	None	Potential collisions with overhead lines. Project-specific mitigation measure developed as part of detail species-specific evaluation in the BA, in consultation with USFWS.

5.13.2.4.1 Whooping Crane Migration Analysis

Although critical habitat for the whooping crane has not been designated within the Study Corridor, the Project is within the whooping crane migration corridor. This migration corridor provides the area within which whooping cranes are most likely to occur during spring and fall migration periods. The center of the corridor represents the core of the area followed by the cranes. The wider the corridor, the more likely

cranes would occur within the corridor area considered. However, as the corridor widens out, the likelihood of crane occurrence decreases with distance from the migration corridor core.

As cranes move east and west along the migration corridor in search of food, water, and roosting areas, they may venture outside the core of the migration corridor, potentially occurring in these fringe areas of the corridor. While crane occurrence at any particular location within the corridor would vary from year to year based on weather conditions and associated availability of water and wetlands and crop stages, over time, the greatest crane occurrence and use would trend toward the core of the migration corridor.

Table 5.13-7 displays the length in miles that the Corridor/Route would occur within each whooping crane percent occurrence migration corridor. Although migration can be highly variable, this data provides an indication of the probability of whooping crane occurrence along the Corridor/Route.

Table 5.13-7: Whooping Crane Percent Migration Corridor

	Length Through Whooping Crane Percent Migration Corridors (miles)					
	75%	**80%**	**85%**	**90%**	**95%**	**Total**
Project Corridor/Route	0.0	28.1	0.0	0.0	0.0	**28.1**

Source: USFWS Whooping Crane Percent Migration Corridor, as depicted in Figure 5.13-6

Whooping cranes are highly dependent on wetlands during migration for roosting, resting, and feeding and have been known to use wetland areas within the Project counties. Wetland acres were quantified within 1 mile of the Corridor/Route as a measure of the likelihood of whooping cranes to utilize the area near the Project. The Corridor/Route would be located within 1 mile of 326.6 acres of NWI wetlands. Further analysis of potential whooping crane habitat was conducted through a Resource Selection Function (RSF) analysis. The result of this analysis is provided in Appendix O, Biological Assessment. This analysis depicts the probability of stopover likelihood to help identify areas of greatest risk or concern for the crane during migration.

5.13.2.4.2 Surveys for Species under USFWS Jurisdiction

Coordination has occurred with USFWS to determine the level of investigations required to provide information for the BA prepared for this Project. As a result of that coordination and preparation of the BA, desktop reviews and field surveys were conducted in fall 2012 and spring 2013 for the following species.

Sprague's Pipit

A GIS analysis will be done utilizing the ND GAP Analysis land cover data as the basis for identification of grasslands with native prairie components. From these data, an analysis will be done to identify larger blocks of native prairie, which could constitute possible Sprague's pipit habitat. A presence survey for Sprague's pipit will be conducted in native grasslands greater than 72 acres prior to initiating construction activities in areas identified as habitat for the species, if construction activities are to be done during the nesting season (April 15 through August 1).

Piping Plover

Licht (2001) stated that the size of natural wetlands used by piping plovers in North Dakota ranged from three to 2,576 hectares (ha). Based on NWI data, there are over 1,270 wetland basins within a half mile on either side of the total proposed Corridor/Route alignment. Two non-riverine, wetlands approximately three ha or greater are crossed by the proposed project. These non-riverine wetland areas would be surveyed prior to construction, if construction is to occur from April 1-August 31 in these areas, to confirm if these locations are occupied or not by piping plovers.

Raptor Nest Surveys

A survey for raptor nests within a 2-mile wide survey corridor (1 mile on either side of the Corridor/Route centerline) will be conducted in spring 2016. A second survey of the area for raptor nests may be conducted later in spring 2016 to determine occupancy of the nests. Should it be necessary, due to the construction schedule, additional surveys may be conducted in the spring of 2017.

Nesting Migratory Birds

A survey for nesting migratory birds would be conducted in spring 2016 within the ROW in those areas where construction has not started but would occur during the nesting season. Follow up surveys would be conducted as necessary based on the progress of construction.

No surveys would be required for other species under the jurisdiction of USFWS.

5.13.2.4.3 U.S. Forest Service Sensitive and Management Indicator Species Surveys

Coordination with the USFS Dakota Prairie Grasslands office (USFS, 2012b) resulted in USFS providing a list of sensitive wildlife species. However, the Corridor/Route does not cross any LMNG and no Special Use Permit (SUP) to cross USFS lands would be required.

5.13.2.4.4 Proposed Substations

No special status species or habitat for these species is known to occur within the site boundaries for any of the three proposed substations. Impacts on special status species resulting from construction and operation of these sites would not occur.

5.13.3 Mitigation

- Basin Electric and its contractors would restore any new construction-related temporary access roads to the natural condition of the surrounding area after construction is completed.
- Basin Electric and its contractors would re-vegetate disturbed areas outside of the substations and within the ROW using native vegetation and certified weed-free seed and mulch to protect native vegetation and wildlife habitat.
- To prevent the spread of undesirable plants from one area to another, Basin Electric and its contractors would inspect equipment for seeds and other vegetative material and power-wash prior to transport to new areas.
- Basin Electric and its contractors would coordinate with the Commission to determine appropriate mitigation for the vegetation removed. Typically, for these types of projects, the tree and shrub vegetation is replaced at a ratio of 2:1, reducing the overall loss of these vegetation types over time. The tree replacement plan is included in Appendix Q.
- Basin Electric and its contractors would coordinate with USACE and the State of North Dakota to obtain the necessary permits if impacts on wetlands, streams, or other waterbodies are unavoidable.
- Basin Electric and its contractors would avoid wetland areas while accessing the ROW during construction. Design and install temporary low-water crossings or culverts, if needed, so as not to inhibit fish passage, or create upstream or downstream habitat changes.
- Basin Electric and its contractors would conduct raptor and migratory bird surveys along and adjacent to the proposed transmission line route prior to construction. Coordinate with USFWS and NDGFD to develop and implement a plan to protect any identified nests from adverse effects during construction. Coordinate with USFWS to implement an appropriate Avian Protection Plan for operation of the transmission line.
- Basin Electric and its contractors would design the proposed Project to meet the requirements for the protection of avian species from electrocution and line strikes, according to the guidelines in the Avian Power Line Interaction Committee's "Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006" (APLIC, 2012).

- Basin Electric and its contractors would coordinate with NDGFD regarding sharp-tailed grouse habitat. Structures will not be placed within 0.25 mile of active lek sites. In addition, consult with USFWS and NDGFD prior to construction within a 2-mile radius of an active lek during the period of March 1 through June 15.
- Basin Electric and its contractors would coordinate with USFWS to avoid construction in designated critical habitat during the piping plover nesting season (mid-April to mid-August) and in interior least tern nesting habitat during the nesting season.
- Basin Electric and its contractors would implement measures identified in the BA for the protection of sensitive species, including:
  - Survey of potential piping plover habitat if construction would occur in these areas between April 1 and August 31. No construction would occur in these areas if nesting piping plovers are present.
  - Construction activities within grassland areas greater than 72 acres will be limited to outside the April 15 to August 1 time frame. If construction activities are required to occur within this period, surveys for Sprague's pipit will be conducted ahead of construction in grasslands greater than 72 acres to determine occupancy of the action area. If action area is found to contain Sprague's pipit, no construction would occur within 958 feet of the occupied parcel except if the proposed construction is on the opposite side of a current disturbance (e.g. road).

5.14 Summary of Corridor/Route Impacts

The construction and operation of Basin Electric's proposed Project could have a potential impact on environmental and human resources located in northwestern North Dakota. A summary of potential impacts and mitigation by resource is located in Table 5.14-1.

Table 5.14-1: Summary of Project Impacts and Mitigation

Resource	Corridor/Route		Substations		Mitigation
	Permanent Impacts	Temporary Impacts	Permanent Impacts	Temporary Impacts	
Socioeconomics	Economic benefit to businesses and surrounding communities from increased electrical capacity and reliability. Potential changes in property values. Property tax revenues of $4,515 annually to Project counties.	Economic benefit to local communities during construction as a result of construction crews generating local revenue.	Economic benefit to businesses and surrounding communities from increased electrical capacity and reliability. Potential changes in property values.	Minor economic benefit to local communities during construction as a result of construction crews generating local revenue.	• The construction contractor, after assessing utilization of existing housing availability, should plan to establish its own housing in the form of man camps and/or RVs brought in from outside the region to a number of locations secured by the contractor. • Work with agricultural producers to minimize disruptions during the harvest season and to limit the impact on the farmers' ability to maneuver equipment in the vicinity of the immediately affected area. • Work with individual landowners to try to coordinate the timing of construction to minimize short-term impacts on agriculture. • Initiate discussions with local fire and police districts prior to construction and work with the districts and other appropriate emergency response providers to develop fire and emergency response plans.
Land Use	511.2 acres of ROW would be required and would be restricted from some types of future development. Approximately 0.1 acre of soil (0.0009-acre per structure) would be permanently removed.	Loss of use for landowners within ROW on private lands during construction. Access restrictions and/or loss of use within ROW during construction on state or federal	36 acres would be permanently converted from agriculture use to utility use.	Construction-related impacts such as increased noise and dust on surrounding agricultural lands.	• Coordinate with landowners for potential measures to minimize Project impacts on uses on specific properties. • Coordinate with appropriate state land management agencies to obtain appropriate permits and easements for portions of the Corridor/Route traversing public lands.. • Obtain the appropriate permits as necessary to comply with county and township zoning ordinances. • Plan and conduct construction activities to minimize temporary disturbance, displacement of crops, and interference with agricultural activities. • Restore compacted cropland soils as close as possible to

Resource	Corridor/Route		Substations		Mitigation
	Permanent Impacts	Temporary Impacts	Permanent Impacts	Temporary Impacts	
	36 acres of land would be required for construction of new substations and require permanent conversion from agricultural uses to a utility use. Corridor/Route would include state and federal properties. Corridor/Route would include approximately 36.4 acres of school trust lands.	properties. Disturbance from heavy equipment may result in some crop loss during construction.			pre-construction conditions using tillage. • Compensate landowners for any new land rights required for ROW or access road easements. • Compensate landowners at market value for any new land rights required for ROW easements or acquired for new temporary or permanent access roads on private lands. This should include compensation at market values for agricultural production lost during the construction period.
Infrastructure-Transportation	No long-term effects on utility infrastructure are anticipated. No long-term effects on transportation are anticipated. Potential impacts on airports within 10 nautical miles would be avoided through	Existing utility infrastructure would be traversed during construction activities and may be temporarily taken out of service. Some temporary road closures are	No effect	Short-term interruption of existing transmission lines during construction activities may result in minor temporary impacts. The introduction of material haul trucks and road closures during	• Time conductor stringing across North Dakota State Highway 1806 and ND State Highway 23 to avoid peak traffic, in consultation with NDDOT. • Mark a detour route, if required by NDDOT, and provide traffic information to motorists in advance of the detour, consistent with the Manual on Uniform Traffic Control Devices (Federal Highway Administration, 2012). • Coordinate with townships, counties, and NDDOT to redress any road damage related to construction of the Project. • Coordinate with FAA to avoid or minimize impacts on local aircraft facilities.

Resource	Corridor/Route		Substations		Mitigation
	Permanent Impacts	Temporary Impacts	Permanent Impacts	Temporary Impacts	
	coordination with FAA.	likely during construction activities and may result in short-term adverse impacts.		construction activities may result in short-term adverse impacts.	• Identify existing utilities and coordinate with the owners to implement appropriate measures to protect both facilities and construction workers during crossings.
Public Health and Safety	Long-term adverse effects expected to be negligible to minor. EMFs would be well-below identified thresholds to protect the public. The operation of farm equipment near proposed structures could result in unnecessary contact and/or damage to machinery and/or operators. Standard operating and safety procedures would be employed to deliver services safely.	Hazardous and/or potentially hazardous materials may be encountered during construction, or exposure to energized transmission lines. These impacts are likely to be minor with the implementation of construction plans that focus on worker safety, proper handling of hazardous materials, and spill cleanup.	Long-term adverse effects are expected to be negligible to minor.	Hazardous and/or potentially hazardous materials may be encountered during construction. Impacts on public health and safety are likely to be minor with the implementation of construction plans that focus on worker and public safety, proper handling of hazardous materials, and spill cleanup.	• Prepare a construction plan in accordance with the National Electrical Safety Code and the Occupational Safety and Health Administration's regulations, as required by federal law, to coordinate safety procedures for construction workers. This would also identify procedures should a spill occur or hazardous materials be discovered. • Construct the proposed Project with materials designed to contain electric currents and meet high safety standards. • Employ standardized agency procedures should the transmission line need maintenance or repairs. Standardized agency procedures can help increase the safety of both workers and those in the surrounding area. • Additional measures, such as those identified in Appendix G, are designed so that Basin Electric's operational procedures adhere to a high standard of safety for workers and others close to the construction and operation of the proposed Project.

Resource	Corridor/Route		Substations		Mitigation
	Permanent Impacts	Temporary Impacts	Permanent Impacts	Temporary Impacts	
Air Quality	Potential increase in GHG levels as a result of the operation of the transmission line.	Increases in fugitive dust caused by construction activity, vehicles, and equipment. Increased emissions from construction vehicles and equipment.	Potential increase in GHG levels as a result of the operation of the substations.	Increases in fugitive dust caused by construction activity, vehicles, and equipment. Increased emissions from construction vehicles and equipment	• Use water on roads and disturbed areas to minimize dust. • Re- seed vegetation in disturbed areas outside of the substation/switchyard to prevent wind-blown dust from areas devoid of vegetation. • Implement vehicle idling and equipment emissions requirements, such as establishing operating policies that limit idling time and mechanical modifications to the vehicles that restrict the amount of idle time. • Encourage carpooling and the use of shuttle vans among construction workers to minimize construction-related traffic and associated emissions. • Locate staging areas as close to construction sites as practicable to minimize driving distances. • Locate, where possible, staging areas in previously disturbed or graveled areas to minimize new soil and vegetation disturbance where practicable. • Encourage the use of proper size equipment to maximize energy efficiency. • Use alternative fuels, such as propane or solar, for generators at construction sites or use electrical power, where practicable. • Recycle or salvage non-hazardous construction and demolition debris where practicable. • Dispose of wood debris (burning) in the local area where practicable. • Use local rock sources for road construction where practicable.

Resource	Corridor/Route		Substations		Mitigation
	Permanent Impacts	Temporary Impacts	Permanent Impacts	Temporary Impacts	
Noise	No effect.	Increases in noise levels along the Corridor/Route from construction vehicles and equipment.	No effect.	Increases in noise levels for nearby residences during construction of the substations.	• Use equipment with sound-control devices no less effective than those provided on the original equipment. • Would not use equipment with an un-muffled exhaust. • Would not conduct noise-generating construction activity within 1,000 feet of a residential structure between the hours of 10 p.m. and 7 a.m. • Would take measures to restore the reception to a quality as good as or better than before the interference if the proposed transmission line is found to be the source of radio or television interference in areas with reasonably good previous reception during operation.
Visual	Change in the visual characteristics and viewshed within Project area and for residents located near the transmission line	Visibility of construction vehicles and equipment along Corridor/Route.	Additional visual element added to the landscape.	No effect.	• Would leave (where possible) plants smaller than 8 feet in height within the 150-foot-wide ROW to help reduce the effect of the ROW on visual and aesthetic resources. • Would remove construction debris and other litter from the ROW to minimize visual intrusion to the surrounding landscape. • Would re-vegetate disturbed non-cropland areas of the ROW promptly following construction to reduce visual contrast of ROW within adjacent areas.
Cultural	No adverse effects on NRHP-eligible cultural resources. Based on the Class I cultural resources investigation conducted for the Project, known sites	No adverse effects on NRHP-eligible cultural resources.	No adverse effects on NRHP-eligible cultural resources.	No adverse effects on NRHP-eligible cultural resources.	• Would finish the Class III cultural resource inventory of the Project APE prior to construction and develop mitigation measures where required. • Would span and protect known archaeological sites within the Corridor/Route from disturbance during construction. • Would develop protocol to reduce opportunities for construction workers to collect or disturb discovered

Resource	Corridor/Route		Substations		Mitigation
	Permanent Impacts	Temporary Impacts	Permanent Impacts	Temporary Impacts	
	have been avoided; a portion of the Corridor/Route has been surveyed at the Class III level. The rest of the Corridor/Route would be surveyed and any cultural resource sites would be avoided.				cultural resources. • Develop an Unanticipated Discovery Plan to provide guidance on how to proceed if a previously unknown archaeological or historic resource or human remains are encountered during construction or operation of the Project, including contact of the SHPO, participating tribes as appropriate, and designated representatives of Western and RUS for further evaluation (Appendix D).
Recreation	Approximately 36.4 acres of state land open to dispersed recreational activities such as hunting would be located within the Corridor/Route.	Increased noise, dust, and traffic congestion in recreational areas. Temporary access restrictions during construction on public use areas.	Conversion of land for substations would remove it from further land use, including recreational use. Substations would occupy 36 acres, total.	Increased noise, ground disturbance, access restrictions, and human activity may impede hunting activities around the substation sites.	• Impacts on recreation would largely be associated with changes in viewsheds and general recreational experiences from the presence of the Project. Mitigation measures for viewsheds are described under Aesthetics and Visual Resources. • Recreation would be impacted in the short term by noise and dust from construction activities, equipment, and vehicles; construction-related traffic; and the presence of construction crews. Mitigation measures for these impacts are described under Geology and Soils; Infrastructure and Transportation; and Noise.
Soils and Farmland	Approximately 0.1 acre of soil (0.0009-acre per structure) would be permanently removed. Farmland	Approximately 48 acres (0.29-acre per structure) of temporary soil disturbance	Any farmland within the substation sites would be	No effect.	**Soils:** • Would confine construction activities to the Corridor/Route and around structure locations for placement of the transmission structures. • Would stockpile any topsoil removed during any required

Resource	Corridor/Route		Substations		Mitigation
	Permanent Impacts	Temporary Impacts	Permanent Impacts	Temporary Impacts	
	for crop production permanently impacted only at structure locations	during construction within Corridor/Route, with temporary loss of crop production.	permanently converted to utility use.		leveling of structure sites nearby and replace it following construction. • Would re- grade disturbed ground to as close to pre-construction condition as appropriate for stabilization and re-vegetated or approved for tillage depending on pre-construction land use. • Would locate the construction laydown areas required for the proposed Project at previously disturbed or developed locations, such as vacant lots or agricultural lands, where feasible. • Would place construction materials on pallets or cribbing within the designated laydown areas. • Would return laydown areas to pre-construction condition upon completion of the Project. **Farmland:** • Would compensate landowners for crop damage that may occur as a result of construction and operation of the proposed Project. • Would redress compaction or other construction-related issues that could affect soil productivity and agricultural operations.
Geology and Landforms	Displacement of 247,500 cubic feet of soil and rock during structure foundation borings and construction	Potential for erosion on steeper slopes during construction.	No effect.	No effect.	• Would conduct geotechnical assessments at structure locations to develop a process or approach to minimize the potential development of landslides in susceptible areas during construction. • Would span identified landslide areas and avoid placing structures within susceptible landslide areas.

Resource	Corridor/Route		Substations		Mitigation
	Permanent Impacts	Temporary Impacts	Permanent Impacts	Temporary Impacts	
					• Would prepare a SWPPP for construction activities prior to construction.
Water	No effects anticipated. Three perennial waterways and no FEMA-designated floodplain crossed; all would be spanned. Natural floodplain would be crossed with structure placement.	Potential sedimentation and runoff caused by construction.	No effect.	No effect.	• Would clean up any spills or equipment leaks promptly to prevent materials from entering surface water. • Would appropriately contain and store materials such as fuel, lubricants, and solvents. • Would span floodplains to the extent possible to avoid potential impacts. • Would plant or seed non-agricultural areas that were disturbed during construction; use native seed mixes from the indigenous plants, and plant indigenous species located in the immediate disturbed soil area; coordinate seeding and/or plantings efforts at a time congruent with seeding and growth of the area, not during a time that would preclude germination or rooting. • Would remove excavated material and other debris from flood-prone areas to maintain storage volumes and prevent introduction of debris that may lead to clogged culverts or bridges, resulting in changes to water flow and flood patterns. • Would locate structures and disturbed areas away from rivers and lakes, where practicable. • Would install sediment control measures prior to construction in accordance with plans and permits including: mulch produced through the chipping of removed trees; soil berms; and partially burying logs along the ROW. • Would use wastewater and stormwater control measures

Resource	Corridor/Route		Substations		Mitigation
	Permanent Impacts	Temporary Impacts	Permanent Impacts	Temporary Impacts	
					to meet the effluent limits prior to discharging from construction sites to surface waters. • Would avoid the use of fertilizers, pesticides, or herbicides in or near surface waterbodies. • Would fuel construction vehicles away from surface waterbodies and use appropriate spill prevention and containment procedures. • Equipment washing, storage of petroleum products, lubricants, solvents and hazardous materials, structure sites, and other disturbed areas would be located at least 100 feet from rivers, streams (including ephemeral streams), ponds, lakes, and reservoirs, where practical, by Basin Electric and its contractors. This includes construction vehicles and heavy equipment when parked overnight or longer. • ROW access roads would be located at least 100 feet from rivers, ponds, lakes, and reservoirs, where practical. • If the banks of ephemeral stream crossings are sufficiently high and steep that breaking them down for a crossing will cause excessive disturbance, culverts would be installed by Basin Electric and its contractors using the same measures as for culverts on perennial streams
Biological Resources	Vegetation: Approximately 5.5 acres of woodland removed within Corridor/Route,Less than 1 acre of	Vegetation: Disturbance of vegetation within the Corridor/Route and along	Vegetation: All vegetation removed from 12-acre sites and	Vegetation: No effect. Wildlife: Disturbance to nearby species due to	• Would restore any new construction-related temporary access roads to the natural condition of the surrounding area after construction is completed. • Would re-vegetate disturbed areas outside of the substations and within the ROW using native vegetation

Resource	Corridor/Route		Substations		Mitigation
	Permanent Impacts	Temporary Impacts	Permanent Impacts	Temporary Impacts	
	vegetation permanently removed within Corridor/Route at structure locations. Potential introduction of noxious weeds within Corridor/Route to be avoided by weed mitigation measures. Wildlife: Loss of forested habitat due to removal of 5.5 acres of woodland within the Corridor/Route. Some mortality of small, less-mobile species. Potential avian species collisions with power lines. Aquatic Resources: Change in local aquatic habitats in areas where vegetation is	access roads during construction. Natural Heritage Inventory sensitive ecological community potentially impacted. Wildlife: Disturbance within and near the Corridor/Route during construction due to human intrusion, noise, and construction activity. Temporary loss of habitat due to vegetation clearing within ROW during construction. Aquatic Resources: Potential for	converted to utility use. Wildlife: Loss of habitat within the 36 acres occupied by sites as these are converted to utility use. Aquatic Resources: No effect. Special Status Species: No effect. Wetlands: No effect.	construction activities. Aquatic Resources: No effect. Special Status Species: No effect. Wetlands: Potential sedimentation and runoff caused by construction near wetlands located near substation sites.	and certified weed-free seed and mulch to protect native vegetation and wildlife habitat. • To prevent the spread of undesirable plants from one area to another, Basin Electric and its contractors would inspect equipment for seeds and other vegetative material and power-wash prior to transport to new areas. • Would coordinate with the Commission to determine appropriate mitigation for the vegetation removed. Typically, for these types of projects, the tree and shrub vegetation is replaced at a ratio of 2:1, reducing the overall loss of these vegetation types over time. The tree replacement plan is included in Appendix Q. • Would coordinate with USACE and the State of North Dakota to obtain the necessary permits if impacts on wetlands, streams, or other waterbodies are unavoidable. • Would avoid wetland areas while accessing the ROW during construction. Design and install temporary low-water crossings or culverts, if needed, so as not to inhibit fish passage, or create upstream or downstream habitat changes. • Would conduct raptor and migratory bird surveys along and adjacent to the proposed transmission line route prior to construction. Coordinate with USFWS, USFS, and NDGFD to develop and implement a plan to protect any identified nests from adverse effects during construction. Coordinate with USFWS to develop an Avian Protection Plan for operation of the transmission line. • Would design the proposed Project to meet the requirements for the protection of avian species from electrocution and line strikes, according to the guidelines

Resource	Corridor/Route		Substations		Mitigation
	Permanent Impacts	Temporary Impacts	Permanent Impacts	Temporary Impacts	
	cleared along shoreline. Special Status Species: No adverse effect on listed species, pending implementation of approved measures in BA. Wetlands: No effect. All 7.9 acres of wetland (NWI) within Corridor/Route would be spanned. No structures placed in wetlands, and no wetland vegetation would be cleared.	sedimentation, runoff, and spills during construction to be avoided by use of BMPs. Special Status Species: Potential impacts to grassland habitat for Sprague's pipit and wetland habitat for piping plover within Corridor/Route during construction. Wetlands: Potential sedimentation and runoff caused by construction near wetlands.			in the Avian Power Line Interaction Committee's "Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006" (APLIC, 2012). • Would coordinate with USFWS and NDGFD regarding sharp-tailed grouse habitat. Structures will not be placed within 0.25 mile of active lek sites. In addition, consult with USFWS, USFS, and NDGFD prior to construction within a 2-mile radius of an active lek during the period of March 1 through June 15. • Would coordinate with USFWS to avoid construction in designated critical habitat during the piping plover nesting season (April 1 to August 31). • Would limit construction in grasslands greater than 72 acres to outside the April 15 to August 1 time frame or survey for Sprague's pipit ahead of construction in grasslands greater than 72 acres to determine occupancy of the action area. If action area is found to contain Sprague's pipit, no construction would occur within 958 feet of the occupied parcel except if the proposed construction is on the opposite side of a current disturbance (e.g. road) • Implement measures identified in the BA.

6.0 PUBLIC AND AGENCY COORDINATION

Several public participation activities were conducted as part of this Project. These included:

- Agency and the public were notified about the proposed Project;
- Public announcements about the proposed Project were made in the Federal Register, in the local newspapers, on local radio stations, and through mailings to Project stakeholders;
- Informational scoping meetings were held for agencies and the general public; and
- Comments were received from the several agencies and the public.

The purpose of the public participation process was to gain input about any potential concerns and identify issues that needed to be addressed in the EIS. During this public participation scoping process, contact was made with federal agencies, tribal representatives, state agencies, local officials and the general public. More detail about public participation can be found in the AVS to Neset 345-kV Transmission Project Scoping Report on the RUS website at http://www.rurdev.usda.gov/USP-AVS-Neset.html.

6.1 Initial Project Coordination

Basin Electric made informal contact with various local, state, and federal officials during the early stages of defining the proposed Project. As the Project materialized into a specific type of solution to satisfy the needs of the area, letters that described the proposed Project were sent to various local, state, and federal agencies and requested that any concerns be identified. The Notice of Intent (NOI) informing the public that RUS was intending to prepare an EIS for the proposed Project was published in the *Federal Register* on November 2, 2011.

6.2 Agency Scoping

A second set of letters for the Project was sent by RUS to federal, state, and local agencies; tribal representatives; and organizations and persons that had requested to be on the mailing list for Western or Basin Electric. The agency scoping meeting was conducted on November 14, 2011, in Bismarck, North Dakota, with 12 agencies having representatives in attendance. The agencies represented were:

- Little Missouri Scenic River Commission.
- National Park Service (NPS).
- NDDOH.
- North Dakota SHPO.
- North Dakota Department of Trust Lands.

- North Dakota Transmission Authority.
- USACE.
- USDA-RUS.
- USDA-NRCS.
- USFS.
- USFWS.
- Western.

6.3 Public Scoping

Letters, radio public service announcements, and newspaper advertisements announcing the proposed Project, and the scoping meeting location and times were distributed prior to the public scoping meetings. One meeting was conducted in Williston, North Dakota, on November 15, 2011, and a second meeting was conducted in Killdeer, North Dakota, on November 16, 2011.

6.4 Comments

A total of 38 comment sheets and letters were received during the scoping comment period. Several of the comment sheets and letters identified multiple topics that resulted in the 62 comments in the categories identified below.

Topic (number of comments):

- Air Quality (2).
- Aesthetics (4).
- Conservation (21).
- Environmental justice (1).
- Project information/communication (5).
- Need for the Project (2).
- Noise (1).
- Property values (2).
- Route alternatives (10).
- Vegetation (2).
- Water (3).
- Wildlife (9).

The key issues identified during the EIS comment process were primarily related to the visual impacts and general disturbance to the natural areas along the AVS to Neset alternative corridor that followed U.S. Highway 85 between the TRNP and USFS properties that was also part of the EIS which included this Project.

6.5 Additional Public Participation

Opportunities for public and agency input would occur during the duration of the Project as additional coordination occurs. A notice of availability of the Draft EIS was published in the *Federal Register* on December 7, 2012. Public hearings were subsequently held during the Draft EIS comment period in Killdeer on January 15, 2013, and in Williston on January 16, 2013. Approximately 30 comments were submitted to RUS on the DEIS during the public comment period that ended on January 22, 2013. A notice of available of the Supplemental DEIS was published in the *Federal Register* on December 20, 2013, followed by a public hearing held in Watford City on January 16, 2014. Approximately 45 comments were received during the public comment period which ended on February 3, 2014. The notice of availability of the Final EIS was published in the *Federal Register* on May 30, 2014. Eight comments were received during the 30-day comment period which concluded on June 30, 2014.

7.0 IDENTIFICATION OF REQUIRED PERMITS/APPROVALS

7.1 Permits/Approvals

Federal, state and local laws, regulations, and associated permits, approvals, and coordination that are applicable to the Project are listed in Table 7.1-1.

Table 7.1-1: Permits, Authorizations, and Consultation Required

Federal Agency	Permit, Regulation, or Consultation
RUS	• NEPA compliance (42 USC. 4321) • RUS Environmental Policies and Procedures (7 CFR. 1794)
Western	• NEPA compliance • National Historic Preservation Act (NHPA) (36 CFR. 800) - Section 106 consultation • Section 7 of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531-1544; 50 CFR 22 consultation) • Tribal consultation
USACE	• Clean Water Act (CWA) of 1977 Section 404 and 401 permits
USFWS	• Section 7 of the Endangered Species Act (ESA) consultation • Migratory Bird Treaty Act (MBTA) (16 U.S.C. 701-712) • Bald and Golden Eagle Protection Act (BGEPA) (16 USC 668; 50 CFR 22)
NRCS	• Farmland Protection Policy Act • Farmland Conversion Impact Rating (Form AD-1006)
U.S. Department of Agriculture-Farm Services Agency, North Dakota State Office	• Consultation regarding crossing of lands enrolled in the Conservation Reserve Program (CRP)
FAA	• Form 7460-1: Objects Affecting Navigable Airspace
NPS	• Consultation for National River Inventory (NRI) rivers (Little Missouri River) • National Trails System Act in 1978 [16 U.S.C. 1244 (a)(6)] consultation regarding Lewis & Clark National Historic Trail
EPA	• CWA Section 404 permit • CWA Section 402 compliance • Section 303(d) of CWA compliance, if applicable
Federal Highway Administration	• Permit to cross federal highways and interstate highways
State Agency or Other Permits	• **Permit, Regulation or Consultation**

NDDOT	Road crossing permits, highway access permits, utility permits
North Dakota Parks and Recreation Department (NDPRD)	• Consultation regarding visual impacts to Killdeer Mountain Four Bears Scenic Byway
North Dakota State Land Department	• ND School Trust Lands permit for easements on Trust Lands
North Dakota Public Service Commission	• Certificate of Corridor Compatibility and Route Permit
SHPO	• National Historic Preservation Act (NHPA) – Section 106 compliance
NDGFD	• Consultation to identify any State-listed species of concern • Noxious weeds
NDDOH	• Storm Water Pollution Prevention Plan (SWPPP) • Section 401 Water Quality Certification
Dunn and McKenzie Counties	• Conditional Use permit • County road encroachments • County Floodplain encroachments

8.0 FACTORS CONSIDERED

NDCC Section 49-22-09 of the North Dakota Energy Conversion and Transmission Facility Siting Act lists 11 factors to guide the Commission in evaluation of sites, corridors, and routes. The following sections address these factors where applicable to the Project Corridor/Route.

8.1 Available Research and Investigations Relating to the Effects of the Location, Construction, and Operation of the Proposed Facility on Public Health and Welfare, Natural Resources, and the Environment

Section 5.0 of this Application discusses the research and investigations relating to the effects of the proposed Project on public health and welfare, natural resources, and the environment. Section 5.0 includes a detailed discussion of the resources present within the Project area and a discussion of the potential effects and proposed mitigation in relation to the Corridor/Route. Basin Electric took into consideration impacts to important natural and human resources when selecting the Corridor/Route.

8.2 The Effects of New Energy Conversion and Transmission Technologies and Systems Designed to Minimize Adverse Environmental Effects

Basin Electric would utilize the most recent transmission technologies and systems that minimize impacts to the environment. Section 4.0 discusses the engineering and operational design of the Project and includes a discussion of the proposed structure types and construction techniques. These technologies and techniques are the most appropriate technologies to minimize adverse environmental effects.

8.3 The Potential for Beneficial Uses of Waste Energy from a Proposed Energy Conversion Facility

This factor is not applicable to this Project.

8.4 Adverse Direct and Indirect Environmental Effects Which Cannot be Avoided Should the Proposed Site or Route be Designated

Unavoidable impacts are those that would occur after implementation of mitigation measures. In summary, construction and operation of the proposed Project would convert approximately 36.1 acres of land from agricultural uses to utility uses. This permanently converted acreage would represent a negligible portion (approximately 1 percent) of the cropland in the Study Corridor. The introduction of new transmission lines would permanently change the visual landscape of the Project area. Oil and gas development in the area has already introduced visual contrast to the natural landscape, and the introduction of a transmission line would likely be less noticeable because of the existing visual intrusions.

Other unavoidable impacts would occur due to increased traffic from construction personnel. As indicated in the air emission and transportation analyses, these temporary impacts would be minor and would not significantly affect the environmental quality of the area. Other environmental impacts of the proposed Project, such as construction traffic to access tower facilities, would produce impacts that are temporary in nature, and restoration of the natural landscape would occur following these temporary impacts. These relatively minor impacts to environmental resources would be offset to some degree by the societal benefit of better electrical service to western North Dakota. It is not possible to quantify this benefit, as individuals would weigh the tradeoffs differently and assign widely variable values to each resource.

8.5 Alternatives to the Proposed Site, Corridor, or Route Which are Developed During the Hearing Process and which Minimize Adverse Effects

As discussed in Section 1.0, alternatives to the proposed Corridor/Route were identified by Basin Electric and reviewed during various stages of the NEPA process carried out by RUS and/or Western. The AES and MCS prepared as part of the process were used to evaluate system alternatives for the proposed Project and to develop suitable macro-corridors for routing a transmission line within the Project area. The EIS included a detailed evaluation and comparison of alternative routes and a no action alternative. Through these processes, the Corridor/Route presented in this Application has been selected as the best location for the North Killdeer Loop transmission line route.

8.6 Irreversible and Irretrievable Commitments of Natural Resources Should the Proposed Site, Corridor, or Route be Designated

Irreversible resource commitments include damage to a resource that is not recoverable for use by future generations. The small size of the permanent footprint, approximately 36.1 acres, means that there would be minimal irreversible damage to regional natural resources. This would primarily involve the soil and agricultural property used for the structures and substations; restoration after the life of the transmission line would reduce these potential irreversible impacts.

Irretrievable resource commitments also include permanent losses of nonrenewable resources such as fossil fuels. Natural gas, energy, and non-recyclable materials used in construction and operation would represent irretrievable commitments of non-renewable resources that would not be available for use in other projects.

8.7 The Direct and Indirect Economic Impacts of the Proposed Facility

Section 5.1.2 includes a discussion of the direct and indirect economic impacts of the proposed Project. The Project would provide direct economic benefits of approximately $16.2 million in wages for

construction workers and indirect economic benefits of approximately $10.4 million in expenditures in the local communities by construction workers. Furthermore, the Project would provide induced economic benefits to businesses and the surrounding communities from increased electrical capacity and reliability.

8.8 Existing Plans of the State, Local Government, and Private Entities for Other Developments at or in the Vicinity of the Proposed Site, Corridor, or Route

As discussed in Section 5.2.2, the Project would be consistent with future land use development plans. All applicable zoning and land use approvals would be obtained for the proposed Project prior to construction. Basin Electric would also coordinate with USFWS, USACE, the North Dakota Department of Trust Lands, and other applicable agencies, regarding impacts to state and federal properties, as necessary.

8.9 The Effect of the Proposed Site or Route on Existing Scenic Areas, Historic Sites and Structures, and Paleontological or Archaeological Sites

Section 5.8.2 discusses the potential effects of the Project on cultural resources. One hundred percent coverage Class III surveys would occur on the Corridor/Route. A Class III survey of the proposed Roundup, Kummer Ridge, and Patent Gate substation sites did not identify any cultural resources present. Additional coordination with SHPO would be conducted regarding adverse effects to NRHP-eligible cultural resources within the Corridor/Route and the need for additional cultural resources surveys for the Project prior to construction.

8.10 The Effect of the Proposed Site or Route on Areas Which are Unique Because of Biological Wealth or Because They are Habitats for Rare and Endangered Species

Section 5.13.2 discusses the effects of the Project on biological resources, including wetlands, vegetation, wildlife, and special status species. Approximately 5.5 acres of woodland potentially would be removed within the Corridor/Route, resulting in a loss of forested habitat for some wildlife. Approximately 0.1 acre of vegetation would be permanently removed as a result of structure placement with the Corridor/Route. The Project would have no effect on wetlands, as all 7.9 acres of wetlands within the Corridor/Route would be spanned, and no structures would be placed in wetlands. Coordination with USFWS and NDGFD would continue regarding adverse effects of the Project on special status species. Section 7 Consultation on Endangered Species would be conducted as part of the EIS process, and any Reasonable and Prudent measures would be implemented.

8.11 Problems Raised by Federal Agencies, Other State Agencies, and Local Entities

State and federal agencies reviewed the Project area for concerns and provided comment as part of the EIS/NEPA process for the Project. Specific scoping agency comments and concerns, as well as coordination efforts, are discussed in detail under the applicable resource categories in Section 5.0. Comments on the DEIS were received from the public and agencies in late January 2013. Issues and responses from the public and agencies were submitted to support the Final EIS that was issued in May 2014.

9.0 QUALIFICATIONS OF CONTRIBUTORS

Name/Project Role	Education and Professional Experience
Amanda Wangler Project Manager Basin Electric	B.S. Electrical Engineering
Cris Miller Sr. Environmental Project Specialist Basin Electric	B.S. Civil Engineering
Gary Christenson Project Engineer Basin Electric	B.S. Civil Engineering
Cory Bauer Project Engineer Basin Electric	B.S. Civil Engineering
Steve Thornhill Project Manager Burns & McDonnell	M.S. Biology B.S. Biology
John Dunham Environmental Scientist Burns & McDonnell	B.S. Fisheries & Wildlife Biology
Jennifer Bell Environmental Scientist Burns & McDonnell	B.S. Environmental Science Master of Urban and Regional Planning (MURP)
Kate Samuelson Environmental Scientist Burns & McDonnell	B.S. Biology, Environmental Studies M.S. Environmental Science
Kimball Banks Regional Manager Metcalf Archaeological Consultants, Inc.	Ph.D. Anthropology with an emphasis on Archaeology M.A. Anthropology with an emphasis on Archaeology
Clayton Derby Senior Manager/Wildlife Biologist Western EcoSystems Technology, Inc.	MS Zoology and Physiology, University of Wyoming

10.0 REFERENCES

Avian Power Line Interaction Committee (APLIC). 2012. *Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2012*. Edison Electric Institute, APLIC, and the California Energy Commission. Washington, DC, and Sacramento, CA.

Bailey, R.G. 1995. *Description of the Ecoregions of the United States*. 2nd ed. Misc. Publ. No. 1391 (rev) Washington D.C. USDA Forest Service. 108 p.

Bakken Dispatch. 2011. The Housing Shortage and Other Impacts on Williston, ND. The Bakken Dispatch: The North Dakota Bakken Oil Boom – News, Jobs, Stocks, and Information. Available at: http://www.bakkendispatch.com/housing-shortage-impacts-williston (accessed September 2014).

Bangsund, D.A. and N.M. Hodur. 2013. North Dakota State University. Agribusiness and Applied Economics Report 704. *Williston Basin 2012: Projections of Future Employment and Population North Dakota Summary*. Available at: http://purl.umn.edu/142589 (accessed November 25, 2013).

Basin Electric Power Cooperative (Basin Electric). January 2012. Williston Tie Project: Application to the North Dakota Public Service Commission for a Waiver of Procedures and Timelines, and Consolidated Certificate of Corridor Compatibility and Route Permit (PU-11-692).

Bighorn Institute. 2012. Facts About Bighorn Sheep. Available at: http://www.bighorninstitute.org/faq.html (accessed September 2014).

Billing, L. 2013. City police set new records for arrests. McKenzie County Farmer. Available at: http://www.watfordcitynd.com/?id=10&nid=1985 (accessed March 2013).

Brady, N.C. 1996. *The Nature and Properties of Soils*. Nyle C. Brady. Raymond R. Weil - 11th edition.

Bryce, Sandra. James M. Omernik, David E. Pater, Michael Ulmer, Jerome Schaar, Jerry Freeouf, Rex Johnson, Pat Kuck, and Sandra H. Azevedo. 1998. *Ecoregions of North Dakota and South Dakota*. Jamestown, ND: Northern Prairie Wildlife Research Center Online. Available at: http://www.npwrc.usgs.gov/resource/habitat/ndsdeco/index.htm (accessed September 2014).

Bureau of Economic Analysis (BEA). 2012. Local Area Personal Income and Employment Data. Available at http://www.bea.gov/regional/index.htm (accessed September 2014).

Bureau of Labor Statistics. 2014. Local Area Unemployment Statistics. Available at: http://www.bls.gov/lau (accessed August 2014).

Butterflies and Moths of North America. 2012. Attributes of *Poanes viator*, *Euphyes dion*, *Poanes Massasoit*, and *Phyciodes batesii*. Available at: http://www.butterfliesandmoths.org/species/Poanes-viator http://www.butterfliesandmoths.org/species/Euphyes-dion http://www.butterfliesandmoths.org/species/Poanes-massasoit http://www.butterfliesandmoths.org/species/Phyciodes-batesii (accessed October 2012).

Chalmers, J.A. 2012a. High Voltage Transmission Lines and Montana Real Estate Values. Available from NorthWestern Energy. Available at: http://www.northwesternenergy.com/documents/ElectricTransmission/HighVoltageFinalReport-pdf (accessed May 11, 2012).

Chalmers, J.A. 2012b. High-Voltage Transmission Lines and Rural, Western Real Estate Values. *The Appraisal Journal*, Winter 2012: 1-16. Available from NorthWestern Energy. Available at: http://www.northwesternenergy.com/documents/ElectricTransmission/HighVoltageValues.pdf (accessed May 11, 2012).

Chalmers, J.A. 2012c. Transmission Line Impacts on Rural Property Values. *Right of Way*. May/June 2012: 32-36.

City of Williston. 2011. Williston Capital Improvements Plan, January 2011. Available at: http://www.cityofwilliston.com/usrfiles/CM/Docs/WillistonCIPBrochure.pdf (accessed January 2012).

Dalrymple, Amy. 2014. Watford City Leaders Break Ground on $59 Million Health Care Complex. McKenzie County Healthcare Systems, Inc. Available at: http://mckenziehealth.com/archives/628 (accessed September 2014).

Domaskin, A. 2011. Crime overwhelming law enforcement in oil patch. *Great Plains Examiner*. Available at: http://www.greatplainsexaminer.com/2011/12/09/crime-overwhelming-law-enforcement-in-oil-patch/ (accessed December 2011).

Dunn County Planning Commission. 2011. Dunn County Comprehensive Plan, adopted October 12, 2011.

Dunn County Planning Commission. 2012. Dunn County Land Development Code, adopted March 7, 2012.

Edison Electric Institute. 1984. *Electric Power Plant Environmental Noise Guide, Volume 1, 2nd Edition.*

Egan, M.D. 1988. *Architectural Acoustics*. McGraw-Hill, New York.

Electric Power Research Institute. 2004. Electromagnetic Interference with Implanted Medical Devices. Available at www.epri.com (accessed August 2014).

Ellis, B. 2011. Crime turns oil boomtown into wild west. CNN Money. Available at http://money.cnn.com/2011/10/26/pf/America_boomtown_crime/index.htm (accessed December 2011).

Energy Information Administration (EIA). 2012. North American Electric Reliability Corporation (NERC) Regions. Available at: http://205.254.135.7/cneaf/electricity/chg_str_fuel/html/fig02.html (accessed July 16, 2012).

Environmental Laboratory. 1987. Wetlands Research Program Technical Report Y-87-1 (online edition). *Corps of Engineers Wetlands Delineation Manual.* Available at: http://el.erdc.usace.army.mil/wetlands/pdfs/wlman87.pdf (accessed October 2012).

EPA. 2014. Counties Designated "Nonattainment" Map. Available at: http://www.epa.gov/oaqps001/greenbk/mapnpoll.html (accessed August 2014).

EPA. 2011. North Dakota Water Quality Assessment Report. Available at: http://iaspub.epa.gov/waters10/attains_state.control?p_state=ND (accessed July 2011).

EPA. 2009. Greenhouse Gas Equivalencies Calculator. http://www.epa.gov/cleanrgy/energy-resources/calculator.html (accessed June 2011).

EPA. 2006. Global Anthropogenic Emissions of Non-CO2 Greenhouse Gases, 1990-2020. Report 430-R-06-003. http://www.epa.gov/climatechange/economics/international.html (accessed June 2011).

Federal Aviation Administration (FAA). 2011. National Flight Data Center. Available at: www.faa.gov/airport_safety/airportdata_5010/menu/index.cfm (accessed July 2011).

Federal Communication Commission (FCC). 2012. Geographic Information Systems Databases. Available at: http://wireless.fcc.gov/geographic/index.htm?job=licensing_database_extracts (accessed September 2014).

Federal Highway Administration. 2012. 2009 MUTCD with Revisions 1 and 2, May 2012. Available at: http://mutcd.fhwa.dot.gov/kno_2009r1r2.htm (accessed August 14, 2012).

Federal Energy Regulatory Commission (FERC). 2006. Rules Concerning Certification of the Electric Reliability Organization; Procedures for the Establishment, Approval and Enforcement of Electric Reliability Standards, Order No. 672, FERC Stats. & Regs. ¶31,204 (2006). Available at: http://www.ferc.gov/whats-new/comm-meet/072006/E-5.pdf (accessed November 9, 2012).

Federal Emergency Management Agency (FEMA). 1984. Dunn County, North Dakota (Unincorporated Areas). Map Index. Community Panel Numbers 380026 0001-0750. Effective Date: March 1, 1984.

Federal Emergency Management Agency (FEMA). 2013. McKenzie County, North Dakota (and Unincorporated Areas). Map Number 38053CIND1. Effective Date: September 10, 2013.

Fong, C. 2012. State and Local Taxes: An Overview and Comparative Guide. Office of the State Tax Commissioner. Bismarck, ND.

Fong, C. 2013. 51th Biennial Report for the Biennial Period of July 1, 2011 through June 30, 2013. Office of the State Tax Commissioner. Bismarck, ND.

U.S. General Services Administration (GSA). 2014. FY 2013 Per Diem Rates for North Dakota. Available at: http://www.gsa.gov/portal/category/100120 (accessed September 2014).

Hagel, T. 2011. Personal communication with Todd Hagel, Assistant State Conservationist, Water Resources, North Dakota NRCS. December 13, 2011.

Hoberg, T. and C. Gause. 2006. *Reptiles and Amphibians of North Dakota*. Available at: http://www.npwrc.usgs.gov/resource/herps/amrepnd/index.htm (accessed July 2011).

Holdman, Jessica. 2012. Small North Dakota Airports Adjust to More Business. Bismarck Tribune. Available at: http://bismarcktribune.com/business/small-north-dakota-airports-adjust-to-more-business/article_608a39b0-0416-11e2-a015-0019bb2963f4.html (accessed September 2014).

Institute of Electrical and Electronics Engineers Standards Association. 2012. *National Electrical Safety Code*. Available at: http://standards.ieee.org/about/nesc/index.html (accessed June 2012).

International Commission on Non-Ionizing Radiation Protection (ICNIRP). 2010. *ICNIRP Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic and Electromagnetic Fields (1 Hertz to 100 Kilohertz).* Available at: http://www.icnirp.de/documents/LFgdl.pdf (accessed June 2012).

Intergovernmental Panel on Climate Change (IPCC). 2007. Climate Change 2007: Synthesis Report, Summary for Policymakers. http://www.ipcc.ch (accessed September 2014).

Integrated System (IS). 2011. Eastern Montana/Western North Dakota Load Serving Study Facility Additions Justification – August 2011.

Jackson, T. 2010. Electric Transmission Lines: Is there an Impact on Rural Land Values? *Right of Way* (November/December). Available at: http://www.realanalytics.com/Transmission%20Lines%20and%20Rural%20Land.pdf (accessed May 11, 2012).

Jackson, T. O. and J. Pitts. 2007. *The Effects of Electric Transmission Lines on Property Values: A Literature Review*. Journal of Real Estate Literature, 18(2), 239–259: 258.

Jones, S.L. 2010. Sprague's Pipit (*Anthus spragueii*) Conservation Plan. U.S. Department of Interior, Fish and Wildlife Service, Washington, DC. 56 pp.

Kardmas, Lee & Jackson, Inc. (KLJ). 2012. *Power Forecast 2012. Williston Basin Oil and Gas Related Electrical Load Growth Forecast*. 135pp.

Klungle, M.M. and M.W. Baxter. 2005. Lower Missouri and Yellowstone rivers pallid sturgeon study. Report submitted to Western Area Power Administration. Montana Department of Fish, Wildlife and Parks, Fort Peck, MT. 23 pp.

LeBeau II, S.C. 2009. Reconstructing Lakota Ritual in the Landscape: The Identification and Typing System for Traditional Cultural Property Sites. PhD dissertation, University of Minnesota.

Licht, D. S. 2001. Relationship of Hydrological Conditions and Populations of Breeding Piping Plovers. The Prairie Naturalist 33(4): December 2001.

Licht, D. S. and S. H. Fritts. 1998. Gray wolf (*Canis lupus*) occurrences in the Dakotas. U.S. Fish and Wildlife Service. Jamestown, ND: Northern Prairie Wildlife Research Center. Available at: http://www.npwrc.usgs.gov/resource/mammals/wolves/index.htm. (Version 17JUN98) (accessed November 9, 2012).

Lott, C.A. 2006. Distribution and Abundance of the Interior Population of the Least Tern (*Sternula antillarum*), 2005. U.S. Army Corps of Engineers, Engineer Research and Development Center. Vicksburg, MS. 88 pp.

Lymn, Katherine. 2014. ND County Commits More for Airport Runway Project. *Prairie Business*. Available at: http://www.prairiebizmag.com/event/article/id/19633/group/Transportation/ (accessed September 2014).

McKenzie County Commission. 2013a. McKenzie County Zoning Ordinance. Adopted March 2013.

McKenzie County Commission. 2013b. McKenzie County Comprehensive Plan. Adopted January 2013.

Midwest Reliability Organization (MRO). 2010. Available at: http://www.midwestreliability.org/01_about_mro/overview/mro_manual/MRO_Reliability_Plan.pdf (accessed September 2014).

Montana Natural Heritage Program and Montana Fish, Wildlife and Parks. n.d. Montana Gray Wolf - *Canis lupus*. *Montana Field Guide*. 2012. Available at: http://FieldGuide.mt.gov/detail_AMAJA01030.aspx (accessed November 2012).

National Audubon Society, Inc. 2012. Long-billed Curlew (*Numenius americanus*). Available at: http://birds.audubon.org/species/loncur (accessed October 2012).

National Institute of Environmental Health Sciences (NIEHS). 1999. NIEHS *Report on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields*, released on June 15, 1999.

National Wildlife Federation. 2012. Mammals. Bighorn Sheep. *Wildlife Library.* Available at: http://www.nwf.org/Wildlife/Wildlife-Library/Mammals/Bighorn-Sheep.aspx (accessed October 2012).

NERC. 2013. NERC Regions Map. Available at: http://www.nerc.com/AboutNERC/keyplayers/Pages/Regional-Entities.aspx (accessed August 18, 2014).

North Dakota Department of Agriculture (NDDOA). 2014. County and City Noxious Weeds List. Available at: http://www.nd.gov/ndda/program/noxious-weeds (accessed September 2014).

North Dakota Department of Health (NDDOH). 2005. Emergency Medical Services and Trauma. Ambulance Service Areas. http://www.ndhealth.gov/EMS/ProviderMap/ (accessed September 2014).

North Dakota Department of Health (NDDOH). 2012. Water Treatment Plant Contacts.

North Dakota Department of Mineral Resources (NDDMR). 2011. Presentation to Basin Electric Board of Directors, May 11, 2011.

North Dakota Department of Transportation (NDDOT). 2012. 2012 North Dakota Crash Summary. Available at: http://www.dot.nd.gov/divisions/safety/docs/crash-summary.pdf (accessed August 2014).

North Dakota Department of Transportation (NDDOT). 2013. District Project Information. Available at: http://www.dot.nd.gov/projects/western-nd/williston-district.htm (accessed August 2014).

North Dakota Game and Fish Department (NDGFD). 2014. Limited Pronghorn Season to Open. Available at: http://gf.nd.gov/news/limited-pronghorn-season-open (accessed September 2014).

North Dakota Game and Fish Department (NDGFD). 2012. Bighorn Sheep Numbers Increase. Available at: http://gf.nd.gov/news/bighorn-sheep-numbers-increase (accessed October 2012).

North Dakota Game and Fish Department (NDGFD). 2011. 2011 PLOTS Guide. Available at: http://gf.nd.gov/maps/plots.html (accessed July 2011).

North Dakota Game and Fish Department (NDGFD). 2010a. Fish Species. Available at: http://gf.nd.gov/fishing/species.html (accessed August 2011).

North Dakota Game and Fish Department (NDGFD). 2010b. Hunting and Trapping in North Dakota. Species Information. Available at: http://gf.nd.gov/hunting/ (accessed July 2011).

North Dakota Game and Fish Department (NDGFD). 2010c. Birds of North Dakota Field Checklist. Available at: http://gf.nd.gov/multimedia/ndoutdoors/issues/articles-brochures/nd-birds-check-list/ (accessed July 2011).

North Dakota Game and Fish Department (NDGFD). 2008. Black-tailed Prairie Dog Distribution. Southwest North Dakota. Available at: http://gf.nd.gov/gnf/maps/hunting/p-dog-towns-map.pdf (accessed October 2012).

North Dakota Game and Fish Department (NDGFD). 2005. Wildlife Action Plan. 100 Species of Conservation Priority. Available at: http://gf.nd.gov/conservation/levels-list.html#levelI (accessed August 2011).

North Dakota Geographic Information System (ND GIS). 2011. Data files for North Dakota resources. Available at: www.nd.gov/gis/mapsdata/data/ (accessed May 2011).

North Dakota Geologic Survey (NDGS). 2011. Available at: https://www.dmr.nd.gov/ndgs/ (accessed June 2011).

North Dakota Industrial Commission. 2014. ND Monthly Bakken Oil Production Statistics. Available at: https://www.dmr.nd.gov/oilgas/stats/statisticsvw.asp (accessed March 22, 2014).

North Dakota Petroleum Council (NDPC). 2014. Bakken by the Numbers, July 2014 Edition. Available at: file:///C:/Users/kstaver/Downloads/Facts_Figures.pdf (accessed September 2014).

North Dakota Pipeline Authority (NDPA). 2014. Oil and Gas GIS Data. Available at: https://www.dmr.nd.gov/pipeline/ (accessed September 2014).

State Historical Society of North Dakota (ND SHPO). 2008. North Dakota Comprehensive Plan for Historic Preservation: Archaeological Component. Available at: http://history.nd.gov/hp/stateplan_arch.html (accessed November 9, 2012).

N.D. State Land Department. 2011. Surface Management Division. Available at: http://www.land.nd.gov/surface/surface.htm (accessed August 2011).

North Dakota State Water Commission (NDSWC). 2005. *A Reference Guide – Water in North Dakota*.

North Dakota State Water Commission (NDSWC). 2011. Maps and Data Sources. Major Drainage Sub-Basins of North Dakota. Available at:

http://www.swc.state.nd.us/4dlink9/4dcgi/GetSubCategoryRecord/Map%20and%20Data%20Resources/Published%20Maps (accessed December 2011).

Ondracek, Witwer, & Bertsch. 2010. North Dakota Communities Acutely Impacted by Oil and Gas Development: Housing Demand Analyses. Available at: http://www.ndhfa.org/Default.asp?nMenu=02356 (accessed December 2011).

Pagel, J.E., D.M. Whittington, and G.T. Allen. 2010. Interim Golden Eagle Technical Guidance: Inventory and Monitoring Protocols; and Other Recommendations in Support of Golden Eagle Management and Permit Issuance. US Fish and Wildlife Service (USFWS). February 2010. Available online at: http://steinadlerschutz.lbv.de/fileadmin/www.steinadlerschutz.de/terimGoldenEagleTechnicalGuidanceProtocols25March2010_1_.pdf

Ramsey, C. and H. Sleeper. 1994. *Architectural Graphic Standards, 9th Edition*. John Wiley and Sons, New York.

Ratliff, Pat. 2014. Killdeer, County agree to axe wastewater plant request. Dunn County Herald. Available at: : http://www.dunncountyextra.com/killdeer-county-agree-axe-wastewater-plant-request/ (accessed September 2014).

Ruggles, K. 2011. Work begins to extend City's water and sewer service. McKenzie County Farmer. Available at http://www.watfordcitynd.com/?id=10&nid=1372 (accessed September 2014).

Shelley, K. 2013. U.S. Fish & Wildlife Service, Personal communication.

Shepherd, M.D. 2005. Species Profile: *Atrytone arogos* and *Hesperia ottoe*. In Shepherd, M.D., D.M. Vaughan, and S.H. Black (Eds). *Red List of Pollinator Insects of North America*. CD-ROM Version 1 (May 2005). Portland, OR: The Xerces Society for Invertebrate Conservation. Available at: http://www.xerces.org/wpcontent/uploads/2008/09/atrytone_arogos.pdf and http://www.xerces.org/wpcontent/uploads/2008/09/hesperia_ottoe.pdf (accessed October 2012).

Smith, N. 2011. Officials question census. *Williston Herald*. Available at http://www.willistonherald.com/news/officials-question-census/article_3dde9461-f005-5765-a0d3-2e43792fa285.html (accessed September 2014).

T. Dan Bracken. Inc. 2001. Schultz-Hanford Area Transmission Line Project. Available at: http://www.eh.doe.gov/NEPA/eis/eis0325/appxI/sch-ha-emf-080601final-rev.pdf (accessed 2007).

Title 57. n.d. Taxation. Chapter 57-06, Assessment and Taxation of Public Utilities. Available at: http://www.legis.nd.gov/cencode/t57c06.pdf (accessed September 2014).

Towner, J. 2011, November 23. Letter to M. Plank from U.S. Fish and Wildlife Service.

U.S. Army Corps of Engineers (USACE). 2007. Garrison Dam/Lake Sakakawea Master Plan with Integrated Programmatic Environmental Assessment. Missouri River, North Dakota. Update of Design Memorandum MGR-107D. Available at: http://www.nwo.usace.army.mil/html/Lake_Proj/MasterPlan/GarrisonMP.pdf (accessed August 2011).

U.S. Army Corps of Engineers (USACE). 2011. U.S. Army Corps of Engineers, Omaha District. Lake Sakakawea. Available at: http://www.nwo.usace.army.mil/html/Lake_Proj/garrison/lake.html (accessed December 2011).

U.S. Census Bureau. 2012a. 2008-2012 *American Community Survey 5-Year Estimates, Dunn and McKenzie Counties Selected Economic Characteristics*. American FactFinder. Available at: http://factfinder2.census.gov (accessed June 2014).

U.S. Census Bureau. 2012b. 2008-2012 *American Community Survey 5-Year Estimates, Dunn and McKenzie Counties Demographic and Housing Estimates*. American FactFinder. Available at: http://factfinder2.census.gov (accessed June 2014).

U.S. Census Bureau. 2012c. 2008-2012 *American Community Survey 5-Year Estimates, Total Population of Alexander, Arnegard, Dunn Center, Killdeer, and Watford City*. American FactFinder. Available at: http://factfinder2.census.gov (accessed June 2014).

U.S. Census Bureau. 2000. 2000 Census Summary File 4, *Dunn and McKenzie Counties*. American FactFinder. Available at: http://factfinder2.census.gov (accessed June 2014).

U.S. Census Bureau. 1990. 1990 Census. American FactFinder. Available at: http://factfinder.census.gov (accessed December 2011).

USDA. 2009. RUS Bulletin 1724E-200. Design Manual for High Voltage Transmission Lines. Revised May 2009.

USDA. 2012a. 2012 Census of Agriculture State Profile: North Dakota. Available at: http://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/North_Dakota/cp99038.pdf (accessed August 2014).

USDA. 2012b. 2012 Census of Agriculture County Profile: Dunn County, North Dakota. Available at: http://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/North_Dakota/cp38025.pdf (accessed August 2014).

USDA. 2012c. 2012 Census of Agriculture County Profile: McKenzie County, North Dakota. Available at: http://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/North_Dakota/cp38053.pdf (accessed August 2014).

U.S. Department of Agriculture (USDA). 2011. National Invasive Species Information Center. Laws and Regulations. Available at: http://www.invasivespeciesinfo.gov/laws/execorder.shtml (accessed August 2011).

USDA, Natural Resources Conservation Service (USDA-NRCS). 2011a. Land Resource Regions and Major Land Resource Areas of the United States, Caribbean, and the Pacific Basin. Major Land Resource Regions Custom Report. Available at: http://soils.usda.gov/MLRAExplorer (accessed October 2011).

USDA, Natural Resources Conservation Service (USDA-NRCS). 2011b. Plants Database. Wetland Indicator Status. Available at: http://plants.usda.gov/wetland.html (accessed August 2011).

USDA, Natural Resources Conservation Service (USDA-NRCS). 2011c. North Dakota Wetlands Reserve Program . Available at: http://www.nd.nrcs.usda.gov/programs/WRP/wrp.html (accessed July 2011).

USDA, Natural Resources Conservation Service (USDA-NRCS). 2011d. Wetlands Reserve Program. Available at: www.nrcs.usda.gov/wps/ (accessed December 2011).

USDA-NRCS. 2014. Soil Data Mart. Available at: http://soildatamart.nrcs.usda.gov/ (accessed August 2014).

USDA-NRCS. 2006. Major Land Resource Regions Custom Report. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. Available at: http://soils.usda.gov/MLRAExplorer (accessed November 2011).

USFWS. n.d. Whooping Crane (Grus americana). Available at: http://ecos.fws.gov/docs/life_histories/B003.html (accessed November 9, 2012).

USFWS. 1987. Northern Rocky Mountain Wolf Recovery Plan. U.S. Department of the Interior, USFWS, Denver, CO. 119 pp.

USFWS. 1989. Black-footed Ferret Survey Guidelines for Compliance with the Endangered Species Act. Denver, CO and Albuquerque, NM.

USFWS. 1990. Recovery Plan for the Interior Population of the Least Tern Sterna Antillarum. U.S. Department of the Interior, USFWS. Twin Cities, MN. 90 pp.

USFWS. 1993. Pallid Sturgeon Recovery Plan. U.S. Department of the Interior, USFWS, Bismarck, ND. 55 pp.

USFWS. 2002. Status Assessment and Conservation Guidelines, Dakota Skipper. April 2002. Available at: http://www.fws.gov/midwest/endangered/insects/pdf/dask-status.pdf (accessed November 9, 2012).

USFWS. 2003. Status Assessment and Conservation Plan for the Western Burrowing Owl in the United States. Biological Technical Publication. Available at: http://www.fws.gov/mountainprairie/species/birds/wbo/Western%20Burrowing%20Owlrev73003a.pdf (accessed October 2012).

USFWS. 2007a. Dakota Skipper Conservation Guidelines, Hesperia dacotae (Skinner) (Lepidoptera: Hesperiidae). September 2007. Available at: http://www.fws.gov/northdakotafieldoffice/SkipGuidelines07.pdf (accessed November 9, 2012).

USFWS. 2007b. International Recovery Plan, Whooping Crane (Grus americana). Third Revision. March 2007. Available at: http://ecos.fws.gov/docs/recovery_plan/070604_v4.pdf (accessed November 9, 2012).

USFWS. 2007c. National Bald Eagle Management Guidelines. May 2007. Available at: http://www.fws.gov/northeast/EcologicalServices/pdf/NationalBaldEagleManagementGuidelines.pdf (accessed October 2012).

USFWS. 2008. 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation-North Dakota. Available at: http://www.census.gov/prod/www/abs/fishing.html (accessed October 2011).

USFWS. 2009a. Status Assessment and Conservation Action Plan for the Long-Billed Curlew (Mumenius americanus). Biological Technical Publication. Available at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/FocalSpecies/Plans/LBCU_Plan_2009.pdf (accessed October 2012).

USFWS. 2009b. The Black-Tailed Prairie Dog Conservation Assessment and Strategy. Available at: http://www.fws.gov/mountainprairie/species/mammals/btprairiedog/BTPDConservationAgreement1999.pdf (accessed October 2012).

USFWS. 2010. 12-Month Finding on a Petition to List Sprague's Pipit as Endangered or Threatened Throughout Its Range. U.S. Department of the Interior, USFWS. Federal Register. Vol. 75, No. 178: 56028-56050.

USFWS. 2011a. Endangered Species Program. Species County Lists. Available at: http://www.fws.gov/endangered/ (accessed July 2011).

USFWS. 2011b. Black-footed Ferret (Mustela nigripes). North Dakota Field Office Species Profile. Last updated October 1, 2011. Available at: http://www.fws.gov/northdakotafieldoffice/endspecies/species/black-footed_ferret.htm (accessed November 9, 2012).

USFWS. 2011c. U.S. Fish and Wildlife Service, Species Assessment and Listing Priority Assignment Form. Available at: http://www.fws.gov/midwest/endangered/insects/pdf/DAKSKCandidateAssessForm2011.pdf (accessed November 9, 2012).

USFWS. 2011d. Gray Wolf (Canis lupus). Biologue. U.S. Department of the Interior, USFWS. Available at: http://www.fws.gov/midwest/wolf/aboutwolves/biologue.htm (accessed November 9, 2012).

USFWS. 2011e. Least tern (Sterna antillarum). North Dakota Field Office Species Profile. Last updated October 1, 2011. Available at: http://www.fws.gov/northdakotafieldoffice/endspecies/species/least_tern.htm (accessed November 9, 2012). USFWS. 2011f. Pallid Sturgeon (Scaphirhynchus albus). North Dakota Field Office Species Profile. Last updated October 1, 2011. Available at: http://www.fws.gov/northdakotafieldoffice/endspecies/species/pallid_sturgeon.htm (accessed November 9, 2012).

USFWS. 2011g. Endangered Species Program. Species County Lists. Available at: http://www.fws.gov/northdakotafieldoffice/county_list.htm (accessed October 2012).

USFWS. 2011h. Endangered Species. Mountain-Prairie Region. Black-Tailed Prairie Dog. Available at: http://www.fws.gov/mountain-prairie/species/mammals/btprairiedog/ (accessed October 2012).

USFWS. 2011i. Endangered Species. Midwest Region. Poweshiek Skipperling (Oarisma poweshiek). Candidate Species. Available at: http://www.fws.gov/midwest/endangered/insects/posk/ (accessed October 2012).

USFWS. 2012a. Endangered Species: North Dakota Field Office Species Profile, Gray Wolf. U.S. Department of the Interior, USFWS. Available at: http://www.fws.gov/northdakotafieldoffice/endspecies/endangered_species.htm (accessed November 9, 2012).

USFWS. 2012b. Endangered Species: North Dakota Field Office Species Profile, Piping Plover. U.S. Department of the Interior, USFWS. Available at: http://www.fws.gov/northdakotafieldoffice/endspecies/endangered_species.htm (accessed November 9, 2012).

USFWS. 2012c. Whooping Crane (Grus americana). 5-Year Review: Summary and Evaluation. Available at: http://ecos.fws.gov/docs/five_year_review/doc3977.pdf (accessed November 9, 2012).

USFWS. 2012d. The Baird's Sparrow. Audubon National Wildlife Refuge Complex, Mountain-Prairie Region. Available at: http://www.fws.gov/audubon/audnwr2.htm (accessed October 2012).

USFWS. 2012e. Endangered Species Act Success Story: Bald Eagle (*Haliaeetus leucocephalus*). Available at:

http://www.fws.gov/northdakotafieldoffice/endspecies/endangered_species_act_success_bald_eagle.htm (accessed October 2012).

USFWS. 2012f. Species of Habitat Fragmentation Concern. Greater Prairie Chicken. Available at: http://www.fws.gov/northdakotafieldoffice/Greater%20Prairie%20Chicken.pdf (accessed October 2012).

USFWS. 2012g. U.S. Counties within North Dakota in which the Greater sage-grouse, entire is known to or believed to occur. Available at: http://ecos.fws.gov/speciesProfile/profile/countiesByState.action?entityId=8741&state=North%20Dakota (accessed October 2012)

USFWS. 2012h. Sage-Grouse Conservation Objectives Draft Report. Available at: http://www.fws.gov/mountainprairie/species/birds/sagegrouse/20120803conservationobjectivesteamdraftreport.pdf (accessed October 2012).

US Fish and Wildlife Service (USFWS). 2013. Eagle Conservation Plan Guidance. Module 1 - Land-Based Wind Energy. Version 2. Division of Migratory Bird Management, USFWS. April 2013. Available online at: http://www.fws.gov/migratorybirds/Eagle_Conservation_Plan_Guidance-Module%201.pdf

USFWS. 2014a. Dakota skipper (Hesperia dacotae). North Dakota Field Office Species Profile. Last updated April 9, 2014. Available at: http://www.fws.gov/northdakotafieldoffice/endspecies/species/dakota_skipper.htm (accessed November 9, 2012).

USFWS. 2014b. North Dakota Field Office. County Occurrence of Endangered, Threatened, and Candidate Species and Designated Critical Habitat in North Dakota. Available at: http://www.fws.gov/northdakotafieldoffice/county_list.htm (accessed September 2014).

U.S. Forest Service (USFS). 2012a. Personal communication with David Valenzuela on October 18, 2012.

USFS. 2012b. Personal communication with Dan Svingen, Grasslands Biologist, Dakota Prairie Grasslands Office, Bismarck, N.D. Sent on August 16, 2012.

USFS. 2010. Dakota Prairie Grasslands. Available at: http://www.fs.fed.us/r1/dakotaprairie/index.shtml (accessed July 2011).

USFS. 2005a. Greater Prairie-Chicken (*Tympanuchus cupido*): A Technical Conservation Assessment. Prepared for the USDA Forest Service, Rocky Mountain Region, Species Conservation Project. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/greaterprairiechicken.pdf (accessed October 2012).

USFS. 2005b. Loggerhead Shrike (*Lanius ludovicianus*): A Technical Conservation Assessment. Prepared for the USDA Forest Service, Rocky Mountain Region, Species Conservation Project. Available at http://www.fs.fed.us/r2/projects/scp/assessments/loggerheadshrike.pdf (accessed October 2012).

USFS. 2002. Nest Site Selection and Productivity of Burrowing Owls Breeding on the Little Missouri National Grassland. 2001 Annual Report. Available at: http://www.fs.fed.us/r1/dakotaprairie/projects/survey_projects/burowls.pdf (accessed October 2012).

USFS. 2001. Northern Great Plains Management Plans Revision. (accessed via compact disk available at Northern Great Plains Planning, USDA Forest Service, Chadron, NE).

USFS. 1992. Carbon Storage and Accumulation is the United States Forest Ecosystems. General Technical Report WO-59. August 1992.

U.S. Geological Survey (USGS). 2009. North Dakota Water Science Center. North Dakota Basin Maps. Available at: http://nd.water.usgs.gov/data/basinmap.html (accessed July 2011).

USGS . 2008. National Assessment of Oil and Gas Fact Sheet: Assessment of Undiscovered Oil Resources in the Devonian-Mississippian Bakken Shale Formation, Williston Basin Province, Montana and North Dakota, 2008. Available at: http://pubs.usgs.gov/fs/2008/3021/pdf/FS08-3021_508.pdf (accessed December 2011).

USGS. 2006a. Breeding Birds of North America. Long-billed curlew (*Numenius americanus* [Bechstein]). Northern Prairie Wildlife Research Center. Available at: http://www.npwrc.usgs.gov/resource/birds/bbofnd/species/2640.htm (accessed October 2012).

USGS. 2006b. Northern Prairie Wildlife Research Center. North Dakota's Federally Listed Endangered, Threatened, and Candidate Species - 1995. Dakota Skipper Butterfly (*Hesperia dacotae*), Regal Fritillary Butterfly (*Speyeria idalia*), and Tawny Crescent Butterfly (*Phyciodes batesii*). Available at: http://www.npwrc.usgs.gov/resource/wildlife/nddanger/species/hespdaco.htm. http://www.npwrc.usgs.gov/resource/wildlife/nddanger/species/speyidal.htm. http://www.npwrc.usgs.gov/resource/wildlife/nddanger/species/phycbate.htm. (accessed October 2012).

USGS. 2006c. Northern Prairie Wildlife Research Center. North Dakota's Federally Listed Endangered, Threatened, and Candidate Species - 1995. Atlas of North Dakota Butterflies. Available at: http://www.npwrc.usgs.gov/resource/insects/bflynd/index.htm#contents (accessed October 2012).

USGS. 1995. North Dakota's Federally Listed Endangered, Threatened, and Candidate Species - 1995. Northern Prairie Wildlife Research Center. Available at: http://www.npwrc.usgs.gov/resource/wildlife/nddanger/species/laniludo.htm (accessed October 2012).

USGS. 1983. Guide to North Dakota's Ground-Water Resources, Water Supply Paper, 2236.

USGS, Northern Prairie Wildlife Research Center (USGS-NPWRC). 2006. Checklist of North Dakota Mammals. Available at: http://www.npwrc.usgs.gov/resource/mammals/mammals/cheklist.htm (accessed August 2011).

Vaughan, D.M., and M.D. Shepherd. 2005. Species Profile: *Speyeria idalia*. In Shepherd, M.D., D.M. Vaughan, and S.H. Black (EDS). Red List of Pollinator Insects of North America. CD-ROM Version 1 (May 2005). Portland, OR: The Xerces Society for Invertebrate Conservation. Available at: http://www.xerces.org/wpcontent/uploads/2008/09/speyeria_idalia.pdf (accessed October 2012).

Western Area Power Administration (Western). 2010. *Williston to Tioga Transmission Line Project Environmental Assessment*, March 2010. Available at: https://www.wapa.gov/ugp/Environment/EnvWillTiogaEA.htm (accessed June 2011).

Whitehead, R.L. 1996. *Groundwater Atlas of the United States: Montana, North Dakota, South Dakota, Wyoming*. HA 730-I. U.S. Geological Survey. Available at: http://pubs.usgs.gov/ha/ha730/ch_i/index.html (accessed August 2011).

11.0 LAND ACQUISITION STATUS

Basin Electric is progressing with its land acquisition efforts and has successfully obtained the necessary easements or purchased land from 56 percent of the landowners for a total of 51 percent of the Corridor/Route miles as of October 2014. See Table 11.0-1 below.

Table 11.0-1: Land Acquisition Status by County

Landowners to Acquire	Landowners Acquired	Left to Acquire	Percentage Acquired
48	27	21	56%
Miles to Acquire	**Miles Acquired**	**Left to Acquire**	**Percentage Acquired**
26.87	13.83	13.04	51%

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Application to the North Dakota Public Service Commission

Consolidated Certificate of Corridor Compatibility & Route Permit

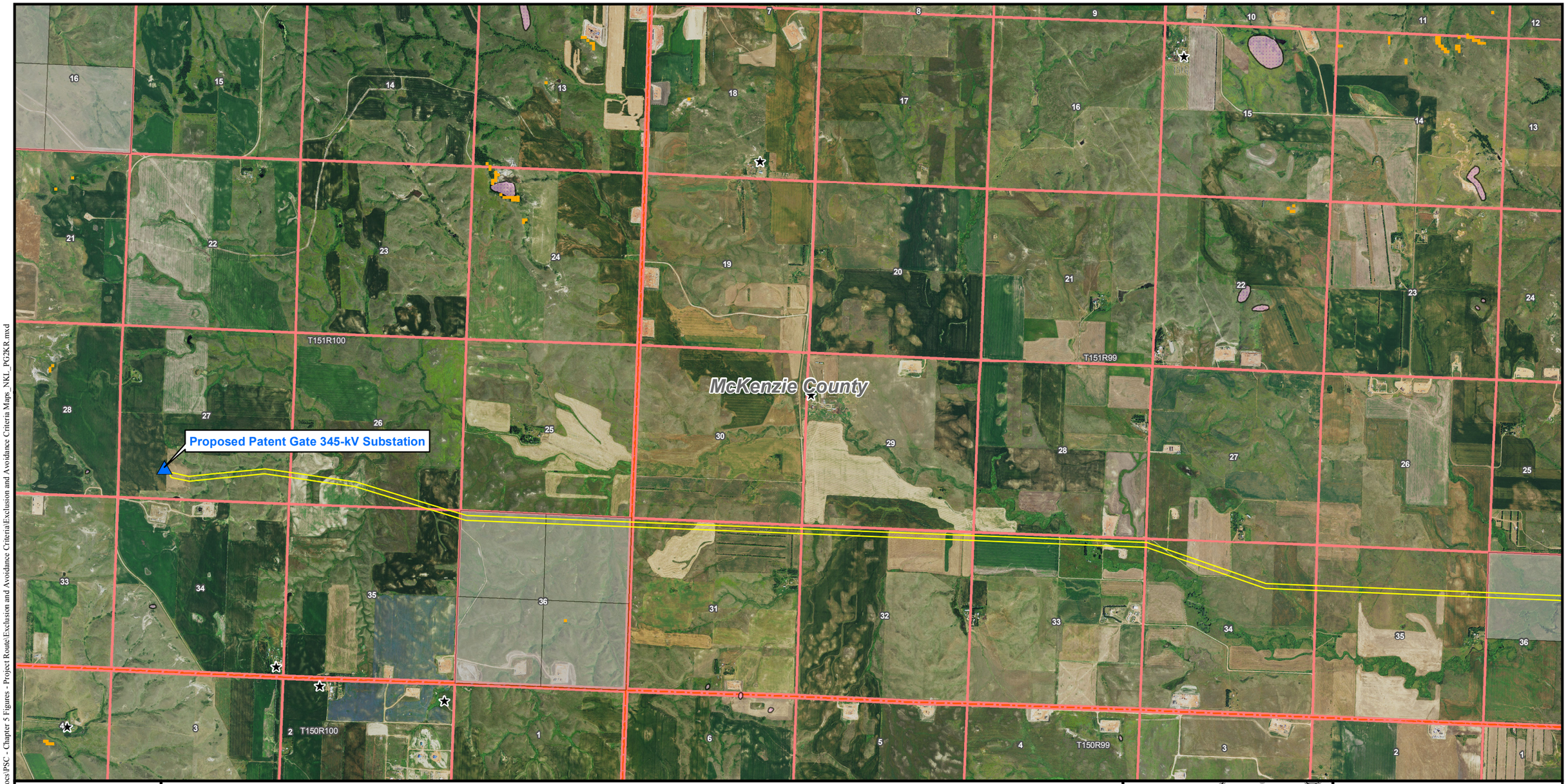
Volume II

BASIN ELECTRIC POWER COOPERATIVE
A Touchstone Energy® Cooperative

Basin Electric Power Cooperative

North Killdeer Loop Phase I
345-kV Transmission Line Project

November 2014



NORTH

0 3,000
Feet

- Corridor/Route 150'
- Proposed Substation
- Man Camp
- Residence
- County Boundary
- Civil Townships
- Public Land Survey Sections

Exclusion Areas

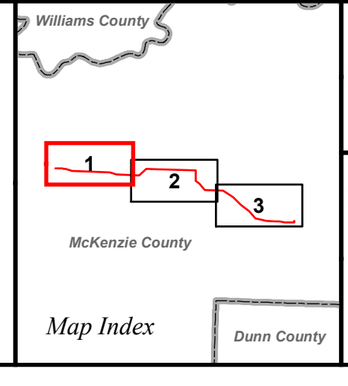
No Exclusion Areas

Avoidance Areas

- Center Pivot Irrigation
- Landslide Deposit
- Waterbody
- State-Owned School Lands

Slope Greater than 10%

- 10% - 20 %



Exclusion and Avoidance Criteria

Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Detailed Project Route Maps
Sheet 1 of 3

Source: USDA NAIP 2014 Aerial Photography; NDNHI, North Dakota GIS; National Park Service; State Historical Society; Burns & McDonnell.

October 30, 2014

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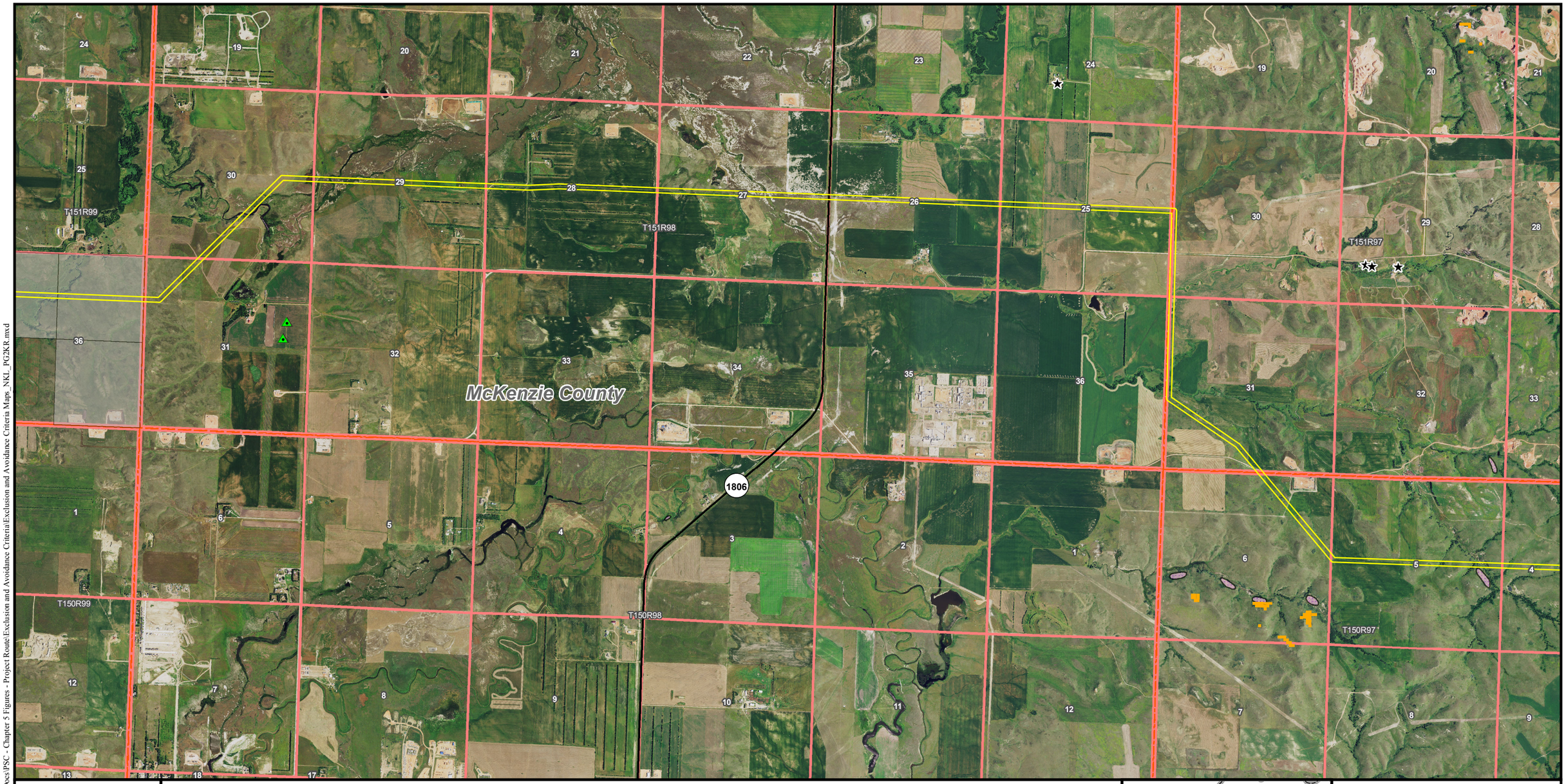


NORTH

0 3,000
Feet

- Corridor/Route 150'
- Proposed Substation
- Man Camp
- Residence
- County Boundary
- Civil Townships
- Public Land Survey Sections

Exclusion Areas

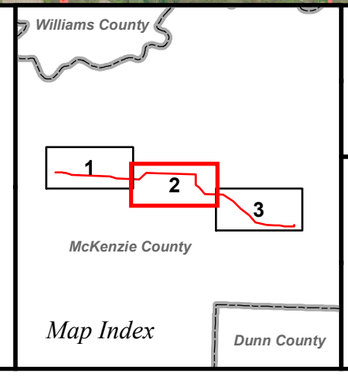
No Exclusion Areas

Avoidance Areas

- Center Pivot Irrigation
- Landslide Deposit
- Waterbody
- State-Owned School Lands

Slope Greater than 10%

- 10% - 20 %



Exclusion and Avoidance Criteria

Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Detailed Project Route Maps
Sheet 2 of 3

Source: USDA NAIP 2014 Aerial Photography; NDNHI, North Dakota GIS; National Park Service; State Historical Society; Burns & McDonnell.

October 30, 2014

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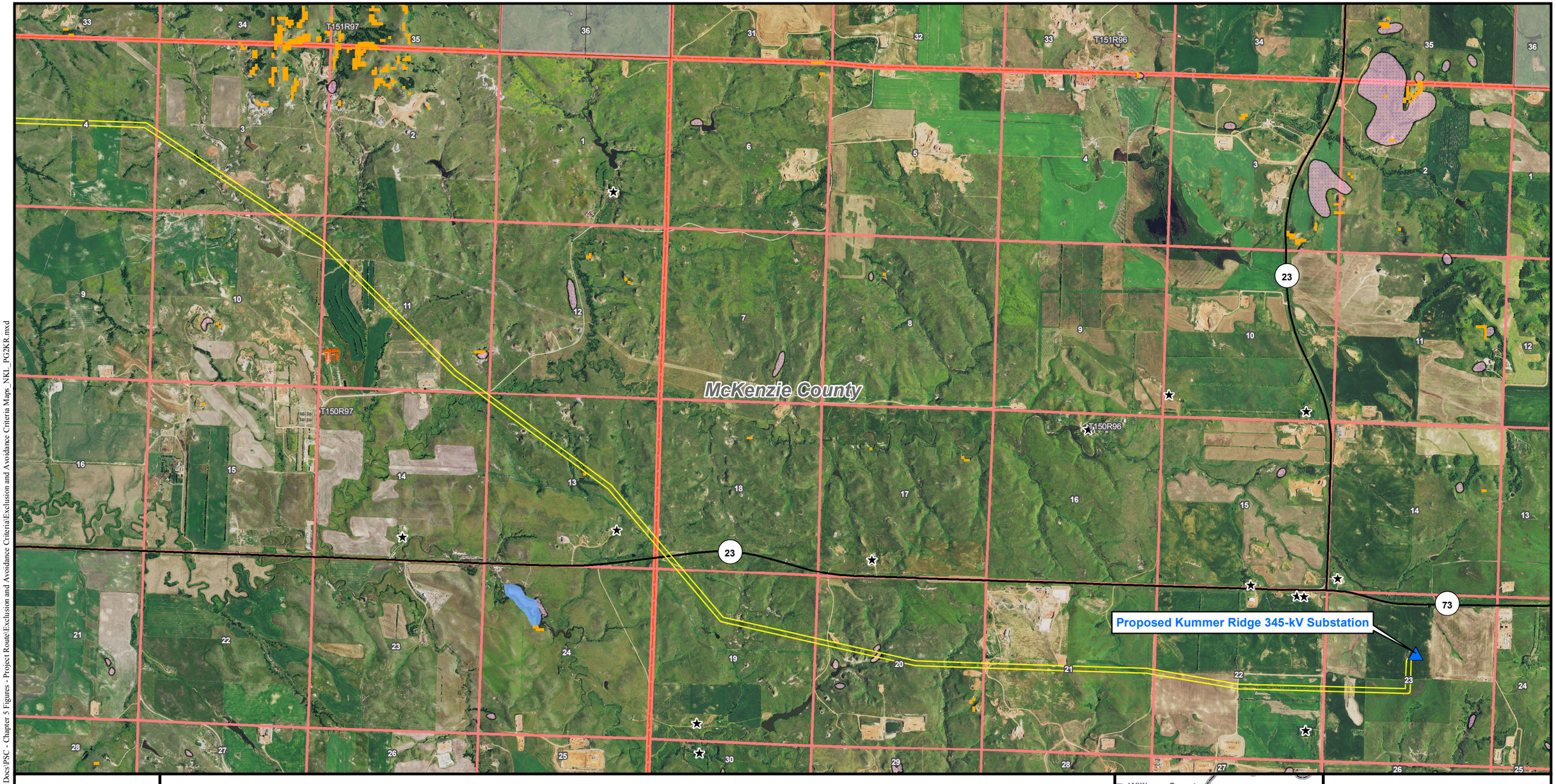

NORTH

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Feet

Corridor/Route 150'
Proposed Substation
Man Camp
Residence
County Boundary
Civil Townships
Public Land Survey Sections

Exclusion Areas

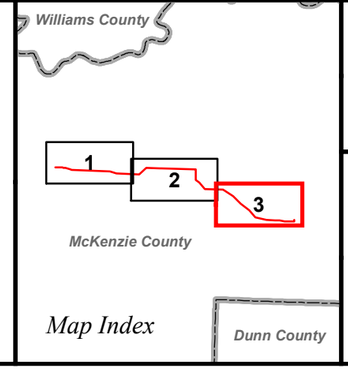
No Exclusion Areas

Avoidance Areas

Center Pivot Irrigation
Landslide Deposit
Waterbody
State-Owned School Lands

Slope Greater than 10%

10% - 20 %



Exclusion and Avoidance Criteria

Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Detailed Project Route Maps
Sheet 3 of 3

Source: USDA NAIP 2014 Aerial Photography; NDNHI, North Dakota GIS; National Park Service; State Historical Society; Burns & McDonnell.

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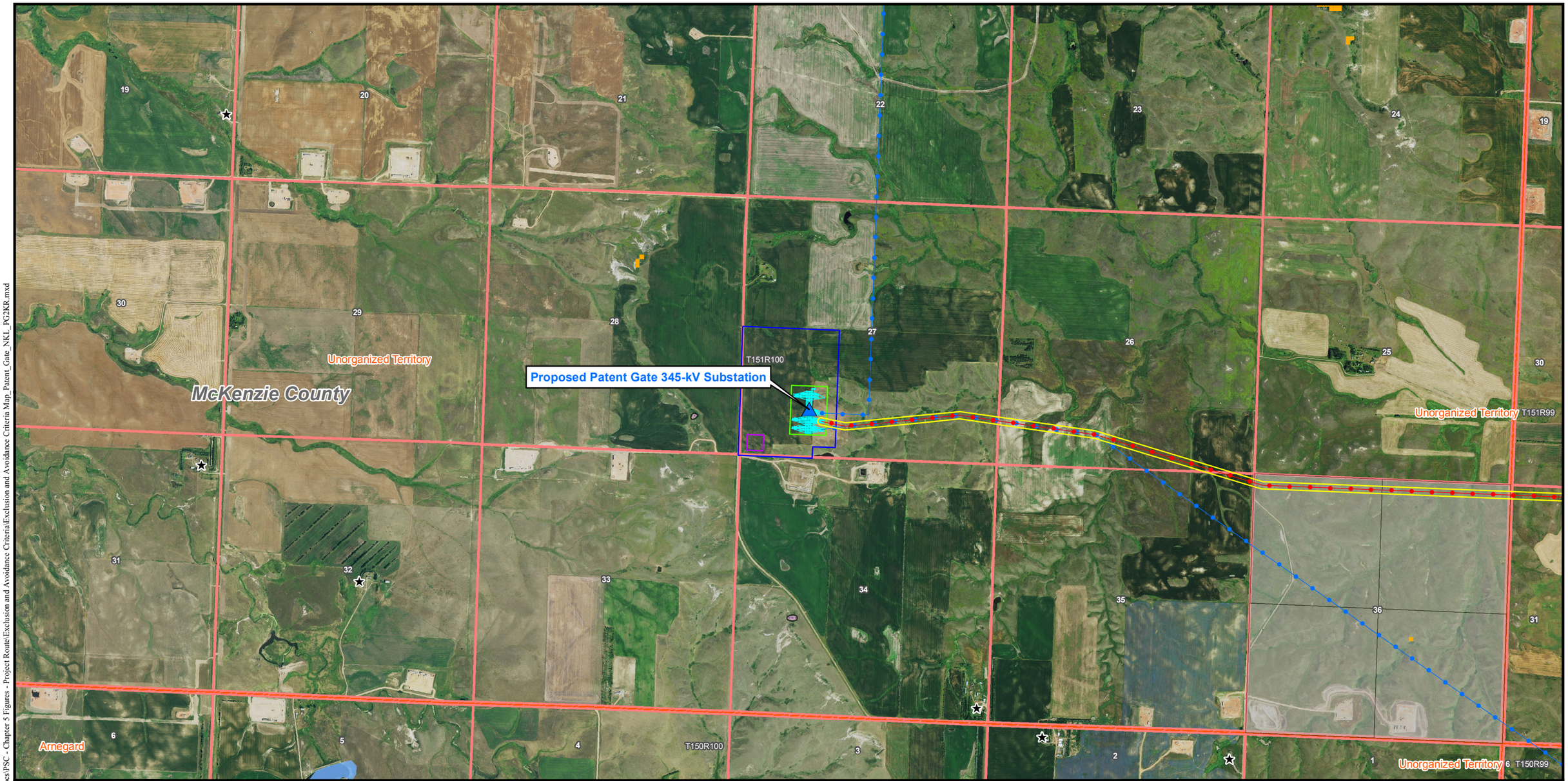

NORTH

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Feet

- Project Corridor 150'
- Project Route
- AVS to Neset Route
- Substation Property Boundary
- Substation Fence
- Mechanical Fence
- Substation Equipment
- Man Camp
- ★ Residence

- County Boundary
- Municipal Boundary
- Civil Townships
- Public Land Survey Sections

Exclusion Areas

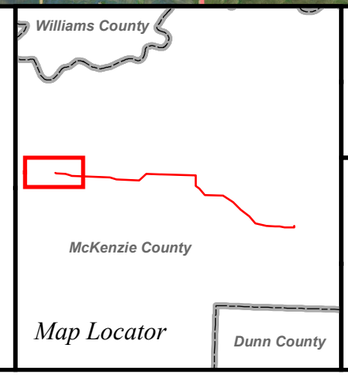
No Exclusion Areas

Avoidance Areas

- Center Pivot Irrigation
- Landslide Deposit
- Waterbody
- State-Owned School Lands

Slope Greater than 10%

- 10% - 20 %



Exclusion and Avoidance Criteria

Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Detailed Project Route Maps
Patent Gate Substation

Source: USDA NAIP 2014 Aerial Photography; NDNHI, North Dakota GIS; National Park Service; State Historical Society; Burns & McDonnell.

October 30, 2014

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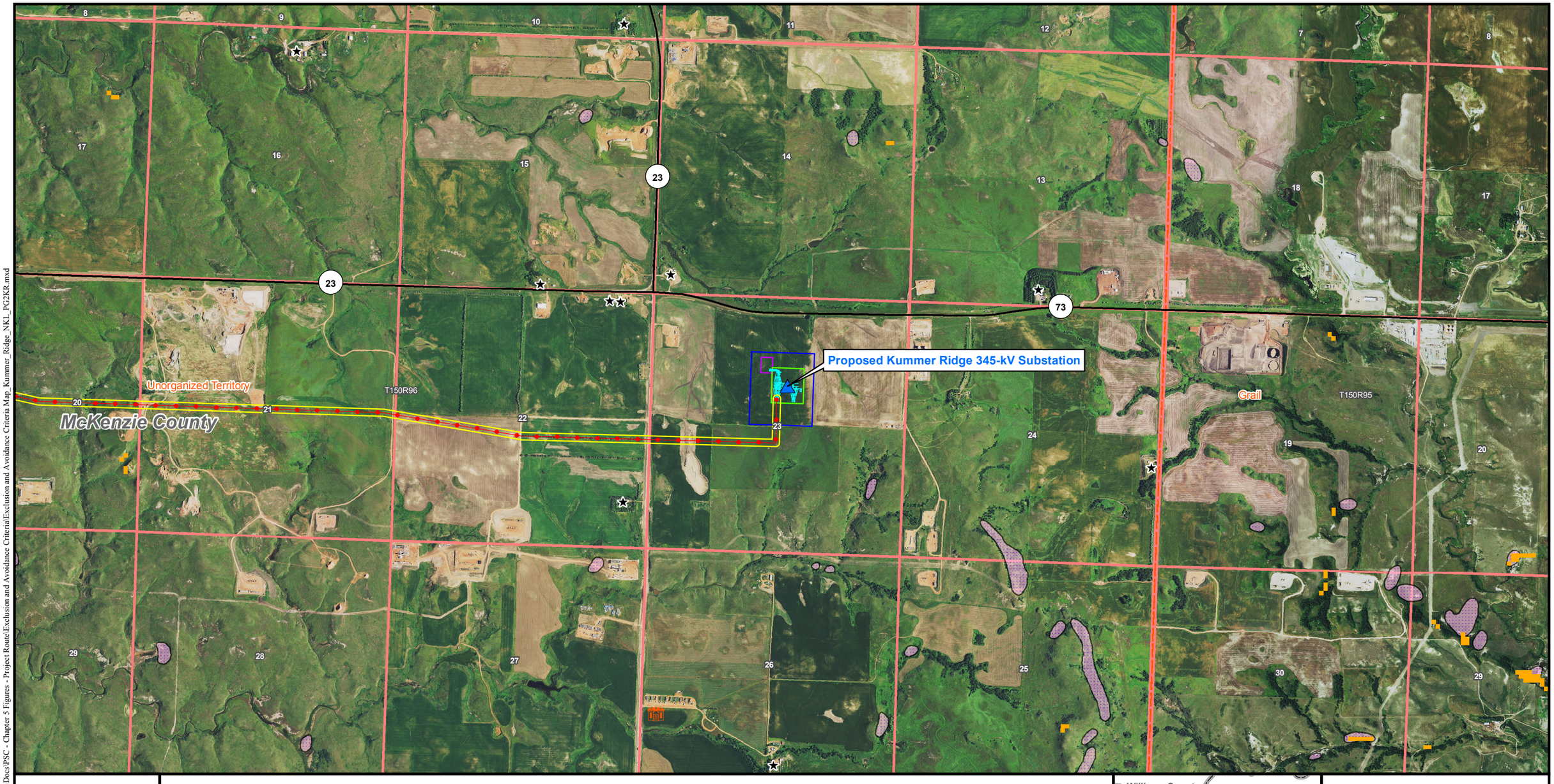

NORTH

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Feet

- Project Corridor 150'
- Project Route
- Substation Property Boundary
- Substation Fence
- Mechanical Fence
- Substation Equipment
- Man Camp
- ★ Residence

- County Boundary
- Municipal Boundary
- Civil Townships
- Public Land Survey Sections

Exclusion Areas

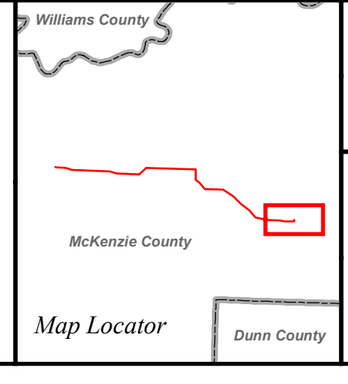
No Exclusion Areas

Avoidance Areas

- Center Pivot Irrigation
- Landslide Deposit
- Waterbody
- State-Owned School Lands

Slope Greater than 10%

- 10% - 20 %



Exclusion and Avoidance Criteria

Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Detailed Project Route Maps
Kummer Ridge Substation

Source: USDA NAIP 2014 Aerial Photography; NDNHI, North Dakota GIS; National Park Service; State Historical Society; Burns & McDonnell.

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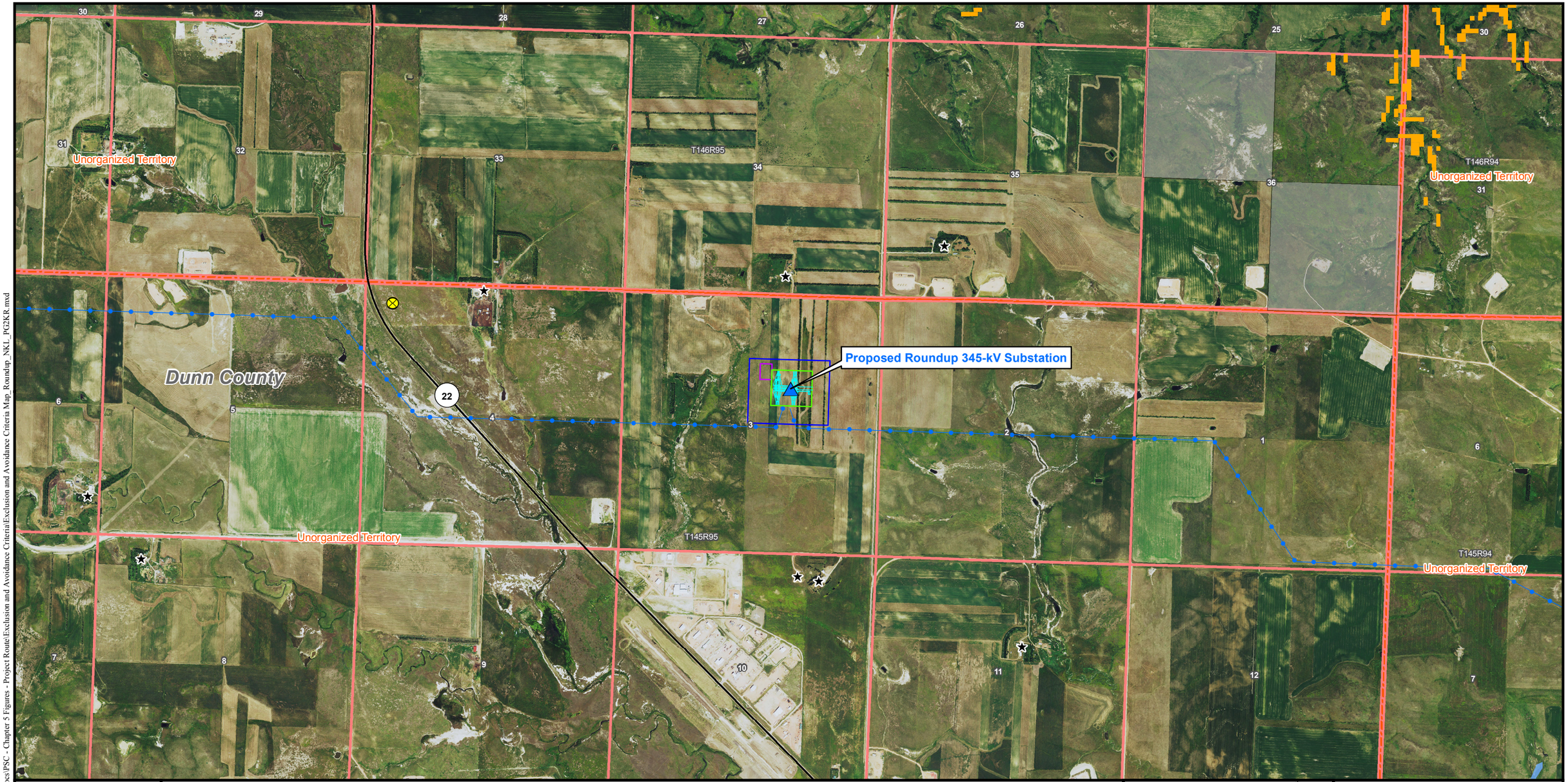

NORTH

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Feet

- AVS to Neset Route
- Substation Property Boundary
- Substation Fence
- Mechanical Fence
- Substation Equipment
- Man Camp
- ★ Residence

- County Boundary
- Municipal Boundary
- Civil Townships
- Public Land Survey Sections

Exclusion Areas

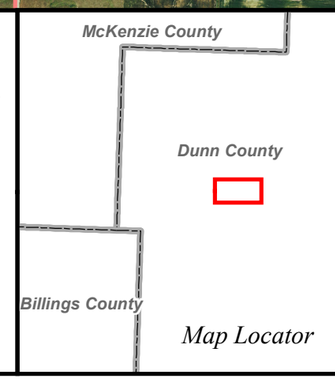
- ⊗ State Sensitive Species Habitat/Occurrence

Avoidance Areas

- Center Pivot Irrigation
- Landslide Deposit
- Waterbody
- State-Owned School Lands

Slope Greater than 10%

- 10% - 20 %



Exclusion and Avoidance Criteria

Basin Electric Power Cooperative
North Killdeer Loop
345-kV Transmission Project
Detailed Project Route Maps
Roundup Substation

Source: USDA NAIP 2014 Aerial Photography; NDNHI, North Dakota GIS; National Park Service; State Historical Society; Burns & McDonnell.

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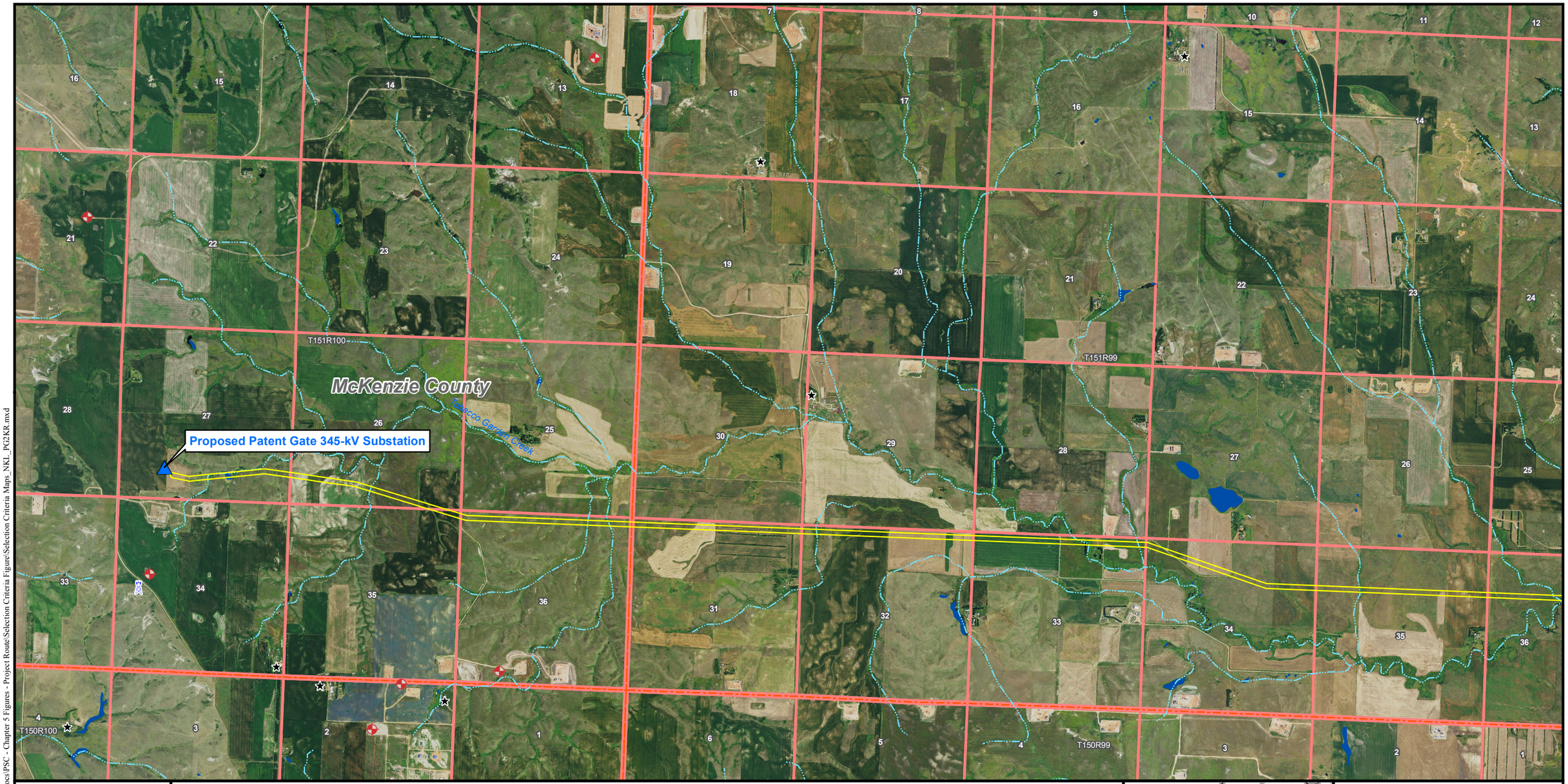

NORTH

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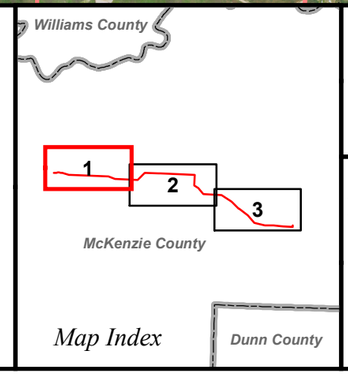
Feet

- Corridor/Route 150'
- Proposed Substation
- County Boundary
- Public Land Survey Sections
- Civil Townships

Selection Criteria

- Man Camp
- Residence
- Oil Well
- Telecommunication Tower
- Perennial Stream
- Intermittent Stream
- NWI Wetlands



Selection Criteria

Basin Electric Power Cooperative
Antelope Valley Station to Neset
345-kV Transmission Project
Detailed Project Route Maps
Sheet 1 of 3

Source: USDA NAIP 2014 Aerial Photography; Federal Communications Commission; North Dakota GIS; National Park Service; State Historical Society; FEMA; Burns & McDonnell.

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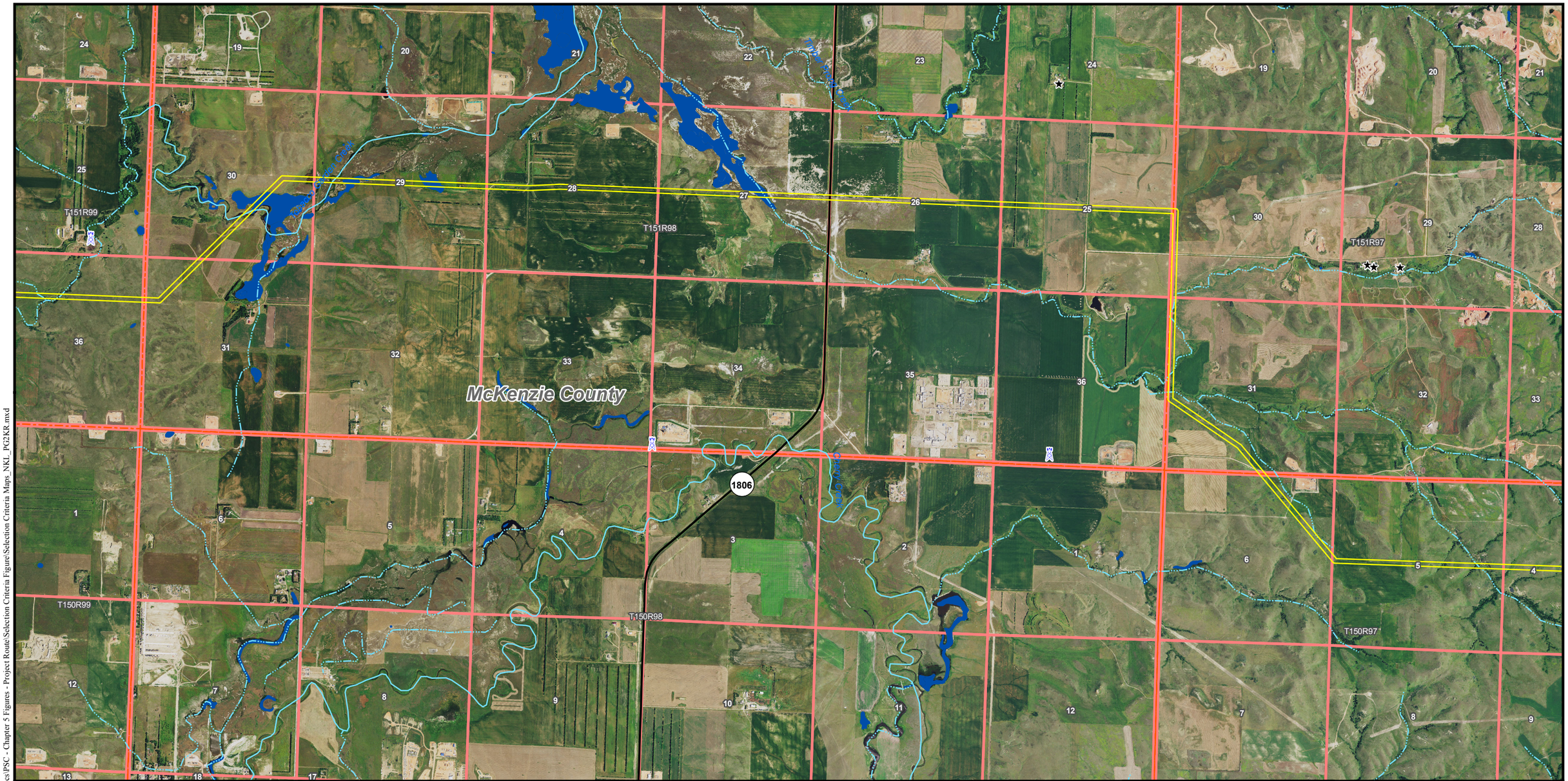

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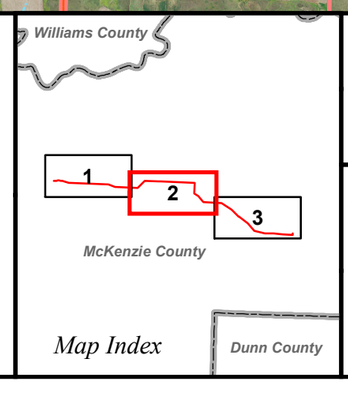
- NWI Wetlands



Selection Criteria

Basin Electric Power Cooperative
Antelope Valley Station to Neset
345-kV Transmission Project
Detailed Project Route Maps
Sheet 2 of 3

Source: USDA NAIP 2014 Aerial Photography; Federal Communications Commission; North Dakota GIS; National Park Service; State Historical Society; FEMA; Burns & McDonnell.

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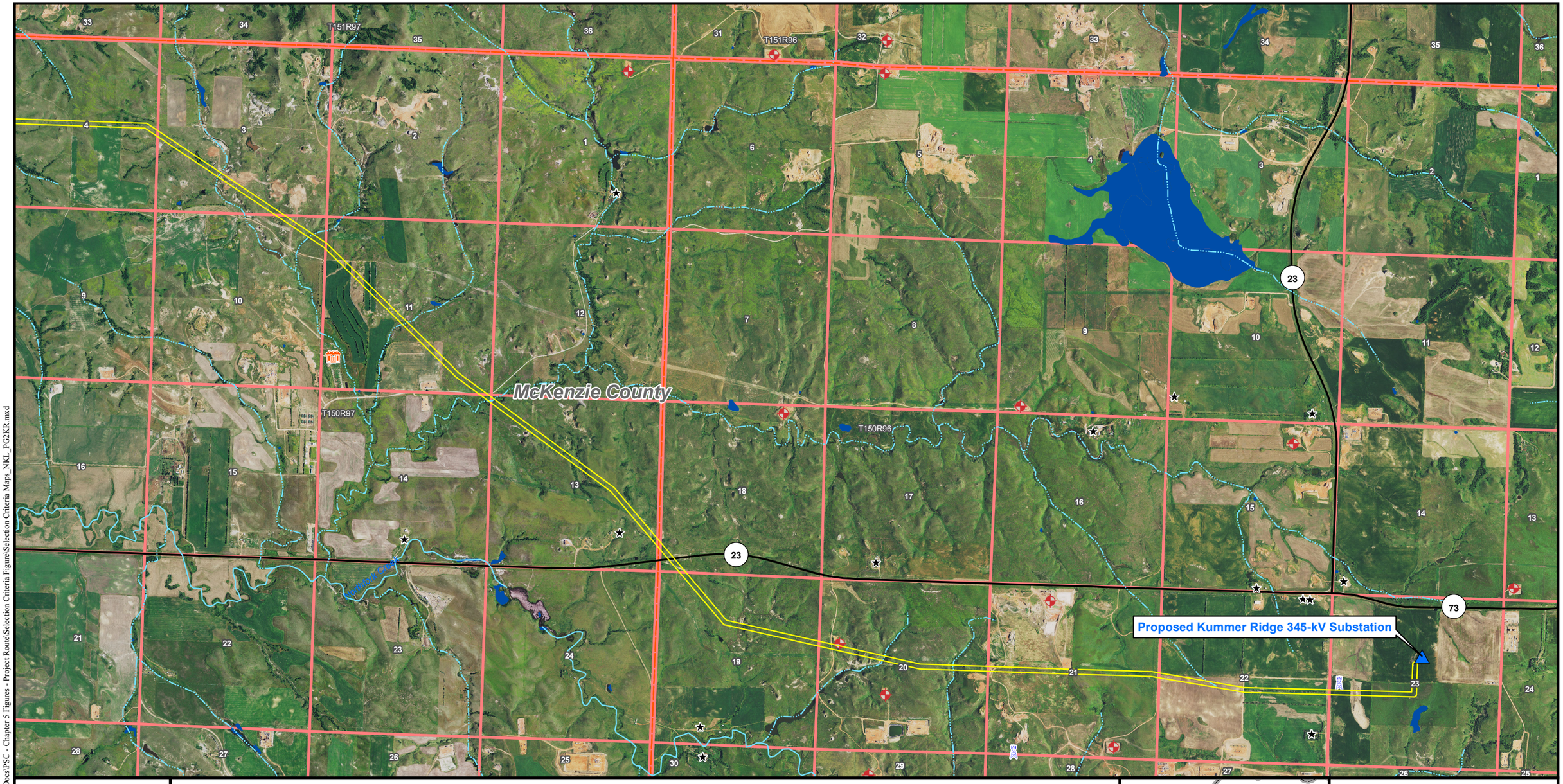

NORTH

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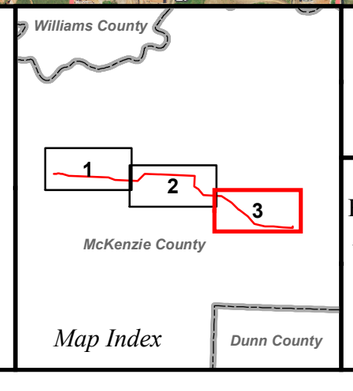
Feet

Corridor/Route 150'
Proposed Substation
County Boundary
Public Land Survey Sections
Civil Townships

Selection Criteria

Man Camp
Residence
Oil Well
Telecommunication Tower
Perennial Stream
Intermittent Stream
NWI Wetlands



Selection Criteria

Basin Electric Power Cooperative
Antelope Valley Station to Neset
345-kV Transmission Project
Detailed Project Route Maps
Sheet 3 of 3

Source: USDA NAIP 2014 Aerial Photography; Federal Communications Commission; North Dakota GIS; National Park Service; State Historical Society; FEMA; Burns & McDonnell.

October 30, 2014

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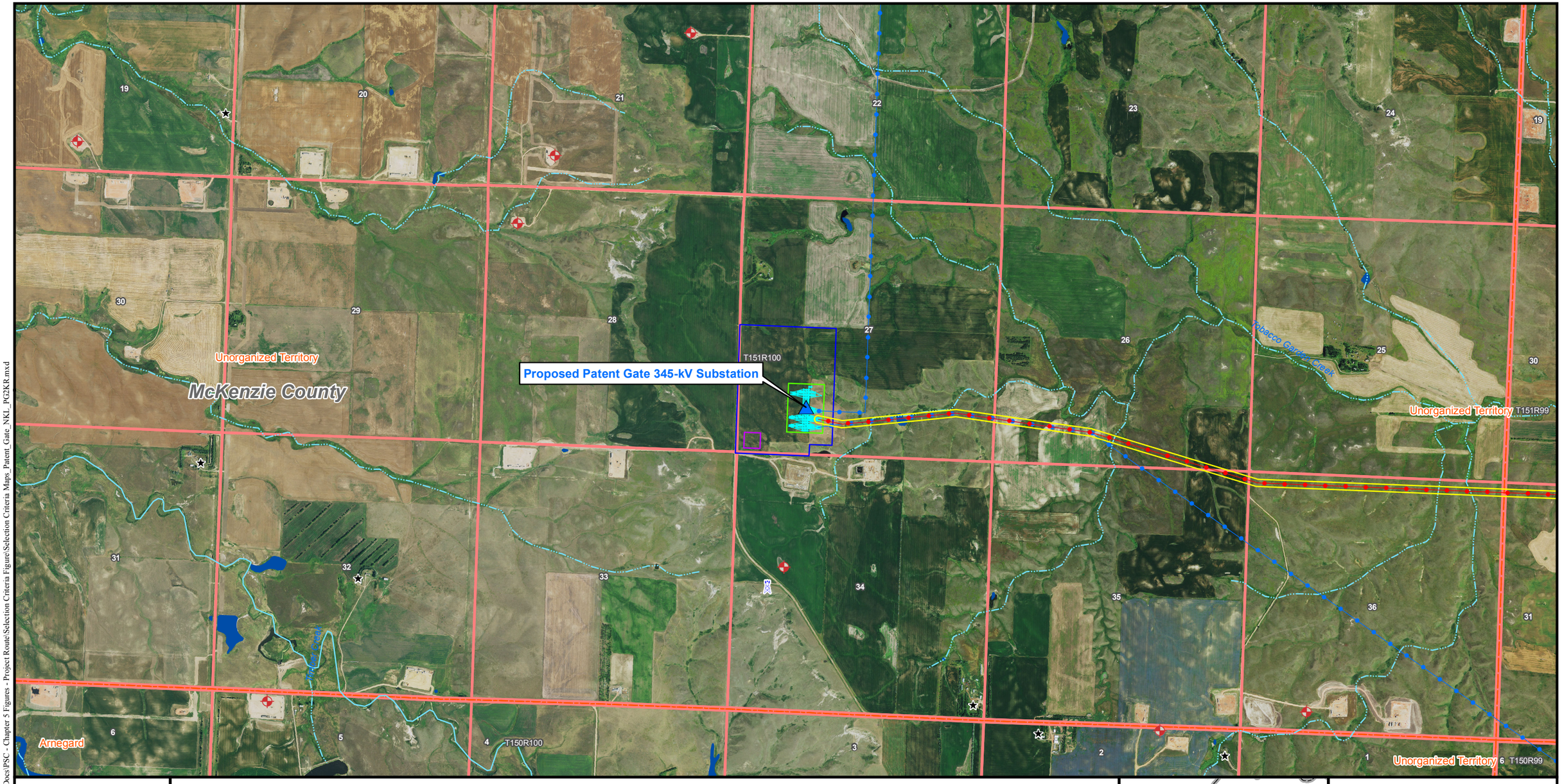

NORTH

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Feet

- Project Corridor 150'
- Project Route
- AVS to Neset Route
- Substation Property Boundary
- Substation Fence
- Mechanical Fence
- Substation Equipment
- County Boundary
- Municipal Boundary
- Public Land Survey Sections
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Selection Criteria

- Man Camp
- Residence
- Oil Well
- Telecommunication Tower
- Perennial Stream
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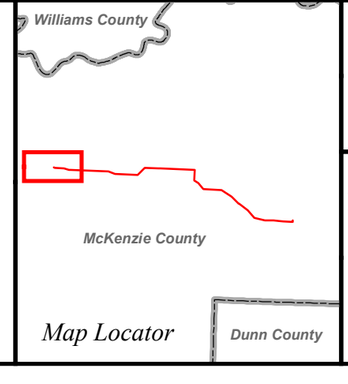

Selection Criteria

Basin Electric Power Cooperative
Antelope Valley Station to Neset
345-kV Transmission Project
Detailed Project Route Maps
Patent Gate Substation

Source: USDA NAIP 2014 Aerial Photography; Federal Communications Commission; North Dakota GIS; National Park Service; State Historical Society; FEMA; Burns & McDonnell.

October 30, 2014

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Proposed Kummer Ridge 345-kV Substation

Unorganized Territory

McKenzie County

T150R96

T150R95

Crail

Redfork Creek

Oil Creek

NORTH

0 2,000

Feet

- Project Corridor 150'
- Project Route
- Substation Property Boundary
- Substation Fence
- Mechanical Fence
- Substation Equipment
- County Boundary
- Municipal Boundary
- Public Land Survey Sections
- Civil Townships

Selection Criteria

- Man Camp
- Residence
- Oil Well
- Telecommunication Tower
- Perennial Stream
- Intermittent Stream
- NWI Wetlands

Williams County

McKenzie County

Dunn County

Map Locator

Selection Criteria

Basin Electric Power Cooperative
Antelope Valley Station to Neset
345-kV Transmission Project
Detailed Project Route Maps
Kummer Ridge Substation

Source: USDA NAIP 2014 Aerial Photography; Federal Communications Commission; North Dakota GIS; National Park Service; State Historical Society; FEMA; Burns & McDonnell.

October 29, 2014

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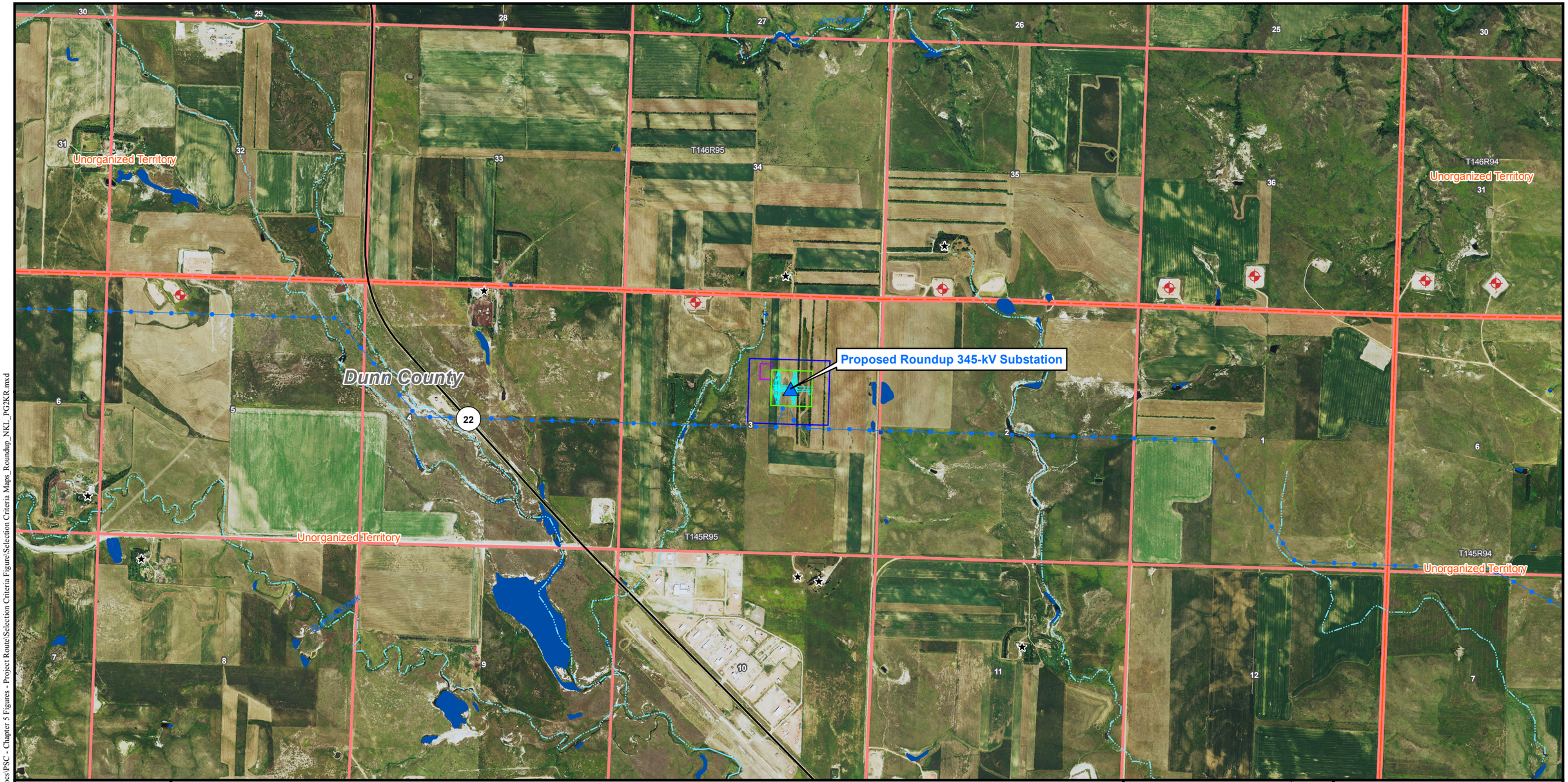

NORTH

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Feet

- AVS to Neset Route
- Substation Property Boundary
- Substation Fence
- Mechanical Fence
- Substation Equipment
- County Boundary
- Municipal Boundary
- Public Land Survey Sections
- Civil Townships

Selection Criteria

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- Oil Well
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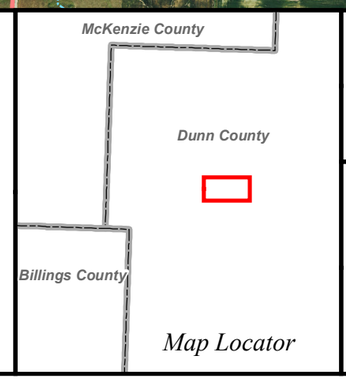
- Perennial Stream
- Intermittent Stream
- NWI Wetlands



Selection Criteria

Basin Electric Power Cooperative
Antelope Valley Station to Neset
345-kV Transmission Project
Detailed Project Route Maps
Roundup Substation

Source: USDA NAIP 2014 Aerial Photography; Federal Communications Commission; North Dakota GIS; National Park Service; State Historical Society; FEMA; Burns & McDonnell.

October 29, 2014

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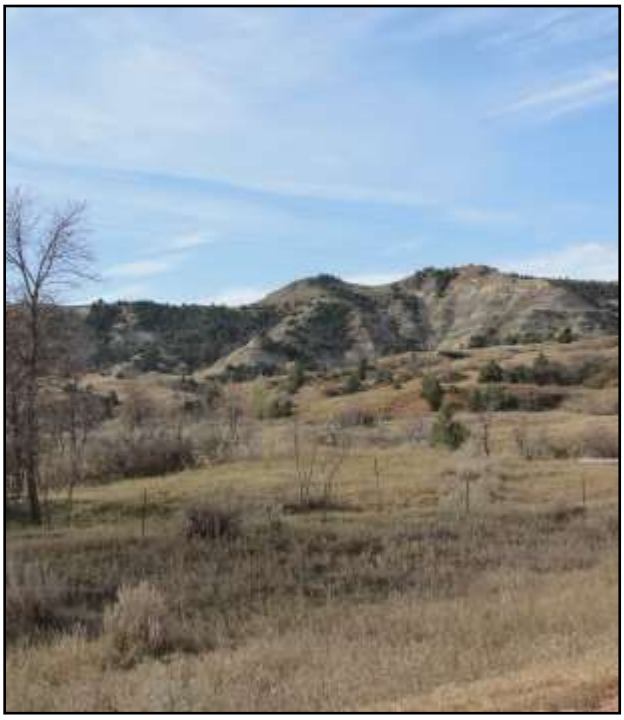
Application to the North Dakota Public Service Commission:

Consolidated Certificate of Corridor Compatibility and Route Permit

Volume III



BASIN ELECTRIC POWER COOPERATIVE
A Touchstone Energy® Cooperative

Basin Electric Power Cooperative

North Killdeer Loop Phase I
345-kV Transmission Project

November 2014

APPENDIX A – RUS RECORD OF DECISION

RECORD OF DECISION

Antelope Valley Station to Neset Transmission Project

U.S. Department of Agriculture

RURAL UTILITIES SERVICE

September 2014

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INTRODUCTION

A. Background

Basin Electric is proposing to construct, operate, and maintain a new electrical transmission line connecting the existing Antelope Valley Station (AVS), Charlie Creek, Williston, and Neset substations with five newly proposed delivery substations. The overall project area identified for this project proposal encompasses parts of Mercer, Dunn, McKenzie, Williams, and Mountrail counties in North Dakota. The proposed project includes the construction of 345-kilovolt (kV) transmission line facilities from Basin Electric's AVS generation facility located in northwestern North Dakota to increase the capacity and reliability of the electricity transmission infrastructure of the region. The line would connect AVS with Basin Electric's Charlie Creek and Neset substations and Western Area Power Administration's (Western) Williston Substation. It would also provide new substation facilities to connect the proposed line into the current transmission system and provide locations for load-serving connections. Several alternatives, including a no-action alternative and three different build alternatives were evaluated in the Environmental Impact Statement (EIS).

The Rural Utilities Service (RUS) issued a Draft Environmental Impact Statement (DEIS) evaluating the environmental implications of Basin Electric's AVS to Neset Transmission Project in November 2012. The originally proposed project, as evaluated in the DEIS, considered the development of a single 345-kV transmission line and two new substations in one of two alternative routes. The project was proposed to increase transmission line capacity to meet the expected increase in load. However, subsequent to the issuance of the DEIS, a new load forecast showed the load increasing above and beyond the original forecast by nearly 50 percent (Kardmas, Lee & Jackson, Inc. [KLJ], 2012). Therefore the original project as described in the DEIS would not achieve capacity needs or reliability standards.

RUS prepared a Supplemental Draft Environmental Impact Statement (Supplemental DEIS) for the AVS to Neset Transmission Project proposal to evaluate project changes that occurred after the DEIS was published and the comment period closed. To accommodate additional load requirements, new alternatives were evaluated in the Supplemental DEIS that included building a transmission line on both routes A and B (now identified as Alternative C) and two additional alternatives, similar to the alignment of Alternative B. The primary difference is a double-circuit 345-kV line (Alternative D) or two parallel lines (Alternative E) running 63 miles from the Red Substation near Killdeer to the new White Substation and on to the Blue Substation and the additional Killdeer South Substation would be required. The Killdeer South Substation would interconnect the Red Substation to the existing AVS to Charlie Creek 345-kV transmission line by 12 miles of parallel 345-kV single-circuit transmission line. Additional project components including substations were evaluated under each of these alternatives in the Supplemental DEIS. The Supplemental DEIS was published in December 2013 and the Final EIS was published in May 2014. A detailed description of the project alternatives is included in the FEIS.

B. NEPA Compliance

Basin Electric has requested financial assistance from RUS to construct the AVS to Neset Transmission Project proposal. RUS determined that the agency's decision to finance the project would constitute a major federal action that may have a significant impact on the environment within the context of the National Environmental Policy Act of 1969 (NEPA). RUS is serving as the lead federal agency for the EIS of the project, and Western and the United States Forest Service-Dakota Prairie Grasslands, McKenzie Ranger District(USFS) are serving as cooperating agencies. . RUS, in cooperation with Western and USFS, prepared an EIS in compliance with the requirements of NEPA and the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 Code of Federal Regulations [CFR] 1500-1508). Western is serving as the lead federal agency for compliance with Section 106 of the National Historic Preservation Act (NHPA) and its implementing regulations (36 CFR 800) to take into account effects to historic properties and consultation under Section 7 of the Endangered Species Act (ESA) for threatened and endangered species.

A Notice of Intent to prepare an EIS was published in the Federal Register on November 2, 2011, informing the public of the intent by RUS to prepare an EIS. The notice initiated the 30-day public scoping period and included the dates for public scoping meetings that were held November 15 and 16, 2011 in Williston and Killdeer, North Dakota, respectively. A Notice of Availability of the DEIS for the AVS to Neset Transmission Project was published in the Federal Register on December 7, 2012. Two public hearings were held on January 15 and 16, 2013, in Killdeer and Williston, North Dakota, respectively. A Notice of Availability of the Supplemental DEIS was published in the Federal Register on December 20, 2013, followed by a public hearing held in Watford City, North Dakota on January 16, 2014. The notice of availability of the FEIS was published in the Federal Register on May 30, 2014.

DESCRIPTION OF PROJECT

The federally preferred alternative includes approximately 278 miles of transmission line, including 265 miles of new 345-kV transmission line and 13 miles of new 230-kV line, five new substations and additional equipment, but no expansion, to four existing substations. The federally preferred alternative includes the following project components:

- 45 miles of 345-kV transmission line connecting the existing AVS Substation to a new Red Substation near Killdeer, including an approximately 3/4 mile segment immediately west of AVS Substation where the proposed line would be double-circuited with an existing line
- 21 miles of 345-kV transmission line connecting the new Red Substation to the existing Charlie Creek Substation

- 27 miles of 345-kV transmission line connecting the new Red Substation to the new White Substation and 36 miles of 345-kV transmission line connecting the White Substation to the new Blue Substation
- 51 miles of 345-kV transmission line from the Charlie Creek Substation to the Blue Substation
- 24 miles of 345-kV transmission line from the Blue Substation to the proposed Judson Substation
- Two 230-kV single-circuit transmission lines running parallel for 5 miles connecting the Blue Substation to Western's 230-kV transmission line
- 2 miles of 230/115-kV double-circuit transmission line connecting the proposed Judson Substation to the Williston Substation
- 61 miles of 345-kV transmission line connecting the proposed Judson Substation to the proposed Tande Substation, approximately 31 miles of which would be double-circuited with a MWEC 115-kV line associated with other regional improvement projects
- 1 mile of 230-kV transmission line connecting the proposed Tande Substation to the Neset Substation
- Ten temporary equipment laydown/material and staging areas of approximately five acres each will be located along the transmission line route. These locations include Tande, Daniel, Jackman, Judson, Patent Gate, Tarnavsky, Charlie Creek, Jepson, Gaugler and AVS.

Judson, Tande, and Blue 345/230-kV Substations

The proposed Judson and Blue substations would be constructed to interconnect the proposed 345-kV lines to Western's Williston Substation and to Western's Williston to Charlie Creek 230-kV transmission line along U.S. Highway 85 south of the Missouri River, respectively. Basin Electric's Tande Substation would be constructed to interconnect the 345-kV transmission system to the existing 230-kV system at Basin Electric's Neset Substation located near Tioga. The Judson and Tande substations would each occupy approximately 12 acres of land. The Blue Substation consists of both 345/230-kV and 345/115-kV equipment, therefore a 25 acre parcel would be required.

Red, White, and Blue 345/115-kV Substations

To interconnect the proposed 345-kV lines into the local 115-kV system and serve the load demands of the Williston Load Pocket and surrounding area, three new 345/115-kV substations would be constructed along the 345-kV system The Red Substation would be located near Killdeer. The White Substation would be located north of the Red Substation and east of Watford City. The Blue Substation would be located south of the Missouri River. The Red Substation and White Substation would occupy approximately 12 acres of land each. The Blue Substation site would be approximately 25 acres because it would also include a 345/230-kV component as noted above.

Route Alignment

The alignment for the 345-kV lines and associated facilities are shown on Figure 2-3. Throughout the environmental review process, Basin Electric continued engineering development and worked with agencies and landowners to address potential project-related concerns. As final design, ROW acquisition, and construction progresses, Basin Electric will continue to work with agencies and landowners to address site-specific concerns. Minor project adjustments are likely to occur and would address concerns and minimize overall impacts, resulting in few if any changes to the potential impacts of the project.

DECISIONS TO BE MADE/AUTHORITIES

This Record of Decision (ROD) documents findings specific to potential RUS financial assistance for the proposed project and specific terms and conditions that will apply. The RUS ROD is based on the environmental, engineering, and economic acceptability of the project. The RUS decision centers around a review of the project proposal's technical and economic justification, reliability, and environmental issues, and the location, in its entirety (both federally managed lands and private property).

The Forest Service (USFS) and Western Area Power Administration (Western) have issued their decisions in separate RODs specific to the decisions associated with the project proposal. The Forest Supervisor for the Little Missouri National Grasslands (LMNG) is responsible for deciding whether to issue a Special Use Permit (SUP) under the Federal Land Policy and Management Act, with terms and conditions for the construction, maintenance, and operation of a transmission line through lands administered by USFS on LMNG. Western is responsible for considering the interconnection request in accordance with its General Requirements for Interconnection and the Federal Power Act. Western is also serving as the lead federal agency for

compliance with Section 106 of NHPA for historic properties and for consultation regarding Section 7 of the ESA.

ENVIRONMENTALLY PREFERRED ALTERNATIVE

In accordance with the provisions of NEPA, 40 C.F.R. §1502.14(e), the Final EIS identifies the environmentally preferred alternative. Based on the analysis and consideration of public comments on the Draft EIS and the Supplemental Draft EIS, the environmentally preferred alternative was identified as Alternative D (construction of a double circuit line). The environmentally preferred alternative is similar to the federally preferred alternative with the primary differences being the construction of a 345/345-kV double-circuit lines north of Killdeer for 63 miles to the Blue Substation, the additional Killdeer South 345-kV Switchyard, a 345-kV transmission line connection between the Red Substation and the Killdeer South Switchyard, and no line construction between the existing Charlie Creek Substation and the new Blue Substation. The environmentally preferred alternative would include construction of approximately 251 miles of transmission line beginning at the AVS Substation and ending at the Neset Substation, including 13 miles of new 230-kV line and 238 miles of new 345-kV transmission line, of which 65.3 miles would be 345/345-kV double-circuit. The environmentally preferred alternative would also include construction of five new substations, one switchyard, and additional equipment but no expansion to the four existing substations. The environmentally preferred alternative would include the following project components:

- 45 miles of 345-kV transmission line connecting the existing AVS Substation to a new Red Substation near Killdeer, including 2.3 miles immediately west of AVS substation where the proposed line would be double-circuited with an existing line to facilitate future coal mine operations
- 21 miles of 345-kV transmission line connecting the Red Substation to the existing Charlie Creek Substation
- A new Killdeer South Switchyard south of Killdeer along Basin Electric's existing AVS to Charlie Creek 345-kV transmission line
- Two 345-kV single-circuit transmission lines running parallel for approximately 12 miles between the Red Substation and the new Killdeer South Switchyard
- 27 miles of 345/345-kV double-circuit transmission line connecting the Red Substation to the new White Substation and 36 miles of 345/345-kV double-circuit transmission line connecting the White Substation to the new Blue Substation
- 24 miles of 345-kV transmission line from the Blue Substation to the proposed Judson Substation

- Two 230-kV, single-circuit transmission lines running parallel for 5 miles connecting the Blue Substation to Western's 230-kV transmission line
- 2 miles of 230/115-kV double-circuit transmission line connecting the proposed Judson Substation to the Williston Substation
- 61 miles of 345-kV transmission line connecting the proposed Judson Substation to the proposed Tande Substation, approximately 31 miles of which would be double-circuited with a MWEC 115-kV line associated with other regional improvement projects
- 1 mile of 230-kV transmission line connecting the proposed Tande Substation to the Neset Substation

Additional substation facilities for the environmentally preferred alternative would be the same as those discussed previously for federally preferred alternative.

RANGE OF ALTERNATIVES CONSIDERED

A. Action Alternatives

Originally, two alternatives, A and B, and a no-action alternative were considered and evaluated in the DEIS. Due to increased electricity demand projections required to meet the need for the project, particularly in McKenzie County, a Supplemental DEIS was prepared to address the increased demand. Alternatives A and B were eliminated from further consideration in the Supplemental DEIS because they no longer satisfied the purpose and need for the project as a result of the increased load demand. The Supplemental DEIS evaluated three alternatives and a no-action alternative. These alternatives included:

- Alternative C (the federally preferred alternative), which combined Alternative A and portions of Alternative B (as identified in the DEIS)
- Alternative D (the environmentally preferred alternative), which included the construction of 345-kV double-circuit lines north of Killdeer for 63 miles along Alternative B (as identified in the DEIS)
- Alternative E, which is similar to Alternative D except for the construction of two 345-kV lines running parallel north of Killdeer for 63 miles

Of all the corridors and alignments considered, the corridors and alignments for Alternatives C, D, and E were determined to best avoid physical and environmental constraints. Route alignments within these corridors are considered fully in the EIS. Constructing the AVS-to-

Charlie Creek-to-Judson-to-Tande-to-Neset transmission line with the North Killdeer Loop using 345-kV transmission lines with associated substations and inter-connections was determined to best satisfy the project's purpose and need. Table 1 provides a comparison of project components by alternative.

B. The No Action Alternative

The no-action decision means that the RUS would not provide financial assistance for the project proposal. Under the no-action alternative, the AVS to Neset Transmission Project would not be constructed. It should be noted that Basin could seek financial assistance for the project from another source. The existing environment within the project area would remain the same and no land would be used for transmission lines, facilities, or substations. The no-action alternative does not meet the identified purpose and need for the project. Under this alternative, it is expected that load growth will increase beyond the load-serving capacity of the existing transmission system for the Williston/Tioga region by 2016, resulting in transmission system reliability issues and violating te criteria established by North American Electric Reliability Corporation (n\NERC) for transmission reliability in the region. Moreover, if the transmission lines are not built, it is probable that oil and gas operations would develop alternative sources of electrical power, including the use of diesel generators, which could potentially lead to greater environmental impacts.

Table 1: Components of Project Alternatives

		Alternative C	Alternative D	Alternative E
Transmission Line Segments	**Kilovolts**	**Miles**	**Miles**	**Miles**
AVS Substation to Red Substation	345	45	45	45
Red Substation to Charlie Creek Switchyard	345	21	21	21
Red Substation to Killdeer South Switchyard	345	N/A	24	24
Charlie Creek Substation to Blue Substation	345	51	N/A	N/A
Red Substation to White Substation	345	27	27	54
White Substation to Blue Substation	345	36	36	72
Blue Substation to Western's 230-kV Line	230	10	10	10
Blue Substation to Judson Substation	345	24	24	24
Judson Substation to Williston Substation	230	2	2	2
Judson Substation to Tande Substation	345	61	61	61
Tande Substation to Neset Substation	230	1	1	1
Total miles		**278**	**251**	**314**
Substations/Switchyards				
		Acres	**Acres**	**Acres**
AVS Substation (345kV)	Existing	19	19	19
Red Substation (345kV)	Proposed	12	12	12
Charlie Creek Substation (345/230/115kV)	Existing	10	10	10
White Substation (345/115kV)	Proposed	12	12	12

		Alternative C	Alternative D	Alternative E
Blue Substation (345/230/115kV)	Proposed	25	25	25
Judson Substation (345/230kV)	Proposed	12	12	12
Williston Substation (230/115kV)	Existing	9	9	9
Tande Substation (345/230kV)	Proposed	12	12	12
Neset Substation (230/115kV)	Existing	8	8	8
Killdeer South Switchyard (345kV)	Proposed	N/A	12	12
Cost Analysis				
Total Cost Transmission		$352 million	$374 million	$399 million
Total Cost Substation		$155 million	$188 million	$188 million
Total Project Cost		$507 million	$562 million	$587 million
Incremental Cost from Alternative C		--------	$55 million	$80 million
Discussion:		Preferred based on higher reliability rating at a lower cost, provides future growth	Removed from consideration due to failure to achieve stated purpose and need due to lower reliability and redundancy at higher cost	Removed from consideration due to failure to achieve stated purpose and need due to lower reliability and redundancy at much higher cost

DECISION AND REASONS FOR DECISION

A. Decision

RUS has made the following decisions with respect to this project proposal:

- RUS has determined that the NEPA process has been satisfied with respect to a potential request for financial assistance from Basin Electric for this project.

- RUS has reviewed the proposed project's justification and associated engineering studies and agrees that the proposed project meets the stated purpose and need. The engineering design of the proposed project, with all overhead construction, was approved by RUS.

- The line would be constructed in accordance with the FEIS. RUS has determined that the proposed project would be approximately 278 miles of transmission line, including 265 miles of new 345-kV transmission line and 13 miles of new 230-kV line, five new substations and additional equipment, but no expansion, to four existing substations. The proposed project includes the construction of 345-kilovolt (kV) transmission line facilities from Basin Electric's AVS generation facility in northwestern North Dakota to increase the capacity and reliability of the electricity transmission infrastructure of the region. The line would connect AVS with Basin Electric's Charlie Creek and Neset substations and Western Area Power Administration's (Western) Williston Substation. It would also provide new substation facilities to connect the proposed line into the current transmission system and provide locations for load-serving connections.

- Historically, RUS has not approved financing of underground transmission systems in rural areas. RUS prefers overhead transmission line construction for this project due to length of the transmission line and higher costs associated with underground transmission line construction. RUS has reviewed Basin Electric's Underground Policy that states that Basin will consider construction of underground high voltage facilities when the local jurisdictions or landowners agree to bear the increased cost of the underground facilities. RUS has found this policy to be both reasonable and prudent. The policy is also in agreement with other major utilities

- This decision is based on the following documents:

  - *Macro-Corridor and Alternatives Evaluation Study for the AVS to Neset 345-kV Transmission Line Project, October, 2011.*

  - *Antelope Valley Substation to Neset Transmission Project Draft Environmental Impact Statement, November 2012.*

  - *Antelope Valley Substation to Neset Transmission Project Supplemental Draft Environmental Impact Statement, December 2013.*

  - *Antelope Valley Substation to Neset Transmission Project Final Environmental Impact Statement, May 2014.*

B. Reasons for the Decision

RUS's decision is to select the federally preferred alternative. The primary reasons for this decision are explained below.

The federally preferred alternative (Alternative C from the FEIS) is consistent with the purpose and need of the proposed project and complies with applicable laws and regulations. Route characteristics and potential impacts of each of the alternatives are discussed in more detail in Chapter 3 of the FEIS.

RUS concluded that this federally preferred alternative best meets the project's stated purpose and need while minimizing or mitigating potential impacts. This project is critical to serve the growing load of electric consumers in western North Dakota and eastern Montana in the vicinity of the Bakken oil fields. The preferred alternative best meets both the capacity needs (a forecasted load of 909 MW expected to occur by 2018-2019 winter season) and reliability standards (adequacy and security). Given the possibilities of transmission line outages and the required application of NERC/Midwest Reliability Organization (MRO) standards, a looped system like the one provided by the federally preferred alternative C is much more reliable than either a double-circuit transmission line as presented in Alternative D of the FEIS (the environmentally preferred alternative) or two parallel lines as presented in Alternative E.

It is likely that over time an event, like a tornado in summer or ice storm in the winter, will occur in the area of the proposed project. While it is less likely that such an event would affect a single area when it occurs, it is likely to take out a portion of the double-circuit line (Alternative D) or both the parallel lines (Alternative E). Such a loss of both 345-kV lines to the load centers near Watford City and Williston, North Dakota, would result in interruptions to large numbers of electrical customers. In contrast, with the looped system proposed under the federally preferred alternative, the likelihood of a severe event resulting in an outage of both 345-kV lines proceeding northward would be greatly reduced because the critical high-voltage lines are not on common structures or near each other. This aspect of the federally preferred alternative, as well as the fact that it is the lowest cost alternative, were significant considerations in identifying it as the preferred alternative. Further the federally preferred alternative presents geographical separation that provides for future growth in western McKenzie County.

Western and USFS concur with RUS' selection of the federally preferred alternative. Concurrence of both agencies is dependent on the project proponent implementing all mitigation measures outlined in Appendix A of the FEIS and obtaining a SUP from USFS for portions of the line that cross the LMNG.

OTHER ALTERNATIVES CONSIDERED AND ELIMINATED

This section discusses the alternatives that have been considered throughout the planning process but were eliminated for various reasons from further consideration. These alternatives, as well as other alternatives considered as a result of the revised purpose and need for the project, are summarized below and are discussed in detail in the *Macro-Corridor and Alternatives Evaluation Study for the AVS to Neset 345-kV Transmission Line Project.*

System Upgrades

As an alternative to constructing a new line, numerous operating scenarios and system facility upgrades were developed and evaluated for the Integrated System (IS). For the Basin Electric service area, the designated Reliability Coordinator is the IS. The IS consists of the Western Area Power Administration, Basin Electric, and Heartland Consumers Power District and is the backbone of the high-voltage transmission grid in the upper Great Plains. These scenarios were modeled with different line ratings, line carrying capacities, and system contingencies. The initial effort to improve the area transmission system focused on upgrading local equipment to reduce system limitations. These improvements included a second 230/115-kV transformer at the Williston Substation and second 345/230-kV transformers at both Belfield and Charlie Creek substations.

Area line ratings are increased by upgrading terminal equipment or actually raising transmission line structures to increase clearances to improve the line rating. These line rating increases have already or are scheduled to occur on the Richland-Williston 115-kV line, the Baker-Hettinger 230-kV line, and the Mandan-Dickinson-Belfield 230-kV line. To improve voltage profile, several capacitor bank installations are underway at the existing Watford City, Kennaston, Grenora, Minot SW, and Logan substations.

In addition, 115-kV line improvements are underway. These include a new 115-kV line connecting the Blaisdell to Berthold Substations and a new 115-kV line connecting the Snake Creek Pump Station to the Blaisdell and Tioga Substations. These projects are being implemented through a shared effort of Basin Electric, its membership, and Western. However, evaluation of these system upgrades indicate that this alternative would not meet the increased load forecast.

Additional 115-kV Lines

Constructing and operating several additional 115-kV lines based on predicted load growth were considered. Basin Electric member cooperatives identified these proposed new lines to serve specific loads. These transmission lines would not have been operated as part of the overall electricity transmission network and are needed with or without the proposed project. Identified lines include:

- Mountrail-Williams Electric Cooperative (MWEC) 115-kV lines to serve the Tioga and Blaisdell areas
- MWEC 115-kV line between Watford City and Swenson
- MWEC 115-kV lines between Charlie Creek and Halliday
- 115-kV line connection between Snake Creek Pumping Station and Parshall with an interconnection at Blaisdell

Construction and operation by the different member cooperatives of these 115-kV facilities would mitigate many of the existing system limitations through 2014. These facilities would reduce loading on the McHenry-Souris 115-kV line, Logan-Tioga 115-kV line, and Charlie Creek-Williston 230-kV line, which could be transmission constraints during peak load conditions. However, many of the current system limitations, such as the potential for low voltages, voltage collapses, and transmission line overloads could still occur even with the construction and operation of the proposed new lines as early as 2015. The critical outage is the loss of the Charlie Creek-Watford City 230-kV line, which results in low voltages across northwest North Dakota and also overloads the Richland-Williston 115-kV line.

Based on the limitations of the system even with the proposed new lines and the subsequent NERC criteria violations, these projects would not fully meet the need of the proposed project in creating system reliability and therefore were not carried forward for analysis.

Alternative Corridors

Potential alternatives to address the inability of the current system to meet projected load forecasts beyond the 2014-2016 time period were identified and analyzed. These alternatives included an evaluation of numerous macro-corridors, as discussed in the *Macro-Corridor and Alternatives Evaluation Study for the AVS to Neset 345-kV Transmission Line Project*, October, 2011, for constructing additional 345-kV or greater voltage. Corridors for the development of alternative routes for project construction were identified in the macro-corridor analysis. Other macro-corridors were dismissed. A summary of these corridors and reasons for dismissal are provided below.

One macro-corridor that was evaluated and eliminated would run north from the AVS Substation to the existing Neset Substation near Tioga. This alternative would require the line to cross both the Fort Berthold Reservation and Lake Sakakawea. Crossing the Fort Berthold Reservation would involve a lengthier approval process that would likely delay the project well beyond 2016, leading to declines in the electric reliability of the region. Based on the project load growth of increases of approximately 15 percent in 2014 and 2015, the timeliness of project completion is critical, and this route creates a scenario that does not meet the need of the proposed project.

In addition, crossing Lake Sakakawea presents some significant engineering challenges. The line would have to be placed at significant depths in the lake and would require specialized equipment that is normally used for ocean work and not available within the region. This would add significant costs and logistical issues to the project. For these reasons, this north corridor was eliminated from further consideration.

An additional macro-corridor that was considered and subsequently eliminated included a corridor that would have extended westward from the existing Charlie Creek Substation. This corridor would cross a significant distance of very rough terrain with limited access for structure placement. It would also cross significant areas of the LMNG and increase overall project length. This corridor would increase costs and create logistical obstacles for the project. Therefore, it was eliminated from further consideration.

Another corridor evaluated and eliminated connected the Leland Olds Station to the Neset Substation by routing a 345-kV line around the east side of Lake Sakakawea. Leland Olds Station is located near Stanton, North Dakota approximately 18 miles east of AVS. This corridor would extend northward towards Minot, connecting at the existing Logan Substation, extending westward to connect with the proposed Tande Substation, and finally terminating at the existing Neset Substation. This alternative would cross the Missouri River, be adjacent to significant U.S. Department of the Interior, Fish and Wildlife Service (USFWS) wildlife refuge complexes, and cross hundreds of miles of the Missouri Coteau region that includes significant wetland resources and migratory waterfowl nesting and stopover habitat. Although the electrical delivery capacity of this alternative to the Tioga area is similar to the alternatives being carried forward, this alternative would not address the added load-serving capacity in McKenzie County and Alternatives C, D, or E would still be required to meet the overall project purpose and need. As a result of the additional infrastructure required, length of line, and the potential for additional environmental impacts, this alternative was eliminated from further consideration.

All routes considered would cross the Missouri River and/or Lake Sakakawea. In addition, several of the corridors eliminated would cross significant areas of topographic relief with limited access, as well as more remote, undisturbed natural areas. The construction of the AVS-to-Charlie Creek-to-Judson-to-Tande-to-Neset 345-kV transmission lines with associated substations and interconnections was determined to best satisfy the project's purpose and need.

One alternative to constructing and operating the single 345-kV North Killdeer Loop circuit between the Red and Blue substations would be to construct two parallel 345-kV lines between the Charlie Creek Substation and the Blue Substation. These parallel lines would follow the

proposed alignment of Alternative C between the Charlie Creek and Blue substations. This alternative would provide adequate power delivery to McKenzie County. The primary obstacle for construction of two parallel lines from Charlie Creek Substation to the Blue Substation would be their placement on USFS managed lands east of U.S. Highway 85 and east of the Theodore Roosevelt National Park (TRNP). To maintain power delivery in the event that one line fails as part of a catastrophic event or natural disaster, such as tornadoes or icing, the two circuits would need to be constructed on separate poles on separate alignments. The separation between the lines would need to be a minimum of 150 feet—centerline to centerline (NERC, 2014). Two sets of structures would increase the visual impact of the project, and in addition, it is likely that one set would be located outside the USFS preferred utility corridor (as considered in the Northern Great Plains Management Plan Revision FEIS [USFS, 2001]) along the east side of U.S. Highway 85. Furthermore, the terrain east of U.S. Highway 85, which cuts into the Little Missouri River Valley, would force a second parallel line up to higher ground adjacent to the road corridor causing the second line to be more visible from the TRNP and the USFS designated Roadless areas (Lone Butte and Long X Divide). North of this area, the parallel lines would also cross LMNG parcels that were avoided or minimized in the routing of Alternative C as a single 345-kV line. Most notably, a parallel line further east of the Alternative C alignment would extend into the Lone Butte designated Roadless area and would not be consistent with USFS management activities for that area. Additionally, having two 345-kV lines within relative proximity increases the risk of regional power delivery failure to this critical area from a catastrophic event.

Alternative Routes Near the Killdeer Mountain Battlefield Study Area

Basin's proposed corridor passed near the Killdeer Mountain Battlefield (KMB) Historic Site. Several routes were located within the corridor. At the North Dakota Public Service Commission (NDPSC) hearing in September 2013 for Basin's route application (DEIS Alternative A), several members of the public expressed concern about possible impacts to the KMB site and the American Battlefield Protection Program's defined study area. The original location in the corridor was futher south from the KMB. The NDPSC approved Basin's route. Subsequent to issuing the SDEIS, Basin met with landowners in the area and the landowners preferred line location was closer to KMB historic site (approximately 1½ miles south). RUS has received comments on both the SDEIS and FEIS regarding the location of the preferred Alternative (Alternative C) through the Killdeer Mountain Battlefield Study Area. These comments indicate that an additional alternative should be developed that would eliminate the need to route the transmission line through the study area. During the initial review of alternativeroute locations in the area were identified and evaluated, however, based on the meetings with the affectd landowners the present location was identified as acceptable.

New 500-kV Line AVS to Williston Area to Neset

Several alternatives were considered that evaluated constructing a 500-kV line. These included a single 500-kV line within a retained macro-corridor or a combination of single 345-kV lines between AVS and Charlie Creek and Judson and Tande along with a single 500-kV line between Charlie Creek and Williston to provide additional capacity within the service area. While the construction of a 500-kV line could address the system capacity needs of the project purpose and need, no other 500-kV facilities are present in North Dakota. Thus, development of a 500-kV

line would require significant expansion and possible relocation of numerous substations throughout the area to accommodate the 500-kV transformers and other equipment, including AVS, Charlie Creek, and Judson, which increase project cost and timeline. In addition, constructing a 500-kV line would require a larger ROW and increased tower height. Construction of 500-kV facilities was eliminated from further consideration because of the increased environmental impact, cost, and schedule.

Additional Generation

The results of the power supply study (IS, 2011) indicate that sufficient regional electrical generation is available to serve the region. However, limited transmission capacity prevents it from being accessible to serve the regional demand. As a result, additional generation is not required, nor would it meet the purpose and need for the project. The IS did indicate, however, that between 2012 and 2016 several local distribution transmission line projects will be required to correct deficiencies at specific locations. In addition, the study notes that voltage support, provided through new generation, would be required at strategic locations to prevent any interruptions of service on the existing transmission lines that would result from the increased thermal loading because of voltage or current flow fluctuations on the lines due to the increasing electrical demand. In response to those studies, Basin Electric is developing the Pioneer Generation Station, near Williston and the Lonesome Creek Station, near Alexander to provide the necessary voltage support during periods of peak demand in the region.

Phase I of both projects includes a 45-MW simple cycle combustion turbine that was brought online in 2013. Phase II of both projects consists of placing two additional 45-MW simple cycle combustion turbines at each location. At the present time, the Pioneer Phase II project is operational, while Lonesome Creek Station Phase II is under construction and expected to begin initial commercial operations in December 2014. These projects, consisting of approximately 270 MW of capacity, are needed to protect the reliability of power delivery and load-serving capacity in the region of the proposed AVS to Neset Transmission Project. Further, because these facilities are intermediate and peaking resources that can chase load, they are ideal for addressing the immediate power needs in this area and providing reliable peaking power for the whole IS once the AVS to Neset Transmission Project is completed. This is an ideal complementary form of generation to any additional wind generation that is added to the IS in the future. Because most of the new load in northwest North Dakota is of a 24-hour-a-day, 7-days-a-week, 365-days-a-year variety, wind is a not an available option to supply this new load. Thus, complementary generation such as natural-gas-combustion-turbines would also need to be developed along with the available wind resources.

Further, this new generation would avoid and displace portable generation and combustion-engine-driven oil and gas extraction engines at the wells. It would also hasten the capture of more of the natural gas at the well-heads, and avoid both the flaring and release of natural gas during the oil extraction process.

New generation built to serve the growing load on the IS since 2000 has been almost exclusively wind and natural gas, including:

- More than 700 MW of new wind generation capacity owned or purchased through power-purchase contracts by Basin Electric.
- Approximately 300 MW of natural-gas-combined-cycle generation owned and operated by Basin Electric that began commercial operation in August 2012 near White, South Dakota.
- Approximately 380 MW of natural-gas-combustion-turbine generation owned and operated by Basin Electric near Groton, South Dakota, and Culbertson, Montana.

The purpose of the AVS to Neset Transmission Project is to increase high-voltage transmission line system reliability and the transmission load-serving capacity in the region. Once the AVS to Neset Transmission Project is completed, new additional natural-gas-peaking power would become more readily available to all IS customers, not just the customers in northwest North Dakota. As such, development of additional generation, without considerable additional transmission capacity, would not meet the regional load requirements. Except for voltage support type projects, sufficient regional electrical generation is available to serve the region. However, limited transmission capacity prevents it from being accessible to serve the regional demand. As a result, additional generation is not sufficient to meet the purpose and need for the project, and was therefore dropped from further consideration.

Alternative C Variations

To address the concerns of USFS and commenters regarding the potential impacts of the Project to LMNG, an additional alternative was evaluated that would double circuit a portion of Alternative C along the U.S. Highway 85 corridor (see Figure 2-1).

This modification of Alternative C investigated the potential to double circuit the proposed 345-kV line with an existing Western 230-kV line located within the U.S. Highway 85 corridor area. Double-circuiting focused on the area of the Little Missouri River Badlands.

While different voltages, the 345-kV Basin Electric line and the Western 230-kV line would provide system redundancy and back up for each other. Double-circuiting these lines present the potential for both lines to be out of service at the same time as a result of maintenance requirements, a weather event, or other circumstances. Basin Electric and Western are required to comply with the reliability standards of the NERC/MRO.

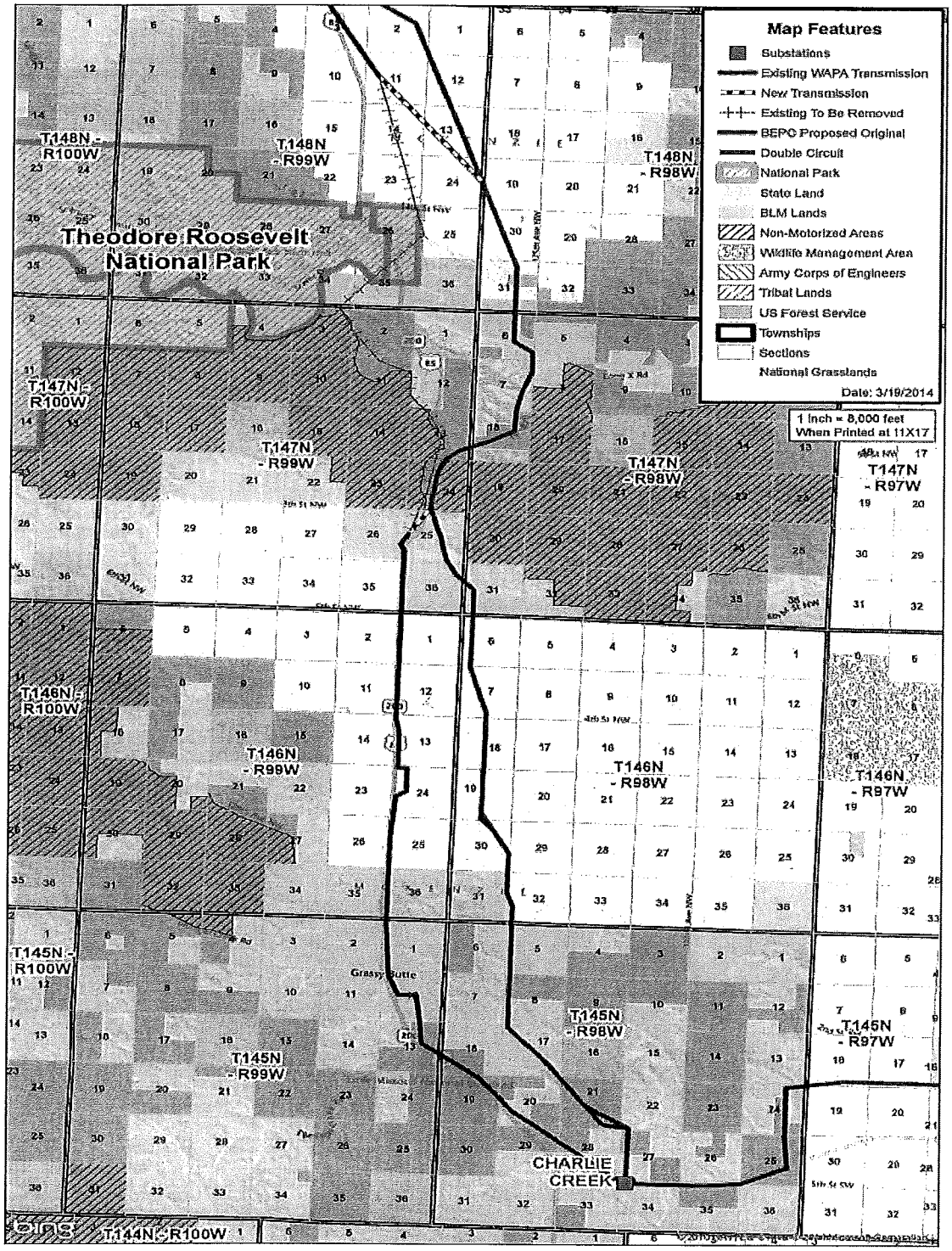
A loss of both lines to the load centers near Watford City and Williston, North Dakota, would result in interruptions to large numbers of electrical customers. To prevent such reliability failures, the MRO standard for reliability limits the length of double circuit segments of transmission lines to less than 1 mile for any transmission segment.

One option for double-circuiting in this area was to relocate the alignment of Alternative C to follow the alignment of the existing 230-kV line and rebuild the existing 230-kV line as a double circuit 345/230-kV line. This alternative was eliminated from consideration for several reasons.

- The existing 230-kV line could not be taken out of service to allow construction of the double circuit line, requiring the new line to be constructed while the existing line was still energized. Such construction poses considerable safety risks and therefore significantly increases construction time and cost.

- The double-circuit structures would be approximately 25 feet taller than the single circuit 345-kV structures and approximately 50 to 60 feet taller than the existing 230-kV structures and increase potential visual impacts, particularly for the TRNP, which the existing line crosses.

Figure 2-2: Alternative C Variations



- While double circuiting the line segment through the Little Missouri River Badlands would address considerations of impacts to USFS and the U.S. Department of the Interior, National Park Service (NPS) lands, it would not be viable because the modification would not be compliant with MRO standards as noted above.

Consideration was also given to building a new 345/230-kV double-circuit line parallel and adjacent to the existing Western 230-kV line. This option would avoid the construction difficulties and safety concerns with construction in an energized transmission ROW and also enable the Western line to stay in service until construction was completed. At that time, with Alternative C completed, it would be possible to take the 230-kV line out of service for a short period to transfer it to the new double-circuit structures. The portion of the existing 230-kV line transferred could then be removed and the ROW restored. This alternative was also eliminated from further consideration because of potential impacts associated with acquiring and constructing a new ROW across the TRNP and associated impacts from removal of the existing line. The new double-circuit line would also be considerably taller (approximately 50 to 60 feet) than the existing 230-kV structures, contributing to greater visual impacts.

Finally, construction of several miles of a 345/230-kV double circuit line along the alignment of Alternative C within the U.S. Highway 85 corridor was considered. For this modification, Alternative C would be constructed along the proposed alignment, but would include double-circuit structures for several miles in the U.S. Highway 85 corridor. Following construction, the 230-kV line corresponding to the section of double-circuit 345/230-kV line would be transferred to the 345-kV structures. These structures would need to be approximately 25 feet taller than the single circuit 345-kV structures. Once transferred, the 230-kV structures would be removed and the ROW restored. This modification was also eliminated from further consideration because it would not meet the overall purpose and need for the project of increasing system reliability because it would fail to meet MRO standard TPL-503-MRO-01. This standard requires that a double-circuit transmission line be less than 1 mile long to maintain system reliability. These system reliability standards would apply to both Western's 230-kV line and the 345-kV line proposed by Basin Electric. In addition, this option would have an additional administrative burden under the Federal Land Policy Management Act, which governs the issuance and management of ROWs on federal public lands.

Additional Alternative C Variations

In the Little Missouri River Badlands area, the alignment of Alternative C would cross approximately 2.6 miles of LMNG within the U.S. Highway 85 corridor. Several commenters expressed concern for the potential visual impacts of locating Alternative C along the east side of the highway, while a Western 230-kV line currently exists along the west side of the highway. In response to these concerns, variations of double-circuit and parallel alignments and configuration of Alternative C were considered in this limited area where the line crosses LMNG

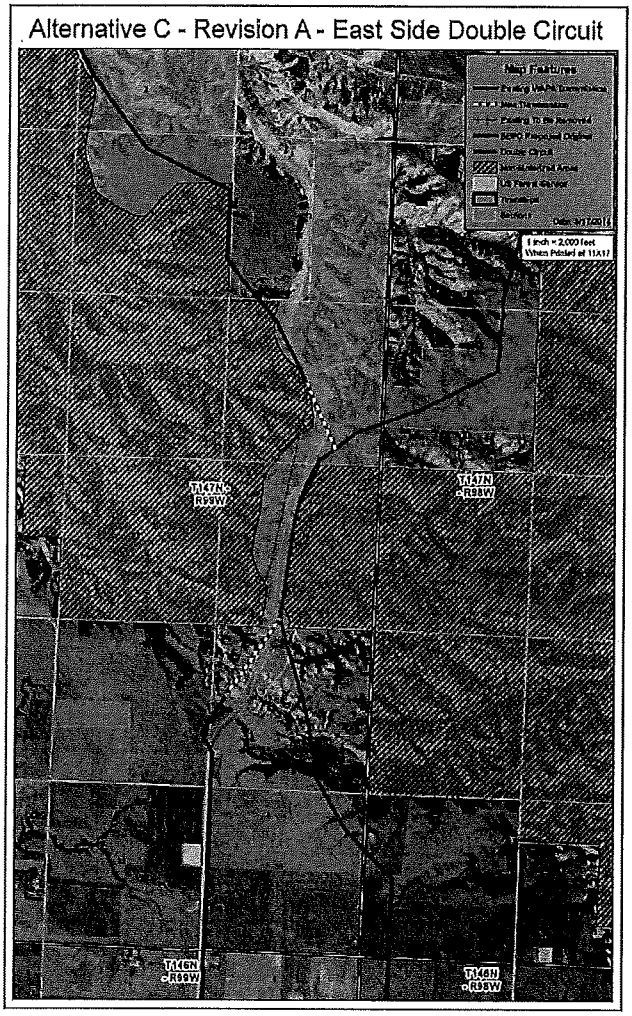
lands to better compare and assess the potential impacts, including visual impacts. Those variations are described below.

Alternative C is located on the east side and parallel to U.S. Highway 85 for approximately 1 mile in T147N; R99W; Section 24. The area in Section 24 is a topographical ridge that separates two large drainages; the larger basin to the west represents a much larger viewshed from a highway traveler's perspective. To the east of U.S. Highway 85, the drainage is much smaller and falls to the east prior to turning north toward the Little Missouri River. Immediately on the west side of the highway there is a generally flat area approximately 700 feet wide that is occupied by U.S. Highway 85, the USFS Summit Campground and Trailhead Park, and Western's existing north to south aligned 230-kV transmission line. Immediately west of this area the topography falls off quickly in a large heavily eroded area of the Little Missouri River Badlands. Conversely, the east side of the highway looks into the side-hill of the engineering cut created in the construction of the highway grade.

Three variations of a proposed double-circuit alignment are possible in this area. A map of the double circuiting is shown on Figure 2-2. For simplicity, only the east side double circuiting is visually depicted on the figure. Alignments on the west side of U.S. Highway 85 would follow the existing Western 230-kV line.

The three variations that were evaluated to possibly minimize the visual impacts to LMNG lands are described as follows. Each of these variations involved less than 1 mile of double circuit to remain compliant with MRO reliability requirements. A double-circuit segment could be constructed on the west side of U.S. Highway 85 that would eliminate the need for any structures on the east side of the highway for this particular segment. The second variation to Alternative C would be to place a single circuit 345-kV line parallel to the existing 230-kV segment on the west side of U.S. Highway 85. Under this scenario, no structures would be placed on the east side of the segment in question. The single circuit structures would not require the additional 25 foot structure height. However because there is insufficient room between the existing 230-kV line and the existing U.S. Highway 85 Highway, the parallel 345-kV alignment would be required to be constructed to the west of the existing 230-kV line. To accomplish this, the proposed 345-kV line would pass over the existing 230-kV line and the corresponding structure height would be increased approximately 20 feet. This alternative would require an additional 150 feet of ROW within the USFS Summit Campground and Trailhead Park.

Figure 2-2: Alternative C-1



The west side double-circuit and west side single-circuit alternatives present additional construction, engineering, operational safety complexities, increased costs, and visual impacts that are not present on the east side alternative. Therefore these alternatives were considered but dismissed from further consideration.

A third variation considered included constructing Alternative C along the proposed alignment east of U.S. Highway 85, using double-circuit structures for approximately 1 mile. Following completion of construction, the corresponding section of Western's 230-kV line along the west side of the highway would be relocated onto the 345/230-kV double circuit structures. This variation of Alternative C was retained for further consideration in the FEIS and is discussed in Section 2.4.2 of the FEIS.

Undergrounding All or Portions of Transmission Line

Underground construction of electricity transmission lines, particularly extra high-voltage lines is generally considered as part of the evaluation of project alternatives for the routing and development of new EHV transmission lines. Construction of underground transmission lines has been effectively used for many years in a number of specific applications and circumstances around the country. These applications include:

- areas of considerable congestion where new, undeveloped ROW is unavailable or so limited that the reduced ROW width for undergrounding presents not just a viable alternative, but in many cases, the only practical alternative;
- areas where height restrictions (such as on or around airports) prevent use of overhead lines;
- areas of considerable visual sensitivity (such as nationally designated scenic resources or National Register historic properties) where overhead lines would significantly impact the visual setting of the area; and
- areas of significantly elevated land values where large portions of the additional costs of underground construction can be off-set by significant reductions in overall project cost obtained through the use of much narrower ROW.

The AVS to Neset Transmission Project area in North Dakota presents none of these challenges or constraints. While there are areas with height restrictions, these have been easily avoided through route development. Additionally, areas of scenic value would be crossed by the proposed project and may affect certain viewsheds but others can be avoided. The abundance of open, undeveloped land creates no compelling reason to consider underground construction and its associated costs, challenges, and impacts; therefore, undergrounding has not been considered as a viable alternative for this project.

AGENCY AND PUBLIC INPUT

A Notice of Intent to Hold Public Scoping Meetings and Prepare an EIS was published in the *Federal Register* on November 2, 2011, informing the public of the intent by RUS to prepare an EIS and to hold public scoping meetings. The notice initiated the 30-day public scoping period and included the dates for public scoping meetings that were held November 15 and 16 in Williston and Killdeer, North Dakota, respectively. The purpose of the public scoping meetings was to provide the public with information regarding the proposed project, answer questions, identify concerns regarding the potential environmental impacts that may result from construction and operation of the project, and gather information to determine the scope of issues to be addressed in the RUS environmental review process and documentation of the project (RUS, 2012). The notification process, public scoping meeting materials, and the process for collecting public comments are described in more detail in the Public Scoping Report (RUS, 2012).

A notice of availability of the DEIS for the AVS to Neset Transmission Project was published in the *Federal Register* on December 7, 2012. Two public hearings were held on January 15 and 16, 2013, in Killdeer and Williston, North Dakota, respectively. Approximately 30 comments were submitted to RUS on the DEIS during the public comment period that ended on January 22, 2013. These comments are summarized in Appendix B of the FEIS. No comments regarding impacts to historic resources were submitted.

A notice of availability of the Supplemental DEIS was published in the *Federal Register* on December 20, 2013, followed by a public hearing held in Watford City, North Dakota on January 16, 2014. Public comments were accepted on the document until February 3, 2014. Approximately 45 comments were received on the document; these comments and responses are summarized in Appendix C of the FEIS.

A notice of availability of the Final EIS was published in the *Federal Register* on May 30, 2014. Six comments were received on the document. Eight comment letters were received and are included in Appendix 1.

FINDINGS REQUIRED BY OTHER LAWS

Numerous laws require that decisions be consistent with their provisions. The FEIS and ROD complies or is consistent with all applicable laws including but not limited to those listed below. In addition, a number of federal, state and local permits and approvals would be required prior to construction. A complete list is found in the FEIS on Table 6-1.

A. National Environmental Policy Act of 1969 (NEPA)

The analysis in support of RUS's decisions was performed under statutory requirements and regulations set forth under NEPA. All appropriate steps of the NEPA process were followed including public scoping, identification of issues, development of alternatives, disclosure of environmental consequences, and public comment periods. The entirety of documentation for this project supports compliance with NEPA.

B. The Endangered Species Act

The proposed project is subject to compliance with the Endangered Species Act (ESA). The ESA of 1973 designates and provides for the protection of threatened and endangered plants and animals and their critical habitat. For the proposed project, Western acted as the lead agency for Section 7 consultation under the ESA. Throughout this process, Western consulted with the U.S. Department of the Interior, Fish and Wildlife Service (USFWS) to establish a list of protected species; prepare a Biological Assessment (BA) of the potential for the proposed project to

adversely affect listed species; provide coordination between state and federal biological resource agencies to assess impacts and propose mitigation; and develop appropriate mitigation strategies for all adverse impacts on federally listed species. Western determines in its BA the proposed AVS project would have "no effect" on the threatened gray wolf (Canis lupus), the endangered pallid sturgeon (Scaphirhynchns albus), or the endangered black-footed ferret (Musleia nigripes). In addition, Western has determined that the project "may affect, but is not likely to adversely affect" the Sprague's pipit, the threatened piping plover (Charadrius melodus), designated critical habitat for the piping plover, the endangered interior least tern (Slernula antillarum), the endangered whooping crane (Gray americana), the Northern long-eared bat, the Dakota skipper, and the red-knot. In addition, Western provided an in depth analysis of a Line Marking Plan which proposes to mark approximately 93 percent of the total alignment (over 253 miles of the line, with exception of 21 miles through the Badlands) with bird flight diverters on the static wire. The line marking measures proposed are expected to increase the visibility of the tap line to enhance visual cues for migrating whooping cranes, piping plovers, interior least terns, and Sprague's pipit and, therefore, minimize the potential for collision with the line.

Based upon the project description, conservation measures identified the analysis of potential effects to each species and associated avoidance and minimization measures, and the Line Marking Plan and associated rationale, the USFWS concluded that the effects to the above-mentioned federally-listed species are either insignificant or discountable and therefore concurred with the analysis provided in the March 2014, Biological Assessment submitted to USFSW by Western.

C. Clean Water Act

Clean Water Act (CWA) Section 404 authorizations may be required for the project, because its construction may result in discharge of dredged and/or fill material into waters of the United States. The U.S. Army Corps of Engineers (USACE) is the agency responsible for determining whether to issue a permit for wetland impacts associated with the project. Receipt of a Section 404 permit and adherence to the terms and conditions of the permit, including any associated compensatory mitigation and best management practices (BMPs) to reduce sedimentation and erosion control, would demonstrate the project's compliance with the CWA. Specific permit conditions, including the quantity or extent of compensatory mitigation and specific BMPs, would be determined by USACE after a project alternative has been selected. Field inspections of the project would evaluate and verify compliance with permits and the CWA.

D. Clean Air Act

There are no significant effects on any aspect of air quality covered by the Clean Air Act or associated regulations from this decision.

E. National Historic Preservation Act

Section 106 of NHPA requires federal agencies to take into account the effects of their undertakings on historic properties and seek to accommodate historic preservation concerns through consultation among the agency officials and other parties. The goal of consultation is to identify historic properties potentially affected by the undertaking; assess effects; and seek ways to avoid, minimize, or mitigate any adverse effects on historic properties.

Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to take into account the effects of their undertakings on historic properties and provide the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment on such effects. The regulations (36 CFR Part 800), implementing Section 106 establish the procedures through which the statutory requirements are met. In order to reach a decision regarding an undertaking, a federal agency is required to implement the regulatory procedures in consultation with nonfederal parties, including the North Dakota State Historic Preservation Office (NDSHPO), Indian tribes, the applicant, Basin Electric, and others with an interest in the project. RUS, Western and the USFS have determined that the individual federal action, which each may take, makes the AVS to Neset Transmission Project an undertaking subject to Section 106 review.

To meet their collective responsibilities, RUS was designated as the lead for NEPA review because its financial assistance will affect all aspects of the AVS to Neset Transmission Project. For Section 106, RUS and USFS agreed, pursuant to 36 CFR § 800.2(a)(2), to designate Western as the lead federal agency because of the availability of its regional staff to actively direct and participate in consultation. In accordance with 36 CFR § 800.8(a)(1), RUS and Western have coordinated implementation Section 106 regulatory procedures with the steps taken to fulfill the requirements of NEPA. As part of this coordination, pursuant to 36 CFR § 800.2(d)(3), Western relied on implementation of the RUS NEPA procedures to meet the agencies' collective Section 106 requirements for public involvement.

Section 106 review was initiated with the participation of the NDSHPO in one of the NEPA Scoping meetings held in November 2011. Indian tribes also were invited to participate in these NEPA scoping meetings, but none attended. Therefore, by letter dated January 31, 2012, Western invited fourteen Indian tribes with a possible interest in the project's effects on historic properties, including the Standing Rock Sioux Tribe (SRST), to participate in Section 106 review. Only two tribes responded to this invitation, and neither wished to participate directly in Section 106 review.

None of the commenters on the DEIS, which was issued in December 2012, expressed concerns about impacts to cultural resources, including historic properties. However, in February 2013, the SRST asked to become a consulting party in Section 106 review. Western granted this request.

The 1864 Battle of Killdeer Mountain is regarded as a highly significant engagement between the U.S. military and the Sioux Nation during the Dakota Wars. A one acre State Historic Site

commemorating this battle is located in Dunn County, North Dakota approximately one and one half miles north of the proposed transmission line. However, in a 2010 report the American Battlefield Protection Program (ABPP), which is part of the National Park Service, identified approximately 17, 000 acres+ as a study area in which activities related to this battle may have occurred. Approximately eight miles of the proposed transmission line passes through the ABPP Killdeer Mountain Battlefield (KMB) study area. These entire eight miles are privately owned and Basin Electric has obtained all the necessary easements from the private landowners.

During the September 2013 North Dakota Public Service Commission (PSC) hearing for Basin Electric's route application (DEIS Alternative A), several members of the public expressed concern about possible impacts to the ABPP defined battlefield study area. In addition to these objections the United Tribes of North Dakota issued a resolution (#9-13-10) opposing Basin Electric's project and any further development at the site of the Battle of Killdeer Mountain. In response to September 3, 2013 SHPO recommendations to the PSC, the federal agencies agreed to move a proposed substation out of the KMB study area, and to conduct study of the eight miles of transmission line right-of-way crossing through the KMB study area to determine if material evidence of the battle is present. The agencies also conducted additional study and analysis to better assess possible the visual effects of the project. In order to ensure the identification of historic properties of religious and cultural significance to Indian tribes, Western hosted a meeting in September 2013 between the federal agencies and the SRST. The Sisseton Wahpeton Oyate (SWO), which had requested and been granted consulting party status, also participated in this consultation meeting. Along with these two Indian tribes, the North Dakota SHPO and Basin Electric, Western granted consulting party status to the following additional parties - the Killdeer Mountain Alliance (KMA), the ABPP, Mr. and Mrs. Craig Dvirnak (private landowners), and the Center for Heritage Renewal at North Dakota State University.

Because the project will cover a large land area to which access, in some cases, has been restricted, the federal agencies determined it appropriate to use a phased approach to the identification and evaluation of historic properties and the assessment and resolution of adverse effects to them. Therefore, since effects on historic properties cannot be fully determined prior to federal action, the agencies determined that, pursuant to 36 CFR § 800.14(b)(1)(ii), execution of a Programmatic Agreement (PA) to be appropriate to fulfill the requirements of Section 106 review. RUS agreed to assist Western in managing PA preparation and consultation. Accordingly, RUS prepared the first draft of the PA, which it then submitted to the consulting parties in March 2014 along with a schedule for concluding Section 106 review. In accordance with 36 CFR § 800.6(a)(1)(i)(C), RUS invited the ACHP to participate in consultation. The ACHP provided RUS with an informal affirmative response on April 10, 2014.

Starting on April 16, 2014, RUS, with the assistance of Western and USFS, hosted several meetings with consulting parties to establish the terms of the PA and consider the possible effects of the project on certain historic properties. The primary issue considered was the level of effort needed to reasonably understand the nature and geographic scope of the KMB, and the possible impact of the project on it. As a result of this consultation effort, the federal agencies and the SHPO agreed to treat the Killdeer Mountain, Medicine Hole and, as described in the FEIS, the KMB historic property as eligible for listing on the National Register of Historic Places. On July 2, 2014, Section 106 review concluded with the execution by RUS, Western,

USFS, the ACHP and the North Dakota SHPO of the PA titled, *Programmatic Agreement Among the Western Area Power Administration, the Rural Utilities Service, the U.S. Forest Service, the Advisory Council on Historic Preservation and the North Dakota State Historic Preservation Office Regarding the AVS-Neset 345 kV Transmission Line Project to be Constructed in Mercer, Dunn, Billings, McKenzie, Williams and Mountrail Counties, North Dakota.* With its execution, the federal agencies are now legally committed to the implementation of the terms of the PA.

In accordance with the terms of the PA, the federal agencies proposed that the AVS-Neset Transmission Line Project would have no adverse effect on Killdeer Mountain, Medicine Hole and, as described in the FEIS, the KMB historic property. On August 4, 2014, the NDSHPO concurred with this proposed finding of no adverse effect with the correct understanding that it applies only to the three historic properties and not to the undertaking in its entirety. The KMA filed an objection to this finding of no adverse effect dated August 22, 2014. In accordance with the terms of the PA, the federal agencies will resolve this objection, seeking the advice of the ACHP, through the established procedures in 36 CFR § 800.5(c).

F. Energy Policy Act

The Energy Policy Act of 2005 granted the Federal Energy Regulatory Commission (FERC) the authority to impose mandatory reliability standards on transmission systems. To accomplish this, FERC designated NERC as the Electric Reliability Organization with the authority to establish, approve, and enforce the reliability standards. NERC then delegated the authority for proposing and enforcing the reliability standards to particular regions. For the Basin Electric service area, the MRO was designated. The MRO accomplishes its monitoring and enforcement obligations by designating Reliability Coordinators. For the Basin Electric service area, the designated Reliability Coordinator is the IS. The IS consists of the Western Area Power Administration, Basin Electric, and Heartland Consumers Power District and is the backbone of the high-voltage transmission grid in the upper Great Plains. It is the responsibility of the IS to adhere to the reliability standards by providing a high-voltage transmission system grid in the region of eastern Montana, North Dakota, and South Dakota.

G. Executive Order 12898 (Environmental Justice)

Executive Order 12898 (February 11, 1994, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations) directs each federal agency "to make achieving environmental justice part of its mission by identifying and addressing, as appropriate,

disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low income populations." In July 1999, the EPA issued its Final Guidance for Consideration of Environmental Justice in Clean Air Act Reviews. The concepts explained in this guidance are applicable beyond Clean Air Act reviews.

The EPA's guidance has been applied to the public analysis and decision processes in coming to this decision. The AVS to Neset Transmission Project do not disproportionately impact any minority or low income populations; and the project complies with Executive Order 12898.

H. Important Farmland

The AVS to Neset Transmission Project ROW is expected to cross approximately 88 acreas of farmland that is designated by the National Resource Conservation Service as prime farmland, 1,604 acres of farmland of statewide importance and 62 acres of prime farmland if drained or irrigated. Together these lands constitute 35 percent of the lands in the ROW. The permanent disturbance occurring from placement of structures within the ROW constitutes less than 1 percent of total land within the ROW. This includes approximately 0.88 acres of prime farmland.

Impacts to important farmland will be avoided to the greatest extent possible through careful pole placements. Due to the minor amount of important farmland potentially affected, RUS has determined that the AVS to Neset Transmission Project will not significantly impact important farmlands.

I. Executive Order 11990 (Wetlands) of May, 1977

This Executive Order directs RUS to take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. In compliance with this Order, RUS evaluated the proposed project's potential to adversely affect wetlands [insert the finding] (see Final EIS Table 3-13). This decision is in compliance with this Order.

J. Executive Order 11988 (Floodplains) of May, 1977

This Executive Order directs the RUS to provide leadership and to take action to (1) minimize adverse impacts associated with occupancy and modification of floodplains and reduce risks of flood loss, (2) minimize impacts of floods on human safety, health, and welfare, and (3) restore and preserve the natural and beneficial values served by floodplains. ApproximatEley 14.3 acres of open water occur within the right-of-way. Nineteen perennial waterways and 16.5 acres of Federal Emergency Management Agency (FEMA) designated floodplains would be crossed by the proposed project. All open water, waterways and floodplains will be spanned. Basin will obtain a Section 10 permit from the U.S. Army Corps of Engineers for crossing of the Missouri River. The transmission line will cross the Missouri River adjacent to an existing transmission line within a utility corridor. RUS has anticipated that there will be no impacts to floodplains.

K. North Dakota Energy Conservation and Transmission Facility Siting Act (Public Service Commission)

In addition to compliance with all applicable federal regulations and permits, approvals must be granted by the state of North Dakota. The North Dakota Energy Conversion and Transmission Facility Siting Act states that it is necessary to ensure that the location, construction, and operation of energy conversion and transmission facilities will produce minimal adverse effects on the environment and on the welfare of the citizens of the state by providing that no energy conversion or transmission facility shall be located, constructed, and operated within North Dakota without a certificate of site compatibility and a route permit acquired pursuant to Chapter 49-22 of the North Dakota Century Code (North Dakota Century Code, 2011a). It is state policy to site energy conversion facilities and to route transmission facilities in an orderly manner compatible with environmental preservation and the efficient use of resources. To comply with the North Dakota Energy Conversion and Transmission Facility Siting Act, sites and routes shall be chosen to minimize adverse human and environmental impacts while ensuring continuing system reliability and integrity and ensuring that energy needs are met and fulfilled in an orderly and timely fashion. The Certificate of Corridor Compatibility establishes a corridor through which the proposed facilities may be routed. The Route Permit is acquired through a pre-application route development phase, a review of completeness, a public meeting process, and finally a route approval that is contingent on adherence to other federal, state, or local permitting considerations (North Dakota Public Service Commission [NDPSC], 2012).

The North Dakota Public Utility Commission approved AVS to Neset Route (Alternative A) on April 23, 2014.

L. Required Permits, Licenses, Grants and Authorizations

Prior to construction, Basin Electric will need to acquire a number of permits from other federal, state and local agencies. Permits are listed in the FEIS, *Table 6-1.*

CONSISTENCY WITH RUS POLICIES

In accordance with the Rural Electrification Act of 1936, as amended, (7 United States Code [U.S.C.] 901 et seq.), RUS is authorized to make loans and loan guarantees to finance the construction of electric distribution, transmission, and generation facilities including system improvements and replacements required to furnish and improve electric service in rural areas, as well as demand side management, energy conservation programs, and on- and off-grid renewable energy systems. Basin Electric is requesting financial assistance from RUS for the proposed

345-kV transmission line(s) and substations in Mercer, Dunn, McKenzie, Williams, and Mountrail counties. RUS's proposed federal action is to decide whether to provide financial assistance for the project; accordingly completing the NEPA process is one requirement, along with other technical and financial considerations in processing Basin Electric's application.

RUS' agency actions include the following:

- Provide engineering reviews of the purpose and need, engineering feasibility, and cost of the proposed project.
- Ensure that the proposed project meets the borrower's requirements and prudent utility practices.
- Evaluate the financial ability of the borrower to repay its potential financial obligations to RUS.
- Review and study the alternatives to mitigate and improve transmission reliability issues.
- Ensure that adequate transmission service and capacity are available to meet the proposed project needs.
- Ensure that NEPA and other environmental laws and requirements and RUS environmental policies and procedures are satisfied prior to taking a federal action.

RUS Loan Review

This ROD is not an approval of the expenditure of federal funds. The ROD concludes the agency's environmental review process in accordance with NEPA and RUS's Environmental Policies and Procedures (7 CFR Part 1794). The ultimate decision as to loan approval depends upon the conclusion of this environmental review process plus financial and engineering analyses. Issuance of the ROD will allow these reviews to proceed.

Right to Administrative Review

This Record of Decision concludes the agency's environmental review process pursuant to the National Environmental Policy Act and the RUS's Environmental Policies and Procedures (7 CFR Part 1794). There are no provisions to appeal this decision. Legal challenges to the ROD may be filed in federal district court under the Administrative Procedures Act.

APPROVAL

This Record of Decision is effective on signature.

Dated: SEP 13 2014

JACQUELINE M. PONTI-LAZARUK
Acting Administrator
Rural Utilities Program

Contact Person

For additional information on this Record of Decision or the Environmental Impact Statement, please contact Mr. Dennis Rankin, Environmental Protection Specialist, at USDA, Rural Utilities Service, 1400 Independence Avenue, SW., Room 2244, Stop 1571, Washington, D.C. 20250-1571; telephone: (970) 403-3559; fax: (202) 720-1953; or e-mail: dennis.rankin@wdc.usda.gov.

APPENDIX 1. AVS-NESET 345 KV TRANSMISSION LINE PROJECT

FINAL ENVIRONMENTAL IMPACT STATEMENT

COMMENT LETTERS & RESPONSES

NORTH DAKOTA DEPARTMENT OF HEALTH (JUNE 18, 2014)

KILLDEER MOUNTAIN ALLIANCE (JULY 1, 2014)

BADLANDS CONSERVATION ALLIANCE (JUNE 27, 2014)

VALERIE BLUEMLE (JUNE 30, 2014)

TERRY MOORE (JUNE 8, 2014)

ARLEN D. DOMINEK (JUNE 13, 2014)

WAYNE HAUGE (JUNE 14, 2014)

FEDERAL AVIATION ADMINISTRATION (JULY 8, 2014)

NORTH DAKOTA
DEPARTMENT *of* HEALTH

ENVIRONMENTAL HEALTH SECTION
Gold Seal Center, 918 E. Divide Ave.
Bismarck, ND 58501-1947
701.328.5200 (fax)
www.ndhealth.gov

June 18, 2014

Mr. Dennis Rankin
Environmental Protection Specialist
USDA, Rural Utilities Service
1400 Independence Ave. SW, Stop 1571
Washington, DC 20250-1571

Re: Final EIS for Basin Electric's Proposed
Antelope Valley Station to Neset 345-kV Transmission Project
Dunn, McKenzie, Mercer, Mountrail & Williams Counties in North Dakota

Dear Mr. Rankin:

This department has reviewed the information concerning the above-referenced project submitted under date of May 23, 2014, with respect to possible environmental impacts.

This department believes that environmental impacts from the proposed construction will be minor and can be controlled by proper construction methods. With respect to construction, we have the following comments:

1. All necessary measures must be taken to minimize fugitive dust emissions created during construction activities. Any complaints that may arise are to be dealt with in an efficient and effective manner.

2. Care is to be taken during construction activity near any water of the state to minimize adverse effects on a water body. This includes minimal disturbance of stream beds and banks to prevent excess siltation, and the replacement and revegetation of any disturbed area as soon as possible after work has been completed. Caution must also be taken to prevent spills of oil and grease that may reach the receiving water from equipment maintenance, and/or the handling of fuels on the site. Guidelines for minimizing degradation to waterways during construction are attached.

3. Projects disturbing one or more acres are required to have a permit to discharge storm water runoff until the site is stabilized by the reestablishment of vegetation or other permanent cover. Further information on the storm water permit may be obtained from the Department's website or by calling the Division of Water Quality (701-328-5210). Check with the local officials to be sure any local storm water management considerations are addressed. Storm water runoff from the project area discharges to a 303(d) listed water body (Little Missouri River). Extra care should be taken to ensure construction activity does not affect the water body.

4. Noise from construction activities may have adverse effects on persons who live near the construction area. Noise levels can be minimized by ensuring that construction equipment is equipped with a recommended muffler in good working order. Noise effects can also be minimized by ensuring that construction activities are not conducted during early morning or late evening hours.

The department owns no land in or adjacent to the proposed improvements, nor does it have any projects scheduled in the area. In addition, we believe the proposed activities are consistent with the State Implementation Plan for the Control of Air Pollution for the State of North Dakota.

If you have any questions regarding our comments, please feel free to contact this office.

Sincerely,

L. David Glatt, P.E., Chief
Environmental Health Section

LDG:cc
Attach.

NORTH DAKOTA
DEPARTMENT of HEALTH

ENVIRONMENTAL HEALTH SECTION
Gold Seal Center, 918 E. Divide Ave.
Bismarck, ND 58501-1947
701.328.5200 (fax)
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Construction and Environmental Disturbance Requirements

These represent the minimum requirements of the North Dakota Department of Health. They ensure that minimal environmental degradation occurs as a result of construction or related work which has the potential to affect the waters of the State of North Dakota. All projects will be designed and implemented to restrict the losses or disturbances of soil, vegetative cover, and pollutants (chemical or biological) from a site.

Soils

Prevent the erosion of exposed soil surfaces and trapping sediments being transported. Examples include, but are not restricted to, sediment dams or berms, diversion dikes, hay bales as erosion checks, riprap, mesh or burlap blankets to hold soil during construction, and immediately establishing vegetative cover on disturbed areas after construction is completed. Fragile and sensitive areas such as wetlands, riparian zones, delicate flora, or land resources will be protected against compaction, vegetation loss, and unnecessary damage.

Surface Waters

All construction which directly or indirectly impacts aquatic systems will be managed to minimize impacts. All attempts will be made to prevent the contamination of water at construction sites from fuel spillage, lubricants, and chemicals, by following safe storage and handling procedures. Stream bank and stream bed disturbances will be controlled to minimize and/or prevent silt movement, nutrient upsurges, plant dislocation, and any physical, chemical, or biological disruption. The use of pesticides or herbicides in or near these systems is forbidden without approval from this Department.

Fill Material

Any fill material placed below the high water mark must be free of top soils, decomposable materials, and persistent synthetic organic compounds (in toxic concentrations). This includes, but is not limited to, asphalt, tires, treated lumber, and construction debris. The Department may require testing of fill materials. All temporary fills must be removed. Debris and solid wastes will be removed from the site and the impacted areas restored as nearly as possible to the original condition.

Rankin, Dennis - RD, Washington, DC

From: Rob Sand <killdeermtn@gmail.com>
Sent: Tuesday, July 01, 2014 12:01 AM
To: Rankin, Dennis - RD, Washington, DC
Cc: G. Edward Dickey
Subject: Killdeer Mountain Alliance Comments on the FEIS, AVS-NESET 345 kV TRANSMISSION LINE PROJECT and PA

Mr.Dennis Rankin

Environmental Protection Specialist
USDA, Rural Utilities Service
1400 Independence Avenue, SW, Stop 1571
Washington, DC 20250-1571

Killdeer Mountain Alliance (KMA) Comments on the FEIS

The Killdeer Mountain Alliance has faithfully participated in the meetings regarding the AVS-NESET 345 kV TRANSMISSION LINE PROJECT and the Programmatic Agreement process (PA) that followed the release of the SDEIS, We believe that the final EIS minimizes well-documented impacts that the proposed transmission line would have on the Killdeer Mountain Battlefield, in order to avoid developing an alternative route, as required by NEPA.

In other words, we believe that the purpose of the PA has been to pave the way for approval of the route across the historic Killdeer Mountain Battlefield, regardless of the cultural and historical issues raised by many expert parties. The Agencies have achieved this by declaring that the Battlefield has already been so degraded that another intrusion will have no significant impact.

One of the guidelines for determining that a site has lost its integrity is that the area would no longer be recognizable by someone who had been there at the time of the historical event. Despite the present limited oil field development, the terrain is still very recognizable. Ms. Dean, the RUS lead on this effort, has largely dismissed the concerns and objections of the Killdeer Mountain Alliance, the United Tribes of North Dakota, and the NPS-Battlefield Protection Program.

The Killdeer Mountain Alliance has repeatedly asked the participating agencies to require Basin Electric to present an alternative route for public consideration, to no avail. It appears that the Department of Agriculture wants this project to go forward as designed, and that the NEPA requirement to develop an alternative route that would avoid obvious further degradation of the documented confines of the Battlefield has been ignored.

How ironic it will be if the 150th anniversary of the Battle of Killdeer Mountain is commemorated by the RUS funding degradation of a site clearly documented by the expert agency of the Federal Government, the National Park Service, as a site of particular historic and cultural importance to the Nation.

We are disappointed in the process.

Sincerely,

Rob Sand and G. Edward Dickey
Killdeer Mountain Alliance

BADLANDS CONSERVATION ALLIANCE
A VOICE FOR WILD NORTH DAKOTA PLACES

Badlands Conservation Alliance
Field Office
801 North 10 Street
Bismarck, ND 58501
701-255-4958 badlandsconservationalliance.org

June 27, 2014

Mr. Dennis Rankin
Environmental Protection Specialist
U.S. Department of Agriculture
Rural Utilities Service
1400 Independence Avenue SW
Stop 1571
Washington, DC 20250-1571

RE: Proposed Antelope Valley Station to Neset 345-kV Transmission Project
Final Environmental Impact Statement (FEIS)

Dear Mr. Rankin:

Badlands Conservation Alliance (BCA) is a western North Dakota based non-profit organization focused on public lands and public natural resources in western North Dakota, particularly Theodore Roosevelt National Park and the Little Missouri National Grassland. The majority of our members, and certainly the charter members, live in or originated in the small communities and rural landscapes surrounding these public lands. Members hold significant familiarity with these lands and value them for a host of ecological, heritage and personal reasons, frequently through multiple generations.

BCA attended the open house for this project in Killdeer, ND on November 16, 2011 and submitted comments during the scoping period. We again had representation at the public hearing in Killdeer, ND on January 15, 2013 and submitted comments on the Draft EIS dated January 21, 2013.

We attended and testified at North Dakota Public Service Commission (NDPSC) hearings in Killdeer, ND on September 4, 2013, and likewise in Williston, ND on September 12, 2013.

Under all of the above described circumstances we voiced opposition to any route that passed within or near the North Unit of Theodore Roosevelt National Park as well as the Long X Divide and Lone Butte roadless areas on the Little Missouri National Grassland.

In an attempt to find resolution for Basin Electric's proposed line we offered a number of opportunities and mitigation strategies.

In comments on the Supplemental Draft Environmental Impact Statement, Badlands Conservation Alliance asked that Alternative D, including route corrections for the Killdeer Mountain Battlefield study area, be selected as the Preferred Alternative. BCA maintains the sanctity of Theodore Roosevelt National Park and the significance that the USFS-managed, unroaded areas Lone Butte and Long X Divide bring to that Park's future, to our wildlife populations, and to historic and future quality of life issues. These increasingly rare parcels are templates for future oil and gas reclamation. We urged the Rural Utilities Service, the USFS,

Western, and Basin Electric to pursue an alternative for the proposed transmission line on that basis and with solidarity that a solution satisfactory to all interests might be adopted.

It was not.

While Alternative D is the Environmentally Preferred Alternative, Alternative C is the FEIS Preferred Alternative for reasons of reliability and redundancy. Additions have been made to the FEIS that support this selection, but the conclusion does not address our concerns. Indeed, the FEIS suggests that Alternatives D and E were included with a pre-determination that they did not satisfy *Purpose and Need* and served only as placeholders for the required range of reasonable alternatives.

BCA appreciates that analysis found in this FEIS acknowledges concerns BCA has expressed for negative impacts to Theodore Roosevelt National Park, the Little Missouri National Grassland's roadless areas Lone Butte and Long X Divide, Aesthetics and Visual Resources, Biological Resources including wildlife habitat, and Recreation and Tourism. However, manipulation of the findings in the FEIS fails to accurately weigh the essential value, the current and future significance, and what BCA would describe as the 'purpose and need' for protecting and sustaining these resources.

The proposed Antelope Valley Station to Neset 345-kV Transmission Project is a major undertaking. As we have stated previously, there were fallibilities expressed in the SDEIS that are continued in the FEIS and skew assessments.

The extent of industrial development in western North Dakota begs the NEPA process to address on the ground realities. To conclude that a 278 mile transmission line impacts 1.4 acres of surface land use (plus 73 acres for substation development) is a farce. It is typical NEPA language, but it is a farce.

To state: *Because the proposed project would support further development in the study area, indirect cumulative impacts on wildlife are likely to occur from additional development in the area; however, the project's contribution to these impacts is expected to be minimal* (FEIS, Cumulative Impact, page 4-27) is shallow analysis. This proposed transmission line is being built to service the oil and gas industry. If there were no line, development would either slow to meet supply or find another form of power as reflected by the FEIS statement on page 4-41 of the FEIS: *The cities and industrial developers would likely find another source of electric power, such as self-generation, if the proposed action were not built.*

BCA is neither opposing adequate electric transmission in western North Dakota nor denying the need. However, we are emphatically voicing our responsibility to defend the integrity and significance of Theodore Roosevelt National Park, Lone Butte roadless area and Long X Divide *suitable for wilderness*. Construction of Alternative C through the 'eye of the needle' would result in dramatic long term negative impacts. For many, even a majority of those invested in these management designations, the proposed project would cause permanent impairment of a degree that could provoke permanent dis-use for the life of the individual, a scenario that often becomes generational by default.

The FEIS repeatedly attempts to point out the limited length of Alternative C's passage through the valley of the Little Missouri State Scenic River and frames that mileage in terms of the larger 278 mile project, degrading its importance. To the contrary, it is rather due to the very compactness and adjacency of these parcels that they hold such significance. There is NO other place on the 1 million acre Little Missouri National Grassland where this circumstance arises. It is unique and irreplaceable.

It is this area of the *Affected Environment* where *Aesthetics and Visual Resources* most overlap with *Recreation and Tourism*. *Table 4-1: Cumulative Impact Boundaries by Resource Area* on page 4-2 of the FEIS states that the *Aesthetic and Visual Resources* spatial boundary for this project *will be 10 miles around the proposed route*. That parameter would encompass nearly the entirety of Long X Divide *suitable for wilderness* and Lone Butte roadless area.

The spatial boundary for Recreation and Tourism in the same table is defined as *1 mile of the transmission line; and/or extent of visual, air quality, water quality, traffic and noise impacts.* Considering the uniqueness of USFS management description and rarity of acreage under said designation, the need to preserve current qualities is paramount. BCA finds that FEIS language under *4.4.10 Recreation and Tourism* on page 4-43 is totally disingenuous: *Under Alternatives C, D, and E, the proposed project would avoid the TRNP and the Lone Butte and Long X Divide management areas of the LMNG. Therefore, it would not be expected to have any cumulative impacts on recreational use of those areas.*

In reference to USFS scenic integrity objectives, the FEIS uses Lone Butte itself at a distance of 3.8 miles from the proposed Alternative C to allow the statement: *Only very distant views of the corridor would be noticeable from this vantage point* (FEIS, page 3-25). It avoids acknowledgment in this section that the proposed transmission line runs immediately at the western boundary of the equally significant and larger Lone Butte roadless area. The capacity for this 'eye of the needle' to "absorb" the proposed 345kV transmission line is a contradiction in terms.

Such examples as the above are like saying there is no impact to the homeowner should a disruptive facility be erected down the centerline of the public sidewalk crossing her property - especially if she stays away from the sidewalk and safely up on the front porch. Context matters.

Considerable effort has been made in the FEIS to expand the discussion on reliability and redundancy. Among other references, included are the Energy Policy Act of 2005 and Midwest Reliability Organization standard TPL-503-MRO-01, System Performance, Section R1.2.

BCA reviewed the USFS Special Use Permit Draft Record of Decision on this project prior to submitting these comments. The USFS document refers to the October 2009 Memorandum of Understanding for transmission siting on federal lands.

This MOU appears to be a complicated process of determination with very specific requirements. It appears to have played a major part in the selection of Alternative C as the Federally Preferred Alternative.

It is necessary that the interested public have a clear understanding of the process and the responsible authorities participating. We request that a timeline of project meetings and consultations and the Consolidated Administrative Record be made available.

An alternative noted as Alternative C-1 is a new addition to the FEIS. While it may be an effort to diminish the impacts to the proposed corridor between Long X Divide *suitable for wilderness* and Lone Butte roadless area, the FEIS does not supply the viewshed analysis necessary to determine its effectiveness. An analysis of impacts on Lone Butte, Long X Divide and the North Unit of Theodore Roosevelt National Park must be completed and submitted to the public for consideration. The above mentioned MOU should make this practicable and timely.

Furthermore, mention is made on page 2-34 of the FEIS that Alternative C would include *2.3 miles immediately west of AVS Substation where the proposed line would be double circuited*

with an existing line to facilitate future coal mine operations. The footnote included states: *Midwest Reliability Organization (MRO) standard TPL-503-MRO-01, System Performance, Section R1.2 provides for a variance from the 1 mile limitation on double circuiting on a case-by-case basis, including at substation entrances as in this case.*

BCA found that MRO Section R1.2 cited states: *Any two circuits of a multiple circuit towerline excludes transmission circuits where multiple circuit towers are used over a cumulative distance of 1 mile or less in length. Planning Coordinator and/or Transmission Planner may ask for a variance to the multiple circuit towerline exclusion from the MRO on a case by case basis for short distances that are longer than 1 mile (e.g., station entrance, river crossings).* Underlining is BCA's.

Figure 2-1: Alternative C Variations on page 2-26 of the FEIS shows the potential for double circuiting of the existing WAPA line with the proposed Basin Electric line through the 'eye of the needle' and across the Little Missouri River valley, ultimately removing the problematic and existing WAPA through the Park.

Page 3-26 of the FEIS states: *In portions of the project area where the proposed transmission line transects areas with moderate scenic integrity levels, special mitigation strategies could be employed to reduce impacts on visual and aesthetic resources.* Three strategies are bulleted, the third being:

- *Offsets – Correcting an existing aesthetic problem identified within the viewshed of a proposed project may qualify as an offset or compensation for project impacts. A decline in the landscape quality associated with a proposed project can, at least partially, be offset by the correction. In some circumstances a net improvement may be realized.*

Prior to any decision regarding this proposed project, full consideration and analysis must be given to the alternative illustrated in *Figure 2-1.* If the Transmission MOU process adequately communicated between impacted agencies, this alternative should have been fully considered. If 2.3 miles of double circuiting is an acceptable variance "to facilitate future coal mine operations" then certainly a variance is valid "compensation" for a National Park, the 'eye of the needle,' and the Little Missouri State Scenic River valley.

Again, BCA has consistently and in good faith participated in the public NEPA process throughout the life of this proposed project. The easy dismissal of Environmentally Preferred Alternative D based solely on industry is beyond disappointing. Alternative C-1 cannot be accepted or rejected without a full viewshed analysis. Selection of Alternative C WITH the full offset variance illustrated in *Figure 2-1* could be the solution that lets this project move forward.

Respectfully,

Jan Swenson, ED
Badlands Conservation Alliance

cc: Thomas Tidwell, Chief, US Forest Service
Dennis Neitzke, Supervisor, Dakota Prairie Grasslands
Jay Frederick, McKenzie District Ranger, Dakota Prairie Grasslands

June 30, 2014

Mr. Dennis Rankin

Environmental Protection Specialist

USDA, Rural Utilities Service

1400 Independence Avenue, SW, Stop 1571

Washington, DC 20250-1571

COMMENTS REGARDING THE FINAL EIS FOR THE AVS-NESET 345 kV TRANSMISSION LINE PROJECT AND PROGRAMMATIC AGREEMENT (PA)

Mr. Rankin,

My name is Valerie Bluemle, I identify myself as a member of Killdeer Mountain Alliance, a fifth generation North Dakotan, and am employed in Cultural Resource Management in ND. Reading the one transcript available to the public regarding S. 106 consultation I disagree with the decisions made regarding Killdeer Mountain Battlefield, Killdeer Mountain as a whole and sites within, and the Diamond C Ranch, or I should say the complete lack of mention and regard to it. The following are my comments by page number.

1-4

It seems rather peculiar to me that WAPA initiated consultation January 31, 2012 and not one tribe was granted consulting party status until February 2013. It is not clear to me how it took over a year for the tribes to become participants. Did the tribes initially deny any interest, was it certain to the agencies that the tribes received or were aware of your initial attempt to consult them on this project? They certainly raised opposition once they were granted consulting party status, so why is it that it took one whole year for them to react?

1-6 and 1-7

Did Basin explore other energy alternatives, or is coal the only energy source examined. Why or why not? These options could and should include wind, solar, water, and gas from the oil fields.

3-24

The eastern segment is classified as having low scenic integrity? By whom? How? Where is the evidence to support this statement?

How would the Western segment not impact the overall scenic integrity, or scenic designation of the highway? What is the cumulative impact? Where is the tipping point for this area? How does this affect the scenic aspect that the highway offers when considering the view the passerby has of the Killdeer Mountains?

3-26

What does SIO mean, and how is the reader supposed to interpret what a high or moderate SIO is? The average adult should be able to read an EIS and understand the language and analysis within. http://www.shipleygroup.com/news/articles/0611.pdf

3-148

Why "probably"? Did anyone ask the tribes what spurred their participation? An EIS is supposed to contain conclusions, not assumptions and guesses.

3-149

Was the corridor a six mile wide corridor, or six mile long corridor? If the corridor was six miles wide I do not understand why Metcalf and ND SHPO failed to identify the battlefield, picket burials, the Diamond C Ranch, and Medicine Hole as significant and potentially eligible sites to avoid. The battlefield when it was recorded in 1993 was known to not be completely identified in the initial inventory and that boundary was noted as likely being larger.

3-159

Do these recommendations follow the standards of NPS Bulletin 40 and KOCOA standards? Wouldn't KOCOA be best employed to determine areas that warrant metal detection?

3-160

There is more to the history and meaning of Killdeer Mountains. In Josephine Waggoner's book Witness under the Chapter of Sitting Bull is a story about Sitting Bull and a Cheyenne friend. They created a fence line to drive deer to a specific ledge and drove the deer off the top. This is the first deer jump that I have been made aware of. LaDonna Brave Bull Allard has publicly shared traditions about Killdeer Mountain publicly involving marriages, births, medicine, and hunting.

The North Dakota: A Guide to the Northern Prairie State by the Federal Writers Project is available in the ND State Library and discusses Signal Rock and other geographic features of Killdeer Mountain. Signal Rock appears to be especially significant to the tribes. It is noted that they carved seats out of the rock and kept fires going there. A blogger also mentions Signal Rock. http://www.pbi.50megs.com/pb3a.html

3-161

Why was it that early on the KMB State Historic Site noted, but not the full boundaries of the battlefield, or even that the full boundaries were unknown to the proponent?

3-162

Recently the SHPO designated the site lead? Recently is open to interpretation. When did they designate it as a site lead? Please clarify. Also why did they only "recently" designate it as a site lead instead of in 2010 when the document was released to the public? SHPO is noted as having been a participant not only in the ABPP document, but also again by Kristen McMasters of the ABPP during the S 106 consultation.

3-162

Why is it doubtful that the study of the battlefield would be completed before completion of the FEIS. Did someone talk to Dr. Isern? Where is the proof and evidence to make this statement a fact?

3-164

How did the battle at Killdeer restore security in MN, IA and DT? Where is the evidence to support that this statement is true?

SRST states that this is the largest battle fought between the military and the tribes? Where and when? Citations? The first person that I heard to publicly make the statement that this is the largest military engagement on the N. Plains with tribes was by Dr. Isern before a ND legislative committee, and then again by him in the local newspapers.

How did the battle at Killdeer Mountain restore agricultural and commercial productivity in the region? How many white people were in Dakota Territory to farm, or commercially support the Union? Is there a citation to support this?

Why is the battle only significant at the national level because of its association with the Civil War? The mission was genocidal and scorched earth tactics to subdue the N. Plains tribes in order to open up the territories for miners, ranchers and homesteading. Manifest Destiny was the overarching theme. The North West Indian Expedition is a US military expedition as documented in the War of the Rebellion: A Compilation of the Official Records of the Union and Confederate Armies. This is one the largest battles of over a 1000 combat engagements to come, which were all part of Federal Indian policy. Nothing about this battle is confined to only local and regional significance. Even Sitting Bull himself is a global and nationally significant figure. http://newsfeed.time.com/2012/07/25/the-20-most-influential-americans-of-all-time/slide/sitting-bull/ This battle ties in to the Ft. Laramie Treaty, The Homestead Act and much more.

Chief Medicine Bear is known to have been at the battle. Chief Gall is a well-known and fought at Killdeer. http://www.amazon.com/Gall-Lakota-Robert-W-Larson-ebook/dp/B006IS4Q58/ref=sr_1_1?s=books&ie=UTF8&qid=1404192948&sr=1-1&keywords=chief+gall LaDonna Brave Bull Allard has stated publicly that her relative Rain-In-The-Face fought at Killdeer, he is best known for having fought Custer at the Battle of the Little Bighorn.

Criterion D could also include information for a KOCOA study and HALS documentation. The local tribes have stated that this was a place of human activity where they gathered for many purposes; camping, hunting, trading, prayer, ceremony, and so on. The research potential here goes beyond just archaeology regarding the battle.

3-165

Why does the KOCOA method exceed a reasonable and good faith effort? Did SHPO, WAPA, RUS, or USFS know about and consider KOCOA prior to S 106 consultation in which Kristen McMasters and Dr. Rothaus mentioned KOCOA methods? Did anyone analyze the costs to present to the public in this document?

Why is the landowner worried about a nomination to the NRHP? This is not relevant! A property will not be placed on the NRHP if the landowner or the majority of landowners objects!!! http://www.nps.gov/nr/national_register_fundamentals.htm

How are four oil wells a significant intrusion on the landscape? They are temporary intrusions for one thing, and two - any person from the battle event or prior would still recognize the terrain and landmarks. Where is the analysis to prove that this is a significant intrusion? Where is the analysis to prove that the battlefield has lost integrity that it would no longer be recognizable to the people at the battle?

The 2014 report suggests that the Sioux controlled and used the high ground to their advantage. Suggests? Isn't this supposed to be a conclusive and definitive document? Does historical evidence and tribal input support what the report "suggests"?

KMB was the frontier? Whose frontier? To the N. Plains tribes this was their home.

Why is there no mention of the significance of the historic Diamond C Ranch and its association with President Theodore Roosevelt?

3-167

Does a temporary mar on the landscape from resource extraction truly result in a devastating impact? Why is a temporary impact utilized as an excuse for a cumulative and permanent impact?

What additional analysis subsequent to the issuance of the Supplemental DEIS did the agencies determine it inappropriate to treat the Study Area as if it were eligible for the NRHP? Where is the analysis for the public to read in this document? The public deserves some evidence for the logic used in an EIS and I hope it is based on something scientific rather than mere beliefs and feelings.

In regard to the United Tribes resolution this paragraph only discusses their point regarding the burials, and in my opinion misses the whole point of the resolution. The resolution opposed all development at Killdeer Mountain Battlefield and the mountain itself. I also question why the writer of the EIS is interpreting what the cultural importance is when the agencies are supposedly doing S 106 consultation with the tribes. The tribes engaged could tell you whether or not the burials enhance their significance.
http://www.indianz.com/News/2013/09/12/unitedtribesresolution.pdf

Since the evidence found in archaeological testing has led to only speculative evidence is there a method of work that would lead to more conclusive evidence of the battlefield boundaries? Isn't the KOCOA method the leading standard for defining the boundaries of a battlefield, not metal detecting?

3-168

Regarding public interest I would say there has been quite a lot for the low population state of ND. I have never heard such a ruckus over preservation in ND except in the case of Elkhorn Ranch. How much public interest does it take for the agencies to understand that this place is important to the people and our national history for the agencies to recognize that we do not view this as a good faith effort at identification, avoidance or mitigation? ND has few environmental and conservation groups, small universities with small departments for the social sciences, and small scattered

groups that show interest in regional and state history. I would and should dare to call this an Environmental Justice issue. I'm not sure what a responsive public interest in ND should look like to the federal agencies. Is there a chart for this, or some scientific basis for dismissing the groups that stand for preservation of the battlefield and Killdeer Mountain? With as much public interest as there has been why should there not be further study? Why are the landowner concerns relevant when they can easily be resolved with proper information and why are the landowners false beliefs promoted in this document more important than the public interest in preserving the battlefield? Why do the agencies not consider a minor adjustment to the proposed alternative and move it out of the study area? The agencies apparently have studied a 6 mile wide area which should offer some flexibility. Is there no where within that 6 mile corridor that this decision would have less of a visual impact to the battlefield or at least to the core of the battlefield and Killdeer Mountain?

I disagree with the use of the United Tribes of North Dakota statement saying they acknowledge the state and federal agencies have little authority to protect this site. In this project the state and federal agencies have total authority and jurisdiction with which to protect this site. In this project the sites are being degraded by the use of federal funds as approved by the PSC, NDSHPO, RUS, WAPA, and the USFS.

Why didn't the proponent in the Class I and Class III identify all of the sites associated with the battle that were already on record in the SHPO files? If it was a six mile wide corridor they should have reviewed all the documents that supported the presence of the battlefield and it being largely identified including Medicine Hole, picket burials, and the Diamond C Ranch. The site was already known to exist regardless of the 2010 ABPP document.

3-169

4) Why only analyze the KMB state historic site and Medicine Hole? The whole Killdeer Mountain is significant to the tribes and KMB is more than 1 acre. It was only partially identified in 1993 and it was clear in the site files of SHPO to be larger.

3-170

Why are their findings more relevant than the investigations done by SHPO and NPS for the 2010 document? What changed that the boundaries are smaller? How are they so much smaller that there is a finding of No Adverse Effect? Does the transmission line no longer go through what has been defined as the Core Area? Does it no longer have a visual, direct or cumulative impact on any area of the battlefield as defined by the ABPP and NDSHPO?

Where are the transcripts for the meeting held on May 9, 2014 with the consulting parties?

3-171

Consultation regarding the PA was positive? According to whom? Did anyone that requested participation in S 106 consultation sign the PA? Killdeer Mountain Alliance did not sign. I wouldn't even begin to suggest or interpret that as being positive or meeting a positive outcome.

3-172

Diamond C Ranch? Signal Rock? These places are also in the vicinity of Alternatives C, D and E.

3-175 and 3-176

Production facilities such as wells, tanks, gas and oil gathering lines are temporary intrusions and their impacts vary. The land will be reclaimed according to ND law. The landscape is both industrial and agricultural, but mostly agricultural. Despite the intrusions of the industry on the landscape I firmly disagree that the KMB study area lacks integrity. The landforms are still intact that make Killdeer Mountain and the points used in the battle identifiable and recognizable to anyone that had been there in historic and prehistoric times.

4-39

So the agencies believe that there is NO ADVERSE EFFECT because the character, setting and feeling are significantly altered. Does this mean that a soldier, warrior, or any other person present would not recognize the battlefield today? I should think that unless the hills are all flattened and Killdeer Mountain itself is removed from existence there is no way this statement is true. There is not nearly enough development at Killdeer Battlefield to significantly alter the landscape. Who made this opinion and where is the scientific proof that it is true?

4-40

How has the battlefield been detrimentally impacted? If the well pads were all reclaimed it would just be farm fields and ranches once again and look the same as before oil and gas development. Reclamation should be addressed in the EIS. This document is supposed to cover cumulative impacts both positive and negative. The battlefield and Killdeer Mountain will likely exist forever on a human time scale; this industrial development is a temporary intrusion that will maybe last a generation.

Page 4 of the PA Identification and Treatment

Why do the agencies agree that the battlefield is smaller? Kristen McMasters stated in the meeting that SHPOs were heavily involved in the defining and boundaries created for the Civil War sites. This would mean the current ND SHPO would have been part of that process. Why do they feel differently now? Kristen McMasters said the boundaries were conservative, as did Dr. Richard Rothaus. Why is there suddenly so much disagreement between the agencies that was not apparent when completing the 2010 study?

Why won't the agencies at least acknowledge the potential eligible boundary created by the NPS? Why do the agencies continue calling this site by new names? The Battle of Killdeer Mountain is how it has been known for 150 years, who are these agencies to change its name?

The transmission line is having a direct and visual impact on the battlefield. How is this no adverse effect? What are the mitigation measures that have resulted in the No Adverse Effect? Kristen McMasters proposed some good mitigation ideas. I especially liked the HALS documentation recommendation, and interpretation suggestion. Why are the agencies not open to further mitigation that would benefit the public?

Thank you for taking the time to address my comments.

Regards,

Valerie Bluemle

June 8, 2014

USDA – RUS
1400 Independence Avenue SW
Stop 1571
Washington DC 20250-1571

To: Mr. Dennis Rankin, Environmental Protection Specialist
Re: Proposed AVS Electrical Power Transmission Line Location

With regards to the Basin Electric Power Cooperative Antelope Valley to Neset transmission line in North Dakota, I want to urge that the final route be located such that it is a respectful distance from the Killdeer Mountain Battlefield site (KMBS). This site has special meaning for both immigrant and indigenous descendants of the battle and should be regarded as a historical treasure.

I have reviewed the FEIS dated May 2014 and in looking at the Fig. 2-3 map of the preferred proposed alternative C route it appears that the transmission lines *could* be in the eastern view shed of the KMBS. It's hard to get a perspective of scale from the map but I would submit that *if* the KMBS view shed were to be affected by overhead power lines on the eastern horizon that perhaps a 10 - 15 mile stretch of the line be placed underground to eliminate view shed concerns.

Thank you for your consideration of this issue.

Sincerely,

Terry Moore

301 Rodeo Drive Apt 305
Killdeer, ND 58640

mooret115@gmail.com

Rankin, Dennis - RD, Washington, DC

From: Arlen D. Dominek <arlen.nodak32@nodakhalcyon.com>
Sent: Friday, June 13, 2014 1:32 PM
To: Rankin, Dennis - RD, Washington, DC
Subject: FW: proposed Basin Electric power transmission between Antelope Valley Station and Neset Substation in North Dakota

Dear Mr. Rankin:

I never received any response from you regarding my request for information.

Nor have I received any subsequent updates from RUS regarding construction of this transmission line.

Please advise.

From: arlen.nodak32@nodakhalcyon.com
Sent: Thursday, 15 March, 2012 17:09
To: dennis.rankin@wdc.usda.gov
Subject: proposed Basin Electric power transmission between Antelope Valley Station and Neset Substation in North Dakota

Dear Mr. Rankin:

I am contacting you with regards to the proposed construction of a transmission line by Basin Electric between the Antelope Valley Station and Neset Substation.

Since this transmission line will apparently cross property which I own west of Williston, I am interested in the criteria applied by the Rural Utilities Service in terms of limiting the impact of this line and the Service's position overall with regards to the placement of power lines.

Since there are already numerous electrical power transmission lines coursing throughout western North Dakota that serve the areas for additional power supplies have been proposed, I am trying to understand the need to develop additional infrastructure that does not capitalize or leverage existing infrastructure.

In particular, I am trying to understand if consideration has been given to

- the usage of existing easements for power line transmission to allow sharing of those easements,
- the construction of new lines along easements paralleling existing easements that would support current and proposed transmission,
- or the construction along the most direct routes between supplier (Antelope Valley Station) and consumers.

Construction of new power lines parallel to existing easements, presumably already having what was considered to be the most expedient route at the time of construction, would allow for greater overall transmission capabilities while minimizing the footprint of the transmission infrastructure, hopefully accompanied by the abandonment of the old easements.

I would like to learn the Service's position on this, particularly with regards to the proposed transmission line.

I would also like to learn what requirements for incorporation of wind and solar power are being established for construction of this project so as to promote our country's becoming less dependent upon foreign energy sources and increase our usage of more green power.

Respectfully submitted,
Arlen D. Dominek

50 East Road, 2G
Delray Beach, Florida 33483

Rankin, Dennis - RD, Washington, DC

From:	Wayne Hauge <whcpa@hotmail.com>
Sent:	Saturday, June 14, 2014 8:21 AM
To:	Rankin, Dennis - RD, Washington, DC
Cc:	2 Brandon
Subject:	Basic Electric Eminent Domain Concern

To: Dennis Rankin, Engineering and Environmental Staff, Washington DC

RE: Comment on Basin Electric Eminent Domain, 2014.

Dear Mr. Rankin:

A short comment about the pending eminent domain proceeding to be held by Basin Electric to cross my family's original homestead with a 345kV high-energy transmission line.

I agree there needs to be a dependable supply of stable energy to western North Dakota in order to extract petroleum products and provide for working personnel for such effort, but simply object to the placement of their line.

It appears the line selected is in the form of a land grab to obtain a current easement in an area which has not yet been developed, rather than provide some sort of intelligent tiered approach since there will in all likelihood be several more such electric lines within the next 10 years.

Why not develop an energy grid utilizing a corridor into which such expansion could be built?

I am not unreasonable in my request to leave alone my family's homestead land, and indeed offered other lands to Basin Electric 1.5 miles south of the proposed route for the purpose of creating such energy corridor, something I testified to at a PSC meeting held in Tioga, North Dakota last fall. Not that my words fell on deaf ears, but there was never any interest by Basin Electric to deviate from their original path, because it would cost about $1M per mile to change their line. Is my family's original homestead land worth $1M? It is to me, but I am a small farmer who does not have friends in high enough places to make a difference.

My objection isn't as much about property rights and infringement by law of eminent domain as it is simple objection to placement of something in an area not yet developed.

Although I've spent several thousand dollars in legal fees to put together a plan to fight this process, it has been suggested by my attorneys that I look for the best deal rather than to fight to the end and lose. This land is worth more to me than money and I will do whatever I can as an individual to counter a large utility company from forcing a multi-lifetime easement of 99 years upon my family's homestead land.

Perhaps by my objections, someone, somewhere will see what it is I am saying and actually start to have a conversation to develop an energy grid with a level of intelligence, rather than just putting a high-energy transmission line on undeveloped property.

Where's the next line going to go? Or the one after that? Or the one after that? Mountrail/Williams REC of western ND stated in the same PSC meeting mentioned above, that they conservatively project a "need" for 3 times the current proposed 345kV line by 2025. Where are those lines going to go?

U.S. Department
of Transportation
**Federal Aviation
Administration**

Great Lakes Region
2300 East Devon Avenue
Des Plaines, IL 60018

JUL 0 8 2014

Mr. Mark Plank
United States Department of Agriculture
Rural Development
1400 Independence Ave, SW
Washington, DC 20250

Dear Mr. Plank,

Thank you for your letter dated May 23, 2014, requesting EIS comments on Basin Electric Power Cooperative's proposed Antelope Valley Station Transmission Project in North Dakota.

Upon review, we have determined there are a number of public use airports within your study area. We do not anticipate any direct impacts to these airports. However, your proposal may impact the airspace surrounding one or more of the public use airports in the study area. Please refer to the Federal Aviation Administration's (FAA) Obstruction Evaluation website at https://oeaaa.faa.gov/oeaaa/external/portal.jsp for information.

Thank you again for providing the FAA the opportunity to comment on your proposal. If you or your staff, require further assistance, please contact me at (847) 294-7295.

Sincerely,

Barry D. Cooper
Regional Administrator
Great Lakes Region

APPENDIX B – COMMISSION CORRESPONDENCE

PUBLIC SERVICE COMMISSION

STATE OF NORTH DAKOTA

Certificate of Corridor Compatibility Number 152

This is to certify that the Commission has designated a transmission facility corridor for Basin Electric Power Cooperative for approximately 197 miles of new, high voltage 345 kV and 230 kV alternating current transmission line and associated facilities extending from Basin Electric's existing Antelope Valley Station and terminating at the Neset 230 kV Substation located near Tioga, North Dakota

This certificate is issued in accordance with the Findings of Fact, Conclusions of Law and Order Order of this Commission dated April 23, 2014 in Case No. PU-11-696 and is subject to the conditions and limitations noted in the Order.

Bismarck, North Dakota, April 23, 2014.

ATTEST:

Jeannell Nitschke

Executive Secretary

PUBLIC SERVICE COMMISSION

Commissioner

PUBLIC SERVICE COMMISSION

STATE OF NORTH DAKOTA

Route Permit Number 164

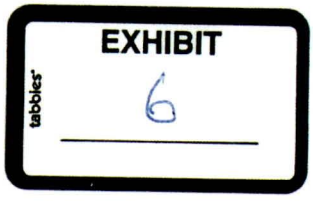
This is to certify that the Commission has designated a transmission facility route for Basin Electric Power Cooperative for approximately 197 miles of new, high voltage 345 kV and 230 kV alternating current transmission line and associated facilities extending from Basin Electric's existing Antelope Valley Station and terminating at the Neset 230 kV Substation located near Tioga, North Dakota

This permit is issued in accordance with the Findings of Fact, Conclusions of Law and Order of this Commission dated April 23, 2014 in Case No. PU-11-696 and is subject to the conditions and limitations noted in the Order.

Bismarck, North Dakota, April 23, 2014.

ATTEST: ***PUBLIC SERVICE COMMISSION***

Executive Secretary ***Commissioner***



STATE OF NORTH DAKOTA

PUBLIC SERVICE COMMISSION

Basin Electric Power Cooperative **Case No. PU-11-696**
345 kV Trans. Line – Mercer, Dunn, McKenzie, Williams
Siting Application

CERTIFICATION RELATING TO ORDER PROVISIONS
TRANSMISSION FACILITY SITING

I am Duey Marthaller, a representative of Basin Electric Power Cooperative ("Company") with authority to bind Company to requirements to be set forth by the Commission in its Order and I certify the following:

1. Company understands and agrees that any Certificate of Corridor Compatibility or Route Permit issued by the Commission will be subject to the conditions and criteria set forth in Chapter 49-22 of the North Dakota Century Code and Chapter 69-06-08 of the North Dakota Administrative Code, and that Company shall be responsible for compliance with this order and conditions and criteria set forth in the applicable laws and rules.

2. Company agrees to hold a preconstruction conference prior to commencement of any construction, which must include a Company representative, its construction supervisor, and a representative of Commission Staff, to ensure that Company fully understands the conditions set forth in the Commission's order.

3. Company agrees to comply with the rules and regulations of all other agencies having jurisdiction over any phase of the transmission facility including all city, township, and county zoning regulations.

4. Company understands and agrees that it shall obtain all other necessary licenses and permits, and shall provide copies of all licenses and permits to the Commission prior to construction activity associated with the transmission facility that requires said license or permit.

5. Company agrees to inform the Commission and the Commission's third-party construction inspector of its intent to start construction on the transmission facility prior to the commencement of construction. Once construction has started, Company shall keep the Commission and the Commission's third-party construction inspector updated on construction activities on a weekly basis.

6. Company understands and agrees that any Certificate of Corridor Compatibility or Route Permit issued by the Commission is subject to suspension or revocation and may, in an appropriate and proper case, be suspended or revoked for failure to

comply with the Commission's order, the conditions and criteria of the certificate or subsequent modification, or failure to comply with the applicable statutes, rules, regulations, standards, and permits of other state or federal agencies.

7. Company agrees to maintain records that will demonstrate that it has complied with the requirements of the Commission's order issuing a Certificate of Corridor Compatibility or Route Permit, and that it will preserve these records for Commission inspection at any reasonable time upon reasonable notice.

8. Company agrees to construct and operate the transmission facility in the manner described in Company's application, in any late filed exhibits, and supplemental materials (Application). To the extent there are any conflicts or inconsistencies between Company's Application and the provisions in this Certification Relating to Order Provisions, the Certification provisions control.

9. Company agrees to report promptly to the Commission the presence in the permit area of any critical habitat or threatened species, endangered species, bald eagles, or golden eagles of which Company becomes aware and which were not previously reported to the Commission.

10. Company understands and agrees that all cultural resource mitigation plans must be submitted to the North Dakota State Historic Preservation Office and approved prior to the start of any fieldwork and construction activity in the affected area.

11. Company understands and agrees that if any cultural resource, paleontological site, archeological site, historical site, or grave site is discovered during construction, it must be marked, preserved and protected from further disturbances until a professional examination can be made and a report of such examination is filed with the Commission and the State Historical Society and clearance to proceed is given by the Commission.

12. Company understands and agrees that all buried facility crossings of graded roads must be bored unless the responsible governing agency specifically permits Company to open cut the road.

13. Company understands and agrees that all pre-existing township and county roads and lanes used during construction must be repaired or restored to a condition that is equal to or better than the condition prior to the construction of the transmission facility and that will accommodate their previous use, and that areas used as temporary roads or working areas during construction must be restored to their original condition.

14. Company understands and agrees that construction must be suspended when weather conditions are such that construction activities will cause irreparable

damage to roads or land, unless adequate protection measures approved by the Commission are taken.

15. Company understands and agrees that all topsoil, up to 12 inches, or topsoil to the depth of cultivation, whichever is greater, over and along trench areas where cuts will be made, must be stripped and segregated from the subsoil. Any area on which excavated subsoil will be placed must also be stripped of topsoil. After backfilling is completed, any excess subsoil must be placed over the excavation area, blending the grade into existing topography. Topsoil must be replaced over areas from which it was stripped only after the subsoil is replaced.

16. Company understands and agrees that reclamation, fertilization, and reseeding is to be done according to the Natural Resources Conservation Service recommendations, unless otherwise specified by the landowner and approved by the Commission.

17. Company understands and agrees that its obligation for reclamation and maintenance of the right-of-way will continue throughout the life of the transmission facility.

18. Company understands and agrees that its obligation for reclamation and maintenance of the transmission facility, associated facilities, and roadways will continue throughout the life of the transmission facility.

19. Company agrees to comply with the Tree and Shrub Mitigation Specifications, attached.

20. Company understands and agrees that it shall work with landowners and residents to mitigate any increase in television and residential radio interference that results from the construction of the transmission facility.

21. Company understands and agrees that it shall repair or replace all fences and gates removed or damaged during all phases of construction and operation of the transmission facility.

22. Company understands and agrees that it shall repair or replace all drainage tile broken or damaged as a result of construction and operation of the transmission facility.

23. Company understands and agrees that staging areas or equipment shall not be located on land owned by a person other than Company unless otherwise negotiated with landowners.

24. Company understands and agrees that it shall remove all waste that is a product of construction and operation, restoration, and maintenance of the site, and properly dispose of it on a regular basis.

25. Company understands and agrees that it shall, as soon as practicable upon the completion of the construction of the transmission facility, restore the area affected by the activities to as near as is practicable to the condition as it existed prior to the beginning of construction.

26. Company understands and agrees that it shall provide any necessary safety measures for traffic control or to restrict public access to the transmission facility.

27. Company understands and agrees that it shall advise the Commission of any extraordinary events which take place at the site of the transmission facility, including injuries to any person, or the death of any threatened or endangered species on the site within five business days of such event.

28. Company understands and agrees that it shall advise the Commission of the discovery of a large number of dead birds or bats on the site within five business days of such event.

29. Company understands and agrees that it shall implement a procedure for how complaints concerning the transmission facility will be handled by Company

30. Upon request, Company agrees to provide the Commission with engineering design drawings of the transmission facility prior to construction.

31. Company understands and agrees that it shall inform the Commission in writing of any plans to modify the transmission facility or of any plans to modify the site plan for the transmission facility. Company understands and agrees to obtain written approval from the Commission prior to any modifications to the site plan or the transmission facility. Approval may be granted after notice and opportunity for hearing.

32. Company agrees to provide the Commission with both an electronic and a paper copy of the corridor approved by the Commission and the facility design specifications for the construction of the transmission facility showing the location of the transmission facility as built, and will provide this information within 3 months of the completion of the construction. Company also agrees to provide an electronic version of the corridor approved by the Commission and the facility design specifications for the construction of the transmission facility showing the location of the transmission facility as built that can be imported into ESRI GIS mapping software within 3 months of the completion of the construction. This electronic map data must be referenced to the North Dakota coordinate system of 1983, North

and/or South zones US Survey feet (NAD 83) UTM Zone 13N or 14N feet (NAD 83), or geographic coordinate system (WGS 84) feet. The vertical data must be in the appropriate vertical datum for the coordinate system used. All submissions must specify the datum in which the data was developed.

33. Company understands and agrees that the authorizations granted by any Certificate of Corridor Compatibility or Route Permit issued by the Commission for the transmission facility are subject to modification by order of the Commission if deemed necessary to protect further the public or the environment.

34. Company understands and agrees that in the event Company desires to construct, within any corridor granted by a Certificate of Corridor Compatibility in this proceeding, a transmission facility or energy conversion facility that was not included in Company's application in this proceeding, Company shall apply to the Commission for a Route Permit or Site Certificate for the facility.

35. Company shall notify the Commission, as soon as reasonably possible, if any damage, as defined by North Dakota Century Code Chapter 49-23, occurs to underground facilities during construction conducted under the certificate or permit issued in this proceeding. In the event of any damage to underground facilities, Company shall suspend construction in the vicinity of the damage until compliance with One-Call Excavation Notice System requirements under North Dakota Century Code Chapter 49-23 has been determined and clearance to proceed has been given by the Commission.

36. Company understands and agrees that the corridor certificate and route permit are subject to suspension or revocation and may, after hearing, be suspended or revoked for failure to comply with the Commission's order, requirements of the One-Call Excavation Notice System under North Dakota Century Code Chapter 49-23, the conditions and criteria of the certificate or permit or subsequent modification, or failure to comply with applicable statutes, or rules, regulations, standards, and permits of other state or federal agencies.

Dated this 26 day of August, 2013.

BASIN ELECTRIC POWER COOPERATIVE

By Duane A Marthaller
Duey Marthaller

Its Manager Civil Engineering

STATE OF NORTH DAKOTA

PUBLIC SERVICE COMMISSION

Basin Electric Power Cooperative
345 kV Trans. Line – Mercer, Dunn, McKenzie, Williams
Siting Application

Case No. PU-11-696

Tree and Shrub Mitigation Specifications

Inventory

1. Trees and shrubs anticipated to be cleared, including those that are considered invasive species or noxious weeds (*e.g., Caragana arborescens, Elaeagnus angustifolia, Rhamnus cathartica, Tamarix chinensis, T. parviflora, T. ramosissima, Ulmus pumila*), must be inventoried before cutting. The inventory must record the location, number, and species of trees and shrubs.

2. In windbreaks, shelterbelts and other planted areas, trees or shrubs anticipated to be cleared, regardless of size, must be inventoried for replacement.

3. In native growth areas, trees anticipated to be cleared that are 1 inch diameter at breast height (dbh) or greater must be inventoried for replacement.

4. In native growth areas, shrubs anticipated to be cleared in the permanent right-of-way must be inventoried for replacement.

5. In native growth areas outside the permanent right-of-way, shrubs must be cut flush with the surface of the ground, taking care to leave the naturally occurring seed bank and root stock intact. If soil disturbance is necessary, the native topsoil must be preserved and replaced after construction. Shrubs must be allowed to regenerate naturally where native topsoil is preserved and replaced. Where native topsoil is not preserved and replaced, shrubs anticipated to be cleared must be inventoried for replacement.

6. In native growth areas, trees and shrubs may be inventoried by actual count or by a sampling method that will properly represent the woody vegetation population. A sampling plan developed by the company, filed with the North Dakota Public Service Commission (Commission) and approved prior to the start of construction must define the sampling method to be used for trees, for tall shrubs and for low shrubs. The data from the sample plots must be extrapolated to the total acreage of the wooded area to be cleared to determine the species and quantity of trees and shrubs to be replaced.

Clearing for Construction

7. Trees and shrubs must be selectively cleared, leaving mature trees and shrubs intact where practical.

8. The maximum width of clear cuts through windbreaks, shelterbelts and all other wooded areas is 50 feet, unless otherwise approved by the Commission.

9. If the area of trees or shrubs actually cleared differs from the area inventoried, the difference in number of trees and shrubs to be replaced must be noted on the inventory.

Replacement

10. Prior to tree and shrub replacement, documentation identifying the number and variety of trees and shrubs removed, as well as the mitigation plan for the proposed number, variety, type, location and date of replacement plantings, must be filed with the Commission for approval.

11. Two 2-year-old saplings must be planted for every one tree removed. Two shrubs (stem cuttings) must be planted for every one shrub removed.

12. Except in the case of invasive or noxious species, trees and shrubs must be replaced by the same species or similar species, suitable for North Dakota growing conditions as recommended by the North Dakota Forest Service.

Invasive or noxious species must be replaced by similar non-invasive or non-noxious species suitable for North Dakota growing conditions as recommended by the North Dakota Forest Service.

13. Landowners must be given the option of having replacement trees and shrubs planted on the landowner's property, either on or off the right-of-way. The landowner must also be given the opportunity to waive those options in writing in order to have replacement trees and shrubs planted off the landowner's property.

14. At the conclusion of the project, documentation identifying the actual number, variety, type, location and date of the replacement plantings must be filed with the Commission.

15. Tree and shrub replacements must be inspected annually, in September, for three years. The first annual inspection must be at least one year from the anniversary date of the original plantings. A report of each annual inspection must be submitted to the Commission by October 1 of each year, documenting the condition of plantings and any woodlands work completed as of September of each year. If after the third annual report the survival rate is less than 75%, the Commission may order additional planting(s).

APPENDIX C – DESIGN DATA REPORT

(To be filed to Docket separately)

APPENDIX D - WORK PLAN FOR DISCOVERY OF UNANTICIPATED CULTURAL RESOURCES ARTIFACTS

Unanticipated Discovery Plan

For

Basin Electric Power Cooperative

AVS to Neset 345-kV Transmission Project

March 2014

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1.0 Emergency Contact List

Entity	Name	Role	Telephone Number
Western Area Power Administration	David Kluth	Western Archeologist	605.354.0556
United States Forest Service	Merv Floodman	USFS Archeologist	
United States Army Corps of Engineers	David Cain	USACE Archeologist	701.255-0015
Basin Electric Power Cooperative	Lucas Tiegen	Manager of Construction	701.223-0441
Basin Electric Power Cooperative	Cris Miller	Senior Environmental Project Administrator	701.223-0441
Basin Electric Power Cooperative	Gary Christenson	Project Manager	701.223-0441
Basin Electric Power Cooperative	Paul Telehy	On-Site Construction Coordinator	701.223.0441
Metcalf Archaeological Consultants, Inc.		Project Archaeologist	701.258-1215
State Historical Society of North Dakota	Paul Picha	State Archaeologist	701.328-3574
Standing Rock Sioux Tribe THPO	Wasté Win Young	Tribal Historic Preservation Office	701.854-2120
Sisseton-Whapeton Sioux Tribe	Dianne Desrosiers	Tribal Historic Preservation Office	605.698-3584

2.0 Unanticipated Discovery of Cultural Resources – Non-Federal lands

2.1 Procedures at Time of Discovery of Unanticipated Cultural Resources

If unanticipated cultural resources are discovered during construction of Basin Electric Power Cooperative's (Basin Electric) AVS to Neset 345-kV Transmission Project (Project), all construction activity will immediately cease within 100 feet in all directions from the discovery. Basin Electric's On-site Construction Coordinator, his team of Field Inspectors and/or the contractor will immediately report the discovery to all parties identified in the Emergency Contact List in Section 1.0 of this plan. Ground-disturbing construction activities will not occur within 100 feet in any direction from the cultural resource. In the event that an archaeologist, tribal monitor, or other necessary persons are not immediately available on site to assess the discovery, the contractor will cover or otherwise secure and protect the discovery until such time that an archaeologist and tribal monitor can inspect and evaluate the discovery.

Metcalf's archaeologist, in conjunction with the tribal monitor, when available, will ascertain and document through the use of forms, notes, and photographs, the nature and the extent of

the resource, and the potential for intact deposits. Evaluation will involve an examination of the ground surface, backfill piles (which may require screening), and exposed construction surfaces. Metcalf's archaeologist will discuss the potential for additional impacts to the resource with the construction manager. Based on this examination, Metcalf's archaeologist will recommend the locus is:
(1) not a historic property, such as an isolated find or a resource that is not eligible for inclusion in the National Register of Historic Places (NRHP);
(2) a historic property, eligible for inclusion in the NRHP
(3) a resource for which additional information is required to ascertain extent and NRHP eligibility.

All cultural resources affected by construction activities will be evaluated using the criteria of eligibility for the NRHP. Western will then make a determination of eligibility in consultation with the appropriate parties (i.e., MOA signatories or per Section 106 requirements). If further avoidance of the resource is not possible, Metcalf will prepare a Historic Properties Treatment Plan (HPTP) following guidance provided by the Advisory Council on Historic Preservation or other appropriate Federal guidelines. The plan would be submitted by Western to all interested parties for review and comment.

Metcalf will also complete a North Dakota Site Form for the unanticipated discovery and submit copies to Western and the NDSHPO for review.

2.2 Emergency Salvage of Cultural Resources

Unstable earth conditions in trenches or other unforeseen natural or cultural events could endanger cultural resources discovered during construction of the transmission line. If cultural resources are in imminent danger of adverse impacts, Basin Electric will apply prudent methods to stabilize landforms around the unanticipated discovery. Once stabilized the resource shall be assessed as described above, subject to safety concerns.

2.3 Curation or Disposition of Cultural Materials

All cultural materials recovered from privately owned lands are the property of the landowner. After necessary laboratory analysis is completed, Basin Electric will provide the landowner with descriptions of cultural materials and photographs, if requested, from his/her property. Basin Electric will return the cultural material to the landowner; if the landowner does not want the material, Basin Electric will arrange to have it curated at the State Historical Society of North Dakota.

3.0 Unanticipated Discovery of Human Remains – Non-Federal Lands

Any human remains encountered in a discovery situation will be handled according to the provisions of North Dakota Law. Treatment of human remains found on state or private lands in North Dakota is governed primarily under two laws: Protection of Human Burial Sites,

Human Remains and Burial Goods in North Dakota Century Code (NDCC 23-06-27) and Protection of Prehistoric Sites and Deposits in the North Dakota Administrative Code (NDAC 40-02-03).

If human remains are discovered, all ground-disturbing construction activity will immediately cease within 100 feet in all directions from the human remains, and the construction supervisor will notify Basin Electric and Metcalf's archaeologist immediately. As required by law, Basin Electric will notify the appropriate County Sheriff within 24 hours of discovery and the SHSND's of the finding. The Project is located in Mercer, Dunn, McKenzie, Williams and Mountrail counties.

If law enforcement permits and under the direction of law enforcement and the Metcalf archaeologist, Basin Electric and/or the contractor will secure the location by flagging or roping the perimeter of the avoidance area and covering or otherwise protecting the human remains and any associated materials. The remains will not be further disturbed prior to completion of consultations with respective agencies and compliance with the appropriate laws unless such disturbance is necessary to preserve or protect the human remains. Any disturbance necessary to preserve or protect the remains must be done in consultation with law enforcement, SHSND, and Metcalf's archaeologist. The 100-foot-radius avoidance area may be expanded if the context suggests additional human remains may exist within the construction area or if construction activities outside the 100-foot-radius area might destabilize or otherwise degrade the context of the human remains.

Law enforcement will determine whether the finding is associated with a crime scene within 15 days. If deemed not a crime scene, law enforcement will notify the SHSND of their findings. **No cultural resource investigations of human remains can occur without written approval from SHSND.** Metcalf's archaeologist will work with SHSND to obtain agreement to conduct investigations of the location. If the remains are determined Native American, or if the ethnic identity of the remains is unknown, SHSND will notify the Intertribal Re-interment Committee. A meeting of interested parties will be set up as soon as possible, preferably within 36 hours of the decision that there is no evidence of a crime, to ensure that the disturbed remains receive the maximum protection and that costly delays are avoided. Together the SHSND, in consultation with the tribes (as appropriate) and Basin Electric will agree upon a suitable action.

Work cannot proceed until the stipulations of Protection of Human Burial Sites, Human Remains and Burial Goods in North Dakota Century Code (NDCC 23-06-27) and Protection of Prehistoric Sites and Deposits in the North Dakota Administrative Code (NDAC 40-02-03) have been met.

4.0 Unanticipated Discovery of Cultural Resources –Federal lands

All Field Inspectors have the responsibility to monitor the construction of sites for potential cultural resources throughout construction. If, during the course of construction on federal lands, unanticipated cultural resources are identified, the Construction Supervisor will immediately stop tasks in the vicinity of the potential find and notify Basin Electric and the Metcalf archaeologist. The Metcalf archaeologists, in turn, will notify the archaeologist of the appropriate federal agency and the NDSHPO. The Metcalf archaeologist will survey the site and provide an immediate verbal report to Basin Electric, the agency archaeologist and the NDSHPO and consult with the NDSHPO and the agency archaeologist as per the requirements of Section 106 of the National Historic Preservation Act (NHPA).

If the unanticipated discovery is determined to be not eligible for inclusion on the NRHP, Basin Electric will proceed with the project following written concurrence from the NDSHPO and the agency archaeologist. If the site is determined to be potentially eligible for inclusion on the NRHP, additional work such as a Determination of Eligibility of Data Recovery will be performed as required/approved by the NDSHPO and the agency archaeologist. Further construction at the site will be suspended until all criteria of Section 106 of the NHPA and other Federal and state regulation have been successfully completed.

Basin Electric will curate all recovered cultural material according to the direction of agency archaeologist. Material must be curated in a facility that satisfies the requirements in 36 CFR 79 - *Curation* of Federally Owned and Administered Archeological Collections.

5.0 Unanticipated Discovery of Human Remains – Federal Lands

If human remains and/of a burial are encountered on federal lands, these remains, features and any associated artifacts shall be left undisturbed, work at the site of discovery shall cease immediately, and the site shall be secured from further trespass. Basin Electric shall immediately contact the agency archaeologist. Basin Electric will assist the agency archaeologist in complying with the Native American Graves Protection and Repatriation Act (NAGPRA; U.S.C. 3001 *et seq*), as appropriate.

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APPENDIX E - PLAN AND PROFILE

(To be filed to Docket separately)

APPENDIX F - LEGAL DESCRIPTION FOR THE PROJECT CORRIDOR/ROUTE

(To be filed to Docket separately)

APPENDIX G - STANDARD MITIGATION MEASURES

Appendix A—Standard Mitigation/Conservation Measures and Best Management Practices (BMPs) to be Used by Basin Electric for the Proposed AVS to Neset Transmission Project

General	
Gen-1	The requirements of all applicable federal, state, and local environmental laws, executive orders, and regulations will be met during construction and operation of the proposed project.
Gen-2	All permit conditions required by federal, state, and local agencies will be adhered to for construction and operation of the proposed project.
Gen-3	Prior to construction, all construction personnel and heavy equipment operators will be instructed on the protection of cultural, paleontological, and ecological resources, and all applicable permit requirements. Construction contracts will address: • Federal, state, and local laws regarding antiquities, fossils, plants, and wildlife, including collection/removal • The importance and necessity of protecting such resources • All applicable permit requirements
Air Quality	
Air-1	The emission of dust into the atmosphere during construction will be minimized to the extent practical during the excavation and transport of material, site grading, and movement of equipment. Methods and equipment will be used as necessary to suppress or prevent dust during these operations such as use of water trucks, covers on truck beds, attentiveness to dust creation on local gravel roads, or other dust management strategies.
Air-2	All construction equipment and vehicles will be maintained in efficient operating condition and comply with applicable state and federal emission standards. Engine idling time will be limited and equipment will be shut down when not in use. Vehicles and equipment that show excessive emissions or other inefficient conditions will not be operated until repairs or adjustments are made.
Air-3	All waste materials shall be disposed of at permitted waste disposal areas or landfills. Burning or burying waste materials on the right-of-way (ROW) would not be permitted. Tree and grubbing residue may be buried on site or in the ROW with landowner approval.
Air-4	Nuisance to persons, dwellings, or crops resulting from dust originating from construction will be minimized. Oil and other petroleum derivatives will not be used for dust control. Speed limits on local gravel roads will be enforced to reduce dust.

Water Resources	
Water-1	Construction activities will comply with the requirements of North Dakota permits for stormwater discharges for construction activities, which specify appropriate best management practices (BMPs), erosion and sediment control measures, and disposal practices. BMPs will be included in a Stormwater Pollution Prevention Plan. Construction activities adjacent to or encroaching on streams or waterways, including work within ROWs, construction of access roads on hillsides, and dewatering work for structure foundations, or earthwork operations will be conducted to prevent disturbed soils, muddy water, and eroded materials from entering streams or waterways by construction of intercepting ditches, bypass channels, barriers, settling ponds, or by other approved means.
Water-2	Construction activities will be conducted to prevent the accidental spillage of solid matter contaminants, debris, hazardous liquids, or other pollutants into streams, waterways, lakes, land, and underground aquifers. Such pollutants and waste include, but are not restricted to, refuse, garbage, cement, concrete, sanitary waste, industrial waste, oil, and other petroleum products, aggregate processing tailing, and mineral salts. A hazardous materials management and spill prevention plan will be developed for construction that addresses storage, use, transportation, and disposal of hazardous materials, and an emergency response plan will be in place in the event of an accidental spill.
Water-3	Excavated material or construction materials will not be stockpiled or deposited near or on stream banks, lake shorelines, or other waterway perimeters unless protected from high water or storm runoff or encroachment upon the actual waterway itself.
Water-4	Wastewater discharge from any construction operations will not enter streams, waterways, or other surface waters without the appropriate permit(s).
Water-5	Equipment washing, storage of petroleum products, lubricants, solvents and hazardous materials, structure sites, and other disturbed areas will be located at least 100 feet, where practical, from rivers, streams (including ephemeral streams), ponds, lakes, and reservoirs. This includes construction vehicles and heavy equipment when parked overnight or longer.
Water-6	ROW access roads will be located at least 100 feet, where practical, from rivers, ponds, lakes, and reservoirs.

Water-7	All stream crossings considered jurisdictional by the U.S. Army Corps of Engineers (USACE) will be crossed by permit only. Where required, culverts of adequate size to accommodate the estimated peak flow of the stream will be installed. Disturbance of the stream banks and beds during construction will be minimized and temporary during the construction period. Disturbed areas will be revegetated in accordance with mitigation measures listed for soil/vegetation resources and USACE policy regarding the removal of vegetation.
Water-8	If the banks of ephemeral stream crossings are sufficiently high and steep that breaking them down for a crossing will cause excessive disturbance, culverts will be installed using the same measures as for culverts on perennial streams.
Water-9	Heavy equipment movement near streams and other surface waters will be minimized, to the extent practical.
Water-10	Narrow flood-prone areas will be spanned.
Geology and Minerals, Paleontology, and Soils	
Geo-1	Removed topsoil will be used as engineered fill, as appropriate, or stockpiled and re-spread subsequent to construction where allowed.
Geo-2	Access roads will generally follow the contour of the land to the greatest extent practical rather than a straight line along the ROW where steep features will result in a higher erosion potential.
Geo-3	To the extent practical, excavated areas will be re-contoured so that large volumes of water will not collect and stand therein. Before being abandoned, the sides of excavations will be brought to stable slopes, giving a natural appearance, and revegetated. Waste soil piles will be shaped to provide a natural appearance.
Biological Resources	
Bio-1	Prior to construction, potentially-impacted wetland areas will be identified and marked. Wetland and riparian areas will be avoided to the extent practical by spanning of the wetlands and the placement of structures outside of wetland areas. If wetland or riparian areas are unavoidable, impacts will be minimized or mitigated. Jurisdictional waters that are impacted as a result of implementing the proposed project will be mitigated in accordance with USACE requirements.
Bio-2	Care will be used in preserving the natural landscape and vegetation. Construction operations will be conducted to prevent, to the extent practical, any unnecessary destruction, scarring, or defacing of the natural surroundings, vegetation, trees, and native shrubbery in the vicinity of the work. Vegetation will be replaced at landowner's request, provided mitigation complies with North American Electric Reliability Council (NERC) requirements.

Bio-3	Basin Electric Power Cooperative (Basin Electric) will implement BMPs to address the potential spread of noxious weeds during construction activities. Example measures will include the washing of construction vehicles prior to use at construction work sites, revegetation with a native seed mix, and control of noxious weeds during ROW maintenance activities.
Bio-4	Upon completion of work, all non-agricultural disturbed areas and construction staging areas not needed for maintenance access will be re-graded so that all surfaces drain naturally, blend with the natural terrain, and are reseeded to blend with native vegetation with a seed mixture certified as free of noxious or invasive weeds. All destruction, scarring, damage, or defacing of the landscape resulting from construction will be repaired as appropriate.
Bio-5	Construction staging areas will be located and arranged in a manner to preserve trees and vegetation to the maximum practicable extent. Unless otherwise agreed upon by the landowner, all storage and construction materials and debris will be removed from the construction staging areas once construction is complete, and the areas returned to original use or re-graded and seeded as for nonagricultural disturbed areas.
Bio-6	Native shrubs that will not interfere with access or the safe operation of the transmission line will be allowed to reestablish in the ROW. Areas with native shrubs that are disturbed will be replanted with regionally-native species following the disturbance.
Bio-7	Trees and shrubs anticipated to be cleared, including those that are considered invasive species or noxious weeds, will be inventoried before cutting. The inventory will record the location, number, and species of trees and shrubs. In windbreaks, shelterbelts, and other planted areas, trees or shrubs anticipated to be cleared, regardless of size, will be inventoried for replacement. In native growth areas, trees anticipated to be cleared that are 1-inch diameter at breast height (dbh) or greater will be inventoried for replacement, as well as all shrubs in the permanent ROW.
Bio-8	In native growth areas outside the permanent ROW, shrubs will be cut flush with the surface of the ground, taking care to leave the naturally occurring seed bank and root stock intact. If soil disturbance is necessary, the native topsoil will be preserved and replaced after construction is completed. Shrubs will be allowed to regenerate naturally where native topsoil is preserved and replaced. Where native topsoil is not preserved and replaced, shrubs anticipated to be cleared will be inventoried for replacement.
Bio-9	In native growth areas, trees and shrubs will be replaced according to Basin Electric's Tree Management Plan. This plan, filed and approved with the North Dakota Public Service Commission (NDPSC), provides for the identification and re-establishment of appropriate numbers and types of trees and shrubs removed as part of ROW clearing and maintenance.

Bio-10	Trees and shrubs will be selectively cleared, leaving mature trees and shrubs intact where practical. The width of clear cuts through windbreaks, shelterbelts and all other wooded areas will be limited to 50 feet or less unless otherwise approved by NDPSC. If the area of trees or shrubs actually cleared differs from the area inventoried, the difference in number of trees and shrubs to be replaced will be noted on the inventory.
Bio-11	Prior to replacement, documentation identifying the number and variety of trees removed as well as the mitigation plan for the proposed number, variety, type, location and date of replacement plantings will be filed with NDPSC for approval. Replanting will use native tree species for the local area, and planting replacement trees in existing areas of native prairie will be avoided. Tree replacement will be on a 2 to 1 basis with 2-year-old saplings. Shrub replacement will be on a 2 to 1 basis with stem cuttings. Trees and shrubs will be replaced by the same species or similar species, except in the case of invasive species or noxious weeds, suitable for North Dakota growing conditions as recommended by the North Dakota Forest Service.
Bio-12	Landowners will be given the option of having replacement trees or shrubs planted off the ROW on the landowner's property or waiving that requirement in writing and allowing those replacement trees or shrubs to be planted at alternative locations.
Bio-13	At the conclusion of the project, documentation identifying the actual number, variety, type, location, and date of the replacement plantings will be filed with NDPSC. Tree and shrub replacements will be inspected once a year for three years, on or about the anniversary of the plantings, and, on or shortly before October 1 of each year, a report will be submitted to the Commission documenting the condition of replacement planting and any woodlands work completed. If after 3 years from the anniversary of the plantings the survival rate is less than 75 percent, NDPSC may order additional planting(s).
Bio-14	Basin Electric's system-wide Avian Protection Plan will be implemented to minimize impacts on nesting birds, as well as to minimize the electrocution and collision of migratory and resident bird species. The Avian Protection Plan includes design provisions for adequate distance between conductors and distances between conductors and grounded surfaces to minimize electrocution risk. It also includes methods for minimizing bird collisions, such as line marking techniques, developed in accordance with recommendations contained in the most recent Avian Power Line Interaction Committee publication "Reducing Avian Collisions with Power Lines, State of Art in 2012". The Avian Protection Plan follows guidelines described at www.aplic.org.
Bio-15	Holes drilled or excavated for pole placement or foundation construction and left unattended overnight will be marked and secured with temporary fencing to reduce the potential for livestock and wildlife to enter the holes, and for public safety.

Cultural Resources	
CR-1	In accordance with 36 CFR Section 800.14(6)(1), the Agencies will execute a Programmatic Agreement that establishes procedures for the identification of historic properties and the assessment and mitigation of adverse effects. Thus, mitigation of impacts of the AVS to Neset Transmission Project on historic properties will be governed by the Programmatic Agreement.
CR-2	To prevent damage to cultural resources, a professional archeologist will flag and monitor areas of potential disturbance to cultural resources during construction of the AVS-Neset Transmission Project components. In addition, all sites identified during construction will be marked as a sensitive location on operation and maintenance maps.
CR-3	During construction, if any paleontological resources are discovered on federal lands, work will cease within a 50-foot radius of the discovery. Any fossils discovered will not be disturbed, and U.S. Department of Agriculture (USDA), Rural Utilities Service, USDA Western Area Power Administration, the U.S. Forest Service, and NDSHPO will be notified of the discovery immediately. Appropriate action to avoid or minimize any impact to the discovery will be identified and implemented.
Land Use	
Land-1	The minimum area necessary will be used for access roads during project construction.
Land-2	When practical, transmission structures will be located and designed to conform to the terrain. Leveling and benching of the structure sites will be the minimum necessary to allow structure assembly and erection.
Land-3	Transmission structures will be located, where practical, to span sensitive land uses. Where practical, construction access roads will be located to avoid sensitive conditions.
Land-4	The precise location of all structure sites, ROW, and other disturbed areas will be determined with landowners' or land management agencies' input.
Land-5	The movement of crews and equipment will be limited to the ROW and areas surveyed for cultural, historical, and biological resources, including access routes. To the extent practicable, the contractor will limit movement on the ROW to minimize damage to grazing land, crops, or property and will avoid marring the land.
Land-6	Where practical, construction activities will be scheduled during periods when agricultural activities will be minimally affected or the landowner will be compensated accordingly.

Land-7	Fences, gates, and similar improvements that are removed or damaged will be promptly repaired or replaced.
Land-8	Transmission structure design and placement will be selected to reduce potential conflicts with agricultural practices and to reduce the amount of land required for transmission lines.
Land-9	ROW will be purchased through negotiations with each landowner affected by the proposed project. Payment will be made of full value for crop damages or other property damage during construction or maintenance.
Land-10	Any ruts will be leveled, filled, and graded, or otherwise eliminated in an approved manner. Ruts, scars, and compacted soils from construction activities in productive hay or crop lands will be loosened and leveled by scarifying, harrowing, disking, or other appropriate methods. Damage to ditches, tile drains, terraces, roads, and other land features will be corrected. Land contours and facilities will be restored as nearly as practical to their original conditions.
Public Health and Safety	
PH-1	When appropriate, pilot vehicles will accompany the movement of heavy equipment. Traffic control barriers and warning devices will be used when appropriate.
PH-2	All necessary provisions will be made to conform to safety requirements for maintaining the flow of public traffic and avoiding congestion at critical locations. Construction operations will be conducted to offer the least possible obstruction and inconvenience to public traffic, such as by the use of pilot cars to accompany trucks with oversized loads and slow-moving vehicles, scheduling heavy equipment transport to avoid high traffic periods, and where feasible, use of existing rail facilities. Construction workers will be encouraged to carpool to the construction site.
PH-3	Design will include reasonable mitigation measures to reduce problems of induced currents into conductive objects within the ROW. Problems of induced currents during construction and operation will be resolved, to the mutual satisfaction of the parties involved.
PH-4	Complaints of radio or television interference generated by the transmission line will be investigated and appropriate mitigation measures will be implemented.
PH-5	Audible noise from construction and operation of the proposed project will be addressed as necessary on a case-by-case basis.
PH-6	Transmission line materials will be designed to minimize corona. Tension will be maintained on all insulator assemblies to assure positive contact between insulators, thereby avoiding sparking. Caution will be exercised during construction to avoid nicking the conductor surface, which may provide points for corona to occur.

PH-7	The construction contractor will establish a health and safety program that incorporates Occupational Safety and Health Administration standards such as requirements for hearing protection, personal protective equipment, site access, chemical exposure limits, safe work practices, training program, and emergency procedures. The program will be reviewed with fire department personnel and emergency services personnel to reduce risk of construction and operation activities interfering with emergency response or evacuation plans and procedures.
PH-8	At the end of every work day, contractors will secure all construction areas to protect equipment and materials and discourage public access. Fueling of vehicles will be conducted in compliance with established procedures designed to minimize fire risks and fuel spills.
Visual Resources	
Vis-1	Structure types (designs) will be uniform, to the extent practical.
Vis-2	Structures will be setback from roadways an appropriate distance to reduce potential visual impacts at highway and trail crossings while still enabling over-road clearances to be maintained.
Vis-3	Construction areas will be maintained in a neat and orderly manner, free of trash and debris.
Noise	
Noise-1	An adequate buffer will be maintained around the proposed substation sites to minimize construction and operational noise impacts on area residents.
Noise-2	Power lines will be designed to minimize noise from energized conductors.
Noise-3	To avoid nuisance noise conditions, transmission line construction within 1,000 feet of a residence will be limited to daytime hours whenever practical.
Noise-4	To avoid nuisance conditions due to construction noise, all internal combustion engines used in connection with construction activity will be fitted with an approved muffler and spark arrester.

In addition to the mitigation/conservation measures discussed above, other more specific measures are being implemented for the AVS to Nest Transmission Project. These measures are designed to minimize impacts of the project as identified in the Final Environmental Impact Statement (FEIS). Further measures may be identified after publication of this this document.

Biological Resources	
	Prohibit construction in designated critical habitat for piping plover during the nesting season (mid-April to mid-August).
	Conduct a presence survey for piping plover prior to initiating construction activities in areas identified as habitat for the species, if construction occurs during nesting season (April 1 through August 31).
	Conduct an occupancy survey for Sprague's pipit prior to construction activities in areas identified as habitat for the species if construction is proposed to occur between April 15 and August 1.
	Coordinate with USFS and North Dakota Game and Fish Department (NDGFD) to avoid construction during bighorn sheep lambing season (April 1 through July 1) in the Little Missouri Badlands area and Little Missouri National Grasslands.
	Selectively clear trees and shrubs leaving mature trees and shrubs less than 8 feet tall intact where practical, in areas where the ROW crosses lands managed by USACE near the Missouri River. This action will support the wildlife migration corridor in this area.
	Generally do not place structures within 0.25 mile of active greater sage-grouse and plains sharp-tailed grouse lek sites. In addition, Basin Electric will consult with the agencies prior to construction within a 1-mile radius of an active lek during the period of March 1 through June 15. If construction will occur within 1 mile of any historic lek during this time period, surveys will be done prior to construction to determine use of the lek.
	Avoid construction activities within 1,000 feet of suitable hibernacula during the winter hibernation period (roughly late fall to early spring), to decrease direct impacts on the long-eared bat during construction. In addition to avoiding hibernacula during construction, all mature, dead, or dying trees will be left intact, where they do not pose a safety concern for line reliability.

	Prepare a complete habitat assessment according to the *Guidelines for Biological Survey Reports – U.S. Army Corps of Engineers, Garrison Project, June 2010*. This assessment will fully discuss the biological resources found within the project ROW located across USACE lands. Surveys for this report will be conducted in spring 2014. Reports will be submitted and approved by USACE prior to commencement of construction activities on USACE lands.
	Survey the selected alternative for eagle and other raptor nests in 2014 prior to construction. Following surveys, 1-mile buffers will be established between February 1 and July 31, and construction activity (including helicopter flights) will be prohibited within this area during this time period.
Land Use	
	Restrict cattle from grazing within the ROW after construction is completed until grass is re-established within the ROW.
	The North Dakota Natural Heritage Inventory database indicates that a significant ecological community of western little bluestem prairie is located within 1,000 feet of the centerline for the Red to Charlie Creek segment for of the preferred alternative. It is anticipated that the construction and operation of line will avoid this sensitive area, since it is not within the ROW. However, if this area will be affected based on the final route alignment Basin Electric will coordinate closely with the Natural Heritage Inventory and NDGFD to avoid, minimize, or mitigate any adverse impacts to this area.
Transportation and Infrastructure	
	Follow the American Railway Engineering and Maintenance-of-Way Association specifications for steady and rail-to-ground and equipment-to-ground voltage levels to avoid electrical interference from capacitive, electric and magnetic, and conductive effects.
	Provide appropriate as-built drawings to USACE, following completion of construction.
Visual Resources	
	Construct structures of weathering steel (compared to galvanized steel construction) to reduce visual contrast to the surrounding landscape in the areas at the Little Missouri and Missouri River crossings.
Construction Plans	

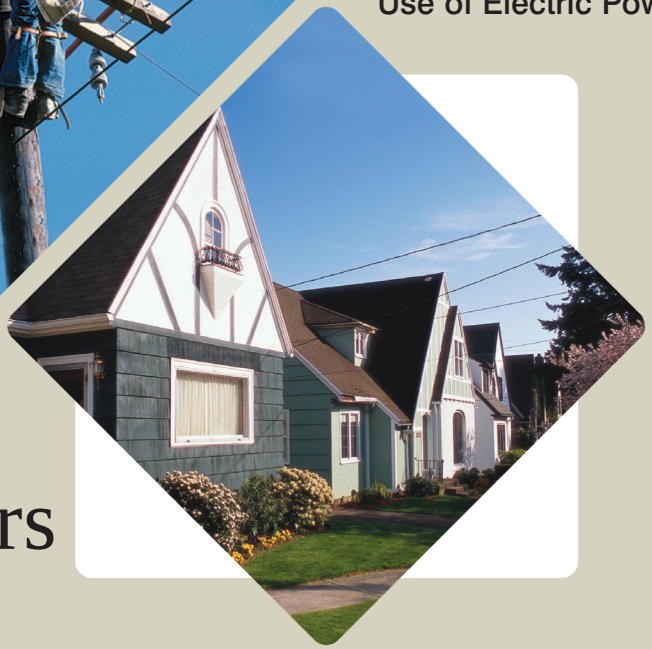
	Submit a construction work plan to USACE prior to the commencement of construction activities on portions of the ROW managed by USACE. Following completion of construction, Basin Electric will provide appropriate as-built drawings to USACE.

APPENDIX H - NIEHS REPORT

June 2002

EMF

Electric and Magnetic Fields Associated with the Use of Electric Power



Questions & Answers

prepared by the
National Institute of Environmental Health Sciences
National Institutes of Health

EMF RAPID
Electric and Magnetic Fields Research and Public Information Dissemination Program

sponsored by the
NIEHS/DOE EMF RAPID Program

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1 **EMF Basics** 4

Reviews basic terms about electric and magnetic fields.

2 **Evaluating Potential Health Effects** 10

Explains how scientific studies are conducted and evaluated to assess possible health effects.

3 **Results of EMF Research** 16

Summarizes results of EMF-related research including epidemiological, clinical, and laboratory studies.

4 **Your EMF Environment** 28

Discusses typical magnetic exposures in homes and workplaces and identifies common EMF sources.

5 **EMF Exposure Standards** 46

Describes standards and guidelines established by state, national, and international safety organizations for some EMF sources and exposures.

6 **National and International EMF Reviews** 50

Presents the findings and recommendations of major EMF research reviews including the EMF RAPID Program.

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Selected references on EMF topics.

Introduction

Since the mid-twentieth century, electricity has been an essential part of our lives. Electricity powers our appliances, office equipment, and countless other devices that we use to make life safer, easier, and more interesting. Use of electric power is something we take for granted. However, some have wondered whether the electric and magnetic fields (EMF) produced through the generation, transmission, and use of electric power [power-frequency EMF, 50 or 60 hertz (Hz)] might adversely affect our health. Numerous research studies and scientific reviews have been conducted to address this question.

Unfortunately, initial studies of the health effects of EMF did not provide straightforward answers. The study of the possible health effects of EMF has been particularly complex and results have been reviewed by expert scientific panels in the United States and other countries. This booklet summarizes the results of these reviews. Although questions remain about the possibility of health effects related to EMF, recent reviews have substantially reduced the level of concern.

The largest evaluation to date was led by two U.S. government institutions, the National Institute of Environmental Health Sciences (NIEHS) of the National Institutes of Health and the Department of Energy (DOE), with input from a wide range of public and private agencies. This evaluation, known as the Electric and Magnetic Fields Research and Public Information Dissemination (EMF RAPID) Program, was a six-year project with the goal of providing scientific evidence to determine whether exposure to power-frequency EMF involves a potential risk to human health.

In 1999, at the conclusion of the EMF RAPID Program, the NIEHS reported to the U.S. Congress that the overall scientific evidence for human health risk from EMF exposure is weak. No consistent pattern of biological effects from exposure to EMF had emerged from laboratory studies with animals or with cells. However, epidemiological studies (studies of disease incidence in human populations) had shown a fairly consistent pattern that associated potential EMF exposure with a small increased risk for leukemia in children and chronic lymphocytic leukemia in adults. Since 1999, several other assessments have been completed that support an association between childhood leukemia and exposure to power-frequency EMF. These more recent reviews, however, do not support a link between EMF exposures and adult leukemias. For both childhood and adult leukemias, interpretation of the epidemiological findings has been difficult due to the absence of supporting laboratory evidence or a scientific explanation linking EMF exposures with leukemia.

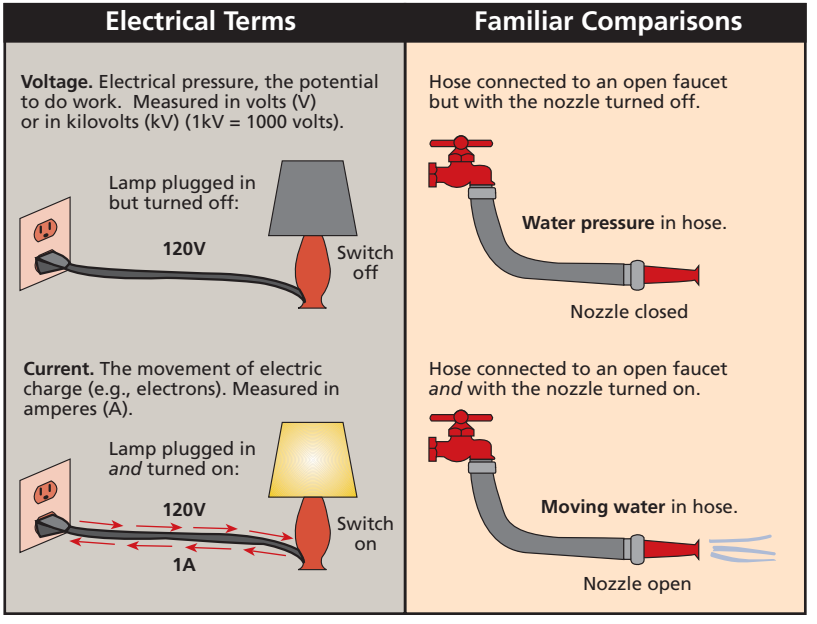
EMF exposures are complex and exist in the home and workplace as a result of all types of electrical equipment and building wiring as well as a result of nearby power lines. This booklet explains the basic principles of electric and magnetic fields, provides an overview of the results of major research studies, and summarizes conclusions of the expert review panels to help you reach your own conclusions about EMF-related health concerns.

1 EMF Basics

This chapter reviews terms you need to know to have a basic understanding of electric and magnetic fields (EMF), compares EMF with other forms of electromagnetic energy, and briefly discusses how such fields may affect us.

Q A What are electric and magnetic fields?

Electric and magnetic fields (EMF) are invisible lines of force that surround any electrical device. Power lines, electrical wiring, and electrical equipment all produce EMF. There are many other sources of EMF as well (see pages 33–35). The focus of this booklet is on power-frequency EMF—that is, EMF associated with the generation, transmission, and use of electric power.



Voltage produces an electric field and current produces a magnetic field.

Electric fields are produced by voltage and increase in strength as the voltage increases. The electric field strength is measured in units of volts per meter (V/m). Magnetic fields result from the flow of current through wires or electrical devices and increase in strength as the current increases. Magnetic fields are measured in units of gauss (G) or tesla (T).

Most electrical equipment has to be turned on, i.e., current must be flowing, for a magnetic field to be produced. Electric fields are often present even when the equipment is switched off, as long as it remains connected to the source of electric power. Brief bursts

of EMF (sometimes called "transients") can also occur when electrical devices are turned on or off.

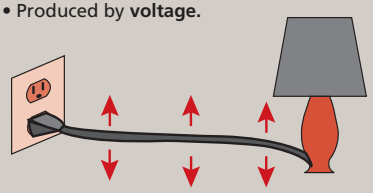
Electric fields are shielded or weakened by materials that conduct electricity—even materials that conduct poorly, including trees, buildings, and human skin. Magnetic fields, however, pass through most materials and are therefore more difficult to shield. Both electric fields and magnetic fields decrease rapidly as the distance from the source increases.

Even though electrical equipment, appliances, and power lines produce both electric and magnetic fields, most recent research has focused on potential health effects of magnetic field exposure. This is because some epidemiological studies have reported an increased cancer risk associated with estimates of magnetic field exposure (see pages 19 and 20 for a summary of these studies). No similar associations have been reported for electric fields; many of the studies examining biological effects of electric fields were essentially negative.

A Comparison of Electric and Magnetic Fields

Electric Fields

- Produced by **voltage.**

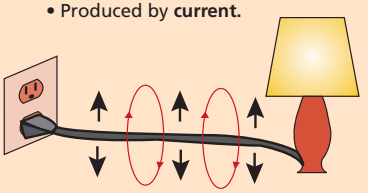


Lamp plugged in but turned off.
Voltage produces an electric field.

- Measured in **volts per meter (V/m)** or in **kilovolts per meter (kV/m).**
- **Easily shielded** (weakened) by conducting objects such as trees and buildings.
- Strength decreases rapidly with increasing distance from the source.

Magnetic Fields

- Produced by **current.**

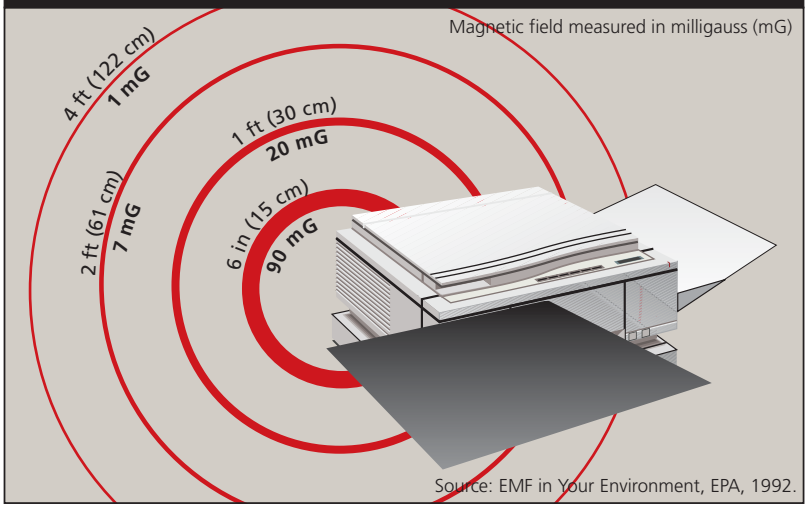


Lamp plugged in and turned on. Current now produces a magnetic field also.

- Measured in **gauss (G)** or **tesla (T).**
- **Not easily shielded** (weakened) by most material.
- Strength decreases rapidly with increasing distance from the source.

An appliance that is plugged in and therefore connected to a source of electricity has an electric field even when the appliance is turned off. To produce a magnetic field, the appliance must be plugged in and turned on so that the current is flowing.

Magnetic Field Strength Decreases with Distance



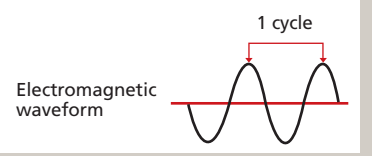
You cannot see a magnetic field, but this illustration represents how the strength of the magnetic field can diminish just 1–2 feet (30–61 centimeters) from the source. This magnetic field is a 60-Hz power-frequency field.

Characteristics of electric and magnetic fields

Electric fields and magnetic fields can be characterized by their wavelength, frequency, and amplitude (strength). The graphic below shows the waveform of an alternating electric or magnetic field. The direction of the field alternates from one polarity to the opposite and back to the first polarity in a period of time called one cycle. Wavelength describes the distance between a peak on the wave and the next peak of the same polarity. The frequency of the field, measured in hertz (Hz), describes the number of cycles that occur in one second. Electricity in North America alternates through 60 cycles per second, or 60 Hz. In many other parts of the world, the frequency of electric power is 50 Hz.

Frequency and Wavelength

Frequency is measured in hertz (Hz).
1 Hz = 1 cycle per second.



Examples:

Source	Frequency	Wavelength
Power line (North America)	60 Hz	3100 miles (5000 km)
Power line (Europe and most other locations)	50 Hz	3750 miles (6000 km)

Q How is the term EMF used in this booklet?

A The term "EMF" usually refers to electric and magnetic fields at extremely low frequencies such as those associated with the use of electric power. The term EMF can be used in a much broader sense as well, encompassing electromagnetic fields with low or high frequencies (see page 8).

Measuring EMF: Common Terms

Electric fields

Electric field strength is measured in volts per meter (V/m) or in kilovolts per meter (kV/m). 1 kV = 1000 V

Magnetic fields

Magnetic fields are measured in units of gauss (G) or tesla (T). Gauss is the unit most commonly used in the United States. Tesla is the internationally accepted scientific term. 1 T = 10,000 G

Since most environmental EMF exposures involve magnetic fields that are only a fraction of a tesla or a gauss, these are commonly measured in units of microtesla (μT) or milligauss (mG). A milligauss is 1/1,000 of a gauss. A microtesla is 1/1,000,000 of a tesla. 1 G = 1,000 mG; 1 T = 1,000,000 μT

To convert a measurement from microtesla (μT) to milligauss (mG), multiply by 10.
1 μT = 10 mG; 0.1 μT = 1 mG

When we use EMF in this booklet, we mean extremely low frequency (ELF) electric and magnetic fields, ranging from 3 to 3,000 Hz (see page 8). This range includes power-frequency (50 or 60 Hz) fields. In the ELF range, electric and magnetic fields are not coupled or interrelated in the same way that they are at higher frequencies. So, it is more useful to refer to them as "electric and magnetic fields" rather than "electromagnetic fields." In the popular press, however, you will see both terms used, abbreviated as EMF.

This booklet focuses on extremely low frequency EMF, primarily power-frequency fields of 50 or 60 Hz, produced by the generation, transmission, and use of electricity.

Q How are power-frequency EMF different from other types of electromagnetic energy?

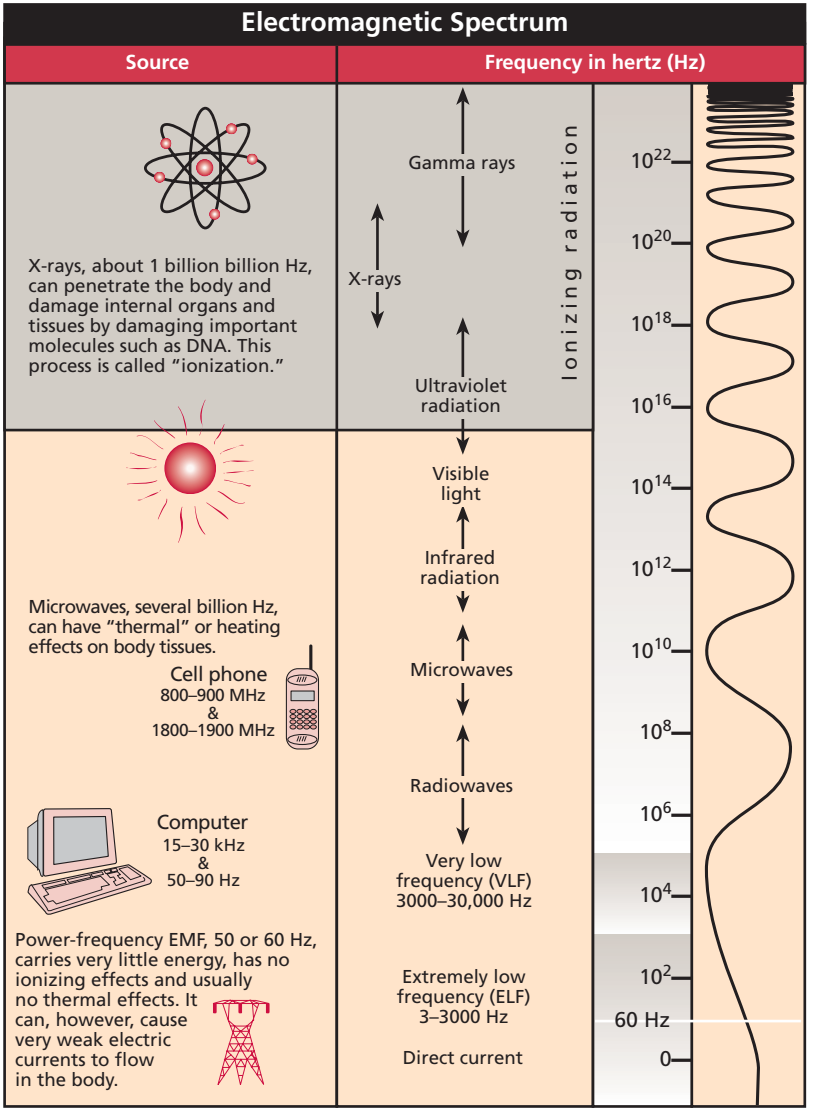
A X-rays, visible light, microwaves, radio waves, and EMF are all forms of electromagnetic energy. One property that distinguishes different forms of electromagnetic energy is the frequency, expressed in hertz (Hz). Power-frequency EMF, 50 or 60 Hz, carries very little energy, has no ionizing effects, and usually has no thermal effects (see page 8). Just as various chemicals affect our bodies in different ways, various forms of electromagnetic energy can have very different biological effects (see "Results of EMF Research" on page 16).

Some types of equipment or operations simultaneously produce electromagnetic energy of different frequencies. Welding operations, for example, can produce electromagnetic energy in the ultraviolet, visible, infrared, and radio-frequency ranges, in addition to power-frequency EMF. Microwave ovens produce 60-Hz fields of several hundred milligauss, but they also create microwave energy inside the oven that is at a much higher frequency (about 2.45 billion Hz). We are shielded from the higher frequency fields inside the oven by its casing, but we are not shielded from the 60-Hz fields.

Cellular telephones communicate by emitting high-frequency electric and magnetic fields similar to those used for radio and television broadcasts. These radio-frequency and microwave fields are quite different from the extremely low frequency EMF produced by power lines and most appliances.

Q How are alternating current sources of EMF different from direct current sources?

A Some equipment can run on either alternating current (AC) or direct current (DC). In most parts of the United States, if the equipment is plugged into a household wall socket, it is using AC electric current that reverses direction in the electrical wiring—or alternates—60 times per second, or at 60 hertz (Hz). If the equipment uses batteries, then electric current flows in one direction only. This



The wavy line at the right illustrates the concept that the higher the frequency, the more rapidly the field varies. The fields do not vary at 0 Hz (direct current) and vary trillions of times per second near the top of the spectrum. Note that 10^4 means 10 x 10 x 10 x 10 or 10,000 Hz. 1 kilohertz (kHz) = 1,000 Hz. 1 megahertz (MHz) = 1,000,000 Hz.

produces a "static" or stationary magnetic field, also called a direct current field. Some battery-operated equipment can produce time-varying magnetic fields as part of its normal operation.

Q What happens when I am exposed to EMF?

A In most practical situations, DC electric power does not induce electric currents in humans. Strong DC magnetic fields are present in some industrial environments, can induce significant currents when a person moves, and may be of concern for other reasons, such as potential effects on implanted medical devices (see page 47 for more information on pacemakers and other medical devices).

AC electric power produces electric and magnetic fields that create weak electric currents in humans. These are called "induced currents." Much of the research on how EMF may affect human health has focused on AC-induced currents.

Electric fields

A person standing directly under a high-voltage transmission line may feel a mild shock when touching something that conducts electricity. These sensations are caused by the strong electric fields from the high-voltage electricity in the lines. They occur only at close range because the electric fields rapidly become weaker as the distance from the line increases. Electric fields may be shielded and further weakened by buildings, trees, and other objects that conduct electricity.

Magnetic fields

Alternating magnetic fields produced by AC electricity can induce the flow of weak electric currents in the body. However, such currents are estimated to be smaller than the measured electric currents produced naturally by the brain, nerves, and heart.

Q Doesn't the earth produce EMF?

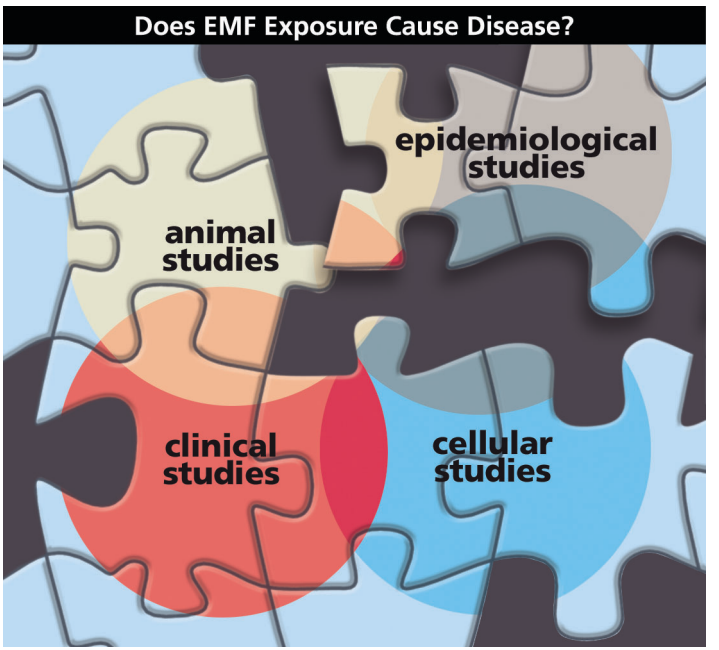
A Yes. The earth produces EMF, mainly in the form of static fields, similar to the fields generated by DC electricity. Electric fields are produced by air turbulence and other atmospheric activity. The earth's magnetic field of about 500 mG is thought to be produced by electric currents flowing deep within the earth's core. Because these fields are static rather than alternating, they do not induce currents in stationary objects as do fields associated with alternating current. Such static fields can induce currents in moving and rotating objects.

2 Evaluating Potential Health Effects

This chapter explains how scientific studies are conducted and evaluated to assess potential health effects.

Q How do we evaluate whether EMF exposures cause health effects?

A Animal experiments, laboratory studies of cells, clinical studies, computer simulations, and human population (epidemiological) studies all provide valuable information. When evaluating evidence that certain exposures cause disease, scientists consider results from studies in various disciplines. No single study or type of study is definitive.



Laboratory studies and human studies provide pieces of the puzzle, but no single study can give us the whole picture.

Laboratory studies

Laboratory studies with cells and animals can provide evidence to help determine if an agent such as EMF causes disease. Cellular studies can increase our understanding of the biological mechanisms by which disease occurs. Experiments with animals provide a means to observe effects of specific agents under carefully controlled conditions. Neither cellular nor animal studies, however, can recreate the complex nature of the whole human organism and its environment. Therefore, we must use caution in applying the results of cellular or animal studies directly to humans or concluding that a lack of an effect in laboratory studies proves that an agent is safe. Even with these limitations, cellular and animal studies have proven very

useful over the years for identifying and understanding the toxicity of numerous chemicals and physical agents.

Very specific laboratory conditions are needed for researchers to be able to detect EMF effects, and experimental exposures are not easily comparable to human exposures. In most cases, it is not clear how EMF actually produces the effects observed in some experiments. Without understanding how the effects occur, it is difficult to evaluate how laboratory results relate to human health effects.

Some laboratory studies have reported that EMF exposure can produce biological effects, including changes in functions of cells and tissues and subtle changes in hormone levels in animals. It is important to distinguish between a biological effect and a health effect. Many biological effects are within the normal range of variation and are not necessarily harmful. For example, bright light has a biological effect on our eyes, causing the pupils to constrict, which is a normal response.

Clinical studies

In clinical studies, researchers use sensitive instruments to monitor human physiology during controlled exposure to environmental agents. In EMF studies, volunteers are exposed to electric or magnetic fields at higher levels than those commonly encountered in everyday life. Researchers measure heart rate, brain activity, hormonal levels, and other factors in exposed and unexposed groups to look for differences resulting from EMF exposure.

Epidemiology

A valuable tool to identify human health risks is to study a human population that has experienced the exposure. This type of research is called epidemiology.

The epidemiologist observes and compares groups of people who have had or have not had certain diseases and exposures to see if the risk of disease is different between the exposed and unexposed groups. The epidemiologist does not control the exposure and cannot experimentally control all the factors that might affect the risk of disease.

Most researchers agree that epidemiology—the study of patterns and possible causes of diseases—is one of the most valuable tools to identify human health risks.

Q How do we evaluate the results of epidemiological studies of EMF?

A Many factors need to be considered when determining whether an agent causes disease. An exposure that an epidemiological study associates with increased risk of a certain disease is not always the actual cause of the disease. To judge whether an agent actually causes a health effect, several issues are considered.

Strength of association

The stronger the association between an exposure and disease, the more confident we can be that the disease is due to the exposure being studied. With cigarette smoking and lung cancer, the association is very strong—20 times the normal risk. In the studies that suggest a relationship between EMF and certain rare cancers, the association is much weaker (see page 19).

Dose-response

Epidemiological data are more convincing if disease rates increase as exposure levels increase. Such dose-response relationships have appeared in only a few EMF studies.

Consistency

Consistency requires that an association found in one study appears in other studies involving different study populations and methods. Associations found consistently are more likely to be causal. With regard to EMF, results from different studies sometimes disagree in important ways, such as what type of cancer is associated with EMF exposure. Because of this inconsistency, scientists cannot be sure whether the increased risks are due to EMF or other factors.

Biological plausibility

When associations are weak in an epidemiological study, results of laboratory studies are even more important to support the association. Many scientists remain skeptical about an association between EMF exposure and cancer because laboratory studies thus far have not shown any consistent evidence of adverse health effects, nor have results of experimental studies revealed a plausible biological explanation for such an association.

Reliability of exposure information

Another important consideration with EMF epidemiological studies is how the exposure information was obtained. Did the researchers simply estimate people's EMF exposures based on their job titles or how their houses were wired, or did they actually conduct EMF measurements? What did they measure (electric fields, magnetic fields, or both)? How often were the EMF measurements made and at

what time? In how many different places were the fields measured? More recent studies have included measurements of magnetic field exposure. Magnetic fields measured at the time a study is conducted can only estimate exposures that occurred in previous years (at the time a disease process may have begun). Lack of comprehensive exposure information makes it more difficult to interpret the results of a study, particularly considering that everyone in the industrialized world has been exposed to EMF.

Confounding

Epidemiological studies show relationships or correlations between disease and other factors such as diet, environmental conditions, and heredity. When a disease is correlated with some factor, it does not necessarily mean that the correlated factor causes the disease. It could mean that the factor occurs together with some other factor, not measured in the study, that actually causes the disease. This is called confounding.

For example, a study might show that alcohol consumption is correlated with lung cancer. This could occur if the study group consists of people who drink and also smoke tobacco, as often happens. In this example, alcohol use is correlated with lung cancer, but cigarette smoking is a confounding factor and the true cause of the disease.

Statistical significance

Researchers use statistical methods to determine the likelihood that the association between exposure and disease is due simply to chance. For a result to be considered "statistically significant," the association must be stronger than would be expected to occur by chance alone.

Meta-analysis

One way researchers try to get more information from epidemiological studies is to conduct a meta-analysis. A meta-analysis combines the summary statistics of many studies to explore their differences and, if appropriate, calculates an overall summary risk estimate. The main challenge faced by researchers performing meta-analyses is that populations, measurements, evaluation techniques, participation rates, and potential confounding factors vary in the original studies. These differences in the studies make it difficult to combine the results in a meaningful way.

Pooled analysis

Pooled analysis combines the original data from several studies and conducts a new analysis on the primary data. It requires access to the original data from individual studies and can only include diseases or factors included in all the studies, but it has the advantage that the same parameters can be applied to all studies. As with meta-analysis, pooled analysis is still subject to the limitations of the experimental

design of the original studies (for example, evaluation techniques, participation rates, etc.). Pooled analysis differs from meta-analysis, which combines the summary statistics from different studies, not their original data.

Q How do we characterize EMF exposure?

A No one knows which aspect of EMF exposure, if any, affects human health. Because of this uncertainty, in addition to the field strength, we must ask how long an exposure lasts, how it varies, and at what time of day or night it occurs. House wiring, for example, is often a significant source of EMF exposure for an individual, but the magnetic fields produced by the wiring depend on the amount of current flowing. As heating, lighting, and appliance use varies during the day, magnetic field exposure will also vary.

For many studies, researchers describe EMF exposures by estimating the average field strength. Some scientists believe that average exposure may not be the best measurement of EMF exposure and that other parameters, such as peak exposure or time of exposure, may be important.

Q What is the average field strength?

A In EMF studies, the information reported most often has been a person's EMF exposure averaged over time (average field strength). With cancer-causing chemicals, a person's average exposure over many years can be a good way to predict his or her chances of getting the disease.

There are different ways to calculate average magnetic field exposures. One method involves having a person wear a small monitor that takes many measurements over a work shift, a day, or longer. Then the average of those measurements is calculated. Another method involves placing a monitor that takes many measurements in a residence over a 24-hour or 48-hour period. Sometimes averages are calculated for people with the same occupation, people working in similar environments, or people using several brands of the same type or similar types of equipment.

Q How is EMF exposure measured in epidemiological studies?

A Epidemiologists study patterns and possible causes of diseases in human populations. These studies are usually observational rather than experimental. This means that the researcher observes and compares groups of people who have had certain diseases and exposures and looks for possible "associations." The epidemiologist must find a way to estimate the exposure that people had at an earlier time.

Association

In epidemiology, a positive association between an exposure (such as EMF) and a disease is not necessarily proof that the exposure *caused* the disease. However, the more often the exposure and disease occur together, the stronger the association, and the stronger is the possibility that the exposure may increase the risk of the disease.

Some exposure estimates for residential studies have been based on designation of households in terms of "wire codes." In other studies, measurements have been made in homes, assuming that EMF levels at the time of the measurement are similar to levels at some time in the past. Some studies involved "spot measurements." Exposure levels change as a person moves around in his or her environment, so spot measurements taken at specific locations only approximate the complex variations in exposure a person experiences. Other studies measured magnetic fields over a 24-hour or 48-hour period. Exposure levels for some occupational studies are measured by having certain employees wear personal monitors. The data taken from these monitors are sometimes used to estimate typical exposure levels for employees with certain job titles. Researchers can then estimate exposures using only an employee's job title and avoid measuring exposures of all employees.

Methods to Estimate EMF Exposure

Wire Codes

A classification of homes based on characteristics of power lines outside the home (thickness of the wires, wire configuration, etc.) and their distance from the home. This information is used to code the homes into groups with higher and lower predicted magnetic field levels.

Spot Measurement

An instantaneous or very short-term (e.g., 30-second) measurement taken at a designated location.

Time-Weighted Average

A weighted average of exposure measurements taken over a period of time that takes into account the time interval between measurements. When the measurements are taken with a monitor at a fixed sampling rate, the time-weighted average equals the arithmetic mean of the measurements.

Personal Monitor

An instrument that can be worn on the body for measuring exposure over time.

Calculated Historical Fields

An estimate based on a theoretical calculation of the magnetic field emitted by power lines using historical electrical loads on those lines.

3 Results of EMF Research

This chapter summarizes the results of EMF research worldwide, including epidemiological studies of children and adults, clinical studies of how humans react to typical EMF exposures, and laboratory research with animals and cells.

Q Is there a link between EMF exposure and childhood leukemia?

A Despite more than two decades of research to determine whether elevated EMF exposure, principally to magnetic fields, is related to an increased risk of childhood leukemia, there is still no definitive answer. Much progress has been made, however, with some lines of research leading to reasonably clear answers and others remaining unresolved. The best available evidence at this time leads to the following answers to specific questions about the link between EMF exposure and childhood leukemia:

Is there an association between power line configurations (wire codes) and childhood leukemia? No.

Is there an association between measured fields and childhood leukemia? Yes, but the association is weak, and it is not clear whether it represents a cause-and-effect relationship.

Q What is the epidemiological evidence for evaluating a link between EMF exposure and childhood leukemia?

A The initial studies, starting with the pioneering research of Dr. Nancy Wertheimer and Ed Leeper in 1979 in Denver, Colorado, focused on power line configurations near homes. Power lines were systematically evaluated and coded for their presumed ability to produce elevated magnetic fields in homes and classified into groups with higher and lower predicted magnetic field levels (see discussion of wire codes on page 15). Although the first study and two that followed in Denver and Los Angeles showed an association between wire codes indicative of elevated magnetic fields and childhood leukemia, larger, more recent studies in the central part of the United States and in several provinces of Canada did not find such an

association. In fact, combining the evidence from all the studies, we can conclude with some confidence that wire codes are not associated with a measurable increase in the risk of childhood leukemia.

The other approach to assessing EMF exposure in homes focused on the measurements of magnetic fields. Unlike wire codes, which are only applicable in North America due to the nature of the electric power distribution system, measured fields have been studied in relation to childhood leukemia in research conducted around the world, including Sweden, England, Germany, New Zealand, and Taiwan. Large, detailed studies have recently been completed in the United States, Canada, and the United Kingdom that provide the most evidence for making an evaluation. These studies have produced variable findings, some reporting small associations, others finding no associations.

National Cancer Institute Study

In 1997, after eight years of work, Dr. Martha Linet and colleagues at the National Cancer Institute (NCI) reported the results of their study of childhood acute lymphoblastic leukemia (ALL). The case-control study involved more than 1,000 children living in 9 eastern and midwestern U.S. states and is the largest epidemiological study of childhood leukemia to date in the United States. To help resolve the question of wire code versus measured magnetic fields, the NCI researchers carried out both types of exposure assessment. Overall, Linet reported little evidence that living in homes with higher measured magnetic-field levels was a disease risk and found no evidence that living in a home with a high wire code configuration increased the risk of ALL in children.

United Kingdom Childhood Cancer Study

In December 1999, Sir Richard Doll and colleagues in the United Kingdom announced that the largest study of childhood cancer ever undertaken—involving nearly 4,000 children with cancer in England, Wales, and Scotland—found no evidence of excess risk of childhood leukemia or other cancers from exposure to power-frequency magnetic fields. It should be noted, however, that because most power lines in the United Kingdom are underground, the EMF exposures of these children were mostly lower than 0.2 microtesla or 2 milligauss.

After reviewing all the data, the U.S. National Institute of Environmental Health Sciences (NIEHS) concluded in 1999 that the evidence was weak, but that it was still sufficient to warrant limited concern. The NIEHS rationale was that no individual epidemiological study provided convincing evidence linking magnetic field exposure with childhood leukemia, but the overall pattern of results for some methods of measuring exposure suggested a weak association between increasing exposure to EMF and increasing risk of childhood leukemia. The small number of cases in these studies made it impossible to firmly demonstrate this association. However, the fact that similar results had been observed in studies of different populations using a variety of study designs supported this observation.

A major challenge has been to determine whether the most highly elevated, but rarely encountered, levels of magnetic fields are associated with an increased risk of leukemia. Early reports focused on the risk associated with exposures above 2 or 3 milligauss, but the more recent studies have been large enough to also provide some information on levels above 3 or 4 milligauss. It is estimated that 4.5% of homes in the United States have magnetic fields above 3 milligauss, and 2.5% of homes have levels above 4 milligauss.

What is Cancer?

Cancer

"Cancer" is a term used to describe at least 200 different diseases, all involving uncontrolled cell growth. The frequency of cancer is measured by the incidence—the number of new cases diagnosed each year. Incidence is usually described as the number of new cases diagnosed per 100,000 people per year.

The incidence of cancer in adults in the United States is 382 per 100,000 per year, and childhood cancers account for about 1% of all cancers. The factors that influence risk differ among the forms of cancer. Known risk factors such as smoking, diet, and alcohol contribute to specific types of cancer. (For example, smoking is a known risk factor for lung cancer, bladder cancer, and oral cancer.) For many other cancers, the causes are unknown.

Leukemia

Leukemia describes a variety of cancers that arise in the bone marrow where blood cells are formed. The leukemias represent less than 4% of all cancer cases in adults but are the most common form of cancer in children. For children age 4 and under, the incidence of childhood leukemia is approximately 6 per 100,000 per year, and it decreases with age to about 2 per 100,000 per year for children 10 and older. In the United States, the incidence of adult leukemia is about 10 cases per 100,000 people per year. Little is known about what causes leukemia, although genetic factors play a role. The only known causes are ionizing radiation, benzene, and other chemicals and drugs that suppress bone marrow function, and a human T-cell leukemia virus.

Brain Cancer

Cancer of the central nervous system (the brain and spinal cord) is uncommon, with incidence in the United States now at about 6 cases in 100,000 people per year. The causes of the disease are largely unknown, although a number of studies have reported an association with certain occupational chemical exposures. Ionizing radiation to the scalp is a known risk factor for brain cancer. Factors associated with an increased risk for other types of cancer—such as smoking, diet, and excessive alcohol use—have not been found to be associated with brain cancer.

To determine what the integrated information from all the studies says about magnetic fields and childhood leukemia, two groups have conducted pooled analyses in which the original data from relevant studies were integrated and analyzed. One report (Greenland et al., 2000) combined 12 relevant studies with magnetic field measurements, and the other considered 9 such studies (Ahlbom et al., 2000). The details of the two pooled analyses are different, but their findings are similar. There is weak evidence for an association (relative risk of approximately 2) at exposures above 3 mG. However, few individuals had high exposures in these studies; therefore, even combining all studies, there is uncertainty about the strength of the association.

The following table summarizes the results for the epidemiological studies of EMF exposure and childhood leukemia analyzed in the pooled analysis by Greenland et al. (2000). The focus of the summary review was the magnetic fields that occurred three months prior to diagnosis. The results were derived from either calculated historical fields or multiple measurements of magnetic fields. The North American

Residential Exposure to Magnetic Fields and Childhood Leukemia

	Magnetic field category (mG)					
	>1 – ≤2 mG		>2 – ≤3 mG		>3 mG	
First author	Estimate	95% CL	Estimate	95% CL	Estimate	95% CL
Coghill	0.54	0.17, 1.74	No controls		No controls	
Dockerty	0.65	0.26, 1.63	2.83	0.29, 27.9	No controls	
Feychting	0.63	0.08, 4.77	0.90	0.12, 7.00	4.44	1.67, 11.7
Linet	1.07	0.82, 1.39	1.01	0.64, 1.59	1.51	0.92, 2.49
London	0.96	0.54, 1.73	0.75	0.22, 2.53	1.53	0.67, 3.50
McBride	0.89	0.62, 1.29	1.27	0.74, 2.20	1.42	0.63, 3.21
Michaelis	1.45	0.78, 2.72	1.06	0.27, 4.16	2.48	0.79, 7.81
Olsen	0.67	0.07, 6.42	No cases		2.00	0.40, 9.93
Savitz	1.61	0.64, 4.11	1.29	0.27, 6.26	3.87	0.87, 17.3
Tomenius	0.57	0.33, 0.99	0.88	0.33, 2.36	1.41	0.38, 5.29
Tynes	1.06	0.25, 4.53	No cases		No cases	
Verkasalo	1.11	0.14, 9.07	No cases		2.00	0.23, 17.7
Study summary	0.95	0.80, 1.12	1.06	0.79, 1.42	1.69*	1.25, 2.29
	1 – <2 mG		2 – <4 mG		≥4 mG	
**United Kingdom	0.84	0.57, 1.24	0.98	0.50, 1.93	1.00	0.30, 3.37

95% CL = 95% confidence limits.
Source: Greenland et al., 2000.

* Mantel-Haenszel analysis (p = 0.01). Maximum-likelihood summaries differed by less than 1% from these summaries; based on 2,656 cases and 7,084 controls. Adjusting for age, sex, and other variables had little effect on summary results.

** These data are from a recent United Kingdom study not included in the Greenland analysis but included in another pooled analysis (Ahlbom et al. 2000). The United Kingdom study included 1,073 cases and 2,224 controls.

For this table, the column headed "estimate" describes the relative risk. Relative risk is the ratio of the risk of childhood leukemia for those in a magnetic field exposure group compared to persons with exposure levels of 1.0 mG or less. For example, Coghill estimated that children with exposures between 1 and 2 mG have 0.54 times the risk of children whose exposures were less than 1 mG. London's study estimates that children whose exposures were greater than 3 mG have 1.53 times the risk of children whose exposures were less than 1 mG. The column headed "95% CL" (confidence limits) describes how much random variation is in the estimate of relative risk. The estimate may be off by some amount due to random variation, and the width of the confidence limits gives some notion of that variation. For example, in Coghill's estimate of 0.54 for the relative risk, values as low as 0.17 or as high as 1.74 would not be statistically significantly different from the value of 0.54. Note there is a wide range of estimates of relative risk across the studies and wide confidence limits for many studies. In light of these findings, the pooling of results can be extremely helpful to calculate an overall estimate, much better than can be obtained from any study taken alone.

studies (Linet, London, McBride, Savitz) were 60 Hz; all other studies were 50 Hz. Results from the recent study from the United Kingdom (see page 17) are also included in the table. This study was included in the analysis by Ahlbom et al. (2000). The relative risk estimates from the individual studies show little or no association of magnetic fields with childhood leukemia. The study summary for the pooled analysis by Greenland et al. (2000) shows a weak association between childhood leukemia and magnetic field exposures greater 3 mG.

Q Is there a link between EMF exposure and childhood brain cancer or other forms of cancer in children?

A Although the earliest studies suggested an association between EMF exposure and all forms of childhood cancer, those initial findings have not been confirmed by other studies. At present, the available series of studies indicates no association between EMF exposure and childhood cancers other than leukemia. Far fewer of these studies have been conducted than studies of childhood leukemia.

Q Is there a link between residential EMF exposure and cancer in adults?

A The few studies that have been conducted to address EMF and adult cancer do not provide strong evidence for an association. Thus, a link has not been established between residential EMF exposure and adult cancers, including leukemia, brain cancer, and breast cancer (see table below).

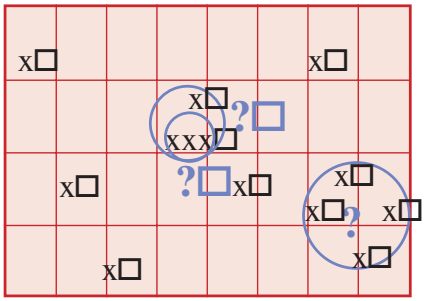
Residential Exposure to Magnetic Fields and Adult Cancer

First author	Location	Type of exposure data	Results (odds ratios)		
			Leukemia	CNS tumors	All cancers
Coleman	United Kingdom	Calculated historical fields	0.92	NA	NA
Feychting and Ahlbom	Sweden	Calculated & spot measurements	1.5*	0.7	NA
Li	Taiwan	Calculated historical fields	1.4*	1.1	NA
Li	Taiwan	Calculated historical fields		1.1 (breast cancer)	
McDowall	United Kingdom	Calculated historical fields	1.43	NA	1.03
Severson	Seattle	Wire codes & spot measurements	0.75	NA	NA
Wrensch	San Francisco	Wire codes & spot measurements	NA	0.9	NA
Youngson	United Kingdom	Calculated historical fields	1.88	NA	NA

CNS = central nervous system.
*The number is statistically significant (greater than expected by chance).
Study results are listed as "odds ratios" (OR). An odds ratio of 1.00 means there was no increase or decrease in risk. In other words, the odds that the people in the study who had the disease (in this case, cancer) and were exposed to a particular agent (in this case, EMF) are the same as for the people in the study who did not have the disease. An odds ratio greater than 1 may occur simply by chance, unless it is statistically significant.

Q Have clusters of cancer or other adverse health effects been linked to EMF exposure?

A An unusually large number of cancers, miscarriages, or other adverse health effects that occur in one area or over one period of time is called a "cluster." Sometimes clusters provide an early warning of a health hazard. But most of the time the reason for the cluster is not known. There have been no proven instances of cancer clusters linked with EMF exposure.



The definition of a "cluster" depends on how large an area is included. Cancer cases (x's in illustration) in a city, neighborhood, or workplace may occur in ways that suggest a cluster due to a common environmental cause. Often these patterns turn out to be due to chance. Delineation of a cluster is subjective—where do you draw the circles?

Q If EMF does cause or promote cancer, shouldn't cancer rates have increased along with the increased use of electricity?

A Not necessarily. Although the use of electricity has increased greatly over the years, EMF exposures may not have increased. Changes in building wiring codes and in the design of electrical appliances have in some cases resulted in lower magnetic field levels. Rates for various types of cancer have shown both increases and decreases through the years, due in part to improved prevention, diagnosis, reporting, and treatment.

Q Is there a link between EMF exposure in electrical occupations and cancer?

A For almost as long as we have been concerned with residential exposure to EMF and childhood cancers, researchers have been studying workplace exposure to EMF and adult cancers, focusing on leukemia and brain cancer. This research began with surveys of job titles and cancer risks, but has progressed to include very large, detailed studies of the health of workers, especially electric utility workers, in the United States, Canada, France, England, and several Northern European countries. Some studies have found evidence that suggests a link between EMF exposure and both leukemia and brain cancer, whereas other studies of similar size and quality have not found such associations.

California

A 1993 study of 36,000 California electric utility workers reported no strong, consistent evidence of an association between magnetic fields and any type of cancer.

Canada/France

A 1994 study of more than 200,000 utility workers in 3 utility companies in Canada and France reported no significant association between all leukemias combined and cumulative exposure to magnetic fields. There was a slight, but not statistically significant, increase in brain cancer. The researchers concluded that the study did not provide clear-cut evidence that magnetic field exposures caused leukemia or brain cancer.

North Carolina

Results of a 1995 study involving more than 138,000 utility workers at 5 electric utilities in the United States did not support an association between occupational magnetic field exposure and leukemia, but suggested a link to brain cancer.

Denmark

In 1997 a study of workers employed in all Danish utility companies reported a small, but statistically significant, excess risk for all cancers combined and for lung cancer. No excess risk was observed for leukemia, brain cancers, or breast cancer.

United Kingdom

A 1997 study among electrical workers in the United Kingdom did not find an excess risk for brain cancer. An extension of this work reported in 2001 also found no increased risk for brain cancer.

Efforts have also been made to pool the findings across several of the above studies to produce more accurate estimates of the association between EMF and cancer (Kheifets et al., 1999). The combined summary statistics across studies provide insufficient evidence for an association between EMF exposure in the workplace and either leukemia or brain cancer.

Q Have studies of workers in other industries suggested a link between EMF exposure and cancer?

A One of the largest studies to report an association between cancer and magnetic field exposure in a broad range of industries was conducted in Sweden (1993). The study included an assessment of EMF exposure in 1,015 different workplaces and involved more than 1,600 people in 169 different occupations. An association was reported between estimated EMF exposure and increased risk for chronic lymphocytic leukemia. An association was also reported between exposure to magnetic fields and brain cancer, but there was no dose-response relationship.

Another Swedish study (1994) found an excess risk of lymphocytic leukemia among railway engine drivers and conductors. However, the total cancer incidence (all tumors included) for this group of workers was lower than in the general Swedish population. A study of Norwegian railway workers found no evidence for an association between EMF exposure and leukemia or brain cancer. Although both positive and negative effects of EMF exposure have been reported, the majority of studies show no effects.

Q Is there a link between EMF exposure and breast cancer?

A Researchers have been interested in the possibility that EMF exposure might cause breast cancer, in part because breast cancer is such a common disease in adult women. Early studies identified a few electrical workers with male breast cancer, a very rare disease. A link between EMF exposure and alterations in the hormone melatonin was considered a possible hypothesis (see page 24). This idea provided motivation to conduct research addressing a possible link between EMF exposure and breast cancer. Overall, the published epidemiological studies have not shown such an association.

Q What have we learned from clinical studies?

A Laboratory studies with human volunteers have attempted to answer questions such as,

Does EMF exposure alter normal brain and heart function?
Does EMF exposure at night affect sleep patterns?
Does EMF exposure affect the immune system?
Does EMF exposure affect hormones?

The following kinds of biological effects have been reported. Keep in mind that a biological effect is simply a measurable change in some biological response. It may or may not have any bearing on health.

Heart rate

An inconsistent effect on heart rate by EMF exposure has been reported. When observed, the biological response is small (on average, a slowing of about three to five beats per minute), and the response does not persist once exposure has ended.

Two laboratories, one in the United States and one in Australia, have reported effects of EMF on heart rate variability. Exposures used in these experiments were relatively high (about 300 mG), and lower exposures failed to produce the effect. Effects have not been observed consistently in repeated experiments.

Sleep electrophysiology

A laboratory report suggested that overnight exposure to 60-Hz magnetic fields may disrupt brain electrical activity (EEG) during night sleep. In this study subjects were exposed to either continuous or intermittent magnetic fields of 283 mG. Individuals exposed to the intermittent magnetic fields showed alterations in traditional EEG sleep parameters indicative of a pattern of poor and disrupted sleep. Several studies have reported no effect with continuous exposure.

Hormones, immune system, and blood chemistry

Several clinical studies with human volunteers have evaluated the effects of power-frequency EMF exposure on hormones, the immune system, and blood chemistry. These studies provide little evidence for any consistent effect.

Melatonin

The hormone melatonin is secreted mainly at night and primarily by the pineal gland, a small gland attached to the brain. Some laboratory experiments with cells and animals have shown that melatonin can slow the growth of cancer cells, including breast cancer cells. Suppressed nocturnal melatonin levels have been observed in some studies of laboratory animals exposed to both electric and magnetic fields. These observations led to the hypothesis that EMF exposure might reduce melatonin and thereby weaken one of the body's defenses against cancer.

Many clinical studies with human volunteers have now examined whether various levels and types of magnetic field exposure affect blood levels of melatonin. Exposure of human volunteers at night to power-frequency EMF under controlled laboratory conditions has no apparent effect on melatonin. Some studies of people exposed to EMF at work or at home do report evidence for a small suppression of melatonin. It is not clear whether the decreases in melatonin reported under environmental conditions are related to the presence of EMF exposure or to other factors.

Q What effects of EMF have been reported in laboratory studies of cells?

A Over the years, scientists have conducted more than 1,000 laboratory studies to investigate potential biological effects of EMF exposure. Most have been *in vitro* studies; that is, studies carried out on cells isolated from animals and plants, or on cell components such as cell membranes. Other studies involved animals, mainly rats and mice. In general, these studies do not demonstrate a consistent effect of EMF exposure.

Most *in vitro* studies have used magnetic fields of 1,000 mG (100 μT) or higher, exposures that far exceed daily human exposures. In most incidences, when one laboratory has reported effects of EMF exposure on cells, other laboratories have not been able to reproduce the findings. For such research results to be widely accepted by scientists as valid, they must be replicated—that is, scientists in other laboratories should be able to repeat the experiment and get similar results. Cellular studies have investigated potential EMF effects on cell proliferation and differentiation, gene expression, enzyme activity, melatonin, and DNA. Scientists reviewing the EMF research literature find overall that the cellular studies provide little convincing evidence of EMF effects at environmental levels.

Q Have effects of EMF been reported in laboratory studies in animals?

A Researchers have published more than 30 detailed reports on both long-term and short-term studies of EMF exposures in laboratory animals (bioassays). Long-term animal bioassays constitute an important group of studies in EMF research. Such studies have a proven record for predicting the carcinogenicity of chemicals, physical agents, and other suspected cancer-causing agents. In the EMF studies, large groups of mice or rats were continuously exposed to EMF for two years or longer and were then evaluated for cancer. The U.S. National Toxicology Program (http://ntp-server.niehs.nih.gov/) has an extensive historical database for hundreds of different chemical and physical agents evaluated using this model. EMF long-term bioassays examined leukemia, brain cancer, and breast cancer—the diseases some epidemiological studies have associated with EMF exposure (see pages 16–23).

Several different approaches have been used to evaluate effects of EMF exposure in animal bioassays. To investigate whether EMF could promote cancer after genetic damage had occurred, some long-term studies used cancer initiators such as ultraviolet light, radiation, or certain chemicals that are known to cause genetic damage. Researchers compared groups of animals treated with cancer initiators to groups treated with cancer initiators and then exposed to EMF, to see if EMF exposure promoted the cancer growth (initiation-promotion model). Other studies tested the cancer promotion potential of EMF using mice that were predisposed to cancer because they had defects in the genes that control cancer.

Animal Leukemia Studies: Long-Term, Continuous Exposure Studies, Two or More Years in Length

First author	Sex/species	Exposure/animal numbers	Results
Babbitt (U.S.)	Female mice	14,000 mG, 190 or 380 mice per group. Some groups treated with ionizing radiation.	No effect
Boorman (U.S.)	Male and female rats	20 to 10,000 mG, 100 per group	No effect
McCormick (U.S.)	Male and female mice	20 to 10,000 mG, 100 per group	No effect
Mandeville (Canada)	Female rats	20 to 20,000 mG, 50 per group *In utero* exposure	No effect
Yasui (Japan)	Male and female rats	5,000 to 50,000 mG, 50 per group	No effect

10 milligauss (mG) = 1 microtesla (μT) = 0.001 millitesla (mT)

Leukemia

Fifteen animal leukemia studies have been completed and reported. Most tested for effects of exposure to power-frequency (60-Hz) magnetic fields using rodents. Results of these studies were largely negative. The Babbitt study evaluated the subtypes of leukemia. The data provide no support for the reported epidemiology findings of leukemia from EMF exposure. Many scientists feel that the lack of effects seen in these laboratory leukemia studies significantly weakens the case for EMF as a cause of leukemia.

Breast cancer

Researchers in the Ukraine, Germany, Sweden, and the United States have used initiation-promotion models to investigate whether EMF exposure promotes breast cancer in rats.

The results of these studies are mixed; while the German studies showed some effects, the Swedish and U.S. studies showed none. Studies in Germany reported effects on the numbers of tumors and tumor volume. A National Toxicology Program long-term bioassay performed without the use of other cancer-initiating substances showed no effects of EMF exposure on the development of mammary tumors in rats and mice.

The explanation for the observed difference among these studies is not readily apparent. Within the limits of the experimental rodent model of mammary carcinogenesis, no conclusions are possible regarding a promoting effect of EMF on chemically induced mammary cancer.

Other cancers

Tests of EMF effects on skin cancer, liver cancer, and brain cancer have been conducted using both initiation-promotion models and non-initiated long-term bioassays. All are negative.

Three positive studies were reported for a co-promotion model of skin cancer in mice. The mice were exposed to EMF plus cancer-causing chemicals after cancers

had already been initiated. The same research team as well as an independent laboratory were unable to reproduce these results in subsequent experiments.

Non-cancer effects

Many animal studies have investigated whether EMF can cause health problems other than cancer. Researchers have examined many endpoints, including birth defects, immune system function, reproduction, behavior, and learning. Overall, animal studies do not support EMF effects on non-cancer endpoints.

Q A Can EMF exposure damage DNA?

Studies have attempted to determine whether EMF has genotoxic potential; that is, whether EMF exposure can alter the genetic material of living organisms. This question is important because genotoxic agents often also cause cancer or birth defects. Studies of genotoxicity have included tests on bacteria, fruit flies, and some tests on rats and mice. Nearly 100 studies on EMF genotoxicity have been reported. Most evidence suggests that EMF exposure is not genotoxic. Based on experiments with cells, some researchers have suggested that EMF exposure may inhibit the cell's ability to repair normal DNA damage, but this idea remains speculative because of the lack of genotoxicity observed in EMF animal studies.

4 Your EMF Environment

This chapter discusses typical magnetic field exposures in home and work environments and identifies common EMF sources and field intensities associated with these sources.

Q How do we define EMF exposure?

A Scientists are still uncertain about the best way to define "exposure" because experiments have yet to show which aspect of the field, if any, may be relevant to reported biological effects. Important aspects of exposure could be the highest intensity, the average intensity, or the amount of time spent above a certain baseline level. The most widely used measure of EMF exposure has been the time-weighted average magnetic field level (see discussion on page 15).

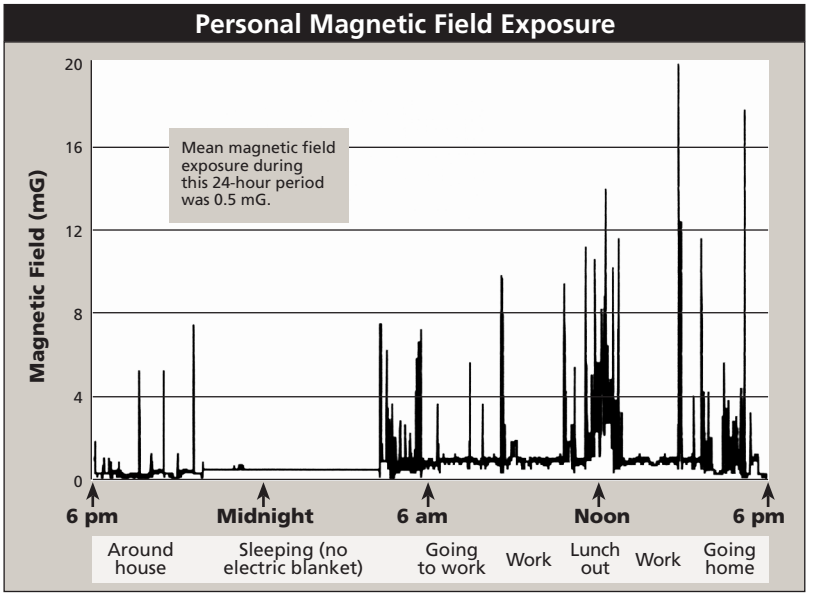
Q How is EMF exposure measured?

A Several kinds of personal exposure meters are now available. These automatically record the magnetic field as it varies over time. To determine a person's EMF exposure, the personal exposure meter is usually worn at the waist or is placed as close as possible to the person during the course of a work shift or day.

EMF can also be measured using survey meters, sometimes called "gaussmeters." These measure the EMF levels in a given location at a given time. Such measurements do not necessarily reflect personal EMF exposure because they are not always taken at the distance from the EMF source that the person would typically be from the source. Measurements are not always made in a location for the same amount of time that a person spends there. Such "spot measurements" also fail to capture variations of the field over time, which can be significant.

Q A What are some typical EMF exposures?

The figure below is an example of data collected with a personal exposure meter.



In the above example, the magnetic field was measured every 1.5 seconds over a period of 24 hours. For this person, exposure at home was very low. The occasional spikes (short exposure to high fields) occurred when the person drove or walked under power lines or over underground power lines or was close to appliances in the home or office.

Several studies have used personal exposure meters to measure field exposure in different environments. These studies tend to show that appliances and building wiring contribute to the magnetic field exposure that most people receive while at home. People living close to high voltage power lines that carry a lot of current tend to have higher overall field exposures. As shown on page 32, there is considerable variation among houses.

Q A What are typical EMF exposures for people living in the United States?

Most people in the United States are exposed to magnetic fields that average less than 2 milligauss (mG), although individual exposures vary.

The following table shows the estimated average magnetic field exposure of the U.S. population, according to a study commissioned by the U.S. government as part

of the EMF Research and Public Information Dissemination (EMF RAPID) Program (see page 50). This study measured magnetic field exposure of about 1,000 people of all ages randomly selected among the U.S. population. Participants wore or carried with them a small personal exposure meter and kept a diary of their activities both at home and away from home. Magnetic field values were automatically recorded twice a second for 24 hours. The study reported that exposure to magnetic fields is similar in different regions of the country and similar for both men and women.

Estimated Average Magnetic Field Exposure of the U.S. Population

Average 24-hour field (mG)	Population exposed (%)	95% confidence interval (%)	People exposed* (millions)
> 0.5	76.3	73.8–78.9	197–211
> 1	43.6	40.9–46.5	109–124
> 2	14.3	11.8–17.3	31.5–46.2
> 3	6.3	4.7–8.5	12.5–22.7
> 4	3.6	2.5–5.2	6.7–13.9
> 5	2.42	1.65–3.55	4.4–9.5
> 7.5	0.58	0.29–1.16	0.77–3.1
> 10	0.46	0.20–1.05	0.53–2.8
> 15	0.17	0.035–0.83	0.09–2.2

*Based on a population of 267 million. This table summarizes some of the results of a study that sampled about 1,000 people in the United States. In the first row, for example, we find that 76.3% of the sample population had a 24-hour average exposure of greater than 0.5 mG. Assuming that the sample was random, we can use statistics to say that we are 95% confident that the percentage of the overall U.S. population exposed to greater than 0.5 mG is between 73.8% and 78.9%. Source: Zaffanella, 1993.

The following table shows average magnetic fields experienced during different types of activities. In general, magnetic fields are greater at work than at home.

Estimated Average Magnetic Field Exposure of the U.S. Population for Various Activities

Average field (mG)	Population exposed (%)				
	Home	Bed	Work	School	Travel
> 0.5	69	48	81	63	87
> 1	38	30	49	25	48
> 2	14	14	20	3.5	13
> 3	7.8	7.2	13	1.6	4.1
> 4	4.7	4.7	8.0	< 1	1.5
> 5	3.5	3.7	4.6		1.0
> 7.5	1.2	1.6	2.5		0.5
> 10	0.9	0.8	1.3		< 0.2
> 15	0.1	0.1	0.9		

Source: Zaffanella, 1993.

Q A What levels of EMF are found in common environments?

Magnetic field exposures can vary greatly from site to site for any type of environment. The data shown in the following table are median measurements taken at four different sites for each environment category.

EMF Exposures in Common Environments
Magnetic fields measured in milligauss (mG)

Environment	Median* exposure	Top 5th percentile
OFFICE BUILDING		
Support staff	0.6	3.7
Professional	0.5	2.6
Maintenance	0.6	3.8
Visitor	0.6	2.1
SCHOOL		
Teacher	0.6	3.3
Student	0.5	2.9
Custodian	1.0	4.9
Administrative staff	1.3	6.9
HOSPITAL		
Patient	0.6	3.6
Medical staff	0.8	5.6
Visitor	0.6	2.4
Maintenance	0.6	5.9
MACHINE SHOP		
Machinist	0.4	6.0
Welder	1.1	24.6
Engineer	1.0	5.1
Assembler	0.5	6.4
Office staff	0.7	4.7
GROCERY STORE		
Cashier	2.7	11.9
Butcher	2.4	12.8
Office staff	2.1	7.1
Customer	1.1	7.7

*The median of four measurements. For this table, the median is the average of the two middle measurements.
Source: National Institute for Occupational Safety and Health.

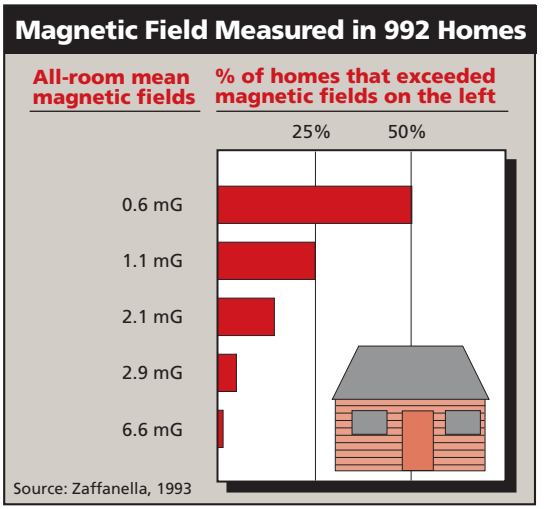
Q A What EMF field levels are encountered in the home?

Electric fields

Electric fields in the home, on average, range from 0 to 10 volts per meter. They can be hundreds, thousands, or even millions of times weaker than those encountered outdoors near power lines. Electric fields directly beneath power lines may vary from a few volts per meter for some overhead distribution lines to several thousands of volts per meter for extra high voltage power lines. Electric fields from power lines rapidly become weaker with distance and can be greatly reduced by walls and roofs of buildings.

Magnetic fields

Magnetic fields are not blocked by most materials. Magnetic fields encountered in homes vary greatly. Magnetic fields rapidly become weaker with distance from the source.



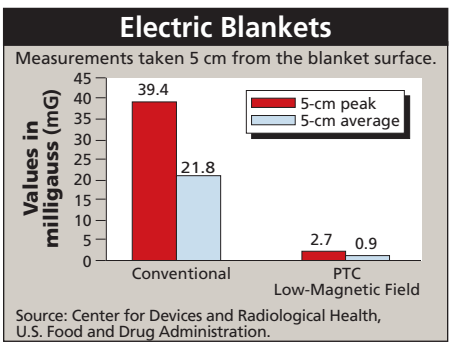
The chart on the left summarizes data from a study by the Electric Power Research Institute (EPRI) in which spot measurements of magnetic fields were made in the center of rooms in 992 homes throughout the United States. Half of the houses studied had magnetic field measurements of 0.6 mG or less, when the average of measurements from all the rooms in the house was calculated (the all-room mean magnetic field). The all-room mean magnetic field for all houses studied was 0.9 mG. The measurements were made away from electrical appliances and reflect primarily the fields from household wiring and outside power lines.

If you are comparing the information in this chart with measurements in your own home, keep in mind that this chart shows averages of measurements taken throughout the homes, not the single highest measurement found in the home.

Q A What are EMF levels close to electrical appliances?

Magnetic fields close to electrical appliances are often much stronger than those from other sources, including magnetic fields directly under power lines. Appliance fields decrease in strength with distance more quickly than do power line fields.

The following table, based on data gathered in 1992, lists the EMF levels generated by common electrical appliances. Magnetic field strength (magnitude) does not depend on how large, complex, powerful, or noisy the appliance is. Magnetic fields near large appliances are often weaker than those near small devices. Appliances in your home may have been redesigned since the data in the table were collected, and the EMF they produce may differ considerably from the levels shown here.



The graph shows magnetic fields produced by electric blankets, including conventional 110-V electric blankets as well as the PTC (positive temperature coefficient) low-magnetic-field blankets. The fields were measured at a distance of about 2 inches from the blanket's surface, roughly the distance from the blanket to the user's internal organs. Because of the wiring, magnetic field strengths vary from point to point on the blanket. The graph reflects this and gives both the peak and the average measurement.

Sources of Magnetic Fields (mG)*

Office Sources

	Distance from source 6″	1′	2′	4′
AIR CLEANERS				
Lowest	110	20	3	–
Median	180	35	5	1
Highest	250	50	8	2
COPY MACHINES				
Lowest	4	2	1	–
Median	90	20	7	1
Highest	200	40	13	4
FAX MACHINES				
Lowest	4	–	–	–
Median	6	–	–	–
Highest	9	2	–	–
FLUORESCENT LIGHTS				
Lowest	20	–	–	–
Median	40	6	2	–
Highest	100	30	8	4
ELECTRIC PENCIL SHARPENERS				
Lowest	20	8	5	–
Median	200	70	20	2
Highest	300	90	30	30
VIDEO DISPLAY TERMINALS (see page 48) (PCs with color monitors)**				
Lowest	7	2	1	–
Median	14	5	2	–
Highest	20	6	3	–

Bathroom Sources

	Distance from source 6″	1′	2′	4′
HAIR DRYERS				
Lowest	1	–	–	–
Median	300	1	–	–
Highest	700	70	10	1
ELECTRIC SHAVERS				
Lowest	4	–	–	–
Median	100	20	–	–
Highest	600	100	10	1

Workshop Sources

	Distance from source 6″	1′	2′	4′
BATTERY CHARGERS				
Lowest	3	2	–	–
Median	30	3	–	–
Highest	50	4	–	–
DRILLS				
Lowest	100	20	3	–
Median	150	30	4	–
Highest	200	40	6	–
POWER SAWS				
Lowest	50	9	1	–
Median	200	40	5	–
Highest	1000	300	40	4
ELECTRIC SCREWDRIVERS (while charging)				
Lowest	–	–	–	–
Median	–	–	–	–
Highest	–	–	–	–

Living/Family Room Sources

	Distance from source 1′	2′	4′
CEILING FANS			
Lowest	–	–	–
Median	3	–	–
Highest	50	6	1
WINDOW AIR CONDITIONERS			
Lowest	–	–	–
Median	3	1	–
Highest	20	6	4
COLOR TELEVISIONS**			
Lowest	–	–	–
Median	7	2	–
Highest	20	8	4

Continued

Sources of Magnetic Fields (mG)*

	Distance from source 6″	1′	2′	4′
Kitchen Sources				
BLENDERS				
Lowest	30	5	–	–
Median	70	10	2	–
Highest	100	20	3	–
CAN OPENERS				
Lowest	500	40	3	–
Median	600	150	20	2
Highest	1500	300	30	4
COFFEE MAKERS				
Lowest	4	–	–	–
Median	7	–	–	–
Highest	10	1	–	–
DISHWASHERS				
Lowest	10	6	2	–
Median	20	10	4	–
Highest	100	30	7	1
FOOD PROCESSORS				
Lowest	20	5	–	–
Median	30	6	2	–
Highest	130	20	3	–
GARBAGE DISPOSALS				
Lowest	60	8	1	–
Median	80	10	2	–
Highest	100	20	3	–
MICROWAVE OVENS***				
Lowest	100	1	1	–
Median	200	4	10	2
Highest	300	200	30	20
MIXERS				
Lowest	30	5	–	–
Median	100	10	1	–
Highest	600	100	10	–

	Distance from source 6″	1′	2′	4′
Kitchen Sources				
ELECTRIC OVENS				
Lowest	4	1	–	–
Median	9	4	–	–
Highest	20	5	1	–
ELECTRIC RANGES				
Lowest	20	–	–	–
Median	30	8	2	–
Highest	200	30	9	6
REFRIGERATORS				
Lowest	–	–	–	–
Median	2	2	1	–
Highest	40	20	10	10
TOASTERS				
Lowest	5	–	–	–
Median	10	3	–	–
Highest	20	7	–	–
Bedroom Sources				
DIGITAL CLOCK****				
Lowest		–	–	–
Median		1	–	–
High		8	2	1
ANALOG CLOCKS (conventional clockface)****				
Lowest		1	–	–
Median		15	2	–
Highest		30	5	3
BABY MONITOR (unit nearest child)				
Lowest	4	–	–	–
Median	6	1	–	–
Highest	15	2	–	–

Continued

Sources of Magnetic Fields (mG)*

	Distance from source 6″	1′	2′	4′
Laundry/Utility Sources				
ELECTRIC CLOTHES DRYERS				
Lowest	2	–	–	–
Median	3	2	–	–
Highest	10	3	–	–
WASHING MACHINES				
Lowest	4	1	–	–
Median	20	7	1	–
Highest	100	30	6	–
IRONS				
Lowest	6	1	–	–
Median	8	1	–	–
Highest	20	3	–	–

	Distance from source 6″	1′	2′	4′
Laundry/Utility Sources				
PORTABLE HEATERS				
Lowest	5	1	–	–
Median	100	20	4	–
Highest	150	40	8	1
VACUUM CLEANERS				
Lowest	100	20	4	–
Median	300	60	10	1
Highest	700	200	50	10
SEWING MACHINES				
Home sewing machines can produce magnetic fields of 12 mG at chest level and 5 mG at head level. Magnetic fields as high as 35 mG at chest level and 215 mG at knee level have been measured from industrial sewing machine models (Sobel, 1994).				

Source: EMF In Your Environment, U.S. Environmental Protection Agency, 1992.

* Dash (–) means that the magnetic field at this distance from the operating appliance could not be distinguished from background measurements taken before the appliance had been turned on.

** Some appliances produce both 60-Hz and higher frequency fields. For example, televisions and computer screens produce fields at 10,000-30,000 Hz (10-30 kHz) as well as 60-Hz fields.

*** Microwave ovens produce 60-Hz fields of several hundred milligauss, but they also create microwave energy inside the appliance that is at a much higher frequency (about 2.45 billion hertz). We are shielded from the higher frequency fields but not from the 60-Hz fields.

**** Most digital clocks have low magnetic fields. In some analog clocks, however, higher magnetic fields are produced by the motor that drives the hands. In the above table, the clocks are electrically powered using alternating current, as are all the appliances described in these tables.

Q A What EMF levels are found near power lines?

Power transmission lines bring power from a generating station to an electrical substation. Power distribution lines bring power from the substation to your home. Transmission and distribution lines can be either overhead or underground. Overhead lines produce both electric fields and magnetic fields. Underground lines do not produce electric fields above ground but may produce magnetic fields above ground.

Power transmission lines

Typical EMF levels for transmission lines are shown in the chart on page 37. At a distance of 300 feet and at times of average electricity demand, the magnetic fields from many lines can be similar to typical background levels found in most homes. The distance at which the magnetic field from the line becomes indistinguishable from typical background levels differs for different types of lines.

Power distribution lines

Typical voltage for power distribution lines in North America ranges from 4 to 24 kilovolts (kV). Electric field levels directly beneath overhead distribution lines may vary from a few volts per meter to 100 or 200 volts per meter. Magnetic fields directly beneath overhead distribution lines typically range from 10 to 20 mG for main feeders and less than 10 mG for laterals. Such levels are also typical directly above underground lines. Peak EMF levels, however, can vary considerably depending on the amount of current carried by the line. Peak magnetic field levels as high as 70 mG have been measured directly below overhead distribution lines and as high as 40 mG above underground lines.

Q How strong is the EMF from electric power substations?

A In general, the strongest EMF around the outside of a substation comes from the power lines entering and leaving the substation. The strength of the EMF from equipment within the substations, such as transformers, reactors, and capacitor banks, decreases rapidly with increasing distance. Beyond the substation fence or wall, the EMF produced by the substation equipment is typically indistinguishable from background levels.

Q Do electrical workers have higher EMF exposure than other workers?

A Most of the information we have about occupational EMF exposure comes from studies of electric utility workers. It is therefore difficult to compare electrical workers' EMF exposures with those of other workers because there is less information about EMF exposures in work environments other than electric utilities. Early studies did not include actual measurements of EMF exposure on the job but used job titles as an estimate of EMF exposure among electrical workers. Recent studies, however, have included extensive EMF exposure assessments.

A report published in 1994 provides some information about estimated EMF exposures of workers in Los Angeles in a number of electrical jobs in electric utilities and other industries. Electrical workers had higher average EMF exposures (9.6 mG) than did workers in other jobs (1.7 mG). For this study, the category "electrical workers" included electrical engineering technicians, electrical engineers, electricians, power line workers, power station operators, telephone line workers, TV repairers, and welders.

Typical EMF Levels for Power Transmission Lines*

115 kV

	Approx. Edge of Right-of-Way	15 m (50 ft)	30 m (100 ft)	61 m (200 ft)	91 m (300 ft)
Electric Field (kV/m)	1.0	0.5	0.07	0.01	0.003
Mean Magnetic Field (mG)	29.7	6.5	1.7	0.4	0.2

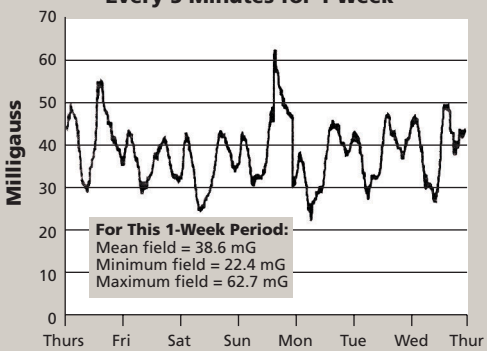
230 kV

	Approx. Edge of Right-of-Way	15 m (50 ft)	30 m (100 ft)	61 m (200 ft)	91 m (300 ft)
Electric Field (kV/m)	2.0	1.5	0.3	0.05	0.01
Mean Magnetic Field (mG)	57.5	19.5	7.1	1.8	0.8

500 kV

	Approx. Edge of Right-of-Way	20 m (65 ft)	30 m (100 ft)	61 m (200 ft)	91 m (300 ft)
Electric Field (kV/m)	7.0	3.0	1.0	0.3	0.1
Mean Magnetic Field (mG)	86.7	29.4	12.6	3.2	1.4

Magnetic Field from a 500-kV Transmission Line Measured on the Right-of-Way Every 5 Minutes for 1 Week



Electric fields from power lines are relatively stable because line voltage doesn't change very much. Magnetic fields on most lines fluctuate greatly as current changes in response to changing loads. Magnetic fields must be described statistically in terms of averages, maximums, etc. The magnetic fields above are means calculated for 321 power lines for 1990 annual mean loads. During peak loads (about 1% of the time), magnetic fields are about twice as strong as the mean levels above. The graph on the left is an example of how the magnetic field varied during one week for one 500-kV transmission line.

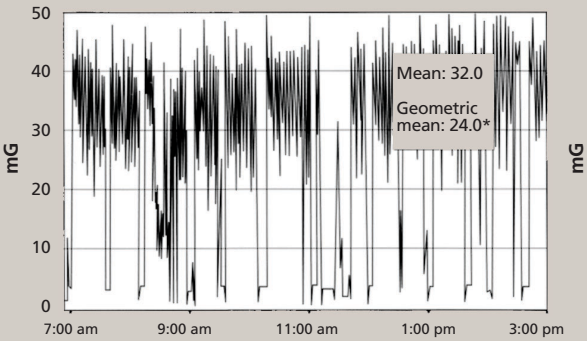
*These are typical EMFs at 1 m (3.3 ft) above ground for various distances from power lines in the Pacific Northwest. They are for general information. For information about a specific line, contact the utility that operates the line.
Source: Bonneville Power Administration, 1994.

Q What are possible EMF exposures in the workplace?

A The figures below are examples of magnetic field exposures determined with exposure meters worn by four workers in different occupations. These measurements demonstrate how EMF exposures vary among individual workers. They do not necessarily represent typical EMF exposures for workers in these occupations.

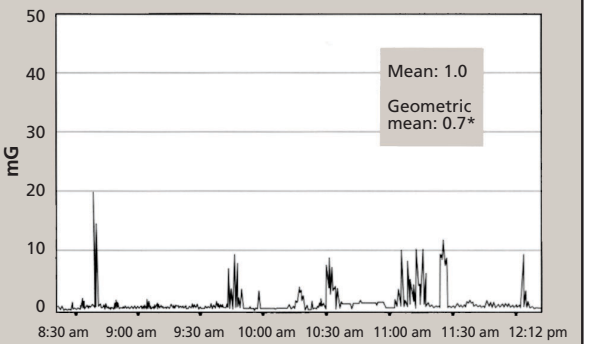
Magnetic Field Exposures of Workers (mG)

Sewing machine operator in garment factory



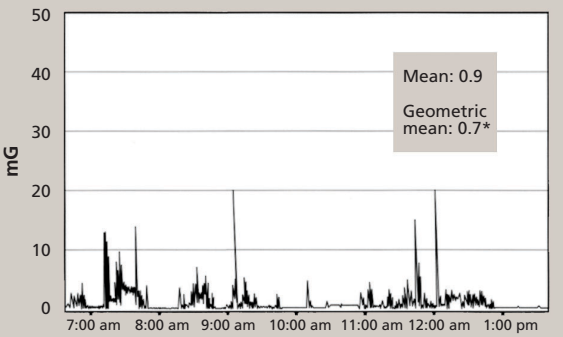
The sewing machine operator worked all day, took a 1-hour lunch break at 11:15 am, and took 10-minute breaks at 8:55 am and 2:55 pm.

Maintenance mechanic



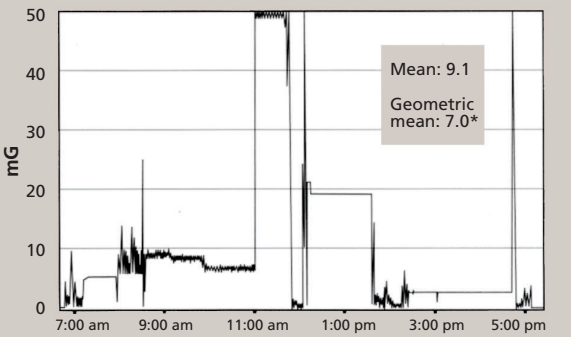
The mechanic repaired a compressor at 9:45 am and 11:10 am.

Electrician



The electrician repaired a large air-conditioning motor at 9:10 am and at 11:45 am.

Government office worker



The government worker was at the copy machine at 8:00 am, at the computer from 11:00 am to 1:00 pm and also from 2:30 pm to 4:30 pm.

*The geometric mean is calculated by squaring the values, adding the squares, and then taking the square root of the sum.
Source: National Institute for Occupational Safety and Health and U.S. Department of Energy.

The tables below and on page 41 can give you a general idea about magnetic field levels for different jobs and around various kinds of electrical equipment. It is important to remember that EMF levels depend on the actual equipment used in

EMF Measurements During a Workday

Industry and occupation	ELF magnetic fields measured in mG	
	Median for occupation*	Range for 90% of workers**
ELECTRICAL WORKERS IN VARIOUS INDUSTRIES		
Electrical engineers	1.7	0.5–12.0
Construction electricians	3.1	1.6–12.1
TV repairers	4.3	0.6–8.6
Welders	9.5	1.4–66.1
ELECTRIC UTILITIES		
Clerical workers without computers	0.5	0.2–2.0
Clerical workers with computers	1.2	0.5–4.5
Line workers	2.5	0.5–34.8
Electricians	5.4	0.8–34.0
Distribution substation operators	7.2	1.1–36.2
Workers off the job (home, travel, etc.)	0.9	0.3–3.7
TELECOMMUNICATIONS		
Install, maintenance, & repair technicians	1.5	0.7–3.2
Central office technicians	2.1	0.5–8.2
Cable splicers	3.2	0.7–15.0
AUTO TRANSMISSION MANUFACTURE		
Assemblers	0.7	0.2–4.9
Machinists	1.9	0.6–27.6
HOSPITALS		
Nurses	1.1	0.5–2.1
X-ray technicians	1.5	1.0–2.2
SELECTED OCCUPATIONS FROM ALL ECONOMIC SECTORS		
Construction machine operators	0.5	0.1–1.2
Motor vehicle drivers	1.1	0.4–2.7
School teachers	1.3	0.6–3.2
Auto mechanics	2.3	0.6–8.7
Retail sales	2.3	1.0–5.5
Sheet metal workers	3.9	0.3–48.4
Sewing machine operators	6.8	0.9–32.0
Forestry and logging jobs	7.6	0.6–95.5***

Source: National Institute for Occupational Safety and Health.
ELF (extremely low frequency)—frequencies 3–3,000 Hz.
* The median is the middle measurement in a sample arranged by size. These personal exposure measurements reflect the median magnitude of the magnetic field produced by the various EMF sources and the amount of time the worker spent in the fields.
** This range is between the 5th and 95th percentiles of the workday averages for an occupation.
*** Chain saw engines produce strong magnetic fields that are not pure 60-Hz fields.

the workplace. Different brands or models of the same type of equipment can have different magnetic field strengths. It is also important to keep in mind that the strength of a magnetic field decreases quickly with distance.

If you have questions or want more information about your EMF exposure at work, your plant safety officer, industrial hygienist, or other local safety official can be a good source of information. The National Institute for Occupational Safety and Health (NIOSH) is asked occasionally to conduct health hazard evaluations in workplaces where EMF is a suspected cause for concern. For further technical assistance contact NIOSH at 800-356-4674.

Q A What are some typical sources of EMF in the workplace?

Exposure assessment studies so far have shown that most people's EMF exposure at work comes from electrical appliances and tools and from the building's power supply. People who work near transformers, electrical closets, circuit boxes, or other high-current electrical equipment may have 60-Hz magnetic field exposures of hundreds of milligauss or more. In offices, magnetic field levels are often similar to those found at home, typically 0.5 to 4.0 mG. However, these levels can increase dramatically near certain types of equipment.

EMF Spot Measurements

Industry and sources	ELF magnetic fields (mG)	Other frequencies	Comments
ELECTRICAL EQUIPMENT USED IN MACHINE MANUFACTURING			
Electric resistance heater	6,000–14,000	VLF	
Induction heater	10–460	High VLF	
Hand-held grinder	3,000	–	Tool exposures measured at operator's chest.
Grinder	110	–	Tool exposures measured at operator's chest.
Lathe, drill press, etc.	1–4	–	Tool exposures measured at operator's chest.
ALUMINUM REFINING			
Aluminum pot rooms	3.4–30	Very high static field	Highly-rectified DC current (with an ELF ripple) refines aluminum.
Rectification room	300–3,300	High static field	
STEEL FOUNDRY			
Ladle refinery			
Furnace active	170–1,300	High ULF from the ladle's big magnetic stirrer	Highest ELF field was at the chair of control room operator.
Furnace inactive	0.6–3.7	High ULF from the ladle's big magnetic stirrer	Highest ELF field was at the chair of control room operator.
Electrogalvanizing unit	2–1,100	High VLF	
TELEVISION BROADCASTING			
Video cameras (studio and minicams)	7.2–24.0	VLF	
Video tape degaussers	160–3,300	–	Measured 1 ft away.
Light control centers	10–300	–	Walk-through survey.
Studio and newsrooms	2–5	–	Walk-through survey.
HOSPITALS			
Intensive care unit	0.1–220	VLF	Measured at nurse's chest.
Post-anesthesia care unit	0.1–24	VLF	
Magnetic resonance imaging (MRI)	0.5–280	Very high static field, VLF and RF	Measured at technician's work locations.
TRANSPORTATION			
Cars, minivans, and trucks	0.1–125	Most frequencies less than 60 Hz	Steel-belted tires are the principal ELF source for gas/diesel vehicles.
Bus (diesel powered)	0.5–146	Most frequencies less than 60 Hz	
Electric cars	0.1–81	Some elevated static fields	
Chargers for electric cars	4–63	–	Measured 2 ft from charger.
Electric buses	0.1–88	–	Measured at waist. Fields at ankles 2-5 times higher.
Electric train passenger cars	0.1–330	25 & 60 Hz power on U.S. trains	Measured at waist. Fields at ankles 2-5 times higher.
Airliner	0.8–24.2	400 Hz power on airliners	Measured at waist.
GOVERNMENT OFFICES			
Desk work locations	0.1–7	–	Peaks due to laser printers.
Desks near power center	18–50	–	
Power cables in floor	15–170	–	
Building power supplies	25–1,800	–	
Can opener	3,000	–	Appliance fields measured 6 in. away.
Desktop cooling fan	1,000	–	Appliance fields measured 6 in. away.
Other office appliances	10–200	–	

Source: National Institute for Occupational Safety and Health, 2001.
ULF (ultra low frequency)—frequencies above 0, below 3 Hz.
ELF (extremely low frequency)—frequencies 3–3,000 Hz.
VLF (very low frequency)—frequencies 3,000–30,000 Hz (3–30 kilohertz).

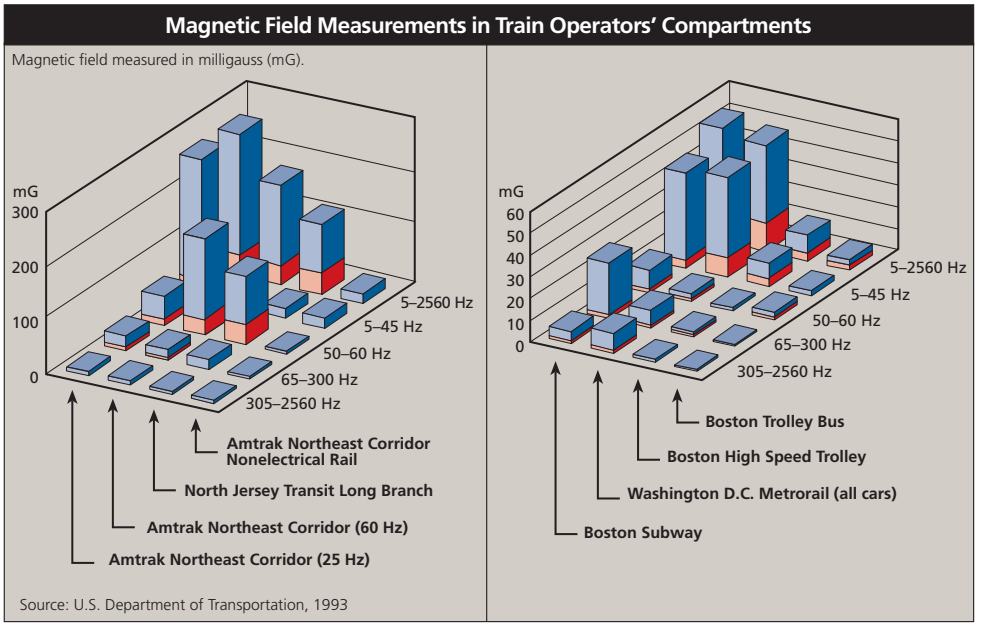
Q A What EMF exposure occurs during travel?

Inside a car or bus, the main sources of magnetic field exposure are those you pass by (or under) as you drive, such as power lines. Car batteries involve direct current (DC) rather than alternating current (AC). Alternators can create EMF, but at frequencies other than 60 Hz. The rotation of steel-belted tires is also a source of EMF.

Most trains in the United States are diesel powered. Some electrically powered trains operate on AC, such as the passenger trains between Washington, D.C. and New Haven, Connecticut. Measurements taken on these trains using personal exposure monitors have suggested that average 60-Hz magnetic field exposures for passengers and conductors may exceed 50 mG. A U.S. government-sponsored exposure assessment study of electric rail systems found average 60-Hz magnetic field levels in train operator compartments that ranged from 0.4 mG (Boston high speed trolley) to 31.1 mG (North Jersey transit). The graph on the next page shows average and maximum magnetic field measurements in operator compartments of several electric rail systems. It illustrates that 60 Hz is one of several electromagnetic frequencies to which train operators are exposed.

Workers who maintain the tracks on electric rail lines, primarily in the northeastern United States, also have elevated magnetic field exposures at both 25 Hz and 60 Hz. Measurements taken by the National Institute for Occupational Safety and Health show that typical average daily exposures range from 3 to 18 mG, depending on how often trains pass the work site.

Rapid transit and light rail systems in the United States, such as the Washington D.C. Metro and the San Francisco Bay Area Rapid Transit, run on DC electricity. These DC-powered trains contain equipment that produces AC fields. For example, areas of strong AC magnetic fields have been measured on the Washington Metro close to the floor, during braking and acceleration, presumably near equipment located underneath the subway cars.



These graphs illustrate that 60 Hz is one of several electromagnetic frequencies to which train operators are exposed. The maximum exposure is the top of the blue (upper) portion of the bar; the average exposure is the top of the red (lower) portion.

Q How can I find out how strong the EMF is where I live and work?

A The tables throughout this chapter can give you a general idea about magnetic field levels at home, for different jobs, and around various kinds of electrical equipment. For specific information about EMF from a particular power line, contact the utility that operates the line. Some will perform home EMF measurements.

You can take your own EMF measurements with a magnetic field meter. For a spot measurement to provide a useful estimate of your EMF exposure, it should be taken at a time of day and location when and where you are typically near the equipment. Keep in mind that the strength of a magnetic field drops off quickly with distance.

Independent technicians will conduct EMF measurements for a fee. Search the Internet under "EMF meters" or "EMF measurement." You should investigate the experience and qualifications of commercial firms, since governments do not standardize EMF measurements or certify measurement contractors.

At work, your plant safety officer, industrial hygienist, or other local safety official can be a good source of information. The National Institute for Occupational Safety and Health (NIOSH) sometimes conducts health hazard evaluations in workplaces where EMF is a suspected cause for concern. For further technical assistance, contact NIOSH at 800-356-4674.

Q How much do computers contribute to my EMF exposure?

A Personal computers themselves produce very little EMF. However, the video display terminal (VDT) or monitor provides some magnetic field exposure unless it is of the new flat-panel design. Conventional VDTs containing cathode ray tubes use magnetic fields to produce the image on the screen, and some emission of those magnetic fields is unavoidable. Unlike most other appliances which produce predominantly 60-Hz magnetic fields, VDTs emit magnetic fields in both the extremely low frequency (ELF) and very low frequency (VLF) frequency ranges (see page 8). Many newer VDTs have been designed to minimize magnetic field emissions, and those identified as "TCO'99 compliant" meet a standard for low emissions (see page 48).

Q What can be done to limit EMF exposure?

A Personal exposure to EMF depends on three things: the strength of the magnetic field sources in your environment, your distance from those sources, and the time you spend in the field.

If you are concerned about EMF exposure, your first step should be to find out where the major EMF sources are and move away from them or limit the time you spend near them. Magnetic fields from appliances decrease dramatically about an arm's length away from the source. In many cases, rearranging a bed, a chair, or a work area to increase your distance from an electrical panel or some other EMF source can reduce your EMF exposure.

Another way to reduce EMF exposure is to use equipment designed to have relatively low EMF emissions. Sometimes electrical wiring in a house or a building can be the source of strong magnetic field exposure. Incorrect wiring is a common source of higher-than-usual magnetic fields. Wiring problems are also worth correcting for safety reasons.

In its 1999 report to Congress, the National Institute of Environmental Health Sciences suggested that the power industry continue its current practice of siting power lines to reduce EMF exposures.

There are more costly actions, such as burying power lines, moving out of a home, or restricting the use of office space that may reduce exposures. Because scientists are still debating whether EMF is a hazard to health, it is not clear that the costs of such measures are warranted. Some EMF reduction measures may create other problems. For instance, compacting power lines reduces EMF but increases the danger of accidental electrocution for line workers.

We are not sure which aspects of the magnetic field exposure, if any, to reduce. Future research may reveal that EMF reduction measures based on today's limited understanding are inadequate or irrelevant. No action should be taken to reduce EMF exposure if it increases the risk of a known safety hazard.

5 EMF Exposure Standards

This chapter describes standards and guidelines established by state, national, and international safety organizations for some EMF sources and exposures.

Q Are there exposure standards for 60-Hz EMF?

A In the United States, there are no federal standards limiting occupational or residential exposure to 60-Hz EMF.

At least six states have set standards for transmission line electric fields; two of these also have standards for magnetic fields (see table below). In most cases, the maximum fields permitted by each state are the maximum fields that existing lines produce at maximum load-carrying conditions. Some states further limit electric field strength at road crossings to ensure that electric current induced into large metal objects such as trucks and buses does not represent an electric shock hazard.

State Transmission Line Standards and Guidelines

	Electric Field		Magnetic Field	
State	On R.O.W.*	Edge R.O.W.	On R.O.W.	Edge R.O.W.
Florida	8 kV/m[a] 10 kV/m[b]	2 kV/m	—	150 mG[a] (max. load) 200 mG[b] (max. load) 250 mG[c] (max. load)
Minnesota	8 kV/m	—	—	—
Montana	7 kV/m[d]	1 kV/m[e]		
New Jersey	—	3 kV/m		
New York	11.8 kV/m 11.0 kV/m[f] 7.0 kV/m[d]	1.6 kV/m	—	200 mG (max. load)
Oregon	9 kV/m	—	—	—

*R.O.W. = right-of-way (or in the Florida standard, certain additional areas adjoining the right-of-way). kV/m = kilovolt per meter. One kilovolt = 1,000 volts. [a]For lines of 69-230 kV. [b]For 500 kV lines. [c]For 500 kV lines on certain existing R.O.W. [d]Maximum for highway crossings. [e]May be waived by the landowner. [f]Maximum for private road crossings.

Two organizations have developed voluntary occupational exposure guidelines for EMF exposure. These guidelines are intended to prevent effects, such as induced currents in cells or nerve stimulation, which are known to occur at high magnitudes, much higher (more than 1,000 times higher) than EMF levels found typically in

occupational and residential environments. These guidelines are summarized in the tables on the right.

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) concluded that available data regarding potential long-term effects, such as increased risk of cancer, are insufficient to provide a basis for setting exposure restrictions.

The American Conference of Governmental Industrial Hygienists (ACGIH) publishes "Threshold Limit Values" (TLVs) for various physical agents. The TLVs for 60-Hz EMF shown in the table are identified as guides to control exposure; they are not intended to demarcate safe and dangerous levels.

ICNIRP Guidelines for EMF Exposure

Exposure (60 Hz)	Electric field	Magnetic field
Occupational	8.3 kV/m	4.2 G (4,200 mG)
General Public	4.2 kV/m	0.833 G (833 mG)

International Commission on Non-Ionizing Radiation Protection (ICNIRP) is an organization of 15,000 scientists from 40 nations who specialize in radiation protection.
Source: ICNIRP, 1998.

ACGIH Occupational Threshold Limit Values for 60-Hz EMF

	Electric field	Magnetic field
Occupational exposure should not exceed	25 kV/m	10 G (10,000 mG)
Prudence dictates the use of protective clothing above	15 kV/m	–
Exposure of workers with cardiac pacemakers should not exceed	1 kV/m	1 G (1,000 mG)

American Conference of Governmental Industrial Hygienists (ACGIH) is a professional organization that facilitates the exchange of technical information about worker health protection. It is not a government regulatory agency.
Source: ACGIH, 2001.

Q Does EMF affect people with pacemakers or other medical devices?

A According to the U.S. Food and Drug Administration (FDA), interference from EMF can affect various medical devices including cardiac pacemakers and implantable defibrillators. Most current research in this area focuses on higher frequency sources such as cellular phones, citizens band radios, wireless computer links, microwave signals, radio and television transmitters, and paging transmitters.

Sources such as welding equipment, power lines at electric generating plants, and rail transportation equipment can produce lower frequency EMF strong enough to interfere with some models of pacemakers and defibrillators. The occupational exposure guidelines developed by ACGIH state that workers with cardiac pacemakers should not be exposed to a 60-Hz magnetic field greater than 1 gauss (1,000 mG) or a 60-Hz electric field greater than 1 kilovolt per meter (1,000 V/m) (see ACGIH guidelines above). Workers who are concerned about EMF exposure effects on pacemakers, implantable defibrillators, or other implanted electronic medical devices should consult their doctors or industrial hygienists.

Nonelectronic metallic medical implants (such as artificial joints, pins, nails, screws, and plates) can be affected by high magnetic fields such as those from magnetic resonance imaging (MRI) devices and aluminum refining equipment, but are generally unaffected by the lower fields from most other sources.

The FDA MedWatch program is collecting information about medical device problems thought to be associated with exposure to or interference from EMF. Anyone experiencing a problem that might be due to such interference is encouraged to call and report it (800-332-1088).

Q What about products advertised as producing low or reduced magnetic fields?

A Virtually all electrical appliances and devices emit electric and magnetic fields. The strengths of the fields vary appreciably both between types of devices and among manufacturers and models of the same type of device. Some appliance manufacturers are designing new models that, in general, have lower EMF than older models. As a result, the words "low field" or "reduced field" may be relative to older models and not necessarily relative to other manufacturers or devices. At this time, there are no domestic or international standards or guidelines limiting the EMF emissions of appliances.

The U.S. government has set no standards for magnetic fields from computer monitors or video display terminals (VDTs). The Swedish Confederation of Professional Employees (TCO) established in 1992 a standard recommending strict limits on the EMF emissions of computer monitors. The VDTs should produce magnetic fields of no more than 2 mG at a distance of 30 cm (about 1 ft) from the front surface of the monitor and 50 cm (about 1 ft 8 in) from the sides and back of the monitor. The TCO'92 standard has become a *de facto* standard in the VDT industry worldwide. A 1999 standard, promulgated by the Swedish TCO (known as the TCO'99 standard), provides for international and environmental labeling of personal computers. Many computer monitors marketed in the U.S. are certified as compliant with TCO'99 and are thereby assured to produce low magnetic fields.

Beware of advertisements claiming that the federal government has certified that the advertised equipment produces little or no EMF. The federal government has no such general certification program for the emissions of low-frequency EMF. The U.S. Food and Drug Administration's Center for Devices and Radiological Health (CDRH) does certify medical equipment and equipment producing high levels of ionizing radiation or microwave radiation. Information about certain devices as well as general information about EMF is available from the CDRH at 888-463-6332.

Q Are cellular telephones and towers sources of EMF exposure?

A Cellular telephones and towers involve radio-frequency and microwave-frequency electromagnetic fields (see page 8). These are in a much higher frequency range than are the power-frequency electric and magnetic fields associated with the transmission and use of electricity.

The U.S. Federal Communications Commission (FCC) licenses communications systems that use radio-frequency and microwave electromagnetic fields and ensures that licensed facilities comply with exposure standards. Public information on this topic is published on two FCC Internet sites: http://www.fcc.gov/oet/info/documents/bulletins/#56 and http://www.fcc.gov/oet/rfsafety/

The U.S. Food and Drug Administration also provides information about cellular telephones on its web site (http://www.fda.gov/cdrh/ocd/mobilphone.html).

6 National and International EMF Reviews

This chapter presents the findings and recommendations of major EMF research reviews, including the U.S. government's EMF RAPID Program.

Q What have national and international agencies concluded about the impact of EMF exposure on human health?

A Since 1995, two major U.S. reports have concluded that limited evidence exists for an association between EMF exposure and increased leukemia risk, but that when all the scientific evidence is considered, the link between EMF exposure and cancer is weak. The World Health Organization in 1997 reached a similar conclusion.

The two reports were the U.S. National Academy of Sciences report in 1996 and, in 1999, the National Institute of Environmental Health Sciences report to the U.S. Congress at the end of the U.S. EMF Research and Public Information Dissemination (RAPID) Program.

The U.S. EMF RAPID Program

Initiated by the U.S. Congress and established by law in 1992, the U.S. EMF Research and Public Information Dissemination (EMF RAPID) Program set out to study whether exposure to electric and magnetic fields produced by the generation, transmission, or use of electric power posed a risk to human health. For more information about the EMF RAPID Program, visit the web site (http://www.niehs.nih.gov/emfrapid).

The U.S. Department of Energy (DOE) administered the overall EMF RAPID Program, but health effects research and risk assessment were supervised by the National Institute of Environmental Health Sciences (NIEHS), a branch of the U.S. National Institutes of Health (NIH). Together, DOE and NIEHS oversaw more than 100 cellular and animal studies, as well as engineering and exposure assessment studies. Although the EMF RAPID Program did not fund any additional epidemiological studies, an analysis of the many studies already conducted was an important part of its final report.

The electric power industry contributed about half, or $22.5 million, of the $45 million eventually spent on EMF research over the course of the EMF RAPID Program. The NIEHS received $30.1 million from this program for research, public outreach, administration, and the health assessment evaluation of extremely low frequency (ELF) EMF. The DOE received approximately $15 million from this program for engineering and EMF mitigation research. The NIEHS contributed an additional $14.5 million for support of extramural and intramural research including long-term toxicity and carcinogenicity studies conducted by the National Toxicology Program.

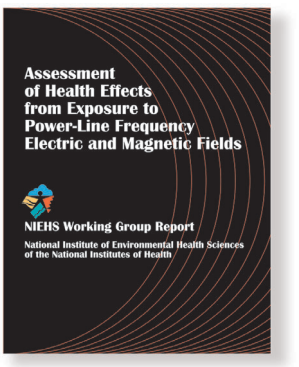
EMF RAPID Program Interagency Committee

- National Institute of Environmental Health Sciences
- Department of Energy
- Department of Defense
- Department of Transportation
- Environmental Protection Agency
- Federal Energy Regulatory Commission
- National Institute of Standards and Technology
- Occupational Safety and Health Administration
- Rural Electrification Administration

An interagency committee was established by the President of the United States to provide oversight and program management support for the EMF RAPID Program. The interagency committee included representatives from NIEHS, DOE, and seven other federal agencies with EMF-related responsibilities.

The EMF RAPID Program also received advice from a National EMF Advisory Committee (NEMFAC), which included representatives from citizen groups, labor, utilities, the National Academy of Sciences, and other groups. They met regularly with DOE and NIEHS staff to express their views. NEMFAC meetings were open to the public. The EMF RAPID Program sponsored citizen participation in some scientific meetings as well. A broad group of citizens reviewed all major public information materials produced for the program.

NIEHS Working Group Report 1998



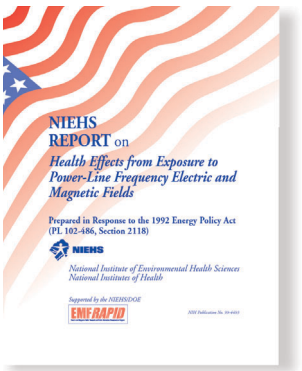
In preparation for the EMF RAPID Program's goal of reporting to the U.S. Congress on possible health effects from exposure to EMF from power lines, the NIEHS convened an expert working group in June 1998. Over 9 days, about 30 scientists conducted a complete review of EMF studies, including those sponsored by the EMF RAPID Program and others. Their conclusions offered guidance to the NIEHS as it prepared its report to Congress.

Using criteria developed by the International Agency for Research on Cancer, a majority of the members of the working group concluded that exposure to power-frequency EMF is a possible human carcinogen.

The majority called their opinion "a conservative public health decision based on limited evidence for an increased occurrence of childhood leukemias and an increased occurrence of chronic lymphocytic leukemia (CLL) in occupational settings." For these

diseases, the working group reported that animal and cellular studies neither confirm nor deny the epidemiological studies' suggestion of a disease risk. This report is available on the NIEHS EMF RAPID web site (http://www.niehs.nih.gov/emfrapid).

NIEHS Report to Congress at Conclusion of EMF RAPID Program



In June 1999, the NIEHS reported to the U.S. Congress that scientific evidence for an EMF-cancer link is weak.

The following are excerpts from the 1999 NIEHS report:

> The NIEHS believes that the probability that ELF-EMF exposure is truly a health hazard is currently small. The weak epidemiological associations and lack of any laboratory support for these associations provide only marginal, scientific support that exposure to this agent is causing any degree of harm.
>
> The scientific evidence suggesting that extremely low frequency EMF exposures pose any health risk is weak. The strongest evidence for health effects comes from associations observed in human populations with two forms of cancer: childhood leukemia and chronic lymphocytic leukemia in occupationally exposed adults. While the support from individual studies is weak, the epidemiological studies demonstrate, for some methods of measuring exposure, a fairly consistent pattern of a small, increased risk with increasing exposure that is somewhat weaker for chronic lymphocytic leukemia than for childhood leukemia. In contrast, the mechanistic studies and the animal toxicology literature fail to demonstrate any consistent pattern across studies, although sporadic findings of biological effects (including increased cancers in animals) have been reported. No indication of increased leukemias in experimental animals has been observed.

The full report is available on the NIEHS EMF RAPID web site (http://www.niehs.nih.gov/emfrapid).

No regulatory action was recommended or taken based on the NIEHS report. The NIEHS director, Dr. Kenneth Olden, told the Congress that, in his opinion, the conclusion of the NIEHS report was not sufficient to warrant aggressive regulatory action.

The NIEHS did not recommend adopting EMF standards for electric appliances or burying electric power lines. Instead, it recommended providing public information about practical ways to reduce EMF exposure. The NIEHS also suggested that power companies and utilities "continue siting power lines to reduce exposures and . . . explore ways to reduce the creation of magnetic fields around transmission and distribution lines without creating new hazards." The NIEHS encouraged manufacturers to reduce magnetic fields at a minimal cost, but noted that the risks do not warrant expensive redesign of electrical appliances.

The NIEHS also encouraged individuals who are concerned about EMF in their homes to check to see if their homes are properly wired and grounded, since incorrect wiring or other code violations are a common source of higher-than-usual magnetic fields.

National Academy of Sciences Report

In October 1996, a National Research Council committee of the National Academy of Sciences (NAS) released its evaluation of research on potential associations between EMF exposure and cancer, reproduction, development, learning, and behavior. The report concluded:

> Based on a comprehensive evaluation of published studies relating to the effects of power-frequency electric and magnetic fields on cells, tissues, and organisms (including humans), the conclusion of the committee is that the current body of evidence does not show that exposure to these fields presents a human-health hazard. Specifically, no conclusive and consistent evidence shows that exposures to residential electric and magnetic fields produce cancer, adverse neurobehavioral effects, or reproductive and developmental effects.

The NAS report focused primarily on the association of childhood leukemia with the proximity of the child's home to power lines. The NAS panel found that although a link between EMF exposure and increased risk for childhood leukemia was observed in studies that had estimated EMF exposure using the wire code method (distance of home from power line), such a link was not found in studies that had included actual measurements of magnetic fields at the time of the study. The panel called for more research to pinpoint the unexplained factors causing small increases in childhood leukemia in houses close to power lines.

World Health Organization International EMF Project

The World Health Organization (WHO) International EMF Project, with headquarters in Geneva, Switzerland, was launched at a 1996 meeting with representatives of 23 countries attending. It was intended to respond to growing concerns in many member states over possible EMF health effects and to address the conflict between such concerns and technological and economic progress. In its advisory role, the WHO International EMF Project is now reviewing laboratory and epidemiological evidence, identifying gaps in scientific knowledge, developing an agenda for future research, and developing risk communication booklets and other public information. The WHO International EMF Project is funded with contributions from governments and institutions and is expected to provide an overall EMF health risk assessment. Additional information about this program can be found on the WHO EMF web site (http://www.who.int/peh-emf).

As part of this project, in 1997 a working group of 45 scientists from around the world surveyed the evidence for adverse

EMF health effects. They reported that, "taken together, the findings of all published studies are suggestive of an association between childhood leukemia and estimates of ELF (extremely low frequency or power-frequency) magnetic fields."

Much like the 1996 U.S. NAS report, the WHO report noted that living in homes near power lines was associated with an approximate 1.5-fold excess risk of childhood leukemia. But unlike the NAS panel, WHO scientists had seen the results of the 1997 U.S. National Cancer Institute study of EMF and childhood leukemia (see page 17). This work showed even more strongly the inconsistency between results of studies that used a wire code to estimate EMF exposure and studies that actually measured magnetic fields.

Regarding health effects other than cancer, the WHO scientists reported that the epidemiological studies "do not provide sufficient evidence to support an association between extremely-low-frequency magnetic-field exposure and adult cancers, pregnancy outcome, or neurobehavioural disorders."

World Health Organization International Agency for Research on Cancer

The WHO International Agency for Research on Cancer (IARC) produces a monograph series that reviews the scientific evidence regarding potential carcinogenicity associated with exposure to environmental agents. An international scientific panel of 21 experts from 10 countries met in June 2001 to review the scientific evidence regarding the potential carcinogenicity of static and ELF (extremely low frequency or power-frequency) EMF. The panel categorized its conclusions for carcinogenicity based on the IARC classification system—a system that evaluates the strength of evidence from epidemiological, laboratory (human and cellular), and mechanistic studies. The panel classified power-frequency EMF as "possibly carcinogenic to humans" based on a fairly consistent statistical association between a doubling of risk of childhood leukemia and magnetic field exposure above 0.4 microtesla (0.4 μT, 4 milligauss or 4 mG).

In contrast, they found no consistent evidence that childhood EMF exposures are associated with other types of cancer or that adult EMF exposures are associated with increased risk for any kind of cancer. The IARC panel reported that no consistent carcinogenic effects of EMF exposure have been observed in experimental animals and that there is currently no scientific explanation for the observed association between childhood leukemia and EMF exposure. Further information can be obtained at the IARC web sites (http://www.iarc.fr and http://monographs.iarc.fr).

International Commission on Non-Ionizing Radiation Protection

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) issued exposure guidelines to guard against known adverse effects such as stimulation of nerves and muscles at very high EMF levels, as well as shocks and burns caused by touching objects that conduct electricity (see page 47). In April 1998, ICNIRP revised its exposure guidelines and characterized as "unconvincing" the evidence for an association between everyday power-frequency EMF and cancer.

European Union

In 1996, a European Union (EU) advisory panel provided an overview of the state of science and standards among EU countries. With respect to power-frequency EMF, the panel members said that there is no clear evidence that exposure to EMF results in an increased risk of cancer.

Australia—Radiation Advisory Committee Report to Parliament

In 1997, Australia's Radiation Advisory Committee briefly reviewed the EMF scientific literature and advised the Australian Parliament that, overall, there is insufficient evidence to come to a firm conclusion regarding possible health effects from exposure to power-frequency magnetic fields.

The committee also reported that "the weight of opinion as expressed in the U.S. National Academy of Sciences report, and the negative results from the National Cancer Institute study (Linet et al., 1997) would seem to shift the balance of probability more towards there being no identifiable health effects" (see pages 17 and 53).

Canada—Health Canada Report

In December 1998, a working group of public health officers at Health Canada, the federal agency that manages Canada's health care system, issued a review of the scientific literature regarding power-frequency EMF health effects. They found the evidence to be insufficient to conclude that EMF causes a risk of cancer.

The report concluded that while EMF effects may be observed in biological systems in a laboratory, no adverse health effects have been demonstrated at the levels to which humans and animals are typically exposed.

As for epidemiology, 25 years of study results are inconsistent and inconclusive, the panel said, and a plausible EMF-cancer mechanism is missing. Health Canada pledged to continue monitoring EMF research and to reassess this position as new information becomes available.

Germany—Ordinance 26

On January 1, 1997, Germany became the first nation to adopt a national rule on EMF exposure for the general public. Ordinance 26 applies only to facilities such as overhead and underground transmission and distribution lines, transformers, switchgear and overhead lines for electric-powered trains. Both electric (5 kV/m) and magnetic field exposure limits (1 Gauss) are high enough that they are unlikely to be encountered in ordinary daily life. The ordinance also requires that precautionary measures be taken on a case-by-case basis when electric facilities are sited or upgraded near homes, hospital, schools, day care centers, and playgrounds.

Great Britain—National Radiological Protection Board Report

The National Radiological Protection Board (NRPB) in Great Britain advises the government of the United Kingdom regarding standards of protection for exposure to non-ionizing radiation. The NRPB's advisory group on non-ionizing radiation periodically reviews new developments in EMF research and reports its findings. Results of the advisory group's latest review were published in 2001. The report reviewed residential and occupational epidemiological studies, as well as cellular, animal, and human volunteer studies that had been published.

The advisory group noted that there is "some epidemiological evidence that prolonged exposure to higher levels of power frequency magnetic fields is associated with a small risk of leukaemia in children." Specifically, the NRPB advisory group's analysis suggests "that relatively heavy average exposures of 0.4 μT [4 mG] or more are associated with a doubling of the risk of leukaemia in children under 15 years of age." The group pointed out, however, that laboratory experiments have provided "no good evidence that extremely low frequency electromagnetic fields are capable of producing cancer."

Scandinavia—EMF Developments

In October 1995, a group of Swedish researchers and government officials published a report about EMF exposure in the workplace. This "Criteria Group" reviewed EMF scientific literature and, using the IARC classification system, ranked occupational EMF exposure as "possibly carcinogenic to humans." They also endorsed the Swedish government's 1994 policy statement that public exposure limits to EMFs were not needed, but that people might simply want to use caution with EMFs.

In 1996, five Swedish government agencies further explained their precautionary advice about EMF. EMF exposure should be reduced, they said, but only when practical, without great inconvenience or cost.

Health experts in Norway, Denmark, and Finland generally agreed in reviews published in the 1990s that if an EMF health risk exists, it is small. They acknowledged that a link between residential magnetic fields and childhood leukemia cannot be confirmed or denied. In 1994, several Norwegian government ministries also recommended increasing the distance between residences and electrical facilities, if it could be done at low cost and with little inconvenience.

Q What other U.S. organizations have reported on EMF?

A American Medical Association

In 1995, the American Medical Association advised physicians that no scientifically documented health risk had been associated with "usually occurring" EMF, based on a review of EMF epidemiological, laboratory studies, and major literature reviews.

American Cancer Society

In 1996, the American Cancer Society released a review of 20 years of EMF epidemiological research including occupational studies and residential studies of

adult and childhood cancer. The society noted that some data support a possible relationship of magnetic field exposure with leukemia and brain cancer, but further research may not be justified if studies continue to find uncertain results. Of particular interest is the summary of results from eight studies of risk from use of household appliances with relatively high magnetic fields, such as electric blankets and electric razors. The summary suggested that there is no persuasive evidence for increased risk with more frequent or longer use of these appliances.

American Physical Society

The American Physical Society (APS) represents thousands of U.S. physicists. Responding to the NIEHS Working Group's conclusion that EMF is a possible human carcinogen, the APS executive board voted in 1998 to reaffirm its 1995 opinion that there is "no consistent, significant link between cancer and power line fields."

California's Department of Health Services

In 1996, California's Department of Health Services (DHS) began an ambitious five-year effort to assess possible EMF public health risk and offer guidance to school administrators and other decision-makers. The California Electric and Magnetic Fields (EMF) Program is a research, education, and technical assistance program concerned with the possible health effects of EMF from power lines, appliances, and other uses of electricity. The program's goal is to find a rational and fair approach to dealing with the potential risks, if any, of exposure to EMF. This is done through research, policy analysis, and education. The web site has educational materials on EMF and related health issues for individuals, schools, government agencies, and professional organizations (http://www.dhs.ca.gov/ps/deodc/ehib/emf).

Q A What can we conclude about EMF at this time?

Electricity is a beneficial part of our daily lives, but whenever electricity is generated, transmitted, or used, electric and magnetic fields are created. Over the past 25 years, research has addressed the question of whether exposure to power-frequency EMF might adversely affect human health. For most health outcomes, there is no evidence that EMF exposures have adverse effects. There is some evidence from epidemiology studies that exposure to power-frequency EMF is associated with an increased risk for childhood leukemia. This association is difficult to interpret in the absence of reproducible laboratory evidence or a scientific explanation that links magnetic fields with childhood leukemia.

EMF exposures are complex and come from multiple sources in the home and workplace in addition to power lines. Although scientists are still debating whether EMF is a hazard to health, the NIEHS recommends continued education on ways of reducing exposures. This booklet has identified some EMF sources and some simple steps you can take to limit your exposure. For your own safety, it is important that any steps you take to reduce your exposures do not increase other obvious hazards such as those from electrocution or fire. At the current time in the United States, there are no federal standards for occupational or residential exposure to 60-Hz EMF.

7 References

Selected references on EMF topics.

Basic Science

Kovetz A. Electromagnetic Theory. New York: Oxford University Press (2000).

Vanderlinde J. Classical Electromagnetic Theory. New York: Wiley (1993).

EMF Levels and Exposures

Dietrich FM & Jacobs WL. Survey and Assessment of Electric and Magnetic (EMF) Public Exposure in the Transportation Environment. Report of the U. S. Department of Transportation. NTIS Document PB99-130908. Arlington, VA: National Technical Information Service (1999).

Kaune WT. Assessing human exposure to power-frequency electric and magnetic fields. Environmental Health Perspectives 101:121-133 (1993).

Kaune WT & Zaffanella L. Assessing historical exposure of children to power frequency magnetic fields. Journal of Exposure Analysis Environmental Epidemiology 4:149-170 (1994).

Tarone RE, Kaune WT, Linet MS, Hatch EE, Kleinerman RA, Robison LL, Boice JD & Wacholder S. Residential wire codes: Reproducibility and relation with measured magnetic fields. Occupational and Environmental Medicine 55:333-339 (1998).

U.S. Environmental Protection Agency. EMF in your environment: magnetic field measurements of everyday electrical devices. Washington, DC: Office of Radiation and Indoor Air, Radiation Studies Division, U.S. Environmental Protection Agency, Report No. 402-R-92-008 (1992).

Zaffanella L. Survey of residential magnetic field sources. Volume 1: Goals, Results and Conclusions. EPRI Report No. TR-102759. Palo Alto, CA:Electric Power Research Institute (EPRI), 1993;1-224.

EMF Standards and Regulations

Documentation of the Threshold Limit Values and Biological Exposure Indices, 7th Ed. Publication No. 0100. Cincinnati, OH: American Conference of Governmental Industrial Hygienists (2001).

ICNIRP International Commission on Non-Ionizing Radiation Protection. Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz). Health Physics 74:494-522 (1998).

Swedish National Board of Occupational Safety and Health. Low-Frequency Electrical and Magnetic Fields (SNBOSH): The Precautionary Principle for National Authorities. Guidance for Decision-Makers. Solna (1996).

U.S. Department of Transportation, F.R.A. Safety of High Speed Guided Ground Transportation Systems, Magnetic and Electric Field Testing of the Amtrak Northeast Corridor and New Jersey Coast Line Rail Systems, Volume I: Analysis. Washington, DC: Office of Research and Development (1993).

Residential Childhood Cancer Studies

Ahlbom A, Day N, Feychting M, Roman E, Skinner J, Dockerty J, Linet M, McBride M, Michaelis J, Olsen JH, Tynes T & Verkasalo PK. A pooled analysis of magnetic fields and childhood leukemia. British Journal of Cancer 83:692-698 (2000).

Coghill RW, Steward J & Philips A. Extra low frequency electric and magnetic fields in the bedplace of children diagnosed with leukemia: A case-control study. European Journal of Cancer Prevention 5:153-158 (1996).

Dockerty JD, Elwood JM, Skegg DC, & Herbison GP. Electromagnetic field exposures and childhood cancers in New Zealand. Cancer Causes and Control 9:299-309 (1998).

Feychting M & Ahlbom A. Magnetic fields and cancer in children residing near Swedish high-voltage power lines. American Journal of Epidemiology 138:467-481 (1993).

Greenland S, Sheppard AR, Kaune WT, Poole C & Kelsh MA. A pooled analysis of magnetic fields, wire codes and childhood leukemia. EMF Study Group. Epidemiology 11:624-634 (2000).

Linet MS, Hatch EE, Kleinerman RA, Robison LL, Kaune WT, Friedman DR, Severson RK, Haines CM, Hartsock CT, Niwa S, Wacholder S & Tarone RE. Residential exposure to magnetic fields and acute lymphoblastic leukemia in children. New England Journal of Medicine 337:1-7 (1997).

London SJ, Thomas DC, Bowman JD, Sobel E, Cheng TC & Peters JM. Exposure to residential electric and magnetic fields and risk of childhood leukemia. American Journal of Epidemiology 134:923-937 (1991).

McBride ML, Gallagher RP, Thériault G, Armstrong BG, Tamaro S, Spinelli JJ, Deadman JE, Fincham B, Robson D & Choi W. Power-frequency electric and magnetic fields and risk of childhood leukemia in Canada. American Journal of Epidemiology 149:831-842 (1999).

Michaelis J, Schuz J, Meinert R, Zemann E, Grigat JP, Kaatsch P, Kaletsch U, Miesner A, Brinkmann K, Kalkner W, & Karner H. Combined risk estimates for two German population-based case-control studies on residential magnetic fields and childhood leukemia. Epidemiology 9:92-94 (1998).

Olsen JH, Nielsen A & Schulgen G. Residence near high voltage facilities and risk of cancer in children. British Medical Journal 307:891-895 (1993).

Savitz DA, Wachtel H, Barnes FA, John EM & Tvrdik JG. Case-control study of childhood cancer and exposure to 60-Hz magnetic fields. American Journal of Epidemiology 128:21-38 (1988).

Tomenius L. 50-Hz electromagnetic environment and the incidence of childhood tumors in Stockholm county. Bioelectromagnetics 7:191-207 (1986).

Tynes T & Haldorsen T. Electromagnetic fields and cancer in children residing near Norwegian high-voltage power lines. American Journal of Epidemiology 145:219-226 (1997).

UK Childhood Cancer Study Investigators. Exposure to power frequency magnetic fields and the risk of childhood cancer: a case/control study. Lancet 354:1925-1931 (1999).

Verkasalo PK, Pukkala E, Hongisto MY, Valjus JE, Jarvinen PJ, Heikkila KV & Koskenvuo M. Risk of cancer in Finnish children living close to power lines. British Medical Journal 307:895-899 (1993).

Residential Adult Cancer Studies

Coleman MP, Bell CM, Taylor HL & Primie-Zakelj M. Leukemia and residence near electricity transmission equipment: a case-control study. British Journal of Cancer 60:793-798 (1989).

Feychting M & Ahlbom A. Magnetic fields, leukemia, and central nervous system tumors in Swedish adults residing near high-voltage power lines. Epidemiology 5:501-509 (1994).

Li CY, Theriault G & Lin RS. Residential exposure to 60-hertz magnetic fields and adult cancers in Taiwan. Epidemiology 8:25-30 (1997).

McDowall ME. Mortality of persons resident in the vicinity of electricity transmission facilities. British Journal of Cancer 53:271-279 (1986).

Severson RK, Stevens RG, Kaune WT, Thomas DB, Heuser L, Davis S & Sever LE. Acute nonlymphocytic leukemia and residential exposure to power frequency magnetic fields. American Journal of Epidemiology 128:10-20 (1988).

Wrensch M, Yost M, Miike R, Lee G & Touchstone J. Adult glioma in relation to residential power-frequency electromagnetic field exposures in the San Francisco Bay area. Epidemiology 10:523-527 (1999).

Youngson JH, Clayden AD, Myers A & Cartwright RA. A case/control study of adult haematological malignancies in relation to overhead powerlines. British Journal of Cancer 63:977-985 (1991).

Occupational EMF Cancer Studies

Coogan PF, Clapp RW, Newcomb PA, Wenzl TB, Bogdan G, Mittendorf R, Baron JA & Longnecker MP. Occupational exposure to 60-Hertz magnetic fields and risk of breast cancer in women. Epidemiology 7:459-464 (1996).

Floderus B, Persson T, Stenlund C, Wennberg A, Ost A, & Knave B. Occupational exposure to electromagnetic fields in relation to leukemia and brain tumors: a case-control study in Sweden. Cancer Causes Control 4:465-476 (1993).

Floderus B, Tornqvist S, & Stenlund C. Incidence of selected cancers in Swedish railway workers, 1961-79. Cancer Causes Control 5:189-194 (1994).

Sorahan T, Nichols L, van Tongeren M, & Harrington JM. Occupational exposure to magnetic fields relative to mortality from brain tumours: updated and revised findings from a study of United Kingdom electricity generation and transmission workers, 1973–97. Occupational and Environmental Medicine 58(10):626-630 (2001).

Johansen C, & Olsen JH Risk of cancer among Danish utility workers - A nationwide cohort study. American Journal of Epidemiology, 147:548-555 (1998).

Kheifets LI, Gilbert ES, Sussman SS, Guenel P, Sahl JD, Savitz DA, & Theriault G. Comparative analyses of the studies of magnetic fields and cancer in electric utility workers: studies from France, Canada, and the United States. Occupational and Environmental Medicine 56(8):567-574 (1999).

London SJ, Bowman JD, Sobel E, Thomas DC, Garabrant DH, Pearce N, Bernstein L & Peters JM . Exposure to magnetic fields among electrical workers in relation to leukemia risk in Los Angeles County. American Journal of Industrial Medicine 26:47-60 (1994).

Matanoski GM, Breysse PN & Elliott EA. Electromagnetic field exposure and male breast cancer. Lancet 337:737 (1991).

Sahl JD, Kelsh MA, & Greenland S. Cohort and nested case-control studies of hematopoietic cancers and brain cancer among utility worker. Epidemiology 4:21-32 (1994).

Savitz DA & Loomis DP. Magnetic field exposure in relation to leukemia and brain cancer mortality among electric utility workers. American Journal of Epidemiology 141:123-134 (1995).

Sorahan T, Nichols L, van Tongeren M, & Harrington JM. Occupational exposure to magnetic fields relative to mortality from brain tumours: updated and revised findings from a study of United Kingdom electricity generation and transmission workers, 1973–97. Occupational and Environmental Medicine 58:626-630 (2001).

Thériault G, Goldberg M, Miller AB, Armstrong B, Guénel P, Deadman J, Imbernon E, To T, Chevalier A, Cyr D, & Wall C. Cancer risks associated with occupational exposure to magnetic fields among electric utility workers in Ontario and Quebec, Canada and France: 1970–1989. American Journal of Epidemiology 139:550-572 (1994).

Tynes T, Jynge H, & Vistnes AI. Leukemia and brain tumors in Norwegian railway workers, a nested case-control study. American Journal of Epidemiology 139:645-653 (1994).

Laboratory Animal EMF Studies

Anderson LE, Boorman GA, Morris JE, Sasser LB, Mann PC, Grumbein SL, Hailey JR, McNally A, Sills RC & Haseman JK. Effect of 13-week magnetic field exposures on DMBA-initiated mammary gland carcinomas in female Sprague-Dawley rats. Carcinogenesis 20:1615-1620 (1999).

Baum A, Mevissen M, Kamino K, Mohr U & Löscher W. A histopathological study on alterations in DMBA-induced mammary carcinogenesis in rats with 50 Hz, 100 mT magnetic field exposure. Carcinogenesis 16:119-125 (1995).

Babbitt JT, Kharazi AI, Taylor JMG, Rafferty CN, Kovatch R, Bonds CB, Mirell SG, Frumkin E, Dietrich F, Zhuang D & Hahn TJM. Leukemia/lymphoma in mice exposed to 60-Hz magnetic fields: Results of the chronic exposure study TR-110338. Los Angeles: Electric Power Research Institute (EPRI) (1998).

Babbitt JT, Kharazi AI, Taylor JMG, Rafferty CN, Kovatch R, Bonds CB, Mirell SG, Frumkin E, Dietrich F, Zhuang D & Hahn TJM. Leukemia/lymphoma in mice exposed to 60-Hz magnetic fields: Results of the chronic exposure study, Second Edition. Electric Power Research Institute (EPRI) and B. C. Hydro, Palo Alto, California and Burnaby, British Columbia, Canada (1999).

Boorman GA, Anderson LE, Morris JE, Sasser LB, Mann PC, Grumbein SL, Hailey JR, McNally A, Sills RC & Haseman JK. Effect of 26-week magnetic field exposures in a DMBA initiation-promotion mammary gland model in Sprague-Dawley rats. Carcinogenesis 20:899-904 (1999).

Boorman GA, McCormick DL, Findlay JC, Hailey JR, Gauger JR, Johnson TR, Kovatch RM, Sills RC & Haseman JK. Chronic toxicity/oncogenicity of 60 Hz (power frequency) magnetic fields in F344/N rats. Toxicological Pathology 27:267-278 (1999).

Boorman GA, McCormick DL, Ward JM, Haseman JK & Sills RC. Magnetic fields and mammary cancer in rodents: A critical review and evaluation of published literature. Radiation Research 153:617-626 (2000).

Boorman GA, Rafferty CN, Ward JM & Sills RC. Leukemia and lymphoma incidence in rodents exposed to low-frequency magnetic fields. Radiation Research 153:627-636 (2000).

Ekström T, Mild KH & Holmberg B. Mammary tumours in Sprague-Dawley rats after initiation with DMBA followed by exposure to 50 Hz electromagnetic fields in a promotional scheme. Cancer Letters 123:107-111 (1998).

Mandeville R, Franco E, Sidrac-Ghali S, Paris-Nadon L, Rocheleau N, Mercier G, Desy M & Gaboury L. Evaluation of the potential carcinogenicity of 60 Hz linear sinusoidal continuous-wave magnetic fields in Fisher F344 rats. Federation of the American Society of Experimental Biology Journal 11:1127-1136 (1997).

McCormick DL, Boorman GA, Findlay JC, Hailey JR, Johnson TR, Gauger JR, Pletcher JM, Sills RC & Haseman JK. Chronic toxicity/oncogenicity of 60 Hz (power frequency) magnetic fields in B6C3F1 mice. Toxicological Pathology 27:279-285 (1999).

Mevissen M, Lerchl A, Szamel M & Löscher W. Exposure of DMBA-treated female rats in a 50-Hz, 50 microTesla magnetic field: Effects on mammary tumor growth, melatonin levels and T-lymphocyte activation. Carcinogenesis 17:903-910 (1996).

Yasui M, Kikuchi T, Ogawa M, Otaka Y, Tsuchitani M & Iwata H. Carcinogenicity test of 50 Hz sinusoidal magnetic fields in rats. Bioelectromagnetics 18:531-540 (1997).

Laboratory Cellular EMF Studies

Balcer-Kubiczek EK, Harrison GH, Zhang XF, Shi ZM, Abraham JM, McCready WA, Ampey LL, III, Meltzer SJ, Jacobs MC, & Davis CC. Rodent cell transformation and immediate early gene expression following 60-Hz magnetic field exposure. Environmental Health Perspectives 104:1188-1198 (1996).

Boorman GA, Owen RD, Lotz WG & Galvin MJ, Jr. Evaluation of *in vitro* effects of 50 and 60 Hz magnetic fields in regional EMF exposure facilities. Radiation Research 153:648-657 (2000).

Lacy-Hulbert A, Metcalfe JC, & Hesketh R. Biological responses to electromagnetic fields. Federation of the American Society of Experimental Biology (FASEB) Journal 12:395-420 (1998).

Morehouse CA & Owen RD. Exposure of Daudi cells to low-frequency magnetic fields does not elevate MYC steady-state mRNA levels. Radiation Research 153:663-669 (2000).

Snawder JE, Edwards RM, Conover DL & Lotz WG. Effect of magnetic field exposure on anchorage-independent growth of a promoter-sensitive mouse epidermal cell line (JB6). Environmental Health Perspectives 107:195-198 (1999).

Wey HE, Conover DL, Mathias P, Toraason MA & Lotz WG. 50-Hz magnetic field and calcium transients in Jurkat cells: Results of a research and public information dissemination (RAPID) program study. Environmental Health Perspectives 108:135-140 (2000).

National Reviews of EMF Research

American Medical Association. Council on Scientific Affairs. Effects of Electric and Magnetic Fields. Chicago: American Medical Association (December 1994).

National Institute for Occupational Safety and Health, National Institute of Environmental Health Sciences, U.S. Department of Energy. Questions and Answers: EMF in the Workplace. Electric and Magnetic Fields Associated with the Use of Electric Power. Report No. DOE/GO-10095-218 (September 1996).

National Radiological Protection Board. ELF Electromagnetic Fields and the Risk of Cancer. Volume 12:1, Chilton, Didcot, Oxon, UK OX11 ORQ (2001).

National Research Council, Committee on the Possible Effects of Electromagnetic Fields on Biologic Systems. Possible Health Effects of Exposure to Residential Electric and Magnetic Fields. Washington: National Academy Press (1997).

National Institute of Environmental Health Sciences Report on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields. NIH Publication No. 99-4493. Research Triangle Park, National Institute of Environmental Health Sciences (1999).

Portier CJ & Wolfe MS, Eds. Assessment of Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields—NIEHS Working Group Report NIH Publication No. 98-3981. Research Triangle Park, National Institute of Environmental Health Sciences (1998).

APPENDIX I - EMF ANALYSIS

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          ********************************************
          *      C O R O N A   A N D   F I E L D     *
          *       E F F E C T S   P R O G R A M      *
          *   Source: Bonneville Power Administration *
          ********************************************

         +++++++++++++++++++
         + INPUT DATA LIST +

        ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
       10/ 6/2011           5:46:35 pm
     +********  Basin 345/115kV EMF Calcs  ***************************
     +****  Double-Circuit Vertical -- (1)2306.2kcmil, (1)795kcmil ACSR ****
     +      1       0       6       8   362.0    2.00    1.00     .00

     (ENGLISH UNITS OPTION)

        LINE GRADIENTS COMPUTED BY PROGRAM

     PHYSICAL SYSTEM CONSISTS OF   8 CONDUCTORS, OF WHICH   6 ARE ENERGIZED PHASES

     +COMB  MF  XX  XX  XX  XX  XX  XX
     +   4.921   6.562   9.842    .000   1.000  75.000   3.280   4.000   3.280
     +115-A        A   -15.00   90.00    1   1.063     .00   69.70      .0     .88     .00
     +115-B        A   -17.00   65.00    1   1.063     .00   69.70  -120.0     .88     .00
     +115-C        A   -15.00   40.00    1   1.063     .00   69.70   120.0     .88     .00
     +345-A        A    15.00   80.00    1   1.802     .00  209.00      .0    1.65     .00
     +345-B        A    17.00   55.00    1   1.802     .00  209.00  -120.0    1.65     .00
     +345-C        A    15.00   30.00    1   1.802     .00  209.00   120.0    1.65     .00
     +GND-1        A    -8.00  110.00    1    .500     .00     .00      .0     .00     .00
     +GND-2        A     8.00  110.00    1    .500     .00     .00      .0     .00     .00
     +      81  -200.0     5.0
     +       0      .0      .0
```

COMBINED OUTPUT OF AUDIBLE NOISE, RADIO NOISE, TVI, OZONE CONCENTRATION, GROUND GRADIENT AND MAGNETIC FIELD

******** Basin 345/115kV EMF Calcs ***************************
**** Double-Circuit Vertical -- (1)2306.2kcmil, (1)795kcmil ACSR ****

362.0 KV

	DIST. FROM CENTER OF TOWER (FEET)	HEIGHT (FEET)	MAXIMUM GRADIENT (KV/CM)	SUBCON DIAM. (IN)	NO. OF SUBCON	SUBCON SPACING (IN)	VOLTAGE L-N (KV)	PHASE ANGLE (DEGREES)	CURRENT (KAMPS)	CORONA LOSSES (KW/MI)
115-A	-15.00	90.00	6.39	1.06	1.00	.00	69.70	.00	.875	.009
115-B	-17.00	65.00	7.93	1.06	1.00	.00	69.70	-120.00	.875	.038
115-C	-15.00	40.00	7.55	1.06	1.00	.00	69.70	120.00	.875	.028
345-A	15.00	80.00	14.96	1.80	1.00	.00	209.00	.00	1.650	19.347
345-B	17.00	55.00	15.88	1.80	1.00	.00	209.00	-120.00	1.650	28.506
345-C	15.00	30.00	15.44	1.80	1.00	.00	209.00	120.00	1.650	23.775
GND-1	-8.00	110.00	4.80	.50	1.00	.00	.00	.00	.000	.000
GND-2	8.00	110.00	5.50	.50	1.00	.00	.00	.00	.000	.000

AN MICROPHONE HT.= 4.9 FT, RI ANT. HT.= 6.6 FT, TV ANT. HT.= 9.8 FT, ALTITUDE= .0 FT
RI FREQ= 1.000 MHZ, TV FREQ= 75.000 MHZ, WIND VEL.(OZ) = 2.000 MPH, GROUND CONDUCTIVITY = 4.0 MMHOS /M
E-FIELD TRANSDUCER HT.= 3.3FT, B-FIELD TRANSDUCER HT. = 3.3FT

LATERAL DIST FROM REFERENCE (FEET)	AUDIBLE NOISE (RAIN) L50 DBA	AUDIBLE NOISE (FAIR) L50 DBA	RADIO INTERFERENCE (RAIN) L50 DBUV/M	RADIO INTERFERENCE (FAIR) L50 DBUV/M	TVI TOTAL RAIN DBUV/M	OZONE FOR RAIN RATE OF 1.00 IN/HR AT 0. FT.LEVEL PPB	ELECTRIC FIELD KV/M	MAGNETIC FIELD GAUSS
-200.0	47.6	22.6	49.1	32.1	14.8	.000000	.085	.01588
-195.0	47.7	22.7	49.4	32.4	15.0	.000000	.087	.01662
-190.0	47.8	22.8	49.7	32.7	15.2	.000000	.090	.01741
-185.0	47.9	22.9	49.9	32.9	15.4	.000000	.093	.01826
-180.0	48.0	23.0	50.2	33.2	15.6	.000000	.096	.01917
-175.0	48.2	23.2	50.5	33.5	15.9	.000000	.098	.02015
-170.0	48.3	23.3	50.8	33.8	16.1	.000000	.101	.02121
-165.0	48.4	23.4	51.1	34.1	16.3	.000000	.104	.02234
-160.0	48.5	23.5	51.4	34.4	16.5	.000000	.107	.02356
-155.0	48.7	23.7	51.8	34.8	16.8	.000000	.109	.02488
-150.0	48.8	23.8	52.1	35.1	17.0	.000000	.112	.02631
-145.0	49.0	24.0	52.5	35.5	17.2	.000000	.114	.02786
-140.0	49.1	24.1	52.8	35.8	17.5	.000000	.116	.02955
-135.0	49.2	24.2	53.2	36.2	17.8	.000000	.117	.03138
-130.0	49.4	24.4	53.6	36.6	18.0	.000000	.118	.03337
-125.0	49.5	24.5	54.0	37.0	18.3	.000000	.118	.03555
-120.0	49.7	24.7	54.4	37.4	18.6	.000000	.117	.03793
-115.0	49.9	24.9	54.9	37.9	18.9	.000000	.115	.04054
-110.0	50.0	25.0	55.3	38.3	19.2	.000000	.111	.04341
-105.0	50.2	25.2	55.8	38.8	19.5	.000000	.105	.04656
-100.0	50.4	25.4	56.3	39.3	19.8	.000000	.097	.05002
-95.0	50.6	25.6	56.8	39.8	20.1	.000000	.086	.05385
-90.0	50.8	25.8	57.4	40.4	20.5	.000000	.071	.05807
-85.0	51.0	26.0	58.0	41.0	20.8	.000000	.054	.06274
-80.0	51.2	26.2	58.5	41.5	21.2	.000000	.039	.06790

LATERAL DIST FROM REFERENCE (FEET)	AUDIBLE NOISE (RAIN) L50 DBA	AUDIBLE NOISE (FAIR) L50 DBA	RADIO INTERFERENCE (RAIN) L50 DBUV/M	RADIO INTERFERENCE (FAIR) L50 DBUV/M	TVI TOTAL RAIN DBUV/M	OZONE FOR RAIN RATE OF 1.00 IN/HR AT 0. FT.LEVEL PPB	ELECTRIC FIELD KV/M	MAGNETIC FIELD GAUSS
-75.0	51.4	26.4	59.2	42.2	21.5	.000000	.058	.07361
-70.0	51.6	26.6	59.8	42.8	21.9	.000000	.104	.07993
-65.0	51.8	26.8	60.5	43.5	22.3	.000000	.168	.08690
-60.0	52.1	27.1	61.2	44.2	22.7	.000000	.253	.09456
-55.0	52.3	27.3	61.9	44.9	23.2	.000000	.362	.10295
-50.0	52.6	27.6	62.6	45.6	23.6	.000000	.500	.11206
-45.0	52.8	27.8	63.4	46.4	24.3	.000000	.671	.12184
-40.0	53.1	28.1	64.2	47.2	25.0	.000000	.881	.13216
-35.0	53.4	28.4	65.0	48.0	25.7	.000000	1.133	.14286
-30.0	53.7	28.7	65.8	48.8	26.4	.000000	1.432	.15374
-25.0	54.0	29.0	66.6	49.6	27.3	.000000	1.778	.16468
-20.0	54.3	29.3	67.5	50.5	28.2	.000000	2.176	.17580
-15.0	54.7	29.7	68.6	51.6	29.1	.000000	2.629	.18759
-10.0	55.0	30.0	70.3	53.3	30.2	.000000	3.147	.20086
-5.0	55.3	30.3	72.1	55.1	31.2	.000000	3.727	.21630
.0	55.6	30.6	73.9	56.9	32.3	.000022	4.343	.23370
5.0	55.9	30.9	75.4	58.4	33.3	.000115	4.915	.25125
10.0	56.1	31.1	76.4	59.4	34.0	.000254	5.310	.26541
15.0	56.1	31.1	76.8	59.8	34.2	.000401	5.389	.27219
20.0	56.1	31.1	76.4	59.4	34.0	.000536	5.091	.26924
25.0	55.9	30.9	75.4	58.4	33.3	.008542	4.488	.25721
30.0	55.7	30.7	73.9	56.9	32.3	.078357	3.728	.23901
35.0	55.4	30.4	72.1	55.1	31.2	.170008	2.958	.21798
40.0	55.0	30.0	70.3	53.3	30.2	.241779	2.269	.19666
45.0	54.7	29.7	68.9	51.9	29.1	.297819	1.696	.17651
50.0	54.4	29.4	68.1	51.1	28.2	.344113	1.242	.15819
55.0	54.1	29.1	67.3	50.3	27.3	.382264	.893	.14188
60.0	53.8	28.8	66.5	49.5	26.4	.412707	.630	.12750
65.0	53.5	28.5	65.7	48.7	25.7	.435999	.437	.11489
70.0	53.2	28.2	64.8	47.8	25.0	.452955	.301	.10384
75.0	52.9	27.9	64.0	47.0	24.4	.464513	.214	.09414
80.0	52.7	27.7	63.2	46.2	24.0	.471607	.172	.08562
85.0	52.4	27.4	62.5	45.5	23.5	.475091	.164	.07812
90.0	52.2	27.2	61.7	44.7	23.1	.475709	.172	.07148
95.0	51.9	26.9	61.0	44.0	22.7	.474085	.183	.06560
100.0	51.7	26.7	60.3	43.3	22.3	.470733	.192	.06036
105.0	51.5	26.5	59.7	42.7	21.9	.466068	.199	.05570
110.0	51.2	26.2	59.0	42.0	21.5	.460423	.203	.05152
115.0	51.0	26.0	58.4	41.4	21.1	.454061	.204	.04777
120.0	50.8	25.8	57.8	40.8	20.7	.447193	.203	.04439
125.0	50.6	25.6	57.3	40.3	20.4	.439981	.201	.04135
130.0	50.5	25.5	56.7	39.7	20.1	.432554	.198	.03859
135.0	50.3	25.3	56.2	39.2	19.7	.425012	.193	.03609
140.0	50.1	25.1	55.7	38.7	19.4	.417433	.188	.03381
145.0	49.9	24.9	55.3	38.3	19.1	.409875	.182	.03174
150.0	49.8	24.8	54.8	37.8	18.8	.402385	.177	.02984
155.0	49.6	24.6	54.4	37.4	18.5	.394997	.171	.02810
160.0	49.4	24.4	53.9	36.9	18.2	.387736	.165	.02651
165.0	49.3	24.3	53.5	36.5	18.0	.380620	.159	.02504
170.0	49.1	24.1	53.1	36.1	17.7	.373663	.153	.02369
175.0	49.0	24.0	52.8	35.8	17.4	.366874	.147	.02244
180.0	48.9	23.9	52.4	35.4	17.2	.360259	.142	.02129
185.0	48.7	23.7	52.0	35.0	17.0	.353819	.137	.02022
190.0	48.6	23.6	51.7	34.7	16.7	.347556	.131	.01922
195.0	48.5	23.5	51.4	34.4	16.5	.341469	.127	.01830
200.0	48.3	23.3	51.1	34.1	16.3	.335557	.122	.01744

APPENDIX J - NOISE ANALYSIS

Sound Assessment Study

Basin Electric Cooperative

North Killdeer Loop 345-kV Transmission Project

Project No. 61495

October 2014

Sound Assessment Study

prepared for

Basin Electric Cooperative
North Killdeer Loop 345-kV Transmission Project

Project No. 61495

October 2014

prepared by

Burns & McDonnell Engineering Company, Inc.
Kansas City, Missouri

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LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
CadnaA	Computer Aided Design for Noise Abatement
dB	Decibels
dBA	A-weighted decibels
EPA	U.S. Environmental Protection Agency
Hz	Hertz
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
L_{dn}	24-hour average day-night sound levels
L_{eq}	The average sound level for a specific time period
L_p	Sound pressure level
L_w	Sound power level
L_x	The exceedance sound level
MVA	Megavolt amperes
NEMA	National Electric Manufacturers Association

1.0 EXECUTIVE SUMMARY

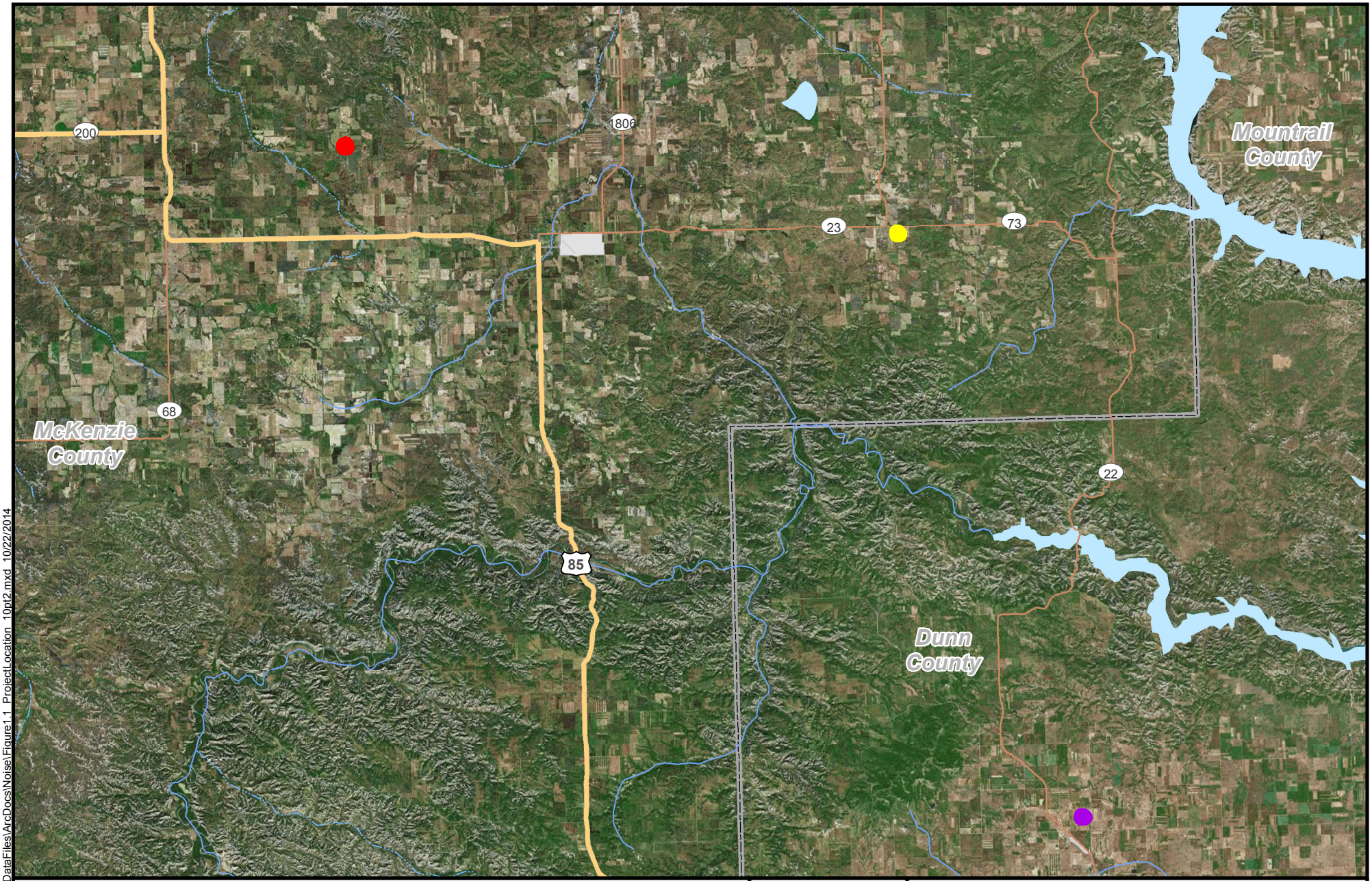
Basin Electric Power Cooperative (Basin Electric) is proposing to build three new substations for the North Killdeer Loop 345-kW Transmission Project (Project) located in northwest North Dakota. The proposed substations are referred to as the Kummer Ridge, Patent Gate, and Roundup substations. The Patent Gate and Kummer Ridge substations would be located in McKenzie County near Watford City, North Dakota. The Roundup substation would be located in Dunn County near Killdeer, North Dakota. See Figure 1-1 for a Project location map showing the proposed substations. Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) was contracted by Basin Electric to conduct a facility sound assessment study to determine the noise impacts of the proposed Project.

The objectives of this study were as follows:

- Identify federal, state, and/or local noise ordinances
- Estimate operational noise levels from the proposed Kummer Ridge, Patent Gate, and Roundup substations
- Examine the potential effects of the predicted noise levels on the surrounding communities due to operation of the proposed substations

Predictive modeling was analyzed for compliance with the U.S. Environmental Protection Agency (EPA) noise guidelines. The predictive modeling demonstrated compliance with the EPA noise guidelines.

The following sections describe the study in further detail.



Legend

- Patent Gate
- Kummer Ridge
- Roundup

NORTH

6 3 0 6

Miles

Burns & McDonnell SINCE 1898

Figure 1-1
Basin Electric Cooperative
North Killdeer Loop 345-kV Transmission Project
Northwest North Dakota
Project Location

R:\Basin\61495_AVS_345\GIS\DataFiles\ArcDocs\Noise\Figure1.1_ProjectLocation_10pt2.mxd 10/22/2014

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, the GIS User Community & Burns & McDonnell.

Issued: 10/22/2014

2.0 ACOUSTICAL TERMINOLOGY

The term “sound level” is often used to describe two different sound characteristics called sound power and sound pressure. Every source that produces sound has a sound power level (L_w). The sound power level is the acoustical energy emitted by a sound source and is an absolute number that is not affected by the environment. The acoustical energy produced by a source propagates through a media as pressure fluctuations. These pressure fluctuations, also called sound pressure (L_p), are what human ears hear and microphones measure.

Sound is physically characterized by amplitude and frequency. The amplitude of sound is measured in decibels (dB) as the logarithmic ratio of a sound pressure to a reference sound pressure (20 microPascals). The reference sound pressure corresponds to the typical threshold of human hearing. Less than a 3-dB change in continuous broadband sound is generally considered “not noticeable” to the average listener. A 5-dB change is generally considered “clearly noticeable,” and a 10-dB change is generally considered a doubling (or halving, if the sound level is decreasing) of the apparent loudness.

Frequency is measured in hertz (Hz), which is the number of cycles per second. The typical human ear can hear frequencies ranging from approximately 20 to 20,000 Hz. Normally, the human ear is most sensitive to sounds in the middle frequencies (1,000 to 8,000 Hz) and is less sensitive to sounds in the low and high frequencies. As such, the A-weighting scale was developed to simulate the frequency response of the human ear to sounds at typical environmental levels. The A-weighting scale emphasizes sounds in the middle frequencies and de-emphasizes sounds in the low and high frequencies. Any sound level to which the A-weighting scale has been applied is expressed in A-weighted decibels or dBA. For reference, the A-weighted sound pressure level and subjective loudness associated with some common sound sources are listed in Table 2-1.

Table 2-1: Typical Sound Pressure Levels Associated with Common Sound Sources

Sound Pressure Level (dBA)	Subjective Evaluation	Environment	
		Outdoor	Indoor
140	Deafening	Jet aircraft at 75 feet	--
130	Threshold of pain	Jet aircraft during takeoff at a distance of 300 feet	--
120	Threshold of feeling	Elevated train	Hard rock band
110		Jet flyover at 1,000 feet	Inside propeller plane
100	Very loud	Power mower, motorcycle at 25 feet, auto horn at 10 feet, crowd sound at football game	--
90	--	Propeller plane flyover at 1,000 feet, noisy urban street	Full symphony or band, food blender, noisy factory
80	Moderately loud	Diesel truck (40 mph) at 50 feet	Inside auto at high speed, garbage disposal, dishwasher
70	Loud	B-757 cabin during flight	Close conversation, vacuum cleaner
60	Moderate	Air-conditioner condenser at 15 feet, near highway traffic	General office
50	Quiet	--	Private office
40	--	Farm field with light breeze, birdcalls	Soft stereo music in residence
30	Very quiet	Quiet residential neighborhood	Inside average residence (without TV and stereo)
20	--	Rustling leaves	Quiet theater, whisper
10	Just audible	--	Human breathing
0	Threshold of hearing	--	--

Source: Adapted from *Architectural Acoustics*, M. David Egan, 1988 and *Architectural Graphic Standards*, Ramsey and Sleeper, 1994.

Sound in the environment is constantly fluctuating; for example, when a car drives by, a dog barks, or a plane passes overhead. Therefore, sound metrics have been developed to quantify fluctuating environmental sound levels. The exceedance sound level, L_x, is the sound level exceeded "x" percent of the sampling period and is referred to as a statistical sound level. L_{eq} is the average sound level for a specific time period. The L_{dn} metric is a 24-hour, time-weighted average sound level that is often used to

represent community sound levels. A 10-dB nighttime penalty is added to the nighttime hours to account for added sensitivity to noise during the night.

3.0 APPLICABLE REGULATIONS

McKenzie and Dunn Counties do not have noise ordinances and there are no city ordinances that apply. The State of North Dakota has a general noise statute based on nuisance, but provides no specific numeric noise limits that must be achieved. Therefore, by default, this Project may be compared to the EPA Guidelines set forth by the Noise Control Act of 1972 (Act)[1]. The Act mandated a national policy "to promote an environment for all Americans free from noise that jeopardizes their health or welfare, to establish a means for effective coordination of federal research activities in noise control, to authorize the establishment of federal noise emission standards for products distributed in commerce, and to provide information to the public respecting the noise emission and noise reduction characteristics of such products." As required by the Act, the EPA published Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety2 in 1974. These levels are shown in Table 3-1.

Table 3-1: EPA Noise Levels Identified to Protect Public Health and Welfare

Effect	Noise Level	Area
Hearing loss	$L_{eq(24)} \leq 70$ dBA	All areas
Outdoor activity interference	$L_{dn} \leq 55$ dBA	Outdoor residential and farm areas and other outdoor areas where people spend widely varying amounts of time, and other places in which quiet is a basis for use
	$L_{eq(24)} \leq 55$ dBA	Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, etc.
Indoor activity interference and annoyance	$L_{dn} \leq 45$	Indoor residential areas
	$L_{eq(24)} \leq 45$ dBA	Other indoor areas with human activities, such as schools, etc.

The levels contained in Table 3-1 were established as a guideline by the EPA, but do not constitute enforceable federal regulations or standards. However, these noise levels represent valid criteria for evaluating the effect of project-generated noise on public health and welfare. Many noise studies performed for new projects compare residential noise levels to these EPA-established guidelines.

The recommended EPA guideline for outdoor activity in residential areas is an L_{dn} of 55 dBA or less. An L_{dn} of 55 dBA can be equated to a steady-state sound level of 48.6 dBA for a 24-hour period, after incorporating the 10-dB penalty for nighttime hours. Due to the absence of local noise regulations, the

[1] United States Code (U.S.C.): 42 U.S.C. 4901 to 4918
[2] The United States Environmental Protection Agency, Office of Noise Abatement and Control

overriding design goal for noise generated by the proposed substations will be an L_{dn} of 55 dBA, per the EPA guidance.

4.0 PREDICTIVE MODELING

Using industry-accepted sound modeling software, Computer Aided Design for Noise Abatement CadnaA, the expected sound pressure levels from the proposed substations were predicted. The software is a scaled, three-dimensional program which takes into account each piece of sound-emitting equipment on the Project site and predicts future sound pressure levels over an area of interest. The model calculates sound propagation based on International Organization for Standardization (ISO) 9613-2:1996, General Method of Calculation. ISO 9613-2 assesses the sound levels based on the octave band center-frequency range from 31.5 to 8,000 Hz. For the model, the atmospheric conditions were assumed to be calm, and the temperature and relative humidity were left at the program default values.

Appropriate sound generation was applied for all sound-radiating surfaces and points. Reflections and shielding were considered when the sound encountered physical structures. Sound data for the Project noise sources was not available. The sound profile for the transformers was calculated using the National Electric Manufacturers Association (NEMA) rating system for an unquieted 333 megavolt ampere (MVA) transformer. The overall sound level was based on a NEMA standard rating[3] level of 90 dBA at the Institute of Electrical and Electronics Engineers (IEEE) Standard Test Code measurement distances[4]. Vendor data for a reactor similar to those at the proposed substations was used. The expected sound-power profiles for the transformers and reactors are shown below in Table 4-1. The modeling layouts for each substation are presented in Figure 4-1 through Figure 4-3.

Table 4-1: Expected Transformer Sound Profiles

Equipment	Transformer Sound Power Level (Lw) at Octave Band Frequency (Hz) (dBA)									Normalized Value (dBA)
	31.5	63	125	250	500	1,000	2,000	4,000	8,000	
Transformer	99	105	107	102	102	96	91	86	79	111
Reactor	26	66	86	60	17	17	17	17	17	86

The proposed Project's predicted sound level impacts are shown in 5 dBA L_{dn} noise contours in Figure 4-4 through Figure 4-6. Table 4-2 shows that the predicted L_{dn} and L_{eq} sound levels at the measurement points can reasonably be expected to meet the applicable EPA limits of L_{dn} of 55 dBA or less and L_{eq} of 48.6 dBA or less.

[3] NEMA Standards Publication No. TR 1-1993 (R2000). *Transformers, Regulators and Reactors*
[4] IEEE Standard C57, 12.90-2006. *IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers*

Table 4-2: Predicted L_{dn} and L_{eq} Sound Levels at Residences

Substation Location	Residence	Predicted Sound Level (L_{dn})	Predicted Sound Level (L_{eq})
Kummer Ridge	R1	50.2	43.8
Kummer Ridge	R2	48.7	42.2
Kummer Ridge	R3	47.1	40.7
Kummer Ridge	R4	47.0	40.6
Kummer Ridge	R5	47.6	41.2
Kummer Ridge	R6	43.7	37.2
Patent Gate	R1	54.4	48.0
Patent Gate	R2	47.1	40.7
Roundup	R1	54.0	47.6
Roundup	R2	47.2	40.8
Roundup	R3	47.2	40.8

Figure 4-1
Basin Electric Cooperative
North Killdeer Loop 345-kV Transmission Project
Modeling Layout
Kummer Ridge Substation

R:\Basin\61495_AVS_345\GIS\DataFiles\ArcDocs\Noise\Figure4-1_KummerRidge.mxd 10/22/2014

Source: NAIP Aerial Photography (McKenzie County, 2012); Burns & McDonnell.

Issued: 10/22/2014

Figure 4-2
Basin Electric Cooperative
North Killdeer Loop 345-kV Transmission Project
Modeling Layout
Patent Gate Substation

R:\Basin\61495_AVS_345\GIS\DataFiles\ArcDocs\Noise\Figure4-2_PatentGate.mxd 10/22/2014

Source: NAIP Aerial Photography (McKenzie County, 2012); Burns & McDonnell.

Issued: 10/22/2014

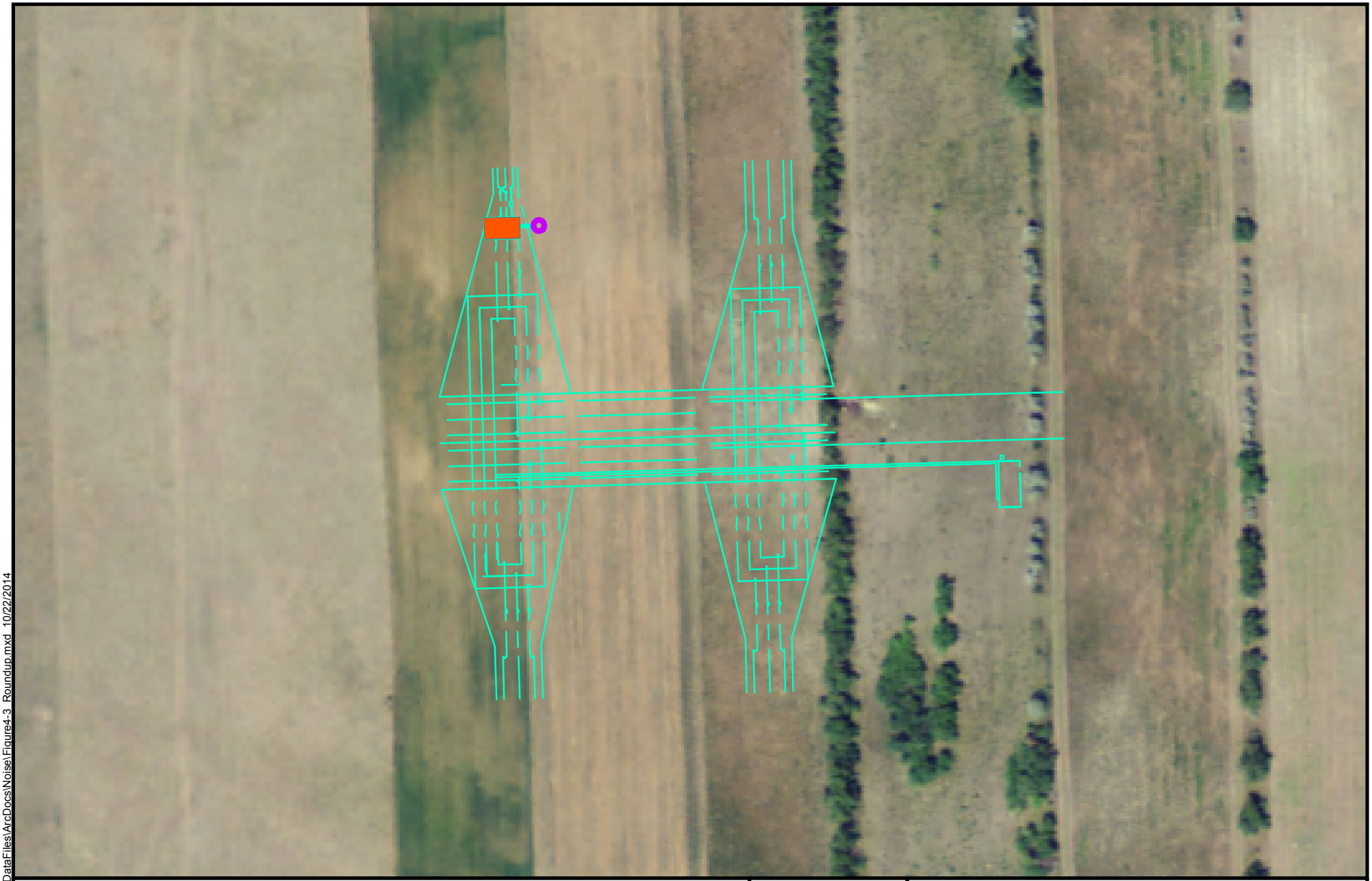
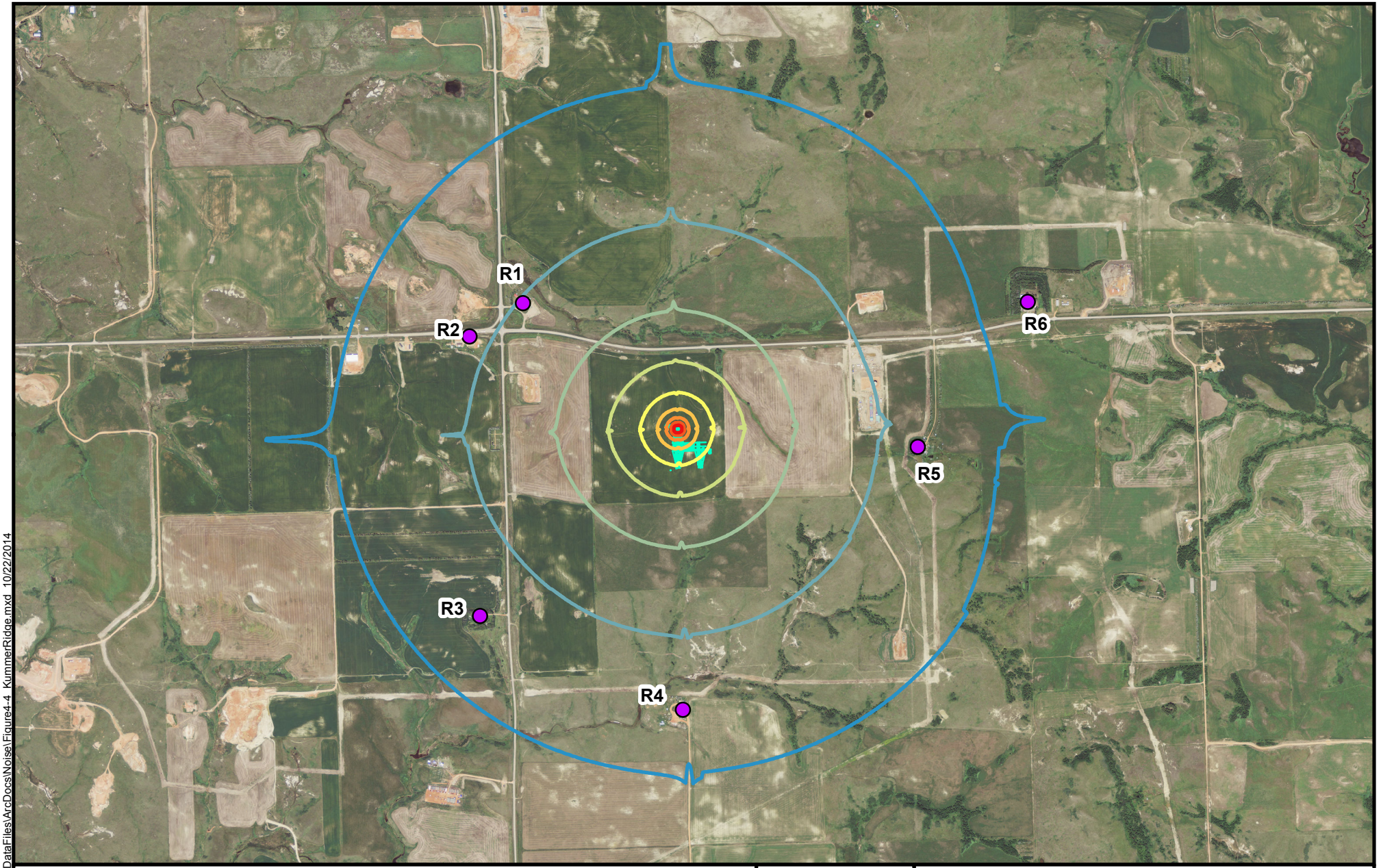


Figure 4-3
Basin Electric Cooperative
North Killdeer Loop 345-kV Transmission Project
Modeling Layout
Roundup Substation

R:\Basin\61495_AVS_345\GIS\DataFiles\ArcDocs\Noise\Figure4-3_Roundup.mxd 10/22/2014

Source: NAIP Aerial Photography (Dunn County, 2012); Burns & McDonnell.

Issued: 10/22/2014



R:\Basin\61495_AVS_345\GIS\DataFiles\ArcDocs\Noise\Figure4-4_KummerRidge.mxd 10/22/2014

Figure 4-4
Basin Electric Cooperative
North Killdeer Loop 345-kV Transmission Project
Ldn Sound Contours
Kummer Ridge Substation

Source: NAIP Aerial Photography (McKenzie County, 2012); Burns & McDonnell.

Issued: 10/22/2014

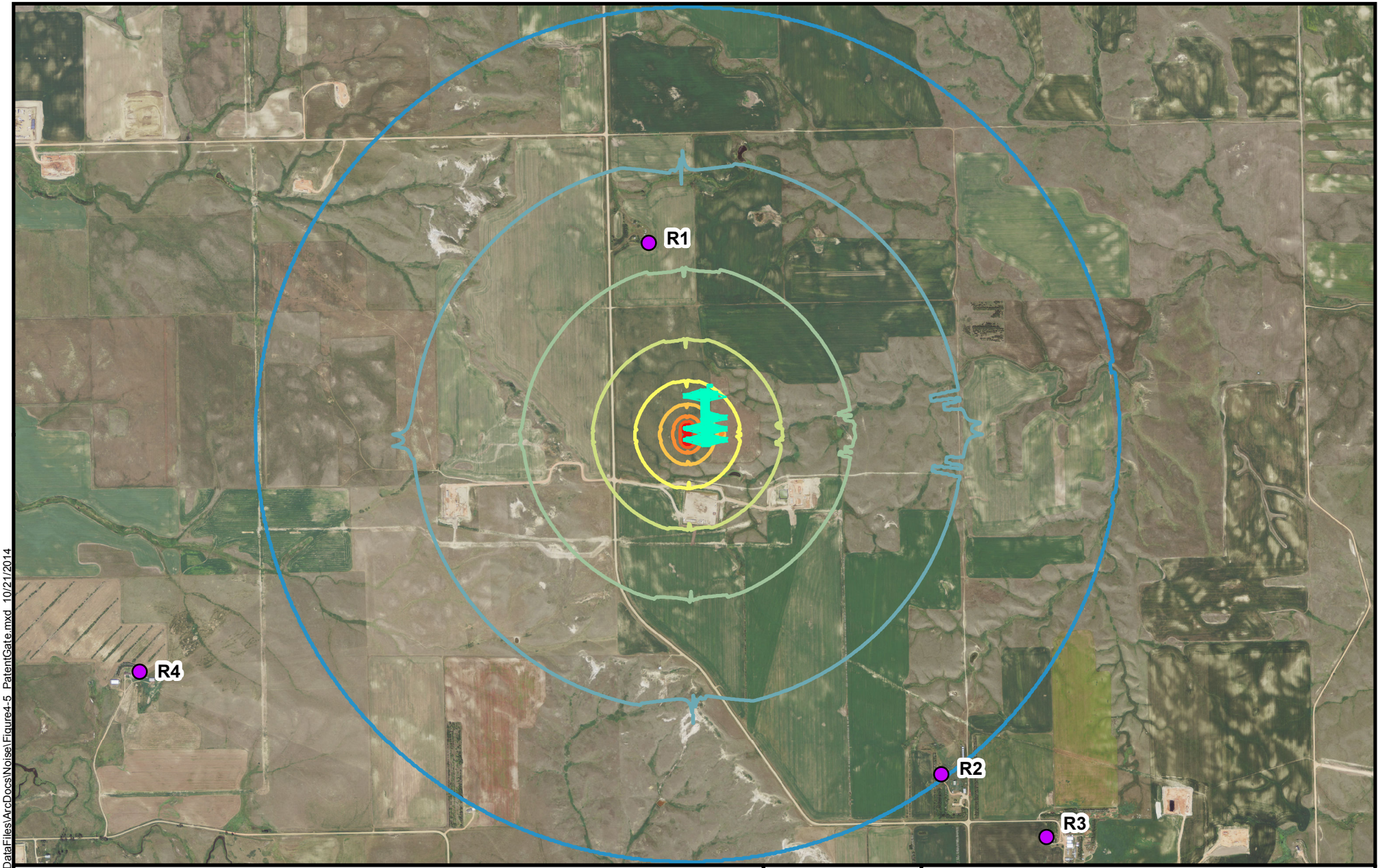
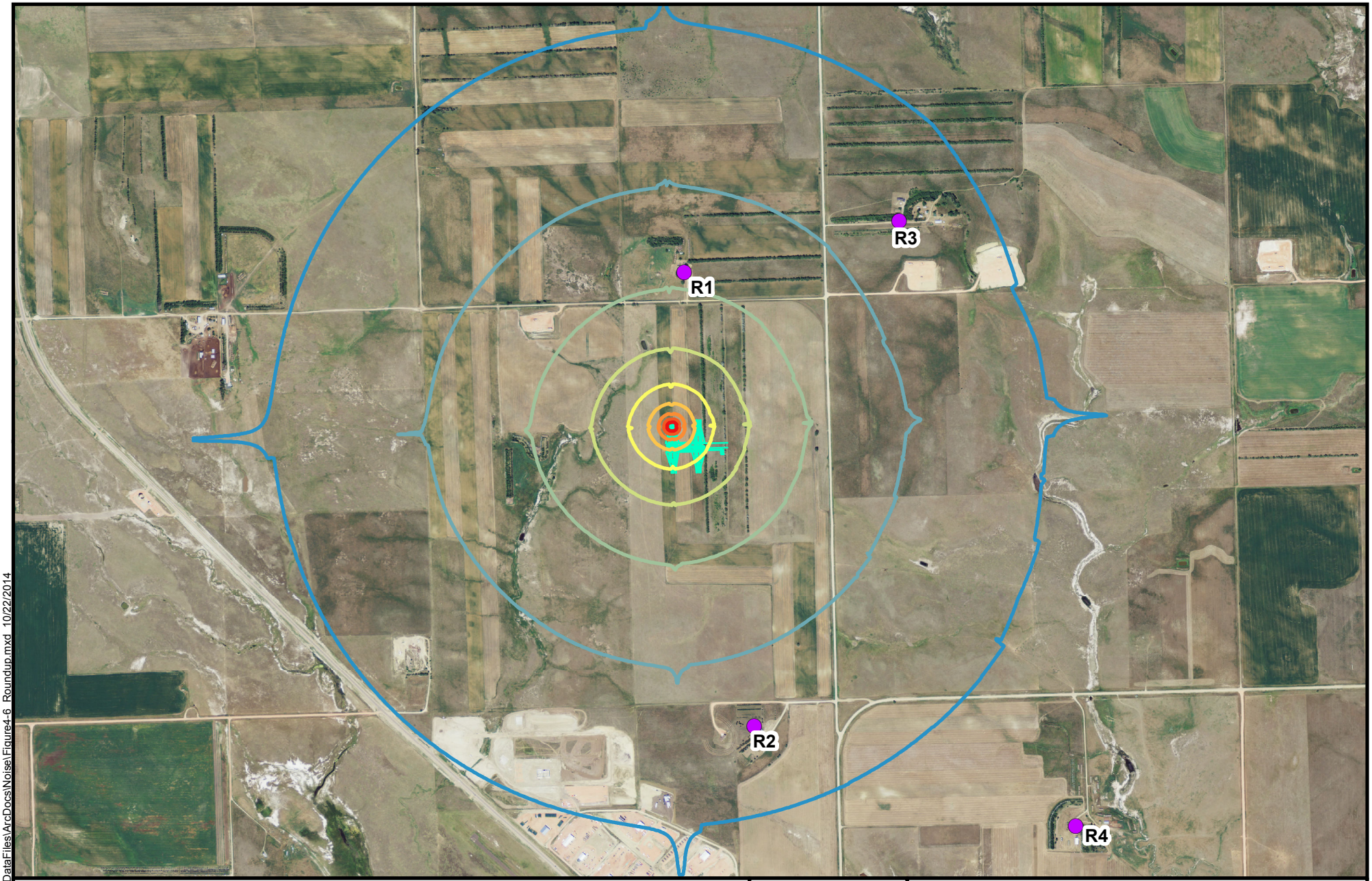


Figure 4-5
Basin Electric Cooperative
North Killdeer Loop 345-kV Transmission Project
Ldn Sound Contours
Patent Gate Substation

R:\Basin\61495_AVS_345\GIS\DataFiles\ArcDocs\Noise\Figure4-5_PatentGate.mxd 10/21/2014

Source: NAIP Aerial Photography (McKenzie County, 2012); Burns & McDonnell.

Issued: 10/22/2014



R:\Basin\61495_AVS_345\GIS\DataFiles\ArcDocs\Noise\Figure4-6_Roundup.mxd 10/22/2014

Figure 4-6
Basin Electric Cooperative
North Killdeer Loop 345-kV Transmission Project
Ldn Sound Contours
Roundup Substation

Source: NAIP Aerial Photography (Dunn County, 2012); Burns & McDonnell.

Issued: 10/22/2014

5.0 CONCLUSION

A sound assessment was performed for Basin Electric's proposed North Killdeer Loop substation project in northwest North Dakota. The evaluation consisted of noise modeling to predict sound levels at nearby residences from the operation of the proposed Kummer Ridge, Patent Gate, and Roundup substations.

No local or State noise ordinances are applicable to the Project. Thus, EPA noise guidelines were used to evaluate noise that would be generated from the operation of the Project. The overriding design goal for noise generated by the proposed substations would be an L_{dn} of 55 dBA or less, per the EPA guidance.

The CadnaA model was used to predict sound levels from the proposed substations. It is expected that the proposed substations would produce overall sound levels below the EPA guideline of 55 dBA (L_{dn}) based on the NEMA sound levels for a 333 MVA transformer. To meet the EPA noise guidelines, it is recommended that Basin require the transformer vendor to guarantee the transformers would meet the NEMA sound level of 90 dBA.

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APPENDIX K - UPDATE FOR CLASS I SURVEY RECORDED CULTURAL RESOURCES AND INVENTORIES

(To be filed to Docket separately)

APPENDIX L - REPRESENTATIVE LIST OF WILDLIFE AND FISH SPECIES IN PROJECT AREA

Representative List of Wildlife and Fish Species Observed or Known to Occur near the Proposed Project

Scientific Name*	**Common Name***
Mammals	
Sorex Cinereus	masked shrew
Myotis lucifugus	little brown myotis
Myotis septentrionalis	northern myotis
Myotis evotis	long-eared myotis
Lasionycteris noctivagans	silver-haired bat
Eptesicus fuscus	big brown bat
Lasiurus borealis	red bat
Lasiurus cinereus	hoary bat
Sylvilagus floridanus	eastern cottontail
Sylvilagus nuttallii	Nuttall's cottontail
Lepus townsendii	white-tailed jackrabbit
Eutamius minimus	least chipmunk
Sciurus niger	fox squirrel
Spermophilus tridecemlineatus	thirteen-lined ground squirrel
Spermophilus richardsonii	Richardson's ground squirrel
Spermophilus franklinii	Franklin's ground squirrel
Cynomys ludovicianus	black-tailed prairie dog
Thomomys talpoides	northern pocket gopher
Perognathus fasciatus	olive-backed pocket mouse
Castor canadensis	beaver
Peromyscus maniculatus	deer mouse
Peromyscus leucopus	white-footed mouse
Onychomys leucogaster	northern grasshopper mouse
Clethrionomys gapperi	southern red-backed vole
Microtus pennsylvanicus	meadow vole
Microtus ochrogaster	prairie vole
Ondatra zibethicus	muskrat
Rattus norvegius	Norway rat
Mus musculus	house mouse
Zapus hudsonius	meadow jumping mouse
Zapus princeps	western jumping mouse
Erethizon dorsatum	porcupine
Canis latrans	coyote
Vulpes vulpes	red fox
Procyon lotor	raccoon
Mustela nivalis	least weasel
Mustela frenata	long-tailed weasel
Mustela vison	mink
Taxidea taxus	badger

Mephitis mephitis	striped skunk
Lutra canadensis	river otter
Felis concolor	mountain lion
Felis rufus	bobcat
Cervus elaphus	elk
Odocoileus hemionus	mule Deer
Odocoileus virginianus	whitetail deer
Antilocapridae americana	pronghorn
Bison bison	bison
Ovis canadensis	bighorn sheep
Reptiles and Amphibians	
Scaphiopus bombifrons	plains spadefoot toad
Bufo woodhousei	Woodhouse's toad
Bufo cognatus	great plains toad
Bufo hemiosphrys	Canadian toad
Rana pipiens	northern leopard frog
Rana sylvatica	wood frog
Pseudacris triseriata	western chorus frog
Ambystoma tigrinum	tiger salamander
Phrynosoma douglassi	short-horned lizard
Sceloporus graciosus	sagebrush lizard
Chrysemys picta belli	western painted turtle
Chelydra serpentina	common snapping turtle
Thamnophis sirtalis	common garter snake
Thamnophis radix	plains garter snake
Opheodrys vernalis	smooth green snake
Heterdon nasicus	western hognose snake
Pituophis catenifer	bullsnake
Coluber constrictor	racer
Crotalus viridis	prairie rattlesnake
Birds	
Perdix perdix	gray partridge
Tympanuchus phasianellus	sharp-tailed grouse
Phasianus colchicus	ring-necked pheasant
Meleagris gallopavo	wild turkey
Zenaida macroura	mourning dove
Ardea herodias	great blue heron
Botaurus lentiginosus	American bittern
Nycticorax nycticorax	black-crowned night heron
Aechmophorus occidentalis	western grebe
Podiceps nigricollis	eared grebe
Grus canadensis	sandhill crane
Fulica americana	American coot
Charadrius melodus	piping plover
Charadrius vociferus	killdeer
Recurvirostra americana	American avocet

Phalaropus tricolor	Wilson's phalarope
Larus delawarensis	ring-billed gull
Sterna hirundo	common tern
Chlidonias niger	black tern
Sternula antillarum	least tern
Bartramia longicauda	upland sandpiper
Actitis macularia	spotted sandpiper
Catoptrophorus semipalmatus	willet
Limosa fedoa	marbled godwit
Tringa melanoleuca	greater yellowlegs
Branta canadensis	Canada goose
Aix sponsa	wood duck
Anas crecca	green-winged teal
Anas discors	blue-winged teal
Anas americana	American widgeon
Aythya valisineria	canvasback
Aythya americana	redhead
Anas strepera	gadwall
Anas platyrhynchos	mallard
Oxyura jamaicensis	ruddy duck
Anas clypeata	northern shoveler
Anas acuta	northern pintail
Tyrannus tyrannus	eastern kingbird
Tyrannus verticalis	western kingbird
Tachyceneta bicolor	tree swallow
Hirundo rustica	barn swallow
Progne subis	purple martin
Eremophila alpestris	horned lark
Parus atricapillus	black-capped chickadee
Sitta carolinensis	white-breasted nuthatch
Troglodytes aedon	house wren
Turdus migratorius	American robin
Sialia sialis	eastern bluebird
Lanius ludovicianus	loggerhead shrike
Toxostoma rufum	brown thrasher
Bombycilla cedrorum	cedar waxwing
Cyanocitta cristata	blue jay
Vireo gilvus	warbling vireo
Carduelis tristis	American goldfinch
Dendroica petechia	yellow warbler
Pheucticus melanocephalus	black-headed grosbeak
Spizella passerina	chipping sparrow
Sturnella neglecta	western meadowlark
Icterus galbula	northern oriole
Quiscalus quiscula	common grackle
Agelaius phoeniceus	red-winged blackbird

Cathartes aura	turkey vulture
Haliaeetus leucocephalus	bald eagle
Aquila chrysaetos	golden eagle
Circus cyaneus	northern harrier
Accipiter cooperii	cooper's hawk
Buteo swainsoni	Swainson's hawk
Buteo jamaicensis	red-tailed hawk
Falco columbarius	merlin
Falco sparverius	American kestrel
Falco mexicanus	prairie falcon
Asio otus	long-eared owl
Asio flammeus	short-eared owl
Bubo virginianus	great-horned owl
Athene cunicularia	burrowing owl
Otus asio	eastern screech owl
Fish	
Esox lucius	northern pike
Sander vitreus	walleye
Sander Canadensis	sauger
Perca flavescens	yellow perch
Etheostoma nigrum	johnny darter
Micropterus salmoides	largemouth bass
Micropterus dolomieu	smallmouth bass
Lepomis macrochirus	bluegill
Pomoxis nigromaculatus	black crappie
Pomoxis annularis	white crappie
Morone Chrysops	white bass
Aplodinotus grunniens	freshwater drum
Ictalurus punctatus	channel catfish
Ameiurus melas	black bullhead
Polyodon spathula	paddlefish
Lepisosteus platostomus	shortnose gar
Oncorhynchus mykiss	rainbow trout
Salmo trutta	brown trout
Salvelinus namaycush	lake trout
Oncorhynchus tshawytscha	chinook salmon
Lota lota	burbot
Catostomus commersonii	white sucker
Ictiobus cyprinellus	bigmouth buffalo
Moxostoma macrolepidotum	shorthead redhorse
Cyprinus carpio	common carp
Pimephales promelas	fathead minnow
Semotilus atromaculatus	creek chub
Notemigonus crysoleucas	golden shiner

Osmerus mordax	rainbow smelt

* Species lists were generated from data gathered from the USGS Northern Prairie Wildlife Research Center Species Lists (2006) and from North Dakota Game and Fish Department's publications of *Raptors of North Dakota* (Hagen and Grondahl, undated), *Songbirds of North Dakota* (Grondahl and Gomes, undated), *Marshbirds and Shorebirds of North Dakota* (Gomes, undated), *Small Mammals of North Dakota* (Grondahl, undated), and *Reptiles and Amphibians of North Dakota* (Hoberg and Gause, undated).

APPENDIX M – RAPTOR NEST SURVEY STUDY

AVS to Neset Transmission Line Project
2014 Raptor Nest Survey

Final Report
April 2014

Prepared for:

Basin Electric Power Cooperative
1717 East Interstate Ave
Bismarck, North Dakota 58503

Prepared by:

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September 4, 2014

Draft Pre-Decisional Document - Privileged and Confidential - Not For Distribution

STUDY PARTICIPANTS

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Terri Thorn	GIS Specialist

REPORT REFERENCE

Derby, C., K. Chodachek, and T. Thorn. 2014. AVS to Neset Transmission Line Project 2014 Raptor Nest Surveys. Final Report April 2014. Prepared for Basin Electric Power Cooperative, Bismarck, North Dakota. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota.

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Appendix A. Historical Golden Eagle Nest Data

I. INTRODUCTION

Basin Electric Power Cooperative (Basin) proposes to construct, operate, and maintain a new electrical transmission line connecting the existing Antelope Valley Substation (AVS and Neset substations (Project; Figure 1). Approximately 262 miles of new 345-kilovolt (kV) transmission line and 13 miles of new 230-kV line will need to be constructed. The new 345-kV transmission line will include new construction in a new right-of-way (ROW) as well as some double circuiting with an existing 115-kV line. The 230-kV connection between the Tande and Neset substations would also require new construction in a new ROW. The 230-kV connection between Judson and Williston substations would involve double circuiting with an existing 115-kV transmission line and no new ROW would be necessary. The overall project area identified for this project encompasses parts of Mercer, Dunn, Billings, McKenzie, Williams, and Mountrail counties in North Dakota.

Under the direction of Basin, Western EcoSystems Technology, Inc. (WEST) has prepared the following report summarizing the results of the 2014 aerial raptor nest survey conducted along the entire length of the proposed Project.

II. METHODS

One aerial survey was conducted from a helicopter in mid-April, a period before leaf out when raptors would be actively tending to a nest or incubating eggs. Aerial surveys were conducted in accordance with the guidance provided in the US Fish and Wildlife Service (USFWS) Eagle Conservation Plan Guidance (April 2013) and USFWS Inventory and Monitoring Protocols (Pagel et al. 2010). An experienced raptor ecologist and a helicopter pilot skilled at this type of survey were used. Raptors are defined here as kites, accipiters, buteos, harriers, eagles, falcons, and owls. However, the main focus of the survey was to identify golden eagle (*Aquila chrysaetos*) nests. Eagle nest surveys focused on locating eyries (large, stick nest structures) in suitable eagle nesting substrate (trees, transmission lines, cliff faces, etc.) within the proposed Project and a one mile buffer either side of the transmission line (Figure 1). Efforts were made to minimize disturbance to breeding raptors; the greatest possible distance at which the species could be identified was maintained, with distances varying depending upon nest location and wind conditions.

In general, all potential golden eagle and raptor nest habitat was surveyed by flying meandering transects between 0.25 and 0.5 mile (0.4 and 0.8 km) apart, flying at speeds of 60-75 mph throughout the proposed Project and associated buffer. Historic golden eagle nest locations provided by the North Dakota Game and Fish Department (NDGFD 2014) were surveyed for nest status and condition. Surveys were typically conducted between 0800 hours and 1700 hours. The locations of all potential raptor nests were recorded using a hand-held Global Positioning System (GPS); coordinates were set at Universal Transverse Mercator (UTMs) North American Datum (NAD) 83 unit. This included all confirmed and potential nests regardless of their activity status. To determine the status of a nest, the biologist relied on clues that included behavior of adults and presence of eggs, young, or whitewash. Attempts were made to

identify the species of raptor associated with each active nest. Raptor species, nest type, nest status, nest condition, and substrate, were recorded at each nest location.

II.A. Terminology

Included below are descriptions of terms used during the documentation of nests (see Results section).

Nest ID - WEST assigned a unique nest identification number for each nest documented.

Species - A species was assigned to each nest where possible, when a nest could not be identified to species it was classified as an unknown raptor nest. Nests documented as unknown raptor species are defined as any stick nest that did not have an occupant associated with it at the time of the survey. Many times nests will become abandoned or no longer used, and over time, may become a historic nest site. Additionally, an unknown number/type of stick nests are used by corvid (ravens and crows) or owl species and may not have been detected as such during aerial raptor surveys based on differences in nesting chronology. Unknown raptor nests, including old nests or nests that could become suitable for raptors, are documented in order to populate a nest database to ensure that future surveys include all potentially suitable nest sites.

Nest Condition - Nest condition was categorized using descriptions ranging from poor to excellent. Although the determination of nest condition can be subjective and may vary between observers, it gives a general sense of when a nest or nest site may have last been used. Nests in poor to fair condition are typically in disrepair, sloughing, or sagging heavily, and would require some level of effort to rebuild in order to be suitable for successful nesting. Nests in good to excellent condition are those that appear to have been well maintained, have a well-defined bowl shape, are not sagging or sloughing, and appear to be suitable for nesting.

Substrate - The substrate in which a nest was observed was recorded to provide observers a visual reference. Substrates range from manmade structures (such as power lines, nest platforms, and dock hoists) to conifer and deciduous trees to cliff faces.

Nest Status - WEST categorizes basic nest use consistent with definitions from the USFWS Eagle Conservation Plan Guidance (April 2013). Nests were classified as occupied if any of the following were observed at the nest structure: (1) an adult in an incubating position, (2) eggs, (3) nestlings or fledglings, (4) occurrence of a pair of adults (or, sometimes sub-adults), (5) a newly constructed or refurbished stick nest in the area where territorial behavior of a raptor had been observed early in the breeding season, or (6) a recently repaired nest with fresh sticks (clean breaks) or fresh boughs on top, and/or droppings and/or molted feathers on its rim or underneath. Occupied nests were further classified as active if an egg or eggs had been laid or nestlings were observed, or inactive if no eggs or chicks were present. A nest that does not meet the above criteria for “occupied” was classified as “unoccupied”.

III. RESULTS

A WEST biologist detected a total of 144 raptor nests representing eight species during aerial surveys conducted on April 18-20, 2014 (Table 1, Figure 1), including five historic and two new golden eagle nest locations (Table 2 and Figure 2). Of these nests, 11 were identified as occupied great-horned owl (*Bubo virginianus*) nests, one long-eared owl (*Asio otus*) nest, 36 as occupied red-tailed hawk (*Buteo jamaicensis*) nests, one nest was occupied by a Canada goose (*Branta canadensis*), and 88 unoccupied, inactive raptor nests (Table 1, Figure 1). Of the historic golden eagle nests, five nest locations were not located which was consistent with 2013 survey efforts (Derby et al. 2013) and previous surveyor results which found nests had fallen from the substrate or were otherwise unable to be relocated (Appendix A). The remaining five historic nest locations were verified and were deemed unoccupied, inactive (Table 2 and Figure 2). Additionally, two potential unoccupied, inactive golden eagle nests were located along the North Killdeer Alternate Route (Table 2 and Figure 2). Both nests were built in trees, were large enough and deep enough for an eagle to use, and were in good to excellent condition (Table 2).

During surveys, a great blue heron (*Ardea herodias*) rookery, with eight occupied, active nests was located along the Little Missouri River, north of Killdeer (Figure 1). Additionally, two black-billed magpie (*Pica hudsonia*) nests were documented during surveys (Figure 1).

IV. SUMMARY

In summary, a total of 144 occupied and unoccupied nest locations were recorded. There were a total of 49 occupied raptor nests (red-tailed hawk-36, great-horned owl - 11, long-eared owl – 1, Canada goose - 1). The five historic golden eagle nests located were unoccupied, inactive. Additionally, two potential unoccupied, inactive golden eagle nests were located along the Killdeer Alternate route.

V. LITERATURE CITED

Derby, C., K. Chodachek, and T. Thorn. 2013. AVS to Neset Transmission Line Project 2014 Raptor Nest Survey. Prepared for Basin Electric Power Cooperative, Bismarck, North Dakota. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. July 13, 2013.

North Dakota Game and Fish Department (NDGFD). 2014. Historical Golden Eagle Nest Database.

Pagel, J.E., D.M. Whittington, and G.T. Allen. 2010. Interim Golden Eagle Technical Guidance: Inventory and Monitoring Protocols; and Other Recommendations in Support of Golden Eagle Management and Permit Issuance. US Fish and Wildlife Service (USFWS). February 2010. Available online at: http://steinadlerschutz.lbv.de/fileadmin/www.steinadlerschutz.de/terimGoldenEagleTechnicalGuidanceProtocols25March2010_1_.pdf

US Fish and Wildlife Service (USFWS). 2013. Eagle Conservation Plan Guidance. Module 1 - Land-Based Wind Energy. Version 2. Division of Migratory Bird Management, USFWS. April 2013. Available online at: http://www.fws.gov/migratorybirds/Eagle_Conservation_Plan_Guidance-Module%201.pdf

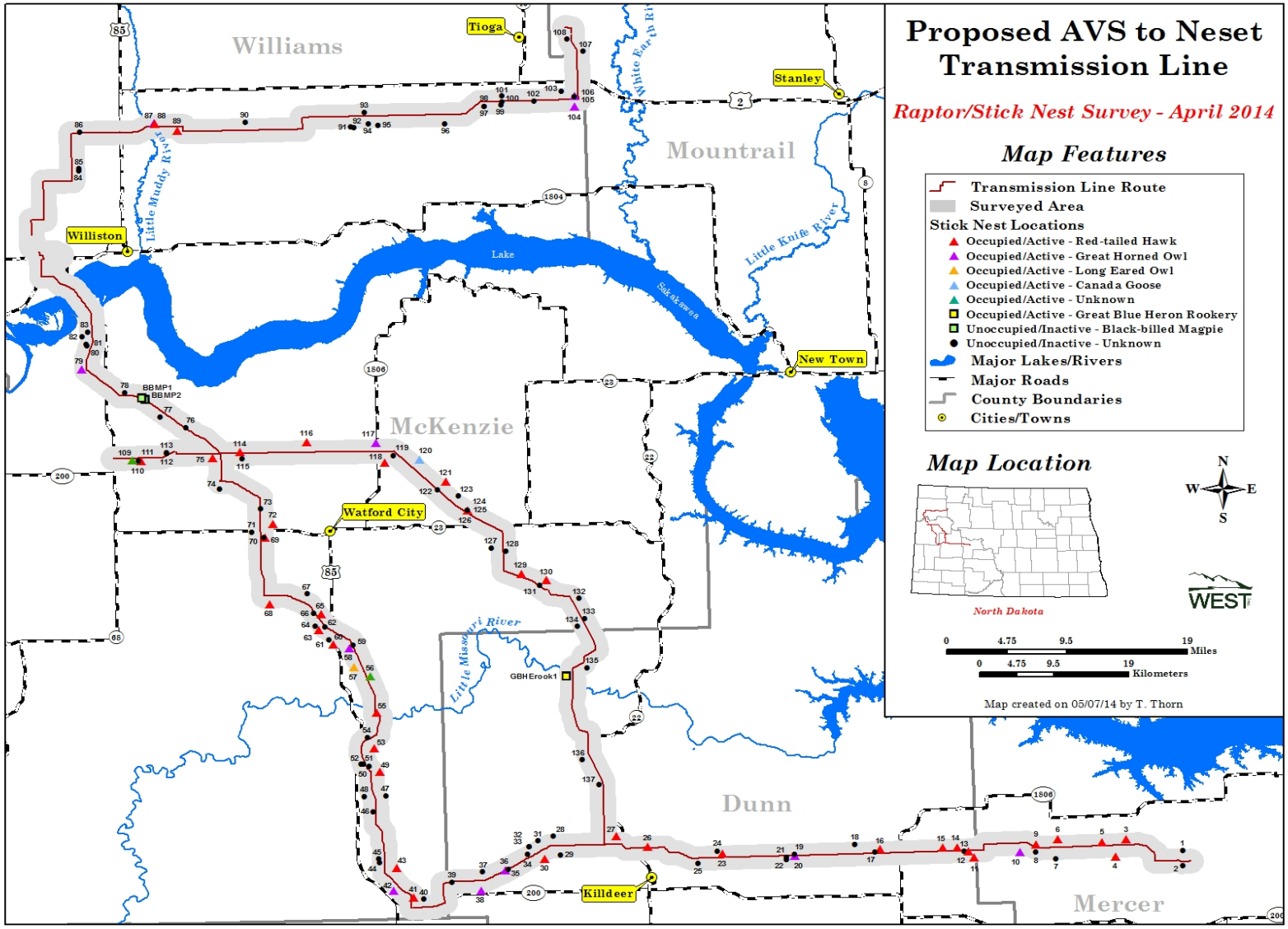

Figure 1. Raptor nest locations (excluding golden eagles) located within survey buffer of the proposed Project in 2014.

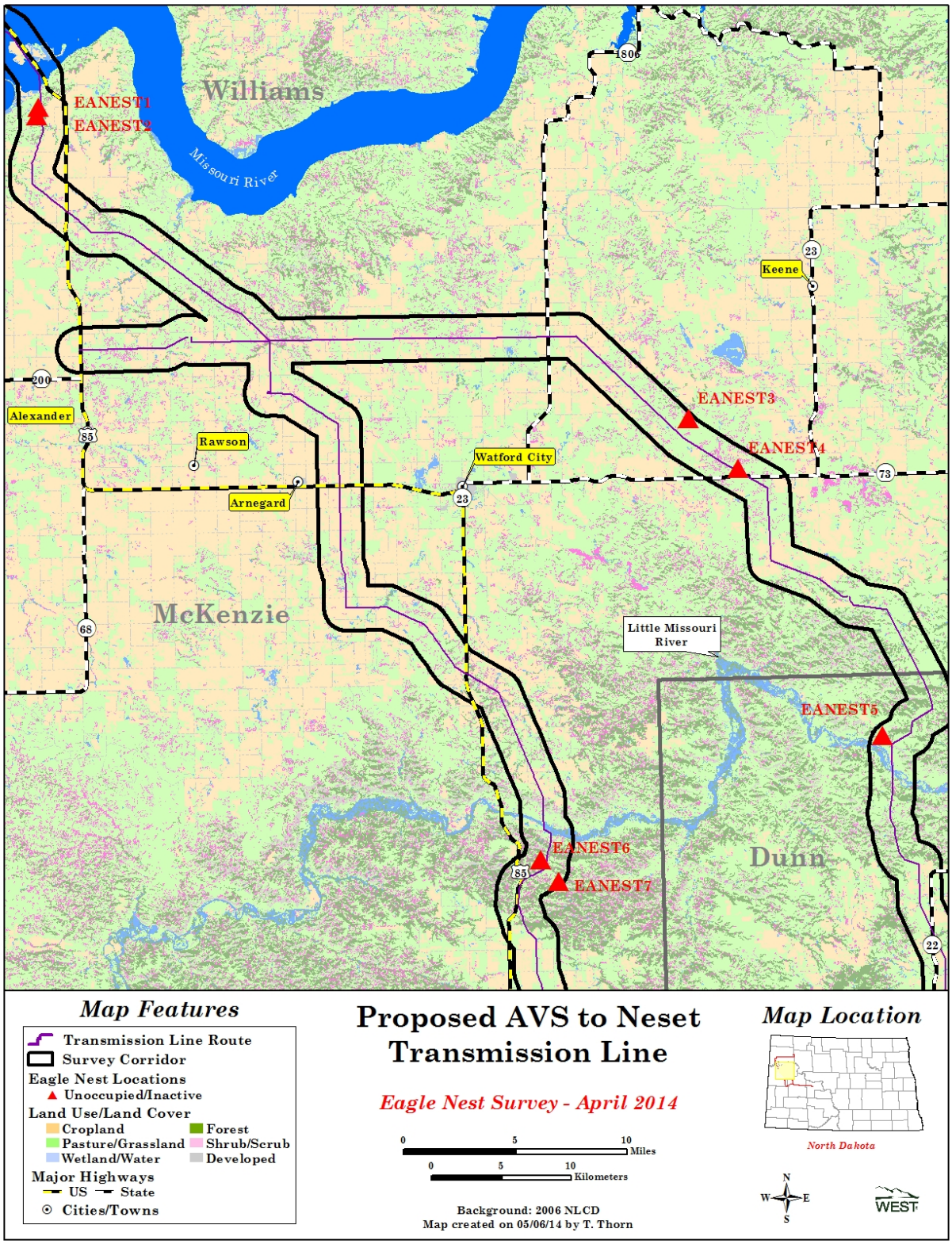

Figure 2. Golden eagle nest locations within survey buffer of the proposed Powerline Project in 2014 (Historical nests that were not located during 2014 surveys are not included).

Table 1. Raptor nest location and features for identified nests during 2014 survey for the AVS to Neset Project (NAD83, Zone 13).

Unique ID	Northing	Easting	Species	Nest Substrate	Status at time of Survey	Condition
1	5252610	737255	Unknown Raptor	Tree	Unoccupied - inactive	Good
2	5250564	737290	Unknown Raptor	Tree	Unoccupied - inactive	Good
3	5254175	729992	Red-tailed Hawk	Tree	Occupied - active	Good
4	5251835	728647	Red-tailed Hawk	Tree	Occupied - active	Good
5	5253750	726945	Red-tailed Hawk	Tree	Occupied - active	Good
6	5254205	721261	Red-tailed Hawk	Tree	Occupied - active	Good
7	5251519	721127	Unknown Raptor	Tree	Unoccupied - inactive	Good
8	5252370	718516	Unknown Raptor	Tree	Unoccupied - inactive	Good
9	5253467	718505	Red-tailed Hawk	Tree	Occupied - active	Good
10	5252443	716464	Great-horned Owl	Tree	Occupied - active	Good
11	5251678	710616	Red-tailed Hawk	Tree	Occupied - active	Good
12	5252543	709864	Red-tailed Hawk	Tree	Occupied - active	Good
13	5252502	709400	Unknown Raptor	Tree	Unoccupied - inactive	Poor
14	5253029	708433	Red-tailed Hawk	Tree	Occupied - active	Good
15	5252982	706620	Red-tailed Hawk	Tree	Occupied - active	Good
16	5252784	698676	Red-tailed Hawk	Tree	Occupied - active	Good
17	5252395	698017	Unknown Raptor	Tree	Unoccupied - inactive	Good
18	5253405	695506	Unknown Raptor	Tree	Unoccupied - inactive	Good
19	5252123	687821	Unknown Raptor	Tree	Unoccupied - inactive	Good
20	5251921	687822	Great-horned Owl	Tree	Occupied - active	Good
21	5251715	686800	Unknown Raptor	Tree	Unoccupied - inactive	Good
22	5251391	686792	Unknown Raptor	Tree	Unoccupied - inactive	Good
23	5252169	678519	Red-tailed Hawk	Tree	Occupied - active	Good
24	5252551	678001	Unknown Raptor	Tree	Unoccupied - inactive	Good
25	5250923	675484	Unknown Raptor	Tree	Unoccupied - inactive	Good
26	5253172	669061	Red-tailed Hawk	Tree	Occupied - active	Good
27	5254598	665085	Red-tailed Hawk	Tree	Occupied - active	Good
28	5254528	657057	Unknown Raptor	Tree	Unoccupied - inactive	Good
29	5252047	657986	Unknown Raptor	Tree	Unoccupied - inactive	Good
30	5251455	655914	Red-tailed Hawk	Tree	Occupied - active	Good
31	5253930	655143	Unknown Raptor	Tree	Unoccupied - inactive	Good
32	5253182	654050	Unknown Raptor	Tree	Unoccupied - inactive	Good
33	5253166	654050	Unknown Raptor	Tree	Unoccupied - inactive	Good
34	5252093	653733	Unknown Raptor	Tree	Unoccupied - inactive	Fair
35	5250037	651265	Unknown Raptor	Tree	Unoccupied - inactive	Good
36	5250000	650869	Great-horned Owl	Tree	Occupied - active	Good
37	5249786	648076	Unknown Raptor	Tree	Unoccupied - inactive	Good
38	5247150	647787	Great-horned Owl	Tree	Occupied - active	Good

Table 1. Raptor nest location and features for identified nests during 2014 survey for the AVS to Neset Project (NAD83, Zone 13).

Unique ID	Northing	Easting	Species	Nest Substrate	Status at time of Survey	Condition
39	5248336	644131	Unknown Raptor	Tree	Unoccupied - inactive	Good
40	5246062	640585	Unknown Raptor	Tree	Unoccupied - inactive	Good
41	5246272	639203	Red-tailed Hawk	Tree	Occupied - active	Good
42	5247167	636688	Great-horned Owl	Tree	Occupied - active	Good
43	5250250	637100	Red-tailed Hawk	Tree	Occupied - active	Good
44	5250984	634936	Unknown Raptor	Tree	Unoccupied - inactive	Good
45	5251500	634789	Unknown Raptor	Tree	Unoccupied - inactive	Good
46	5257852	634156	Unknown Raptor	Tree	Unoccupied - inactive	Good
47	5259993	635758	Unknown Raptor	Tree	Unoccupied - inactive	Good
48	5259905	633027	Unknown Raptor	Tree	Unoccupied - inactive	Good
49	5263235	634949	Red-tailed Hawk	Tree	Occupied - active	Good
50	5263965	633621	Unknown Raptor	Tree	Unoccupied - inactive	Good
51	5264251	632896	Unknown Raptor	Tree	Unoccupied - inactive	Good
52	5264255	632525	Unknown Raptor	Tree	Unoccupied - inactive	Good
53	5266402	634204	Red-tailed Hawk	Tree	Occupied - active	Good
54	5267928	633425	Unknown Raptor	Tree	Unoccupied - inactive	Good
55	5271241	634559	Red-tailed Hawk	Tree	Occupied - active	Good
56	5276191	633727	Unknown Raptor	Tree	Occupied - active	Good
57	5277370	631615	Long-eared Owl	Tree	Occupied - active	Good
58	5279956	630994	Great-horned Owl	Tree	Occupied - active	Good
59	5280387	631580	Unknown Raptor	Tree	Unoccupied - inactive	Good
60	5280537	628948	Red-tailed Hawk	Tree	Occupied - active	Good
61	5281056	628424	Unknown Raptor	Tree	Unoccupied - inactive	Fair
62	5282856	628000	Unknown Raptor	Tree	Unoccupied - inactive	Fair
63	5282418	627146	Red-tailed Hawk	Tree	Occupied - active	Good
64	5282916	626738	Unknown Raptor	Tree	Unoccupied - inactive	Good
65	5284575	627406	Red-tailed Hawk	Tree	Occupied - active	Good
66	5284683	626509	Unknown Raptor	Tree	Unoccupied - inactive	Fair
67	5287343	625660	Unknown Raptor	Tree	Unoccupied - inactive	Good
68	5285910	620838	Red-tailed Hawk	Tree	Occupied - active	Good
69	5294920	620266	Red-tailed Hawk	Tree	Occupied - active	Good
70	5294912	620256	Unknown Raptor	Tree	Unoccupied - inactive	Good
71	5295633	618666	Unknown Raptor	Tree	Unoccupied - inactive	Fair
72	5296810	621326	Red-tailed Hawk	Tree	Occupied - active	Good
73	5298864	619723	Unknown Raptor	Tree	Unoccupied - inactive	Good
74	5301513	614557	Unknown Raptor	Tree	Unoccupied - inactive	Good
75	5305722	613568	Red-tailed Hawk	Tree	Occupied - active	Good
76	5309743	610244	Unknown Raptor	Tree	Unoccupied - inactive	Good

Table 1. Raptor nest location and features for identified nests during 2014 survey for the AVS to Neset Project (NAD83, Zone 13).

Unique ID	Northing	Easting	Species	Nest Substrate	Status at time of Survey	Condition
77	5311201	607007	Unknown Raptor	Tree	Unoccupied - inactive	Poor
78	5314511	602492	Unknown Raptor	Tree	Unoccupied - inactive	Good
79	5317701	596957	Great-horned Owl	Tree	Occupied - active	Good
80	5320868	597610	Unknown Raptor	Tree	Unoccupied - inactive	Good
81	5321066	597574	Unknown Raptor	Tree	Unoccupied - inactive	Good
82	5322076	597040	Unknown Raptor	Tree	Unoccupied - inactive	Good
83	5322719	597749	Unknown Raptor	Tree	Unoccupied - inactive	Fair
84	5344559	596563	Unknown Raptor	Tree	Unoccupied - inactive	Good
85	5344823	596613	Unknown Raptor	Tree	Unoccupied - inactive	Good
86	5349770	596697	Unknown Raptor	Tree	Unoccupied - inactive	Good
87	5350852	606206	Red-tailed Hawk	Tree	Occupied - active	Good
88	5350963	606192	Great-horned Owl	Tree	Occupied - active	Good
89	5349998	609096	Red-tailed Hawk	Tree	Occupied - active	Good
90	5351072	617776	Unknown Raptor	Tree	Unoccupied - inactive	Good
91	5350435	631280	Unknown Raptor	Tree	Unoccupied - inactive	Good
92	5350391	631686	Unknown Raptor	Tree	Unoccupied - inactive	Good
93	5352405	632974	Unknown Raptor	Tree	Unoccupied - inactive	Fair
94	5350906	633457	Unknown Raptor	Tree	Unoccupied - inactive	Good
95	5350630	634713	Unknown Raptor	Tree	Unoccupied - inactive	Fair
96	5350887	643257	Unknown Raptor	Tree	Unoccupied - inactive	Good
97	5353268	648213	Unknown Raptor	Tree	Unoccupied - inactive	Good
98	5353280	648213	Unknown Raptor	Tree	Unoccupied - inactive	Good
99	5353385	650344	Unknown Raptor	Tree	Unoccupied - inactive	Fair
100	5353861	650530	Unknown Raptor	Tree	Unoccupied - inactive	Good
101	5354673	650495	Unknown Raptor	Tree	Unoccupied - inactive	Fair
102	5353984	654624	Unknown Raptor	Tree	Unoccupied - inactive	Good
103	5355316	658125	Unknown Raptor	Tree	Unoccupied - inactive	Fair
104	5353179	659724	Great-horned Owl	Tree	Occupied - active	Good
105	5354539	659793	Unknown Raptor	Tree	Unoccupied - inactive	Good
106	5354610	659766	Great-horned Owl	Tree	Occupied - active	Good
107	5360712	660813	Unknown Raptor	Tree	Unoccupied - inactive	Good
108	5362348	658788	Unknown Raptor	Tree	Unoccupied - inactive	Fair
109	5305362	603392	Unknown Raptor	Tree	Occupied - active	Good
110	5305267	604179	Unknown Raptor	Tree	Unoccupied - inactive	Good
111	5305271	604479	Red-tailed Hawk	Tree	Occupied - active	Good
112	5306254	607733	Unknown Raptor	Tree	Unoccupied - inactive	Good
113	5306455	607771	Unknown Raptor	Tree	Unoccupied - inactive	Good
114	5306525	617104	Red-tailed Hawk	Tree	Occupied - active	Good

Table 1. Raptor nest location and features for identified nests during 2014 survey for the AVS to Neset Project (NAD83, Zone 13).

Unique ID	Northing	Easting	Species	Nest Substrate	Status at time of Survey	Condition
115	5305541	617407	Unknown Raptor	Tree	Unoccupied - inactive	Good
116	5307854	625608	Red-tailed Hawk	Tree	Occupied - active	Good
117	5307778	634382	Great-horned Owl	Tree	Occupied - active	Good
118	5305076	635515	Red-tailed Hawk	Tree	Occupied - active	Good
119	5306041	636657	Unknown Raptor	Tree	Unoccupied - inactive	Good
120	5305506	639923	Canada Goose	Tree	Occupied - active	Good
121	5302563	643332	Red-tailed Hawk	Tree	Occupied - active	Good
122	5301397	642254	Unknown Raptor	Tree	Unoccupied - inactive	Good
123	5300520	644981	Unknown Raptor	Tree	Unoccupied - inactive	Good
124	5298664	646136	Red-tailed Hawk	Tree	Occupied - active	Good
125	5298664	646136	Unknown Raptor	Tree	Unoccupied - inactive	Good
126	5298664	646136	Unknown Raptor	Tree	Unoccupied - inactive	Good
127	5293519	649140	Unknown Raptor	Tree	Unoccupied - inactive	Good
128	5293063	651006	Unknown Raptor	Tree	Unoccupied - inactive	Good
129	5290009	652856	Red-tailed Hawk	Tree	Occupied - active	Good
130	5288474	655297	Unknown Raptor	Tree	Unoccupied - inactive	Good
131	5289227	656111	Red-tailed Hawk	Tree	Occupied - active	Good
132	5286689	660357	Unknown Raptor	Tree	Unoccupied - inactive	Good
133	5283951	661070	Unknown Raptor	Tree	Unoccupied - inactive	Good
134	5282963	660097	Unknown Raptor	Tree	Unoccupied - inactive	Good
135	5277325	661381	Unknown Raptor	Tree	Unoccupied - inactive	Good
136	5264910	660767	Unknown Raptor	Tree	Unoccupied - inactive	Good
137	5261547	662864	Unknown Raptor	Tree	Unoccupied - inactive	Fair

Table 2. Golden eagle nests identified during the 2014 survey for the AVS to Neset Project (NAD83, Zone 13).

Unique ID	Historic ID	Northing	Easting	Nest Substrate	Status at time of Survey	Condition
EANEST7	GE443	5267335	635484	Tree	Unoccupied – inactive	Good
EANEST6	GE703	5268940	634203	Tree	Unoccupied – inactive	Fair
---	GE111LB	5269832	634042	Cliff	Could not locate	---
---	GE094	5309197	613375	Cliff	Could not locate	---
---	GE542	5321134	597707	Tree	Could not locate	---
---	GE540	5322112	596974	Tree	Could not locate	---
EANEST2	GE083	5322508	597937	Cliff	Unoccupied – inactive	Poor
---	GE544	5323050	597753	Cliff	Could not locate	---
EANEST1	GE543	5323121	598011	Cliff	Unoccupied – inactive	Good
EANEST3*	---	5300710	644801	Tree	Unoccupied – inactive	Good
EANEST4*	---	5297099	648399	Tree	Unoccupied – inactive	Excellent
EANEST5	GE030	5277853	658786	Cliff	Unoccupied – inactive	Poor

* - potential golden eagle nest based on size and condition

Appendix A. Historical Golden Eagle Nest Data

Appendix A. Historical Golden Eagle Nest Data.

NESTID	Easting	Northing	NESTTYPE	SOURCE	Comments
GE443	5267335	635484	Tree	UND Golden Eagle Project	5/8/2007 - Large stick nest in tall cottonwood, sticks starting to fall out, 2 track on top of butte, same as k-4
GE703	5268940	634203	Tree	UND Golden Eagle Project	5/15/2009 - Location needs verification
GE111LB	5269832	634041	Cliff	UND Golden Eagle Project	6/6/2010 - Unable to locate for several years, originally from McKenzie ranger computer summary
GE094	5309197	613375	Cliff	UND Golden Eagle Project	7/14/2005 - Nest was falling apart and full of clay, unable to locate for several years
GE542	5321134	597707	Tree	UND Golden Eagle Project	5/6/2004 - Too difficult to see with leaves on
GE540	5322112	596974	Tree	UND Golden Eagle Project	4/13/2006 - Nest to an oil site
GE083	5322508	597937	Cliff	UND Golden Eagle Project	5/6/2004 - Vegetation growing within nest, has not been used recently; oil wells within 0.5 miles; 7/14/2005 – could not relocate – oil development and excavation
GE544	5323050	597753	Cliff	UND Golden Eagle Project	4/13/2006 - Nest in poor shape on long ridge in the middle
GE543	5323120	598011	Cliff	UND Golden Eagle Project	7/14/2005 - Old nest covered in dirt; 4/13/2006 – new nest found
GE030	5277853	658786	Cliff	UND Golden Eagle Project	checked infrequently since 1982, last checked in 2006, never observed occupied, on steep cliff, may have been 2 nests

APPENDIX N - 100 SPECIES OF CONSERVATION PRIORITY FOR NORTH DAKOTA

100 Species of Conservation Priority for North Dakota

Level I Species	Level II Species	Level III Species
horned grebe	northern pintail	whooping crane
American white pelican	canvasback	peregrine falcon
American bittern	redhead	Brewer's sparrow
Swainson's hawk	northern harrier	McCown's longspur
ferruginous hawk	golden eagle	smooth softshell turtle
yellow rail	bald eagle	false map turtle
willet	prairie falcon	northern prairie skink
upland sandpiper	sharp-tailed grouse	northern sagebrush lizard
long-billed curlew	greater prairie chicken	arctic shrew
marbled godwit	greater sage grouse	western small-footed myotis
Wilson's phalarope	piping plover	long-eared myotis
Franklin's gull	American avocet	long-legged myotis
black tern	least tern	plains pocket mouse
black-billed cuckoo	short-eared owl	hispid pocket mouse
Sprague's pipit	burrowing owl	sagebrush vole
grasshopper sparrow	red-headed woodpecker	eastern spotted skunk
Baird's sparrow	loggerhead shrike	gray wolf
Nelson's sharp-tailed sparrow	sedge wren	chestnut lamprey
lark bunting	dickcissel	silver lamprey
chestnut-collared longspur	Le Conte's sparrow	central stoneroller
Canadian toad	bobolink	hornyhead chub
plains spadefoot toad	common snapping turtle	pugnose shiner
smooth green snake	short-horned lizard	blacknose shiner
western hognose snake	redbelly snake	roseyface shiner

black-tailed prairie dog

sturgeon chub

sicklefin chub

pearl dace

blue sucker

pygmy shrew

Richardson’s ground squirrel

swift fox

river otter

black-footed ferret

paddlefish

pallid sturgeon

silver chub

northern redbelly dace

flathead chub

trout-perch

threeridge

wabash pigtoe

mapleleaf

black sandshell

creek heelsplitter

pink heelsplitter

finescale dace

yellow bullhead

flathead catfish

logperch

river darter

pink papershell

APPENDIX O - BIOLOGICAL ASSESSMENT

Antelope Valley Station
Transmission Line Project

Biological Assessment

March 2014

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1.0 Introduction

Basin Electric Power Cooperative (Basin Electric) is a regional wholesale electric generation and transmission cooperative owned and controlled by the member cooperatives it serves. Basin Electric serves approximately 2.8 million customers in 540,000 square miles covering portions of nine states: Colorado, Iowa, Minnesota, Montana, Nebraska, New Mexico, North Dakota, South Dakota, and Wyoming.

Within the Basin Electric service area, northwestern North Dakota is experiencing a rapid increase in development as a result of the activities associated with the extraction of oil from the Bakken shale. The level of development that has occurred and is planned for the future will require numerous increases in infrastructure throughout the region, including an increase in electrical transmission capacity and reliability. Through studies of power supply for the region and the upper Midwest (IS 2011), it has been determined that a new 345-kilovolt (kV) transmission line and associated substation upgrades are needed by 2016 in order to serve the needs of northwestern North Dakota by increasing the capacity to distribute electricity and enhance the reliability of the delivery system. Basin Electric proposes to construct, operate, and maintain a new electrical transmission line connecting the existing AVS, Charlie Creek, Williston, and Neset substations and five newly proposed substations. The overall proposed Project area identified encompasses parts of Mercer, Dunn, McKenzie, Williams, and Mountrail counties in North Dakota.

Federal agencies are required to ensure actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of threatened and endangered species or critical habitat as part of the 1973 Endangered Species Act (ESA 1973). Basin Electric has submitted an application for a loan from the Department of Agriculture, Rural Utilities Service (RUS), has submitted an interconnection request with Western Area Power Administration (Western), and will be crossing US Forest Service (USFS) land (collectively the Action Agencies); a Biological Assessment is required to analyze the proposed new and upgraded transmission lines, substations, and other associated facilities.

1.0.1 Rural Utility Service Proposed Federal Action

Basin Electric is requesting financial assistance from the U.S. Department of Agriculture (USDA), Rural Utilities Service (RUS) to construct the project. RUS has determined that the agency's decision about whether to finance the project would constitute a major federal action that may have a significant impact upon the environment within the context of the National Environmental Policy Act of 1969 (NEPA). Therefore, RUS is serving as the lead federal agency for the NEPA environmental review of the project.

As lead agency, RUS has prepared a Draft Environmental Impact Statement (EIS) in compliance with the requirements of NEPA and the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 Code of Federal Regulations [CFR] 1500-1508).

RUS's agency actions include the following.

- Provide engineering reviews of the purpose and need, engineering feasibility, and cost of the proposed project.
- Ensure that the proposed project meets the borrower's requirements and prudent utility practices.
- Evaluate the financial ability of the borrower to repay its potential financial obligations to RUS.
- Review and study the alternatives to mitigate and improve transmission reliability issues.
- Ensure that adequate transmission service and capacity are available to meet the proposed project needs.
- Ensure that NEPA and other environmental requirements and RUS environmental policies and procedures are satisfied prior to taking a federal action.

1.0.2 Western Area Power Administration Proposed Federal Action

Western's Federal proposed actions are to execute an interconnection agreement and accommodate the addition of components to the existing Williston Substation. Western's existing Williston 230-kV Substation would require the installation of an additional 230-kV power circuit breaker and associated transmission bay bus expansion, including disconnect switches, grounding switches, potential transformers, and protection and control equipment all within the existing substation boundary. Western's Federal Action has no physical impacts outside of the substation boundaries, however; as a cooperator on the National Environmental Policy Act documents, Western is also participating in the Section 7 consultation for the proposed Project and has been designated as the lead agency by RUS to assist in the Section 7 consultation on behalf of RUS.

1.0.3 US Forest Service Proposed Federal Action

USFS has proposed to authorize and subsequently issue a Special Use Permit (SUP) under the Federal Land Policy Management Act, with terms and conditions for the construction, maintenance, and operation of a transmission line through lands administered by USFS on the Little Missouri Nation Grassland (LMNG).

1.1 Description of Basin's Proposed Project

The proposed Project will include approximately 275 miles of transmission line, including 262 miles of new 345-kilovolt (kV) transmission line and 13 miles of new 230-kV line, five new substations, and equipment additions, but no expansion to the four existing substations. Starting from the AVS electric generation facility located near Beulah, North Dakota, the new 345-kV transmission line would connect with Basin Electric's existing Charlie Creek Substation near Grassy Butte, Basin Electric's new Judson Substation west of Williston, with final termination at Basin Electric's new Tande Substation. Additional 230-kV transmission lines would be constructed between the new Judson Substation and the existing U.S. Department of

Energy, Western Area Power Administration's (Western) Williston Substation, and also between the new Tande Substation and Basin Electric's existing Neset 230-kV Substation near Tioga, North Dakota.

This proposed Project would include a 66-mile, 345-kV line from the AVS Substation to the existing Charlie Creek 345-kV Substation. A new 345/115-kV substation, referred to as the Red Substation, would be constructed along this segment of line in the Killdeer area to provide interconnection of the 345-kV line to the local 115-kV system to serve electricity load requirements. The Charlie Creek 345-kV Substation would be connected by a 51-mile segment to the new Blue 345/230-kV Substation. The Blue Substation would be located south of the Missouri River to interconnect the 345-kV line with Western's 230-kV line. A 345/115-kV substation would also be located at the Blue Substation location to provide interconnection from the 345-kV line to the local 115-kV system. An additional 61-mile, 345-kV line would interconnect the Red and Blue substations, providing a loop within the Williston Load pocket area.

A new 345/115-kV substation, referred to as the White Substation, would be constructed along this segment of line also to interconnect with the local 115-kV system for load serving purposes. A single 345-kV line would extend approximately 24 miles north from the Blue Substation to the proposed Judson 345-kV Substation near Williston. The proposed Judson 345-kV Substation would then interconnect with the proposed Tande 345-kV Substation by a 56-mile line segment (including approximately 31 miles of double circuit with Mountrail-Williams Electric Cooperative 115-kV line) and a 2-mile, 230-kV transmission line would interconnect the proposed Judson 345-kV Substation to Western's existing Williston 230-kV Substation. Finally, the proposed Tande 345-kV Substation would interconnect with the existing Neset 230-kV Substation by a 2-mile, 230-kV line segment.

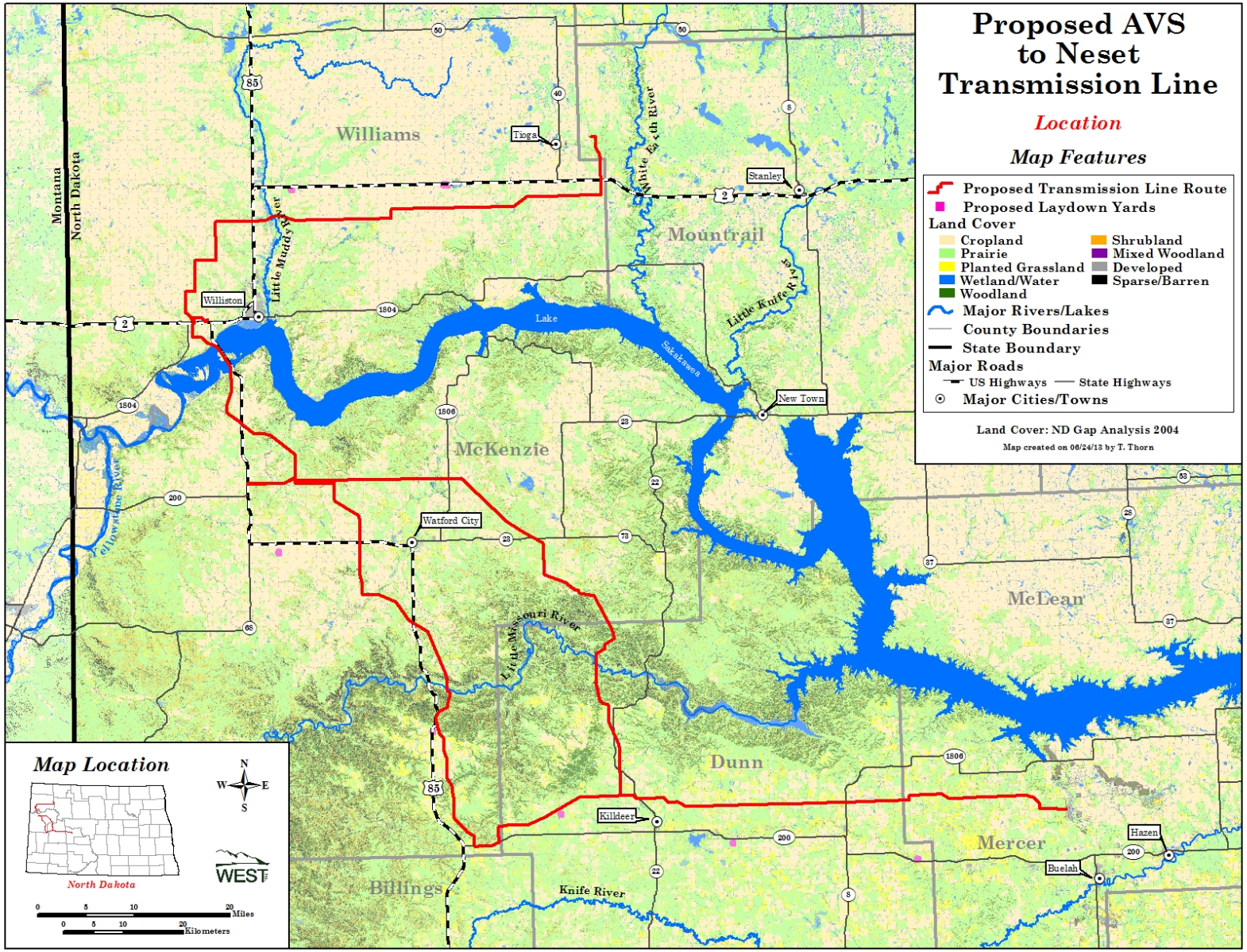

Figure 1. AVS-Neset proposed Project area map.

The proposed Project will require upgrades to Basin Electric's existing facilities at the AVS 345-kV Substation, Charlie Creek 345-kV Substation, Neset 230-kV Substation and Western's Williston 230-kV Substation. These upgrades are all within the existing substations' fence lines. No expansion of physical area is required.

1.1.1 Transmission Line Design

The proposed 345-kV, single-circuit transmission line would be constructed using single-pole or H-frame self-supporting structures within a 150-foot-wide ROW. Double-circuit 345/115-kV lines would be constructed using single-pole, self-supporting structures. The proposed 230-kV, single-circuit transmission line would be constructed using single-pole self-supporting structures within a 100-foot-wide ROW. Several transmission line structure types would be necessary to address the various voltages, terrain, and connector scenarios included as part of different components of the proposed Project. Structures proposed for this proposed Project by Basin Electric are shown in Figures 2-6. A summary of Basin Electric's proposed structure characteristics for each of these structure types is provided in Table 1.

Project construction and design would meet the requirements of the National Electrical Safety Code-Heavy Loading District, RUS design criteria (USDA 2009), and other applicable local or national building codes (Institute of Electrical and Electronics Engineers Standards Association 2012). The Heavy Loading District refers to those areas (including North Dakota) that are subject to severe ice and wind loading. Minimum conductor clearance is measured at the point where conductor sag is in closest proximity to the ground. The proposed transmission line would be constructed with clearances that exceed standards set by the National Electrical Safety Code.

Table 1: AVS-Neset 345-kV Transmission Proposed Project Typical Structure Design Characteristics

Description of Design Component	345-kV (Fig 4.2-1)	230/115-kV (Fig 4.2-2)	345/115-kV (Fig 4.2-3)	230-kV (Fig 4.2-4)	345-kV H-Frame (Fig 4.2-5)
Conductor Size(inches)	1.8	1.345/1.108	1.8/1.108	1.345	1.800
Right-of-way Width (feet)	150	100	150	100	150
Typical minimum and maximum Span Distance between Structures (feet) *	650-1100	700-900	650-1000	650-950	900-1000
Average Span (feet)	950	800	800	800	1000
Minimum and Maximum Structure Height (feet)	100-130	97-127	115-145	70-110	80-100
Average Height of Structures (feet)	115	112	130	95	90
Average Number of Structures per mile	6	6.5	6.5	6.5	5.5
Temporary disturbance per Structure (acre) **	0.0003	0.0002	0.0003	0.0002	0.0004

Description of Design Component	345-kV (Fig 4.2-1)	230/115-kV (Fig 4.2-2)	345/115-kV (Fig 4.2-3)	230-kV (Fig 4.2-4)	345-kV H-Frame (Fig 4.2-5)
Minimum Conductor-to-Ground Clearance to agricultural lands, rural roads and paved highways @ 100 deg C (feet)	30	26	30	26	30
Minimum Conductor-to-Ground Clearance to Railroads @ 100 deg C (feet)	As required by specific Railroad				
Circuit Configuration* **	See Figure	See Figure	See Figure	See Figure	See Figure

* Actual span distance will vary depending on topography.

** Angle and dead-end structures (for longitudinal stability) would be constructed with concrete foundations. Guy wires would not typically be required.

*** Single pole tangent structures would be freestanding on concrete foundations. H-frame tangent structures would likely be directly embedded into the ground.

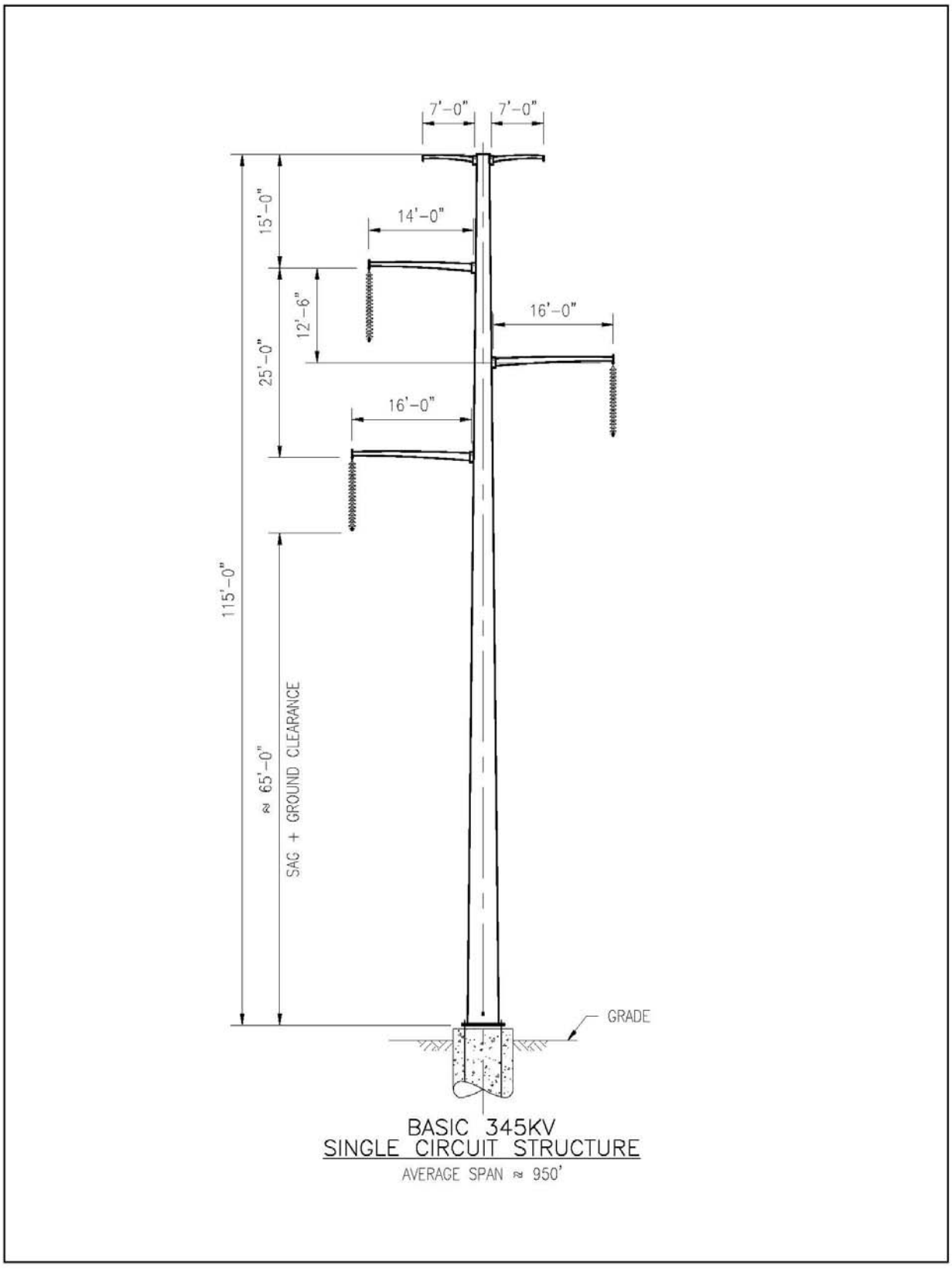

Figure 2. 345-kV Single Circuit Structure

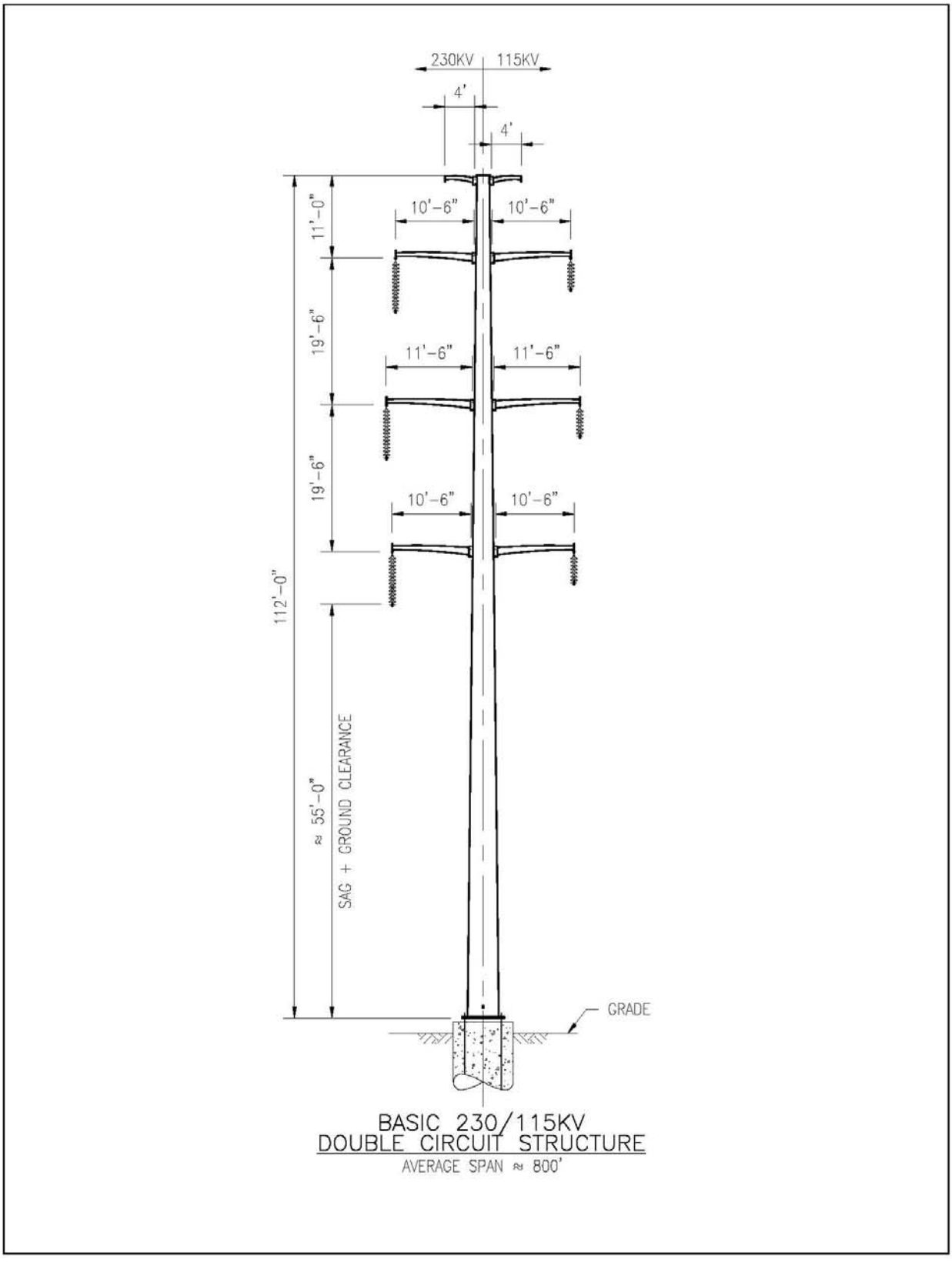

Figure 3. 230/115-kV Double Circuit Structure

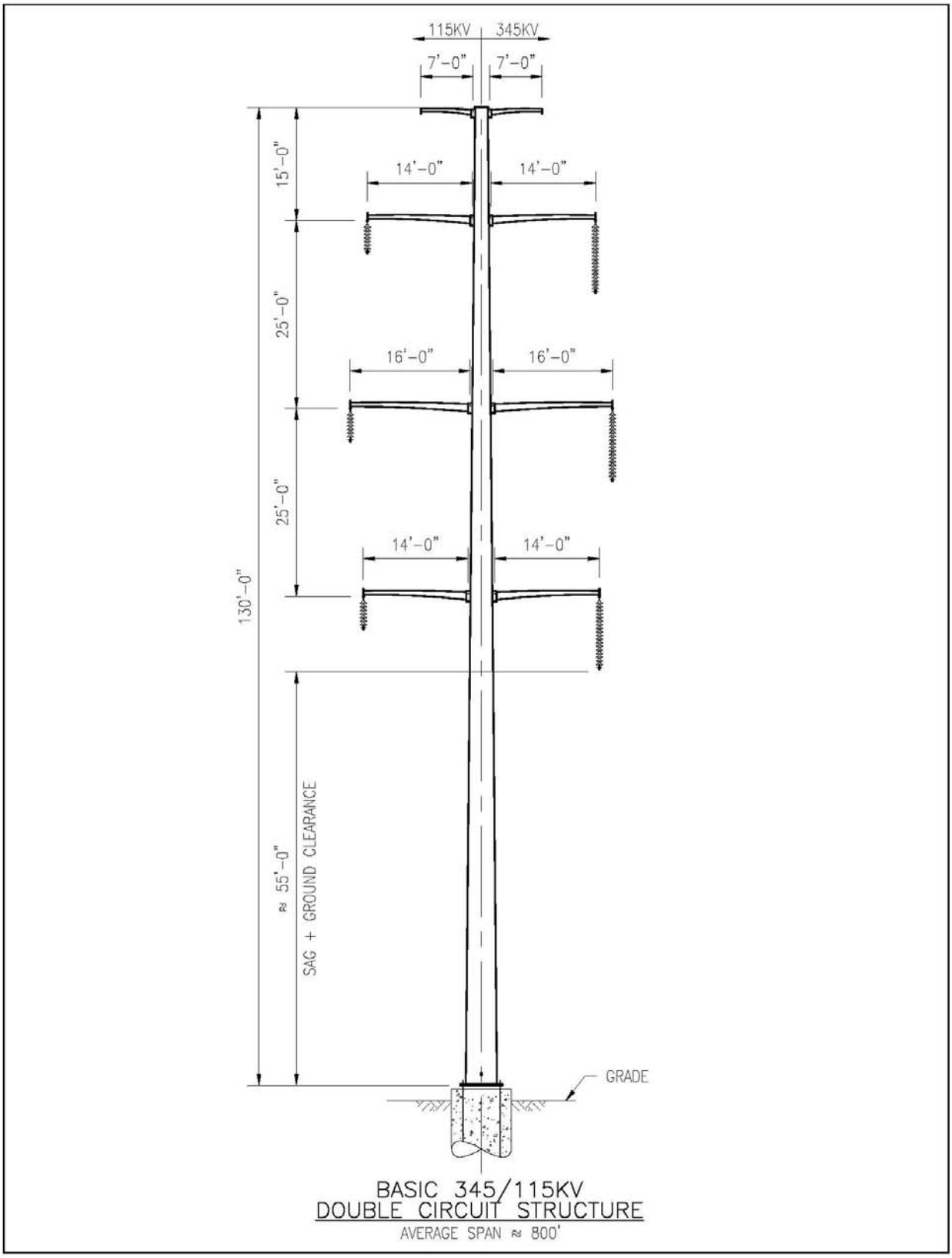

Figure 4. 345/115-kV Double Circuit Structure

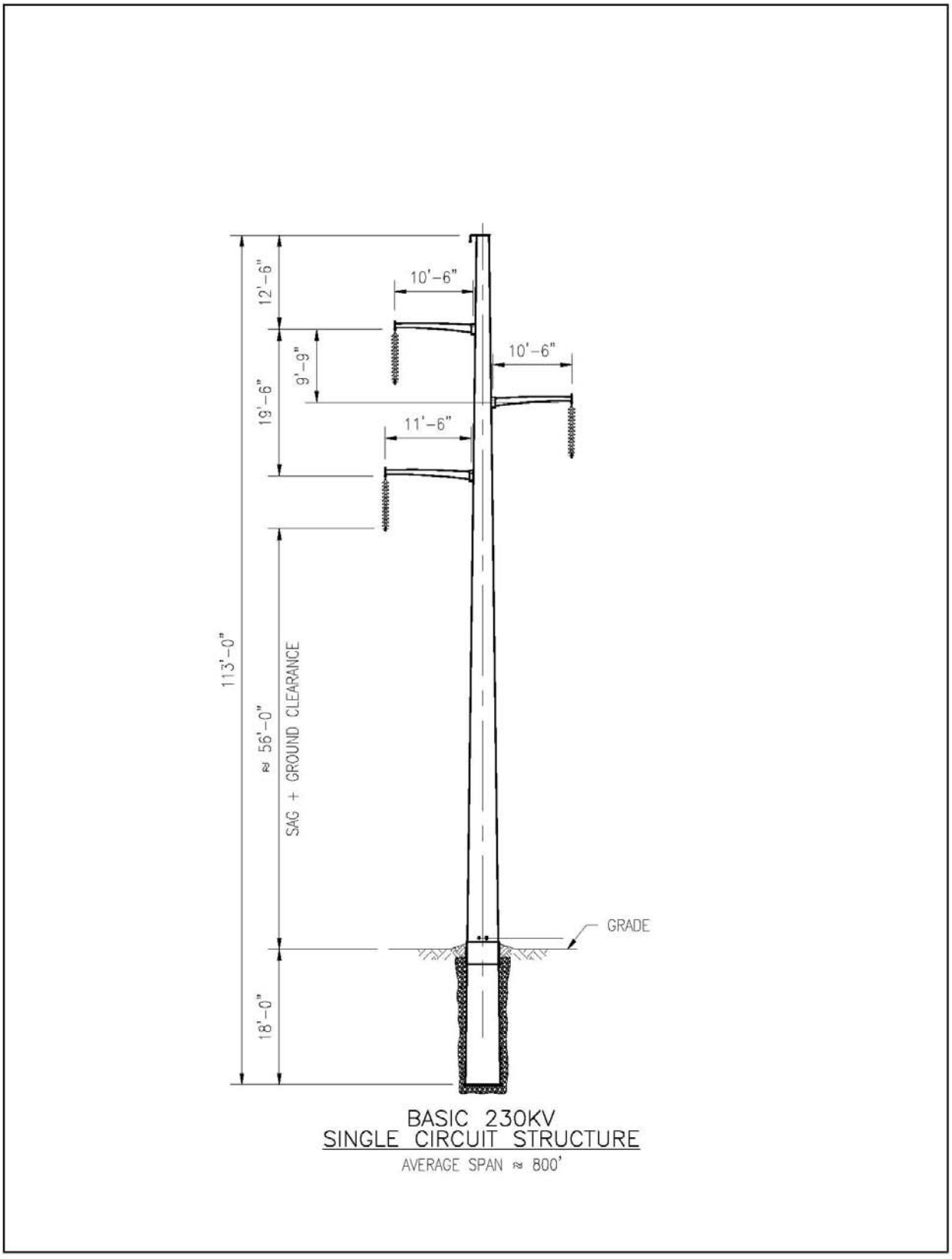

Figure 5. 230-kV Single Circuit Structure

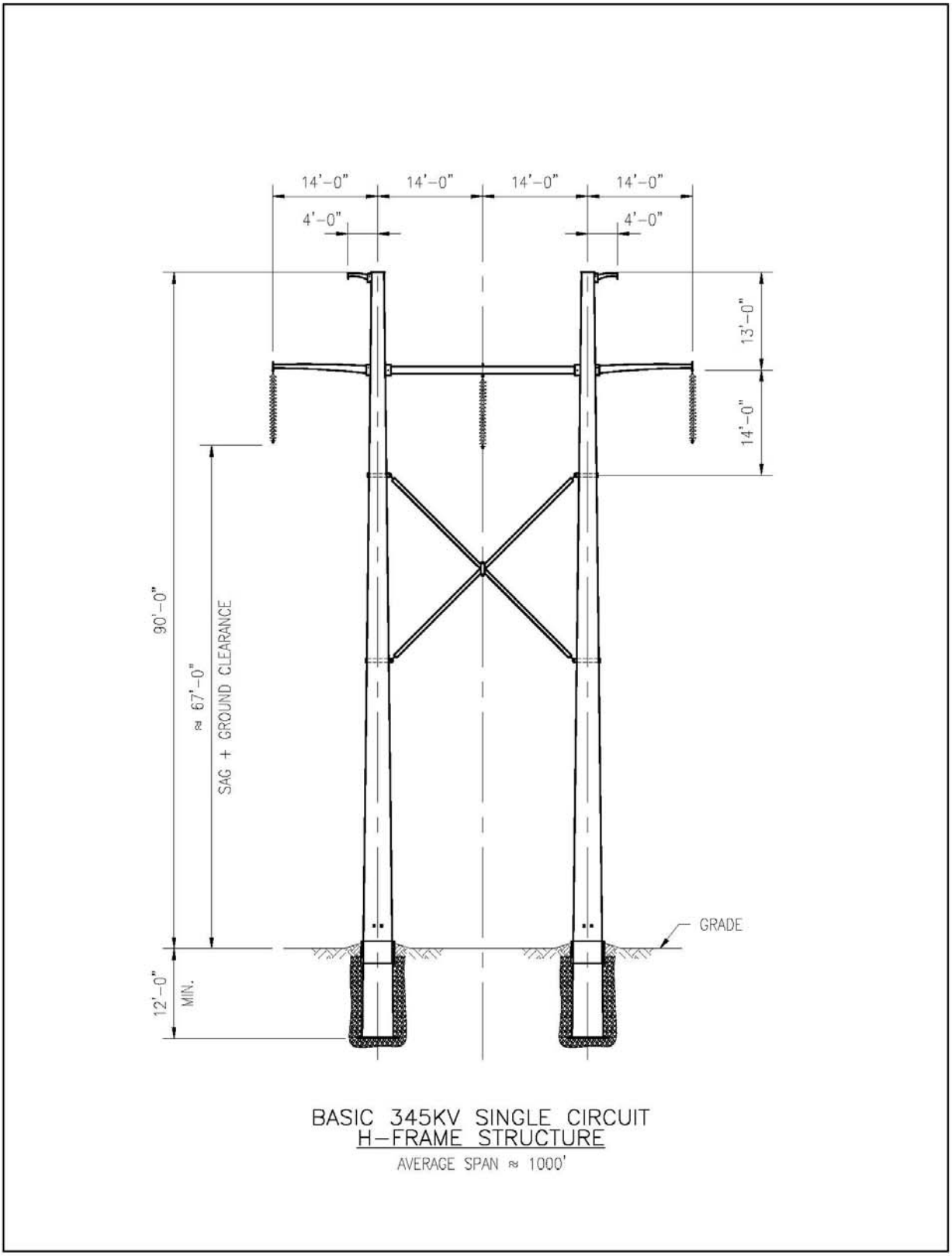

Figure 6. 345-kV Single Circuit H-Frame Structure

Associated Facilities and Proposed Project Components

The proposed overall Project will require the following associated facilities and proposed Project components: Approximately 275 miles of transmission line, including 262 miles of new 345-kV transmission line and 13 miles of new 230-kV line, five new substations, and equipment additions but no expansion to four existing substations. The proposed Project includes the following characteristics:

- 345-kV transmission line connection from AVS Substation to a new 345/115-kV Red Substation near Killdeer;
- 345-kV transmission line connection from the Red Substation to the existing Charlie Creek Substation;
- 345-kV transmission line connection from the Red Substation to the new 345/115-kV White Substation and a 345-kV transmission line connection from the White Substation to the new 345/230/115-kV Blue Substation;
- 345-kV transmission line from the Charlie Creek Substation to the Blue Substation;
- 345-kV transmission line from the Blue Substation to the proposed Judson Substation;
- 230-kV transmission line connection from the Blue Substation to Western's 230-kV transmission line;
- 230/115-kV double-circuit transmission line connection from the proposed Judson 345-kV Substation to Williston 230-kV Substation;
- 345-kV transmission line connection from the proposed Judson 345-kV Substation to the proposed Tande 345-kV Substation, approximately 31 miles of which would be double-circuited with a Mountrail-Williams Electric Cooperative 115-kV line associated with other regional improvement projects; and
- 230-kV transmission line connection from the proposed Tande 345-kV Substation to the Neset 230-kV Substation.

Antelope Valley Station, Charlie Creek, Neset and Western's Williston Substations

The proposed Project will require upgrades to Basin Electric's existing facilities at the Antelope Valley Station 345-kV Substation, Charlie Creek 345-kV Substation, Neset 230-kV Substation and Western's Williston 230-kV Substation. These upgrades are all within the existing Substation's fence line. No expansion of physical area is required. Furthermore no additional power generation capacity will be required for this proposed Project.

Judson, Tande, and Blue 345/230-kV Substations

The proposed Judson and Blue substations would be constructed to interconnect the proposed 345-kV lines to Western's Williston Substation and to Western's 230-kV transmission line along Highway 85 south of the Missouri River, respectively. Basin Electric's Tande Substation would be constructed to interconnect the 345-kV transmission system to the existing 230-kV system at

Basin Electric's Neset 230-kV Substation located near Tioga. The Judson and Tande substations would occupy approximately 12 acres of land. The Blue Substation consists of both 345/230-kV and 345/115-kV equipment, therefore a 25 acre parcel would be required.

Red, White, and Blue 345/115-kV Substations

In order to interconnect the proposed 345-kV lines into the local 115-kV system and serve the load demands of the Williston Load pocket and surrounding area, three new 345/115-kV substations would be constructed along the 345-kV system (Figure 2-1). The Red Substation would be located near Killdeer. The White Substation would be located north of the Red Substation, east of Watford City. The Blue Substation would be located south of the Missouri River. The Red and White substations would occupy approximately 12 acres of land. The Blue Substation site would be approximately 25 acres.

1.1.2 General Construction Techniques

The proposed 345-kV, single-circuit transmission line would be constructed using single-pole or H-frame self-supporting structures within a 150-foot-wide right-of-way. Double-circuit 345/115-kV lines would be constructed using single-pole, self-supporting structures. The proposed 345-kV, single-circuit transmission line would be constructed using single-pole or H-frame self-supporting structures. Detailed construction access considerations and construction techniques are described further in the following sections.

Pre-Construction Activities

Basin Electric and/or its contractors would perform engineering surveys prior to construction of the transmission line. These surveys would consist of centerline location, profile, and access surveys. Pre-construction surveys would likely coincide with other pre-construction activities. Geotechnical studies would be conducted along the transmission line route to determine engineering requirements for structures and foundations. Truck-mounted augers would be transported to selected locations to drill small-diameter boreholes, and borehole cuttings would be analyzed to determine specific soil characteristics. These activities would be conducted after harvest to minimize impacts on agricultural fields. Minimal land disturbance (approximately 400 square feet) would be anticipated for each geotechnical boring site. Additionally, small access trails may be required for some of the boring locations.

Approximately ten temporary construction material and equipment laydown areas would be used for the duration of construction. All laydown areas would be approximately 5 acres in size. Construction laydown areas are typically located at previously disturbed or developed locations such as vacant lots, existing utility yards, or parking lots to avoid or minimize impacts on sensitive resources. Where existing yard locations were not available, preferred locations for yards would be undeveloped areas, such as grazing or cropland that are cleared and flat; have all-weather access; and do not contain streams, wetlands, or other environmentally sensitive resources. Laydown yards consist of flat or gently sloping lands where construction material would be placed on pallets or cribbing. No topsoil would be removed and minimal if any re-

grading is expected to take place at these facilities. Laydown areas will be returned to pre-construction conditions upon completion of the proposed Project.

Vegetation removal within the ROW is anticipated to be minimal throughout a large portion of the proposed Project, especially in rangeland and cropland areas. In more forested portions of the ROW, trees and shrubs would be removed if they would interfere with construction activities or the safe and reliable operation of the transmission line. Vegetation would be removed at ground level to provide access to the ROW. Disposal of trees and shrubs would be consistent with the landowner's wishes and all state waste management regulations. It is expected that the tree and shrub species removed will be replaced at a 2:1 ratio. Final replacement requirements will be dependent on the final regulatory requirements stipulated for the proposed Project through the NDPSC's siting process.

Transmission Structure Site Preparation

Transmission structure site clearing is expected to be minimal over a large portion of the proposed Project, due to much of the right-of-way being located across rangeland, grasslands, or agricultural areas. In these areas, site leveling is expected to be minimal, with simply driving between structure locations and a bore hole made for the structure (see Figure 7 for example of constructed transmission line area one year after construction). In areas of difficult terrain, structure location sites may require more extensive leveling using bulldozers or front-end loaders to ensure the safe operation of equipment. In areas where access is extremely difficult, structure placement will be performed through the use of helicopters. Any blading and leveling would all occur within the boundary of the right-of-way throughout the length of the proposed Project. Soil removed during leveling of structure sites would be stockpiled nearby and replaced following construction. Disturbed ground would be re-graded to as close to pre-construction condition as appropriate for stabilization and re-vegetated or approved for tillage depending on pre-construction land use.

Figure 7. Example photographs showing construction area along transmission line one year after construction.

Structure holes would be drilled by truck-mounted auger or power auger at appropriate locations along the length of the right-of-way. Total land disturbance at each structure location would vary depending on location (i.e. level terrain versus steep, rugged terrain) and structure type. All disturbances related to the boring of structure holes would be confined to the right-of-way. Structures used for the proposed Project would be either directly imbedded into the ground or would be bolted on reinforced poured concrete foundations. Determinations on whether a structure would be directly imbedded into the hole or would require a foundation would be based on available access due to terrain and soil conditions. An estimated 1,161 structures would be used for the proposed Project, with an average of approximately six structures per mile.

Structure Assembly and Erection

Structure components such as pole segments, davit arms, hardware, and insulators would be brought to the structure site via truck and assembled on-site. Davit arms, insulators, and other components would be attached to the structure while on the ground. The bottom section of the structure would be placed into the boreholes and backfilled or bolted onto reinforced foundations using cranes or large boom trucks. In areas of very rough terrain that have limited accessibility or are even inaccessible, such as those areas around the Little Missouri River or Missouri River badlands, some aerial placement of structures by helicopter may be required. The upper sections of the structure would then be slipped over the lower section. Structure setting activities would be done within the boundaries of the right-of-way. Conductor pulling may require some work outside of the permanent right-of-way but within the area of the construction easement.

Stringing and Tensioning of Conductors

Following structure construction, crews would install the conductor wires, overhead groundwire (OHGW) and an optical groundwire (OPGW) using conductor stringing sheave blocks and line pulling and tensioning equipment. The conductor, OHGW and OPGW are kept under tension during the stringing process to keep the conductor clear of energized circuits, the ground, and obstacles that could damage the conductor, OHGW and OPGW surfaces.

Pulling and tensioning sites are typically located at 8,000 to 9,000-foot intervals and at angle point structures. Sites along tangent structures are located within the construction right-of-way; those at angle points typically are located partially outside of the normal right-of-way. Stringing equipment generally consists of wire pullers, tensioners, conductor OHGW and OPGW reels, and sheave blocks. After the conductors, OHGW and OPGW are pulled for a section of line, they are tightened or sagged to the required design tension in compliance with the National Electrical Safety Code (NESC; IEEE 2012). The process would be repeated until the OPGW and conductors are pulled through all sheaves. Conductor stringing also would require access to each structure for securing the conductor to the insulators, OHGW or OPGW to each structure, once final line sag is established.

For public safety and property protection, temporary wooden guard structures would be used to provide temporary support when stringing conductors, OHGW and OPGW across existing

power lines, roads, highways, railroads, and other linear obstacles. The structures would be removed when stringing is complete; the guard structure holes would be backfilled and the sites would be reclaimed. All temporary wooden guard structures would be installed within the transmission line right-of-way. Pipelines crossing will be identified on construction plans and may be visibly marked in the field. Matting will be installed across pipeline rights-of-way as necessary to allow equipment to safely cross these areas. Following construction, matting will be removed and the area restored.

Structure Site Access and Traffic

Construction crews would gain access to the ROW from public roads and section line trails, as well as within the transmission ROW itself in areas with no public access. Access for line construction would be by truck within the ROW. Structures located along section lines would be accessed from section line roads and trails where possible. The exception would be on the lands of the Little Missouri National Grassland (LMNG), managed by the USFS, where permission would need to be obtained from USFS to access any trails or roads that exist along section lines. For most existing access roads and trails, no additional widening, surfacing, or improvements, including culverts would be necessary. New surface access roads are not anticipated for a majority of the line; however, they may be required in certain areas with no access. Access in areas with steep or rugged terrain, particularly near the Little Missouri River and associated tributaries would likely be gained using helicopters and would not require additional new roads. Existing roads and trails used for construction access would be rehabilitated after construction to comparable or better conditions than they were prior to construction activities. New roads would be restored to the natural condition of the surrounding area. Gates installed to facilitate access and to keep livestock from roaming on-site during the construction process would be left in place, with landowner concurrence, following construction of the line. Fences and gates removed during the construction process would be replaced or rebuilt following completion of construction. Temporary overland access would be used in areas not accessible by local roadways or section line trails with the exception of the LMNG.

Temporary overland access routes would result in temporary disturbance and compaction of soil and vegetation. Vegetation along these routes would recover quickly, as no grading would be required (Figure 7).

Substation Construction Procedures

Construction procedures for the Judson and Tande 345-kV Substations would be essentially the same, except for the specific equipment installed. Each site would be approximately 12 acres, although additional area around the substation would be acquired for buffer with adjacent lands and to provide space for transmission line connections. Following survey and staking of the site, erosion control best management practices (BMPs) would be installed. Site access would be prepared, including installation of culverts in adjacent road drainage to install a gravel driveway. No clearing of forested areas is required for any of the substation locations. The site would be graded and fenced. Concrete pads and footing for equipment would be installed. Aggregate would be spread throughout the fenced area. Equipment would be delivered to the site and generally stored inside the fenced area, although some materials may need to be

stored on the property outside the fence due to size or safety considerations. Equipment such as circuit breakers, bus work, capacitors, and dead-ends would be assembled and installed. Transformers would be delivered to the site and installed. Substation control house and supervisory control and data acquisition equipment would be installed. Upon completion of construction activities, disturbed areas outside the fence would be restored and erosion control measures removed.

Procedures for Minimizing Environmental Impact during Construction

Numerous BMPs and mitigation measures have been incorporated into the development and construction of the proposed Project to protect environmental and human resources. These measures are varied and may be intended to address specific resource concerns, be more general in nature, or address multiple areas of concern for different resources. Minimizing measures range from avoiding sensitive resources during route development to conditions for restoring the proposed Project ROW following construction. BMPs that would be implemented as part of the proposed Project are discussed in detail within the proposed Project EIS.

Waste Management

Waste materials resulting from proposed Project construction would be removed from the sites and disposed of in appropriate landfills. Sanitary waste would be removed from the site and disposed of according to local sanitary waste ordinances. Hazardous waste such as oil, gasoline, solvents, paint, and cleaning chemicals would be stored and disposed of in accordance with local, state, and Federal regulations.

Reclamation

Following construction, disturbed areas would be graded and/or leveled to their approximate preconstruction condition to minimize erosion. Compacted agricultural soils would be disced or plowed to loosen the soil. Disturbed areas include temporary overland access trails, staging areas, the transmission ROW, and any other areas disturbed by proposed Project construction activities. Reclamation activities include the removal of all temporary facilities and construction debris, completion and removal of proper erosion control measures, and re-seeding of disturbed ground. Grassland areas would be re-seeded with native species based on county NRCS and USFS recommendations.

1.2 Consultation History

As part of the scoping and overall process, the USFWS provided a species list for the overall Proposed Project area on November 23, 2011. The list indicated that the proposed Project area lies within a region of North Dakota containing habitat and/or potential for occurrence for the following species candidate, threatened, or endangered species and designated critical habitat:

- Interior least tern (*Sternula antillarum*)
- Piping plover (*Charadrius melodus*)
- Piping plover critical habitat
- Whooping crane (*Grus americana*)

- Pallid sturgeon (*Scaphirhynchus albus*)
- Black-footed ferret (*Mustela nigripes*)
- Gray wolf (*Canis lupus*)
- Sprague's pipit (*Anthus spragueii*)
- Dakota skipper (*Hesperia dacotae*)

In addition to the identification of the species that may occur within proximity to the proposed Project, the USFWS noted that the proposed Project crosses designated piping plover critical habitat at the Missouri River.

The rufa subspecies of the red knot (*Calidris canutus rufa*) was proposed for listing as threatened by the USFWS on September 30, 2013. ("Red knot" is used interchangeably for this subspecies throughout the rest of this document). On October 2, 2013 the USFWS proposed listing the northern long-eared bat (*Myotis septentrionalis*) as endangered. These two species are included in this biological assessment as though they were fully listed, as per Western's standard streamlining practice of treating proposed species as fully listed prior to the final determination.

Beside the written correspondence from the USFWS on November 23, 2011, the USFWS also participated in Western and RUS led agency scoping meetings on November 14, 2011. Western also held five in person meetings specifically with the USFWS; one on July 11, 2012 at Western's office in Bismarck, North Dakota, two at the USFWS office in Bismarck, North Dakota on November 19, 2012 and April 18, 2013, and two at the Basin Electric office in Bismarck, North Dakota on August 27, 2013 and December 11, 2013. In addition, the USFWS provided informal comments on preliminary draft Biological Assessments to Western on September 20, 2013 and January 2, 2014.

1.3 Conservation Measures

To avoid and minimize direct and indirect effects, the following conservation measures will be implemented by Basin as part of the proposed Project:

- Design the proposed Project to meet the recommendations for the protection of avian species from electrocution according to the guidelines in the Avian Power Line Interaction Committee's (APLIC) "Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006" (APLIC 2006).
- Design the proposed Project to meet the recommendations for the protection of avian species from collision with overhead lines according to the guidelines in the APLIC's "Reducing Avian Collisions with Power Lines: The State of the Art in 2012" (APLIC 2012).
- Avoid construction within the overall boundary of designated piping plover critical habitat at the Missouri River crossing during the piping plover nesting season (April 1-August 31) and in interior least tern nesting habitat during the nesting season (April 1-August 31).

- Avoid construction within primary constituent elements (i.e., water interface, barren sand beaches and islands, shallow pools on sandbars) for piping plovers at the Missouri River crossing.
- Avoid placing any structures within the flowing waters of the Missouri River to avoid impacts to pallid sturgeon and pallid sturgeon habitat.
- Avoid refueling vehicles within 100 feet of waterway's edge to minimize the potential for hazardous-materials spills reaching a waterway.
- Grading and/or leveling areas to approximate preconstruction conditions to minimize erosion runoff.
- Adherence to USACE permits pursuant to CWA Section 404, including use of BMPs, will minimize potential erosion into waterways.
- Mark the shield wire(s) of the transmission line with bird flight diverts (see description of plan in 1.4 Line Marking Plan below) as applicable.
- Basin Electric will provide the USFWS with a written confirmation that the shield wire(s) were marked and the location of markers.
- Conduct ground disturbing and tree removal in the fall and winter outside of the nesting season. If the ROW is not prepared and construction implemented during the non-nesting season and construction occurs during the breeding season, a qualified biologist would conduct surveys for active nesting birds prior to construction and provide the appropriate construction buffer, which has been 30 feet radius around nests for other transmission line projects in North Dakota (e.g., Basin Electric's Williston-Tioga Project).
- Replanting of disturbed areas with native species will be done expeditiously during the correct planting seasons for the species of interest.
- To avoid direct impact to Sprague's pipit during construction, proposed construction activities within grasslands greater than 72 ac will be limited outside of the April 15-August 1 time period. If construction is not limited to this time period, surveys will be done ahead of construction to determine occupancy of the action area within grasslands greater than 72 ac. If the action area contains Sprague's pipit occurrence, no proposed construction will occur within 958 ft of the occupied parcel except if the proposed construction is on the opposite side of a current disturbance (e.g., road).

The proposed Project Environmental Impact Statement (EIS) describes in more detail other BMPs that would be implemented to minimize general environmental impacts during construction, but they also would help avoid and minimize impacts on federally-listed species.

1.4 Line Marking Plan

The USFWS recommended in their November 23, 2011 technical services comment letter to the Rural Utilities Service that:

"Conservation measures to avoid or reduce potential impacts to whooping cranes include, but are not limited to:

- Burying the new electrical transmission line.

- If burying the new line is not feasible, install and maintain visual marking device on the new transmission line in the 95 percent whooping crane migration corridor within 1 mile of suitable whooping crane stopover habitat and an equal length of existing transmission/distribution line within 1 mile of suitable whooping crane stopover habitat in the whooping crane migration corridor (preferably in the 75 percent migration corridor, but at a minimum within the 95 percent migration corridor)"

The comment letter noted that if the recommendations are followed that there would be justification in making a "not likely to adversely affect" determination for the whooping crane. Further discussion on the determination regarding whooping cranes is found in Section 3.4.

Although the USFWS Region 6 Guidance on power line marking to minimizing impacts to whooping cranes address a general definition of potentially suitable whooping crane migratory stop over habitat, actual identification and quantification of this has been problematic. As of this time there is not a clear definition of "suitable whooping crane migration stopover habitat". Based on GIS analysis, use of a Resource Selection Function (RSF) analysis, and rationale provided in Appendix B, Western proposes an alternative marking plan that deviates from the Region 6 guidance. This plan includes marking the shield wire(s) of the transmission line with bird flight diverters throughout the entire length of the proposed Project corridor, except for sections of the transmission line where it crosses through steep, rugged terrain in the badlands region north and south of the Little Missouri River crossing (Figure 8) that were determined to not be suitable habitat for whooping cranes for the reasons outlined below. The criteria for determining the areas where there was not suitable habitat for the purpose of line marking under this plan was based on the following:

- Areas of the proposed Project that do not have cropland within 0.25 mile and/or
- Areas of the proposed Project in which wetlands are located within steep sided ravine

In other words, if an area of the proposed Project crosses through a landscape in which the wetlands are limited to within steep ravines and there is not cropland nearby, it was determined to not be in suitable whooping crane habitat. All other areas of the proposed Project were assumed to be within suitable whooping crane habitat as there were palustrine wetlands or riverine wetlands or there was potential foraging areas (i.e., cropland) nearby.

Nine segments met the bulleted criteria such that there would not be any diverters installed along approximately 21.6 miles of the proposed Project (Figure 8). The areas not planned for line marking were reviewed in relation to a RSF analysis conducted related to probability of whooping crane use along the proposed Project route (Appendix A); the areas not to be marked were also in the lower categories of potential use. For example, while the strict GIS analysis indicated approximately 21.6 miles of line the badlands was not suitable habitat, the RSF indicates that approximately 28 miles of the proposed Project is within the lowest predicted probability of use category and correlation between the areas identified is high. A review of

other wetland areas outside of those in steep ravines in the badlands area was not completed as part of the GIS exercise or the RSF analysis.

To summarize, the line marking plan will result in marking 253.4 miles of the new transmission line and will not mark 21.6 miles of the new transmission through the badlands region. The marking plan does not include marking of any existing transmission or distribution lines. This marking plan recognizes the changing nature of many of the wetland areas crossed such that in some years sections that are marked would essentially not be within one mile of suitable whooping crane roosting habitat but in other years would be near suitable habitat. As such, the marking plan likely "over marks" what would be required for any one year. Further details can be found in Section 3.4 Whooping Cranes and Appendix B.

APLIC (2012) compared the literature regarding the effectiveness of various line marking devices, with three general types: aerial marker spheres, spirals, and suspended devices. It was determined that because there are few comparative studies, no single device is considered to be the best performing, and factors such as maintenance, ice loading, installation, and costs all need to be considered along with effectiveness in reducing bird strikes. Basin Electric plans to utilize PREFORMED Line Products' spiral yellow bird-flight diverters (Model: BFD-MS-3341 and BFD-MS-3164 or equivalent), or equivalent.

PREFORMED Line Products' spiral yellow bird-flight diverters would be installed along both shield wires. APLIC (2012) indicates that marking the center 60% of the spans is effective in reducing strikes as birds apparently see the towers/poles when closer. The visual marking devices will be spaced 50 feet apart, starting 150 feet away from each structure such that the area representing more than 60% of the center span will be marked (Figure 9). The visual marking devices would be spaced 100 feet apart, but markers would be staggered with each other to give the appearance, looking from the side, that they are 50 feet apart and to make the shield wires more visible in a horizontal plane. Line marking will be done throughout the proposed Project except for the 21.6 miles identified above in response to minimizing potential impacts to whooping cranes. Based on the current route alignment, this will result in marking of approximately 254.4 miles of the proposed Project. This line marking strategy is consistent with the guidance found in the APLIC recommendation on averting bird strikes (APLIC 2012). The proposed Project does not include marking an equal length of existing transmission/distribution line within 1 mile of suitable whooping crane stopover habitat in the whooping crane migration corridor. The existing lines are part of the current environmental baseline of the whooping crane migration corridor. Additional discussion regarding the baseline condition and the risk to migrating cranes is presented in Appendix B.

Basin Electric will provide the USFWS North Dakota Ecological Services with written confirmation that the shield wires of the transmission lines were marked.

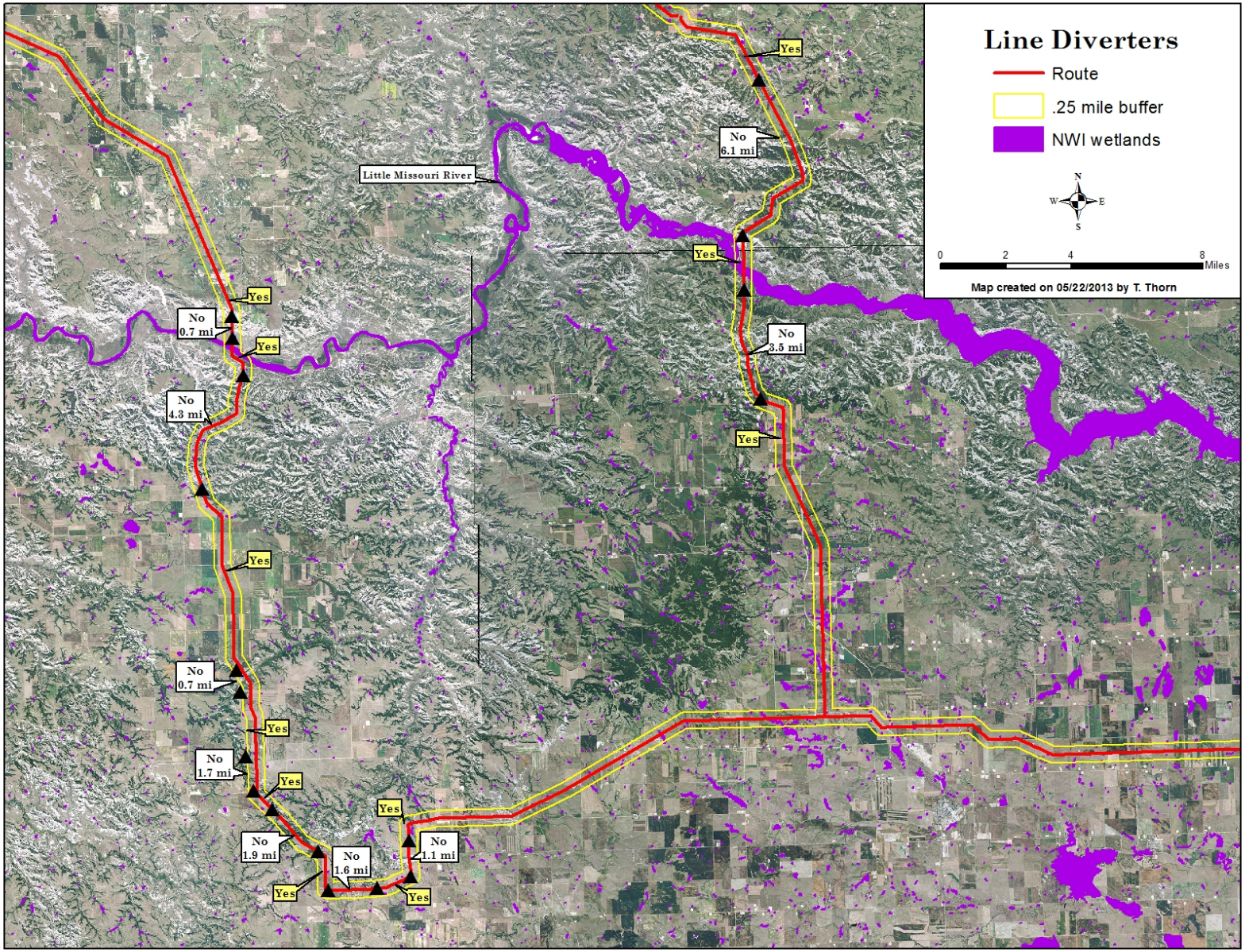

Figure 8. Areas where line marking for whooping cranes will not occur based on analysis of suitable habitat.

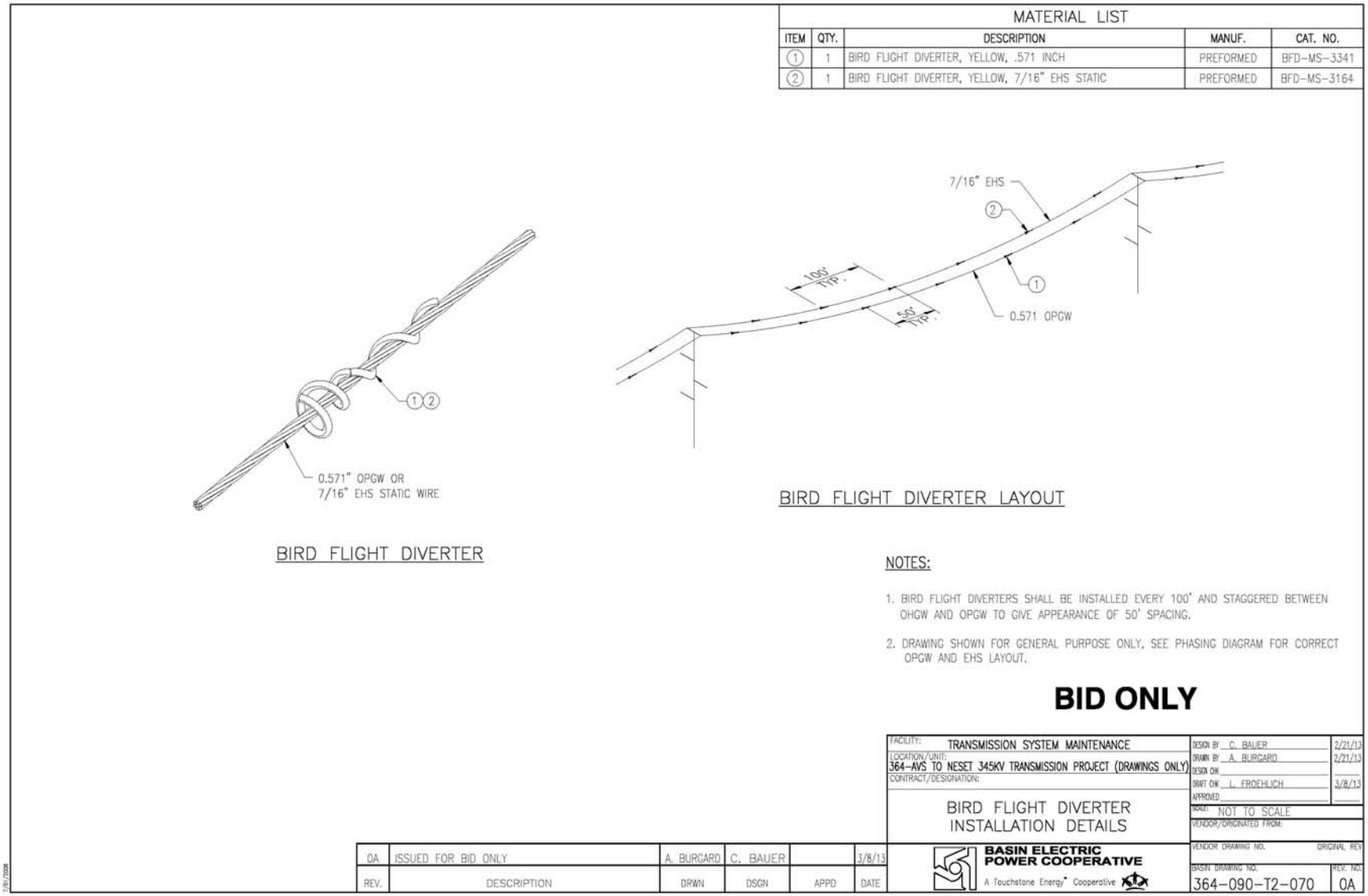

Figure 9. Example schematic of line marking for the proposed Project.

2.0 Action Area

The action area includes the area within the proposed Project that may directly and/or indirectly affect the federally listed species discussed in this BA. The action area varies by species. For most species the action area includes the proposed Project right-of-way (ROW) to be potentially impacted by construction but for other species it can and does include an area away from the ROW where species could be impacted.

The proposed Project and action area extends across four physiographic ecoregions: Missouri Plateau, Little Missouri Badlands, River Breaks, and Glaciated Dark Brown Prairie (Bryce et al. 1998). Physiographic regions generally characterize areas by their topography and geologic features. The Glaciated Dark Brown Prairie ecoregion is confined to the north of the Missouri River/Lake Sakakawea. The River Breaks ecoregion encompasses the area immediately adjacent to the Missouri River/ Lake Sakakawea and its tributaries. The Missouri Plateau and Little Missouri Badlands ecoregions occur south of the Missouri River/Lake Sakakawea (see Geology and Landforms section for further discussion of these ecoregions).

The area contains a variety of biological resources within diverse landscapes consisting of rolling prairies, badland areas, cultivated farmlands, and riparian areas. These landscapes contain diverse vegetative communities that serve as habitat to many species of wildlife. Riparian areas and wetlands within the proposed Project area also provide habitat for plant and animal species dependent on these areas.

3.0 Species Accounts, Effects, and Determinations

Federally endangered, threatened, proposed, and candidate species that the USFWS has indicated may occur in the action area are discussed below.

3.1 Interior Least Tern (*Sternula antillarum*)

Current Status: The interior population (those migrating through and breeding in the middle part of the United States [US]) of least terns was listed as endangered on June 27, 1985 (USFWS 1990). Census data at that time (1990) for the interior population was approximately 5,000 (USFWS 1990). Almost 17,600 adult least terns were recorded during a 2005 range wide census of the interior least tern population (Lott 2006). The majority (11,281) were observed on the lower Mississippi River while 2,044 were recorded on the Missouri River (Lott 2006). The USFWS states that approximately 100 pairs breed in North Dakota (USFWS 2013b), with 34 nests in the Missouri River between Ft. Peck and Lake Sakakawea (Lott and Wiley 2012).

Habitat: Nesting least terns mainly utilize sandbars within the free flowing sections of the Missouri and Yellowstone Rivers in North Dakota and to a lesser extent islands and shorelines of both Missouri River reservoirs (Lake Sakakawea and Lake Oahe) in the state (USFWS 1990, 2013b). Nests are on the ground with a sand or small rocky substrate and devoid of vegetation

(USFWS 1990, 2013b). Breeding least terns will utilize the river and wetlands adjacent to the nest to forage (USFWS 2013b). Prey for least terns is largely comprised of small fish.

Life History: Interior least terns begin arriving at nesting sites as early as late April with peak nesting occurring from mid-June to mid-July (USFWS 1990, 2013b). Least terns are colonial to semi-colonial nesters with their nests being shallow depressions in sandy/pebbly substrate. Clutch size is normally two to three with incubation lasting 20 to 25 days and shared by both sexes. Chicks fledge in about three weeks (USFWS 1990). The interior population of least terns winter along the US Gulf of Mexico and the coasts of Central and northern South America (TWPD 2012). The typical life span of a least tern is one to five years (USFWS 1990).

Action Area: The action area for the interior least tern is the proposed transmission line right-of -way (150 ft), laydown areas, and associated facilities as well as a 0.5 mile buffer around these areas. This proposed Project will cross an area that could contain nesting habitat and foraging habitat for interior least terns on the Missouri River/upper reaches of Lake Sakakawea west of Williston.

3.1.1 Direct Effects

Although unlikely, direct impacts to least terns could be in the form of collision with the overhead lines or by birds, nests, or young being run over by maintenance activities during operation of the proposed Project if maintenance activities are expanded outside of the original construction area which is outside of suitable habitat. No work is planned to occur directly within the Missouri River or other wetland areas and therefore no direct affects would occur during construction.

As the action area does include a crossing of the Missouri River that historically has had nesting least terns, it is possible that least terns could again nest in this region. However, nesting has not occurred within 5 miles of the US Highway 85 bridge since 1994 (Figure 10, M. Delvaux, USACOE, pers. comm., 2013). In addition, it is not known how least terns migrate – either along large rivers or overland – and a collision could occur during migration from birds not nesting within or near the action area. The proposed Project will cross the Missouri River parallel to an existing transmission line and the US Highway 85 bridge, an area largely impacted already. If least terns again nest in this region or fly through the area during migration, the risk of collision will be reduced by installation of visual line marking devices on the static wires of the new transmission line as described in Section 1.4.

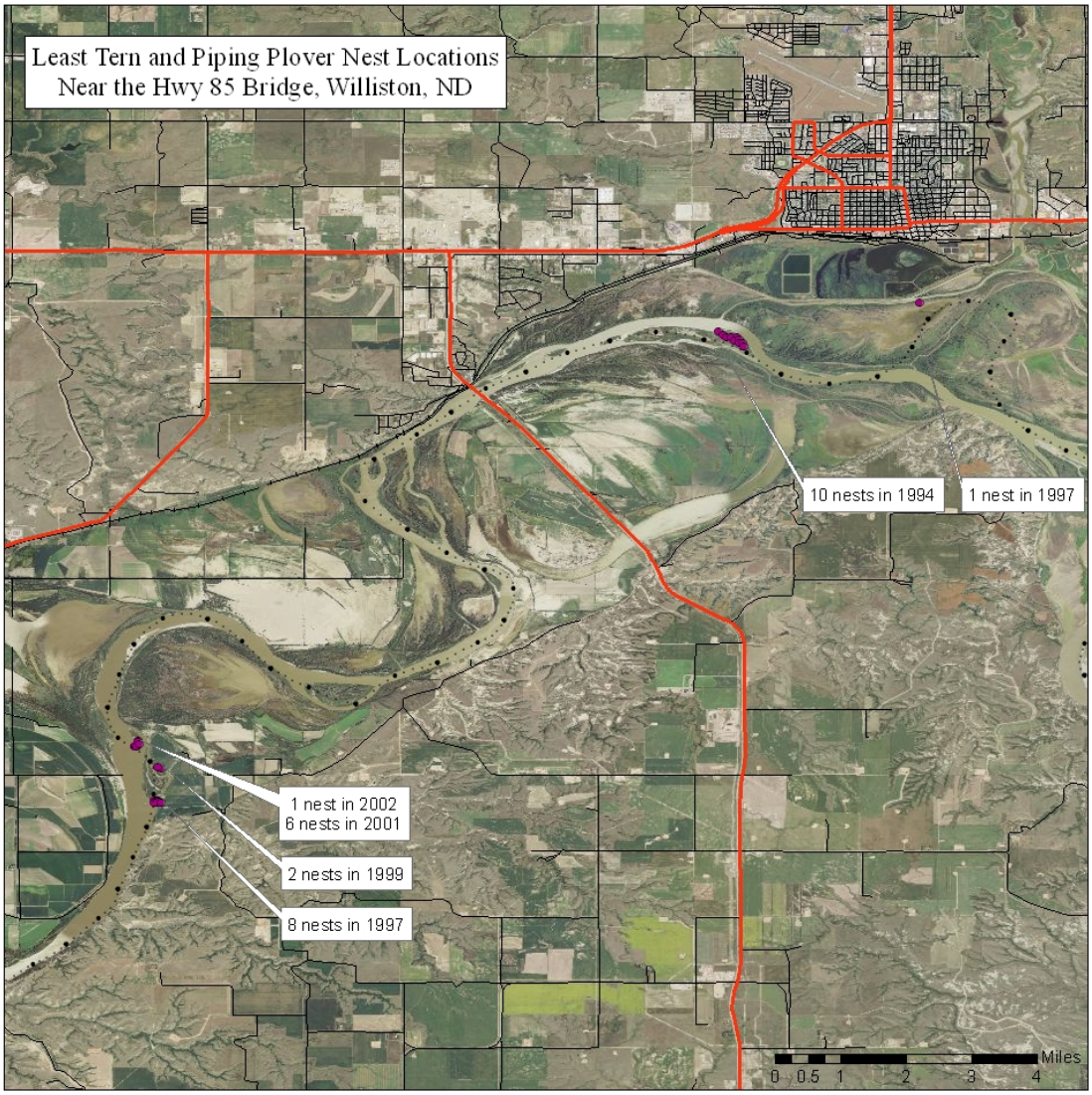

Figure 10. Recent nesting activity for least terns and piping plover near the Project action area. Figure provided by the USACOE, 2013.

3.1.2 Indirect Effects

Indirect effects to least terns could occur if least terns are nesting within the action area during construction such that they are disturbed. Construction will occur either outside of the nesting period (April 1-August 31) or a qualified biologist will search for nesting least terns within potential nesting habitat prior to construction activities within the action area at the Missouri River crossing. If the area is occupied by least terns, no construction would occur within 0.5

mile of the nesting area until all adults and young have departed. No indirect effects are anticipated to the least tern.

3.1.3 Cumulative Effects

Potential cumulative effects to least terns from the proposed Project are those impacts that may add to current impacts on the species. The proposed Project crosses the Missouri River, the only suitable habitat for the species along the route, just upstream of the US Highway 85 bridge crossing and an existing transmission line crossing. The bridge as currently built can act as a dam and pool water behind it during high flows. In addition, the bridge funnels water through one set opening that prevents the river from naturally migrating and forming sandbars and side channels. Regular car and truck traffic over the bridge contribute to the current ambient noise levels and other human impacts. The proposed Project will have line marking done (see Section 1.4) at the river crossing, minimizing any further potential for collision risk to the species compared to what is already in place from the existing line crossing. The proposed Project area does not currently have any potential nesting structure (i.e., bare sand islands) near it and the closest nesting recently was in 1994, approximately 5 miles downstream. The proposed Project will not result in further impacts to the channel configuration and flow nor noise levels or other human impacts to the species. No significant cumulative effects are anticipated to the least tern.

3.1.4 Determination

Based on the preceding discussion, it is determined that with implementation of the visible line marking and construction outside of suitable habitat the proposed Project **may affect, but is not likely to adversely affect** the interior least tern.

3.2 Piping Plover (*Charadrius melodus)*

Current Status: The US Northern Great Plains population (Montana, North Dakota, South Dakota, Minnesota, Iowa, and Nebraska) of piping plovers was listed as threatened on December 11, 1985 (USFWS 2012b). The US portion of this population was estimated at 682 pairs in 1987 with about one half of those breeding in North Dakota (USFWS 1988b). In 2006, this same area had a population estimate of 1,213 pairs and again, a little over half (646 pairs) where recorded in North Dakota (Elliott-Smith et al. 2009).

On September 11, 2002, the USFWS designated critical habitat for the breeding portion of the Northern Great Plains piping plover population (50 Code of Federal Regulations [CFR] Part 17; 2002). There are 11 different critical habitat units designated in North Dakota (USFWS 2013a).

Habitat: In North Dakota, piping plovers utilize barren shores of inland alkali lakes as well as barren sand bars and shorelines of the Missouri River and its' associated reservoirs (USFWS 2012b, 2013a). Approximately 75% of the breeding population utilizes inland lakes while the

remaining population nests in and along the Missouri River system (USFWS 2012b, 2013a). Feeding areas are usually within the wetland or along the shore or sandbar the nest is located on (USFWS 1988b).

Life History: Piping plovers begin arriving in North Dakota in mid-April with egg laying starting in mid-May. Nests are on the ground in sandy and/or small rock substrate of non to slightly vegetated shorelines/sandbars. Nest bowls often contain small pebble or shell fragments. Clutch size is usually four eggs with incubation lasting approximately 28 days and shared by both sexes. Chicks fledge in approximately 21 days. Most piping plovers have left North Dakota by the end of August. Piping plovers breeding on the Northern Great Plains may winter along the Gulf of Mexico coast in the US and Mexico, the southern Atlantic coast of the US, or shorelines of some Caribbean islands (USFWS 1988b).

Action Area: The action area for the piping plover is a one half mile corridor on either side of the proposed transmission line, one half mile radius circle around the lay down areas, and associated facilities.

3.2.1 Direct Effects

No work is planned to occur directly within the Missouri River, primary constituent elements of habitat for piping plovers at the river crossing, or other wetland areas and therefore no direct affects to the species would occur during construction.

No piping plovers have been documented nesting in the proposed Project action area. The closest nesting was approximately 4 miles downstream of the US Highway 85 bridge in 1994 (Figure 10). The most recent nesting in an expanded area was approximately 8 linear miles (22 river miles) upstream in 2002 (M. Delvaux, USACOE, pers. comm., 2013). Although unlikely, due to the lack of suitable habitat along the proposed Project route and lack of bare sand nesting areas, a direct impact to piping plovers could occur in the event of a collision with the transmission line.

It is possible that piping plovers could traverse the action area during local movements for foraging as plovers can travel considerable distance along rivers for foraging flights; however, most piping plover flights from nesting areas to foraging areas are relatively short (Sherfy et al. 2012). In addition, in a study to look at local and long distance shorebird movements using NEXRAD radar, Melcher et al. (2006) found that most shorebirds making flights between foraging sites and roosting sites fly remarkable close to the ground, often barely skimming over the surface.

Beside potential for collision during local foraging flights, piping plovers could fly through the action area during migration. It is not known how piping plovers migrate – either along large rivers or overland – and a collision could occur during migration from birds not nesting within or near the action area. The risk of collision, either during local foraging flights or migration, will be

reduced by installation of visual line marking devices on the static wires of the proposed new transmission line as described in Section 1.4.

3.2.2 Indirect Effects

Indirect effects to piping plovers could occur if plovers are nesting within close proximity of the action area during construction such that they are disturbed. Construction will occur either outside of the nesting period (April 1-August 31) or a qualified biologist will search for nesting piping plover within suitable nesting habitat prior to construction activities within the action area at the Missouri River crossing or at basins greater than 3 ha within the action area. Litch (2001) stated that the size of natural wetlands used by piping plovers in North Dakota ranged from three to 2,576 hectares (ha). There are over 1,270 wetland basins within the half mile action area either side of the proposed transmission line transects. Of these, 41 are approximately three hectares (ha) or greater. Several of these 41 basins are associated with riverine systems (Missouri River, Little Missouri River, Little Muddy River, and Gumbo Creek; Figure 11). There is one wetland basin within a half mile of a proposed lay down area on the southwest edge of Ray, North Dakota, which is three ha or greater. Non-riverine wetland areas, in addition to the Missouri River and Little Missouri River, would be surveyed prior to construction, if construction is to occur from April 1-August 31 in these areas, to confirm if these locations are occupied or not by piping plovers. Surveys would include a minimum of two visits by a qualified biologist during non-windy mornings to determine occupancy. If the areas are occupied by piping plovers, no construction would occur within 0.5 mile of the nesting area until all adults and young have departed. No indirect effects are anticipated to the piping plover.

3.2.3 Cumulative Effects

Potential cumulative effects to piping plovers from the proposed Project are those impacts that may add to current impacts on the species. The proposed Project crosses the Missouri River just upstream of the US Highway 85 bridge crossing and an existing transmission line crossing (Figure 12). This is the main area of suitable piping plover habitat crossed by the proposed Project but other wetland areas greater than 3 ha are also crossed or within the action area that could be suitable habitat under various water regimes (e.g., during dry years when bare beach/bar is exposed; Figure 11). The bridge as currently built can act as a dam and pool water behind it during high flows. In addition, the bridge funnels water through one set opening that prevents the river from naturally migrating and forming sandbars and side channels. Regular car and truck traffic over the bridge contributes to the current ambient noise levels and other human impacts. The proposed Project will not place any poles within wetlands or the Missouri River or other river, minimizing potential impacts to piping plovers. The proposed Project will have line marking done (see Section 1.4) near all wetland areas, minimizing any potential for collision risk to the species compared to what is already in place from the existing line crossing over the Missouri River and other lines in the region. The proposed Project area does not currently have any potential nesting structure (i.e., bare sand islands) at the Missouri River crossing and there has been no known nesting near the line in other locations. The proposed

Project will not result in further impacts to the channel configuration at the Missouri River, will not place structures in wetlands, will not contribute to increased noise levels or other human impacts to the species. No significant cumulative effects are anticipated to the piping plover.

3.2.4 Determination

Based on the preceding discussion, it is determined that with implementation of the visible line marking, construction outside the breeding period, or surveys to confirm no breeding birds are present if construction occurs during the nesting period, the proposed Project **may affect, but is not likely to adversely affect** the piping plover.

3.3 Critical Habitat for Piping Plover (*Charadrius melodus)*

Designated piping plover critical habitat in North Dakota includes both alkali wetlands/lakes and the Missouri River system. Piping plover critical habitat on alkali lakes includes more than the beach areas. Designated piping plover critical habitat on alkali lakes and wetlands includes: (1) shallow, seasonally to permanently flooded, mixosaline to hypersaline wetlands with sandy to gravelly, sparsely vegetated beaches, salt-encrusted mud flats, and/or gravelly salt flats; (2) springs and fens along edges of alkali lakes and wetlands; and (3) adjacent uplands 200 feet (61 meters) above the high water mark of the alkali lake or wetland.

The entire Missouri River system in North Dakota including the main river and associated reservoirs have been designated as piping plover critical habitat. The primary constituent elements of critical habitat on the Missouri River includes sparsely vegetated channel sandbars, sand and gravel beaches on islands, temporary pools on sandbars and islands, and the interface with the river. Critical habitat on Lake Sakakawea includes sparsely vegetated shoreline beaches, peninsulas, islands composed of sand, gravel, or shale, and their interface with the water.

3.3.1 Direct Effects

This proposed Project will cross over designated piping plover critical habitat on the Missouri River/upper reaches of Lake Sakakawea (Figure 13, Unit 11; USFWS 2012b, 2013a), but no structures or other components would be placed into any of the primary constituent elements of sparsely vegetated channel sandbars, sand and gravel beaches on islands, temporary pools on sandbars and islands, or the interface with the river. All structures are planned for placement in upland areas, many of which are in shrub/woodland areas or areas maintained as cropland across the floodplain (Figure 12). In addition, the proposed Project is crossing in an already disturbed location that has an existing transmission line crossing, as well as the US Highway 85 bridge crossing.

Critical habitat in the form of alkali lakes has also been designated in Williams (Unit 1) and Mountrail Counties (Unit 2; USFWS 2012b, 2013a). The closest area to the proposed route

within these two counties is approximately 11 miles (Figure 13). The southern portion of the route, which parallels the southern shore of Lake Sakakawea (designated critical habitat Unit 11; USFWS 2012b, 2013a), is about two and a half miles at its' closest (Figure 13). No direct impacts to designated critical habitat or the primary constituent elements of critical habitat will occur.

3.3.2 Indirect Effects

By following all the erosion control, fueling, and other BMPs, sediment and other contaminates will be prohibited from reaching the Missouri River, or other area of critical habitat. No indirect effects to piping plover critical habitat are anticipated.

3.3.3 Cumulative Effects

The proposed Project crosses the Missouri River, an area of designated critical habitat, just upstream of the US Highway 85 bridge crossing and an existing transmission line crossing (Figure 12). While the project is within the overall boundary of critical habitat, no structures will be placed in any of the primary constituent elements of critical habitat. As currently delineated, the critical habitat for the Missouri River includes all areas within the floodplain, including trees, farms, roads, and other areas of "non-habitat". Given the location of the proposed Project in relation to the Highway 85 bridge, the river through this area is largely confined to the current channels, and while a sandbar may form within the current open water channel it is unlikely that the river will migrate extensively. The proposed Project will not result in further impacts to the floodplain in this area. No other areas of critical habitat are near the action area. No significant cumulative effects are anticipated to piping plover critical habitat.

3.3.4 Determination

Based on the preceding discussion, it is determined that the proposed Project **may affect, but is not likely to adversely affect** designated piping plover critical habitat.

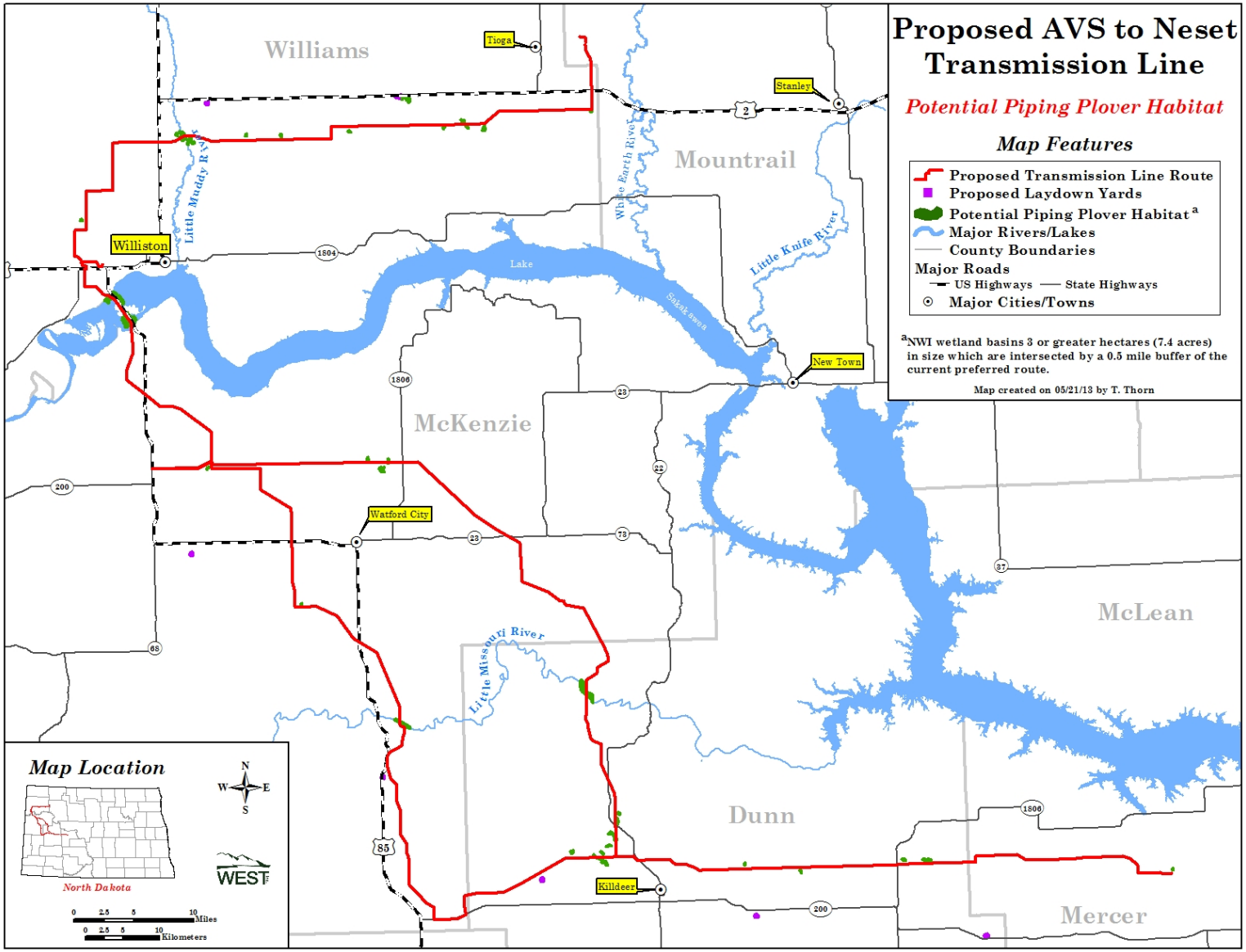

Figure 11. Wetland basins greater than 3 ha that would be surveyed for piping plover if construction occurs within one-half mile during the breeding season.

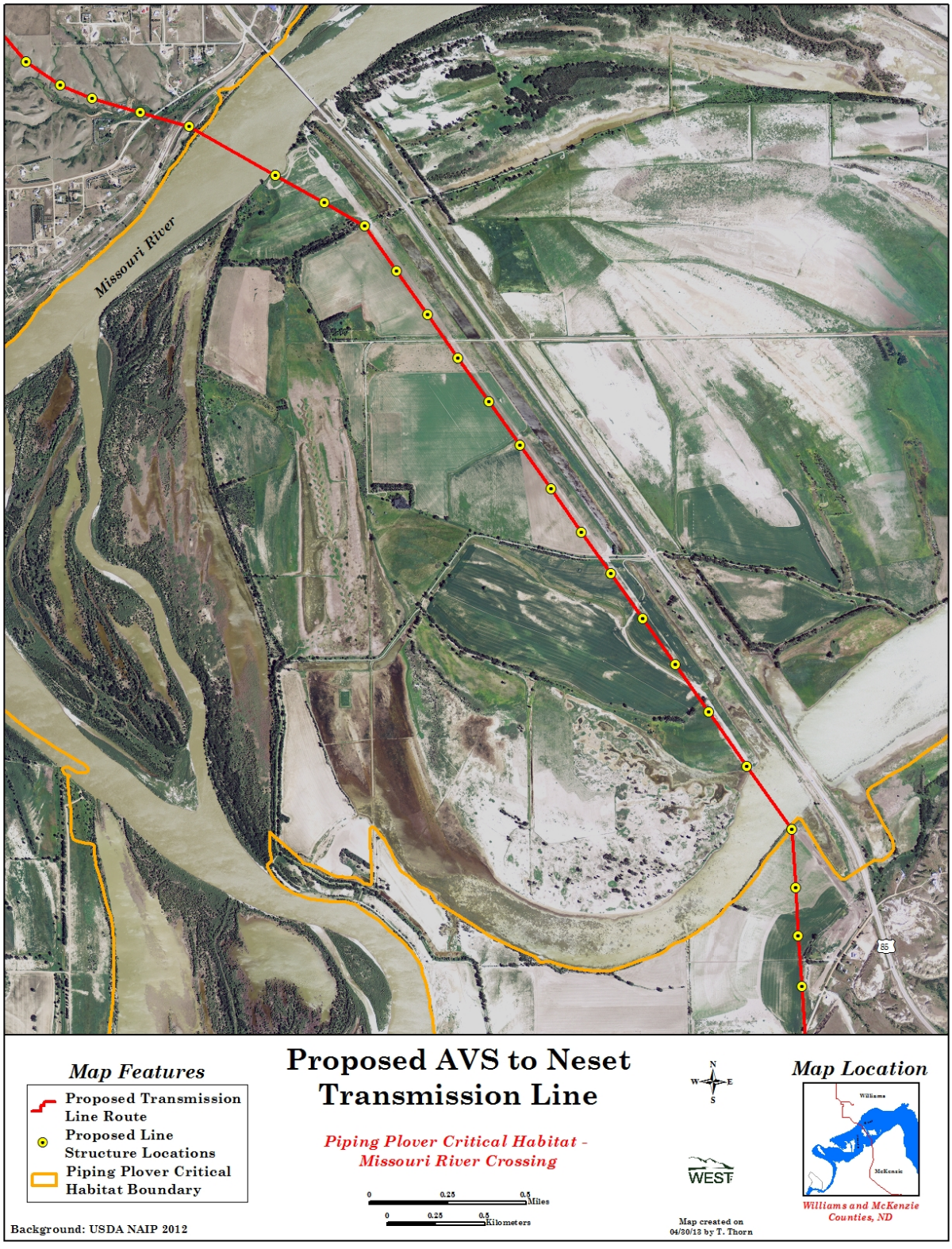

Figure 12. Structure placement at the Missouri River crossing.

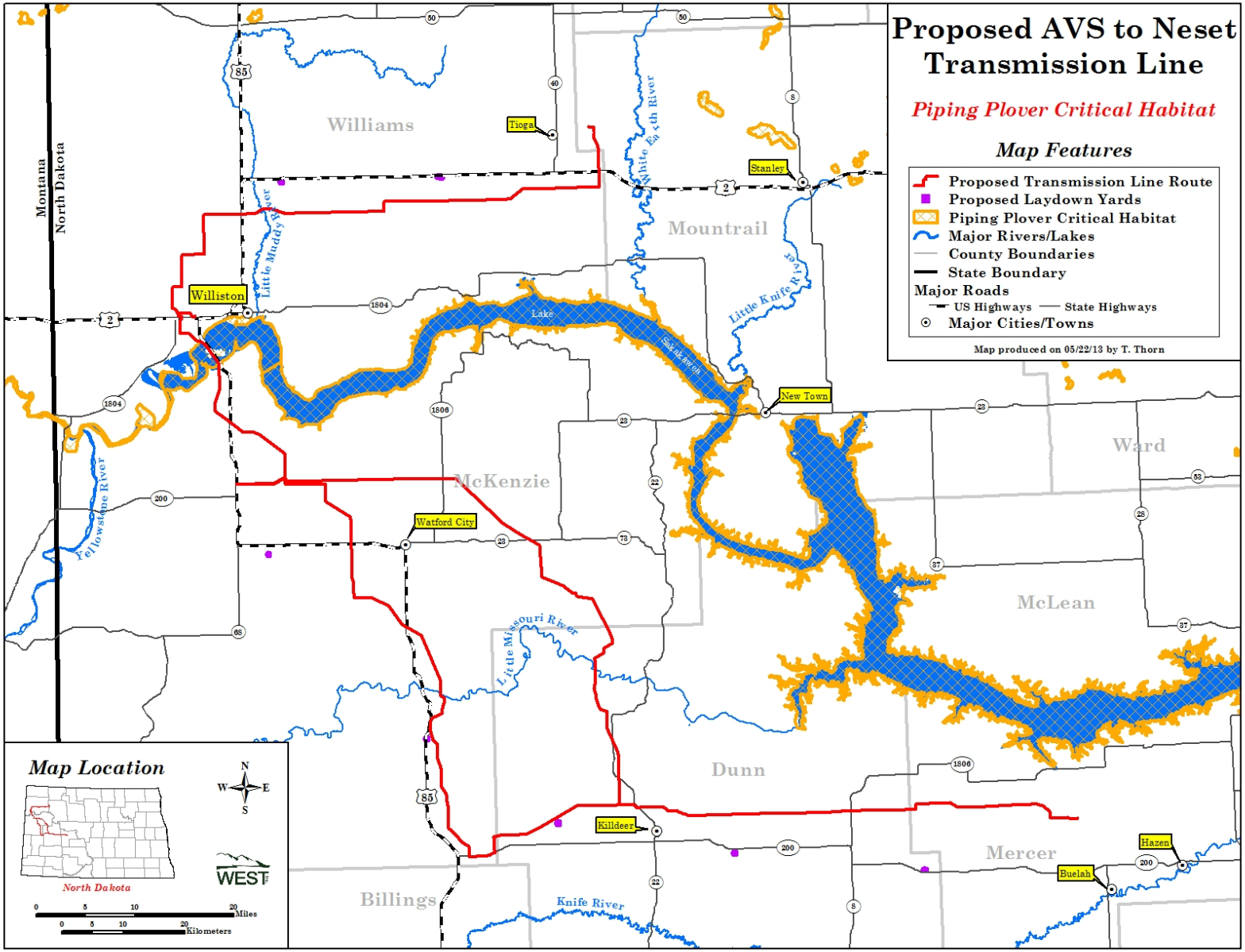

Figure 13. Location of piping plover critical habitat in relation to AVS-Neset proposed Project.

3.4 Whooping Crane (*Grus americana*)

Current Status: The whooping crane was listed as endangered on March 11, 1967 (USFWS 2013c). The only wild, self-sustaining population of whooping cranes is that which breeds in Wood Buffalo National Park in northern Alberta Canada and wintering mainly at Aransas National Wildlife Refuge on the Texas Gulf Coast. This population migrates through North Dakota each spring and fall and had a population estimate of 281 in early spring 2011 (Journey North 2012). There is a re-introduced eastern migratory population which spends the breeding season in Wisconsin and winters on the Florida Gulf Coast. This flock is supplemented yearly with captive reared chicks and aided in migration during their first fall migration. Re-introduced, non-migratory flocks have been established in south central Florida and southwest Louisiana (USFWS 2010a, LDWF 2010-2012). There is no critical habitat designated for whooping cranes in North Dakota.

Habitat: Nesting sites within Wood Buffalo National Park are within small wetlands dominated by bulrush. Whooping cranes utilize the salt marshes along with other interior wetlands and grasslands (USFWS 2010a). While migrating through North Dakota, whooping cranes will use a variety of habitats including cropland, pasture, and shallow, open wetlands. From confirmed whooping crane sighting data, there does not appear to be preferred stop over areas in North Dakota. However, the majority of sightings occur through the central and northwestern parts of the state.

Life History: Breeding whooping cranes will utilize the same territory and general nesting area as the previous year at Wood Buffalo National Park. Nest are usually constructed of bulrushes and on average, 2 eggs are laid in late April/early May. Incubation lasts approximately 30 days and is shared by both sexes. Usually only one chick is fledged. Summer foods include both small aquatic and terrestrial animals and plant berries. Whooping cranes leave the breeding grounds in mid-September singularly, in family groups or in small flocks and will reach Aransas National Wildlife Refuge by mid-November. Preferred winter foods are blue crabs and clams but the cranes will utilize other food sources if needed. Pairs and family groups occupy and defend territories on the wintering grounds. Fertile eggs are usually not produced until whooping cranes are four years old (USFWS 2010a).

Action Area: The proposed Project lies within the documented (95% of confirmed sightings) migration corridor of the Aransas/Wood Buffalo whooping crane population (Figure 14). Since whooping cranes would be most vulnerable to interactions with the proposed Project ascending to or descending from migratory stopover areas, the action area will be one mile on either side of the proposed transmission line based on information in Brown (1993). There are no confirmed whooping crane sightings within the action area (Figure 14). The closest sighting reported is 1.1 miles from the proposed Project.

3.4.1 Direct Effects

The potential direct effect of the proposed Project on whooping cranes includes individuals of the species possibly colliding with the wires during the spring or fall migration periods and permanent loss of habitat as a result of the construction of the proposed Project. Within the overall population of whooping cranes, including the reintroduced migratory populations and the non-migratory reintroduced population in Florida, collision with power lines has been a large factor in known mortality to fledged whooping cranes (CWS and USFWS 2007). Between 1956 and 2007, 45 whooping cranes in all populations had been found as fatalities associated with distribution and transmission lines (Stehn and Wassenich 2007). Of these 45, only nine were from the wild migratory population that travels through the action area and the remaining were in the experimental flocks. There are numerous factors that may relate to why far more whooping crane fatalities from the experimental flocks have been documented than from the Aransas-Wood Buffalo population (see Appendix B). The reasons could include, but are not limited to:

- The experimental flocks, especially the Florida and Wisconsin-Florida flocks, reside in a landscape with differing urban pressures and infrastructure density, resulting in far more transmission and distribution lines.
- Higher human densities likely lead to higher human disturbances that can flush flocks (via vehicle traffic, curious domestic animals, curious people, lights and noise, etc.) from any stopover site, leading to higher collision risks.
- The landscapes between the Aransas-Wood Buffalo population is much different from the landscapes encountered by the experimental populations and this could lead to increased collision risks.
- Experimental populations were trained using ultra-lights to follow certain migration paths, this could lead to great encounters with human interactions.

Of the nine documented fatalities in the Aransas-Wood Buffalo population at overhead lines, one was at a transmission line, a bird found in 1956 in Texas, and the other eight were at smaller distribution lines. It is possible that more collisions appear to be associated with distribution lines, as they are smaller diameter, they are more common in the landscape, and they are typically at lower elevations than transmission lines. The concept of the smaller wires having more risk is also shown in studies of transmission lines where the small shield wires are the wires most often struck by birds in flight (APLIC 2012). Regardless, whooping cranes are susceptible to collisions with overhead lines, likely because of their large body size and wing span, slower wing beat, and relative lack of maneuverability (Stehn and Wassenich 2007).

The proposed route is within the 95 percent migration corridor (Figure 14). Migrating whooping cranes will be most vulnerable to collision with the proposed Project when descending to roost/foraging in the evenings; ascending in the morning to continue migration; or flying between roosting and foraging locations. Power lines dividing roosting (e.g., wetlands) from foraging areas (e.g., croplands) result in more collisions for cranes because they are already flying low and may cross through these areas multiple times each day if their migration is halted for any period of time (Stehn and Wassenich 2007).

Areas of wetlands mixed with cropland compose areas of suitable habitat for the birds to rest and forage during migration. The relative probability of cranes using different areas through the action area, as well as the overall macro-corridor analyzed in the EIS, were investigated through a Resource Selection Function Analysis (RSF; Howlin et al. 2013, see Appendix A). The RSF found that locations with larger areas of water, closer to crop areas and containing more wetlands have a higher potential for use by whooping cranes. Based on the RSF, within the action area there were 114 mi^2 of areas predicted to have high probabilities of use. There were 138 mi^2 of areas predicted to have medium-high use, 144 mi^2 of areas predicted to have medium use, 147 mi^2 of areas predicted to have medium-low use, and 57 mi^2 of areas predicted to have low probability of use (Table 2). Most locations of low probability of use in the RSF analysis area were contained within the badlands (see maps in Appendix A).

Table 2. Whooping Crane RSF Analysis Summary for Action Area

Probability of Use	Area (Sq. Mi.)	Percent of proposed Project Area
High	114	19.0%
Medium High	138	23.0%
Medium	144	24.0%
Medium Low	147	24.5%
Low	57	9.5%
Total	**600**	**100%**

The median value of the predicted relative probability of use was estimated for the RSF analysis grid cells crossed by the transmission line and compared to the distribution of the values in the overall analysis area. There were 1220 grid cells that were crossed by the transmission line. The median value of the RSF for the cells crossed by the transmission line is equivalent to the 48.03 percentile of the distribution of predicted values in the comparison area. In other words, approximately 52% the study area has higher probability of use than the area crossed by the transmission line, and 48% has lower probability of use by whooping cranes. There is only a marginally lower chance that the area crossed by the transmission line will be selected for by whooping cranes more than other areas in the overall analysis area (Appendix A). Again, the area with the predominance of low probability of use is the rugged badlands region. Further, the RSF analysis was based on somewhat dated materials that do not include all of the current oil/gas wells and other infrastructure that has recently been built that likely diminishes the overall probability of use in the region.

In summary, the proposed Project is within the 95% migration corridor and crosses areas of high, moderate, and low potential for use. Stehn and Wassenich (2007) stated that cranes responded to marked lines and tried to avoid the lines, with risk of collision shown to be reduced by 50-80 percent for cranes through line marking (Morkill and Anderson 1991). As such, Basin Electric will mark the entire length except the 21.6 miles of the proposed Project that is located within areas of the rugged badlands to minimize potential line strikes to whooping cranes, see Section 1.4 for a discussion regarding the line marking plan.

The actual amount of habitat lost by the proposed Project will be very minimal, just within the two new substations (12 acres each) and at the tower structures. None of the infrastructure will be placed in wetland areas. Direct effect regarding loss of habitat is not expected to be significant.

3.4.2 Indirect Effects

The primary indirect effect is the potential for avoidance by whooping cranes of the stopover habitat located near the proposed Project; however, if this occurs to a large degree it could significantly lower the risk of direct effects. It is not clear if whooping cranes avoid using areas around transmission lines, or if the avoidance is due more to other infrastructure that is often in the vicinity of transmission lines (e.g., existing roads). Loss of migration habitat is a growing concern regarding the Aransas-Wood Buffalo population, with several wind energy facilities contributing hundreds of thousands or millions of dollars toward habitat protection and enhancements (BEPC 2009, USFWS 2010). Searching for suitable stopover habitat would increase exposure to hazards as birds fly lower for longer distances as well as increased energy demands. If cranes are displaced from quality habitat that is surrounded by lower quality habitat, they may also be subjected to other risks such as other power lines, hunters, disease, and predation. Based on the RSF, the proposed Project falls within areas that have very similar potential for use, overall, as other areas within the action area and larger 36 mile wide RSF analysis area. While cranes have not been shown to be displaced from transmission lines, if they were displaced, there is similar habitat with equal probability of use around the proposed Project which the cranes could utilize with only small flights. Indirect effects to whooping cranes are unlikely through implementation of the proposed Project.

3.4.3 Cumulative Effects

The Aransas-Wood Buffalo population of whooping cranes has been steadily increasing since a low of 15 in the 1940's (USFWS 2009) to a population of nearly 300 in 2011 (M. Tacha, USFWS, pers. comm.). Even with this increase the population is far below the population level needed for recovery (USFWS 2009). This increase in population has occurred under the current conditions of existing transmission lines and distribution lines, as well as other hazards, within the species migratory corridor. The addition of the proposed Project will result in additional hazards to the whooping crane population during their spring and fall migrations, see Appendix B for more details, but with implementation of the line marking, this cumulative effect is being minimized.

3.4.4 Determination

The discussion in Section 1.4 Line Marking Plan, Appendix B, and the above portions of Section 3.4 Whooping Crane all contain aspects that apply directly to the determination for whooping cranes. In summary, based on the information presented, there have not been any documented whooping crane collisions or deaths from transmission lines in the Upper Great Plains and only

one documented whooping crane collision with a large transmission line within the overall Aransas/Wood Buffalo migratory population. Eight collisions with smaller distribution lines have been documented in the Aransas/Wood Buffalo populations. Other collisions from released whooping crane populations have been documented, but these have typically been in areas not as open as the Upper Great Plains (i.e., higher density of distribution and transmission lines, less areas of open wetlands, etc.). The Region 6 Guidance for marking power lines (combined both transmission and distribution lines) is based largely on the premise that 50-80% reduction in risk can be realized from marking lines, but this is based mostly on sandhill cranes and only from a few studies. It is unclear how susceptible whooping cranes or sandhill cranes are to large 345 kv transmission lines on the open Upper Great Plains, but all indications are that they are not susceptible to a great extent and risk of strike is discountable. This discountable risk, along with the "over-marking" of the proposed Project to include all but sections through the badlands region which maintains the environmental baseline, drives the determination by the Action Agencies.

It is determined that the proposed Project **may affect, but is not likely to adversely affect** the whooping crane, based on the preceding discussion, line marking plan outlined in Section 1.4, and information supplied in Appendix B..

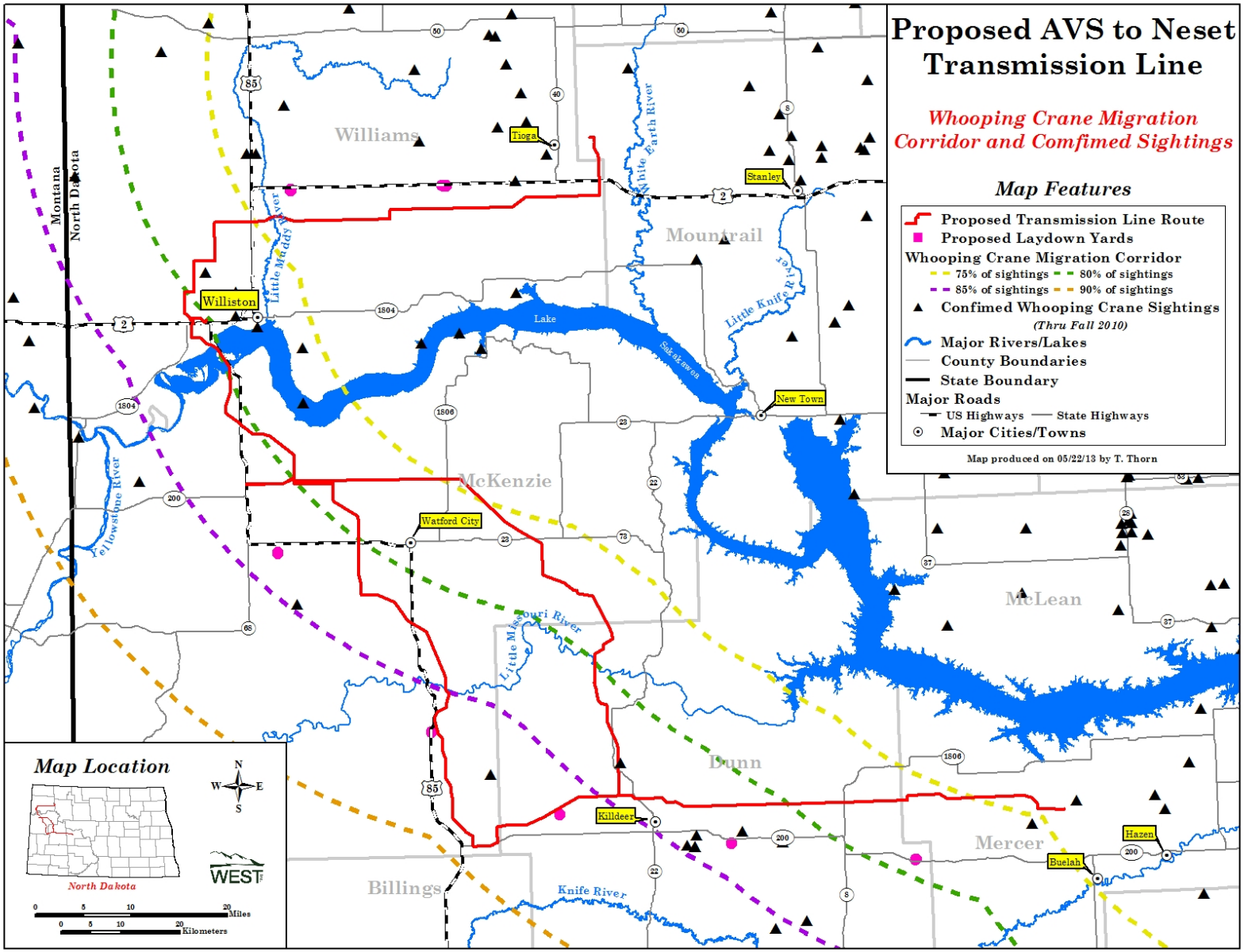

Figure 14. AVS-Neset Project in relation to defined whooping crane migration corridor and confirmed observations.

3.5 Pallid Sturgeon (*Scaphichynchus albus)*

Current Status: The pallid sturgeon was listed as endangered on September 6, 1990 (USFWS 1993). Historically the pallid sturgeon was considered uncommon and historic population estimates on the upper Missouri River are unknown (USFWS 1993). In 2004, there was estimated to be 158 wild adult pallid sturgeon in the Fork Peck and Yellowstone reaches of its range (Klungle and Baxter 2005). Stocking efforts are ongoing through various reaches of the Missouri River, including above Lake Sakakawea.

Habitat: Adult pallid sturgeon historically utilized the bottom of large, turbid, fast flowing rivers. However, their life-cycle requires a wide array of aquatic habitats from floodplain backwaters to main river channels (USFWS 1993).

Life History: Pallid sturgeons are long lived species (up to 40 years) which have been estimated to reach sexual maturity in seven to nine years for males and 15 to 20 years for females (USFWS 1993). Females may spawn only every three to 10 years (USFWS 1993). Spawning is thought to occur between June and August and historically in the upper reaches of the range and coincided with an increase in river flow from mountain runoff. Other environmental factors may influence spawning behavior and timing (USFWS 1993). Feeding ecology of pallid sturgeon is not well understood. It is thought that the diet of young fish is mainly aquatic invertebrates with an increase in small fish consumption as pallid sturgeon age (USFWS 1993). Overall, the life history of pallid sturgeon is not well understood.

Action Area: The pallid sturgeon action area is the area where the proposed Project crosses the Missouri River between the headwaters of Lake Sakakawea and the confluence of the Yellowstone and Missouri Rivers (Figure 1).

3.5.1 Direct Effects

None of the proposed Project will directly impact the Missouri River or other habitat for pallid sturgeon. No structures will be placed directly in the Missouri River nor will any boats be used to cross the river during construction or operations of the proposed Project. No direct impacts to pallid sturgeon due to the proposed Project are anticipated.

3.5.2 Indirect Effects

By following all the erosion control, fueling, and other BMPs, the potential for sediment and other contaminates will be avoided or greatly minimized from reaching the Missouri River, or other waterbody. No indirect effects to pallid sturgeon are anticipated.

3.5.3 Cumulative Effects

No structures will be placed directly in the Missouri River nor will any boats be used to cross the river during construction or operations of the proposed Project (i.e., not direct effects to the species or habitat) and no indirect impacts to the species are anticipated. The proposed Project will not add further stressors within the action area to the species. No cumulative effects to pallid sturgeon are anticipated.

3.5.4 Determination

Based on the preceding discussion, it is determined that the proposed Project will have **no effect** on the pallid sturgeon.

3.6 Gray Wolf (*Canis lupus*)

Current Status: The gray wolf in the lower 48 US states (except Minnesota) was listed as endangered on March 9, 1978 (USFWS 1987). In North Dakota, the gray wolf east of the Missouri River from the South Dakota border to Lake Sakakawea and east of the center line of US Highway 83 to the Canadian border has been recently de-listed. Gray wolves west of this line however are still federally endangered (USFWS 2012a). The closest wolf pack to North Dakota is in northwestern Minnesota (Licht and Fritts 1994); however some wolves from the Rocky Mountain population may actually roam closer to western North Dakota. Wolves seen in North Dakota are probably animals dispersing from established populations in Minnesota and Canada (USFWS 2012a).

Habitat: Historically, the gray wolf occurred throughout the lower 48 US states except for the Southeast and the deserts of the Southwest (USFWS 2011b). Today, sustainable populations can be found in habitats with low road and human densities in the following states: Minnesota, Michigan, Wisconsin, Idaho, Montana, and Wyoming (USFWS 2011b). Although gray wolves could be spotted anywhere in North Dakota, the mostly likely areas would be the forested areas of north-central (Turtle Mountains) and northeast North Dakota (Pembina Hills; USFWS 2012a). There have been 3 verified and 8 probable wolf sightings within 5 miles of the proposed Project based on a review of reported sightings maintained by the NDGFD (Figure 15).

Life History: Gray wolves live in packs consisting of a breeding pair, their young, and other non-breeding adults. The average size litter of five pups is born in late spring and young reach adult size in eight months. Once reaching sexual maturity in two to three years, young wolves may leave the pack in search of a mate to establish a new pack. The average life span of the gray wolf is 10 years (USFWS 2011). The diet of the gray wolf consists mainly of large ungulates such as deer, moose, and elk. However, they are opportunistic and will take smaller animals and domestic livestock. They usually hunt in packs but can make kills of large prey on their own (Montana Field Guide 2012).

Action Area: The action area for the gray wolf is the proposed transmission line right-of -way (150 ft), lay down areas, and associated facilities. Gray wolves along the proposed route would most likely be transient animals and would be expected to spend little time within the action area.

3.6.1 Direct Effects

There are no known wolf packs in North Dakota or the action area. Wolves observed in the state are most likely transient wolves traveling through the state to other territories, and therefore could be found nearly anywhere in the state, including within the action area. The only potential direct effect to the species is during construction when a vehicle may strike a transient animal, but occurrence of a wolf in the region is highly unlikely. In addition, slow driving speed of construction vehicles on rough terrain would further reduce the potential risk of collision.

3.6.2 Indirect Effects

There are no known resident populations in the action area or vicinity. No indirect impacts due to the proposed Project are anticipated to the gray wolf.

3.6.3 Cumulative Effects

Given that there are no known wolf packs in North Dakota, all wolves observed within the state are most likely transient wolves traveling from other existing packs in the Rocky Mountains, Great Lakes area, or Canada. Wolves from these areas would have had to cross under hundreds of over-head lines of different sizes and configurations if they were to be found within the action area. It appears that there are no known limitations to movement from transmission lines on wolves. No cumulative effects to wolves are anticipated.

3.6.4 Determination

Based on the preceding discussion, it is determined that with low potential for species occurrence and slow driving speed of construction vehicles that the proposed Project will have **no effect** on the gray wolf.

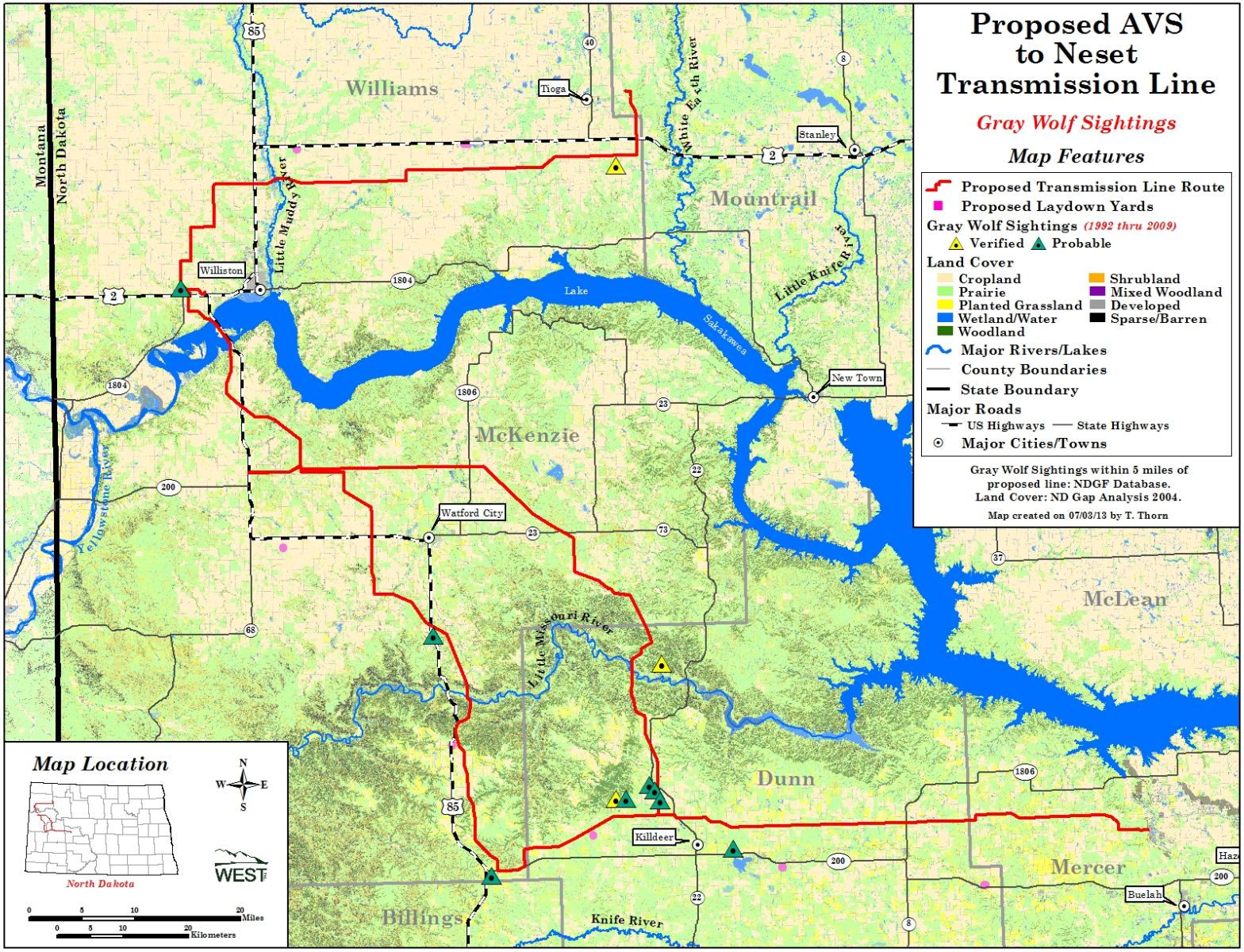

Figure 15. Wolf sightings within 5 miles of the proposed Project.

3.7 Black-footed Ferret (*Mustela nigripes*)

Current Status: Black-footed ferrets were originally listed as a federally listed endangered species on March 11, 1967. Prior to being rediscovered in 1981 near Meetetsee, Wyoming it was believed that the species may have gone extinct (USFWS 1988a). In 1991, 49 captive animals were reintroduced into the wild in Wyoming. Since then, ferrets have been reintroduced into Montana, South Dakota, Colorado, and Arizona and are reproducing in the wild. Unconfirmed sightings from other areas continue to be reported; within North Dakota the majority of the reports have historically come from the southwest part of the state (USFWS, 2011a), but recent evidence indicates that there may be black-footed ferrets in south central North Dakota in 2013 (K. Shelley, USFWS, pers. comm.).

Habitat: The black-footed ferret inhabits short grass prairies, always within close proximity to prairie dog towns. Historically this included inhabiting black-tailed and white-tailed prairie dog colonies throughout the Great Plains. Today they continue to depend almost exclusively on prairie dog (*Cynomys* spp.) colonies as a source of food and shelter (USFWS, 1989), with prairie dogs composing over 90 percent of their diet. Black-footed ferrets are also susceptible to predation by golden eagles, great-horned owls, and coyotes (USFWS, 2011a).

Life History: Black-footed ferrets are sexually mature at 1 year of age, and breeding usually takes place between March and May, with three to four young per litter. Juvenile male ferret mortality rates are high as a result of their dispersing to new areas. Life expectancies for black-footed ferrets are considered to be less than 5 years. Ferrets utilize prairie dog burrows for shelter and raising young (USFWS 2011a).

Action Area: The action area for the black-footed ferret is the proposed transmission line right-of -way (150 ft), laydown areas, and associated facilities. There are no known prairie dog towns within the action area.

3.7.1 Direct Effects

As there are no known black-footed ferrets in the action area or near vicinity and no prairie dog towns are known to occur within the action area, no direct effects are anticipated on black-footed ferrets

3.7.2 Indirect Effects

Similar to Direct effects, given that there are no known black-footed ferrets in North Dakota and no prairie dog towns within the action area or in the immediate vicinity of the action area, no indirect effects are anticipated on black-footed ferrets.

3.7.3 Cumulative Effects

Given that there are no known prairie dog towns (primary habitat for the species) or known occurrences of black-footed ferrets near the proposed Project, impacts of any kind are unlikely. No cumulative effects to black-footed ferrets are anticipated.

3.7.4 Determination

Based on the preceding discussion, it is determined that the proposed Project will have **no effect** on the black-footed ferret.

3.8 Northern Long-Eared Bat (*Myotis septentrionalis*)

Current Status: The northern long-eared bat is proposed for listing as endangered (Service 2013d); critical habitat for this species is also proposed**.** Primary threats to the continued existence of the northern long-eared bat include commercialization of caves leading to an increase in disturbance, pesticides and other contaminants, the loss or degradation of hibernacula, destruction of summer habitat such as the loss of forest cover and degradation of forested habitats, human encroachment and disruption to the crucial events of gestation, postnatal development and post-weaning maturation, and hibernation, and the impacts of disease (rabies, white-nose syndrome, etc.). Of particular recent concern is the impact of white nose syndrome (WNS), which is a fungal infection of the face, wings, nose and respiratory system that has killed over a million bats. Eastern populations of the northern long-eared bat are known to be susceptible to WNS, although the fungus has not been detected in populations in the western region (CBD 2013).

Habitat: The northern long-eared bat ranges from the southeast corner of the Northwest Territory, east across each Canadian province, and covers 38 states in the central and eastern part of the United States including eastern Montana, North Dakota, South Dakota, Kansas, and Nebraska. This species uses caves and mines during hibernation which can begin as early as August and continue through the winter months. No hibernacula are known from North Dakota (Service 2013d).

Life History: This medium-sized bat (3 to 3.7 inch long) is insectivorous and utilizes different roost sites at different seasons. In winter, the northern long-eared bat typically hibernates in caves and mines. Preferred hibernation sites have large passages and entrances, constant temperatures, and high humidity with no air currents. It is common for this species to overwinter in sites with other *Myotis* species. During the summer months, this species relies less on caves and more on old growth and late successional forests for roosts and reproduction. During the summer, they roost under the bark of dead and dying trees. Old and mature forests provide habitat (decaying trees, loose bark, tree snags, and stumps) for roosting, feeding, and maternity colonies of northern long-eared bats. In addition, the northern long-eared bat is also known to

roost in buildings (NatureServe 2013; USFWS 2013d). Nighttime voyages consist of feeding on moths, flies, leafhoppers, caddisflies, and beetles, which they catch while in flight using echolocation. This bat also feeds by gleaning motionless insects from vegetation and water surfaces.

Fidelity to night roosts and hibernation sites has been observed (Tigner and Stukel 2003). The northern long-eared bat does not migrate, but may travel up to 30 mi (48 km) from winter hibernation to summer roosts. Several studies report that home range size for some populations may be as high as 148 to 161 acres (60 to 65 ha) (Owen 2003; NatureServe 2013)

The northern long-eared bat breeds in late summer and early fall when large numbers of bats congregate in and near the entrances of caves and mines. Females will store sperm during hibernation as the gestation period ranges between 50 and 60 days. Females give birth to one pup the following spring (NatureServe 2013).

The northern long-eared bat is a generalist predator of aerial invertebrates (CBD 2010; NatureServe 2013). The species forages at night in forested areas, riparian zones, along forest edges, and in clearings. In the Badlands region of South Dakota, for example, this species is known to forage in wooded riparian zones in lower elevations and in dense forest at higher elevations (CBD 2010).

Action Area: The action area for the northern long-eared bat is the proposed transmission line right-of -way (150 ft.), lay down areas, and associated facilities.

3.8.1 Direct Effects

Potential direct effects on the northern long-eared bat from the proposed Project include collision with the overhead wires, permanent loss of habitat through placement of structures in sites that are in close proximity to potential hibernacula, forested areas, and water sources.

To decrease direct impacts to the species during construction, proposed construction activities within 1,000ft of suitable hibernacula will be avoided during the winter hibernation period (roughly late fall to early spring). Suitable hibernacula include caves and mines meeting the typical description given in the proposed listing (i.e. large caves or mines with large passages and entrances; constant temperatures; and high humidity with no air currents [USFWS 2013d]). In addition to avoiding hibernacula during construction, all mature, dead, or dying trees will be left intact, where not a safety concern for line reliability. This may help to protect foraging, roosting, and maternity sites.

Habitat fragmentation by power lines is unlikely when the line is properly sited to not disturb old growth, forested areas, shelter belts, or riparian galleries. Bats are highly maneuverable and can fly up and over or down and under the power lines; rapidly changing course. Since the diameter of the proposed Project wire is over a third of the bat's body length (average 230-kV conductor is 1.3 inches in diameter, with 345-kV line even larger, Clark, personal

communication) and bats have advanced sonar detection systems, it is unlikely that a bat would fly into a static cable that large relative to their body size.

3.8.2 Indirect Effects

Possible indirect effects to the northern long-eared bat from the proposed Project include auditory disruption (from the audible noise produced from the corona generated by the transmission line).

Electric corona results when high voltage lines ionize the air around the line, which then also becomes a conductor, and an audible hissing sound can be heard. Corona is more prevalent near sharp corners in the line, nicks or scrapes in the line, snow/rain/frost on the line, or around bird flight diverters (APLIC 2012). During wet and rainy conditions, the most corona noise is often realized (Pearson no date). The audible hiss dissipates quickly as you move away from directly under the transmission line to approximately 40-50 dBA at the edge of the right-of-way, similar to ambient noise levels (Pearson no date). In addition to the corona noise dissipating quickly and the fact that corona is more pronounced during rainy conditions when bats are less likely to be flying, indirect effects due to line noise are not expected to be significant even in areas where the proposed Project crosses through suitable foraging habitat.

3.8.3 Cumulative Effects

Within the proposed Project region (North Dakota) and within the action area, significant coal, oil and gas development, infrastructure to advance this development, and agriculture have historically and currently impacted the forested and riparian habitat that the northern long-eared bat utilizes for foraging and roosting. North Dakota has no know hibernacula to date, but in other areas of the country human disturbance of hibernacula and hibernating bats also continues to threaten populations. Such disturbance occurs in the form of cave commercialization, recreational caving, vandalism, and research-related activities. The species is also susceptible to WNS, as mentioned above. Climate change is also expected to impact the northern long-eared bat, although these effects are not well understood. Climate change models have been used to investigate the range expansion of the little brown bat; such range shifts could also be used to predict the range shifts of other bat species (Humphries et al. 2002). While it is unknown if transmission line poles cause displacement, the proper siting of each structure, away from foraging, roosting, and hibernacula sites will minimize the potential for displacement impacts. The addition of corona should not add considerably to the natural sound levels when bats are flying given most corona effect noise occurs during rain/snow conditions.

3.8.4 Determination

Based on the preceding discussion, it is determined that the proposed Project **may affect, but is not likely to adversely affect** the northern long-eared bat.

3.9 Sprague's Pipit (*Anthus spragueii*)

Current Status: The Sprague's pipit was listed as a candidate species on September 15, 2010 (USFWS 2010b). There has been a statistically significant range wide decline in Sprague's pipit population across all of North America of 3.9% yearly from 1966 through 2007 (Breeding Bird Survey data; Jones USFWS 2010). Population trends in the US alone, however, did not show significance for this same time period (Jones 2010). The USFWS works to implement conservation actions for candidate species that may eliminate the need to list the species as threatened or endangered

Habitat: Native grassland is used extensively by Sprague's pipits throughout their life cycle. Typical nest sites are dominated by native grasses and sedges with forbs and shrubs, litter, and bare ground present in lesser amounts. Larger tracts of native grassland in landscapes dominated by grasslands are thought to influence the abundance of Sprague's pipits on their breeding grounds. Jones (2010) states that Sprague's pipits have not been documented nesting in Conservation Reserve Program grasslands, dense nesting cover (waterfowl nesting habitat), or cropland. Large tracts of grassland are also preferred habitat of wintering Sprague's pipits but they may use non-native grasslands to a greater extent. Little if any data is available for habitat preferences during migration.

Life History: Sprague's pipits breed in the historic prairie regions of the northern US and Canada and winter from central Texas south into central Mexico. They arrive on the breeding grounds from mid-April to mid-May with nest initiation any time from the second week of May to early August. Four to five eggs are laid on the ground in a cup shaped nest made of grass. The nest may also be covered with a grass canopy. Incubation is usually 12 to 14 days and mostly done by the female. Generally, Sprague's pipits leave the breeding grounds in late September and arrive on their wintering grounds by early November. The diet of Sprague's pipits consists mostly of arthropods throughout the year (Jones 2010).

Action Area: The action area for the Sprague's pipit is the proposed transmission line right-of-way (150 ft), lay down areas, and associated facilities. Larger tracts of native grassland along the proposed route will be more likely to contain Sprague's pipits.

3.9.1 Direct Effects

Potential direct effects on Sprague's pipit from the proposed Project include collision with the overhead wires, permanent loss of habitat through placement of structures within grasslands, and disturbance of nests, eggs, and adults during construction. Sprague's pipit are limited to large blocks of native grassland, with occurrence only being found in grasslands greater than 72 acres (ac; 29 ha) and nesting being limited apparently to grasslands greater than 358 ac (145 ha) for breeding (Davis 2004). In addition to just overall parcel size, pipits appear to be

disturbed when close to roads, with the species being displaced from within a 985 foot (ft; 300 m) buffer around roads (Linnen 2008).

A GIS analysis was done utilizing the ND GAP Analysis land cover data as the basis for identification of grasslands with native prairie components. Selected roads which appeared to be maintained (crowned and ditched with surface material added) from an ESRI road layer were used to inform the road disturbance analysis. From these data, an analysis was done to identify larger blocks of native prairie which could constitute possible Sprague's pipit habitat.

The action area crosses 30 tracts that are 358 ac or larger and a total of 90 tracts 72 ac or larger (which includes the 30 that are larger than 358 ac). This translates into 28.0 miles of the proposed Project crossing tracts of grassland that are 358 ac or larger. A total of 78.5 miles of the proposed Project crosses grasslands that are 72 ac or larger (again, the 78.5 miles includes the 28.0 miles of the proposed Project within 358 ac or larger grasslands). If a 958 ft buffer around roads and wells is applied, 22 tracts are crossed that are 358 ac or larger and 65 tracts remained that are 72 ac or larger (Figure 16). This translates into a total of 19.9 miles of the proposed Project crossing tracts 358 ac or larger and 34.6 miles of the proposed Project crossing grasslands 72 ac or larger. This analysis was done using as current of information as possible, understanding that further disturbance of grasslands has occurred through ongoing oil well development and other actions.

Given that there is an average of six tower structures per mile, and there is a total of 34.6 miles of native grasslands in blocks greater than 72 ac being crossed, there will be approximately 207 tower structures placed in suitable Sprague's pipit habitat. Each tower structure only permanently removes or significantly disturbs a small portion ground, approximately 6-10 ft wide area, which constitutes a total of approximately 0.3 ac of habitat being removed. To minimize impacts of this disturbance, only native grass and forbs seeds from a local seed source will be used to restore areas around tower structures or the area will be allowed to recolonize naturally from native seed stock in the top soil and seeds from nearby plants.

Sprague's pipit conduct a courtship flight that includes the male conducting a "…prolonged and unique aerial display…" (Robbins 1998 in Jones 2010). During these flights it is possible that the birds could collide with the overhead lines. In addition, Sprague's pipit, like any avian species, could collide with the overhead lines during migration. The line marking plan as identified in Section 1.4 will minimize the risk of collision.

To avoid direct impact to the species during construction, proposed construction activities within grasslands greater than 72 ac will be limited outside of the April 15-August 1 time period. If construction is not limited to this time period, surveys will be done ahead of construction to determine occupancy of the action area within grasslands greater than 72 ac. In this fashion surveys will determine if parcels of native grasslands are "occupied" if displaying males are located during surveys, actual nest locations are unlikely to be found. If the action area contains Sprague's pipit occurrence, no proposed construction will occur within 958 ft of the occupied

parcel except if the proposed construction is on the opposite side of a current disturbance (e.g., road).

3.9.2 Indirect Effects

Potential indirect effects to Sprague's pipit from the proposed Project include auditory disruption to breeding calls from males from the audible noise produced from the corona produced by the transmission line and habitat fragmentation.

Electric corona results when high voltage lines ionize the air around the line, which then also becomes a conductor, and an audible hissing sound can be heard. Corona is more prevalent near sharp corners in the line, nicks or scrapes in the line, snow/rain/frost on the line, or around bird flight diverters (APLIC 2012). During wet and rainy conditions, the most corona noise is often realized (Pearson no date). Male Sprague's pipit, and males from other grassland nesting species, vocalize in the spring to attract a mate, and it could be possible that the audible corona from the proposed Project could disrupt females hearing the calls. The audible hiss dissipates quickly as you move away from directly under the transmission line to approximately 40-50 dBA at the edge of the right-of-way, similar to ambient noise levels (Pearson no date). In addition to the corona noise dissipating quickly and the fact that it is more pronounced during rainy conditions when pipits are less likely to be displaying, indirect effects due to line noise are not expected to be significant even in areas where the proposed Project crosses through suitable habitat.

Sprague's pipit are susceptible to habitat fragmentation (Jones 2010), as indicated in Section 3.8.1 where only larger blocks of native grassland are considered suitable habitat. Examples of disturbance that fragments habitat for Sprague's pipit includes roads, oils wells, housing development, and similar actions that remove large areas of native grassland or carve strips through the native grassland parcels (Jones 2012). It is possible that Sprague's pipit may also negatively respond to transmission line towers, similar to taller trees and shrubs, but data on this are limited (Jones 2012). Given that construction of the proposed Project will result in very limited removal of actual habitat and temporary trails should return to the previous state quickly (see example in Figure 7), fragmentation of habitat due to the transmission line is expected to be limited.

3.9.3 Cumulative Effects

The Sprague's pipit population has been declining throughout their range, but more so in Canada compared to the US. Within the proposed Project region (western North Dakota) and within the action area, significant oil and gas development, infrastructure to advance this development, and agriculture have historically and currently impacted suitable habitat for the species. Sprague's pipits are most susceptible to habitat fragmentation. While it is unknown if transmission line poles cause displacement, the wide spacing and overall small foot print of each structure will minimize the potential for displacement impacts. No established road will be

maintained between structures, with any temporary impacts being returned to their native state quickly through natural seed bank and sod being maintained. The addition of corona should not add considerably to the natural sound levels when pipits are actively calling and establishing territories given most corona effect noise occurs during rain/snow conditions.

The addition of the proposed Project will result in one additional hazard to the Sprague's pipit population during their nesting period in North Dakota as well as spring and fall migrations, but with implementation of the line marking, this cumulative effect is being minimized.

3.9.4 Determination

Based on the preceding discussion, it is determined that the proposed Project **may affect, but is not likely to adversely affect** the Sprague's pipit.

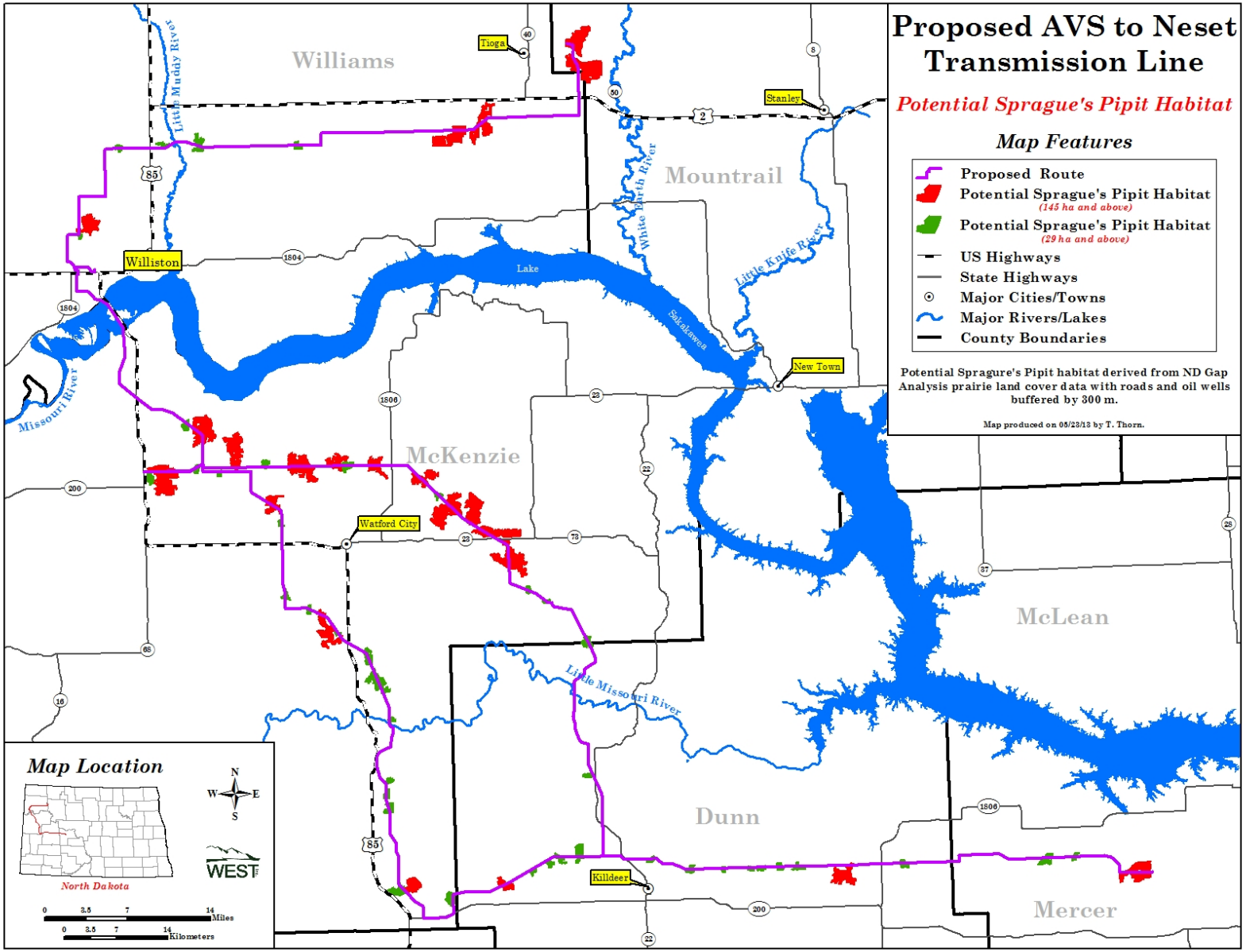

Figure 16. Native grassland parcels greater than 29 ha and 145 ha that could represent Sprague's pipit habitat.

3.10 Dakota Skipper (*Hesperia dacotae*)

Current Status: On 24 October 2013, The Service proposed the Dakota skipper as a threatened species (USFWS 2013g). The Service also proposed a special rule under section 4(d) of the Act that outlines the prohibitions necessary and advisable for the conservation of the Dakota Skipper, if it is listed as a threatened species. The ESA requires that critical habitat be designated to the maximum extent prudent and determinable for species determined to be endangered or threatened species. Therefore, the Service has proposed the designation of critical habitat for the Dakota Skipper (USFWS 2013h).

Habitat: Dakota skipper occurs in two types of habitat (USFWS 2002). The first is relatively flat and moist native bluestem prairie in which three species of wildflowers are usually present and in flower when Dakota skippers are in their adult (flight) stage - wood lily (*Lilium philadelphicum*), harebell (*Campanula rotundifolia*), and smooth camas (*Zygadenus elegans*). The second habitat type is upland (dry) prairie that is often on ridges and hillsides. Bluestem grasses and needlegrasses dominate these habitats and three wildflowers are typically present in high quality sites that are suitable for Dakota skipper: pale purple (*Echinacea pallida*) and upright (*E. angustifolia*) coneflowers and blanketflower (*Gaillardia sp.*). Nectar provides Dakota skipper with both water and food and is crucial for the survival of both sexes during the flight period. Dakota skippers appear to prefer plants, such as purple coneflowers (*Echinacea spp.*), whose nectar cannot be obtained by insect species that do not have a relatively long, slender feeding tube (proboscis). In the absence of preferred plants, Dakota skippers attempt to obtain sufficient nectar from less preferred species.

Of the 38 extant or possibly extant sites in North Dakota, 19 occur within two complexes — Towner-Karlsruhe in McHenry County (13 sites) and Sheyenne Grasslands (6 sites) in Ransom County. The other 19 sites that are presumed extant are isolated. The largest complex in North Dakota is located within McHenry County approximately 70 miles east of the proposed Project area. Figure 17 shows the closest Dakota skipper sites to the proposed Project. Two of these sites were considered extirpated while the third one was listed as vulnerable in 2002 (Figure 17; USFWS 2002). The closest extirpated (unoccupied) site is approximately 3 miles from the proposed Project while the closets vulnerable (currently occupied) site is approximately 6 miles from the proposed Project.

Life History: Dakota skippers have four basic life stages - egg, larva, pupa, and adult. During the brief adult (flight) period in June and July, female Dakota skippers lay eggs on the underside of leaves approximately 1-2 inches above the ground. These eggs take about 10 days to hatch into larvae. After hatching, the pale-brown larvae build shelters at or below the ground surface and emerge at night to feed on grass leaves until late summer or early fall when they become dormant. They overwinter as mid-stage larvae in shelters at or just below ground level, typically in the bases of native bunchgrasses. The larvae emerge to continue development the following spring. Pupation takes about 10 days and occurs primarily in June. Males emerge as adults

about five days before females. If they attain maximum longevity of about three weeks and if adequate sources of nectar are available, females may lay up to about 250 eggs.

Action Area: The action area for the Dakota skipper is the proposed transmission line right-of-way (150 ft), lay down areas, and associated facilities within Dunn, McKenzie and Mountrail Counties. Larger tracts of native grassland with the necessary vegetation types along the proposed route will be more likely to contain suitable Dakota skipper habitat.

3.10.1 Direct Effects

Potential direct effects to the Dakota skipper posed from the proposed Project include direct mortality of adults, the removal or destruction of eggs or larvae, and the loss of habitat due to construction of the proposed transmission line and associated infrastructure if construction occurs within occupied habitat.

Native prairie habitats containing bluestem-needle grass, needlegrass and little bluestem communities, as identified in GAP data, were considered suitable Dakota skipper habitat in reviewing the action area impacts on the species. North Dakota Gap land cover data indicates there is approximately 1,654 acres of native prairie within the action area. Of this total acreage, slightly more than 526 acres would be considered Dakota skipper habitat (bluestem-needlegrass-wheatgrass transition prairie and little bluestem bunch grass prairie).

Within the action area there is approximately 130 acres of these communities with some potential for direct impact, assuming a five m wide disturbance on average between structures (see example in Figure 7) and a 150 foot diameter circle centered on the structures. This area could be temporarily disturbed during construction activities by construction equipment driving between structures and building towers, essentially creating a temporary two-track road. A very small amount of suitable habitat, approximately 0.05 acre, will be permanently lost due to installation and operation of the proposed Project by placement of tower structures.

Given the already isolated and fragmented state of the existing native prairie habitats in the proposed Project area, and small amount of both temporary and permanent impacts within the action area, the proposed Project would be expected to have minimal or insignificant direct effects on the Dakota skipper.

3.10.2 Indirect Effects

The proposed Project would not be expected to have indirect effects on Dakota skipper.

3.10.3 Cumulative Effects

No known populations of Dakota skipper occur within the action area and limited suitable habitat is within the action area. The proposed Project would not be expected to add further cumulative stressors to the species during implementation due to increased noise, direct impacts, or other factors that may impact the species.

3.10.4 Determination

Based on the preceding discussion, it is determined that the proposed Project **may affect, but is not likely to adversely affect** the Dakota skipper. In addition, the proposed Project will have **no effect** on critical habitat.

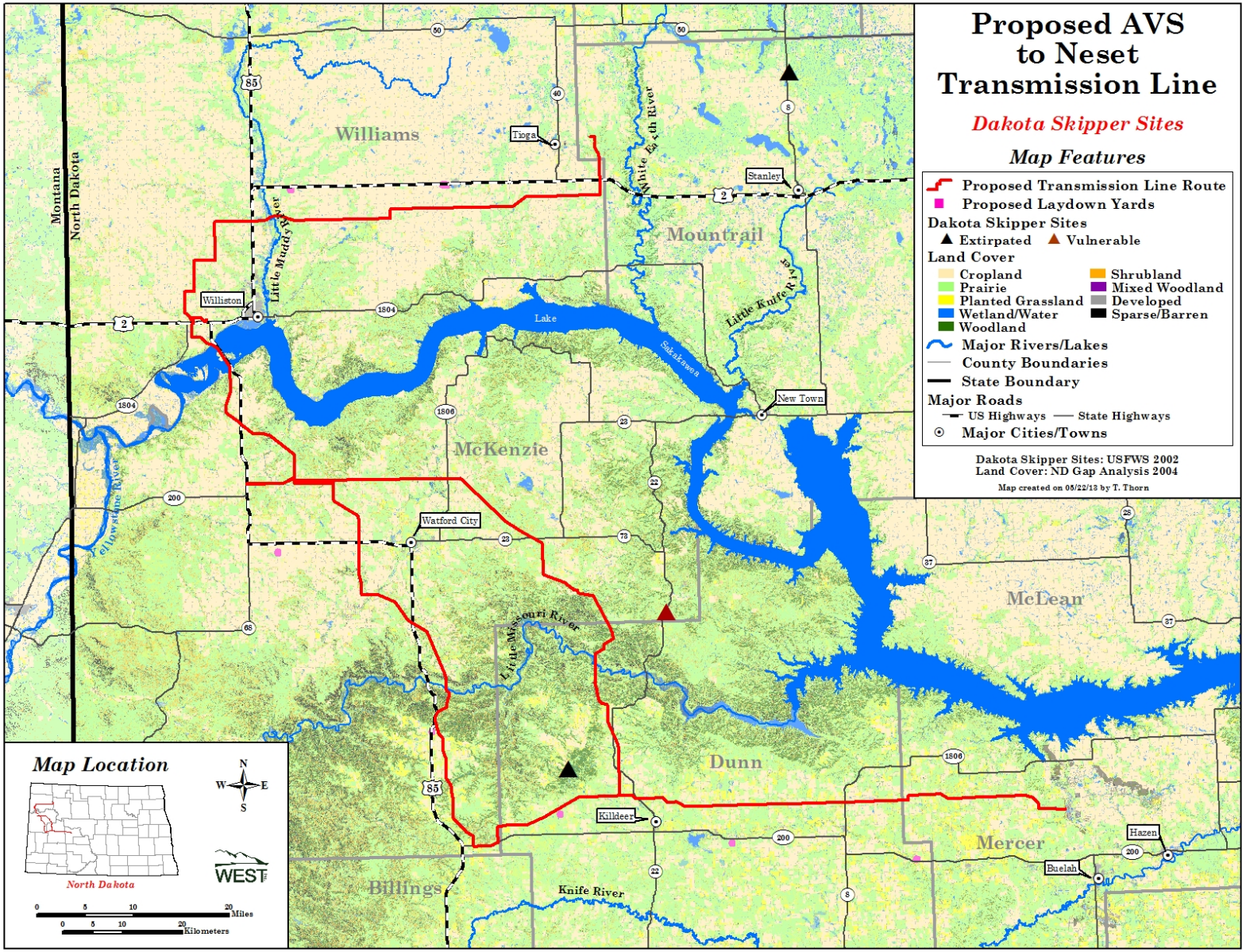

Figure 17. Locations of Dakota skipper in relation to AVS-Neset transmission line Project.

3.11 Rufa Red Knot (*Calidris canutus rufa*)

Current Status: The rufa subspecies of the red knot is proposed for listing as threatened (Service 2013e). Primary threats to the continued existence of this species include climate change as it relates to sea rise, weather patterns, and prey abundance as well as coastal development and shoreline stabilization. In North Dakota, the main threat would be loss of migratory stopover wetlands.

Habitat: The red knot is a long-distance migrant which breeds in the Canadian Artic and winters as far south as coastal Argentina. They can also be found wintering along the northwest Gulf of Mexico, coastal areas from North Carolina to Florida, the Caribbean, and coastal northern South America. Red knots occur mainly along ocean coasts during migration but have been documented in most U.S. states. Little if any information is available on these non-coastal migratory stopover habitats (Service 2013x). Based on energy requirements of long-distance migratory bird species, it would seem likely that red knot stop-over areas would contain abundant food resources.

Life History: This medium-sized shorebird (9 to 11 inches long) is a molluscivore which will supplement its' hard shell diet with softer invertebrate prey. However, during the breeding season, their diet consists of insects. They breed in June (one clutch of four eggs), with nests located in dry, elevated tundra near artic coasts and freshwater wetlands. Although not well documented, it appears breeding female red knots leave the breeding grounds in mid-July, shortly after the eggs hatch, followed by adult males approximately a month later and juveniles shortly thereafter (Service 2013x). Major fall migration stopover areas include southwest Hudson Bay, the U.S. Northeast coast and the northern coast of South America but can be found in various numbers all along the U.S. Atlantic coast and the Caribbean. During spring migration, important stopover habitat includes the South American Atlantic coast, the Virginia barrier islands and Delaware Bay. Nonbreeding red knots (probably one year olds) remain south of the breeding grounds and may be observed in small numbers in the Northern Plains (possibly North Dakota). Of the known red knot wintering areas, all have birds present from December to February but may have birds show up as early as September and stay as late as May.

Action Area: The action area for the red knot is a one half mile corridor on either side of the proposed transmission line, one half mile radius circle around the lay down areas, and associated facilities.

3.8.1 Direct Effects

Although unlikely, direct impacts to red knots could be in the form of collision with the overhead lines. The risk of collision could be reduced by the installation of visual line marking devices on the static wires of the new transmission line as described in Section 1.4 for other wetland related species (least tern, piping plover, and whooping crane). Since no work is planned to occur within wetland areas, no direct affects would occur during construction.

3.8.2 Indirect Effects

Based on existing information, the proposed Project would have no indirect effects on red knots.

3.8.3 Cumulative Effects

The proposed Project lies within an area undergoing rapid oil and gas development along with a shift in agriculture practices (row crop production). These activities are impacting wetlands in general. Climate change is also expected to impact the red knot, especially in its' breeding habitat and coastal migratory and wintering areas (Service 2013e). The impact of climate change to inland red knot habitat is unclear. With proposed line marking for other wetland related species (least tern, piping plover, and whooping crane) and no planned construction in wetland habitat, it is unlikely this project will have a cumulative effect on this species

3.8.4 Determination

Based on the preceding discussion, it is determined that the proposed Project **may affect, but is not likely to adversely affect** the red knot.

4.0 Summary of Determination

The determination of effect (Table 3) is based upon the proposed Project as described in this BA, using information collected by BEPC, information available from public sources, and data provided by state and federal agencies and others. Avoidance and minimization measures have been identified to minimize the proposed Project effects on threatened, endangered, and candidate species and critical habitat.

Proposed Project changes that would require a re-evaluation of effects upon these species include, but may not be limited to:

- Inability or failure to implement one or more of the mitigation measures outlined in this assessment;
- Substantive changes in the proposed design or construction methods that increase adverse effects upon listed species or critical habitat beyond what has been disclosed in this assessment;
- Unknown or previously unaddressed listed species or their habitats are discovered in the action area and cannot be avoided.

Table 3. Summary of Candidate, Threatened, and Endangered Species and Critical Habitat in the Action Area.

Species	Presence in Action Area	Summary of Effects	Determination of Effect
Interior least tern (*Sternula antillarum*)	Least terns may pass through the action area during migrations, but is not known to currently nest within or near the action area, including the Missouri River.	A direct effect to least terns could occur in the event of a collision with the transmission line. Line marking will be done in these areas to minimize potential for line strike.	May affect, but is not likely to adversely affect.
Piping plover (*Charadrius melodus*)	Piping plovers may pass through the action area during migrations. The species is not known to currently nest within or near the action area at the Missouri River or elsewhere.	A direct effect to piping plovers could occur in the event of a collision with the transmission line. Line marking will be done in these areas to minimize potential for line strike.	May affect, but is not likely to adversely affect.
Piping plover critical habitat	The proposed Project crosses over designated critical habitat for piping plovers at the Missouri River. No other areas of critical habitat are near the action area.	No direct effect to the primary constituent elements of critical habitat (e.g., bare sandbars, open water) are anticipated.	May affect, but is not likely to adversely affect.
Whooping crane (*Grus americana*)	No on-the-ground whooping crane use has been documented within the action area, but whooping cranes will migrate over the proposed Project each spring and fall. Suitable habitat is crossed by the proposed Project.	A direct effect to the whooping crane could occur in the event of a collision with the proposed Project. Line marking will be done in these areas to minimize potential for line strike.	May affect, but is not likely to adversely affect.
Pallid sturgeon (*Scaphirhynchus albus*)	Species may be present in the action area at the Missouri River crossing.	Implementation of BMP's will avoid runoff and other contaminates reaching the river, avoiding potential impacts.	No effect
Black-footed ferret (*Mustela nigripes*)	No black-footed ferrets are known to occur within the action area.	No effects are anticipated	No effect
Gray wolf (*Canis lupus*)	Gray wolves have been documented in the region of the action area within the last 25 years.	No direct or indirect impacts to the species are anticipated.	No effect
Northern long-eared bat (*Myotis septentrionalis*)	No hibernacula known in North Dakota; possible roosting and foraging sites. Possible hibernacula may be identified through survey work and will be avoided.	Implementation of avoidance limits direct and indirect effects.	May affect, but is not likely to adversely affect.

Species	Presence in Action Area	Summary of Effects	Determination of Effect
Sprague's pipit (*Anthus spragueii*)	Suitable habitat for Sprague's pipit is within the action area and the species may occur in any of these parcels. The species may migrate through the action area.	A direct effect to the Sprague's pipit could occur in the event of a collision with the proposed Project. Further fragmentation of habitat due to operation of the proposed Project is not anticipated. Line marking will be done in these areas to minimize potential for line strike.	May affect, but is not likely to adversely affect.
Dakota skipper (*Hesperia dacotae*)	Suitable habitat for Dakota skipper is within the action area.	Direct effects to Dakota skipper could occur by crushing individuals during construction. No impacts during operations are anticipated.	May affect, but is not likely to adversely affect. No effect to critical habitat.
rufa red knot *(Calidris canutus rufa)*	Suitable habitat for the red knot is potentially within the action area.	A direct effect to red knots could occur in the event of a collision with the transmission line. Line marking being done for other wetland related species will minimize potential for line strike	May affect, but is not likely to adversely affect.

5.0 Literature Cited

50 Code of Federal Regulations (CFR) 17. 2002. Title 50 - Wildlife and Fisheries, Chapter I -United States Fish and Wildlife Service, Department of the Interior, Subchapter B - Taking, Possession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of Wildlife; Part 17 - Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Northern Great Plains Breeding Population of the Piping Plover; Final Rule. 67 Federal Register (FR) 176: 57638-57717. September 11, 2002.

Avian Power Line Interaction Committee (APLIC). 2006. Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006. Public Interest Energy Research Program (PIER) Final Project Report CEC-500-2006-022. Edison Electric Institute, APLIC, and the California Energy Commission. Washington D.C. and Sacramento, California.

Avian Power Line Interaction Committee (APLIC). 2012. Reducing Avian Collisions with Power Lines: The State of the Art in 2012. Edison Electric Institute and APLIC, Washington D.C. .

Bryce, S., J.M. Omernik, D.E. Pater, M. Ulmer, J. Schaar, J. Freeouf, R. Johnson, P. Kuck, and S.H. Azevedo. 1998. Ecoregions of North Dakota and South Dakota. Northern Prairie Wildlife Research Center (Npwrc) Online. Jamestown, North Dakota South Dakota Ecoregion Map, US Geological Survey (USGS) NPWRC. Modifed August 3, 2006. Ecoregions of North Dakota and South Dakota: http://www.npwrc.usgs.gov/resource/habitat/ndsdeco/index.htm (Version 30NOV1998). South Dakota Ecoregion Map: http://www.npwrc.usgs.gov/resource/habitat/ndsdeco/sodak.htm

Canadian Wildlife Service (CWS) and US Fish and Wildlife Service (USFWS). 2007. International Recovery Plan for the Whooping Crane. Third Revision. Ottawa: Recovery of Nationally Endangered Wildlife (RENEW) and USFWS, Albuquerque, New Mexico. 162 pp.

CBD Center for Biological Diversity, 2010, Petition to List the Eastern Small-footed Bat (*Myotis leibii*) and Northern Long-eared Bat (*Myotis septentrionalis*) as Threatened or Endangered Under the Endangered Species Act. Prepared for the U.S. Department of the Interior, Secretary of the Interior. January 2010.

CBD Center for Biological Diversity, 2013, “White-Nose Syndrome and Bat Hibernation Areas,” Available at http://www.biologicaldiversity.org/campaigns/bat_crisis_white-nose_syndrome/map.html. Accessed 6 January 2014January 2014.

Clark, Ross. 2013. Personal communication from Clark, Professional Electrical Engineer, Western Area Power Administration.

Clean Water Act (CWA). 1972. Clean Water Act. October 18, 1972. 33 United States Code § 1251-1387, 1251 et seq., 2000.

Davis, S.K. 2004. Area Sensitivity in Grassland Passerines: Effects of Patch Size, Patch Shape, and Vegetation Structure on Bird Abundance and Occurrence in Southern Saskatchewan. Auk 121: 1130-1145.

Elliot-Smith, E., S.M. Haig, and B.M. Powers. 2009. Data from the 2006 International Piping Plover Census. US Geological Survey (USGS) Data Series 426. 332 pp.

Endangered Species Act (ESA). 1973. 16 United States Code (USC) § 1531-1544, Public Law (PL) 93-205, December 28, 1973, as amended, PL 100-478 [16 USC 1531 *et seq.*]; 50 Code of Federal Regulations (CFR) 402.

ESRI. 2013. Geographic Information System (GIS) Online Topographic Base Map. ESRI, producers of ArcGIS software. Redlands, California.

Howlin, S, C.Derby, and T.Thorn. 2013. AVS-Neset Transmission Line Whooping Crane Resource Selection Function Analysis. Western EcoSystems Technology, Inc. (WEST).

Humphries, M.M., D.W. Thomas, and J.R. Speakman. 2002. Climate mediated energetic constraints on the distribution of hibernating mammals. Nature 418:313–316

Institute of Electrical and Electronics Engineers (IEEE). 2012. National Electrical Safety Code ® (Nesc). http://standards.ieee.org/about/nesc/

Institute of Electrical and Electronics Engineers Standards Association. 2012. National Electrical Safety Code. Available at: http://standards.ieee.org/about/nesc/index.html.

IS (Integrated System). 2011. Eastern Montana/Western North Dakota Load Serving Study facility Additions Justification-August 2011.

Jones, S.L. 2010. Sprague's Pipit (*Anthus spragueii*) conservation plan. U.S. Department of Interior, Fish and Wildlife Service, Washington, D.C.

Jones, S.L. 2010. Sprague's Pipit (*Anthus spragueii*) Conservation Plan. US Department of Interior, Fish and Wildlife Service, Washington, D.C. Available online at: http://www.fws.gov/mountain-prairie/species/birds/spraguespipit/SpraguesJS2010r4.pdf

Journey North. 2012. Analyzing the Whooping Crane Population Data. Whooping Crane, Journey North. Available online at: http://www.learner.org/jnorth/tm/crane/Population.html

Klungle, M.M. and M.W. Baxter. 2005. Lower Missouri and Yellowstone Rivers Pallid Sturgeon Study. Montana Fish, Wildlife and Parks. Report to Western Area Power Administration, Fort Peck.

Licht, D.S. and S.H. Fritts. 1994. Gray Wolf (Canis lupus) Occurrences in the Dakotas. American Midland Naturalist 132(1): 74-81.

Linnen, C. 2008. The Effects of Oil and Gas Development on Grassland Birds. Prepared for Petroleum Technology Alliance Canada. Prepared by Northern EnviroSearch Ltd., Saskatoon, Saskatchewan. January 2008.

Licht, D.S. Relationship of Hydrological Conditions and Populations of Breeding Piping Plovers. The Prairie Naturalist 33(4).

Lott, C.A. 2006. Distribution and Abundance of the Interior Population of the Least Tern (*Sternula Antillarum*), 2005: A Review of the First Complete Range-Wide Survey in the Context of Historic and Ongoing Monitoring Efforts. ERDC/EL TR-06-13. Dredging Operations and Environmental Research Program. US Army Corps of Engineers(USACE), Engineer Research and Development Center. Prepared for the USACE, Washington, D.C. Monitored by US Army Engineer Research and Development Center, Vicksburg, Massachusetts. November 2006. Available online at: http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA461429&Location=U2&doc=GetTRDoc.pdf

Lott, C.A. and R.L. Wiley. 2012. Effects of Dam Operations on Least Tern Nesting Habitat and Reproductive Success Below Keystone Dam on the Arkansas River. ERDC/EL TR-11-xx. US Army Corps of Engineers(USACE), Engineer Research and Development Center, Vicksburg, Massachusetts.

Louisiana Department of Wildlife and Fisheries (LDWF). 2010-2012. Whooping Cranes. Information available online at: http://www.wlf.louisiana.gov/category/news/whooping-cranes

Melcher, C.P., S.K. Skagen, and L. Randall. 2006. Use of NEXRAD to Study Shorebird Migration in the Prairie Pothole Region: A Feasibility Study. Open File Report 2006-1033. Biological Resources Disipline, US Geological Survey (USGS). 11 pp.

Montana Field Guide. 2012. Gray Wolf - *Canis lupus*. Montana Natural Heritage Program and Montana Fish, Wildlife and Parks. Retrieved on March 21, 2012, from http://FieldGuide.mt.gov/detail_AMAJA01030.aspx

Morkill, A.E. and S.H. Anderson. 1991. Effectiveness of Marking Powerlines to Reduce Sandhill Crane Collisions. Wildlife Society Bulletin 19(4): 442-449.

North Dakota (ND) GAP Analysis. 2004. North Dakota GAP Analysis Project.

Owen, S., M.A. Menzel, M.W. Ford, B.R. Chapman, K.V. Miller, J. Edwards, and P. Wood, 2003, "Home-range size and habitat use by northern Myotis (*Myotis septentrionalis*)," American Midland Naturalist 150:352-359.

Pearson, D. No Date. Calumet to Comanche Transmission Line Project, Magnetic Fields and Audible Noise. Report prepared by Xcel Energy, Transmission Engineering and Design.

Robbins, M.B. 1998. Display Behavior of Male Sprague's Pipits. Wilson Bulletin 110: 435-438.

Sherfy, M.H., Anteau, M.J., Shaffer, T.L., Sovada, M.A., and Stucker, J.H., 2012, Foraging ecology of least terns and piping plovers nesting on Central Platte River sandpits and sandbars: U.S. Geological Survey Open-File Report 2012–1059, 50 p.

Stehn, T.V. and T. Wassenich. 2007. Whooping Crane Collisions with Power Lines: An Issue Paper. Proceedings of the North American Crane Workshop, 2006.

Tigner, J., and E.D. Stukel, 2003, "Bats of the Black Hills: A Description of Status and Conservation Needs," South Dakota Department of Game, Fish, and Parks. Wildlife Division Report 2003-05. 94 pp.

Texas Parks and Wildlife Department (TPWD). 2012. Interior Least Tern (*Sterna antillarum athalassos*). TPWD, Austin, Texas. Accessed November 2012. Available online at: http://www.tpwd.state.tx.us/huntwild/wild/species/leasttern/

US Department of Agriculture (USDA). 2009. Design Manual for High Voltage Transmission Lines. Bulletin 1724E-200. USDA Rural Utilities Service (RUS), Electric Staff Division. . Revised May 2009. Available online at: http://www.rurdev.usda.gov/SupportDocuments/UEP_Bulletin_1724E-200.pdf

US Fish and Wildlife Service (USFWS). 1987. Northern Rocky Mountain Wolf Recovery Plan. Prepared by the USFWS in cooperation with the Northern Rocky Mountain Wolf Recovery Team. August 3, 1987.

US Fish and Wildlife Service (USFWS). 1988a. Black-Footed Ferret Recovery Plan. USFWS, Denver, Colorado. Original approval June 14, 1978. August 8, 1988. 154 pp.

US Fish and Wildlife Service (USFWS). 1988b. Recovery Plan for the Great Lakes and Northern Great Plains Piping Plover. Prepared by the Great Lakes/Northern Great Plains Piping Plover Recovery Team. Available online at: http://ecos.fws.gov/docs/recovery_plan/880512.pdf

US Fish and Wildlife Service (USFWS). 1989. Black-Footed Ferret Survey Guidelines for Compliance with the Endangered Species Act. USFWS. Denver, Colorado and Albuquerque, New Mexico.

US Fish and Wildlife Service (USFWS). 1990. Recovery Plan for the Interior Population of the Least Tern (*Sterna antillarum*). Prepared by the USFWS Grand Island, Nebraska, and Twin Cities, Minnesota. September 1990. Available online at: http://ecos.fws.gov/docs/recovery_plan/900919a.pdf

US Fish and Wildlife Service (USFWS). 1993. Pallid Stugeon Recovery Plan. Prepared by the Pallid Sturgeon Recovey Team, USFWS, Bismarck, North Dakota, and Denver, Colorado. November 7, 1993.

US Fish and Wildlife Service (USFWS). 2002. Status Assessment and Conservation Guidelines, Dakota Skipper. USFWS Twin Cities Field Office, Bloomington, Minnesota.

US Fish and Wildlife Service (USFWS). 2010a. Species Status and Fact Sheet: Whooping Crane. North Florida Ecological Services Office, Southeast Region, USFWS. Updated November 12, 2010. Available online at: http://www.fws.gov/northflorida/WhoopingCrane/whoopingcrane-fact-2001.htm

US Fish and Wildlife Service (USFWS). 2010b. Sprague's Pipit (*Anthus spragueii*). Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions; Proposed Rule. 75 Federal Register, 69222-69294.

US Fish and Wildlife Service (USFWS). 2011a. Black-Footed Ferret - Mustela nigripes - Endangered. J. Clark Salyer National Wildlife Refuge, USFWS Mountain-Prairie Region. April 28, 2011.

US Fish and Wildlife Service (USFWS). 2011b. Endangered and Threatened Wildlife and Plants; Reissuance of Final Rule to Identify the Northern Rocky Mountain Population of Gray Wolf as a Distinct Population Segment and to Revise the List of Endangered and Threatened Wildlife. 76 Federal Register 87: 25590-25592.

US Fish and Wildlife Service (USFWS). 2012a. Lower 48-State and Mexico Gray Wolf (*Canis lupus*) Listing, as Revised; 5-Year Review: Summary and Evaluation. USFWS Washington Office, Arlington, Virginia. February 29, 2012.

US Fish and Wildlife Service (USFWS). 2012b. Species Profile: Piping Plover (*Charadrius melodus*). USFWS Envionmental Conservation Online System (ECOS). Accessed November 2012. ECOS available at: http://ecos.fws.gov/ecos/indexPublic.do; Piping plover profile available online at: http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B079

US Fish and Wildlife Service (USFWS). 2013a. Final Designation of Critical Habitat for Breeding Piping Plovers in North Dakota. North Dakota Field Office, Mountain-Prairie Region, USFWS. Updated February 19, 2013. Unit information available online at: http://www.fws.gov/northdakotafieldoffice/GIS/ppcrithab/ND/ndcrithab.htm

US Fish and Wildlife Service (USFWS). 2013b. Least Tern (*Sterna antillarum*). North Dakota Field Office, Mountain-Prairie Region, USFWS. Updated February 19, 2013. Available online at: http://www.fws.gov/northdakotafieldoffice/endspecies/species/least_tern.htm

US Fish and Wildlife Service (USFWS). 2013c. Species Profile: Whooping Crane (*Grus americana*). USFWS Envionmental Conservation Online System (ECOS). Updated March, 2013. ECOS available at: http://ecos.fws.gov/ecos/indexPublic.do; Whooping crane profile available online at: http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B003

US Fish and Wildlife Service, 2013d, "Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to List the Eastern Small-Footed Bat and the Northern Long-eared Bat as Endangered or Threatened Species; Listing the Northern Long-eared Bat as an Endangered Species; Proposed Rule," *Federal Register* 78: 61046-61080.

US Fish and Wildlife Service, 2013e, "Endangered and Threatened Wildlife and Plants; Proposed Threatened Status for the Rufa Red Knot (*Calisris canutus rufa*); Proposed Rule," *Federal Register* 78: 60024-60098.

US Fish and Wildlife Service, 2013f, "Rufa Red Knot Ecology and Abundance: SUPPLEMENT TO Endangered and Threatened Wildlife and Plants; Proposed Threatened Status for the Rufa Red Knot (*Calisris canutus rufa*). Available at http://www.regulations.gov/#!documentDetail;D=FWS-R5-ES-2013-0097-0004

USFWS. 2013g. Endangered and Threatened Wildlife and Plants; Threatened Status for the Dakota Skipper and Endangered Status for Poweshiek Skipperling. Federal Register 78(206): 63574-63625.

USFWS. 2013h. Endangered and Threatened Wildlife and Plants; Designation of Critical habitat for the Dakota Skipper and Poweshiek Skipperling. Federal Register 78(206): 63625-63627.

Western Area Power Administration. 2012. Williston to Stateline 115 kV Transmission Line Project: Biological Assessment. January 2012.

Appendix A. Whooping Crane RSF Analysis Report

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AVS-Neset Transmission Line

Whooping Crane Resource Selection Function Analysis

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July 3, 2013

NATURAL RESOURCES ◆ SCIENTIFIC SOLUTIONS

INTRODUCTION

A Resource Selection Function (RSF) was developed from whooping crane use locations archived in the Cooperative Whooping Crane Tracking Project GIS (CWCTP-GIS). The basic premise of resource selection modeling (Manly et al. 2002) is that resources (which may be food items, land cover types, or any quantifiable habitat characteristic) that are important to individual whooping cranes will be "used" disproportionately to the availability of those resources in the environment. In this analysis, the characteristics at the use locations were contrasted to characteristics at randomly selected "available" locations in the study area. Standard logistic regression models were developed to estimate a linear function of site characteristics that reliably predicts observed use. The model produces estimates of the relative probability of use at a location in the study area, as a function of the sites' characteristics (Manly et al. 2002).

One of the objectives of this analysis was to compare areas crossed by the transmission line to areas at varying distances from the transmission line as part of the Biological Assessment. Also, the analysis will be used to help identify areas of low potential use for informing a line marking plan to be implemented to minimize potential impacts to whooping cranes.

STUDY AREA

The overall study area for the RSF model was an 18 mile (mi) buffer (36 mile total width) either side of the proposed approximately 276 mi transmission line. The overall study area polygon for the RSF analysis encompasses 8,075 square miles (mi^2; Figure 1). The study area was expanded from an original analysis done to include the updated transmission line defined in May 2013. The study area encompasses both the transmission line and the area potentially impacted by the transmission line and contains a sufficient number of whooping crane observations to enable model parameterization.

A 6 mile buffer surrounding the transmission line (12 mile total width), was also defined for use as a comparison area. Additional summaries were made for a 1 mile buffer (2 mile total width) surrounding the transmission line.

METHODS

The CWCTP-GIS database through fall of 2010 was parsed to include confirmed whooping crane groups detected between 1970 and 2010 on the ground. Sightings of whooping crane groups were taken as one independent observation since crane groups travelling together do not make independent selections of stopover locations. It is assumed that the habitat characteristics of the whooping crane locations in this dataset represent the habitat characteristics that would be used by a random sample of whooping cranes.

The set of points for the resource selection was obtained through a systematic grid placed at a random location. A grid spacing of 0.25 mi x 0.25 mi resulted in 130,504 grid cells. Forty-five of the grid cells contained at least one whooping crane observation.

RSF models predict the probability of detecting a whooping crane group at a location as a function of habitat characteristics of the location (Manly et al. 2002) compared to those characteristics from the know whooping crane use locations. RSFs were estimated using the standard logistic regression model to predict the probability of the species being detected at a sampled site, Π, as a function of p variables X1, X2, ..., Xp that describe the habitat at the site. The form of a logistic regression model is

$$\Pi(x_1,x_2,...,x_p) = \exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_p X_p)$$

where the β values are parameters that are estimated from the data (McCullagh and Nelder 1989).

Variables that have been identified in the literature as being associated with whooping crane habitat were selected a priori. Other variables may be important in predicting probability of use, but the analysis was limited to existing Geographic Information System (GIS) datasets available for the study area. The variables calculated to represent habitat characteristics are given below. Using a GIS, values were extracted for each study area point for the following variables:

- distance to whooping crane migration corridor centerline
- distance to nearest road
- length of roads within two mi and five mi
- distance to centerline of the Missouri and Yellowstone Rivers
- distance to nearest wetland (National Wetlands Inventory; NWI)
- area of all wetlands (NWI) within two mi and five mi
- National Land Cover Database (NLCD) habitat class at centerpoint of gird cell
- distance to nearest cropland
- area of cropland
- area of shrub
- area of water
- area of urban
- distance to closest water
- distance to closest urban

We also considered the quadratic effect for all distance variables, to allow for a non-linear relationship between frequency of use and these variables. The NLCD (Fry et al. 2011) was the source for habitat classes while NWI (USFWS 2012) data was used for wetland analysis. The classes were condensed to represent open water, open space and low intensity development, medium and high intensity development, barren, deciduous and evergreen and mixed forests,

shrub/scrub, grassland, pasture/hay, cultivated crops, woody wetlands, and emergent wetlands. The whooping crane migration corridor (Brei et al. 2009) was obtained electronically from Justin Brei in June of 2010.

An objective variable selection procedure, the Akaike Information Criterion (AIC), was used to evaluate each of the models. The AIC is a measure of the goodness of fit of a model that takes into account the number of variables included in the model. Significance of coefficients was evaluated with the model derived standard errors, though the model with the smallest AIC was taken as the final model despite non-significance of some effects. Model selection was not re-computed for the updated study area (which includes the North Killdeer portion of the proposed Project), based on the May 2013 proposed transmission route, because there were no additional whooping crane observations in the study area. Therefore, results were not expected to change.

The direction of the parameter estimate (positive versus negative) indicates whether the relationship between the variable and whooping crane use is positively or negatively correlated. The test for the significance of the parameter estimate, ie. null hypothesis of the parameter estimate equals zero, is summarized with the p-value of the test. The RSF models were used to predict the relative probability of selection for the transmission line relative to the smaller comparison area within the modeled study area.

A map of the predicted relative probability of whooping crane use was generated for the study area based on the RSF model. Percentiles of the predicted values defined the color scale and provide a visual representation of the predictions of the relative probability of use by whooping cranes. The amount of area in each class of the predicted relative probability of use, within 1 mile of the transmission line, was summarized. The median value of the resource section function was estimated for the transmission line and compared to the distribution of the values in the comparison area (McDonald and McDonald 2002).

RESULTS

There were 45 observations of whooping cranes in the study area spanning from 1977 to 2010 (Figure 1). In a given year, there was a range of 0 to 4 observations of a whooping crane group.

The model developed for whooping crane resource selection contained the following variables: area of water, distance to nearest crops, distance to nearest wetland, and length of roads within five miles (Table 1). The coefficients in the model indicate that the probability of use by whooping cranes is associated with increases in larger areas of water and more roads within five miles. The probability of use by whooping cranes is also associated with decreases in distance to crop areas and wetlands defined by NWI. In other words, cells with larger areas of water, more roads, closer to crop areas and containing more wetlands have a higher potential for use by

whooping cranes. The estimated coefficients of the final model are in Table 2. The geographic distribution of each variable in the model is shown in Figures 2 through 5.

The interpretation of the length of roads within 5 miles as a model covariate may be linked to the biases inherent in the whooping crane locational data in the CWCTP-GIS. As the model suggests, there is a higher relative probability of use by whooping cranes for areas with more roads. Since whooping crane locations present in the dataset were obtained through "convenience sampling" and do not constitute a random sample of observations, we suspect that this covariate is acting as a surrogate for unequal sampling effort. Therefore, predictions produced by the RSF model will be able to account for the unequal sample effort, by holding the value of the length of roads within 5 miles constant at the mean level of the covariate (109 km).

The predicted relative probability of use for the entire study area is shown in Figure 6 as well as in Appendix A. The highest relative probabilities of use are represented by the darkest red color while the lowest relative probabilities of use are represented by the lightest red color. This map depicts how the relative probability of use by whooping cranes varies throughout the study area.

In the 1 mile buffered area surrounding the transmission line, there were 114 mi^2 of areas predicted to have high probabilities of use. There were 138 mi^2 of areas predicted to have medium-high use, 144 mi^2 of areas predicted to have medium use, 147 mi^2 of areas predicted to have medium-low use, and 57 mi^2 of areas predicted to have low probability of use (Table 3).

The median value of the predicted relative probability of use was estimated for the grid cells crossed by the transmission line and compared to the distribution of the values in the comparison area. There were 1220 grid cells that were crossed by the transmission line. The median value of the RSF for the cells crossed by the transmission line is equivalent to the 48.03 percentile of the distribution of predicted values in the comparison area (Figure 7). Approximately 52% the study area has higher probability of use than the area crossed by the transmission line, and 48% has lower probability of use by whooping cranes. There is an approximately equal chance that the area crossed by the transmission line will be selected for by whooping cranes versus other areas in the comparison area.

LITERATURE CITED

Brei, J., M. Tacha, A. Bishop, and R. Grosse. 2009. Whooping Crane Migration Corridors 2009 Methods Summary. Unpublished Report.

Burnham, K. P., and D. R. Anderson. 2002. Model selection and multimodel inference, 2nd Edit. Springer, New York, New York, USA.

Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and Wickham, J., 2011. Completion of the 2006 National Land Cover Database for the Conterminous United States, PE&RS, Vol. 77(9):858-864.

Manly, B.F.J., McDonald, L.L., Thomas, D.L., McDonald T.L., and Erickson, W.E. 2002. Resource Selection by Animals: Sample Design and Analysis for Field Studies, 2nd Edit. Kluwer, Dordrecht.

McCullagh, P., and J. A. Nelder. 1989. Generalized linear models. Second edition. Chapman and Hall, Boca Raton, Florida, USA.

McDonald, T.L., and L.L. McDonald (2002) "A New Ecological Risk Assessment Procedure Using Resource Selection Models and Geographic Information Systems", Wildlife Society Bulletin, v30, p. 1015-1021.

U. S. Fish and Wildlife Service. 2012. National Wetlands Inventory website. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. http://www.fws.gov/wetlands/

Table 1. Top 5 models for whooping crane resource selection as ranked by AIC.

	Model	AIC
1	Water area + distance to crop + distance to NWI wetlands + length of roads within 5 mi	751.9
2	Shrub area + water area + distance to crop + distance to NWI wetlands	752.4
3	Developed area + shrub area + distance to NWI wetlands+ length of roads within 5 mi	752.5
4	Shrub area + water area + distance to crop + length of roads within 5 mi	753.5
5	Water area + distance to crop + distance to centerline + length of roads within 5 mi	754.0

Table 2. Parameter estimates of the top model for whooping crane resource selection.

	Estimate	Standard Error	Z value	p-value
(Intercept)	-8.21	0.50	-16.27	<0.0001
Water area (km^2)	14.34	3.71	3.87	0.0001
Distance to crop (km)	-1.46	0.50	-2.91	0.0036
Distance to NWI wetlands (km)	-2.04	0.77	-2.63	0.0085
Length of roads within 5 mi (km)	0.01	0.00	3.04	0.0023

Table 3. Amount of area within 1 mile of the transmission line in each class of the predicted RSF values. There was 600 mi^2 of area within 1 mile of transmission line. The RSF predicts the relative probability of use by whooping cranes.

RSF prediction class	Area within 1 mile of transmission line (mi^2)
5- Highest predicted use	114
4	138
3	144
2	147
1- Lowest predicted use	57

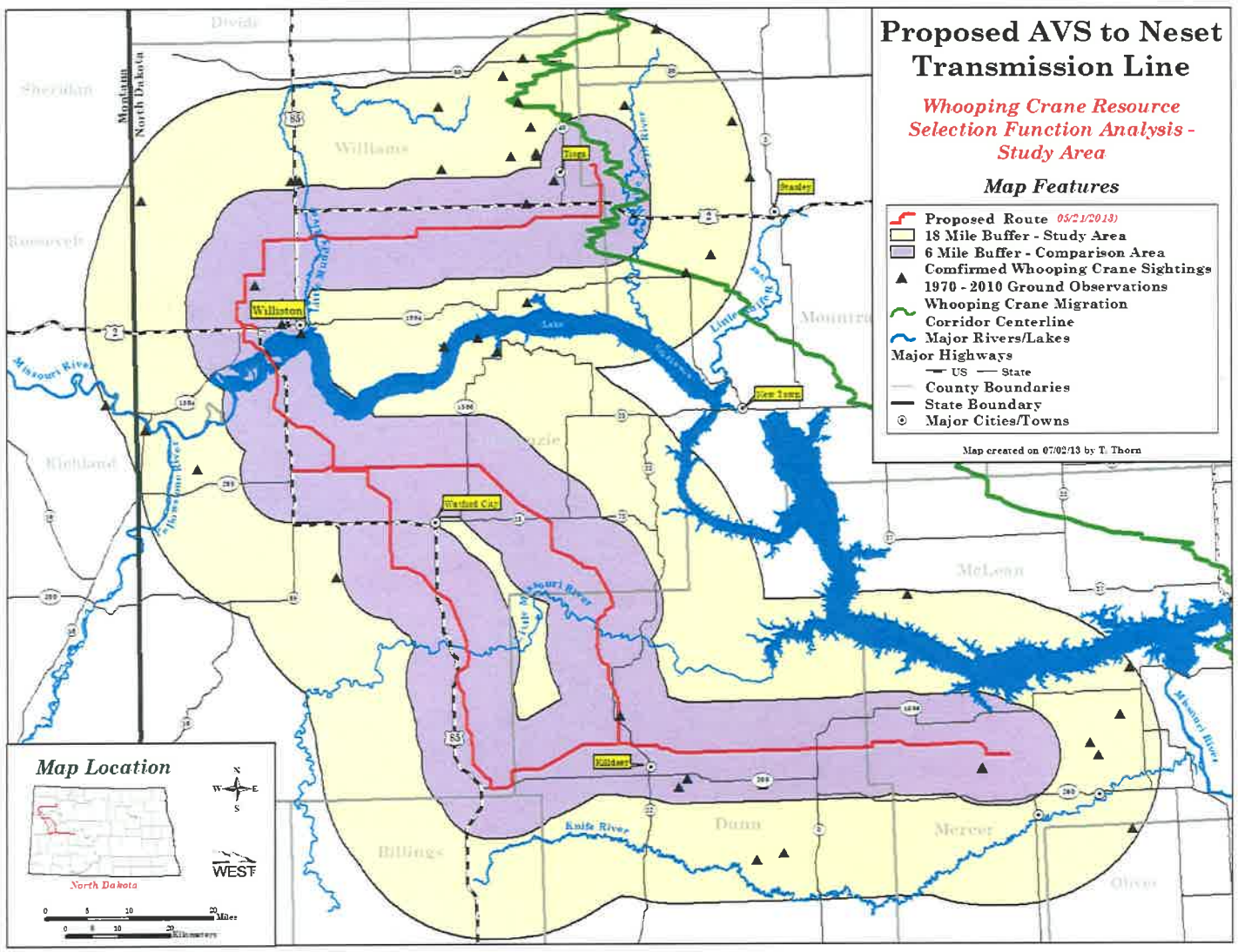


Figure 1. Study area for the whooping crane resource selection analysis.

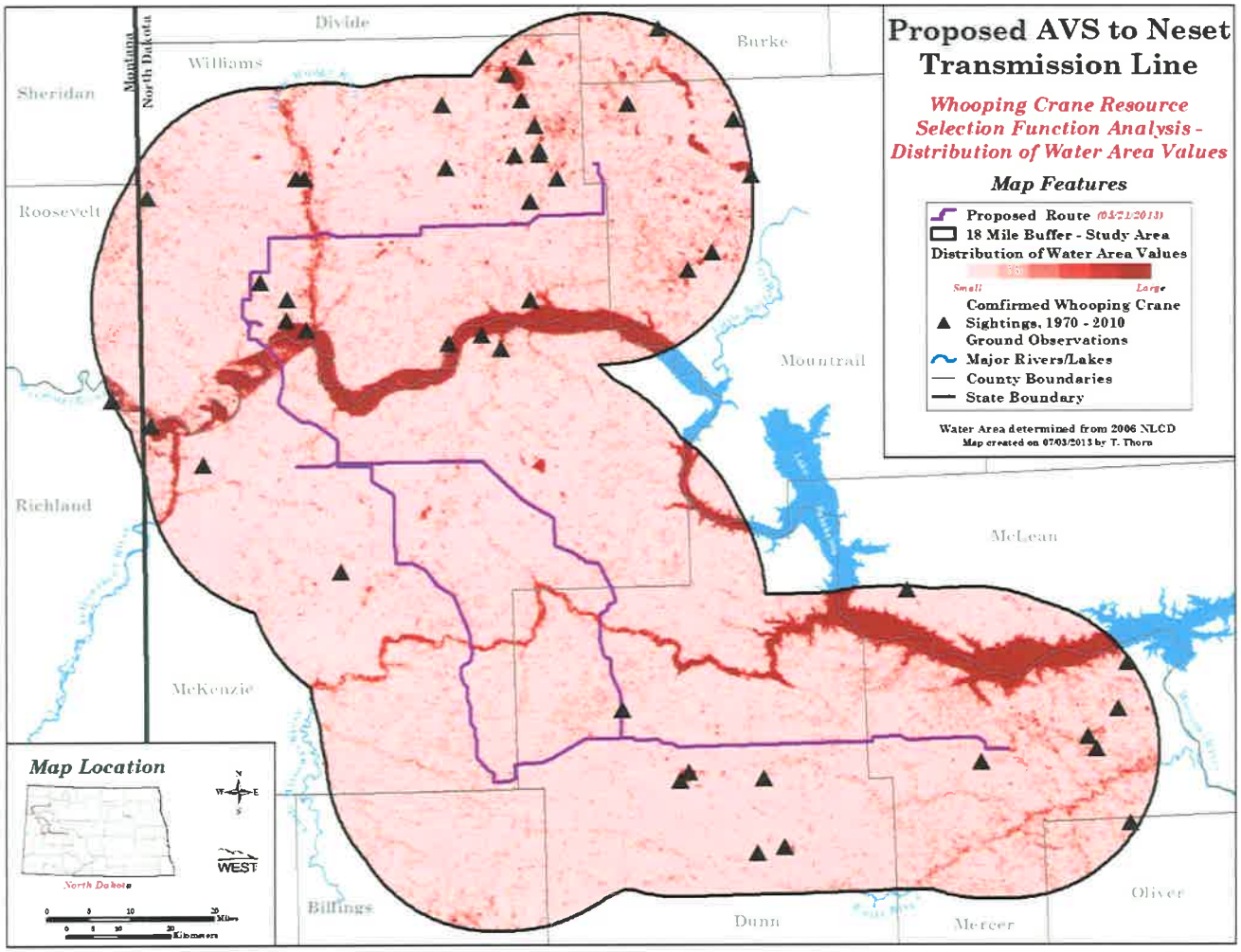


Figure 2. Distribution of values of water area in the study area. Predictions for whooping cranes were based on the variable water area. Areas with large values of water area are represented by red, areas with small values of water area are represented by light pink. Whooping crane observations used in the model are represented by black triangles.

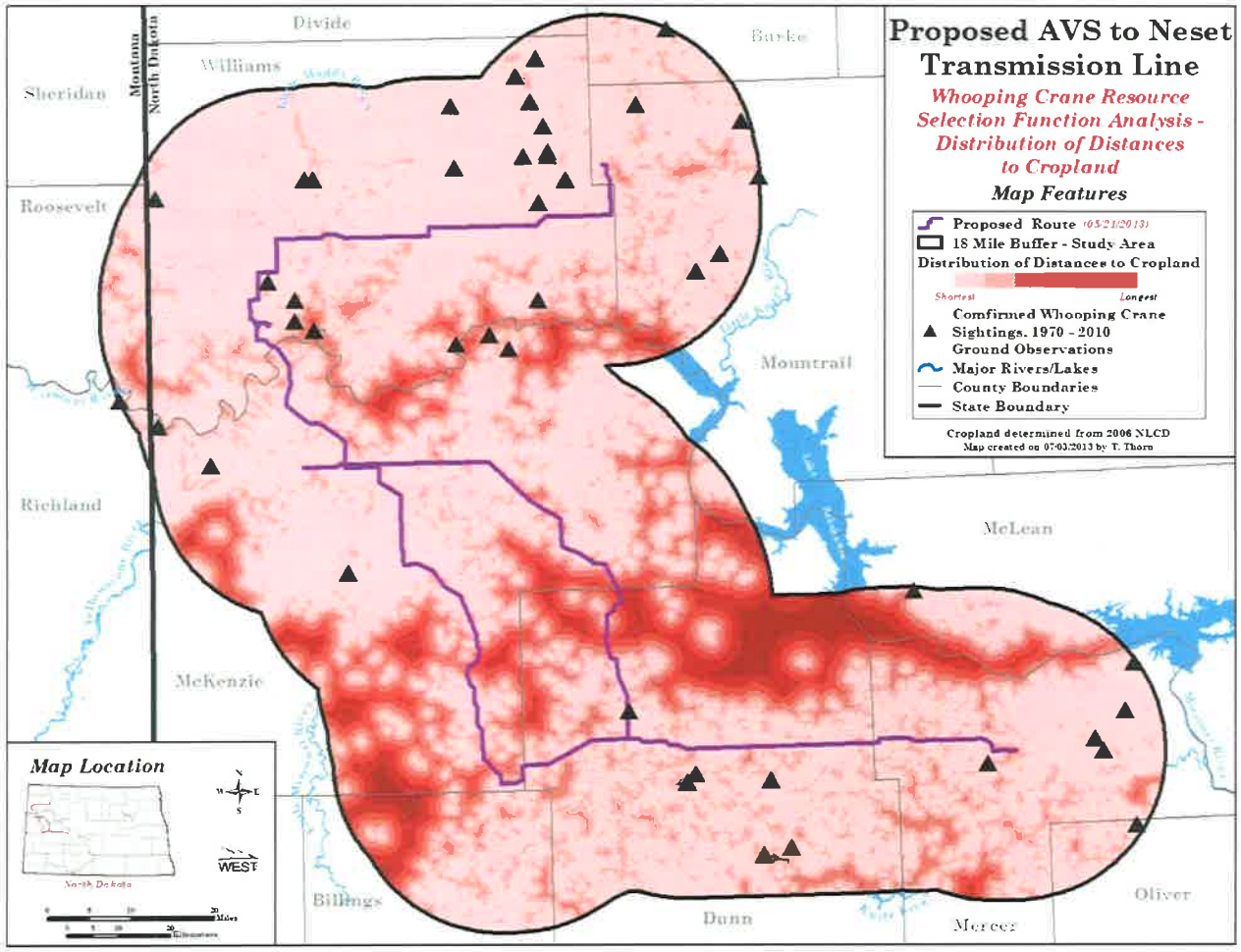


Figure 3. Distribution of values of distance to crop in the study area. Predictions for whooping cranes were based on the variable water area. Areas with large values of distance to crop are represented by red, areas with small values of distance to crop are represented by light pink. Whooping crane observations used in the model are represented by black triangles.

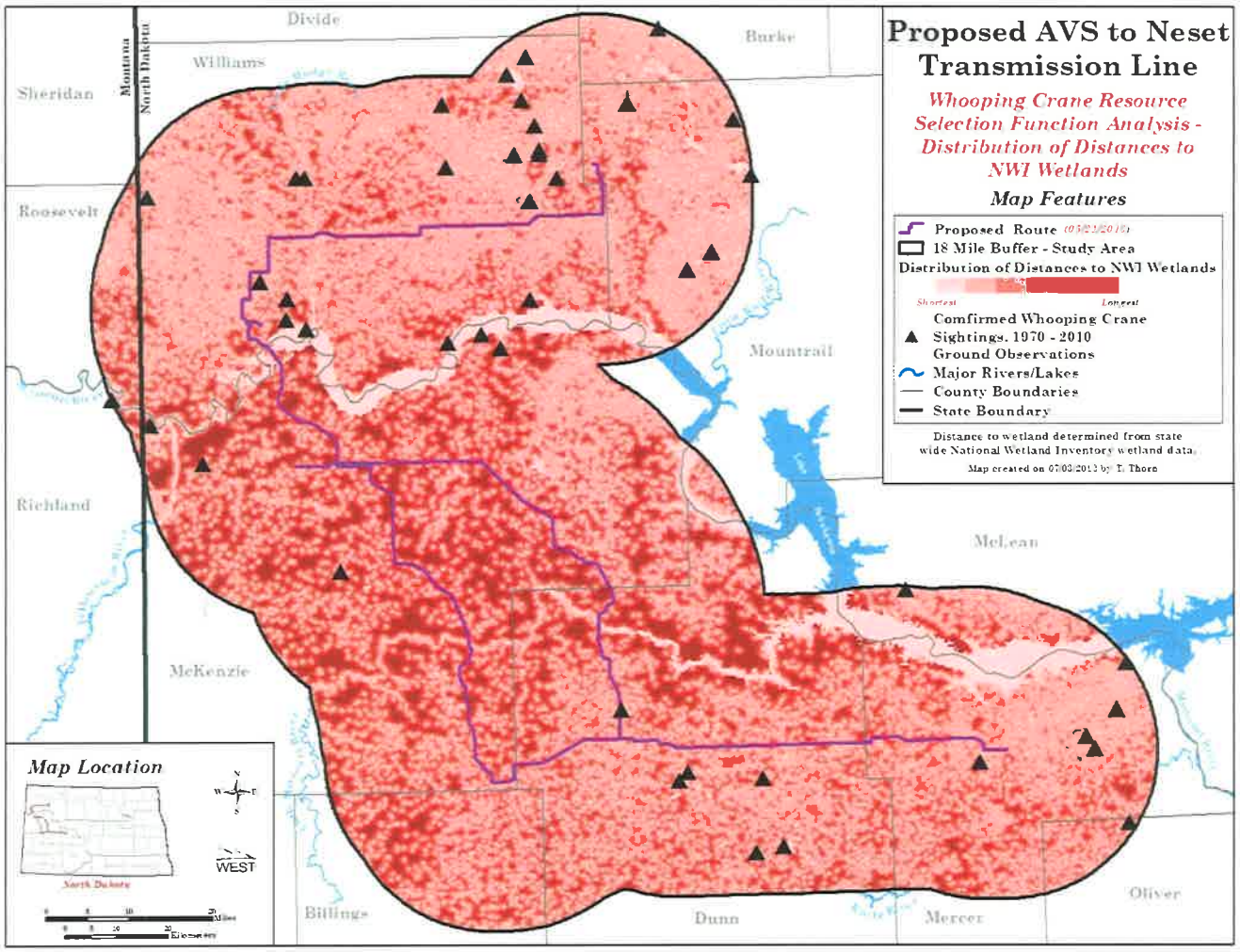


Figure 4. Distribution of values of distance to NWI wetlands in the study area. Areas with large values of distance to NWI wetlands are represented by red, areas with small values of distance to NWI wetlands are represented by light pink. Whooping crane observations used in the model are represented by black triangles.

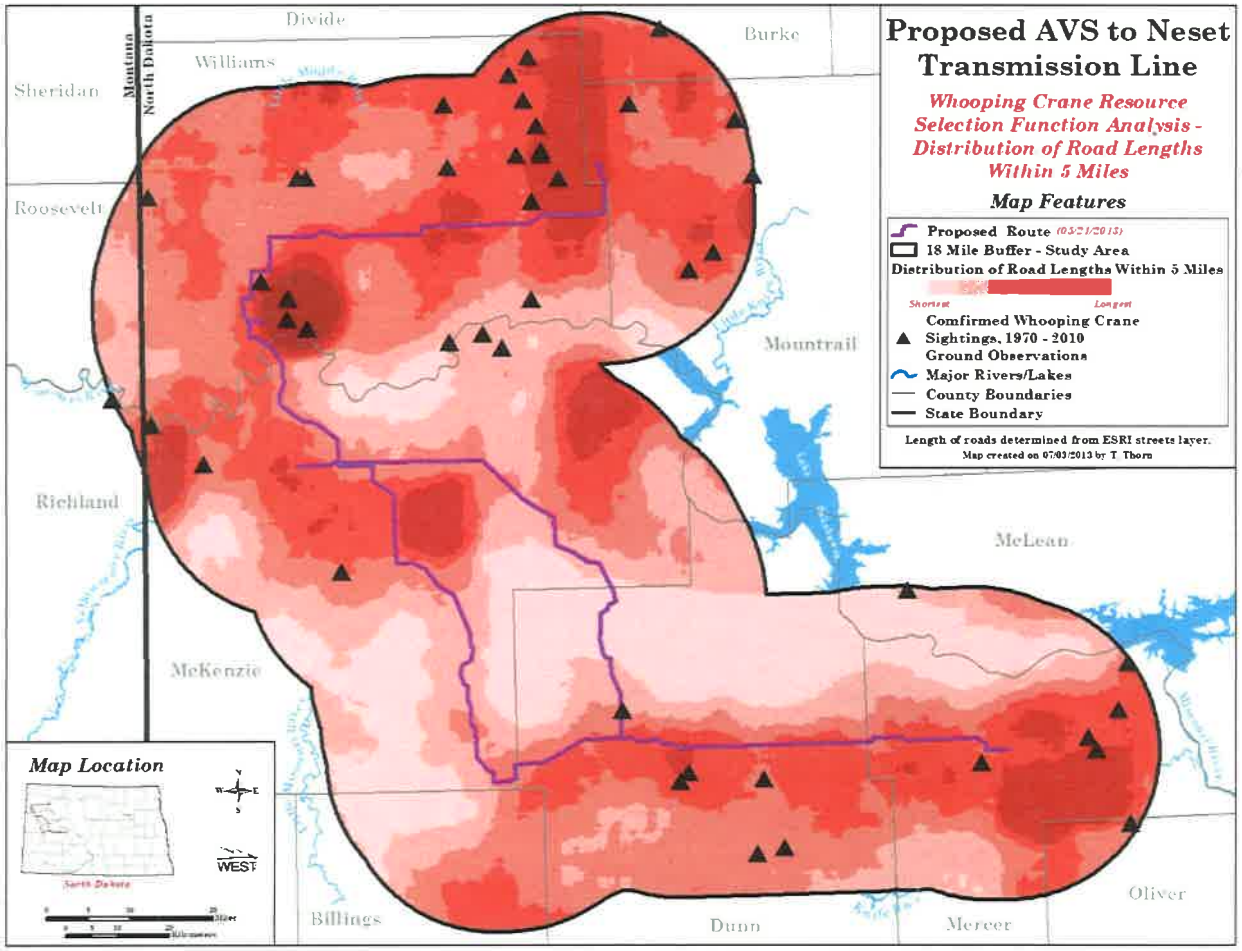


Figure 5. Distribution of values of length of roads within 5 miles in the study area. Predictions for whooping cranes were based on the variable length of roads within 5 miles. Areas with large values of length of roads within 5 miles are represented by red, areas with small values of length of roads within 5 miles are represented by light pink. Whooping crane observations used in the model are represented by black triangles.

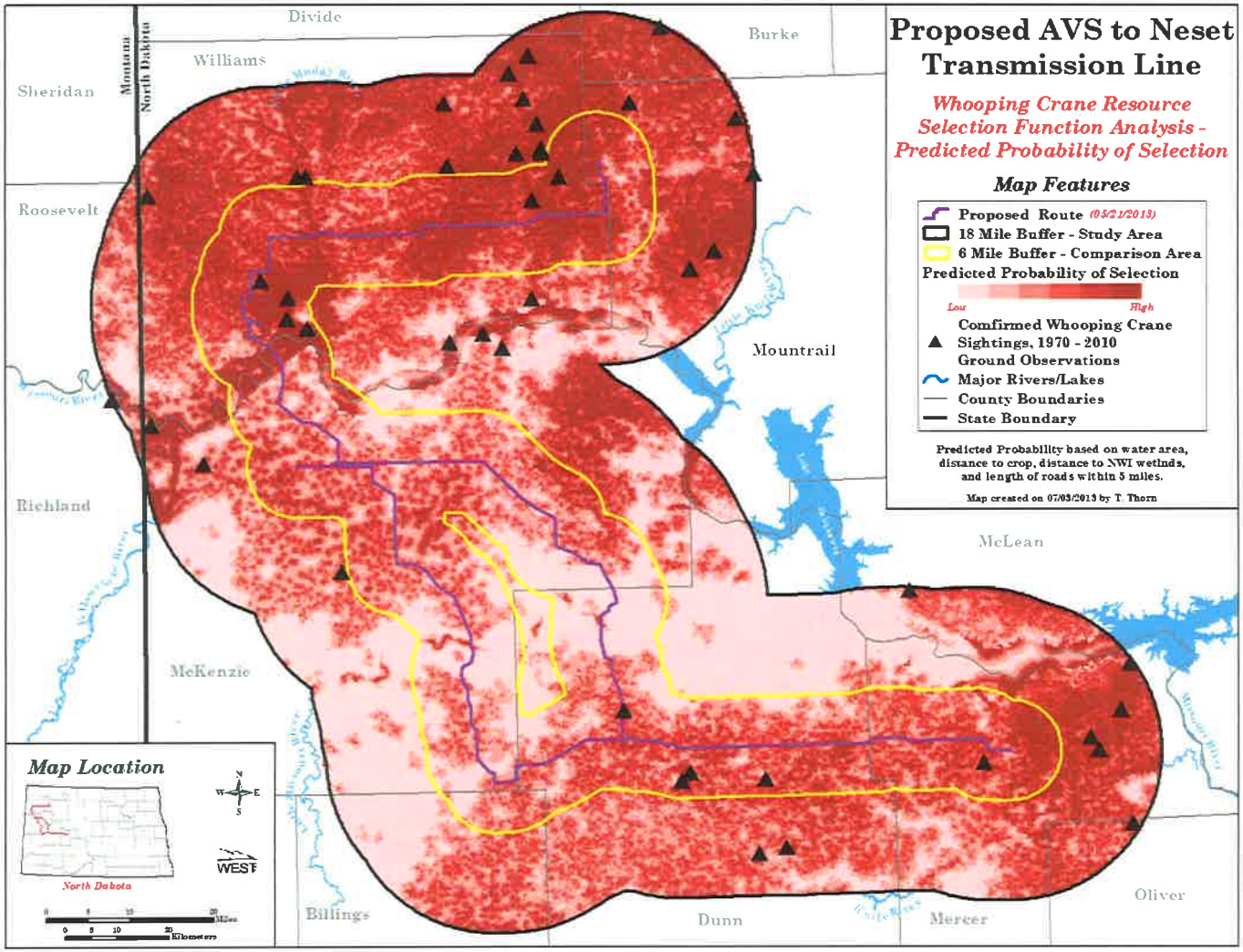


Figure 6. Predicted relative probability of selection for whooping crane in the study area. Areas with highest probability of selection are represented by red, areas with lowest probability of selection are represented by light pink. Whooping crane observations used in the model are represented by black triangles.

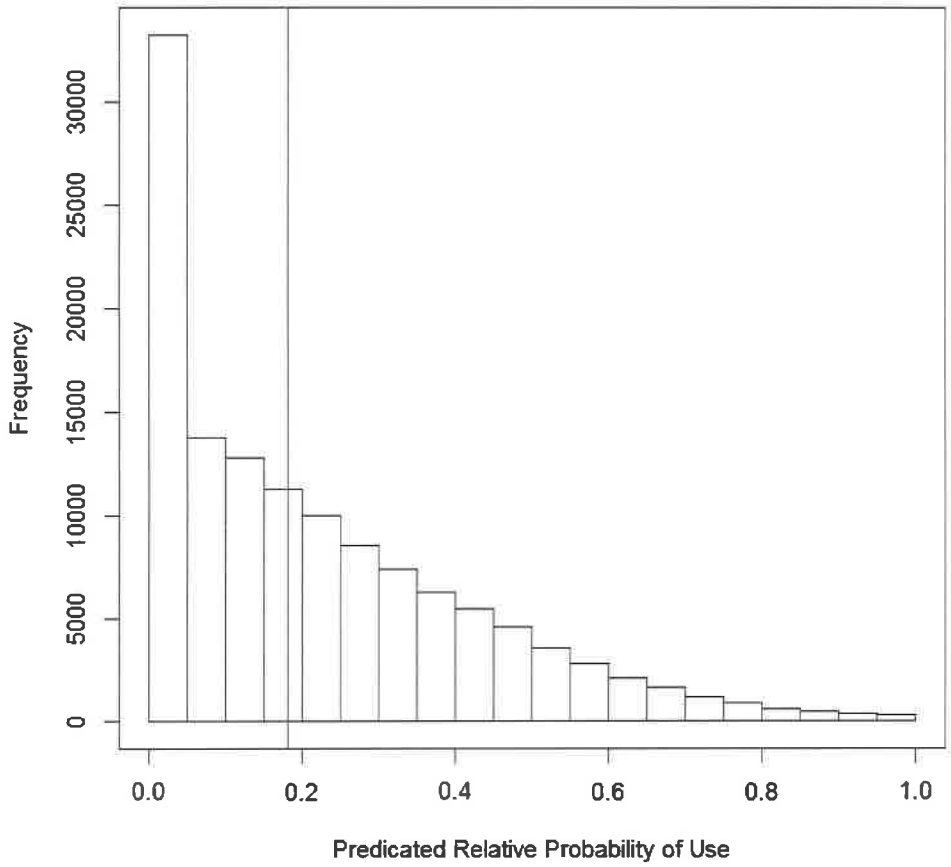
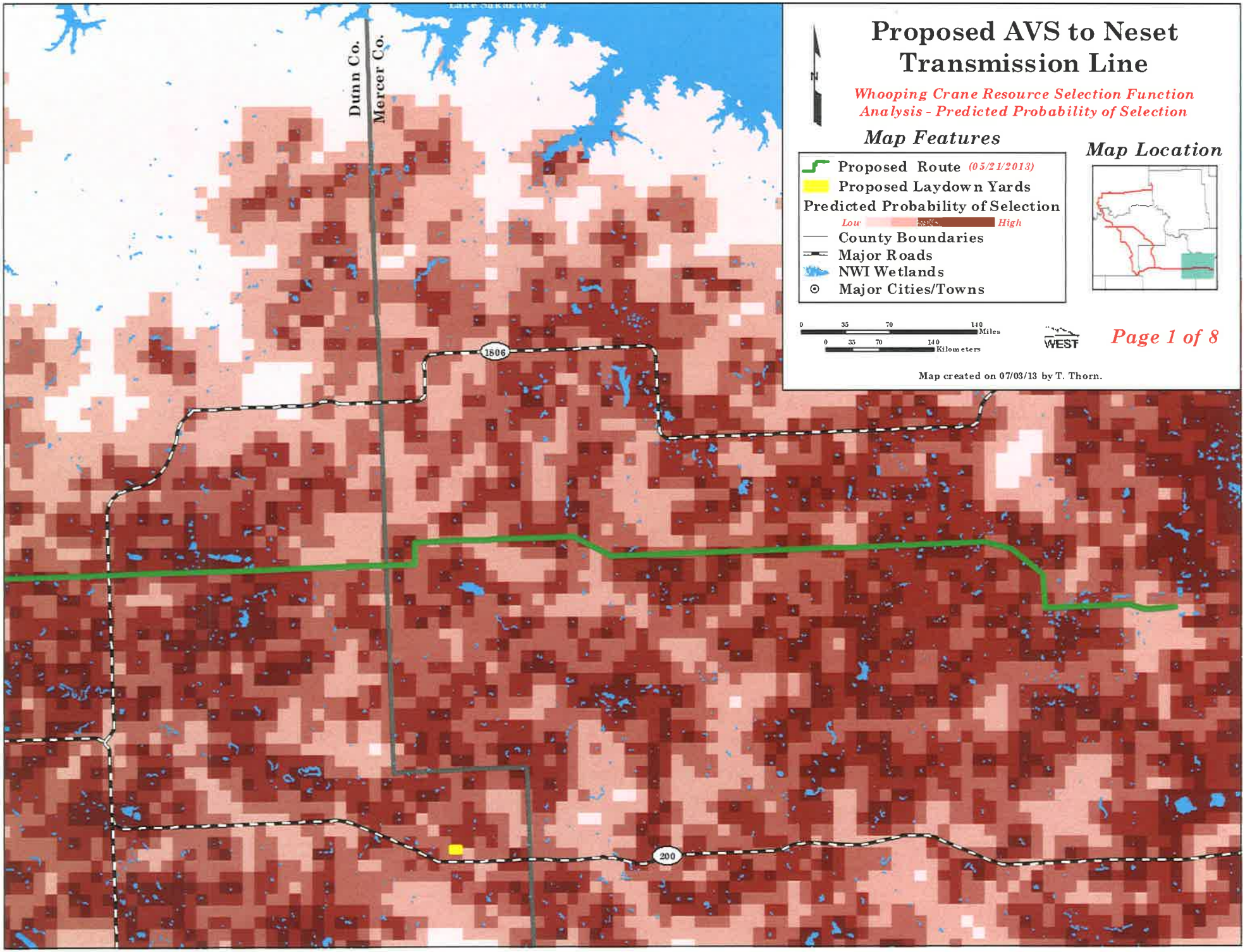


Figure 7. Frequency distribution of RSF predictions for whooping cranes in the study area. The median RSF value for the area crossed by the transmission line is represented by the red line at the 48th percentile of the distribution.

Appendix A. Detailed maps of predicted relative probability of selection for whooping crane



Proposed AVS to Neset Transmission Line

Whooping Crane Resource Selection Function Analysis - Predicted Probability of Selection

Map Features

- Proposed Route *(05/21/2013)*
- Proposed Laydown Yards
- Predicted Probability of Selection
  - *Low* — *High*
- County Boundaries
- Major Roads
- NWI Wetlands
- Major Cities/Towns

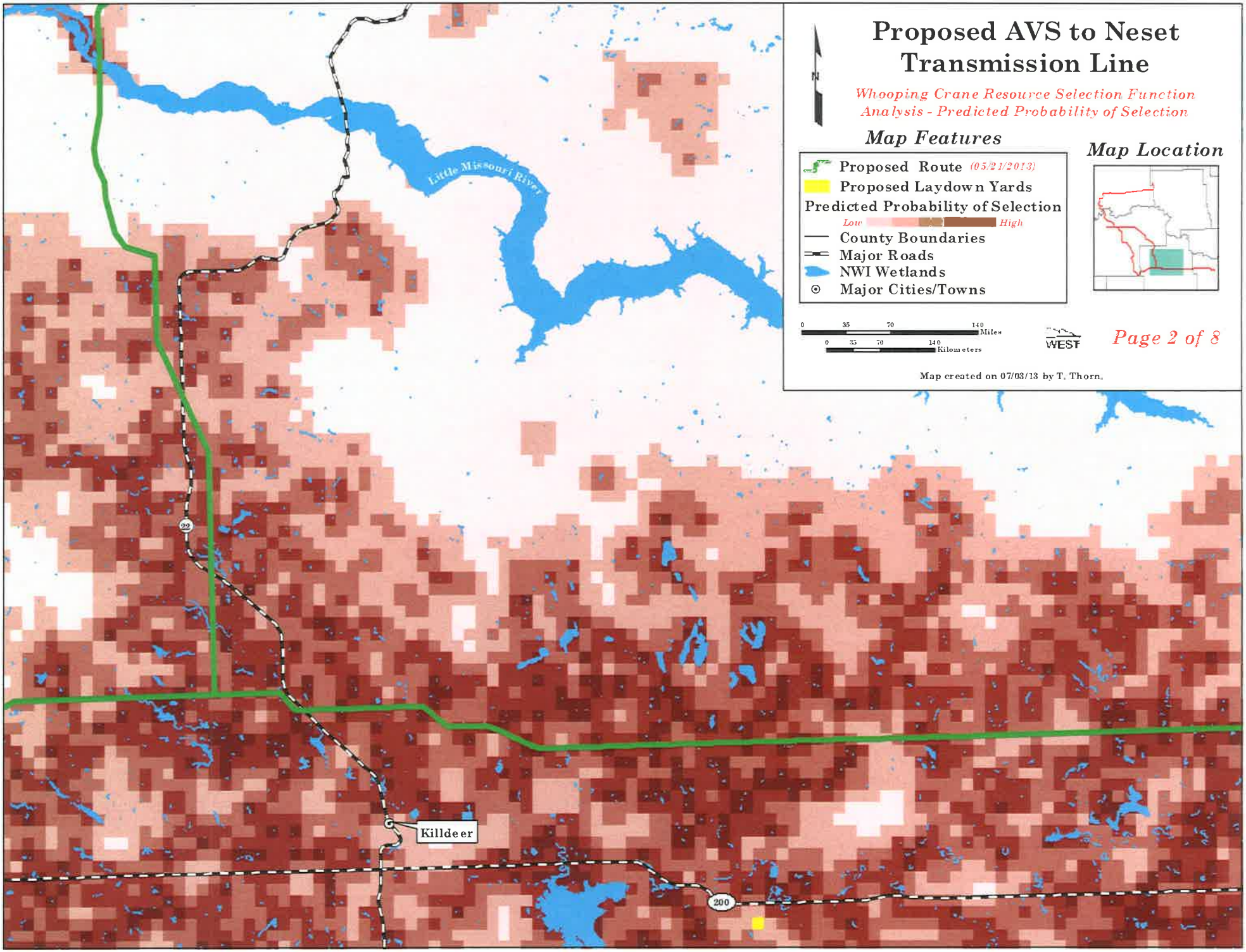
0 35 70 140 Miles

0 35 70 140 Kilometers

WEST

Map Location

Map created on 07/03/13 by T. Thorn.



Proposed AVS to Neset Transmission Line

Whooping Crane Resource Selection Function Analysis - Predicted Probability of Selection

Map Features

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- Predicted Probability of Selection
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- Major Cities/Towns

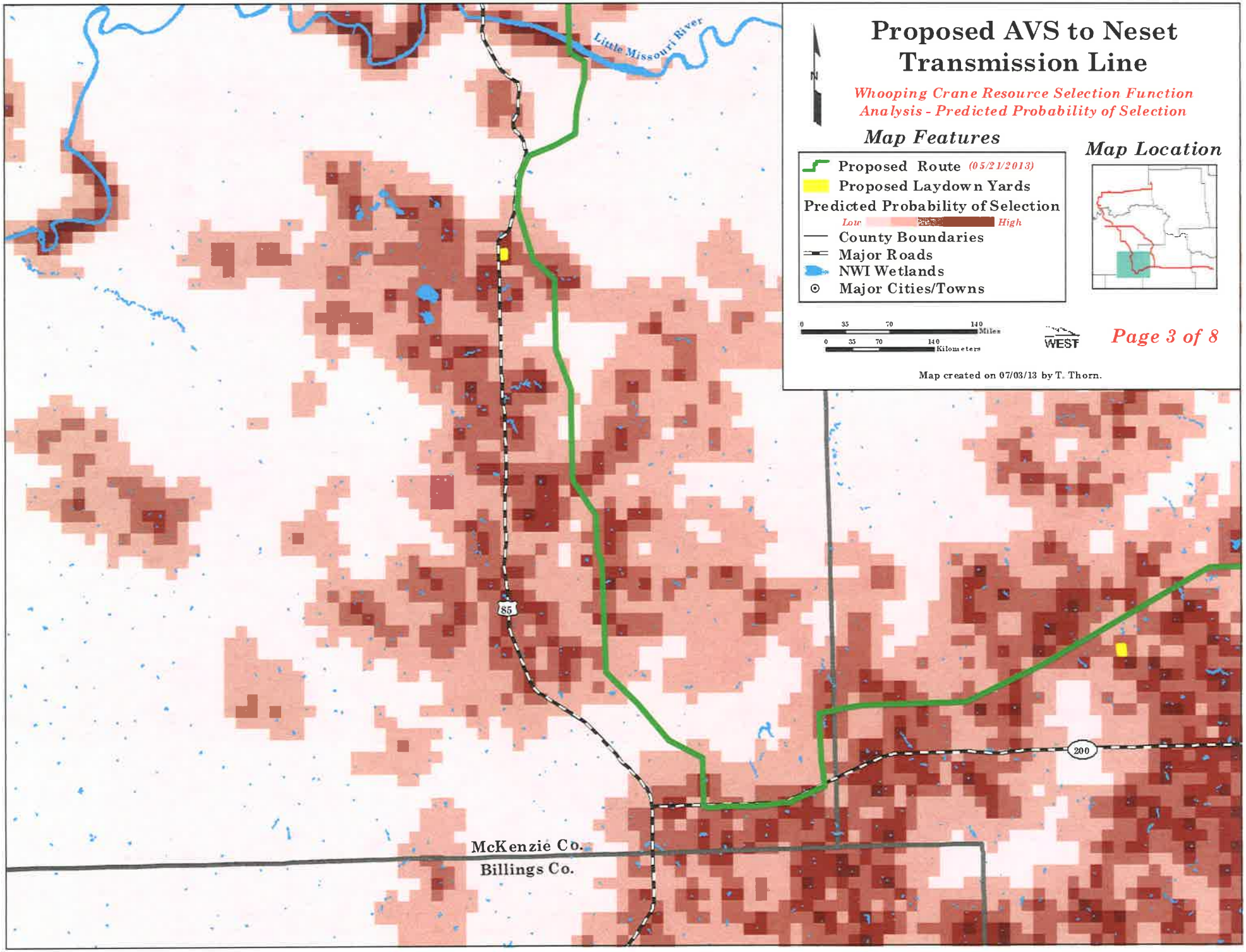
Map Location

0 35 70 140 Miles

0 35 70 140 Kilometers

WEST

Map created on 07/03/13 by T. Thorn.



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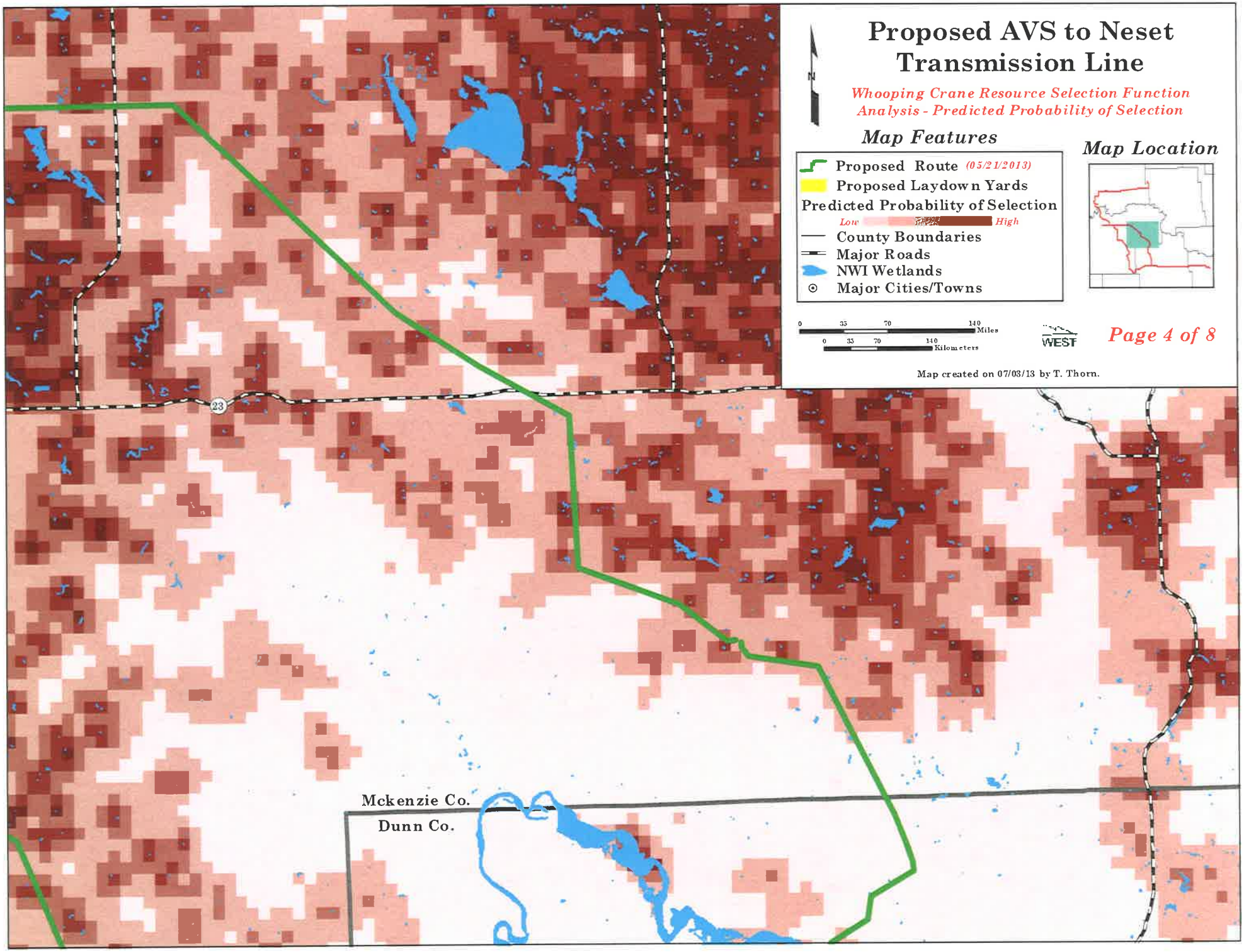
Proposed AVS to Neset Transmission Line
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Map Features
Proposed Route (05/21/2013)
Proposed Laydown Yards
Predicted Probability of Selection
Low
High
County Boundaries
Major Roads
NWI Wetlands
Major Cities/Towns
Map Location
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Page 4 of 8
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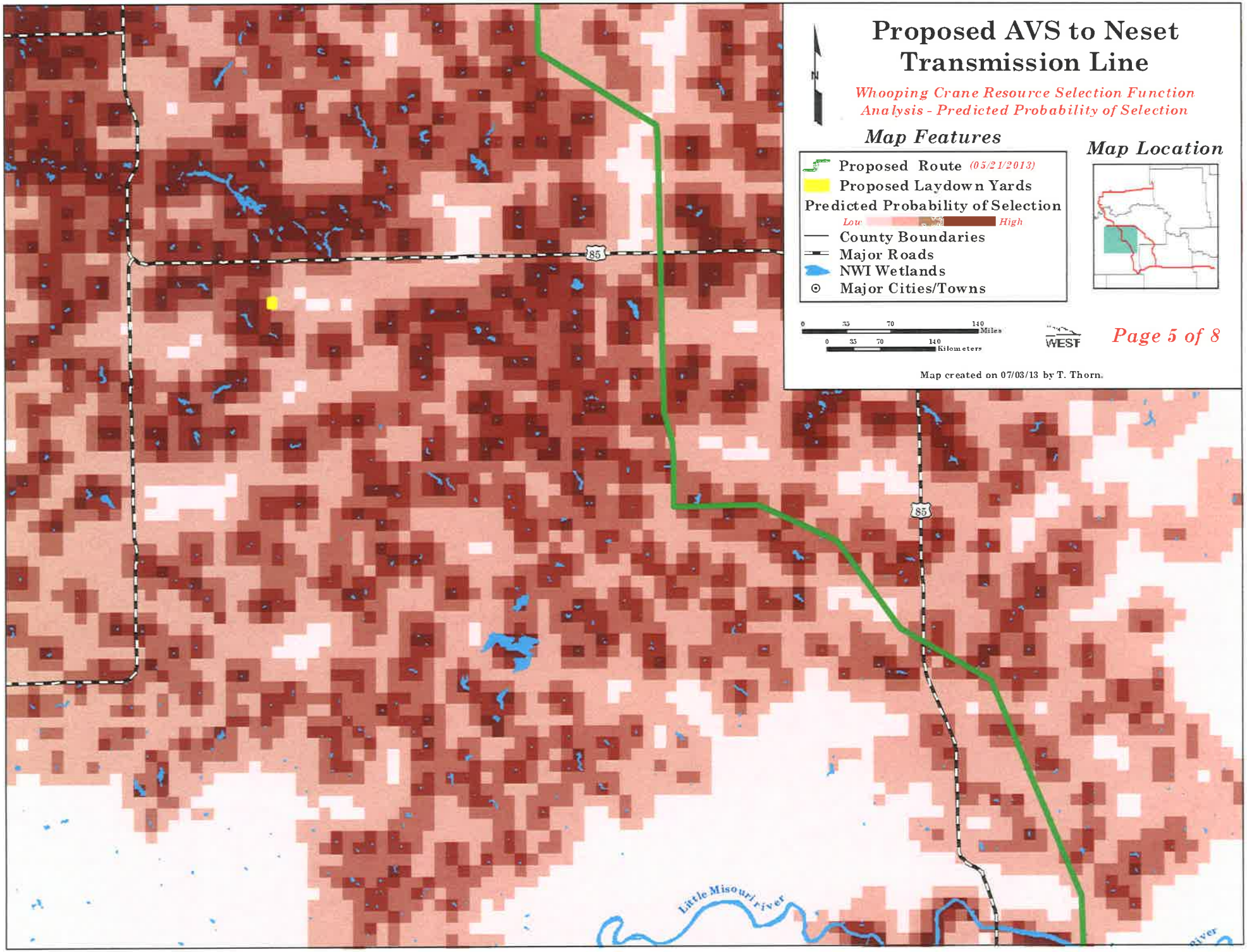
23
Mckenzie Co.
Dunn Co.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Predicted Probability of Selection
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County Boundaries
Major Roads
NWI Wetlands
Major Cities/Towns
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Page 5 of 8
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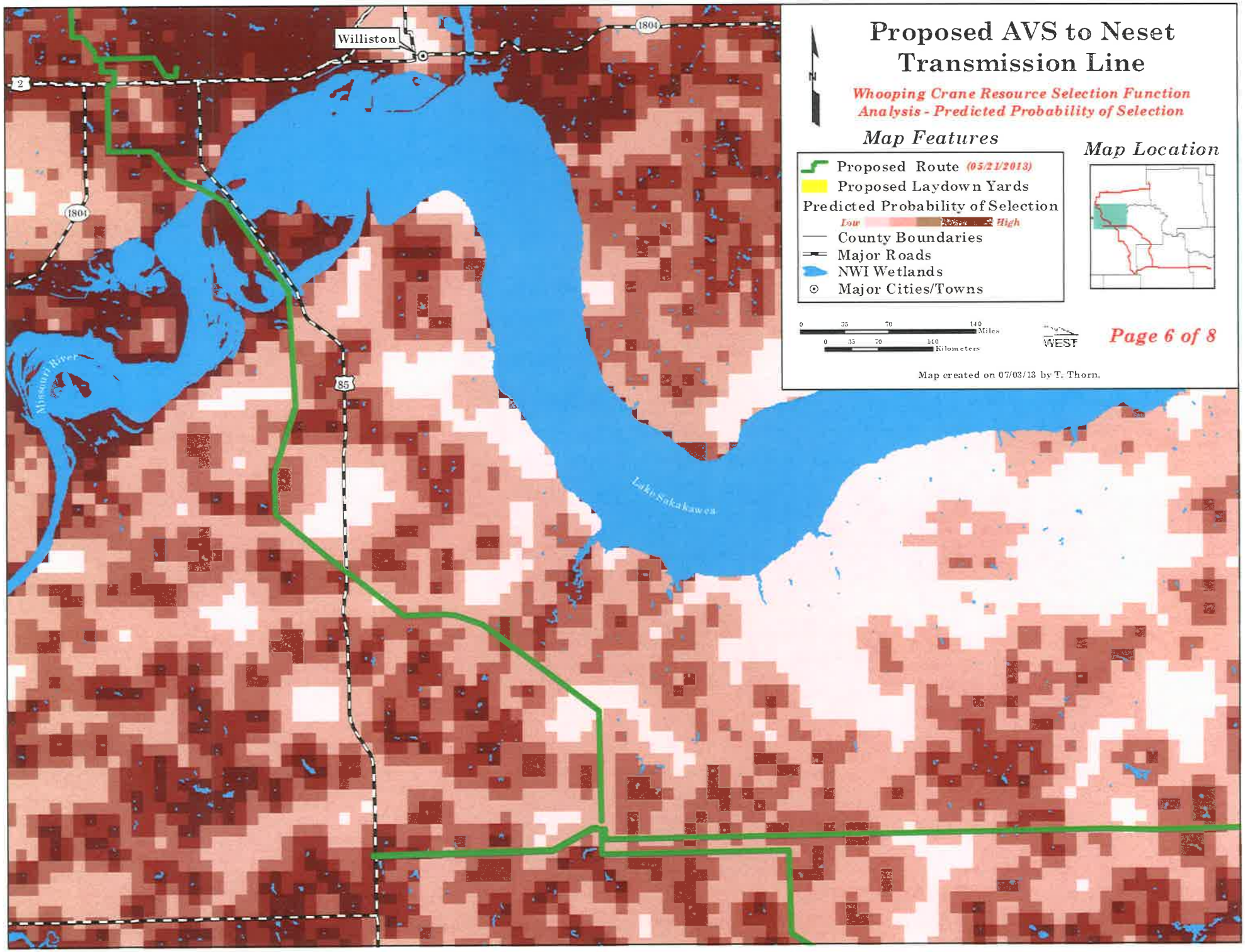
85
85
Little Missouri river



Proposed AVS to Neset Transmission Line

Whooping Crane Resource Selection Function Analysis - Predicted Probability of Selection

Map Features

- Proposed Route *(05/21/2013)*
- Proposed Laydown Yards
- Predicted Probability of Selection
  - *Low* — *High*
- County Boundaries
- Major Roads
- NWI Wetlands
- Major Cities/Towns

Map Location

0 35 70 140 Miles

0 35 70 140 Kilometers

WEST

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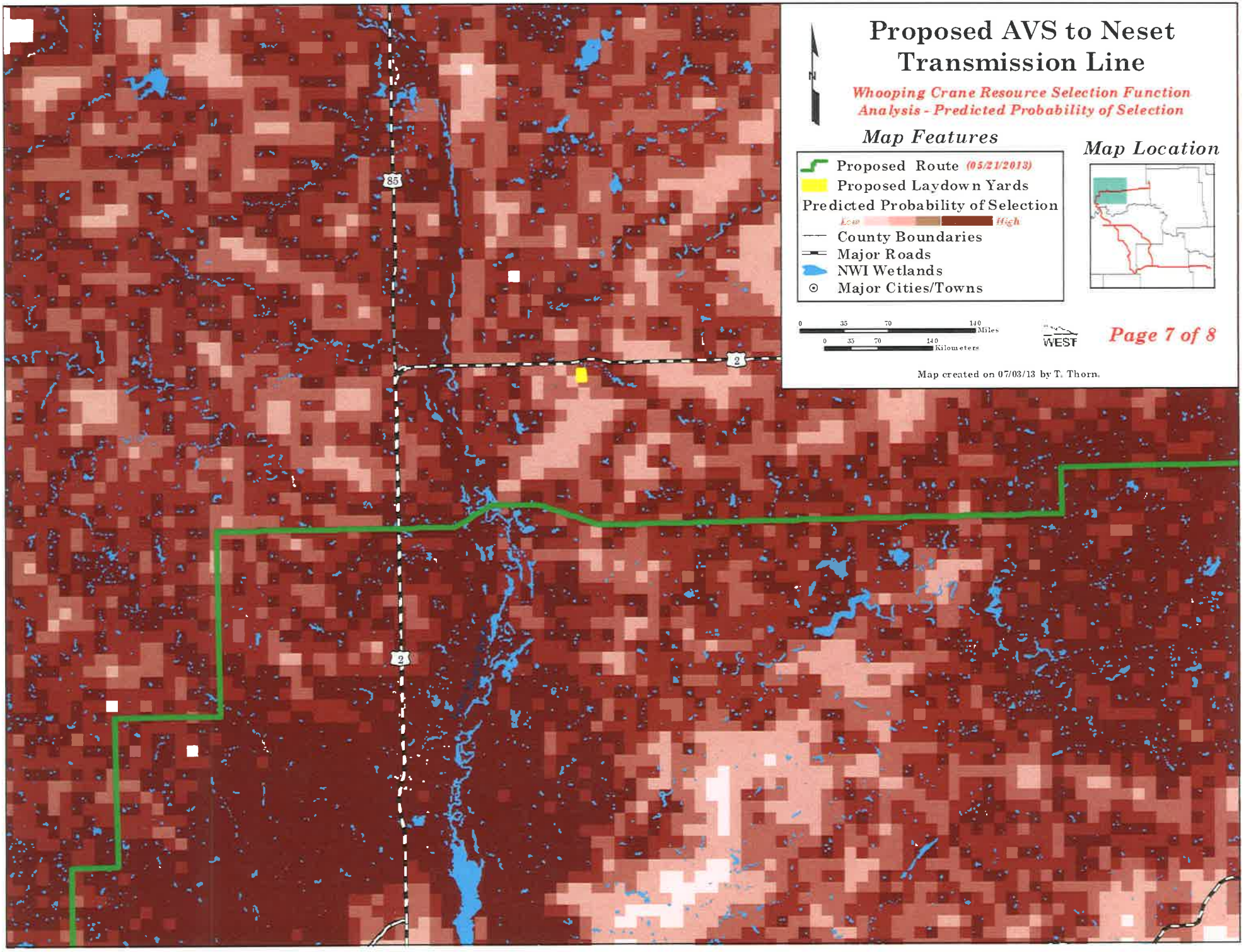

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Whooping Crane Resource Selection Function Analysis - Predicted Probability of Selection

Map Features

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- Proposed Laydown Yards
- Predicted Probability of Selection
  - *Low* — *High*
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Map Location

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0 35 70 140 Kilometers

WEST

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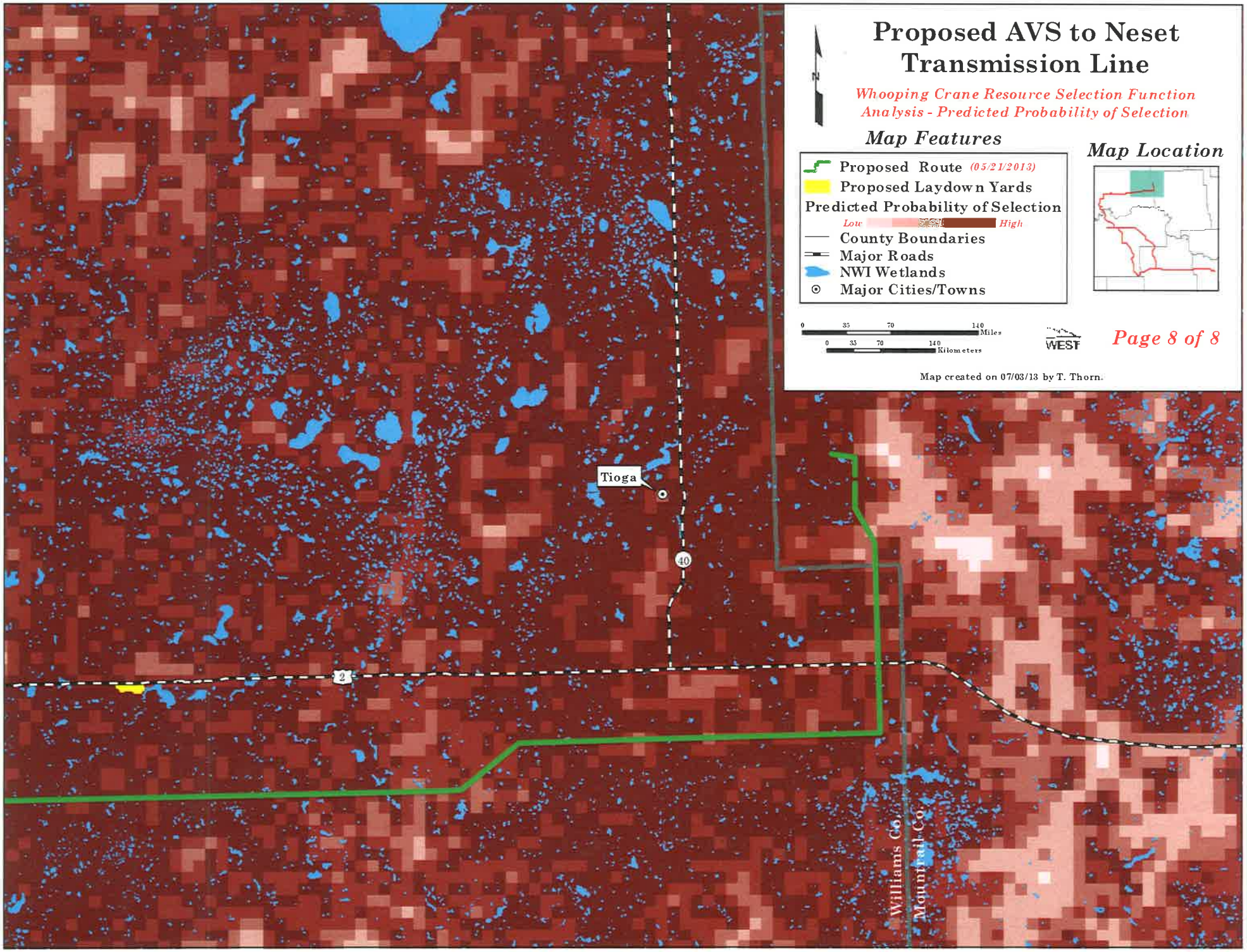
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Low
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County Boundaries
Major Roads
NWI Wetlands
Major Cities/Towns
Map Location
0 35 70 140 Miles
0 35 70 140 Kilometers
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Page 8 of 8
Map created on 07/03/13 by T. Thorn.
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Williams Co.
Mountrail Co.

Appendix B. Summary of Action Agencies' Decision related to Whooping Crane Determination

Rationale for Line Marking Device Installation on New Power Lines Only; Concurrence on Informal Consultation under Section 7 of the Endangered Species Act

Over the past five years, the North Dakota Ecological Services Office (NDES) of the U.S. Fish and Wildlife Service (USFWS), the Rural Utility Service (RUS) and Western Area Power Administration (Western), the latter two hereafter referred to as Action Agencies, have entered into informal consultations for impacts from the construction of new power lines on whooping cranes. One source of difficulty in these consultations has been over the installation of line marking devices for transmission lines on existing infrastructure and the rationale for "one-plus-one" (mile for mile) line marking recommendations. The NDES has indicated that the Action Agencies need to provide a justification for the lack of mile for mile marking on existing lines for new transmission line construction or for other mitigation measures or alternative plans and rationale to reduce the threat of line strikes to discountable levels. This appendix provides the rationale for marking only new power line construction with in one mile of suitable stopover habitat for the whooping crane.

In 2009, the USFWS Region 6 issued draft recommendations designed to assist their biologists "in transmission line (including generation lines, power lines, distribution lines, etc.) project evaluation" (USFWS 2009c) for lessening impacts to the whooping crane and other migratory birds. This guidance document provides "general considerations that may apply to most, but not every situation within the whooping crane migratory corridor"; the document also indicates that "additional conservation measures may be considered and/or discretion may be applied as applicable". The considerations outlined within the document include burying lines, the installation of line marking devices, and avian protection plans.

The 2010, Region 6 issued final recommendations that list the following hierarchy for line marking within the Central Flyway Whooping Crane Migration Corridor, the only migratory corridor for the wild whooping crane population (USFWS 2010):

> If it is not economically or technically feasible to bury lines then we recommend the following conservation measures be implemented:
>
> a) Within the 95-percent sighting corridor (see attached map):
>
> i) Project proponents should mark new lines within 1.0 mile of potentially suitable habitat and an equal amount of existing line within 1.0 mile of potentially suitable habitat (preferably within the 75-percent corridor, but at a minimum within the 95-percent corridor) according to the U.S. Fish and Wildlife Service (USFWS) recommendations described in APLIC 1994 (or newer version as updated).
>
> ii) Project proponents should mark replacement or upgraded lines within 1.0 mile of potentially suitable habitat according to the USFWS recommendations described in APLIC 1994 (or newer version as updated).
>
> b) Outside the 95-percent sighting corridor within a State's borders, Project proponents should mark new lines within 1.0 mile of potentially suitable habitat at the discretion of the local ES field office, based on the biological needs of the whooping crane.

These recommendations are designed to be taken into consideration when planning projects and when the proposed project impacts are evaluated for the effects to the whooping crane. The guidance document makes the process sound flexible and project specific impact focused, however, this has not been the implementation at the NDES Office level for the Action Agencies' Section 7 consultations. In past consultations with NDES, the Action Agencies have agreed to mark any new construction occurring within the flyway, to reduce the risk of the new infrastructure to cranes. The construction of new transmission lines in the only migration corridor of the wild population introduces a new collision risk into the environment; this is not disputed. The recommendation to mark existing infrastructure at a mile-for-mile equivalency is a logistically difficult, expensive, and perpetual minimization measure that stalls many projects. The difficulty with quantifying and evaluating the impacts to cranes from the existing baseline conditions (i.e. existing lines) and the true effects of line marking as a minimization measure is further addressed below and provides the basis for our determination of effect.

The Action Agencies have determined that the level of effects from the construction of new transmission lines, when the new construction is properly marked with line marking devices, does not rise to the level of a "may affect likely to adversely affect" determination that would propel the Section 7 forward into the formal consultation process. The Action Agencies believe the impacts can be minimized to a "may affect not likely to adversely affect" determination by marking the proposed new construction only.

Existing baseline for the whooping crane populations and the mortality risk to whooping cranes derived from power lines

Baseline conditions: The USFWS cites that power lines are the greatest known source of mortality for whooping cranes (Stehn and Wassenich 2008, USFWS 2009 b). Between1959 and 2010, 49 whooping cranes have been killed by colliding with power lines. It is important to note in this information that the bulk of power line mortalities have occurred in the experimental introduced flocks. Of these 49 deaths, nine have occurred in the Aransas Wood Buffalo Population (AWBP) between 1956 and 2002, 21 in the Florida Non-Migratory Flock between 1997 and 2010 , 13 in the non-extant Rocky Mountain Flock between 1977 and 2000, and six in the Wisconsin-Florida Migratory Flock between 2001 and 2009 (Stehn and Wassenich 2008, USFWS 2009 b, NPPD 2012). The differences between the experimental flocks and the AWBP are considerable, in both biology and habitat (Nesbitt 2011).

The experimental flocks, especially the Florida and Wisconsin-Florida flocks, reside in a landscape with differing urban pressures and infrastructure density. Figure 1, below, highlights the general migration paths utilized by each population and the density of power line infrastructure. The scale of the power line infrastructure is coarse, but it is important to note that the density of transmission to distribution is proportionally linked, meaning the higher the transmission line density the higher the distribution line density.

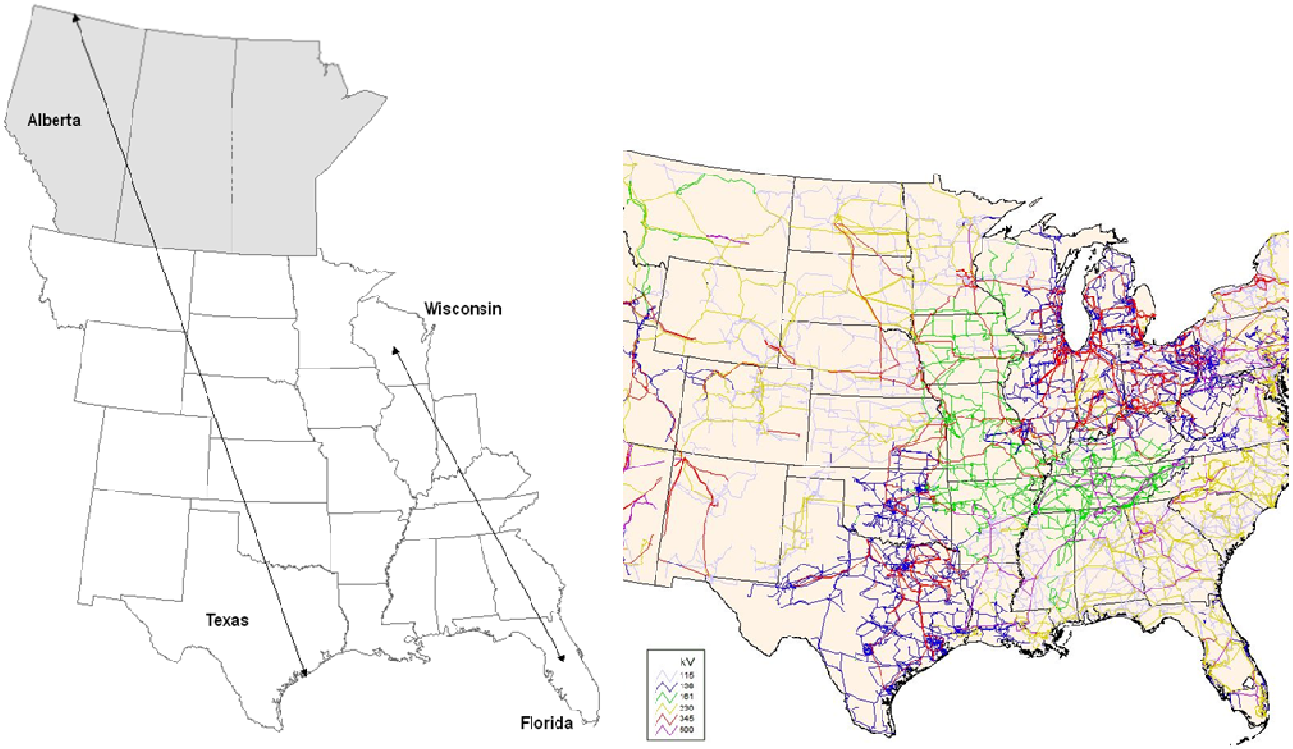

Figure 1. Two migration paths for whooping cranes and transmission line density map. Images courtesy of Texas Parks and Wildlife and Federal Emergency Management Agency

Human disturbance and density also varies between the migrating flocks. The six Central Flyway Whooping Crane Migration Corridor (central flyway) states of the AWBP of Texas, Oklahoma, Kansas, Nebraska, South Dakota and North Dakota have human population of approximately 36.15 million while the six states of Wisconsin-Florida migratory flock, Florida, Georgia, Tennessee, Kentucky, Illinois, and Wisconsin, have a population of 58.68 million (US Census 2010). The human density between these six-state sets is marked. Figure 2, below, highlights the difference in human density along the two migration paths. The human population density in the flyways can be used as an indicator of the human incursion into suitable stopover habitat. Clearly there is far more human incursion along the eastern migration route than in the central flyway. This can impact the availability of proper forage, safe roosting locations, and successful rest during migration. Human disturbance can flush flocks (via vehicle traffic, curious domestic animals, curious people, lights and noise, etc.) from any stopover site. As the transmission line density map indicates, higher human density is linked to higher overhead line density (more people require more power). The increase in line prevalence logically results in higher risk to whooping cranes from collision with overhead lines.

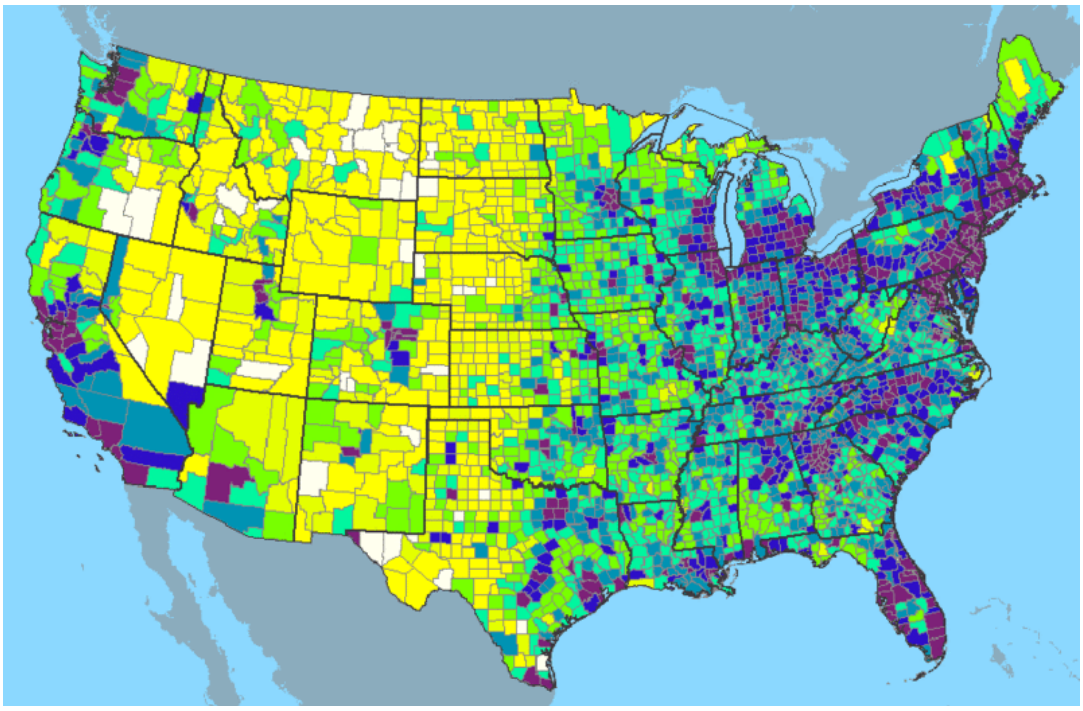

Figure 2. Population Density Estimates based on County Census Data.
Image courtesy of the National Atlas of the United States.

The landscape availability of stopover habitat is also very different between the two routes. The Florida population lives in the southeastern coast plain, while those that migrate to Wisconsin pass through central hardwoods, eastern tall grass prairie, and prairie hardwoods transitional habitats. The AWBP flock migrates from coastal prairies, through oaks and prairies, central mixed grass prairie, and prairie pothole habitats. These habitats vary wildly in the annual precipitation and surface water availability. The human density in the landscape may also limit the availability of suitable stopover locations by limiting wetland size and composition preferred by cranes (Stehn and Wassenich 2008, USFWS 2009 b, and CWS-USFWS 2005).

It may be that whooping crane migration behavior is markedly different between the populations as well. The older birds within the Florida-Wisconsin flock have been taught to migrate by humans using ultra-light aircraft. This may have an impact on the whooping crane's tolerance to human incursion or in the selection factors for the route and stopover locations. Since the majority of the birds within the experimental populations are used to at least some level of human presence in their lifecycle (being raised in pens, near human presences, forage sources different than wild sources, etc) the tolerance levels may not be similar to the wild AWBP flock. This may result in differing levels of human avoidance or acceptance.

Given the differences in human population density, power line density, human incursion into the habitat, differing stopover availability, and possible unique migration behavior differences, consolidating the experimental flocks together with the AWBP does not accurately assess the risk that the AWBP encounters relative to mortality sources in the central flyway. The references in the literature will often lump the collision mortality from

the discrete populations together to estimate risk, yet separate out population growth estimates when applying the risk factors to overall population projections. This appears to be a disparate treatment of the data. It would be best to then disassociate the separate population mortalities and population growth projections, and instead focus on the AWBP whooping crane's risk within the central flyway for the purposes of assessing impacts of proposed projects on the AWBP. Proper disassociation results in the data of nine whooping crane power line mortalities within the AWBP in the last 56 years and a population growth from 18 birds in the wild flock in 1939 (Texas 2013 and Didrickson 2011) to an estimated population of 279 in 2013 (USFWS 2103). The nine mortalities of whooping cranes are detailed in Table 1, below.

Month	Year	State	Line Type
May	1956	TX	Transmission
November	1965	KS	Distribution
April	1967	KS	Distribution
October	1981	SK	Distribution
October	1982	TX	Distribution
October	1988	NE	Distribution
October	1989	NE	Distribution
October	1997	SK	Distribution
April	2002	TX	Distribution

Table 1. Nine Whooping Crane Collisions in AWBP Flock.

When reviewing factors that contribute to bird collisions with power lines, the five primary factors that influence risk include: wing and body size, environmental conditions (low light, high winds, storm fronts, etc.), exposure to lines (line prevalence), the design of the line (diameter of the conductor, vertical configuration, etc.), and avian behavior (APLIC 2012). Of these five factors, two are ecological factors that remain the same regardless of the Action Agencies' actions, the wing and body size of the bird and the environmental conditions. Since both of these factors remain regardless, they will not be addressed. Of the remaining three factors the Action Agencies may have an influence over the location of some of the new lines, the design of some of the new lines, and the habitat modification (and therefore possible behavior modification) of areas within the proximity of some of the new lines. As for existing prevalence, design, and behavior the Action Agencies have little control over the current baseline conditions.

Prevalence: The prevalence of overhead lines in the central flyway is directly linked to the exposure risk of cranes to a source of mortality. Clearly whooping cranes are at risk from death resulting in collision with overhead lines when there have been nine collisions within the AWBP. It is estimated that there is approximately 83,700 miles of transmission line infrastructure in the central flyway states currently, as shown in Table 2. This estimate includes transmission level voltages and sub-transmission level voltages.

Year	Rate of Growth	Miles of OHL
1993	1.445	63,411.68
1995	1.445	65,257.52
1997	1.445	67,157.09
1999	1.445	69,111.95
2001	1.445	71,123.71
2003	1.445	73,194.04
2005	1.445	75,324.63
2007	1.445	77,517.24
2009	1.2213	79,773.68
2011	1.2213	81,734.13
2013	1.2213	83,742.76

Table 2. Miles of Overhead Line for the six central flyway states.

This estimate has been calculated using a 1993 data set for estimated miles of overhead lines (sub-transmission and transmission) in each of the six states from the Energy Information Administration, U.S. Department of Energy. This data set was expanded using the United Nations Infrastructure growth rate curve for the United States (averaged over the three preceding/receding years). This growth curve can estimate the total number of miles of overhead sub-transmission and transmission line from Texas to North Dakota. This is only a course estimate; there is no current dataset, nor any entity collecting data or storing data, on the number of miles of overhead line. As the electric power grid has over 210 owners or operators in these six states alone, it is difficult to gather real time data. RUS keeps data on the number of miles of distribution lines within each state by member utility (RUS 2013). As of 2011, there were 325,292 miles of distribution line from Texas to North Dakota. This only includes the distribution lines, residential taps, subdivision or urban distribution systems that are members of RUS. It is therefore an underestimate of the total miles of overhead distribution lines as not all service providers are members of RUS. As a note of contrast there are approximately 38,000 miles of Interstate and Primary State Highway within these six states (USDOT 2010). This data set indicates that in the past 20 years there has been an annual increase to the risk posed to whooping cranes from the prevalence of overhead wires; yet the population continues to trend upward, Figure 3, below.

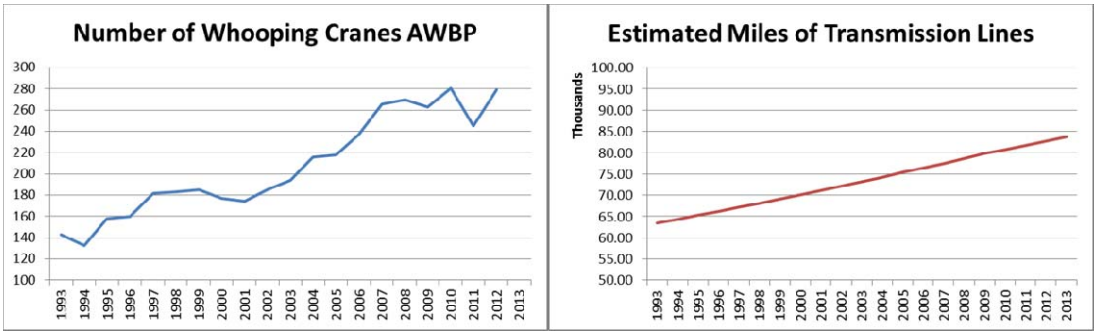

Figure 3. Whooping crane population numbers and transmission line miles from 1993-2013. Data from the USFWS, the International Crane Foundation, and Table 2.

The rate of increase in the whooping crane population is not linear and fluctuations of the population occur on 2-3 year cycle (Didrickson 2011) but generally trend upwards over time. This is a slow and steady increase in the overall flock population since 1993. During this exact same 20 year time period the United States continued to develop more and more overhead infrastructure. Only two recorded collisions occurred from during the last 20 years (1993 to 2013), which does not appear to have significantly influenced the rate of growth for the population as both years of collision (1997 and 2002) represent years of overall population growth.

Design: Table 1, above, accounts for the nine whooping crane mortalities within the central flyway in the past 56 years. Eight of the nine collisions have occurred with distribution lines rather than transmission lines. This may reinforce the concept that smaller diameter lines may prove a higher risk to flying cranes (APLIC 2012). It may also support the idea that the lower elevation lines, i.e. smaller structures and lower to the ground lines, represent a greater risk. The collision risk may simply be a function of the prevalence of distribution lines as well. The risk may be a combination of all three: the diameter of the wire, the elevation of the wire, and the ubiquitous nature of the wire.

The difference in wire diameter between distribution lines and transmission lines differs based on the voltage of the line. The diameter of a typical 12.5 kV distribution line is 0.563 inches where the diameter of a typical 115 kV transmission line is 1.1 inches (Southwire 2003). The increase in diameter of the wire increases the visibility of the wire and can reduce the risk of collision between the two voltages (APLIC 2012). The proposed construction of transmission line may have a lower risk of collision than an equal amount of proposed distribution wire. However, the overhead static wire on transmission lines is generally smaller in diameter than the energized conductor itself and can pose a similar risk as the distribution wire (as they average roughly the same diameter). The static wire is also typically the top wire installed – at the top point height of the line clearance. This all indicates that the ratio of risk reduction attributed to wire diameter is quantifiably unknown. The anecdotal evidence may indicate a reduced risk posed by transmission, but this may not be true in areas with installed static wires. The true risk may be heavily species dependent, i.e. based on avian vision and visual cues, rather than line design.

Avian Behavior: When assessing collision risk along any overhead line it is important to note the location and orientation of the line towards any avian activity within the vicinity (APLIC 2012). The location of the line relative to avian use of the landscape can predict collision risks. Lines that bisect feeding and sheltering sites, or lines that bisect or frame feeding grounds can have a much higher risk of collision than lines that are located in areas with no avian activity taking place. It can be difficult to quantitatively assess the suitability of one location relative to another location without the use of a standardized method. One method available to accomplish this is a Resource Selection Function (RSF), a type of resource selection predictive model, which is further described in Appendix A.

The basic premise of resource selection modeling (Manly et al. 2002) is that resources (which may be food items, land cover types, or any quantifiable habitat characteristic) that are important to individual whooping cranes will be "used" disproportionately to the availability of those resources in the environment. In an RSF, the characteristics at the use locations were contrasted to characteristics at randomly selected "available" locations within a given study area. Standard logistic regression models are developed to estimate a linear function of site characteristics that reliably predict observed use. The model produces estimates of the relative probability of use at a location in the study area, as a function of the sites' characteristics (Manly et al. 2002). This can help to determine if one given site is likely to receive higher use than another location. This in turn can help to determine avian behavior near a given location; is this a more desirable location (based on the set of characteristics that govern stopover selection) than one mile away, resulting in higher frequency of crane use?

There are known concentration areas for whooping cranes within the central flyway; these include the four sites in four states that have been designated critical habitat. These include Cheyenne Bottoms State Wildlife Area and Quivira National Wildlife Refuge (NWR), Kansas; Platte River valley between Lexington and Dehman, Nebraska; Salt Plains NWR), Oklahoma; and Aransas NWR, Texas. These areas experience far greater avian use than surrounding areas and the behavior of the birds at these sites may differ as a result of increased site use and higher numbers of individuals at any given time. As for the rest of the flyway, stopover habitat can range from sparse to abundant, depending on the conditions at a local level. When reviewing the nine known collision locations, the majority of the habitat near the lines would be considered marginal quality habitat (Didrickson 2011). This would represent an inverse relationship between the quality of habitat and the risk to cranes, consistent with the habitat quality investigated near the non-migratory flock collision locations. This just highlights the difficulty in determining risk of collision to cranes on a landscape scale. Collision risk often proves to be highly site specific (APLIC 2012).

While migrating, cranes tend to fly between elevations of 1,000 ft. to 6,000 ft. It is at the start of the day, taking off from their roosting or feeding location, and at the end of the day, coming down to feed or roost, that cranes are most susceptible to collision (Stehn 2007). Wetlands suitable for overnight roost sites for migrating whooping cranes are available throughout the migration corridor in the Dakotas. Associated feeding sites with-in agricultural fields are also available throughout the corridor, within proximate locations of wetlands (Stehn 2007 from Stahlecker 1997a, 1997b). The current 2010 USFWS Region 6 guidance is based on Brown et al. (1984 and 1987) which indicates that the threat to birds posed by collision decreased to zero when the power line was located a mile or more away from bird use areas. This data does not indicate the type of relationship the distance to risk represents, only that at one mile the risk drops to zero. The actual relationship when analyzed may indicate a high reduction in risk within only a short distance from the wetland; Morkill and Anderson (1991) indicated a response within 820 feet of the wetland. As such, a mile is an estimation of distance that has a risk factor of zero.

Indications of Risk: Despite the increase in miles of power line, the whooping crane has managed to make population gains, without the wide spread use of line marking devices. This indicates that while power lines may play a role in mortality rates for the wild migrating flock, the rate at which collision occurs is not enough to prohibit the overall increase of the population. Mortality rates have remained steady during the past 50 years; (Stehn and Strobel 2011) thus assuming that every mile of power line increases the potential for mortality (and a decline in overall whooping crane population numbers) is not based in the available data.

The causes of known mortality account for only about 10% of the actual deaths, as the majority of birds that disappear from the AWBP are completely unaccounted for (Stehn 2007). Mortality and risk data for the AWBP is often extrapolated from recovered carcasses (n=50) and total losses from the population (n=525) from 1950-2010. Such extrapolation and risk assessment requires numerous assumptions on detection probability, predator removal, rate of unrecovered collision mortality, and all the other variables. A simple equation for estimating the number of collision mortalities in the AWBP would look something like this:

Estimated number of collisions = known collisions / percentage of collisions found

If we use the 10% figure attributed to known mortality relative to actual deaths (reported in Stehn 2007) and assume that all unknown mortality is the result of collision, then we can over estimate that 90 whooping cranes have collided with lines since 1956 (90 = 9 known collisions/10% "find rate"). A simple linear relationship would indicate that roughly 1.6 cranes die each year from collision with a power line (90 deaths over a 56 year period). If we partition this out based on the underestimation of 408,992 miles of overhead line (83,700 sub-transmission and transmission plus 325,292 miles of distribution lines) within the central flyway, we end up with a per mile risk of collision of 3.91×10^{-6} mortalities per mile of line (or 0.00000391 crane deaths per mile = 1.6 deaths per year divided by 408, 992 miles of line). This is proportionally a very low risk of collision for any randomly selected mile of overhead line in the central flyway.

Most of the studies cited by the USFWS indicate a 50-80% mortality reduction in collision mortalities once line marking devices have been installed. It is understood that this low end estimation of reduction rate forms the basis for the Region 6 recommendation of additional miles of line equal to the number of new miles of line. This is an oversimplification of the statistical risk of collision presented by overhead lines. Each opportunity for collision is an independent trial and predicted risk of a collision with one line is independent from the risk at any other line. Therefore a one-to-one strategy of marking new lines and old lines to result in no net loss is not a statistically valid justification. Different power lines also have different rates of inherent collision risk (as discussed in avian behavior above, and see APLIC 2012), so marking all lines within one mile of potentially suitable migratory stop over habitat may not yield the same collision reduction rates.

Tracking of cranes via transmitter during the 2011 fall migration indicated that only 6% of stopovers were occurring in North Dakota, while nearly 32% were in Saskatchewan

(USGS 2012). While line marking does have greater benefits in areas of high bird concentration (historic stopover sights, along the Platte River, and designated critical habitat) the installation of thousands of line marking devices in the 95-percent sighting corridor, not located in high crane use areas, is an intensive minimization measure that statistically returns no result. For example marking 255,755 miles of existing line within the dispersed habitat would need to be marked in order to avoid a single crane death on existing line in any given year (1 crane/0.00000391 crane deaths/mile/year).

The average cost of line marking for a one time installation on new construction can be anywhere from $1,300 to $3,200 per mile of line with land based applications. If other environmental restrictions are put in place that require helicopter installation the average cost per mile increases to $12,000 per mile (NPPD 2012). These installation costs do not take into account the cost of installation on an existing line, nor the lifetime maintenance of a device on an energized line. Many of the market available devices have limited life expectancies and require replacement every 5-10 years. Economics do play a role in many utility decisions; often times the power lines are owned by cooperatives, municipalities, or public service districts that are required, under law, to operate at cost. The costs of line marking devices have to be rolled into consumer prices and rate boards can deny these rate increases.

The focus of the Region 6 guidance for risk reductions from cranes focuses on one source of mortality for cranes. However, power lines are not the only source of mortality for the cranes. From November 2008 to April of 2009, 23 whooping cranes perished on the wintering grounds in Texas. The bulk of these deaths were attributed to starvation and resulting disease (USFWS 2009 b, Stehn 2010). It is apparent that power lines are mislabeled as the “single greatest threat of mortality to fledged whooping cranes” (2010 Recommendations, footnote 2) in the AWBP when more than twice as many perish in a single year from malnutrition (23 cranes) then have been documented in the past 56 years as colliding with power lines (9 cranes). Even the over extrapolated 90 deaths due to collisions, spread out over a 56 year period, equaling 1.6 deaths per year, pales with a single winter loss of 23 cranes on a wildlife refuge.

Current Proposed Project Application: For the proposed Basin Electric AVS-Neset Line 275 miles of new transmission line would be constructed in the central flyway. Using the simplified risk estimation from above, this new construction represents and increased risk to the cranes of 0.0011 deaths per year from the new lines (resulting from 275 miles x 0.00000391 crane deaths per mile). Statistically, it would take roughly 910 years for the risk potential to result in a death of a single crane on any single mile of new line.

If the Region 6 guidance is followed for line marking devices, approximately 254 miles of new construction would be marked. This represents a low end cost of roughly $330,200 just for the one time installation of line marking devices. Marking and equal amount of existing line may represent an equal amount of low end cost or a high end estimate of $812,800. This expenditure of anywhere from $660,400 to $1,143,000 would have to be borne by the rate payers of Basin Electric for the one time installation

cost of line marking devices. This does not factor into consideration the long term maintenance or replacement costs of the devices into the future. As for existing infrastructure, this cost estimate does not factor into consideration the cost of replacing or reinforcing the line or static wires to accommodate the additional weight, wind and ice loading, or engineering impacts that installation of line marking devices would have on lines not designed to accommodate the devices.

The cost for Basin to mark approximately 250 miles of new line, a single project, exceeds the estimated dollar amount of $93,000 presented in the 2007 whooping crane recovery plan. It is clear the economic concept of line marking does not match with the on the ground reality of line marking. As line marking devices represent only one solution to the issue of crane population growth (see CWS-USFWS 2005) and the overall reduction in collision risk resulting from line marking is minimal in dispersed, abundant, stopover habitat it does not make sense from both an economic perspective and a conservation perspective to expend well over half a million dollars to reduce the risk to cranes by 0.0011 deaths/year. It makes better sense to reduce the increased risk posed by the construction of new lines and leave the existing lines in dispersed habitat alone; knowing that more can be done to eliminate high risks in crane migration concentrate areas, and that this burden is shared by more than just the utility industry.

References:

APLIC. 2012. Avian Power Line Interaction Committee. Reducing Avian Collisions with Power Lines: The State of the Art in 2012. Edison Electric Institute and APLIC. Washington, D.C.

Brown, W. M. and R.C. Drewien. 1995. Evaluation of two power line markers to reduce crane and waterfowl collision mortality. Wildlife Society Bulletin. 23:217-227.

Brown, W. M., R. C. Drewien, and E. G. Bizeau. 1987. Mortality of cranes and waterfowl from powerline collisions in the San Luis Valley-Colorado. Pages 128-136, in J. C. Lewis and J.W. Ziewitz, eds. Proc. 1985 Crane Workshop. Platte River Whooping Crane Habitat Maintenance Trust and USFWS, Grand Island, Nebraska.

Brown, W. M., R. C. Drewien, and D. L.Walker. 1984. Crane flight behavior and mortality associated with power lines in the San Luis Valley, Colorado. Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow, Idaho, USA.

CWS-USFWS. Canadian Wildlife Service and U.S. Fish and Wildlife Service. 2005. International recovery plan for the whooping crane. Ottawa: Recovery of Nationally Endangered Wildlife (RENEW), and U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 162 pp.

Didrickson, B. 2011. Historic whooping crane numbers. International Crane Foundation. http://www.savingcranes.org/images/stories/site_images/conservation/whooping_crane/pdfs/historic_wc_numbers.pdf

Edison Tech Center. 2010. History of Electrification. Edison Tech Center Website. http://edisontechcenter.org/HistElectPowTrans.html

Howlin, S., C. Derby, and D. Strickland. 2008. Whooping Crane Migrational Habitat Use in the Central Platte River during the Cooperative Agreement Period, 2001-2006. Western EcoSystems Technology, Inc., December 26, 2008. http://www.west-inc.com/reports/WEST%20Whooping%20Crane%20CA%20final.pdf.

McConnell, C. 2011. First Whooping Cranes Arrive On Aransas Wildlife Refuge, Texas. Friday, October 28th, 2011. Whooping Crane Conservation Association. http://whoopingcrane.com/2011/10/

Morkill A.E and S.H. Anderson. 1991. Effectiveness of marking power lines to reduce sandhill crane collisions. Wildlife Society Bulletin. 19:442-449.

Nesbitt. 2011. Differences between Florida whooping crane habitat and central flyway whooping crane habitat. Steve Nesbitt personal communication October 20, 2011.

NPPD. 2012. Nebraska Public Power District. Cost Estimate to Install Line Markers in NPPD Service Territory. James Jenniges personal communication on March 19, 2012.

PEEPS. 2011. Whooping Crane Population Update September 12, 2011. American Birding Association Online Forum. http://birding.typepad.com/peeps/2011/09/whooping-crane-population-update.html

PRESP. 2006. Platte River Endangered Species Partnership. Platte River Recovery Implementation Program: Attachment 4 - Land Plan. http://platteriverprogram.org/Documents/PRRIP%20Attachment%204%20-%20land_plan_final.pdf.

RUS 2013. Rural Utilities Service. The 2011 Statistical Report for Rural Electric Borrowers (March 2013). Informational USDA Rural Utilities Service Bulletin 201-1.

Southwire. 2003. Aluminum Conductor, Steel Reinforced, Bare. Product Catalog for Southwire Company. Carrolleton, Georgia, USA. http://www.southwire.com/ProductCatalog/proddetail.jsp?htmlpreview=true&token=16&desc=ACSR

Stehn, T. 2007. Whooping Cranes and Wind Farms; Guidance for Assessment of Impacts-DRAFT. Whooping Crane Coordinator, United States Fish and Wildlife Service, Aransas National Wildlife Refuge Complex, Austwell, TX. June 1, 2007.

Stehn, T. 2010. Tom Stehn's Whooping Crane Report: January 18, 2010. Accessed online on January 25, 2010. http://www.birdrockport.com/tom_stehn_whooping_crane_report.htm

Stehn, T.V. and T. Wassenich. 2007. Whooping Crane Collisions with Power Lines: An Issue Paper. Proceedings of the North American Crane Workshop, 2006.

Texas. 2013. Texas Parks and Wildlife. Whooping Crane (*Grus americana*). http://www.tpwd.state.tx.us/huntwild/wild/species/whooper/

USDOT. 2010. U.S. Department of Transportation. Federal Highways Administration. Highway Statistics 2010 – Public Road Length- Miles by Functional System. http://www.fhwa.dot.gov/policyinformation/statistics/2010/hm20.cfm

USFWS. 2003. U.S. Fish and Wildlife Service. Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines. May 13, 2003.

USFWS. 2009 a. U.S. Fish and Wildlife Service. Whooping Crane Sighting Database. Sent to Western by Martha Tacha on December 17 2009.

USFWS. 2009 b.U.S. Fish and Wildlife Service. Whooping cranes and wind development - an issue paper. Regions 2 and 6, U.S. Fish and Wildlife Service, April 2009.

USFWS. 2009 c. U.S. Fish and Wildlife Service. Region 6 Field Office Considerations for Evaluating Impacts to Whooping Cranes and other Migratory Birds from Transmission Line Projects. Updated June 4, 2009.

USFWS. 2010. U.S. Fish and Wildlife Service. Region 6 Guidance for Minimizing Effects from Power Line Projects Within the Whooping Crane Migration Corridor. Memorandum from the Assistant Regional Director, Ecological Services, Region 6 to Field Office Project Leaders, Ecological Services, Region 6. February 4, 2010.

USFWS. 2013. U.S. Fish and Wildlife Service. February 15, 2013 Whooping Crane Update. Aransas – U.S. Fish and Wildlife Service. http://www.fws.gov/nwrs/threecolumn.aspx?id=214751208.

USGS. 2012. U.S. Geological Survey, Northern Prairie Wildlife Research Center. Remote Tracking of Aransas-Wood Buffalo Whooping Cranes 2011 Breeding Season and Fall Migration Update. March 2012.

USGS. 2013. U.S. Geological Survey, Northern Prairie Wildlife Research Center. A Comprehensive Review of Observational and Site Evaluation Data of Migrant Whooping Cranes in the United States, 1943-99. Updated February 1, 2013. http://www.npwrc.usgs.gov/resource/birds/wcdata/develop.htm

APPENDIX P - LOAD PROJECTIONS STUDY

(To be filed to Docket separately)

APPENDIX Q - TREE AND SHRUB REPLACEMENT PLAN

Tree and Shrub Mitigation Specifications

Inventory

1. Trees and shrubs anticipated to be cleared, including those that are considered invasive species or noxious weeds (e.g., *Caragana arborescens, Elaeagnus angustifolia, Rhamnus cathartica, Tamarix chinensis, T. parviflora, T. ramosissima, Ulmus pumila*), must be inventoried before cutting. The inventory must record the location, number, and species of trees and shrubs.

2. In windbreaks, shelterbelts and other planted areas, trees or shrubs anticipated to be cleared, regardless of size, must be inventoried for replacement.

3. In native growth areas, trees anticipated to be cleared that are 1 inch diameter at breast height (dbh) or greater must be inventoried for replacement.

4. In native growth areas, shrubs anticipated to be cleared in the permanent right-of-way must be inventoried for replacement.

5. In native growth areas outside the permanent right-of-way, shrubs must be cut flush with the surface of the ground, taking care to leave the naturally occurring seed bank and root stock intact. If soil disturbance is necessary, the native topsoil must be preserved and replaced after construction. Shrubs must be allowed to regenerate naturally where native topsoil is preserved and replaced. Where native topsoil is not preserved and replaced, shrubs anticipated to be cleared must be inventoried for replacement.

6. In native growth areas, trees and shrubs may be inventoried by actual count or by a sampling method that will properly represent the woody vegetation population. A sampling plan developed by the company, filed with the North Dakota Public Service Commission (Commission) and approved prior to the start of construction must define the sampling method to be used for trees, for tall shrubs and for low shrubs. The data from the sample plots must be extrapolated to the total acreage of the wooded area to be cleared to determine the species and quantity of trees and shrubs to be replaced.

Clearing for Construction

7. Trees and shrubs must be selectively cleared, leaving mature trees and shrubs intact where practical.

8. The maximum width of clear cuts through windbreaks, shelterbelts and all other wooded areas is 50 feet, unless otherwise approved by the Commission.

9. If the area of trees or shrubs actually cleared differs from the area inventoried, the difference in number of trees and shrubs to be replaced must be noted on the inventory.

Replacement

10. Prior to tree and shrub replacement, documentation identifying the number and variety of trees and shrubs removed, as well as the mitigation plan for the proposed number, variety, type, location and date of replacement plantings, must be filed with the Commission for approval.

11. Two 2-year-old saplings must be planted for every one tree removed. Two shrubs (stem cuttings) must be planted for every one shrub removed.

12. Except in the case of invasive or noxious species, trees and shrubs must be replaced by the same species or similar species, suitable for North Dakota growing conditions as recommended by the North Dakota Forest Service. Invasive or noxious species must be replaced by similar non-invasive or non-noxious species suitable for North Dakota growing conditions as recommended by the North Dakota Forest Service.

13. Landowners must be given the option of having replacement trees and shrubs planted on the landowner's property, either on or off the right-of-way. The landowner must also be given the opportunity to waive those options in writing in order to have replacement trees and shrubs planted off the landowner's property.

14. At the conclusion of the project, documentation identifying the actual number, variety, type, location and date of the replacement plantings must be filed with the Commission.

15. Tree and shrub replacements must be inspected annually, in September, for three years. The first annual inspection must be at least one year from the anniversary date of the original plantings. A report of each annual inspection must be submitted to the Commission by October 1 of each year, documenting the condition of plantings and any woodlands work completed as of September of each year. If after the third annual report the survival rate is less than 75%, the Commission may order additional planting(s).

APPENDIX R - BIOLOGICAL OPINION

United States Department of the Interior

FISH AND WILDLIFE SERVICE
North Dakota Ecological Services Field Office
3425 Miriam Avenue
Bismarck, North Dakota 58501
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MAY 2 2 2014

In reply, please reference TAILS #: 2012-CPA-0100

Mr. Matt Marsh
Environmental Manager
Western Area Power Administration
Upper Great Plains Regional Office
P.O. Box 35800
Billings, MT 59107-5800

Dear Mr. Marsh:

This is in response to your March 26, 2014, letter and accompanying March 2014 Biological Assessment (BA) requesting informal consultation for the Antelope Valley Station (AVS) to Neset Transmission Line Project. Your letter also included a request for an informal conference concerning the potential effects determination for the candidate and proposed species. Although the Rural Utilities Service (RUS) is the responsible federal agency, the Western Area Power Administration (Western) has been designated by RUS as the lead for Section 7 consultation. The U.S. Fish and Wildlife Service (Service) offers the following comments under the authority of and in accordance with the Endangered Species Act (Act) (16 U.S.C. 1531 *et seq.*).

Western previously submitted a letter to the Service dated January 21, 2014, requesting concurrence with the effects determination to listed species in the November 2013 BA. However, to address newly proposed and candidate species, Western notified the Service (by email dated March 18, 2014) of the intent to engage in voluntary informal conferencing on the following candidate and proposed species for the project:

Sprague's pipit (*Anthus spragueii*)	Candidate
Northern long-eared bat (*Myotis septentrionalis*)	Proposed
Dakota skipper (*Hesperia dacotae*)	Proposed
Rufa red knot (*Calidris canutus rufa*)	Proposed

The Service accepted (by email, dated March 20, 2014) Western's request for informal conferencing. Western subsequently revised the BA (March 2014) to address the new status of these species and, per Western policy, treated the candidate and proposed species as if they were listed species for the analysis of effects. The Service believes this approach meets the needs for informal conferencing on these species.

As documented in the BA, Western has determined that the proposed AVS project would have "no effect" on the threatened gray wolf (*Canis lupus*), the endangered pallid sturgeon (Scaphirhynchus albus), or the endangered black-footed ferret (*Mustela nigripes*). In addition, Western has determined that the project "may affect, but is not likely to adversely affect" the Sprague's pipit, the threatened piping plover (*Charadrius melodus*), designated critical habitat for the piping plover, the endangered interior least tern (*Sternula antillarum*), the endangered whooping crane (*Grus americana*), the Northern long-eared bat, the Dakota skipper, and the rufa red-knot.

During the past year, the Service provided comments on September 20, 2013, to Western concerning the August 2013 Draft BA and on January 2, 2014, concerning the November 2013 Draft BA. Additionally, the Service, Western, and the project proponent, Basin Electric, have held a number of productive meetings that resulted in modifications to the effects analysis and determinations on the whooping crane. Specifically, Western has provided a comprehensive analysis and rationale in Appendix B for their Line Marking Plan. Approximately 93 percent of the total alignment (over 253 miles of the line, with exception of 21 miles through the Badlands) will be marked with bird flight diverters on the static wire. The line marking measures proposed are expected to increase the visibility of the tap line to enhance visual cues for migrating whooping cranes, piping plovers, interior least terns, and Sprague's pipit and, therefore, minimize the potential for collision with the line.

Based upon the project description, conservation measures identified in Section 1.3, the analysis of potential effects to each species and associated avoidance and minimization measures, and Section 1.4 – Line Marking Plan and associated rationale (Appendix B), the Service has concluded that the effects to the above-mentioned federally-listed species are either insignificant or discountable. Therefore, the Service concurs with your determinations.

Additionally, the Service concurs with your effects determinations of "may affect, but is not likely to adversely affect" for the Sprague's pipit, Northern long-eared bat, Dakota skipper, or rufa red-knot. Accordingly, this letter constitutes the Service's Conference Report and this terminates the conference procedures. If any candidate or proposed species are listed in the future, and no changes have occurred in the project design and construction, the Service recommends Western submit a request to the Service to adopt this conference report as a concurrence for the newly listed species to insure Western's compliance with the interagency coordination procedures pursuant to Section 7 of the Act.

The BA also indicates "no effect" determinations for the gray wolf, pallid sturgeon, and the black-footed ferret. There is no requirement under the implementing regulations of the Act (50 CFR Part 402) for action agencies to receive Service concurrence with "no effect" determinations, therefore, the responsibility for "no effect" determinations remains with Western. Accordingly, we recommend Western retain the documentation and analysis for these listed resources in your decisional record.

Pursuant to the implementing regulations of the Act (50 CFR 402.13), this letter concludes informal consultation on the subject action. This action should be re-analyzed if: (1) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this consultation; (2) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the consultation; or (3) a new species is listed or critical habitat is designated that may be affected by this project.

The Service appreciates your efforts to insure the conservation of trust species as part of our joint responsibilities under the Act. If further information is needed, please contact Mr. Roger Collins (701-355-8502 or 701-391-0040) or myself at 701-355-8512.

Sincerely,

Kevin Shelley
Acting Assistant Field Supervisor
North Dakota Field Office

cc: USFWS, Ecological Services, ND/SD ES (S. Larson)
USDA, RUS, Bismarck (Attn: T. Bohan)

Appendix B. Summary of Action Agencies' Decision related to Whooping Crane Determination

Rationale for Line Marking Device Installation on New Power Lines Only; Concurrence on Informal Consultation under Section 7 of the Endangered Species Act

Over the past five years, the North Dakota Ecological Services Office (NDES) of the U.S. Fish and Wildlife Service (USFWS), the Rural Utility Service (RUS) and Western Area Power Administration (Western), the latter two hereafter referred to as Action Agencies, have entered into informal consultations for impacts from the construction of new power lines on whooping cranes. One source of difficulty in these consultations has been over the installation of line marking devices for transmission lines on existing infrastructure and the rationale for "one-plus-one" (mile for mile) line marking recommendations. The NDES has indicated that the Action Agencies need to provide a justification for the lack of mile for mile marking on existing lines for new transmission line construction or for other mitigation measures or alternative plans and rationale to reduce the threat of line strikes to discountable levels. This appendix provides the rationale for marking only new power line construction with in one mile of suitable stopover habitat for the whooping crane.

In 2009, the USFWS Region 6 issued draft recommendations designed to assist their biologists "in transmission line (including generation lines, power lines, distribution lines, etc.) project evaluation" (USFWS 2009c) for lessening impacts to the whooping crane and other migratory birds. This guidance document provides "general considerations that may apply to most, but not every situation within the whooping crane migratory corridor"; the document also indicates that "additional conservation measures may be considered and/or discretion may be applied as applicable". The considerations outlined within the document include burying lines, the installation of line marking devices, and avian protection plans.

The 2010, Region 6 issued final recommendations that list the following hierarchy for line marking within the Central Flyway Whooping Crane Migration Corridor, the only migratory corridor for the wild whooping crane population (USFWS 2010):

> If it is not economically or technically feasible to bury lines then we recommend the following conservation measures be implemented:
>
> a) Within the 95-percent sighting corridor (see attached map):
>
> i) Project proponents should mark new lines within 1.0 mile of potentially suitable habitat and an equal amount of existing line within 1.0 mile of potentially suitable habitat (preferably within the 75-percent corridor, but at a minimum within the 95-percent corridor) according to the U.S. Fish and Wildlife Service (USFWS) recommendations described in APLIC 1994 (or newer version as updated).
>
> ii) Project proponents should mark replacement or upgraded lines within 1.0 mile of potentially suitable habitat according to the USFWS recommendations described in APLIC 1994 (or newer version as updated).
>
> b) Outside the 95-percent sighting corridor within a State's borders, Project proponents should mark new lines within 1.0 mile of potentially suitable habitat at the discretion of the local ES field office, based on the biological needs of the whooping crane.

These recommendations are designed to be taken into consideration when planning projects and when the proposed project impacts are evaluated for the effects to the whooping crane. The guidance document makes the process sound flexible and project specific impact focused, however, this has not been the implementation at the NDES Office level for the Action Agencies' Section 7 consultations. In past consultations with NDES, the Action Agencies have agreed to mark any new construction occurring within the flyway, to reduce the risk of the new infrastructure to cranes. The construction of new transmission lines in the only migration corridor of the wild population introduces a new collision risk into the environment; this is not disputed. The recommendation to mark existing infrastructure at a mile-for-mile equivalency is a logistically difficult, expensive, and perpetual minimization measure that stalls many projects. The difficulty with quantifying and evaluating the impacts to cranes from the existing baseline conditions (i.e. existing lines) and the true effects of line marking as a minimization measure creates a dissention point between the Action Agencies and NDES that is unresolvable in the current informal consultation frame work.

The Action Agencies have determined that the level of effects from the construction of new transmission lines, when the new construction is properly marked with line marking devices, does not rise to the level of a "may affect likely to adversely affect" determination that would propel the Section 7 forward into the formal consultation process. The Action Agencies believe the impacts can be minimized to a "may affect not likely to adversely affect" determination by marking the proposed new construction only. However, the response from the NDES has been a non-concurrence.

Existing baseline for the whooping crane populations and the mortality risk to whooping cranes derived from power lines

Baseline conditions: The USFWS cites that power lines are the greatest known source of mortality for whooping cranes (Stehn and Wassenich 2008, USFWS 2009 b). Between1959 and 2010, 49 whooping cranes have been killed by colliding with power lines. It is important to note in this information that the bulk of power line mortalities have occurred in the experimental introduced flocks. Of these 49 deaths, nine have occurred in the Aransas Wood Buffalo Population (AWBP) between 1956 and 2002, 21 in the Florida Non-Migratory Flock between 1997 and 2010 , 13 in the non-extant Rocky Mountain Flock between 1977 and 2000, and six in the Wisconsin-Florida Migratory Flock between 2001 and 2009 (Stehn and Wassenich 2008, USFWS 2009 b, NPPD 2012). The differences between the experimental flocks and the AWBP are considerable, in both biology and habitat (Nesbitt 2011).

The experimental flocks, especially the Florida and Wisconsin-Florida flocks, reside in a landscape with differing urban pressures and infrastructure density. Figure 1, below, highlights the general migration paths utilized by each population and the density of power line infrastructure. The scale of the power line infrastructure is coarse, but it is important to note that the density of transmission to distribution is proportionally linked, meaning the higher the transmission line density the higher the distribution line density.

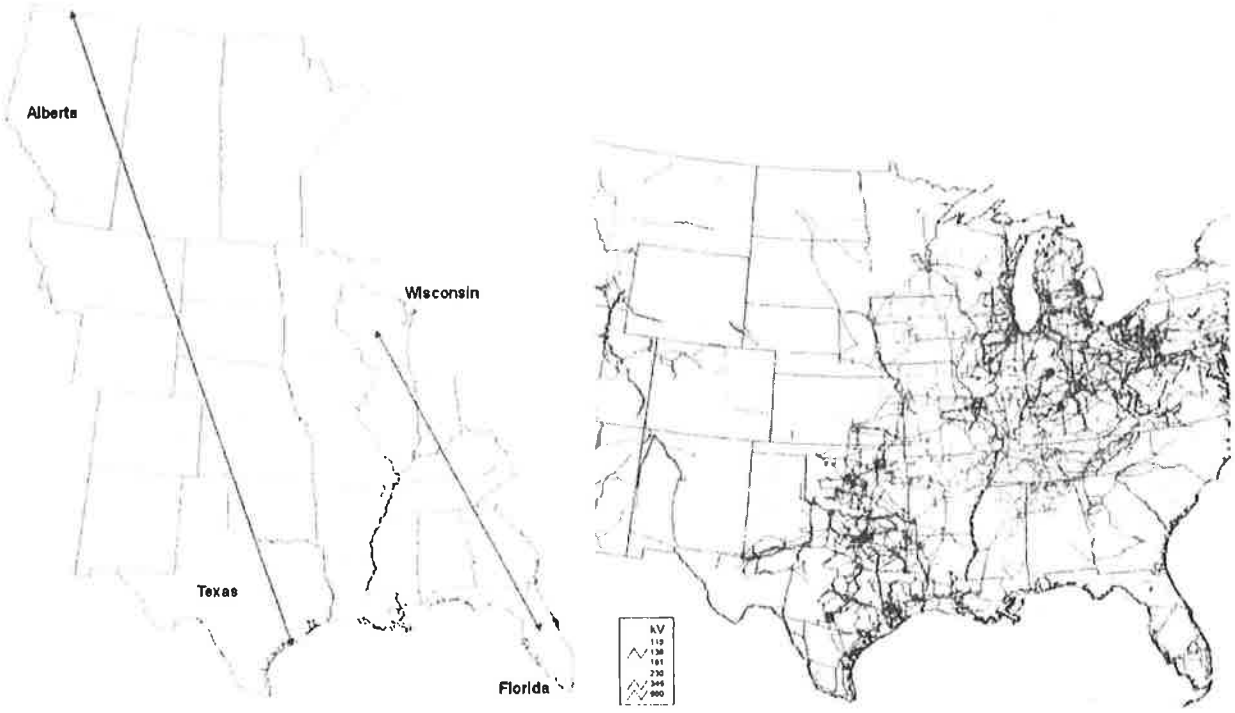

Figure 1. Two migration paths for whooping cranes and transmission line density map. Images courtesy of Texas Parks and Wildlife and Federal Emergency Management Agency

Human disturbance and density also varies between the migrating flocks. The six Central Flyway Whooping Crane Migration Corridor (central flyway) states of the AWBP of Texas, Oklahoma, Kansas, Nebraska, South Dakota and North Dakota have human population of approximately 36.15 million while the six states of Wisconsin-Florida migratory flock, Florida, Georgia, Tennessee, Kentucky, Illinois, and Wisconsin, have a population of 58.68 million (US Census 2010). The human density between these six-state sets is marked. Figure 2, below, highlights the difference in human density along the two migration paths. The human population density in the flyways can be used as an indicator of the human incursion into suitable stopover habitat. Clearly there is far more human incursion along the eastern migration route than in the central flyway. This can impact the availability of proper forage, safe roosting locations, and successful rest during migration. Human disturbance can flush flocks (via vehicle traffic, curious domestic animals, curious people, lights and noise, etc.) from any stopover site. As the transmission line density map indicates, higher human density is linked to higher overhead line density (more people require more power). The increase in line prevalence logically results in higher risk to whooping cranes from collision with overhead lines.

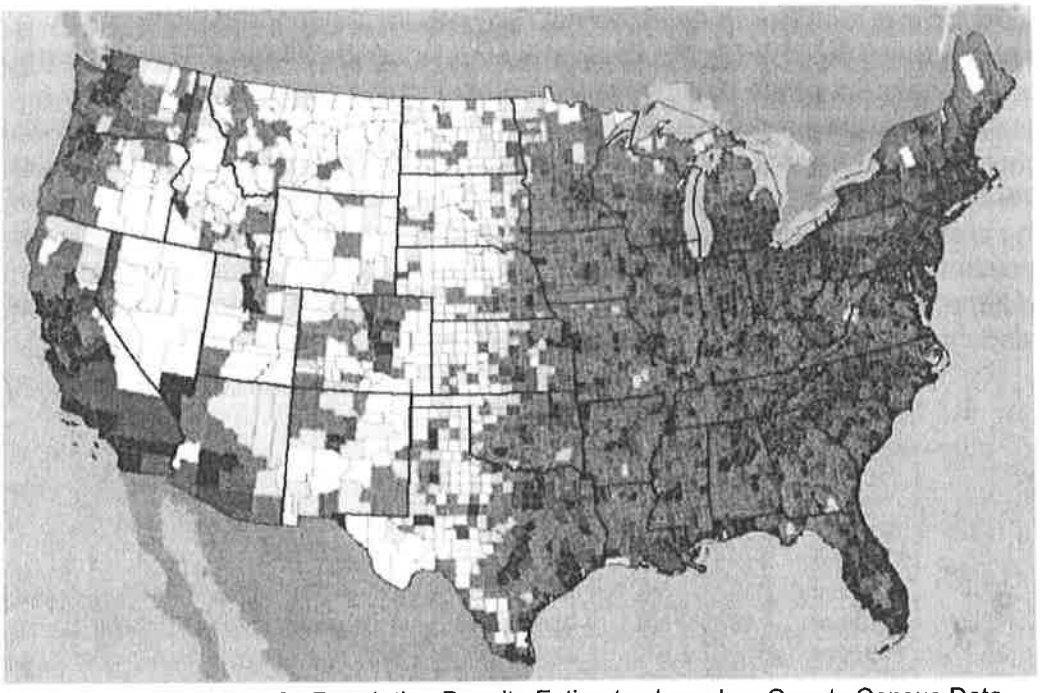

Figure 2. Population Density Estimates based on County Census Data.
Image courtesy of the National Atlas of the United States.

The landscape availability of stopover habitat is also very different between the two routes. The Florida population lives in the southeastern coast plain, while those that migrate to Wisconsin pass through central hardwoods, eastern tall grass prairie, and prairie hardwoods transitional habitats. The AWBP flock migrates from coastal prairies, through oaks and prairies, central mixed grass prairie, and prairie pothole habitats. These habitats vary wildly in the annual precipitation and surface water availability. The human density in the landscape may also limit the availability of suitable stopover locations by limiting wetland size and composition preferred by cranes (Stehn and Wassenich 2008, USFWS 2009 b, and CWS-USFWS 2005).

It may be that whooping crane migration behavior is markedly different between the populations as well. The older birds within the Florida-Wisconsin flock have been taught to migrate by humans using ultra-light aircraft. This may have an impact on the whooping crane's tolerance to human incursion or in the selection factors for the route and stopover locations. Since the majority of the birds within the experimental populations are used to at least some level of human presence in their lifecycle (being raised in pens, near human presences, forage sources different than wild sources, etc) the tolerance levels may not be similar to the wild AWBP flock. This may result in differing levels of human avoidance or acceptance.

Given the differences in human population density, power line density, human incursion into the habitat, differing stopover availability, and possible unique migration behavior differences, consolidating the experimental flocks together with the AWBP does not accurately assess the risk that the AWBP encounters relative to mortality sources in the central flyway. The references in the literature will often lump the collision mortality from

the discrete populations together to estimate risk, yet separate out population growth estimates when applying the risk factors to overall population projections. This appears to be a disparate treatment of the data. It would be best to then disassociate the separate population mortalities and population growth projections, and instead focus on the AWBP whooping crane's risk within the central flyway for the purposes of assessing impacts of proposed projects on the AWBP. Proper disassociation results in the data of nine whooping crane power line mortalities within the AWBP in the last 56 years and a population growth from 18 birds in the wild flock in 1939 (Texas 2013 and Didrickson 2011) to an estimated population of 279 in 2013 (USFWS 2103). The nine mortalities of whooping cranes are detailed in Table 1, below.

Month	Year	State	Line Type
May	1956	TX	Transmission
November	1965	KS	Distribution
April	1967	KS	Distribution
October	1981	SK	Distribution
October	1982	TX	Distribution
October	1988	NE	Distribution
October	1989	NE	Distribution
October	1997	SK	Distribution
April	2002	TX	Distribution

Table 1. Nine Whooping Crane Collisions in AWBP Flock.

When reviewing factors that contribute to bird collisions with power lines, the five primary factors that influence risk include: wing and body size, environmental conditions (low light, high winds, storm fronts, etc.), exposure to lines (line prevalence), the design of the line (diameter of the conductor, vertical configuration, etc.), and avian behavior (APLIC 2012). Of these five factors, two are ecological factors that remain the same regardless of the Action Agencies' actions, the wing and body size of the bird and the environmental conditions. Since both of these factors remain regardless, they will not be addressed. Of the remaining three factors the Action Agencies may have an influence over the location of some of the new lines, the design of some of the new lines, and the habitat modification (and therefore possible behavior modification) of areas within the proximity of some of the new lines. As for existing prevalence, design, and behavior the Action Agencies have little control over the current baseline conditions.

Prevalence: The prevalence of overhead lines in the central flyway is directly linked to the exposure risk of cranes to a source of mortality. Clearly whooping cranes are at risk from death resulting in collision with overhead lines when there have been nine collisions within the AWBP. It is estimated that there is approximately 83,700 miles of transmission line infrastructure in the central flyway states currently, as shown in Table 2. This estimate includes transmission level voltages and sub-transmission level voltages.

Year	Rate of Growth	Miles of OHL
1993	1.445	63,411.68
1995	1.445	65,257.52
1997	1.445	67,157.09
1999	1.445	69,111.95
2001	1.445	71,123.71
2003	1.445	73,194.04
2005	1.445	75,324.63
2007	1.445	77,517.24
2009	1.2213	79,773.68
2011	1.2213	81,734.13
2013	1.2213	83,742.76

Table 2. Miles of Overhead Line for the six central flyway states.

This estimate has been calculated using a 1993 data set for estimated miles of overhead lines (sub-transmission and transmission) in each of the six states from the Energy Information Administration, U.S. Department of Energy. This data set was expanded using the United Nations Infrastructure growth rate curve for the United States (averaged over the three preceding/receding years). This growth curve can estimate the total number of miles of overhead sub-transmission and transmission line from Texas to North Dakota. This is only a course estimate; there is no current dataset, nor any entity collecting data or storing data, on the number of miles of overhead line. As the electric power grid has over 210 owners or operators in these six states alone, it is difficult to gather real time data. RUS keeps data on the number of miles of distribution lines within each state by member utility (RUS 2013). As of 2011, there were 325,292 miles of distribution line from Texas to North Dakota. This only includes the distribution lines, residential taps, subdivision or urban distribution systems that are members of RUS. It is therefore an underestimate of the total miles of overhead distribution lines as not all service providers are members of RUS. As a note of contrast there are approximately 38,000 miles of Interstate and Primary State Highway within these six states (USDOT 2010). This data set indicates that in the past 20 years there has been an annual increase to the risk posed to whooping cranes from the prevalence of overhead wires; yet the population continues to trend upward, Figure 3, below.

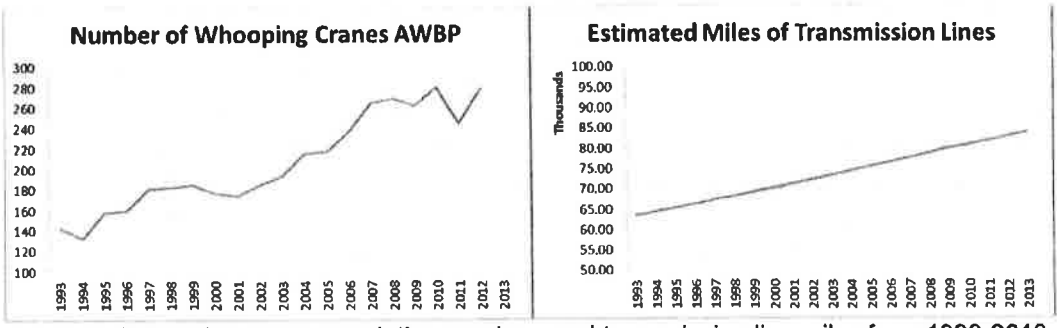

Figure 3. Whooping crane population numbers and transmission line miles from 1993-2013. Data from the USFWS, the International Crane Foundation, and Table 2.

The rate of increase in the whooping crane population is not linear and fluctuations of the population occur on 2-3 year cycle (Didrickson 2011) but generally trend upwards over time. This is a slow and steady increase in the overall flock population since 1993. During this exact same 20 year time period the United States continued to develop more and more overhead infrastructure. Only two recorded collisions occurred from during the last 20 years (1993 to 2013), which does not appear to have significantly influenced the rate of growth for the population as both years of collision (1997 and 2002) represent years of overall population growth.

Design: Table 1, above, accounts for the nine whooping crane mortalities within the central flyway in the past 56 years. Eight of the nine collisions have occurred with distribution lines rather than transmission lines. This may reinforce the concept that smaller diameter lines may prove a higher risk to flying cranes (APLIC 2012). It may also support the idea that the lower elevation lines, i.e. smaller structures and lower to the ground lines, represent a greater risk. The collision risk may simply be a function of the prevalence of distribution lines as well. The risk may be a combination of all three: the diameter of the wire, the elevation of the wire, and the ubiquitous nature of the wire.

The difference in wire diameter between distribution lines and transmission lines differs based on the voltage of the line. The diameter of a typical 12.5 kV distribution line is 0.563 inches where the diameter of a typical 115 kV transmission line is 1.1 inches (Southwire 2003). The increase in diameter of the wire increases the visibility of the wire and can reduce the risk of collision between the two voltages (APLIC 2012). The proposed construction of transmission line may have a lower risk of collision than an equal amount of proposed distribution wire. However, the overhead static wire on transmission lines is generally smaller in diameter than the energized conductor itself and can pose a similar risk as the distribution wire (as they average roughly the same diameter). The static wire is also typically the top wire installed – at the top point height of the line clearance. This all indicates that the ratio of risk reduction attributed to wire diameter is quantifiably unknown. The anecdotal evidence may indicate a reduced risk posed by transmission, but this may not be true in areas with installed static wires. The true risk may be heavily species dependent, i.e. based on avian vision and visual cues, rather than line design.

Avian Behavior: When assessing collision risk along any overhead line it is important to note the location and orientation of the line towards any avian activity within the vicinity (APLIC 2012). The location of the line relative to avian use of the landscape can predict collision risks. Lines that bisect feeding and sheltering sites, or lines that bisect or frame feeding grounds can have a much higher risk of collision than lines that are located in areas with no avian activity taking place. It can be difficult to quantitatively assess the suitability of one location relative to another location without the use of a standardized method. One method available to accomplish this is a Resource Selection Function (RSF), a type of resource selection predictive model, which is further described in Appendix A.

The basic premise of resource selection modeling (Manly et al. 2002) is that resources (which may be food items, land cover types, or any quantifiable habitat characteristic) that are important to individual whooping cranes will be "used" disproportionately to the availability of those resources in the environment. In an RSF, the characteristics at the use locations were contrasted to characteristics at randomly selected "available" locations within a given study area. Standard logistic regression models are developed to estimate a linear function of site characteristics that reliably predict observed use. The model produces estimates of the relative probability of use at a location in the study area, as a function of the sites' characteristics (Manly et al. 2002). This can help to determine if one given site is likely to receive higher use than another location. This in turn can help to determine avian behavior near a given location; is this a more desirable location (based on the set of characteristics that govern stopover selection) than one mile away, resulting in higher frequency of crane use?

There are known concentration areas for whooping cranes within the central flyway; these include the four sites in four states that have been designated critical habitat. These include Cheyenne Bottoms State Wildlife Area and Quivira National Wildlife Refuge (NWR), Kansas; Platte River valley between Lexington and Dehman, Nebraska; Salt Plains NWR), Oklahoma; and Aransas NWR, Texas. These areas experience far greater avian use than surrounding areas and the behavior of the birds at these sites may differ as a result of increased site use and higher numbers of individuals at any given time. As for the rest of the flyway, stopover habitat can range from sparse to abundant, depending on the conditions at a local level. When reviewing the nine known collision locations, the majority of the habitat near the lines would be considered marginal quality habitat (Didrickson 2011). This would represent an inverse relationship between the quality of habitat and the risk to cranes, consistent with the habitat quality investigated near the non-migratory flock collision locations. This just highlights the difficulty in determining risk of collision to cranes on a landscape scale. Collision risk often proves to be highly site specific (APLIC 2012).

While migrating, cranes tend to fly between elevations of 1,000 ft. to 6,000 ft. It is at the start of the day, taking off from their roosting or feeding location, and at the end of the day, coming down to feed or roost, that cranes are most susceptible to collision (Stehn 2007). Wetlands suitable for overnight roost sites for migrating whooping cranes are available throughout the migration corridor in the Dakotas. Associated feeding sites with-in agricultural fields are also available throughout the corridor, within proximate locations of wetlands (Stehn 2007 from Stahlecker 1997a, 1997b). The current 2010 USFWS Region 6 guidance is based on Brown et al. (1984 and 1987) which indicates that the threat to birds posed by collision decreased to zero when the power line was located a mile or more away from bird use areas. This data does not indicate the type of relationship the distance to risk represents, only that at one mile the risk drops to zero. The actual relationship when analyzed may indicate a high reduction in risk within only a short distance from the wetland; Morkill and Anderson (1991) indicated a response within 820 feet of the wetland. As such, a mile is an estimation of distance that has a risk factor of zero.

Indications of Risk: Despite the increase in miles of power line, the whooping crane has managed to make population gains, without the wide spread use of line marking devices. This indicates that while power lines may play a role in mortality rates for the wild migrating flock, the rate at which collision occurs is not enough to prohibit the overall increase of the population. Mortality rates have remained steady during the past 50 years; (Stehn and Strobel 2011) thus assuming that every mile of power line increases the potential for mortality (and a decline in overall whooping crane population numbers) is not based in the available data.

The causes of known mortality account for only about 10% of the actual deaths, as the majority of birds that disappear from the AWBP are completely unaccounted for (Stehn 2007). Mortality and risk data for the AWBP is often extrapolated from recovered carcasses (n=50) and total losses from the population (n=525) from 1950-2010. Such extrapolation and risk assessment requires numerous assumptions on detection probability, predator removal, rate of unrecovered collision mortality, and all the other variables. A simple equation for estimating the number of collision mortalities in the AWBP would look something like this:

Estimated number of collisions = known collisions / percentage of collisions found

If we use the 10% figure attributed to known mortality relative to actual deaths (reported in Stehn 2007) and assume that all unknown mortality is the result of collision, then we can over estimate that 90 whooping cranes have collided with lines since 1956 (90 = 9 known collisions/10% "find rate"). A simple linear relationship would indicate that roughly 1.6 cranes die each year from collision with a power line (90 deaths over a 56 year period). If we partition this out based on the underestimation of 408,992 miles of overhead line (83,700 sub-transmission and transmission plus 325,292 miles of distribution lines) within the central flyway, we end up with a per mile risk of collision of 3.91×10^{-6} mortalities per mile of line (or 0.00000391 crane deaths per mile = 1.6 deaths per year divided by 408, 992 miles of line). This is proportionally a very low risk of collision for any randomly selected mile of overhead line in the central flyway.

Most of the studies cited by the USFWS indicate a 50-80% mortality reduction in collision mortalities once line marking devices have been installed. It is understood that this low end estimation of reduction rate forms the basis for the Region 6 recommendation of additional miles of line equal to the number of new miles of line. This is an oversimplification of the statistical risk of collision presented by overhead lines. Each opportunity for collision is an independent trial and predicted risk of a collision with one line is independent from the risk at any other line. Therefore a one-to-one strategy of marking new lines and old lines to result in no net loss is not a statistically valid justification. Different power lines also have different rates of inherent collision risk (as discussed in avian behavior above, and see APLIC 2012), so marking all lines within one mile of potentially suitable migratory stop over habitat may not yield the same collision reduction rates.

Tracking of cranes via transmitter during the 2011 fall migration indicated that only 6% of stopovers were occurring in North Dakota, while nearly 32% were in Saskatchewan

(USGS 2012). While line marking does have greater benefits in areas of high bird concentration (historic stopover sights, along the Platte River, and designated critical habitat) the installation of thousands of line marking devices in the 95-percent sighting corridor, not located in high crane use areas, is an intensive minimization measure that statistically returns no result. For example marking 255,755 miles of existing line within the dispersed habitat would need to be marked in order to avoid a single crane death on existing line in any given year (1 crane/0.00000391 crane deaths/mile/year).

The average cost of line marking for a one time installation on new construction can be anywhere from $1,300 to $3,200 per mile of line with land based applications. If other environmental restrictions are put in place that require helicopter installation the average cost per mile increases to $12,000 per mile (NPPD 2012). These installation costs do not take into account the cost of installation on an existing line, nor the lifetime maintenance of a device on an energized line. Many of the market available devices have limited life expectancies and require replacement every 5-10 years. Economics do play a role in many utility decisions; often times the power lines are owned by cooperatives, municipalities, or public service districts that are required, under law, to operate at cost. The costs of line marking devices have to be rolled into consumer prices and rate boards can deny these rate increases.

The focus of the Region 6 guidance for risk reductions from cranes focuses on one source of mortality for cranes. However, power lines are not the only source of mortality for the cranes. From November 2008 to April of 2009, 23 whooping cranes perished on the wintering grounds in Texas. The bulk of these deaths were attributed to starvation and resulting disease (USFWS 2009 b, Stehn 2010). It is apparent that power lines are mislabeled as the "single greatest threat of mortality to fledged whooping cranes" (2010 Recommendations, footnote 2) in the AWBP when more than twice as many perish in a single year from malnutrition (23 cranes) then have been documented in the past 56 years as colliding with power lines (9 cranes). Even the over extrapolated 90 deaths due to collisions, spread out over a 56 year period, equaling 1.6 deaths per year, pales with a single winter loss of 23 cranes on a wildlife refuge.

Current Proposed Project Application: For the proposed Basin Electric AVS-Neset Line 275 miles of new transmission line would be constructed in the central flyway. Using the simplified risk estimation from above, this new construction represents and increased risk to the cranes of 0.0011 deaths per year from the new lines (resulting from 275 miles x 0.00000391 crane deaths per mile). Statistically, it would take roughly 910 years for the risk potential to result in a death of a single crane on any single mile of new line.

If the Region 6 guidance is followed for line marking devices, approximately 254 miles of new construction would be marked. This represents a low end cost of roughly $330,200 just for the one time installation of line marking devices. Marking and equal amount of existing line may represent an equal amount of low end cost or a high end estimate of $812,800. This expenditure of anywhere from $660,400 to $1,143,000 would have to be borne by the rate payers of Basin Electric for the one time installation

cost of line marking devices. This does not factor into consideration the long term maintenance or replacement costs of the devices into the future. As for existing infrastructure, this cost estimate does not factor into consideration the cost of replacing or reinforcing the line or static wires to accommodate the additional weight, wind and ice loading, or engineering impacts that installation of line marking devices would have on lines not designed to accommodate the devices.

The cost for Basin to mark approximately 250 miles of new line, a single project, exceeds the estimated dollar amount of $93,000 presented in the 2007 whooping crane recovery plan. It is clear the economic concept of line marking does not match with the on the ground reality of line marking. As line marking devices represent only one solution to the issue of crane population growth (see CWS-USFWS 2005) and the overall reduction in collision risk resulting from line marking is minimal in dispersed, abundant, stopover habitat it does not make sense from both an economic perspective and a conservation perspective to expend well over half a million dollars to reduce the risk to cranes by 0.0011 deaths/year. It makes better sense to reduce the increased risk posed by the construction of new lines and leave the existing lines in dispersed habitat alone; knowing that more can be done to eliminate high risks in crane migration concentrate areas, and that this burden is shared by more than just the utility industry.

References:

APLIC. 2012. Avian Power Line Interaction Committee. Reducing Avian Collisions with Power Lines: The State of the Art in 2012. Edison Electric Institute and APLIC. Washington, D.C.

Brown, W. M. and R.C. Drewien. 1995. Evaluation of two power line markers to reduce crane and waterfowl collision mortality. Wildlife Society Bulletin. 23:217-227.

Brown, W. M., R. C. Drewien, and E. G. Bizeau. 1987. Mortality of cranes and waterfowl from powerline collisions in the San Luis Valley-Colorado. Pages 128-136, in J. C. Lewis and J.W. Ziewitz, eds. Proc. 1985 Crane Workshop. Platte River Whooping Crane Habitat Maintenance Trust and USFWS, Grand Island, Nebraska.

Brown, W. M., R. C. Drewien, and D. L.Walker. 1984. Crane flight behavior and mortality associated with power lines in the San Luis Valley, Colorado. Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow, Idaho, USA.

CWS-USFWS. Canadian Wildlife Service and U.S. Fish and Wildlife Service. 2005. International recovery plan for the whooping crane. Ottawa: Recovery of Nationally Endangered Wildlife (RENEW), and U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 162 pp.

Didrickson, B. 2011. Historic whooping crane numbers. International Crane Foundation. http://www.savingcranes.org/images/stories/site_images/conservation/whooping_crane/pdfs/historic_wc_numbers.pdf

Edison Tech Center. 2010. History of Electrification. Edison Tech Center Website. http://edisontechcenter.org/HistElectPowTrans.html

Howlin, S., C. Derby, and D. Strickland. 2008. Whooping Crane Migrational Habitat Use in the Central Platte River during the Cooperative Agreement Period, 2001-2006. Western EcoSystems Technology, Inc., December 26, 2008. http://www.west-inc.com/reports/WEST%20Whooping%20Crane%20CA%20final.pdf.

McConnell, C. 2011. First Whooping Cranes Arrive On Aransas Wildlife Refuge, Texas. Friday, October 28th, 2011. Whooping Crane Conservation Association. http://whoopingcrane.com/2011/10/

Morkill A.E and S.H. Anderson. 1991. Effectiveness of marking power lines to reduce sandhill crane collisions. Wildlife Society Bulletin. 19:442-449.

Nesbitt. 2011. Differences between Florida whooping crane habitat and central flyway whooping crane habitat. Steve Nesbitt personal communication October 20, 2011.

NPPD. 2012. Nebraska Public Power District. Cost Estimate to Install Line Markers in NPPD Service Territory. James Jenniges personal communication on March 19, 2012.

PEEPS. 2011. Whooping Crane Population Update September 12, 2011. American Birding Association Online Forum. http://birding.typepad.com/peeps/2011/09/whooping-crane-population-update.html

PRESP. 2006. Platte River Endangered Species Partnership. Platte River Recovery Implementation Program: Attachment 4 - Land Plan. http://platteriverprogram.org/Documents/PRRIP%20Attachment%204%20-%20land_plan_final.pdf.

RUS 2013. Rural Utilities Service. The 2011 Statistical Report for Rural Electric Borrowers (March 2013). Informational USDA Rural Utilities Service Bulletin 201-1.

Southwire. 2003. Aluminum Conductor, Steel Reinforced, Bare. Product Catalog for Southwire Company. Carrolleton, Georgia, USA. http://www.southwire.com/ProductCatalog/proddetail.jsp?htmlpreview=true&token=16&desc=ACSR

Stehn, T. 2007. Whooping Cranes and Wind Farms; Guidance for Assessment of Impacts-DRAFT. Whooping Crane Coordinator, United States Fish and Wildlife Service, Aransas National Wildlife Refuge Complex, Austwell, TX. June 1, 2007.

Stehn, T. 2010. Tom Stehn's Whooping Crane Report: January 18, 2010. Accessed online on January 25, 2010. http://www.birdrockport.com/tom_stehn_whooping_crane_report.htm

Stehn, T.V. and T. Wassenich. 2007. Whooping Crane Collisions with Power Lines: An Issue Paper. Proceedings of the North American Crane Workshop, 2006.

Texas. 2013. Texas Parks and Wildlife. Whooping Crane (*Grus americana*). http://www.tpwd.state.tx.us/huntwild/wild/species/whooper/

USDOT. 2010. U.S. Department of Transportation. Federal Highways Administration. Highway Statistics 2010 – Public Road Length- Miles by Functional System. http://www.fhwa.dot.gov/policyinformation/statistics/2010/hm20.cfm

USFWS. 2003. U.S. Fish and Wildlife Service. Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines. May 13, 2003.

USFWS. 2009 a. U.S. Fish and Wildlife Service. Whooping Crane Sighting Database. Sent to Western by Martha Tacha on December 17 2009.

USFWS. 2009 b.U.S. Fish and Wildlife Service. Whooping cranes and wind development - an issue paper. Regions 2 and 6, U.S. Fish and Wildlife Service, April 2009.

USFWS. 2009 c. U.S. Fish and Wildlife Service. Region 6 Field Office Considerations for Evaluating Impacts to Whooping Cranes and other Migratory Birds from Transmission Line Projects. Updated June 4, 2009.

USFWS. 2010. U.S. Fish and Wildlife Service. Region 6 Guidance for Minimizing Effects from Power Line Projects Within the Whooping Crane Migration Corridor. Memorandum from the Assistant Regional Director, Ecological Services, Region 6 to Field Office Project Leaders, Ecological Services, Region 6. February 4, 2010.

USFWS. 2013. U.S. Fish and Wildlife Service. February 15, 2013 Whooping Crane Update. Aransas – U.S. Fish and Wildlife Service. http://www.fws.gov/nwrs/threecolumn.aspx?id=214751208.

USGS. 2012. U.S. Geological Survey, Northern Prairie Wildlife Research Center. Remote Tracking of Aransas-Wood Buffalo Whooping Cranes 2011 Breeding Season and Fall Migration Update. March 2012.

USGS. 2013. U.S. Geological Survey, Northern Prairie Wildlife Research Center. A Comprehensive Review of Observational and Site Evaluation Data of Migrant Whooping Cranes in the United States, 1943-99. Updated February 1, 2013. http://www.npwrc.usgs.gov/resource/birds/wcdata/develop.htm

APPENDIX S - PERMITS

(To be filed to Docket separately)

APPENDIX T - PROGRAMMATIC AGREEMENT FOR CULTURAL RESOURCES

PROGRAMMATIC AGREEMENT
AMONG
THE WESTERN AREA POWER ADMINISTRATION,
THE RURAL UTILITIES SERVICE,
THE U.S. FOREST SERVICE,
THE ADVISORY COUNCIL ON HISTORIC PRESERVATION
AND
THE NORTH DAKOTA STATE HISTORIC PRESERVATION OFFICE
REGARDING
THE AVS-NESET 345 kV TRANSMISSION LINE PROJECT
TO BE CONSTRUCTED IN
MERCER, DUNN, BILLINGS, MCKENZIE, WILLIAMS AND MOUNTRAIL COUNTIES,
NORTH DAKOTA

WHEREAS, in accordance with the Rural Electrification Act of 1936 (7 U.S.C. §§ 901-950b), the Rural Utilities Service (RUS) is authorized to provide federal financial assistance for the development of electric infrastructure in rural America; and

WHEREAS, Basin Electric Power Cooperative, Inc. (Basin Electric) intends to request federal financing assistance from RUS to modify four (4) existing substations-Antelope Valley Station (AVS), Charlie Creek, Williston and Neset, and to construct approximately 278 miles of transmission line - 265 miles of new 345 kilovolt (kV) transmission line and 13 miles of new 230 kV line - along with five (5) new substations (Blue, Judson, Tande, Redand White), and ancillary facilities, such as access roads, and temporary construction work and staging areas, in Mercer, Dunn, Billings, McKenzie, Williams and Mountrail Counties, North Dakota (AVS-Neset Project); and

WHEREAS, in accordance with the Federal Power Act, 16 U.S.C. Chapter 12, the Western Area Power Administration (Western) is authorized to provide interconnections among electric facilities; and

WHEREAS, Basin Electric has requested that Western authorize an interconnection between the Williston Substation and the Williston to Charlie Creek 230 kV transmission line; and

WHEREAS, the U.S. Forest Service (USFS) is considering a request by Basin Electric for the AVS-Neset Project to cross lands managed by that federal agency; and

WHEREAS, RUS, Western and USFS (the Agencies) have determined that the individual federal actions which each may take would make the AVS-Neset Project an undertaking subject to review under Section 106 of the National Historic Preservation Act, 16 U.S.C. § 470, and its implementing regulations, "Protection of Historic Properties" (36 CFR Part 800); and

WHEREAS, RUS and USFS have agreed, in accordance with 36 CFR § 800.2(a)(2), that Western will be the lead federal agency for the purposes of review under 36 CFR Part 800 (Section 106 review); and

WHEREAS, RUS has been designated as the lead agency for review under the National Environmental Policy Act (NEPA) conducted pursuant to 7 CFR Part 1794; and

WHEREAS, based on the NEPA analysis conducted pursuant to 7 CFR Part 1794, RUS will select a 1000-foot wide corridor within which the AVS-Neset Project can be constructed; and

WHEREAS, the North Dakota Public Service Commission approved the 150-foot-wide right-of-way (ROW) designated as original Alternative A for construction of the AVS-Neset Project; and

WHEREAS, the North Dakota Public Service Commission still must consider approval of the 150-foot-wide right-of-way (ROW) designated as original Alternative B; and

WHEREAS, Western has determined that the area of potential effects (APE) for the direct effects of this undertaking consists of the 150-foot-wide ROW, beginning at the AVS near Beulah, North Dakota and terminating at the Neset Substation near Tioga, North Dakota, as well as all Project-related access roads, associated appurtenances, such as substations, and ancillary facilities, such as temporary construction work and staging areas that may be located outside of the ROW and may not be contiguous; and

WHEREAS, Western also has established an APE for indirect (visual) effects that is one-half mile wide from the centerline on either side of the ROW; and

WHEREAS, in accordance with 36 CFR § 800.4(b)(2) and 36 CFR § 800.5(a)(3), respectively, Western is phasing identification and evaluation of historic properties and application of the criteria of adverse effect because the AVS-Neset Project consists of a corridor where access has been restricted in certain cases; and

WHEREAS, in accordance with 36 CFR § 800.14(b)(1)(ii), execution of a Programmatic Agreement (PA) is appropriate because effects on historic properties cannot be fully determined prior to approval of the Project; and

WHEREAS, RUS has agreed to manage the development and execution of this PA on behalf of Western; and

WHEREAS, in consultation with the SHPO, Western has determined that the AVS-Neset Project could have an adverse effect on historic properties (that is, properties which are listed on or eligible for listing on the National Register of Historic Places (NRHP); and

WHEREAS, on January 31, 2012, Western invited the Flandreau Santee Sioux Tribe, the Santee Sioux Nation, the Assiniboine and Sioux Tribes of the Fort Peck Indian Reservation, the Spirit Lake Nation, the Fort Belknap Indian Community, the Standing Rock Sioux Tribe (SRST), the Leech Lake Band of Ojibwe, the Three Affiliated Tribes of the Fort Berthold Reservation, the Lower Sioux Indian Community, the Turtle Mountain Band of Chippewa, the Minnesota Chippewa Tribe, the Upper Sioux Indian Community, the Prairie Island Indian Community, and the White Earth Band of Ojibwe to participate in consultation for the AVS-Neset Project; and

WHEREAS, the Leech Lake Band of Ojibwe declined the invitation to participate in consultation; and

WHEREAS, the White Earth Band of Ojibwe declined the invitation to participate in consultation, but asked to be kept informed of the progress of Section 106 review; and

WHEREAS, the remaining twelve (12) Indian tribes did not respond to the January 31, 2012 invitation; and

WHEREAS, in February 2013, the SRST asked to participate in consultation for the AVS-Neset Project; and

WHEREAS, in April 2013, Western confirmed consulting party status for the SRST; and

WHEREAS, in September 2013, the Sisseton Wahpeton Oyate (SWO) requested and was granted consulting party status; and

WHEREAS, the SRST and the SWO have participated in consultation and have been invited to sign this PA as concurring parties; and

WHEREAS, Basin Electric has participated in consultation and has been invited to sign this PA as an invited signatory; and

WHEREAS, the Killdeer Mountain Alliance (KMA) has participated in consultation and has been invited to sign this PA as a concurring party; and

WHEREAS, the Center for Heritage Renewal at North Dakota State University (Center) has participated in consultation and has been invited to sign this PA as a concurring party; and

WHEREAS, the American Battlefield Protection Program (ABPP) has participated in consultation and has been invited to sign this PA as a concurring party; and

WHEREAS, Mr. and Mrs. Craig Dvirnak have participated in consultation and have been invited to sign this PA as concurring parties; and

WHEREAS, on March 25, 2014, RUS, on behalf of Western, invited the Advisory Council on Historic Preservation (ACHP) to participate in consultation, in accordance with 36 CFR § 800.6(a)(1)(i)(C), providing the specified documentation; and

WHEREAS, via email dated April 10, 2014, the ACHP advised RUS that it would participate in consultation; and

WHEREAS, pursuant to 36 CFR § 800.6(a)(1)(iii), on May 6, 2014, the ACHP formally notified Western of its decision to participate in consultation; and

WHEREAS, the ACHP, North Dakota SHPO, SRST, SWO, Basin Electric, KMA, Center, ABPP and the Dvirnaks are considered "consulting parties;" and

WHEREAS, definitions of the terms used in this PA are defined in 36 CFR § 800.16;

NOW, THEREFORE, the Agencies, the ACHP, and the North Dakota SHPO agree that the undertaking will be implemented in accordance with the following stipulations in order to take into account the effect of the undertakings on historic properties.

STIPULATIONS

The Agencies will ensure that the following stipulations are carried out.

I. STANDARDS AND CONDITIONS

A. Archeological, historical, or architectural studies, including visual effects analysis, required by the Agencies under the terms of this PA will be carried out by or under the direct supervision of a professional who, at a minimum, meets the Secretary of the Interior's

Professional Qualification Standards (48 FR 44716, September 29, 1983) in the appropriate field.

B. Studies to identify and evaluate historic properties of importance to Indian tribes will be carried out by or under the direct supervision of an individual who possesses the requisite knowledge and expertise as recognized by the SRST and SWO, and who has been identified as a tribal cultural specialist by those tribes.

C. Basin Electric will not initiate construction of any segment of the AVS-Neset Project until Section 106 review conducted in accordance with the terms of this PA has been satisfied for that segment.

D. In order to ensure that the terms of this PA are properly coordinated and implemented, Basin Electric will establish and facilitate open communication between its engineers, environmental contractors, tribal cultural specialists, and professional archeologists during the performance of the phased identification and treatment, and phased construction of AVS-Neset Project components.

E. Western, in consultation with RUS and USFS, may identify and invite other parties to participate in consultation during implementation of the terms of this PA. A copy of Western's invitation and the party's affirmative response will be attached to this PA. The newly participating party will be considered to be one of the consulting parties in addition to those listed in the Preamble to this PA.

II. IDENTIFICATION AND TREATMENT

A. Identified Historic Properties

1. The Agencies and the North Dakota SHPO have agreed to treat the Killdeer Mountains, Medicine Hole (32DUX370) and, as described in the Final Environmental Impact Statement (FEIS), the Killdeer Mountain Battlefield (KMB) historic property as eligible for listing on the NRHP for the purposes of Section 106 review for the AVS-Neset Project only.
2. The Agencies and SHPO agree that because of its religious significance to Indian tribes, particularly its acknowledged use for vision quests, the boundaries of Killdeer Mountain are sufficiently expansive to fall within the boundary of indirect APE.
3. The Agencies and SHPO further agree that due to costs and schedules it is not reasonable to definitively identify the boundaries of the KMB historic property at this time.
4. In accordance with 36 CFR § 800.5(b) and (c), within thirty (30) days of execution of this PA the Agencies will formally propose for consulting party review that the AVS-Neset Project will have no adverse effect on Killdeer Mountain, Medicine Hole, or the KMB historic property. After consideration of objections filed in accordance with 36 CFR § 800.5(c)(2) and (3), should the Agencies agree that the AVS-Neset Project will have an adverse effect on any of the above historic properties, they will consult with the consulting parties to identify appropriate treatment in accordance with Stipulation II.G of this PA.

B. Phasing: For each construction component of the AVS-Neset Project, Basin Electric will complete the requirements of Stipulations II through VII as directed by the Agencies.

C. Design Changes: Each and every change in the location of AVS-Neset Project components is subject to review under the terms of this PA. Basin Electric will submit any proposed design change which might alter the scope of the APE for direct and indirect effects to the Agencies for their review. The Agencies, in consultation with the consulting parties, will determine if, pursuant to 36 CFR § 800.4(b)(1), further study is needed to identify affected historic properties for the specific design change. Identification and treatment of historic

properties for design changes will be implemented by Basin Electric in accordance with the terms of this PA.

D. Identification: For each construction component of the AVS-Neset Project, Basin Electric will conduct study of the APE, as directed by the Agencies, to identify historic properties which might be affected by the AVS-Neset Project pursuant to the regulatory standard established by 36 CFR § 800.4(b)(1). Thus far, this effort has produced the following studies:

1. In order to identify known historic properties and other cultural resources in the APE, at the direction of Western Basin Electric completed a Class I literature review of a large study area which contains the APE.
2. In September 2012, Basin Electric initiated, and will continue to implement, Class II (Reconnaissance) and Class III (Pedestrian) cultural resources surveys of the ROW, reroutes, access roads, substations and laydown areas wherever access has been granted by the private landowner. Findings to date are described in the interim report titled, *Basin Electric Power Cooperative's Antelope Valley Station to Neset 345 kV Transmission Line: A Class II and Class III Cultural Resource Inventory in Dunn, McKenzie, Mercer, Mountrail and Williams Counties, North Dakota, Interim Report* (April 2013). This survey includes subsurface testing of structure locations only within the eight (8) miles which cross the 2010 KMB study area, and any other parts of the APE that would be impacted by construction activities.
3. The findings of Basin Electric's geophysical survey (metal detection inventory) of eight (8) miles of the centerline of the ROW which may cross the Killdeer Mountain Engagement historic property is presented in the report titled, *Draft Basin Electric Power Cooperative's Antelope Valley State To Neset 345 kV Transmission Line: 2013 Supplemental Investigations Through The Killdeer Mountain Battlefield Study Area in Dunn County North Dakota* (February 2014).
4. In October 2013, Basin Electric initiated and will continue to conduct a survey of the APE to identify historic properties of importance to the SRST and the SWO. This survey is being performed by the SRST's preferred tribal cultural specialist (Basin Electric's contractor). The preferred tribal cultural specialist has completed study of the Project segment between AVS and the Missouri River wherever permission to access for survey had been granted in November, 2013. The Tribal Cultural Survey resumed in the Spring of 2014.
5. Western, in consultation with RUS, USFS and the consulting parties, may require that Basin Electric conduct a study of the APE for indirect effects to identify historic properties which might experience adverse visual effects resulting from construction of the AVS-Neset Project.
6. As directed by Western, Basin Electric will conduct evaluation studies, as appropriate, in accordance with 36 CFR § 800.4(c)(1).

E. Interim Reporting: When the studies described in Stipulation II.D have been completed for a particular constructive component or components, Basin Electric will prepare a draft interim report to submit to Western which will then distribute it to RUS, USFS and the consulting parties.

1. The interim report will
   a. Describe the historic properties and other cultural resources identified and the methods of identification;
   b. Identify those resources for which additional study might be needed;

c. Include recommendations regarding the NRHP eligibility of identified cultural resources;
d. Illustrate the geographic relationship between the identified historic properties and other cultural resources, the APE, the ROW, and the proposed structures and other AVS-Neset Project-related ground disturbance; and
e. Propose treatment, including those measures which would avoid adverse effects.

2. When determined acceptable by the Agencies, Western will submit the draft interim report to the consulting parties for their review. The consulting parties will have thirty (30) days from receipt to provide written comments to Western on the draft interim report.
3. Western will ensure that written comments submitted in a timely manner are considered in preparation of the final interim report. Western will provide one copy of the final interim report to the other Agencies and consulting parties.

F. Avoidance: The avoidance of adverse effects to historic properties is the treatment preferred by Western, RUS and USFS. Accordingly, Basin Electric will seek agreement with Western, RUS, USFS and the consulting parties on the identification of historic properties and implementation of appropriate and reasonable avoidance measures.

1. Whenever the Western and the consulting parties agree, Basin Electric will incorporate agreed upon avoidance measures into the draft interim report required under Stipulation II.D, and AVS-Neset Project plans and specifications.
2. Wherever Western and a consulting party(ies) cannot reach agreement, the objection will be resolved in accordance with Stipulation IX.

G. Treatment

1. Pursuant to 36 CFR § 800.4(c)(2) and 36 CFR § 800.5(a), Western, in consultation with RUS, USFS and the consulting parties, will determine if historic properties are located in the direct and indirect effects APEs, and, when present, if they will be adversely affected by construction of a AVS-Neset Project phase. When Western determines that adverse effects cannot be avoided, it will consult with RUS, USFS and the consulting parties to identify those treatment measures, which are in the public interest and will minimize or mitigate such effects to historic properties.
2. When the Agencies and the consulting parties agree on treatment measures to address adverse effects to historic properties for an AVS-Neset Project phase, Basin Electric will prepare a Treatment Plan (Plan) describing the agreed upon measures, the manner in which they will be carried out, and a schedule for their implementation.
3. Disputes regarding treatment, including but not limited to the adequacy or implementation of treatment measures, will be resolved by the Agencies in accordance with Stipulation IX.
4. Western will ensure that the Plan takes into account applicable State, tribal and professional standards and guidance.
5. When treatment consists of or includes data recovery, the Plan will identify the specific research questions to be addressed by data recovery with an explanation of their relevance, the archeological methods to be used, and provisions for public interpretation and education subject to confidentiality restrictions required by 36 CFR § 800.6(a)(5).
6. Basin Electric will submit the Plan to the SHPO and consulting parties for review. These parties will have thirty (30) days from receipt to submit a written review. The

Agencies will take into account timely comments and recommendations submitted by the consulting parties.

7. The Agencies will ensure that Basin Electric implements all approved Plans prior to beginning construction of that Project component.

H. Protection During Construction

1. Prior to beginning construction of the AVS-Neset Project component, Basin Electric will mark identified stone features and historic properties within the APE for that phase. The marked areas will include the location of the stone feature or historic property as well as a fifty (50) foot buffer around it.
2. Basin Electric will consult with the consulting parties to determine the manner in which each stone feature or historic property will be marked.
3. Basin Electric will include the requirement to avoid marked areas, designated as "exclusion areas," as defined in Stipulation II.H1 and 2 in construction contracts.
4. Anytime project construction will or is likely to occur within the fifty (50) foot buffer, Western, and Basin Electric will consult with the SRST, the SWO and other consulting parties as appropriate to determine additional protective measures to be implemented.
5. Basin Electric will ensure that construction contracts stipulate that all work will be done within the ROW or areas as designed by Basin Electric.

I. Post-Construction Protection: To ensure the protection of these stone features and historic properties post-construction, Basin Electric will designate their location including the 50 foot buffer as "exclusion areas" on Operation and Maintenance maps of the permanent right-of-way. Basin Electric will avoid all marked exclusion areas during performance of operations and maintenance activities.

III. U.S. FOREST SERVICE LANDS

A. Prior to the release of funding for construction of any component of AVS-Neset Project that will cross USFS lands, Western will document for RUS the manner in which the terms of this PA on USFS lands have been implemented.

B. RUS may release financial assistance for the construction of a component of AVS-Neset Project that will cross USFS lands once the terms of this PA have been implemented on USFS lands and a special use permit has been issued by the USFS.

IV. CURATION

A. Any artifacts, materials, or records removed from federal land that are not subject to the Native American Graves Protection and Repatriation Act (NAGPRA) will be curated by the federal agency in accordance with 36 CFR Part 79. The USFS will curate any artifacts, materials, or records not subject to NAGPRA at the State Historical Society of North Dakota (SHSND) Museum.

B. Basin Electric will return all artifacts and materials recovered through implementation of the terms of this PA from nonfederal lands to the respective landowner. The respective landowner may then elect to donate the artifacts and materials to a local curation facility acceptable to the SHPO/ SHSND.

V. CONFIDENTIALITY

A. The Agencies will protect information about historic properties, including location information or information provided by Indian tribes to assist in the identification of such properties, especially properties of religious and cultural significance to Indian tribes, to the

extent allowable under Section 304 of the National Historic Preservation Act, 16 U. S. C. § 470w3, 36 CFR § 800.11(c) and other applicable legal requirements.

B. The Agencies will work with the SRST, SWO and Basin Electric to develop and implement additional measures to protect location information about important tribal cultural resources.

VI. POST- REVIEW UNANTICIPATED DISCOVERIES ON FEDERAL LANDS

A. Basin Electric will treat the unanticipated discovery of cultural resources and human remains on Federal lands in accordance with Appendix I, *Unanticipated Discovery Plan and Discovery of Human Remains Protocols, Northern Region, USDA*, v1, September 2011, of the Region I Heritage Protection Plan.

B. When the post-review unanticipated discovery contains human remains, NAGPRA [25 U.S.C. 3001 et. seq.] and its implementing regulations (43 CFR Part 10) also apply.

VII. POST- REVIEW UNANTICIPATED DISCOVERIES ON NONFEDERAL LANDS

A. If previously unidentified historic properties or unanticipated effects to historic properties are discovered during AVS-Neset Project construction on non-federal lands, Basin Electric's construction contractor will immediately halt all activity within a one hundred (100) foot radius of the discovery; notify Basin Electric of the discovery; and implement interim measures to protect the discovery from looting and vandalism.

B. Immediately upon receipt of the notification required in Stipulation VII.A, Basin Electric, with the assistance of an individual meeting the professional standards in Stipulation I will inspect the construction site to

1. Determine the extent of the discovery;
2. Ensure that construction activities have halted;
3. Clearly mark the one hundred (100) foot buffer area surrounding the discovery;
4. Implement additional measures, as appropriate, to protect the discovery from looting and vandalism; and
5. Notify the Agencies, the ACHP, the North Dakota SHPO, SRST and the SWO. The points of contact for such notification are listed in Attachment 3.

C. Basin Electric may resume construction outside of the one hundred (100) foot buffer area surrounding the discovery as marked in Stipulation VII.B.3 once all of the terms of Stipulation VII.B. have been completed.

D. Upon receipt of the notification, Western and RUS will treat the discovery in accordance with 36 CFR § 800.13(b)(3) and (c). The consulting parties will have 48 hours from receipt of the notification submitted in accordance with 36 CFR § 800.13(b)(3) to respond.

E. When the discovery may contain human remains, Basin Electric's construction contractor will comply with the requirements of Stipulation VII.A. Immediately upon receipt of notification from its construction contractor, Basin Electric will comply with Stipulation VI.B, notify the Intertribal Reinterment Committee of the discovery of human remains, and comply with the requirements of North Dakota Century Code § 23-06-27 and 55-03 as well as North Dakota Administrative Code Chapter 40-02-03.

E. Basin Electric may resume construction activities in the area of the discovery once the terms of Stipulation VII have been implemented.

F. Basin Electric will ensure that the requirements of Stipulation VII are incorporated into all construction contracts.

VIII. REPORTING

A. Until construction is complete, every six (6) months following the execution of this PA, Basin Electric will submit a written report electronically to signatories and consulting parties.
B. The report will describe:
    1. The period covered by the report;
    2. Progress on implementation of the terms of the PA during that period of time;
    3. The Project schedule and any proposed scheduling changes;
    4. Any proposed design changes;
    5. Progress on development of construction plans and specifications by construction component;
    6. Construction completed during the period;
    7. Status of identification efforts and implementation of treatment conducted pursuant to Stipulation II; and
    8. The treatment of any post-review discoveries pursuant to Stipulations VI and VII.

IX. DISPUTE RESOLUTION

A. Should any signatory or consulting party to this PA object in writing at any time to any actions proposed or the manner in which the terms of this PA are implemented, the Agencies, within the limits of their individual authority, will consult with such party to resolve the objection. If the Agencies agree that the objection cannot be resolved, they will forward all documentation relevant to the dispute, including the resolution they propose, to the ACHP.

B. Upon receipt of adequate documentation, the ACHP will provide the Agencies with its advice or comment on the resolution of the objection within thirty (30) days.
    1. Prior to reaching a final decision on the dispute, the Agencies will prepare a written response that takes into account any timely advice or comment regarding the dispute received from the ACHP and other consulting parties, and provide them with a copy of this written response. The Agencies will proceed according to their final decision.
    2. If the ACHP does not provide its advice regarding the dispute within thirty (30) days, the Agencies may make a final decision on the dispute and proceed accordingly. Prior to reaching a final decision, the Agencies will prepare a written response that takes into account any timely comments from the consulting parties to the PA regarding the dispute, and provide them and the ACHP with a copy of such written response.

C. The responsibility of the Agencies to carry out all other actions subject to the terms of this PA that are not the subject of the dispute remain unchanged.
D. If at any time during the implementation of the measures stipulated in this PA an objection should be raised by the public, the signatory in receipt of the objections will notify the other signatories and consult with the objecting party to seek resolution. If the Agencies determine that the objection cannot be resolved, then they will seek the advice or comment of ACHP in accordance with Stipulation IX.A and B.

X. TERM OF AGREEMENT

A. The terms of this PA will expire September 30, 2024 unless the signatories agree to extend its term prior to expiration.

B. Six (6) months prior to September 30, 2024, Basin Electric will notify the Agencies and other consulting parties of the impending expiration. The Agencies may consult with the consulting parties to reconsider the terms of the PA and amend it in accordance with

Stipulation XI. The Agencies will notify the consulting parties as to the course of action each will pursue.

C. The PA will terminate when all of its stipulations have been carried out and all AVS-Neset Project phases are in service.

XI. AMENDMENT

A. This PA may be amended when such an amendment is agreed to in writing by all signatories. The amendment will be effective on the date it is executed by all of the signatories and filed with ACHP.

B. Prior to reaching agreement, the signatories, led by Western, will consult with the consulting parties on the terms of any proposed amendment to this PA.

XII. TERMINATION

A. If any signatory to this PA determines that its terms will not, or cannot be carried out, that signatory will immediately consult with the other signatories to attempt to develop an amendment in accordance with Stipulation XI. If within thirty (30) days an amendment cannot be reached, any signatory may terminate the PA upon written notification to the other signatories.

B. Once the PA has been terminated, and prior to work continuing on the AVS-Neset Project, the Agencies must either:
   1. Execute an agreement pursuant to 36 CFR Part 800; or
   2. Request, take into account, and respond to the comments of ACHP pursuant to 36 CFR § 800.7. The Agencies will notify the consulting parties as to the course of action each will pursue.

EXECUTION of this PA by the Agencies and the ND SHPO, and implementation of its terms evidence that the Agencies have taken into account the effects of this undertaking on historic properties and afforded the ACHP a reasonable opportunity to comment.

Signatories:

Western Area Power Administration

By: _____ Date: 6/20/14
Robert J. Harris, Regional Manager
Upper Great Plains Region

US Department of Agriculture Rural Utilities Service

By: _____ Date: 6/20/14
Mark S. Plank, Director
Engineering and Environmental Staff
Water and Environmental Programs

US Department of Agriculture U.S. Forest Service

By: _____ Date: 6/20/2014
Dennis D. Neitzke, Supervisor
Dakota Prairie Grasslands

Advisory Council on Historic Preservation

By: _____ Date: 7/2/14
John M. Fowler, Executive Director

North Dakota State Historic Preservation Office

By: _____ Date: 6-23-14
Merlan E. Paaverud, Jr., State Historic Preservation Officer

Invited Signatory:

Basin Electric Power Cooperative, Inc.

By: Claire M. Olson Date: 23 June 2014
Claire M. Olson, Senior Vice President and General Counsel

Tribal Concurring Parties:

Sisseton Wahpeton Oyate of the Lake Traverse Reservation

By: _____ Date: _____

Standing Rock Sioux Tribe

By: _____ Date: _____

Other Concurring Parties:

Mr. Craig and Mrs. Rhonda Dvirnak

By: _____ Date: _____

American Battlefield Protection Program

By: _____ Date: _____
Paul Hawke, Director

Killdeer Mountain Alliance

By: _____ Date: _____
G. Edward Dickey

North Dakota State University Center for Heritage Renewal

By: _____ Date: _____
Professor Tom Isern, Director

APPENDIX U - ND SHPO LETTER OF CONCURRENCE

STATE HISTORICAL SOCIETY OF NORTH DAKOTA

Jack Dalrymple
Governor of North Dakota

North Dakota State Historical Board

Calvin Grinnell
New Town - President

A. Ruric Todd III
Jamestown - Vice President

Margaret Puetz
Bismarck- Secretary

Albert I. Berger
Grand Forks

Gereld Gerntholz
Valley City

Diane K. Larson
Bismarck

Chester E Nelson, Jr.
Bismarck

Sara Otte Coleman
Director
Tourism Division

Kelly Schmidt
State Treasurer

Alvin A. Jaeger
Secretary of State

Mark Zimmerman
Director
Parks and Recreation Department

Grant Levi
Director
Department of Transportation

Merlan E. Paaverud, Jr.
Director

Accredited by the American Alliance of Museums since 1986

March 13, 2014

Mr. Cris Miller
Basin Electric Power Cooperative
1717 East Interstate Avenue
Bismarck, ND 58503

ND SHPO Ref.:14-0756 RUS "Basin Electric Power Cooperative's Red, White, and Blue Substations: A Class III Cultural Resource Inventory in Dunn and McKenzie Counties, North Dakota"

Dear Mr. Miller,

We reviewed ND SHPO Ref.:14-0756 RUS "Basin Electric Power Cooperative's Red, White, and Blue Substations: A Class III Cultural Resource Inventory in Dunn and McKenzie Counties, North Dakota," and find the report acceptable. We concur with a "No Historic Properties Affected" determination, provided the project remains as described and mapped in the above-captioned report and provided that sites 32DU1919, 32DU1920, and 32MZ2657 and site lead 32DUx129 are all avoided by the project.

Thank you for the opportunity to review this project. If you have any questions please contact Susan Quinnell, Review and Compliance Coordinator at (701) 328-3576, e-mail squinnell@nd.gov

Sincerely,

Merlan E. Paaverud, Jr.
State Historic Preservation Officer (North Dakota)
and Director, State Historical Society of North Dakota

Burns & McDonnell: Making our clients successful for more than 100 years