Plan of Development for the Chokecherry and Sierra Madre Wind Energy Project

Prepared for:
US Bureau of Land Management, Rawlins Field Office

Submitted by:
Power Company of Wyoming, LLC

January 12, 2012

Power Company of Wyoming LLC

Table of Contents

1. Project Overview and Purpose and Need 1-1
1.1 Demand for Renewable Energy 1-1
1.2 Regional and Site Wind Resource 1-3
1.3 Project Overview 1-4
1.4 NEPA Analysis and Site-Specific PODs 1-5
1.5 PCW's Purpose and Need for Project 1-6

2. Project Site Characteristics and Environment 2-1
2.1 Location 2-1
2.2 Site Characteristics 2-1
2.2.1 Terrain 2-1
2.2.2 Wind Resource 2-4
2.2.3 Geology 2-6
2.2.4 Vegetation 2-9
2.2.5 Water Resources 2-11
2.2.6 Water Use and Rights 2-11
2.2.7 Land Ownership 2-12
2.2.8 Land Availability and Use 2-13

3. Project Components and Design 3-1
3.1 Wind Turbines 3-1
3.1.1 Rotor 3-3
3.1.2 Nacelle 3-4
3.1.3 Tower 3-5
3.1.4 Control System and Electrical Connection 3-6
3.1.5 Aviation Warning Lights 3-6
3.1.6 Dimensions and Characteristics 3-7
3.2 Electrical Collection System 3-8
3.2.1 Wind Turbine Connections 3-9
3.2.2 Underground Collection 3-10
3.2.3 Overhead Collection 3-12
3.2.4 SCADA 3-14
3.3 Collection Substations 3-15
3.4 Internal Transmission 3-16
3.5 Interconnection Substation 3-18
3.6 Rail Facility 3-19
3.7 Operations and Maintenance Buildings 3-23
3.7.1 Operations Center 3-23
3.7.2 Maintenance Facilities 3-24
3.8 Met Towers 3-25
3.9 Foundations 3-26

3.9.1 Wind Turbine Foundations 3-26
3.9.2 Collection and Transmission Structure Foundations 3-30
3.9.3 Other Foundations 3-30
3.10 Wind Turbine Pads 3-31
3.11 Roads 3-32
3.11.1 Road Types and Descriptions 3-32
3.11.2 Water Crossings 3-37

4. Construction 4-1
4.1 Pre-Construction Activities 4-1
4.1.1 Site Survey 4-1
4.1.2 Project Component Siting 4-2
4.1.3 Geotechnical Investigation 4-2
4.1.4 Design Engineering 4-2
4.1.5 Field Verification/Flagging 4-3
4.2 Project Construction Activities 4-3
4.2.1 Rail Facility 4-3
4.2.2 Roads 4-4
4.2.3 Wind Turbine Pads 4-5
4.2.4 Wind Turbine Foundations 4-6
4.2.5 Wind Turbine Installation 4-8
4.2.6 Electrical Collection System 4-12
4.2.7 Substations (Collection, Interconnection) 4-15
4.2.8 Internal Transmission 4-16
4.2.9 Wind Turbine Commissioning 4-17
4.2.10 Operations and Maintenance Buildings 4-18
4.3 Temporary Construction Facilities 4-18
4.3.1 Construction Trailer Complex 4-18
4.3.2 Delivery Staging Area and Laydown Yards 4-19
4.3.3 Concrete Batch Plants 4-20
4.3.4 Water Facilities 4-21
4.3.5 Construction Stage Only Roads 4-22
4.4 General Construction Information 4-24
4.4.1 Construction Schedule 4-24
4.4.2 Construction Workforce 4-32
4.4.3 Construction Equipment 4-33
4.4.4 Health and Safety Program 4-33
4.4.5 Materials Estimates 4-33
4.4.6 Transport to the Project Site 4-34
4.4.7 Transport within Project Site 4-34
4.4.8 Blasting 4-35
4.4.9 Excess Soils 4-35
4.4.10 Construction Communications 4-36

4.4.11 Waste Management 4-36

5. Operations and Maintenance 5-1
5.1 Project Operations 5-1
5.1.1 Wind Turbines 5-1
5.1.2 Electrical Collection and Transmission 5-1
5.1.3 Nighttime Operations 5-1
5.1.4 Rail Facility 5-2
5.2 Project Maintenance 5-2
5.2.1 Scheduled Turbine Maintenance 5-3
5.2.2 Unscheduled Turbine Maintenance 5-3
5.2.3 Road Maintenance 5-4
5.2.4 Collection System 5-4
5.2.5 Substations 5-5
5.2.6 Transmission Lines 5-5
5.2.7 Other Facilities 5-5
5.3 Operations and Maintenance Workforce 5-5
5.3.1 Health and Safety Program 5-7

6. Decommissioning 6-1
6.1 Pre-Decommissioning Activities 6-1
6.1.1 Decommissioning Planning Workshop 6-1
6.2 Project Decommissioning Activities 6-1
6.2.1 Wind Turbines 6-1
6.2.2 Foundations 6-2
6.2.3 Wind Turbine Pads 6-2
6.2.4 Electrical Collection System 6-2
6.2.5 Collection Substations 6-2
6.2.6 Internal Transmission 6-2
6.2.7 Interconnection Substation 6-3
6.2.8 Operations and Maintenance Buildings 6-3
6.2.9 Met Towers 6-3
6.2.10 Roads 6-3
6.2.11 Rail Facility 6-3
6.3 Temporary Decommissioning Facilities 6-4
6.3.1 Trailer Complex and Laydown Yards 6-4
6.4 General Decommissioning Information 6-4
6.4.1 Decommissioning Schedule 6-4
6.4.2 Decommissioning Workforce 6-4
6.4.3 Decommissioning Equipment 6-5
6.4.4 Health and Safety Program 6-6
6.4.5 On-Site Transportation 6-6
6.4.6 Waste Management 6-6

7. Environmental Resources 7-1

7.1 Wildlife 7-1
7.1.1 Avian Species and Bats 7-2
7.1.2 Greater Sage-Grouse 7-5
7.1.3 Other Wildlife Species 7-6
7.1.4 Wildlife Habitat Management Areas 7-7
7.1.5 Fisheries 7-8
7.2 Vegetation 7-8
7.2.1 Revegation 7-10
7.2.2 Weed Management 7-10
7.3 Water 7-10
7.3.1 Consumptive Water Usage 7-10
7.3.2 Consumptive Water Sources 7-11
7.3.3 Stormwater Pollution Prevention Plan (SWPPP) 7-11
7.4 Wetlands 7-13
7.5 Soils 7-14
7.5.1 Soil Segregation and Storage 7-15
7.5.2 Erosion Control Measures 7-15
7.5.3 Erosive Soils 7-15
7.5.4 Spill Prevention and Containment 7-16
7.6 Air Quality 7-16
7.7 Visual Resources 7-17
7.8 Cultural Resources 7-17
7.9 Paleontological Resources 7-18
7.10 Reclamation 7-19
7.11 Watershed 7-19
7.12 Fire Safety 7-19
7.13 Land Use 7-20

8. Example Project Layout 8-1
8.1 Wind Turbines 8-2
8.2 Foundations 8-2
8.3 Roads and Wind Turbine Pads 8-2
8.4 Electrical Collection System 8-2
8.5 Collection Substations 8-3
8.6 Internal Transmission 8-3
8.7 Interconnection Substation 8-4
8.8 Rail Facility 8-4
8.9 Operations and Maintenance Buildings 8-4
8.10 Temporary Construction Facilities 8-5
8.11 Construction Schedule 8-5
8.12 Workforce and Equipment Estimates 8-7

9. List of Contributors 9-1

10. References 10-1

11. Glossary 11-1
Appendix A. Applicant Committed Measures A-1
Appendix B. Health and Safety Plan Requirements B-1
Appendix C. Transportation Management Plan C-1
Appendix D. Environmental Compliance Plan D-1
Appendix E. Master Reclamation Plan E-1
Appendix F. Watershed Monitoring Plan F-1
Appendix G. Erosion Control Plan G-1
Appendix H. Dust Control Plan H-1
Appendix I. Blasting Plan I-1
Appendix J. Weed Management Plan J-1
Appendix K. Typical Wind Energy Project Diagrams K-1
Appendix L. Example Project Diagrams and Estimates L-1
Appendix M. Significant Changes from March 2009 POD M-1
Appendix N. Sage-Grouse Conservation Plan N-1

Table of Figures

Figure 1-1. US Wind Resource Map 1-3
Figure 1-2. Wyoming Wind Resource Map 1-4
Figure 2-1. Ranch Location within Carbon County, Wyoming 2-2
Figure 2-2. Site Topography 2-2
Figure 2-3. Terrain in northern (left) and southern (right) Chokecherry 2-3
Figure 2-4. Terrain on (left) and below (right) Miller Hill 2-3
Figure 2-5. Terrain on (left) and below (right) Sage Creek Rim 2-4
Figure 2-6. Terrain in Sage Creek Valley 2-4
Figure 2-7. Project Met Tower and SODAR Unit 2-5
Figure 2-8. Wind Resource Map of Project Site 2-6
Figure 2-9. Dominant Vegetation Cover Map of Project Site 2-10
Figure 2-10. Land Ownership Map of Project Site 2-13
Figure 3-1. Wind Turbine Diagram 3-2
Figure 3-2. Example Modern Wind Turbines in Wyoming 3-2
Figure 3-3. Turbine Blades and Rotor 3-3
Figure 3-4. Typical Nacelle Components 3-4
Figure 3-5. Wind Turbine Tower 3-5
Figure 3-6. Example Aviation Warning Light 3-7
Figure 3-7. Typical Wind Turbine/GSU Configurations 3-9
Figure 3-8. Typical TR-XLP (left) and ERP (right) Cable 3-10
Figure 3-9. Examples of Junction Boxes 3-11
Figure 3-10. Example Riser Pole Structure 3-13
Figure 3-11. Example One- and Two-Transformer Collection Substations 3-16
Figure 3-12. Example Transmission Structures 3-17
Figure 3-13. Example Wind Energy Rail Transload Facilities 3-20
Figure 3-14. Primary and Alternate Rail Facility Locations 3-21
Figure 3-15. Blades and Nacelles on Rail Cars 3-22
Figure 3-16. Example Guyed (left) and Non-Guyed (right) Met Towers 3-26
Figure 3-17. Completed Mat Foundation Before and After Backfill 3-28
Figure 3-18. Steel Piles During Mat Foundation Construction 3-29
Figure 3-19. Tensionless Pier Foundation Installation 3-30
Figure 3-20. Example Turbine Pads During Construction (left) and Operations (right) 3-32
Figure 3-21. Example Haul Road 3-35
Figure 3-22. Example Turbine Roads with Compacted Shoulders 3-36
Figure 3-23. Diagram of At-Grade LWC – Aggregate Surface Diagram 3-39
Figure 3-24. Examples of At-Grade LWC – Aggregate Surface 3-39
Figure 3-25. Diagram of At-Grade LWC – Concrete Surface Diagram 3-39
Figure 3-26. Examples of At-Grade LWC – Concrete Surface 3-40
Figure 3-27. Diagram of At-Grade LWC – Geocell Surface Diagram 3-40
Figure 3-28. Examples of At-Grade LWC – Geocell Surface 3-40
Figure 3-29. Diagram of Vented LWC – Traditional Culverts 3-41
Figure 3-30. Examples of Vented LWC – Traditional Culverts 3-41

Figure 3-31. Diagram of Vented LWC – Box Culverts 3-42
Figure 3-32. Diagram of Vented LWC – Bridge 3-42
Figure 3-33. Examples of Vented LWC – Box Culvert (left) and Bridge (right) 3-42
Figure 3-34. Diagram of Vented LWC - Natural Stream Bottom Structures 3-43
Figure 3-35. Examples of Vented LWC – Embedded Arc Culvert 3-44
Figure 4-1. Example Road Construction 4-5
Figure 4-2. Example Wind Turbine Pad Use During Construction 4-6
Figure 4-3. Example Wind Turbine Foundation Construction 4-7
Figure 4-4. Example Wind Turbine Installation 4-11
Figure 4-5. Example Wind Turbine Blade Installation 4-12
Figure 4-6. Example Underground Collection System Installation 4-13
Figure 4-7. Example Collection Substations Under Construction 4-16
Figure 4-8. Example Transmission Structures Under Construction 4-17
Figure 4-9. Example Delivery Staging Area 4-20
Figure 4-10. Example Project Layout 4-26
Figure 4-11. Example Site Transport Trucks 4-35
Figure 8-1. Example Project Layout 8-1
Figure 8-2. Example Project Layout Workforce Estimate 8-8

Table of Tables

Table 2-1. Project Application Area Land Ownership 2-12
Table 3-1. Turbine Attributes 3-8
Table 3-2. Electrical Collection Typical Trench Dimensions 3-11
Table 3-3. Electrical Collection Typical Overhead Structure Dimensions 3-14
Table 3-4. Collection Substation Typical Dimensions 3-15
Table 3-5. Internal Transmission Typical Structure Dimensions 3-18
Table 3-6. Interconnection Substation Typical Dimensions 3-19
Table 3-7. Rail Facility Delivery Requirements 3-22
Table 3-8. Common Wind Turbine Foundation Solutions 3-27
Table 3-9. Wind Turbine Foundation Dimensions 3-28
Table 3-10. Expected Project Road Design Parameters 3-33
Table 3-11. Low Water Crossing Design Preliminary Selection Criteria 3-38
Table 4-1. Conceptual Construction Sequence 4-25
Table 4-2. Expected Construction Workforce Breakdown 4-32
Table 4-3. Expected Construction Equipment Breakdown 4-33
Table 5-1. Common Wind Turbine Fluid Volumes 5-3
Table 5-2. Operations and Maintenance Workforce Breakdown 5-6
Table 6-1. Expected Decommissioning Workforce Breakdown 6-5
Table 6-2. Expected Decommissioning Equipment Breakdown 6-5
Table 8-1. Example Layout Collection System Breakdown 8-3
Table 8-2. Example Layout Construction Schedule Breakdown 8-5
Table 8-3. Example Layout Workforce Breakdown 8-7
Table 8-4. Example Layout Equipment Breakdown 8-8

Acronyms and Abbreviations

ACM	Applicant Committed Measure
ac	acre
ac-ft	acre-feet
AWS	AWS Truepower
bgs	below ground surface
BMP	Best Management Practices
BLM	Bureau of Land Management
BOP	balance of plant
CCSM	Chokecherry and Sierra Madre
CIG Plant	Colorado Interstate Gas Rawlins Operations Facility
CC	Chokecherry development area
cy	cubic yard
DEIS	Draft Environmental Impact Statement
EIA	Energy Information Administration
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
ft	feet
GHG	greenhouse gas
GSU	generator step-up
IM	Instruction Memorandum
LiDAR	light detection and ranging
LWC	Low water crossing
MASW	Multi-Channel Analysis of Surface Wave
MH	Miller Hill portion of the Sierra Madre development area
met	meteorological (as in met tower)
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NREL	US Department of Energy's National Renewable Energy Laboratory
NRHP	National Register of Historic Places
O&M	operations and maintenance
PA	Programmatic Agreement
PCW	Power Company of Wyoming, LLC
POD	Plan of Development
RFO	Rawlins Field Office
RMP	Resource Management Plan
ROD	Record of Decision
ROW	right-of-way
RPS	Renewable Portfolio Standard

SEO	State Engineer's Office
SCADA	Supervisory Control and Data Acquisition
SCB	Sage Creek Basin
SGCA	sage-grouse core area
SM	Sierra Madre
SODAR	sonic detection and ranging
SPCC	Spill Prevention, Containment, and Control Plan
SWCA	SWCA Environmental Consultants
SWPPP	Storm Water Pollution Prevention Plan
TOTCO	The Overland Trail Cattle Company
USFWS	US Fish and Wildlife Service
VRM	visual resource management
WEST	Western EcoSystems Technologies, Inc.
WGFD	Wyoming Game and Fish Department
WHMA	Wildlife Habitat Management Areas
WTG	Wind Turbine Generator

1. Project Overview and Purpose and Need

This chapter describes the Chokecherry and Sierra Madre Wind Energy Project (Project) and Power Company of Wyoming LLC's (PCW) purpose and need for the Project. This chapter includes a description of the Project wind resource and summarizes the nation's demand for clean, renewable energy, a demand that this Project will help fulfill.

1.1 Demand for Renewable Energy

The United States is facing an unparalleled energy challenge resulting in a critical need for the development of clean, renewable energy. The Energy Information Administration (EIA) projects that renewable-generated electricity will account for 15 percent of the total U.S. electricity generation by 2035 (EIA 2011). This growth is fueled by the rapid expansion of non-hydroelectric renewable generation to meet greenhouse gas (GHG) reduction goals and state mandates for renewable energy production. Nowhere is the demand for renewable energy stronger than in the Desert Southwest (consisting of the states of California, Arizona and Nevada) where there is a convergence of strong load growth, ratepayer demand for renewable energy and increasing legislative mandates.

According to the 2010 US Census, the Desert Southwest saw a 13 percent population increase between 2000 and 2010 (US Census 2011). Data from the Energy Information Agency shows that the electricity demand for the Desert Southwest states between 2000 and 2009 (the last year data was available) increased more than 34,000 GWh/yr (EIA 2010). As demonstrated by the steady population growth and increased demand for electricity, this region has a need for new electricity sources. In addition, legislators and ratepayers in these areas have demonstrated the desire for a substantial amount of their electricity to come from clean, renewable sources by creating Renewable Portfolio Standards (RPS). Currently, the percentage of electricity consumed that must come from renewable sources is mandated at the following levels:

- California: 33% by 2020
- Nevada: 25% by 2025
- Arizona: 15% by 2025

In 2008, a study by National Grid estimated 55,000 gigawatt-hours per year (GWh/yr) of new renewable generation would be necessary to meet these standards. As it stands today, wind is the ideal source for much of this new renewable energy due to the availability and reliability of the wind resource in the Western United States (especially Wyoming), the high level of technological maturity, the price competitiveness compared to other renewables, the compatible land use with Western ranching and farming, and the minimal water requirements for project operation. A September 2011 study by the Western Electricity Coordinating Council showed that Wyoming wind is the best source of cost-effective, high-capacity renewable energy to help meet the demands of California's future energy market.

In addition to the renewable portfolio standards established by individual states, the U.S. has also developed energy policies driven by the desire to reduce GHG emissions and improve the nation's energy security. As part of an overall strategy to develop a diverse portfolio of domestic energy supplies for the future, the National Energy Policy of 2001 and the Energy Policy Act of 2005 encourage the development of renewable energy resources, including wind energy. The U.S. has significant potential for wind energy development, especially on public lands in the West. Federal energy policies, including the following, have led to an increased demand to develop cleaner, more abundant domestic supplies of energy.

- **National Energy Policy of 2001** was created by a National Energy Policy Development Group to "develop a national energy policy designed to help the private sector, and, as necessary and appropriate, State and local governments, promote dependable, affordable, and environmentally sound production and distribution of energy for the future."
- **Executive Order (EO) 13212, Actions to Expedite Energy-Related Projects**, was signed on May 18, 2001, to implement recommendations from the National Energy Policy Development Group to establish a policy that federal agencies should take appropriate actions, to the extent consistent with applicable law, to expedite projects to increase the production, transmission, or conservation of energy.
- **Energy Policy Act of 2005 (Public Law [P.L.] 109-58)** was signed into law on August 8, 2005. Section 211 of the Act states, "It is the sense of the Congress that the Secretary of the Interior should, before the end of the 10-year period beginning on the date of enactment of this Act, seek to have approved non-hydropower renewable energy projects located on the public lands with a generation capacity of at least 10,000-MWs of electricity."
- **Wind Energy Development Program Instruction Memorandum (IM) No. 2009-043** is one of the efforts undergone by the BLM to further support wind energy development on public lands and also to minimize potential environmental and sociocultural effects. The BLM also previously initiated preparation of a Programmatic EIS in October 2003 and published the *Record of Decision (ROD) for Implementation of a Wind Energy Development Program and Associated Land Use Plan Amendments* in 2005.
- A number of IMs have been released in 2011 which update IM No. 2009-043 and implement additional policies designed to further facilitate the environmentally responsible development of solar and wind energy projects on public lands. Among these are **IM No. 2011-060 Solar and Wind Energy Applications – Due Diligence** which seeks to avoiding land speculation on rights-of-way by stringently applying existing due diligence requirements to each application, as well as **IM No. 2011-061 Solar and Wind Energy Applications – Pre-Application and Screening** which seeks to prioritize applications with fewer resource conflicts and a likelihood of success by engaging in additional up front screening of each application.

The Project is an ideal opportunity to allow the Department of Interior to meet a significant portion of their obligations and objectives under the nation's energy policies as well as to provide a secure renewable energy resource that is in high demand.

1.2 Regional and Site Wind Resource

The Western US contains some of the nation's strongest on-shore wind resources. Based upon wind resource mapping performed by AWS Truepower (AWS) for the US Department of Energy's National Renewable Energy Laboratory (NREL) shown in Figure 1-1, only about 2 percent of the continental US land area has the annual average wind resources above 20 mph (8.8 meters per second) considered ideal for wind turbine operation. Much of the total ideal wind resource exists in mountainous areas that are impractical for wind energy development. However, about 5 percent of this ideal resource is concentrated in Carbon County, Wyoming, much of which is located on the Project Site and on terrain well suited for wind energy development (see Figure 1-2). With most of the remaining ideal wind resource either undevelopable or east of Carbon County (and therefore further from the Desert Southwest), the Project Site is uniquely suited to host a high-producing wind energy project.

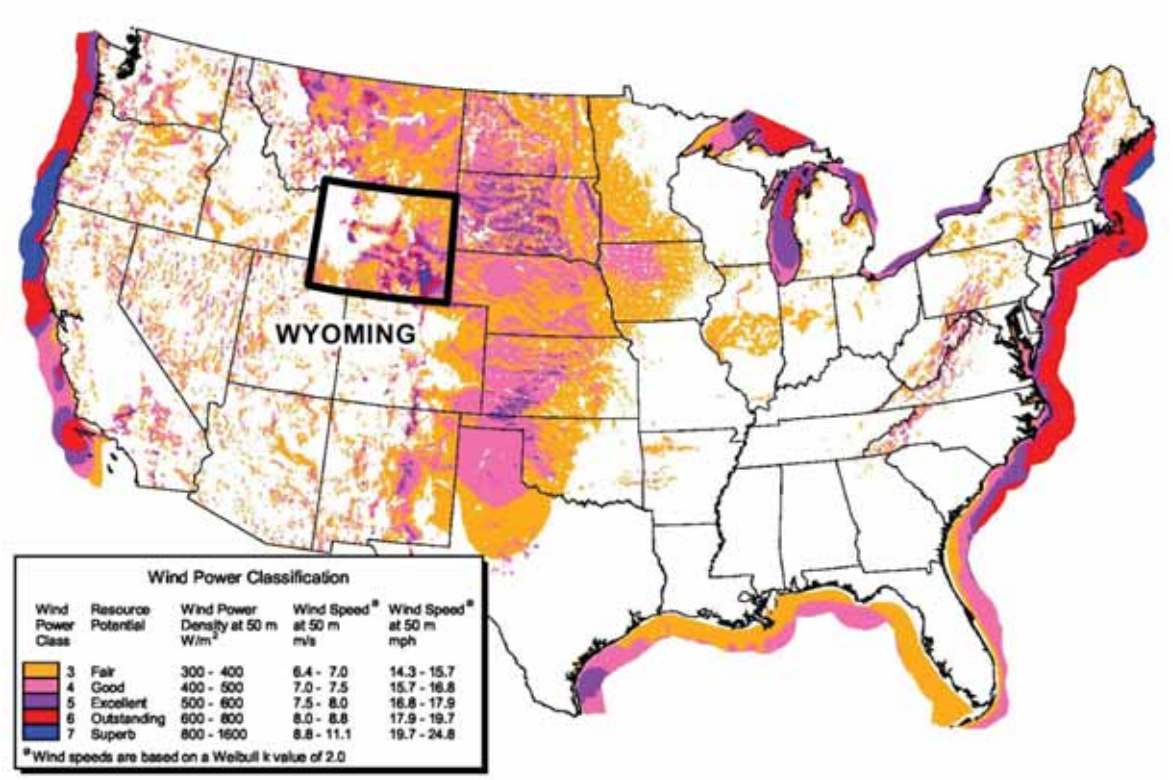


Figure 1-1. US Wind Resource Map

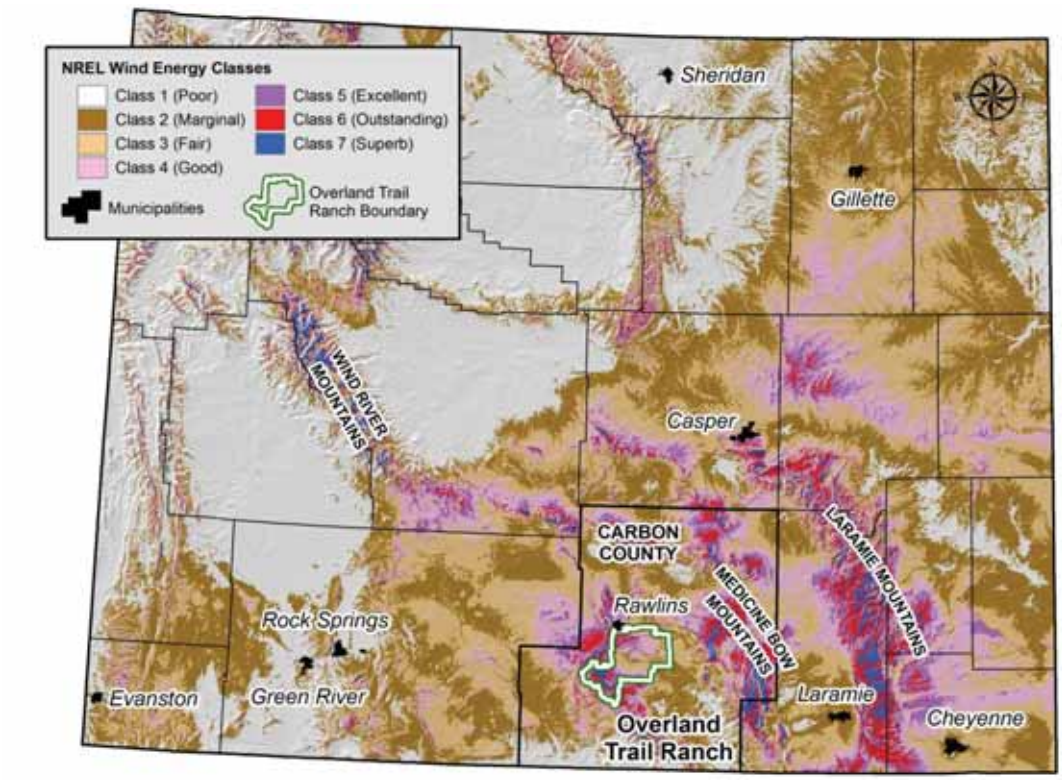


Figure 1-2. Wyoming Wind Resource Map

1.3 Project Overview

PCW proposes to construct and operate the Chokecherry and Sierra Madre (CCSM) Wind Energy Project located in Carbon County, Wyoming. The Project consists of 1,000 wind turbines capable of generating approximately 2,000 to 3,000 MW of clean, renewable wind energy. The Project has a proposed life of 30 years after which the continued viability of the Project will be reevaluated. The Project provides enough electricity to power more than 790,000 households, resulting in a reduction in CO2 emissions of 7 to 11 million tons per year.[1]

The Project is situated within an area of primarily private and public lands, with some state lands interspersed. The vast majority of the private lands are owned by The Overland Trail Cattle Company LLC (TOTCO), an affiliate of PCW. PCW has obtained a wind easement from TOTCO to use TOTCO's private lands within the Overland Trail Ranch (the Ranch) for the proposed wind energy project. Additional agreements would be obtained from other private landowners if PCW plans to use other private lands for the Project. PCW has applied for the necessary special use lease from the State of Wyoming, Board of Land Commissioners to construct and operate the wind farm on state lands. The public lands are administered by the Rawlins Field Office (RFO) of the Bureau of Land Management (BLM).

[1] This estimate assumes that wind generation is displacing traditional coal generation and that coal generation produces average emissions of 1,050 tons of CO2 per GWh (EIA 2011, Tables A8 and A18)

In 2008 PCW filed a Wind Site Testing and Monitoring Application (Application) with the Bureau of Land Management (BLM) for a right-of-way (ROW) grant on the public lands encompassing a portion of the Ranch. The Application Area includes the entire Wind Site Testing and Monitoring Application Area and Application Areas for rights-of-way (ROWs) of ancillary facilities. The requested ROW grant is for a term of 30 years with the option to renew the ROW grant and upgrade the wind facility, as necessary.

This Plan of Development (POD) is submitted in compliance with BLM guidance on processing ROW applications for wind energy projects on public lands administered by the BLM (BLM 2008b). Under the direction of the BLM, this Plan of Development (POD) has been developed to be consistent with the Draft Environmental Impact Statement (DEIS) issued by the BLM on July 22, 2011 (BLM 2011). Review and finalization of the Environmental Impact Statement (EIS) document is ongoing. PCW anticipates BLM publishing the Notice of Availability of the Final EIS in mid-2012. Revisions made to the EIS after issuance of the DEIS on July 22, 2011 may not be reflected in this document.

1.4 NEPA Analysis and Site-Specific PODs

As set forth in the DEIS, BLM's Proposed Action (Proposed Action) is to decide whether the area identified in PCW's application for a wind energy development right-of-way grant would be acceptable for development of a wind farm and identify the appropriate development strategy. The BLM has determined that an EIS is required under the National Environmental Policy Act of 1969 (NEPA; Title 42 United States Code [USC] Section 4321, et seq.) to analyze and disclose the potential environmental impacts of the proposed project for BLM decision-making.

Due to the large area considered and substantial number of turbines to be sited, the BLM has decided to go through the NEPA process to establish a strategy for future development. Future siting of wind turbine generators (WTGs) and associated PODs would be submitted consistent with the strategy adopted in the Record of Decision (ROD) for the EIS. While the broad-scale EIS evaluates a general area, specific effects will be evaluated in subsequent NEPA analysis based on site-specific proposals within the selected alternative boundary

BLM has proposed submission of four, possibly five, separate site-specific PODs in alignment with the right-of-way grant applications filed by PCW. They are:

1. The internal haul road
2. The rail distribution center (may be a separate POD or combined with the internal haul road)
3. The Sierra Madre development area
4. The Project transmission line
5. The Chokecherry development area

The site-specific PODs will be submitted in sequence in accordance with the BLM's ROD. Currently, PCW anticipates filing the site-specific PODs in the order identified above.

Depending on the terms and conditions of the ROD, PCW would likely file the site-specific PODs such that construction for the internal haul road could begin in year 1, the rail center in year 1, the Sierra Madre development area in year 2, the transmission line in year 3, and the Chokecherry development area in year 3. Construction of the various Project components may occur over a number of years; however, in compliance with proposed BLM mitigation measure GEN-1, PCW would limit surface disturbance to areas where turbines would be constructed within 12 months with a goal to mitigate effects from surface disturbance to wildlife, soils, water, and vegetation. Alternatively, PCW has proposed sequencing the site-specific PODs based upon annual construction activities rather than by Project component and right-of-way grant application. Such sequencing meets the purpose and intent of GEN-1 while allowing PCW to incorporate design changes learned through Project construction. It would also allow PCW to incorporate improvements in Project components resulting from technological advances. This alternate approach would serve to minimize variance requests.

The site-specific PODs will contain a detailed engineering design describing specific activities in the necessary detail to allow BLM to evaluate and analyze site-specific impacts. Prior to submission of the site-specific PODs, threatened and endangered species surveys, BLM sensitive species surveys, cultural surveys and other field surveys will be conducted as required by BLM in the ROD. The results of these surveys will be incorporated into the site-specific PODs and accompanying reclamation plans, and appropriate avoidance, minimization and mitigation measures applied consistent with the ROD.

1.5 PCW's Purpose and Need for Project

PCW conceptualized the Project in response to the high demand for renewable energy and exceptional wind resources described above. Several factors discussed below form the purpose and need for the Project.

PCWs purpose and need for the Project contains four main components:

- Extracting the maximum potential wind energy for the site;
- Developing a 1,000 wind turbine project with an installed capacity of between 2,000 MW and 3,000 MW;
- Developing the Sierra Madre development area first; and
- Constructing the Project as rapidly as possible on an optimized schedule[2].

Extracting the Maximum Wind Energy Potential

As discussed in Section 1.1 above, the nation is facing an unparalleled energy challenge resulting in a critical need for development of clean, renewable energy. This critical need

[2] PCW originally proposed building the Project over a three year period. To mitigate potential socio-economic effects caused by a large labor force, PCW agreed to a four year construction period. In the DEIS, BLM evaluated a five year construction period which was incorporated into proposed mitigation measure GEN-1.

results from both state RPS requirements and projected load growth demand. PCW has met with a number of potential customers who may purchase the clean, renewable wind energy to be generated from the Project. Based upon these discussions, PCW reasonably believes that it can and will sell all power generated from the Project. The market-based demand for renewable energy in the Desert Southwest region has been well documented and is discussed in Section 1.1 above. Moreover, at the January 25, 2010 meeting of the Wyoming Infrastructure Authority Board, a Black & Veatch presentation (Black & Veatch 2010) provided an estimate that in 2014 California alone will require 24,191 GWh of additional renewable energy to meet its RPS goal. Therefore, the estimated 7,000 to 10,500 GWh/yr of the Proposed Action is less than one-third to one-half of the estimated need for California alone in 2014. In addition to the Desert Southwest region, there are additional markets that may represent sales opportunities for PCW depending on available transmission.

Extracting the maximum potential wind energy for the site is also supported by the BLMs Final Programmatic EIS on Wind Energy Development on BLM Administered Lands in the Western United States (BLM 2005), and BLMs Wind Energy Development Policy (BLM 2008b) which states that "[f]ollowing a strategy of extracting the maximum potential wind energy from a given site will minimize the overall environmental impacts."

The high demand and multiple markets for this renewable energy resource as well as the minimization of impacts make development of the Project to its maximum potential the most prudent development strategy.

Wind Turbine Numbers and Installed Capacity

Turbine Models. PCW has not determined the wind turbine models that will be used for the Project. Turbine technology has made significant advances in the past five years with several manufacturers introducing new, more efficient and larger capacity models. This trend can be expected to continue in the foreseeable future, therefore PCW will select turbine model(s) for the Project at the time the final, site specific PODs are developed. This will allow PCW maximum flexibility to select the most appropriate model(s) for the Project at the time of development. At Project conception, commercially available wind turbines believed suitable for the Project had nameplate capacities of between 1.5 and 3 MW each.

Transmission Interconnections. PCW is anticipating a connection onto one of the several transmission projects being developed in Wyoming, including Energy Gateway West and South, Zephyr, Overland, and TransWest Express. Each of these lines have design options for up to 3,000 MW. A portion of the generation could also be connected to the existing PacifiCorp 230 kV transmission line on the northern edge of the Project Site.

Number of Wind Turbines. PCW determined that development of the entire Chokecherry and Sierra Madre Wind Site Testing and Monitoring Areas (WYW-166845 and WYW-166846) using the Applicant Committed Measures (ACM) listed in Appendix A (with the exception of A-1-03, keeping development outside Sage Grouse Core Area) could host up to 2,387 wind turbines.

Removing all locations within Sage Grouse Core Area reduced the potential number of turbines by 397, many of which were located in the high-wind portions of Miller Hill. Further removing an additional 52 turbines with below-acceptable wind resource, PCW found that the Project site could host up to 1,938 wind turbines. However, such a dense build-out of the site would lead to significant wake losses on many turbines, as well as locating many turbines in areas with lower-than-ideal wind resource. By increasing the spacing between turbines slightly and avoiding some lower wind locations, the Project would have a better overall efficiency and return on investment. PCW therefore determined that a total Project size of 1,000 turbines was ideal for the Project site.

Project Size. After consideration of all of the above factors, PCW determined that a 1,000 wind turbine development with a name plate capacity of between 2,000 and 3,000 MW meets PCW's purpose and need of extracting the maximum wind energy from the site. The Project is not constrained by buildable terrain and 1,000 turbines is a reasonable number of generators for the Project area, current available turbine models range in nameplate capacity from 1.5 to 3 MW, and transmission is expected to be available to transmit up to 3,000 MW to the Desert Southwest and other potential markets.

Since the object of the Project is to serve the renewable energy demands of a market distant from the Project Site, specifically the Desert Southwest, the Project has the additional cost burden of long-distance transmission wheeling charges, something most domestic wind energy projects do not face. As with all other forms of energy generation designed to be coupled with long-distance transmission, the economics of such projects are stronger as the projects increase in size. PCW therefore determined that a project of a size similar to many other wind projects (500 MW or less) would not be economically sufficient, and that a much larger size would be required.

Developing Sierra Madre First

The Sierra Madre development area possesses the best, highest-quality wind resource within the Project Site and therefore the highest wind energy potential. Developing this area first will result in an earlier return on investment for PCW, improved Project economics, and earlier availability of clean wind energy to consumers.

Construction Schedule

PCW's purpose and need as described in the December 2009 letter to the BLM (PCW 2009) included development of the Project over a three year period to minimize invested capital prior to generating a return on investment. Constructing the Project in this well-planned, optimized time frame also brings the Project to fruition as soon as practicable, thus leading to more clean energy being available sooner which will also help reduce pollution and greenhouse gas emissions generated by traditional fossil fuel-based energy sources.

As part of PCW's Applicant Proposed Alternative submitted in April 2010 to the BLM (PCW 2010), PCW prepared a 4-year construction schedule which contemplated commencing

infrastructure work prior to the mobilization of a full construction crew. This schedule was developed to mitigate concerns regarding potential socioeconomic impacts during the first year of construction. This schedule also provided a contingency in the event the ROD was issued later in the construction season when it would be too late to commence turbine pad construction but when infrastructure construction could still begin. This contingent year was referred to by PCW as "year 0".

The DEIS introduced and evaluated a proposed mitigation measure labeled GEN-1 that has the practical effect of extending the construction period an additional construction season by incorporation of the contingent year 0 as an additional construction year thereby creating a five year schedule. To maintain consistency with the DEIS, PCW has prepared a construction schedule that includes five years of Project construction. A detailed description of this schedule is provided in Section 4.4.1 and is also applied to the example Project layout in Section 8.11.

PCW recognizes that the schedule has evolved throughout the EIS process in an effort to address potential resource impacts. PCW's purpose and need continues to be construction of the Project as expeditiously as possible for the reasons outlined in the original December 2009 letter. While PCW has prepared a revised Project schedule consistent with mitigation measure GEN-1, PCW will continue to work with BLM to identify methods of accelerating construction where feasible and consistent with BLM's ROD.

Summary

PCWs purpose and need is to plan, develop, construct and operate a wind energy project capable of supplying a significant portion of the Desert Southwest's demand for renewable energy at market based rates. PCW can best accomplish this by building a 1,000 wind turbine project with an installed capacity of between 2,000 and 3,000 MW that will extract the maximum potential from the wind energy site. Developing the areas with the highest wind resource first (e.g., Sierra Madre) and constructing the Project on an optimized schedule also directly affect Project economics. The Project is designed to achieve a balance between renewable energy demands, project economics, and environmental sensitivities.

2. Project Site Characteristics and Environment

The proposed Project consists of 1,000 wind turbines and associated infrastructure capable of generating approximately 2,000 to 3,000 MW of clean, renewable wind energy. This chapter describes the Project location, site characteristics and environment.

2.1 Location

The Project is located primarily within the bounds of the Ranch in Carbon County, Wyoming. The Ranch is operated by TOTCO as a cattle ranch with some associated agricultural production and is located south of the communities of Rawlins and Sinclair and west of Saratoga. The Ranch boundary is within Townships 16 through 21 North and Ranges 85 through 89 West of the 6th Principal Meridian, Carbon County, Wyoming. Comprising approximately 320,000 acres, the Ranch has sufficient room to accommodate roughly 2,400 wind turbines. The boundary of the Ranch is shown on Figure 2-1 and Figure 2-2.

For development and permitting purposes, the land on which the Project will be located is divided into two separate areas: "Chokecherry" is the northern portion, and "Sierra Madre" is the southern portion. Figure 2-1 and Figure 2-2 display the extent of the separate ROW application areas for Chokecherry and Sierra Madre as defined in Section 1.1 and Figure 1-2 of the DEIS (BLM 2011), with the combined lands referred to collectively as the Project Application Area. The portions within each application area on which PCW expects Project facilities to be located are referred to as the development areas, also shown in Figure 2-1 and Figure 2-2, which are primarily the portions of each application area outside the Sage Grouse Core Area (see Section 7.1.2) and those lands PCW has applied for which BLM has not yet taken action. The combined development areas are collectively referred to as the Project Site.

2.2 Site Characteristics

The site characteristics of the Project Site are ideal for wind energy development. These characteristics are discussed below.

2.2.1 Terrain

The terrain of the Project Site includes high desert, sagebrush steppe, rolling hills, elevated plateaus, and some meadows. The elevation of the site ranges from 6,500 feet above mean sea level near the North Platte River to nearly 8,500 feet on the northeastern edge of Miller Hill. A terrain map of the site is included as Figure 2-2.

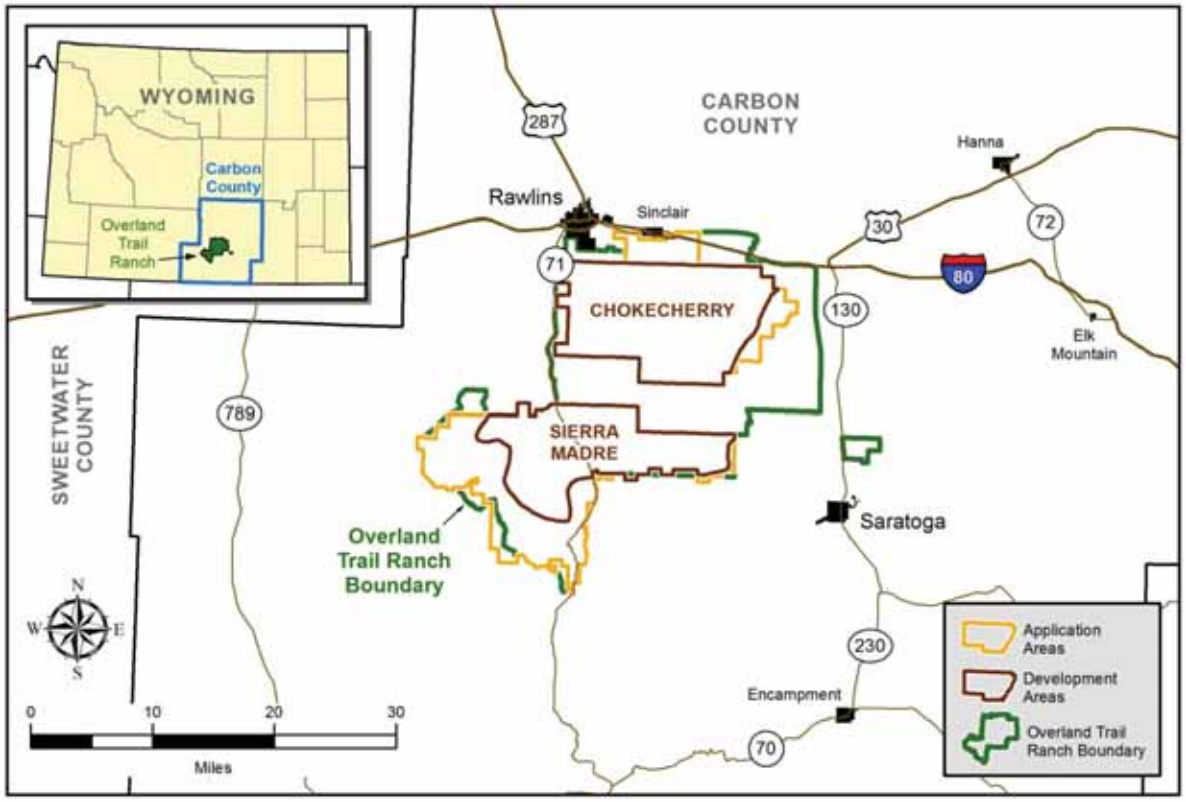


Figure 2-1. Ranch Location within Carbon County, Wyoming

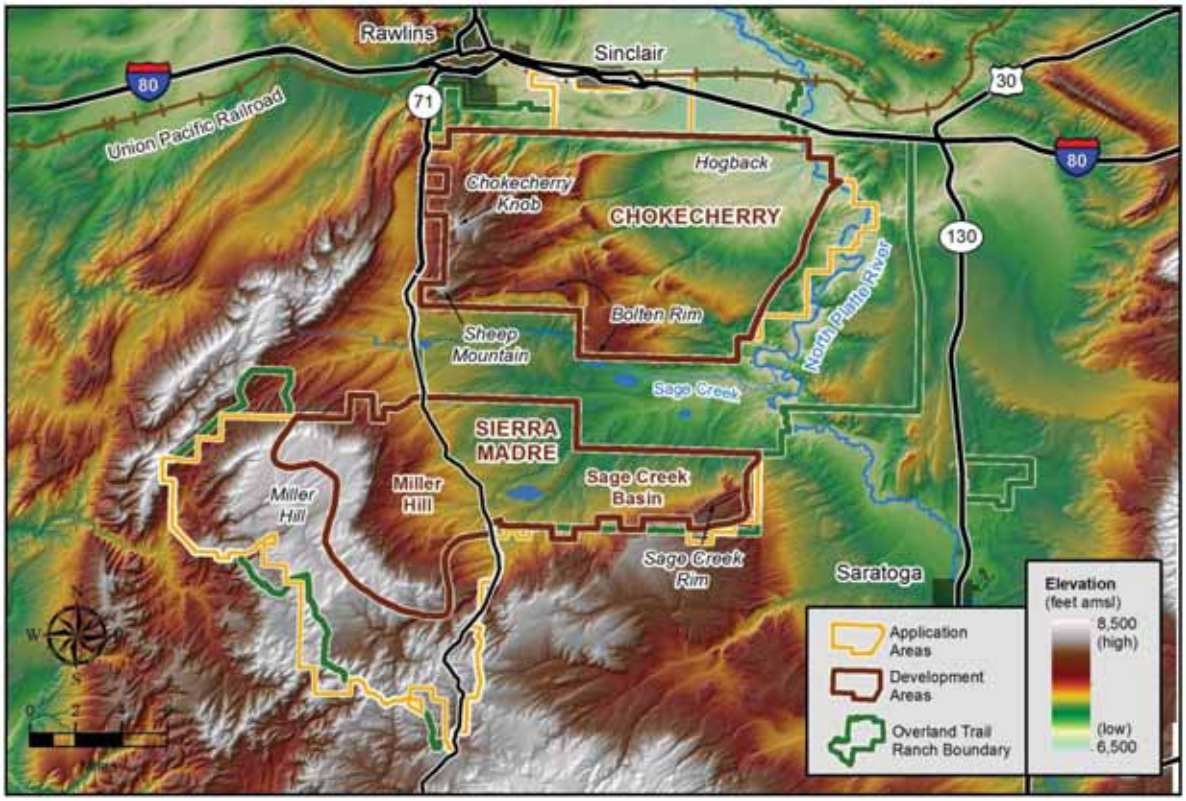


Figure 2-2. Site Topography

The site is dominated by three topographic features separated by a wide valley. To the north, the Chokecherry development area consists of ridges and rolling hills (including Chokecherry Knob and Sheep Mountain) that generally slope downward from the southwest to the northeast toward the North Platte River. Most of the northern portion of the Chokecherry development area is defined by a small east-west ridge known as the Hogback, and the south is defined by a nearly shear face known as the Bolten Rim.

Figure 2-3. Terrain in northern (left) and southern (right) Chokecherry

The Sierra Madre development area of the site is dominated by Miller Hill in the southwestern portion of the Project Site. This hill is essentially a mesa with fairly steep slopes, although the slopes are moderated in the northeast and southern portions of the hill. The top of the hill slopes gently toward the southwest; it is relatively flat near the rim, but becomes more undulating approximately one mile from the rim edge. The area east of Miller Hill is mostly rolling hills and low ridges.

Figure 2-4. Terrain on (left) and below (right) Miller Hill

The southeast portion of the Sierra Madre development area includes Sage Creek Rim, which has terrain similar to Miller Hill, although this feature is not as large or high. Only a small portion of the top of the hill is within the Project Site.

Figure 2-5. Terrain on (left) and below (right) Sage Creek Rim

The area between these features is a desert valley comprised of Sage Creek and a number of small ephemeral tributaries. Much of this valley is outside the development areas for wind turbines, although the Project haul road (see Section 2.5) and internal transmission line (see Section 2.8) cross the valley.

Figure 2-6. Terrain in Sage Creek Valley

2.2.2 Wind Resource

PCW has undertaken an industry-leading effort to accurately measure and map the wind resource on the Ranch. Since mid-2007, PCW has had meteorological (met) towers installed to analyze and record the wind conditions. PCW has installed 34 met towers across the Ranch, of which 32 are presently in operation throughout the wind development areas. PCW has also invested in a sonic detection and ranging (SODAR) unit to measure the wind conditions up to 200 meters above ground level, and is using the SODAR in conjunction with the met towers to carefully map the wind shear characteristics across the site.

Figure 2-7. Project Met Tower and SODAR Unit

PCW has engaged AWS to develop and manage the Project's wind resource measurement program. AWS is a respected wind industry leader in the analysis of wind resource data, and has pioneered many techniques. AWS is frequently used by leading wind developers, lending institutions, and government agencies such as NREL. PCW and AWS are working closely to ensure that the program evaluates all areas of project development and meets industry best practices.

The wind resource monitoring program has verified that the Project Site has large areas of Class 5 (deemed "Excellent" by NREL), Class 6 ("Outstanding"), and Class 7 ("Superb") wind. AWS has mapped wind conditions across the Project Site. These maps are being used to evaluate potential wind turbine layouts, ensuring a high degree of project efficiency. These large expanses of land with high wind conditions are a unique feature of the Project Site.

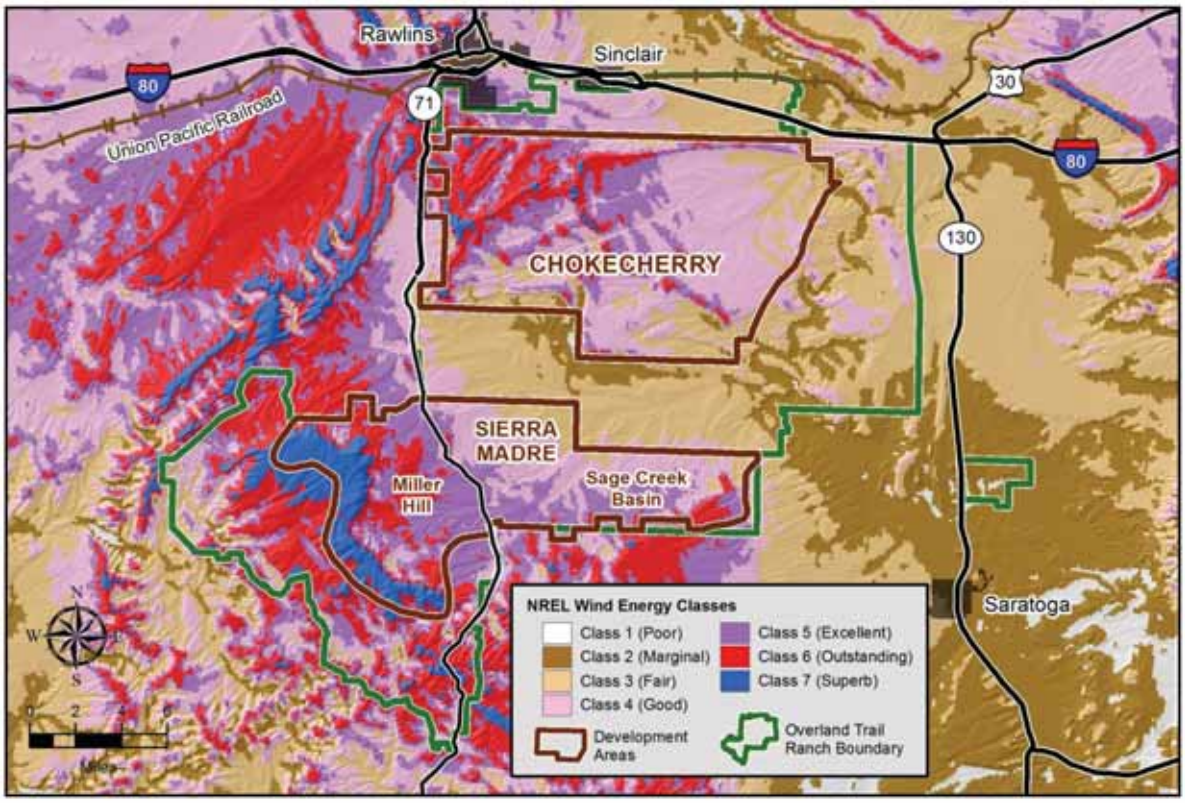


Figure 2-8. Wind Resource Map of Project Site

2.2.3 Geology

The known geology of the Project Site is discussed below.

2.2.3.1 Surface Geology

According to Chapman et al. (2004), surface geology of the Project Site consists of Quaternary alluvium, colluvium, outwash deposits, and eolian deposits derived from Tertiary and Cretaceous claystone, sandstone, and sedimentary rock (majority of Project); and Quaternary alluvium and colluvium, gravel and fan deposits, and areas of active and stabilized dune sand and loess underlain with Tertiary and Cretaceous siltstone, sandstone, claystone, and areas of shale marlstone (northeast portion of the Chokecherry Development Area).

Chokecherry

The Chokecherry Development Area is covered primarily by residuum and slopewash and colluvium landforms mapped by Case et al. (1998). The residuum landform is composed of residuum mixed with alluvium, eolian, slopwash, grus, and/or bedrock outcrops. The slopewash and colluvium landform is composed of scattered deposits of slopewash, residuum, grus, glacial, periglacial, alluvium, eolian, and/or bedrock outcrops. In addition, alluvial fan and dissected alluvial fan landforms are located around the Grenville Dome within the Chokecherry Development Area, and alluvium and bedrock landforms comprise small areas on the extreme northern, eastern, and southern portions of the Project Site. The alluvial fan and dissected

alluvial fan landforms are fan deposits mixed with scattered deposits of slopewash and residuum. The bedrock landform is defined as bedrock and glaciated bedrock including hot spring deposits and volcanic necks, mixed with scattered shallow deposits of eolian, grus, slopewash, colluvium, residuum, glacial, and alluvium.

Sierra Madre

The majority of the Sierra Madre Development Area is covered by the residuum landform defined by Case et al. (1998). Small areas around the perimeter of the application area are covered by the landslide landform, which is composed of landslide deposits mixed with scattered deposits of slopewash, residuum, Tertiary landslides, and bedrock outcrops. The slopewash and colluvium landform comprises fingers of surface landforms in the northern, southern, and extreme eastern portions of the development area. The dissected alluvial fan landform comprises a very small area on the extreme eastern portion of the Sierra Madre Development Area.

The composition of overburden soils in some areas of the Project Site may necessitate consideration of over-excavated foundations at a few wind turbine sites. The composition and thermal properties of the soils may also lead to the review of the need for engineered backfill in some underground collection system trenches. The composition and thermal properties of overburden soil will be evaluated as part of a detailed geotechnical investigation conducted prior to the final design.

2.2.3.2 Bedrock Geology

In August 2011, Terracon performed a preliminary geotechnical investigation of the Project Site. This investigation included 26 subsurface borings plus 6 electrical and thermal resistivity test sites, all performed per typical industry practice and standards. The investigation results showed that bedrock competent for foundation construction was found throughout the Project Site, covered by between 0 and 24 feet of overburden (typically less than 10 feet). In this context, competent bedrock is defined as un-weathered rock that is likely suitable for supporting large foundations. As part of a future, more detailed geotechnical investigation, bedrock will be cored to more precisely define the depth to competent rock. Samples collected from bedrock coring will be analyzed to determine with more certainty if the rock is suitable for foundation installation. In the areas where bedrock was found to be both very shallow and highly cemented, it may be necessary to review alternative methods for rock break-up for foundation installation and underground collection system trenches (such as pneumatic breakers or blasting).

Chokecherry

The entirety of the Chokecherry Development Area, excepting only a few proposed turbines along the northern margin, is sited on Mesaverde sandstones and shales of the Kindt Basin. The Kindt Basin is a shallow syncline where Mesaverde sandstones and shales are underlain by Steele Shale on the flanks of the syncline and are overlain by Lewis Shale in the structural

center of the feature. The Mesaverde sandstones are well exposed and form prominent cliffs and ridges around the basin.

Geotechnical boring logs from the initial investigation indicate that bedrock across the Chokecherry Development Area is at or near the ground surface. Bedrock is a mix of claystone and sandstone, commonly interbedded.

Sierra Madre

In the Sierra Madre Development Area, the Miller Hill plateau is an extension of the Sierra Madre range as it plunges northwestward through the Project Site toward the Atlantic Rim, a topographically high trend of westward-dipping Mesaverde sandstone strata on the eastern margin of the Washakie basin. The dissected Miller Hill plateau is held up by a resistant cap of Miocene sediments. High elevations of the Sierra Madre Development Area, including Miller Hill and Sage Creek Rim, are capped by these resistant Miocene sediments. The majority of turbines below Miller Hill are sited on the Niobrara formation and the Frontier formation and Mowry and Thermopolis shales. The lowest portions below Miller Hill and the majority of the turbines in Sage Creek Basin are sited on Steele shale that extends across the valley between the Chokecherry and Sierra Madre Development Areas. Turbines are not sited within mapped landslide deposits.

Geotechnical boring logs completed on the Miocene cap of Miller Hill show depths to competent bedrock ranging from 5 to 7 feet below ground surface (bgs); bedrock is sandstone or conglomerate. Weathered bedrock was observed at shallow depths (1 to 5 feet bgs). Claystone bedrock was observed at variable depths in borings completed at lower elevations within the Niobrara formation (1 foot bgs for weathered claystone; up to 9 feet bgs for competent rock).

Conglomerate bedrock was encountered at 3 feet bgs in a boring completed within the Miocene sediments on Sage Creek Rim. At lower elevations within the Steele shale of Sage Creek Basin, interbedded sandstone and claystone was observed at 3 feet bgs, giving way to claystone at 7 feet bgs.

Interconnection Substation, Rail Facility, Haul Road, and Internal Transmission

The area of the interconnection substation is within alluvium and colluvium (intermittent layers of clay, silt, and sand) overlying the Steele shale and Niobrara formation. Geotechnical boring logs indicate that the depth to claystone bedrock ranges from 2 feet bgs in the northeast corner to 24 feet bgs in the southwest corner of Township 21 N, Range 86 W, Section 31 (bedrock depths were 2, 3, 5, 7, and 24 feet bgs).

The primary rail site development area (see Figure 3-14) is sited primarily on Miocene sediments and Quaternary alluvium and colluvium deposits. The eastern and southern edges are underlain by the Frontier formation. The southern portion of the development area also extends into the Steele shale and Niobrara formation. A geotechnical boring completed within

Township 21 N, Range 86 W, Section 29 (Frontier formation) suggests that the depth to claystone bedrock (4.5 feet bgs) is consistent with what was observed in Section 31.

The proposed haul road and internal transmission lines cross the same bedrock units discussed in the Chokecherry and Sierra Madre sections above as they pass through and between these development areas. Outside of these development areas, a geotechnical boring completed along CR407 (CIG Plant Road) shows that claystone bedrock is only 3 feet bgs. Bedrock is also very shallow near where the proposed haul road intersects the Bolten Road (1 foot to claystone) and in the southern portion of Sage Creek Basin (1.5 fet to sandstone; claystone at 10 feet bgs).

2.2.4 Vegetation

To better understand site-specific vegetation and habitat conditions across the Project Site, SWCA Environmental Consultants (SWCA) completed a detailed vegetation mapping effort in 2009. Vegetation was characterized at more than 500 locations across the Ranch (both within and outside the Project Site) and within 3-miles of the Ranch boundary. The resulting information was critical for the quantification of the availability and quality of greater sage-grouse habitat across the Project Site.

For each vegetation sampling location, vegetation attribute data were collected to quantify and characterize vegetation conditions (e.g., abundance of plant species and overall structure of the vegetation). Attribute data collected included a list of overstory and understory vegetation and functional groups, dominant plant species, percent cover estimates, shrub density, and overstory and understory height. The locations of any rare plant species and noxious weed occurrences were documented and recorded using sub-meter resolution GPS technology. Physiographic features (e.g., topography, soil, geologic formation, slope, elevation) were recorded and georeferenced for the surrounding area of each sampling transect. Photopoints were established along each transect and six digital photos were taken for each location.

The data collected were used by SWCA to create a high-resolution (4 m^2) vegetation classification (Figure 2-9) that has been used as the basis for many of PCW's planning efforts (sage-grouse conservation projects, avian surveying locations, project design, etc.). Among the existing vegetation of the Ranch, plant communities were categorized into seven vegetation classifications primarily defined by dominant vegetative functional groups and dominant species, and include:

- sparsely vegetated
- aspen/mixed conifer woodlands
- salt desert shrub
- sagebrush steppe - characterized by both mountain big sagebrush (Artemisia tridentata ssp. vaseyana) and Wyoming big sagebrush (Aretmisia tridentata ssp. wyomingensis);
- montane shrubland
- upland grasslands

- lowland mesic zones

Sagebrush steppe was further divided into two classifications, sagebrush steppe and dense sagebrush communities, which are characterized by overall canopy cover and shrub density of varying sagebrush species. In addition, lowland mesic zones include three vegetation communities found in areas associated with hydric conditions and are specific to riparian areas, mesic meadows, and/or National Wetlands Inventory (NWI) wetlands. These three vegetation communities were grouped into one vegetation class, lowland mesic zones, to more accurately assess habitat that is seasonally utilized by greater sage-grouse. Additional land cover includes portions of the Ranch that are either barren landscapes or open water, or areas that have been exceedingly modified by human development, i.e., developed/urban areas, roadways (barren landscapes), and agriculture/pastureland. Approximately 82.3 % of the Ranch (255,708 acres) is covered by either sagebrush or salt desert shrub communities, while other less frequently occurring plant communities are more restricted by elevation, topography, soil, hydrology, and development.

Figure 2-9 shows the general locations for these dominant vegetation cover types on the Ranch. Greater detail on the vegetation cover is provided in Section 6.4.

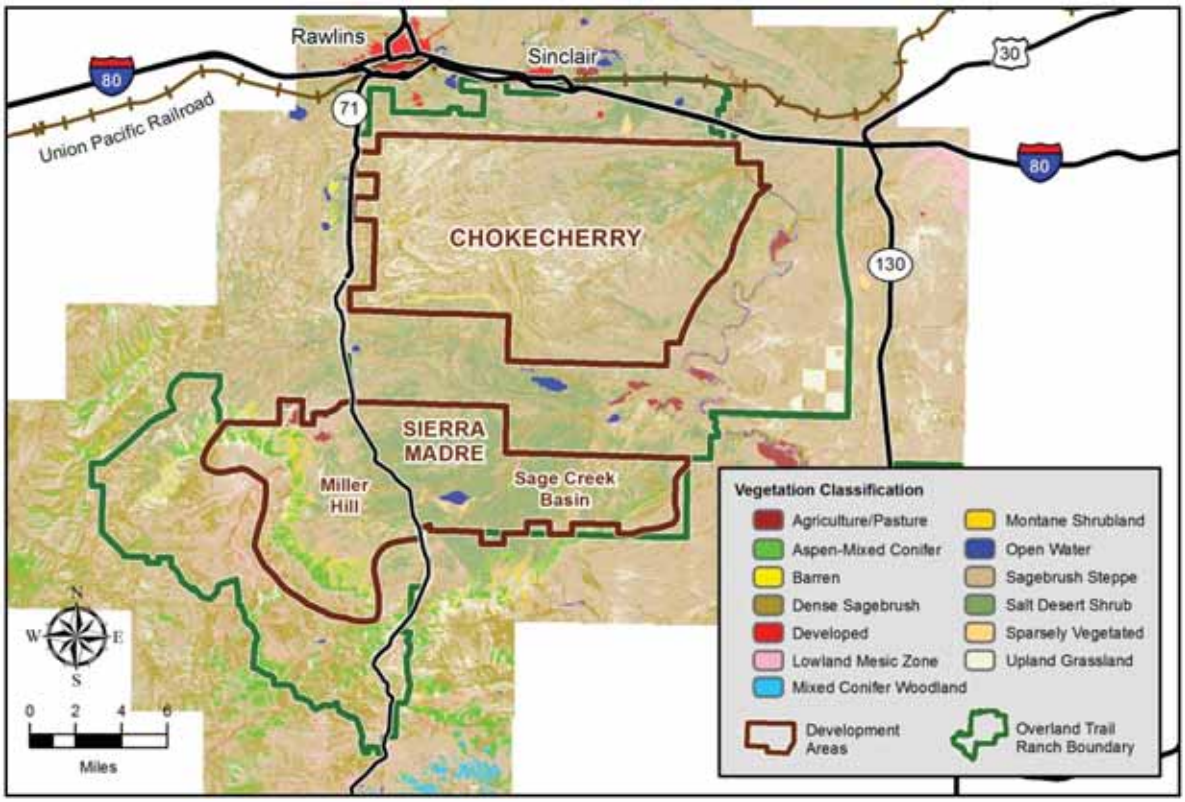


Figure 2-9. Dominant Vegetation Cover Map of Project Site

2.2.5 Water Resources

The spectrum of water resources that exist within the Project Site are discussed below.

2.2.5.1 Surface Water Resources

The Project Site is located within Division 1 of the Wyoming State Engineer's Office (SEO) and includes waters in both the North Platte River and Little Snake River drainages. The surface water resources within the Ranch boundary include the North Platte River as well as several perennial streams including Sage Creek, Miller Creek, and Rasmussen Creek in the North Platte drainage and Muddy Creek in the Little Snake drainage. In addition, there are several ephemeral streams and a few isolated springs located throughout. There are also numerous stock ponds and some larger irrigation reservoirs including Kindt, Rasmussen, Johnson, and Sage Creek reservoirs.

2.2.5.2 Groundwater Resources

Groundwater resources and well yields within the Project Site are variable due to rapidly changing geologic features, varying dependence on recharge, and extensive faults and fractures throughout the area. The primary accessible water bearing formations on the property include alluvial, and Mesaverde and Nugget Sandstone formations. Yields and depths of each aquifer are highly variable and dependent upon specific well locations. Confined conditions in some formations have led to artesian wells in a few isolated areas of the Project Site.

Portions of the Project Site are located in areas identified by the SEO as being hydrologically connected to the North Platte River and/or its tributaries. New groundwater resource development opportunities in those areas that are hydrologically connected to the North Platte River system may be limited by the North Platte Decree as implemented by the SEO.

2.2.5.3 Municipal Resources

Municipal supplies for the City of Rawlins and the Town of Sinclair are located in close proximity to the Project Site. Opportunities to obtain both raw water and treated water from Rawlins and Sinclair may exist in certain locations. The raw water supply pipeline for Rawlins runs from their well field south of the Project Site north along WY71/CC401 (Sage Creek Road) through the Sierra Madre Development Area and along the western edge of the Chokecherry Development Area. Treated water supplies may be available along the north edge of the Chokecherry Application Area near Sinclair and the Colorado Interstate Gas Rawlins Operations Facility (CIG Plant).

2.2.6 Water Use and Rights

The Project will require water for industrial uses during construction (see Section 4.3.4), and will have limited permanent water demands associated with operations (see Section 5.3). The Ranch owns numerous direct flow, storage, and groundwater rights within the Project Site far in excess of the amounts required to build, operate, and decommission the Project. These rights are currently approved and adjudicated for irrigation, domestic, and stock watering uses. The right to temporarily or permanently change the location and type of use of these existing water

rights may be negotiated with TOTCO. Additional options to meet long term water supply needs may include negotiation of a water supply agreement with the City of Rawlins or Town of Sinclair. The specific water rights that will supply each sequence of the Project will be identified in the site-specific PODs.

2.2.7 Land Ownership

The Project Application Area is located primarily on the Ranch. Much of the Ranch is located within an ownership region known as the "checkerboard", in which land section ownership alternates between private lands (mostly owned by TOTCO) and federal lands managed by the BLM. A small percentage of State Board and Wyoming Game & Fish Department (WGFD) lands are also within the Project Application Area. The Chokecherry Development Area is completely within the "checkerboard". The majority of Sierra Madre Development Area is in the "checkerboard" except for the southern portion in Townships 16N and 17N, Ranges 87W to 89W. The breakdown of land ownership within the Application Areas is shown in Table 2-1; a map is included in Figure 2-10.

Table 2-1. Project Application Area Land Ownership

Ownership/Lease Type	Total Project Application Area (acres | %)	Chokecherry Application Area (acres | %)	Sierra Madre Application Area (acres | %)
Bureau of Land Management	107,175 | 48%	48,601 | 46%	58,574 | 50%
State Board and Wyoming Game & Fish	10,314 | 5%	1,937 | 2%	8,377 | 7%
Private	105,200 | 47%	54,881 | 52%	50,319 | 43%
TOTAL	**222,689**	**105,419**	**117,270**
Source: Chokecherry and Sierra Madre Wind Energy Project Draft EIS (BLM 2011)			

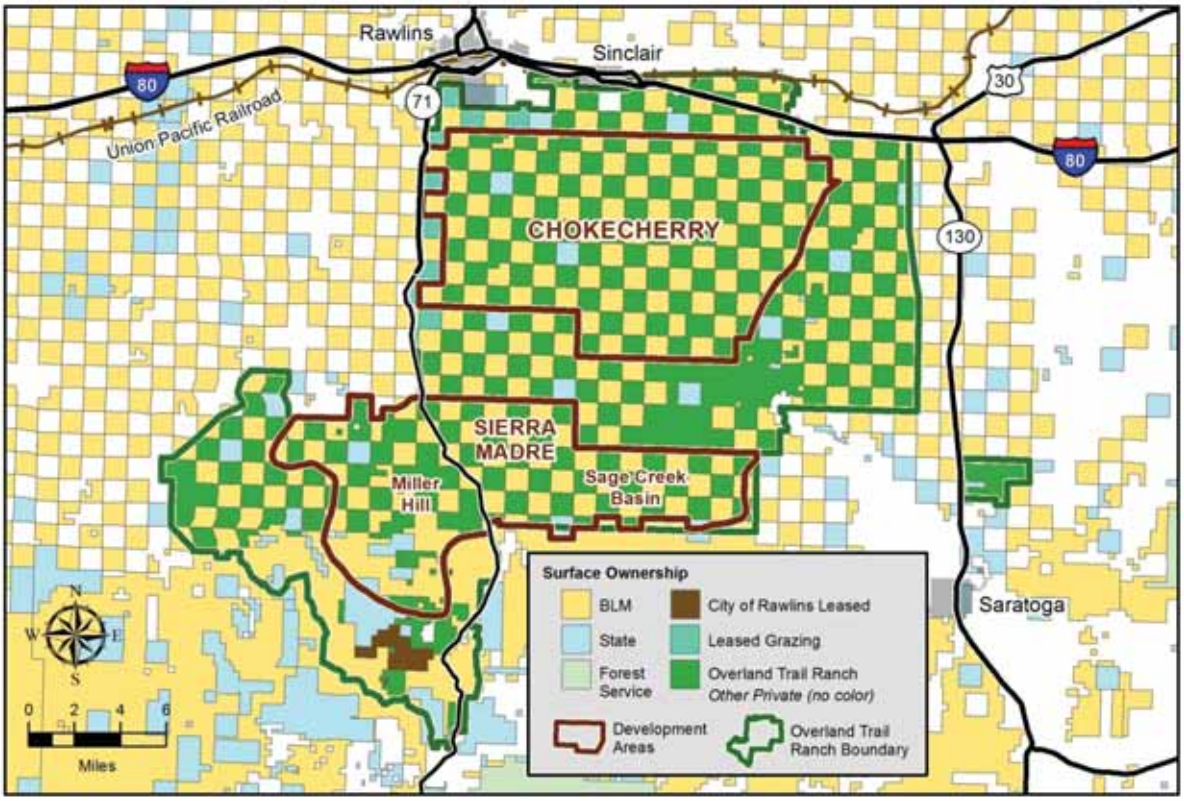


Figure 2-10. Land Ownership Map of Project Site

2.2.8 Land Availability and Use

The Project Site is mainly agricultural land managed by TOTCO, without any significant commercial or industrial development except within the I-80 corridor. The communities of Rawlins, Sinclair, and Saratoga are in the vicinity of the Ranch. There are no private year round residences within the Ranch boundary, however, there are two private seasonal-use cabins in the northern portion of the Sierra Madre development area, specifically small tracts in Section 9, Township 18 N, Range 88 W. TOTCO maintains the grazing leases on the federal property, and operates the site as a cattle ranch with capacity for up to 5,000 head of cow/calf and yearlings. The Ranch also has approximately 2,500 acres of irrigated hay fields which support the cattle operation.

The northern boundary of the Project Site borders Interstate 80 and the Union Pacific Railroad, allowing for the delivery of components and personnel with a minimum amount of infrastructure development and effect on the nearby communities. In alignment with Wyoming's role as the nation's leading energy exporting state, much of the region around the Ranch is already involved in energy creation, mostly in the form of natural gas extraction. Specifically, the Atlantic Rim natural gas development area is along the western boundary of the Ranch. As such, the development of an energy project within the Ranch is not dissimilar to other active energy development that has been underway in the region for decades.

3. Project Components and Design

This section describes the individual components and design features that cumulatively comprise the Project.

A full range of components and options that may be used for the Project are included in this section to facilitate a comprehensive review process. While the design and function of each major element of the Project is described in this section, the construction method is described in Section 4. All final component selections and designs will be submitted to the BLM in the site-specific PODs for detailed analysis.

3.1 Wind Turbines

The most significant element of the Project are the wind turbines. Wind turbines are devices that convert the kinetic energy of the wind into electrical generation. The major components of a wind turbine, shown in Figure 3-1, work together to accomplish this task. The movement of air over the airfoils of the turbine blades induce lift, which causes the rotor (blades connected to a central hub) to turn. This rotational mechanical energy is transferred to an electrical generator located in the nacelle via the turbine's drivetrain, which consists of bearings, shafts, and in many turbine models, gearboxes. Rotation of the generator converts the mechanical energy to electrical energy, which is transferred out of the turbine through a series of cables, transformers, power electronics, and switchgear. The majority of the turbine components need to be located high above the ground to facilitate the capture of strong and even winds, and are therefore supported by a turbine tower. Each of these components are discussed in more detail below.

While many designs have been tested, the most reliable design for wind turbines has been the three-bladed, upwind, horizontal-axis "Danish" design on steel monopole towers described above. The wind energy industry previously explored other wind turbine designs (two blades, downwind, vertical axis, and lattice towers to name a few) but all utility-scale commercial wind turbine manufacturers have migrated to the design presented in this section. While other wind turbine designs exist in conceptual or research form, none of these designs are yet considered commercially viable; all have an element of technological risk far too high for any utility-scale wind energy project. As such, PCW is not considering these designs for the Project.

The discussion below includes the range of values and technology expected to be available over the construction period of the Project. If any attributes of PCW's final selected turbine models deviate significantly from what is discussed below, PCW will highlight those attributes in the site-specific PODs.

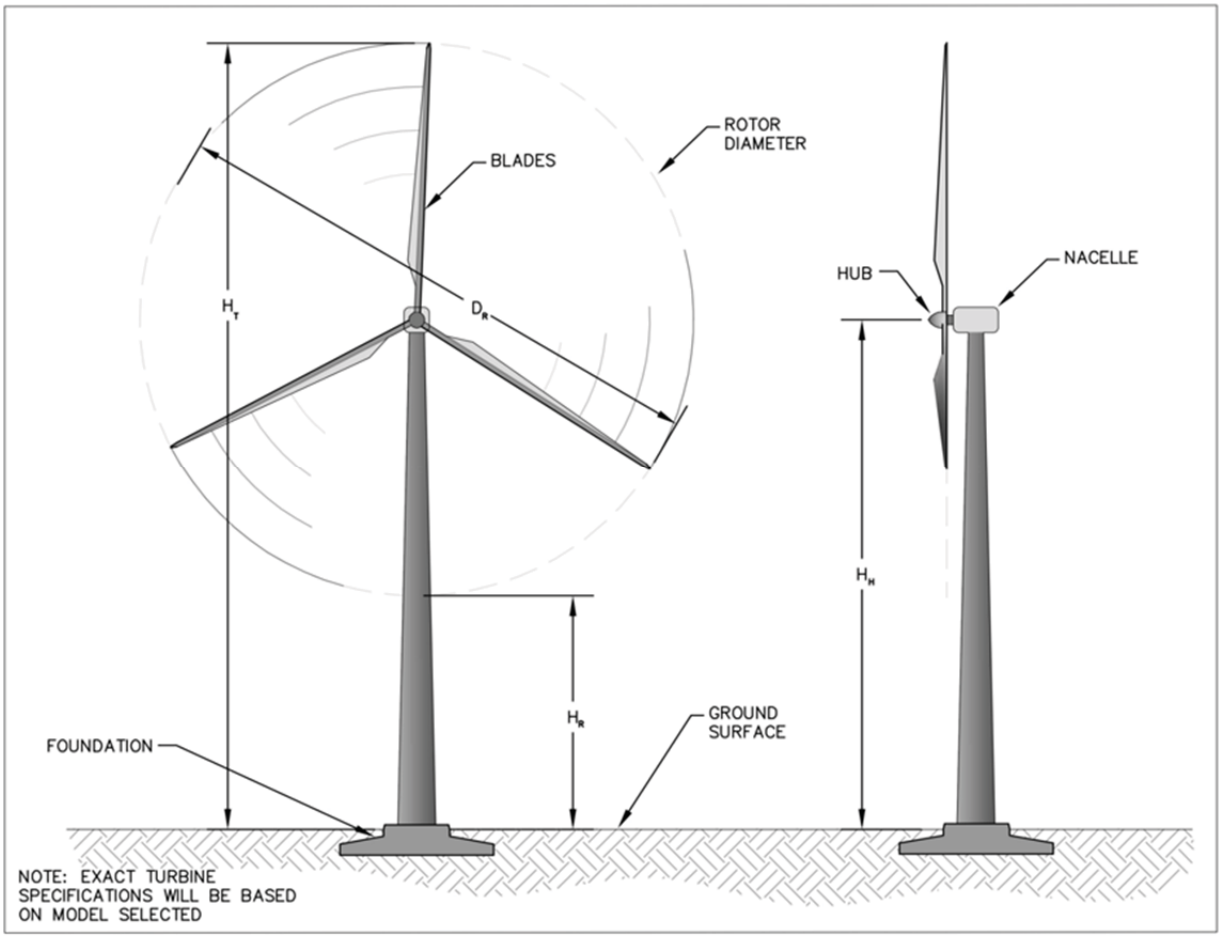


Figure 3-1. Wind Turbine Diagram

Figure 3-2. Example Modern Wind Turbines in Wyoming

3.1.1 Rotor

A wind turbine rotor consists of three individual blades connected to a central hub. The hub connects onto the low-speed shaft in the turbine's nacelle (see Section 3.1.2). The hub is usually covered by a fiberglass nosecone to provide protection from the elements and improve aesthetics.

Wind turbine blades are constructed with a fiberglass reinforced epoxy or polyester resin airfoil placed on a round steel root. Increasingly, blades also include carbon fiber to increase overall length (as longer blades capture more energy) and strength without adding significant weight. Airfoils designed specifically for wind turbines, and other innovations including twist and coatings, increase overall blade efficiency and reduce operational noise.

Most modern wind turbines utilize some form of pitch control for the blades in the rotor. At periods of low wind, blades are pitch to capture as much wind energy as possible until the turbine reaches rated power. To regulate the turbine's output power at rated, and avoid the airfoil going into stall, the blade pitch is feathered out of the wind to varying degrees (dependent upon wind speed). When turbines are shut down, the blades are feathered completely out of the wind to minimize the lift on the blades and the overall forces on the turbine. The blade pitch can be accomplished either through hydraulic or electric motor systems depending upon the turbine model.

Figure 3-3. Turbine Blades and Rotor

3.1.2 Nacelle

The nacelle is the structure situated directly atop the tower that houses all of the generating components such as the gearbox, the electrical generators, low- and high-speed shafts, controller, and brakes (see Figure 3-4). The rotor is connected to the low-speed shaft within the nacelle near the turbine's main bearing. Depending upon the turbine design, the low speed shaft is connected to the turbine's electrical generator either directly or through a mechanical gearbox. Located on either the low-speed or high-speed shafts will be a mechanical brake system.

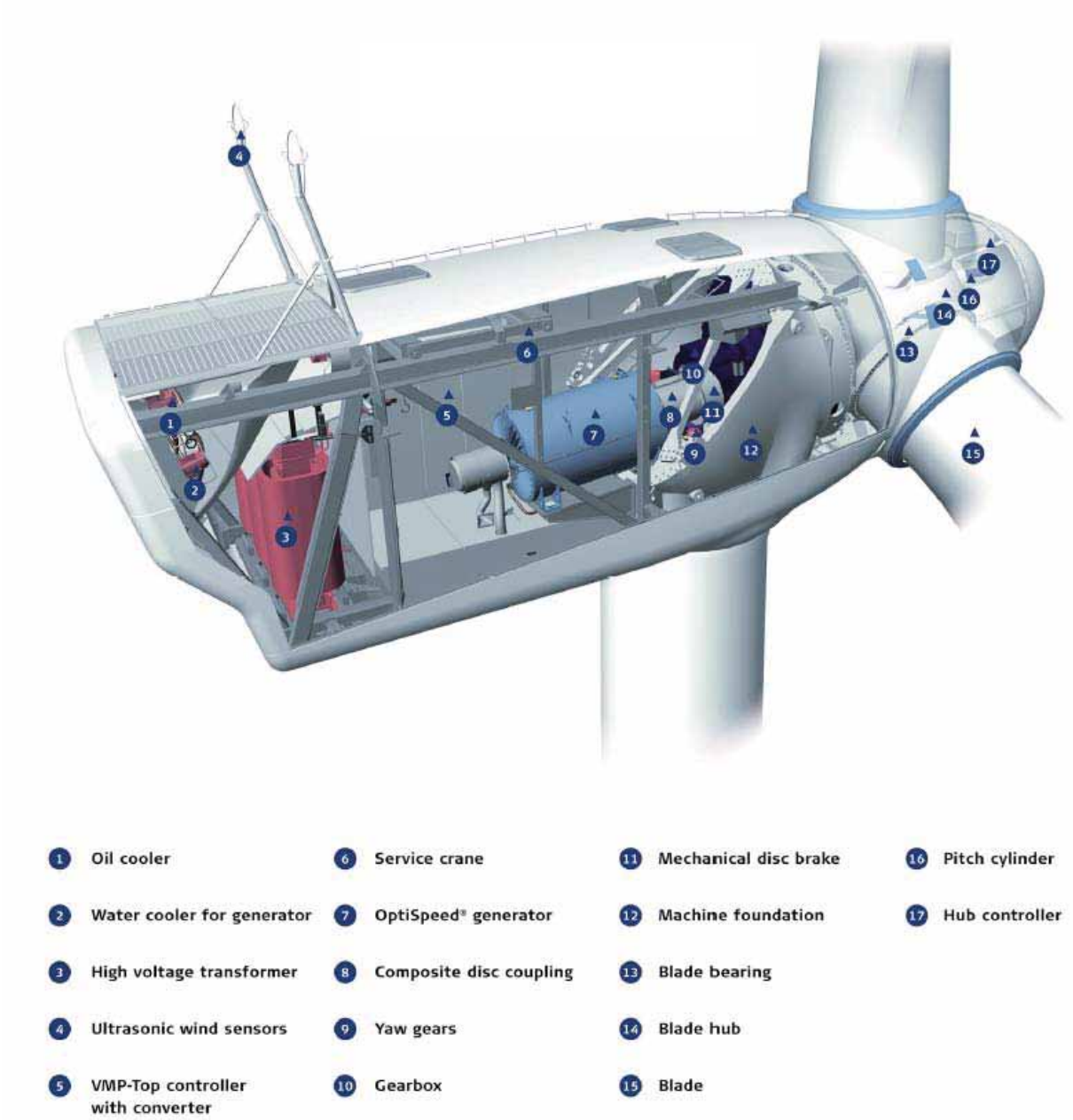


Figure 3-4. Typical Nacelle Components

The nacelle houses the turbine's primary control system, which is discussed in more detail in Section 3.1.4.

A yaw drive is mounted between the top of the tower and the nacelle. This drive will swivel the nacelle and rotor to keep them facing into the wind as the wind direction changes. Wind speed and direction sensors mounted on the nacelle provide the data regarding the wind direction.

Another key wind turbine component located within the nacelle is the cooling system. Water, air, or combined cooling systems provide temperature control for the generator, gearbox, and ambient nacelle conditions.

3.1.3 Tower

For all wind turbine designs under consideration for the Project, the nacelle and rotor would supported by a tapered tubular steel monopole tower. The towers are bolted together at each wind turbine pad site from three or four pre-fabricated sections: base, middle (lower and upper), and top. Within the towers, the turbine's access ladder, electrical and control cables, and down-tower electrical and control cabinets are located.

Figure 3-5. Wind Turbine Tower

3.1.4 Control System and Electrical Connection

The electricity created by the generator is often at a low voltage (600 V or lower), and needs to be transformed to the Project's collection voltage (34.5 kV). Some turbine models situate the transformer within the nacelle (as shown in Figure??), while others locate it at ground level adjacent to the turbine tower. Most turbines incorporate power electronics to their operation to increase overall turbine electrical performance and meet utility grid requirements without the need for additional equipment within the Project substations.

The control system within a wind turbine allows for independent and automatic control of all turbine components. The turbine's sophisticated internal sensors track wind and electrical grid conditions, and the control system allows the turbine to run depending upon those conditions. As such, turbines are automated and do not require external human control to operate, although such remote control is available if needed. Similarly wind turbines track their internal status and will shut themselves down if there is a maintenance issue

Remote monitoring, control, and data collection is achieved through fiber optic cables. These cables are buried within the same trenches as the electrical collection system, and tie the turbines back to the Operations Center. Fiber optic cables are less prone to weather interference than radio or microwave systems, hence they achieve a higher degree of reliability.

3.1.5 Aviation Warning Lights

As wind turbines are more than 200 feet in height, aviation warning lights are required. According to the Federal Aviation Administration (FAA) Technical Note (FAA 2005) and subsequent Advisory Circular update (FAA 2007), the FAA recommends:

- The selection of turbines with aviation warning lights should be such that, when the lights strobe, pilots get a clear indication of the extent of the wind energy project.
- When arranged in clusters, the turbines on the outside edge and the end of rows should be equipped with lights.
- There should be a gap of no more than ½ mile between lighted turbines.
- The most effective lighting choice is medium-intensity red L-864 flashing lights.
- Light flashing should be synchronized.

Based upon the above recommendations, PCW will install synchronized red lights on roughly 35 percent of the Project wind turbines. The lights will be installed in such a manner as to limit their visibility from the ground while maintaining the appropriate visibility to pilots. Figure 3-6 shows examples of L-864 lights; note these examples are not mounted to limit ground visibility.

Figure 3-6. Example Aviation Warning Light

PCW has evaluated the feasibility of utilizing radar-controlled aviation warning systems that only activate the lights when aircraft is determined to be nearby. PCW has found this technology to be evolving and has not yet reached full acceptance by the FAA or wind industry. The first North American installation of such a system for a wind energy project was in mid-2011, and on a relatively small wind energy project (less than 5 percent the number of turbines as the CCSM Project). An initial review of the CCSM Project determined that over 50 radar units would be required, and that all units would need to be operating for the system to work (if a single radar goes off-line, it would be necessary to activate the lights). Because PCW determined this technology has not yet reached commercial maturity, it is not integrated into the Project design. PCW will continue to monitor the progress of the technology, and may elect to propose adding it to the Project design when commercial maturity is reached.

3.1.6 Dimensions and Characteristics

PCW has not yet selected which turbine models will be utilized for the Project. Table 3-1 provides a range of sizes and turbine attributes that PCW expects to be available at the time turbines are selected. Final turbine selections will be made in site-specific PODs.

For evaluation purposes, PCW proposes that maximum height of the wind turbine towers will be 328 feet (100 meters) from ground level to the turbine hub, and that maximum rotor diameters will be 394 feet (120 meters). These dimensions represent a composite of the largest on-shore turbine components currently available. If technological improvements or design changes to turbines result in substantive changes to the above turbine attributes which may be inconsistent with BLM's ROD, then PCW will consult with BLM before submission of the site-specific PODs incorporating such technological improvements or design changes.

Table 3-1. Turbine Attributes

Turbine Attribute	Expected Range
Rated Power	1.5 – 3.0 MW
Rotor Diameter (D_R)	253 – 394 ft. (77 – 120 m)
Tower Height (H_H)	256 – 328 ft. (78 – 100 m)
Top of Rotor Plane (H_T)	383 – 525 ft. (117 – 160 m)
Bottom of Rotor Plane (H_R)	130 – 197 ft. (40 –60 m)
Tower Type	Tubular Steel
Turbine Color	RAL 7035 (roughly 5% gray) or similar
Cut-In Wind Speed	7 – 9 mph (3 – 4 m/s)
Nominal Wind Speed	27 – 34 mph (12 – 15 m/s)
Cut-Out Wind Speed	48 – 56 mph (20 – 25 m/s)
Rotor Speed	4 – 20 RPM

The operational characteristics of each wind turbine model are somewhat unique. Turbine models achieve their maximum efficiency at different average wind speeds, with some models targeted for lower wind conditions that others. Given the varying wind conditions across the large Project site, PCW will likely select more than one turbine model for use in the Project. The use of multiple turbine models will increase the Project's efficiency, aligning with the Project's purpose and need. Also, given that all commercial turbine models have the same general physical appearance (three blades rotating the same direction on monopole towers), there should be no visual perception of the different models. PCW will define the sites where each model will be installed in the site-specific PODs.

3.2 Electrical Collection System

Wind turbines are interconnected to transmit their generated electricity to the grid. This series of connections is commonly referred to as the collection system. Given the nameplate rating range for wind turbines and that they are spread over a large area, it is most efficient to utilize medium voltages (34.5 kV being the most common) for the collection system, since low voltage would have large losses and require many more connections, and high voltage is expensive and difficult to use. Multiple turbines are grouped together onto a single collection circuit and "daisy-chained". This method is repeated with several circuits to connect all turbines in a given area to the nearby collection substation. See Appendix L-3 for example conceptual one-line diagrams showing how the turbines are connected by circuits to the collection substation. See Section 3.3 for a description of the collection substations.

The collection circuits utilize a combination of underground and overhead systems to connect the wind turbines to the collection substation. The final combination of underground and overhead systems will be a function of the wind turbine and substation locations, and will take into consideration a wide range of technical, environmental, and economic factors.

Underground segments are used for connection between adjacent wind turbines. Once the number of turbines connected to a circuit reaches the design limit, that circuit is connected back to a collection substation via a dedicated connection (often called "home runs"). In general, shorter home runs will be made with underground cables, and longer home runs will be made with overhead lines, although technical, topographic, or environmental issues will effect which solution is used (for example, multiple circuits can be accommodated on an overhead line).

3.2.1 Wind Turbine Connections

Wind turbines connect to the collection system either at a generator step-up (GSU) transformer next to the turbine base, or at a medium-voltage terminal in the turbine base. Figure 3-7 below depicts these connections and contrasts the routing of medium voltage (shown in black) and low voltage (shown in white) cables.

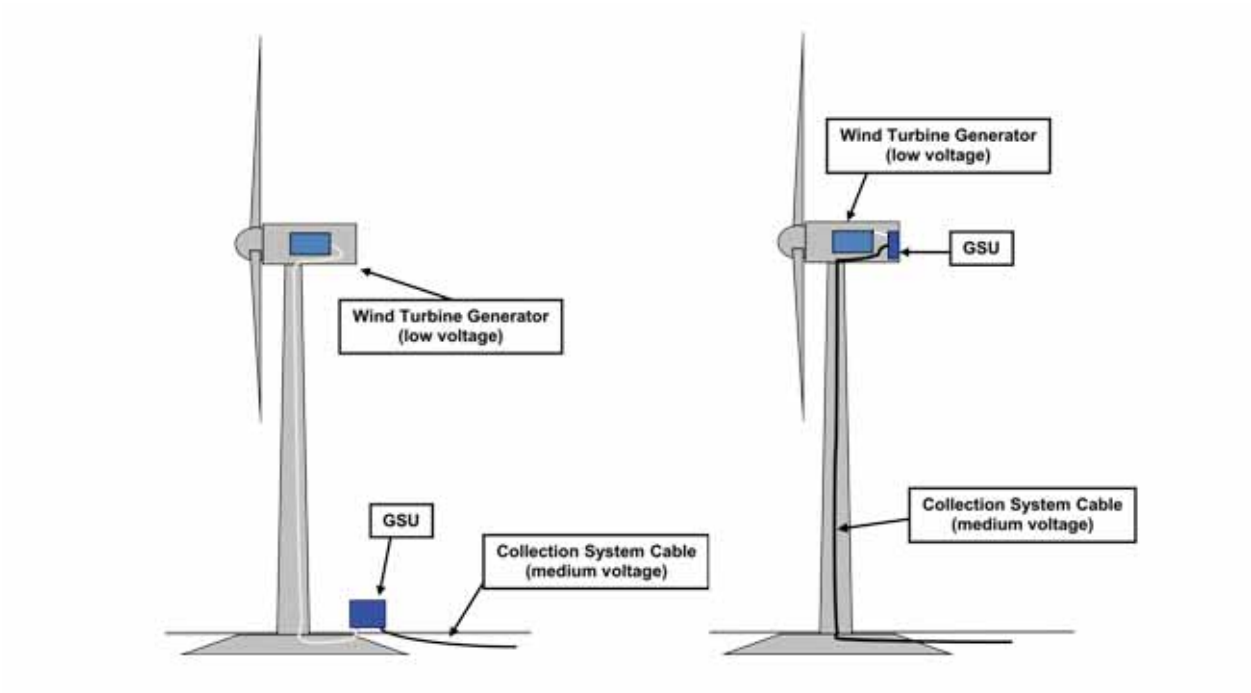


Figure 3-7. Typical Wind Turbine/GSU Configurations

For wind turbines with the GSU located in the nacelle, 34.5 kV cables run down the tower and connect to 34.5 kV switchgear located within the base of the wind turbine. The collection system enters the turbine base to connect to the switchgear via a conduit system embedded in the turbine foundation. Turbines that are mid-circuit will have an in-and-out configuration where the collection system will loop in to connect to the switchgear and loop out. Turbines located at the end of a circuit will just have one set of collection cables connecting to the wind turbine switchgear.

For wind turbines with the GSU located adjacent to the base of the wind turbines, low-voltage cables run from the generator in the nacelle down the tower and connect to low-voltage switchgear located within the base of the wind turbine tower. Low-voltage cabling will exit the turbine via a conduit system embedded in the turbine foundation which connects the grid side of the low-voltage switchgear to the GSU located outside of the tower but adjacent to the turbine base. The collection system then connects to the 34.5 kV side of the GSU. Turbines that are mid-circuit will have an in-and-out configuration where the collection system will loop in to connection to the GSU and loop out. Turbines located at the end of a circuit will just have one set of collection cables connecting to the wind turbine switchgear.

3.2.2 Underground Collection

The underground portions of the collection system will consist of the power cable (three single-conductor cables), trench ground conductor, and fiber optic cable buried in a trench. The power cable is a 35 kV-class cable suitable for direct burial. The main power conductor is made of stranded aluminum, and is insulated with either tree-retardant cross-linked polyethylene (TR-XLP) or ethylene propylene rubber (EPR) (Figure 3-8). Each cable has a copper concentric neutral and a poly-ethylene (PE) jacket. Three single-conductor cables are used as opposed to a single three-conductor cable to allow for efficient construction techniques with regards to placement, splicing, and terminating. The trench ground conductor is typically made of stranded bare copper. Both power conductor and ground conductors will be sized appropriately based on the final layout, wind turbine size, and soil and surrounding conditions. The fiber optic cable is typically a single-mode fiber optic cable that contains twelve separate fibers in a single cable.

Figure 3-8. Typical TR-XLP (left) and ERP (right) Cable

A typical trench cross section showing the power cables, trench ground conductor, and fiber optic cable is shown in Appendix K-4. The three single-conductor power cables are arranged in a “trefoil” configuration, where each cable is touching the other two in a triangular configuration. This method helps to balance the three-phase system and can allow for a narrower trench to be used. Typical trench dimensions are shown in Table 3-2 below.

Due to the size of the Project, there will be areas where multiple underground circuits may be run in parallel. In these cases, each circuit will have a dedicated trench, and will be separated by a minimum of twelve feet in order to avoid de-rating the cables due to effects of mutual heating. Wherever practical, the trenches will follow the project access roads, although PCW does expect there to be instances where the trenches need to deviate from access roads for technical or environmental reasons. In instances where underground collection lines are

routed away from roads and may need to cross ephemeral or perennial streams, PCW will explore the feasibility of using methods other than open trenching for cable placement. Appendix K-2 shows typical arrangements where one or more circuits parallel an access road. The amount of temporary disturbance for the trenches along roadways is provided in Appendix L-4.

Table 3-2. Electrical Collection Typical Trench Dimensions

Design Criteria	Label	Common Dimensions
Trench Depth	D1	42 in.
Cable Burial Depth	D2	36 in.
Marking Tape Depth	D3	18 in.
Trench Width	W1	24 in.
Cable Separation	W2	12 in.
Cable Wall Spacing	W3	6 in.
Bedding Material Depth	B_1	4 – 6 in.
Cover Depth	B_2	12 in.
Note: Dimensions are preliminary and will vary depending on terrain conditions and final detailed design.		

For long runs of cable, it will be necessary to utilize a splice box in order to join segments together for a single circuit. Above ground splices, or two-way junction boxes are utilized to allow for ease of operations and maintenance in the event of a failure, and also to allow for proper acceptance testing during installation. Figure 3-9 below shows an example junction box at an operating wind project.

Figure 3-9. Examples of Junction Boxes

Junction boxes are typically located alongside an access road to allow for easy access, and are protected from vehicles using bollards. Similarly, at points in the underground portion of the collection system where the circuit needs to “branch” off in different directions to connect

turbines, a three-way or four-way junction box is utilized to allow for efficient use of underground cable while lessening the overall disturbance.

3.2.3 Overhead Collection

Overhead collection will be used in combination with the underground sections in order minimize overall disturbance, collection system lengths, and electrical losses. One or more underground collection segments can connect to a single overhead collection line, allowing for more wind turbines to be connected to a given circuit, which also reduces the overall number of circuits needed for the project and space in the substations. Typically, the overhead lines will be utilized as the homerun of a circuit. Overhead lines can also be used as a favorable solution through difficult terrain when the alternative is to route around the difficult terrain, increasing the overall disturbance and equipment needed.

PCW intends to utilize wood poles for the overhead collection system wherever possible. Turning structures, wider spans, or steep terrain could require the use of light duty steel poles in some areas of the project. Steel poles will either be fabricated with “weathering” steel or other finishes that meet BLM requirements. Other material options (such as modular fiberglass poles finished to appropriate BLM-mandated colors) could also be utilized if specific needs for such structure types arise. PCW will determine which structure type will be used where in the site-specific PODs.

Underground segments will transition and connect onto the overhead line via a “riser pole” as shown in Figure 3-10 below.

Figure 3-10. Example Riser Pole Structure

A given circuit may have multiple riser poles to allow multiple segments to feed into the overhead homerun. The overhead segments will be a combination of single circuit and double circuit structures. See Appendix K-4 for typical structure details. Typical dimensions for the different structure types are shown below in Table 3-3.

Wherever practical, two overhead electrical circuits will be installed on a single set of structures in a double circuit formation. This approach allows for further minimizing of disturbance due to collection system installation and also reduces the amount of equipment needed. To the extent practical, the overhead collection system routing will follow terrain features such as valleys or the base of ridgelines in order to reduce the visual effect of the overhead lines.

Table 3-3. Electrical Collection Typical Overhead Structure Dimensions

Structure Type	Angle Range	Structure Height	Pole Top to Shield Wire/OPGW	Shield Wire/OPGW to Conductor Spacing	Conductor Arm Spacing	Conductor Arm Length	Pole Circuit Spacing	Fiber Pole Mounted Splice Box Dropdown	Embedment Depth	Jumper Spacing	Deck Spacing
		"H"	"A"	"A[2]"	"B"	"C"	"D"	"E"	"F"	"G"	"J"
Single Circuit											
Riser	N/A	55-75	1	4	5	5.7	N/A	16.5	7.5-9.5	3.75	N/A
Light Angle	0-8°	50-70	0.75	3.25	4	1.5	N/A	N/A	5-9	N/A	N/A
Heavy Angle	8-30°	60-75	0.75	3.25	6	5	N/A	N/A	8-9.5	N/A	N/A
Deadend	Any	55-75	0.75	3.25	6	5	N/A	N/A	7.5-9.5	N/A	N/A
Double Circuit											
Light Angle	0-8°	50-70	0.75	3.25	4	4.5	5	N/A	5-9	N/A	N/A
Heavy Angle	8-30°	60-75	0.75	3.25	6	5	11.5	N/A	8-9.5	N/A	N/A
Deadend	Any	55-75	0.75	3.25	6	5	11.5	N/A	7.5-9.5	N/A	N/A
Triple Circuit											
Post Tangent	0-8°	65-85	0.75	3.25	4	4.5	5	N/A	8.5-10.5	N/A	10
Tangent	8-30°	65-85	0.75	3.25	6	5	11.5	N/A	8-9.5	N/A	12
Deadend	Any	70-90	0.75	3.25	6	5	11.5	N/A	9-1	N/A	12

Note: Dimensions are preliminary and will vary depending on terrain conditions and final detailed design. All Dimensions are in ft. See Appendix K-4 for overhead collection line structure sketches.

3.2.4 SCADA

In order to ensure safe and efficient operation of the wind project, each wind turbine is connected to a central Supervisory Control and Data Acquisition (SCADA) system which allows for the turbines to be controlled and monitored remotely. The turbines are connected together with fiber optic circuits that are buried with the collection circuits on underground sections and hung on the same structures for the overhead sections. Typically, the fiber optic "circuit" connects the same turbines that are connected to the power circuit and ultimately connects back to the central SCADA server located at the project's Operations Center (most often through intermediate connections at the collection substation). Monitoring and control of the project can occur at the Operations Center or remotely. The Project may also utilize microwave or radio systems between the collection substations and the Operations Center as back-up to the fiber optic system.

3.3 Collection Substations

The collection substations are used to "collect" generation from groups of wind turbines within the Project and transfer it to the Project's 230 kV internal transmission network. The collection substations are strategically located for accessibility, constructability, and sited in order to minimize the overall collection system lengths.

Due to the uneven distribution of turbines and difference in terrain across the Project Site, the final design may utilize different size substations. For example, a large cluster of turbines may connect to a larger three-transformer substation, where a smaller cluster of turbines would connect to a smaller single-transformer substation. However, in order to minimize overall disturbance due to the collection system and also provide for a more efficient electrical design, PCW may elect to build multiple medium-sized substations as opposed to a single large substation in each area.

PCW expects that up to three collection substation sizes may be utilized for the Project. The following are typical substation dimensions for the three configurations, based on sketches shown in Appendix K-5. The final substation sizes, dimensions, and equipment used will be determined in site-specific PODs.

Table 3-4. Collection Substation Typical Dimensions

Configuration	Width W	Length L	Estimated Long-Term Acreage
One Transformer Substation	250 ft.	350 ft.	2.0 ac
Two Transformer Substation	410 ft.	425 ft.	4.0 ac
Three Transformer Substation	525 ft.	425 ft.	5.1 ac
Note: Dimensions are preliminary and will vary depending on terrain conditions and final detailed design. See Appendix K-5 for substation sketches.			

The major equipment found within the substations will include power transformers, aluminum and steel buswork and structures, circuit breakers and other protective devices, relaying, and control instrumentation. The protection and relaying systems will utilize battery backup systems. Portable generators may also be used in the event of a long-term outage, but no fuel will be permanently stored at the substations. Example collection substations under construction are shown below in Figure 3-11.

Figure 3-11. Example One- and Two-Transformer Collection Substations

3.4 Internal Transmission

The Project's 230 kV transmission network will transfer the electrical generation from the collection substations throughout the site to an interconnection substation along the Project's northern boundary. PCW intends to construct the network using wooden H-frame structures wherever practical and efficient. In locations of steep or narrow terrain, or if the demands of the double-circuit portions of the line exceed the design of the wooden H-frames, PCW will utilize either steel lattice or steel monopole structures. PCW will determine which structure type is used where in the site-specific PODs.

Monopole structures will either be fabricated using "weathering" steel (such as core-ten) materials, or fabricated with other finishes that meet BLM requirements (PCW does not intend to paint towers due to the associated high long-term maintenance requirements). PCW will explore feasible options for "duller" finishes for lattice structures, however the design of these structures already makes them less visible than the monopole design. The structures will likely use vertical or delta configuration to minimize the required distance between parallel circuits. Example structures are shown in Figure 3-12 below, and sample structure sketches and diagrams are provided in Appendix K-6. Typical dimensions and clearances are shown in Table 3-5. For simplicity, PCW is providing a complete family of structures for only one design type (steel monopole), and single- and double-circuit tangent structures for the other design types (wooden H-frame and steel lattice) for comparison.

Figure 3-12. Example Transmission Structures

PCW expects that 230 kV is the ideal voltage for the internal transmission network as lower voltages would require more transmission lines, and higher voltages are much more expensive and not in use in this region of Wyoming. The use of 230 kV will also allow PCW to design and build the transmission network to standards consistent with the utilities operating in the region (such as Rocky Mountain Power, Carbon Power and Light, Tri-State, and Western Area Power Administration).

Minimum horizontal and vertical clearances will be calculated using National Electric Safety Code (NESC) or similar requirements. Where practical, the transmission line corridor will follow the haul road or other Project roads, negating the need for an independent transmission line construction road. In areas where the transmission line deviates from the Project roads, “spur” roads will be necessary for construction and maintenance activities. PCW will strive to minimize such deviations where possible, however terrain and proximity to wind turbines will likely necessitate some deviations. In addition to the access to each transmission structure, temporary effects will occur along the centerline of each transmission line for wire stringing.

Table 3-5. Internal Transmission Typical Structure Dimensions

Structure Type	Angle Range	Structure Height "H"	Shield/OPGW Arm "SW"	Shield Wire to Conductor Arm Spacing "A"	Conductor Arm Spacing "B"	Conductor Arm Length "C"	Conductor Arm Length - Left "C1"	Conductor Arm Length - Right "C2"	Foundation Depth "F1"	Foundation Diameter "F2"
Steel Monopole - Single Circuit										
Tangent	0-1°	140	6	8	18	8.5	N/A	N/A	18	6
Light Angle	1-15°	140	7	8	18	8	N/A	N/A	21	7
Heavy Angle	15-30°	140	7	8	18	18	N/A	N/A	23	7
Light Deadend	30-45°	140	N/A	13	18	N/A	N/A	N/A	25	8
Heavy Deadend	45-90°	140	N/A	13	18	N/A	N/A	N/A	28	9
Steel Monopole - Double Circuit										
Tangent	0-1°	140	6	8	18	8.5	N/A	N/A	22	7
Light Angle	1-15°	140	7	8	18	N/A	18	8	25	8
Heavy Angle	15-30°	140	7	8	18	18	N/A	N/A	27	9
Light Deadend	30-45°	140	6	13	18	8.5	N/A	N/A	30	10
Heavy Deadend	45-90°	140	6	13	18	8.5	N/A	N/A	34	11
Wooden H-Frame – Single Circuit										
Tangent	0-1°	50-70	N/A	8	N/A	8.5	N/A	N/A	7-9	N/A
Wooden H-Frame – Double Circuit										
Tangent	0-1°	70-90	N/A	8	18	8.5	N/A	N/A	9-11	N/A
Steel Lattice – Single Circuit										
Tangent	0-1°	140	11	4	22	13.5	N/A	N/A	20	3
Steel Lattice – Double Circuit										
Tangent	0-1°	140	7	8	18	8.5	N/A	N/A	25	3.5
Note: Dimensions are preliminary and will vary depending on terrain conditions and final detailed design. All Dimensions are in ft. See Appendix K-6 for transmission line structure sketches.										

The transmission line design will utilize appropriate best practices as identified by the Avian Power Line Interaction Committee.

3.5 Interconnection Substation

Near the northern boundary of the Project Site, the internal transmission network would interconnect the Project with existing and planned regional transmission lines so that the wind generation could be transmitted to the energy off-takers. This interconnection would occur in a substation that connects each of the Project's internal transmission lines with these external transmission lines. PCW expects this station would operate entirely at 230 kV. The typical

dimensions for the interconnection substation are shown below in Table 3-6. A plan view of the interconnection substation is provided in Appendix K-7.

Table 3-6. Interconnection Substation Typical Dimensions

Configuration	Width W	Length L	Estimated Long-Term Acreage
230 kV Switchyard	500 ft.	500 ft.	5.7 ac
Note: Dimensions are preliminary and will vary depending on terrain conditions and final detailed design. See Appendix K-7 for substation sketch.			

The location of the interconnection substation has not been fixed. PCW anticipates it will likely be located either in Township 21 N, Range 86 W, Section 31 or Section 33. Final determination of these or other potential locations will depend upon the transmission system interconnection used by PCW.

3.6 Rail Facility

To reduce effects on local roadways that may occur given the amount of equipment, components, and material necessary to build the Project, PCW will bring as many of these items as practical to the Project Site by rail. As some components have dimensions beyond those of certain rail bridges, tunnels, and curves, PCW is working with turbine vendors and the Union Pacific Railroad to determine any issues with the transport of the turbine components from the vendor fabrication centers to the Project Site. Early indications are that these issues can be resolved and that rail transport is feasible and cost effective.

An evaluation of the existing rail centers in Rawlins and Sinclair by Union Pacific have indicated those centers are not capable of accepting the loads required, therefore PCW plans to build a rail transload/distribution facility as part of the Project. This facility would be adjacent to the Union Pacific main line that exists along the northern boundary of the Project Site.

A rail transload facility is designed to bring in loads to a specific, high-use location to be transferred to other transportation solutions. In this case, the Project's rail facility will transport construction materials (such as steel, aggregate, and cement), wind turbine components, and other equipment to the Project Site as necessary for construction. These loads will be transferred to the Project's primary delivery staging area for later transport to the locations within the Project where they are needed. The configuration of the rail facility will allow for trains to be routed completely off the main lines, and for components and material to be off-loaded and transferred to the Project's primary delivery staging area in a rapid manner. The primary delivery staging area will be located adjacent to the rail facility, with the potential for an additional laydown yard to be established adjacent to the Project's Operations Center and construction trailer complex (most likely in Township 21 N, Range 86 W, Section 33). A

conceptual design for the rail facility ("wye" configuration) is provided in Appendix K-8. Example wind energy rail transload facilities are shown in Figure 3-13.

Figure 3-13. Example Wind Energy Rail Transload Facilities

PCW has not yet selected a final location for the rail facility. The most ideal location would be a "wye" configuration track coming south off the main line between Rawlins and Sinclair (see "Primary Rail Site" in Figure 3-14). This location allows for loads to be taken directly onto the Project Site without needing to be first routed onto public roads. This location also has the least effect on existing buried utilities. PCW would use the haul road as described in Section 3.11 for vehicle access to the rail facility.

The Transportation Management Plan (Appendix C) evaluates the traffic effects of the rail facility being located at both this primary site and an alternate site north of I-80 (see Figure 3-14). PCW does not expect any improvements will be required to public roads, although placement of the rail facility north of I-80 may require traffic control measures be utilized at Exit 221 on I-80 during peak construction times. PCW continues to work with Union Pacific to determine the best site and configuration for the rail facility.

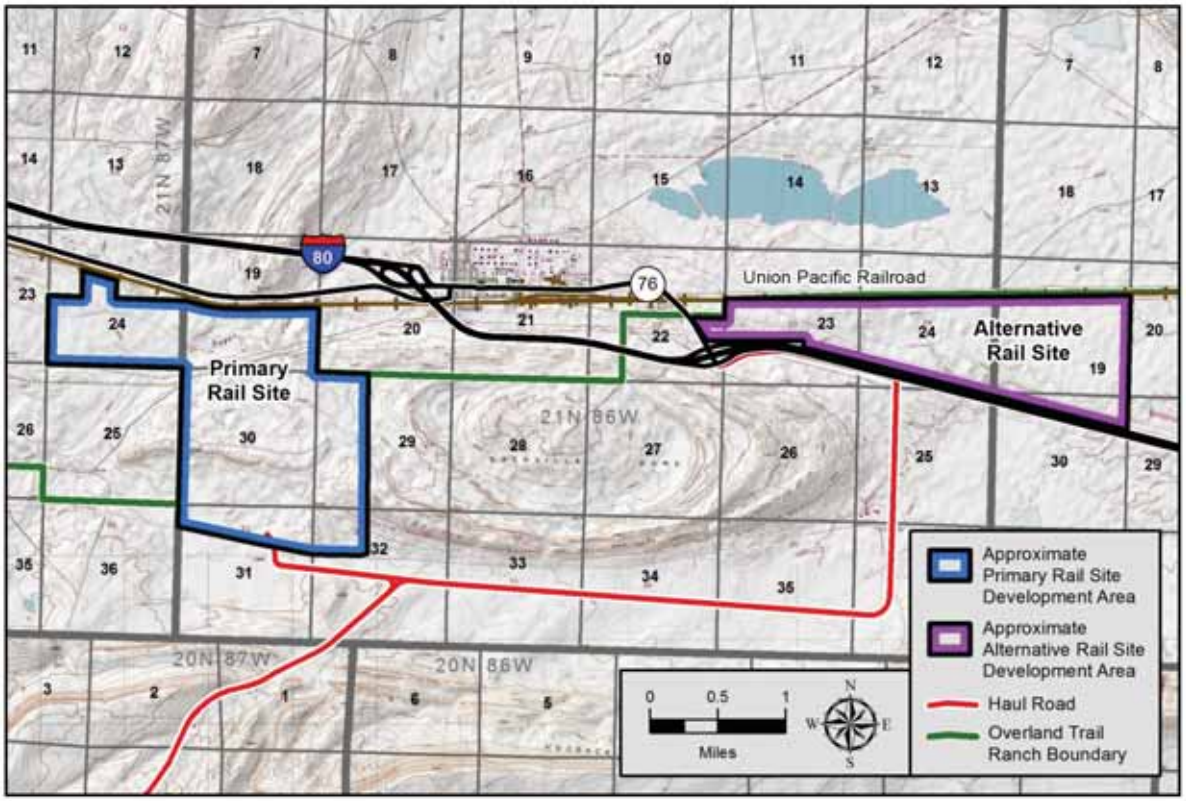


Figure 3-14. Primary and Alternate Rail Facility Locations

The rail facility is being designed to accommodate the Project's deliveries and anticipated construction schedule. An initial estimate of the amount of material and components to be delivered to the rail facility is provided in Table 3-7 below. Wind turbine components will most likely arrive on unit trains of similar components (such as all blades, tower sections, or nacelles). The wind turbine component trains are assumed to be up to 7,000 feet long consisting of between 45 and 70 cars per train depending upon component type (car lengths vary by component type). Some components are commonly transported on typical 80 foot flatbed cars using specialized cribbing, while others may arrive on specially-fabricated railcars. Figure 3-15 shows wind turbine blades transported with two blades on three cars (with the center car acting as an "idler" due to the blade lengths), as well as larger nacelles transported on vendor-provided brackets. Construction material trains (for aggregate and similar materials) were assumed to be 3,500 feet long and consisting of far fewer cars due to the increased weight per car. Union Pacific operating requirements for this main line corridor mandate that the entire unit train pull completely off the main track in a continuous move and placed onto facility off-loading tracks as needed. This operating scenario will utilize a total length of 13,700 feet of running track off the main line.

Table 3-7. Rail Facility Delivery Requirements

Component/Material	Total Amount Required	Average per Car	Total Cars Required	Equivalent Trains
Wind Turbines				
Nacelles	1,000 units	1	1,000	
Blades	3,000 units	0.75	4,000	
Tower Sections	4,000 units	1	4,000	
Hubs	1,000 units	5	200	
Anchor/Base Rings	1,000 units	3	334	
Other Components	4,000 units	4	1,000	
TOTAL WIND TURBINES	**14,000 units**		**10,534**	**175 trains**
Material				
Aggregate	2,800,000 CY	250	11,200	187
Cement	194,000 tons	100	1,940	33
Fly Ash (for concrete)	34,000 tons	95	570	10
Sand (for concrete)	369,000 tons	100	3,690	62
Foundation Steel	50,000 tons	100	500	9
Collection Cable	2,000 reels	10	200	4
Collection Structures	1,200 structures	15	80	1.5
Transmission Structures	400 structures	5	80	1.5
Substation Components	2500 tons	50	50	1
Other Material/Equipment			1,000	20
TOTAL MATERIAL			**19,310**	**329 trains**

Figure 3-15. Blades and Nacelles on Rail Cars

PCW is currently assuming the rail facility to have a disturbance area of approximately 250 acres. This includes the running track off the main line (with an assumed 24 feet wide and 13,700 feet long trackbed), off-loading sidings, travel areas for cranes and trucks, and the delivery staging area. As the rail facility is expected to remain in operation after the Project construction is completed, PCW is assuming the disturbance amount for both temporary and long-term estimates.

Once constructed, the rail facility will be able to accommodate changes in the rates of component and material delivery by adjusting the level of staffing and number of cranes and trucks on-site. To maintain a more steady labor force and limit the potential for Project construction effects due to transport disruptions, PCW is expecting to begin deliveries to the delivery staging area starting in May of each year of construction.

Virtually all components and material will be delivered to the Project Site via rail; however, certain components and materials may be delivered by truck as it may not be feasible to deliver these items by rail. This may include a few final turbine components where there are not enough to make dispatching a unit train economical. This may also include material needed in smaller quantities where rail transport is not economically practical, such as small tools, bottled water, office goods, and miscellaneous deliveries. It is also possible that, if construction of the rail facility is delayed, some initial truck deliveries of material may be required.

As described in the Transportation Management Plan (Appendix C), the Project materials needed while the rail facility is under construction will be trucked to the Project site.

3.7 Operations and Maintenance Buildings

Most wind energy projects have a single operations and maintenance (O&M) building that includes all offices, services, parts storage, and employee facilities. Given the size and scale of the Project, PCW expects to utilize a separate dedicated operations center and likely multiple maintenance buildings rather than the traditional single combined building. These buildings are expected to be pre-engineered buildings assembled and finished on-site.

3.7.1 Operations Center

The Operations Center will be the facility that will monitor the output and status of all turbines and maintain communications between the Project, transmission providers, and off-take utilities. It will include a central control room, computer server rooms, and offices. This center will likely be staffed at all times, and will house the rest rooms, locker rooms, kitchen and break rooms for all Project personnel. It will also be the reception point for the Project.

While a final location has not yet been chosen, it is likely the Operations Center will be located in the northern part of the Project Site along the haul road. PCW currently anticipates the center will be located with Township 21 N, Range 86 W, Section 33, which may be the same section in which the construction trailer complex and additional laydown yard will be located (see conceptual arrangement diagram in Appendix L-2). Current assumptions are that the

Operations Center will be a single floor (total roof peak height of about 14 feet) pre-engineered building with approximately 7,500 square feet of office and storage space (building dimensions: 50 feet by 150 feet).

Given the relative proximity to Rawlins and Sinclair, PCW anticipates connecting the center to municipal water and sewer systems. If such connections are not feasible or are cost prohibitive, PCW will install a septic system for the building, and explore the potential for a water well.

Power for the center will be through a connection to the local distribution utility (Rocky Mountain Power). Given the critical nature of the center, a back-up generator with fuel storage will most likely be installed, along with a limited battery back-up system for the computers.

PCW will explore voice and data communications options through local providers, most likely connected along the same overhead poles as the distribution power connection. It is possible the center will also have a fiber optic connection to the Project's transmission provider.

3.7.2 Maintenance Facilities

The maintenance facilities will be the locations for component, part, and vehicle storage, and will include repair shops and additional restrooms. These facilities will include three major components:

- A maintenance building, which is a fully heated and air conditioned building in which the shop, small parts storage, restrooms, some office space, and diagnostic areas would be located. These buildings are expected to be single-story and pre-engineered with approximately 1,600 square feet of interior space (building dimensions: 40 feet by 40 feet by 14 feet).
- An enclosed storage bay for storage of larger parts and components, as well as vehicles and other machinery. The bay would be attached to the maintenance building but only have minimal heating. These buildings are expected to be single-story but with a higher roof than the maintenance building, be pre-engineered, and have approximately 7,500 square-feet of interior space (building dimensions: 50 feet by 150 feet by 20 feet). The storage bay may be attached to the maintenance building, or sited nearby.
- A modest outdoor storage yard for very large components (such as turbine blades), vehicles, and machinery.

The number and location of the maintenance facilities will depend upon the final project layout and locations of various turbine models. Current expectations are for two maintenance facilities, one likely in the center of the Chokecherry Development Area (perhaps adjacent to one of the substations), and one in the Sierra Madre Development Area near CR401 (Sage Creek Road).

Depending upon their final locations, these facilities will receive power either through the Project's collection system or through the local utility. Voice and data communications will be through fiber optic connections to the operations center. The buildings will most likely have

septic systems, and PCW will explore the potential of installing water wells or on-site water storage for sanitary systems.

3.8 Met Towers

As discussed in Section 2.2.2, PCW currently operates a fleet of temporary met towers across the Project Site to record wind conditions. When the Project is constructed, a smaller number of permanent met towers will be installed that will also track wind conditions and allow operators to compare those conditions to wind turbine performance. PCW will install some or all permanent met towers a number of months before nearby temporary towers are removed so that overlapping data collection can occur, allowing for a site calibration of the new towers to the existing data set to be done. Once site calibrations are performed, all temporary met towers will be removed.

The permanent met towers will have heights at least to the wind turbine hub height. PCW has not yet selected a design for the met towers, but anticipates the towers to be steel monopole, or lattice. PCW will explore the potential of using non-guyed towers, however site conditions may require guyed structures. The guyed lattice design is what PCW currently has deployed as the Chokecherry 8 and Sierra Madre 5 met towers. Figure 3-16 shows examples of guyed and non-guyed met towers. PCW will select the met tower design to be used in the site-specific PODs.

Sensors on the met towers will include anemometers, wind direction vanes, air temperature probes, and humidity sensors. The output of these sensors will be connected via fiber optics to the nearest wind turbine, and then back to the operations center over the Project's fiber optic network.

Figure 3-16. Example Guyed (left) and Non-Guyed (right) Met Towers

3.9 Foundations

Foundations will be required for most of the Project components previously discussed. The typical range of foundation designs for each component found at modern wind energy projects is described below.

3.9.1 Wind Turbine Foundations

Wind turbine foundation design will rely on evaluating existing geological site conditions and determining the option most technically and economically appropriate for the site. The foundation design will be based on the site-specific geotechnical design parameters, wind turbine manufacturer design requirements, site climate conditions, and wind turbine industry standards. The design of the foundations will generally consider the following:

- Turbine manufacturer loading and design requirements.

- Global stability calculations of the turbine/foundation system to ensure proper resistance to overturning and sliding.
- Concrete reinforcement.
- Net allowable bearing stresses, foundation stiffness calculations, and overall and differential settlements for the foundation system.
- Backfill density over the foundation and grading above and around the foundation.

PCW will utilize a single foundation design (most likely a mat foundation) for as many turbine locations as practical. Where necessary due to site conditions or design requirements, alternate designs may also be used. Unfavorable site conditions that would warrant considering alternative foundation designs may include the discovery of soft or non-compactable subsurface materials, karst deposits, collapsible soils, compressible soils, friable or weathered bedrock, or the presence of soil types that cannot support the bearing capacities required. Common foundation solutions to various soil conditions are listed in Table 3-8.

Table 3-8. Common Wind Turbine Foundation Solutions

	Good Native Soils	Soft Soils	Karst Deposits	Collapsible Soils	Compressible Soils	Friable or Weathered Bedrock	Low Bearing Capacity
Mat Foundation w/o Soil Improvements	●						
Mat Foundation with Over-Excavation		●					●
Mat Foundation with Soil Stabilization		●	●	●	●	●	●
Tensionless Pier Foundation	●						

To determine site conditions, PCW will to perform a geotechnical analysis at each wind turbine location. This typically involves a boring at each site to a depth necessary to evaluate the soil and rock conditions that may effect foundation design (50 to 100 feet typically), however, PCW is also exploring alternative methods to obtain the necessary geotechnical data using fewer borings.

A comparison of the typical range of dimensions for each foundation type is provided in Table 3-9 below. The foundations will be located within the wind turbine pads, therefore the surface disturbance associated with foundations is accounted for in the disturbance area of the wind turbine pads. Each foundation design is briefly discussed in the following sub-sections. Additional details will be provided in site-specific PODs.

Table 3-9. Wind Turbine Foundation Dimensions

Design	Total Width	Total Depth	Concrete Amt
Mat	50 – 65 ft.	10 – 20 ft.	400 – 600 cy
Mat with Over-Excavation	60 – 75 ft.	20 – 30 ft.	400 – 600 cy
Mat with Soil Stabilization	50 – 65 ft.	10 – 20 ft. foundation 50 – 100 ft. piles	400 – 600 cy
Tensionless Pier	15 – 20 ft.	50 – 75 ft.	100 – 200 cy

3.9.1.1 Mat Foundation Without Soil Improvement

Mat foundations (also referred to as spread footings or inverted "T" designs) are steel-rebar reinforced cast-in-place foundations. This design includes an octagonal or round underground "mat", and a pedestal that connects the underground mat to the above-ground tower base section. See example diagram in Appendix K-1. Construction of this foundation design is relatively simple as the rebar is fabricated and shaped off-site and sent to the Project Site in sets. Excavation and concrete placement does not require unusual equipment, and the design works well over a variety of soil types. As such the mat foundation is the most commonly used by the wind energy industry where conditions allow.

Figure 3-17. Completed Mat Foundation Before and After Backfill

3.9.1.2 Mat Foundation with Over-Excavation

On sites where mat foundations may be a good solution but geotechnical engineers recommend soil improvement near the surface, a common approach is to over-excavate the area around the foundation and replace the native subsoils with those more suitable for foundation construction (to be obtained on-site within other already disturbed areas). While the depth and width of the over-excavation depends entirely upon the soil conditions, values of 5 to 10 feet in each direction are not uncommon.

Excavated subsoils not backfilled will be disposed of per the requirements of the Project Master Reclamation Plan.

3.9.1.3 Mat Foundation with Soil Stabilization

In contrast to over-excavation of sites requiring geotechnical improvement near the surface, geotechnical analysis may lead engineers to recommend deeper soil improvements to support the mat foundation. In those instances, soil stabilization techniques may be utilized. These techniques may include the installation of pilings (either steel or concrete) under the foundation to a depth necessary to stabilize loose soils or reach more competent material. Other solutions include dynamic compaction, where native materials are compacted until the required soil properties are achieved.

Based on early geotechnical analysis of the Project Site and the lack of previous on-site development, there are expected to be few if any sites requiring soil stabilization.

Figure 3-18. Steel Piles During Mat Foundation Construction

3.9.1.4 Tensionless Pier

An alternative approach to the mat foundation design is the tensionless pier (often referred to the Patrick and Henderson, or “P+H” design). This design involves the installation of a hollow cylinder of steel rebar reinforced concrete. The concrete is placed into compression at the time of construction, hence functioning as a tensionless pier.

The width of the cylinder is similar to that of the bottom of the wind turbine tower base section. The overall depth is determined by the geotechnical conditions, but is generally much deeper than a mat foundation design. It is often this depth, along with wind turbine manufacturer requirements, that determine when this foundation design is used. Given the preliminary geotechnical results from the Project Site, PCW is currently not anticipating the use of the tensionless pier foundation design.

Figure 3-19. Tensionless Pier Foundation Installation

3.9.2 Collection and Transmission Structure Foundations

The structures intended for use with the overhead collection system include wooden poles and steel monopole structures, as discussed in Section 3.2.3. For the internal transmission lines, the structures likely to be used include wooden H-frames, steel monopoles and lattice structures as discussed in Section 3.4.

Wooden poles used in single-pole or H-frame structures are most commonly directly embedded into the ground without the use of a concrete foundation. Holes just larger than the pole diameter are augured into the ground to a common depth of up to 10 feet for distribution lines and 15 feet for transmission lines. After the poles are placed into the holes and aligned, the holes are backfilled with native material, aggregate or a small amount of concrete.

Steel monopole structures such as those that may be used for the internal transmission lines are each secured to a foundation. Typically monopole transmission structure foundations are drilled piers ranging 4 to 12 feet in diameter and approximately 15 to 60 feet deep. The piers can be reinforced by full length anchor bolt cages (see Figure 4-8) or partial depth anchor bolts with full length reinforcement bar cages.

Steel lattice structures are also secured to foundations, one under each of the towers “feet”. These foundations are commonly small pier or block designs, and can be pre-fabricated or cast in place.

3.9.3 Other Foundations

Foundations will also be required for various other project components and facilities. External wind turbine components (such as padmounted transformers or external electrical boxes, if required by turbine design) and smaller substation items will utilize precast foundations set on structural fill often requiring minimal shallow excavations. The current range of potential

equipment will allow PCW to integrate wind turbine component foundations into the disturbed area of the wind turbine foundation to avoid unnecessary additional ground disturbance. Any substation components would be within the boundary of the substation long-term disturbed area.

Project buildings, larger substation components (such as substation transformers), and permanent met towers will utilize cast-in-place foundations designed for the Project Site soil and climate conditions. As with the wind turbine foundations, geotechnical sampling and analysis will need to be performed at the locations for these foundations to ensure proper design.

Design details for these foundations will be included in site-specific PODs.

3.10 Wind Turbine Pads

Prior to the construction of each wind turbine, PCW will establish an area around each turbine site in which the foundation will be built, the turbine cranes can be situated, and turbine components can be staged. This area will have two general zones. The inner zone will support the foundation, component staging, and crane placement, and will need to be cleared of vegetation, graded level, and compacted. Depending upon soil conditions, surface aggregate may also be required. The inner zone will be of sufficient distance from the access road to allow for adequate crane movement and safety during turbine erection. An outer zone is also required for most turbine designs to allow for the assembly of the turbine rotor (blades and hub) prior to rotor placement on the turbine, as well as component staging prior to erection. These outer zones typically only require high vegetation to be removed or trimmed, and grading only if the existing slopes exceed the activity tolerances. A diagram of a typical wind turbine pad is included in Appendix K-3.

Upon completion of the turbine assembly, the site will be reclaimed per the requirements of the Project's master reclamation plan (Appendix E). Remaining above ground facilities will be the turbine itself, road access to the turbine, and a maintenance circle or "beauty ring" of aggregate around the turbine base of sufficient width to allow for operations and maintenance activities. PCW will remove the crane pads at the conclusion of construction. If cranes are required during operations and maintenance activities, PCW will re-establish temporary crane pads as needed (although alternative equipment may be available during such maintenance activities to limit the crane pad requirements).

Figure 3-20. Example Turbine Pads During Construction (left) and Operations (right)

3.11 Roads

Construction of the Project will require the establishment of access roads between Project Site access points to existing public roads, wind turbine sites, and all other project facilities. These roads will be used to support all aspects of project construction, operations, and decommissioning. The goal of the Project road design is to facilitate the necessary movement of personnel and material in a safe and efficient manner while minimizing the road network's overall environmental footprint and effects to nearby public roads. PCW will design and construct multiple road designs based upon anticipated levels of use (see discussion below). To the extent practical and efficient, PCW will utilize existing ranch roads routes (both improved and two-track) for the new Project roads. PCW may also construct some roads to access temporary construction or demolition facilities, such as staging areas. Any such roads would be removed and reclaimed at the same time as the associated temporary facilities per the Master Reclamation Plan (Appendix E).

Access roads will be designed in accordance with wind industry standards and will meet the BLM Gold Book (BLM 2007) and BLM Manual 9113 (BLM 1985) requirements. A summary of typical industry standards that will be adhered to are provided in Table 3-10. Final roadway alignments and designs will be submitted to BLM in site-specific PODs.

3.11.1 Road Types and Descriptions

The Project will consist of various classifications of roads depending on their intended function, traffic volumes, and reliability requirements. Each road classification will be designed to different geometrical design standards, structural road sections, and speed limits. The expected design parameters for each road classification are summarized in Table 3-10, displayed in Appendix K-2, and described in the following subsections. The final designs will be determined during the detailed design process and described further in site-specific PODs. Information on the temporary and permanent disturbance aspects of these roads are presented in Appendix L-4.

Table 3-10. Expected Project Road Design Parameters

Design Criteria (min)		Haul Road	Arterial Road	Turbine Road
Design Speed		30-40 mph	15-30 mph	15 mph
Permanent Road Width		40'	24'	16'
Temporary Shoulder Width (both sides) – Construction Stage Only		N/A	6' (12' total)	10' (20' total)
Tangent Length Between Hor. Curves		140'	140'	140'
Design Road Profile Grades[1]		0%(min) 10% (max)	0%(min) 14% (max)	0%(min) 14% (max)
Culvert/Water Crossing Design (storm event)		10-20 year	2-10 year	2-5 year
Allowable Deflection		6" in 50'	6" in 50'	6" in 50'
Horizontal Curves (Centerline)		300'-500'	150'-300'	150'
Intersection Turning Radius (Edge of Traveled way)		135'	135'	135'
Tangent Length Between Vertical Curves		100'-200'	50'-100'	50'
Vertical Curve Length		75'-150'	50'-75'	50'
K-Value	**Crest**	15-30	12.5-15	12.5
	Sag	15-30	12.5-15	12.5
Roadway crown		1% (min) 2% (max)	1% (min) 2% (max)	1% (min) 2% (max)
Roadway cross slope (continuous)		1%	1%	1%
Notes: [1]Grades are preferred values, there will be instances in the Project design where grades are exceeded for limited distances.				

A significant design element unique for wind energy projects is the necessity for the movement of large cranes. As crane breakdown and assembly between each turbine site is impractical, wind energy project roads commonly have compacted shoulders wide enough for tracked cranes to "walk" between turbine sites. Crane movement also drives other road design elements (such as slopes). The other most significant element driving wind project road design is the transport limitations of trucks delivering wind turbine components. Given the large overall dimensions and significant weight of some of these components, road design elements such as curve radii and road deflection will be kept within tolerances to be specified in detail in the site-specific PODs.

Stormwater management includes the design and construction of roadside ditches that will parallel many of the proposed internal resource roads. These ditches will divert stormwater and snowmelt runoff safely away from the roads and back into the natural swales and streams throughout the Project. Some resource roads will be constructed along the crest of the hills and ridge tops, providing positive drainage away from the road in both directions and eliminate

the need for ditches. Many roads will be constructed perpendicular to drainage ways requiring the need to capture and collect the runoff.

While design criteria will remain consistent throughout the Project, changing site conditions may require alternate design and construction approaches. For instance, aggregate width and thickness will depend upon the bearing capacity of the native soils as much as the design requirements of the road. Soil conditions in some portions of the Project Site might also require the use of geosynthetic materials (such as woven fabric or geogrids) to provide necessary bearing capacity as well as durability enhancement. PCW will identify all such design requirements in the site-specific PODs, however some site condition challenges may not be identified until construction is underway. In such instances, PCW will work with the BLM to identify and utilize appropriate solutions.

PCW will not use road surfacing methods other than gravel (such as chip seal, asphalt, or concrete) due to the very high construction cost and the limited life of other surfacing methods due to the expected volume of construction traffic. The large number of heavy loads to be transported along Project roads would cause these surfaces to break down quickly, requiring frequent repairs and may lead to the rapid development of unsafe conditions. Road maintenance and longevity is more cost effectively served by gravel roads, which is why they are exclusively used on wind energy projects except in a very few and specialized circumstances.

The design elements summarized in Table 3-10 are based upon current guidelines for transport from several wind turbine vendors. It is possible that some requirements may change based upon the final turbine selection and the continual evolution of wind energy transport techniques. PCW anticipates the effect of any such changes to be minimal.

3.11.1.1 Haul Road

The haul road is designed to facilitate the movement of all project components, material, and workforce throughout the site while minimizing the effects on local roads and residents. This road will be the primary connection between the Project Site's main access from I-80 (via Exit 221 and CR407/CIG Road), northern facilities (rail, staging areas, and operations center), and the wind energy development areas.

To accommodate all of the deliveries for the Project, the haul road will be routed to provide access to each development area. The haul road route will go from the rail facility and construction trailer complex in the north through the center of Chokecherry and into the Sage Creek valley. There the road will split, with one segment going to Miller Hill and the other to Sage Creek Basin. The haul road will provide access to the major Project facilities including the substations, operation and maintenance facilities, and the project laydown areas. The only location where the haul road will effect public roads is a single crossing of CR401 (Sage Creek Road).

The haul road will be designed to allow for two-way semi-truck traffic. The road will be constructed to a design width that accommodates the construction traffic volumes with a high level of safety. The road will be designed to a higher speed however it will likely be posted and operated at a lower speed. Following construction, it is anticipated that the haul road will remain at its full design width. Since this haul road will accommodate all of the Project traffic, the structural section will be the largest of the three classifications, designed to account for the heavy and frequent loads and high performance standard.

Construction of the haul road will require wider corridors of disturbance and grading in places than the other road classifications. The alignment of the haul road will be designed while keeping the natural lay of the land in mind, and balancing efforts to reduce the grading required while adhering to the design standards required for functionality and safety. New and improved stream crossings may be required, but shall be minimized to the extent possible.

Figure 3-21. Example Haul Road

3.11.1.2 Arterial Roads

Arterial roads will be constructed off of the haul road to provide access to major areas of the Project. Construction traffic, turbine deliveries, and crane travel on these roads will still be significant, however these roads will be designed and constructed to standards that allow for more flexibility to traverse more complex terrain and land use constraints. These arterial roads may be located in areas of the Project that contain increasingly steeper slopes, narrow and winding ridges and valleys, and waterways. Biological, cultural, and other environmental and land based constraints and setbacks will also be considered in determining the roads best and final locations.

Arterial roads may require an increased level of maintenance during and after construction due the steeper slopes, reduced structural sections, and reduced hydraulic design standards. These design considerations are often necessary to construct roads in difficult terrain while maintaining an environmentally responsible design.

During construction these roads may be constructed as wide as the haul road to facilitate two-way traffic and crane travel. Following construction the width of these roads will be reduced to the permanent design width, and the disturbed area no longer needed restored in accordance with the Project Master Reclamation Plan.

3.11.1.3 Turbine Roads

Turbine roads will be constructed to provide access to specific turbine locations throughout the Project. These roads may originate from either the haul road or arterial roads. Turbine roads will experience much less construction traffic and crane travel over the life of the road compared to other roads on the project. These roads will be designed and constructed to a different standard than the haul and arterial roads to allow further flexibility around terrain and land use constraints.

During construction these roads will consist of an aggregate roadway designed for one-way traffic with wide shoulders. Project deliveries are intended to travel across the aggregate roadway, where crane travel will require the use of the shoulders to maneuver through the Project. Following construction, the wide shoulders will be reduced and the disturbed land reclaimed per the Project Reclamation Plan.

Figure 3-22. Example Turbine Roads with Compacted Shoulders

3.11.1.4 Special Cases

In addition to the roads described above, there will be some instances of special road conditions as well as shorter roads for special access needs. These access roads are described below.

Expanded Turning Radii

There will be locations along the haul, arterial, and turbine roads where site topography causes the design curves to not be adequate for optimal traffic flow. In those instances, PCW would utilize expanded turning radii in the curves. Many of these radii would be removed at the end of construction, however some may remain during the operations stage.

Transmission Line and Met Tower Access

Access to overhead collection or transmission structure locations for construction and maintenance of the lines will be required. Because access to these locations will be brief and infrequent, PCW will use designs that minimize the level of disturbance. For instances where structures are near other Project roads and the soil conditions allow, PCW will designate corridors where "drive and crush" access is allowed. Drive and crush is a standard industry practice involving overland travel without mechanical clearing (such as blading) of vegetation. If soil conditions do not allow for drive and crush access, PCW will build access spur roads to the structures. Such spur roads will involve the minimum amount of improvement necessary to allow for structure construction and maintenance access. Similar access will also be provided to Project met towers.

Facility Access (Substations, Buildings)

PCW anticipates siting Project facilities, such as substations and operations and maintenance buildings, near project roads. If such facilities are not directly adjacent to the Project roads (due to slopes, drainages, or similar concerns), PCW will construct facility access roads. These access roads are expected to be similar to the turbine access roads described above. Specifically for access roads to the substations, the transport requirements of substation equipment will provide primary design constraints.

3.11.2 Water Crossings

The Project's roads will require crossing natural drainage channels and streams on the site. Some of these crossings will consist of improving existing ranch road crossings, while others will be in new locations. PCW will direct the design to minimize the number of crossing required even if somewhat longer road lengths are required, however some water crossings will be unavoidable to access all project areas, turbine locations, and facilities. Low water crossings (LWC) will be utilized across the site to provide a balance between the Project's road design requirements and the sensitivity of the environmental constraints.

PCW has identified several design options for LWC's based upon industry practices and US Forest Service guidelines (USFS 2006). These designs are characterized in the subsections below. For each LWC required, PCW will evaluate the road design requirements, stream flow characteristics, and geometry of the existing channel to determine the optimum design. A general LWC suitability matrix for each type of crossing is summarized in Table 3-11 below. A more detailed selection methodology, along with the LWC design to be used for each specific crossing, will be provided in the site-specific PODs. During the detailed design process, PCW may identify additional designs for consideration in site-specific PODs.

Table 3-11. Low Water Crossing Design Preliminary Selection Criteria

	At-Grade			Vented		
	Aggregate Surface	Concrete Surface	Geocell Surface	Traditional Culverts	Box Culvert /Bridge	Natural Stream Bottom Structure
Low road use and stream is ephemeral	●			●		
Low base flow with high peak "flashy" flows	●		●	●		
High base flow with high peak flows		●		●	●	
Channel bottom and stream bank materials are soft or erodible		●	●	●		
Maintaining stream function is important	●		●		●	●
Driving through water is frequently prohibited/long traffic delays are unacceptable				●	●	●
Channel is incised or entrenched				●	●	
Channel is very broad	●	●			●	
Channel carries a lot of large wood debris	●	●	●			
Drainage passes periodic debris torrents through an incised channel				●	●	●
Barrier is needed to exclude exotic species		●	●	●		
Grade control structure is needed		●	●	●		

The diagrams and photos in the following subsections were taken from the US Forest Service guidelines (USFS 2006).

3.11.2.1 At-Grade Low Water Crossing – Aggregate Surface

This crossing design matches the elevation of the existing drainage channel as closely as possible. The driving surface is constructed of rip-rap and crushed aggregate. The crossing is appropriate for drainage channels with relatively low flows and relatively low vehicle traffic.

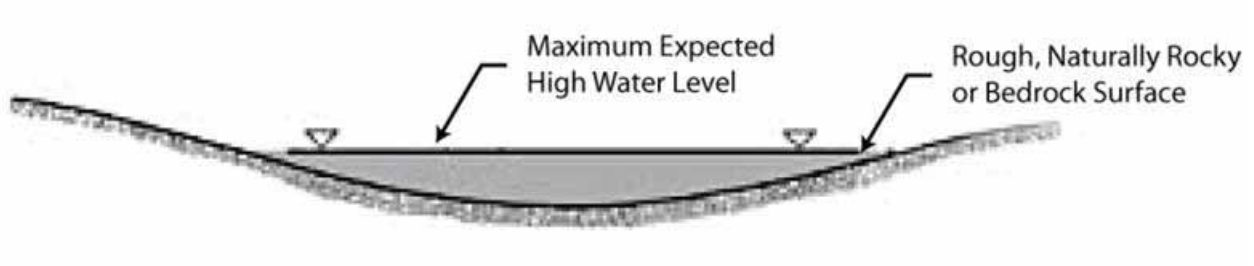


Figure 3-23. Diagram of At-Grade LWC – Aggregate Surface Diagram

Figure 3-24. Examples of At-Grade LWC – Aggregate Surface

3.11.2.2 At-Grade Low Water Crossing – Concrete Surface

This crossing design matches the elevation of the existing drainage channel as closely as possible. The driving surface is constructed of concrete in the form of a slab, planks, or cable concrete. The crossing is appropriate for drainage channels with moderate low flows where erosion is a concern. Additionally, the concrete can provide for an improved driving surface compared to an aggregate crossing.

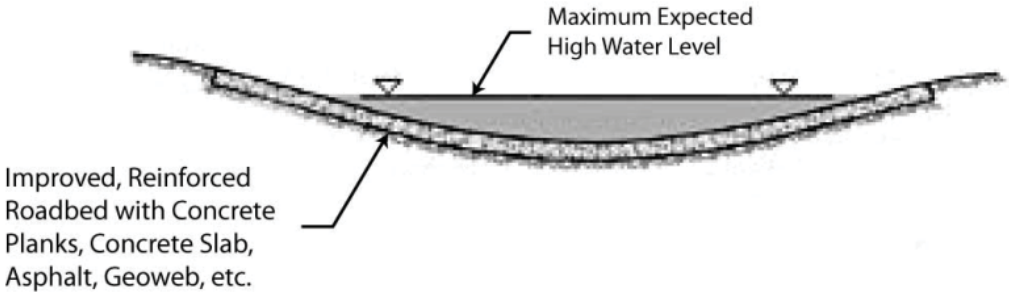


Figure 3-25. Diagram of At-Grade LWC – Concrete Surface Diagram

Figure 3-26. Examples of At-Grade LWC – Concrete Surface

3.11.2.3 At-Grade Low Water Crossing – Geocell Surface

This crossing design matches the elevation of the existing drainage channel as closely as possible. The structure is similar to an aggregate surface, except the geocell helps contain the aggregate so it doesn't wash away.

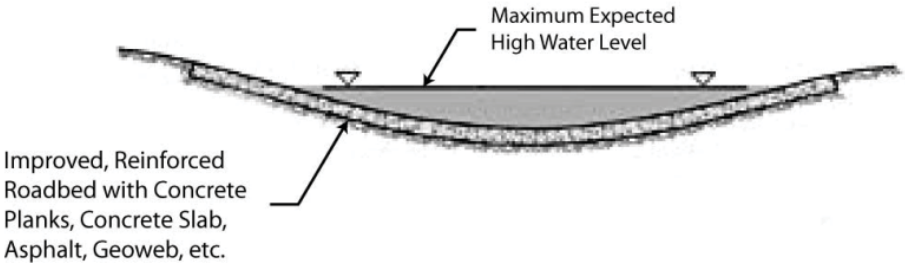


Figure 3-27. Diagram of At-Grade LWC – Geocell Surface Diagram

Figure 3-28. Examples of At-Grade LWC – Geocell Surface

3.11.2.4 Vented Low Water Crossing – Traditional Culverts

This crossing design allows low flows to pass through culverts (vents) while higher flows resulting from events exceeding the water crossing design levels provided in Table 3-10 will likely result in water overtopping the road. Depending on the flows, there can be a single culvert or multiple culverts. This crossing is appropriate for drainage channels with low to

moderate flows or where it preferable that the driving surface remain dry during most drainage channel flows.

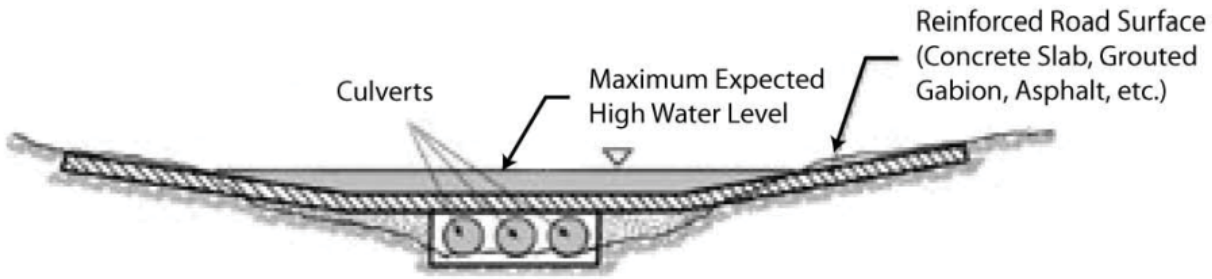


Figure 3-29. Diagram of Vented LWC – Traditional Culverts

Figure 3-30. Examples of Vented LWC – Traditional Culverts

3.11.2.5 Vented Low Water Crossing – Box Culverts or Low Water Bridge

This crossing design allows moderate flows to pass through the box culvert (vents) while higher flows resulting from events exceeding the design rainfall or snowmelt levels provided in Table 3-10 will likely result in water overtopping the road. This crossing is appropriate for drainage channels with moderate to high flows and where it is preferable that the driving surface remain dry during most drainage channel flows. For particularly wide crossings or very special cases, PCW might consider the use of a concrete bridge if no other solution is feasible.

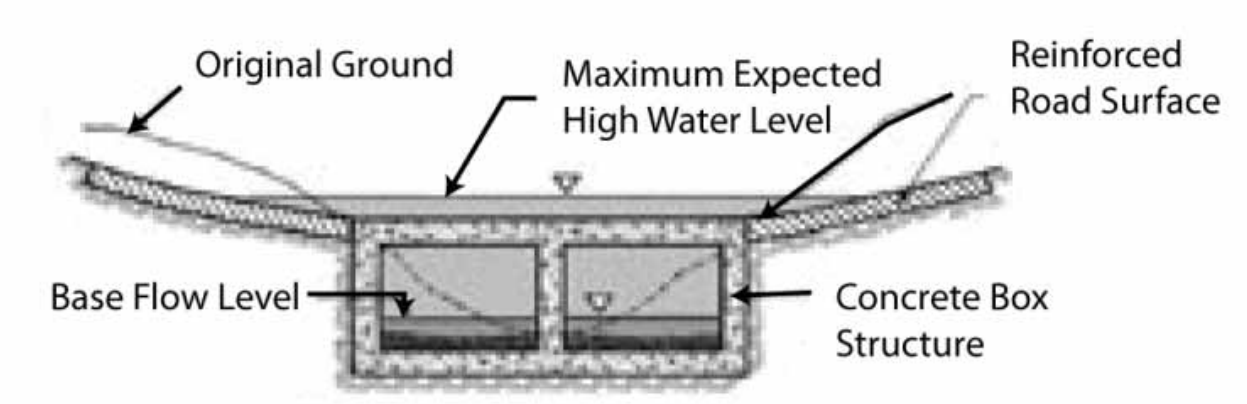


Figure 3-31. Diagram of Vented LWC – Box Culverts

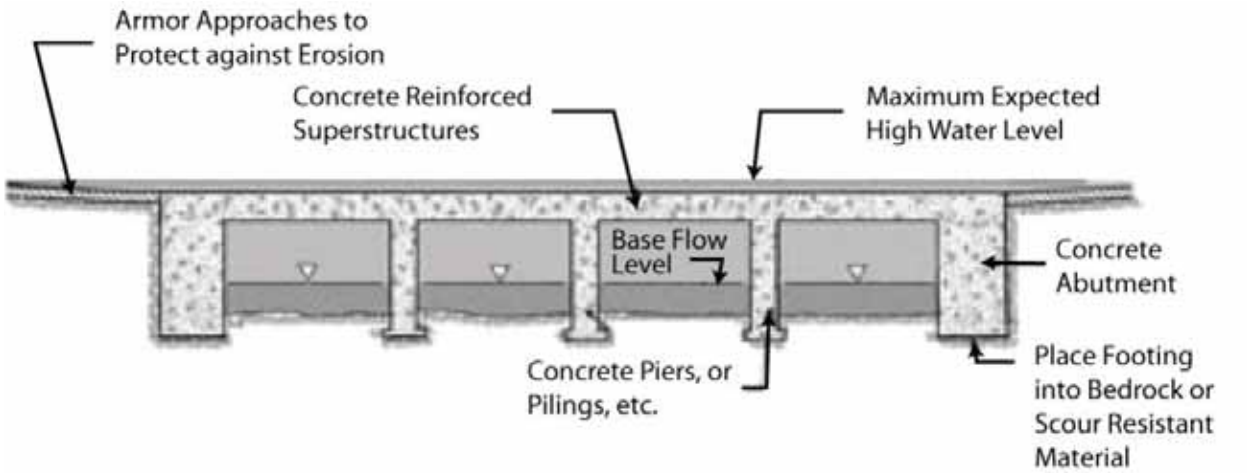


Figure 3-32. Diagram of Vented LWC – Bridge

Figure 3-33. Examples of Vented LWC – Box Culvert (left) and Bridge (right)

3.11.2.6 Vented Low Water Crossing – Natural Stream Bottom Structures

Natural stream bottom structure designs are similar to the vented traditional culvert or box crossing designs, but installed more deeply embedded to ensure that a natural stream bottom is maintained for biological purposes. PCW will consider such options where it is critical to maintain an existing natural stream bottom, and where the intended road use allows for these options to be implemented.

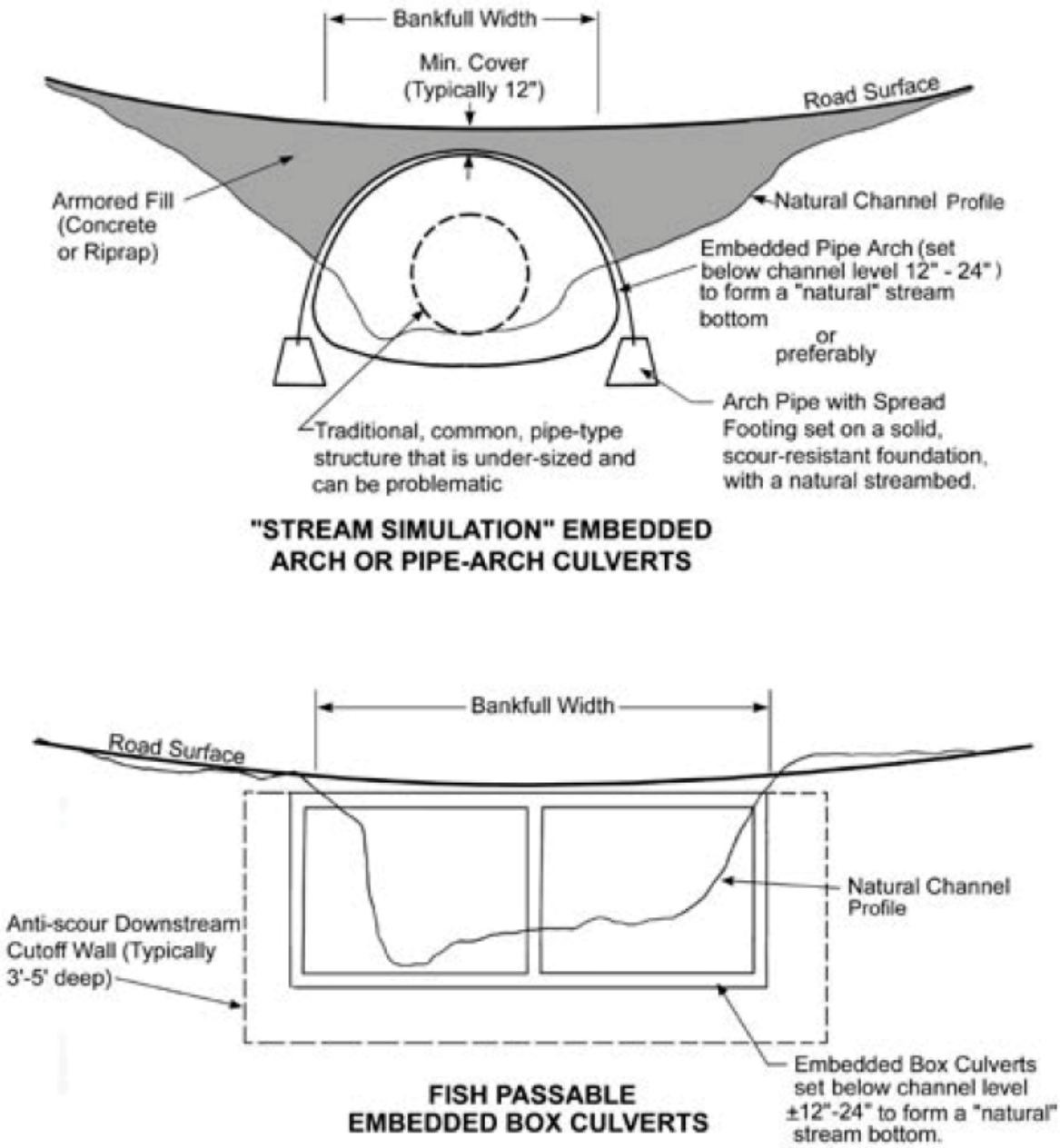


Figure 3-34. Diagram of Vented LWC - Natural Stream Bottom Structures

Figure 3-35. Examples of Vented LWC – Embedded Arc Culvert

4. Construction

Common techniques for the construction of a wind energy project are described in this chapter. PCW has provided information on the range of construction approaches anticipated for the Project, however, construction approaches will not be finalized until the detailed design of the Project is complete. Additional details will be provided in site-specific PODs.

4.1 Pre-Construction Activities

Pre-construction activities are those that occur prior to a construction contractor mobilizing on-site. This section describes those pre-construction activities that have been completed, as well as those activities that will be conducted in the future. Some preconstruction activities and data collection efforts are ongoing. The Project design will continue to be updated and refined to utilize the best data and information available.

4.1.1 Site Survey

PCW conducted an aerial survey of the Project Site in July and August 2010, which included the acquisition of orthophotography and light detection and ranging (LiDAR) elevation data. This survey was done to provide the topographic data needed to design the Project and support permitting efforts. The orthophotography was collected as 4-band imagery (RGB + near infrared) at 1-foot resolution for the Ranch and a 3-mile buffer outside of the Ranch boundary (totaling 880 square miles). LiDAR data were collected at 0.7-meter return spacing for a 475 square-mile area focused on the potential wind development areas. The full LiDAR point cloud was bare-earth processed (artificial infrastructure was removed to reveal the true ground surface). Additional derivatives were created from the LiDAR data for use in conceptual design and project planning, including key model masspoints and breaklines, 1-foot contour lines, and a terrain dataset in geodatabase format.

From June to August 2011, PCW completed a survey along the utility corridor in the northern portion of the Ranch to determine the location of existing utility infrastructure. The survey included those portions of Township 21N, Ranges 85W to 87W located south of the Union Pacific Railroad tracks. Underground pipelines were located and their positions were recorded using a real-time kinematic (RTK) survey unit. All above-ground structures, including pipeline markers, valve assemblies, cathodic protection units, and utility poles were surveyed. All features were photo documented and input into a fully attributed GIS-compatible geodatabase.

As the design for the Project evolves, PCW will perform additional ground surveys for ownership and ground-verification of the LiDAR data as needed. Such surveys are expected to occur in areas near the Ranch boundary or where a high degree of topographical accuracy is needed (such as substation locations).

4.1.2 Project Component Siting

PCW has developed a preliminary turbine layout to support project design efforts. This preliminary layout was developed using the best available data to create the most efficient layout to meet the Project purpose and need. The layout utilized the Project wind data and aerial survey and considered general industry practice as well as known technical and environmental design factors, the layout was then further refined using a numeric wind energy computational model (openWind).

PCW is currently physically reviewing the turbine locations generated in the preliminary layout to determine the suitability of each location for wind turbine installation. This review process is commonly referred to as micrositing. The goal of micrositing is to determine if relatively small turbine relocations can improve the efficiency of the layout and if there are any local site characteristics that would hamper turbine installation or operation.

PCW has also developed conceptual alignments and locations for the Project infrastructure and support facilities (such as roads, collection system, and substations) that support the preliminary turbine layout. As micrositing is performed and the layout is further refined, PCW will continue to revise these conceptual designs. Following micrositing of the turbines, micrositing of the infrastructure and support facilities will also be performed. The micrositing process will also address the applicable stipulations included in the Project ROD.

As the Project continues to develop, PCW may need to revise the Project layout in whole or in part to explore the use of different wind turbine models or spacing techniques. In such an event, the component siting procedure discussed above, including preliminary siting, modeling and micrositing, will be completed again using the revised criteria.

4.1.3 Geotechnical Investigation

To facilitate the Project's design, a detailed geotechnical investigation will be necessary to determine the geology and soil conditions at each wind turbine site and where other Project facilities will be located. A typical detailed geotechnical investigation includes a single boring at each proposed turbine location, compaction tests along roadways, and test pit excavations near the proposed substations, rail facility, and along the collection system routes. PCW is also considering alternative methods for completing the detailed investigation, such as a decreased number of boring locations combined with MASW and Seismic Refraction testing in areas that are suspected to have similar soil and/or bedrock conditions (e.g., along turbine rows within the same mapped geologic units). Any alternative approaches to the detailed geotechnical investigation will require approval from the turbine vendor and must meet manufacturer specifications and warranty requirements.

4.1.4 Design Engineering

After the site survey, component siting, and geotechnical investigations are completed, PCW will complete a detailed Project design. Wind turbines are standardized and designed by the

turbine vendors independent of the Project. PCW will make a wind turbine selection and then assemble an engineering team to design the balance of plant (BOP), which consists of all elements of the Project except the wind turbines. The Project design will be divided into multiple scopes of work which will be defined by the geographical extent of the work as well as the project elements to be built. Each scope is commonly developed as packages divided amongst the engineering disciplines (such as civil, structural, and electrical packages). The Project design scopes of work will be organized to meet PCW's project schedule and will support the development of each site-specific POD.

4.1.5 Field Verification/Flagging

Once the design engineering is complete for a particular scope of work, and the design has been approved through a site-specific POD, the final pre-construction activity will be to perform field verification and flagging. Site surveying will be completed to delineate the disturbance boundaries for each of the elements within the scope of work as well as critical locations and centerlines for construction. Surveying will also be used to delineate those areas that must be avoided by construction activities. PCW will develop a flagging program that will clearly mark the areas for disturbance and avoidance.

As a part of the field verification, PCW will identify utility features near construction areas and have them surveyed and marked. The depth of any underground utilities near construction areas will be determined by potholing or similar methods. Design engineers will then review the field flagging to verify that the actual locations align with design expectations. If any issues are discovered, they will be addressed through alignment corrections or design updates.

Any identification or construction work done near underground utilities will be performed in coordination with the relevant utility owners and operators. PCW will also evaluate underground utilities with regards to Project roads that may be built over the utilities to determine if there are additional design considerations or if engineering support is needed from utility owners and operators.

4.2 Project Construction Activities

Following completion of pre-construction activities, PCW will begin Project construction. The range of expected activities associated with the construction of each Project element is discussed below. Project construction details will be submitted in site-specific PODs.

4.2.1 Rail Facility

Construction of the rail facility will occur in two stages: site preparation and track construction. Site preparation will begin with topsoil removal, which will be stockpiled and stored per the guidelines in the Master Reclamation Plan. The site will then be excavated, graded, and compacted and the necessary drainage structures and features will be installed. Sub-ballast aggregate material will then be placed to support the trackbed and provide a barrier for storm water infiltration of the subgrade.

Once the site preparation is completed, the track materials (rail, cross ties, and fasteners) will be assembled to form the running track and turnouts. Near the completion of the facility, Union Pacific will install the switches and crossings necessary to connect the facility to the main line. Upon completion, all track components will be inspected and tested as needed to verify they meet railroad requirements.

Permanent access to the rail facility will be via the haul road. However, it is possible the rail facility will be built before or at the same time as the haul road. In such an instance, PCW will prioritize the construction of the haul road to the rail facility site to provide construction access. PCW may explore alternatives, such as temporary road access to the rail site using existing roads, in the site-specific PODs.

During the construction of the rail facility, the Project's delivery storage area, adjacent to the rail facility, will also be constructed. The construction of this area is described in Section 4.3.2.

4.2.2 Roads

The construction of the Project roads begins with clearing and grading operations. The topsoil that is cleared and graded will be stockpiled or placed in a berm along the outer edge of the road disturbance area (see Section 7.5). Every effort will be made to separate the topsoil from any subgrade material during this operation, so that the topsoil can be effectively used during reclamation of the road ROW. Erosion control measures will be employed to preserve the stockpiles of topsoil throughout the project life (see Appendix G). The clearing and grading of any vegetated areas will also include the use and stockpiling of waste vegetation for reclamation as defined in the Project's Master Reclamation Plan (see Appendix E).

Gravel will be applied to the permanent driving surface of certain roads as determined during the Project final design and identified in site-specific PODs. The final amount of gravel applied depends upon many factors including geotechnical conditions, slope, erosion potential, anticipated traffic levels, and other safety issues. PCW will determine the expected width of gravel for each portion of the road during the Project final design, however it is not uncommon to expand upon the gravel surface based upon experience during construction. Due to the increased complexity associated with removing excess gravel during reclamation, PCW will limit the use of excess gravel. In instances where additional gravel is needed, it will be kept within the temporary disturbance limits of the road. It is common that, when only the permanent driving surface receives gravel, that some traffic may drive off the gravel and onto the cleared and compacted driving surface along the gravel when passing other traffic. Such passing is done at low speeds to maintain safety and limit dust emissions.

The equipment typically used during the construction of roads consists of bulldozers, motor graders, compaction equipment, aggregate hauling trucks and water trucks. The bulldozers and motor graders will complete the clearing and grading operations. The compaction equipment, typically vibratory rollers, will compact the subgrade prior to placement of the aggregate. The compaction rollers will also be used after the delivery and grading of the road

aggregate. For roads in which crane travel is intended, the compaction rollers will also compact the road shoulders to the widths necessary for the crane travel. It may also be necessary to occasionally use a water truck to condition the subgrade soils in order to meet the compaction requirements for the subgrade, as well as for dust control during and after road construction.

Figure 4-1. Example Road Construction

At the completion of the road construction, PCW will test the roads to verify that they meet design requirements. This testing will include proof-rolling or similar techniques for deflection verification.

4.2.3 Wind Turbine Pads

The construction of the wind turbine pad inner zone (described in Section 3.10) will be performed at the time of foundation construction (described in Section 3.9.1). Where possible, PCW will delay the establishment of the outer zone to within a few weeks of turbine erection to minimize time between ground disturbance and the beginning of reclamation. See Figure K-3-1 for an illustration of the inner and outer zones.

Much of the construction of the turbine pads occurs in a manner similar to that of road construction. For the inner zone of the pad, and the portions of the outer zone where grading

will be necessitated by terrain, the topsoil is cleared and stockpiled per the requirements of the Project Master Reclamation Plan. The inner zone will be compacted using compaction rollers and water trucks as needed. If soil conditions require, an aggregate surface will be placed across the inner zone.

When backfilling for the turbine foundation is complete (see Section 4.2.4), the crane pad is generally installed next. The crane pad is part of the inner zone and is constructed to provide the erection cranes with a level surface from which to erect the turbine components, and is commonly about 50 feet wide and 80 feet long for a 400 ton crane. The equipment used to build the crane pad includes a bulldozer and vibratory roller compactor. The bulldozer will also be used to complete any clearing around the foundation area to accommodate the trucks that will be delivering the turbine components.

Following the completion of the foundation and backfill operations, the turbine pad is prepared for off-load and erection of the turbine components (discussed in Section 4.2.5). Areas for wind turbine component laydown are prepared within slope requirements set by the pad design and wind turbine manufacturers, and any necessary compaction is performed. Upon completion of the turbine erection, the wind turbine pads will be reclaimed to the long-term pad design discussed in Section 2.5.3 in accordance with the Master Reclamation Plan.

Figure 4-2. Example Wind Turbine Pad Use During Construction

4.2.4 Wind Turbine Foundations

For the purposes of illustrating wind turbine foundation construction techniques and processes, PCW has assumed that a mat foundation will be used; this is the most common foundation anticipated for the Project and is a conservative assumption for the amount of disturbance. If geotechnical or other considerations require a different foundation type (such as those described in Section 3.9.1), a modified construction approach will be required and will be described in the site-specific PODs.

A mat wind turbine foundation consists of an anchor bolt cage in a steel reinforced concrete structure. The area above the foundation is cleared of any vegetation and the topsoil is

removed and separated from the subgrade material as part of the wind turbine pad construction (see Section 3.10). The foundation is excavated to the design depth using tracked excavators. Upon completion of the excavation, a thin (commonly two to three inches thick) concrete surface called a mudmat is poured. The mudmat provides a clean and level working surface from which to assemble the foundation. On the mudmat, workers begin assembling the bottom layer of the concrete reinforcing. An anchor bolt cage is then assembled and placed on the bottom layer of steel reinforcing. Workers then assemble a top layer of steel reinforcing intermeshed through the anchor bolt cage. Forms are then placed around the steel reinforcing and anchor bolt cage in preparation for pouring the base section of the foundation. The base section of the foundation is then poured using ready mixed concrete trucks discharging into a concrete telebelt or concrete pump truck to accommodate the size of the foundation.

Figure 4-3. Example Wind Turbine Foundation Construction

Following placement of the base section of the foundation, workers place a circular form around the exposed anchor bolt cage to pour the foundation pedestal. Approximately one foot of the anchor bolts are left exposed above the pedestal forms for connection to the base tower flange. Additional steel reinforcing is placed within the pedestal forms, as well as polyvinyl chloride (PVC) conduit to allow connection of the turbine to the collection system upon turbine

erection. After all the reinforcing and conduit is installed, the concrete is poured for the pedestal.

Following adequate concrete curing time, the forms are stripped and backfill of the foundation begins. The backfill operations are contingent upon the concrete reaching the required strength. Backfill operations involve a bulldozer and vibratory roller compactor. The backfill is placed in incremental lifts per the engineer's design requirements and tested for compaction requirements to provide the necessary overburden on the foundation (as defined in the final Project design and submitted in the site-specific POD). All excavated material is commonly used in the backfill operation to achieve positive drainage from the turbine base. After completion of the backfill operations, the site is ready for the remaining turbine pad preparation discussed in Section 3.10.

4.2.5 Wind Turbine Installation

For the purposes of this document, wind turbine installation includes the following activities (addressed in the order presented):

- off-load of the turbine components
- erection of the base and mid sections of the tower
- assembly of the rotor
- erection of the top tower sections, nacelle and rotor
- internal connections and mechanical completion

Each of the above activities will utilize different equipment, and in some cases, different erection crews.

With the wind turbine pad and foundation complete, the site is ready for off-loading of the turbine components. Each turbine component will be delivered to the turbine pad on a semi-tractor and trailer configured to accommodate the length and weight of the component. Each site will receive three to four tower sections (dependent upon the turbine manufacturer), three blades, one hub, one nacelle, two to four electrical components (such as down-tower assemblies, padmounted transformers, or switchgear), and crates of bolts and other components. The typical equipment used to off-load these components consists of rough terrain cranes, forklifts and a crawler crane. There are two rough terrain cranes that typically off-load the tower sections and blades by performing tandem picks at each end of the component. The hub is off-loaded using a single rough terrain crane. Depending on the weight and configuration of the nacelle, a crawler crane may be required to off-load the nacelle. The forklifts are used to place dunnage under the turbine components to keep them off the ground and stored them in a secure manner prior to their erection. All of the components are placed within the turbine pad adjacent to the crane pad such that they are within the picking radius of the various cranes that will be used to erect that component. The typical process of unloading consists of the delivery truck pulling into the pre-determined position near the crane pad, the crane(s) then position next to the component and the rigging is attached to the component and

the crane(s). The component is then lifted off the delivery truck, the truck pulls forward, the forklifts set the dunnage under the component and the crane(s) lower the component onto the dunnage. This process repeats until every turbine component is off-loaded.

After all the turbine components have been off-loaded, the site is ready to begin erection of the tower base and mid (or lower-mid for a 4 segment tower) sections. Prior to any cranes arriving at the site, a forklift often places wooden crane mats on the crane pad. This is done to support the crawler crane during its erection activities. The erection of the base and mid-sections is typically performed by a 200 to 300 ton crawler crane. The crawler crane walks itself onto the crane pad and mats that are adjacent to the foundation and staged turbine components. The crawler crane is accompanied by a smaller rough terrain “helper” crane that assists in lifting the tower sections from the ground to a vertical position. A forklift assists with moving dunnage and crane mats during the operation. The base tower section is prepared by placing the required rigging at each end of the tower. The crawler crane and helper crane hook onto the rigging and jointly lift the base tower section. The tower section is lifted to a vertical position and placed on crane mats to allow the rigging on the bottom of the tower to be removed. The crawler crane then lifts the tower section and it is placed on the anchor bolts that were left extended on the foundation pedestal. The base section is then leveled and bolted to the anchor bolt cage. The contractor then places grout under the tower to form the final connection between the tower and foundation.

After successfully erecting the base section and allowing sufficient time for the grout to set up, the next tower section (mid or lower-mid) is lifted and placed onto the tower base in a manner similar to that described above. The two tower sections are then bolted together prior to the crane being released. For a four segment tower, the upper-mid section is then lifted and placed onto the lower-mid section in the same manner, or in the alternative, the upper-mid section may be bolted onto the lower-mid section prior to lifting. Upon completion of the tower erection, the crawler crane then walks to the next site to perform the same operation.

Following installation of the turbine tower, the rotor must be built. Certain turbine manufacturers allow the assembly of the rotor on the ground and then the erection of the complete rotor by the main erection crane. When completed in this manner, the rotor assembly typically consists of a 100 to 200 ton crawler crane and a forklift to assist its operation. The crawler crane lifts each blade and positions it into the opening in the hub. The crew bolts the blade to the hub and positions dunnage under the blade to support it. The crawler crane continues to lift and place the remaining blades on the hub until the rotor is complete. The crews tie down the assembled rotor to prevent it from moving until it is read for erection. Upon completion of assembling the rotor, the crawler crane and forklift walk to the next site and repeat this operation.

The main erection crane is the next crawler crane to visit the turbine site. The main erection crane is typically a 400 to 600 ton crawler crane. Its purpose is to erect the remaining upper tower section(s), nacelle and hub. The main erection crane is assisted by a rough terrain

"helper" crane and forklifts. The main erection crane walks onto the crane pad and mats to perform the erection activities. Similar to the installation of the base and mid-sections described above, the main erection crane and helper crane hook rigging onto each end of the upper tower section(s) and lift them to a vertical position, the bottom rigging is then removed and the tower section is placed on those sections already assembled. Once all the tower sections have been erected and bolted together, the main erection crane will then be rigged to a beam that allows the nacelle to be lifted. The main erection crane will lift and position the nacelle over the top tower section's flange to allow it to be bolted together. The next step is to lift the assembled rotor and attach it to the nacelle. The crawler crane and helper crane lift the rotor together until it reaches a vertical position, at which time the rigging for the helper crane is removed. The crawler crane lifts and positions the rotor so that the bolt holes align with the nacelle and the two components fasten together. After the rotor is securely attached to the nacelle, the main erection crane removes its rigging from the rotor and walks to the next turbine site to repeat this operation.

While PCW expects to assemble the rotor on the ground and preform one lift to place it, there are certain turbine manufacturers that do not permit the rotor to be assembled on the ground. These manufacturers require that each individual blade be attached to the hub after it is erected. In this case, the turbine site will be visited by another crawler crane after the main erection crane has erected the nacelle and hub. The typical crane used for attaching the blades is a 200 to 300 ton crawler crane. It is typically assisted by a forklift. The crane attaches to a beam specifically designed to lift each individual blade up to the hub. The crane lifts the blade and positions it so that the bolts align with the opening in the hub and it is inserted and bolted securely. The crew in the turbine then rotates the hub in order to properly position it for the next blade. The crane then attaches to the next blade and repeats the procedure. After all three blades are securely fasted to the hub the crawler crane walks to the next site to repeat the operation.

Once the major components of the wind turbine are assembled, work is done internally to connect the generation equipment in the nacelle with drop cables in the tower and the control system in the base. All mechanical connections are secured and checked. When these activities are completed, generally over the course of 2 to 4 days, the turbine has achieved a state of mechanical completion and is ready for commissioning (described in Section 3.2.9)

It is important to note that the procedure described above is general. Wind turbine vendors may have very specific procedures that differ somewhat from those described for each turbine model. The installation procedures for all current commercial turbine models are similar, however, and PCW does not expect significant deviation from the above procedures. PCW will provide the exact procedure for the chosen turbine models in site-specific PODs.

Figure 4-4. Example Wind Turbine Installation

Figure 4-5. Example Wind Turbine Blade Installation

4.2.6 Electrical Collection System

PCW expects to construct both underground and overhead 34.5 kV electrical collection systems. The majority of the 34.5 kV collection system would be underground, however there will be areas of the project where terrain and economics would drive the usage of overhead collection. The 34.5 kV electrical collection system connects each WTG to a substation.

4.2.6.1 Underground Collection System

The placement of 34.5 kV collection cables into the ground can either be done with one-pass trenching machines, or by laying the cables into excavated trenches which are then backfilled. Initial geotechnical information indicates that the depth of rock is very shallow on the Project Site, making it unlikely that the single-pass trenching machine method will be sufficient. As such, the open trench method (which has the greater level of disturbance between the two options) is described below.

For open-trench collection system installation, a separate trench (detailed in Section 3.2.2 and Appendix K-4) would be utilized for each collection circuit. Trenches would be excavated with a trenching machine or backhoe; however, if competent rock is encountered at shallow depth, it would be necessary to jackhammer rock locally or drill and blast sections to open up a trench. If the rock content in local soil conditions is negligible, the collector cables and fiber-optic cables will be placed directly on the bottom of these trenches. The native material excavated from the trench will be sifted for rocks, backfilled on top of the cables, and compacted with a vibratory compactor. The backfill will be placed in lifts to achieve sufficient soil compaction and allow for the warning tape to be installed.

If the rock content in local soil conditions is high enough to cause risk of cable jacket damage during installation, bedding material (likely sifted backfill from elsewhere on the Project Site, or possibly engineered backfill from off-site) will be placed in the trench prior to installing the

collector cables and fiber-optics. In such rocky conditions, it is also likely that the soil excavated from the trench will have too much rock content to be used to backfill the trench without damaging the cables. In those instances, an engineered backfill (soil with good thermal dissipation properties that is free of rocks) will be utilized to backfill the trench. Such backfill may be obtained from within the site, or imported from an off-site quarry or pit, as determined in the site-specific PODs As above, the backfill will be placed into the trench in lifts for compaction and warning tape installation.

Figure 4-6. Example Underground Collection System Installation

Geotechnical testing in the area around the cables will determine the heat dissipation properties of the soil. If necessary, the engineered backfill for the trenches may include material necessary to improve the overall thermal properties. Such material improvements would be determined in the detailed collection system design and included in site-specific PODs.

Where splices are necessary in collection system cables, above-ground splice boxes will be installed above the collection cable trench. Similarly, in locations where two or more sets of underground lines converge, pad mounted switch panels would be used to tie the lines together into one or more sets of larger feeder conductors. These above-ground boxes are commonly four to six feet across and four feet high, constructed of plastic and fiberglass material appropriate for medium-voltage connections, and colored green. PCW would install concrete bollards around the boxes to avoid accidental damage by Project vehicles.

4.2.6.2 Overhead Collection System

The installation of the overhead collection system involves the placement of electrical poles and the stringing of cables between the poles. As discussed in Section 3.2.3, PCW intends to use wooden poles where possible and light-duty steel as needed. PCW will explore the use of

lighter all-terrain vehicles (such as ATV's and pick-up trucks) to minimize the surface disturbance necessary to access the poles and string cable between them. A minimal amount of clearing may be required to provide necessary access to the work areas.

Installation of the two types of poles used in the overhead collection system generally involves the following steps:

- **Pole Framing.** The components of the structures (poles, cross-arms, insulators, and hangers) are brought to the locations of their installation to be assembled. This work is typically performed on the ground just prior to erection of the structures.
- **Setting Direct Embedded Poles.** The medium-voltage wooden poles under consideration are often embedded into the ground without the use of a separate foundation. The construction process consists of first excavating the holes for the structure to the required depth. This can be accomplished through the use of a vertical drilling rig or excavator. Once the excavation for a structure is completed, the structure is hoisted into place by either a boom truck or all-terrain crane. The structure is checked for proper embedment depth, alignment and plumb. The structure is held in place while it is backfilled with either aggregate/rock or concrete. The backfill is mechanically vibrated or tamped in lifts to eliminate voids and assure proper bearing pressure. After the pole is backfilled, it is released.
- **Foundations.** In the event that some overhead collection system poles require a concrete foundation, e.g. steel poles, such foundations would be installed 3 to 5 weeks ahead of the structure erection to allow concrete to reach design strength. The foundation site is excavated, and frames placed onto excavated soil or a mudmat. Steel reinforcement is added within the frame, and concrete is poured. Once the concrete has reached sufficient strength, the forms are removed and the area backfilled. As an alternative, PCW may choose to utilize precast foundations based on the soil conditions and technical requirements. The surface disturbance of either foundation design is similar.

Once the pole installation is complete, stringing can begin. Stringing involves the pulling of the conductors through the stringing dollies by means of ropes. The use of guard structures will be required when crossing public roads. Guard structures are simply temporary wood structures or nets that prevent the pulling lines or conductor from falling onto the roadway. PCW does not currently expect any overhead collection lines to cross public roads.

The stringing dollies are attached to the insulators at the time of framing, and a rope line is looped down the structure to aid in the pulling of the stringing line. The line is pulled through the dollies from a tensioner to a dead end point on the line and attached to conductors located on a reel trailer. The tensioner then pulls the conductor though the dollies. When the desired span or reel length is reached, the reel end of the cable is placed into the dead end structures and the proper tension is applied.

Once the proper tension and sag is obtained, the cable is clipped into place. This process involves the removal of the stringing dollies and the installation of the cable clamps to firmly hold the conductor. The clipping process can be performed by bucket trucks. Once completed the line is brought into service.

4.2.7 Substations (Collection, Interconnection)

Each substation site is first cleared of vegetation and the topsoil is removed. The topsoil will be separated and stockpiled per the requirements of the Project's Master Reclamation Plan. The site is then graded to subgrade elevation per the requirements of the final design. Structural footings and underground utilities, along with electrical conduit and a grounding grid are installed, followed by aboveground structures and equipment. A chain-link fence is constructed around the new substation for security and to restrict unauthorized persons, livestock, and wildlife from entering the substation. The site is then finish graded and gravel surfaced, and reclamation is initiated outside the substation fence.

Control buildings will most likely be prefabricated, and will be assembled or placed onto concrete slabs within the substations. Major equipment to be installed inside the control buildings consists of relays, control panels, servers, communication equipment, power supplies, a battery bank for back-up power, and a heating/cooling system.

Steel structures are erected on concrete footings to support switches, electrical buswork, instrument transformers, lightning arrestors, and other equipment, as well as termination structures for incoming and outgoing transmission lines. Per common utility practice, these structures are fabricated from tubular steel and galvanized. Structures are grounded by thermally welding one or more ground wires to each structure.

Major equipment will be set by crane and either bolted or welded to the foundations. Oil spill containment basins will be installed around major oil-filled transformers and other equipment. Smaller equipment, included air switches, current and voltage instrument transformers, insulators, electrical buswork, and conductors will be mounted on the steel structures.

Control cables are pulled from panels in the control building, through the underground conduits and concrete trench system, to the appropriate equipment. After the cables are connected, the controls are set to the proper settings, and all equipment is tested before the transmission line is energized.

Figure 4-7. Example Collection Substations Under Construction

4.2.8 Internal Transmission

The installation of the internal transmission lines is similar with respect to that of the overhead collection system, however the size of the equipment involved is significantly larger. Clearing and grubbing will be performed to provide access to the transmission line structure sites for construction activities. Clearing and grubbing will be minimized where possible and will be clearly defined in the construction plan.

Installation of wooden H-frame transmission structures is very similar to those of the wooden overhead collection system poles described in Section 4.2.6.2.

Installation of monopole or lattice steel transmission structures with concrete foundations generally involves the following steps:

- **Foundations.** Transmission foundations (described in Section 2.4.2) are typically installed 3 to 5 weeks ahead of the structure erection to allow concrete to reach design strength. The foundation site is excavated, and frames placed onto excavated soil or a mudmat. Steel reinforcement is added within the frame, and concrete is poured. Once the concrete has reached sufficient strength, the forms are removed and the area backfilled.
- **Structure Framing.** The components of the structures (pole pieces, cross-arms, insulators, and hangers) are brought to the locations of their installation to be assembled. This work is typically performed on the ground prior to erection of the structures. At sites where terrain or environmental constraints don't allow for on-site assembly, the framing will be done at a nearby staging area.
- **Setting Base Plate Poles.** Once the concrete has reached sufficient strength and the structures are framed, the structures can be erected onto the foundations. This is commonly done by cranes or boom trucks. The structure is hoisted off the ground and then set onto the foundation. The structure is checked for alignment and plumb, and if necessary leveled by adding shims or adjusting leveling nuts. If required for the design,

grouting is then added to the base of the tower and allowed sufficient time (generally 2 to 4 weeks) to cure.

It is possible for steel monopole transmission structures to be installed by direct embedment. This process would be similar to that of the overhead collection poles described in Section 4.2.6.2. If PCW determines that steel monopoles are necessary for any portion of the Project, PCW will provide additional installation details in site-specific PODs.

Once the structure installation has been completed, the conductor is strung per the procedure discussed in Section 4.2.6.2.

Figure 4-8. Example Transmission Structures Under Construction

4.2.9 Wind Turbine Commissioning

Once wind turbine mechanical completion has been achieved and the collection system is available to receive generation, control of the turbine will then be transferred to the turbine manufacturer for commencement of commissioning activities. It is also important to note that backfeed power is required to be available from the grid in order to commence full commissioning. If backfeed power is not available, pre-commissioning will be required. In order to perform pre-commissioning, temporary generators will be used to provide the WTG with the required power to perform full commissioning. Wind turbine commissioning will be performed individually for each turbine in the Project.

Wind turbine commissioning consists of numerous checks, verifications, and tests in regard to turbine assembly and functionality. Once the initial checks are all performed, the turbine is allowed to run under supervision to verify full functionality. When these activities are complete, the turbine manufacturer will present a commissioning completion certificate and transfer control of the turbine back to PCW. At that time the turbine will be ready to run in

typical unattended mode.

If the collection system is not available to accept generation when commissioning is desired to start, the turbine vendor can perform commissioning in two steps. The pre-commissioning step involves checking the control and communications systems, and as many other turbine systems as possible without grid power. Once the collection system is available, the remaining commissioning items are performed, including the test operation. This process is commonly done when time available to commission the turbines is expected to be short once the collection system is available.

4.2.10 Operations and Maintenance Buildings

Construction of the operations and maintenance buildings will involve conventional construction techniques for pre-engineered buildings, with the erection of the buildings on concrete foundations. Typical construction activities include the following:

- survey and stake site
- clear and grub site, stockpiling top soil per the Project Master Reclamation Plan
- perform site grading
- install underground utility connections (water, power, communications, sewer)
- construct concrete building foundations (designed for the local soil conditions)
- erect the building structures and exterior enclosures with small, all-terrain cranes
- install interior equipment and finishes
- install parking and drive areas
- install permanent security fences around outdoor storage yards

4.3 Temporary Construction Facilities

In addition to the long-term facilities constructed for the Project, temporary facilities will be needed during the construction stage. These facilities are described below.

4.3.1 Construction Trailer Complex

The construction trailer complex will be graveled and will house the temporary office trailers for the on-site project management staff, as well as multiple storage containers for project tools and equipment. It will also serve as the main marshaling area for the entire Project. This complex would also include temporary portable sanitation facilities (portable toilets), fuel storage, waste disposal containers, parking for up to 2,000 vehicles, and possibly an area for vehicle maintenance. The entire complex would be fenced, gated and lit for security.

Equipment typically used to establish the complex site includes bulldozers, motor graders, compaction equipment, aggregate hauling trucks, and water trucks. The bulldozers and motor graders will complete the clearing and grading operations. The compaction equipment, typically vibratory rollers, will compact the subgrade prior to placement of the aggregate. The compaction rollers will also be used after the delivery and grading of the aggregate. It may also be necessary to occasionally use a water truck for dust control during and after construction.

Once the site is prepared, the trailers will arrive to the Project by truck. The trailers will be placed on stands, and the double and triple-wide trailers will be connected together. Trailers will be connected to temporary power and telephone connections. Portable toilets will be delivered to areas adjacent to the trailers.

4.3.2 Delivery Staging Area and Laydown Yards

A delivery staging area is commonly a storage yard into which components and material are delivered. These items will remain in the yard until they are needed for construction. Some items are stored uncovered, while others may be stored in cargo containers or crates. Staging areas are commonly graded and graveled, surrounded by fencing, and may include night lighting and security.

In most wind energy projects, the wind turbine components are brought to the site by truck. The typical arrangement for truck deliveries are for turbine components to be delivered right to the turbine pad on which they are needed, and stored there until the turbine erection is performed. This is to avoid double-handling of components. Because PCW is intending to receive most Project deliveries by rail, and given the volume of material that will arrive with each train and the required speed in which the trains must be unloaded, it is not feasible to delay the unloading process while components are trucked directly to the turbine pads from the trains. Rather, components will be unloaded from the trains onto a main staging area adjacent to the rail facility. Within this area, components will be organized by type and kept until they are needed on the site. Figure 4-9 shows a delivery staging area of this type.

Figure 4-9. Example Delivery Staging Area

Given the integration of the primary delivery storage area with the rail facility, PCW is expecting at least a portion of that area to remain intact after Project construction is completed. As discussions with Union Pacific have not yet determined the long-term extent of the storage area, PCW is currently assuming the entire area will remain long-term.

In addition to the delivery storage area, PCW expects to have laydown yards on the Project Site. The laydown yards are primarily used to store construction material (aggregate, steel, cement, and other items) in areas close to construction sites. The concrete batch plants will also be located within the laydown yards. PCW expects to have laydown yards in key locations within the Chokecherry and Sierra Madre development areas. If necessary, PCW will establish an additional delivery storage area or laydown yard near the construction trailer complex.

4.3.3 Concrete Batch Plants

Temporary concrete batch plants will be used for preparing and mixing the concrete used for wind turbine foundations, the footings and the pads at the substations, the operations and maintenance buildings foundations, and other necessary project facilities. The batch plant complexes consist of a mixing plant, areas for sand and aggregate stockpiles, an access road, and truck load-out and turnaround areas (see Appendix L-2). The batch plants themselves consist of cement storage silos, water and mixture tanks, aggregate hoppers, and conveyors to deliver different materials.

PCW is anticipating operating two batch plants simultaneously each year when foundations are being built (currently scheduled for Years 2 through 4). The batch plants will be located within Project laydown yards close to the sites where foundations are being poured. The batch plants will be relocated as needed to maintain an efficient operation.

4.3.4 Water Facilities

Water use during construction will be primarily for dust suppression and compaction of roads, as well as batch plant operations, as discussed in Section 6.5. To minimize land disturbance, water supply facilities will be collocated within laydown yards and adjacent to concrete batch plants where possible. As discussed in Section 2.2.5, many sources of water are available to meet Project water demands, therefore the necessary facilities and structures are varied depending on the supply and location. The main components of the water supply system and the range of variations are discussed below.

4.3.4.1 Surface Water Supplies

Where possible, existing water diversion structures will be used, although improvements may be necessary due to the age of the existing structures and equipment. Surface water diversion structures will include the placement of new submersible or vertical turbine pumps directly into surface water supplies or into existing gravity fed ditches. All pump intakes will be properly designed and screened to reduce impingement and entrainment. Once diverted, water will be pumped from the surface water source into a temporary storage tank. From the storage tank water may then be trucked to its final place of use or may be transported via pipeline. A pipeline arrangement may require an additional surge tank and booster station along its length to provide the necessary flow and pressure at the final place of use. Water conveyance structures will be minimized to the extent possible and are dependent upon the distance between the point of diversion and the place of use. Where possible, pipelines will be located within existing road right of ways or within the bounds of the batch plant or laydown area. Additional storage may be required at the end of the pipeline to allow for a constant water supply at the place of use. This type of surface water supply arrangement requires the most infrastructure and would be applicable to water supplies taken directly from the North Platte River or similar sources. An example arrangement for a surface water supply such as the North Platte River is shown in Appendix L-2.

4.3.4.2 Groundwater Supplies

Where possible, existing water diversion structures will be used, although improvements may be necessary due to the age of the existing structures and equipment. Groundwater supplies will be diverted through water supply wells via submersible or vertical turbine pumps. Following pumping, the water will be discharged to a storage tank and trucked to its place of use, or will be discharged directly into water supply piping. Water conveyance structures will be minimized to the extent possible and are dependent upon the distance between the point of diversion and the place of use. Where possible, pipelines will be located within existing road right of ways or within the bounds of the batch plant or laydown area. Additional storage tanks

and booster pumps may be required depending upon the final water supply requirements. A representative groundwater supply configuration is shown in Appendix L-2.

4.3.4.3 Water Treatment Facilities

It is anticipated that water treatment may be required to meet water quality standards for specific uses on site, including batch plant operations. If water treatment is required, temporary water treatment facilities would be leased or purchased. A variety of skid or trailer mounted water treatment equipment is available from multiple vendors that could meet the water treatment needs of the Project. Where possible the water treatment equipment would be co-located with batch plants or laydown yards to minimize disturbance.

4.3.4.4 Temporary Storm Water Treatment

The Wyoming NDPES permit requires that temporary storm water treatment ponds be provided for areas greater than 10 acres in size draining to a common point. The project has several areas throughout the site that will fall within this requirement, including the rail facility, laydown yards, substations, and site building. The required disturbed area for these ponds has been included in the disturbance estimates for each facility listed in Appendix L-4. The specific design for the ponds and grading will be provided in site-specific PODs.

4.3.5 Construction Stage Only Roads

The following roads and civil features support the construction stage of the Project. At the end of construction, these features will be reclaimed per the requirements of the Master Reclamation Plan (Appendix E).

4.3.5.1 Turnarounds

Turnaround locations will be provided for Project delivery vehicles. Typically these locations are at the end of the turbine roads, along the turbine roads, or within the disturbance area of the turbines themselves. Typical kinds of turnarounds that may be used are a continuous cul-de-sac style or hammerhead (3-point turn).

In areas of challenging topography, or other restrictive features such as a ridge top, it may not be feasible to construct a typical turnaround. In these instances alternative methods of turning delivery vehicles may be utilized. Following component delivery, a trailer may be detached from the tractor and hoisted in the air by the project cranes, allowing the tractor to make a 180 degree 3-point turn, the trailer is then rotated by the cranes and lowered to the ground where the tractor can reattach and exit the site. PCW will determine where such special construction methods are necessary in the site-specific PODs.

4.3.5.2 Crane Erection/Teardown Areas

The large cranes used for turbine erection will be brought into the site on flatbed semi-trailers and assembled onsite. The cranes will be assembled adjacent to the first turbine that is erected, and ultimately disassembled adjacent to the last turbine that is erected. Then each crane will be hauled away either to another region of the project or offsite altogether.

Temporary erection and teardown areas will be identified during final design and will be cleared and leveled to provide adequate working area for these activities. Once erection and teardown is complete, the area will be restored to original condition and vegetation will be re-established in accordance with the project reclamation plan. PCW will make reasonable efforts to identify as many locations for crane erection as possible that are either already sufficiently level to avoid significant earthwork, or to perform crane erection and teardown in previously disturbed areas (such as laydown yards or wind turbine pads).

4.3.5.3 Crane Paths

Once assembled, the large erection cranes will generally "walk" from turbine to turbine utilizing the new project resource roads and compacted shoulders. In addition, it may be necessary to move the crane cross-country on predetermined crane path routes. Crane path routes will be determined during final design, but will generally connect dead end adjacent turbine strings that don't otherwise require a permanent road to be constructed. These paths will be cleared of heavy brush, leveled where necessary, and compacted. Once crane travel is complete, the paths will be restored to original condition and re-established in accordance with the project Master Reclamation Plan. PCW will make reasonable effort to minimize the number of crane paths required outside of the Project roads.

4.3.5.4 Water Extraction Facility Access Road

If the North Platte River becomes the Project water source, access from the Project Site to a water extraction facility would be accomplished through the construction of a new facility road. The facility road would generally follow an existing two track road, but there will be locations that require new routing to accommodate the road upgrades required for the water trucks. Once water extraction is no longer required, the road would be restored to original condition and re-established in accordance with the Project's Master Reclamation Plan.

PCW anticipates that any buried water pipeline will be located within the disturbed area for the access road where possible. This pipeline would be removed when the water extraction facility access road is reclaimed at the end of construction.

4.3.5.5 Emergency Egress Routes

To provide a safe working environment during the construction stage, PCW may devise emergency egress routes from remote areas of the Project Site. These routes would allow construction personnel to rapidly access public roads if necessary for extreme weather or medical evacuations, and for emergency vehicles to get onto the site quickly. Such routes may only be designated two-track roads, or improved roads similar to the turbine roads described above. The routes will be marked as for emergency use only and will not be used for routine construction access. For disturbance estimation purposes, PCW assumed emergency egress routes would have the same disturbance levels as turbine access roads.

4.4 General Construction Information

This section provides information regarding the expected schedule, labor force, equipment needs, and material requirements for the construction of the Project. Some additional construction information not previously provided is also included below.

4.4.1 Construction Schedule

To align with the DEIS, PCW has prepared a schedule to construct the Project over a five year period (Years 1 through 5). The sequence of construction is presented in Table 4-1, and described below. This schedule is intended to allow PCW to install wind turbines within 12 months of the initial ground disturbance of the associated turbine location. Interim reclamation will begin in accordance with the Master Reclamation Plan (Appendix E) once wind turbine installation and associated construction activities are completed.

For each year of construction, PCW intends to perform construction activities within practical and allowable construction seasons. Each season will include the late spring, summer, and fall months as allowed by weather conditions and environmental timing stipulations. Seasonal timing stipulations as set forth in the ROD will be incorporated into each site-specific POD. PCW understands that some timing stipulations, such as the greater sage-grouse restriction, apply only to activities causing new surface disturbance, and that PCW can utilize roads built in previous years during this period as needed for construction in other, non-restricted areas.

The portions of the development areas referred to in the schedule below (Miller Hill, Sage Creek Basin, Western Chokecherry, and Eastern Chokecherry) are shown in Figure 4-10.

Table 4-1. Conceptual Construction Sequence

Facility	Year 1	Year 2	Year 3	Year 4	Year 5
Support Facilities					
Staging Areas	Trailer Cmplx Northern	Miller Hill	SCB West CC	Eastern CC	
Substations		MH Site Prep Int. Site Prep	MH Complete Int. Complete SCB Prep CC-A Prep	SCB Complete CC-A Complete CC-B,C Prep	CC-B,C Complete
Buildings			Ops Center SM Maint.	CC Maint.	
Rail Facility	Complete				
Transportation Network					
Internal Haul Road	All				
Resource Roads		All MH	All SCB West CC	East CC	
Wind Turbines					
WTG Pads		MH Inner	MH Outer SCB Inner West CC Inner	East CC	
WTG Foundations		MH Partial	MH Remaining SCB West CC Partial	West CC Remaining; East CC Partial	East CC Remaining
WTG Installation			MH	SCB West CC	East CC
Transmission					
Collection System		MH	SCB West CC	East CC	
Transmission			MH to Int.	SCB to SM CC-A to Int.	CC-B to Int. CC-A to Int.
Notes: Int. = Interconnection; CC = Chokecherry; MH = Miller Hill area of Sierra Madre; SCB = Sage Creek Basin area of Sierra Madre					

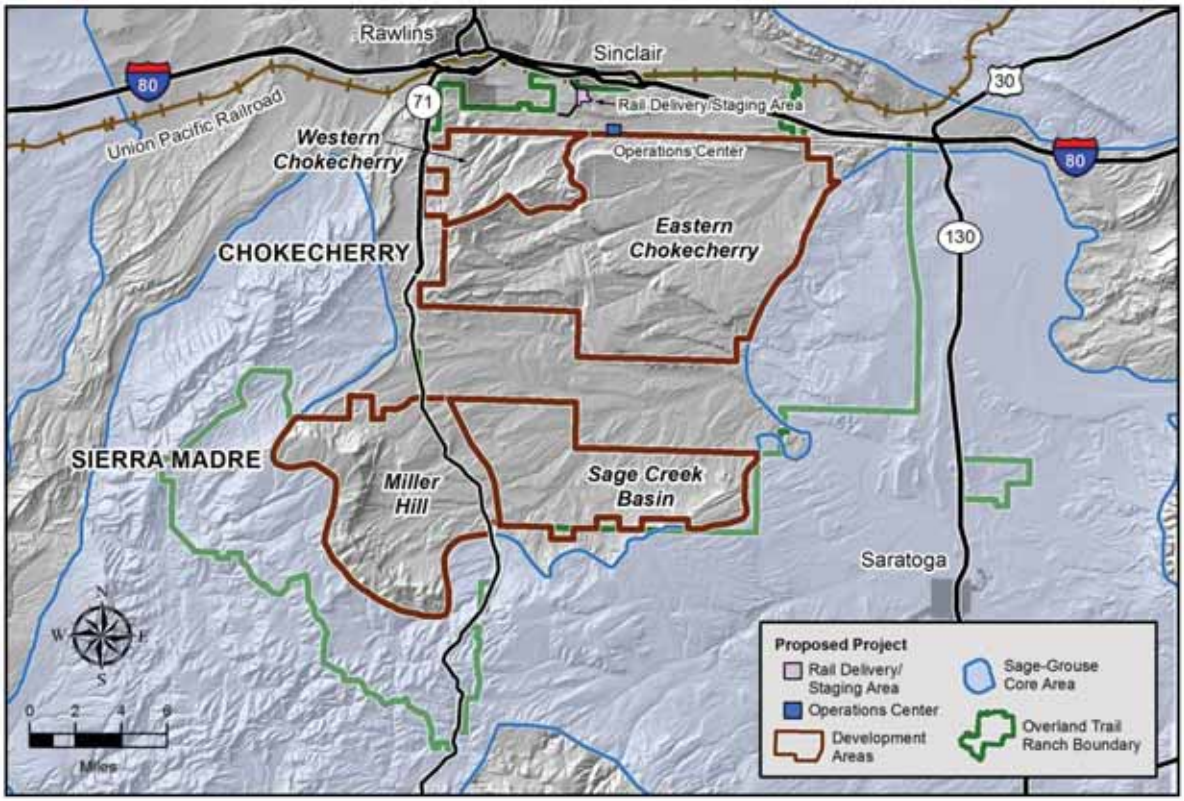


Figure 4-10. Construction Sequencing Areas

4.4.1.1 Year 1

The plan for Year 1 is to construct the following Project elements:

- Rail facility and associated delivery staging area
- Haul road
- Construction trailer complex (initial mobilization)
- Water extraction facility at the North Platte River (if needed)

The construction scheduled for Year 1 focuses on the rail facility, haul road, and delivery staging area. The rail facility includes the delivery staging area for material, equipment, and turbines for the next four years of construction. It is expected that construction of the rail facility will last approximately seven months. The initial work will focus on preparing the site in terms of clearing and grubbing and establishing the correct elevations for the remaining work. The general site work will be followed by placement of the track, including any sub-ballast needed for track preparation and the actual placement of the track itself. The final work will involve installation of the switches and control systems and tying the rail facility to the Union Pacific main line.

The haul road will also be constructed during Year 1. The haul road represents the main artery of the project running from the northern Project entrance and rail facility through the Chokecherry development area to the Sierra Madre development areas (Miller Hill and Sage

Creek Basin). The haul road will be used to transport all the materials, equipment, and personnel needed in each of the areas of construction. The intent is to build the entire of haul road so that each portion of the Project is accessible at the start of Year 2. This will improve the efficiency of subsequent years of construction, minimize the potential for weather delays, and assist in leveling the Project labor force and equipment fleet (those resources can construct other roads in Year 2). If the time required to build the entire haul road in Year 1 is found to exceed the time available, PCW will prioritize completion of the haul road to Miller Hill, and will complete access to Sage Creek Basin in Year 2.

One construction challenge involved with the construction of the haul road in Year 1 is the lack of availability of the rail facility for aggregate delivery. PCW remains committed to constructing the Project in a safe, efficient, and responsible manner. As such, PCW's plan is to limit the number of aggregate delivery trucks required and to construct the haul road with a minimum aggregate surface for the relatively light-duty use of the road before mobilization in Year 2. This surface will maintain road stability and usage until the rail facility is operational, at which time the remaining aggregate can be delivered to the site. When this aggregate is available at the rail facility, PCW will apply the full design surface onto the haul road before significant construction and delivery traffic begins in Year 2. If the rail facility is not completed until the end of Year 1, PCW will add the remaining aggregate to the haul road as soon as construction mobilizes in Year 2.

Year 1 will also include site preparation for the trailer complex and mobilization of enough office trailers to manage the work in Year 1. The laydown areas in the Sierra Madre, Miller Hill and Sage Creek Basin would also be prepared. The schedule for these areas is concurrent with the haul road, July 15 to October 31. These sites will be the staging areas for materials, equipment, concrete batch plant(s), and tool storage necessary for construction in Year 2. Similar to the haul road, it is beneficial to complete the site preparation (including grading and gravel placement) of these areas during Year 1 so that resources can be committed to completing the other civil work in Year 2, reducing the labor force and equipment requirements. If completed in Year 1, these facilities will be ready at the beginning of Year 2 for the immediate staging and storage of materials and mobilization of the trailer complex.

4.4.1.2 Year 2

The plan for Year 2 is to construct the following Project elements:

- Full mobilization of the Project's trailer complex
- Miller Hill project roads and wind turbine pad inner zones
- Initial Miller Hill wind turbine foundations (approximately 200)
- Miller Hill collection system
- Miller Hill collection substations site preparation
- Interconnection substation site preparation

Year 2 marks the beginning of construction of turbine access roads, turbine foundations, electrical collection (both underground and overhead), and the preparation of substation sites.

The construction will focus on the Miller Hill portion of the Sierra Madre development area. All work will be performed starting July 15, and is planned to go through the end of October (with additional time available in November if weather allows).

All additional trailers and facilities necessary for the Project's trailer complex will be mobilized.

PCW intends to construct all of the roads for the Miller Hill area in Year 2. As the access roads are installed and the turbine sites become accessible, turbine pad preparation and turbine foundation excavation will begin. PCW intends to prepare the inner zone of the turbine pads for all Miller Hill turbines in Year 2. However, due to limitations of the construction season, PCW intends to construct only about 200 turbine foundations in this year. For those pads where foundations are installed, the excavated areas around the foundations will be backfilled and the inner zones of the pads completed per the Project design. For those pads where foundations are not construction, PCW will not begin foundation excavation until Year 2, and the pads will remain simply graded and graveled.

The laydown area in Miller Hill will be used for staging of construction materials. A concrete batch plant will be set up in this area and operated for all of Year 2 construction.

The entire collection system for Miller Hill will be installed in Year 2. Connection points will be established in the turbine pads and substation sites so that the collection system can be connected to equipment that will be installed in Year 3.

Preparatory work will be performed for the substations in the Miller Hill area, as well as the Project's interconnection substation. All site grading work will be done, and equipment foundations constructed. A gravel surface will be placed over the extent of the substation site.

4.4.1.3 Year 3

The plan for Year 3 is to construct the following Project elements:

- Installation and commissioning of the wind turbines in the Miller Hill area (approximately 350)
- Completion of Miller Hill collection substations
- Completion of interconnection substation
- Installation of internal transmission line from Miller Hill to interconnection substation
- Sage Creek Basin and Western Chokecherry project roads and wind turbine pad inner zones
- Approximately 350 wind turbine foundations in Miller Hill, Sage Creek Basin, and Western Chokecherry
- Sage Creek Basin and Western Chokecherry collection system
- Sage Creek Basin and Western Chokecherry collection substation site preparation
- Operations Center and Sierra Madre Maintenance Facilities built

Construction during Year 3 will include all the types of activities included in Year 2 plus turbine erection and substation and building construction. The focus will be to complete work on around 350 turbines and associated facilities in the Miller Hill area, and begin civil work in Sage Creek Basin and Western Chokecherry. Construction activities on roads and pads completed in Year 2 will begin approximately June 1, while construction involving new surface disturbance will not begin until July 15. All work is scheduled to be concluded by the end of October, with some flexibility to extend into November if weather conditions allow.

The laydown yards for Sage Creek Basin and Western Chokecherry will be prepared at the start of the construction season so that they can be utilized for Year 4 construction.

In Year 3, PCW intends to construct the project roads and inner turbine pads in the Sage Creek Basin and Western Chokecherry areas.

PCW expects to take delivery of approximately 350 wind turbines at the rail facility in Year 3. The turbines will be transported to their respective sites in the Miller Hill area where they will be erected. A few weeks prior to the arrival of turbines at pad locations, PCW will prepare the outer zone of the turbine pads to allow for component delivery. The minimum amount of vegetation removal and site work will be performed as needed to facilitate the turbine's installation.

During Year 4, PCW expects to install approximately 350 wind turbine foundations. These will involve any remaining turbine locations in the Miller Hill area, and then those in the Sage Creek Basin area. All remaining foundations will be installed in the Western Chokecherry area. For these foundations, PCW expects to utilize concrete batch plants in both the Miller Hill and Chokecherry laydown yards.

The collection system for Sage Creek Basin and Western Chokecherry will be installed in Year 3. Additionally, connections will be made to the wind turbines and substations installed in the Miller Hill area.

The Miller Hill collection substations which saw site work in Year 2 will be completed, energized, and commissioned in Year 3. Similarly, the interconnection substation will be completed. PCW will perform the site preparation for the collection substation in Sage Creek Basin, and the substation in Western Chokecherry.

The transmission line from the Miller Hill substations to the interconnection substation will be constructed in Year 3.

Upon completion of the Miller Hill wind turbines, substations, and transmission line, as well as the interconnection substation, the commissioning process will begin. By the end of November Year 3, all 350 installed wind turbines should be commissioned and operational.

The Operations Center will be constructed and staffed to operate the commissioned turbines. The Maintenance Facility in Sierra Madre will also be constructed.

Reclamation will begin in the Miller Hill area as site disturbing activities are completed. Similarly, reclamation will begin around the interconnection substation and the internal transmission line (where practical). If timing allows, reclamation will begin on the Miller Hill laydown yard.

4.4.1.4 Year 4

The plan for Year 4 is to construct the following Project elements:

- Installation and commissioning of the wind turbines in the Sage Creek Basin and Western Chokecherry areas (approximately 300)
- Completion of Sage Creek Basin and Western Chokecherry collection substations
- Installation of internal transmission lines from Sage Creek Basin to Miller Hill, and from completed Western Chokecherry substation to interconnection substation
- Eastern Chokecherry project roads and inner zone wind turbine pads
- Approximately 350 wind turbine foundations in Western and Eastern Chokecherry
- Eastern Chokecherry collection system
- Eastern Chokecherry collection substations site preparation
- Chokecherry Maintenance Facility built

Construction during Year 4 will focus on the completion of the Sage Creek Basin and Western Chokecherry areas. All remaining project roads and inner-zone turbine pads will be constructed. As with previous years, construction activities on roads and pads completed the previous years will begin approximately June 1, while construction involving new surface disturbance won't begin until July 15. All work is scheduled to be concluded by the end of October, with some flexibility to extend into November if weather conditions allow.

The laydown yard for Eastern Chokecherry will be prepared at the beginning of the season so that it can be utilized for Year 4 construction.

During Year 4, PCW expects to receive an additional approximately 300 turbines through the rail facility. The turbines will be transported to the Sage Creek Basin and Western Chokecherry sites, where they will be erected. Within a few weeks prior to the arrival of turbines at pad locations, PCW will prepare the outer zone of the turbine pads to allow for component delivery. The minimum amount of vegetation removal and site work will be performed to facilitate the turbine's installation.

In Year 4, all remaining roads and inner zone turbine pads will be constructed. Approximately 350 turbine foundations will be constructed in Western and Eastern Chokecherry. PCW expects road construction to be concluded by the end of September, and foundations by the end of October. Batch plants are expected in the Chokecherry and trailer complex laydown yards.

The remaining collection system in Chokecherry will be installed. Collection system connections will be made to all turbines erected in Year 4.

The Sage Creek Basin and Western Chokecherry substations whose sites were prepared in Year 3 will be completed and commissioned. Any collection substation sites in Eastern Chokecherry will be prepared.

The transmission line from the Sage Creek Basin substation to the connection point on the Miller Hill – interconnection substation line will be built. Additionally, the transmission line from the completed Western Chokecherry substation to the interconnection substation will be built.

Upon completion of the Year 4 wind turbines, substations, and transmission lines, the commissioning process will begin. By the end of November, the additional 300 installed wind turbines should be commissioned and operational.

The Maintenance Facility (or Facilities) in Chokecherry will be constructed.

Reclamation will be continued from Year 3 and begin in the Sage Creek Basin and Western Chokecherry areas. If timing allows, reclamation will begin in the Sage Creek Basin and Western Chokecherry laydown yards.

4.4.1.5 Year 5

The plan for Year 5 is to construct the following Project elements:

- Installation and commissioning of the wind turbines in the Eastern Chokecherry area (approximately 350)
- Completion of Eastern Chokecherry collection substations
- Installation of internal transmission lines from the completed Eastern Chokecherry substations to the interconnection substation
- Remaining Eastern Chokecherry wind turbine foundations
- Full Project demobilization

Construction during Year 5 will be focused on completion of the Eastern Chokecherry turbines, removal of temporary construction facilities, and reclamation. No new surface disturbances are expected in Year 5 except for the establishment of wind turbine pad outer zones. Where the outer zones require no surface changes, work can begin approximately June 1 or whenever weather allows. All work is scheduled to be concluded by the end of October, with some flexibility to extend into November if weather conditions allow.

In Year 5, all remaining turbines not previously delivered will arrive at the rail facility. These turbines will be transported to the Eastern Chokecherry sites and erected.

The collection system will be connected to the turbines erected in Year 5.

The Eastern Chokecherry substations will be completed and commissioned.

The transmission line from the Eastern Chokecherry substations to the interconnection facility will be installed.

Upon completion of the Eastern Chokecherry wind turbines, substations, and transmission lines, the commissioning process will begin. By the end of November, all Project wind turbines should be commissioned and operational.

All remaining temporary construction facilities will be removed. Reclamation across the project will begin or continue from previous years.

4.4.2 Construction Workforce

The workforce required to build the Project will be made up of a wide array of skillsets, including heavy civil work, iron work, concrete batching and placement, large mechanical assembly, crane work, electricians, and more. Some skillsets may be available regionally, and PCW will seek to hire those local skilled workers available. However, much of the workforce will be "travelers", many of whom are experienced in wind energy project construction and build projects throughout the country.

PCW has estimated the range of total workforce expected during each year of construction, and included it in Table 4-2. The final workforce requirements will depend greatly upon the final layout and construction plan, however this table should provide a range of total on-site Project personnel. These totals reflect all PCW and contractor personnel necessary for the performance and management of construction. Not included in these totals are BLM or other regulatory personnel.

Table 4-2. Expected Construction Workforce Breakdown

	Year 0	Year 1	Year 2	Year 3	Year 4
May	Up to 100	Up to 50	Up to 50	Up to 50	Up to 50
June	Up to 100	Up to 50	200 – 400	200 – 400	200 – 400
July	150 – 300	300 – 400	900 – 1,200	900 – 1,200	700 – 1,000
Aug	150 – 300	300 – 400	900 – 1,200	900 – 1,200	700 – 1,000
Sep	150 – 300	300 – 400	900 – 1,200	900 – 1,200	700 – 1,000
Oct	100 – 200	200 – 300	600 – 900	600 – 900	600 – 900
Nov	Up to 100	Up to 100	Up to 200	Up to 200	Up to 200

PCW anticipates the workforce will most likely work a single shift of 10 hours per day, 6 days per week. If schedule or weather constraints require, the workforce could be split into multiple shifts for limited periods of time. Most often this involves the erection of wind turbines being done when the winds are lowest, which may occur at night. The scheduling of these shifts can be dynamic and based on week-ahead and day-ahead forecasting. Alternative shifts would be

done within the peak workforce levels specified in the permit issued by the Wyoming Industrial Siting Council.

4.4.3 Construction Equipment

PCW has estimated the amount of equipment that will be used on the Project Site during construction (included in Table 4-3). The vast majority of this equipment will be transported to the Project at the beginning of the construction season in which it is needed, remain within the site during its use, and will be removed at the end of each season. Most of this equipment will be brought to and removed from the site by trucks or rail cars. The movement of the construction equipment is included in the Transportation Management Plan in Appendix C.

Table 4-3. Expected Construction Equipment Breakdown

Activity	Year 0	Year 1	Year 2	Year 3	Year 4
General Pick-Up Trucks	200	350	850	900	750
Other Equipment	200	200	400	450	300
TOTAL	**400**	**550**	**1,250**	**1,350**	**1,050**

4.4.4 Health and Safety Program

A Human Health and Safety Plan will be fully developed and implemented prior to the start of construction (typical components of such a plan are included in Appendix B). All Project personnel regardless of employer will work under strict approved safety guidelines that will be established prior to the start of the construction activities.

Safety is of the utmost importance on a construction site. Numerous potential hazards exist that can only be mitigated through education and vigilance. Warning signs will be posted along public roadways indicating upcoming dates of construction activities that could effect those roads, and PCW will have safety personnel along those roads during the activities to coordinate the traffic and construction activities. In addition, areas where supplies and equipment will be stored or areas deemed hazardous will also be properly secured (e.g., fenced) to prevent theft, tampering, or injury. Areas with construction in progress will be secured so that those without proper safety training will not be able to access them. Wind turbine access doors will remain locked whenever personnel are not at the turbine. Workers will be trained in health and safety issues as they pertain to the work site to prevent safety issues from arising and to address those that do. In case of an emergency, there will be an emergency response plan in place, and workers will be trained in proper implementation of its protocols.

4.4.5 Materials Estimates

The initial estimates for the maximum quantities of turbine components and materials required to construct the Project were presented as the basis of the rail facility design in Section 3.6. A revised estimate of the quantities, including a breakdown by year of construction, will be developed as the Project design and construction plans are finalized, and provided in the site-specific PODs.

4.4.6 Transport to the Project Site

PCW expects to receive equipment and material to the Project through the rail facility. Details regarding the delivery of components into that facility are included in Section 2.10. As discussed in Section 3.4.1, PCW may also explore delivery of some material to existing rail facilities in Sinclair or Rawlins while the Project rail facility is under construction in Year 1.

The majority of daily traffic to the Project will be personal vehicles of the workforce. The effect of these vehicles on the local traffic conditions is evaluated in the Transportation Management Plan attached in Appendix C. As allowed by the ROD, PCW will address in the site-specific PODs whether workforce members will report to the Project using WY71/CR401 (Sage Creek Road) when working in the Sierra Madre development area or if all traffic must pass through the construction trailer complex.

Prior to the start of construction each year, PCW expects to meet with the Wyoming Department of Transportation, Carbon County, City of Rawlins, and Town of Sinclair officials to discuss the expected traffic patterns for the project. PCW expects to provide local officials with monthly updates on Project construction, including any expected changes to the planned traffic patterns.

4.4.7 Transport within Project Site

The transportation of equipment and materials from the rail facility to where they are required on-site will be accomplished with various types of trucks and trailers. The materials used for the foundations, collection systems, and a majority of substation components will be transported to the designated areas by flatbed semi-trucks. The cement will be transported to the batch plants using dry bulk trailers. The aggregate will be transported from the rail facility to areas throughout the site using belly dump and side dump semi-trucks. The turbine components will be loaded onto specially designed transport trailers pulled by a semi-tractor. The oversize and overweight components for the substation (such as the 230/34.5 kV transformers) will be hauled on lowboy/flatbed trailers that are specifically designed for those weights. All liquids on site will be transported in tanker trucks. The main liquid items that will require transport will be water and fuel. The transportation of earth moving equipment and erection equipment on-site will be accomplished by using lowboy trailers and flatbed trailers.

The major source of transportation for moving the workforce on site will be through the use of pick-up trucks. The trucks will be staged at the construction trailer complex where workers will gather each day and use the pick-up trucks to mobilize to their work areas. The workers will return to the trailer complex at the end of their shift and park the pick-up trucks and exit the Project in their personal vehicles.

The only location where vehicles working with the Project would potentially cross a public road is where the haul road crosses CC401 (Sage Creek Road). PCW is expecting to perform traffic control at this crossing, likely stopping construction traffic to allow the small amount of public

traffic that uses CC401 to pass. There are expected to be few instances where public traffic would be held up briefly when large loads are crossing CC401.

Figure 4-11. Example Site Transport Trucks

4.4.8 Blasting

Initial geotechnical information has found that there may be some locations on-site where blasting may be advantageous for trench, foundation or road construction. PCW has developed an initial Blasting Plan (Appendix I), and in the event the final construction plan calls for limited blasting, PCW will include detailed plans for blasting in the site-specific PODs.

4.4.9 Excess Soils

In the process of constructing the Project, excess soils may be generated. These excess soils will most likely come from "cut" sections in the road construction, where the existing grade along a route must be reduced to meet road design criteria. PCW intends to prioritize a localized balance in cut and fill material requirements for road construction in the Project design. This should allow excess soils to be placed as fill material in areas near the cuts that generated the soils, so that the timeframe any excess soils need to be stockpiled will be minimized to the extent practical. If temporary stockpiling is necessary, it will be designed and performed in accordance with the Project's Master Reclamation Plan (Appendix E).

Excess soils are not anticipated to be generated for typical at-grade road construction, electrical line trenching, or for the construction of turbine pads and foundations. The final design for proposed road elevations across generally flat terrain will take into consideration anticipated excess soils by raising the road profiles as-needed so as not to generate unnecessary and unwanted excess material. Where excess material is unavoidably generated, it will be integrated into the road design to provide for positive drainage away from the roadway. Soils removed during trenching will be used to backfill the trenches. For the turbine pads and foundations, final turbine elevations will take into consideration the excess soil generated by raising the final grade 1 to 2 ft. so that the excess soil can be used to fill around the turbine base and provide positive drainage away from the turbine pedestal.

4.4.10 Construction Communications

During the construction stage of the Project, PCW may investigate means of improving the wireless communications on-site. Mobile radio repeaters and cellular stations may be placed on-site in areas already disturbed for Project construction. If any such equipment is used, it will be licensed with appropriate regulatory agencies and removed upon construction completion.

4.4.11 Waste Management

At the onset of construction, PCW will work with the BLM and Project construction contractors to develop a Waste Management Plan that identifies the waste streams that are expected to be generated at the site and that addresses hazardous waste determination procedures, waste storage locations, waste-specific management and disposal requirements, inspection procedures, and waste minimization procedures. This plan shall address all solid and liquid wastes that may be generated at the site.

All construction-related waste will be transported to and stored within a temporary area designated for waste until it is collected for transport to a final landfill destination by a licensed hauler. Materials that can be recycled will be stored and transported separately. Used or waste fuel, grease, and oil for equipment and vehicles will be stored prior to recycling or disposal within appropriate secondary containment and will be handled in accordance with all applicable rules and regulations. Any concrete left over will be hauled and disposed of at a permitted site. Sanitary waste will be handled by a licensed sanitary waste vendor.

Additionally, PCW, the BLM, and the Project construction contractors will develop a Hazardous Materials (HAZMAT) Management Plan addressing storage, use, transportation, and disposal of each hazardous material anticipated to be used at the site. The plan will identify all hazardous materials that will be used, stored, or transported at the site. It will establish inspection procedures, storage requirements, storage quantities, inventory control, non-hazardous product substitutes, and disposition of excess materials. The plan will also identify requirements for notices to federal and local emergency response authorities and include emergency response plans.

Hazardous materials are typically limited for a project of this nature. However, the following materials are anticipated to be used during construction and operation:

- Fuel (diesel and unleaded) for construction equipment and vehicles
- Lubricants and mineral oils
- Cleaners, industrial material

5. Operations and Maintenance

This chapter describes the expected activities for the operations and maintenance of the Project. As portions of the project complete construction, the wind turbines in those portions will begin to generate electricity. As this generation begins, those portions of the project will transition from the construction stage to the operations stage. Requirements for the operation of the wind turbines and other Project equipment, as well as post-construction maintenance requirements, are described below.

5.1 Project Operations

This section describes the common non-maintenance and non-repair activities performed on the Project between the completion of construction and the commencement of decommissioning.

As compared to many other forms of electrical energy generation, wind energy facilities do not have high operational staffing requirements. Operators at the Operations Center will watch for alarms or issues with the Project's components, manage any outages, and coordinate forecasting and reporting needs with utilities and regulators. Given the Project's size, it is assumed operators will be on duty at all times.

In addition to the operators, the Project will have administrative staff on duty during the business day. This will include project management and support staff. A staffing breakdown is provided in Table 5-2.

5.1.1 Wind Turbines

Wind turbines operate autonomously, based upon internal sensors detecting the conditions of the wind, power grid, and the turbine itself. When the electric grid is available to accept generation and there is sufficient wind, wind turbines will operate and generate power in an automatic mode. If the turbine's sensors detect an issue with the turbine or grid, the turbine will shut down and send a notification to the Operations Center through the Project's SCADA system as to the nature of the issue.

5.1.2 Electrical Collection and Transmission

As with the wind turbines, the components that make up the electrical collection and transmission systems respond automatically to the requirements of the wind turbines and electrical grid. While manual operation of the system's switches is possible, it is only done on an emergency basis.

5.1.3 Nighttime Operations

The majority of site activities will occur during daylight hours. During instances where nighttime activities are required in substations, PCW is currently planning to utilize a combined switched and motion-detection system for exterior lights. A master control switch for exterior

lights will be placed at the gate so that lights can be activated prior to personnel entering the yard (as required for safety). These lights will remain on when movement is detected within the substation, and for a "safety time period" (perhaps 30 to 60 minutes) after motion has been detected to facilitate worker safety. A few minutes prior to the end of the safety time period, the lights will flash to warn personnel that the lights are about to turn off. If motion is still not detected, the lights will then turn off at the end of the safety time period. The lights will turn back whenever motion is detected until the master switch at the substation gate is turned off. A similar system will be used for activities outside the operations and maintenance buildings (with master switches likely within the buildings). This approach will minimize the time the lights are on to avoid attracting wildlife, but provide adequate safety for project personnel. It should also minimize the instances of false motion detection needlessly activating the lights.

Nighttime operations activities outside the buildings and substations will be rare, and consist mainly of those maintenance activities discussed in Section 5.2. Any such activities would utilize temporary lighting fixtures that would not be used long-term.

5.1.4 Rail Facility

Once the construction stage of the Project is completed, relatively few loads will be brought to the site. This will include some spare parts for maintenance needs, and possibly additional aggregate to maintain Project roads. Given the amount of parts or material needed, PCW anticipates many of these deliveries will be more economical by truck rather than train. As such, the rail facility will not be operated often for the Project during the operations stage.

5.2 Project Maintenance

As with any energy facility, a key factor to achieving maximum efficiency of the Project once it is constructed is proper maintenance. PCW intends to implement a maintenance plan that will encompass all aspects of the Project. Features of the maintenance plan are discussed below.

PCW will employ technicians to perform Project maintenance who are properly trained and equipped for the required tasks. This will include a number of wind turbine technicians, high voltage technicians for the transmission lines, substations, and collection system, and civil technicians for the roads and related earthwork. If required, PCW may engage specialized technicians on an as-needed basis for limited periods of time.

PCW will develop a winter access plan for the Project. This plan will include when and how snow clearing would be performed, and when alternative equipment (such as snow cats) would be used. PCW would stage such alternative equipment where it would likely be needed (such as the base of Miller Hill) during the winter months to give technicians easy access to the equipment.

5.2.1 Scheduled Turbine Maintenance

Wind turbine manufacturers specify a turbine maintenance schedule for each turbine model. PCW will base the Project's maintenance protocol on these manufacturer recommendations to maintain high reliability and maximum efficiency.

The requirements for scheduled maintenance vary by turbine vendor, but often include the following:

- Visual and noise inspection of all major turbine components
- Torque checks on tower and component bolts
- Level and leak check on lubrication systems
- Lubricate appropriate seals and bearings
- Level and leak check and sampling of gearbox oil
- Replace gearbox oil filters
- Brake system inspections
- Test control and emergency systems
- Inspect aviation warning lights

The frequency of scheduled maintenance is typically between six months and a year.

If the sampling and testing of turbine fluids determine that such fluids need to be replaced, that work would also be a scheduled maintenance activity. Such replacements are only performed when necessary, with industry averages around once every five years. The types and quantities of turbine fluids that may need field replacement are provided in Table 5-1.

Table 5-1. Common Wind Turbine Fluid Volumes

Turbine Fluid	Common Volume Range
Gearbox Oil	200 - 300 gal
Coolant	50 - 150 gal
Hydraulic Oil	10 - 60 gal

PCW will prioritize the performance of scheduled maintenance during the summer months for areas of the Project where winter winds are particularly high and when site access is more challenging.

5.2.2 Unscheduled Turbine Maintenance

Even with a comprehensive and effective scheduled maintenance program, turbines will require additional repairs at unscheduled times. If such repair needs cause the turbine to go off-line, PCW will perform the necessary unscheduled maintenance as soon as practical to return the turbine to service.

The majority of unscheduled maintenance involves relatively minor repairs internal to the turbine, and hence can be performed whenever necessary.

If an unscheduled maintenance activity requires work outside the turbine (such as blade cleaning or repair), or if tools or components need to be winched on the outside of the tower, then work would be performed as soon as weather conditions allow.

There will be some instances where a major turbine component (such as gearbox, generator, or blade) requires replacement, and an external crane would be necessary. In such an instance, PCW would re-establish a crane pad at the turbine site, possibly using an existing access road or adjacent area. The crane would be trucked to the site and assembled on the crane pad. Once the component replacement was complete, the crane would be disassembled and trucked from the turbine site, allowing the turbine to return to service. The crane pad would be reclaimed per the reclamation plan upon completion of the maintenance activity.

It is unlikely that turbines requiring unscheduled maintenance at the same time would be close enough together to make walking cranes between them viable. However, if such a situation did occur and walking the crane between sites was deemed appropriate, PCW would re-establish the compacted road shoulders as was done during the Project construction. Once the crane had moved and the unscheduled maintenance was completed, PCW would restore the road shoulders per the reclamation plan.

5.2.3 Road Maintenance

The Project roads would receive continuous maintenance as needed. Road surfaces would be bladed and maintained to allow for safe access to all Project areas and to minimize dust generation. Periodic inspection, cleaning, and maintenance would be done for all drainages and erosion control measures.

5.2.4 Collection System

Once construction is complete, little maintenance on the collection system should be needed. Most maintenance issues that do occur on underground electrical lines do so at junction points or splices, which is why those points are done in above-ground splice boxes where they can be repaired easily. If an issue occurred with a section of underground cable away from a junction box, PCW would first perform testing to determine the location of the fault. Once the location was known, a small portion of the cable would be excavated and replaced. The excavation disturbance would then be reclaimed per the requirements of the reclamation plan.

PCW is planning on using above-ground lines for portions of the collection system. These lines will be frequently inspected, and repaired as needed. If a section of overhead line needed to be replaced, it would be done in a manner similar to the original installation. PCW would also perform any necessary vegetation management around overhead collection system lines to remove tree branches within about 50 feet of the structures or conductor.

5.2.5 Substations

Preventative maintenance for substation equipment is often performed on an annual basis, commonly requiring a brief (less than 1 day) shut-down and de-energization. PCW will have high-voltage technicians on-staff to perform and supervise such maintenance, and perform any as-needed maintenance outside the planned preventative maintenance.

Virtually all substation maintenance can be performed within the substation fence, and without using large equipment. Such work is often performed at ground level, or using utility boom trucks.

5.2.6 Transmission Lines

Transmission lines will be inspected frequently, commonly at least once per quarter plus after any strong storm events. Such inspections will occur from the ground and using nearby project roads. PCW would also perform any necessary vegetation management around overhead collection system lines to remove tree branches within about 50 feet of the structures or conductor.

When deemed necessary, inspection and maintenance work would be performed on the transmission line. This may require portions of the line to be de-energized, and crews to perform close inspections using utility boom trucks.

5.2.7 Other Facilities

The met towers on site would receive annual and as-needed maintenance to replace sensors, check structure conditions, and check guy wire tension (if applicable). As with the wind turbines, aviation warning lights will be equipped with sensors to notify maintenance personnel if any issues arise that require service.

As with any building, the site buildings (Operations Center and maintenance buildings) would receive as-needed maintenance.

5.3 Operations and Maintenance Workforce

As the construction of each portion of the Project is completed, the responsibility for it will be turned over to the operations and maintenance personnel. Table 5-2 lists the estimated number of personnel required for each job function described below. As with all projects, it is expected that some personnel will be qualified to work in multiple areas to balance workforce needs. PCW would look first to the local labor pool to fill these positions.

In response to some maintenance issues, PCW may find it necessary to engage additional personnel for short periods of time. The number of technicians and length of deployment would be determined when the issue occurs.

Table 5-2. Operations and Maintenance Workforce Breakdown

Job Function	Year 2	Year 3	Year 4+
Number of Wind Turbines	*350*	*700*	*1,000*
Management & Administration	4	6	8
Operations	4	5	6
Wind Turbine Maintenance	33	66	94
High Voltage Maintenance	2	2	2
Civil Maintenance	2	2	2
Environmental Monitoring	2	2	2
TOTAL	**47**	**83**	**114**
Note: Numbers may vary somewhat if the number of turbines completed each year changes.			

Management and Administration
This category includes the Project Manager, other management staff, and project administrative personnel. These personnel would be located in the Operations Center.

Operations
Operations staff would manage the Project's SCADA system, oversee Project performance, manage the response to any unscheduled maintenance needs, and perform reporting services to the Project's off-takers. These personnel would be located in the Operations Center.

Wind Turbine Maintenance
This category encompasses the majority of the operations and maintenance staff, and includes all personnel involved with the maintenance of the wind turbines themselves. Most of this staff would be wind turbine technicians who will work in teams to perform maintenance on the turbines. It would also include technician foremen, training staff, and safety personnel.

High Voltage Maintenance
The high voltage maintenance staff would be technicians specially trained in the maintenance of high voltage equipment. Their primary responsibility will be to maintain the Project's substations and transmission lines.

Civil Maintenance
These technicians will maintain the Project's civil features, including roads, turbine pads, and erosion control measures. They will also maintain the water crossing features.

Environmental Monitors
The environmental monitoring team will perform the site monitoring for compliance with site environmental plans and permits.

5.3.1 Health and Safety Program

As with the construction stage of the Project, a Human Health and Safety Plan will be fully developed and implemented. The operations stage version of this plan will be very similar to that for the construction stage, however, it will address additional issues regarding the size of the staffing and the year-round nature of the work.

6. Decommissioning

This chapter describes the methods and means to decommission the Project at the end of the Project's useful life, expected to be 30 years after initial operation.

As with the construction of the Project, the activities described below are discussed in general terms. PCW will develop a decommissioning POD for review and approval by BLM. As with other PODs, the decommissioning POD will include a reclamation plan specific to the covered activities.

6.1 Pre-Decommissioning Activities

Prior to the commencement of field decommissioning work, the following activities will be performed.

6.1.1 Decommissioning Planning Workshop

PCW will hold a workshop to determine the scope and requirements for project decommissioning to insure that current decommissioning standards are met. PCW will also solicit input from affected landowners, as well as relevant local and state agencies. Items to be discussed will include:

- Which roads to leave unreclaimed
- Options for off-site recycling, scrap, and landfill facilities
- Requirements for final reclamation

6.2 Project Decommissioning Activities

PCW currently expects that the following activities will need to be performed to achieve project decommissioning. The exact requirements for equipment removal, including the depth to which buried components are extracted, will depend upon the requirements of the ROD and common industry practices at the time of decommissioning.

6.2.1 Wind Turbines

Turbine disassembly will be accomplished using large cranes similar to those used for installation. Components will be removed in reverse-order of installation, and placed either directly onto trucks for removal from the Project Site, or onto the ground near the turbine base for eventual loading onto trucks.

Wind turbine tower sections will most likely be transported to scrap yards where they will be recycled. Similarly, nacelles will probably be transported to scrap yards where they will be disassembled, with components either reused, scrapped, or landfilled. Blades and nacelle covers will most likely be broken down and either landfilled or recycled. The options for wind turbine recycling are evolving, and are expected to be very different at the time of Project decommissioning than they are currently.

Following removal of the turbine and foundation, the site will be recontoured to the extent practical, and any remaining foundation elements buried. Topsoil replacement and revegetation will be performed per the decommissioning reclamation plan.

6.2.2 Foundations

Foundations will be exposed using backhoes, bulldozers and other heavy earth moving equipment. The top portion of the foundations, which consist of the upper portions of the pedestal for the expected mat foundations, will be broken up and removed. The remaining portion of the foundation will remain in place.

6.2.3 Wind Turbine Pads

To facilitate wind turbine removal, it may be necessary to restore portions of the turbine pads to construction stage conditions. Specifically, crane pads will likely be necessary to remove the turbine components, and some areas around the pads may need to be compacted to allow turbine components to be stored on the ground until they can be removed from the site.

Once the wind turbine components and any above-ground electrical elements have been removed and the upper portions of the foundations removed, the turbine pad can be reclaimed. The site will be recontoured to the extent practical, and any remaining foundation elements buried. Topsoil replacement and revegetation will be performed per the decommissioning reclamation plan.

6.2.4 Electrical Collection System

Above-ground elements of the collection system, such as the overhead poles, junction boxes, and padmounted transformers will be removed. Underground cables buried less than two feet below grade will be removed, and cables buried more than two feet will remain in place. Any areas disturbed in the collection system decommissioning will be reclaimed per the decommissioning reclamation plan.

6.2.5 Collection Substations

Collection substations internal to the Project Site will be removed. All above-ground equipment will be removed, as will any below-ground equipment and material buried two feet or less. The site will be recontoured to the extent practical, with topsoil replaced and revegetated per the decommissioning reclamation plan.

6.2.6 Internal Transmission

Internal 230 kV transmission lines that connect the collection substations to the interconnection substation will be removed. All above-ground equipment and structures will be removed, and the upper two feet of the structure foundations will be removed in a manner similar to that of the wind turbine foundations. Structure base areas will be recontoured and reclaimed per the decommissioning reclamation plan.

6.2.7 Interconnection Substation

The interconnection substation for the Project will be removed in a manner consistent with the collection substations. If at some future time other permitted transmission lines or generation facilities interconnect into the substation such that decommissioning and removal of the substation would lead to instability of the transmission grid, then the interconnection substation would remain and continue under the operation and maintenance of PCW or a regional transmission operator such as Rocky Mountain Power or Western Area Power Administration until such time as decommissioning and removal is feasible.

6.2.8 Operations and Maintenance Buildings

The Operations Center and maintenance buildings would be demolished. The building sites would be recontoured and revegetated per the requirements of the decommissioning reclamation plan.

6.2.9 Met Towers

All Project met towers would be removed, including all above-ground equipment and structures, as well as the upper two feet of met tower foundations. Met tower areas would be recontoured and reclaimed per the decommissioning reclamation plan.

6.2.10 Roads

To perform the decommissioning activities, it may be necessary to return some roads to their construction stage conditions. This will allow for efficient crane access to the turbine sites and facilitate removal of the wind turbine components by truck.

Once decommissioning has been completed at the turbine pads, substation sites, and maintenance buildings, PCW will remove and reclaim the roads based upon the decommissioning reclamation plan. This will likely include the removal of aggregate and any unnecessary culverts, de-compaction of the road base, and recontouring of larger cuts and fills.

6.2.11 Rail Facility

PCW would utilize the rail facility to remove wind turbine components and other materials from the Project Site. In a manner similar to the construction stage of the project, components would be taken from the site to the delivery staging area adjacent to the rail facility. From there, components would be loaded onto railcars for shipment to identified recycling, scrap, or landfill facilities.

After all components and material have been removed from the site, the rail facility would be decommissioned. Above-ground material such as aggregate, rails, and cross-ties would be removed, and the site recontoured. The site would be revegetated per the decommissioning reclamation plan.

In the event that PCW turns over control of the rail facility to another party (such as the Union Pacific Railroad), PCW will file application with BLM to assign its right-of-way grant for any rail facilities on public lands to the successor operator.

6.3 Temporary Decommissioning Facilities

As with construction, it may be necessary to establish temporary facilities to facilitate Project decommissioning.

6.3.1 Trailer Complex and Laydown Yards

The personnel involved in the decommissioning of the Project will require temporary office space, and equipment and material storage. Because the Operations Center and maintenance buildings will be removed as part of the decommissioning, PCW will need to establish a trailer complex and laydown yards within the Project Site similar to those used during the construction stage. Where practical, PCW will utilize the areas adjacent to the existing buildings and storage yards within the Project Site at the Operations Center and maintenance buildings. If additional areas are needed, they will be established in a manner similar to those described in Sections 3.3.1 and 3.3.2.

6.4 General Decommissioning Information

This section provides information regarding the expected schedule, labor force, equipment needs, and material requirements for the decommissioning of the Project.

6.4.1 Decommissioning Schedule

PCW has developed an estimate of workforce and equipment requirements based upon a three year decommissioning schedule. During that period the project would be divided into geographical areas, with all of the decommissioning activities occurring in each area in a single season. The area boundaries will be determined when the decommissioning POD is developed.

The decommissioning schedule will be re-evaluated prior to the start of the decommissioning activity. A final schedule will be presented in the POD developed for the decommissioning stage.

The schedule and activities discussed below do not include any long-term reclamation activities that would continue past the end of decommissioning. Those activities are discussed in the reclamation plan. PCW anticipates the workforce and equipment required for long-term reclamation will be small in comparison.

6.4.2 Decommissioning Workforce

The workforce estimate reflects PCW's current plans for decommissioning and will be revised for the decommissioning POD.

As with the construction of the Project, the workforce necessary to decommission the Project

will be made up of skilled labor, including heavy civil work, concrete demolition, large mechanical disassembly, crane work, electricians, and more. Some skillsets may be available locally or regionally, and PCW will seek to hire those skilled workers as available. However, much of the workforce may be "travelers", many of whom are experienced in wind energy project construction and demolition.

PCW has estimated the workforce expected during each year of construction and included it in Table 6-1. These totals reflect all PCW and contractor personnel necessary for the performance and management of decommissioning.

Table 6-1. Expected Decommissioning Workforce Breakdown

	Year 1	Year 2	Year 3
April	Less than 200	Less than 200	200 – 300
May	300 – 400	300 – 400	300 – 400
June	300 – 400	300 – 400	300 – 400
July	300 – 400	300 – 400	300 – 400
Aug	300 – 400	300 – 400	300 – 400
Sep	200 – 300	200 – 300	300 – 400
Oct	200 – 300	200 – 300	300 – 400

PCW anticipates the workforce will work a single shift of 10 hours per day, 6 days per week. If schedule or weather constraints require, an additional shift could be added, most likely in the later months of the yearIdeally the work shift for all workers would be during daylight hours, however it is not uncommon for weather issues to require some work be done at different times. Most often this involves the removal of wind turbines being done when the winds are lowest, which may occur at night. The scheduling of these shifts can be dynamic and based on week-ahead and day-ahead forecasting. While these variations will affect the time of day the workforce is on-site, it should not affect the total size of the workforce engaged in the Project's decommissioning.

6.4.3 Decommissioning Equipment

PCW has estimated the amount of equipment that will be used for the Project's decommissioning. See Table 6-2. The vast majority of this equipment will remain within the site during use, and will be brought to and removed from the site by trucks or rail cars.

Table 6-2. Expected Decommissioning Equipment Breakdown

	Year 1	Year 2	Year 3
General Pick-Up Trucks	350	350	350
Other Equipment	150	150	150
TOTAL	**500**	**500**	**500**

6.4.4 Health and Safety Program

The health and safety program for Project decommissioning will have similar components and goals as that for construction, as discussed in Section 3.4.4 and Appendix B.

6.4.5 On-Site Transportation

The methods of removing components and material from the Project Site will be very similar to those used for construction, as discussed in Section 3.4.7. Trucks will be used to transport items from the turbine pads to the rail facility, where they will be transferred to rail cars for transport to off-site recycling or disposal centers.

6.4.6 Waste Management

The decommissioning activity will have a waste management plan similar to the one developed for construction, discussed in Section 3.4.9. In addition to the waste associated with the operation of equipment and generated by the workforce, the plan will include the manner for handling of equipment and material removed during the decommissioning activity. Disposal of all waste items will occur off-site in properly-permitted and approved disposal centers identified at the beginning of the decommissioning activity.

7. Environmental Resources

PCW will plan and implement all aspects of the Project with the intent of minimizing effects to environmental resources, to the extent practicable, from any new infrastructure required. Measures will be applied to avoid, minimize, or mitigate potential effects to environmental resources from construction and operation of the Project. The following sections discuss the environmental resources within the Project Site and the Applicant Committed Mitigation Measures (ACMs) for each resource. An overview of the ACMs for the environmental resources within the Project Site is provided in Appendix A.

7.1 Wildlife

PCW will plan and implement all aspects of the Project with the intent of minimizing effects to wildlife and fish species, to the extent practicable, from any new infrastructure and surface disturbing activities required. Measures will be applied to avoid, minimize, or mitigate potential effects to wildlife species from construction and operation of the Project. Potential effects to wildlife can be grouped into three primary categories; loss of habitat, displacement, and mortality. Surface disturbing activities may result in site-specific effects due to the loss and fragmentation of habitat, changes in surrounding hydrology, and increased anthropogenic influences.

Site-specific information on avian, bat, and special status species occurrence was collected by Western EcoSystems Technologies, Inc. (WEST) and SWCA Environmental Consultants (SWCA) in the Application Area in 2008-2009 and 2010-2011 to provide baseline information. Site-specific surveys and/or monitoring for Endangered Species Act (ESA) threatened and endangered species, BLM sensitive species and other wildlife and fish species will take place during each stage of the Project and will be discussed in the site-specific PODs for each of the right-of-way grants. The data collected will be used to reduce the potential effects of project construction and operation to the extent practicable. Based upon this data, PCW will continue to revise proposed plans and microsite infrastructure and facilities prior to construction to avoid, minimize, or mitigate effects to sensitive wildlife and fish species.

PCW has also developed conservation measures to promote conservation of many wildlife and fish species in the Application Area. The land and water resources on the Ranch, both within and outside of the Application Area, provide the flexibility to promote conservation of wildlife and fish species while still developing the wind resource. PCW is actively coordinating with the BLM, WGFD, and USFWS to identify additional conservation measures and has already begun implementation of many measures to provide conservation uplift for many of the species that would be potentially affected by wind energy development. As many of these species are dependent on the same or similar habitats, conservation actions directed towards one species will have ancillary benefits for many other species. Many of these conservation measures are included as Applicant Committed Measures (ACM) in Appendix A.

Compliance with the terms and conditions of BLM's ROD and right-of-way grants and the application of ACMs will serve to avoid and/or minimize impacts to wildlife and their associated habitats. Appendix A contains the ACMs identified by PCW to avoid, minimize, and mitigate impacts to wildlife and fish resources. The terms and conditions of the ROD and right-of-way grants may contain timing and spatial stipulations designed to avoid or minimize impacts to wildlife on public lands. If exceptions to timing and spatial stipulations are needed for construction and/or operations of the Project, PCW will work with BLM and other agencies to identify appropriate strategies and mitigation measures to ensure impacts do not exceed those disclosed in the NEPA analysis.

7.1.1 Avian Species and Bats

Mitigation measures will be applied to avoid, minimize, and mitigate potential avian and bat species effects from construction and operation of the Project. Turbines will be sited to avoid and/or minimize potential effects to native species, particularly BLM sensitive species. PCW is working in close coordination with the USFWS, WGFD and the BLM to develop mitigation and conservation strategies for avian and bat species and an Avian Protection Plan and Eagle Conservation Strategy (hereafter jointly referred to as an APP), the development of a Bat Protection Plan (BPP) and compliance with BLM Instruction Memorandum No. 2010-156 (IM 2010-156). The APP and BPP will evaluate options to avoid, minimize, and mitigate project effects through pre-construction surveys, siting, operations, and monitoring.

7.1.1.1 Surveys

PCW's avian and bat surveys, monitoring and conservation approach will enable the development of wind resources in a manner that is consistent with the conservation of avian and bat species. Results of the survey program will allow PCW to identify the most appropriate advanced conservation practices to avoid, minimize, and mitigate potential risks to avian and bat species.

Since 1996, specific surveys have been conducted of mapped raptor nests in the RFO. These records have been supplemented with raptor nests located as part of the permitting process for development activities such as pipelines and oil and gas developments (Cline 2010). Year-long baseline avian and bat use surveys were conducted in the Application Area in 2008-2009 and 2010-2011. Avian and bat survey efforts will continue as necessary in the years prior to construction. Survey results characterize seasonal, spatial, and temporal use of surrounding habitat (WEST 2009a, 2008a, 2008b, SWCA 2011a). Sampling intensity for all survey efforts was designed to document use and behavior by habitat and season within the Application Area.

Efforts in 2008 and 2009 included:

- Baseline avian use surveys were conducted approximately bi-weekly during summer and winter (June 15 to August 31; November 16 to December 31) and weekly during the fall (September 1 to October 15) and spring (March 16 to May 31).
- Aerial surveys were used to locate and map active and inactive raptor nests within 1 mile of the Application Area during May 2008.
- An acoustic bat study was conducted at six locations in the Chokecherry and Sierra Madre areas to determine the spatial and temporal variation of bat use.

Efforts in 2010 and 2011 include:

- An avian radar system is being used across the Application Area to survey avian and bat activity and habitat use patterns. Avian radar systems collect detailed avian and bat use data 24-hours per day and can map activity across an approximate 66 square-mile area surrounding the radar location. Radar data will identify high use areas and enable PCW to site the wind project in a manner that will reduce effects to avian and bat species. Five locations were surveyed with the radar in 2011 to provide precise use data in the wind development areas. Additional radar survey sites are planned for 2012.
- Raptor use surveys were conducted at 15 locations across the Ranch to map raptor use of the Project area in locations that are not being directly surveyed by the radar. Each site is surveyed 8 hours per survey day to determine possible exposure rates for raptors and other avian species.
- Avian point count surveys are being conducted at 15 locations across the ranch to document migratory and resident use of the Project area.
- Breeding and resident bird grid surveys have been conducted at 16 locations throughout the wind development areas to map the relative abundance and density of bird activities during non-migratory periods.
- Raptor nest surveys have been completed for all areas within 5 miles of wind development areas (an area of nearly 700,000 acres). Helicopter surveys were used to survey suitable nesting habitat and to survey known nests for other large raptor species. Follow-up ground surveys were used to document nest success, identify nest condition, and to locate additional raptor nests that could not be identified during helicopter surveys.
- Prey base evaluations are being conducted to evaluate areas containing prey densities sufficient for eagle and large raptor foraging activities.
- Burrowing owl (*Athene cunicularia*) nest surveys have been completed in several sections in the northern portions of the Chokecherry development area near the potential internal haul road, operations facility, and substation locations.
- Nest condition has been documented for all known ferruginous hawk (*Buteo regalis*) nests located within the Application Area. Each nest was surveyed via helicopter with follow-up ground visits to evaluate whether a nest still existed and what the current condition of the nest is.

- Acoustic bat surveys are continuing in locations surrounding the avian radar system to evaluate nocturnal biological activity and determine how much, if any of the activity is related to bat use.

7.1.1.2 Avian Species Activity

Passerines are by far the most abundant bird type observed in the Application Area during all seasons with the exception of winter when all avian activity levels are low. The most commonly observed passerine species are horned lark (*Eremophila alpestris*), vesper sparrow (*Pooecetes gramineus*), Brewer's sparrow (*Spizella breweri*), western meadowlark (*Sturnella neglecta*), and sage thrasher (*Oreoscoptes montanus*).

Raptor occurrence is highest during fall migratory periods, followed by summer, spring and winter. Nest surveys were completed from helicopter for all areas within 1 mile of the Application Area in 2008 (WEST 2008a) and within 5 miles of all probable turbine locations in 2011 (SWCA 2011). Red-tailed hawk (*Buteo jamaicensis*) nests were the most abundant of all raptor species followed by prairie falcon (*Falco mexicanus*), great horned owl (*Bubo virginianus*), golden eagle (*Aquila chrysaetos*), and bald eagle (*Haliaeetus leucocephalus*). Most nests observed during both survey events were inactive and of varying condition. Most nests in the Chokecherry development area were located in the extreme southern portion along the Bolten Rim although several also occurred along a ridgeline that runs east-west through the northern end of the Chokecherry development area. Far fewer nests were located within the Sierra Madre development area along steep, wooded slopes that lead away from the area on the north and east face of Miller Hill.

The annual mean raptor use within the Application Area (0.46 raptors/plot/20-minute survey), as determined though fixed-point bird use surveys, was compared with other wind-energy facilities that implemented comparable protocols (36 other wind-energy facilities were included in the analysis). The annual mean raptor use at these wind-energy facilities ranged from 0.09 to 2.34 raptors/plot/20-minute survey (Erikson et al. 2011). Based on the results from these wind-energy facilities, a ranking of seasonal raptor mean use was developed as: low (0 to 0.5 raptors/plot/20-minute survey); low to moderate (0.5 to 1.0); moderate (1.0 to 2.0); high (2.0 to 3.0); and very high (>3.0). Under this ranking, mean raptor use in the Application Area is considered to be low, with the Application Area ranking twenty-second when compared with the 36 other wind-energy facilities.

7.1.1.3 Bat Species Activity

Bat activity in the Application Area is highest from mid-July through the end of August, at which point bat activity abruptly decreases as weather grows cooler. Bats with high-frequency calls (≥35 kilohertz [kHz]) were most common (63% of all detections). High-frequency bats are generally small bats including *Myotis* spp. Low frequency bats (calls <35 kHz) made up the remaining detections.

The Application Area is not located near any large, known bat colonies or features that are likely to attract large numbers of bats. Additionally, the Application Area does not contain topographic features that may funnel migrating bats, and is lacking large tracts of forest cover, unlike high-mortality wind-energy facilities in the eastern United States. Based on the relative scarcity of bat foraging and roosting habitat in the Application Area (e.g., wetlands and forested areas), the majority of bat fatalities are expected to be individuals migrating through the Application Area rather than local, breeding bats. However, an open landscape is no guarantee of low mortality (Gruver et al. 2009; Baerwald 2006; Jain 2005).

7.1.2 Greater Sage-Grouse

Greater sage-grouse (hereafter sage-grouse) use different habitats seasonally and have specific habitat needs for male courtship displays, nesting, early and late brood-rearing, and winter foraging. Surface disturbing activities may result in site-specific losses of sage-grouse habitat due to the removal and loss of sagebrush (*Artemisia* spp.) cover and surrounding vegetation communities, changes in surrounding hydrology, and increased anthropogenic influences. In an effort to reduce effects to sage-grouse, PCW has developed a Conservation Plan (Appendix N) which contains additional ACMs and conservation measures. In addition, PCW will comply with Wyoming Governor's Executive Order 2011-5 (EO 2011-5) and commits to no construction activities within Wyoming's Sage-Grouse Core Management Areas as they are identified in EO 2011-5 Version 3 map..

Conservation measures are being implemented not only in the Application Area but across the Ranch to conserve current sage-grouse populations. Conservation and enhancement of sage-grouse and the sagebrush ecosystem in conjunction with the Project development is a primary objective in the future of these lands. Selected conservation measures that are currently being implemented across the Ranch are listed below.

- Implementation of a robust sage-grouse surveying effort to evaluate population characteristics and habitat use across the Ranch and surrounding areas.
- Development of a detailed vegetation map of the Ranch to assess sage-grouse habitat quality and use.
- Application of habitat improvements through enhanced rangeland management, vegetation treatments, and revegetation efforts to increase habitat quality throughout the Ranch.
- Removal of fences to reduce risks for collisions and mortality.
- Installation of bird diverters on select fences and guyed met towers to reduce risks for collisions and mortality.
- Identification and closure of unused and unnecessary roads to reduce fragmentation and remove conduits for predators.
- Installation of escape ramps in stock water tanks to reduce drowning risks.

7.1.2.1 Surveys

Baseline data were collected on sage-grouse in the Application Area in 2008-2009 and 2010-2011. Sage-grouse use different habitats seasonally and have specific habitat needs for male courtship displays, nesting, early and later brood-rearing, and winter foraging. Survey results characterize seasonal, spatial, and temporal use of surrounding habitat (WEST 2009b, 2009c, 2008c, 2008d, SWCA 2011b). Sampling intensity for all survey efforts was designed to document use and behavior by season and habitat within the Application Area.

Efforts in 2008 and 2009 included:

- Baseline surveys on sage-grouse lek activity and attendance in the Application Area during spring 2008 and spring 2009.
- Aerial surveys to map active and inactive leks and locate new leks within 4 miles of the Application Area in the spring of 2009.
- Brood-rearing surveys to determine if the Application Area provides suitable habitat and to identify the location of brood-rearing habitat during the late spring/early summer of 2008 and 2009.

Efforts in 2010 and 2011 include:

- Baseline surveys on sage-grouse lek activity and attendance in the Application Area during spring 2010 and 2011.
- Habitat models to assess potential Project effects to sage-grouse and to identify important nesting, brood-rearing, and winter habitat areas.
- Lek attendance/sightability studies to evaluate the efficacy of lek surveying protocols.
- Sage-grouse GPS tracking to document survival, locate new leks, monitor use throughout the Application Area, and evaluate conservation measures.
- Nest inventories to determine nesting success and nest proximity to leks in the Application Area.
- Brood surveying to document brood-rearing success, characterize brood-rearing habitat, and evaluate chick-brood rearing hen survival rates in the Application Area.
- Vegetation attribute documentation in seasonal habitats to model resource selection functions of varying sage-grouse life stages in the Application Area.

7.1.3 Other Wildlife Species

Site-specific surveys will be conducted for other wildlife species, including BLM sensitive species, to help guide final facility layouts and transmission line alignments. Location of surveys, species of interest, and protocols for completing surveys will be identified in detail in the site-specific POD developed for each of the right-of-way grants. PCW will continue to utilize the outcome of site-specific surveys to microsite infrastructure in order to avoid, minimize, or mitigate effects to sensitive wildlife species.

7.1.3.1 Surveys

Baseline surveys for BLM sensitive species and other wildlife species were conducted in the Application Area in 2008-2009. Sampling intensity for all survey efforts was designed to document use and behavior by habitat and season within the Application Area.

Big game species that may be present within the Application Area include elk (*Cervus Canadensis*), mule deer (*Odocoileus hemionus*), and pronghorn (*Antilocapra americana*). Range types for these species include winter, winter-yearlong, crucial winter, crucial winter-yearlong, and spring-summer-fall. PCW along with TOTCO is coordinating with WGFD on potential management practices of big game species that include mule deer and pronghorn antelope surveying using GPS transmitters.

Efforts to date include:

- Big game seasonal ranges were identified across the Application Area using the big game seasonal ranges designated by the WGFD (WEST 2008e).
- PCW continues to coordinate with WGFD and BLM to survey big game populations in the Application Area and identify appropriate management actions for the portions of the population that might be affected by the Project.
- Observations and mapping of white-tailed prairie dog (*Cymys leucurus*) and black-footed ferret (*Mustela nigripes*) were conducted from aircraft and ground surveys within the Application Area during the months of May through September 2008 (WEST 2008f).
- Specific surveys were conducted to map suitable habitat for mountain plover (*Charadrius montanus*) within the Application Area and record any observations of individual birds (WEST 2008g).

Further site-specific wildlife surveys will take place within areas potentially affected as identified in the site-specific PODs and in accordance with the terms and conditions of the ROD. PCW will continue to incorporate the outcome of site-specific surveys to microsite infrastructure in order to avoid (if possible), minimize, or mitigate effects to sensitive wildlife species.

7.1.4 Wildlife Habitat Management Areas

The Application Area contains portions of two Wildlife Habitat Management Areas (WHMAs) that are managed with specific goals and objectives. The Red Rim-Grizzly WHMA is managed in accordance with a cooperative agreement between the BLM and the WGFD to maintain and enhance wildlife habitat conditions in conjunction with livestock grazing. The Upper Muddy Creek Watershed-Grizzly WHMA was designated in the BLM's Rawlins Field Office Resource Management Plan to manage for the Colorado River fish species unique to the watershed; manage crucial winter habitat for elk and mule deer; and to seek the cooperation of owners of adjacent property in management of habitat. The Upper Muddy Creek Watershed/Grizzly WHMA overlaps a large portion of the Grizzly area of the Red Rim-Grizzly WHMA. In an effort to reduce effects to wildlife, PCW will not construct any facilities within portions of the Red Rim-

Grizzly WHMA and Upper Muddy Creek Watershed-Grizzly WHMA that are within the Wyoming Sage-Grouse Core Management Area Version 3 Map (EO 2011-5).

7.1.5 Fisheries

Fish habitats in the Application Area include perennial and intermittent streams, springs, lakes and reservoirs. The Application Area is located within two watersheds; Upper North Platte Watershed in the Platte River Basin and the Muddy Creek Watershed in the Upper Colorado River Basin. The management of fisheries within the Application Area is the responsibility of the WGFD and is shared between the Laramie and Green River WGFD fisheries regions. Fish habitat is related to the hydrologic conditions of the riparian areas and uplands associated with, or contributing to, a specific stream or waterbody, and to stream channel characteristics. The Application Area provides habitats for many native species, including bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*Catostomus latipinnis*), roundtail chub (*Gila robusta*), and Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*). PCW is working in coordination with WGFD and BLM to develop conservation strategies for fish species in the Muddy Creek watershed and implement surveying efforts for these fish species. In addition, PCW will be conducting watershed evaluations throughout the Application Area to document hydrologic conditions and stream channel characteristics (see Appendix F – Watershed Monitoring Plan).

7.2 Vegetation

The Application Area lies within three Level IV ecoregions; rolling sagebrush steppe, salt desert shrub basins, and foothills shrubland. Plant community descriptions were developed based on a combination of the ecoregion descriptions (Chapman et al. 2004), the Final RFO RMP (BLM 2008), and field reconnaissance surveys for the EIS (AECOM 2009). Additionally, PCW has developed a high-resolution vegetation community map for the entire application area as well as all areas within 3 miles of the boundary of the Ranch. The detailed vegetation layer is a high-resolution (4 m^3) layer based on data collected at more than 500 points throughout the Application Area. These datasets will be used during project design to identify sensitive vegetation types for avoidance and to optimize the reclamation plans for each construction stage.

A majority of the Chokecherry development area is mapped as rolling sagebrush steppe. The rolling sagebrush steppe is a semiarid region of unglaciated plains and hills, featuring primarily ephemeral drainages. The potential natural vegetation in this ecoregion is listed as (Chapman et al. 2004):

- western wheatgrass (*Elymus smithii*)
- needle-and-thread (*Stipa comata*)
- blue grama (*Bouteloua gracilis*)
- Sandberg bluegrass (*Poa secunda*)
- prairie junegrass (*Koeleria macrantha*)
- various species of rabbitbrush (*Chrysothamnus sp. and Ericameria nauseosa*)

- fringed sage (*Artemisia frigida*)
- Wyoming big sagebrush
- silver sagebrush (*Artemisia cana*)
- black sagebrush (*Artemisia nova*) in lowlands
- mountain big sagebrush in higher elevation uplands

The salt desert shrub basin occurs on the northeast margin of the Ranch and portions of the Sierra Madre development area. The salt desert shrub basin ecoregion is a semiarid, unglaciated set of plains, nearly level floodplains, terraces, and rolling alluvial fans. Most stream courses in this ecoregion are ephemeral and the channels are typically incised. The potential natural vegetation for this ecoregion is defined as (Chapman et al. 2004):

- greasewood
- Gardner's saltbush (*Atriplex gardneri*)
- shadscale (*Atriplex confertifolia*)
- bud sage (*Picrothamnus desertorum*)
- big sagebrush (*Artemisia tridentata* spp.)
- alkali cordgrass (*Spartina gracilis*)
- Indian ricegrass (*Oryzopsis hymenoides*)
- blowout grass (*Redfieldia flexuosa*)
- alkali wildrye (*Leymus simplex*)
- needle-and-thread.

The remainder of the site consists of foothills shrubland established on unglaciated hills, ridges, and footslopes. Drainages in this ecoregion include perennial, intermittent, and ephemeral streams. Precipitation is greater here than in the two preceding ecoregions, averaging 12 to 18 inches annually. The potential natural vegetation for this ecoregion includes (Chapman et al. 2004):

- mountain mahogany (*Cercocarpus montanus*)
- mountain big sagebrush
- blue grama
- prairie junegrass
- western wheatgrass

There are pockets of aspen, limber pine (*Pinus flexilis*), and Douglas fir (*Pseudotsuga menziesii*), on north-facing slopes. Riparian vegetation in this ecoregion may include various willow species (*Salix* spp.), narrowleaf cottonwood (*Populus angustifolia*), box elder (*Acer negundo*), and wild plum (*Prunus* sp.).

Carbon County does not contain ESA critical habitat for any plant species (USFWS 2008). However, the Application Area may potentially provide habitat for two federally listed threatened plant species, the Ute ladies'-tresses orchid (*Spiranthes diluvialus*) and Colorado butterfly plant (*Guara neomexicana* spp. *coloradensis*). Although potential sites for the

Colorado butterfly plant exist within the Application Area, the elevation is higher than its known range; 5,000 to 6,400 feet (NatureServe 2008), thus, it would be unlikely to occur in the Application Area. Efforts to locate the two plant species within a portion of the Application Area were conducted during 2008 (WEST 2008g, 2008h) and as part of vegetation surveys completed during PCW's detailed vegetation mapping efforts. Neither plant was located in the Application Area during these surveys. Site-specific surveys for both plants will be completed prior to surface disturbing activities in suitable habitat and will beincorporated into the site-specific PODs.

According to the BLM Wyoming Sensitive Species Policy and List (BLM 2010), potential habitat for six BLM sensitive species occurs within the Project. A review of BLM and WYNDD plant records concluded that only persistent sepal yellowcress (*Rorippa calycina*) has been documented within 1 mile of the Application Area. The species was located within approximately 1,300 feet of the Chokecherry area in 1981 and again in 1992. Surveys for these plants within a portion of the Application Area were conducted during 2008. Surveys for BLM sensitive plants will be completed in suitable habitat prior to surface disturbing activities in those areas and this information incorporated into the site-specific PODs.

7.2.1 Revegation

A Master Reclamation Plan has been developed for areas disturbed by Project construction (Appendix E). PCW will also develop a detailed reclamation plan for each site-specific POD. These site-specific POD reclamation plans will consider site-specific conditions and design considerations in greater detail than that contained in the Master Reclamation Plan and will address reclamation methods and issues specific to each POD.

7.2.2 Weed Management

A Weed Management Plan has been developed for preventing, controlling, and monitoring noxious weeds and invasive species (Appendix J).

7.3 Water

Within the Project there are numerous existing water resources and water rights that may be available for use by the Project. The final water supply developed for the Project will take into consideration environmental concerns along with water resource availability and infrastructure needs. Where possible PCW will make use of existing water resources and infrastructure by utilizing existing water rights as well as taking advantage of municipal supplies that may be available to meet long term needs. Throughout Project construction, operation, and decommissioning, PCW will work to minimize water demand and make the most efficient use of the water resources available.

7.3.1 Consumptive Water Usage

The amount of water PCW will use for construction of the Project depends greatly upon the final lengths and design of the roads and the dust control methods used. Initial estimates are

for approximately 500 to 600 acre-feet of water. An update to the estimate, including a breakdown of consumption by use, will be provided in the site-specific PODs.

Water usage for the Project includes industrial uses such as dust suppression, road compaction and concrete production, as well as domestic and sanitary uses. PCW will strive to efficiently use water throughout the Project and minimize overall water consumption while meeting the Project requirements. The amount of water PCW will use for the construction of the Project depends greatly upon the final Project design and associated roads and the dust control methods used. PCW's preference is to use magnesium chloride for dust suppression where allowed to minimize the water demands of the Project and the vehicular traffic associated with dust suppression activities. Use of magnesium chloride is not prohibited by the Rawlins RMP. Water consumption throughout the construction stage of the Project is initially estimated at 450 to 500 acre-feet with water usage during operations being drastically less. Using magnesium chloride for dust suppression may reduce water demands by as much as 30 percent, reducing overall water consumption to 315_to 350_acre-feet during the construction stage. An update to this estimate, including a breakdown of consumption by use, will be provided in the site-specific PODs.

7.3.2 Consumptive Water Sources

The water resources available on the Ranch are discussed in detail in Section 2.2.5. Currently all available water sources are under consideration as supplies for the Project, although PCW has committed to obtaining no more than 10% of its water supply from the Little Snake River Basin. The water supply requirement for the Little Snake River Basin approximates the disturbance within the basin. All other water resources will be evaluated to develop a final water supply plan that can meet the needs of the Project while balancing economic and environmental considerations and minimizing the energy and transportation required to move the water to its final place of use. Water resources will be used in compliance with all applicable SEO rules and regulations. Water from one basin will not be discharged to any live or intermittent stream in the other (i.e. there will be no cross basin surface water transfers). Water supply infrastructure will be collocated within other proposed or existing disturbance areas to the extent possible to minimize effects.

7.3.3 Stormwater Pollution Prevention Plan (SWPPP)

PCW will provide a project specific Storm Water Pollution Prevention Plan (SWPPP) in accordance with federal, state, and local regulations. The SWPPP is completed to provide a temporary and permanent sediment and erosion control design to ensure the project is in compliance with applicable rules and regulations. The SWPPP will identify practices to implement for erosion and sediment control, temporary and permanent stormwater treatment (if necessary), and stormwater monitoring.

The SWPPP will take into account studies that have been completed for the Project, such as environmental studies, geotechnical information, endangered species studies, and cultural

resource studies Unique site attributes such as soil erosivity, topography and special, unique or impaired receiving waters will also be incorporated.

The SWPPP and erosion control plan will be all inclusive for the Project and will include not only the road and turbine construction activity but all support activities including underground electrical collection systems, overhead transmission lines, concrete batch plant area, operation and maintenance facility, rail facility, temporary staging areas, temporary crane paths and stream crossings.

Temporary (T) and permanent (P) erosion and sediment control BMP's along with the procedures to be used to establish additional temporary BMP's as necessary for site conditions during construction will be identified within the SWPPP and on relevant construction plans prepared for the Project. The range of BMPs anticipated to be utilized on the Project include but are not limited to the following:

1. **(T) Project Sequencing / Design BMP:** This should minimize exposure of soils at any given time and allow for concurrent stabilization of soils following construction activity of the access roads, temporary crane paths and turbine sites.
2. **(T) Silt Fence BMP:** Silt fences will be used as perimeter controls down gradient of exposed soils during construction to capture suspended sediment particles on site to extent possible. Silt fences will be installed near the constructed roads where they intersect with existing roads to protect the ditches from sediment laden runoff as well. Silt fence will be used around the turbine locations, access roads, crane paths, lay-down area and concrete batch plant area. The standard silt fence will also be used in smaller watershed areas where the contributing areas are typically less. The standard silt fence will also be used for stockpiles.
3. **(T) Rock Entrance / Exit Tracking Control BMP:** Rock construction entrances will be installed where access to a construction area is needed from adjacent paved surfaces to minimize sediment tracking and may be used at the temporary and permanent access roads, lay down areas, batch plant locations and elsewhere where ever the site exits onto existing paved surfaces.
4. **(P) Riprap Energy Dissipation:** Rock will be used as needed at the discharge of culverts within the site to prevent scour erosion from occurring during high flow conditions. Riprap will also be used where needed at access road intersections where road ditch crossings are needed if vegetation / blanket are not sufficient to control scour.
5. **(T) Temporary Ditch Crossing BMP:** Temporary ditch crossing locations may be needed. Perimeter controls (such as silt fence) will be used at the crossing location to minimize runoff from the exposed soils. The crossing will be done during dry conditions or if the streams are wet / flowing a temporary dam and bypass pump may be used to install the crossing.
6. **(T) Dewatering:** A temporary sump and rock base may be used as needed where a temporary pump is installed to dewater an area of accumulated water. If a rock base cannot be used the pump intake shall be elevated to draw water from the top

of the water column to limit sedimentation. Energy dissipation (riprap) may be applied to the discharge area of the pump hose if necessary. The water may be discharged to a large flat vegetated area for filtration / infiltration prior to flowing into receiving waters or conveyances / ditches. If discharge water is turbid; dewatering bags, temporary traps and rock weepers or other adequate BMPs may be needed to control sediment discharge.

7. **(T) Erosion control blanket and seed BMP:** Erosion control blankets (double sided netting with wood and / or straw fiber) may be used as temporary stabilization for areas of steep slopes and for areas of concentrated flow (ditches, swales and similar areas around culverts). Seed will be applied in these areas with the blanket for temporary and / or permanent vegetative growth as necessary.
8. **(T) Temporary mulch cover and seed BMP:** Temporary mulch cover (straw / hay type) will be applied to provide temporary erosion protection of exposed soils areas with generally flat slopes. Seed will be applied with the mulch for temporary and / or permanent vegetative growth as necessary. Straw mulch (straw / hay type) is used for all soil types where slopes are flat and no significant concentrated flows are present. The mulch is disc-anchored to the soil to keep it from blowing away. The mulch prohibits the effect of the rain drop from dislodging soil and subsequently carrying the soil away during sheet drainage. In sandy soils the use of tackifier may be used to assist the disc anchoring if the mulch cannot be secured to the sandy soils.
9. **(P) Permanent seed and temporary mulch and / or erosion control blanket BMP:** In areas of final grade permanent seed will be applied to promote vegetative cover for permanent erosion control (areas may include the temporary crane paths, adjacent areas to the access roads, for temporary cover at the lay-down and batch plant location when the areas are no longer needed). Temporary mulch and / or blanket will be applied to areas of permanent seeding to provide temporary erosion protection until the permanent seed is established.

Throughout the Project, PCW will perform inspections of the SWPPP features in accordance with the ROD and all applicable rules and regulations. Such inspections will be prescribed on a periodic basis or after significant rainfall events. Inspection frequencies and procedures will be detailed in the SWPPP.

7.4 Wetlands

The riparian/wetland cover type in the Application Area includes riparian vegetation, wetlands, and wet meadows. Wetlands and wet meadows are restricted to the Sierra Madre development area and the transmission line corridor of the Application Area. Although the Chokecherry development area may include development in some riparian areas, more riparian vegetation may be affected in conjunction with the Sierra Madre development area.

Effects could potentially occur due to construction of Project features, such as roads and transmission lines, which may unavoidably cross wetlands. Types of potential effects may

include the direct loss of wetland habitat due to Project infrastructure; alteration of the hydrologic processes due to Project infrastructure or soil compaction; and altered surface runoff patterns. Surface disturbing activities would be avoided to the maximum extent practicable.

On BLM lands, surface disturbing activities would be avoided in the following areas:

1) Identified 100-year floodplains;
2) Areas within 500 feet of perennial waters, springs, and wetland and riparian areas; and
3) Areas within 100 feet of the inner gorge of ephemeral channels.

Exceptions may be granted by the BLM based on an environmental analysis and site-specific engineering and mitigation plans. Only those actions within areas that cannot be avoided and that provide protection for the resource identified would be approved.

IWhere riparian/wetland features cannot be completely avoided, effects would be minimized through design modifications, as necessary. Facilities would be sited to avoid and/or minimize effects; however, where effects are anticipated, mitigation measures would be employed to minimize effects. All effects would be the minimum necessary to accomplish the Project, and where effects can not be avoided, appropriate permits will be obtained from the U.S. Army Corps of Engineers as required. Because of PCW's commitment to additional BMPs and conservation measures, wetlands effects on private and state land would be avoided, minimized, or mitigated. Any construction that occurs in or adjacent to wetlands and streams would use BMPs to protect surface water quality and minimize effects to those resources.

7.5 Soils

A variety of soils occur across the Project Site. Soil variability stems primarily from a variety of parent materials as influenced by topography, aspect, elevation, vegetation, and differential rates of mineral weathering. Soils within the Project Site are primarily derived from sedimentary formations and are predominantly Orthents; soils that are shallow to very deep and medium to fine textured and have a frigid temperature regime, an aridic moisture regime, and mixed or bentonitic mineralogy.

A number of soils within the Project Site have constraints that might limit the potential for successful reclamation as a result of soil texture, strength, physical and chemical properties, and erodibility. Soil constraints include high clay content, alkalinity, salinity, sodicity, and (lack of) precipitation, water holding capacity, hydric soils, soil depth, rock fragment content, erosion potential, and flooding potential.

Surface disturbing activities may result in site-specific losses to long-term soil productivity due to accelerated erosion and soil mixing. Because soil formation of topsoil is a slow process, it can take decades for topsoil to recover in arid environments and for soil productivity to

recover. Mitigation measures and BMPs are designed to reduce effects to soil resources. PCW will adhere to the Project's Master Reclamation and Erosion Control Plans to reduce soil erosion and facilitate reclamation efforts by maintaining soil quality, productivity, and biological characteristics.

7.5.1 Soil Segregation and Storage

Topsoil will be salvaged from surface disturbing activities and stockpiled in order to maintain the biological, chemical, and physical integrity of the soil resource. Components of soil handling include the identification, erosion protection, placement, and incorporation of salvaged soil stockpiles. The BLM requires that topsoil and appropriate subsoil be properly maintained through clearly identifying, delineating, and segregating salvaged topsoil and appropriate subsoils based on a site-specific soil evaluation (BLM 2009). Stockpiled soil material will be protected from erosion, degradation, and contamination by incorporating measures specified in the Erosion Control Plan. Stockpiles will be established in predetermined locations and clearly identified. Productivity will be maintained in properly stored soil material and reincorporated back into the disturbed landscape during site preparation to support future reclamation efforts. Soil handling protocols are presented in the Project Master Reclamation Plan (Appendix E).

7.5.2 Erosion Control Measures

Erosion control measures will be implemented to avoid, minimize, or mitigate effects from surface disturbing activities and restore the landscape back to a natural state. Erosion control measures will be installed prior to and immediately following surface disturbing activities. Initial stabilization measures will be used to control surface runoff and erosion and to ensure biophysical conditions are maintained until long-term reclamation can be initiated. Immediately following surface disturbing activities, temporary runoff and erosion control measures will be implemented where necessary to ensure soil stabilization. Runoff and erosion control structures will be inspected, maintained, and cleaned-out; inspections will be necessary following large runoff events (such as spring snowmelt runoff and large precipitation events). Erosion control and mitigation measures are presented in the Project Erosion Control Plan (Appendix E) and will be further detailed in the SWPPP for each site-specific POD.

7.5.3 Erosive Soils

The Project will occur in an arid environment that contains erosive soils. Surface disturbing activities may result in exposed soils, accelerated soil erosion, increased potential for mass failure, and reduced soil productivity. The Project ROD and SWPPP will provide guidance and protocols to control and reduce soil erosion to minimize effects to the soil resource, surrounding watersheds, and upland rangeland. In addition to implementing erosion control measures and BMPs, PCW has committed to avoid or minimize any surface disturbing activities on slopes greater than 25 percent to avoid effects to potentially sensitive soils and limited reclamation areas. Additional efforts will be made to site turbines and infrastructure in locations that would reduce potential effects to soils with high erosion potential.

7.5.4 Spill Prevention and Containment

The possibility of fuel and oil spills from construction equipment exists. The Spill Prevention, Containment, and Control Plan (SPCC) describes measures to avoid, minimize, and mitigate potential spills and is provided as an appendix to the SWPPP. In addition, this plan establishes emergency response procedures, lines of communications, and responsibilities. Although hazardous spills are not anticipated during project activities, the SPCC provides the protocols and control measures that will be implemented in the event of a spill. Potential spills from construction and operation would most likely be from refueling of construction equipment and backup generators; however, lubricating oils and hydraulic fluids may also potentially be a source of contamination. Fuel storage, refueling areas, and construction equipment maintenance areas will be established and clearly identified in order to minimize the potential effect of a spill to the environment. In the event of a spill, all material would be contained and contaminated soils would be transported, managed, and disposed of according to procedures outlined in the SPCC.

7.6 Air Quality

Pollutants emitted during construction and operation of a wind energy project include particulates (fugitive dust), as well as nitrogen dioxide (NO_2), carbon monoxide (CO), and sulfur dioxide (SO_2) from roadways, batch plants, construction activities and engines powering construction equipment and other mobile sources. Fugitive volatile organic compounds (VOCs) emissions are relatively small compared to other potential pollutants. These same pollutants, as well as others, are emitted by industrial facilities in the region including refineries, natural gas pipelines, compressor stations, mines, and sawmill operations. Fugitive VOCs also are emitted by exploration and production of oil and natural gas in the region.

Effects to air quality include increases in criteria pollutants including fugitive dust emissions, emissions of hazardous air pollutants, and GHG emissions. Taking into account the emission information estimated for the Project and project-specific air quality analyses conducted in the area, such as Desolation Flats and Atlantic Rim, the BLM concludes that increases in concentrations of CO, NOX, SO_2, PM10, and PM2.5 in the Project area would be unlikely to cause any exceedance of federal or state ambient air quality standards (BLM 2008b). Although the Project would emit low levels of pollutants principally from mobile sources during construction and operation, the net effect of the Project would be to improve atmospheric conditions since the generation of electricity from wind turbines would reduce the need for electricity generated in fossil fuel-fired power plants. The Project would displace between 7 and 11 million tons of CO_2 per year. Project implementation would result in a valuable renewable resource for power generation to augment fossil fuel-fired generation facilities.

PCW will comply with all federal, state, and local emissions standards for air quality. In addition, PCW will implement the following ACMs to control dust and reduce vehicle emissions:

- Water would be applied as deemed necessary by PCW's environmental inspector per the terms of the Dust Control Plan (Appendix H) to disturbed surfaces (such as exposed, dry, and unfrozen soil) during construction. During operation, dust control would occur as needed in those areas where vehicular traffic exceeds normal operational needs. If, for example, heavy equipment is brought on site for maintenance or if vehicular traffic exceeds a few vehicles per day, additional dust control watering may be initiated.
- Magnesium chloride may be applied, if necessary and as allowed, for adequate dust suppression. These treatments would occur on an as-needed basis, depending on weather conditions and the amount of traffic on the road.
- All roads used for Project access would be surfaced with gravel to further reduce potential dust emissions.
- Dust abatement techniques would be used on unpaved, unvegetated surfaces to minimize airborne dust. Dust abatement techniques would be employed on construction materials and stockpiled soils if they are a source of fugitive dust. Dust abatement techniques would be used before and during surface clearing, excavation, or blasting activities.
- Speed limits would be posted along all Project access roads and enforced during construction and maintenance activities.
- All construction equipment would be maintained in good working condition and would contain appropriate pollution control devices to minimize trace gas emissions.

7.7 Visual Resources

Visual resources on public lands within the Application Area are managed for multiple uses according to the direction set forth in the Rawlins RMP/ROD (BLM 2008a). The Rawlins RMP provides that proposals for wind energy development will be considered on a case-by-case basis and will generally be allowed within the Resource Area except in exclusion areas. Based upon the BLM's preferred alternative in the Draft Visual Resource Management Plan Amendment/DEIS (BLM 2011), all wind turbines, transmission lines, collector lines, and other aboveground facilities will be located on VRM Class IV lands; no facilities, with the exception of new access roads, are anticipated to be on VRM Classes II and III lands in the Application Area. Wind energy development is compatible with VRM Class IV and, in some instances, VRM Class III management objectives.

7.8 Cultural Resources

Cultural resource literature reviews were conducted for the entire Application Area and 5 miles beyond the Project Site boundary for analyzing the cultural resource situation in the DEIS. This review, conducted through the Wyoming Cultural Resources Office and the BLM RFO, identified all previously conducted cultural resources investigations and previously recorded cultural resources within the area covered by the search . A total of 344 cultural resources investigations have been previously conducted in the files search study area (Zietz et al, 2010). Of these 128 are within the Application Area. Investigations within the Application Area include:

- 111 Class III intensive field inventories,
- 4 Class II sample surveys, 3 historic overview surveys,
- 5 monitoring projects,
- 1 site testing project,
- 1 mitigation project, and
- 3 unspecified other projects.

Previous cultural resource investigations identified a total of 1,211 cultural sites in the search area. Of these sites, 467 are located within the Application Area. Those 467 sites include:

- 286 prehistoric sites,
- 83 historic sites,
- 93 multicomponent sites consisting of both prehistoric and historic components, and
- 5 sites of unknown cultural affiliation.

Of the 467 sites, 2 are listed on the National Register of Historic Places (NRHP), 67 are eligible for inclusion on the NRHP, 197 are not eligible for inclusion on the NRHP, and 201 currently are unevaluated for NRHP nomination.

Class III inventories of all proposed disturbance areas associated with the site-specific PODs will be conducted prior to construction. Files search information will be updated for each area prior to Class III inventories proceeding. The area-specific inventories will be completed prior to Project construction and with enough lead time to allow for evaluation of sites located during the inventories, assessment of effects, and mitigation, if necessary. Results of the inventories will be documented in a technical report submitted to the BLM and Wyoming State Historic Preservation Office (SHPO) for review and concurrence. All cultural resource identification, evaluation, and treatment, including as a result of unexpected discovery at such time that construction has been permitted, will follow the stipulations of the Programmatic Agreement (PA) established for the Project.

Effects to historic trails and other historic properties such as traditional cultural properties (TCPs) where setting contributes to the NRHP eligibility would be addressed in accordance with the conditions of the PA for the Project.

To the extent practicable, avoidance and minimization measures will be incorporated into final Project design. Where avoidance is not possible, sites will be mitigated in accordance with the PA for cultural resources. Unexpected discoveries of cultural resources during construction will be handled in accordance with the Project PA.

7.9 Paleontological Resources

Federal protection for scientifically important paleontological resources would apply to construction and/or other related Project effects that would occur on publicly managed lands.

The Application Area includes formations that have potential for scientifically valuable fossils (Niobrara, Cloverly, and Morrison Formations). Fossil localities have been found within the Application Area (Uinta Paleontological Associates, Inc. 2006). However, based on the location of exposed fossil-bearing formations (generally slopes greater than 25 percent), it is not anticipated that construction and operation of the Project will substantially effect fossils. In the event that fossils are discovered during construction activities, PCW will immediately notify the BLM.

7.10 Reclamation

A Master Reclamation Plan has been developed for areas disturbed by new construction. It is provided in Appendix E. PCW will develop detailed reclamation plans for each of the site-specific PODs. These plans will consider site-specific conditions and design considerations that were not incorporated into the Master Reclamation Plan.

7.11 Watershed

Effects to watershed resources could occur as a result of surface disturbance and changes in hydrologic conditions and stormwater/meltwater routing to streams and drainages. PCW has worked in close coordination with BLM to develop and implement a Watershed Monitoring Plan (Appendix F) that will characterize baseline conditions prior to Project construction and assess potential changes in watershed and stream characteristics following construction activities.

7.12 Fire Safety

PCW will enforce a fire safety protocol to be adhered to by all Project personnel. Common elements of wind energy project fire safety protocol include the following:

Vehicles

- Plan and manage the work and the movement of vehicles. All vehicles are to remain on established roads unless specifically permitted (such as for new road construction), and then not operated off-road while working alone.
- In the event a vehicle gets stuck, shut the engine off. Periodically inspect the area adjacent to the exhaust system for evidence of ignition of vegetation. Do not "rock" the vehicle to free it, but rather await assistance to pull it out. Inspect the area after the vehicle has been moved.
- No parking on vegetation, especially tall grass.

Fueling

- Project laydown yards will have designated refueling stations. These stations will have secondary containment of all fuel storage tanks, and vegetation will be removed in and around the refueling station. Fire extinguishers and firefighting gear will be located at the refueling stations. Spill containment and clean-up equipment will also be kept at the refueling stations.

- Field refueling will be done away from the laydown yard refueling stations only when it is impractical to take vehicles and machinery to the refueling stations (such as for cranes). In those instances, a designated and marked fuel vehicle will perform the refueling in a location deemed safe by the equipment operator. The refueling truck will have firefighting and spill containment and clean-up gear on-board.

Smoking

- Smoking shall only be allowed in the designated smoking areas on the project.

Fire Suppression and Emergency Preparedness

The site will be equipped with the following including instruction in proper use:

- Each vehicle used onsite shall have a fire extinguisher of sufficient type and capacity to suppress small fires around vehicles. Vehicle occupants shall be familiar with the location of these fire extinguishers. All employees who may have a need to use a fire extinguisher shall be current in their training on the general principals of fire extinguisher use and the hazards involved with incipient stage firefighting.
- Prior to start of each year of construction work activities, coordination workshops will be held with local public safety agencies, such as those for Rawlins, Saratoga, and the BLM RFO. Project activity updates will be provided to these agencies on a regular (typically monthly) basis.
- Prior to performing "hot work" (anything that creates a spark or an open flame is considered hot work) a Hot Work Permit Must be issued.
- A fire watch, equipped with a suitable fire extinguisher, shall be maintained for a period of 30 minutes after completion of work in a specific area and at the end of each day's activities.

PCW will develop a site-specific fire safety protocol in the site specific PODs. The protocol will be evaluated on a regular basis to see if additional provisions are warranted. Also, during periods of high fire danger, enhanced precautions will be taken.

7.13 Land Use

As mentioned earlier, the Project Site is currently part of a working cattle ranch owned and operated by TOTCO. PCW will coordinate with TOTCO to minimize the effect of Project construction and operation on ranch activities. Permitted land uses within the Project Site, such as grazing, may be disrupted during construction or decommissioning, but the effect is expected to be minor and temporary. While some temporary fencing may be required to exclude cattle from Project-related potentially hazardous areas, their ability to access water sources will not be limited.

The public's current ability to access federal lands in the Application Area will not be affected except for safety and security reasons during construction and decommissioning. Temporary road closures on CR401 (Sage Creek Road) will occur when equipment or delivery vehicles are

crossing the road. As CR505W (Miller Hill Road) is routed through a portion of the Project Site, it is likely that road may also see brief closures when construction occurs on or adjacent to the road. Signs will be posted along CR401 and CR505W informing drivers of frequent brief road closures during construction activities. Given recorded traffic volumes on these roads, effects to the public are expected to be negligible.

PCW will identify the locations and depths of utility features near construction areas. The existence of these utilities will be accounted for in the Project's design, and PCW will have them marked during construction as a further safety measure. Project construction and operation activities will not restrict access to existing utilities or associated infrastructure and will be designed and implemented with the protection of existing utilities in mind.

8. Example Project Layout

Because the EIS process is currently underway and the final requirements of the Project are not yet identified, PCW does not have a finalized layout. Instead, PCW is providing an example layout of the Project elements described in Chapter 3. While this layout will be subject to change based upon the final requirements and input, the example allows the BLM and stakeholders an opportunity to clearly understand how the Project's layout might be achieved.

In April 2010, PCW submitted to BLM the Applicant Proposed Alternative, which was a conceptual design layout that aligned with the ACMs and BMPs summarized in Appendix A. This layout was the basis for Alternative 1R (Alt 1R) in the DEIS. Since that submittal, PCW has continued to collect new wind resource data, perform more wildlife observations, and obtain other information. PCW has utilized this information to update the Project layout to improve overall efficiency while still working with the same ACMs and BMPs as Alt 1R (see Figure 8-1). The total temporary and long-term surface disturbance levels of the example layout also closely align with those from Alt 1R, and are estimated to be:

- Temporary disturbance = 7,221 acres
- Long-term disturbance = 1,544 acres

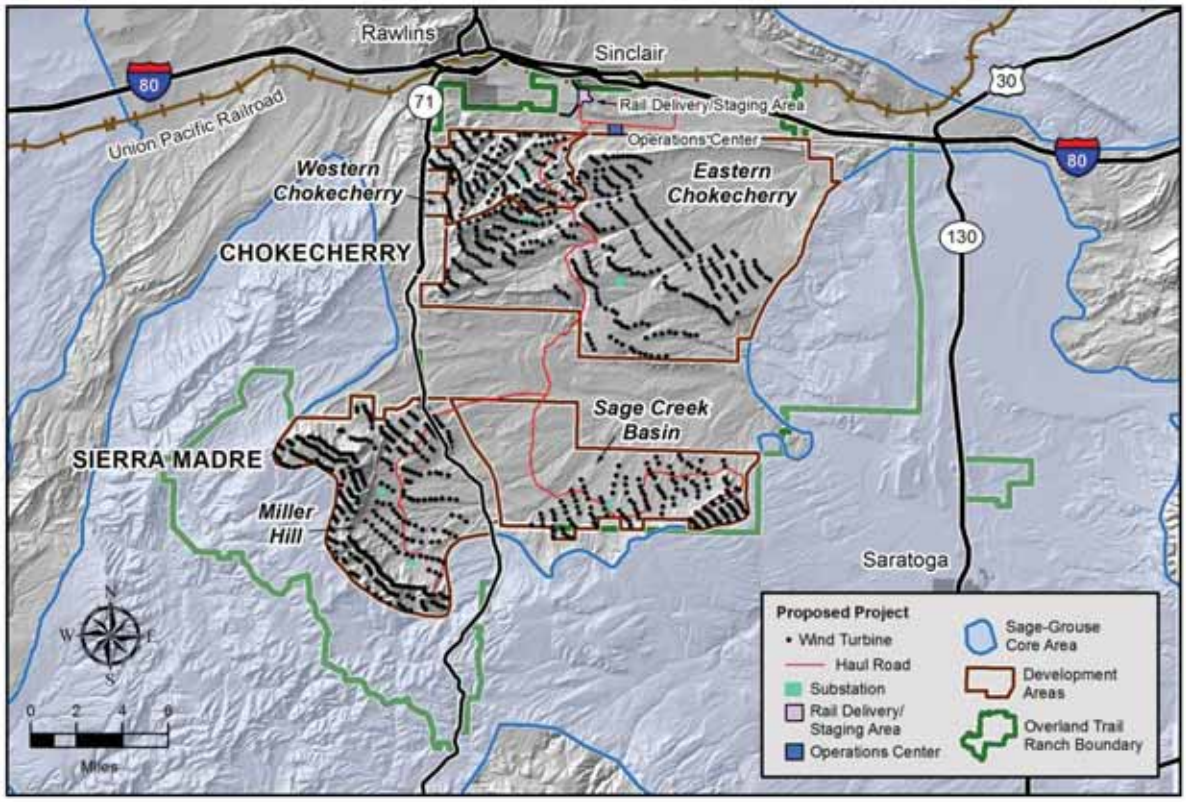


Figure 8-1. Example Project Layout

Information on how the elements of a wind energy project are deployed in this example layout are discussed briefly below. Maps, additional diagrams, and the surface disturbance summary table for this example layout are included in Appendix L. The surface disturbance summary is based upon the typical limits of disturbance discussed above and the amount or length of each design element estimated. PCW will revise the disturbance estimates with each site-specific POD as the design is refined.

The information provided in this chapter is only intended to specify the assumptions made for the example layout. The final design of the Project will be determined through the site-specific PODs.

8.1 Wind Turbines

The layout assumes the use of 1,000 wind turbines, each rated 3.0 MW. While no specific wind turbine models were chosen, for the purposes of turbine spacing PCW assumed turbines with 120 meter rotors. The layout is based on the setback requirements for the land within the development area, but does not include the land applied for by PCW but which BLM has not yet taken action.

8.2 Foundations

For the example layout, PCW is assuming typical mat foundations without soil improvement for all wind turbines.

8.3 Roads and Wind Turbine Pads

The lengths of the conceptual road alignment determined for this example layout are approximately:

- Haul Road: 58 miles
- Arterial Roads: 93 miles
- Turbine Roads: 220 miles
- Other Roads: 31 miles

The breakdown of the initial and long-term disturbance for these roads and other Project civil construction are listed in the surface disturbance summary in Appendix L-4.

The Project is not yet at a level of design to determine likely water crossing designs to be used, or specific limits of disturbance at each wind turbine pad. These design elements will be determined in the detailed design and submitted in site-specific PODs.

8.4 Electrical Collection System

The collection system will connect the wind turbines to the substations described below. Table 8-1 below describes the estimated breakdown of the collection system configuration for this layout. PCW estimated that almost 20 percent of the total length of the circuits would be overhead, mostly in areas of long homeruns and where circuits go through steep terrain (such

as from the top of Miller Hill to the base). Of the underground portion, PCW estimated less than 5 percent may be routed in trenches separate from the Project roads.

Table 8-1. Example Layout Collection System Breakdown

Routing Option	Chokecherry	Sierra Madre	Total
Underground Collection System			
Single Circuit	121 mi	101 mi	221 mi
Two Circuits	25 mi	16 mi	40 mi
Three Circuits	4.7 mi	3.9 mi	8.6 mi
Four Circuits	1.2 mi	2.3 mi	3.4 mi
Five Circuits	1.4 mi	0.8 mi	2.2 mi
Six Circuits	0.3 mi	1 mi	1.3 mi
Seven Circuits	0.2 mi	0 mi	0.2 mi
Separate from Roads	11.2 mi	7.4 mi	18.4 mi
TOTAL	**165 mi**	**132 mi**	**295 mi**
Overhead Collection System			
Overhead Collection	29 mi	39 mi	68 mi
Notes: Routing options for underground collection refers to the number of circuits existing along a roadway, except for Separate from Roads, which is the combined circuit length.			

8.5 Collection Substations

PCW is estimating that the most efficient solution for collection design, based on both electrical losses and overall disturbance, is to utilize six collection substations. These substations would be configured in the following manner:

Chokecherry

- CC-A Substation: 164 wind turbines, two transformers
- CC-B Substation: 203 wind turbines, three transformers
- CC-C Substation: 137 wind turbines, two transformers

Sierra Madre

- SM-A Substation: 212 wind turbines, three transformers
- SM-B Substation: 136 wind turbines, two transformers
- SCB-A Substation: 148 wind turbines, two transformers

8.6 Internal Transmission

For simplicity, the example layout is assuming steel monopole transmission structures utilized throughout the Project that can accommodate up to two circuits per set. The routing of the transmission line is along the haul road route, and is shown in Appendix L. The current design is for five transmission circuits running on three sets of structures:

Structure Set 1

- Single circuit from substation SM-B to substation SM-A: 4.6 miles
- Double circuit from substation SM-A to haul road connection point: 9.8 miles
- Single circuit from substation SCB-A to haul road connection point: 7.7 miles
- Double circuit from haul road connection point to interconnection substation: 15.4 miles
- TOTAL LENGTH: 37.5 miles

Structure Set 2

- Single circuit from substation CC-C to connection point near CC-B: 4.7 miles
- Single circuit from substation CC-B to connection point near CC-B: 1.9 miles
- Double circuit from connection point near CC-B to interconnection substation: 5.0 miles
- TOTAL LENGTH: 11.6 miles

Structure Set 3

- Single circuit from substation CC-A to interconnection substation: 3.6 miles

It is important to note that as much of the transmission system as possible is routed so that multiple structure sets are parallel to each other. The total length of the combined transmission corridor is approximately 41 miles.

8.7 Interconnection Substation

The interconnection substation is located in Township 21 N, Range 86 W, Section 31.

8.8 Rail Facility

The Primary Rail Site as described in Section 3.6 is assumed.

8.9 Operations and Maintenance Buildings

PCW is assuming a total of three operations and maintenance buildings. The Operations Center is assumed in the northeast corner of Township 21 N, Range 86 W, Section 33. Two Maintenance Facilities are assumed, one near Miller Hill and one in Chokecherry. The Miller Hill facility would be located near CC401 (Sage Creek Road) and CC505W (Miller Hill Road) in Township 18 N, Range 88 W, Section 11. The Chokecherry facility would be located on the interior of the Ranch and adjacent to the CC-A substation in Township 20 N, Range 87 W, Section 15.

PCW is assuming that connections can be made to the appropriate power, telecommunications, water and sewer utilities at the CIG Plant. PCW would install overhead poles for the electrical power and telecommunications lines from the Operations Center to the CIG Plant along one edge of the haul road, and install buried water and sewer lines along the other. Because these lines are within the disturbed area of the haul road, no additional temporary disturbance will be incurred. The power and telecommunications lines would be installed at the beginning of Year

1 for temporary connection to the construction trailers, then permanent connection to the Operations Center. The water and sewer lines would be installed in Year 3 when the Operations Center is built.

8.10 Temporary Construction Facilities

The temporary construction facilities for the Project are described in Section 4.3. The locations of these facilities are assumed to be:

- Construction trailer complex: T21N R86W S33, 160 acres
- Chokecherry laydown yard at CC-A: T20N R87W S15 and S16, 80 acres
- Chokecherry laydown yard at CC-C: T19N R86W S5, 80 acres
- Miller Hill laydown yard: T18N R88W S11, 80 acres
- Sage Creek Basin laydown yard: T18N R86W S29, 80 acres

PCW is anticipating that 4 to 8 triple wide, 14 to 16 double wide, and 8 to 10 single wide temporary construction office trailers would be required. The construction trailers are located within the same complex as the Operations Center (see Figure L-2-1 in Appendix L).

Concrete batch plants will be located at these laydown yards during periods when foundation construction is occurring nearby. PCW expects to deploy up to two concrete batch plants at any given time.

8.11 Construction Schedule

Based on the schedule approach detailed in Section 4.4.1, Table 8-2 below details the amount of anticipated construction to be performed by year for the example layout.

Table 8-2. Example Layout Construction Schedule Breakdown

Facility	Year 1	Year 2	Year 3	Year 4	Year 5
Miller Hill Area of Sierra Madre (348 WTGs)					
WTG Install			All		
WTG Pads		All inner zone	All outer zone		
WTG Foundations		200	Remaining 148		
Roads		All			
U/G Collection		All			
O/H Collection		All			
Substations		Site prep	Complete		
Sage Creek Basin Area of Sierra Madre (148 WTGs)					
WTG Install				All	
WTG Pads			All inner	All outer	

Facility	Year 1	Year 2	Year 3	Year 4	Year 5
			zone	zone	
WTG Foundations			All		
Roads			All		
U/G Collection			All		
O/H Collection			All		
Substations			Site prep	Complete	
Western Chokecherry Area (164 WTGs)					
WTG Install				All	
WTG Pads			All inner zone	All outer zone	
WTG Foundations			64	Remaining 100	
Roads			All		
U/G Collection			All		
O/H Collection			All		
Substations			CC-A site prep	CC-A Complete	
Eastern Chokecherry Area (340 WTGs)					
WTG Install					All
WTG Pads				All inner zone	All outer zone
WTG Foundations				250	Remaining 90
Roads				All	
U/G Collection				All	
O/H Collection				All	
Substations				CC-B Site Prep CC-C Site Prep	CC-B & CC-C Complete
Total Project Facilities					
Haul Road	All				
Transmission			SM – Int.	SCB – SM CC-A – Int.	CC-C – Int. CC-B – Int.
Interconnection		Site Prep	Complete		
Rail Facility	Build Rail Facility	Operate for Project Deliveries			
Buildings			Ops Center SM Maint	CC Maint	

Facility	Year 1	Year 2	Year 3	Year 4	Year 5
Temporary Construction Facilities					
Trailer Complex	Site Prep Partial Mob.	Full Mobilize			Demobilize
Laydown Yards	Northern (if necessary)	Miller Hill	SCB West CC	East CC	
Key:	Pre-Construction				
	Construction Underway				
	Post-Construction				
Notes:	Int. = Interconnection Substation				

8.12 Workforce and Equipment Estimates

PCW has applied the estimate range for labor and equipment described in Section 4.4 to the example layout. The tables below show the resulting total estimates for manpower and equipment.

Table 8-3. Example Layout Workforce Breakdown

Month	Year 1	Year 2	Year 3	Year 4	Year 5	Peak	TOTAL
May	55	25	15	15	15	55	
June	55	25	318	368	374	374	
July	169	361	1,088	1,021	877	1,088	
Aug	169	385	1,206	1,133	955	1,206	
Sep	169	385	1,176	1,113	845	1,176	
Oct	141	221	796	714	605	796	
Nov	50	25	99	103	105	105	
Peak Workers	169	385	1,206	1,133	955	**1,206**	
Total Annual Worker Months	808	1,427	4,698	4,467	3,776		**15,176**

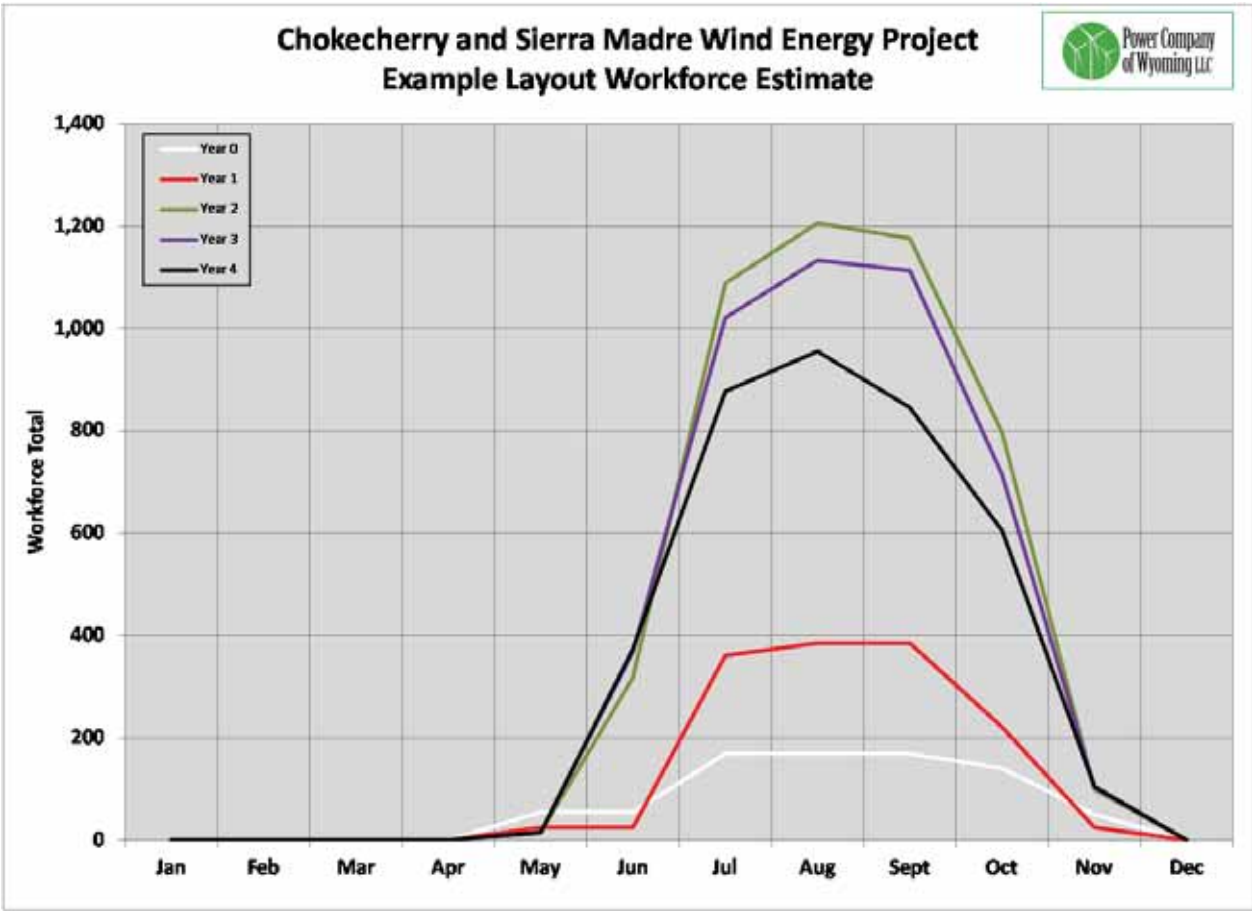


Figure 8-2. Example Project Layout Workforce Estimate

Table 8-4. Example Layout Equipment Breakdown

Activity	Year 1	Year 2	Year 3	Year 4	Year 5
General Pick-Up Trucks	200	350	850	900	750
Roads and Pads	188	92	102	122	104
Foundations	0	56	56	56	56
Erection	0	0	144	144	144
Substation	0	12	30	30	12
Collection	0	45	45	45	0
Transmission	0	0	52	26	26
Site Buildings	0	0	7	7	0
TOTAL	**388**	**555**	**1,286**	**1,330**	**1,092**

9. List of Contributors

The following companies and individuals prepared this Plan of Development.

Primary Authors

Power Company of Wyoming
Ryan Jacobson, PE – Director of Engineering and Construction
Garry Miller – Vice President of Lands and Environmental Affairs
Kelly Cummins, PE – Senior Landman and Environmental Engineer
Mike Johnsen – Project Geologist/GIS Specialist

Black & Veatch
Sean Tilley, PE – Engineering Manager, B&V Energy
Matt Barbian, PE – Electrical Engineer, B&V Energy
Justin Ray, PE – Electrical Engineer and Wind Energy Consultant, B&V Energy
Robert Nasset, PE – Civil and Transmission Engineer, B&V Energy

MA Mortenson
Tim Kannmacher – Construction Executive, Renewable Energy Group
Ross Montgomery – Design Phase Manager, Renewable Energy Group

SWCA
Jon Kehmeier – Program Director, Natural Consultants
Dr. Nathan Wojcik – Senior Ecologist

Westwood Professional Services
Steve Windingland, PE – Director, Wind Energy
Dan Beckmann, PE – Director, Transmission
Mallory Lindgren – GIS Specialist

Contributing Authors
Atkins
AWS Truepower
Professional Logistics Group

10. References

AECOM. 2009. Field Reconnaissance Effort Involving Vegetation Cover Type Ground-truthing. July 2010.

Baerwald, E. F. 2006. Bat Fatalities in Southern Alberta. Presented at the Wildlife Research Meeting VI, San Antonio, Texas. National Wind Coordinating Collaborative. November 2006.

Black & Veatch, 2010. Need for Renewables and Gas Fired Generation in WECC. Presentation to the Wyoming Infrastructure Authority Board, Jackson, WY. January 25, 2010.

Bureau of Land Management (BLM). 1985. BLM Manual 9113 - Roads. United States Department of Interior, Bureau of Land Management, Washington, D.C. June 7, 1985.

Bureau of Land Management (BLM). 2007. Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development (Gold Book), Fourth Edition. United States Department of Interior, Bureau of Land Management, Washington, D.C. 2007.

Bureau of Land Management (BLM). 2005. Record of Decision for Implementation of a Wind Energy Development Program and Associated Land Use Plan Amendments. December 2005.

Bureau of Land Management (BLM). 2008a. Record of Decision and Approved Rawlins Resource Management Plan for Public Lands Administered by the Bureau of Land Management Rawlins Field Office. December 2008.

Bureau of Land Management (BLM). 2008b. Wind Energy Development Policy. Instruction Memorandum No 2009-043. United States Department of the Interior, Bureau of Land Management, Washington, D.C. December 19, 2008.

Bureau of Land Management (BLM). 2009. Wyoming Reclamation Policy. Cheyenne, Wyoming: U.S. Department of the Interior, Bureau of Land Management, Wyoming State Office. Instruction Memorandum No. WY-2009-022. Available online at http://www.blm.gov/pgdata/etc/medialib/blm/wy/resources/efoia/IMs/2009.Par.54664.File.dat/wy2009-22.pdf. Accessed September 2011.

Bureau of Land Management (BLM). 2010a. Bald and Golden Eagle Protection Act – Golden Eagle National Environmental Policy Act and Avian Protection Plan Guidance for Renewable Energy. Instruction Memorandum No 2010-156. United States Department of the Interior, Bureau of Land Management. Washington, D.C. July 9, 2010.

Bureau of Land Management (BLM). 2010b. BLM Wyoming Sensitive Species Policy and List. March 31, 2010.

Bureau of Land Management (BLM). 2011. Chokecherry and Sierra Madre Wind Energy Project Draft Environmental Impact Statement. Department of the Interior Bureau of Land Management (BLM) Rawlins Field Office. July 2011.

Case, James C., Christopher S. Arneson, and Laura L. Hallbe. 1998. Wyoming Surface Geology: Spatial Data and Visualization Center. Laramie, Wyoming.

Chapman, S. S., S. A. Bryce, J. M. Omernik, D. G. Despain, J. SumBerge, and M. Conrad. 2004. Ecoregions of Wyoming (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,400,000).

Cline, H. 2010. Wildlife Biologist, BLM Rawlins Field Office. Personal communication with G. Norman, Western EcoSystems Technology, Inc. (WEST). August 9, 2010.

US Energy Information Administration (EIA). 2010. Retail Sales of Electricity by State by Sector by Provider, 1990-2009 (Data from Form EIA-861). November 2010.

US Energy Information Administration (EIA). 2011. Annual Energy Outlook 2011. DOE/EIA-0383(2011). April 2011. Reference Case Tables.

Erickson, W.P., A. Chatfield, and K. Bay. 2011. Avian Baseline Studies for the North Sky River Final Report, Kern County, California. May 18, 2011 - May 26, 2010. Final Report. Prepared for CH2M HILL, Portland, Oregon. Prepared by Western EcoSystems Technology Inc. (WEST), Cheyenne, Wyoming.

Federal Aviation Administration (FAA). 2005. Technical Note DOT/FAA/AR-TN05/50. Development of Obstruction Lighting Standards for Wind Turbine Farms. James W. Patterson, Jr. United States Department of Transportation, Federal Aviation Administration, Washington, D.C. November 2005.

Federal Aviation Administration (FAA). 2007. Advisory Circular AC70/7460-1K. Observation Marking and Lighting. United States Department of Transportation, Federal Aviation Administration, Washington, D.C. February 1, 2007.

Gruver, J., M. Sonnenburg, K. Bay, and W. Erickson. 2009. Post-Construction Bat and Bird Fatality Study at the Blue Sky Green Field Wind Energy Center, Fond Du Lac County, Wisconsin. July 21 – October 31, 2008 and March 15 – June 4, 2009. Unpublished report prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. December 17, 2009.

Jain, A. 2005. Bird and Bat Behavior and Mortality at a Northern Iowa Windfarm. M.S. Thesis. Iowa State University, Ames, Iowa.

Love, J.D., and Christiansen, A.C., 1985, compilers, 1985, Geologic map of Wyoming: U.S. Geological Survey, scale 1:500,000.

NatureServe 2008. NatureServe Explorer. Internet website: http://www.natureserve.org/. Accessed December 3, 2008.

Power Company of Wyoming. 2008. Digital Orthophoto Quarter-Quads. August 29, 2008.

Power Company of Wyoming. 2009. "PCW Response and Data on BLM Alternatives" letter to BLM. December 2009.

Power Company of Wyoming. 2010. "Applicant Proposed Alternative and BLM Response Letter" letter to BLM. April 23, 2010.

Power Company of Wyoming. 2011. "Methodology of Wind Turbine Number Determination" memo to BLM. February 11, 2011.

SWCA Environmental Consultants, Inc. (SWCA). 2011a. Avian Monitoring Summary for the Chokecherry Sierra Madre Wind Development Project. Carbon County, Wyoming.

SWCA Environmental Consultants, Inc. (SWCA). 2011b. Greater Sage-Grouse (Centrocercus urophasianus) Monitoring Report for the Chokecherry Sierra Madre Wind Development Project. Carbon County, Wyoming.

Uinta Paleontological Associates, Inc. 2006. Paleontological Evaluation, Existing Data Review Along the Proposed Overland Pass Pipeline Project in Southern Wyoming, Northeastern Colorado, and Northwestern Kansas. Prepared for Overland Pass Pipeline Company LLC. September 29, 2006.

U.S. Census Bureau. 2011. Population Distribution and Change: 2000 to 2010. C2010BR-01 March 2011.

U.S. Fish and Wildlife Service (USFWS). 2008. U.S. Fish and Wildlife Service Critical Habitat Portal. Internet website: http://crithab.fws.gov/. Accessed December 2, 2008.

U.S. Forest Service (USFS). 2006. Low-Water Crossings: Geomorphic, Biological and Engineering Design Considerations. U.S. Department of Agriculture, Forest Service. October, 2006.

Western EcoSystems Technology, Inc. (WEST). 2009a. Avian Baseline Studies for the Chokecherry Sierra Madre Wind Resource Area. Carbon County, Wyoming. Final Report June 26 to June 16, 2009.

Western EcoSystems Technology, Inc. (WEST). 2009b. Final Report Greater Sage-grouse Lek Surveys in 2009 for the Chokecherry and Sierra Madres Wind Resource Areas, Carbon County, Wyoming. Prepared for AECOM. October 19, 2009.

Western EcoSystems Technology, Inc. (WEST). 2009c. Greater Sage-grouse Brood Surveys for the Chokecherry and Sierra Madre Wind Resource Areas Carbon County, Wyoming July 13 to September 3, 2009.

Western EcoSystems Technology, Inc. (WEST). 2008a. Raptor Nest Surveys for Chokecherry and Sierra Madre Wind Resource Areas. Carbon County Wyoming.

Western EcoSystems Technology, Inc. (WEST). 2008b. Bat Surveys for the Chokecherry and Sierra Madre Wind Resource Areas. Carbon County, Wyoming. Final Report November 29, 2008.

Western EcoSystems Technology, Inc. (WEST). 2008c. Greater Sage-grouse Lek Surveys for the Chokecherry and Sierra Madre Wind Resource Areas. Carbon County, Wyoming.

Western EcoSystems Technology, Inc. (WEST). 2008d. Greater Sage-grouse Brood Surveys for the Chokecherry and Sierra Madre Wind Resource Areas. Carbon County, Wyoming.

Western EcoSystems Technology, Inc. (WEST). 2008e. Big Game Species in the Chokecherry and Sierra Madre Wind Resource Areas. Carbon County, Wyoming.

Western EcoSystems Technology, Inc. (WEST). 2008f. Prairie Dog and Black-footed Ferret Habitat Analysis Summary, Chokecherry and Sierra Madre Wind Resource Areas.

Western EcoSystems Technology, Inc. (WEST). 2008g. Rare Plant Surveys for Chokecherry and Sierra Madre Wind Resource Areas. Carbon County, Wyoming.

Western EcoSystems Technology, Inc. (WEST). 2008h. Threatened and Endangered Species Issues for the Chokecherry and Sierra Madre Wind Resource Areas. Carbon County, Wyoming.

Wyoming Department of Environmental Quality (WDEQ). 2011. General Permit to Discharge Storm Water Associated with Large Construction Activity Under the Wyoming Pollutant Discharge Elimination System (WYPDES). WYPDES Permit WYR10-0000. Wyoming Department of Environmental Quality. May, 2011.

Zietz, Vanesa, John Kennedy, Michael J. Retter, and Norma Crumbley. 2010. Background Research for the Chokecherry and Sierra Madre Wind Farms, Carbon County, Wyoming. SWCA Cultural Resource Report Number 10-375. Submitted to the Bureau of Land Management-Rawlins Field Office, Wyoming.

11. Glossary

Application Area: Collectively all of the lands within the Chokecherry and Sierra Madre Wind Site Testing and Monitoring Areas (WYW-166845 and WYW-166846).

Backfeed: Energization of new electrical components from the utility grid back toward the wind turbines.

CCSM: The Chokecherry and Sierra Madre Wind Energy Project.

Chokecherry Application Area: The Chokecherry Wind Site Testing and Monitoring Area (WYW-166845)

Chokecherry Development Area: The portion of the Chokecherry Application Area on which PCW expects Project facilities will be located.

Desert Southwest: The states of Arizona, Nevada and California

Grubbing: Shallow digging-up of roots and other vegetation, usually done to level ground without excavating.

Northern Facilities Area: The portion of the Ranch north of the Chokecherry Application Area in which some supporting facilities, such as roads, the rail facility, the interconnection substation, internal transmission lines, and the Operations Center, will be located.

Pre-Construction: activities that occur prior to a construction contractor mobilizing on-site.

Project: The Chokecherry and Sierra Madre Wind Energy Project

Project Site: The land on which the Chokecherry and Sierra Madre Wind Energy Project will be located. In this document, specifically the combined Chokecherry and Sierra Madre Development Areas.

Ranch: The Overland Trail Ranch

Sierra Madre Application Area: The Sierra Madre Wind Site Testing and Monitoring Area (WYW-166846)

Sierra Madre Development Area: The portion of the Sierra Madre Application Area on which PCW expects Project facilities will be located.

TOTCO: The Overland Trail Cattle Company, LLC

Western Interconnection: The power grid for the Western portion of North America

Appendix A. Applicant Committed Measures

Table A-1. Summary of Applicant Committed Measures

Item	Environmental Resource	Applicant Committed Measure
A-1-01	ESA, sensitive species, and other wildlife and fish species	Site-specific surveys and/or monitoring for ESA threatened and endangered species, BLM sensitive species and other wildlife and fish species will take place during each phase of construction. Survey and monitoring approaches will be developed in coordination with USFWS, BLM, and WGFD and will be identified in the site-specific PODs developed for each construction right-of-way grant.
A-1-02	Avian and Bat Species, Golden and Bald Eagles	PCW will develop an Avian Protection Plan (APP), a Bat Protection Plan (BPP) and an Eagle Conservation Strategy (ECS) to identify measures to avoid, minimize, and mitigate project impacts through siting, operations, and monitoring.
A-1-03	Greater Sage-grouse	PCW will comply with EO 2011-5 and commit to no construction activities within Wyoming's SGCA as they are identified in EO 2011-5 (Core Area Version 3 Map).
A-1-04	Wildlife Habitat Management Areas	PCW will not construct any facilities within portions of the Red Rim-Grizzly WHMA and Upper Muddy Creek Watershed-Grizzly WHMA that are within the Wyoming Sage-Grouse Core Management Area Version 3 Map (EO 2011-5).
A-1-05	Mule Deer	PCW will continue to coordinate with WGFD on ongoing mule deer monitoring efforts on the Ranch.
A-1-06	Colorado River Fishes – bluehead sucker, flannelmouth sucker, roundtail chub, Colorado River cutthroat trout	PCW will continue to work with WGFD and BLM to develop conservation and monitoring strategies for native fish species in the Upper Muddy Creek watershed.
A-1-07	Fish species, amphibian species, other stream obligates; water quality	PCW will monitor watershed and stream conditions throughout the Application Area to document hydrologic conditions and stream channel characteristics (see Appendix F – Watershed Monitoring Plan).

Item	Environmental Resource	Applicant Committed Measure
A-1-08	Other wildlife species	PCW will continue to incorporate the outcome of site-specific surveys to microsite infrastructure in order to avoid, minimize, or mitigate impacts to wildlife species.
A-1-09	Wildlife Stipulations	PCW will adhere to the timing and spatial stipulations and exception processes as they are described in the Project ROD.
A-1-10	Wildlife Stipulations	Timing and spatial stipulations will be used on public lands.
A-1-11	Avian and Bat Monitoring	PCW will develop a project Avian Protection Plan, Bat Protection Plan and Eagle Conservation Strategy that will each describe post-construction monitoring efforts for avian and bat species.
A-1-12	Wildlife Monitoring and Survey	PCW will continue to incorporate the outcome of site-specific surveys to microsite infrastructure in order to avoid, minimize, or mitigate impacts to sensitive wildlife species.
A-1-13	Vegetation	Vegetation datasets developed by PCW will be used during project design to identify sensitive vegetation types for avoidance, minimization or mitigation and to optimize the reclamation plans for each construction phase.
A-1-14	Colorado butterfly plant and Ute ladies'-tresses orchid	Site-specific surveys for both plant species will be completed prior to surface disturbing activities in suitable habitat.
A-1-15	Revegetation and Reclamation	PCW will develop detailed reclamation plans for each of the construction phases and right-of-way grants. These plans will consider site-specific conditions and design considerations to maximize reclamation success.
A-1-16	Wetland Resources	Facilities would be sited to avoid and/or minimize impacts.
A-1-17	Wetland Resources	Any construction that occurs in or adjacent to wetlands and streams would use BMPs to protect surface water quality and minimize impacts to those resources.
A-1-18	Cultural Resources	Class III inventories of all proposed disturbance areas associated with the site-specific POD will be conducted prior to construction.

Item	Environmental Resource	Applicant Committed Measure
A-1-19	Cultural Resources	All cultural resource identification, evaluation, and treatment, including as a result of unexpected discovery at such time that construction has been permitted, will follow the stipulations of the Programmatic Agreement (PA) established for the project.
A-1-20	Paleontological Resources	In the event that fossils are discovered on public lands during construction activities, PCW will suspend work in that area, have an on-call paleontologist review the fossils, and notify the BLM. PCW expects the significance of the discovery and the resulting course of action to be determined within 48 hours of discovery.
A-1-21	Watershed Resources	PCW has implemented a watershed monitoring program to evaluate potential impacts of project construction and operations. PCW commits to continue watershed monitoring efforts for three years post-construction.
A-1-22	Greater Sage-Grouse	PCW will work cooperatively with BLM and WGFD to perform annual lek monitoring within the Ranch in accordance with approved WGFD protocols during pre-construction, construction and for five years post-construction.
A-1-23	Greater Sage-Grouse	PCW will work with BLM and private landowners to identify fences that pose a significant collision risk to sage-grouse. Identified fences will be removed or marked as practicable. To date PCW and TOTCO have removed over 10 miles of fence and have marked an additional 16 miles of fence with reflective bird diverters.
A-1-24	Greater Sage-Grouse	PCW will work with BLM and private landowners to evaluate proposed new fences and determine the risk of such fences to sage-grouse. If significant risk exists, new fence construction will be deferred where possible; if fences must be constructed they will be marked with reflective bird diverters.
A-1-25	Avian Species including Bald and golden Eagles and Greater Sage-Grouse	Guy wires on meteorological towers will be marked with reflective bird diverters. To date PCW has marked all guy wires on Project meteorological towers with reflective bird diverters.

Item	Environmental Resource	Applicant Committed Measure
A-1-26	Wildlife including Greater Sage-Grouse, Other Avian Species and Small Mammals	PCW will work with private landowners to install metal mesh escape ladders in water tanks that pose a risk to wildlife species. To date, PCW and TOTCO have installed metal mesh escape ramps on many Ranch water tanks.
A-1-27	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	PCW will work with BLM and private landowners to stabilize and rehabilitate burned areas to promote the biological integrity of the site and limit expansion of invasive species. In 2010 PCW and TOTCO pursued stabilization and recovery of a burned area in the Chokecherry site with an emphasis on rapid recovery and use of the area by sage-grouse and other species.
A-1-28	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	PCW will work with private landowners and water right owners to pursue water improvement conservation projects to benefit greater sage-grouse and other wildlife species in accordance with all applicable rules and regulations.
A-1-29	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	PCW will work with private land owners to enhance fallow agricultural fields on the Ranch located east of the North Platte River. Enhancements include vegetation treatments to improve forage and cover for greater sage-grouse.
A-1-30	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	To minimize habitat fragmentation PCW will work with BLM and private landowners to close unnecessary roadways and reclaim such roads where practicable.
A-1-31	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	PCW will work with BLM and private landowners to control the spread of noxious and invasive plant species.
A-1-32	Greater Sage-Grouse	PCW will work with private landowners to suspend the hunting of sage-grouse on private lands within the Ranch
A-1-33	Greater Sage-Grouse	PCW will cooperate with agencies and private land owners to evaluate and implement predator control techniques to benefit sage-grouse as appropriate.

Table A-2. Summary of Applicant Committed Measures

Item	Resource Concern	Restriction Distance	Jurisdiction			Applies To			Notes
			Private	State	BLM	WTGs	Subs	Roads Collection T-Line	
A-2-01	Cultural Historic Trails	1 mile WTGs, 0.25 mile surface of the Overland Trail	Y	Y	Y	Y	Y	No, minimize crossings, cross at right angles	1 mile setback from the center of the Overland Trail as presently mapped (2008 RMP/ROD) in all areas except the following sections, where the BLM's RMP requirement of 0.25 miles were used: T18N R87W S6; T18N R88W S1; T18N R88W S2; T18N R88W S4; T18N R88W S7; T18N R88W S9; T18N R89W S11; T18N R89W S12; T18N R89W S13; T18N R89W S14; and the unmapped Overland Trail alternative route located in T18N R88W S6, T18N R89W S1, T18N R89W S2, T18N R89W S11, and T18N R89W S10.
A-2-02	Lands and Realty - City/ Town Limits	Structure base 0.5 mile setback	Y	Y	Y	Y	Y	No	Setback only applies to "towers," term not defined in Act; PCW to apply setback to WTGs, overhead
A-2-03	Lands and Realty Homes/ Occupied Buildings	Greater of 5.5 times total structure height or 1,000 ft. setback	Y	Y	Y	Y	N	No	Setback only applies to "towers," term not defined in Act; PCW to apply setback to WTGs, overhead collection, and transmission structures based on the height of each structure
A-2-04	Lands and Realty - ROW Setback	5D from ROW boundary	N	N	Y	Y	N	No	Waiver may be granted

Item	Resource Concern	Restriction Distance	Jurisdiction			Applies To			Notes
			Private	State	BLM	WTGs	Subs	Roads Collection T-Line	
A-2-05	Lands and Realty - Subdivisions	Greater of 5.5 times total structure height or 1,000 ft. setback	Y	Y	Y	Y	Y	Yes, except underground	Setback applies to all above-ground construction, underground appears permissible within setback
A-2-06	Lands and Realty - WTGs	Tower base 1.1 times total structure height from external property lines	Y	Y	Y	Y	N	No	Setback only applies to "towers," term not defined in Act; PCW to apply setback to WTGs, overhead collection, and transmission structures based on the height of each structure
A-2-07	Lands and Realty - WTGs	Tower base 1.1 times total structure height from any public ROWs	Y	Y	Y	Y	N	No	Setback only applies to "towers," term not defined in Act; PCW to apply setback to WTGs, overhead collection, and transmission structures based on the height of each structure
A-2-08	Recreation - Teton Reservoir	1 mile boundary WTGs of Teton Reservoir	Y	Y	Y	Y	N	No	WTG placement would be prohibited within one mile of the Teton Reservoir Recreation Site.
A-2-09	Water - North Platte River	1 mile high water mark WTGs of the North Platte River	Y	Y	Y	Y	Y	No, avoid if possible	WTG placement would be prohibited within one mile of the ordinary high water mark of the North Platte River.

Item	Resource Concern	Restriction Distance	Jurisdiction			Applies To			Notes
			Private	State	BLM	WTGs	Subs	Roads Collection T-Line	
A-2-10	Wildlife - Red Rim Grizzly Wildlife Habitat Area (WHMA)	No development within Red Rim-Grizzly WHMA within the Wyoming Sage-Grouse Core Management Areas Version 3 Map (finalized June 29, 2010)	Y	Y	Y	Y	Y	Yes	The Wyoming Game and Fish Department's (WGFD) Red Rim-Grizzly WHMA is approximately 37,630 acres in total, of which approximately 1,200 acres (3%) lie outside Sage-Grouse Core Management Areas Version 3. The area outside Sage-Grouse Core Management Areas Version 3 is located in the northeast corner of the Grizzly WHMA and is a part of or adjacent to Miller Hill. PCW may locate facilities within this area of the Grizzly WHMA.
A-2-11	Wildlife-Sage-Grouse Core Breeding Area	No facilities within the Wyoming Sage-Grouse Core Management Area Version 3 Map (finalized June 29, 2010)	Y	Y	Y	Y	Y	Yes	No construction of any facilities (WTGs, roads, transmission lines, collector lines, substations, staging areas, etc.) in Wyoming's Sage-Grouse Core Management Areas Version 3 (finalized June 29, 2010).

Table A-3. Applicant Committed Best Management Practices

Item	Resource Concern	Measure
A-3-01	Air – Dust Control	Water would be applied twice per day, or as deemed necessary by the Environmental Inspector, to all disturbed surfaces (i.e., exposed, dry, and unfrozen) during construction. During operation, dust control would occur twice per day in those areas where vehicular traffic exceeds normal operational needs. If, for example, heavy equipment is brought on site for maintenance or if vehicular traffic exceeds a few vehicles per day, additional dust control watering would be initiated.
A-3-02	Air – Dust Control	Magnesium chloride may be applied, if necessary, for adequate dust suppression. These treatments would occur on an as-needed basis, depending on weather conditions and the amount of traffic on the road.
A-3-03	Air – Dust Control	The driving surface of all roads constructed for project access would be surfaced with gravel to further reduce potential dust emissions.
A-3-04	Air – Dust Control	Dust abatement techniques would be used on unpaved, unvegetated surfaces to minimize airborne dust. Dust abatement techniques would be employed on construction materials and stockpiled soils if they are a source of fugitive dust. Dust abatement techniques would be used before and during surface clearing, excavation, or blasting activities.
A-3-05	Air – Dust Control	Speed limits (e.g., 25 miles per hour [mph] [40 kilometers per hour [km/h]) would be posted along all access roads and enforced during construction and maintenance activities and enforced to reduce airborne fugitive dust.
A-3-06	Air – Vehicle Emissions	All construction equipment would be maintained in good working condition and would contain appropriate pollution control devices to minimize trace gas emissions.
A-3-07	Cultural and Paleontological Resources	Unexpected discovery of cultural or paleontological resources during construction would be brought to the attention of the responsible BLM authorized officer immediately. Work would be halted in the vicinity of the find to avoid further disturbance to the resources while they are being evaluated and appropriate mitigation measures are being developed.
A-3-08	General – Decommissioning	Prior to the termination of the right-of-way authorization, a decommissioning plan would be developed and approved by the BLM. The decommissioning plan would include a decommissioning impact analysis, site reclamation plan and monitoring program. All management plans, BMPs, and stipulations developed for the construction phase would be applied to similar activities during the decommissioning phase as agreed to between BLM and PCW.

Item	Resource Concern	Measure
A-3-09	General – Decommissioning	All turbines and ancillary (above-ground) structures would be removed from the site.
A-3-10	General – Avoidance of sensitive areas	PCW would work with the BLM to mitigate for environmentally sensitive areas. Marshy soils, drainage bottoms, and riparian areas would be avoided to the extent practicable.
A-3-11	General – Electrical Lines	All underground electrical collector lines would be buried in a manner that minimizes additional surface disturbance (e.g., along roads or other paths of surface disturbance when possible).
A-3-12	General – Environmental Compliance	An Environmental Compliance Plan (ECP) would be developed and implemented to monitor implementation of mitigation measures during project construction. An Environmental Inspector would be on-site to oversee the implementation of the Project ECP.
A-3-13	General – Maintenance	The transmission lines would be inspected two times per year by ground or aerial patrols, and maintenance would be performed as necessary. Substation maintenance activities would include routine, scheduled equipment maintenance and grounds keeping. Once reclamation is complete and vegetation is stable, noxious weed surveys of the Project areas would be conducted on a regular basis. Inspection of the Project access roads and internal resource roads would include weed monitoring and treatment, as outlined in the Weed Management Plan.
A-3-14	General – Maintenance	Inoperative turbines would be repaired, replaced or removed in a timely manner.
A-3-15	General – Mitigation Measures	All control and mitigation measures established for the Project in the POD and the resource-specific management plans that are part of the POD would be maintained and implemented throughout the operational phase, as appropriate. These control and mitigation measures would be reviewed and revised, as needed, based on the mutual agreement of PCW and BLM, to address changing conditions or requirements within the Project area, throughout the operational phase. This dynamic approach would help ensure that impacts from operations are kept to a minimum.
A-3-16	General – Project Disturbance	The number and size/length of roads, temporary fences, lay-down areas, and borrow areas would be minimized.
A-3-17	General – Project Footprint	The area disturbed by construction-related activities (i.e., footprint) would be kept to a minimum.
A-3-18	General – Project Footprint	The area disturbed by operational-related activities (i.e., footprint) would be kept to a minimum.

Item	Resource Concern	Measure
A-3-19	Geology – Seismic Considerations	All structures will be built to appropriate seismic requirements for the local geology.
A-3-20	Hazardous Materials – SPCC Plan	A Spill Prevention, Control, and Countermeasures (SPCC) Plan would be implemented during the construction and operation phases of Project. The SPCC would define procedures to be used in the event of an accidental spill from vehicles or other equipment.
A-3-21	Hazardous Materials – Accidental Release	In the event of an accidental release of hazardous materials to the environment, the operator would document the event, including a root cause analysis, appropriate corrective actions taken, and a characterization of the resulting environmental or health and safety impacts. Documentation of the event would be provided to the BLM authorized officer and other federal and state agencies, as required.
A-3-22	Hazardous Materials – ESA	A Phase I Environmental Site Assessment would be required prior to the purchase of a property and would be conducted by a trained and experienced environmental professional. If the Phase I Environmental Site Assessment identifies potential hazardous substances, a Phase II Environmental Site Assessment is usually conducted to confirm the presence and extent of contamination.
A-3-23	Hazardous Materials – Handling	Pursuant to the Project's Hazardous Materials Management Plan, all personnel handling hazardous materials would be trained appropriately on the dangers of, and safety precautions to be taken, when working with hazardous materials. Any hazardous materials used on-site would be documented and properly labeled. Material Safety Data Sheets (MSDS) and proper handling procedures would be located on-site. In the event a significant chemical spill occurs, personnel should evacuate the immediate area (as required) and report the release. The Emergency Response Team would be called to the area to assess the extent of the emergency and would determine appropriate response actions based on the Emergency Response Plan.
A-3-24	Hazardous Materials – Secondary Containment	Secondary containment would be provided for all on-site hazardous materials and waste storage, including fuel. In particular, fuel storage (for construction vehicles and equipment) would be a temporary activity occurring only for as long as is needed to support construction activities.
A-3-25	Hazardous Materials – Storage, Handling, and Disposal	Safety measures would be implemented in accordance with Occupational Safety and Health Administration (OSHA) standards and operator requirements. Petroleum products (e.g., lubricating oils and greases) and items such as touch-up paint and fiberglass blade repair materials would be stored on-site for maintenance operations. All such wastes/substances would be handled, stored in a secured location, and disposed of in accordance with applicable federal, state, and local regulations.

Item	Resource Concern	Measure
A-3-26	Health and Safety – Crane Operation	Crane safety training would be conducted to ensure riggers and ground workers understand the hazards of working around mobile cranes and that they watch for signs of problems at all times, especially if power lines are nearby. Standard operating procedures would be developed and implemented for safely lifting loads. A written engineered lift plan for all critical lifts would be developed and followed.
A-3-27	Health and Safety – Crane Operation	Crane operators would take the following steps to protect themselves and other workers when operating mobile cranes on the Project Sites: 1) the minimum clearance between power lines and the crane or load would be 10 ft. for lines rated 50-kV or below; 2) for lines over 50-kV, the minimum clearance would be 10 ft. plus 0.4 foot for each 1-kV over 50-kV; 3) operation of a crane outside of design limitations, manufacturer's specifications, or without the load charts would be prohibited; 4) cranes would be operated only when wind velocities are under the maximum speeds stipulated for safe operation (these velocities are generally stated in the manufacturer's specifications); 5) cranes would be inspected daily prior to each use, monthly, and annually, and the records of these inspections would be available on the machine; 6) rigging equipment would be inspected daily; 7) all operators of mobile cranes would have, and be familiar with, the additional requirements in the ANSI standard; 8) the latch in the hook throat opening would never be tied back; and 9) employees would not be suspended from the cranes and the use of cranes for suspended personnel platforms would be avoided.
A-3-28	Health and Safety – Crane Operation	Meteorological stations would monitor wind speeds on the job site to support safe crane operating standards.
A-3-29	Lands and Realty – Foreign Lines, Monuments, and Markers	All foreign lines would be marked. Monuments and markers (i.e., General Land Surveys and BLM Cadastral Survey Corners, reference corners, U.S. Coastal and Geodetic benchmarks) would be protected during the construction and operational phases of the Project. In the event that a monument or marker is disturbed, the employee would report the incident in writing to the Authorized Officer. PCW, in consultation with the BLM or other appropriate agency, would be responsible for re-surveying and replacing any markers that are disturbed.
A-3-30	Noise – Blasting and Noisy Activity	If blasting or other noisy activities are required during the construction period, nearby residents would be notified in advance.
A-3-31	Noise – Construction Equipment	All equipment would have sound-control devices no less effective than those provided on the original equipment. All construction equipment used would be adequately muffled and maintained.

Item	Resource Concern	Measure
A-3-32	Noise – Construction Equipment	All stationary construction equipment (i.e., compressors and generators) would be located as far as practicable from nearby residences.
A-3-33	Noise – Road Use	Road use specifications designed to keep traffic to a minimum would be implemented to the maximum extent practical.
A-3-34	Noise – Turbine Noise	All WTGs would be properly maintained to prevent excessive noise.
A-3-35	Public Health and Safety – Construction Practices	A Project Health and Safety Plan would be implemented in accordance with OSHA standards. Hard hat requirements and "authorized personnel only" signs would be posted at the entrance to the main access points during construction. Permanent signs would be posted at gates on the main access roads. Safety signs (e.g., speed limits, steep grades, etc.) would be placed along the main access roads in accordance with local, state, and federal regulations. Safety signing would be posted on all transformers, at high-voltage facilities, along roads, and around towers (if necessary) in conformance with applicable state and federal regulations.
A-3-36	Public Health and Safety – Construction Practices	A comprehensive and continuous occupational Injury and Illness Prevention Program (IIPP) would be implemented and enforce a code of safe practices (CSP) for all employees. A designated field safety person would be responsible for on-site management and administration of the IIPP and CSP. Occupational safety and health matters would be communicated to employees by written documentation, staff meetings, formal and informal training, weekly safety meetings, and posted information. Communication from employees to supervisors or safety representatives about unsafe or unhealthy conditions would be encouraged and may be verbal or written. Results of investigations of any employee safety suggestion or report of hazard would be distributed to all employees affected by the hazard or posted, as appropriate.
A-3-37	Public Health and Safety – Construction Practices	Each supervisor would conduct an inspection to identify unsafe working conditions and practices, as follows: 1) weekly in all areas; 2) whenever new substances, procedures, or equipment that may represent a new safety or health hazard are introduced to the job site; and 3) whenever a supervisor is made aware of a new or previously unrecognized hazard. A hazard checklist or hazard assessment form would be used to document inspections. Employees may not enter a hazard area without appropriate protective equipment, training, and prior specific approval by the IIPP and CSP administrator.
A-3-38	Public Health and Safety – Fire Management	Fire control would be provided pursuant to the Project's Fire Safety Plan.

Item	Resource Concern	Measure
A-3-39	Public Health and Safety – Fire Management	Fire prevention standards would be followed to reduce the risk of a fire, in accordance with 36 CFR 261 and the Wyoming Interagency Fire Restriction Plan. All hot work that is to occur on site would be done in accordance with OSHA Regulation 29 CFR 1910.252(a).
A-3-40	Reclamation	All areas of disturbed soil would be reclaimed using weed-free native grasses, forbs, and shrubs. Reclamation activities would be undertaken as early as possible on disturbed areas not required for operation.
A-3-41	Reclamation – Roadways	Access roads would be regraded, the topsoil replaced, and all disturbed areas would be re-vegetated. Any roadway damage due to the transport of the heavy equipment would be repaired on the public roadways upon the completion of Project construction and decommissioning.
A-3-42	Reclamation – Topsoil	Topsoil from all decommissioning activities would be salvaged and reapplied during final reclamation.
A-3-43	Reclamation – Vegetation	All areas of disturbed soil would be reclaimed using weed-free native shrubs, grasses, and forbs. The vegetation cover, composition, and diversity would be restored to values commensurate with the ecological setting.
A-3-44	Recreation – Public Access	Temporary fencing would be installed around staging areas and storage yards during construction to limit public access. Public access to open excavations would be limited by either installation of locked gates at public access points, or utilization of other approved means of limiting public access.
A-3-45	Recreation – Public Access	Permanent fencing would be installed and maintained around electrical substations, and turbine tower access doors would be locked to limit public access during operations.
A-3-46	Roads – General Design	DELETED[1]
A-3-47	Roads – General Design	Access roads and on-site roads would be surfaced with aggregate materials, wherever appropriate.
A-3-48	Roads – General Design	Access roads would be located to follow natural contours where possible and minimize side hill cuts.
A-3-49	Roads – General Design	DELETED[1]

[1] Power Company of Wyoming (PCW). 2012. Memorandum from G. Miller (PCW) to P. Murdock (BLM) dated April 10, 2012.

Item	Resource Concern	Measure
A-3-50	Roads – General Design	Roads would be located upwind from WTG rows, where possible, such that drifting caused by towers or transformers is not likely to accumulate on roads.
A-3-51	Roads – General Design	Roads are designed in accordance with the BLM Gold Book (BLM 2007a) design criteria as well as the BLM Manual 9113: Roads (BLM 1985).
A-3-52	Roads – General Design	Existing roads would be used, but only if in safe and environmentally sound locations. If new roads are necessary, they would be designed and constructed to the appropriate BLM road design standards where practical and be no higher than necessary to accommodate their intended functions (e.g., traffic volume and weight of vehicles).
A-3-53	Roads – General Design	Final roadway alignments will include erosion control measures to stabilize steeper slopes and to prevent loss of soil. These measures will include hay bales, shallow swales and ditches, rock/rip rap embankments, and culvert outlet protection. Final alignments will be ground-verified using BLM Rawlins Field Office knowledge of potentially problematic areas for road construction and/or maintenance.
A-3-54	Roads – General Design	Where road intersection improvements are required to accommodate extra long vehicles, potential upgrades could include placement of relocating signs, placement of temporary paving, and use of flaggers, as needed. All intersection improvements would be restored to their original condition upon the completion of construction.
A-3-55	Roads – General Design	Where road-cattle guard intersection improvements are required to accommodate overweight vehicles, potential road profile upgrades may be required to allow travel safely over the cattle guards. All damaged cattle guards would be replaced upon the completion of construction.
A-3-56	Roads – General Design	All existing roads that would be used as primary access locations to the Project area would need to be upgraded to accommodate the anticipated extra traffic generated by the Project. Most of these roads are county roads or two-track roads that would need to be widened to accommodate the construction traffic. All necessary federal, state, and local permits would be obtained to complete this work prior to construction.
A-3-57	Roads – General Design	During the course of construction, if excessive wear and tear to the existing roadway surface is evident, these road surfaces would be restored to their original condition upon the completion of construction. Where necessary, consultation with the UPRR would be required to change the roadway profile at specific at-grade railroad crossings to smooth the existing hump for low-profile vehicles; consultation with various utility companies would be required to elevate the risk of oversized vehicles in relation to low-hanging power lines.

Item	Resource Concern	Measure
A-3-58	Roads – General Design	Due to crest and sag vertical curves in the roadway profile, select locations would require re-grading prior to hauling extra long loads. Any grades greater than 10 percent would require assist vehicles on-hand for the large tractor-trailers hauling WTG components. Any grades greater than 7 percent would require assist vehicles on-hand. These locations would be verified during the final design process. In addition, any construction site with grades ranging from 5 to 7 percent on non-paved roadways would require an assist vehicle on stand-by during adverse weather or road conditions.
A-3-59	Roads – General Use	Traffic would be restricted to the roads developed for the Project. Use of other unimproved roads would be restricted to emergency situations. Signs would be placed along construction roads to identify speed limits, travel restrictions, and other standard traffic control information.
A-3-60	Roads – Maintenance	Most road maintenance would be performed on an as-needed basis. The frequency and type of maintenance that would be required would be determined by routine inspections. The inspections would be performed on a regular basis and following snowmelt or heavy or prolonged rainfall. Inspections would identify maintenance needs for reduction of ruts and holes, maintenance of crowns and outslopes to keep water off the road, replacement of surfacing materials, clearing of sediment blocking ditches and culverts, maintenance of interim reclamation, and noxious weed control.
A-3-61	Roads – Maintenance	All roads would be maintained in a safe and environmentally responsible manner.
A-3-62	Roads – Operation Access	Project operation would require the use of the new roads for equipment and personnel to reach the WTGs. In addition, an access road that runs adjacent to each WTG site and the project substations would be used.
A-3-63	Roads – Operation Access	Internal resource roads would be located within the project boundaries and would provide access to each WTG. All internal resource roads would be surfaced with gravel. As part of routine maintenance activities, internal resource roads would be maintained in a condition that allows for continued access to the WTGs.
A-3-64	Roads – Reclamation	Abandoned roads and roads that are no longer needed would be recontoured and revegetated.
A-3-65	Soils and Geology –Slopes	Operators would identify unstable slopes and local factors that can induce slope instability. Operators also would avoid creating excessive slopes during excavation and blasting operations. Special construction techniques would be used where applicable in areas of steep slopes, erodible soil, and stream channel crossings.

Item	Resource Concern	Measure
A-3-66	Soils – Erosion Control	Erosion control measures would be employed as described in the Master Reclamation Plan
A-3-67	Soils – Erosion Control	Permanent erosion control devices would be installed during project construction and may include, but are not limited to, waterbars, roadside ditches with subsurface culverts, berms, trash racks on culverts, energy-dissipating structures, mulches, and establishment of permanent vegetation. Erosion controls that comply with county, state, and federal standards would be applied. Practices such as jute netting, silt fences, and check dams would be applied near disturbed areas. The Environmental Inspector would monitor construction to ensure that erosion control devices are functioning properly.
A-3-68	Soils – Erosion Control	Final roadway alignments would include erosion control measures to stabilize steeper slopes and to prevent loss of soil. These measures would include hay bales, shallow swales and ditches, rock/rip rap embankments, and culvert outlet protection.
A-3-69	Soils – Erosion Control	If, during operation, it is determined that snow accumulation causes significant accelerated erosion, appropriate mitigation measures (e.g., snow fence construction) would be developed and implemented.
A-3-70	Soils – Excavation and Blasting Activities	Foundations and trenches would be backfilled with originally excavated material as much as possible. Excess excavation materials would be disposed of only in approved areas or, if suitable, stockpiled for use in reclamation activities.
A-3-71	Soils – Excavation and Blasting Activities	Borrow material would be obtained only from authorized and permitted sites. Existing sites would be used in preference to new sites when possible.
A-3-72	Soils – Topsoil Handling	Topsoil from all excavations and construction activities would be salvaged and reapplied during reclamation.
A-3-73	Soils – Topsoil Handling	Topsoil material suitable for site reclamation would be removed in conjunction with clearing and grading and reserved in local stockpiles. Topsoil storage areas would generally be located within staging areas and alongside roadways during construction.
A-3-74	Soils – Wet Soils During Construction	Construction activities would be suspended when soils are wet. Construction would resume when soils become dry enough to support construction equipment. The Environmental Inspector (EI) would determine when conditions are too wet to continue.

Item	Resource Concern	Measure
A-3-75	Transportation – Traffic Considerations	To minimize impacts on local commuters, consideration would be given to limiting construction vehicles traveling on public roadways during the morning and late afternoon commute time. Consideration would also be given to opportunities for busing of construction workers to the job site to reduce traffic volumes.
A-3-76	Transportation – Transportation Planning	Ongoing ground transportation planning would be conducted to evaluate road use, minimize traffic volume, and ensure that roads are maintained adequately to minimize associated impacts.
A-3-77	Transportation – Transportation Planning	Following the finalization of site access locations and proposed roadways, a Traffic Management Plan would be developed for traffic both on and off-site. The Traffic Management Plan would discuss flagging guidelines on and off site, specifics of auxiliary lanes if needed, requirements for signage during construction of the project, passing zone and striping details for the existing public roadways, and other details specific to the individual approved access locations leading to and from, and on, the Project area.
A-3-78	Vegetation – Noxious Weed	Noxious weed surveys would be conducted to evaluate the presence and aerial extent of noxious weed and invasive species populations within the Project area. Preventative management measures would be applied as warranted pursuant to the Project's Weed Management Plan.
A-3-79	Visual Resources	Operators would reduce visual impacts during construction by clearly delineating construction boundaries and minimizing areas of surface disturbance; preserving vegetation to the greatest extent possible; utilizing undulating surface disturbance edges; stripping, salvaging and replacing topsoil; contoured grading; controlling erosion; using dust suppression techniques as required; and restoring exposed soils as closely as possible to their original contour and vegetation.
A-3-80	Visual Resources	Operators would monitor and maintain visual mitigation measures for the approved project in accordance with a visual monitoring and compliance plan. The operator would maintain revegetated surfaces until a self-sustaining stand of vegetation is reestablished and visually adapted to the undisturbed surrounding vegetation.
A-3-81	Waste Management – Disposal	Wastes would be properly containerized and removed periodically for disposal at appropriate off-site permitted disposal facilities.

Item	Resource Concern	Measure
A-3-82	Waste Management – Wastewater	Any wastewater generated in association with temporary, portable sanitary facilities would be periodically removed by a licensed hauler and introduced into an existing municipal sewage treatment facility or otherwise disposed of in accordance with applicable state and local laws and regulations. Temporary, portable sanitary facilities provided for construction crews would be adequate to support expected on-site personnel and would be removed at completion of construction activities.
A-3-83	Water – SWPPP	The Project's SWPPP would be implemented in accordance with the Wyoming Department of Environmental Quality (WDEQ) requirements to obtain National Pollutant Discharge Elimination System (NPDES) compliance under Wyoming's NPDES permit WYR10-0000. The SWPPP would describe site-specific erosion control and stream crossing measures that would be implemented during the construction and operation phases of the Project. The Environmental Inspector would direct activities to ensure compliance with the SWPPP.
A-3-84	Water – Excavation and Blasting Activities	DELETED[2]
A-3-85	Water – Excavation and Blasting Activities	Operators would avoid creating hydrologic conduits between two aquifers during foundation excavation and other activities.
A-3-86	Water – Road Design	DELETED[2]
A-3-87	Water – Road Drainage	Whenever possible, existing drainage systems would not be altered, especially in sensitive areas such as erodible soils or steep slopes. Potential soil erosion would be controlled at culvert outlets with appropriate structures. Catch basins, roadway ditches, and culverts would be cleaned and maintained regularly.
A-3-88	Water – Road Locations	Roads would be located away from drainage bottoms and avoid wetlands, if practicable.
A-3-89	Water – Stream Crossings	Access roads would be located to minimize stream crossings. All structures crossing streams would be located and constructed so that they do not decrease channel stability or increase water velocity. Operators would obtain all applicable federal and state permits.

[2]Power Company of Wyoming (PCW). 2012. Memorandum from G. Miller (PCW) to P. Murdock (BLM) dated April 10, 2012.

Item	Resource Concern	Measure
A-3-90	Water – Waterbodies and Wetlands	Waters of the U.S., including wetlands, will be avoided to the maximum extent practicable. Where these features cannot be completely avoided, impacts will be minimized through design modification, as necessary. Facilities (e.g., turbines, substations, staging areas) would be sited to avoid and/or minimize impacts; however, where impacts are anticipated (e.g., use of Project roads), minimization measures would be employed to minimize impacts (e.g., use of culverts to maintain downstream flow/drainage).
A-3-91	Water – Waterbodies and Wetlands	All impacts would be the minimum necessary to accomplish the Project, would be mitigated, and the appropriate Section 404 permit would be obtained from the U.S. Army Corps of Engineers (USACE) Wyoming Regulatory Office prior to the start of construction. To complete the Section 404 permit, a delineation of all Waters of the U.S. (WUS), including wetlands, would be performed by qualified wetland scientists to obtain current site-specific data regarding the location and extent of aquatic features within the Project area. Current resource mapping (e.g., U.S. Geological Survey (USGS) topographic maps, U.S. Fish and Wildlife Service (USFWS) NWI maps, Federal Emergency Management Agency (FEMA) floodplain maps, Natural Resources Conservation Service (NRCS) soils data, etc.) would be used to guide this future delineation effort. All aquatic features delineated in the field would be recorded using Global Positioning System (GPS) with sub-meter accuracy.
A-3-92	Water – Waterbodies and Wetlands	Any construction that occurs in or adjacent to wetlands and streams would use Applicant Committed BMPs listed in Appendix A to protect surface water quality and to minimize impacts to those resources.
A-3-93	Wildlife – Department of the Interior (DOI) Wind Turbine Guidelines	Although strictly voluntary on non-federal lands, PCW will review the DOI Wind Turbine Guidelines Advisory Committee Wind Turbine Guidelines (anticipated in late summer 2010) once they are finalized with the intention of complying with them as applicable and appropriate and to the extent they do not conflict with any requirements set out by the BLM in its ROD, any agreements entered into between PCW and the USFWS, or other controlling laws, permits, or regulations.
A-3-94	Wildlife – Disturbance and Harassment	All employees, contractors, and site visitors would be instructed to avoid harassment and disturbance of wildlife, especially during reproductive (e.g., courtship and nesting) seasons. During construction, pets would not be permitted on site; during operation, pets would be controlled to avoid harassment and disturbance to wildlife.
A-3-95	Wildlife – Excavation and Blasting Activities	Explosives would be used only within specified times and at specified distances from sensitive wildlife or streams and lakes, as established by the BLM or other federal and state agencies.

Item	Resource Concern	Measure
A-3-96	Wildlife – Habitat Restoration	In accordance with the habitat restoration plan, restoration would be undertaken as soon as practical after completion of construction activities to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats.
A-3-97	Wildlife – Vehicle Collisions	Project personnel and contractors would be instructed and required to adhere to speed limits commensurate with road types, traffic volumes, vehicle types, and site-specific conditions, to ensure safe and efficient traffic flow and to reduce wildlife collisions and disturbance and airborne dust.
A-3-98	Wildlife – Yellow-billed Cuckoo	Yellow-billed cuckoo habitat (i.e., riparian areas) would be avoided to the maximum extent possible.

Appendix B. Health and Safety Plan Requirements

PCW will work with the construction contractors hired to build the Project to develop a comprehensive health and safety plan. The common elements of such a plan include:

- Document Control
- Zero Injury Safety Policy
- Project Responsibilities
- Site Safety Committee
- Safety Meetings
- Drug and Alcohol Free Workplace Policy
- Hazardous Communication / Right to Know
- Bloodborne Pathogens
- Employee Orientation
- Zero Tolerance Program
- Disruption Avoidance Plan
- Emergency Response Plan
- Crisis Management Plan
- Site Security Plan
- Fire Prevention and Suppression Plan
- Severe Weather Plan
- Fall Protection
- Respiratory Protection
- Confined Space
- Scaffold Standards
- Electrical
- Lock Out / Tag Out
- Traffic Control Plan
- Personal Protective Equipment Requirements
- Permitted Work Requirements
- Blasting Requirements
- Competency Requirements
- Pre-Task Planning Procedures
- Driving Requirements
- Excavation Requirements
- Work Observations / Daily Safety Audits
- Stretching Program
- Toolbox Talks
- Environmental
- Snake / Insect Bites and Dangerous Animals
- Hunting Safety

- Accident / Incident Reporting
- Forklift Operator Qualifications
- Crane Operator Qualifications
- Lift Planning
- Crane Walking Procedure
- In Cab Crane Books
- Open Talk

Appendix C. Transportation Management Plan

Chokecherry and Sierra Madre Wind Energy Project

Preliminary Transportation Management Plan

Prepared for

555 Seventeenth Street
Suite 2400
Denver, CO 80202

Prepared by

4601 DTC Boulevard, Suite 700
Denver, CO 80237

Table of Contents

1. Introduction 1

2. Project Definition 3
2.1 Proposed Rail Distribution Center 3
2.1.1 Preferred Site 3
2.1.2 Alternate Site 4

3. Existing Infrastructure 5
3.1 Locations and Conditions 5
3.1.1 Interstate 80 5
3.1.2 US287 6
3.1.3 WY130 7
3.1.4 WY76 7
3.1.5 WY71/CC401 (Sage Creek Road) 7
3.1.6 CC407 (CIG Road) 8
3.1.7 Other Local Roads 8
3.2 Existing Traffic 9
3.2.1 Existing Traffic Volumes 9
3.2.2 Existing Traffic Operations 11
3.3 Restrictions and Permit Requirements 12
3.3.1 Physical Restrictions 12
3.3.2 Weight Restrictions 13
3.3.3 Timing Restrictions 13
3.3.4 Load Type Restrictions 13
3.3.5 Permit Requirements 13

4. Project Traffic Effects – Construction 15
4.1 Project Traffic 15
4.1.1 Material/Component Deliveries 15
4.1.2 Labor Force 17
4.2 Traffic Analysis – Year One 19
4.2.1 Trip Generation 19
4.2.2 Trip Distribution 20
4.2.3 Trip Assignment 21
4.2.4 Analysis Results 21
4.3 Traffic Analysis – Year Three 22
4.3.1 Trip Generation 23
4.3.2 Trip Distribution 26
4.3.3 Trip Assignment 29
4.3.4 Analysis Results 29

4.4 Potential Mitigation Options 31
4.4.1 Component Deliveries on Public Roadways 32
4.4.2 Labor Force Commuting Traffic at I-80 Exit 221 32
4.4.3 Labor Force Commuting Traffic on WY71 33

5. Project Traffic Effects – Operations 34
5.1 Operations Traffic 34
5.1.1 Types of Trips 34
5.1.2 Labor Force 34
5.2 Traffic Analysis 34
5.2.1 Trip Generation 34
5.2.2 Analysis Parameters 35
5.2.3 Analysis Results 35
5.3 Potential Mitigation Options 35

6. Project Traffic Effects – Decommissioning 36
6.1 Project Traffic 36
6.1.1 Material/Component Requirements 36
6.1.2 Labor Force 37
6.2 Traffic Analysis 37
6.2.1 Trip Generation 37
6.2.2 Trip Distribution 41
6.2.3 Analysis Results 41
6.3 Potential Mitigation Options 43

Appendix A. Traffic Volume Diagrams 1

Appendix B. Existing Traffic Counts 1
B-1. 2008 TMC 2
B-2. 2008 ADT 3
B-3. 2010 TMC 4
B-4. 2010 ADT 5

Appendix C. Level of Service Reports 1

C-1. Existing Level of Service Reports 2

C-2. Year One Level of Service Reports 3

C-3. Year Three Preferred Rail Level of Service Reports: All Workers Report to North Access 4

C-4. Year Three Preferred Rail Level of Service Reports: Workers Allowed to use SH 71 5

C-5. Year Three Alternate Rail Level of Service Reports: All Workers Report to North Access 6

C-6. Year Three Alternate Rail Level of Service Reports: Workers Allowed to use SH 71 7

C-7. Operations and Maintenance Level of Service Reports 8

C-8. Decommissioning Level of Service Reports: Preferred Rail Facility 9

C-9. Decommissioning Level of Service Reports: Alternate Rail Facility 10

Table of Figures

Figure 1. Project Location within Carbon County, Wyoming 1
Figure 2. Rail Facility Locations 4
Figure 3. Existing Roadway Network 5
Figure 4. Typical Diamond and Trumpet Interchange Schematics 6
Figure 5. WY71/CC401 Road Conditions 8
Figure 6. Peak Month Hourly Trips – Construction 20
Figure 7. Trip Distribution – Construction Year One Peak 21
Figure 8. Average Off-Site Daily Traffic – Construction 23
Figure 9. Construction Transport Routes 27
Figure 10. Trip Distribution – Construction Year Three Peak, Primary Rail Site 28
Figure 11. Trip Distribution – Construction Year Three Peak, Alternate Rail Site 28
Figure 12. Average Off-Site Daily Traffic – Decommissioning 39
Figure 13. Peak Month Hourly Trips – Decommissioning Year 3 Peak 40
Figure 14. Traffic Volumes - Existing A-2
Figure 15. Traffic Volumes – Construction Year One Peak (July) A-3
Figure 16. Traffic Volumes – Construction Year Three Peak (July), Preferred Rail Site, Labor Force Using WY71 and Exit 221 ..... A-4
Figure 17. Traffic Volumes – Construction Year Three Peak (July), Preferred Rail Site, Labor Force Using Exit 221 Only A-5
Figure 18. Traffic Volumes – Construction Year Three Peak (July), Alternate Rail Site, Labor Force Using WY71 and Exit 221 ..... A-6
Figure 19. Traffic Volumes – Construction Year Three Peak (July), Alternate Rail Site, Labor Force Using Exit 221 Only A-7
Figure 20. Traffic Volumes – Operations A-8
Figure 21. Traffic Volumes – Decommissioning Year Three Peak, Preferred Rail Site A-9
Figure 22. Traffic Volumes – Decommissioning Year Three Peak, Alternate Rail Site A-10

Table of Tables

Table 1. Daily Count Data 9
Table 2. LOS Criteria for Signalized and TWSC Intersections 11
Table 3. Public Intersection Level of Service Analysis – Current Conditions 12
Table 4. Total Truckloads of Project Construction Material 17
Table 5. Total Labor Force Commuting to Site During Construction 18
Table 6. Total Daily Traffic Volume Estimate – Construction Year One 19
Table 7. Public Intersection LOS Analysis – Construction Year One Peak Month 22
Table 8. Total Daily Traffic Volume Estimate – Construction, Primary Rail Site 24
Table 9. Total Daily Traffic Volume Estimate – Construction, Alternate Rail Site 25
Table 10. Public Intersection LOS Analysis – Construction Year Three Peak, Primary Rail Site ... 30
Table 11. Public Intersection LOS Analysis – Construction Year Three Peak, Alternate Rail Site. 31
Table 12. Public Intersection LOS Analysis – Effects of Staggered Start Time 33
Table 13. Public Intersection LOS Analysis – Operations 35
Table 14. Total Truckloads of Project Decommissioning Material 36
Table 15. Total Labor Force Commuting to Site During Decommissioning 37
Table 16. Total Daily Traffic Volume Estimate – Decommissioning, Primary Rail Site 38
Table 17. Total Daily Traffic Volume Estimate – Decommissioning, Alternate Rail Site 41
Table 18. Public Intersection LOS Analysis – Decommissioning Peak, Primary Rail Site 42
Table 19. Public Intersection LOS Analysis – Decommissioning Peak, Alternate Rail Site 43

1. Introduction

The Power Company of Wyoming, LLC (PCW) proposes to construct the Chokecherry and Sierra Madre wind energy project (Project) located in Carbon County, Wyoming. The Project is contained within the Application Area shown on Figure 1 and consists of two major development areas, the Chokecherry site and the Sierra Madre site located approximately 9 miles apart. The majority of the Project is contained within the boundary of the Overland Trail Ranch (Ranch), also shown on Figure 1. This Preliminary Transportation Management Plan (TMP) estimates the off-site (off the Ranch) traffic generated by the Project's construction, operation, and decommissioning, and evaluates its effect on the surrounding roadway network and existing traffic. This TMP is consistent with the Project requirements contained in the Project 2011 Plan of Development (POD).

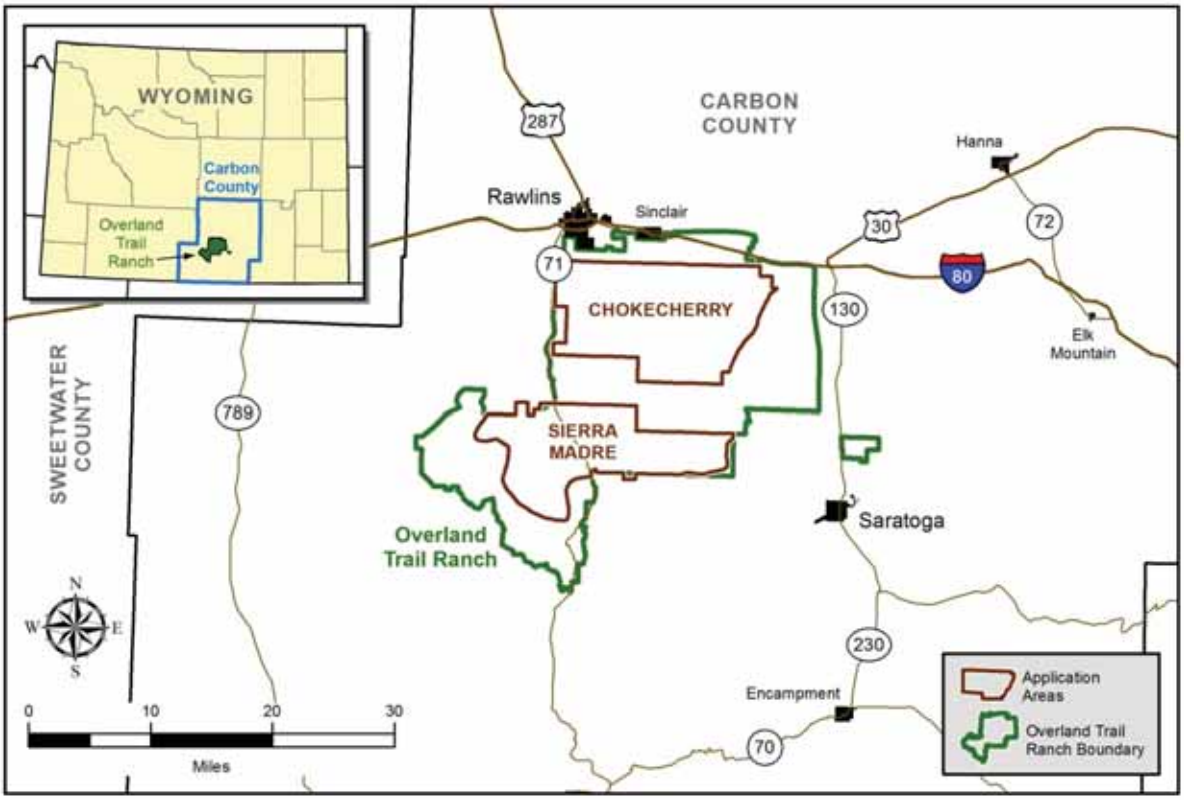


Figure 1. Project Location within Carbon County, Wyoming

The traffic analysis for each year of the Project's construction, operations, and decommissioning shows that the periods with the highest traffic levels that warrant the most analysis are:

- Construction Year One (prior to Project rail facility operation, all materials will need to be trucked in)
- Construction Year Three (most peak hour traffic during construction of the Project)
- Operations Typical Year

- Decommissioning Year Three (most peak hour traffic during decommissioning of the Project)

Evaluation of the peak hours during these periods determined instances where traffic generated by the Project's construction may exceed the capacity of the nearby roadway network. As such, the TMP determined feasible mitigation methods for addressing these instances and limiting the overall effects. Traffic outside the peak hours is expected to be lower, and hence not require as much (if any) traffic mitigation to increase capacity.

This TMP uses various conservative assumptions so that the results indicate the highest traffic levels possible. One significant assumption is that the construction and decommissioning schedule includes significant seasonal limitations, which requires that activities be performed over a compressed period each year. Easing of these limitations could significantly decrease peak traffic levels and lessen public roadway effects. Another assumption is that workers commuting to and from the Project will commute during existing peak hours. While it is probable that most of the commuting worker trips will occur somewhat before the current local morning peak and somewhat later than the current local evening peak, PCW wanted to evaluate the effects of the peak hours aligning to analyze a worst-case scenario.

This TMP evaluates only the traffic directly generated by the Project, including component and material deliveries and the Project workforce traffic. Traffic caused by indirect and induced businesses is not included The locations of these businesses and the amount of associated traffic is unknown and is not under PCW's control. Socioeconomic and other effects are not included in this report.

This TMP is preliminary, and is intended to identify the range of transportation effects for the Project. Detailed Traffic Management Plans will be developed for each subsequent site-specific POD. These detailed TMPs will evaluate the expected traffic patterns and recommend appropriate mitigation methods, such as the use of flaggers, if necessary.

2. Project Definition

PCW will construct 1,000 wind turbines and associated infrastructure capable of generating approximately 2,000 to 3,000 MW of clean, renewable wind energy. Infrastructure that will be constructed as part of the project includes roads, an electric collection and transmission system, substations, site buildings for Project operations, and a rail distribution center.

The construction of the Project is anticipated to occur over five years, with the construction season occurring in the months of May through November each year. In certain areas of the Project additional timing stipulations will apply which will compress the annual construction season on either end.

The first year of construction (Year One) includes the construction of the project haul road as well as the proposed rail facility. During this period, all materials will be hauled to the Project by truck, therefore Year One was analyzed as a special case to ensure that any effects to the surrounding road network were captured.

Construction activities will generate the highest number of workers and construction traffic in Year Three, and therefore the peak month of Year Three (July) serves as the highest volume scenario considered in the construction analysis. Similarly, May through August of Year Three of decommissioning was determined to have the highest traffic and is used as the basis for the decommissioning analysis. As no peak case occurs during Project operations, the typical daily traffic expectations are evaluated.

2.1 Proposed Rail Distribution Center

Given the volume of materials and equipment necessary to build the Project, PCW has determined the most efficient manner to transport these goods is via rail. The existing rail distribution center in the Town of Rawlins (the Rocky Express) cannot be used to receive WTG components because this facility is not adequately sized for the Project. Similar challenges exist at the rail facility in Sinclair, and delivery to either facility would require significant heavy truck traffic within the respective communities. Therefore, PCW intends to develop a new rail distribution center for the Project that is located on the Ranch. As described in the 2011 Project POD, it is anticipated that the rail facility will be constructed during Construction Year One. The primary and alternate rail facility locations are shown in Figure 2. Because the location has not yet been finalized, both alternatives are analyzed within this TMP to determine potential effects on the existing roadway network.

2.1.1 Preferred Site

PCW's preference is to locate the rail facility within the Ranch near the UPRR main line, , south of I-80 near the northern entrance to the Project. The anticipated configuration for a rail distribution center in this area is a track coming south off the main line between Rawlins and Sinclair in Township 21 North, Ranges 86 and 87 West. This location will allow construction

materials to be delivered by rail directly to the Project and construction vehicles hauling these deliveries will not have to utilize public roads or cross I-80.

2.1.2 Alternate Site

If the preferred site is found to be impossible to develop, PCW has identified an alternate area for the rail facility. This alternate site is adjacent to and east of WY76 and between I-80 and the UPRR main line. While still within the Ranch, the alternate site is on the opposite side of I-80 from the Project and further from the Project's northern entrance. Development of the rail facility at the alternate site would require all loads traveling from the rail facility to the Project to use public roads and to cross I-80.

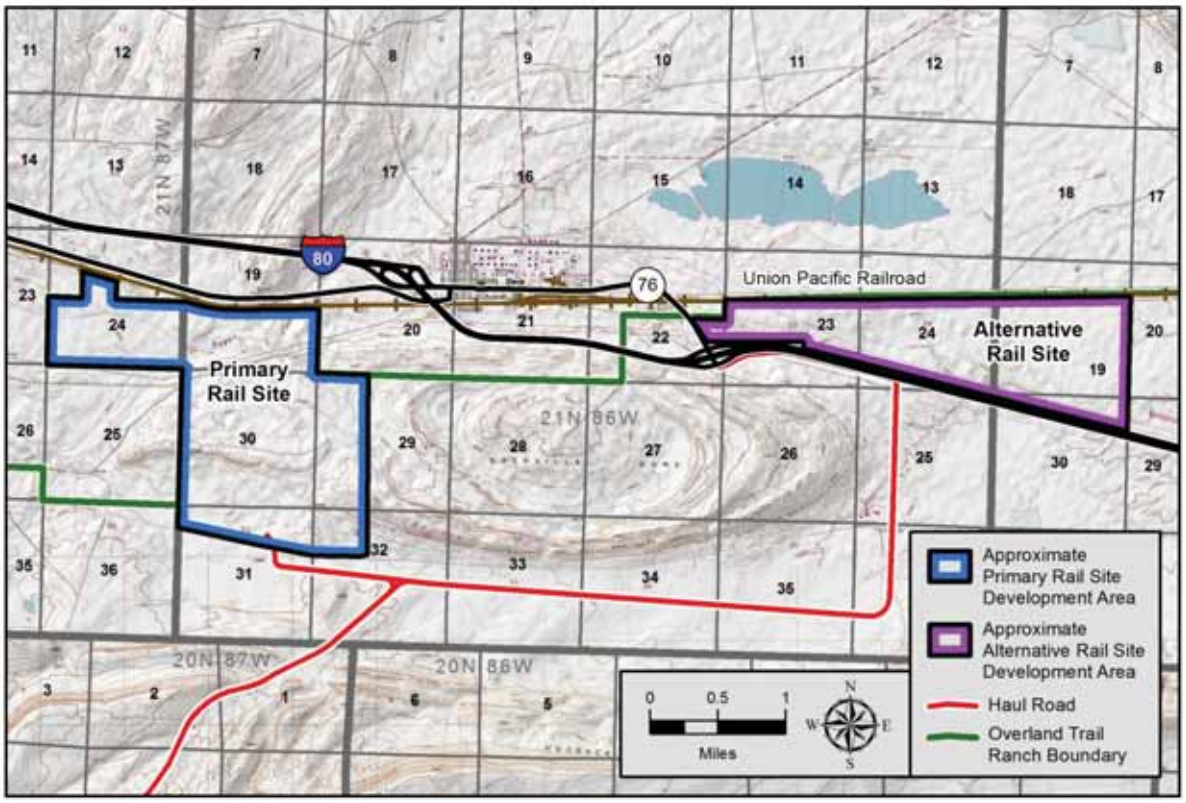


Figure 2. Rail Facility Locations

3. Existing Infrastructure

The first step in evaluating the effects on the public roadways in the vicinity of the Project is to understand the location, condition, and current use of those roadways. A discussion of the existing infrastructure is provided in this chapter.

3.1 Locations and Conditions

This section discusses the location and conditions of the existing roadways and routes that can be used to access the Project. All traffic entering and exiting the Project is expected to come from the north end of the site. The land south of the site is currently sparsely developed and the roadway network has limited connectivity to nearby towns and other resources. The existing routes that may be used by the Project are described below and shown in Figure 3. The conditions of the roadways surrounding the Project were initially reviewed by PCW in 2009, and have been periodically observed since.

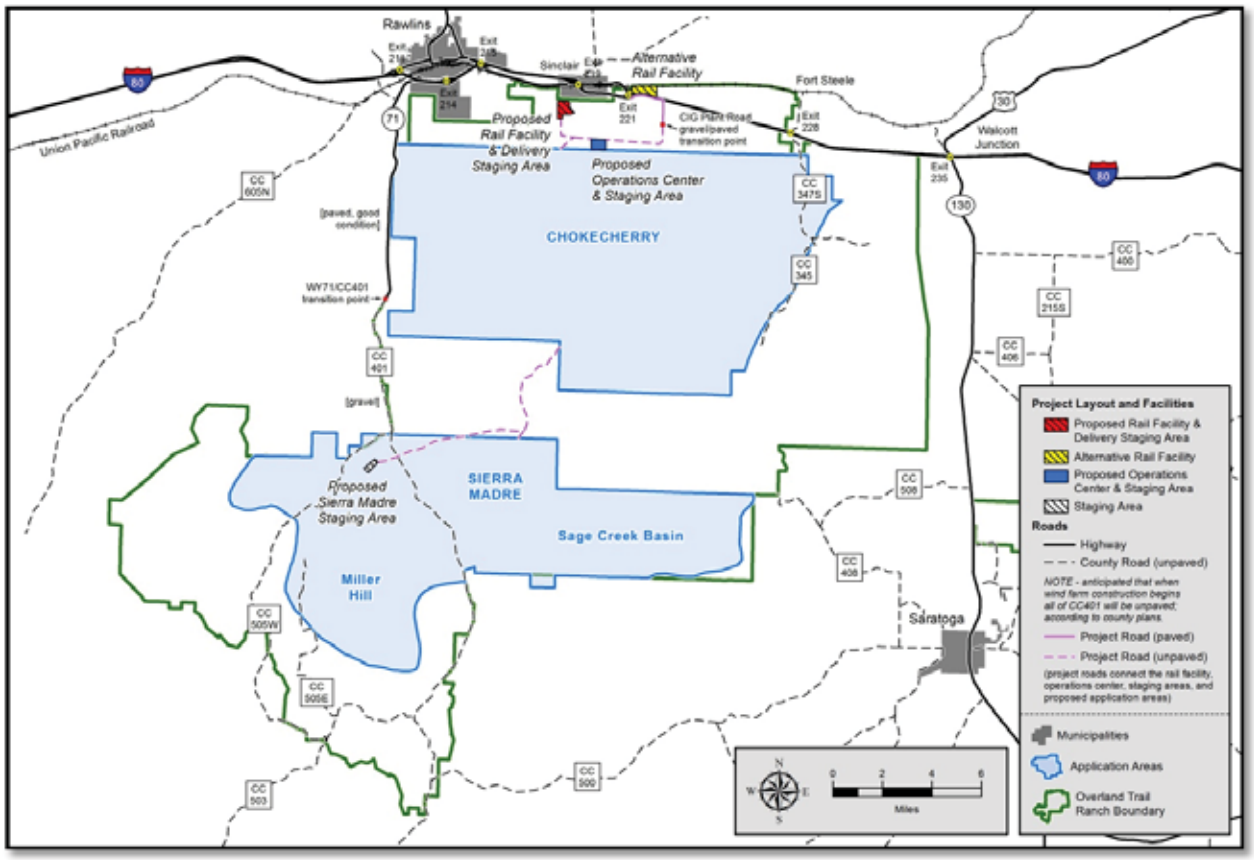


Figure 3. Existing Roadway Network

3.1.1 Interstate 80

Interstate 80 (I-80) is a four-lane divided highway with 12-foot lanes, approximately 8-foot shoulders, and is the primary east-west route through this region of Wyoming. I-80 has three exits to Rawlins (exits 211, 214, and 215) and two exits to Sinclair (exits 219 and 221) that are

near the Project. An additional exit north of the project is located at Fort Steele (exit 228). Walcott Junction (exit 235) is located east of the Project boundary and leads to Saratoga via Wyoming Highway 130 (WY130). All of the interstate access locations are diamond interchanges with the exception of exit 215 at Rawlins, which is a trumpet interchange with free movements in all directions (see Figure 4). The on- and off-ramps do not typically have acceleration or deceleration lanes on the interstate, but the ramps are typically at least 1,700 feet, which is an adequate length to allow vehicles to accelerate or decelerate.

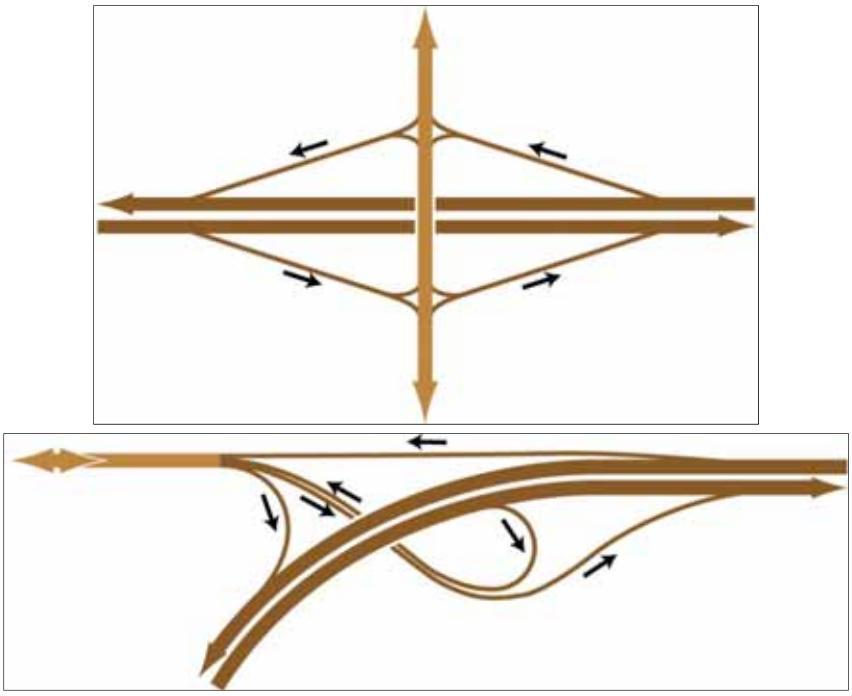


Figure 4. Typical Diamond and Trumpet Interchange Schematics

I-80 has asphalt pavement that is in good condition. No construction or resurfacing of the pavement on I-80 within proximity of the Project has been done recently, except for the bridge for the overpass of WY76, which was replaced in 2010.

3.1.2 US287

United States Route 287 (US287) is a nearby major route that carries traffic north and south through Rawlins. The road is a two-lane undivided paved highway with auxiliary lanes through Rawlins with lane widths of at least 12 feet and shoulder widths varying from 1 foot to 4 feet. This road intersects with multiple streets carrying both residential and commercial traffic through town. At the northern end of Rawlins, US287 divides into a business route and a bypass, with the eastern section carrying the bypass traffic that leads to I-80 exit 214 and the western section designated as the business route that leads through town and to I-80 exit 211. From exit 214 eastbound, I-80/US287 is a shared route until US287 splits off in Laramie, Wyoming.

3.1.3 WY130

WY130 is a two-lane undivided highway east of the project area with 12-foot lanes and typically 4-foot shoulders. The segment of this highway from Saratoga to I-80 is a north-south rural route with high speeds, low volumes, and an asphalt surface in good condition. This highway does not provide direct access to the Project, but may be used as a commuter route for workers residing in Saratoga.

3.1.4 WY76

WY76 is a two-lane undivided highway that is the primary non-interstate connection between Rawlins and Sinclair. This highway has an asphalt surface in good condition. As this highway is on the opposite side of the railroad from the Project, PCW does not anticipate a direct connection to WY76 for site access, however it may be utilized as a commuter route for the Project labor force residing in Rawlins.

3.1.5 WY71/CC401 (Sage Creek Road)

WY71/CC401 (combined referred to locally as Sage Creek Road or the South Highway) is a primarily north-south route that is located west of the Chokecherry area of the Project, and bisects the Sierra Madre area. The WY71 portion begins in Rawlins just north of exit 214. The road travels along the south side of Rawlins for the first mile in an east-west direction. The land use along this section of WY71 within Rawlins is undeveloped and does not provide direct access to residences. There are collector roads (Davis Street, Jackson Street, and Washington Street) that intersect with WY71 along the first mile. WY71 passes under I-80 and becomes a primarily north-south route for the remainder of its length. South of I-80, WY71 is a rural highway with a typical posted speed limit of 65 miles per hour. There are intermittent residential driveways that directly access WY71, as well as multiple county roads, two-track roads, and gated field accesses. There are various segments along the entire length of the highway with steep vertical curves and limited vertical and horizontal sight distance. Adjacent to Chokecherry, the state maintenance of the road ends, and the road becomes Carbon County Road 401 (CC401) and remains rural with minimal traffic. The lane widths are typically 12 feet along WY71, and the shoulders vary by section from no shoulders to 3-foot wide shoulders.

WY71/CC401 has various pavement conditions (see Figure 5) and portions are currently undergoing reconstruction. Approximately the first 1.5 miles of WY71 (from Higley Boulevard to the I-80 overpass) is asphalt in good condition. The second segment of WY71 (from the I-80 overpass to the end of WY71 over a distance of 9.5 miles) is a new overlay of asphalt in excellent condition. The remainder of this road is CC401, which is the portion currently undergoing reconstruction. The first segment of CC401 (from the beginning of CC401 nearly 6 miles to a cattle guard just south of Miller Hill Road) is paved and varies from poor to fair condition. The second segment of CC401 has a new overlay of pavement and is in excellent condition. The third segment of CC401 is a gravel road in fair to good condition that extends south beyond the Project boundary. PCW anticipates that, by the time construction begins on the Project, all segments of CC401 will be reconstructed to a gravel road in good condition.

Figure 5. WY71/CC401 Road Conditions

All Project options studied in this TMP plan on crossing CC401 at one location (within the third segment described above). Additionally, this TMP is studying the use of WY71/CC401 as a route for commuting traffic from Rawlins or I-80 to a staging area in the Sierra Madre project area. Any such commuting traffic would utilize all the WY71/CC401 segments described above.

3.1.6 CC407 (CIG Road)

At I-80 exit 221, CC407 (commonly referred to as CIG Road) begins south of the I-80 ramps (where WY76 ends), travels east and then south and provides access to the Colorado Interstate Gas Energy Plant. The road from I-80 to the CIG plant (approximately 2.25 miles long) has 12-foot lanes with no shoulders, is paved and in fair to good condition, and is maintained (PCW has conflicting information regarding whether WYDOT or Carbon County perform maintenance and to what extent). South from the CIG Energy Plant, an unpaved road leads into the Chokecherry area. As this road provides access to several pipelines and fiber optic lines, several private users maintain it as necessary. The gravel road received maintenance in 2011 and is currently in good condition.

PCW anticipates using the paved portions of the CIG road to provide access to the Project.

3.1.7 Other Local Roads

I-80 exit 228 (Fort Steele) is near the northern edge of the Chokecherry area. This interchange connects to CC347, which travels south along the North Platte River and leads into the Chokecherry site. CC347 is unpaved, less than two lanes wide, and has several instances of steep grades and sharp turns. The extent of the improvements that would be required for use during Project construction due to the grade, turns, and a portion of the road through a small ridge make use of CC347 impractical.

CC505E and CC505W (the eastern and western portions of Miller Hill Road) provides access onto Miller Hill from CC401. As this road is within the boundary of the Project, any use of it would be considered internal to the Project, and therefore outside the scope of this TMP.

CC500 (Jack Creek Road) is a two-lane gravel road connecting CC401 to Saratoga. Portions of this road are only in fair condition, and the condition of the road tends to vary over the course of the year. Due to safety concerns regarding this road, PCW is not anticipating its use for the Project.

CC408/CC508 are two-lane gravel roads that connect Saratoga to the western boundary of the Ranch. PCW does not expect to allow the labor force to report to the Project from this Ranch entrance, and therefore did not evaluate the use of these roads.

3.2 Existing Traffic

Once the type and locations of the roads around the Project were identified, PCW evaluated the current usage of these roads. The current traffic volumes and traffic operations are discussed below.

3.2.1 Existing Traffic Volumes

An analysis of the existing traffic conditions was performed as part of this TMP. To conduct the analysis, existing traffic volume data was collected at multiple key intersections along potential travel routes through Rawlins and Sinclair during the morning (AM) and evening (PM) peak weekday hours. The data collection for these existing conditions included intersection turning movement counts (TMC) and daily traffic data, which were collected in December 2008. Additional average daily traffic (ADT) volumes for the summer were collected in August 2010.

The TMC data provide distribution information for vehicles entering and exiting key intersections to determine the existing travel patterns in the area. The intersections where counts were taken are all public roadways, including the I-80 on- and off-ramps at exits 211, 214, and 221, and several intersections anticipated to be affected by construction traffic along US287 and WY71, as shown in Figure 14 in Appendix A. The figure also shows the number of vehicles making each movement during the existing AM and PM peak hours. These volumes will serve as the basis for the existing conditions analysis

Table 1. Daily Count Data

Count Location	Nearby Intersection	December ADT	August ADT (Peak Month)
I-80 at MP 208.65[1]	Spruce Street interchange	9,000 (2009)	14,400 (2009)
Spruce Street[1]	West of 4th Street	5,500 (2009)	9,100 (2009)
WY71	South of I-80 bridge	250 (2008)	450 (2010)
WY76	North of truck stop	N/A	490 (2010)
WY76	North of westbound off-ramp	N/A	1,830 (2010)
CC407 (CIG Road)	South of I-80	N/A	120 (2010)
Note: [1]WYDOT website data; all other data in table field-collected by PCW.			

Daily counts identify the average daily through traffic along a corridor throughout an entire day. Table 1 shows the bi-directional (eastbound plus westbound, or northbound plus southbound) daily traffic volumes at several locations near the Project. These values represent a typical weekday traffic level for the roadway. These daily counts were extrapolated from data collected by PCW in December 2008 and August 2010, and data collected by WYDOT in 2009 (and obtained by PCW from the WYDOT website).

Based on the assumption that peak hour traffic volumes are roughly 10 percent of daily totals, I-80 is expected to have traffic volumes of approximately 1,500 vehicles per hour (375 pc/h/ln, assuming equal distribution) at peak times. Using the *Highway Capacity Manual* (HCM) (Transportation Research Board, 2000) methodology, a four-lane interstate like I-80 (two lanes in each direction) with an estimated free flow speed of 70 miles per hour has the maximum directional capacity of 770 passenger cars/hour/lane (pc/h/ln) to maintain the optimal level of service (LOS) rating (LOS A), and 1,770 pc/h/ln to maintain the minimally acceptable rating (LOS C). For this analysis, 375 pc/h/ln is clearly within the LOS A rating. LOS is discussed in more detail below.

According to the HCM, two-lane highways have a typical capacity of 1,700 passenger cars per hour per direction to maintain a LOS C or better. The ADT volume on WY71, based on data collected in December 2008, is 450 vehicles, which is a LOS A and well under capacity for a two-lane highway.

Additional daily traffic volumes were collected by PCW between September and November of 2010 and between April and October of 2011 to determine the traffic fluctuations due to seasonal and recreational traffic. These additional counts were collected at two locations: WY71 just south of I-80 overpass (in 2010 only), and CC401 near the proposed haul road crossing location (in both 2010 and 2011). For the data that was collected in 2010, the days that carried the highest volume of traffic along WY71 and CC401 during the two-month period occurred during two peak weekends in October. The maximum volume that occurred was nearly 800 vehicles per day at the WY71 location and 580 vehicles per day at the CC401 location. The maximum hourly volume during the two-month period of combined northbound and southbound traffic was 60 vehicles per hour near I-80 and 45 vehicles per hour near the haul crossing. This peak traffic volume was short-lived and only occurred on two weekends in October. During the remainder of the two months the data were collected in 2010, the ADT was 465 vehicles per day at the WY71 location, which is consistent with the data collected in December 2008. At the CC401 location the ADT was 230 vehicles per day during the two month period in 2010. The average combined northbound and southbound peak hour volume during the two months data were collected at the CC401 location was 10 vehicles per hour in the AM peak and 15 vehicles per hour in the PM peak. Even during the peak time of year, the maximum volume of traffic is still well under the capacity of a two-lane road and operates at a LOS A. The data collected over six months in 2011 on CC401 had an even lower daily traffic volume (160 vehicles per day), hence also operating well within the LOS A designation.

3.2.2 Existing Traffic Operations

Operating conditions on roadways within the study area are a function of the delay experienced by drivers at public roadway intersections. None of the existing area roadways experience levels of congestion that warrant adding capacity. Traffic operations for key signalized and un-signalized intersections were analyzed using the methods described in the HCM. Based on the HCM, the overall performance of an intersection is determined based on the level of control delay experienced by motorists at the intersection. For signalized intersections, the delay for each individual turning movement is evaluated, then entire approaches are graded, and finally the intersection as a whole can be given a single LOS. For two-way stop controlled (TWSC) intersections, each minor approach is given a separate LOS and the worst LOS is reported as a single rating for the intersection.

The traffic data were input into analysis software (HCS+ for stop-controlled intersections and Synchro for signalized intersections) to determine the LOS. Depending on the level of delay that is experienced, an intersection can be scored on a LOS scale and given a letter grade from "A" to "F," with "A" being the best possible grade for the intersection. The ranges of delay for each LOS are shown in Table 2.

Table 2. LOS Criteria for Signalized and TWSC Intersections

LOS	Control Delay per Vehicle (sec)	
	Signalized	Unsignalized
A	≤ 10	0 – 10
B	> 10 – 20	> 10 – 15
C	> 20 – 35	> 15 – 25
D	> 35 – 55	> 25 – 35
E	> 55 – 80	> 35 – 50
F	> 80	> 50

The existing average AM and PM peak hour intersection LOS and delay (average delay in seconds per vehicle) are listed in Table 3 and shown in Figure 14. Based on the results of the analysis, all of the intersections operate at LOS B or better during the peak hours of the day, indicating that there are no existing operational deficiencies.

Table 3. Public Intersection Level of Service Analysis – Current Conditions

Intersection	Morning Peak (AM)		Afternoon Peak (PM)	
	Delay (sec)	LOS	Delay (sec)	LOS
US287 Bypass/Higley Boulevard and 3rd Street	10.0	B	9.7	A
US287 Bypass/Higley Boulevard and Cedar Street[1]	11.0	B	10.5	B
WY71 and Jackson Street	9.0	A	9.0	A
WY71 and Washington Street	9.1	A	9.3	A
WY71/Locust Street and South Higley Boulevard	10.1	B	10.1	B
I-80 EB and Spruce Street	9.2	A	10.1	B
I-80 WB and Spruce Street	8.8	A	9.7	A
I-80 EB and South Higley Boulevard	10.3	B	9.4	A
I-80 WB and South Higley Boulevard	10.2	B	10.3	B
I-80 EB and WY76	9.1	A	9.2	A
I-80 WB and WY76	8.7	A	8.8	A
Notes: [1]Signalized intersection				

3.3 Restrictions and Permit Requirements

The final step in evaluating the existing roadway infrastructure around the Project is to understand the restrictions and permitting requirements for using those roadways. These requirements are discussed below.

3.3.1 Physical Restrictions

Physical restrictions are defined as those limiting the width, height, or length of trucks or loads. Many of these, such as those due to height and width, are posted along roadways. Others may involve evaluating a road's geometry against the transport requirement of very large loads, such as those for wind turbine components. As the turbine models for the Project have not yet been selected, PCW has not done a detailed analysis of the geometries of the roads around the site. Such analyses will be performed for the TMPs associated with the site-specific PODs.

On WY71, there is an existing underpass at I-80 with a maximum clearance of 15 feet 2 inches. This limitation would likely effect WTG tower base sections and other extra-large components. PCW also predicts that several hills and some curves on WY71/CC401 will be outside the requirements of many wind turbine vendors' transport guidelines. However, it is not anticipated that WY71 will be used for large deliveries.

Within Rawlins, there are restrictions for trucks on Washington Street at the UPRR underpass due to a low clearance of less than 12 feet. No project vehicles other than passenger vehicles or pickup trucks are anticipated on this route. On the 6th Street bridge crossing the UPRR, there is a truck restriction in place that allows local deliveries only. Both the underpass and bridge have relatively narrow lanes with minimal to no shoulders and are not viable routes for any

construction vehicles other than pickup trucks. PCW does not anticipate that large loads will utilize these roads.

3.3.2 Weight Restrictions

There are no bridges along or over I-80 near the project, or on WY71, that have posted weight restrictions for vehicles. An annual bridge condition report prepared by WYDOT District 1 in 2009 indicates the WY76 bridge over I-80 at exit 221 (Sinclair) is rated as "fair" overall. Deck, superstructure, and substructure are all rated as "good." The posting status of the bridge is "Open, no restriction." In preliminary discussions with WYDOT staff, proposed bridge loading and equivalent single axle load (ESAL) calculations and any other pertinent project information will be required to determine the suitability of the bridge for project activities. This analysis is required for WYDOT approval before using the bridge for project deliveries.

3.3.3 Timing Restrictions

PCW is not aware of any existing timing-based restrictions on the use of the roadways discussed above.

3.3.4 Load Type Restrictions

It is not anticipated that any of the loads being transported for the Project will face particular restrictions due to their load-type. Some loads, such as fuel or dust mitigation chemicals, may have permitting requirements regarding the routes available.

3.3.5 Permit Requirements

The common permit requirements that apply to Project access roads and highway transport are briefly discussed below.

3.3.5.1 Access Permits

The Project anticipates requiring new access points along CC401 and possibly WY71. Any new access locations that have direct access to WY71 will have to follow the WYDOT procedures for obtaining an access permit. It is anticipated that new access points along CC401 will be required to follow the same process as those on WY71. Any existing roads that are proposed as access locations may need to obtain a revised access permit due to the increase in the number of trips on the roadway. WYDOT requires that a traffic effect study accompany all requests for access to a project that will generate more than 50 trips a day. As required by the access permitting process, a traffic effect study will be completed for the project once the site plan and trip estimates have been finalized.

The approval of new or revised access permits by WYDOT will require that the access locations meet safety standards. Detailed analysis of each new or revised access will be conducted in conjunction with the permitting process.

According to the Federal Highway Administration's Manual on Uniform Traffic Control Devices (MUTCD), the desired stopping sight distance for an access on a highway with a posted speed

limit of 65 miles per hour is 645 feet. For the access location proposed along WY71, there will be at least this desired sight distance in regard to vertical and horizontal curves on both approaches to the access. When the final access locations are determined, all proposed accesses will meet these sight distance requirements.

3.3.5.2 WYDOT Permits

As indicated above, some of the vehicles transporting equipment to and from the Project are anticipated to be oversized and/or overweight. It is anticipated that vehicles traveling on the interstate and state highway system will comply with WYDOT standards for oversize and overweight vehicles.

Wyoming issues permits for oversize and overweight vehicles that are up to 18 feet in width, 17 feet in height, and 90 feet in length for single trailers or 110 feet in length for double trailers. The weight limit for overweight vehicles is 150,000 pounds gross vehicle weight (additional guidelines are identified on the state's website). Vehicles that exceed these requirements will need to obtain additional permits to travel on the interstate and state highway system. Additionally, WYDOT requires escorts (two each per truck) on primary and secondary highways when any tractor-trailer combination is longer than 110 feet or wider than 14 feet. This information will be verified during the permitting process as the Wyoming Highway Patrol may require more escorts at its discretion. Oversize loads may only be transported during daylight hours and convoys of oversized vehicles may travel in a group of no more than two units with their own escorts.

If the Project rail facility is constructed at the preferred location in construction Year , it is anticipated that few if any oversize/overweight loads will be traveling on public roads except to cross CC401 to reach the Miller Hill Project area. If, however, the rail facility is built in the alternate location, it is anticipated that WYDOT permitting requirements will need to be followed for oversize/overweight vehicles traveling from the alternate rail distribution center to the Project's northern entrance.

It is anticipated that, during the permitting process, WYDOT will review the recommended travel paths for oversized and overweight loads to determine whether the bridge structures will be able to handle a large load. It is anticipated that this information will include ADTs, ESAL calculations, and bridge loadings for analysis. This analysis is required for WYDOT to grant approval before using the bridge for Project deliveries.

4. Project Traffic Effects – Construction

This chapter evaluates the effects of Project generated traffic on the surrounding roadways during construction. This chapter includes a description of the type of traffic that will be generated by the Project, an evaluation of the Project traffic, and a discussion of potential mitigation options.

4.1 Project Traffic

PCW has defined two general types of trips generated by the Project during construction. The first type of trip is the delivery of construction equipment, components and materials to the Project. The second is the daily commute of the labor force to the Project to perform the construction activities.

4.1.1 Material/Component Deliveries

As discussed in the 2011 Project POD, PCW intends to bring as much of the construction materials, components and equipment to the Project via rail as practical. These items will arrive at a the rail distribution facility and will be off-loaded to an adjacent delivery staging area for storage until they are transported to the Project by truck. See the Project POD for details on the rail facility. The vehicles and equipment necessary to transport the construction material, components, and equipment are briefly discussed below.

4.1.1.1 Wind Turbine Components

As a conservative estimate, it is assumed that 15 truckloads will be required for each of the 1,000 WTGs that will be erected during the four-year construction schedule. Each WTG consists of four tower sections, nacelle, three blades, hub, rotor cover, and smaller miscellaneous parts and equipment.

The WTG components that are oversize or overweight typically have specialized trailers attached to heavy-haul semi tractors. Nacelles use lowboy/flatbed trailers, often with 19 axles or more. Tower sections may also utilize flatbed trailers, with base sections often transported using Schnabel-type trailer attachments. Blades will use telescoping trailers and will be transported singly or in pairs (for this TMP, single blades per truck were assumed). Example photographs of turbine components being transported by truck are provided in the 2011 Project POD.

4.1.1.2 Aggregate

For this TMP, PCW assumed that aggregate would be hauled by belly-dump trucks with a 24 CY volume.

4.1.1.3 Additional Construction Vehicles

A variety of other vehicles will deliver the remaining construction materials required for the Project. Many, like cement, sand, and ash needed for the concrete batch plants, will use dump trucks suitable for the loads they are carrying. Steel rebar and electrical structures will be

transported on flatbed trailers. Water trucks (likely 10,000 gallon capacity each) with dispersion nozzles will be used for dust control and road construction. Depending upon the terrain, two- or three-axle concrete mixers will deliver concrete from batch plants to foundation sites.

4.1.1.4 Heavy Equipment

Numerous pieces of heavy equipment will be transported to the Project by articulated trailers and vans. Heavy equipment consists of WTG assembly haul trucks, graders, dozers, rippers, backhoes, and front-end loaders, as well as mobile cranes that will be used for WTG erection. There will be approximately 450 pieces of heavy equipment on the Project during the highest construction volume. Most of these pieces of equipment will be trucked to the project over the course of the first few months of the construction season and hauled back out at the completion of the construction year. It is assumed that once these pieces of heavy equipment are delivered to the project, they will remain on site until they are no longer required and will be incrementally removed as the demand for heavy equipment winds down over the course of the construction season.

4.1.1.5 Required Materials and Equipment

Based on the Project schedule and range of values provided in the 2011 Project POD, Table 4 below lists the estimated total number of truckloads required to build the Project. These include truckloads of construction materials, components, and equipment transported to the Project, as well as trips made off-site by Project personnel. It is important to note that the truckloads only constitute a one-way trip, as trucks will need to return to their origin after delivering their load.

The truckloads of material and equipment are regardless of the final rail solution. For those items that arrive to the Project by rail, these truckloads represent their movement from the rail facility to their final location on the Project. For those few items that do not arrive by rail, these truckloads represent the long-distance trucks delivering to the site.

The on-site truckloads represent the delivery of concrete and water within the Project from on-site batch plants and water sources. These truckloads will not affect the local roadways except for those that may cross CC401 in the Sierra Madre area.

Table 4. Total Truckloads of Project Construction Material

Items	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
Imported from Off-Site						
Wind Turbine Components	0	0	5,220	4,680	5,100	15,000
Aggregate	43,122	19,246	25,309	24,022	1,572	113,270
Cement/Sand/Ash	18	4,312	8,010	7,504	2,003	21,846
Foundation Steel	0	950	1,710	1,663	428	4,750
Collection System Cables/Structures	0	186	119	199	0	504
Transmission Line Cables/Structures	0	0	644	584	622	1,850
Substation Components	0	0	20	40	40	100
Buildings/Trailers	25	25	100	50	50	250
Other Materials	2,000	2,000	2,000	2,000	2,000	10,000
Equipment Deliveries	466	580	1,944	1,952	1,696	6,638
Personnel Off-Site Trips	852	329	627	378	0	2,187
TOTAL IMPORTED	**46,482**	**27,628**	**45,702**	**43,072**	**13,510**	**176,394**
On-Site Only						
Concrete	50	12,320	22,885	21,440	5,724	62,418
Water	2,248	4,073	4,986	6,191	424	17,922
TOTAL ON-SITE	**2,298**	**16,393**	**27,871**	**27,631**	**6,147**	**80,340**

4.1.2 Labor Force

The other significant source of trips along public roads is the daily commute to the Project by the labor force. PCW expects the labor force to use a variety of personal vehicles to commute to the Project on a daily basis. Once workers arrive on-site, they will use a fleet of pick-up trucks or vans to move from the Project entrances to their locations of work within the Project. While it is expected that most of the labor force will remain on the site during the entire workday, this TMP does account for some traffic into Rawlins and Sinclair using the Project pick-up trucks.

Daily commuting traffic is expected to make up between 60 and 80 percent of the total construction traffic. This TMP uses the labor force breakdown in Table 5 (based on the ranges provided in the 2011 Project POD) to determine the total number of workers arriving at the Project daily during construction.

Table 5. Total Labor Force Commuting to Site During Construction

Month	Year 1	Year 2	Year 3	Year 4	Year 5
May	100	50	50	50	50
June	100	50	400	400	400
July	300	400	1200	1200	1000
Aug	300	400	1200	1200	1000
Sep	300	400	1200	1200	1000
Oct	200	300	900	900	900
Nov	100	100	200	200	200

For this TMP, PCW assumed that the labor force that will perform the construction activities will commute each day from the surrounding communities, rather that assuming some or all would originate from a temporary Project "man-camp".

The locations where the labor force will be housed are not yet determined, however for the purposes of this study PCW assumed the labor force housing distribution as:

- 65 percent: Rawlins Area
- 10 percent: East of Rawlins (Laramie area)
- 15 percent: West of Rawlins (Rock Springs and Wamsutter area)
- 10 percent: South of Rawlins (Saratoga area)

The percentages are assumed to be constant regardless of the labor force size or year of construction. It is further assumed that each worker will make one trip to and one trip from the Project per day. For the workers traveling from outside the Rawlins area, it is assumed that there will be 1.5 workers per vehicle due to carpooling. For workers originating in Rawlins, the general assumptions made regarding what parts of town they would be coming from are:

- 56 percent: Near 287/Cedar
- 24 percent: South of Railroad, north of I-80
- 20 percent: Near Spruce Street

Due to the general nature of this TMP, a detailed study was not conducted regarding origination of workforce, but assumptions were made based on the locations of residential properties and hotels in Rawlins.

4.1.2.1 Other

While there will likely be other types of traffic to the Project (e.g. courier deliveries and inspections), such traffic is not of sufficient volume to affect the TMP findings, and hence was not considered in the analysis.

4.2 Traffic Analysis – Year One

After defining the number of required truckloads and workers, PCW estimated the volume of traffic generated during construction of the Project. This data was then used to calculate the subsequent effects on the public roadways near the Project. This analysis is presented below.

The software program called Traffix was used to estimate the combined (existing plus Project traffic) condition. A Traffix model is able to analyze the effects of the construction traffic on the existing roadway network. This model allows the user to change origins and destinations to be flexible in the analysis. The following subsections describe the components of a Traffix model: trip generation, trip distribution, and trip assignment.

4.2.1 Trip Generation

The first step in analyzing the Project traffic conditions is to generate trip rates for the construction traffic. The peak hour construction volumes were added to the existing traffic volumes discussed in Section 3.2 to determine what intersection traffic volumes will be during the peak construction month. Section 4.1.1.5 defined the years in which materials, components, and equipment arrive at the Project. PCW took the monthly truckloads, and computed daily trips based upon the Project schedule described in the 2011 Project POD. These trips were then combined with the daily commuting workforce trips to determine the expected daily trips for Year One as shown in Table 6.

Table 6. Total Daily Traffic Volume Estimate – Construction Year One

Vehicle Type	Activity Month						
	May	Jun	Jul	Aug	Sep	Oct	Nov
Construction Year One							
Delivery Trucks[1]	9	129	1,206	1,075	1,163	620	10
Aggregate	*0*	*117*	*1,154*	*983*	*1,064*	*551*	*0*
WTG Components[2]	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other Deliveries	*9*	*12*	*53*	*93*	*99*	*69*	*10*
Labor Force Commute	177	177	530	530	530	353	177
Total	**186**	**305**	**1,736**	**1,605**	**1,693**	**973**	**187**

The overall traffic pattern of Year One differs somewhat from Years Two through Five. This is because the rail facility will not yet be constructed, so all construction materials will have to be trucked to the Project. During the peak month of Year One (July) nearly 70 percent of the traffic (1,206 trips) will be due to the transport of construction materials and equipment. The remaining 530 trips will be the labor force commute, divided evenly at 265 trips each during the morning and afternoon peak hours. The Year One peak daily trip breakdown is compared to the other construction cases in Figure 6. PCW estimates that the required labor force and materials required to build the rail facility in Year One will be the same regardless of whether it is constructed at the primary or alternate rail site.

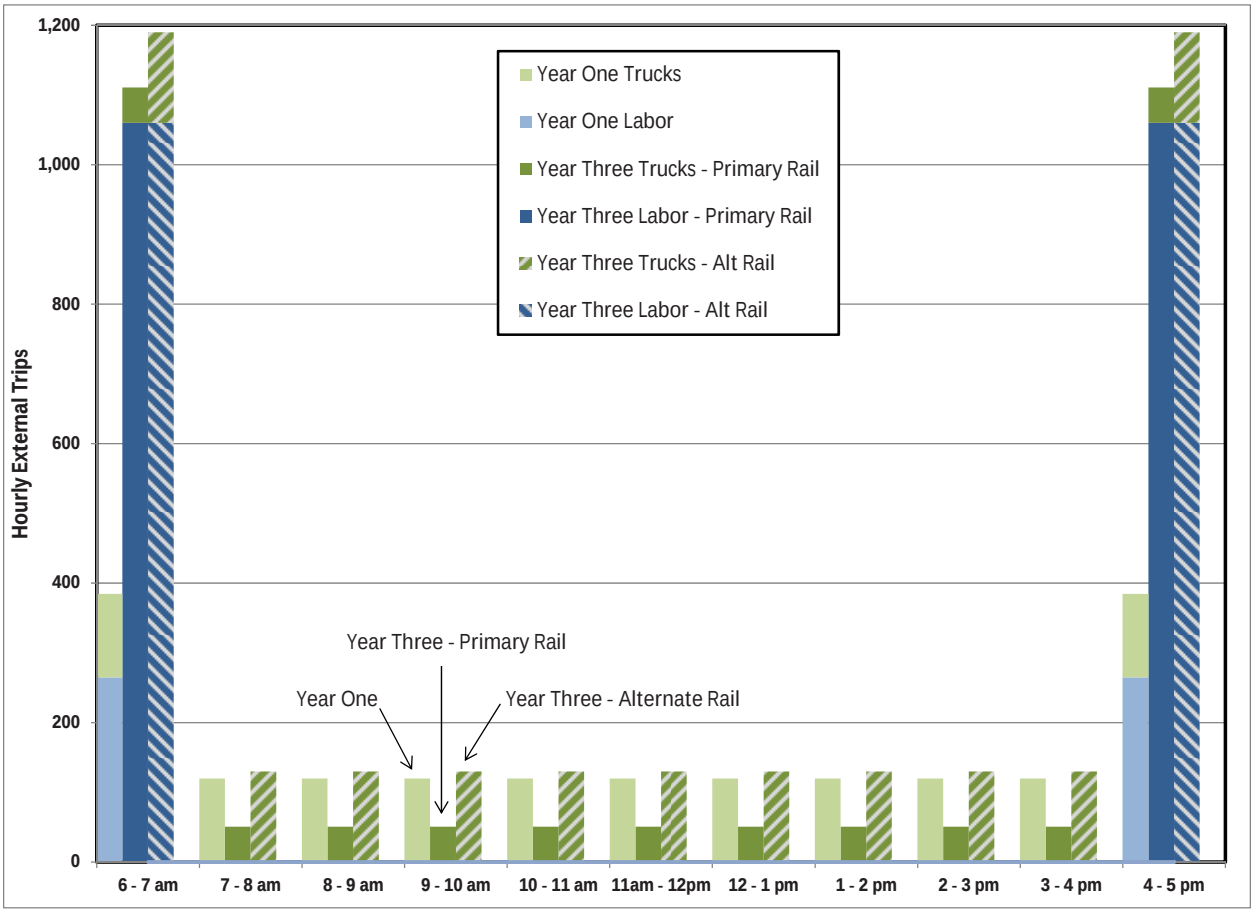


Figure 6. Peak Month Hourly Trips – Construction

4.2.2 Trip Distribution

The origin and destination was determined for each Project construction trip in the peak month. Labor force commute trips were determined based upon the origin assumptions and destination options described in Section 4.1.2. Construction material and component delivery trips were assumed to all occur by truck because the rail facility is being constructed in Year One. The resulting distribution for the peak of Year One is shown in Figure 7.

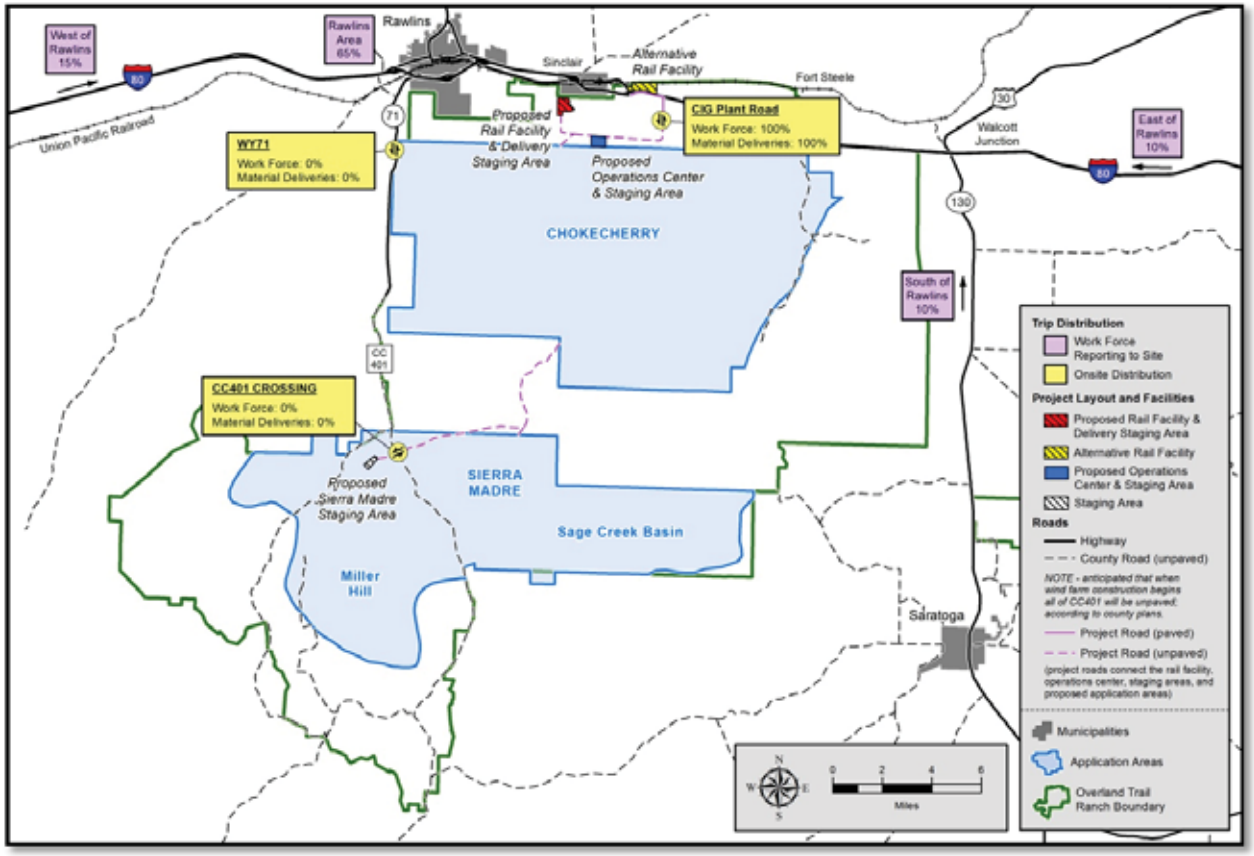


Figure 7. Trip Distribution – Construction Year One Peak

4.2.3 Trip Assignment

After trips were distributed between likely origins and destinations, they were assigned to specific roadways and added to existing traffic to allow analysis of project operational conditions. For construction delivery vehicles arriving from east or west of Rawlins, the preferred route will be for the vehicles to travel on I-80, use exit 221 (WY76) in Sinclair, and travel along CIG Road to the Project, as described in Section 4.3. Due to the unknown location of the aggregate source, one third of the of aggregate vehicles were assumed to arrive from north of Rawlins during Year One, using the US287 bypass to Cedar Street, then onto I-80 east to exist 221, and then along CIG road to the Project. The aggregate vehicles add approximately 20 trips per hour per direction to the roadway network within the town of Rawlins during working hours. When the aggregate facility location is finalized, this value may change. No delivery traffic was assumed to arrive from south of the Project. It was assumed that all workers during Year One would use the same route to access the Project.

4.2.4 Analysis Results

Once the turning movement volumes were generated for the existing traffic plus Project traffic, operational conditions analysis was completed for the peak of Year One. The existing plus Project analysis used the same methods for calculating intersection LOS as described in Section 3.2.2. The LOS and delay (in seconds per vehicle) resulting from the analysis for the peak of

Year One is listed in Table 7 and shown in Figure 15 (Appendix A). As no work is being performed in the Miller Hill area during Year One, a secondary commuting option was not evaluated. In Year One, the operations of all intersections operate at LOS C or better. As such, no mitigation measures would likely be required.

Table 7. Public Intersection LOS Analysis – Construction Year One Peak Month

Intersection	Morning Peak (AM)						Afternoon Peak (PM)					
	Existing		Use 221		Use WY71		Existing		Use 221		Use WY71	
	Dly	LOS	Dly	LOS	Dly	LOS	Dly	LOS	Dly	LOS	Dly	LOS
US287 Bypass/Higley Boulevard and 3rd Street	10.0	A	10.0	A			9.7	A	11.0	B		
US287 Bypass/Higley Boulevard and Cedar Street[1]	11.0	B	9.1	A			10.5	B	10.9	B		
WY71 and Jackson Street	9.0	A	8.9	A			9.0	A	8.9	A		
WY71 and Washington Street	9.1	A	9.2	A			9.3	A	9.3	A		
WY71/Locust Street and South Higley Boulevard	10.1	B	10.1	B			10.1	B	10.5	B		
I-80 EB and Spruce Street	9.2	A	9.6	A			10.1	B	10.1	B		
I-80 WB and Spruce Street	8.8	A	8.8	A			9.7	A	9.6	A		
I-80 EB and South Higley Boulevard	10.3	B	9.6	A			9.7	A	9.7	A		
I-80 WB and South Higley Boulevard	10.2	B	10.5	B			10.3	B	10.3	A		
I-80 EB and WY76	9.1	A	10.9	B			9.2	A	9.4	A		
I-80 WB and WY76	8.7	A	9.9	A			8.8	A	15.3	C		

Notes: [1]Signalized intersection
Dly = Average intersection delay (seconds)
Use 221 = labor force required to report to north end of Project via I-80 Exit 221
Use WY71 = portion of labor force assigned to Sierra Madre can utilize WY71/CC401
Delay estimates for signalized intersections assume optimized traffic signal operations.
Delay estimates assume uniform flow entering intersections during the peak hour.

4.3 Traffic Analysis – Year Three

An analysis of the peak hour traffic conditions during the highest month of construction activity (July of Year Three) was performed as part of this TMP. This analysis used the same process described in Section 4.2.

4.3.1 Trip Generation

The number of projected monthly trips was calculated for both the preferred and alternate rail facility locations. PCW then determined which trips would occur off-site, based on the location of the rail facility. The resulting off-site trips for each rail facility location are presented below.

4.3.1.1 Primary Rail Site

For the option where the rail facility is developed at the primary location described in Section 2.1.1, the estimated daily off-site trips required for each month of Project construction is defined in Table 8. These volumes represent complete trips, 50 percent into the site and 50 percent out. Figure 8 displays a comparison of the daily trips by month for both rail locations.

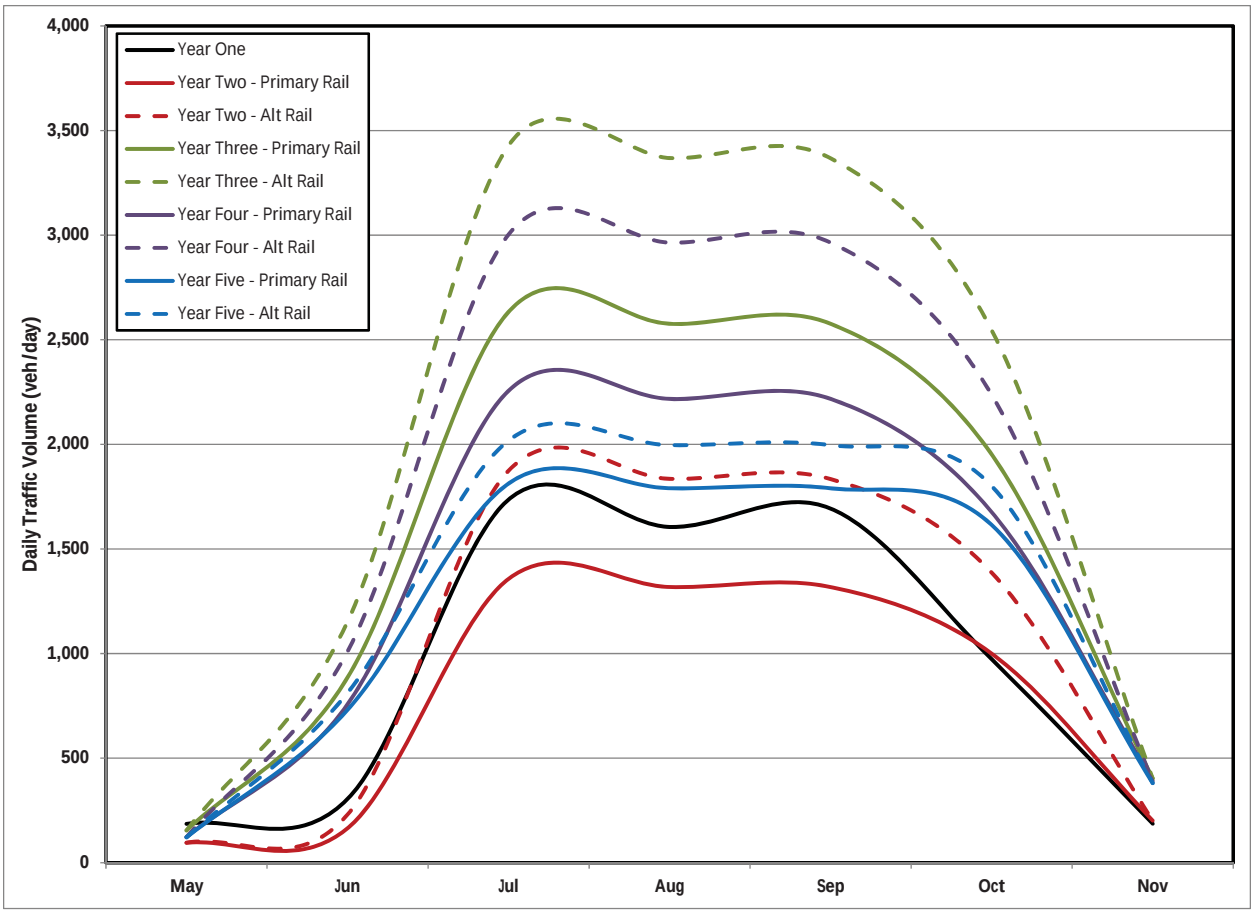


Figure 8. Average Off-Site Daily Traffic – Construction

Table 8. Total Daily Traffic Volume Estimate – Construction, Primary Rail Site

Vehicle Type	Activity Month						
	May	Jun	Jul	Aug	Sep	Oct	Nov
Construction Year One							
Delivery Trucks[1]	9	129	1,206	1,075	1,163	620	10
Aggregate	*0*	*117*	*1,154*	*983*	*1,064*	*551*	*0*
WTG Components[2]	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other Deliveries	*9*	*12*	*53*	*93*	*99*	*69*	*10*
Labor Force Commute	177	177	530	530	530	353	177
Total	**186**	**305**	**1,736**	**1,605**	**1,693**	**973**	**187**
Construction Year Two							
Delivery Trucks[1]	8	77	650	611	611	470	25
Aggregate	*0*	*57*	*455*	*455*	*455*	*341*	*0*
WTG Components[2]	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other Deliveries	*8*	*20*	*195*	*156*	*156*	*128*	*25*
Labor Force Commute	88	88	707	707	707	530	177
Total	**96**	**165**	**1,357**	**1,318**	**1,318**	**1,000**	**202**
Construction Year Three							
Delivery Trucks[1]	67	178	513	456	456	362	49
Aggregate	*0*	*45*	*136*	*136*	*136*	*102*	*0*
WTG Components[2]	*0*	*39*	*117*	*117*	*117*	*88*	*0*
Other Deliveries	*67*	*94*	*259*	*203*	*203*	*172*	*50*
Labor Force Commute	88	707	2,120	2,120	2,120	1,590	353
Total	**155**	**885**	**2,633**	**2,576**	**2,576**	**1,952**	**403**
Construction Year Four							
Delivery Trucks[1]	35	50	136	97	97	87	37
Aggregate	*0*	*16*	*49*	*49*	*49*	*37*	*0*
WTG Components[2]	*0*	*3*	*10*	*10*	*10*	*7*	*0*
Other Deliveries	*34*	*31*	*78*	*38*	*38*	*43*	*37*
Labor Force Commute	88	707	2,120	2,120	2,120	1,590	353
Total	**123**	**757**	**2,256**	**2,217**	**2,217**	**1,677**	**391**
Construction Year Five							
Delivery Trucks[1]	33	23	46	23	23	25	28
Aggregate	*0*	*1*	*3*	*3*	*3*	*3*	*0*
WTG Components[2]	*0*	*4*	*10*	*10*	*10*	*9*	*0*
Other Deliveries	*33*	*18*	*34*	*10*	*10*	*13*	*28*
Labor Force Commute	88	707	1,767	1,767	1,767	1,590	353
Total	**122**	**730**	**1,813**	**1,790**	**1,790**	**1,615**	**381**

Notes: [1]Sum of all delivery trucks, including aggregate, WTG components, and other.
[2]Excludes pilot cars

The highest overall traffic volumes occur in July of Year Three, with an average of 2,633 off-site vehicle trips per day. Approximately 80 percent of the traffic is due to the labor force commute, with 1,060 trips each for the morning and afternoon peak hours of 7:00am and

5:00pm (the total labor force number of 1,200 was lowered somewhat by some assumptions for carpooling). The remaining 513 daily trips are due to deliveries assumed to occur throughout the work day, as presented in Figure 6 (in comparison to the other Project construction cases). It is important to note that half of all truckloads for all construction vehicles will be empty, so only half of the truckloads traveling over structures will be overweight. Also, while it is the intention of PCW that as much of the Project's construction materials and components arrive by rail as possible, it is likely that some amount will still arrive by truck due to logistical issues. The 513 daily off-site delivery trips during the peak month reflect a TMP assumption that 10 percent of deliveries will be made by truck, plus the portion of overall deliveries that need to be made to the Miller Hill area and therefore must cross CC401.

4.3.1.2 Alternate Rail Site

As the alternate site for the rail facility is located on the opposite side of I-80 from the Project, all deliveries from the rail facility to the site will occur on public roads. These daily public road deliveries for the alternate site are provided in Table 9. As shown in Figure 8, this causes a significant increase in traffic for the same construction activities as compared to the primary rail site option.

Table 9. Total Daily Traffic Volume Estimate – Construction, Alternate Rail Site

Vehicle Type	Activity Month						
	May	Jun	Jul	Aug	Sep	Oct	Nov
Construction Year One							
Delivery Trucks[1]	9	129	1,206	1,075	1,163	620	10
Aggregate	*0*	*117*	*1,154*	*983*	*1,064*	*551*	*0*
WTG Components[2]	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other Deliveries	*9*	*12*	*53*	*93*	*99*	*69*	*10*
Labor Force Commute	177	177	530	530	530	353	177
Total	**186**	**305**	**1,736**	**1,605**	**1,693**	**973**	**187**
Construction Year Two							
Delivery Trucks[1]	8	142	1,168	1,128	1,128	857	25
Aggregate	*0*	*104*	*828*	*828*	*828*	*621*	*0*
WTG Components[2]	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other Deliveries	*8*	*38*	*340*	*300*	*300*	*236*	*25*
Labor Force Commute	88	88	707	707	707	530	177
Total	**96**	**230**	**1,874**	**1,835**	**1,834**	**1,387**	**202**
Construction Year Three							
Delivery Trucks[1]	67	445	1,308	1,248	1,247	956	49
Aggregate	*0*	*200*	*601*	*601*	*601*	*451*	*0*
WTG Components[2]	*0*	*71*	*213*	*213*	*213*	*160*	*0*
Other Deliveries	*67*	*175*	*493*	*433*	*433*	*345*	*50*
Labor Force Commute	88	707	2120	2120	2120	1590	353
Total	**155**	**1,152**	**3,428**	**3,368**	**3,367**	**2546**	**403**

Vehicle Type	Activity Month						
	May	Jun	Jul	Aug	Sep	Oct	Nov
Construction Year Four							
Delivery Trucks[1]	35	303	883	844	844	647	37
Aggregate	*0*	*163*	*490*	*490*	*490*	*368*	*0*
WTG Components[2]	*0*	*32*	*96*	*96*	*96*	*72*	*0*
Other Deliveries	*34*	*108*	*298*	*258*	*258*	*216*	*37*
Labor Force Commute	88	707	2,120	2,120	2,120	1,590	353
Total	**123**	**1,010**	**3,003**	**2,964**	**2,964**	**2,237**	**391**
Construction Year Five							
Delivery Trucks[1]	33	105	252	229	230	211	28
Aggregate	*0*	*12*	*31*	*31*	*31*	*27*	*0*
WTG Components[2]	*0*	*40*	*99*	*99*	*99*	*89*	*0*
Other Deliveries	*33*	*54*	*123*	*100*	*100*	*95*	*28*
Labor Force Commute	88	707	1,767	1,767	1,767	1,590	353
Total	**122**	**812**	**2,018**	**1,996**	**1,996**	**1,801**	**381**

Notes: [1]Sum of all delivery trucks, including those delivering aggregate, WTG components, and other material and equipment.
[2]Excludes pilot cars

The highest overall traffic volumes still occur in July of Year Three, but now with an average of 3,428 off-site vehicles trips per day (or 130 percent of the primary rail site option). The labor force commute of 1,060 trips during each peak hour now constitutes only 62 percent of the total traffic, the delivery traffic on public roads increases from 513 for the primary rail site to 1,308 for the alternate site. The hourly breakdown of the daily off-site traffic in the peak of Year Three for the alternate rail site option is shown in Figure 6 (in comparison to the other construction cases).

4.3.2 Trip Distribution

The origin and destination was determined for each Project construction trip in the peak month. Labor force commute trips were determined based upon the origin assumptions and destination options described in Section 4.1.2. This TMP assumed two options for the labor force to commute to the Project. The first option would require all workers to report to the staging area at the northern end of the Chokecherry area, resulting in all labor force traffic using exit 221 in Sinclair. The second option would allow workers assigned to the Sierra Madre and Sage Creek Basin sites to use WY71. Both options are shown in Figure 9.

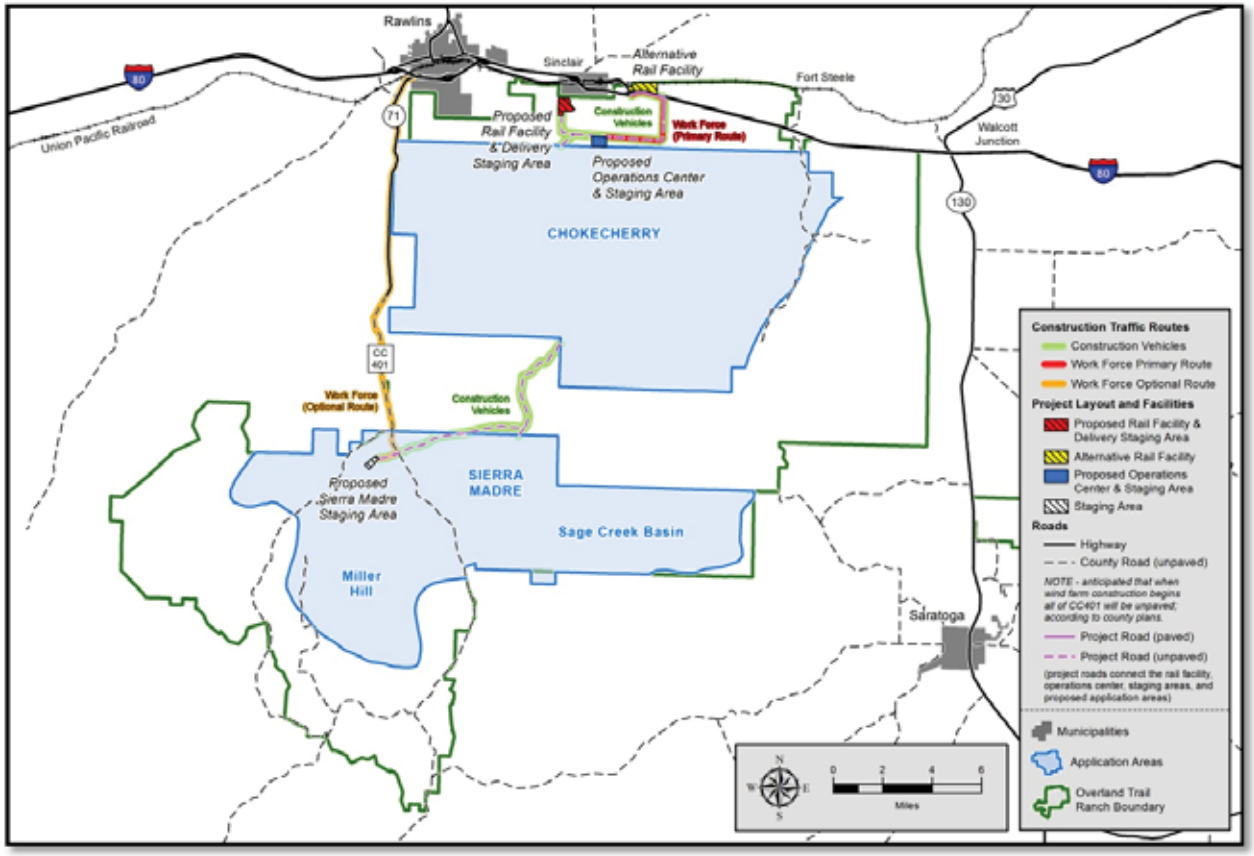


Figure 9. Construction Transport Routes

Construction material and component delivery trips were determined based upon the estimates in Section 4.1.1.5 and the construction schedule outlined in the 2011 Project POD. The resulting distributions for the primary and alternate rail facility locations for the peak of construction are displayed in Figure 10 and Figure 11.

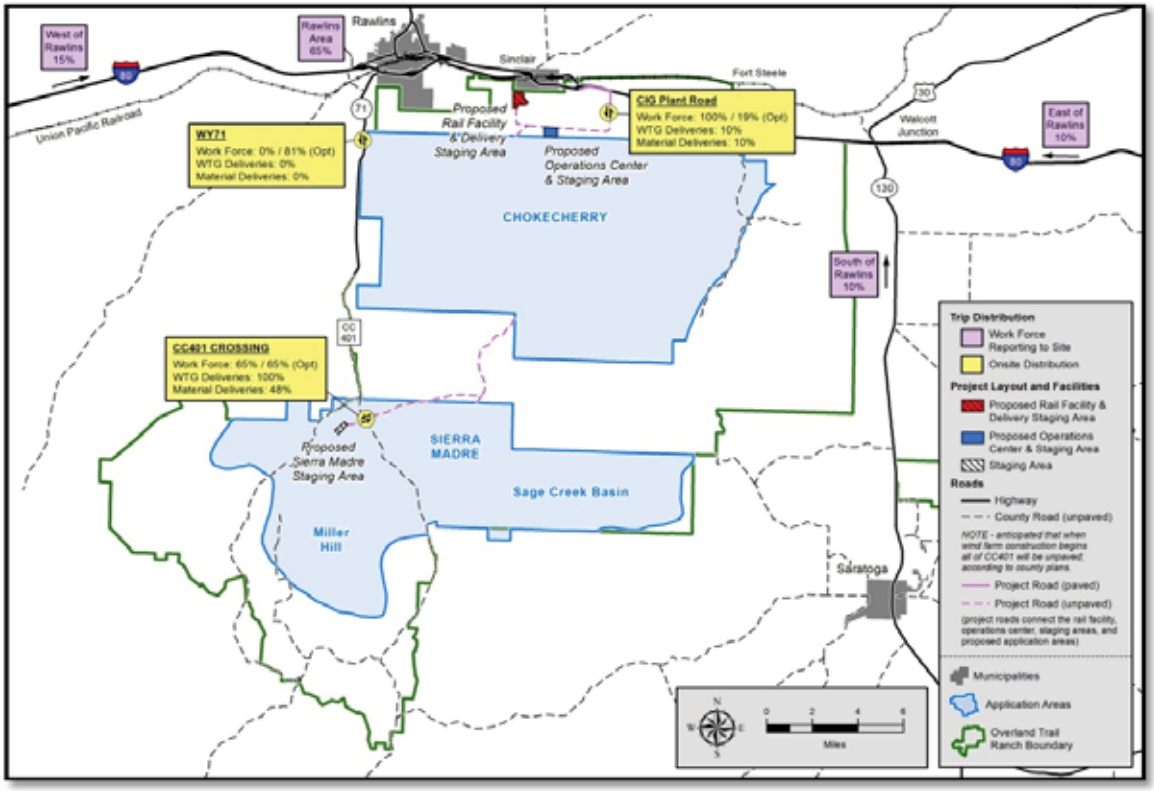


Figure 10. Trip Distribution – Construction Year Three Peak, Primary Rail Site

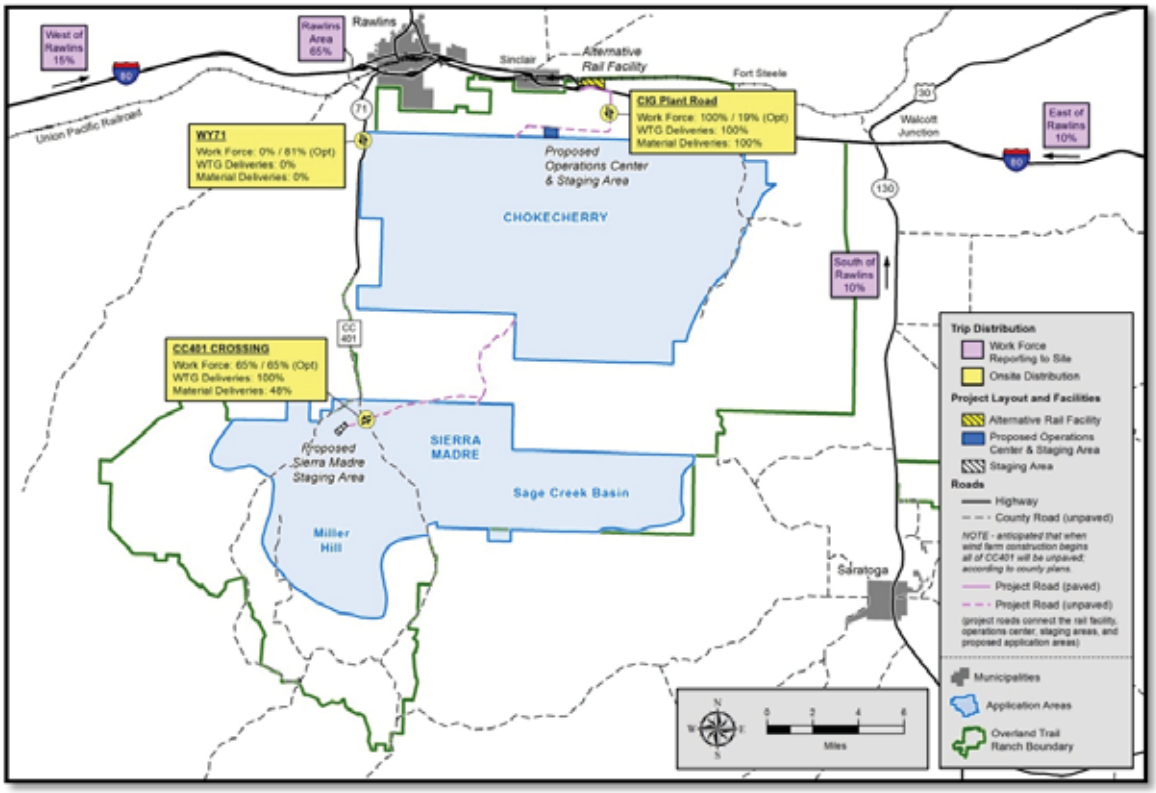


Figure 11. Trip Distribution – Construction Year Three Peak, Alternate Rail Site

4.3.3 Trip Assignment

After trips were distributed between likely origins and destinations, they were assigned to specific roadways and added to existing traffic to allow analysis of project operational conditions. For truck deliveries to the Project, it is expected that the delivery truck traffic will be limited to truck routes, interstate, and state highways where possible to minimize effects to Rawlins, Sinclair, and Saratoga. In the alternate rail facility location case, heavy vehicles will be routed from the rail facility on WY76, south across the I-80 overpass at exit 221, to CIG Road, and then onto the Project's haul road. Due to the I-80 overpass bridge's limited width, flaggers will be required whenever oversize vehicles cross the bridge.

Materials destined for the Miller Hill area of the Sierra Madre site will be transported along the project's internal haul road and will cross CC401 to reach the western portion of the site. Flaggers will be needed at the crossing with CC401 to reduce potential conflicts with public traffic.

For construction delivery vehicles arriving from east or west of Rawlins, the preferred route will be for the vehicles to travel on I-80, use exit 221 (WY76) in Sinclair, and travel along CIG Road to the Project, as described in Section 4.3. A small amount of delivery vehicles were assumed to arrive from north of Rawlins, using the US287 bypass to Cedar Street, then onto I-80 east to exit 221, and then along CIG road to the Project. No delivery traffic was assumed to arrive from south of the Project.

4.3.4 Analysis Results

For each case and option analyzed, the following effects to the public roadways around the Project were determined. For the peak traffic month during the Project construction (July Year Three), the following effects were estimated for both rail site options and both labor force commuting options.

4.3.4.1 Primary Rail Site

The LOS and delay (in seconds per vehicle) resulting from the primary rail site option during the peak volume case are listed in Table 10 and shown in Figure 16 and Figure 17 (Appendix A).

The operations for most of the intersections are at LOS C or better with the addition of project traffic for both peak periods with several exceptions. If all workers are required to report to the north Chokecherry access, the eastbound I-80 ramp and WY76 intersection will fail during the AM peak hour, and the westbound I-80 ramp and WY76 intersection will fail during the PM peak hour. In the AM peak, the eastbound ramp volume is over 900vph, and traffic on the ramp is stop-controlled and has to wait for gaps in WY76 traffic, which results in excessive delay. The PM peak hour traffic exiting the site results in a failing moment for the stop-controlled left-turn movement from westbound I-80 to WY76. While there are not high volumes making the westbound turn movement, due to the high opposing volumes of northbound traffic turning onto I-80 there are few gaps for the side street approach.

Table 10. Public Intersection LOS Analysis – Construction Year Three Peak, Primary Rail Site

Intersection	Morning Peak (AM)						Afternoon Peak (PM)					
	Existing		Use 221		Use WY71		Existing		Use 221		Use WY71	
	Dly	LOS	Dly	LOS	Dly	LOS	Dly	LOS	Dly	LOS	Dly	LOS
US287 Bypass/Higley Boulevard and 3rd Street	10.0	B	9.8	A	9.8	A	9.7	A	9.8	A	9.8	A
US287 Bypass/Higley Boulevard and Cedar Street[1]	11.0	B	8.2	A	8.3	A	10.5	B	12.4	B	11.2	B
WY71 and Jackson Street	9.0	A	8.9	A	**39.7**	**E**	9.0	A	8.9	A	31.3	D
WY71 and Washington Street	9.1	A	9.1	A	15.9	C	9.3	A	9.3	A	15.5	C
WY71/Locust Street and South Higley Boulevard	10.1	B	11.7	B	**51.1**	**F**	10.1	B	11.6	B	23.5	C
I-80 EB and Spruce Street	9.2	A	12.1	B	10.4	B	10.1	B	10.1	B	10.1	B
I-80 WB and Spruce Street	8.8	A	9.0	A	8.9	A	9.7	A	10.4	B	9.9	A
I-80 EB and South Higley Boulevard	10.3	B	10.3	B	13.0	B	9.7	A	9.7	A	15.4	C
I-80 WB and South Higley Boulevard	10.2	B	11.8	B	15.8	C	10.3	B	11.0	B	13.4	B
I-80 EB and WY76	9.1	A	**>300**	**F**	9.8	A	9.2	A	15.1	C	9.5	A
I-80 WB and WY76	8.7	A	10.2	B	9.2	A	8.8	A	**>300**	**F**	11.4	B

Notes: [1]Signalized intersection
Dly = Average intersection delay (seconds)
Use 221 = labor force required to report to north end of Project via I-80 Exit 221
Use WY71 = portion of labor force assigned to Sierra Madre can utilize WY71/CC401
Delay estimates for signalized intersections assume optimized traffic signal operations.
Delay estimates assume uniform flow entering intersections during the peak hour.

Under the scenario that workers will be allowed to use WY71, the intersection of WY71 and S Higley Boulevard will operate at a LOS F in the morning peak hour. The westbound stop-controlled approach fails due to a lack of available gaps from high volumes of traffic making a northbound left turn. However, this level of delay is on the lowest approach volume at the intersection (less than 20 vehicles out of 785 traveling through the intersection) and all other approaches operate at a LOS B or better. These issues, and potential mitigation strategies, are discussed in Section 4.4.

While only the peak month of the highest year of construction was analyzed, the results can be applied to the subsequent years as well. However, due to the limited construction planned in Sierra Madre in Year Four, it is unlikely that workers using WY71 will significantly reduce the number of trips utilizing Exit 221. Because the number of peak hour trips will be lower in Year Four, the results will have similar or less effect than in Year Three.

4.3.4.2 Alternate Rail Site

The LOS and delay (in seconds per vehicle) resulting from the alternate rail site option during the peak volume case are listed in Table 11 and shown in Figure 18 and Figure 19 (Appendix A).

Table 11. Public Intersection LOS Analysis – Construction Year Three Peak, Alternate Rail Site

Intersection	Morning Peak (AM)						Afternoon Peak (PM)					
	Existing		Use 221		Use WY71		Existing		Use 221		Use WY71	
	Dly	LOS	Dly	LOS	Dly	LOS	Dly	LOS	Dly	LOS	Dly	LOS
US287 Bypass/Higley Boulevard and 3rd Street	10.0	B	9.8	A	9.8	A	9.7	A	9.8	A	9.8	A
US287 Bypass/Higley Boulevard and Cedar Street[1]	11.0	B	8.2	A	8.3	A	10.5	B	12.4	B	11.2	B
WY71 and Jackson Street	9.0	A	8.9	A	**39.7**	**E**	9.0	A	8.9	A	31.3	D
WY71 and Washington Street	9.1	A	9.1	A	15.9	C	9.3	A	9.3	A	15.5	C
WY71/Locust Street and South Higley Boulevard	10.1	B	11.7	B	**51.1**	**F**	10.1	B	11.6	B	23.5	C
I-80 EB and Spruce Street	9.2	A	12.1	B	10.4	B	10.1	B	10.1	B	10.1	B
I-80 WB and Spruce Street	8.8	A	9.0	A	8.9	A	9.7	A	10.4	B	9.9	A
I-80 EB and South Higley Boulevard	10.3	B	10.3	B	13.0	B	9.7	A	9.7	A	15.4	C
I-80 WB and South Higley Boulevard	10.2	B	11.8	B	15.8	C	10.3	B	11.0	B	13.4	B
I-80 EB and WY76	9.1	A	**>300**	**F**	10.3	A	9.2	A	13.5	B	9.9	A
I-80 WB and WY76	8.7	A	11.2	B	9.8	A	8.8	A	**>300**	**F**	12.3	B

Notes: [1]Signalized intersection
Dly = Average intersection delay (seconds)
Use 221 = labor force required to report to north end of Project via I-80 Exit 221
Use WY71 = portion of labor force assigned to Sierra Madre can utilize WY71/CC401
Delay estimates for signalized intersections assume optimized traffic signal operations.
Delay estimates assume uniform flow entering intersections during the peak hour.

The results for the alternate rail site case were similar to that of the primary rail site case, with the exception of some additional delays at the I-80 and WY76 intersection (both eastbound and westbound). This is because the difference between these cases, that of the delivery traffic crossing I-80 along WY76/CIG Road, adds some additional delay to this intersection.

4.4 Potential Mitigation Options

Through the analysis performed above, PCW identified potential effects to the public roadways surrounding the Project due to the Project's expected construction traffic. Overall, PCW anticipates that no capacity improvements will be required to the existing roadways or intersections to accommodate the construction traffic volumes, although some oversize loads

may require temporary geometric improvements. However, some effects may be reduced using the potential mitigation options discussed below.

4.4.1 Component Deliveries on Public Roadways

Public roadway effects by trucks making deliveries of heavy materials or components (often oversize or overweight) may benefit from special operations considerations. As these vehicles are slow to accelerate and generally make wide turns compared to passenger vehicles, PCW believes overall safety may be improved if flaggers are utilized where such delivery traffic is occurring. In the case of the alternate rail site location, flaggers will likely need to temporarily stop public traffic on the I-80 overpass bridge at exit 221 to allow oversize trucks to cross. This closure may be necessary due to the limited width of the bridge.

Another option may be to eliminate or restrict delivery traffic during the peak hours when the labor force is arriving or departing the site. This would eliminate the longer delays caused by the interaction of the heavy vehicles clearing the intersections and the high volume of passenger vehicles.

Whenever a significant volume of Project traffic is using the haul road and crossing CC401, PCW expects to use flaggers to control this intersection. PCW intends to instruct the flaggers to favor stopping Project traffic when public vehicles arrive rather than the reverse. This will minimize any delays to the public traffic while having little effect on Project traffic as the volume of public traffic on CC401 is very low.

Due to limitations within the available traffic analysis software, PCW was not able to directly quantify the effect flaggers will have on intersection traffic. However, experience has shown that the ability of flaggers to be flexible and adaptive in traffic management by allowing longer queues of vehicles to clear intersections as needed is superior to the addition of temporary timed traffic lights.

4.4.2 Labor Force Commuting Traffic at I-80 Exit 221

If all workers are required to report to the north Chokecherry access, the eastbound I-80 ramp and WY76 intersection will fail during the morning peak hour, and the westbound I-80 ramp and WY76 intersection will fail during the afternoon peak hour as discussed in Section 4.3.1.1. One option to address this issue would be to utilize flaggers to control the traffic across the I-80 overpass and at each of the ramps. This dynamic approach would allow flaggers to ensure traffic does not back up onto the interstate. If combined with a potential limitation of Project delivery traffic during the peak hours as described in 4.4.1 above, this approach is expected to be more effective than adding timed temporary traffic signals. However, as mentioned previously, current software limitations do not allow for the effect of flaggers to be quantified.

Another option identified by PCW would be to stagger the start- and end-shift times for the labor force on the Project. Rather than requiring the entire labor force to report to the site at the same time, PCW examined the effect of dividing the shift into two equal groups, with the

second starting and ending one hour later than the first. As shown in Table 12, the effect of this change onto the I-80/WY76 intersection was dramatic, reducing the delay times substantially and improving the expected LOS from an "F" to a "C" during the peak traffic times.

Table 12. Public Intersection LOS Analysis – Effects of Staggered Start Time

Intersection	Time Period	Single Start Time		Staggered Start Time	
		Delay	LOS	Delay	LOS
Construction Year Three Peak Month (July), Preferred Rail Location					
I-80 EB and WY76	Morning Peak	>300	F	15.4	C
I-80 WB and WY76	Afternoon Peak	>300	F	22.3	C
Construction Year Three Peak Month (July), Alternate Rail Location					
I-80 EB and WY76	Morning Peak	>300	F	16.1	C
I-80 WB and WY76	Afternoon Peak	>300	F	24.5	C

4.4.3 Labor Force Commuting Traffic on WY71

Under the scenario that workers are allowed to use WY71/CC401 to report to the Sierra Madre area, two intersections of WY71 within Rawlins (at Jackson Street and at South Higley Boulevard) will operate below a LOS "D".

The WY71/Jackson Street intersection is shown to have a LOS "E" during the morning peak meaning the intersection operating unacceptably. The specific location of housing facilities within Rawlins for the workers is still unknown, so a high volume of workers from Rawlins are modeled as traveling southbound on Jackson Street to access SH 71. The addition of worker traffic results in the poor LOS at this intersection. However, since these delays are likely worst-case and only occur during the morning peak hour, mitigation will likely not be required. This location can be monitored during construction and if observed delays or queues during the morning hours are excessive, then a flagger may be utilized during the morning peak period.

During the morning peak hour, the WY71/South Higley Boulevard delay does cause a LOS "F". The westbound stop-controlled approach fails due to a lack of available gaps from high volumes of traffic making a northbound left-turn. However, this level of delay is on the lowest approach volume at the intersection (less than 20 vehicles out of 785 traveling through the intersection) and all other approaches operate at a LOS B or better. Because this condition will only occur during one hour of the day, and the number of vehicles affected is so low, it is likely that mitigation will not be needed at this intersection. However, if residents experience excessive delays due to construction traffic, flaggers can be provided during the morning peak hours.

5. Project Traffic Effects – Operations

This chapter evaluates the effects Project traffic will have on the public roadways surrounding the Project during operations.

5.1 Operations Traffic

As with construction, the first step in understanding what effects Project traffic will have on the nearby public roads during operations is to evaluate the additional traffic the Project will generate. This evaluation is described below.

5.1.1 Types of Trips

During operations, the traffic expected on a daily basis will be almost entirely from the labor force, either reporting to and from the site or making trips during the business day. Some additional deliveries of large components will occur at times, however not on such a frequent basis as to affect the daily traffic patterns of the surrounding roadways.

In order to make a conservative estimate, PCW assumed that the entire operations labor force would commute to the Project from Rawlins.

5.1.2 Labor Force

PCW is estimating that the Project will have a staff of approximately 114 full-time employees during operations. The labor force is expected to commute to the Project using personal vehicles. For the purposes of this TMP, it was assumed that all labor force traffic will use I-80 exit 221 to access the Project. Trips made by the labor force during the business day are expected to occur in Project pick-up trucks. Additional trips caused by deliveries to the Project will be few in number and occur only on an as-needed basis.

5.2 Traffic Analysis

With the required workforce and routing options defined, PCW estimated the volume of traffic generated during the operations of the Project and the subsequent effects on the public roadways near the Project. This analysis used the same process described in Section 4.2. This analysis is presented below.

5.2.1 Trip Generation

Because traffic during Project operations is expected to be constant, PCW performed the traffic analysis on a typical day. This included the daily commute of 114 employees, which for the purposes of this TMP was assumed to work a single shift, meaning all workers arrive to and depart from the site during the same peak hours.

PCW also assumed that the labor force may make additional trips to and from the Project during the business day. Even assuming each employee makes two such off-site trips per day, these would not occur during the peak hour and would not change the peak traffic levels. Hence the peak hours were the volumes that defined the study parameters for this analysis.

5.2.2 Analysis Parameters

The same approach defined in Section 4.4.2 was utilized to analyze traffic effects during the operation of the Project.

5.2.3 Analysis Results

The LOS and traffic delay resulting from the typical daily Project traffic is listed in Table 13.

Table 13. Public Intersection LOS Analysis – Operations

Intersection	Morning Peak (AM)						Afternoon Peak (PM)					
	Existing		Use 221		Use WY71		Existing		Use 221		Use WY71	
	Dly	LOS	Dly	LOS	Dly	LOS	Dly	LOS	Dly	LOS	Dly	LOS
US287 Bypass/Higley Boulevard and 3rd Street	10	A	10	A			9.7	A	11	B		
US287 Bypass/Higley Boulevard and Cedar Street[1]	11	B	8.9	A			10.5	B	10.2	B		
WY71 and Jackson Street	9	A	8.9	A			9	A	8.9	A		
WY71 and Washington Street	9.1	A	9.1	A			9.3	A	9.2	A		
WY71/Locust Street and South Higley Boulevard	10.1	B	9.9	A			10.1	B	10.2	B		
I-80 EB and Spruce Street	9.2	A	9.3	A			10.1	B	10.1	B		
I-80 WB and Spruce Street	8.8	A	8.7	A			9.7	A	9.5	A		
I-80 EB and South Higley Boulevard	10.3	B	9.5	A			9.7	A	9.7	A		
I-80 WB and South Higley Boulevard	10.2	B	10.4	B			10.3	B	10.3	B		
I-80 EB and WY76	9.1	A	9	A			9.2	A	9.7	A		
I-80 WB and WY76	8.7	A	8.7	A			8.8	A	9.7	A		

Notes: [1]Signalized intersection
Dly = Average intersection delay (seconds)
Use 221 = labor force required to report to north end of Project via I-80 Exit 221
Use WY71 = portion of labor force assigned to Sierra Madre can utilize WY71/CC401
Delay estimates for signalized intersections assume optimized traffic signal operations.
Delay estimates assume uniform flow entering intersections during the peak hour.

The analysis concluded that the operations for all intersections studied are at LOS B or better, which indicates the Project's operations will have little overall effect to the public roadways near the Project.

5.3 Potential Mitigation Options

Because the intersections near the Project maintained an LOS of B or better, no mitigation measures are required.

6. Project Traffic Effects – Decommissioning

This chapter evaluates the effects Project traffic will have on the public roadways surrounding the Project during decommissioning. The first step in understanding what effects the Project's decommissioning traffic will have on the public roads near the site is to evaluate the new traffic Project decommissioning will generate. This evaluation is described below.

6.1 Project Traffic

The types of trips required for decommissioning are the same as those for construction, which are described in Section 4.2. Because the Project's decommissioning is anticipated to occur in thirty years, background traffic volumes were grown by 2 percent to account for growth in the region. This growth rate is based on growth projections for Carbon County by the Wyoming Department of Administration and Information.

6.1.1 Material/Component Requirements

The vehicles and equipment necessary to transport the decommissioning material, components, equipment, and labor force to and from the Project are assumed to be the same as those for construction, as described in Section 4.2.

Based on the Project schedule and range of values provided in Chapters 2 and 5 of the 2011 Project POD, Table 14 below lists the estimated total number of truckloads required to decommission the Project. These include truckloads of Project materials, components, and equipment to be removed from the site, as well as trips made off-site by Project personnel.

Table 14. Total Truckloads of Project Decommissioning Material

Items	Year 1	Year 2	Year 3	TOTAL
Removed Off-Site				
Wind Turbine Components	5,220	5,220	4,560	**15,000**
Aggregate	19,038	29,041	40,822	**88,900**
Concrete Removal	2,231	2,148	1,862	**6,242**
Collection System Cables/Structures	81	82	71	**233**
Transmission Line Cables/Structures	644	647	559	**1,850**
Substation Components	20	54	36	**110**
Buildings/Trailers	30	20	30	**80**
Other Materials	3,719	2,960	3,321	**10,000**
Equipment Removal	1,180	1,180	1,180	**3,540**
Personnel Off-Site Trips	439	329	47	**815**
TOTAL REMOVED	**32,601**	**41,680**	**52,489**	**126,770**
On-Site Only				
Water	8	16	8	**33**

The truckloads of material and equipment are regardless of the final rail solution discussed in Chapter 4 of this TMP. For those items that depart the site by rail, these truckloads represent

their movement from the Project to the rail facility. For those few items that do not leave by rail, these truckloads represent the long-distance trucks departing the site.

The on-site truckloads represent the delivery of water within the Project from on-site water sources for dust control. These truckloads will not affect the local roadways except for those that may cross CC401 in the Sierra Madre area.

6.1.2 Labor Force

The other significant source of traffic along public roads would be the daily commute to the Project by the labor force. Daily commuting traffic is expected to make up over 90 percent of the peak hour Project decommissioning traffic. Based on the ranges provided in Chapter 5 of the 2011 Project POD, this TMP assumed the breakdown in Table 15 for the total labor force arriving to the site daily during the decommissioning.

Table 15. Total Labor Force Commuting to Site During Decommissioning

Month	Year 1	Year 2	Year 3
April	200	200	300
May	400	400	400
June	400	400	400
July	400	400	400
Aug	400	400	400
Sep	300	300	300
Oct	300	300	300

The routing options for Project decommissioning are assumed to be the same as those for Project construction, as described in Section 4.3. However, given the lower labor force requirements, PCW made the conservative assumption that only exit 221 would be used for the labor force commute.

6.2 Traffic Analysis

With the required truckloads and routing options defined, PCW estimated the volume of traffic generated during the decommissioning of the Project and the subsequent effects on the public roadways near the Project. This analysis used the same process described in Section 4.2. This analysis is presented below.

6.2.1 Trip Generation

The number of projected monthly trips was calculated for both the preferred and alternate rail facility locations. PCW then determined which trips would occur off-site, based on the location of the rail facility. The resulting off-site trips for each rail facility location option are presented below.

6.2.1.1 Primary Rail Site

For the primary rail facility option as described in Section 2.1.1, the estimated daily off-site trips required for each month of Project decommissioning is provided in Table 16. These volumes represent complete trips, 50 percent into the site and 50 percent out. Figure 12 compares the daily decommissioning traffic for the primary and alternate rail site options.

Table 16. Total Daily Traffic Volume Estimate – Decommissioning, Primary Rail Site

Vehicle Type	Activity Month						
	Apr	May	Jun	Jul	Aug	Sep	Oct
Decommissioning Year One							
Removal Trucks[1]	22	43	43	43	43	32	32
Labor Force Commute	400	800	800	800	800	600	600
Total	**422**	**843**	**843**	**843**	**843**	**632**	**632**
Decommissioning Year Two							
Removal Trucks[1]	28	56	56	56	56	42	42
Labor Force Commute	400	800	800	800	800	600	600
Total	**428**	**856**	**856**	**856**	**856**	**642**	**642**
Decommissioning Year Three							
Removal Trucks[1]	51	68	68	68	68	51	51
Labor Force Commute	600	800	800	800	800	600	600
Total	**651**	**868**	**868**	**868**	**868**	**651**	**651**

Notes: [1]Sum of all removal trucks, including those removing aggregate, WTG components, and other material and equipment.
[2]Excludes pilot cars

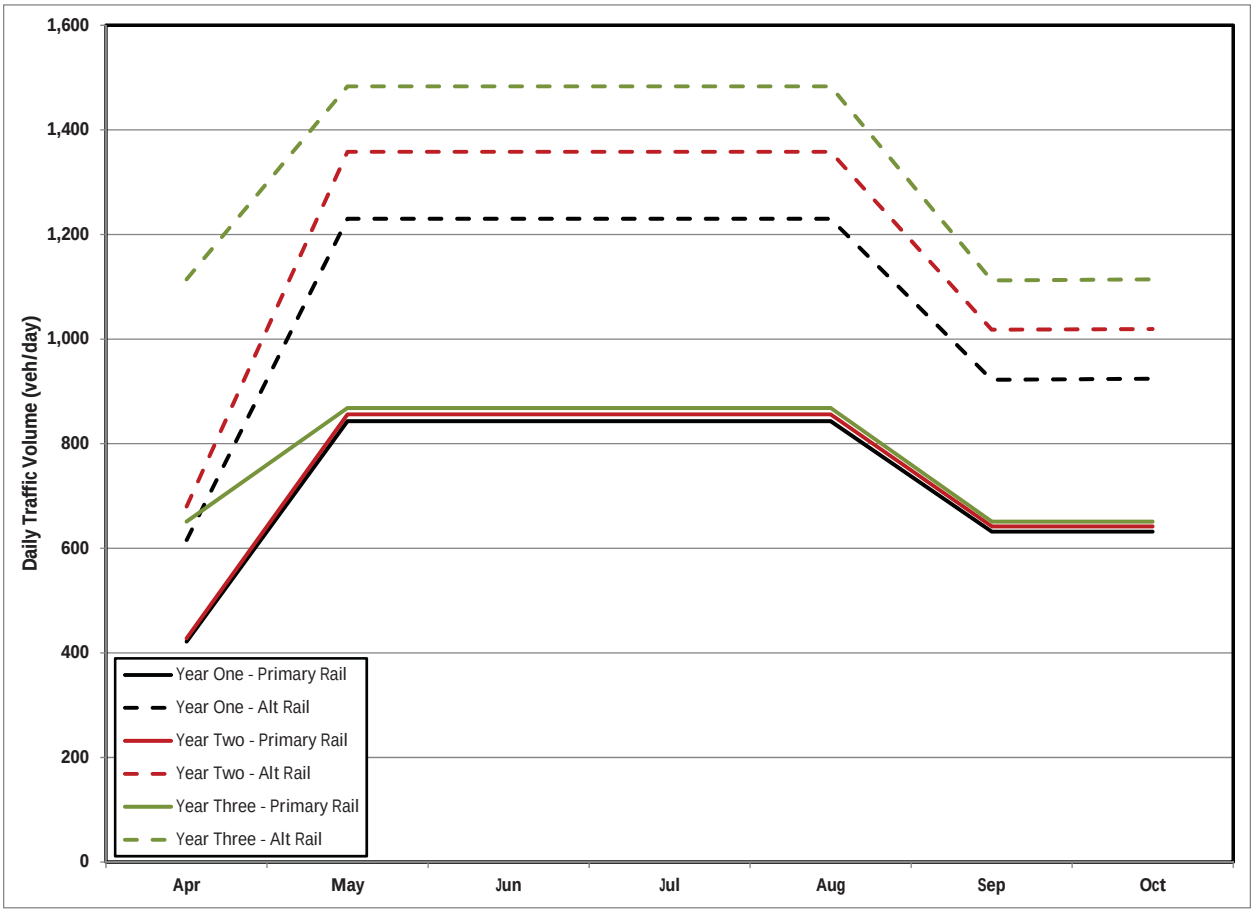


Figure 12. Average Off-Site Daily Traffic – Decommissioning

The highest overall volumes of traffic occur in between May and August of Year Three, with an average of 868 off-site vehicles trips per day. Approximately 90 percent of the traffic is due to the labor force commute, with 400 trips each for the morning and afternoon peak hours of 7:00am and 5:00pm. The remaining 68 daily trips are due to trips associated with material removal that are assumed to occur throughout the work day, as presented in Figure 13. It is important to note that half of all truckloads for all construction vehicles will be empty, so only half of the oversized truckloads traveling over structures will be overweight. Also, while it is the intention of PCW that as much of the Project's construction materials and components be removed by rail, it is likely that some amount will still depart by truck due to logistical issues. The 68 daily off-site delivery trips during the peak month reflect a TMP assumption that 10 percent of deliveries will be made by truck, plus the portion of overall deliveries that need to be made to the Miller Hill area and therefore must cross CC401.

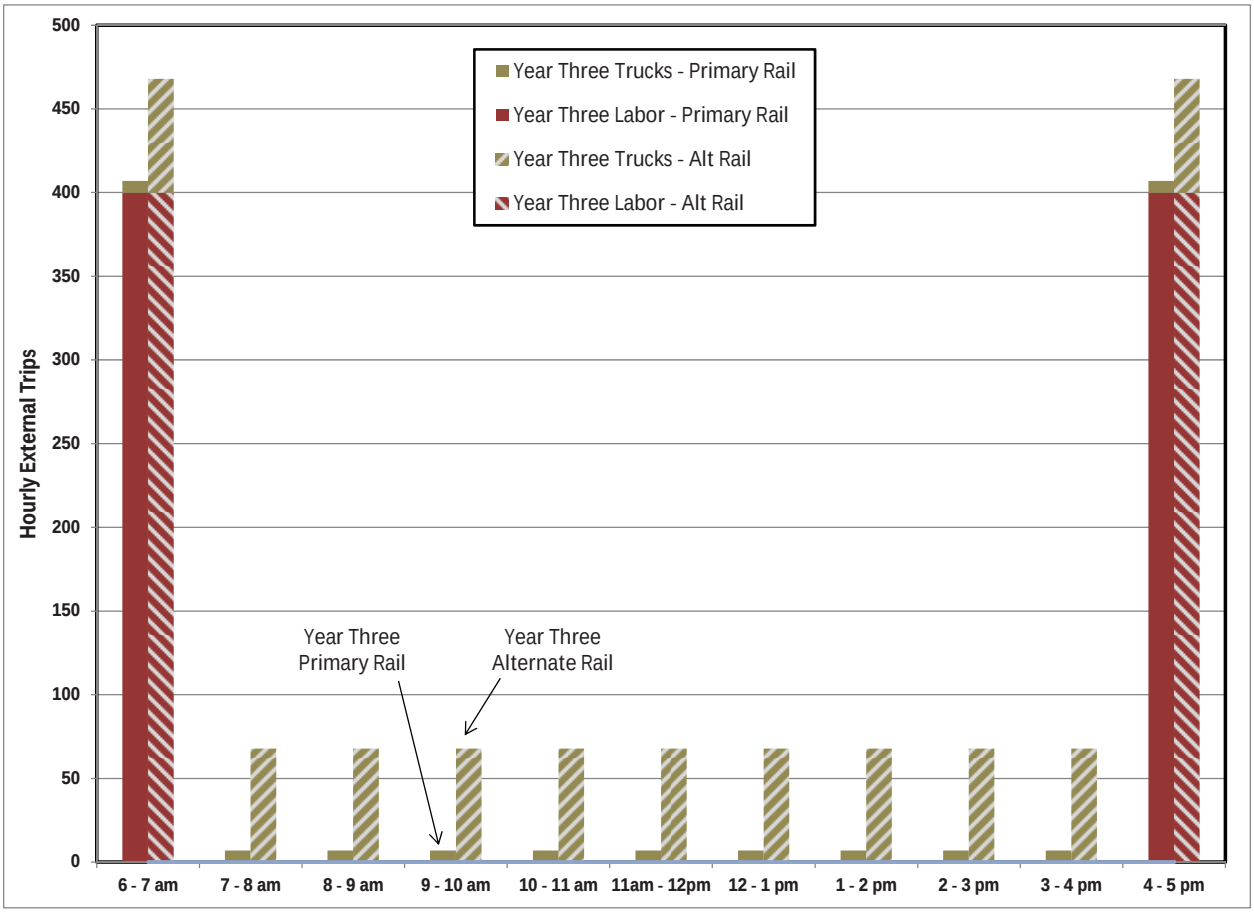


Figure 13. Peak Month Hourly Trips – Decommissioning Year 3 Peak

6.2.1.2 Alternate Rail Site

As the alternate site for the rail facility is located on the opposite side of I-80 from the Project, all deliveries from Project to the rail facility will occur on public roads. As shown in Figure 12 and broken-out in Table 17, this causes as significant increase in traffic for the same decommissioning activities as compared to the primary rail site option.

The highest overall volumes of traffic continue to occur between May and August of Year Three, but now with an average of 1,483 off-site vehicles trips per day (or 170 percent of the primary rail site option). The labor force commute of 400 trips during each peak hour now constitutes only 54 percent of the total traffic, the delivery traffic on public roads increases from 68 for the primary rail site to 683 for the alternate site. The hourly breakdown of the daily off-site traffic for the peak of Year Three for the alternate rail site option is compared to the primary rail site option in Figure 13.

Table 17. Total Daily Traffic Volume Estimate – Decommissioning, Alternate Rail Site

Vehicle Type	Activity Month						
	Apr	May	Jun	Jul	Aug	Sep	Oct
Decommissioning Year One							
Removal Trucks[1]	216	430	430	430	430	322	324
Labor Force Commute	400	800	800	800	800	600	600
Total	**616**	**1,230**	**1,230**	**1,230**	**1,230**	**922**	**924**
Decommissioning Year Two							
Removal Trucks[1]	280	558	558	558	558	418	419
Labor Force Commute	400	800	800	800	800	600	600
Total	**680**	**1,358**	**1,358**	**1,358**	**1,358**	**1,018**	**1,019**
Decommissioning Year Three							
Removal Trucks[1]	514	683	683	683	683	512	514
Labor Force Commute	600	800	800	800	800	600	600
Total	**1,114**	**1,483**	**1,483**	**1,483**	**1,483**	**1,112**	**1,114**

Notes: [1]Sum of all removal trucks, including those removing aggregate, WTG components, and other material and equipment.
[2]Excludes pilot cars

6.2.2 Trip Distribution

The origin and destination was determined for each Project construction trip in the peak month. Labor force commute trips were determined based upon the origin assumptions and destination options described in Section 4.1.2. In order to analyze a worst-case scenario it was assumed that all workers would report to the north access. Project material and component removal trips were determined based upon the estimates in Section 6.4.1 and the decommissioning schedule outlined in the 2011 Project POD.

6.2.2.1 Trip Assignment

After trips were distributed between likely origins and destinations, they were assigned to specific roadways and added to existing traffic to allow analysis of project decommissioning operational conditions. For decommissioning vehicles departing to the east or west of Rawlins, the preferred route will be for the vehicles to travel CIG Road to exit 221 (WY76) in Sinclair, and then onto I-80. A small amount of vehicle traffic was assumed to depart to the north of Rawlins using the US287 bypass. No traffic was assumed to depart to the south of the Project.

6.2.3 Analysis Results

For each case and option analyzed, the following effects to the public roadways around the Project were determined. For the peak traffic period during the Project decommissioning, the following effects were estimated for both rail site options.

6.2.3.1 Primary Rail Site

The LOS and delay (in seconds per vehicle) resulting from the primary rail site option during the peak volume case are listed in Table 18.

Table 18. Public Intersection LOS Analysis – Decommissioning Peak, Primary Rail Site

Intersection	Morning Peak (AM)				Afternoon Peak (PM)			
	Existing		Use 221		Existing		Use 221	
	Dly	LOS	Dly	LOS	Dly	LOS	Dly	LOS
US287 Bypass/Higley Boulevard and Cedar Street[1]	11.0	B	8.3	A	10.5	B	10.6	B
WY71 and Jackson Street	9.0	A	9.0	A	9.0	A	8.9	A
WY71 and Washington Street	9.1	A	9.3	A	9.3	A	9.4	A
WY71/Locust Street and South Higley Boulevard	10.1	B	10.3	B	10.1	B	10.7	B
I-80 EB and Spruce Street	9.2	A	9.8	A	10.1	B	10.1	B
I-80 WB and Spruce Street	8.8	A	8.8	A	9.7	A	9.7	A
I-80 EB and South Higley Boulevard	10.3	B	9.6	A	9.7	A	9.7	A
I-80 WB and South Higley Boulevard	10.2	B	10.7	B	10.3	B	10.3	B
I-80 EB and WY76	9.1	A	12.2	B	9.2	A	10.5	B
I-80 WB and WY76	8.7	A	9.4	A	8.8	A	15.6	C

Notes: [1]Signalized intersection
Dly = Average intersection delay (seconds)
Use 221 = labor force required to report to north end of Project via I-80 Exit 221
Delay estimates for signalized intersections assume optimized traffic signal operations.
Delay estimates assume uniform flow entering intersections during the peak hour.

The operations for all intersections are at LOS C or better with the addition of Project traffic for both peak periods.

6.2.3.2 Alternate Rail Site

The LOS and delay (in seconds per vehicle) resulting from the alternate rail site option during the peak volume case are listed in Table 19.

The results for the alternate rail site case were similar to that of the primary rail site case, with the exception of some additional delays at the I-80 and WY76 intersection (both eastbound and westbound). This is due to the addition of delivery traffic crossing I-80 along WY76/CIG Road in the alternate rail facility scenario.

Table 19. Public Intersection LOS Analysis – Decommissioning Peak, Alternate Rail Site

Intersection	Morning Peak (AM)				Afternoon Peak (PM)			
	Existing		Use 221		Existing		Use 221	
	Dly	LOS	Dly	LOS	Dly	LOS	Dly	LOS
US287 Bypass/Higley Boulevard and Cedar Street[1]	11.0	B	8.4	A	10.5	B	10.6	B
WY71 and Jackson Street	9.0	A	9.0	A	9.0	A	8.9	A
WY71 and Washington Street	9.1	A	9.3	A	9.3	A	9.4	A
WY71/Locust Street and South Higley Boulevard	10.1	B	10.3	B	10.1	B	10.7	B
I-80 EB and Spruce Street	9.2	A	9.8	A	10.1	B	10.1	B
I-80 WB and Spruce Street	8.8	A	8.8	A	9.7	A	9.7	A
I-80 EB and South Higley Boulevard	10.3	B	9.7	A	9.7	A	9.7	A
I-80 WB and South Higley Boulevard	10.2	B	10.7	B	10.3	B	10.3	B
I-80 EB and WY76	9.1	A	12.9	B	9.2	A	10.9	B
I-80 WB and WY76	8.7	A	10.0	A	8.8	A	17.2	C

Notes: [1]Signalized intersection
Dly = Average intersection delay (seconds)
Use 221 = labor force required to report to north end of Project via I-80 Exit 221
Delay estimates for signalized intersections assume optimized traffic signal operations.
Delay estimates assume uniform flow entering intersections during the peak hour.

6.3 Potential Mitigation Options

Because the intersections near the Project maintained an LOS of C or better, no mitigation measures are required.

Appendix A. Traffic Volume Diagrams

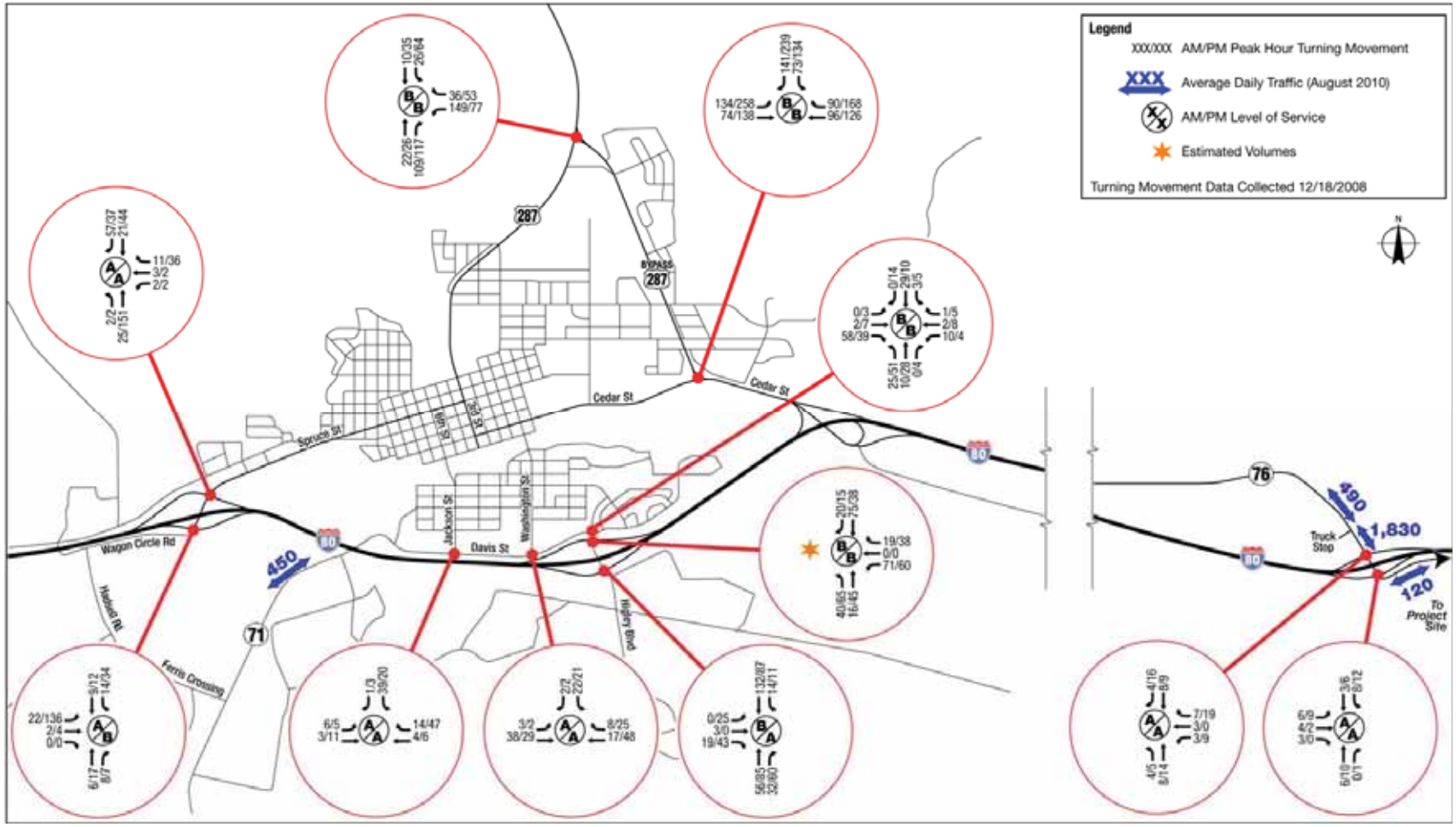


Figure 14. Traffic Volumes - Existing

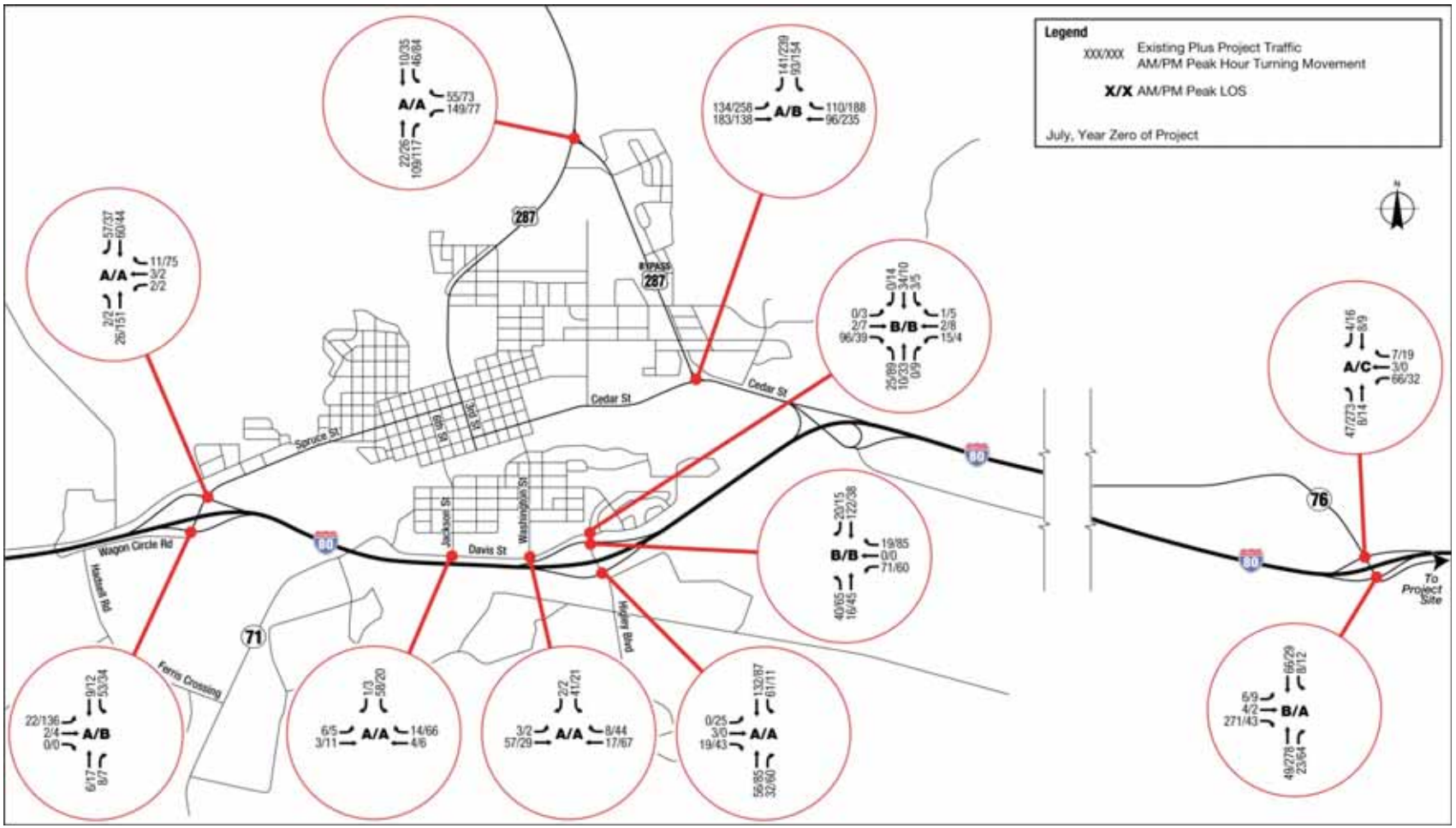


Figure 15. Traffic Volumes – Construction Year One Peak (July)

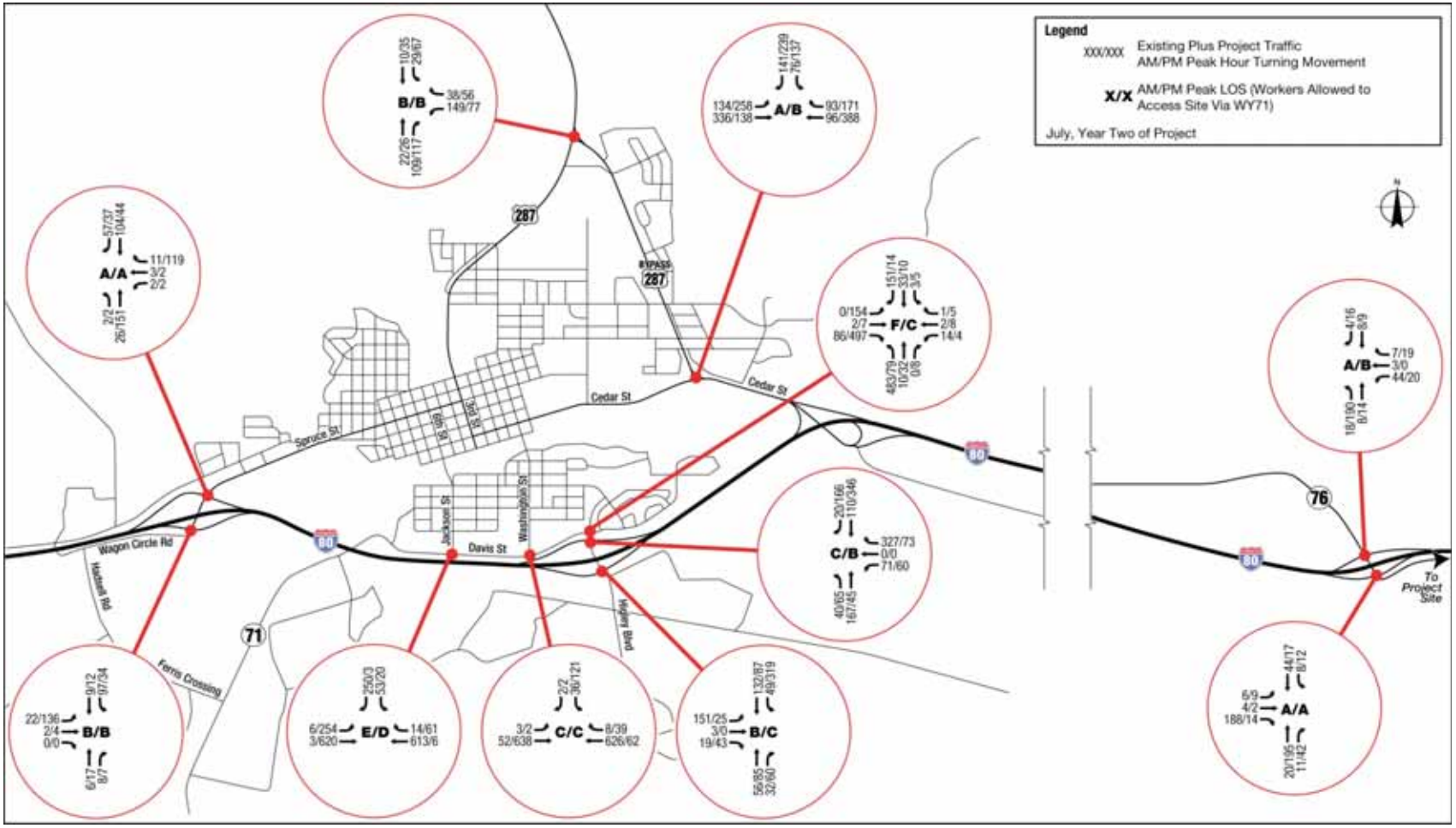


Figure 16. Traffic Volumes – Construction Year Three Peak (July), Preferred Rail Site, Labor Force Using WY71 and Exit 221

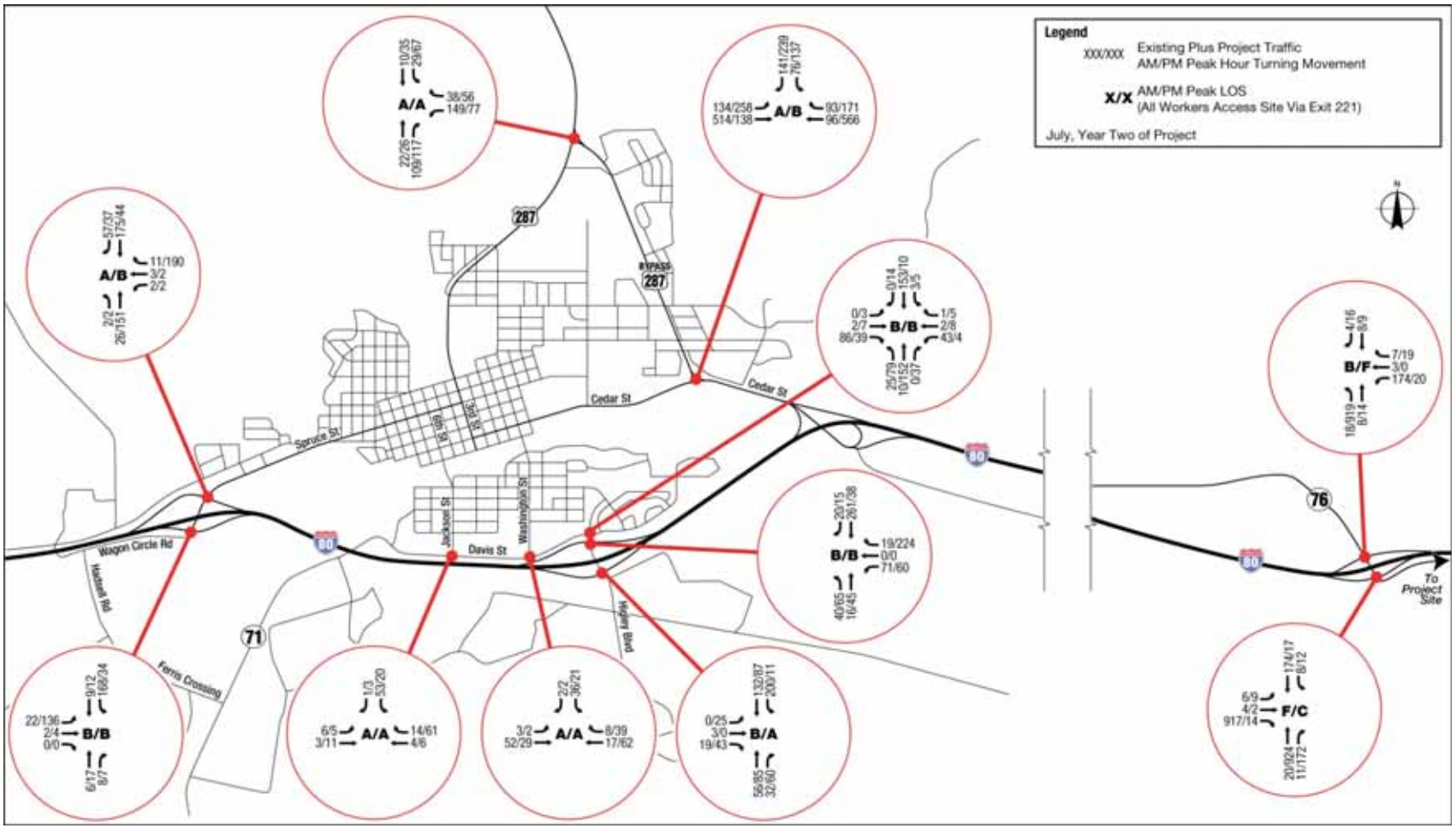


Figure 17. Traffic Volumes – Construction Year Three Peak (July), Preferred Rail Site, Labor Force Using Exit 221 Only

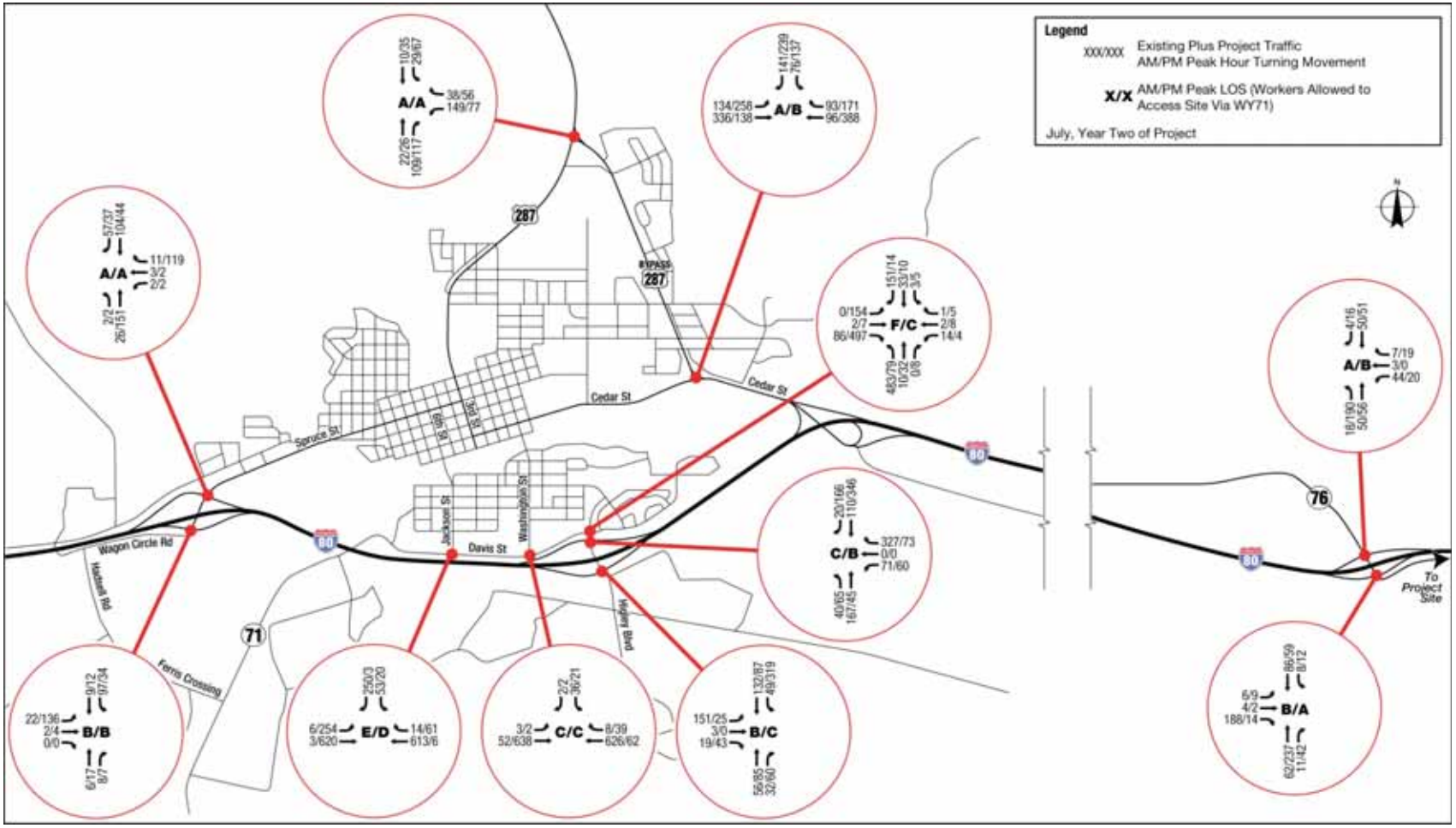


Figure 18. Traffic Volumes – Construction Year Three Peak (July), Alternate Rail Site, Labor Force Using WY71 and Exit 221

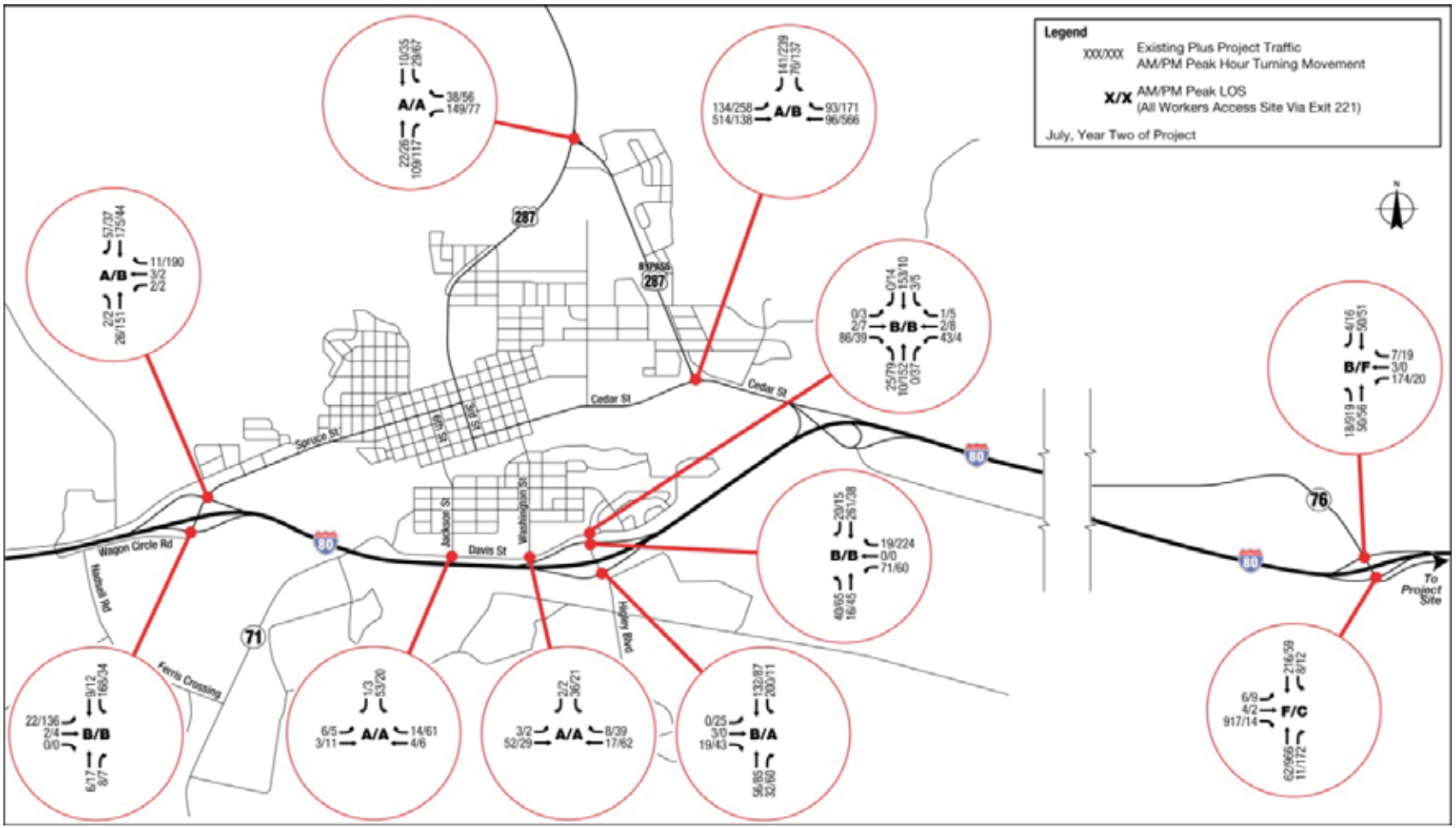


Figure 19. Traffic Volumes – Construction Year Three Peak (July), Alternate Rail Site, Labor Force Using Exit 221 Only

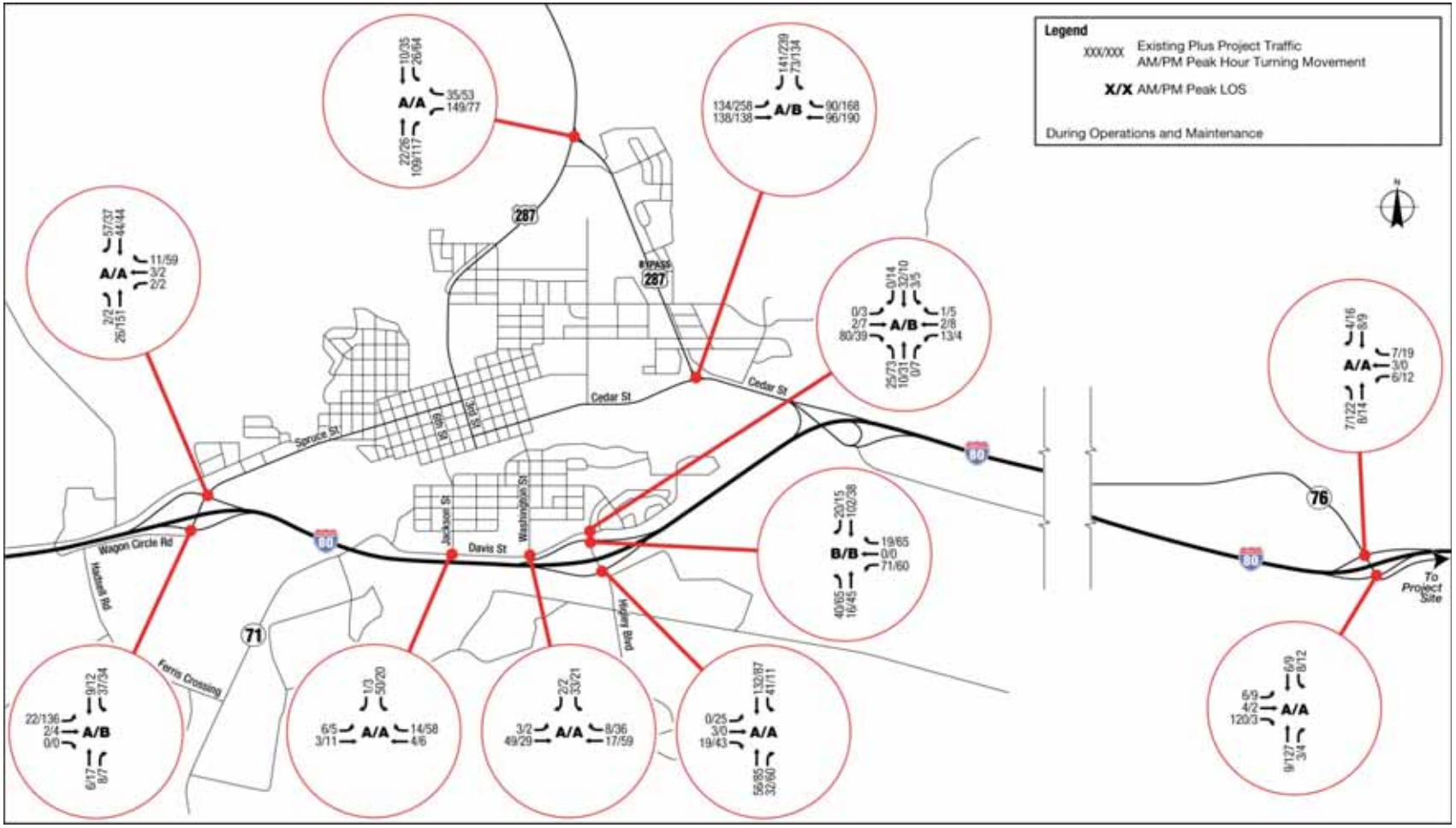


Figure 20. Traffic Volumes – Operations

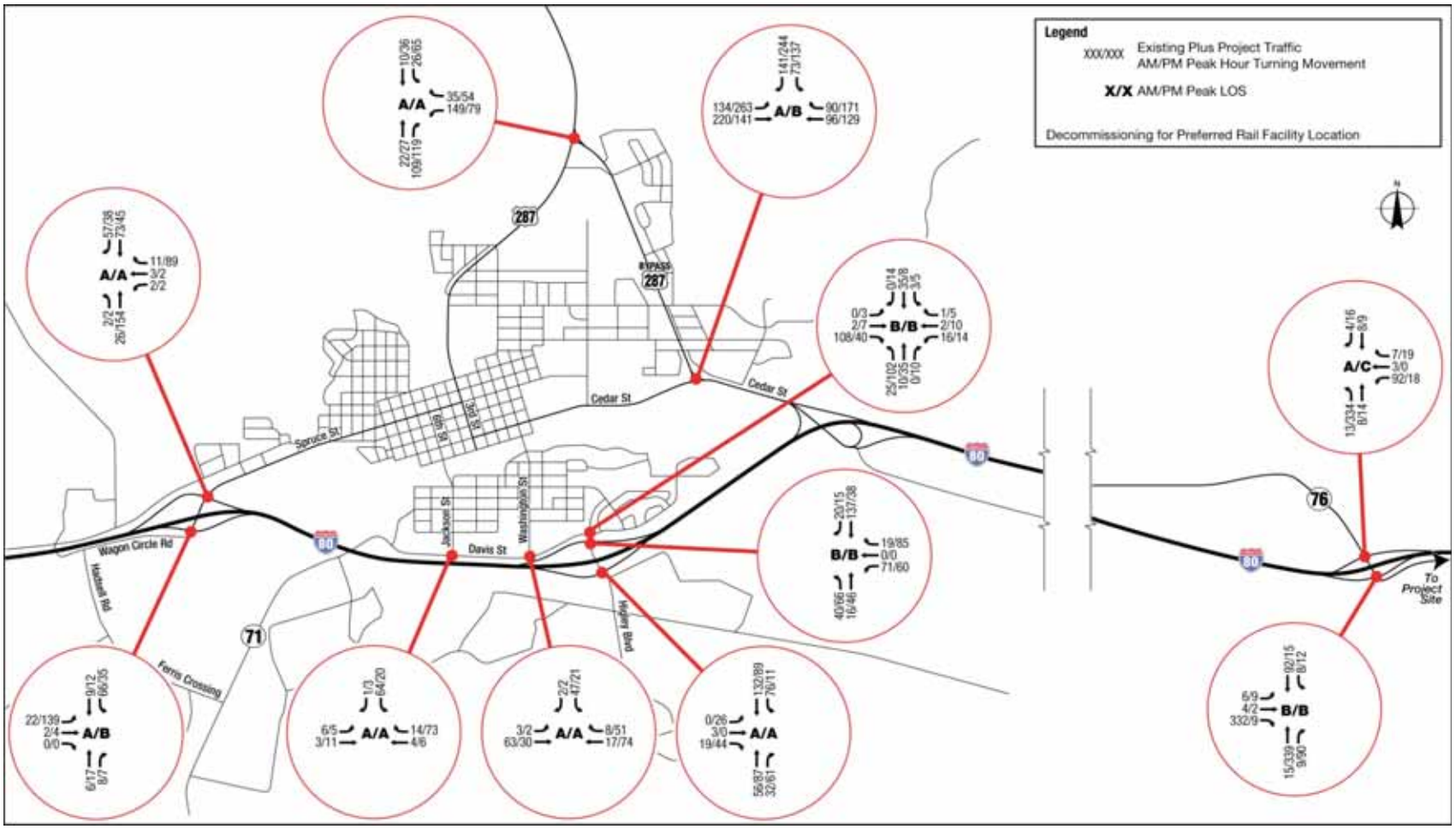


Figure 21. Traffic Volumes – Decommissioning Year Three Peak, Preferred Rail Site

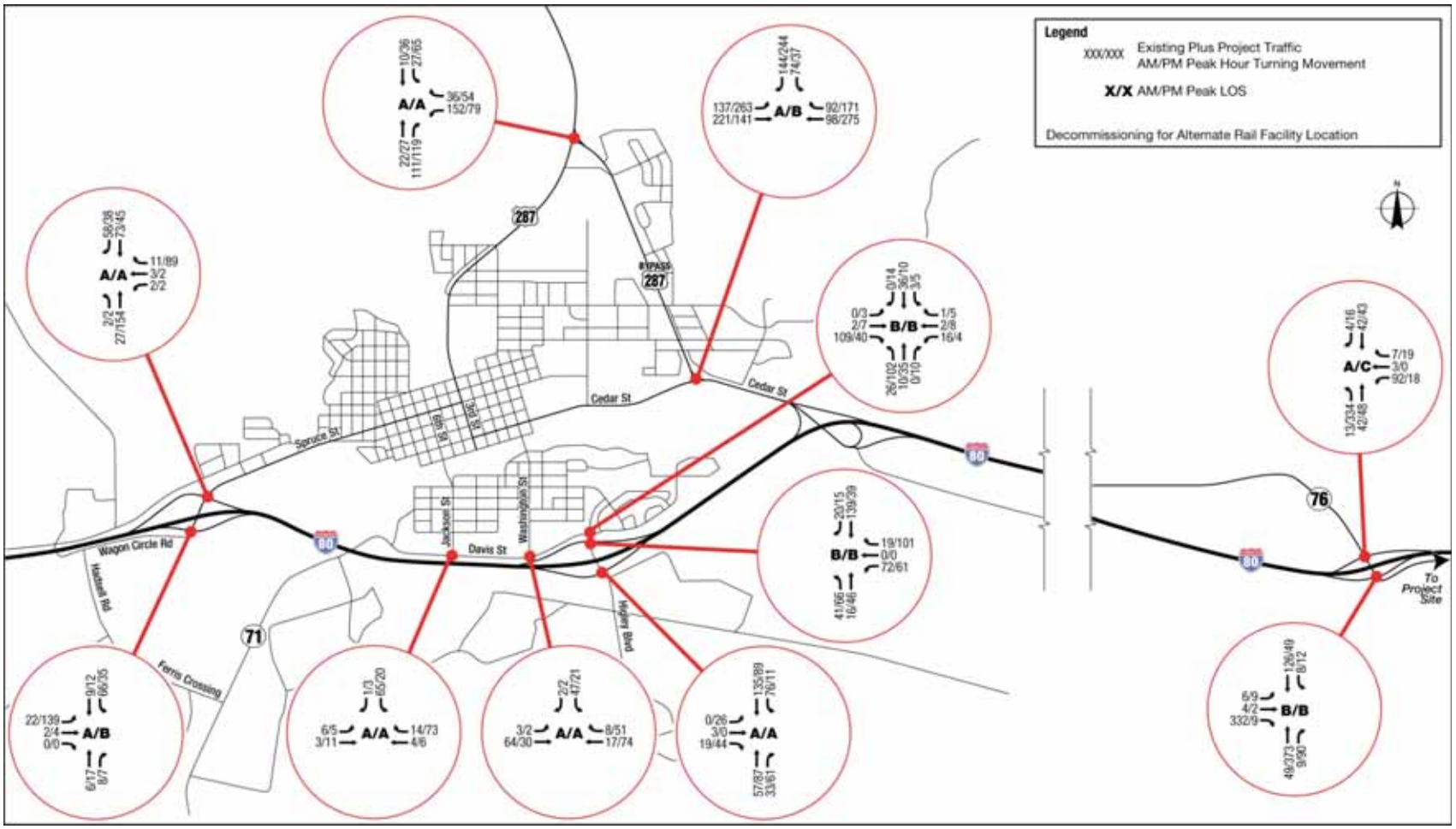


Figure 22. Traffic Volumes – Decommissioning Year Three Peak, Alternate Rail Site

Appendix B. Existing Traffic Counts

B-1. 2008 TMC

B-2. 2008 ADT

B-3. 2010 TMC

B-4. 2010 ADT

Appendix C. Level of Service Reports

C-1. Existing Level of Service Reports

C-2. Year One Level of Service Reports

C-3. Year Three Preferred Rail Level of Service Reports: All Workers Report to North Access

C-4. Year Three Preferred Rail Level of Service Reports: Workers Allowed to use SH 71

C-5. Year Three Alternate Rail Level of Service Reports: All Workers Report to North Access

C-6. Year Three Alternate Rail Level of Service Reports: Workers Allowed to use SH 71

C-7. Operations and Maintenance Level of Service Reports

C-8. Decommissioning Level of Service Reports: Preferred Rail Facility

C-9. Decommissioning Level of Service Reports: Alternate Rail Facility

Appendix D. Environmental Compliance Plan

To be provided later.

Appendix E. Master Reclamation Plan

Chokecherry and Sierra Madre Wind Energy Project

Master Reclamation Plan

Prepared for

555 Seventeenth Street
Suite 2400
Denver, CO 80202

Prepared by

SWCA Environmental Consultants
295 Interlocken Blvd., Suite 300
Broomfield, CO 80021
(303) 487-1183 / Fax (303) 487-1245
www.swca.com

May 2011

TABLE OF CONTENTS

Page

1.0 Introduction 1
1.1 Definitions and Objectives 1
1.1.1 Initial Stabilization 2
1.1.2 Long-term Reclamation 2
1.2 Reclamation Success Standards 2
1.2.1 Surface and Soils Stabilization Standards 2
1.2.2 Revegetation Standards 3
1.2.3 Landscape Reconstruction Standards 4
1.3 BLM Reclamation Requirements 4
2.0 Pre-Disturbance Site Characterization 4
2.1 Ecological Site Delineation 5
2.1.1 Pre-Disturbance Site Assessment 5
2.1.2 Soil 5
2.2 Reference Sites 6
2.3 Photopoints 6
2.4 Identify Limited Reclamation Potential Areas 6
2.4.1 Abiotic Landscape Features 7
2.4.2 Topsoil/Subsoil 7
2.4.3 Vegetation 7
3.0 Surface-Disturbing Activities 7
3.1 Construction Planning 8
3.1.1 Facility Layout 8
3.1.2 Design Documentation 8
3.2 Waste Material Management 8
3.2.1 Handling of Contaminated Soil Material 9
3.2.2 Disposal of Waste Materials 9
3.3 Subsurface Integrity 9
3.3.1 Stabilization 9
3.3.2 Water Quality 10
4.0 Soil Management 10
4.1 Soil Handling 10
4.1.1 Maintain Biological, Chemical, and Physical Integrity 10
4.2 Landscape Reconstruction and Erosion Control 12
4.2.1 Landscape Reconstruction 12
4.2.2 Soil Stabilization and Erosion Protection 13
5.0 Site Preparation and Revegetation 16
5.1 Soil Materials 16
5.1.1 Re-establish Chemical, Physical, and Biological Properties 17
5.1.2 Compaction 17
5.1.3 Protect Seeding Surface 17
5.2 Establish Desired Plant Community 17
5.2.1 Seeding 18
6.0 Weed Management 20
7.0 Reclamation Monitoring 20

7.1 Monitoring Parameters 21
7.2 Compliance 21
7.3 Identify Additional Reclamation 22
8.0 References 23

1.0 INTRODUCTION

This Master Reclamation Plan for the Chokecherry and Sierra Madre Wind Energy Project (Project) provides an overview of the reclamation goals and standards that will be used to ensure successful reclamation of disturbed areas created by the Project. The reclamation procedures outlined in this document describe the methodologies, monitoring, and reporting requirements for reclaiming disturbances associated with the Project and were developed based on Bureau of Land Management (BLM) Wyoming Reclamation Policy (2009), management directives presented in the Rawlins Field Office (RFO) Resource Management Plan (RMP) (BLM 2008) and RFO Reclamation Guidance (BLM 2011), Wyoming Department of Environmental Quality (WDEQ) Land Quality Division reclamation guidelines (WDEQ 2007), State of Wyoming's reclamation guidance for wind development, and coordination with BLM staff.

The Project area contains private lands; federal lands administered by the BLM ("public lands"); state lands under the management of the Wyoming State Board of Land Commissioners (the "State Land Board"), and lands under the administration of the Wyoming Game and Fish Commission ("WGFC") (collectively referred to as "state lands"). The Master Reclamation Plan and the procedures and standards outlined herein will apply to public lands within the Project area. While the preference will be to use the procedures and standards of the Master Reclamation Plan, specific reclamation techniques, standards, and schedules on private lands and state lands may vary and will be developed in coordination with private landowners, the State Land Board or WGFC as appropriate. Reclamation procedures in this document outline measures that will be taken to effectively reclaim areas disturbed by the Project, minimize Project effects to natural resources, and comply with federal and state regulations. For the purposes of this document, reclamation measures are presented in a general, non-specific manner. Detailed or site-specific reclamation measures and techniques will be shown in site-specific reclamation plans to be developed following final Project design as part of each site-specific Plan of Development (POD). This Reclamation Plan is intended to be dynamic to adapt to changing conditions and technologies. PCW will cooperate with the BLM Authorized Officer (AO) to update, modify, or change the procedures should it be warranted due to site conditions or other factors.

1.1 DEFINITIONS AND OBJECTIVES

Reclamation objectives emphasize eventual ecosystem reconstruction to maintain a safe and stable landscape and meet the desired outcomes of the land use plan, which means returning the land to a condition approximate to or better than pre-disturbance conditions. Reclamation for this plan is defined as the rehabilitation of a disturbed area to make it acceptable for designated use that often requires regrading, replacement of topsoil, revegetation, and other measures. Reclamation objectives include initial stabilization goals and long-term reclamation measures to ensure biophysical conditions are maintained in the short term to achieve long-term goals of revegetation and ecosystem reconstruction.

1.1.1 Initial Stabilization

Initial (or temporary) stabilization is initiated immediately after construction. The goal of initial stabilization is to stabilize soils and control erosion until long-term reclamation techniques are implemented.

1.1.2 Long-term Reclamation

Long-term reclamation refers to measures applied to stabilize disturbed areas, control runoff and erosion, and achieve reclamation goals and objectives concurrently with construction, maintenance and operation, or decommissioning of facilities. There are two stages of long-term reclamation.

- Interim reclamation is initiated following construction on areas that are not required for regular operations and routine maintenance activities, but which may be re-disturbed during non-routine maintenance and Project decommissioning. The objective of interim reclamation is to maintain a healthy, biologically active topsoil; control erosion; and minimize habitat, visual, and forage loss on those portions of the disturbed area not needed for operations for the life of the Project or until final reclamation is initiated.
- Final reclamation is initiated following construction for areas that will not be re-disturbed during operations and maintenance; and after decommissioning of the Project for all other areas. The objective of final reclamation is to return the land to a condition approximating that which existed prior to disturbance with allowances for an improved and/or stable ecological condition, if possible. This includes reconstruction of the landform to its original state along with re-establishment of a stable vegetative community, hydrologic systems, visual resources, agricultural values, and wildlife habitats.

1.2 RECLAMATION SUCCESS STANDARDS

Reclamation success standards will be used to assess whether the reclamation requirements are being met. On disturbed lands that are not needed for future activities, final reclamation will be pursued immediately. These standards apply on public lands. While the preference will be to use these standards on private lands and state lands, specific reclamation success standards on private lands and state lands may vary and will be developed in coordination with private landowners, the State Land Board or WGFC as appropriate.

1.2.1 Surface and Soils Stabilization Standards

Undesirable materials (e.g., contaminated soils, potentially hazardous materials) will be isolated and/or removed to protect the reclaimed landscape from contamination. The land surface will be recontoured and other soil conservation, surface manipulation, and water management techniques will be implemented to establish stable slopes, watercourses, and drainage features to minimize erosion and sedimentation (also protecting surface water and groundwater resources). The soil surface must be stable and have adequate surface roughness to reduce run-off and capture rainfall and snow melt. Additional short-term measures, such as

the application of mulch or mechanical surface roughening may be used to limit surface soil movement.

1.2.2 Revegetation Standards

Vegetation production and relative species diversity will approximate the composition and characteristics of adjacent undisturbed reference sites. These reference sites will be established prior to disturbance during site characterization and are further discussed in section 2.2. The vegetation will stabilize the site and support the planned post-disturbance land use, provide for natural plant community succession and development, be self-perpetuating, and noxious weeds will be controlled in accordance with the standards set forth herein. On public lands, the BLM has zero tolerance for state-listed noxious weed species and all noxious weeds will be controlled. While the preference will be to use these standards on private lands and state lands, specific revegetation standards on private lands and state lands may vary and will be developed in coordination with private landowners, the State Land Board or WGFC as appropriate to meet specific land use standards. Revegetation will be deemed successful when the following criteria are met.

- A self-sustaining and locally native plant community is established on the site. Seed mixtures will be developed based on site-specific characteristics following BLM guidance. Vegetation will have a density sufficient to control erosion and non-native plant invasion and re-establish wildlife habitat and forage production.
- Sufficient species diversity is established on sites on public lands. No single species will account for more than 30 percent of total vegetative composition on public lands unless it is evident at higher levels in adjacent undisturbed reference sites.
- Vegetative cover on the site meets appropriate standards. Reclamation of permanent vegetative cover will be determined successful when the basal cover of desirable perennial species is at 80 percent and dominant species is at 90 percent of the adjacent undisturbed reference site in accordance with the RFO RMP (BLM 2008) and/or in accordance with the appropriate standard developed in coordination with private landowners, the State Land Board or WGFC as appropriate.
- Resilient vegetation is established on the site. Plants must be resilient as evidenced by well-developed root systems and successful reproduction (vegetative and sexual).
- Shrub communities are established on sites on public lands (only in communities where shrubs were present prior to construction). Shrubs must be well established, at least in a “young” age class (not comprised mainly of seedlings that may not survive until the following year) showing evidence of reproduction.
- Invasive plant and noxious weed species are a minor component of the plant community on the site. Part of successful revegetation includes maintaining native plant communities with minimal weed occurrences. Invasive plant species should account for less than 5 percent total plant cover and reclamation species should be outcompeting weed species within two years of reclamation initiation; however, total percent cover of these species should be commensurate with adjacent reference sites.

On public lands, the BLM has zero tolerance for state-listed noxious weed species and all noxious weeds will be controlled.

1.2.3 Landscape Reconstruction Standards

Landscape reconstruction will be deemed successful when the original landform has been restored or approximated for disturbed areas that are not required for regular operations and maintenance activities. For landscape reconstruction to be deemed successful, the reclaimed landscape will have characteristics that approximate the visual quality of adjacent areas with regard to location, scale, contour, color, and orientation of major landscape features and will support existing and future land uses. Erosional features will be less than or equal to the surrounding area. While the preference will be to use these landscape reconstruction standards on private lands and state lands, specific standards on private lands and state lands may vary and will be developed in coordination with private landowners, the State Land Board or WGFC as appropriate.

1.3 BLM RECLAMATION REQUIREMENTS

Reclamation requirements are designed to ensure adherence to the BLM Wyoming Reclamation Policy (2009) and the BLM Instruction Memorandum No. WYD-03-2011-002 (BLM 2011). BLM reclamation requirements for Wyoming apply to all surface-disturbing activities and must be addressed in the reclamation plan. Where Wyoming BLM reclamation requirements differ from other applicable federal laws, rules, and regulations, those requirements supersede the BLM Wyoming Reclamation Policy (2009). State and/or local statues or regulations may also apply. The Wyoming BLM reclamation requirements are addressed individually in the following sections of the Reclamation Plan.

2.0 PRE-DISTURBANCE SITE CHARACTERIZATION

Pre-disturbance site characterization is a critical component for reclamation monitoring to describe the surrounding landscape, determine ecological community types, and assess biophysical parameters during planning. Pre-disturbance survey provides data that allow for proper planning and timely implementation of activities, as well as the landscape, soil, and vegetation characteristics to be recreated with reclamation practices. This characterization also provides the baseline information to assess and survey rangeland conditions and trends to maintain Wyoming Standards and Guidelines for Healthy Rangelands (BLM 1997).

Components of pre-disturbance site characterization include establishing undisturbed adjacent reference sites and identifying limited reclamation potential (LRP) sites. This baseline information will include topographic, hydrologic, vegetation, and soil parameters and will be used to define site-specific reclamation guidelines. Pre-disturbance assessments of drainages will be completed in accordance with the Project Watershed Monitoring Plan. LRP sites possess unique landscape characteristics that present distinctive challenges and make meeting reclamation requirements more challenging (BLM 2009). Identifying LRP sites during pre-disturbance characterization will provide information for site-specific reclamation requirements and limitations. By establishing baseline conditions of the surrounding

landscape, reclamation goals and success standards will be more accurately assessed through the reclamation monitoring plan.

2.1 ECOLOGICAL SITE DELINEATION

Biophysical and physiographic parameters will be characterized in each proposed disturbance site to assess pre-disturbance conditions, delineate ecological sites, and identify revegetation techniques (BLM 2011). An ecological site is a specific kind of land defined by its physical characteristic that differs from other communities within a landscape in its ability to produce and support a distinctive type and amount of vegetation, and in its ability to respond similarly to management actions and natural disturbances (Natural Resources Conservation Service [NRCS] 2003). Ecological sites have not been fully mapped by the NRCS for the Project area; however, within the RFO, 10 ecological site descriptions (ESD) are recognized (BLM 2011). NRCS soil surveys along with aerial imagery, climate, land management, and other natural factors will be used to delineate ecological site boundaries. Photo reference points (photopoints) will be established to provide a qualitative standard for pre-existing conditions and for comparison purposes during post-construction monitoring. The combination of protocols described below will be used for identifying topographic features (slope and aspect), variations in plant composition and cover, and soil surface properties.

2.1.1 Pre-Disturbance Site Assessment

A low-intensity inventory will be conducted for disturbance areas to rapidly assess plant community characterizations, soil surface indicators, and general soil types to ensure that each identified ecological site is appropriately classified (Agricultural Research Service [ARS] 2011). During the site assessment, general attributes will be confirmed through a qualitative assessment of topography, vegetation, and soil. Steep slopes (greater than 25 percent), aspect, and unique topographic features (i.e., rock outcrops, unique boulders, natural moss rock piles, etc.) will be identified.

2.1.2 Soil

Detailed observations of the soil properties and processes will assist in delineating each ecological site (Moseley et al. 2010), while providing the baseline information necessary to assess reclamation needs. Soil components are differentiated by parent material, landform, slope component and complexity, temperature regimes, and moisture regimes. Soil types are further classified by diagnostic horizons, physical and chemical properties, fragment inclusions, and root distribution. Soil characteristics will be gleaned partly from the established Order 3 soil survey data; however, additional information (i.e., physical and chemical properties) will be gathered to further describe soil conditions (ARS 2011). Data gaps in the existing soil data will be identified and fulfilled as needed. Standardized sampling protocols will be used to maintain the quality of data and to compare attributes between adjacent undisturbed reference sites and reclaimed areas.

Soil erodibility will be defined for each disturbance area as described by the correlated soil components and complexes. Soil erosion features will be assessed for each disturbance area using the Erosion Condition Classification System (BLM 1980), which evaluates soil movement, surface litter, surface rock fragments, pedestalling, row patterns, rills, and gullies.

The Erosion Condition Classification System will identify the erosion risk for each site as stable, slight, moderate, critical, or severe.

2.2 REFERENCE SITES

An adjacent undisturbed reference site will be assigned to each disturbance area prior to any surface disturbance activity. A single reference site may be used for more than one disturbance area when the disturbance areas have similar characteristics and fall within the same ecological site type (i.e., a string of turbines on the same ridgeline). Conversely, more than one reference site may be necessary for an individual surface disturbance (i.e., larger facilities and linear features may include multiple ecological sites and may require multiple reference sites). The adjacent undisturbed reference site will be used to establish pre-construction site conditions against which site-specific reclamation goals and standards will be assessed. Reference sites on private lands and state lands and reclamation assessment standards will be developed in cooperation with private landowners, State Land Board or WGFC as appropriate.

Vegetation attributes (i.e., species composition, species cover, and invasive plant and noxious weed occurrences) will be quantified to provide a more precise estimate of the existing vegetation conditions (BLM 2011). Standardized sampling protocols will be used to maintain the quality of data and to compare attributes between adjacent undisturbed reference sites and reclaimed areas. The Step-Point method measures the basal cover percentage for individual species, total basal cover percentage, and species composition by basal cover percentage (BLM 2011). This methodology is both quantitative, reproducible, and it is also possible to collect a fairly large number of samples within a relatively short period of time, providing a comparison of revegetation success in the reclaimed area to the existing native vegetation in an adjacent area. During site assessments, occurrences of invasive plants and noxious weeds will be identified and recorded (i.e., shapefile).

2.3 PHOTOPOINTS

Digital photographs will be used to document conditions of vegetation, site stability, erosion, and other features or conditions subject to change over time. Each photograph will include the direction of photo (compass), from where it was taken, and what is captured in the photo (e.g. reference site, sampling transect, noxious weeds [or lack of], etc.). Photographs from the photopoints will be taken during the same time of year.

2.4 IDENTIFY LIMITED RECLAMATION POTENTIAL AREAS

The BLM has defined LRP sites that are particularly difficult to restore due to highly sensitive physical, biological, and/or chemical characteristics (BLM 2009). LRP sites require additional site-specific reclamation standards, which will be developed for areas identified as LRP sites based on the characteristics listed below. Best Management Practices (BMPs) and other strategies will be developed on a site-specific basis to mitigate effects and/or to increase reclamation success. BMPs will address the site-specific requirements of the Project and local environment. While the preference will be to use these LRP reclamation standards on private lands and state lands, specific standards on private lands and state lands may vary and will be

developed in coordination with private landowners, the State Land Board or WGFC as appropriate.

2.4.1 Abiotic Landscape Features

Abiotic landscape features that determine LRP areas include topography (slope and aspect), unique features, parent materials (geological substrates), and climate. LRP areas include slopes greater than 25% with south- or southwest-facing aspects; cliffs or rock outcrops that will be destroyed during construction and difficult or impossible to re-establish; soils with marine shale, clay/siltstone, or seleniferous (selenium-bearing) geological substrates; and some areas where the annual precipitation is below 9 inches (BLM 2011).

2.4.2 Topsoil/Subsoil

Soils with limited reclamation potential are soils with a depth of less than 3 inches, a soil pH greater than 8.4, soil electrical conductivity (EC) greater than 8 deciSiemens per meter (dS/m) (which helps identify strongly saline soils), or a sodium absorption ratio (SAR) greater than 13 (which helps identify sodic soils). Soils with no visible biological activity, with a surface heavily stabilized by biological crusts, abiotic white crusts, abiotic black crusts, or dominated by coarse material greater than 0.08 inch in diameter are also signs of LRP areas. These usually indicate salty conditions, old surfaces which are stable after years of protection by biological crusts, or soils which are potentially quite gravelly. Some gravel surfaced soils have had wind and water erosion over time such that only gravels and cobbles remain over very thin, if any, topsoil. These sites usually have very sparse vegetation.

2.4.3 Vegetation

Unique vegetation communities with limited reclamation potential include halophytes (e.g., saltbush [*Atriplex* spp.], greasewood [*Sarcobatus* spp.]) and selenium accumulators (e.g., two-grooved milkvetch [*Astragalus bisulcatus*], prince's plume [*Stanleya pinnata*], woodyaster [*Xylorhiza glabriuscula*]). The presence of invasive species alone normally would not indicate an LRP area; however, some invasive species are halophytes and are indicative of unsuitable soil. Cushion plant, mountain shrub, silver sagebrush (*Artemisia cana*), spiny hopsage (*Grayia spinosa*), or alkali sage communities may also be indicative of LRP areas. Many of these plants do not have seed available commercially, and also have narrow site parameters for seedling establishment and growth. Plants growing on very shallow, saline upland, saline lowland, sands, clayey, shallow clayey, impervious clay, shallow igneous, or badland ecological sites also do not have seed available commercially, and have poor soil characteristics for seedling establishment and growth.

3.0 SURFACE-DISTURBING ACTIVITIES

Components of surface-disturbing activities will be described in the site-specific POD for each stage of construction. Construction planning will provide a description of the extent of the Project area covered by the site-specific reclamation plan. Pre-disturbance assessments will provide the baseline information needed for construction planning. Waste material management will follow measures outlined in the Project Waste Management Plan. Sources

of contamination will be controlled and BMPs will be implemented to protect surface water and groundwater quality.

3.1 CONSTRUCTION PLANNING

Upon final Project design, site-specific PODs will be completed to include a facility layout, location and detail of surface-disturbing activities, and design documentation. This information will be used to determine specific reclamation techniques and reclamation timing for different construction elements and locations. Project construction will take place over a four to five-year period and a staged approach will be implemented. Each surface-disturbing activity will be assigned to a construction stage and total surface disturbance acres will be calculated for each stage of construction. Based on the level of disturbance and site-specific reclamation standards, a monitoring schedule will be determined for each surface-disturbing activity. A site-specific reclamation plan will be developed for each site-specific POD and monitoring will begin immediately following construction with soil stabilization followed by interim reclamation. The site-specific POD will provide detailed descriptions of the Project components described in the following subsections.

3.1.1 Facility Layout

New facilities for the Project include the rail distribution facility and staging area, operation and maintenance (O&M) facility, substations, batch plants, water extraction sites, turbines, roads, and above- and below-ground electrical lines. Each facility will have long-term (i.e., life of the Project) and temporary disturbance footprints. Soil stabilization measures and weed control will be implemented for temporary disturbances at each facility.

The site-specific POD will include the Project roadway system and design. The roadway system and design will allow active monitoring of interim and final reclamation.

3.1.2 Design Documentation

The site-specific POD will include design documentation of each surface disturbing activity. The documentation will include shapefiles delineating the total disturbance area (i.e., footprint), permanent disturbance area (i.e., life of the Project), short-term disturbance area, and proposed infrastructure locations. Delineated disturbance areas will include attributes describing the level of disturbance (i.e., permanent versus temporary, vegetation treatment, and topsoil treatment) and an initial soil stabilization plan. Each surface-disturbing activity that is removing and relocating topsoil will identify and delineate a stockpile location within or adjacent to the disturbance footprint.

3.2 WASTE MATERIAL MANAGEMENT

The BLM Wyoming Reclamation Policy (2009) requires that all waste materials are managed through the segregation, treatment, and/or bio-remediation of contaminated soil material; by burying only authorized waste materials on site; and ensuring that all waste materials moved off-site are transported to an authorized disposal facility. Waste disposal concerns for the Project will be specifically addressed in the Waste Management Plan.

3.2.1 Handling of Contaminated Soil Material

Contaminated soils can be defined as any soils that are subjected to a foreign substance that modifies the chemical properties of soils to the extent that vegetation re-establishment is not achievable within a reasonable amount of time following Project implementation. All contaminated soils will be transported, managed, and disposed of according to procedures outlined in the Waste Management Plan and Storm Water Pollution Prevention Plan (SWPPP).

3.2.2 Disposal of Waste Materials

The construction contractor will keep all hazardous, non-hazardous, special, and general trash wastes separate and will not mix waste streams. Hazardous material will be managed and disposed of as determined by the Project POD and Waste Management Plan.

It is anticipated that any excess material from subsurface excavations will be incorporated back into the disturbed landscape; however, if excess or unsuitable materials are generated they will be properly disposed of in accordance with the Waste Management Plan at the location designated in each site-specific POD.

3.3 SUBSURFACE INTEGRITY

The BLM Wyoming Reclamation Policy (2009) requires that subsurface integrity is maintained and that sources of groundwater and surface water contamination are eliminated by properly plugging subsurface openings; stabilizing and properly backfilling underground workings; and controlling sources of contamination by implementing BMPs to protect groundwater and surface water quality.

Subsurface openings and underground workings associated with the development will be described in the site-specific POD. Any subsurface openings related to water wells will be developed and plugged per industry standards. Underground workings for infrastructure such as collection lines, cathodic protection, and other infrastructure will be trenched and backfilled with the same excavated material or appropriately engineered backfill materials in a reverse method from which it was excavated. Backfilled material will be compacted to Project design standards with topsoil salvage and redistribution per predetermined depths. Drainages and other water body crossings will be evaluated at the time of Project planning and construction to determine appropriate subsurface BMPs to be implemented at water crossings. Trench breakers made from sand bags or prefabricated concrete bags may be used at the outer extents of wetlands and drainage crossings to minimize the potential for any ‘French drain’ effect or inadvertent subsurface drainage of water bodies. Trench breakers may also be used to prevent ‘piping’ or lateral subsurface water movement along trenched gathering lines in areas where collecting lines parallel water bodies and stream courses.

3.3.1 Stabilization

Subsurface stabilization will include compaction of redistributed subsoils to Project design standards as identified in each site-specific POD.

3.3.2 Water Quality

Water quality will be maintained during surface-disturbing activities using BMPs and engineering controls identified in the site-specific POD, SWPPP, and in compliance with the Clean Water Act (CWA).

4.0 SOIL MANAGEMENT

Soil is constantly being weathered through biological processes, which develop the structure and function essential to sustaining vegetation communities and providing wildlife habitat. Thus, maintaining soil structure and function is critical for successful reclamation efforts. During surface-disturbing activities, topsoil will be separated and handled differently than other soil layers, and topsoil will be salvaged during construction for use in site preparation to support future reclamation efforts. Components of soil management include soil handling, landscape reconstruction, and surface runoff and erosion control. The BLM hydrologist and soil scientist will be consulted to determine if a drainage is large enough or important enough to require additional site-specific soil management procedures. Soils on public lands will be managed with approved measures. While the preference will be to use these management practices on private lands and state lands, specific soil management practices on private lands and state lands may vary and will be developed in coordination with private landowners, the State Land Board or WGFC as appropriate.

4.1 SOIL HANDLING

A critical component of reclamation is to maintain the biological, chemical, and physical integrity of the soil resource by establishing a series of guidelines for the proper handling of topsoil and subsoil. For each surface-disturbing activity, topsoil, and in some instances subsoil, will be salvaged from surface disturbance activities and stockpiled. Proper salvaging techniques involve delineating soil type and determining soil depth. Components of soil handling will include the identification, erosion protection, placement, and incorporation of salvaged soil stockpiles. The BLM Wyoming Reclamation Policy (2009) requires that all topsoil and appropriate subsoil be properly maintained through clearly identifying, delineating, and segregating all salvaged topsoil and subsoil based on a site-specific soil evaluation, including depth, chemical, and physical properties; by protecting all stored material from erosion, degradation, and contamination, and seeding soils to be stored more than one growing season with desirable native vegetation; placing soils in the appropriately identified locations and providing the necessary signage for identifying stockpiles; and incorporating stored soil material back into the disturbed landscape.

4.1.1 Maintain Biological, Chemical, and Physical Integrity

Maintaining and restoring the biological, chemical, and physical characteristics is necessary to meet reclamation success standards and maintain healthy rangelands. During all surface-disturbing activities, topsoil will be identified and salvaged separately from spoil and stockpiled to support future reclamation efforts. Suitable topsoil typically has physical and chemical properties that promote vegetation growth, rather than inhibit vegetation establishment. Suitable topsoil typically is a well-developed, non-shallow soil with neutral

soil pH, low salt content, low to moderate SAR, and loamy texture. Sandy or clayey soils with very little biological activity, no topsoil or very shallow topsoil (less than 3 inches), high alkalinity and/or salinity, or elevated SAR (greater than 13) should be avoided. Abiotic crusts, well-developed cryptobiotic crusts, and soils with high coarse fragment content should also be identified as poor topsoil conditions.

4.1.1.1 Salvaging

Prior to all surface-disturbing activities, topsoil potential will be evaluated and salvage depth determined during pre-construction site characterization. Additional soil physical and chemical characteristics will be evaluated during ecological site delineations. If the ecological site and soil salvage depth cannot be identified from the pre-construction site characterization, additional soil pits and rapid soil tests will be necessary to evaluate site-specific topsoil conditions.

Salvage depth diagrams developed from pre-construction site characteristics will be used to determine the appropriate surface soil material salvage depth. When separating soil by horizon, segregation will occur based upon horizon diagnostics and noted changes in physical indicators (e.g., color, texture, structure, etc.) using a soil pit.

4.1.1.2 Stockpiling

Stored soil material (i.e., stockpiles) will be incorporated into the disturbed landscape. During construction planning and topsoil salvage potential evaluation (i.e., evaluation of soil depth map and ecological sites), the amount of salvaged soil will be calculated and stockpile locations identified within the disturbance footprint. Preliminary evaluations during construction planning and surface disturbance geographic information system (GIS) files will include identified stockpile locations (see 3.1 Construction Planning). Alternatively, stockpile locations within the disturbed area will be determined following site-specific salvage depth evaluations and topsoil volume calculations. Placement of stockpiles will be planned to minimize disturbance during interim and final reclamation. Topsoil stockpiles for linear features (e.g., roads, gathering lines, etc.) will be stored adjacent to the disturbed area on native soil and seeded with the approved seed mixture.

Stored soil material will be protected from erosion, degradation, and contamination. Soil stabilization will be implemented as soon as practicable on all topsoil and spoil stockpiles. Vegetation will be salvaged and stockpiled along with topsoil to provide erosion protection, maintain natural inocula, and incorporate native seeds and organic matter. Additional mulching and natural tackifiers may be used to protect exposed stockpile surfaces. Stockpiles to be stored beyond one growing season will be seeded with a site-specific seed mixture. The seed mixture will be determined from the ecological site. Seeding stockpiles with an approved and appropriately designed seed mixture (i.e., designed with locally adapted plant species unique to the specific ecological site and biophysical conditions) presents a unique opportunity to predetermine the compatibility and establishment success rate of the site-specific seed mixture.

Topsoil and spoil stockpiles will be designed to minimize the surface area occupied and will be constructed to maintain geomorphic stability until they are used for reclamation. Spoil will

be salvaged and stockpiled separately from topsoil. All stockpiles will be located so as not to affect existing drainages. In some cases, a disturbed area may cover more than one ecological site and topsoil from each ecological site will be segregated. Topsoil and spoil stockpiles will be clearly marked and noted on site maps. Topsoil attributes and unique identifiers will be included with all shapefiles, and each stockpile will be identified with the necessary signage. Whenever possible, topsoil will be used immediately and not stockpiled for future use. Stockpiles will be seeded with desired vegetation after one growing season and piles left for more than two years will be no deeper than 2 feet, including the native topsoil underneath.

4.1.1.3 Timing of Construction

The site-specific PODs will provide a detailed construction schedule consistent with BLM terms and conditions of approval for the Project.

4.2 LANDSCAPE RECONSTRUCTION AND EROSION CONTROL

Surface runoff and erosion control in areas exposed to surface-disturbing activities will be accomplished by reconstructing the landscape and maintaining soil stability. The BLM Wyoming Reclamation Policy (2009) requires that a complementary visual composition is re-established; the landscape is reconstructed to the approximate original contour and consistent with the land use plan, such that highwalls, cut slopes, and/or topographic depressions are eliminated; and that sheet and rill erosion on or adjacent to the reclaimed area is minimized. The landscape will be reconstructed to achieve a desired topography, slope stability, and surface stability. Water courses and drainage features will be reconstructed, where applicable, to maintain the drainage pattern, profile, and dimension to approximate the natural features and pre-disturbance hydrologic characteristics. The BLM hydrologist and soil scientist will be consulted to determine if a drainage is large enough or important enough to require additional site-specific reclamation procedures. Slope stability will be controlled by implementing erosion control measures and BMPs per the Erosion Control Plan to minimize sheet and rill erosion. Surface stability will be controlled by maintaining the physical properties of the soil and by treating compacted surfaces with appropriate technologies. For private and state lands, landscape reconstruction and erosion control activities will be completed in adherence with appropriate regulatory requirements and while the preference will be to use these standards on private lands and state lands, specific standards on private lands and state lands may vary and will be developed in coordination with private landowners, the State Land Board or WGFC as appropriate.

4.2.1 Landscape Reconstruction

Site stability will be re-established following landscape reconstruction to the approximate original contour by maximizing the geomorphic stability and topographic diversity of the reclaimed landscape (BLM 2009). Re-establishing the complementary visual composition of a disturbed area will ensure that the reclaimed area does not result in a long-term change to the scenic quality of the overall landscape. This includes recontouring the disturbed area to be consistent with the land use plan and to provide a natural landscape capable of supporting viable populations and a diversity of native plant and wildlife habitat (BLM 2008).

4.2.1.1 Topography/Recontouring

Landscape reconstruction will restore the disturbed area back to its approximate original landscape by recreating the physical characteristics that approximate the visual quality of adjacent areas with regard to location, scale, contour, color, and orientation of major landscape features.

Recontouring will be accomplished through backfilling, grading, and site stabilization. Areas to be backfilled include wind turbine pads, cut slopes, collector line trenches, roadside borrow ditches, and facility foundations. Gathering line trenches will be backfilled so that the soil berm is less than 3 inches high. In most cases, dozers, loaders, scrapers, and motor graders are typically used for backfilling and grading. Spoil for backfill will be obtained from fill material and spoil stockpiles.

4.2.1.2 Stream Channels/Drainages

Temporary stream and drainage crossings, along with associated riparian areas, will be restored to approximate pre-construction conditions following disturbances. Disturbances will be minimized and restored as quickly as feasible. Linear construction disturbances will be narrowed to the minimum width necessary to develop the Project. Temporary culvert placement will be required for live and flowing streams to maintain down-gradient water quality. All topsoils in drainages will be salvaged to predetermined depths for surface redistribution following development. Topsoil salvage in wetlands will be segregated and redistributed by wetland zone as applicable. Following development, channels and swale slopes will be recontoured to allow for unrestricted surface flows with a gradient that matches adjacent undisturbed areas. Embankment slopes will be recontoured to match adjacent undisturbed slopes on either side of the disturbance. In the event that sheer vertical embankments occur, recontouring and restoration will be addressed on a site-specific basis.

4.2.2 Soil Stabilization and Erosion Protection

Erosion control measures will be implemented to avoid, minimize, or mitigate effects from surface-disturbing activities and restore the landscape back to a natural state. Erosion control measures will be installed prior to and immediately following surface-disturbing activities. Initial stabilization measures will be used to control surface runoff and erosion and to ensure biophysical conditions are maintained until long-term reclamation can be initiated. Long-term erosion control measures will be established at two stages of reclamation—interim reclamation and final reclamation—with an overriding goal of revegetation and ecosystem reconstruction.

Immediately following surface-disturbing activities, temporary runoff and erosion control measures will be implemented where necessary to ensure soil stabilization. Applications will include mulching and netting of biodegradable blankets stapled firmly to the soil surface, applying sediment control, respreading scalped vegetation, and constructing water bars, diversion ditches, sediment fences, and energy dissipaters. Road right-of-ways and gathering lines will require stabilization on both sides of drainage channels and will be determined on site-specific evaluations. Following construction and soil stabilization, long-term measures will be applied to further stabilize disturbed areas and control surface runoff and erosion to

meet reclamation standards. Erosion and sedimentation control measures and structures will be installed across all cut-and-fill slopes. Surface runoff and sedimentation control measures will be established by constructing sediment trapping devices and water bars, as well as by timely mulching and revegetation of exposed disturbed areas. Runoff discharged from water bars will be redirected into undisturbed vegetation and away from all natural drainages. Silt fences or other sediment filtering devices will be installed at the inside edge of proposed surface disturbances. Trench breakers will be used to prevent the flow of water into trenches that have been backfilled or temporarily left open. Trench breakers will not be constructed from topsoil but rather from spoil. All runoff and erosion control structures will be inspected and maintained per the SWPPP and Environmental Compliance Plan; additional inspections will be completed following large runoff events (i.e., spring snowmelt runoff, large precipitation events, etc.). Substandard or ineffective structures will be cleaned out and maintained until the desired vegetation is established and soil stability is attained at the reclaimed area.

Interim reclamation is necessary to maintain viable, healthy ecosystems until decommissioning. Basic reclamation standards include maintaining active topsoil, establishing erosion control measures, and minimizing habitat, visual, and forage loss following surface-disturbing activities. Interim reclamation may be necessary on previously reclaimed areas in the event of redisturbance following unforeseen maintenance needs and requirements. Final reclamation will take place on surfaces that will not be disturbed during operations and maintenance activities, and during decommissioning of the Project to reconstruct the landscape, meet objectives of the land use plan, and provide healthy habitat and rangelands. Infrastructure, debris, equipment, and contaminated soils will be removed from all facilities and wind turbine pads and the landscape will be re-established to a self-sustaining state, including hydrologic systems, visual resources, and stable vegetative and wildlife communities. The BLM will determine when long-term (interim or final) reclamation success standards are met on public lands.

4.2.2.1 Slope Stability

Turnouts, water ditches, and water bars may be constructed across side slopes at periodic intervals according to slope gradient along recontoured and disturbed slopes. The spacing will depend on soil particle cohesiveness and whether mulching, soil binder, or tackifier is applied in conjunction with placement of water bars during earthwork reclamations. Water bars will be seeded per predetermined prescriptions and repaired as needed throughout the life of the Project or until final reclamation measures are deemed successful.

Minimize Erosion and Mass Wasting

Administrative BMPs and project planning will be used to avoid and minimize surface disturbances in LRP sites as practicable. Structural BMPs implemented during Project development will further reduce the potential for erosion. The Project SWPPP and Project Watershed Monitoring Plan will further assist in identifying erosion problems until the Project reaches success criteria outlined in the interim and final reclamation measures and the Project SWPPP.

Drainage Structures
Drainage control structures may include both temporary and more permanent features. Temporary drainage control structures include check dams, sediment traps, temporary culverts, and rip rap, or structures associated with a surface water discharge point. These structures will be maintained during development and removed during various stages of construction and reclamation. More permanent drainage control structures include culverts and rip-rap associated with roads, substations, and other Project infrastructure. Temporary structures will be implemented and managed per the Project SWPPP, Erosion Control Plan and POD. Structures placed in jurisdictional waters of the U.S. will be installed and reclaimed in compliance with Section 404 of the CWA including any regional, general, and special conditions included with applicable authorizations.

4.2.2.2 Surface Stability

Re-establishing the surface stability at disturbed sites is critical to providing a soil profile in which plant roots have the adequate pore space to grow and penetrate subsoil horizons. Compaction eliminates natural pore spaces by removing air and destroying soil aggregates, which does not allow the movement of air, water, microbes, and nutrients throughout the soil. Compacted soils are often impenetrable and increase surface runoff and erosion potential. Soils susceptible to compaction and associated ecological sites will be identified during pre-disturbance site characterization. Prior to reclamation, susceptible soils will be tested to determine the level of compaction and highly compacted areas will be identified.

Compaction Testing
Soil compaction takes place below the surface making it difficult to detect. Compaction will be tested for all road and facility disturbances and in additional disturbed areas where soil is more susceptible to compaction. Soil compaction will be tested at appropriate depths depending on soil type and depth.

Ripping and Aeration
Compacted areas such as roads and wind turbine pads will be addressed using appropriate methods such as ripping, aeration, discing or harrowing to improve soil aeration, water infiltration, and root penetration. Decompaction will be necessary for all roads and facilities; however, this measure will not be necessary for all surface disturbance activities. Compaction testing of susceptible soils will be completed at the site-specific level to determine decompaction requirements. Surface roughening procedures (e.g., pitting and gouging) will be applied, as necessary, to promote soil air flow and concentrate water into pits and gouges.

Motor graders or tractors equipped with ripping shanks are typically used for ripping. Ripper shanks will be set approximately 1 to 2 feet apart Discing and harrowing are typically accomplished using a tractor-drawn disc or harrow. Discs are typically set 2 to 6 inches deep. Ripped areas will be disced, if necessary, to fill in deep furrows (where topsoil would be lost) and break up large clods (to which topsoil would not adhere). .

Moisture Content
Mulching of decompacted surfaces will promote moisture capture while providing additional protection from erosion. Decompacted surfaces will be mulched with certified weed-free native grass, hay, small grain straw, wood straw, and/or live mulch. Alternatively, cotton, jute,

or synthetic netting may be applied. Mulch will be crimped into the soil, tackified, or incorporated into erosion control blankets to prevent it from blowing or washing away and from entering waterways. If the soils are sandy, snow fencing may be necessary to trap additional moisture. On steep slopes where it is unsafe to operate equipment, at sites where soils have greater than 35 percent surface fragment content, or on notably unstable areas, hydromulch, biodegradable erosion control netting, or matting will be firmly attached to the soil surface.

5.0 SITE PREPARATION AND REVEGETATION

Site preparation restores the disturbed area back to the original landscape by recreating the physical characteristics that approximate the landscape features of adjacent areas and pre-disturbance conditions. Disturbed areas on public lands will be reseeded in adherence with BLM-approved measures and seed mixtures. The BLM hydrologist and soil scientist will be consulted to determine if a drainage is large enough or important enough to require additional site-specific preparation and revegetation procedures. While the preference will be to use these standards on private lands and state lands, specific standards on private lands and state lands may vary and will be developed in coordination with private landowners, the State Land Board or WGFC as appropriate. Components of site preparation and revegetation include landscape reconstruction, site preparation for vegetation, and native plant community establishment.

5.1 SOIL MATERIALS

The long-term establishment and viability of the desired plant community is dependent upon providing adequate surface and subsurface properties (BLM 2009). Seedbed preparation maximizes seeding efficiency, improves reclamation success and includes topsoil replacement, discing, and surface roughening techniques. Soil conditioning and amendments may be necessary to ameliorate poor topsoil and subsoil quality. While the preference will be to use these standards on private lands and state lands, specific standards (including the need for soil conditioning and amendments) on private lands and state lands may vary and will be developed in coordination with private landowners, the State Land Board, or WGFC as appropriate.

The BLM Wyoming Reclamation Policy (2009) requires that each reclamation site is adequately prepared for revegetation by using the proper soil handling techniques, by re-establishing the original vertical profile, and by implementing the necessary BMPs to ensure seed protection and successful seedling establishment. Appropriate erosion control devices will be installed on reclaimed areas prior to topsoil replacement, as necessary. Compacted areas will be treated with the most appropriate methods and technologies to improve soil aeration, water infiltration, and root penetration (see 4.2.2.2 Surface Stability). Compaction will be reduced to below the root zone (i.e., 18–24 inches below the surface) prior to topsoil redistribution to promote the establishment of desired plant species.

5.1.1 Re-establish Chemical, Physical, and Biological Properties

Soil materials will be redistributed in a manner to preserve the chemical, physical, and biological properties similar to the original soil profile. Topsoil is typically replaced using scrapers, dozers, and/or motorgraders. If multiple topsoils were stockpiled, stockpiles will be marked with stakes and flagging and the correct topsoil will be redistributed to the appropriate depth according to the ecological site. If the stockpile for a given location contains insufficient topsoil to for redistribution, topsoil will be mixed with suitable spoil or imported from another stockpile with similar properties (i.e., same ecological site). Topsoil will not be replaced on contaminated material—all contaminated material will be removed or otherwise handled in accordance with the Waste Management Plan.

5.1.2 Compaction

After topsoil replacement, compacted soils will be addressed using appropriate methods such as discing, harrowing, ripping or aeration to reduce soil compaction, break up soil clods, improve root and water penetration, and provide a friable but firm seedbed. The surface will be roughened to reduce wind and water erosion and promote moisture capture. If the surface is roughened during decompaction, other moisture-capture techniques may not be necessary.

5.1.3 Protect Seeding Surface

Mulching will be necessary in reclaimed areas where surface roughening is not adequately reducing wind and water erosion or promoting moisture capture. Mulch incorporates organic matter and protects the soil surface from wind and water erosion and raindrop impact while also providing a sufficient seedbed to hold seeds in place and protect seedlings (see 4.2.2.2 Surface Stability). Reclaimed areas will be uniformly mulched with certified weed-free native grass, hay, small grain straw, wood straw, and/or live mulch at a rate sufficient to maintain appropriate cover.

5.2 ESTABLISH DESIRED PLANT COMMUNITY

The primary objective of revegetation is to establish the species composition, diversity, structure, and total ground cover appropriate for the desired plant community (BLM 2009). Proper seeding mixtures will be used to reclaim disturbed areas on public lands with native vegetation. According to established criteria, the seed mixture selection process for public lands will consider BLM pick lists, seed availability and price, growth form, seasonal variety, and prevailing dominant species. While the preference will be to use these seed mixtures on private lands and state lands, specific seed mixtures on private lands and state lands may vary and will be developed in coordination with private landowners, the State Land Board or WGFC as appropriate to meet specific land use objectives. To increase the likelihood of successful reclamation, locally adapted native plant materials will be selected based on the site characteristics and ecological setting (i.e., the pre-disturbance site characterization)when possible. The BLM Wyoming Reclamation Policy (2009) requires that a desired self-perpetuating native plant community is established by providing the species composition, diversity, structure, and total ground cover appropriate for the desired plant community; enhancing critical resource values (e.g., wildlife, range, recreation, etc.) by augmenting plant community characteristics, where appropriate; selecting genetically appropriate native plant

materials; and using non-native plants to aid in the re-establishment of native plant communities only as an approved short-term and non-persistent alternative to native plant materials.

5.2.1 Seeding

Seeding will be implemented during all stages of development depending on initial or long-term reclamation objectives. Initial seeding will be used to achieve temporary vegetation coverage or stabilization for soil stockpiles, or until interim or final reclamation measures can be conducted. Longer term reclamation measures will include seeding following the redistribution of soils to the original vertical profiles, compaction evaluations, mulching and amendment additions, soil roughening with other BMPs, and other reclamation measures identified in the POD, Erosion Control Plan and Project SWPPP for a particular area.

5.2.1.1 Designing a Seed Mixture

Seed mixtures will be tailored to establish species diversity, composition, and ground cover appropriate for each desired plant community. Only approved, certified weed-free seeds will be used. Based on established criteria, the seed mixture selection process will consider commercial availability and price, growth form, seasonal variety, and prevailing dominant and locally adapted species. The BLM must approve the specific seed mixture for each reclamation prescription on public lands. Seed mixtures for private and state lands will be developed in coordination with private landowners, the State Land Board, or WGFC as appropriate to meet specific land management objectives. The seed mixture will contain the following elements.

- Species composition and diversity for the desired plant community, ecological setting, and current soil properties.
- Native dominant herbaceous species that support or augment the post-disturbance land uses, including species-specific wildlife habitat, rangelands, and other public uses.
- Full shrub and/or sub-shrub species when these species will help achieve reclamation objectives while supporting post-disturbance land uses and/or wildlife habitat needs.
- Native forb species or other BLM, State Land Board, WGFC, or landowner-approved plant species, as appropriate for management objectives.

5.2.1.2 Seed Banking/Seed Collection

Seed banking and onsite seed collection will only be considered if native and locally adapted seed sources are not available.

5.2.1.3 Selecting Seed

Seed selections will be based on ecological sites, reclamation objectives, and post-disturbance land uses. Seed mixtures will then be further refined based on immediate soil management, wildlife, or rangeland needs. Basic seed mixtures per general ecological site have been developed for ecological sites in the RFO and will form the basis for seed mixtures throughout the Project. Final seed mixtures will be developed based on the following criteria: general conditions within the ecological site; species adaptations to site conditions;

commercial availability and cost; usefulness of the species for rapid site stabilization; species success in past revegetation efforts; and compliance with Executive Order 13112 and BLM Manual 1745 (i.e., use of native species) (BLM 1992). The use of non-native species on public lands will only be considered based on the documented failure to revegetate any area with native species.

5.2.1.4 Seeding Rates

Seeding rates will vary by application method, reclamation objective, desired plant community, and more immediate wildlife needs. Typically, broadcast seeding may require two to three times the amount of seed as drill seeding to achieve similar results. Reclamation areas around specific wildlife habitats or environmentally sensitive areas may require quicker establishment of vegetation for erosion control and may necessitate higher seeding rates.

5.2.1.5 Seed Timing

In general, the timing of seeding will follow final earthwork and grading associated with each stage of development and during the reclamation stages. Temporary coverage seeding will take place immediately following initial disturbances to stabilize soils. Permanent seeding measures will take place within the most optimal times of seeding., Seeding timing will consider elevation, annual rainfall, reclamation and storm water management needs, and land use management objectives. All seeding measures will use guidance provided by storm water inspections.

5.2.1.6 Seeding Techniques

There are a variety of techniques and methods for the application of seed depending on specific site conditions and objectives. Drill seeding or other similar planting methods will be primarily used where the terrain is accessible by equipment and cost effective. A drill equipped with depth bands, a seed agitator, and packer wheels will be used to ensure optimum seed placement and soil contact during drill seeding. Planting depths will vary, but will typically be between ¼ to ½ inch below the surface. Rice hulls or other benign material will be added as necessary to ensure even distribution in drill rows. Drill seeding equipment will be calibrated to distribution rates specific to each seed mixture. Shrub seeding will be conducted separately from herbaceous species seeding along separate drill rows to minimize competition from faster growing herbaceous species. In some areas cross drill seeding or overlapping patterns may be used to mimic more natural areas or further protect a particular site from erosion forces.

Broadcast seeding will be used when drill techniques are not feasible due to slopes, substrate, access, and cost effectiveness. Broadcast seeding will occur on a roughened seedbed and then will be lightly harrowed, chained, or raked to cover the seed. The seeding rate for broadcast seeding will be a minimum of double the recommended rate of the mixtures developed for drill seeding. The broadcast seeder will be properly calibrated based on recommended mixture rates. Hand broadcast seeding will occur in smaller areas, on steep slopes, or on substrates that are not capable of supporting seeding equipment causing excessive tire or tread ruts. Slopes in excess of 2:1 will be hand broadcast and hand raked as feasible.

6.0 WEED MANAGEMENT

Noxious, non-native, and invasive weed control will occur for Project activities for the life of the Project. The BLM Wyoming Reclamation Policy (2009) requires that noxious and invasive plant species are actively managed on public lands by assessing pre-existing weed occurrences before initiating any surface-disturbing activities; developing a weed management plan; controlling noxious and invasive weeds by implementing an integrated management approach; and monitoring treatments and weed populations. Weed control measures will be in accordance with the Project Weed Management Plan and will be developed in cooperation with private landowners, the State Land Board, or WGFC as appropriate to meet specific land use standards.

Weed management is a cooperative effort between the surface landowner and BLM. Noxious and invasive weeds are controlled annually using herbicides. Several weed species have been identified in or immediately adjacent to the Project area (BLM 2001). Four weed species have been identified as needing management: perennial pepperweed (*Lepidium latifolium*), halogeton (*Halogeton glomeratus*), Russian knapweed (*Centaurea repens*), and tamarisk (*Tamarix pentandra*) (BLM 2001).

The presence, distribution, and density of noxious/invasive weeds in the Project will be assessed and monitored prior to and during construction activities. A weed control plan will be developed and will accompany the site specific POD for each stage of the Project. It will include the following elements.

- Coordination with the BLM to determine priorities for weed management.
- Methods for minimizing the spread of invasive plants, such as
    - minimization of surface disturbance when possible to reduce the potential area for noxious and invasive weed establishment;
    - an integrated management approach for controlling invasive plants.
- Techniques for monitoring invasive plant occurrences and treatments.

7.0 RECLAMATION MONITORING

The BLM Wyoming Reclamation Policy (2009) requires that a reclamation monitoring and reporting plan be developed and implemented by conducting compliance and effectiveness monitoring in accordance with a BLM-approved monitoring protocol; evaluating monitoring data for compliance with the Reclamation Plan; documenting and reporting monitoring data and recommending revised reclamation strategies; implementing revised reclamation strategies as needed; and repeating the process of monitoring, evaluating, documenting, reporting, and implementing until reclamation goals are achieved. Performance monitoring is required to evaluate reclamation progress to determine the potential for success and if remediation is required. Reclamation success will be based on the objectives specified in Section 1.2.

The Project reclamation monitoring protocol will be developed with four primary objectives: 1) to document the condition of reclaimed areas relative to the adjacent undisturbed reference

sites; 2) to provide an expeditious means for monitoring all reclamation sites to document reclamation progress; 3) to standardize monitoring protocols across the Project and incorporate digital data-tracking and database development; and 4) to establish a monitoring plan for managing bond release.

7.1 MONITORING PARAMETERS

Reclamation monitoring will occur annually in accordance with BLM requirements. Vegetation will be evaluated against reclamation success standards (Section 1.2) and the reference sites established during pre-disturbance planning. In addition, erosional assessments and photopoints will be completed to support reclamation monitoring efforts.

7.2 COMPLIANCE

A data dictionary has been developed by the BLM RFO to track monitoring parameters. An annual monitoring report will be submitted to the BLM RFO March 1 of each year and will include the following.

- Geo-referenced database.
- A minimum of three GIS shapefiles:
    - Type 1 "Surface Disturbance" includes all "as-built disturbance," interim/final reclamation, and long-term disturbance data (annual submittals are dependent upon surface disturbance and reclamation occurring during each monitoring year).
    - Type 2 "Ecological Sites" include polygons for ecological site information mapped to the as-built. (This will only be submitted during the first annual report.)
    - Type 3 "Weed Infestations" include polygons for weed infestations associated with disturbance.
- Digital photographs.
- Reference site attributes.
- Interpretation of monitoring data.

The application of GPS, GIS, and digital data-tracking during reclamation and monitoring activities allows for in-depth knowledge of disturbance site conditions and will facilitate more informed and targeted remediation actions. By incorporating standardized monitoring protocols and a universal data dictionary, the information can be used to establish a field-wide, geo-referenced database with immediate access to disturbance acres, reclamation status, and monitoring history. In addition, this information provides the BLM with a reclamation history perspective to evaluate reclamation success and expedite future reclamation activities.

The monitoring approach is designed to allow reclamation inspectors a standardized tool for evaluating reclamation status throughout the Project and is to be used to make informed decisions on what actions are needed to obtain field-wide reclamation success. These

decisions may range from a high-level action such as revising the reclamation plans to a simple remedial action such as installing a silt fence. The record will be essential to tracking reclamation progress and initiating appropriate remedial actions for the life of the Project.

7.3 IDENTIFY ADDITIONAL RECLAMATION

The BLM will provide a determination as to whether or not reclamation assessments are accurate and success standards are being met. Monitoring reclamation success on private lands and state lands will be coordinated with private landowners, the State Land Board, or WGFC as appropriate to meet specific land use standards. If necessary, the BLM will provide input on remedial actions to facilitate reclamation success. Administrative BMPs may include reseeding non-attainment areas, soil stabilization and amendments, weed control, mulching, and irrigation.

8.0 REFERENCES

Bureau of Land Management (BLM). 1980. Erosion Condition Classification System. U.S. Department of the Interior, Bureau of Land Management. Tech Note #346.

———. 1992. Introduction, Transplant, Augmentation, and Reestablishment of Fish, Wildlife, and Plants, BLM Manual 1745. U.S. Department of the Interior, Bureau of Land Management. March 1992.

———. 1997. Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming. U.S. Department of the Interior, Bureau of Land Management, Cheyenne, Wyoming. Available online at http://www.blm.gov/wy/st/en/programs/grazing/standards_and_guidelines.html. Accessed January 2011.

———. 2001. Renewal of Grazing Permit and Allotment Management Plan. EA WY-030-EA1-092. Bolten and Pine Grove Allotments. The Overland Trail Cattle Company.

———. 2008. Proposed Resource Management Plan and Final Environmental Impact Statement. U.S. Department of the Interior, Bureau of Land Management, Rawlins Field Office, Rawlins, Wyoming. Available online at http://www.blm.gov/wy/st/en/programs/Planning/rmps/rawlins/feis_prmp.html. Accessed January 2011.

———. 2009. Wyoming Reclamation Policy. Cheyenne, Wyoming: U.S. Department of the Interior, Bureau of Land Management, Wyoming State Office. Instruction Memorandum No. WY-2009-022. Available online at http://www.blm.gov/pgdata/etc/medialib/blm/wy/resources/efoia/IMs/2009.Par.54664.File.dat/wy2009-22.pdf. Accessed January 2011.

———. 2011. Rawlins Field Office Reclamation Guidance. Rawlins, Wyoming: U.S. Department of the Interior, Bureau of Land Management, High Desert District, Rawlins Field Office. Instruction Memorandum No. WYD-03-2011-002. Available online at http://www.blm.gov/pgdata/etc/medialib/blm/wy/field-offices/rawlins/reclamation.Par.0096.File.dat/im-wyd-03-2011-002.pdf. Accessed March 2011.

Moseley, K., P.L. Shaver, H. Sanchez, and B.T. Bestelmeyer. 2010. Ecological site development: a gentle introduction. Rangelands 32(6):16–22.

U.S. Department of Agriculture, Agricultural Research Station (ARS). 2011. Ecological Site Description Introduction. U.S. Department of Agriculture, Agricultural Research Station, Jornada Experimental Range. Available online at http://usda-ars.nmsu.edu/esdIntro.html. Accessed February 2011.

U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS). 2003. Ecological Site Description (ESD) System for Rangeland and Forestland Data. Updated January 26, 2004. U.S. Department of Agriculture, Natural Resources Conservation

Service. Available online at http://esis.sc.egov.usda.gov/Welcome/pgReportLocation.aspx?type=ESD. Accessed January 2011.

Wyoming Department of Environmental Quality (WDEQ). 2007. Land Quality Division Reclamation Guidelines. Available online at http://deq.state.wy.us/lqd/guidelines.asp. Accessed January 2011.

Appendix F. Watershed Monitoring Plan

Chokecherry and Sierra Madre Wind Energy Project

Watershed Monitoring Plan

Prepared for

555 Seventeenth Street
Suite 2400
Denver, CO 80202

Prepared by

SWCA Environmental Consultants
295 Interlocken Blvd., Suite 300
Broomfield, CO 80021
(303) 487-1183 / Fax (303) 487-1245
www.swca.com

November 2011

TABLE OF CONTENTS

Page

1.0 Introduction 1
2.0 Previous and Ongoing Surveying Efforts 1
3.0 Watershed Monitoring Activities 3
3.1 Channel and Streambed Monitoring 3
3.1.1 Perennial Streams 4
3.1.2 Ephemeral Streams 4
3.2 Greenline Monitoring 4
3.3 Streamflow 4
3.4 Water Quality Monitoring 4
3.5 Photo documentation 5
4.0 Coordinated Management 5
5.0 References 5

1.0 INTRODUCTION

This Watershed Monitoring Plan (Plan) for Power Company of Wyoming's (PCW) Chokecherry and Sierra Madre Wind Energy Project (Project) provides an overview of methods that will be used to supplement existing data and better characterize pre-construction and post-construction watershed conditions. Efforts described in this plan will be closely coordinated with the efforts associated with the Project's Master Reclamation Plan (MRP), Stormwater Pollution Prevention Plan (SWPPP), and other ongoing monitoring efforts being completed by the Bureau of Land Management Rawlins Field Office (BLM RFO), the Saratoga-Encampment-Rawlins Conservation District (SERCD), PCW, and The Overland Trail Cattle Company (TOTCO).

The Project is located within the Upper North Platte basin (HUC 10180002) and the Muddy Creek basin (HUC 14050004) (Figure 1). The Muddy Creek Basin falls within the Upper Colorado River Basin and is a tributary to the Little Snake River. Within the Upper North Platte basin, Project activities will occur in the Sage Creek, Iron Spring Draw, and Sugar Creek watersheds. Within the Muddy Creek basin, Project activities will occur in the Upper Muddy Creek watershed. Waters potentially affected by Project activities include Sage Creek, Little Sage Creek, Hugus Draw, Smith Draw, and Iron Spring Draw in the Upper North Platte and McKinney Creek, Grove Creek, and Stoney Creek in the Muddy Creek basin. Several unnamed tributaries to these waters will also be affected by project activities.

The Project is located on private lands, federal lands administered by the BLM ("public lands") and state lands under the management of the Wyoming State Board of Land Commissioners, as well as lands under the administration of the Wyoming Game and Fish Commission (collectively referred to as "state lands"). This Plan is designed to better define current watershed conditions and monitor future conditions of the watersheds. Final monitoring sites may be placed on private, state, or public lands and will monitor channel characteristics and water quality.

2.0 PREVIOUS AND ONGOING SURVEYING EFFORTS

Substantial surveying and watershed enhancement efforts have occurred in the watersheds draining the Project area. These surveying efforts help establish baseline conditions in the Project area and will be used as the basis of future monitoring efforts. Past and ongoing surveying efforts are described in the sections below.

Sage Creek, in the Upper North Platte basin, was removed from Wyoming's 303(d) list in 2008 (WDEQ 2008). Because of naturally high sediment loads originating from highly erodible shale formations and soils, Sage Creek has been identified as a substantial contributor of sediment to the upper North Platte River. In 1997, the SERCD, in cooperation with landowners and other agencies, received a Section 319 Grant from the Environmental Protection Agency (EPA) to address sedimentation issues in Sage Creek and the Upper North Platte River. The grant funded projects to improve water quality in Sage Creek. Projects included rotational grazing management, upland water development, cross fencing, riprap, irrigation structures, culverts, and road reshaping (BLM 2002b; WDEQ 2008, SERCD 2007).

The projects have been implemented and land management Best Management Practices (BMPs) are still in effect. The BMPs consist of a combination of short duration grazing, riparian fences, and drift fencing (WDEQ 2008). Data collected following implementation of projects and BMPs showed reduced sediment loading in the North Platte River and improved riparian and range conditions, which indicates Sage Creek is fully supporting designated water quality classifications (WDEQ 2001). In addition to surveying efforts completed by the SERCD (SERCD 2007), BLM has photo documentation points along Sage Creek and Little Sage Creek and has completed riparian Proper Functioning Condition (PFC) assessments.

Portions of McKinney Creek where Project activities will occur were removed from Wyoming's 303(d) list in 2000 as a result of Section 319 funded watershed improvement projects and BMPs that have been occurring since 1992 (WDEQ 2008). Projects in the Upper Muddy Creek watershed include upland water development, cross fencing, vegetation management, and improved grazing management. Reaches of McKinney Creek downstream of its confluence with Eagle Creek remain on Wyoming's 303(d) list. Impaired reaches are approximately 20 stream-miles downstream from all planned Project activities. Impairment of the downstream reaches of McKinney Creek occurs as a result of channel degradation and naturally high sediment yields from erosive shale formations and soils near the confluence of Eagle and Muddy creeks. Reaches of McKinney Creek adjacent to Project activities are in compliance with Wyoming water quality standards and primarily drain stable sandy to sandy-loam soils with high gravel and cobble content. In addition to and in support of past and ongoing watershed improvement efforts, BLM has multiple photo documentation points and channel surveying sites in the Upper Muddy Creek watershed downstream from planned Project activities. PFC assessments for Upper Muddy Creek have been completed by the BLM.

The BLM has numerous historic photo documentation points in the Iron Springs Draw watershed. However, many of these photo points have not been visited consistently over time and no known channel surveying or water quality data have been collected in the watershed.

Changes in watershed condition in the upper reaches of the Little Sage Creek watershed may have occurred as a result of recent hydrocarbon releases. These hydrocarbon releases are not related to any Project activities. It is believed that water quality samples have been collected to determine the effect of the hydrocarbon release. As those data become available, they will be used to help establish baseline water quality conditions upstream from and in the Project area. Future monitoring efforts to document the effects of the hydrocarbon release will occur separately from this Plan and will not be the responsibility of PCW or TOTCO.

Other future monitoring efforts are anticipated in the Upper Muddy Creek watershed as part of ongoing 303(d) sampling, the Upper Muddy/Grizzly Wildlife Habitat Management Area planning, and potential future fisheries improvement projects planned by the Wyoming Game and Fish Department. These anticipated future monitoring efforts will occur separately from this Plan and will not be the responsibility of PCW or TOTCO.

While substantial surveying, land management, and watershed improvement efforts have occurred and are planned across TOTCO and in the Muddy Creek and Upper North Platte basins, the existing and planned monitoring may not adequately characterize the current

baseline water quality and channel conditions in the watersheds draining the Project area. To remedy this, PCW and the BLM have collaborated to identify the efforts required to better establish baseline watershed conditions and monitor those conditions following Project construction and operations activities. The methods and monitoring approaches identified in this document will be closely coordinated with the MRP, SWPPP, and other compliance and monitoring efforts associated with the Project to streamline all monitoring activities and maximize the benefits of all data being collected.

3.0 WATERSHED MONITORING ACTIVITIES

Monitoring sites will be located throughout the Project area, such that the whole Project is adequately represented. Some existing monitoring sites will be used; however, the majority of sites will be newly established to bracket Project disturbances. Approximate locations of monitoring sites (Figure 1) have been determined based on possible turbine configurations and possible locations of major roads and other Project infrastructure. Final monitoring sites will be determined in coordination with the BLM hydrologist.

There are 21 proposed monitoring sites in the Project area. No additional monitoring sites are anticipated to be needed. Monitoring will be completed on an annual basis prior to construction, throughout construction and for the first three years following construction. After three years of post-construction monitoring, the frequency and type of monitoring will be reassessed. Monitoring efforts will be consistently completed during late summer/early fall baseflow conditions.

All monitoring sites will be permanently monumented using a metal stake or capped and labeled rebar. The location of monitoring sites will be recorded using GPS. Data collected during monitoring efforts will be electronically submitted to BLM for review at the earliest practicable time following field and data entry efforts. The following sections describe the proposed monitoring methods.

3.1 CHANNEL AND STREAMBED MONITORING

During each monitoring event, the physical characteristics of the streambed will be defined. Channel cross sections and a longitudinal profile will be recorded using a total station or other appropriate technology that is positioned directly over the permanent monument stake at each site. Each cross section and the upstream and downstream extents of the longitudinal profile will be monumented. Ends of cross sections will be placed at an elevation of twice the maximum bankfull depth to ensure flood prone areas are captured in surveys (Rosgen 1996). The number of cross sections collected per monitoring site will vary depending on the type of stream flow (i.e., perennial or ephemeral). Cross sections will be used to identify erosional and depositional processes, mass wasting events, and other changes in channel morphology at a site. Wolman pebble counts (Wolman 1954) will be conducted in a zig-zag pattern along the longitudinal profile of the channel to document sediment particle size at each monitoring site.

3.1.1 Perennial Streams

Three cross sections will be measured for all perennial streams. One cross section each will be measured in a pool, a riffle, and a run to document baseline characteristics and monitor future changes in channel shape in each of these major habitat types. In the event that a monitoring site does not have each of the three habitat types, cross sections will be placed in the most representative habitat types for that site.

The longitudinal profile for perennial stream monitoring sites will be measured along the thalweg through each of the three habitat types where cross sections are collected, or for two stream meanders whichever is greater in length. If these conditions do not occur at a particular site, the longitudinal profile and total site length will be capped at 40-times the length of the wetted width.

3.1.2 Ephemeral Streams

One cross section will be measured for all ephemeral streams. The location of the cross section will be in coordination with the BLM hydrologist. A longitudinal profile will be recorded for each ephemeral stream and will encompass two stream meanders. The longitudinal profile will generally follow what would be the channel thalweg if the channel were carrying water.

3.2 GREENLINE MONITORING

Monitoring of the greenline will be used to document trends and changes in riparian vegetation that may influence stream erosional and depositional processes. Where riparian vegetation is not present, greenline monitoring will record upper bank vegetation or vegetation within and adjacent to the channel as appropriate. Greenline monitoring will be completed along the length of the longitudinal profile for each site generally following the methods presented in Cagney (1993). Specific greenline monitoring methods will be determined during initial site visits in coordination with the BLM hydrologist. Greenline transects will be completed on both sides of each stream.

3.3 STREAMFLOW

At perennial stream monitoring sites, flow will be calculated from water velocity measurements (using a Marsh-McBirney flow meter or similar) and water depth measurements collected across a channel cross section. The precise location of flow measurements will vary each year and will depend on channel characteristics and flow volumes.

3.4 WATER QUALITY MONITORING

Water quality samples will be collected at perennial stream monitoring sites and sites with flowing water at the time of monitoring. Turbidity, pH, electrical conductivity, salinity, temperature, and dissolved oxygen will be measured on-site with a handheld water quality meter (Yellow Springs Instrument 556 Handheld Multiparameter Meter or similar). Grab samples will be collected and sent to a certified water quality lab for analysis of total

dissolved solids (TDS), major cations and anions, selenium, and selected other water quality constituents to be determined in coordination with the BLM, private landowners, and the state of Wyoming.

3.5 PHOTO DOCUMENTATION

Prior to monitoring at each location, a reference photograph will be taken of a dry erase board that displays the stream name, monitoring site name, date, time, and names of the data collectors. Site photos will be taken at each cross section in upstream and downstream directions as well as from either side of the cross section. Photos will also be taken for each erosional or depositional feature of each site. A graduated survey rod or other appropriate method will be used to document the scale of each photo that is taken. Site photos will also be taken in upstream and downstream directions at either end and at the center point of each greenline transect. A standard photo log will be used to record the location, direction, and description of each photo that is taken.

4.0 COORDINATED MANAGEMENT

Monitoring will be completed on an annual basis prior to construction, throughout construction and for the first three years following construction. Following the third year of post-construction monitoring, the need for future monitoring will be determined and the frequency and duration of those monitoring activities will be established as necessary. The watershed monitoring process will be integrated into the management framework for other Project monitoring, conservation, and compliance activities.

5.0 REFERENCES

Cagney, J. 1993. Riparian area management: greenline riparian-wetland monitoring. BLM Technical Reference 1737-8. U.S. Department of the Interior Bureau of Land Management, Denver, CO.

Rosgen, D. 1996 Applied River Morphology. Wildland Hydrology, Pagosa Springs, Colorado.

Wolman, M.G. 1954. A method of sampling coarse river-bed material. Transactions of the American Geophysical Union, 35:951-956.

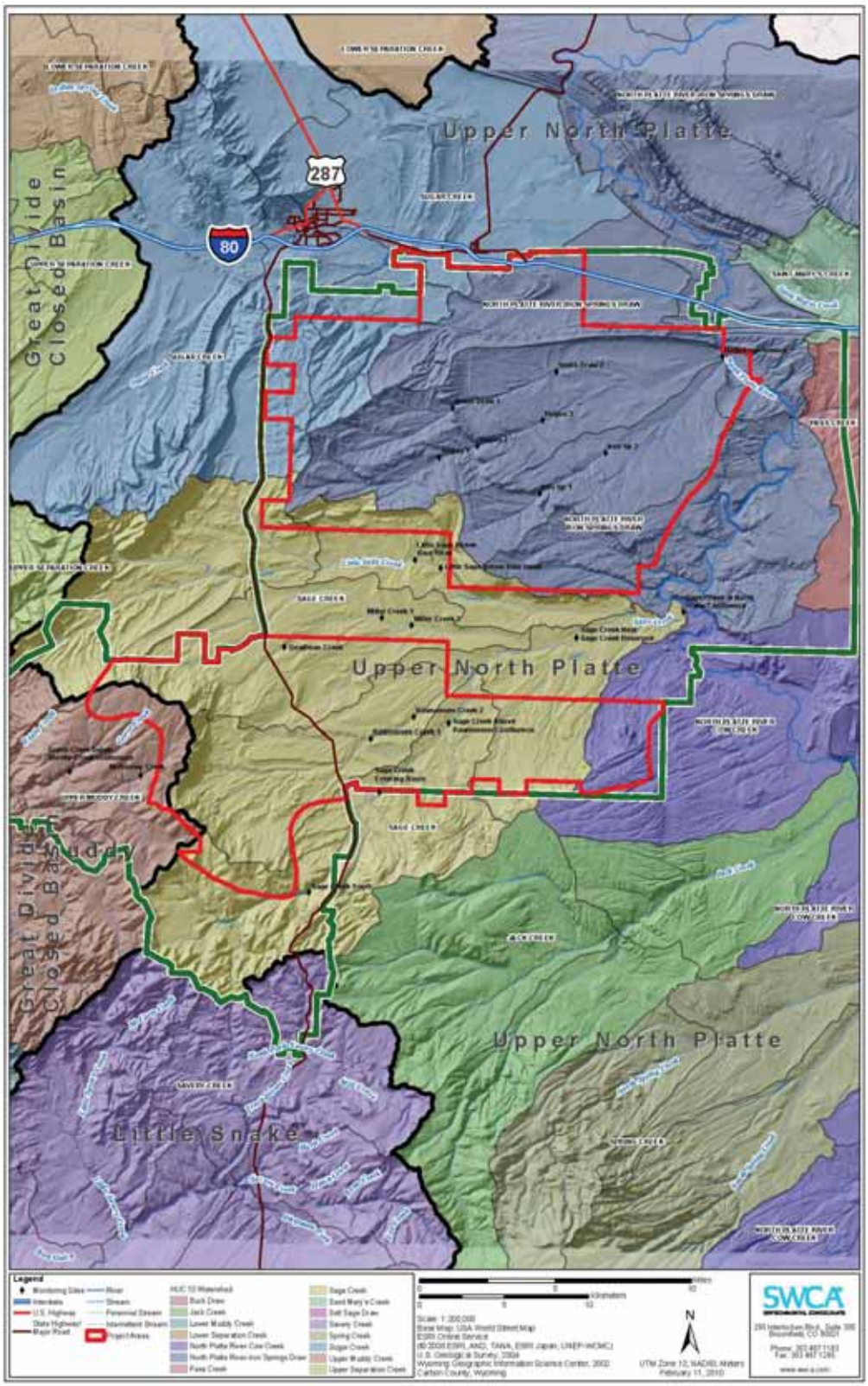


Figure 1. Watersheds and preliminary sampling points in the Project area. Final sampling points will be determined based on site conditions evaluated during the first year of data collection efforts.

Appendix G. Erosion Control Plan

Chokecherry and Sierra Madre Wind Energy Project

Erosion Control Plan

Prepared for

Power Company of Wyoming LLC

555 Seventeenth Street
Suite 2400
Denver, CO 80202

Prepared by

Westwood Professional Services
7699 Anagram Drive
Eden Prairie, MN 55344
(952) 937-5150
www.westwoodps.com

Table of Contents

1. Introduction 1

2. Existing Conditions 1
   2.1 Geology 1
   2.2 Vegetation 1
   2.3 Soils 2

3. Determination of Erosion Risk 2

4. Erosion Mitigation Measures 2
   4.1 Areas of Disturbance 2
   4.2 Erosion Control Devices and Procedures 3

5. Erosion Monitoring and Maintenance 4
   5.1 Site Monitoring for Erosion 4
   5.2 Erosion Control Device Inspection 5
   5.3 Erosion Control Device Maintenance 5

6. Determination of Erosion Control Completion 5

1. INTRODUCTION

This Erosion Control Plan (Plan) for the Chokecherry and Sierra Madre Wind Energy Project (Project) provides an overview of the erosion control goals and standards that will be used by the Project. Power Company of Wyoming, LLC (PCW) will avoid erosion where possible and mitigate as needed to meet all applicable rules, regulations and requirements for the Project. This Plan defines methodologies for determining erosion potential and options for minimizing that potential. Common procedures, methodologies and monitoring and reporting requirements for the installation and maintenance (both short term, and long term) of erosion control devices are also discussed along with the appropriate use of such devices.

This plan is attached to and part of the Project Plan of Development (POD), and as such applies to the Project construction, operation, and decommissioning stages. As with all elements of the POD, this plan provides general information on the overall expectations for the Project. More specific erosion control plans will be provided along with the detailed Project design and construction information in site-specific PODs.

2. EXISTING CONDITIONS

2.1 GEOLOGY

According to Chapman et al. (2004), surface geology in the general Project area consists of Quaternary alluvium, colluvium, outwash deposits, and eolian deposits derived from Tertiary and Cretaceous claystone, sandstone, and sedimentary rock (majority of Project site); and Quaternary alluvium and colluvium, gravel and fan deposits, and areas of active and stabilized dune sand and loess underlain with Tertiary and Cretaceous siltstone, sandstone, claystone, and areas of shale marlstone (northeast portion of Chokecherry development area).

Section 2.2.3 of the Project POD provides an overall summary of the known geology of the Project area.

2.2 VEGETATION

The Wyoming Ecoregion Map indicates that the Project site lies within three Level IV ecoregions. Plant community descriptions were developed based on a combination of the ecoregion descriptions (Chapman et al. 2004), the Final Rawlins Field Office Resource Management Plan (RMP) (BLM 2008), and field reconnaissance surveys (AECOM 2009). In general terms, species composition and distribution vary across the site based on soil type, available soil moisture, elevational gradient, slope aspect, and grazing pressure/disturbance. Aerial photo (PCW 2008) interpretation and ground-truthing (AECOM 2009) produced six dominant vegetation cover types:

- mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*)
- saltbush (*Atriplex* spp.)
- greasewood (*Sarcobatus vermiculatus*)
- Wyoming big sagebrush (*Aretmisia tridentata* ssp. *wyomingensis*)

- aspen (*Populus tremuloides*), and
- riparian/wetlands

Sections 2.2.4 and 7.2 of the Project POD provide greater detail on the vegetation cover and the general locations for these dominant vegetation cover types on the property.

2.3 SOILS

A variety of soils occur across the Project area. Soil variability stems primarily from a variety of parent materials as influenced by topography, aspect, elevation, vegetation, and differential rates of mineral weathering. Soils in the Project area are primarily derived from sedimentary formations and are predominantly Orthents; soils that are shallow to very deep and medium to fine textured and have a frigid temperature regime, an aridic moisture regime, and mixed or bentonitic mineralogy. Sections 2.2.3 and 7.5 of the Project POD provide additional information on the known soil conditions of the Project area.

3. DETERMINATION OF EROSION RISK

The Project will occur in an arid environment that contains erosive soils. Surface disturbing activities may result in exposed soils, accelerated soil erosion, increased potential for mass failure, and reduced soil productivity. This Plan in conjunction with the Stormwater Pollution Prevention Plan (SWPPP) and Master Reclamation Plan (MRP) provide guidance, mitigation measures and protocols to control and reduce soil erosion to minimize effects to the soil resource, surrounding watersheds, and upland rangeland.

As described in Sections 7.3.3 and 7.5.2 of the Project POD, PCW will develop a SWPPP with each site-specific POD that will detail the necessary erosion control features and design. Each SWPPP will consider the existing conditions of the Project site, the activities associated with the site-specific POD, and the requirements of federal, state, and local permits. The SWPPPs will detail erosion control measures appropriate for each specific site and activity. These measures will also align with the revegetation strategies described in the Master Reclamation Plan.

4. EROSION MITIGATION MEASURES

This section described the measures that may be utilized to reduce or eliminate the potential for erosion on the Project site.

4.1 AREAS OF DISTURBANCE

Project related ground disturbances are described in Section 3 of the Project POD. Construction corridors for the Project's linear features such as roads, collection cables, and transmission lines will be identified during final design. These areas include the disturbance necessary to construct the project access roads, turbines, electrical collection cables, substations, rail facility, transmission lines, laydown yards, operations and maintenance building, and other required facilities. Identification of the specific location of these features will allow the ground disturbance and erosion potential to be further refined in each site-specific POD.

Throughout the project area, there are isolated locations that may have enhanced sensitivity to soil erosion due to construction activities. Efforts will be made during design to avoid or minimize disturbing areas that exhibit high potential for erosion and long term stabilization problems. These areas of high erosion potential may include the following:

- Steep slopes
- Highly erodible soil types
- Areas of concentrated storm water runoff

4.2 EROSION CONTROL DEVICES AND PROCEDURES

Not all areas of higher erosion risk can be avoided. Project requirements for transportation across the site, turbine placement, and power collection will require the disturbance of some areas of high erosion potential. When these effects are unavoidable, the Project design will appropriately reflect the increased risk of erosion through the selection of risk appropriate erosion control devices and procedures. Some common erosion control techniques for wind energy projects are listed in Table 1. Any techniques selected during the Project's design stage will be discussed in detail in each site-specific POD.

Table 1. Common Erosion Control Techniques

Technique	Common Usage
Project Staging / Design	Minimize soil exposure duration
Silt Fence	Capture suspended sediment around disturbed areas and stockpiles, in ditches down gradient from disturbed areas
Rock Entrance / Exit	Aggregate installed where construction access intersects public roads
Riprap	Prevent scour by decelerating water at culvert outlets, ditch intersections, and similar drainage points
Dewatering	In short-term disturbed areas where positive drainage cannot be achieved, temporary pumps can remove accumulated water
Mulch Cover	Cover reseeded areas with straw or hay to minimize runoff effects until vegetation established; may require disc-anchoring or use of tackifier
Erosion Control Blanket	Cover reseeded areas where additional stabilization support is needed (such as steep slopes, ditches, swales)

Figure 1. Example Erosion Control Techniques

5. EROSION MONITORING AND MAINTENANCE

PCW understands that a successful erosion control plan requires a continued review of the Project area to evaluate if erosion is occurring and to insure that erosion control devices are functioning properly. The general procedures for monitoring are discussed below. More detailed monitoring requirements will be provided in each site-specific POD.

5.1 SITE MONITORING FOR EROSION

The SWPPP and associated erosion control techniques are intended to address all areas of potential erosion associated with the Project. However, throughout the Project's construction, operations, and decommissioning stages, PCW will continue to monitor the site to identify any new or unforeseen areas of erosion. Additional diligence will be given to locations of greater erosion risk due to steep slopes, sparse vegetation, or highly erosive soils. Should instances of new erosion be observed, PCW will mitigate the erosion occurrence as soon as practicable

utilizing the erosion control techniques contemplated herein in compliance with all applicable rules, regulations, and Project plans and permits.

5.2 EROSION CONTROL DEVICE INSPECTION

While erosion control measures are in place, PCW will perform regular inspections of the erosion control devices. Inspections will be done at defined intervals that align with permit requirements and site conditions, as well as after significant rainfall and snow runoff events. The inspections will be performed by qualified personnel.

5.3 EROSION CONTROL DEVICE MAINTENANCE

Most erosion control devices require routine cleaning and maintenance to maintain effectiveness. As part of the inspection of erosion control devices, PCW will perform any necessary maintenance to ensure the devices are operating per their design requirements. Guidelines for maintenance will be included with each site-specific POD.

Should some devices require extensive or frequent maintenance, PCW may elect to utilize alternative erosion control techniques to better meet the Project needs. Any such alternative techniques shall be in compliance with all applicable rules, regulations, plans and permits for the Project.

6. DETERMINATION OF EROSION CONTROL COMPLETION

As the requirements of the Master Reclamation Plan, ROD, and applicable rules, regulations, plans and permits regarding erosion are met, PCW will phase out the use of erosion control devices. Site monitoring will continue per the terms of the Master Reclamation Plan to ensure revegetation and long-term erosion control methods continue to control erosion after the devices are removed.

Appendix H. Dust Control Plan

Chokecherry and Sierra Madre Wind Energy Project

Fugitive Dust Control Plan

Prepared for

Power Company of Wyoming LLC

555 Seventeenth Street
Suite 2400
Denver, CO 80202

Prepared by

Westwood Professional Services
7699 Anagram Drive
Eden Prairie, MN 55344
(952) 937-5150
www.westwoodps.com

Table of Contents

1. Introduction 1

2. Existing Conditions 1
   2.1 Water Resources 1
   2.2 Soils 1
   2.3 Areas of Enhanced Sensitivity 1

3. Potential Dust Sources 2

4. Reasonably Available Control Measures 2
   4.1 Application of Additives 2
   4.2 Mechanical Solutions 3
   4.3 Operational Solutions 3
   4.4 Design Solutions 4

5. Suppression Method Selection 4

1. INTRODUCTION

This Fugitive Dust Control Plan (Plan) for the Chokecherry and Sierra Madre Wind Energy Project (Project) provides an overview of methods that Power Company of Wyoming, LLC (PCW) can employ to prevent, reduce, or mitigate the amount of fugitive dust in the ambient air as a result of Project activities. PCW will implement this Plan to comply with applicable rules, regulations and Project plans and permits. This Plan is attached to and part of the Project's Plan of Development (POD), and as such applies to the Project's construction, operations, and decommissioning stages. As with all elements of the POD, this Plan provides general information on the overall expectations for the Project. More specific fugitive dust control plans and requirements will be provided along with the detailed Project design and construction information in site-specific PODs.

2. EXISTING CONDITIONS

2.1 WATER RESOURCES

As discussed in Section 2.2.5 of the POD, the Project has access to a variety of water sources including surface water (river, creek, and reservoir), ground water, and municipal sources. Water utilized for dust suppression activities will be obtained in a similar manner to that water obtained for other construction, operations, and decommissioning activities. Additional information on water consumption levels and supply facilities is located in Sections 4.3.4 and 7.3 of the POD. Estimates of water consumption required for the fugitive dust control plan will be contained in each site-specific POD.

2.2 SOILS

A variety of soils occur across the Project area. Soil variability stems primarily from a variety of parent materials as influenced by topography, aspect, elevation, vegetation, and differential rates of mineral weathering. Soils in the Project area are primarily sedimentary outwash formations and are predominantly sandy loams with shallow bedrock.

Soils in the south-central portion of the Sierra Madre site may have enhanced susceptibility to wind and water erosion. These areas may require enhanced or specialized dust control methods, and may be more susceptible to additional erosion caused by some dust control techniques. PCW will determine which methods may be appropriate for these areas in the site-specific POD for the Sage Creek Basin portion of Sierra Madre.

2.3 AREAS OF ENHANCED SENSITIVITY

As discussed in POD Section 2, the Project site is uninhabited ranch land. In the region around the ranch, however, there are locations that may have enhanced sensitivity to dust due to potential temporary effects to visibility or air quality. These areas include:

- City of Rawlins, and Towns of Sinclair and Saratoga
- Teton Reservoir Recreation Area
- Residents along Wyoming Highway 71

Effects to these areas will be explored further as applicable in each site-specific POD.

3. POTENTIAL DUST SOURCES

The following on-site activities have been identified as having the potential for generating fugitive dust:

- Site grading
- Excavation
- Rock crushing
- Blasting
- Materials stockpiling
- Concrete batch plant operations
- Vehicles and equipment driving on unpaved roads (both Project and public)
- Roadway maintenance activities

The specific potential sources of dust will be identified and discussed in each site-specific POD.

4. REASONABLY AVAILABLE CONTROL MEASURES

PCW will provide dust control and suppression throughout the Project to protect surface soils from wind erosion and manage fugitive dust from Project activities. To reduce the amount of fugitive dust generated from Project activities, PCW will implement reasonably available control measures when and where appropriate. Some control measures, such as graveling roads and controlling site access, are not discussed below as they are already part of the Project POD.

4.1 APPLICATION OF ADDITIVES

Dust control through the application of additives may be accomplished by frequent watering and/or chemical stabilization during activities such as clearing or leveling of land, earthmoving, excavation, or movement of trucks or construction equipment over access roads or cleared land. Commercially available dust suppressants, including chloride compounds, lignin compounds, or tree resin emulsion products, if utilized, will be applied in accordance with the manufacturer's specifications and in sufficient concentrations. No significant effects are expected from the potential use of the aforementioned dust suppression techniques[1] (see Table 1 below).

PCW will determine the optimum use of different additives for the various portions of the Project during the detailed design and specify the use in each site-specific POD. The effectiveness of each method will be evaluated during the Project's construction, operations, and decommissioning stages. If specific methods are found to be ineffective, PCW may alter the additive suppressant use or formulation as necessary throughout the Project.

[1] Addo, Jonathan and Sanders, Thomas, Ph.D. "Effectiveness and Environmental Impact of Road Dust Suppressants." Colorado State University. December 1993.

Table 1. Additive Dust Suppressants and Considerations

Dust Suppressant	Comments	Common Frequency of Use	Relative Cost
Fresh Water	Frequent application, significant water usage, can lead to erosion	Daily	Low
Calcium Chloride and Magnesium Chloride	Common rural road use, most effective on roads with low to moderate traffic use; concerns on soil chemistry or vegetation effects if applied more frequently than weekly	Weekly	Medium
Lignin Derivatives	Similar results to chlorides, more expensive, spills into water sources can affect fish and macro - invertebrates	Weekly	High
Tree Resin Emulsions	Very expensive, less effective as other options, increases surface run-off	Weekly	High
Source: Sanders and Addo 1993			

4.2 MECHANICAL SOLUTIONS

Mechanical dust suppression methods will be considered when fugitive dust is generated from sources that can be covered or sheltered efficiently and effectively from the wind source. Table 2 includes a list of dust suppressant methods that will be utilized as needed.

Table 2. Mechanical Dust Suppressants and Considerations

Dust Suppressant	Comments	Common Frequency of Use	Relative Cost
Coverings	Tarps can be used on trucks and small stockpiles as temporary covering. Coverings must be anchored down to prevent wind from removing them.	High Wind Days	Low
Wind Sheltering	Wind fencing barriers made of soil berms, fabric, or wooden structures may be utilized to shield sensitive areas from repeated heavy winds.	Very Isolated Circumstances	Medium

4.3 OPERATIONAL SOLUTIONS

Operational dust suppression methods involve changes to activities and practices to minimize the potential for dust generation. Operational dust suppression methods may be appropriate for land clearing, earthmoving, stockpiling, and transportation activities. Table 3 includes a list of potential dust suppressant methods that PCW may use. Each method will be evaluated following commencement of construction to determine its overall effectiveness.

Table 3. Operational Dust Suppressants and Considerations

Dust Suppressant	Comments	Common Frequency of Use	Relative Cost
Haul vehicle restrictions	Speed restrictions due to high winds and other site conditions.	High Wind Days	Low
Gravel and soil placement equipment	Restrict height and speed at which materials are placed	Daily	Low
Altering loading and unloading procedures	Confine loading and unloading procedures to the downwind side of storage piles.	High Wind Days	Low

4.4 DESIGN SOLUTIONS

Design solutions will be used to mitigate the fugitive dust where practical and effective. Table 4 includes a list of design methods that will be evaluated during Project design.

Table 4. Design Considerations

Dust Suppressant	Comments	Common Frequency of Use	Relative Cost
Pre-grading planning	Time soil grading and disturbances to minimize exposure before surfacing is applied or reclamation begun.	One time	Low
Grading design	Balance cut/fill earthwork to avoid unnecessary stockpiling of materials to the extent possible.	One time	Low
Stockpile Locations	When stockpiling of soils is necessary, design designated locations down-wind of construction activities, buildings, and other dust sensitive sites where possible.	One time	Low
Vegetation	Establish temporary vegetation as quickly as possible in accordance with Project Master Reclamation Plan	Ongoing	Low

5. SUPPRESSION METHOD SELECTION

Fugitive dust control methods will vary depending on the sources of the dust and types of activities. Different dust control methods described throughout this Plan will be more cost effective and will provide a greater level of protection based on the size of the area being treated, the frequency of treatment required, and the availability of resources necessary to implement the prescribed method. PCW will also evaluate the implications of methods that may increase overall water run-off and erosion when determining the optimum solutions. Table 5 includes a list of dust control methods considered for each fugitive dust source.

Table 5. Design Methods Considered

Methods	Roads	WTG Pads	Facilities
Applicational Dust Suppressants			
Fresh Water	●	●	●
Calcium Chloride and Magnesium Chloride	●	●	●
Lignin Derivatives	●	●	●
Tree Resin Emulsions	●	●	●
Mechanical Dust Suppressants			
Coverings		●	●
Wind Sheltering			●
Operational Dust Suppressants			
Haul vehicle restrictions	●		
Gravel and soil placement equipment	●	●	●
Altering loading and unloading procedures	●	●	●
Design Considerations			
Pre-grading planning	●	●	●
Grading design	●	●	●
Stockpile Locations			●
Vegetation	●	●	●

PCW will identify all potential sources of fugitive dust resulting from Project activities and select the dust suppression methods most appropriate for each source. Final design and selection of fugitive dust suppression methods will be identified and described in detail in each site-specific POD.

Appendix I. Blasting Plan

Blasting Plan

Preliminary Requirements

February 23, 2010

Power Company of Wyoming LLC

This document defines the basic requirements for blasting to be used as part of the construction of the Sierra Madre and Chokecherry Wind Energy Projects. It is anticipated these requirements will be incorporated into a comprehensive blasting plan to be prepared by the contractors responsible for such blasting. That plan shall be drafted and presented to appropriate government agencies prior to the commencement of any blasting on-site.

1. Planning and Regulations

1. The blasting company shall hold all necessary federal, state, and local permits required for conducting blasting operations on-site.
2. The blaster in charge of the project site must hold current and sufficient licensure to supervise blasting operations.
3. Blasting company is responsible for notification to all personnel on-site (including at daily briefings), all contractors working on-site, project management, landowners, and appropriate government agencies. The blasting company is also responsible for any public notifications required by government agencies. Any blasting activity requires at least 2 business-days notice to the parties listed above.
4. All blasting activities will take place during daylight hours unless previously arranged with and approved by appropriate government agencies.

2. Safety and Security

1. The blasting contractor shall have primary responsibility for safety in the area around blasting activities, including full authority for controlling persons on-site within a minimum safe distance to be defined by the blasting contractor.
2. The blasting contractor shall keep the minimum amount of explosives on-site as necessary to facilitate efficient operation. All explosives not in the process of being transported, placed, or used for activities that day shall be kept in a secure storage magazine. Adequate security is required around all explosives at all times.
3. No unauthorized personnel are allowed to handle or be within close proximity of explosives.
4. Consistent inventory control is to be maintained at all times by the basting contractor. Inventory levels must be available to appropriate government entities as requested or required by such agencies.
5. No smoking, welding activities, or open flames will be allowed within a minimum safe distance (to be defined by the blasting contractor) of explosives.
6. Blasting shall not be performed during inclement weather, especially thunderstorms. The blasting contractor shall define minimum weather requirements for blasting operations in its plans prior to the commencement of construction.
7. Warning signs shall be placed at least 1,000 feet from the blasting activity on all roadways and common access points. Signs shall be easily legible from vehicles on the roads, and shall be written in both English and Spanish.
8. The blasting contractor must verify the minimum safe distance area is secure, that all safety and planning procedures have been met, and that it has clear and effective communications around the blasting area prior to commencing blasting.

Appendix J. Weed Management Plan

Chokecherry and Sierra Madre Wind Energy Project

Weed Management Plan

Prepared for

555 Seventeenth Street
Suite 2400
Denver, CO 80202

Prepared by

SWCA Environmental Consultants
295 Interlocken Blvd., Suite 300
Broomfield, CO 80021
(303) 487-1183 / Fax (303) 487-1245
www.swca.com

April 2012

TABLE OF CONTENTS

Page
1.0 Introduction 1
2.0 Current Weed Distribution and Management 2
3.0 Weed Management Approach 3
3.1 Weed Management Goals 3
3.1.1 Priorities for Weed Management 4
3.2 Inventory of Weed Species 4
3.3 Weed Management Actions 4
3.3.1 Prevention 4
3.3.2 Treatment Methods 5
3.4 Monitoring 7
4.0 References 8

LIST OF TABLES

Table **Page**
Table 1. Noxious Weed List for the State of Wyoming and Carbon County. 1

LIST OF ATTACHMENTS

Attachment
ATTACHMENT A: Noxious and Invasive Weed Occurrences
ATTACHMENT B: Pesticide Use Proposal Form

1.0 INTRODUCTION

The purpose of this Weed Management Plan ("Plan") is to prescribe methods to prevent, mitigate, and control the spread of noxious and invasive weeds during construction and operation of the Chokecherry and Sierra Madre Wind Energy Project (the "Project") proposed by the Power Company of Wyoming LLC ("PCW"). Federal Invasive Species Executive Order 13112 defines an invasive plant as an alien, non-native, species whose introduction causes or is likely to cause economic or environmental damage or harm to human health (U.S. Federal Register 1999). A noxious weed is any plant designated by a federal, state, or county government as injurious to public health, agriculture, recreation, wildlife or property. Designated noxious weeds in the state of Wyoming and declared weeds in Carbon County are listed in Table 1.

Table 1. Noxious Weed List for the State of Wyoming and Carbon County.

Common Name	Scientific Name
State of Wyoming[1]	
Field bindweed	*Convolvulus arvensis*
Canada thistle	*Cirsium arvense*
Leafy spurge	*Euphorbia esula*
Perennial sowthistle	*Sonchus arvensis*
Quackgrass	*Agropyron repens*
Hoary cress (whitetop)	*Cardaria draba* and *C. pubescens*
Perennial pepperweed (giant whitetop)	*Lepidium latifolium*
Ox-eye daisy	*Chrysanthemum leucanthemum*
Skeletonleaf bursage	*Franseria discolor*
Russian knapweed	*Centaurea repens*
Yellow toadflax	*Linaria vulgaris*
Dalmatian toadflax	*Linaria dalmatica*
Scotch thistle	*Onopordum acanthium*
Musk thistle	*Carduus nutans*
Common burdock	*Arctium minus*
Plumeless thistle	*Carduus acanthoides*
Dyers woad	*Isatis tinctoria*
Houndstongue	*Cynoglossum officinale*
Spotted knapweed	*Centaurea maculosa*
Diffuse knapweed	*Centaurea diffusa*
Purple loosestrife	*Lythrum salicaria*
Saltcedar (tamarisk)	*Tamarix* spp.
Common St. Johnswort	*Hypericum perforatum*
Common tansy	*Tanacetum vulgare*
Russian olive	*Elaeagnus angustifolia*
Carbon County[2]	
Larkspur	*Delphinium* spp.
Halogeton	*Halogeton glomeratus*
Wyeth's Lupine	*Lupinus wyethii*

Common Name	Scientific Name
Pricklypear	*Opuntia* spp.
Black henbane	*Hyoscyamus niger*
Common cocklebur	*Xanthium strumarium*

Sources: [1]Wyoming Weed and Pest Council 2011; [2]Carbon County Weed and Pest 2011

Noxious and invasive weeds can move into disturbed areas and dominate or disrupt natural communities or restoration projects. Noxious weeds compete with native species for soil, water, and other limiting resources. Noxious weeds are often able to out-compete native vegetation and can form monocultures. This degrades the value of agricultural and natural resources, including wildlife habitat. Management of noxious and invasive weeds is a reclamation requirement in the Wyoming Bureau of Land Management (BLM) Reclamation Policy (BLM 2009). The Rawlins Field Office of the BLM has zero tolerance for state-listed noxious weed species. Therefore, weed management is an important part of the reclamation procedures outlined in the Master Reclamation Plan for the Project.

2.0 CURRENT WEED DISTRIBUTION AND MANAGEMENT

Weed management in the Project area is a cooperative effort between the surface landowner and the BLM. Weed management in the Project area will continue in a manner consistent with past efforts and will include coordination between the surface landowner and the BLM. Noxious and invasive weeds are controlled annually using herbicides. The BLM has not specifically surveyed the entire area for invasive and noxious weeds and some of the data collected is from incidental sightings. The absence of recorded weeds does not infer that areas lack weeds, but that these areas may not have been surveyed. Based upon surveys conducted to date, four weed species have been identified as needing management: perennial pepperweed (*Lepidium latifolium*), halogeton (*Halogeton glomeratus*), Russian knapweed (*Centaurea repens*), and tamarisk (*Tamarix* spp.) (BLM 2001).

Weed observations were compiled from known populations and vegetation mapping efforts by the BLM (BLM 2011a) (**Attachment A**). Most of the weeds are associated with drainages, water features, and disturbed areas. Detailed weed mapping of areas to be disturbed will be performed immediately prior to construction when weeds can be treated, avoided, and/or weedy topsoil can be segregated during construction.

Although weed knowledge of the area is not comprehensive, the highest concentrations of known weed populations occur along Little Sage Creek and Sage Creek and extend from west of CCR 401 (Sage Creek Road) to the North Platte River and downriver to Fort Steele.

The Overland Trail Cattle Company LLC ("TOTCO"), which owns the vast majority of private lands within the Project area, and BLM have cooperatively participated in weed control since 1999. An experimental weed burn was jointly conducted in June 2003 (Newberry 2010). The weed burn occurred on Little Sage Creek to remove thick overstory vegetation to better locate and treat perennial pepperweed and Russian knapweed.

Weeds in the Chokecherry area were primarily observed in disturbed areas, within drainages, and water impoundments. The Sierra Madre area is relatively free of noxious and invasive

weeds. In addition to the weeds within the Project area, it is important to note populations of weeds in other adjacent areas since these populations provide the most likely sources for potential infestation. The most common weeds occur within the Sage Creek Basin and Bolten sub-regions and include halogeton, whitetop (*Cardaria draba*), perennial pepperweed, Russian knapweed, cheatgrass (*Bromus tectorum*), leafy spurge (*Euphorbia esula*), and Canada thistle (*Cirsium arvense*). Cheatgrass is found locally throughout the Project area but does have a tendency to be found in the sandier soils. Less common weeds include perennial sowthistle (*Sonchus arvensis*), black henbane (*Hyoscyamus niger*), Russian thistle (*Salsola kali*), poverty weed (*Iva axillaris*), and saltcedar.

3.0 WEED MANAGEMENT APPROACH

Noxious and invasive weed control will occur for Project activities for the life of the Project. All noxious weed occurrences within the Project ROW and areas where invasive weeds are problematic and may potentially contribute to a significant proportion of the vegetation community will be identified and delineated. Weed management will follow the outline established in this Plan and will be implemented prior to surface-disturbing activities and during the reclamation monitoring stage as described in the Master Reclamation Plan (BLM 2011a). The efficiency of the prescribed control measures will be evaluated throughout the Project and the reclamation process.

Weed management for the Project will be dynamic. This approach will be successful by implementing the following actions (Tu and Meyers-Rice 2001):

1. Establish and record weed management goals, while identifying noxious and invasive species that prevent these goals from being reached and prioritize those species based on the severity of their effects.
2. Identify the presence, distribution, and density of noxious and invasive species throughout the Project area.
3. Develop and implement weed control plans to prevent, control, and/or eliminate the effects of priority weed species and, if necessary, re-order priorities based on likely effects on target and/or non-target species.
4. Evaluate the effectiveness of the weed control plans through monitoring, and use this information to modify and improve weed management goals, control priorities, methods, and plans.

3.1 WEED MANAGEMENT GOALS

The goal of weed management in the Project area is to minimize the spread of noxious and/or invasive plant species during the construction and operation of the Project. PCW will assist federal, state, and local agencies' weed control efforts; comply with requirements designed to prevent the spread of noxious and/or invasive plant species; and implement weed control measures on areas of the Project that are identified to be of special concern. Success standards, as defined in the Master Reclamation Plan, will be used to assess whether revegetation requirements for the Project are being met (BLM 2011a). Part of successful revegetation includes maintaining native plant communities with minimal undesirable plant

species. Success standards and management goals are designed to be site-specific to each surface-disturbing activity and the surrounding vegetation.

3.1.1 Priorities for Weed Management

PCW will coordinate with the BLM Authorized Officer (AO) to determine priorities for weed management on federal lands in the Project area. Private landowners, and the State Board of Land Commissioners or the Wyoming Game and Fish Commission as appropriate will be consulted for weed management activities on private and state lands, respectively. Weed species that present the greatest threat to achieving the management goals and that need to be controlled immediately are the highest priority. Factors to consider when establishing priorities and suggested rankings (Tu and Meyers-Rice 2001; Colorado Natural Areas Program [CNAP] 2000) are described below.

- Current extent and expansion potential of the species/population in or near the Project area.
- Current and potential effects of the species.
- Value of the habitats/areas that the species infests or may potentially infest.
- Difficulty of control.

Once identified, a specific control plan for each priority species will be developed. The specific control plan will identify species in need of controlling, treatment locations, period of control, methods to use, and monitoring.

3.2 INVENTORY OF WEED SPECIES

The presence, distribution, and cover of noxious and invasive weeds in areas to be disturbed will be assessed prior to construction activities. Weed surveys of areas to be disturbed will be conducted during the growing season to determine occurrence and abundance within the Project area. Surveys will focus on resources within areas planned for development, including access roads, extra work spaces, and transmission line corridors. Data will be collected using handheld data-logger units and geo-referenced using global positioning system (GPS) locations and delineated shapefiles. This information will be used to supplement the specific control plan for each priority species and assist in monitoring efforts.

3.3 WEED MANAGEMENT ACTIONS

The spread of noxious and invasive weeds is a significant concern in projects that involve any surface-disturbing activities. Measures must be taken to prevent, control, and/or eliminate the effects of these species; and in areas where prevention is not possible, active management and/or control measures must be put in place. Best management practices (BMPs) are necessary to ensure that existing weed occurrences are appropriately identified and controlled, subsequent spread is prevented, and new populations of noxious weeds do not emerge.

3.3.1 Prevention

Prevention is the most cost-effective approach to noxious and invasive weed management. PCW will assist federal, state, and local agency noxious and invasive weed control efforts;

comply with preventative requirements; and implement weed control measures on areas of the Project identified to be of special concern. The following preventive measures will be implemented to prevent the spread of noxious and invasive weeds:

- Prior to construction, provide contractors with information and training regarding noxious weed management, weed identification, and the effects of such weeds on agriculture, livestock, and wildlife. The contractors will be informed of the importance of preventing the spread of noxious and invasive weeds in areas not infested and of controlling the proliferation of weeds already present.
- Prior to construction, noxious and invasive weed infestation areas of concern will be identified and flagged in the field by qualified personnel. The flagging will alert construction personnel to the infestation so that appropriate BMPs may be applied.
- In areas where infestations were identified and flagged in the field, the construction contractor will stockpile cleared vegetation and salvaged topsoil adjacent to the area from which they were stripped to eliminate the transport of soil-borne noxious and invasive weed propagules. These weed-infested stockpiles will be marked with clearly visible signage until reclamation. Soil and vegetative matter will not be moved outside of the identified and marked noxious and invasive weed infestation areas.
- Vehicles and earth moving equipment will be washed when entering the Project area for the first time and will be rewashed after any off road travel through identified and flagged noxious and invasive weed infestation areas.
- Ensure that straw or hay bales used for sediment barrier installations or mulch distribution are weed-free. If weed-free bales are unavailable, use alternative weed-free sediment barrier installations.
- Implement stabilization and/or reclamation of disturbed lands immediately following construction, as outlined in the Master Reclamation Plan.
- Reseeding areas following site disturbance is important. Reseeding will occur as set forth in the Master Reclamation Plan. Continuing revegetation efforts with native seed mixes provides soil stabilization, promotes the establishment of native plant communities, and potentially prevents the spread of noxious and invasive weeds from competition of native plants.
- Disturbed ground may require chemical or mechanical weed control before weeds go to seed.

3.3.2 Treatment Methods

PCW will implement noxious and invasive weed control measures and BMPs in accordance with existing regulations and jurisdictional land management agency or landowner agreements. PCW will continue coordinating with appropriate agencies to determine which weed species will require treatment and/or site-specific mitigation approaches. Within the Project area, general pre- and post-reclamation noxious and invasive weed control will be conducted using herbicide treatment methods. Treatment methods other than herbicide application, such as cultural, mechanical, biological, and enhancement measures, will be considered during the reclamation process to facilitate noxious weed control.

Herbicide

Herbicide application will be used to treat any identified noxious and/or potentially problematic invasive plant population in an effort to reduce infestations prior to soil disturbance caused by construction. Post-reclamation strategies will entail either herbicide application or mechanical treatment to noxious weeds in infestation areas depending on the phenology of the weed species. Herbicide application will occur either following seedbed establishment or after allowing two seasons of growth. Mechanical controls will be used between herbicide treatments to provide short-term control and minimize weed establishment (see below). For most noxious weeds, herbicide spraying is most effective in early spring. On all BLM-administered lands, a pesticide use permit (PUP) will be required prior to any herbicide application (BLM 2011b).

Only herbicides that are approved for use within treated lands (federal, state, or private) will be used. Treatments will not be conducted during precipitation events or when precipitation is expected within 24 hours. If weeds targeted for herbicide treatments are found in the vicinity of limited reclamation potential (LRP) areas or sensitive sites (as outlined in the Master Reclamation Plan), proper buffers established in coordination with the BLM and local agencies will be used to prevent the spread of herbicides to these areas. If weeds are found in LRP areas or sensitive sites, cultural and/or mechanical controls will be implemented. In areas where noxious and invasive weeds may be interspersed with native vegetation, the herbicide application method will be adapted to target only weeds and therefore preserve and retain native plants.

The effects to special status species (see BLM Manual 6840 Special Status Species) will be considered when designing herbicide treatment programs. A selective herbicide and a wick or backpack sprayer will be used to minimize risks to special status plants. Vegetation will not be treated with herbicide during time-sensitive periods (e.g., nesting and migration, sensitive life stages) for special status species in the treatment area. Other treatment methods (i.e., cultural or mechanical treatment) will be implemented during these periods.

Herbicide application is an effective means of reducing the size of noxious weed populations. Applications will be controlled to minimize effects on surrounding vegetation. In areas of dense infestation, a broader application will be used and a follow-up seeding program implemented. Supplemental seeding will be based on criteria outlined in the Master Reclamation Plan. The timing of subsequent revegetation efforts will be based on the life of the selected herbicide.

BLM Manual 9011 (Chemical Pest Control) outlines the policies, and BLM Handbook H-9011-1 (Chemical Pest Control) outlines the procedures, for use of herbicides on public lands. An approved Pesticide Use Proposal is required to apply chemical herbicide (**Attachment B**). All herbicide applications on BLM-administered public lands are required to be applied by a certified commercial applicator(s) and all herbicides used must be from the current list of herbicides approved for application on BLM-administered lands (BLM 2011b).

Cultural/Mechanical

Cultural control refers to management practices that prevent weed spread and promote competition from other native plants (BLM 2011b). This may include native plant seeding, burning, flooding, and limiting livestock grazing or recreational uses in infested areas.

Mechanical control includes mowing, chopping, and discing, which are very effective short-term control. Repeating mechanical treatment weakens plants making them susceptible to disease and competition from other native plants and depletes food reserves. Mowing weeds in newly revegetated areas during the first season of establishment, prior to seed formation, could minimize weed establishment.

3.4 MONITORING

The purpose of the monitoring program is to document whether areas that have been reclaimed are progressing toward revegetation and ecosystem reconstruction. Part of successful revegetation includes maintaining native plant communities with minimal weed species. Monitoring of noxious and invasive weeds will be conducted as part of the reclamation success monitoring described in the Master Reclamation Plan. Invasive plant species should account for less than 5 percent total plant cover, and reclamation species should be outcompeting weed species within two years of reclamation initiation. State-listed noxious weeds (Table 1) should account for 0 percent of the total plant cover. The BLM Rawlins Field Office has a zero tolerance policy for state-listed noxious weed species. Noxious and invasive weeds will be monitored annually in all areas affected by Project construction.

Infestations of noxious and invasive weeds noted during monitoring activities will be treated according to the methods described in this Plan. Small infestations will likely be treated locally with herbicide applications appropriate for the specific species. When a large infestation occurs or reoccurs, an evaluation will be performed to determine what led to the infestation, a specific weed control plan will be developed or modified, and a treatment strategy will be implemented. This evaluation will be made available to relevant local noxious weed supervisory authorities.

The assessment and monitoring of revegetation efforts will take place annually. Known infestation areas and areas of special concern will be monitored, evaluated, and controlled annually and until the noxious and invasive weed occurrence is eradicated or controlled. If necessary, the monitoring schedule may become more or less frequent.

4.0 REFERENCES

Bureau of Land Management (BLM). 2001. Renewal of Grazing Permit and Allotment Management Plan. EA WY-030-EA1-092. Bolten and Pine Grove Allotments. The Overland Trail Cattle Company.

———. 2009. Wyoming Reclamation Policy. Cheyenne, Wyoming: U.S. Department of the Interior, Bureau of Land Management, Wyoming State Office. Instruction Memorandum No. WY-2009-022. Available online at http://www.blm.gov/pgdata/etc/medialib/blm/wy/resources/efoia/IMs/2009.Par.54664.File.dat/wy2009-22.pdf. Accessed January 2011.

———. 2011a. Chokecherry and Sierra Madre Wind Energy Project Draft Environmental Impact Statement (Volume II). U.S. Depart of the Interior, Bureau of Land Management, High Desert District, Rawlins Field Office. Rawlins, WY. BLM/WY/PL-11/005+1430. July 2011.

———. 2011b. Wyoming BLM Weeds and Pests website. Available online at http://www.blm.gov/wy/st/en/programs/weeds_pests.html. Accessed November 21, 2011.

Carbon County Weed and Pest. 2011. Weeds of Carbon County. Carbon County Weed and Pest Information Center, Rawlins, WY. Available online at http://www.carboncountyweed.com/weedspage.htm. Accessed November 21, 2011.

Colorado Natural Areas Program (CNAP). 2000. Creating an Integrated Weed Management Plan: a Handbook for Owners and Managers of Lands with Natural Values. Colorado Natural Areas Program, Colorado State Parks, Colorado Dept. of Natural Resources, and Colorado Dept. of Agriculture, Division of Plant Industry, Denver, CO. 349 pp.

Newbery, C. 2010. Personal communication via Project comment. July 2010.

Tu, M., and B. Meyers-Rice. 2001. Site Weed Management Plan Template. The Nature Conservancy Wildland Invasive Species Program. Available online at http://www.invasive.org/gist/products.html. Accessed May 2011.

Wyoming Weed and Pest Council. 2011. Wyoming Weed and Pest Control Act Designated List. Designated Noxious Weeds .S. 11-5-102 (a)(xi) and Prohibited Noxious Weeds W.S. 11-12-104. Available online at http://www.wyoweed.org/statelist.html. Accessed November 21, 2011.

ATTACHMENT A

Noxious and Invasive Weed Occurrences

Chokecherry Portion of the Project Area and Vicinity

- Numerous Russian knapweed sightings near the UPRR just east of Rawlins.
- Perennial pepperweed is prevalent throughout Sugar Creek.
- The pipeline easement and associated access roads south of the Greenville Dome contain a number of pipeline disturbances with annual weeds including halogeton, cheatgrass, and Russian thistle.
- Cheatgrass, alyssum, and tumble mustard are recorded throughout Chokecherry, mostly on the sandier soils.
- Along the North Platte River, there are several large patches of sow thistle, Russian knapweed, Canada thistle, whitetop, and leafy spurge.
- There is Russian olive and saltcedar scattered along the North Platte River upstream (south) of the I-80 bridge.
- Along Pass Creek, near the gravel pit, there is Russian olive and Russian knapweed.
- Hugus Draw has whitetop scattered throughout, but its heaviest occurrence is the middle section.
- Iron Spring Draw contains Russian knapweed and common whitetop.

Sierra Madre Portion of the Project Area and Vicinity

- Common whitetop occurs along Rasmussen Creek.
- Russian knapweed, whitetop, and Canada thistle occur along Sage Creek east of Sage Creek Road.
- Canada thistle occurs along perennial drainages and roadsides throughout the area.
- Cheatgrass occurs sporadically along the main roads and soil disturbances throughout the area.
- Rasmussen Reservoir, near the confluence of Lone Tree Creek and Rasmussen Creek, has a large stand of saltcedar surrounding its banks.

Other Adjacent Areas

- There is halogeton along the main ranch road and roads in the south central portion of Chokecherry and the natural gas development.
- Starting at Beckman Canyon at the base of Atlantic Rim, Little Sage Creek has numerous occurrences of musk thistle, common whitetop, and Russian thistle. Near Little Sage Reservoir, perennial pepperweed and sowthistle occur to WY 71 (Sage Creek Road). The area surrounding Teton Reservoir contains large patches of saltcedar and perennial pepperweed.
- Perennial pepperweed extends along Little Sage Creek from Teton Reservoir to the confluence with Sage Creek. Numerous occurrences of Russian knapweed also occur along this area.
- Kindt Reservoir is surrounded by large populations of perennial pepperweed, Russian knapweed, saltcedar, and Canada thistle.
- Around the ranch buildings and hay meadows, there are several large patches of Russian knapweed, whitetop, and perennial pepperweed.
- Russian knapweed also extends from these large patches along the ranch roads in all directions.

- Numerous occurrences of leafy spurge, whitetop, Russian knapweed, sowthistle, and Canada thistle have been documented along the North Platte River.
- There also is Russian olive and saltcedar scattered along the North Platte River.

ATTACHMENT B

Pesticide Use Proposal Form

UNITED STATE DEPARTMENT OF THE INTERIOR

BUREAU OF LAND MANAGEMENT

PESTICIDE USE PROPOSAL

STATE:
COUNTY:
FIELD OFFICE:
DURATION OF PROPOSAL:

DATE:
PROPOSAL NUMBER:
EA REFERENCE NUMBER:
DECISION RECORD (DR) NUMBER:

LOCATION:

ORIGINATOR – NAME:
ORIGINATOR – COMPANY:
ORIGINATOR – CONTACT INFORMATION:

I. APPLICATION INFORMATION – (Including mixtures and adjuvants):

1. TRADE NAME(S):
2. COMMON NAME(S):
3. EPA REGISTRATION NUMBER(S):
4. MANUFACTURER(S):
5. METHOD OF APPLICATION:
6. MAXIMUM RATE OF APPLICATION – AS STATED ON THE LABEL:
    a. Formulated Product:
    b. Pounds Active Ingredient or Acid Equivalent:
7. INTENDED RATE OF APPPLICATION:
    a. Formulated product:
    b. Pounds Active Ingredient or Acid Equivalent:
8. APPLICATION DATE(S):
9. NUMBER OF APPLICATIONS:

II. PEST [List specific pest(s) and reason(s) for the proposed application of the pesticide]:

III. DESIRED RESULTS OF THE APPLICATION – LINKED TO THE OBJECTIVES OF THE APPLICATION:

IV. APPLICATION SITE DESCRIPTION:

1. ESTIMATED NUMBER OF ACRES:
2. GENERAL DESCRIPTION (Describe land type or use, size, stage of growth of target species, soil characteristics, and any additional information that may be important in describing the area to be treated.)

V. SENSITIVE ASPECTS AND PRECAUTIONS (Describe sensitive areas – marsh, endangered, threatened, candidate, and sensitive species habitat – and distance to application site. List measures to be taken to avoid impact to these areas):

VI. NON-TARGET VEGETATION (Describe potential immediate and cumulative impacts to non-target pests in Project area as a result of the pesticide application. Identify any planned mitigation measures that will be employed – BE GENERAL, SPECIFICS DISCUSSED IN THE EA):

VII. INTEGRATED PEST MANAGEMENT PRACTICES CONSIDERED IN THE OVERALL PROJECT:

VIII. SIGNATURES:

1. Pesticide Use Proposal's Originator: _____ Date:_____
   a. Company: _____
2. Certified Pesticide Applicator: _____ Date:_____
   a. Printed Name: _____
   b. Address: _____
   c. License Number: _____
   d. Certifying Organization: _____

3. Field Office Weed and Pest Coordinator: _____ Date: _____

4. Field Office Manager: _____ Date:_____

5. BLM State Weed and Pest Coordinator: _____ Date:_____

6. Deputy State Director: _____ Date:_____
   - Concur or Approved
   - Not Concur or Disapproved
   - Concur or Approved With Modifications

     - Any changes (modifications) to this proposal by the state pesticide Coordinator will be listed below or in an attached memo to the manager requesting approval from the Deputy State Director

Appendix K. Typical Wind Energy Project Diagrams

Diagrams of typical wind energy project components are included in this appendix. Descriptions of these components are provided in Chapter 3.

K-1. Foundations

The common wind turbine foundation designs discussed in Section 3.9.1 are illustrated below.

Table K-1-1: Typical dimensions for a 2 to 3 MW turbine

Design	Figure	D_1	D_2	D_3	D_{TOTAL}	W_t	W_{oe}	W_f
Mat	K-1-1	2 ft	4 ft	3 ft	9 ft	16 ft		
Mat w/ Over-Excavation	K-1-2	2 ft	4 ft	3 ft	9 ft	16 ft	Varies	
Mat w/ Piles	K-1-3	2 ft	3 ft	3 ft	11 ft	16 ft		
Tensionless Pier	K-1-4				60 ft	16 ft	16 -22 ft	16 – 22 ft

Figure K-1-1: Mat Foundation without Soil Improvement Illustration

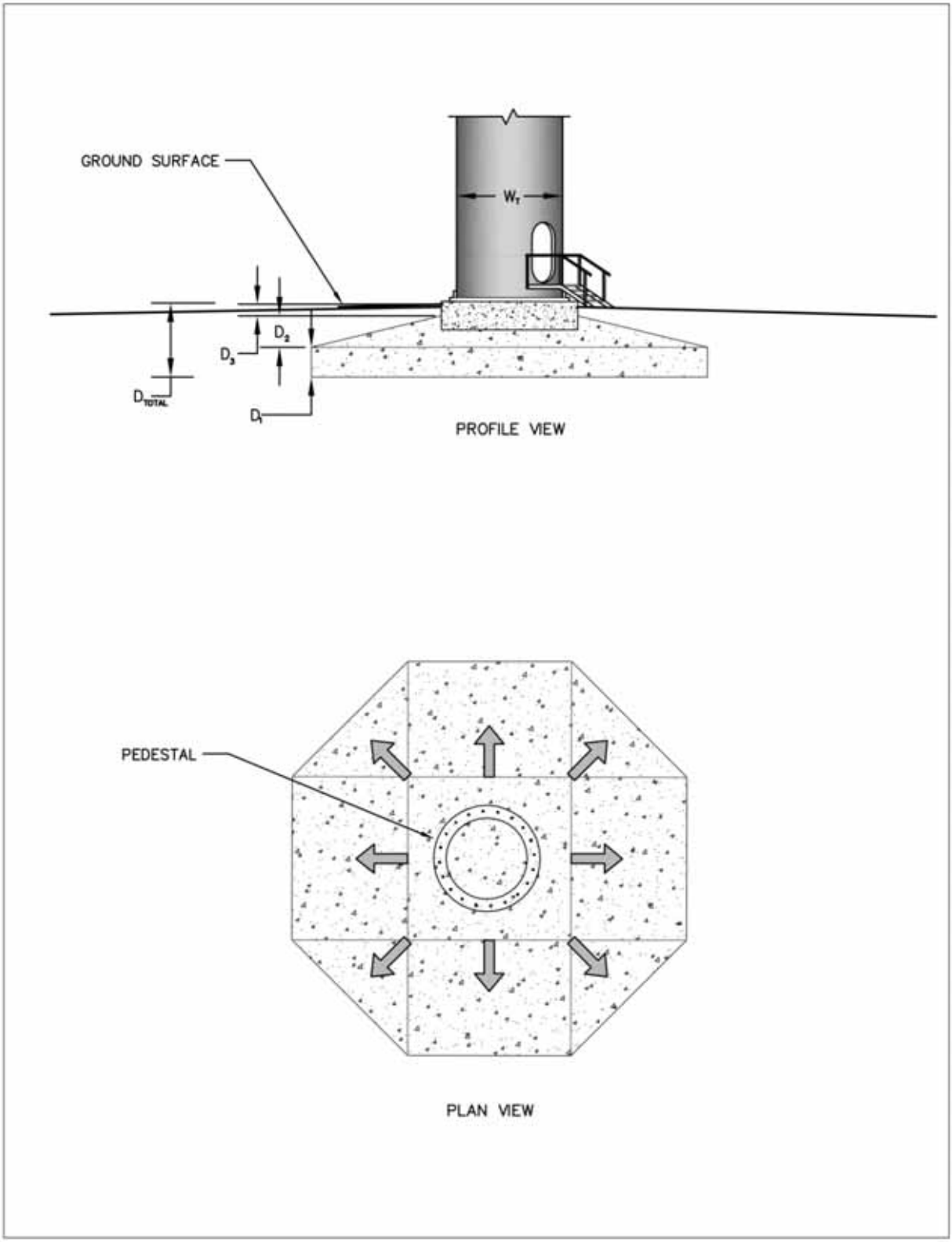


Figure K-1-2: Mat Foundation with Over Excavation

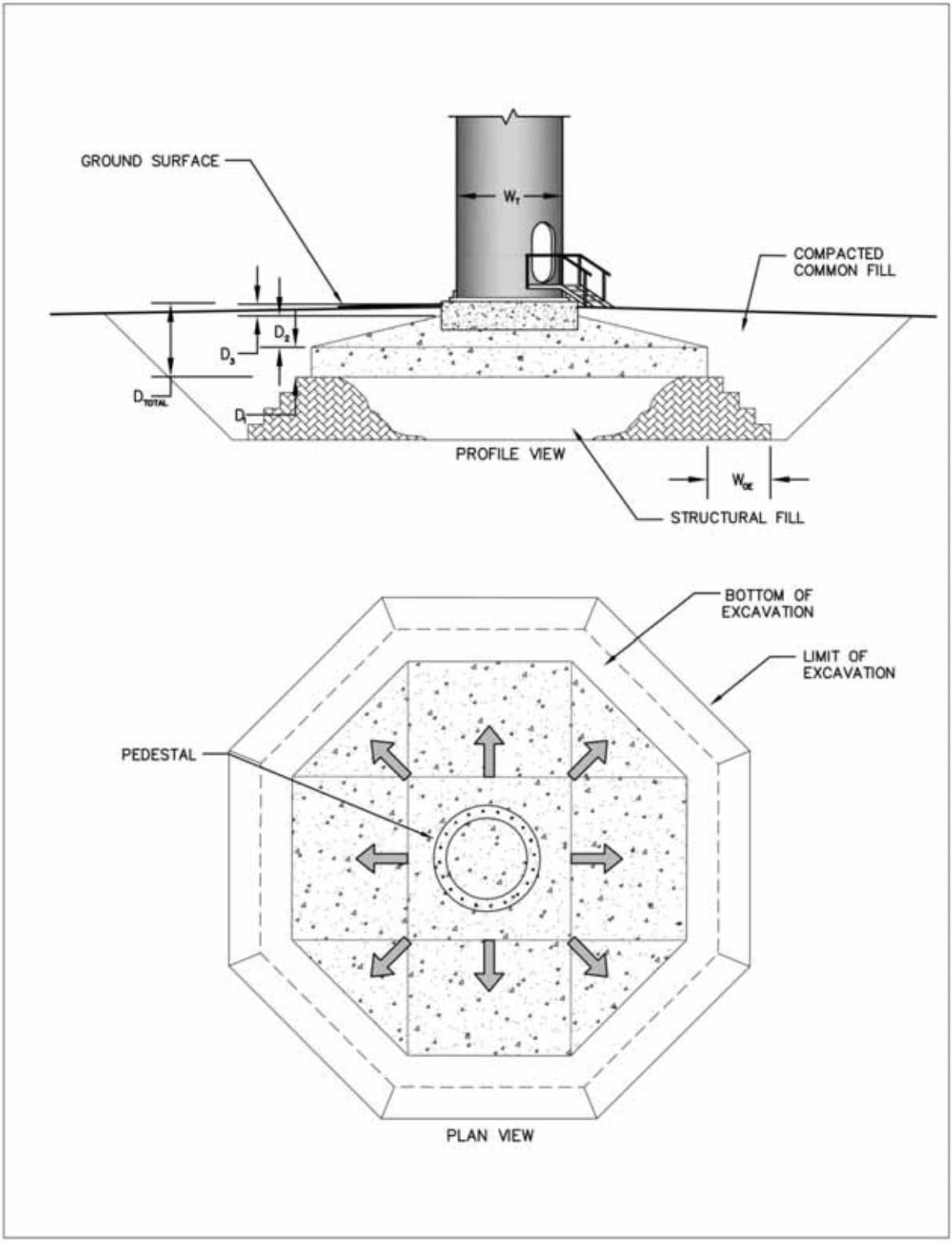


Figure K-1-3: Mat Foundation with Pile Stabilization

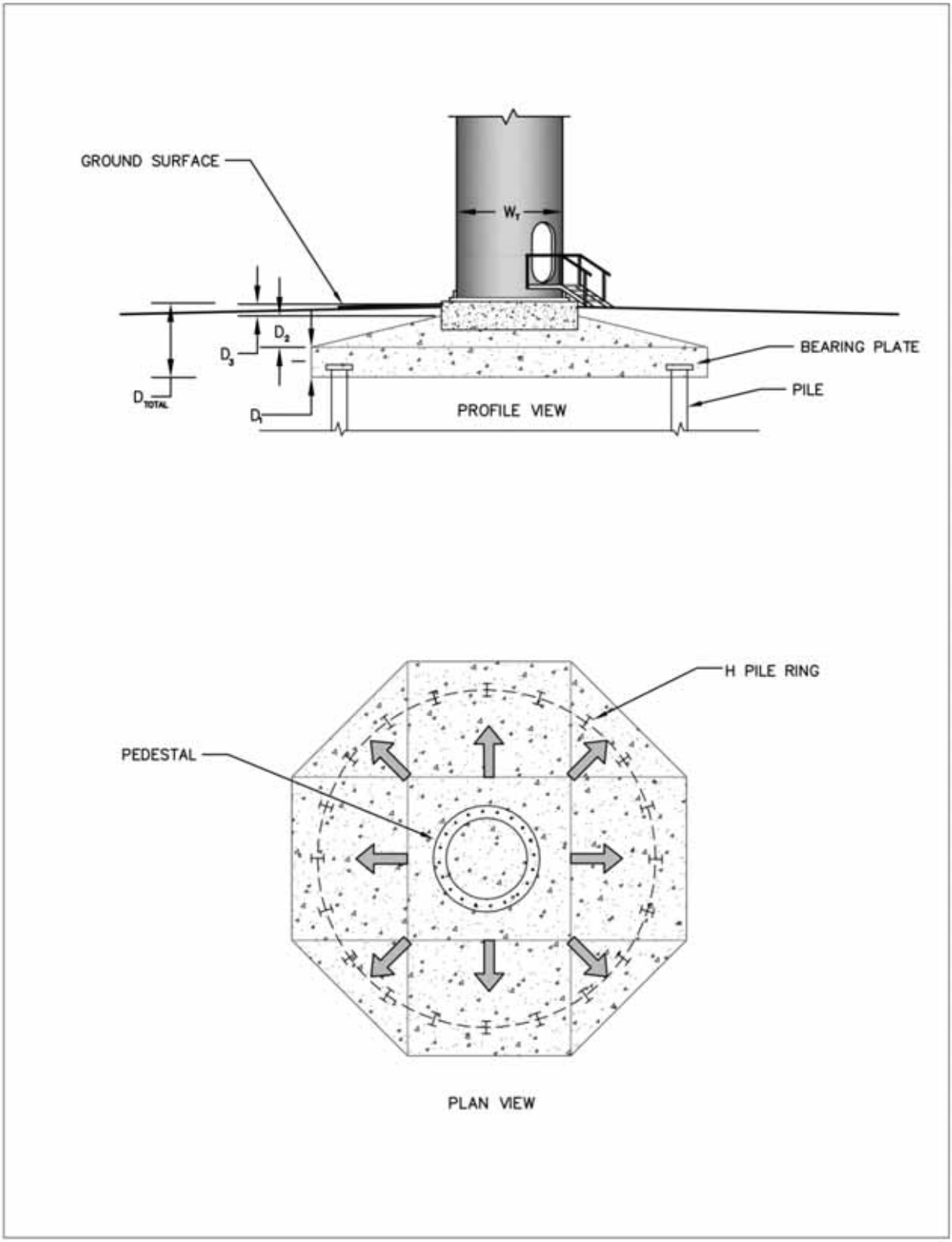


Figure K-1-4: Tensionless Pier Foundation

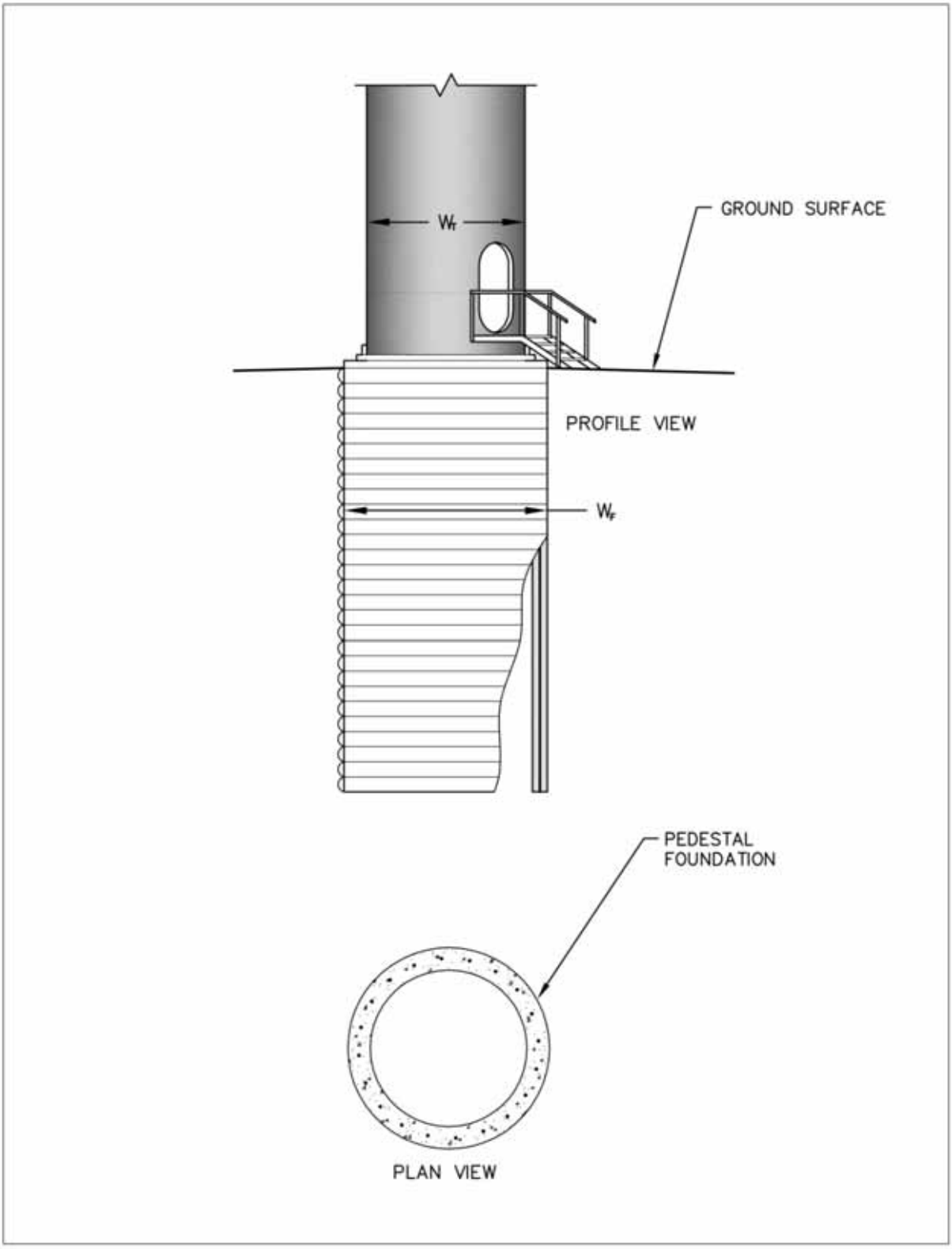
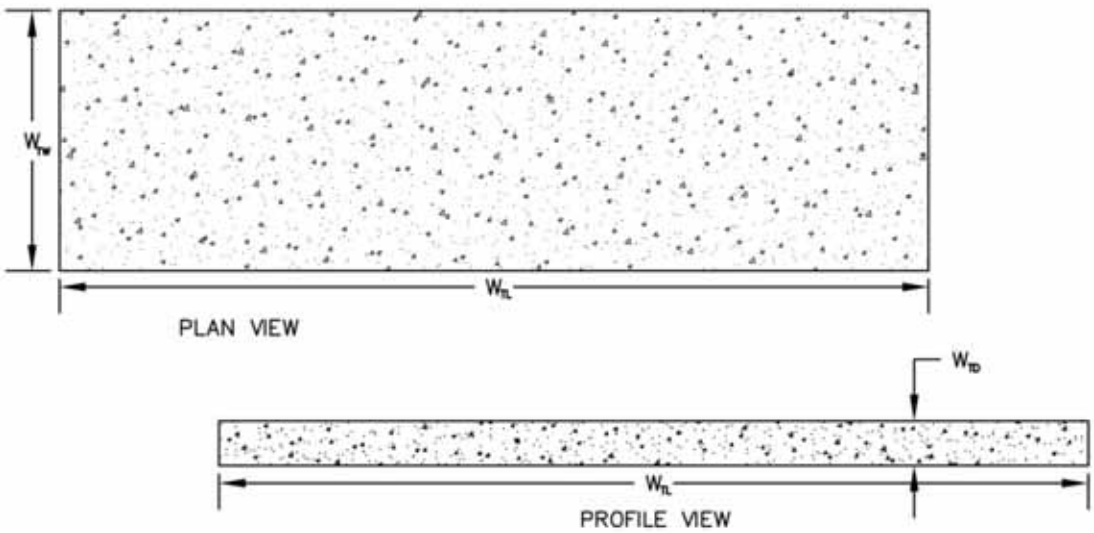
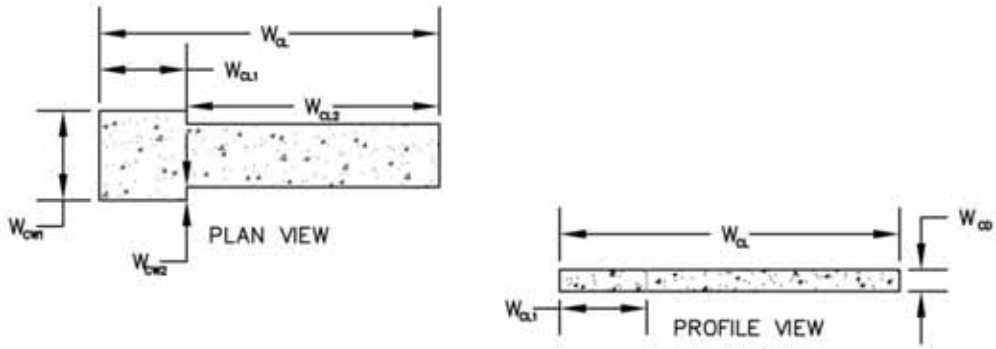


Figure K-1-5: Typical Substation Foundations



Transformer Foundation



Breaker and Control Cabinet Foundation

K-2. Roads

The following diagrams detail typical road cross-sections and stream crossings that PCW expects will be representative of the Project designs. Table K-2-1 provides common dimensions for the cross-sections. Deviations from these will occur where specific terrain requires.

Table K-2-1: Typical Dimensions for Road Cross-Sections

Design	Wrc	Wr	Ws	WC	Wd	Wsl	S1
Typical Roadway Corridor With Ditch Section (Figure K-2-1)							
Haul Road	120 ft	40 ft	5 ft		Up to 25 ft	varies	1-2%
Arterial Road	90 ft	24 ft	7 ft		Up to 25 ft	varies	1-2%
Turbine Road	80 ft	16 ft	11 ft		Up to 25 ft	varies	1-2%
Typical Roadway Corridor With Up To 1 Circuit (Figure K-2-2)							
Haul Road	120 ft	40 ft	5 ft			varies	1-2%
Arterial Road	90 ft	24 ft	7 ft			varies	1-2%
Turbine Road	80 ft	16 ft	11 ft			varies	1-2%
Typical Roadway Corridor with Multiple Circuits (Figure K-2-3)							
Haul Road	120 ft	40 ft	5 ft	12 ft		varies	1-2%
Arterial Road	90 ft	24 ft	7 ft	12 ft		varies	1-2%
Turbine Road	80 ft	16 ft	11 ft	12 ft		varies	1-2%
Typical Roadway Corridor with Overhead Collection (Figure K-2-4)							
Haul Road	120 ft	40 ft	5 ft			varies	1-2%
Arterial Road	90 ft	24 ft	7 ft			varies	1-2%
Turbine Road	80 ft	16 ft	11 ft			varies	1-2%

Figure K-2-1: Typical Roadway Corridor with Ditch Section

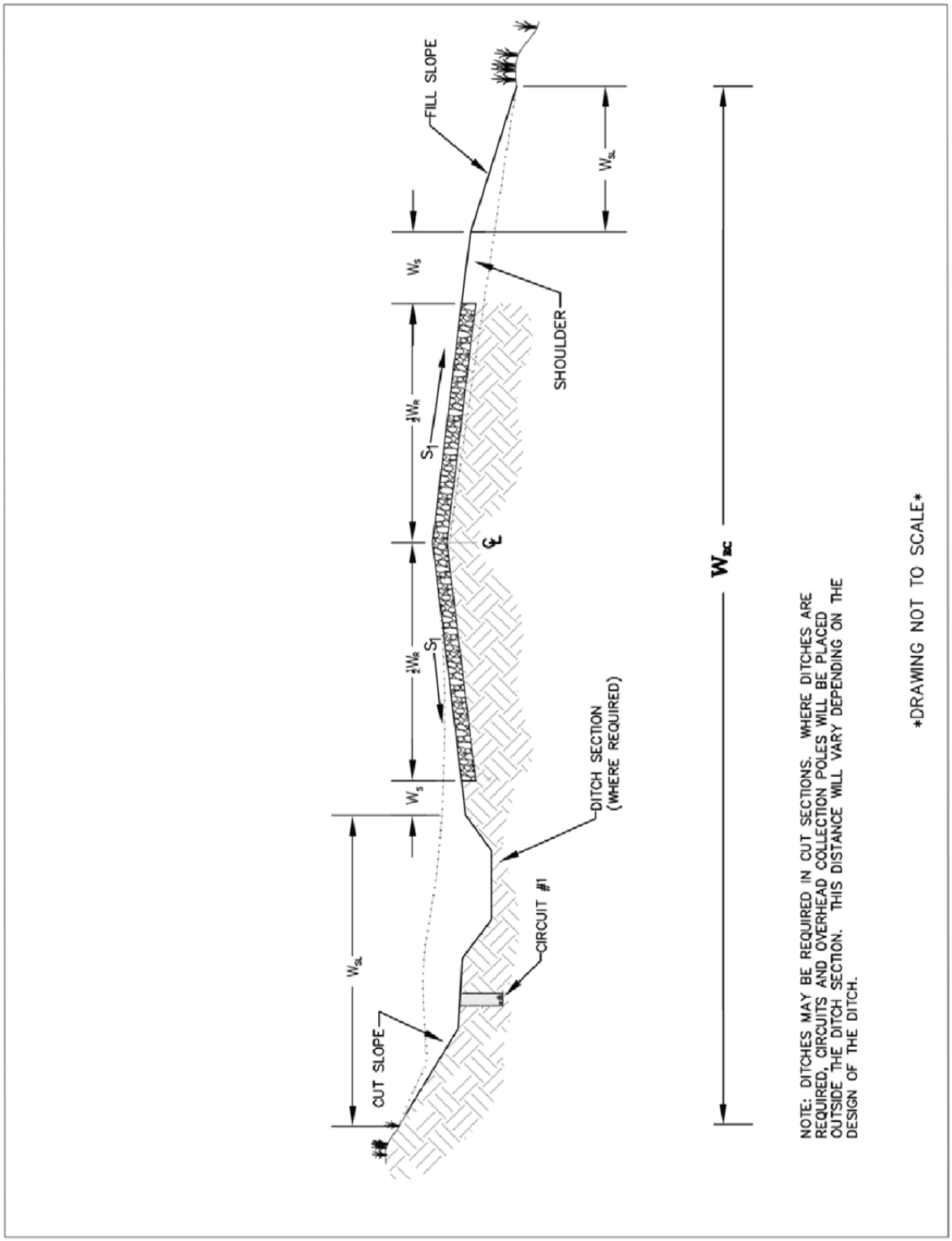


Figure K-2-2: Typical Roadway Corridor With Up To 1 Circuit

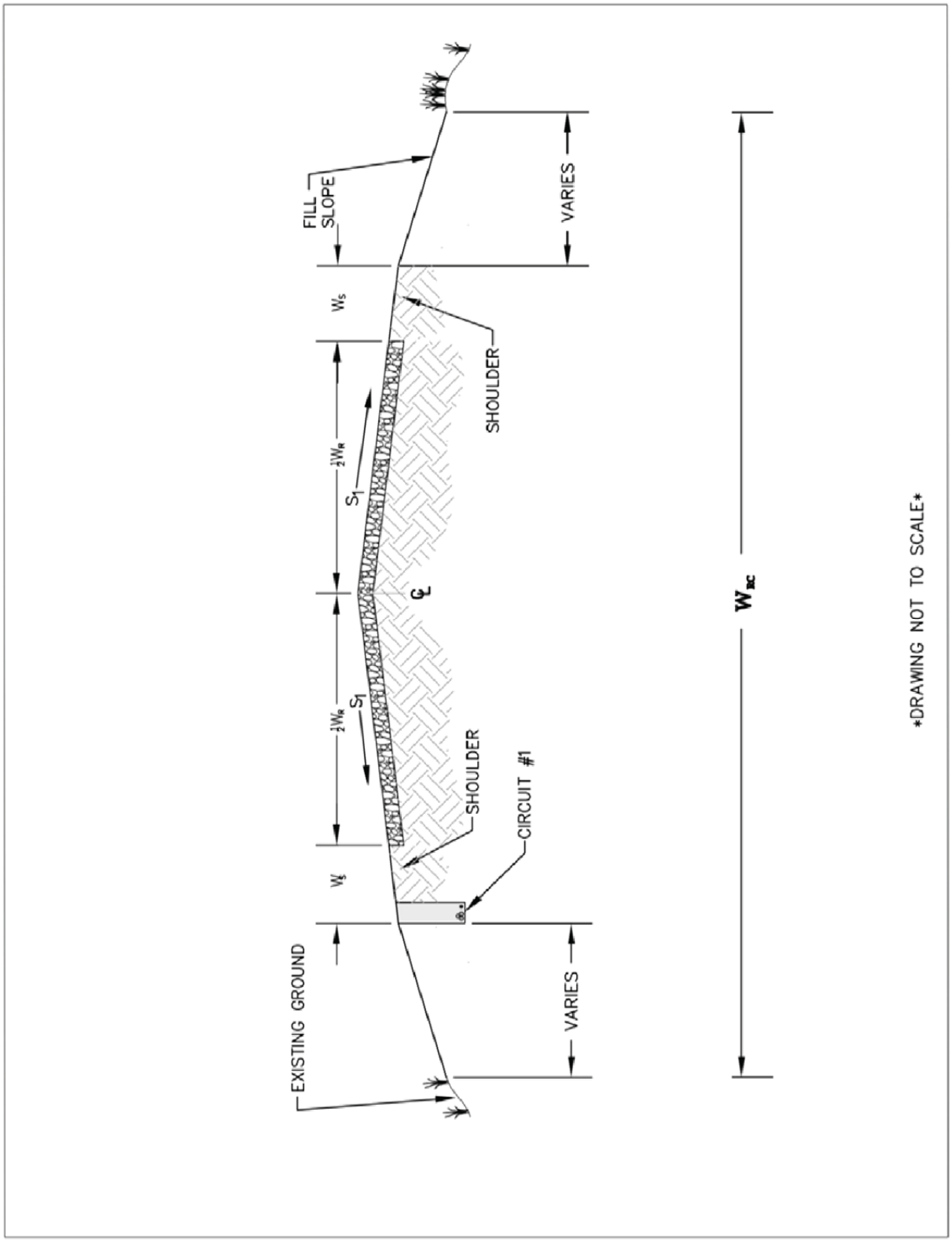


Figure K-2-3: Typical Roadway Corridor with Multiple Circuits

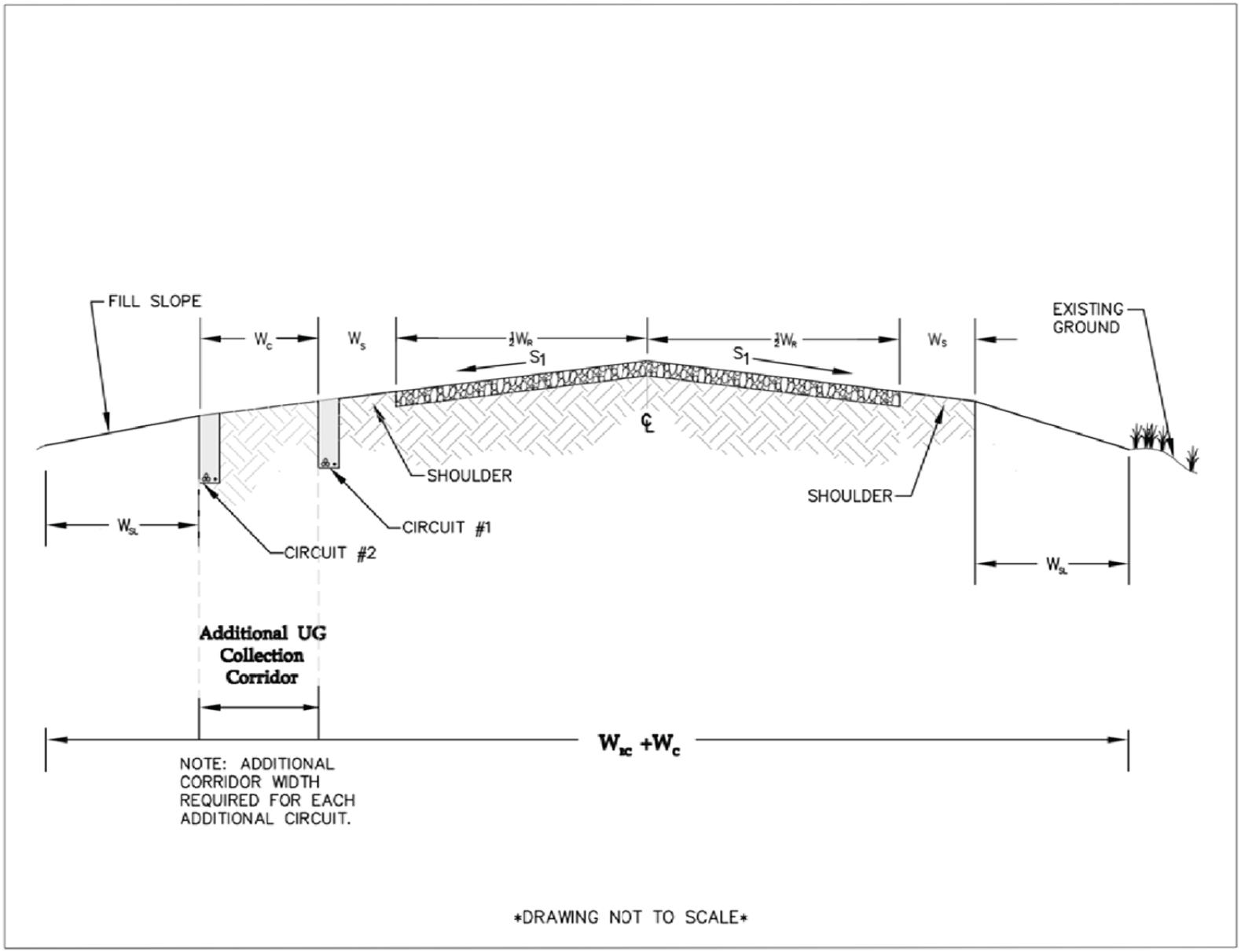


Figure K-2-4: Typical Roadway Corridor with Overhead Collection

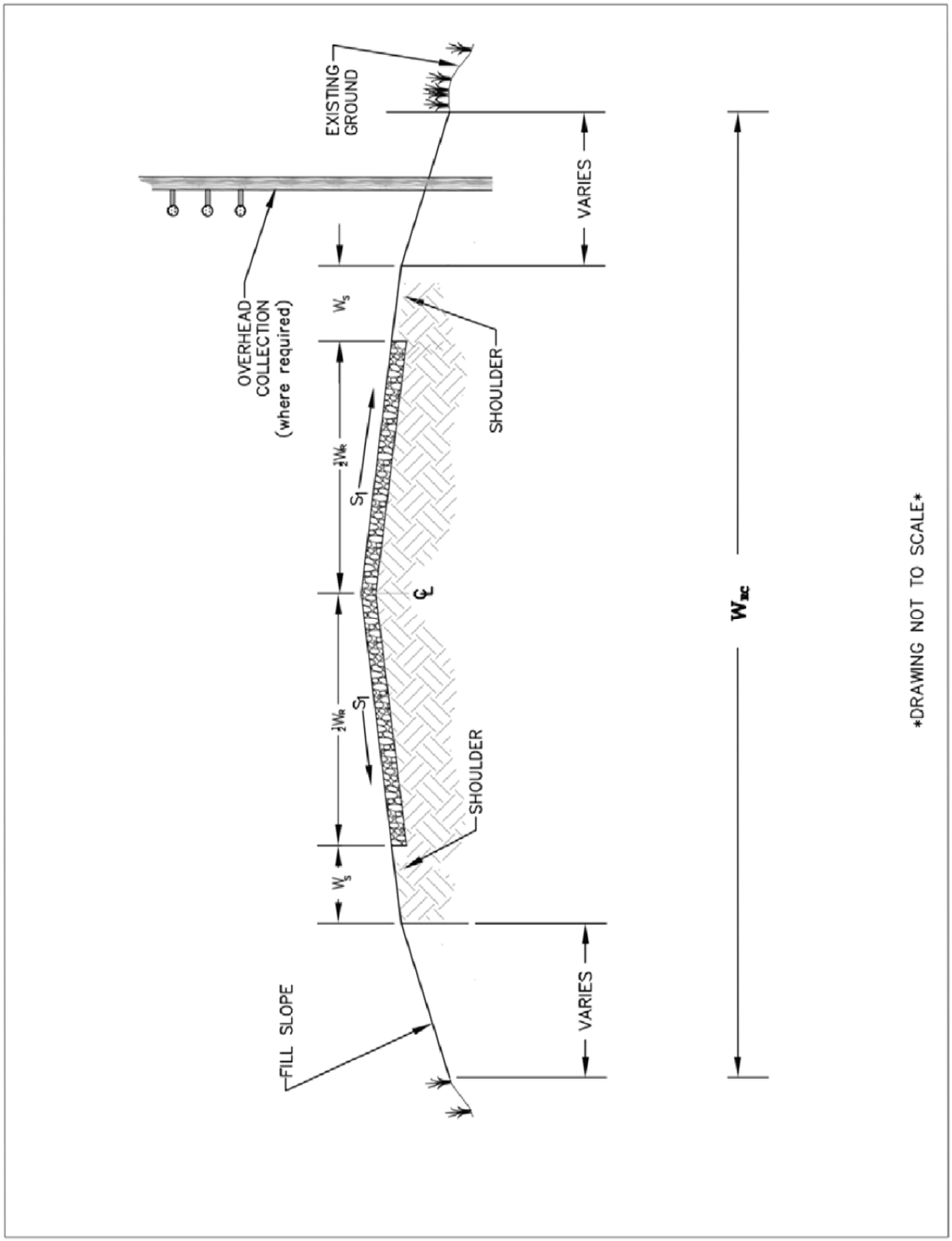


Figure K-2-5: At-Grade Crossing with Aggregate Surface

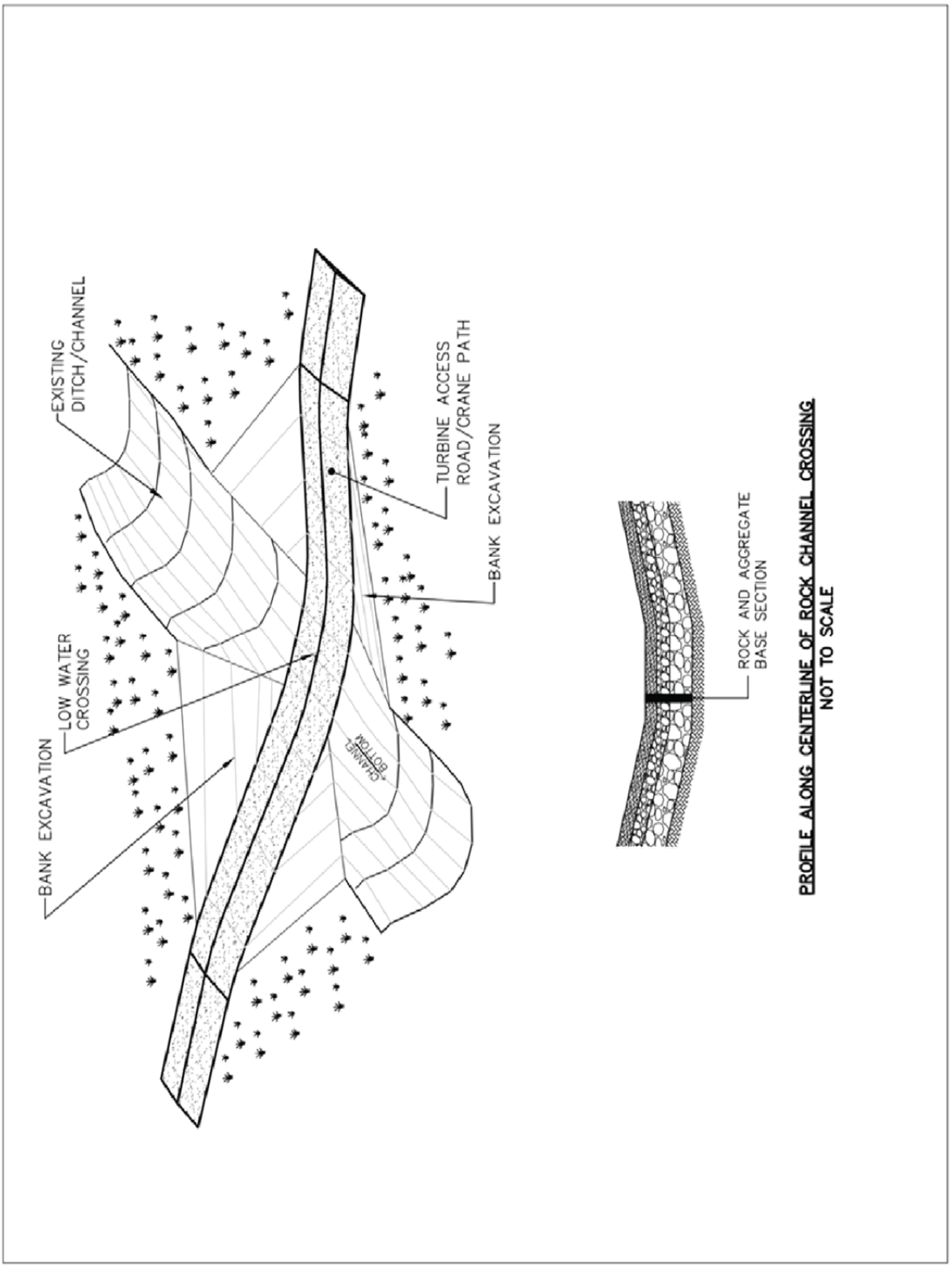


Figure K-2-6: At-Grade Crossing with Geocell Surface

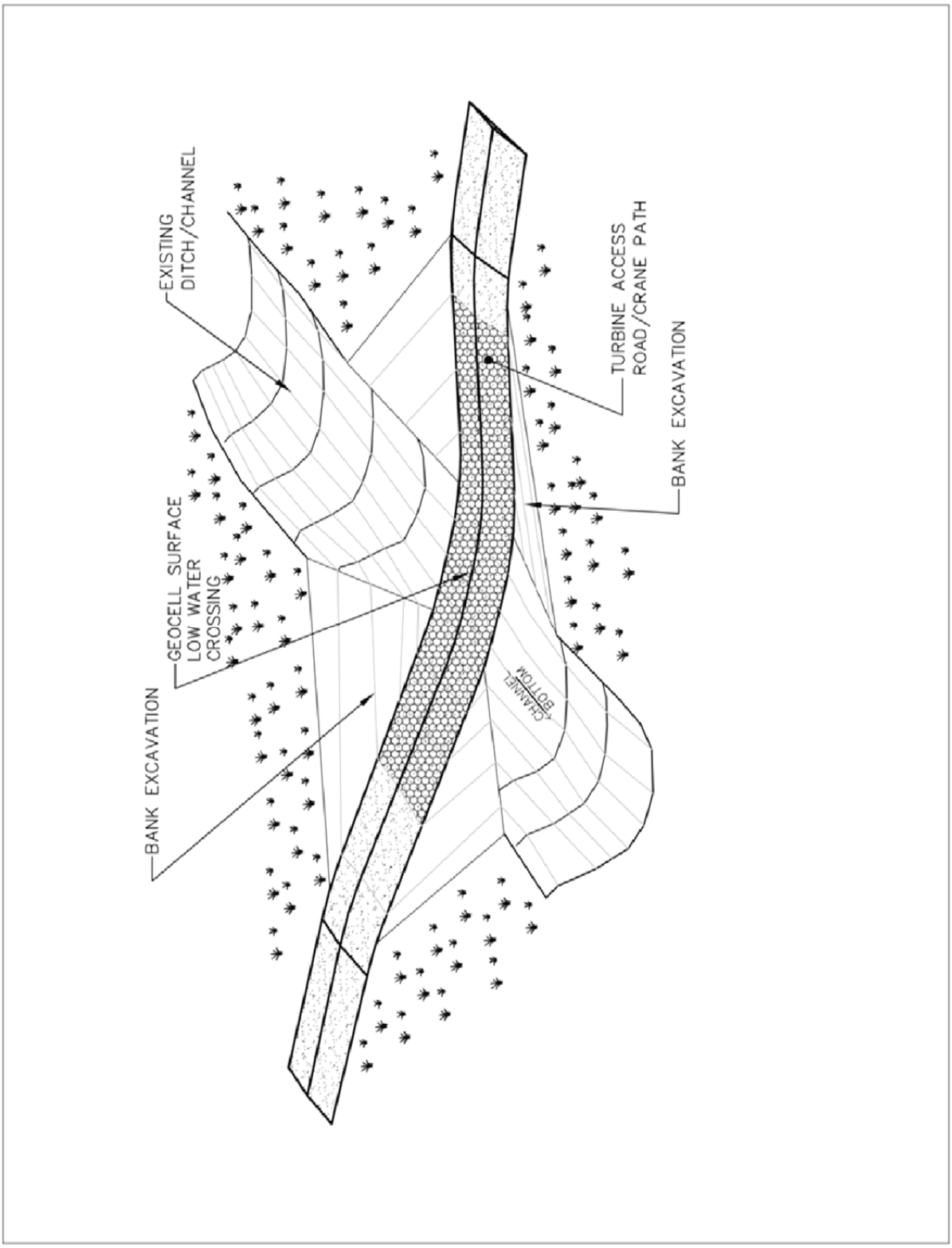


Figure K-2-7: At-Grade Crossing with Concrete Surface

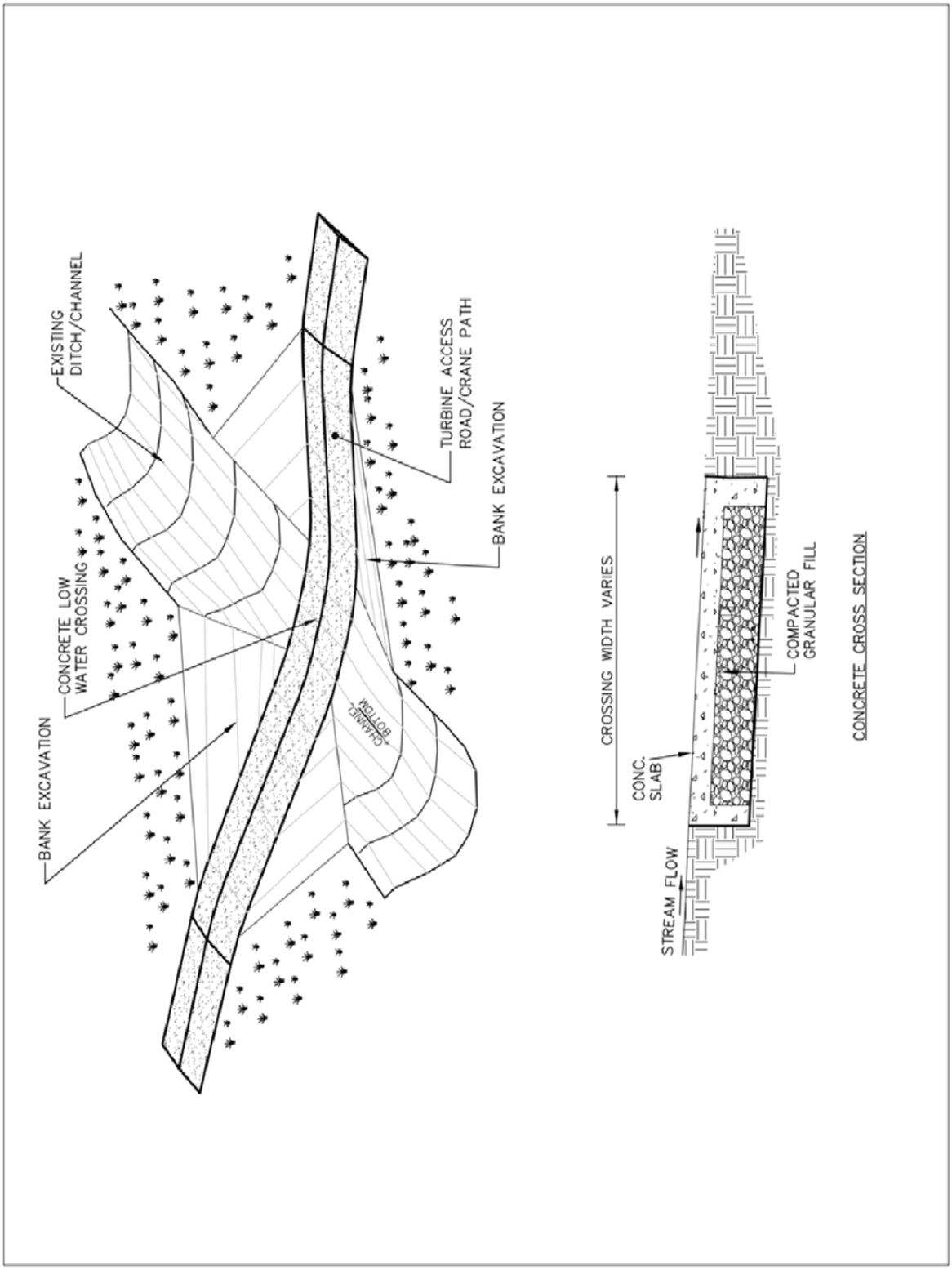


Figure K-2-8: Vented Stream Crossing with Single Culvert

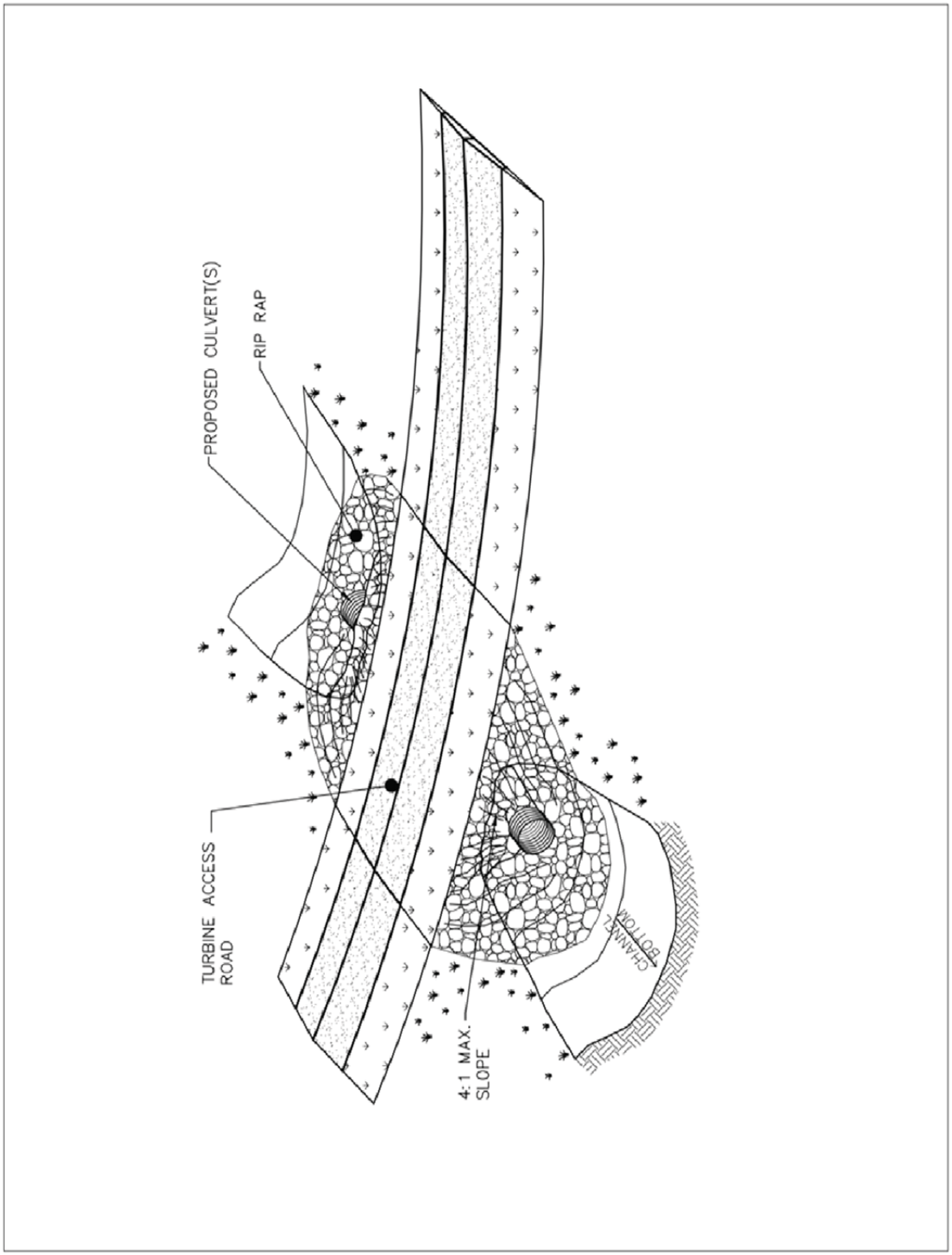


Figure K-2-9: Vented Stream Crossing with Multiple Culverts Option 1

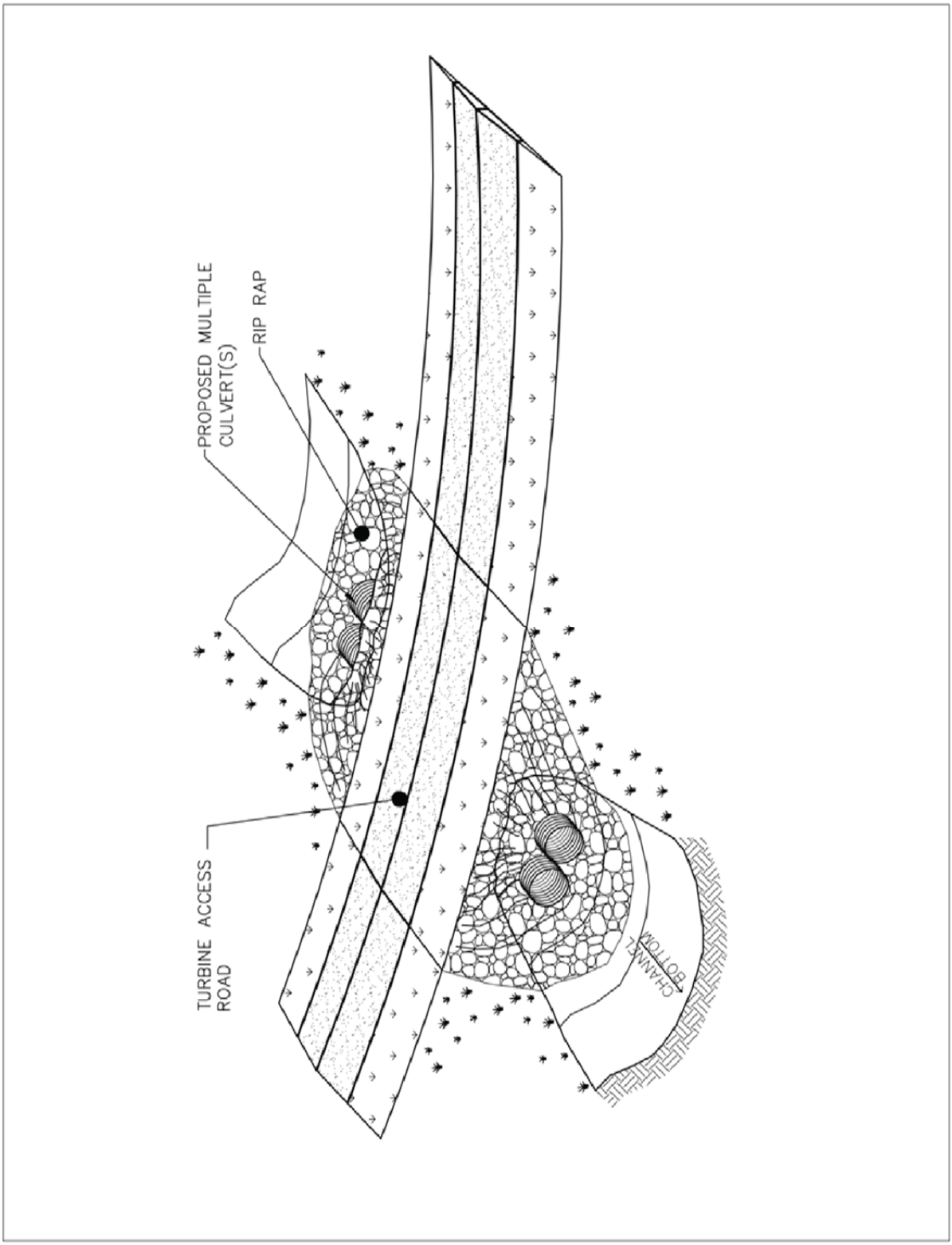


Figure K-2-10: Vented Stream Crossing with Multiple Culverts Option 2

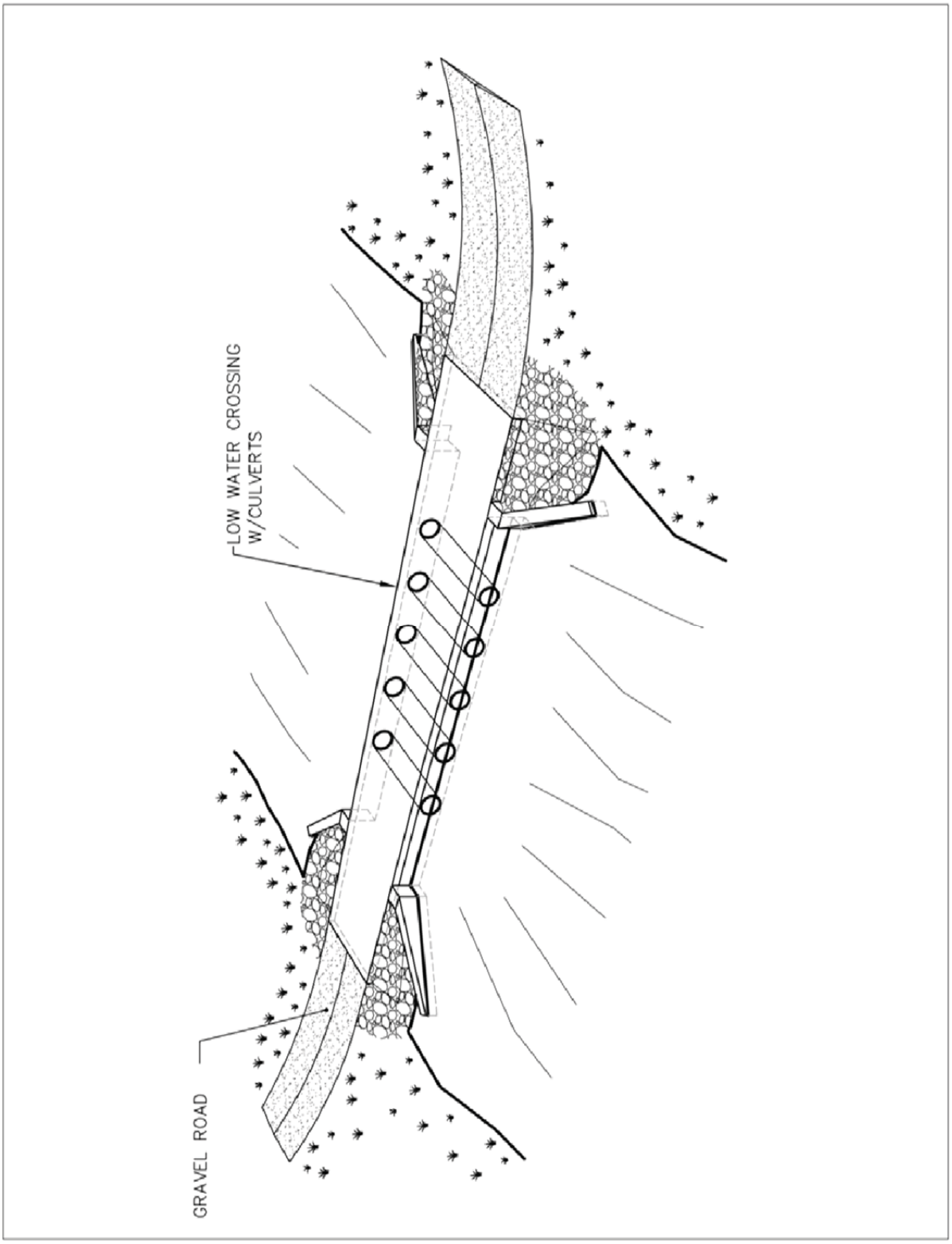


Figure K-2-11: Vented Stream Crossing with Box Culverts or Bridge

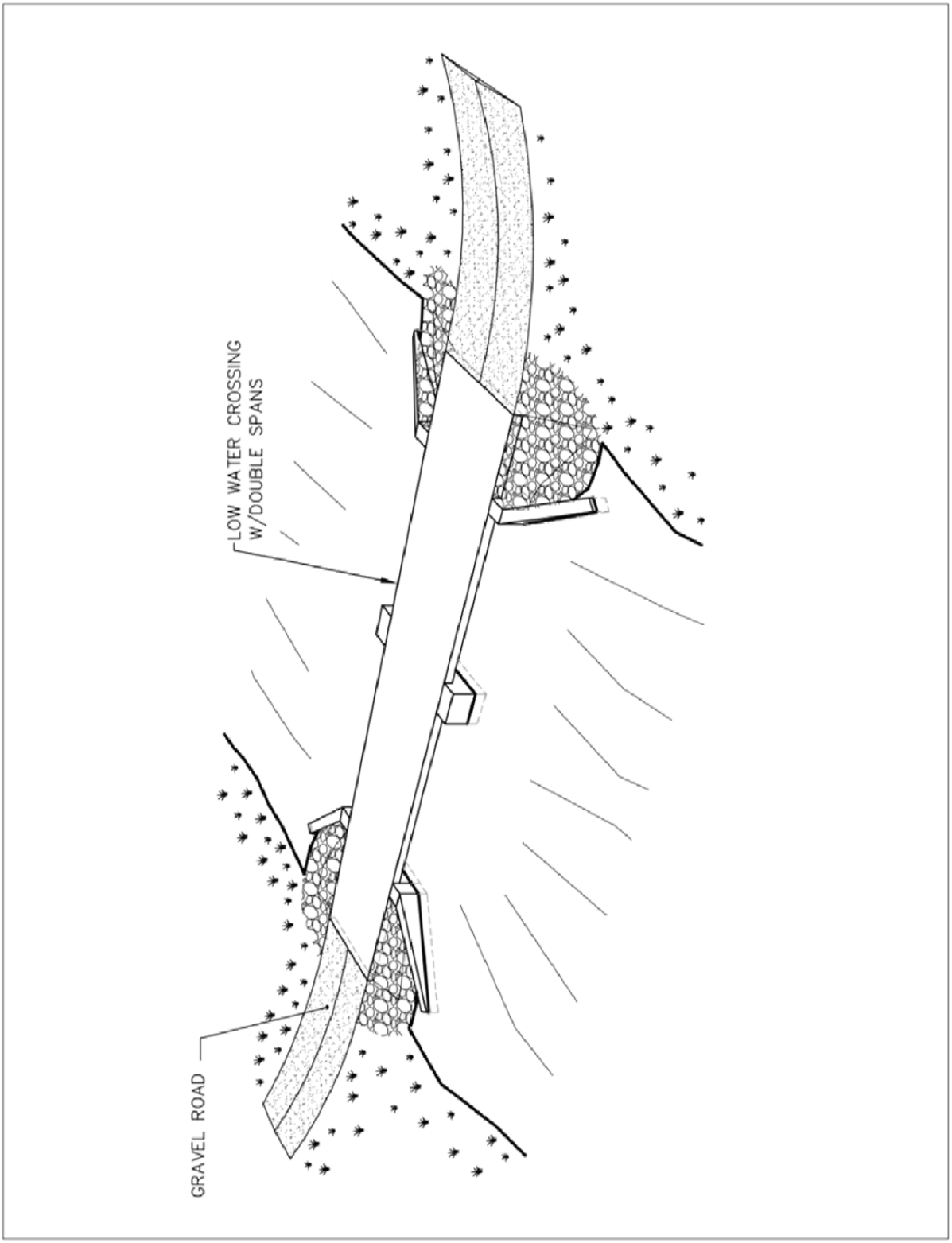
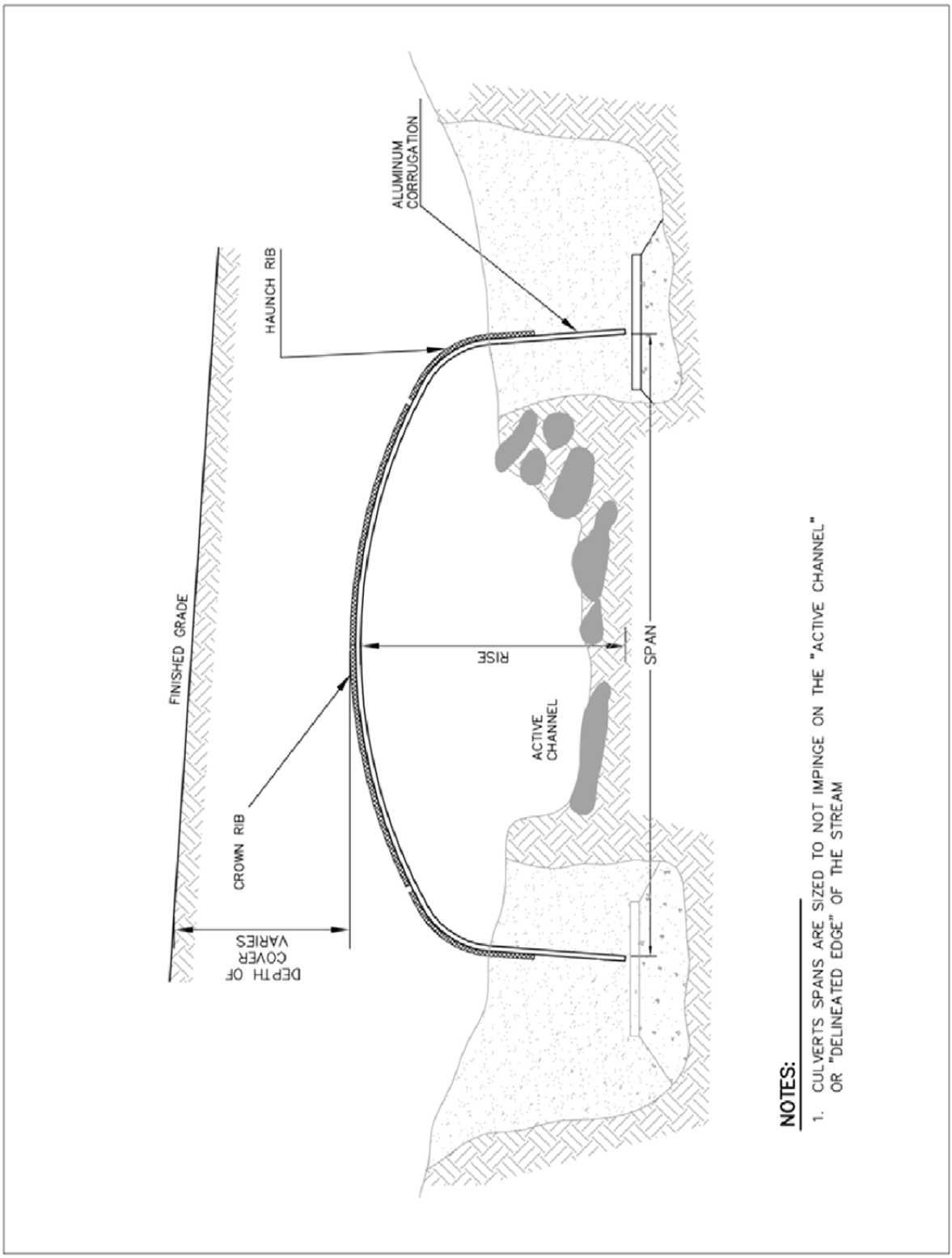


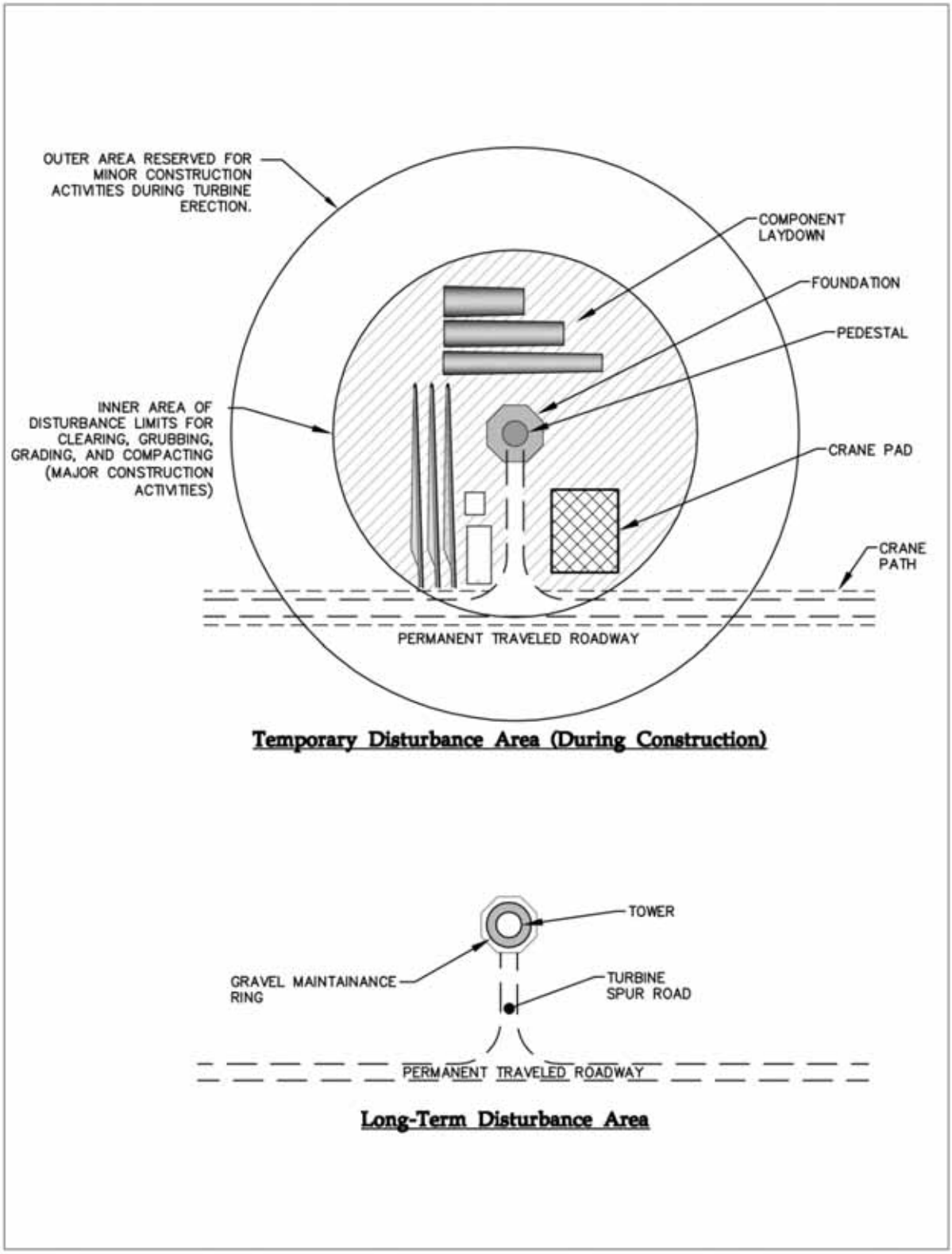
Figure K-2-12: Vented Stream Crossing with Natural Stream Bottom



K-3. Wind Turbine Pads

While the design of the wind turbine pad will be adjusted at each turbine location to account for the local topography, the following figure depicts a typical arrangement.

Figure K-3-1: Typical Wind Turbine Pad Configuration



K-4. Collection System

Diagrams for typical underground and overhead collection system elements are included below.

Figure K-4-1: Typical Underground Collection System Trench Cross-Section

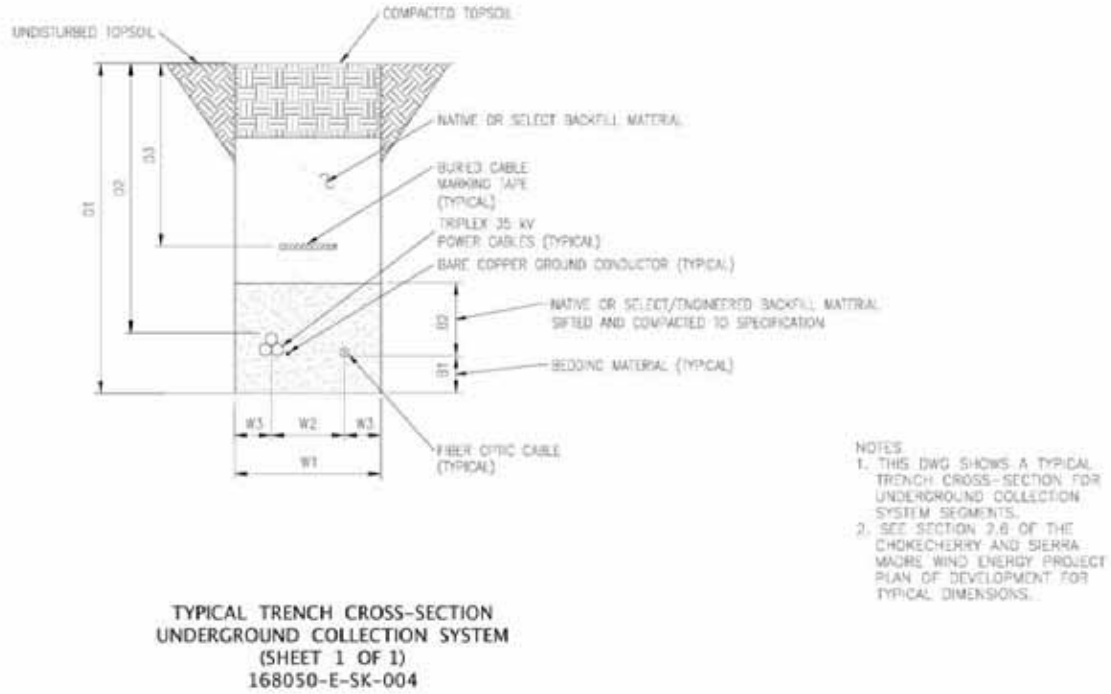
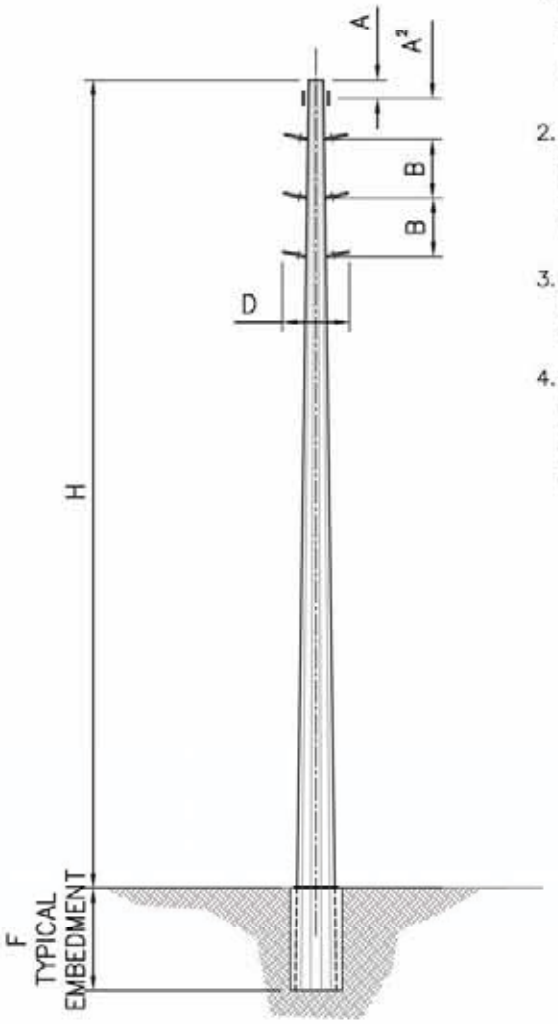


Figure K-4-2: Typical Overhead Collection Structure – Double Circuit, Light Angle



NOTES:

1. DIMENSIONS ARE PRELIMINARY AND WILL VARY DEPENDING GRADE AND LINE ANGLES. TYPICAL POLE HEIGHTS ARE DESIGNED FOR UP TO 20% SLOPES.
2. POLE TYPE SHOWN IS LIGHT DUTY STEEL; HOWEVER, FINAL DESIGN MAY UTILIZE WOOD AND/OR STEEL POLES DEPENDING ON GEOTECH AND LOADING COMBINATIONS.
3. FOUNDATIONS ARE TO BE TYPICAL AUGER DRILLED AND BACKFILLED WITH NATIVE MATERIAL.
4. SEE SECTION 2.6 OF THE CHOKECHERRY AND SIERRA MADRE WIND ENERGY PROJECT PLAN OF DEVELOPMENT FOR TYPICAL DIMENSIONS.

LIGHT ANGLE (0° – 8°)
DOUBLE CIRCUIT TANGENT
POST INSULATOR POLE

NTS

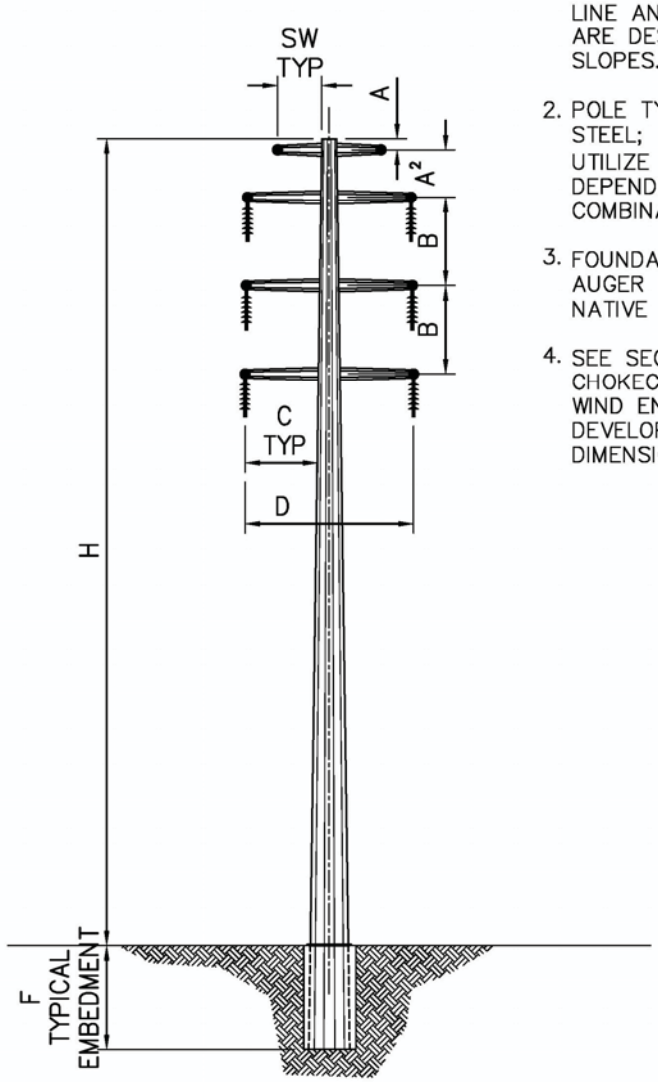
PRELIMINARY
NOT TO BE USED
FOR CONSTRUCTION

TYPICAL 34.5 KV
DC POST STRUCTURE
(SHEET 1 OF 7)
DC-POST REV A

Figure K-4-3: Typical Overhead Collection Structure – Double Circuit, Deadend

NOTES:

1. DIMENSIONS ARE PRELIMINARY AND WILL VARY DEPENDING GRADE AND LINE ANGLES. TYPICAL POLE HEIGHTS ARE DESIGNED FOR UP TO 20% SLOPES.
2. POLE TYPE SHOWN IS LIGHT DUTY STEEL; HOWEVER, FINAL DESIGN MAY UTILIZE WOOD AND/OR STEEL POLES DEPENDING ON GEOTECH AND LOADING COMBINATIONS.
3. FOUNDATIONS ARE TO BE TYPICAL AUGER DRILLED AND BACKFILLED WITH NATIVE MATERIAL.
4. SEE SECTION 2.6 OF THE CHOKECHERRY AND SIERRA MADRE WIND ENERGY PROJECT PLAN OF DEVELOPMENT FOR TYPICAL DIMENSIONS.

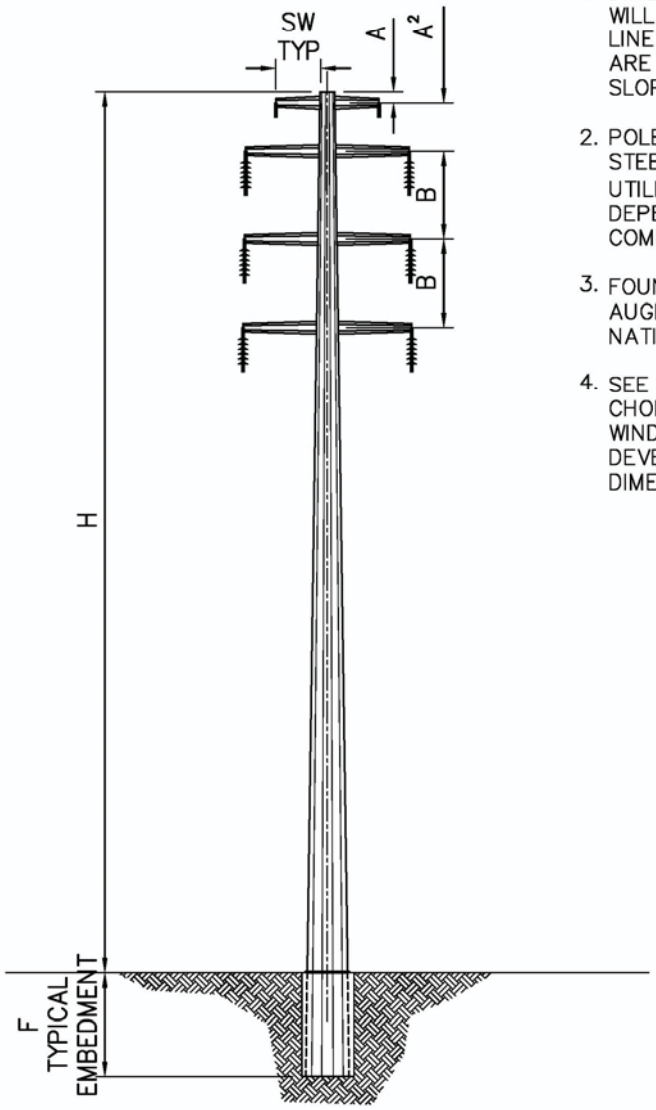


DOUBLE CIRCUIT DEADEND POLE
NTS

PRELIMINARY
NOT TO BE USED
FOR CONSTRUCTION

TYPICAL 34.5 KV
DC DEADEND STRUCTURE
(SHEET 2 OF 7)
DC-DE REV A

Figure K-4-4: Typical Overhead Collection Structure – Double Circuit, Deadend



NOTES:

1. DIMENSIONS ARE PRELIMINARY AND WILL VARY DEPENDING GRADE AND LINE ANGLES. TYPICAL POLE HEIGHTS ARE DESIGNED FOR UP TO 20% SLOPES.
2. POLE TYPE SHOWN IS LIGHT DUTY STEEL; HOWEVER, FINAL DESIGN MAY UTILIZE WOOD AND/OR STEEL POLES DEPENDING ON GEOTECH AND LOADING COMBINATIONS.
3. FOUNDATIONS ARE TO BE TYPICAL AUGER DRILLED AND BACKFILLED WITH NATIVE MATERIAL.
4. SEE SECTION 2.6 OF THE CHOKECHERRY AND SIERRA MADRE WIND ENERGY PROJECT PLAN OF DEVELOPMENT FOR TYPICAL DIMENSIONS.

HEAVY ANGLE (8° - 90°) DOUBLE CIRCUIT TANGENT POLE

NTS

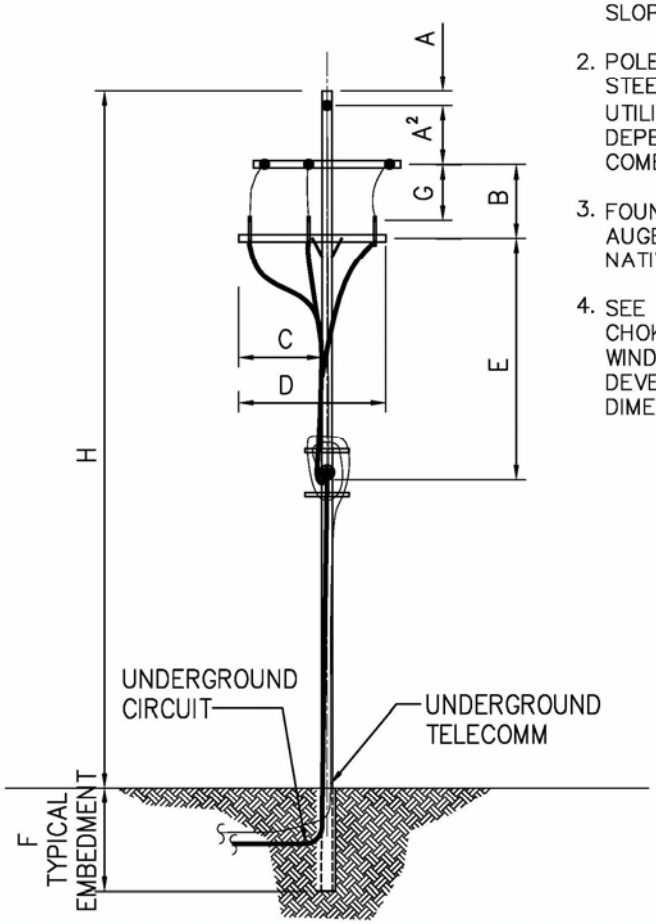
PRELIMINARY
NOT TO BE USED
FOR CONSTRUCTION

TYPICAL 34.5 KV
DC TANGENT STRUCTURE
(SHEET 3 OF 7)
DC-TAN REV A

Figure K-4-5: Typical Overhead Collection Structure – Single Circuit, Riser

NOTES:

1. DIMENSIONS ARE PRELIMINARY AND WILL VARY DEPENDING GRADE AND LINE ANGLES. TYPICAL POLE HEIGHTS ARE DESIGNED FOR UP TO 20% SLOPES.
2. POLE TYPE SHOWN IS LIGHT DUTY STEEL; HOWEVER, FINAL DESIGN MAY UTILIZE WOOD AND/OR STEEL POLES DEPENDING ON GEOTECH AND LOADING COMBINATIONS.
3. FOUNDATIONS ARE TO BE TYPICAL AUGER DRILLED AND BACKFILLED WITH NATIVE MATERIAL.
4. SEE SECTION 2.6 OF THE CHOKECHERRY AND SIERRA MADRE WIND ENERGY PROJECT PLAN OF DEVELOPMENT FOR TYPICAL DIMENSIONS.



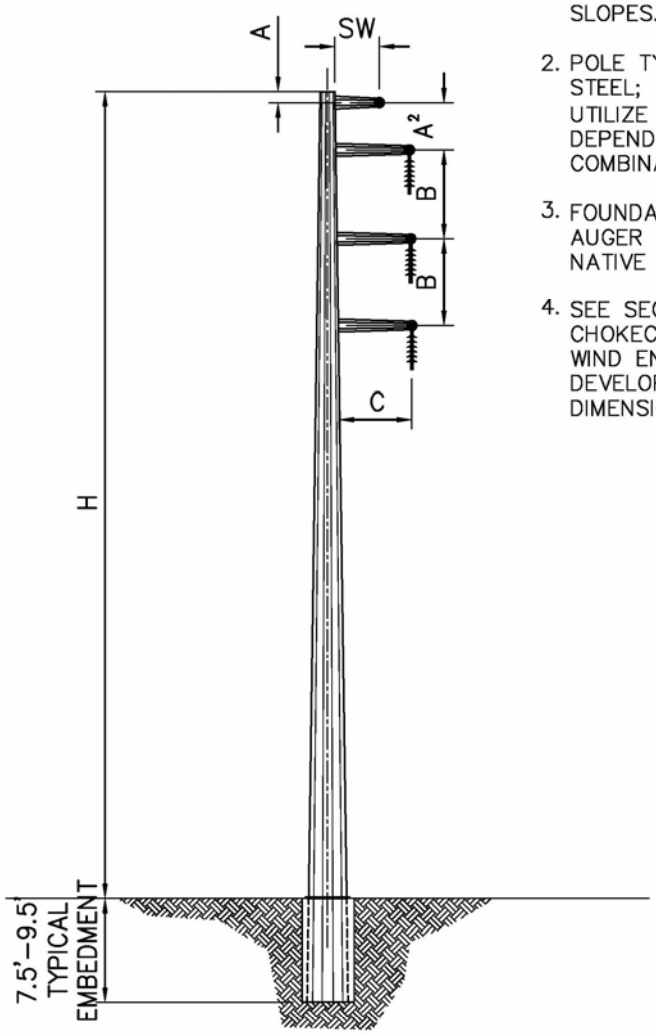
SINGLE CIRCUIT RISER POLE
NTS

TYPICAL 34.5 KV
SC RISER STRUCTURE
(SHEET 4 OF 7)
SC-RISER REV A

Figure K-4-6: Typical Overhead Collection Structure – Single Circuit, Deadend

NOTES:

1. DIMENSIONS ARE PRELIMINARY AND WILL VARY DEPENDING GRADE AND LINE ANGLES. TYPICAL POLE HEIGHTS ARE DESIGNED FOR UP TO 20% SLOPES.
2. POLE TYPE SHOWN IS LIGHT DUTY STEEL; HOWEVER, FINAL DESIGN MAY UTILIZE WOOD AND/OR STEEL POLES DEPENDING ON GEOTECH AND LOADING COMBINATIONS.
3. FOUNDATIONS ARE TO BE TYPICAL AUGER DRILLED AND BACKFILLED WITH NATIVE MATERIAL.
4. SEE SECTION 2.6 OF THE CHOKECHERRY AND SIERRA MADRE WIND ENERGY PROJECT PLAN OF DEVELOPMENT FOR TYPICAL DIMENSIONS.



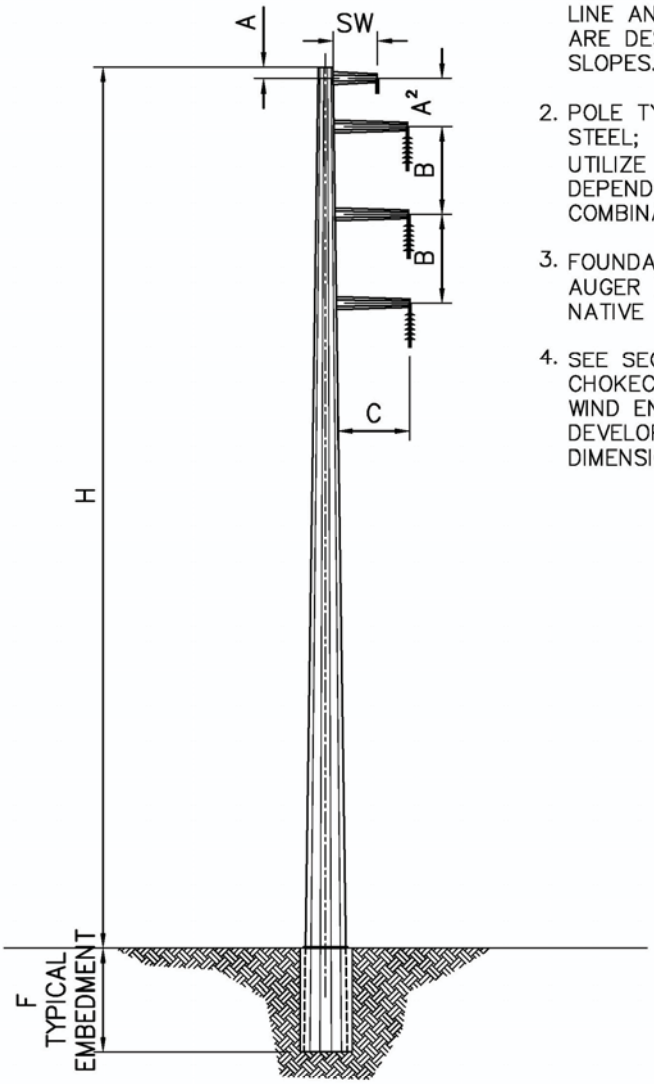
SINGLE CIRCUIT DEADEND POLE
NTS

TYPICAL 34.5 KV
SC DEADEND STRUCTURE
(SHEET 5 OF 7)
SC-DE REV A

Figure K-4-7: Typical Overhead Collection Structure – Single Circuit, Heavy Angle

NOTES:

1. DIMENSIONS ARE PRELIMINARY AND WILL VARY DEPENDING GRADE AND LINE ANGLES. TYPICAL POLE HEIGHTS ARE DESIGNED FOR UP TO 20% SLOPES.
2. POLE TYPE SHOWN IS LIGHT DUTY STEEL; HOWEVER, FINAL DESIGN MAY UTILIZE WOOD AND/OR STEEL POLES DEPENDING ON GEOTECH AND LOADING COMBINATIONS.
3. FOUNDATIONS ARE TO BE TYPICAL AUGER DRILLED AND BACKFILLED WITH NATIVE MATERIAL.
4. SEE SECTION 2.6 OF THE CHOKECHERRY AND SIERRA MADRE WIND ENERGY PROJECT PLAN OF DEVELOPMENT FOR TYPICAL DIMENSIONS.



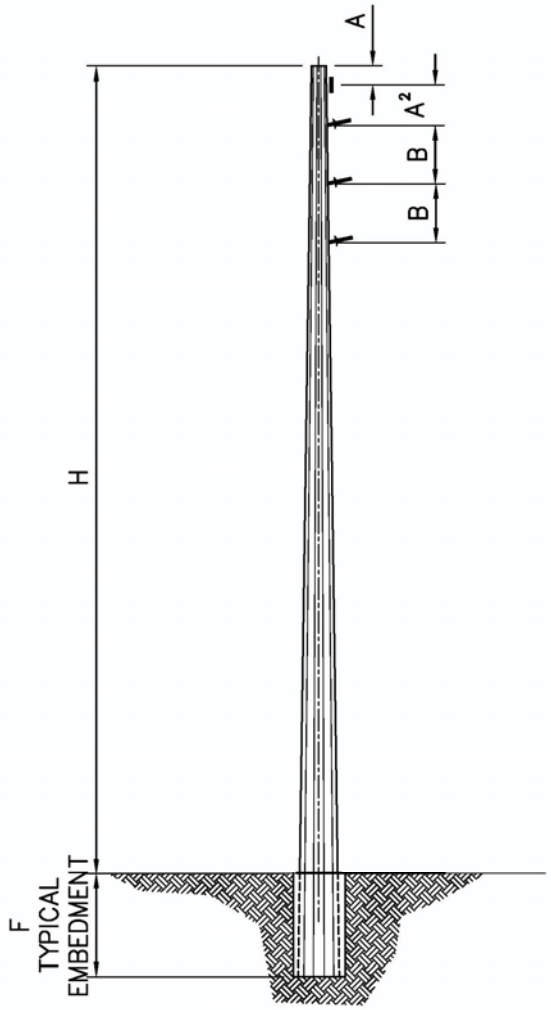
HEAVY ANGLE (8° – 90°) SINGLE CIRCUIT TANGENT POLE

NTS

PRELIMINARY
NOT TO BE USED
FOR CONSTRUCTION

TYPICAL 34.5 KV
SC TANGENT STRUCTURE
(SHEET 6 OF 7)
SC-TAN REV A

Figure K-4-8: Typical Overhead Collection Structure – Single Circuit, Light Angle



NOTES:

1. DIMENSIONS ARE PRELIMINARY AND WILL VARY DEPENDING GRADE AND LINE ANGLES. TYPICAL POLE HEIGHTS ARE DESIGNED FOR UP TO 20% SLOPES.
2. POLE TYPE SHOWN IS LIGHT DUTY STEEL; HOWEVER, FINAL DESIGN MAY UTILIZE WOOD AND/OR STEEL POLES DEPENDING ON GEOTECH AND LOADING COMBINATIONS.
3. FOUNDATIONS ARE TO BE TYPICAL AUGER DRILLED AND BACKFILLED WITH NATIVE MATERIAL.
4. SEE SECTION 2.6 OF THE CHOKECHERRY AND SIERRA MADRE WIND ENERGY PROJECT PLAN OF DEVELOPMENT FOR TYPICAL DIMENSIONS.

LIGHT ANGLE (0° – 8°)
SINGLE CIRCUIT TANGENT
POST INSULATOR POLE

NTS

TYPICAL 34.5 KV
SC POST TANGENT STRUCTURE
(SHEET 7 OF 7)
SC-POST REV A

K-5. Collection Substations

The typical arrangement for wind energy project collection substations are shown below.

Figure K-5-1: Typical Collection Substation – Three Transformer, Plan View

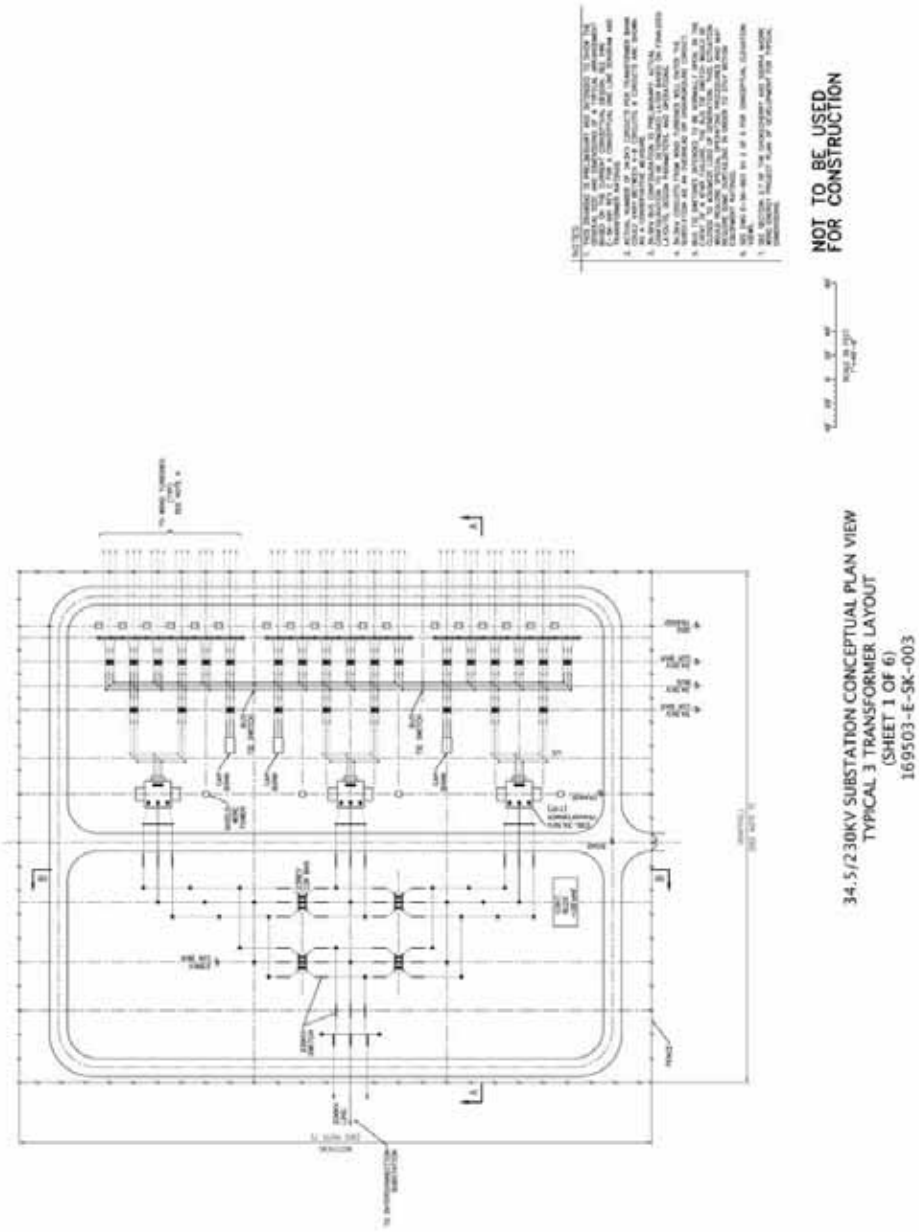


Figure K-5-2: Typical Collection Substation – Three Transformer, Profile View

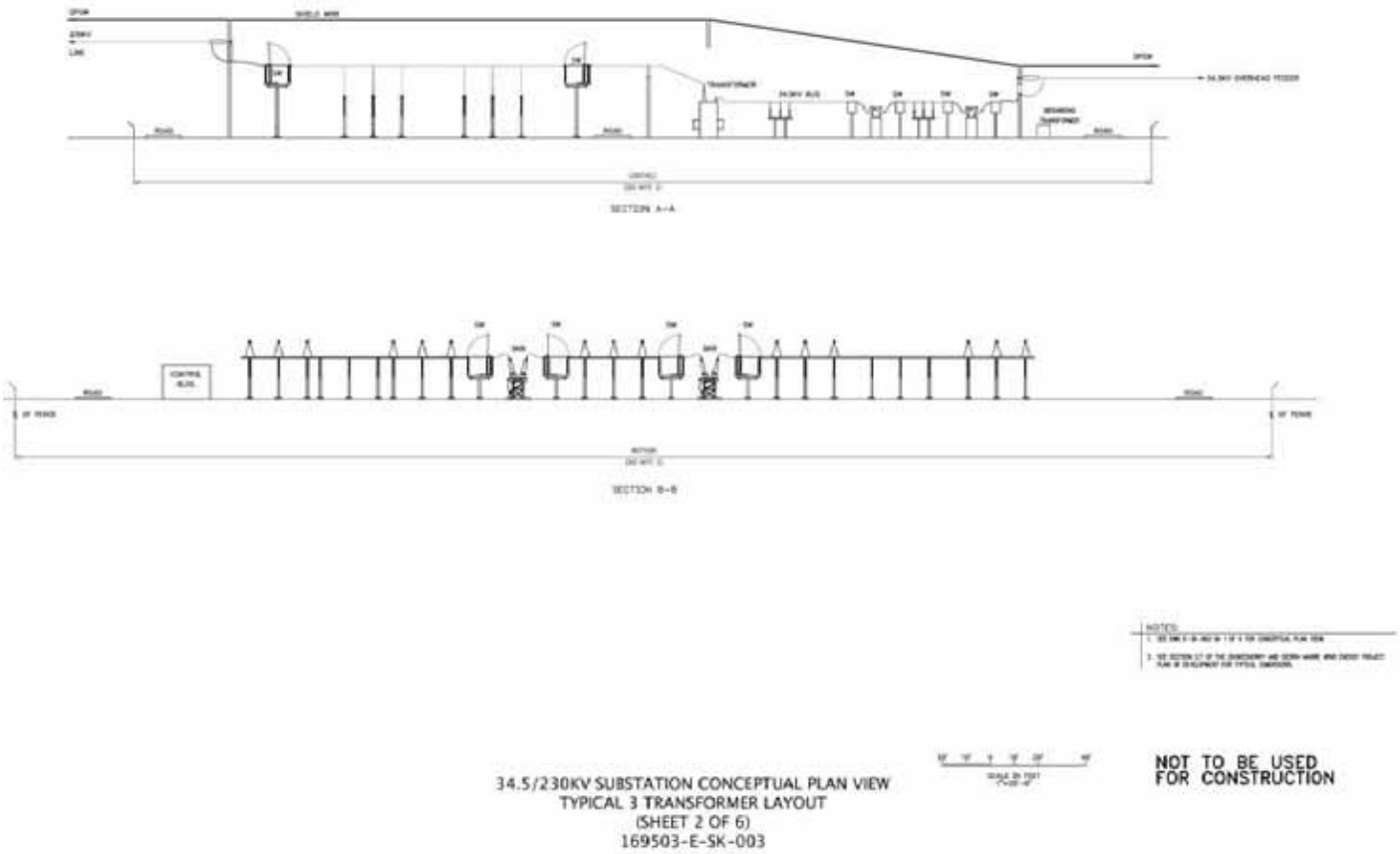


Figure K-5-3: Typical Collection Substation – Two Transformer, Plan View

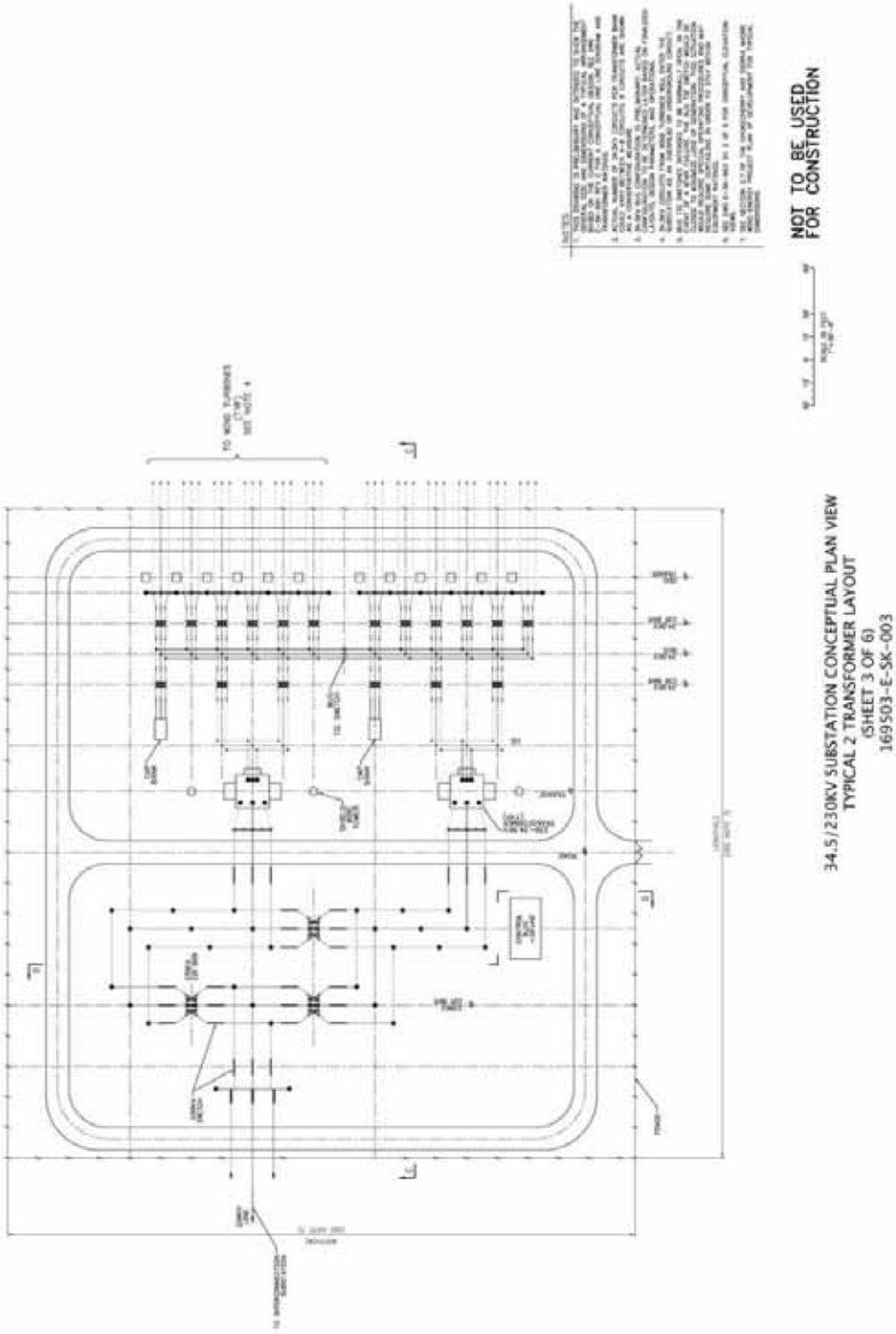


Figure K-5-4: Typical Collection Substation – Two Transformer, Profile View

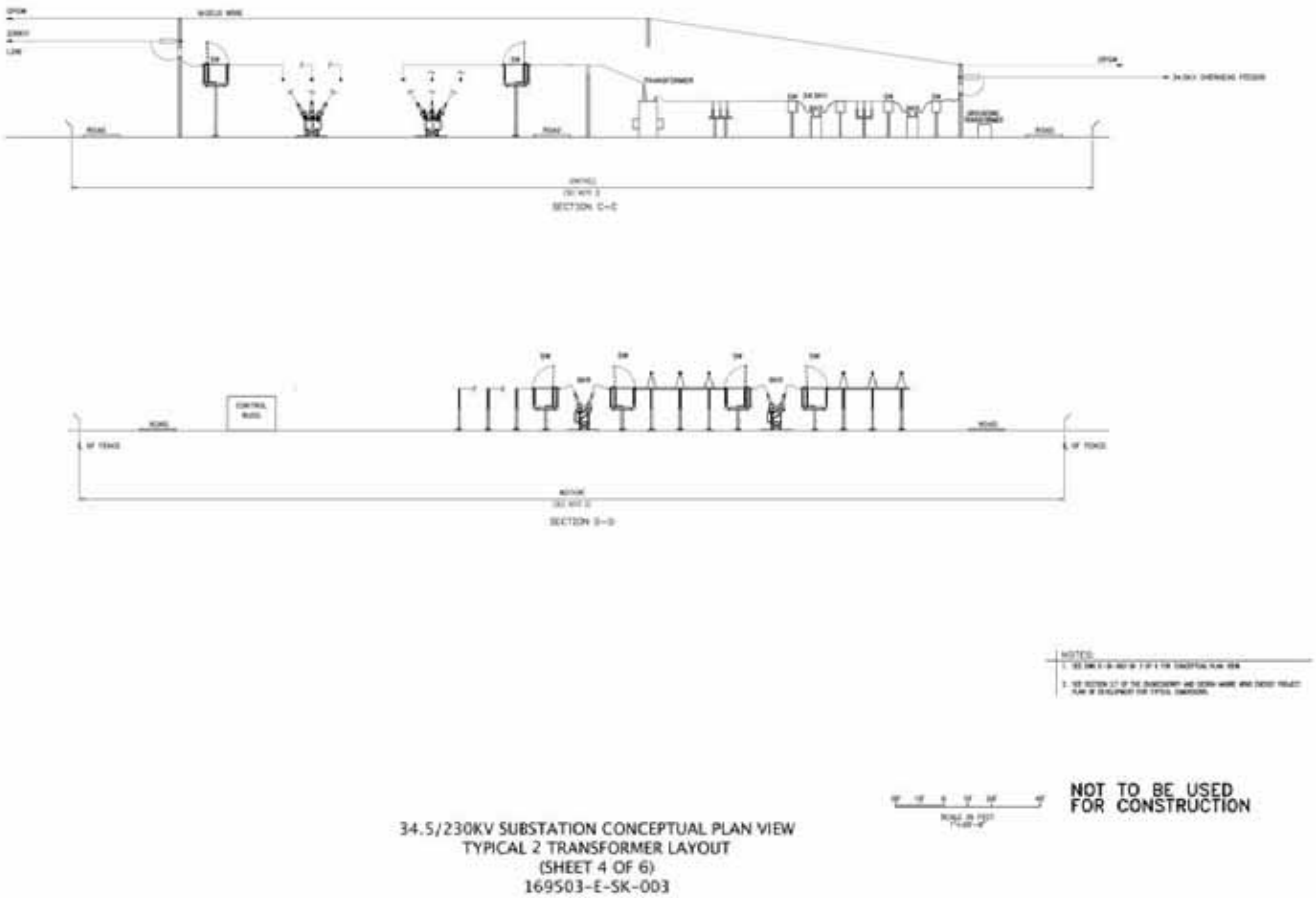


Figure K-5-5: Typical Collection Substation – One Transformer, Plan View

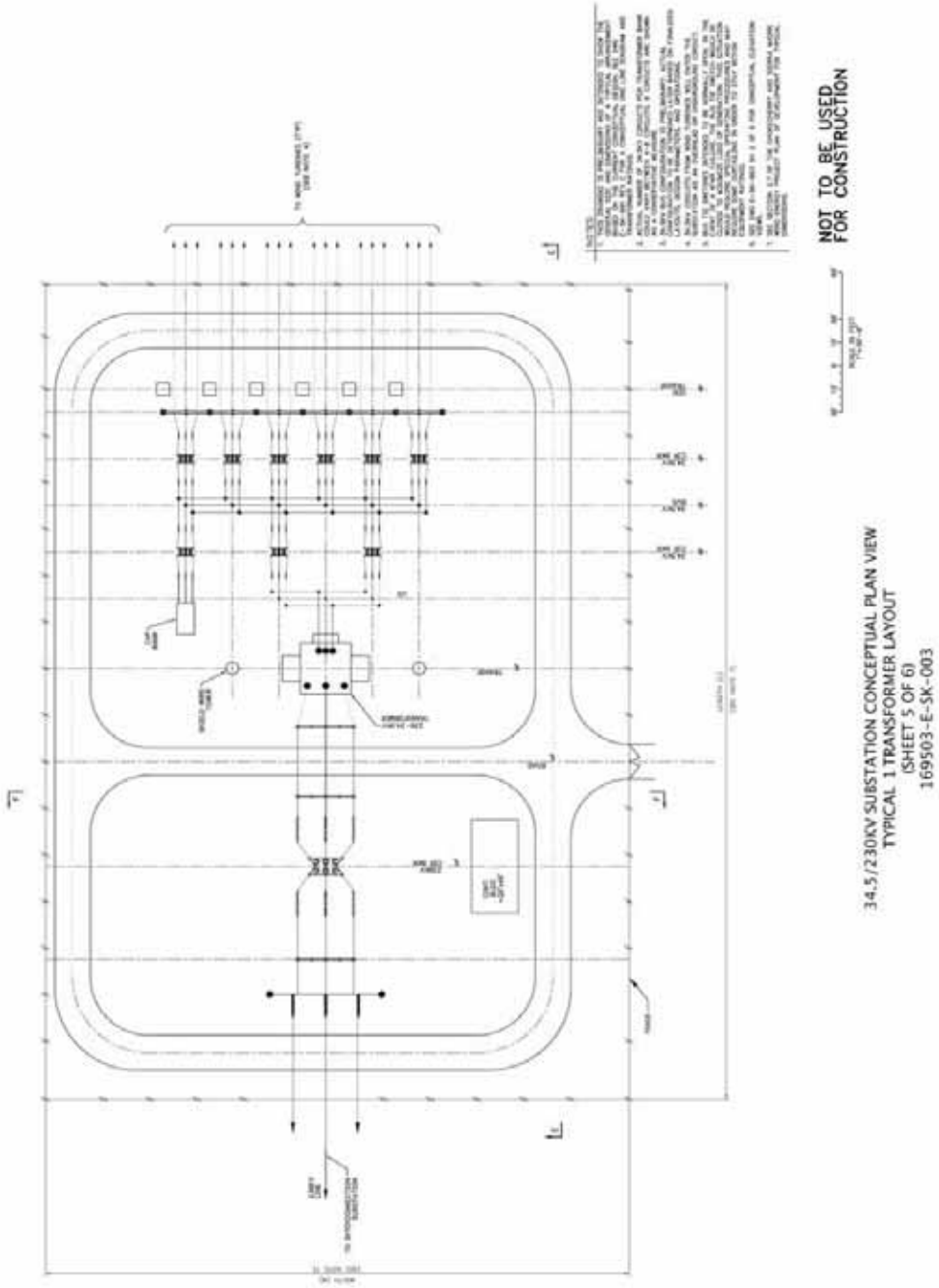
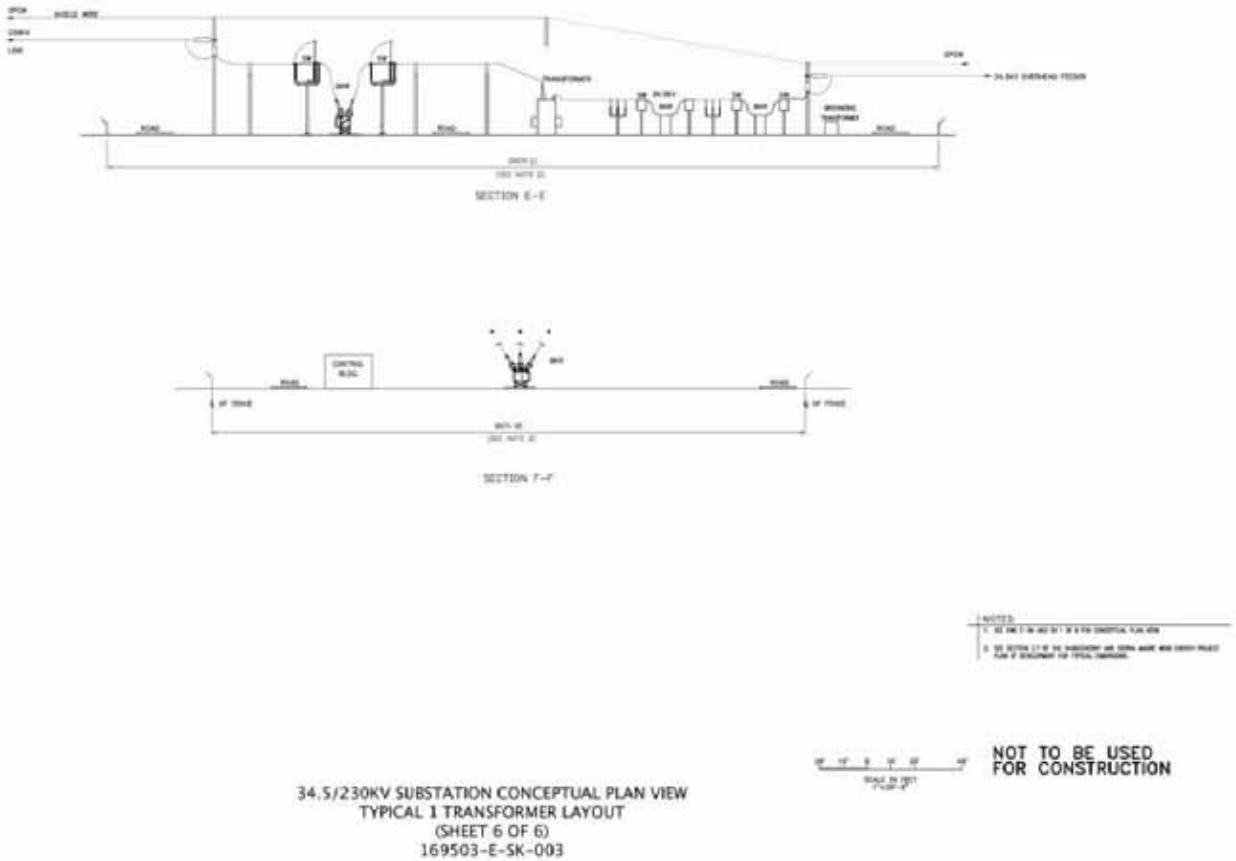


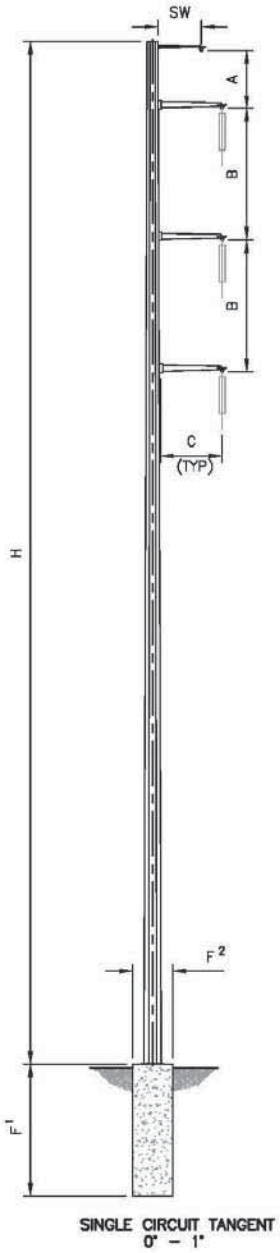
Figure K-5-6: Typical Collection Substation – One Transformer, Profile View



K-6. Transmission Structures

Examples of 230 kV transmissions structures are included below.

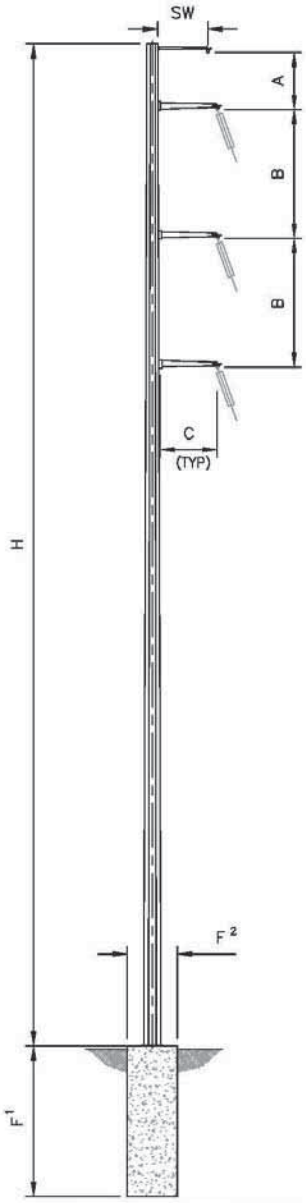
Figure K-6-1: Typical Transmission Structure – Monopole Single Circuit, Tangent



PRELIMINARY
NOT TO BE USED
FOR CONSTRUCTION

TYPICAL 230 kV
SC TANGENT STRUCTURE
(SHEET 1 OF 14)
SC-TANGENT REV A

Figure K-6-2: Typical Transmission Structure – Monopole Single Circuit, Light Angle

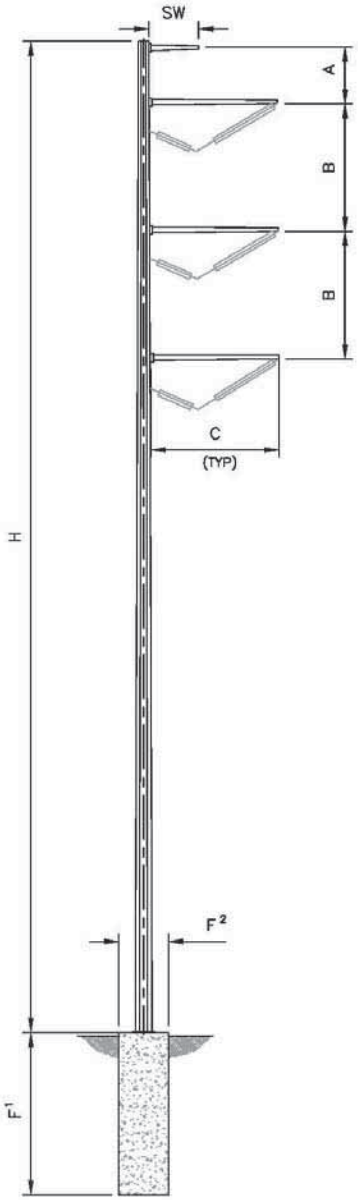


SINGLE CIRCUIT LIGHT ANGLE
1° – 15°

PRELIMINARY
NOT TO BE USED
FOR CONSTRUCTION

TYPICAL 230 kV
SC LIGHT ANGLE STRUCTURE
(SHEET 2 OF 14)
SC-LIGHT ANGLE REV A

Figure K-6-3: Typical Transmission Structure – Monopole Single Circuit, Heavy Angle

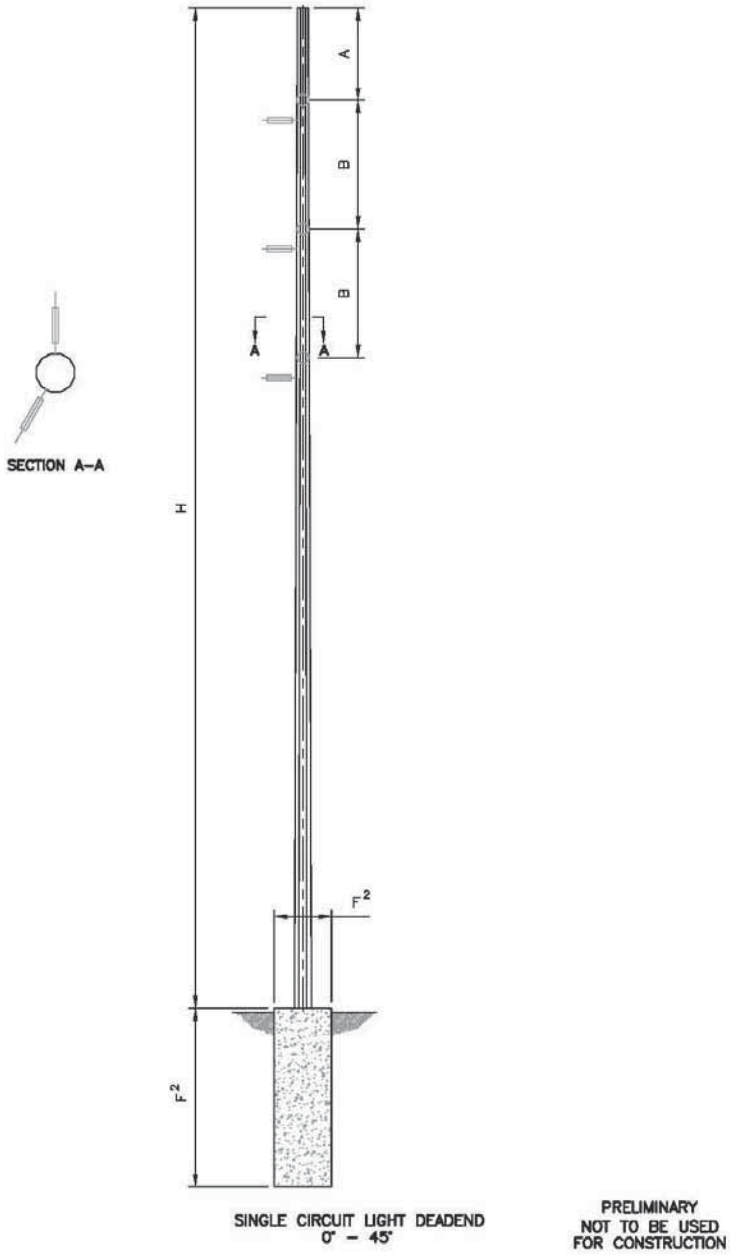


SINGLE CIRCUIT HEAVY ANGLE
15° – 30°

PRELIMINARY
NOT TO BE USED
FOR CONSTRUCTION

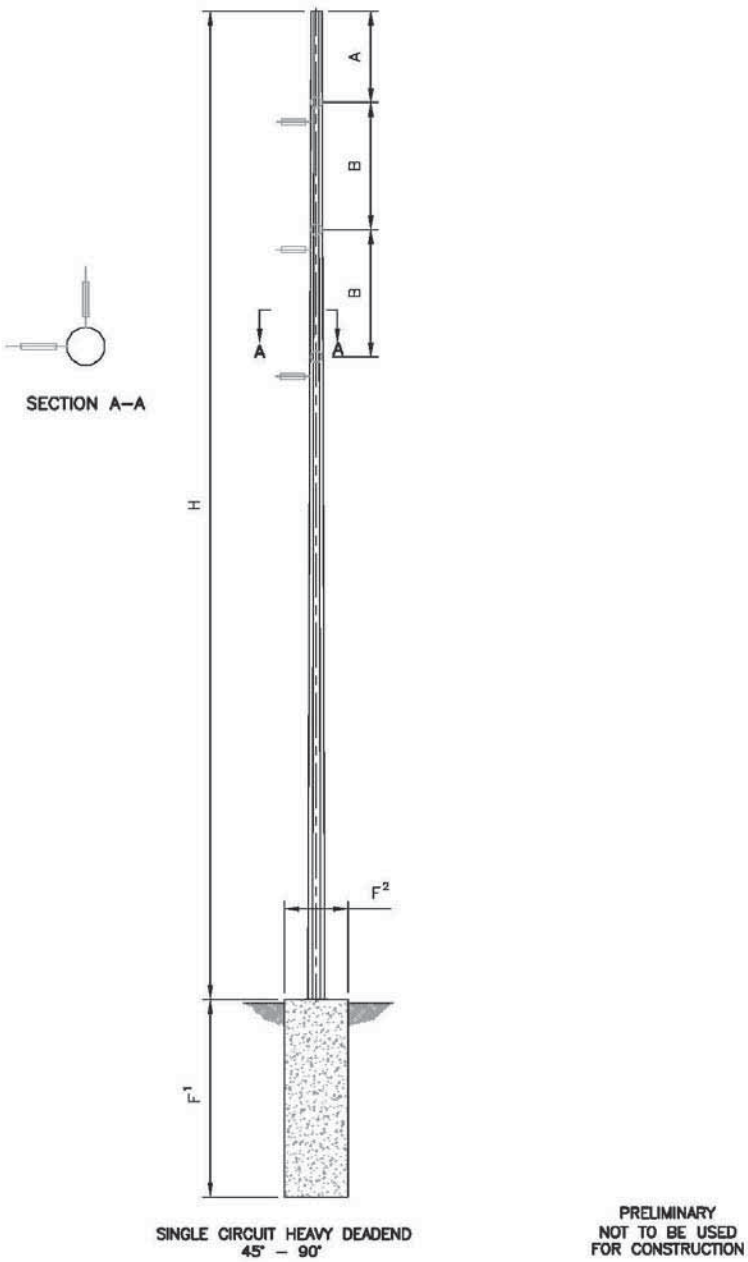
TYPICAL 230 kV
SC HEAVY ANGLE STRUCTURE
(SHEET 3 OF 14)
SC-HEAVY ANGLE REV A

Figure K-6-4: Typical Transmission Structure – Monopole Single Circuit, Light Deadend



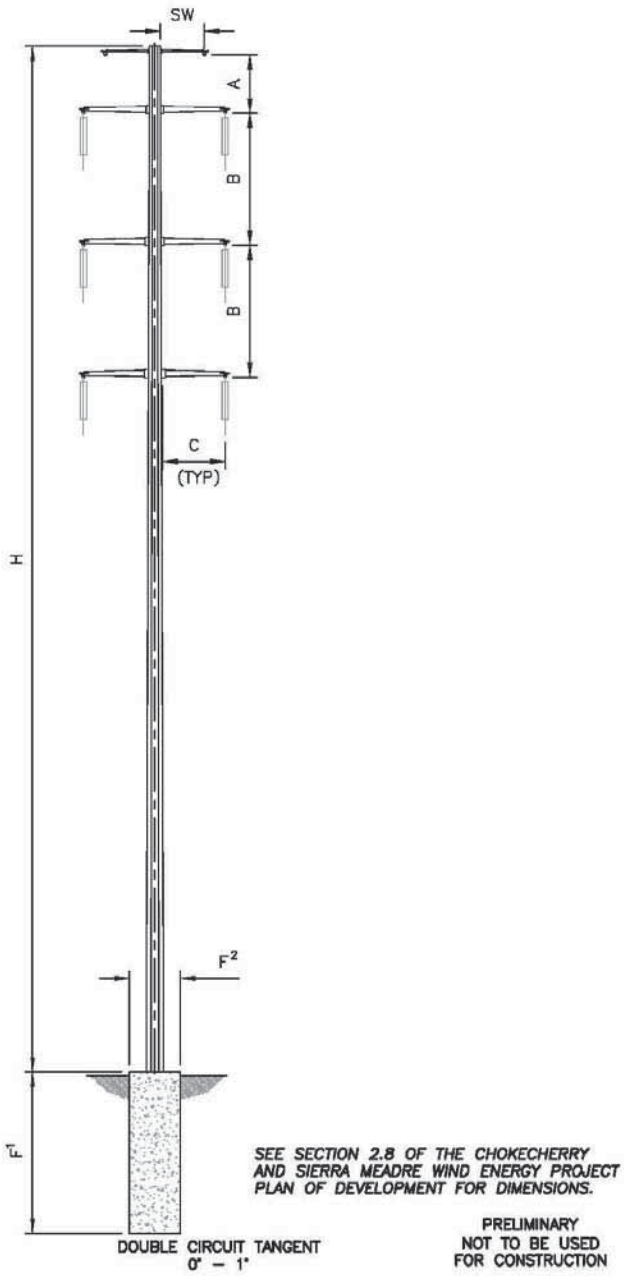
TYPICAL 230 kV
SC LIGHT DEADEND STRUCTURE
(SHEET 4 OF 14)
SC-LIGHT DEADEND REV A

Figure K-6-5: Typical Transmission Structure – Monopole Single Circuit, Heavy Deadend



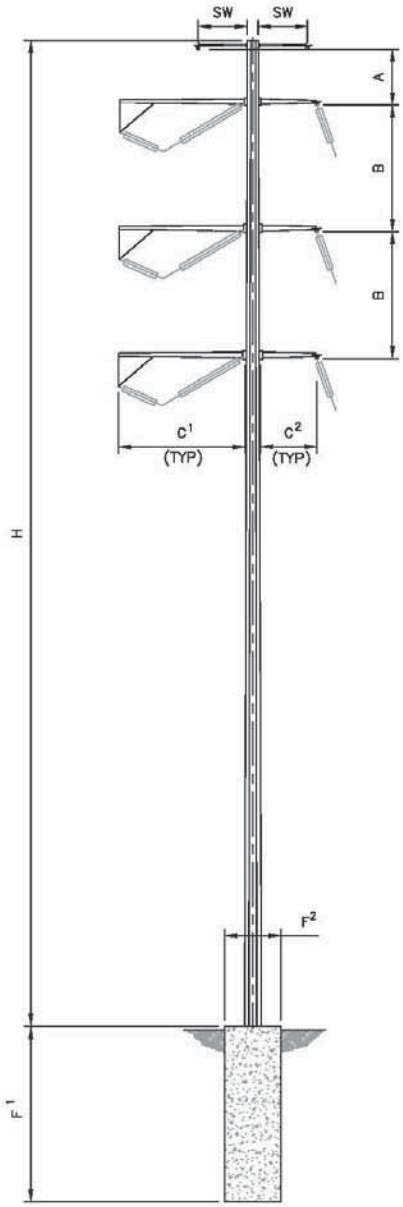
TYPICAL 230 kV
SC HEAVY DEADEND STRUCTURE
(SHEET 5 OF 14)
SC-HEAVY DEADEND REV A

Figure K-6-6: Typical Transmission Structure – Monopole Double Circuit, Tangent



TYPICAL 230 kV
DC TANGENT STRUCTURE
(SHEET 6 OF 14)
DC-TANGENT REV A

Figure K-6-7: Typical Transmission Structure – Double Circuit, Light Angle

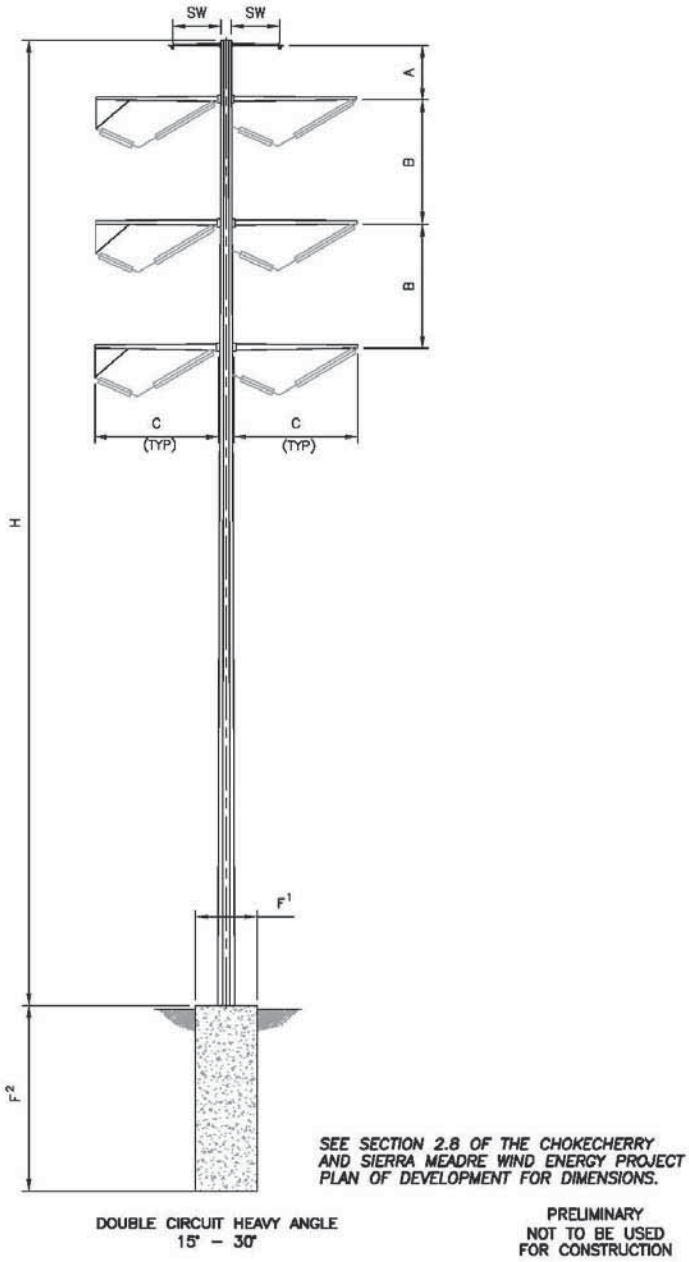


DOUBLE CIRCUIT LIGHT ANGLE
1° – 15°

PRELIMINARY
NOT TO BE USED
FOR CONSTRUCTION

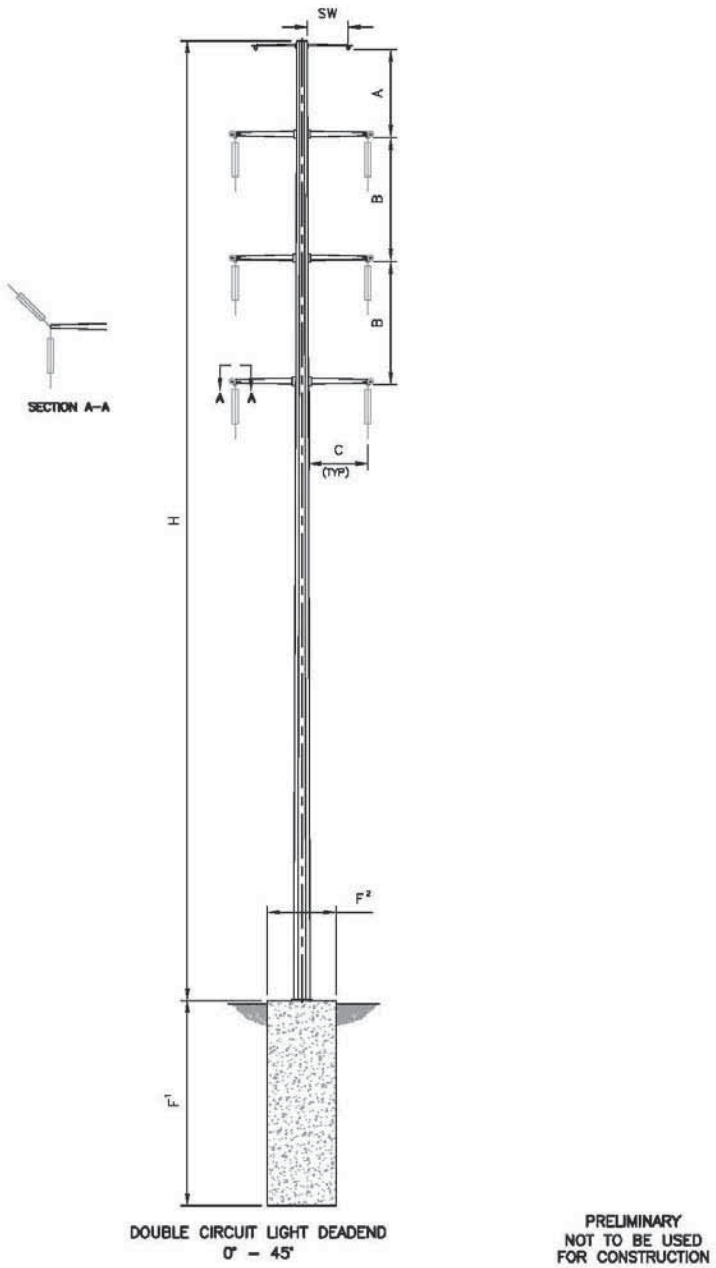
TYPICAL 230 kV
DC LIGHT ANGLE STRUCTURE
(SHEET 7 OF 14)
DC-LIGHT ANGLE REV A

Figure K-6-8: Typical Transmission Structure – Monopole Double Circuit, Heavy Angle



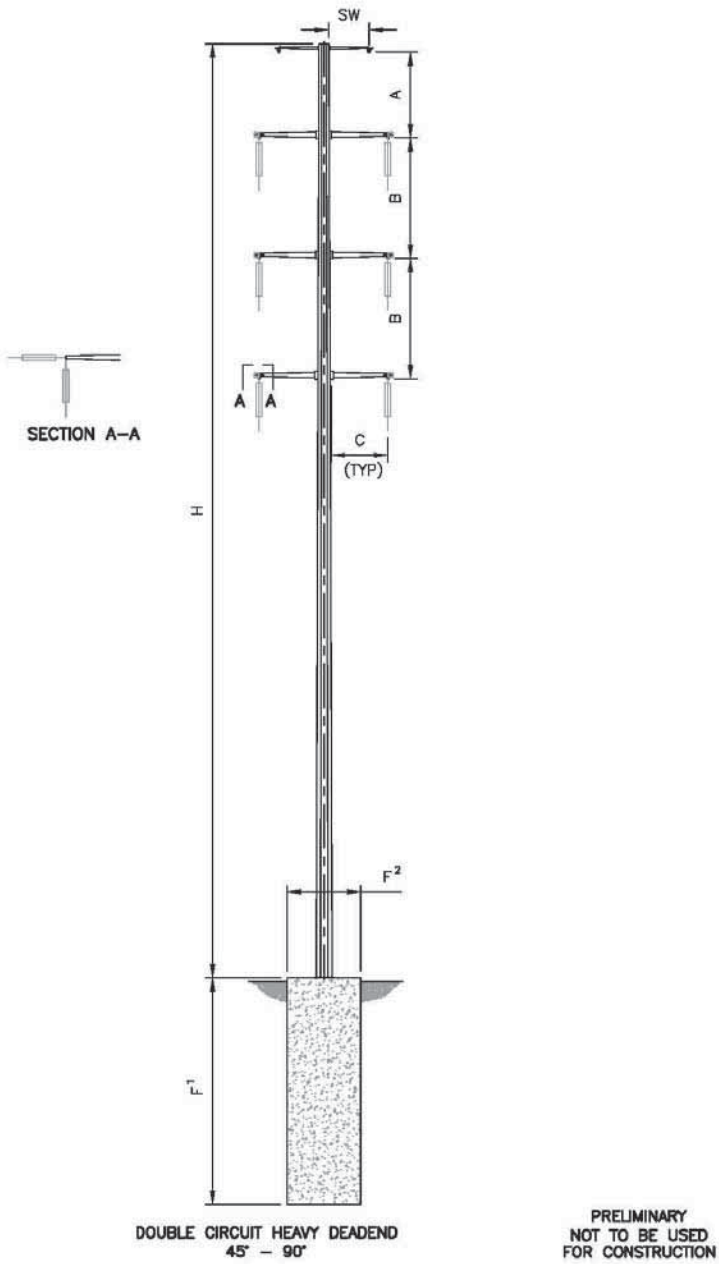
TYPICAL 230 kV
DC HEAVY ANGLE STRUCTURE
(SHEET 8 OF 14)
DC-HEAVY ANGLE REV A

Figure K-6-9: Typical Transmission Structure – Monopole Double Circuit, Light Deadend



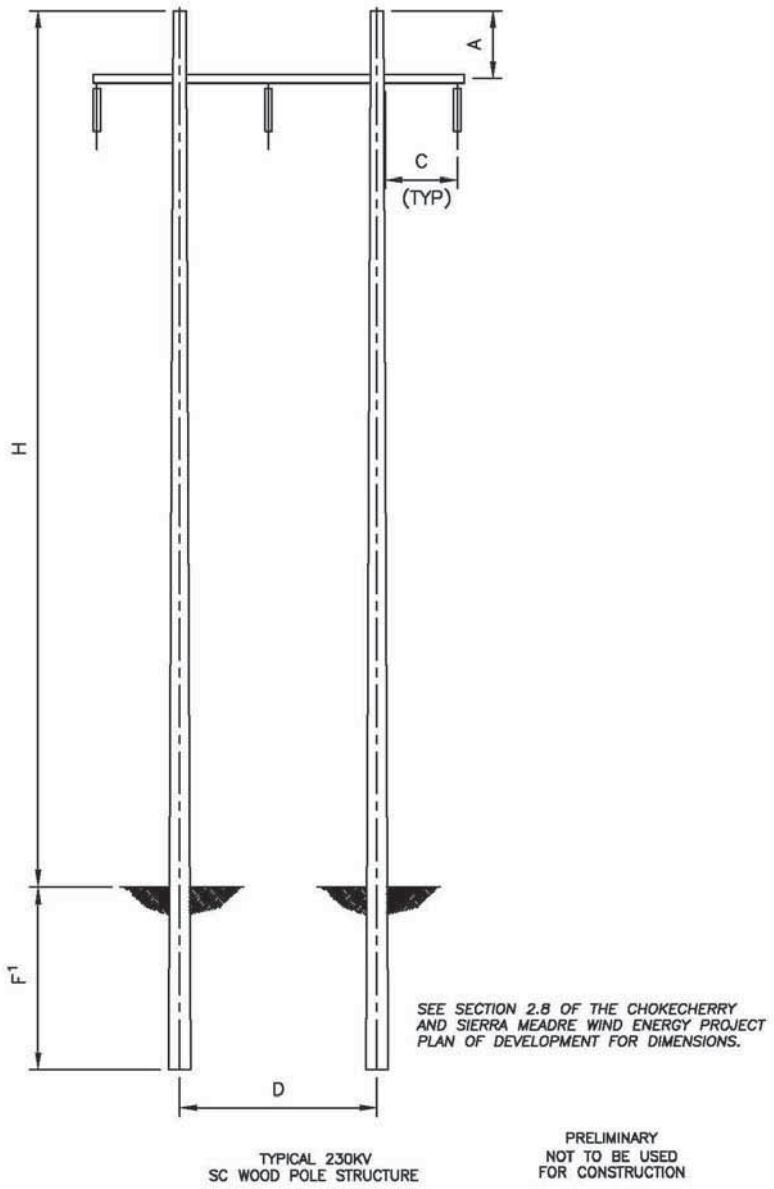
TYPICAL 230 kV
DC LIGHT DEADEND STRUCTURE
(SHEET 9 OF 14)
DC-LIGHT DEADEND REV A

Figure K-6-10: Typical Transmission Structure – Monopole Double Circuit, Heavy Deadend



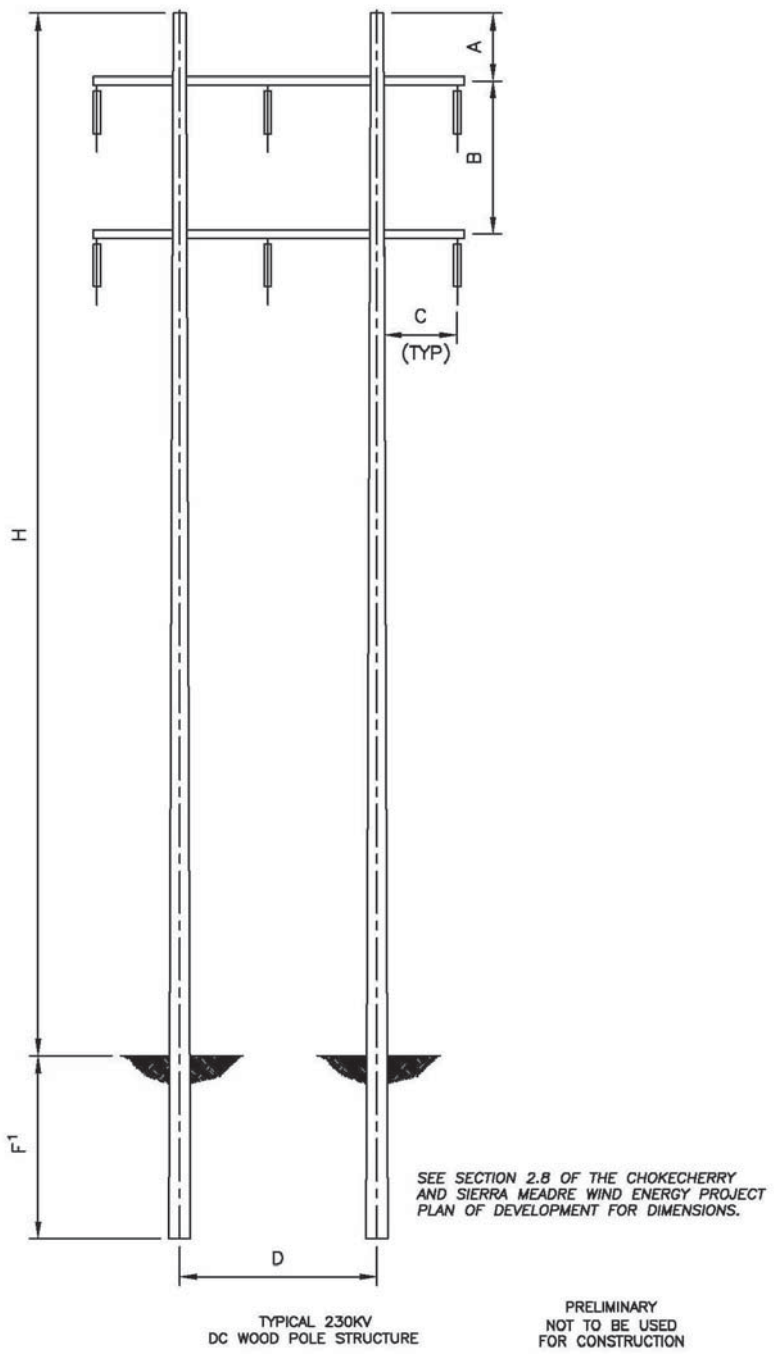
TYPICAL 230 kV
DC HEAVY DEADEND STRUCTURE
(SHEET 10 OF 14)
DC-HEAVY DEADEND REV A

Figure K-6-11: Typical Transmission Structure – H-Frame Single Circuit, Tangent



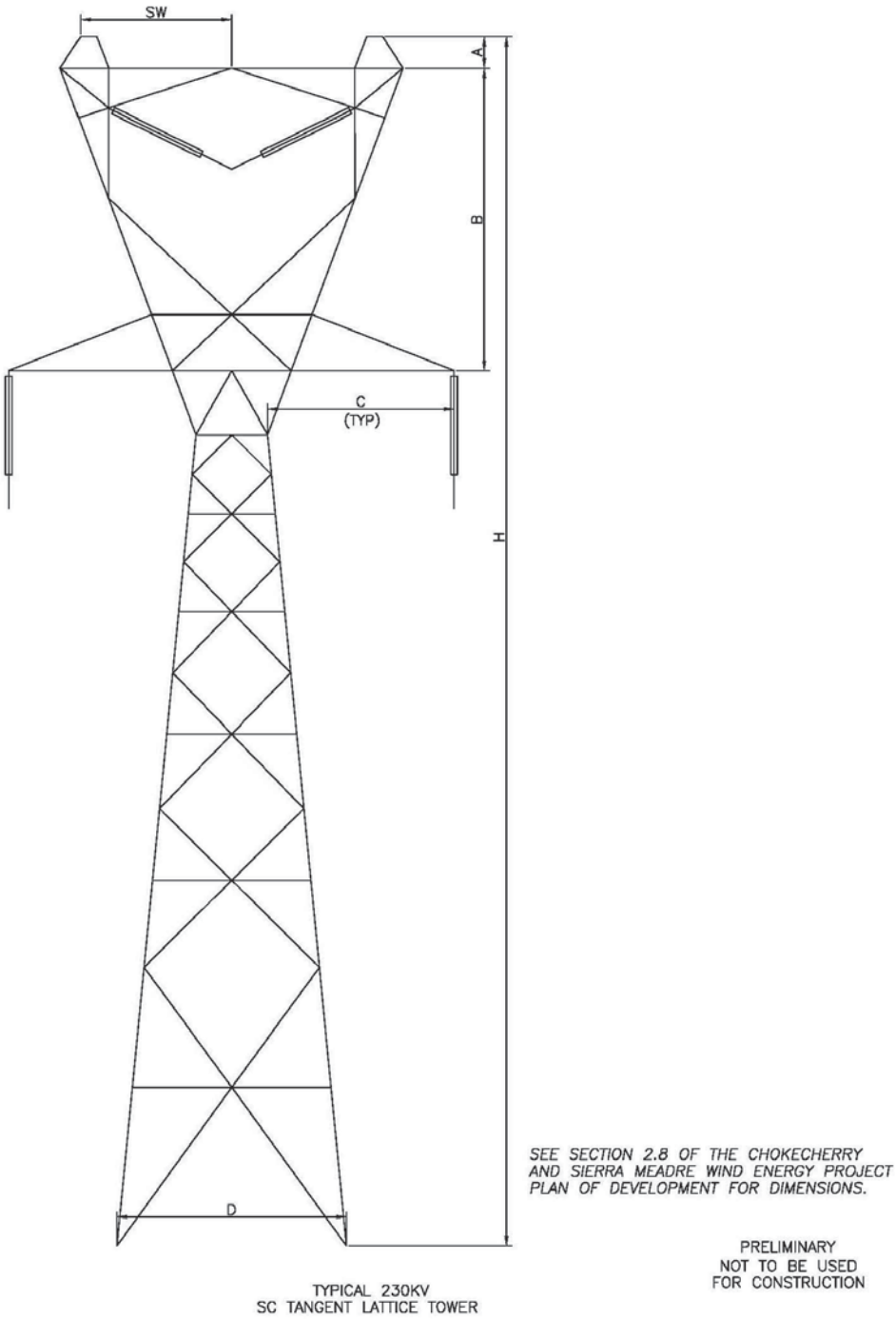
TYPICAL 230 kV
SC TANGENT WOOD H-FRAME STRUCTURE
(SHEET 11 OF 14)
SC-WOOD POLE REV A

Figure K-6-12: Typical Transmission Structure – H-Frame Double Circuit, Tangent



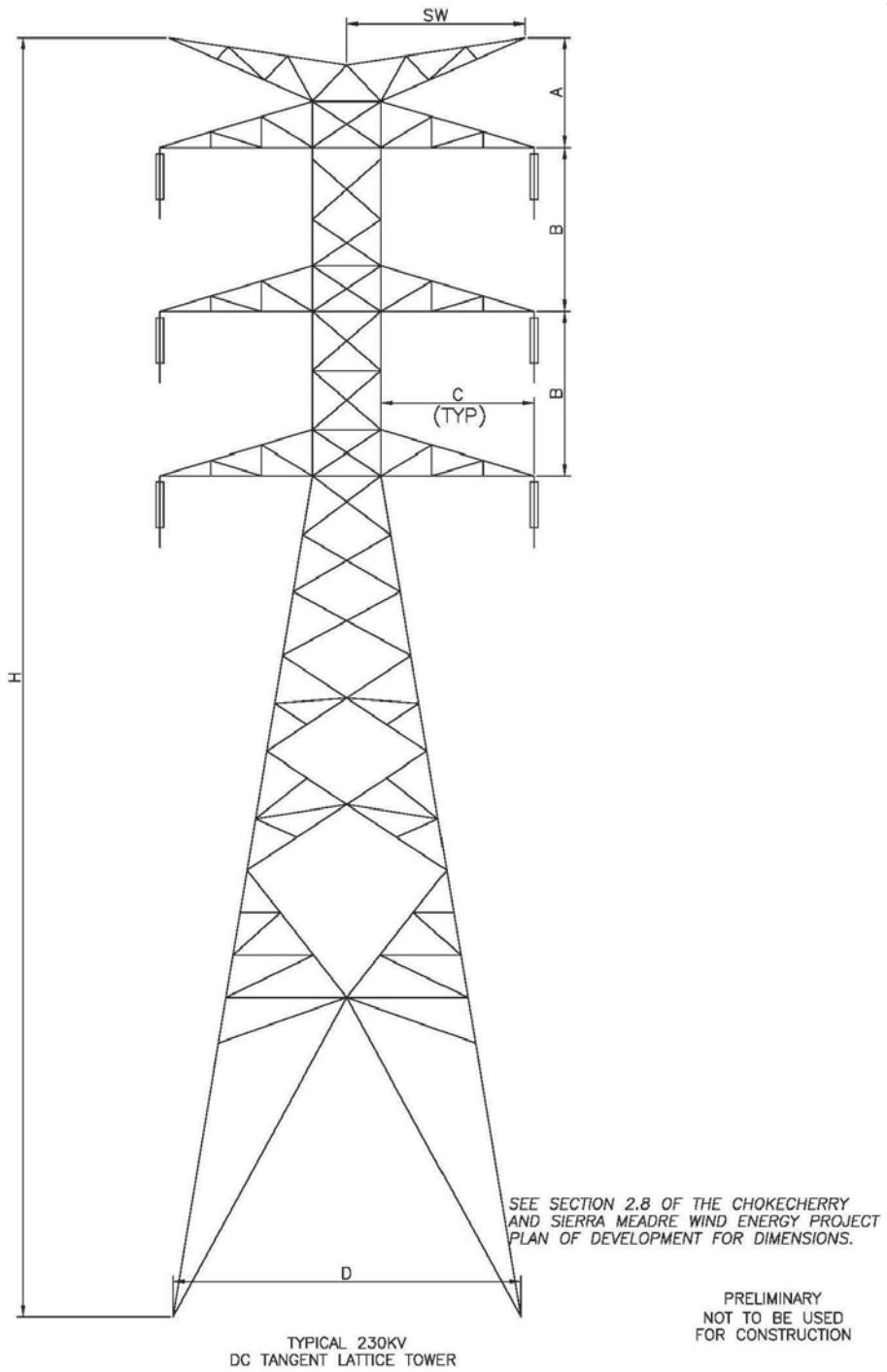
TYPICAL 230 kV
DC TANGENT WOOD H-FRAME STRUCTURE
(SHEET 12 OF 14)
DC-WOOD POLE REV A

Figure K-6-13: Typical Transmission Structure – Lattice Single Circuit, Tangent



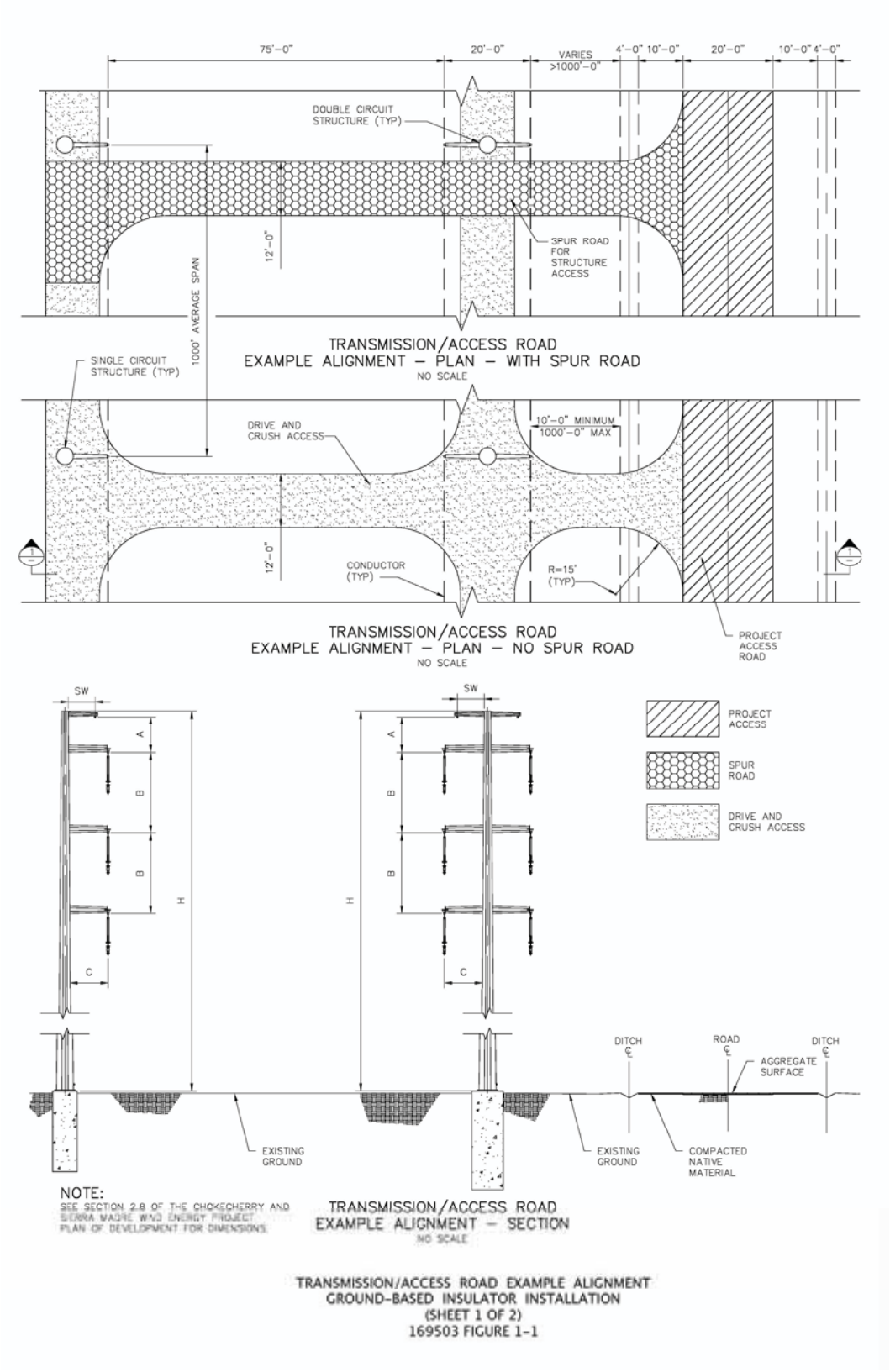
TYPICAL 230 kV
SC TANGENT LATTICE STEEL STRUCTURE
(SHEET 13 OF 14)
SC-TAN LATTICE TOWER REV A

Figure K-6-14: Typical Transmission Structure – Lattice Double Circuit, Tangent



TYPICAL 230 kV
DC TANGENT LATTICE STEEL STRUCTURE
(SHEET 14 OF 14)
DC-TAN LATTICE TOWER REV A

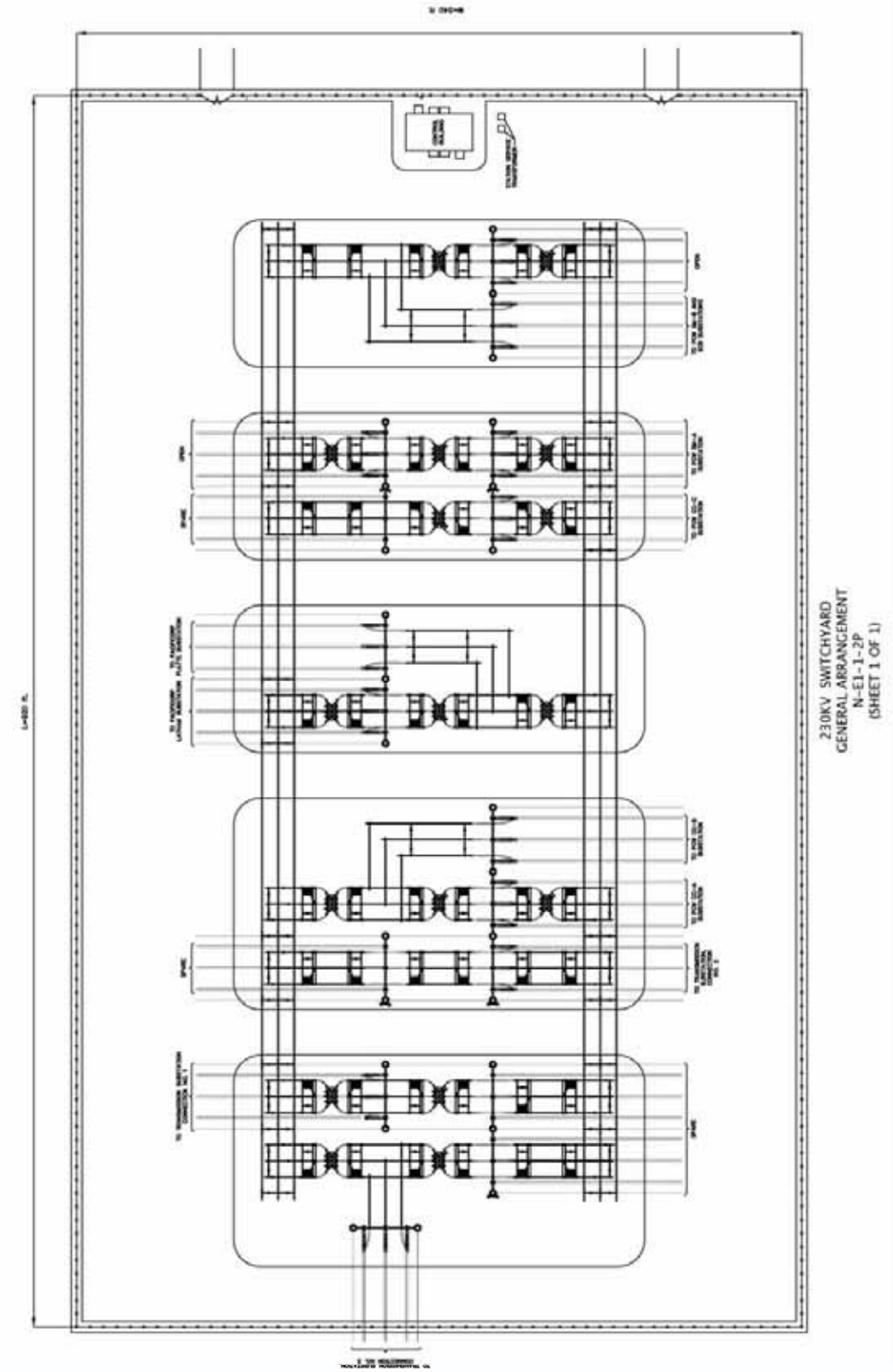
Figure K-6-15: Transmission Line Access Road Configuration



K-7. Interconnection Substation

A conceptual arrangement for the 230 kV interconnection substation is provided below.

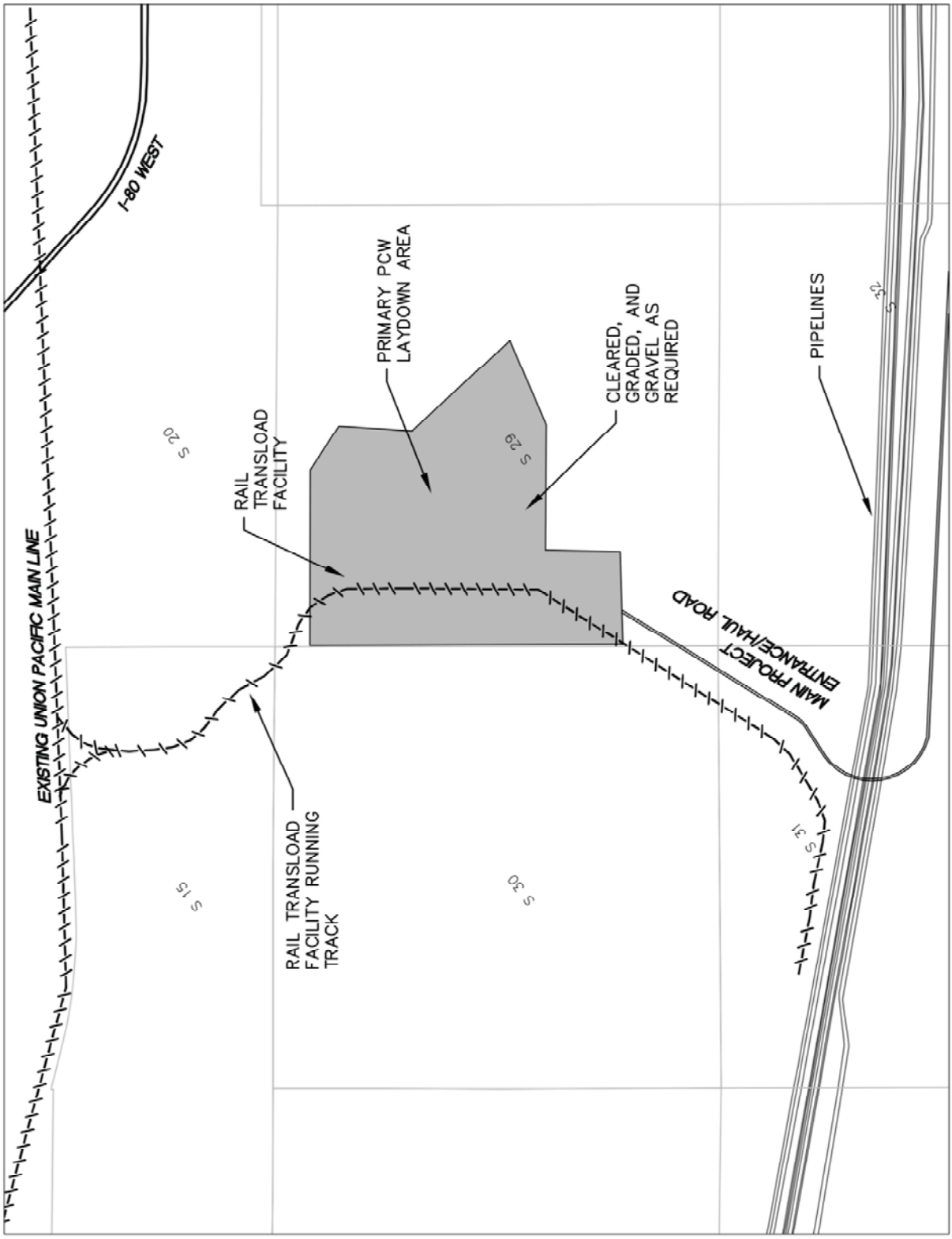
Figure K-7-1: Interconnection Substation – Plan View



K-8. Rail Facility

The general alignment of the rail facility is shown below for the primary site.

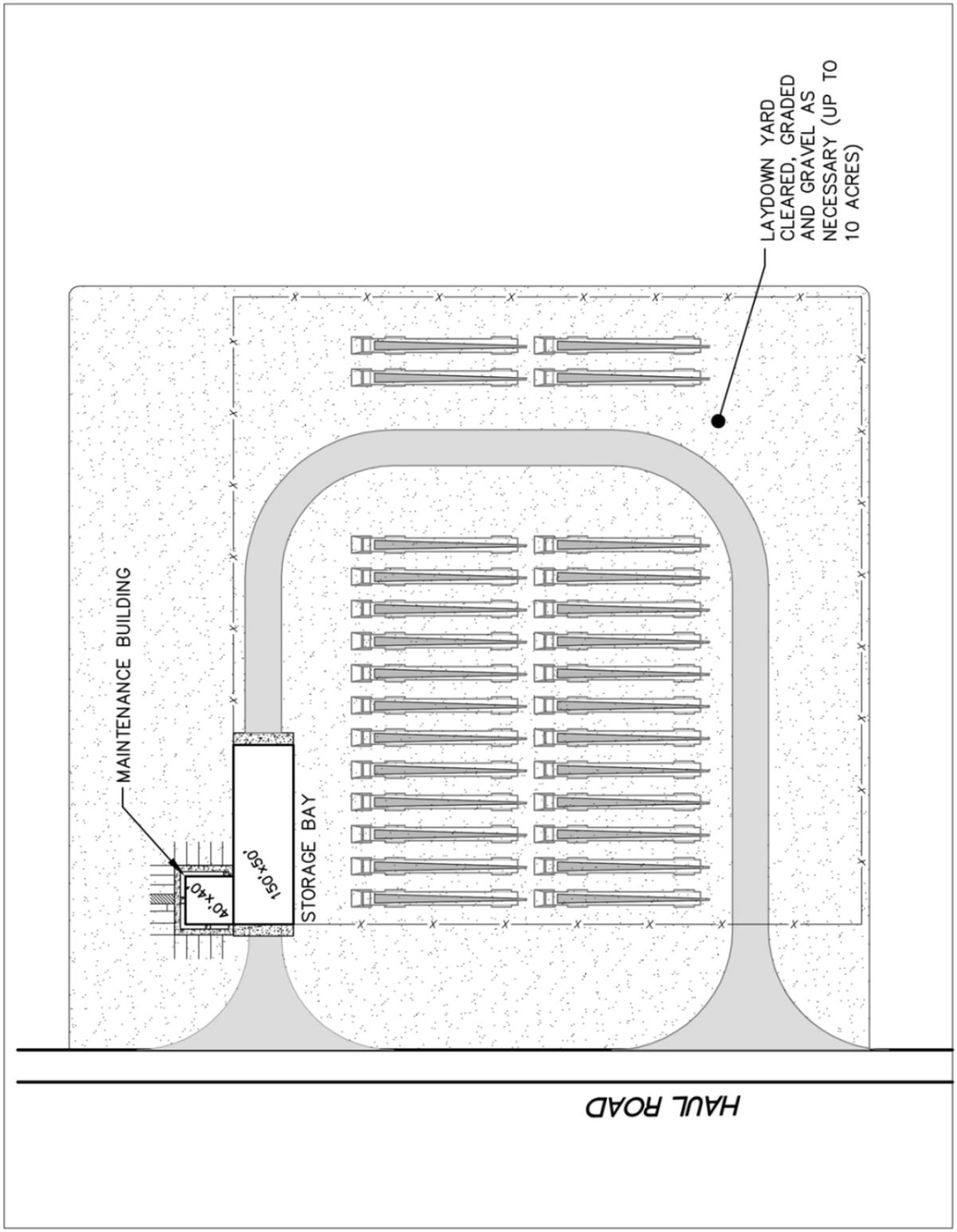
Figure K-8-1: Rail Facility Conceptual Alignment



K-9. Operations and Maintenance Buildings

PCW intends to utilize an Operations Center and one or multiple maintenance buildings. The Operations Center is shown with the construction trailer complex diagram for the example project layout in Appendix L. The conceptual arrangement for the maintenance buildings is shown below.

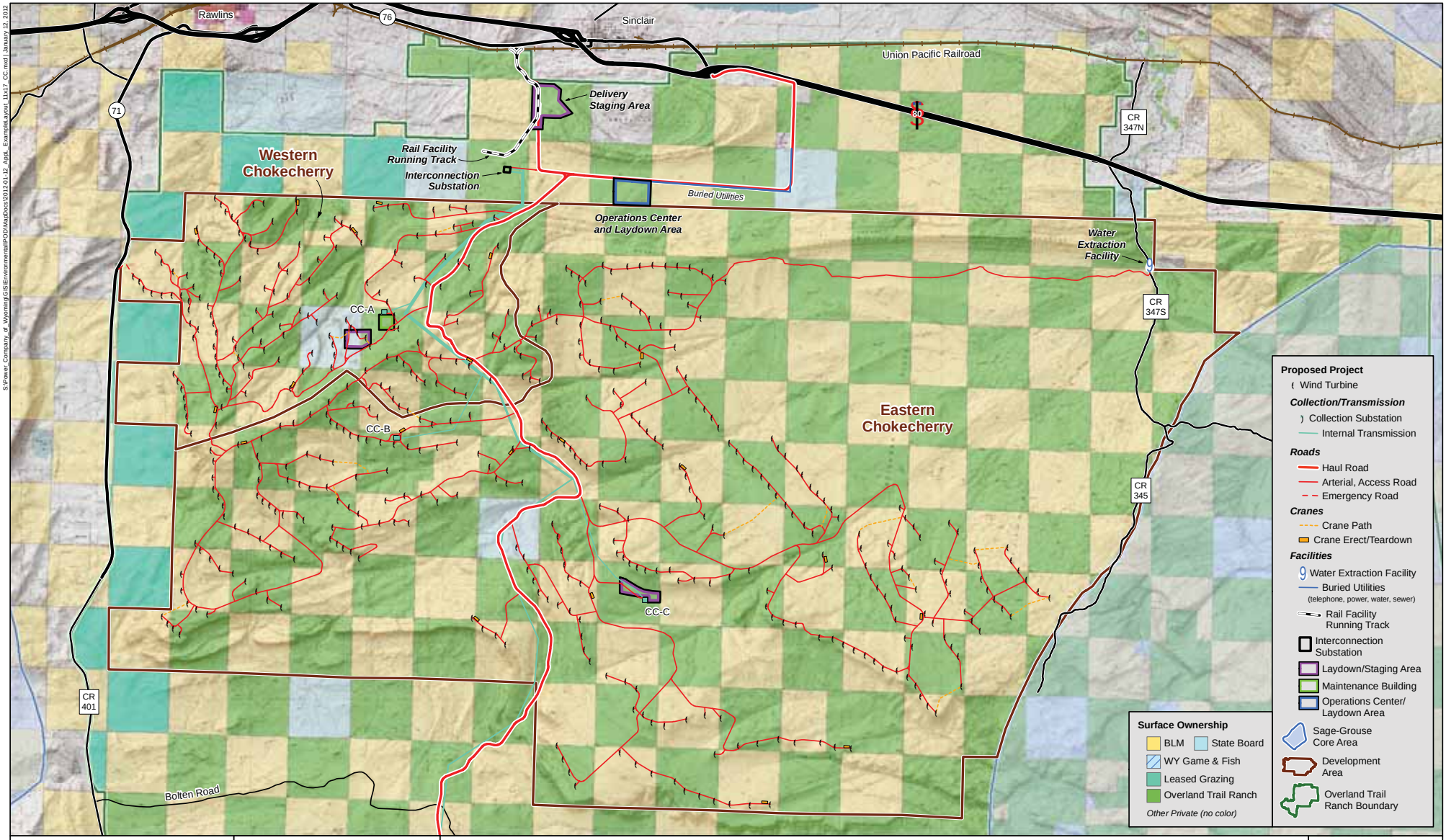
Figure K-9-1: Maintenance Building Conceptual Arrangement



Appendix L. Example Project Diagrams and Estimates

The diagrams and estimates in this appendix apply to the example Project layout described in Section 8. PCW will provide the final design documents, including updated versions of these diagrams and estimates, with the final layout in the subsequent PODs.

L-1. Project Layout Maps



N W E S

0 1 2
Miles

Surface Ownership (BLM and PCW, 2010)
Topographic Base (USGS, 1:24,000)

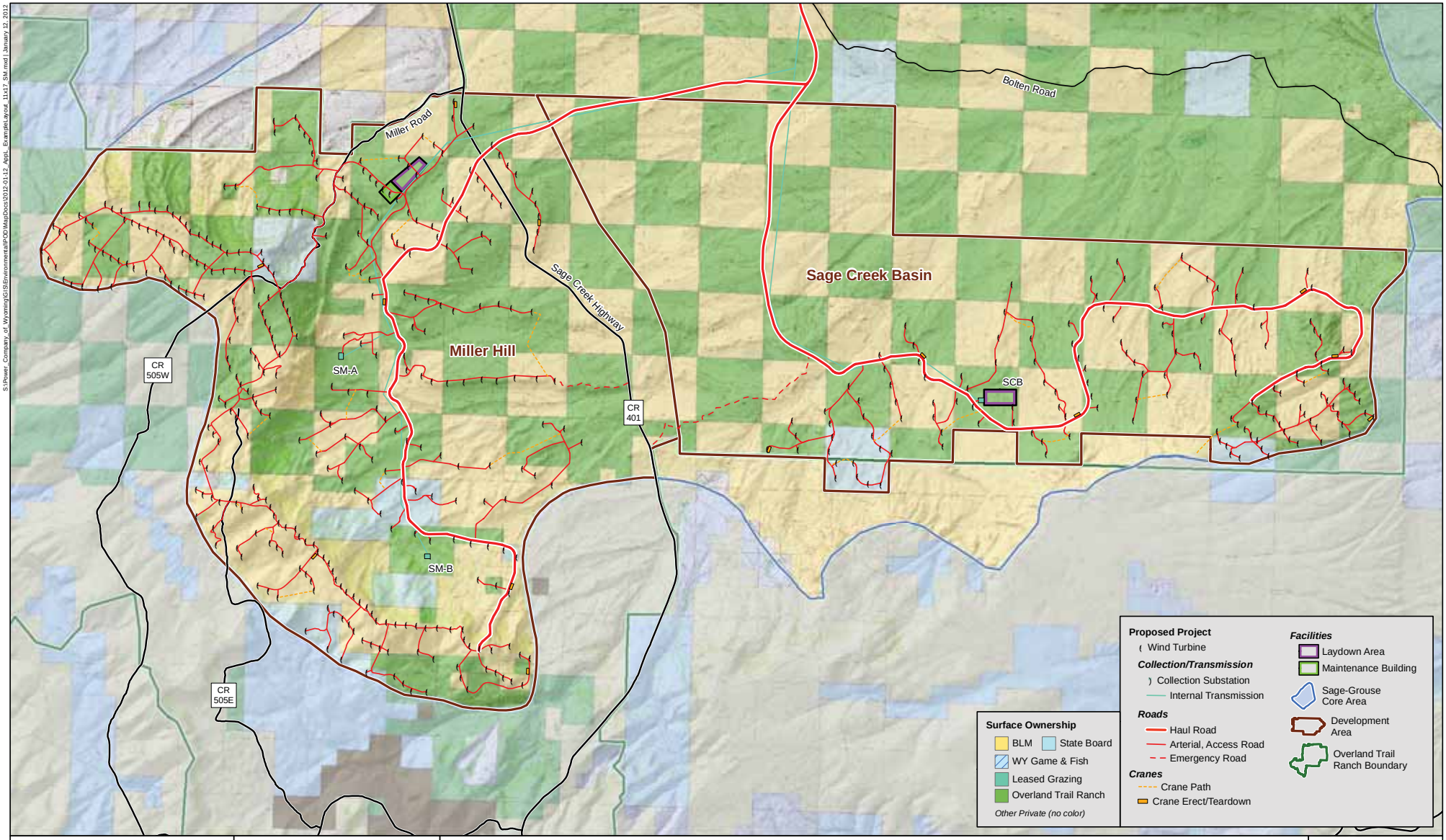
Proprietary & Confidential
FOIA Exempt
5 U.S.C. § 552 (b)(4)

Example Layout - Chokecherry Development Area

Chokecherry and Sierra Madre Wind Energy Project | Jan. 12, 2012

Power Company of Wyoming LLC

S:\Power_Company_of_Wyoming\GIS\Environmental\POD\MapDocs\2012-01-12_Apps_Example Layout_11x17_CC.mxd | January 12, 2012



N
W E
S

0 1 2
Miles

Surface Ownership (BLM and PCW, 2010)
Topographic Base (USGS, 1:24,000)

Proprietary & Confidential
FOIA Exempt
5 U.S.C. § 552 (b)(4)

Example Layout - Sierra Madre Development Area

Chokecherry and Sierra Madre Wind Energy Project | Jan. 12, 2012

Power Company of Wyoming LLC

S:\Power_Company_of_Wyoming\GIS\Environmental\PPO\MapDocs\2012-01\12_Apps_Example\Layout_11x17_SM.mxd | January 12, 2012

L-2. Facility Diagrams

Additional details on the locations and configurations of facilities for the example layout are included below.

Figure L-2-1: Trailer Complex Area

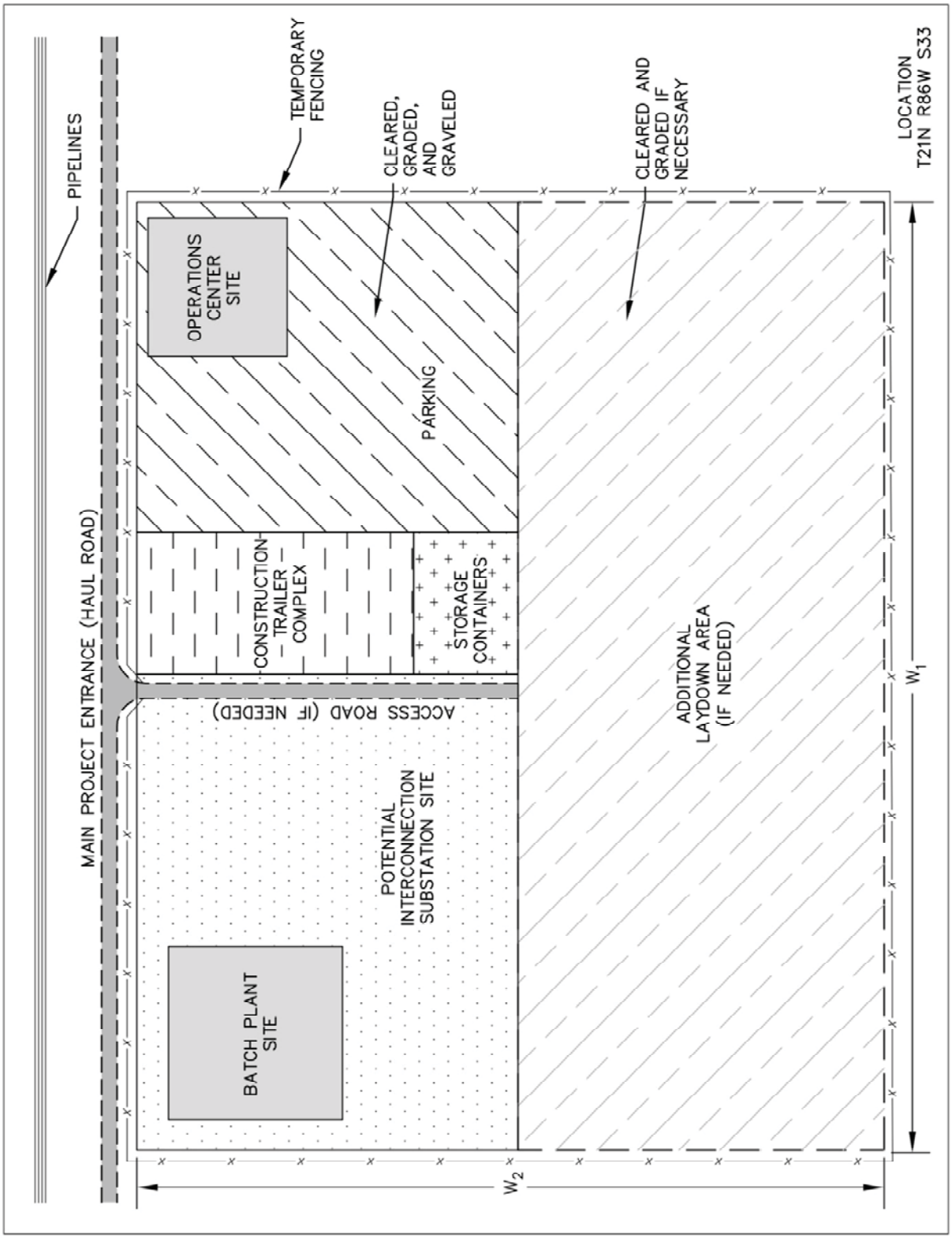


Figure L-2-2: Typical Concrete Batch Plant Configuration

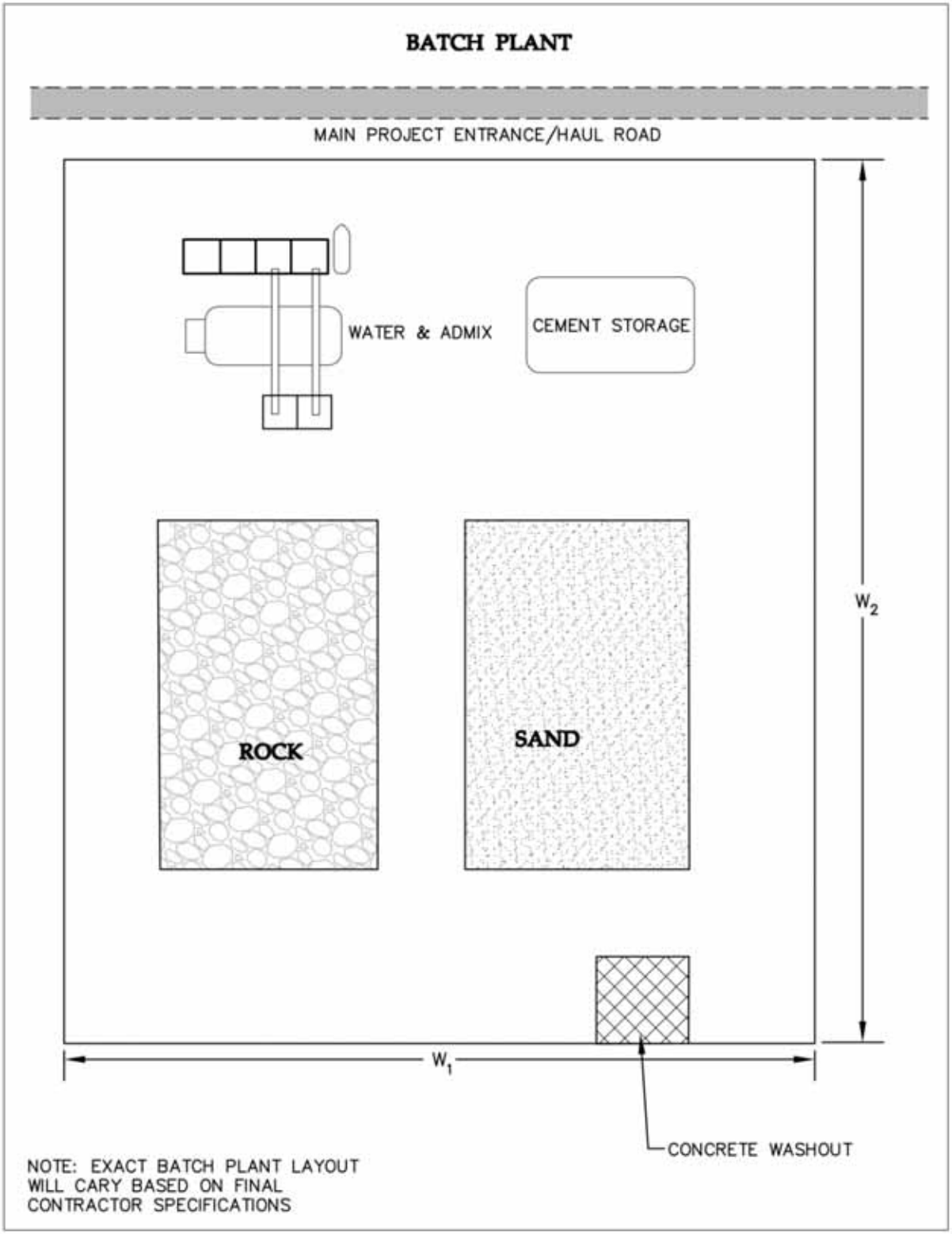


Figure L-2-3: Typical Water Extraction Facility with Adjacent Filing Station

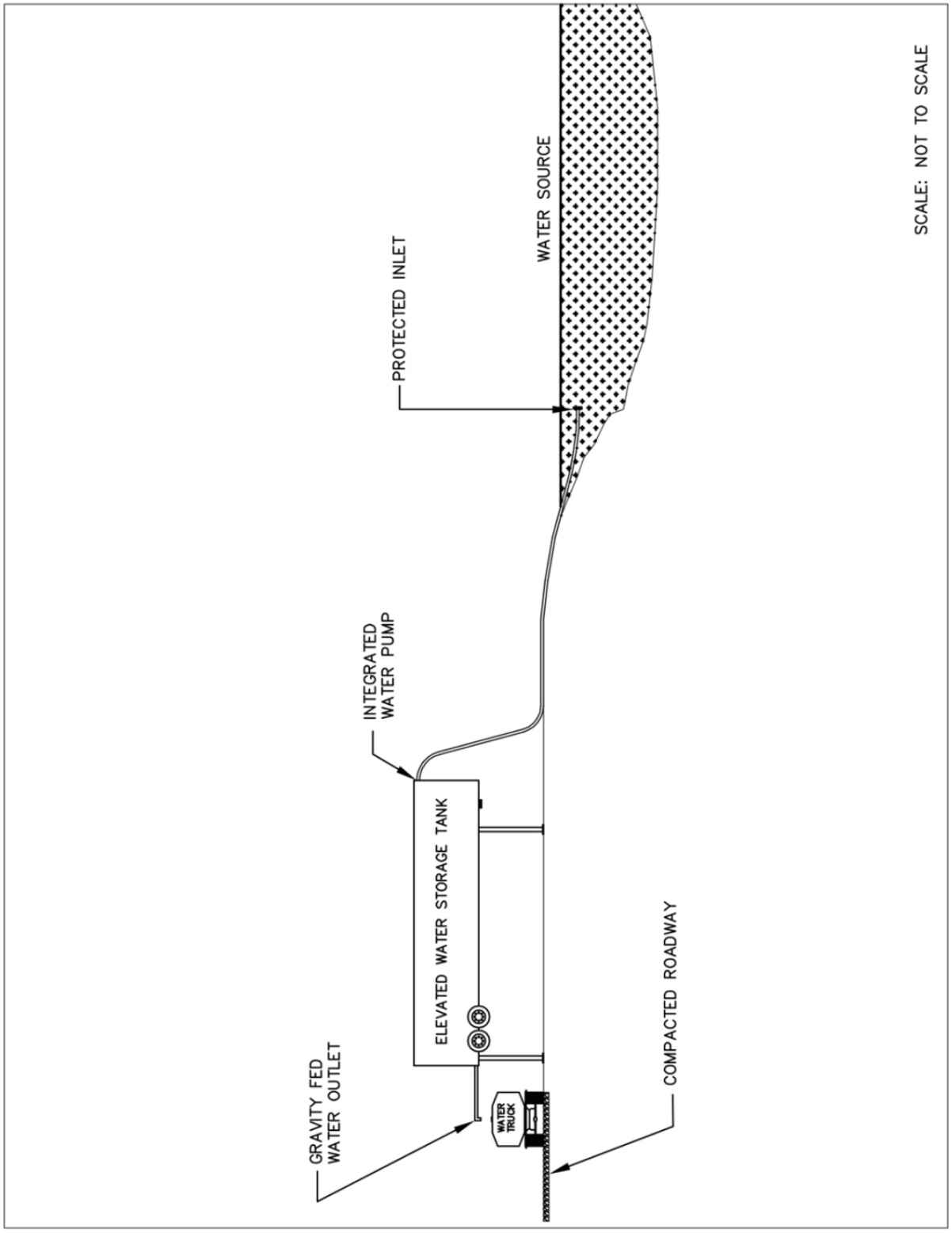
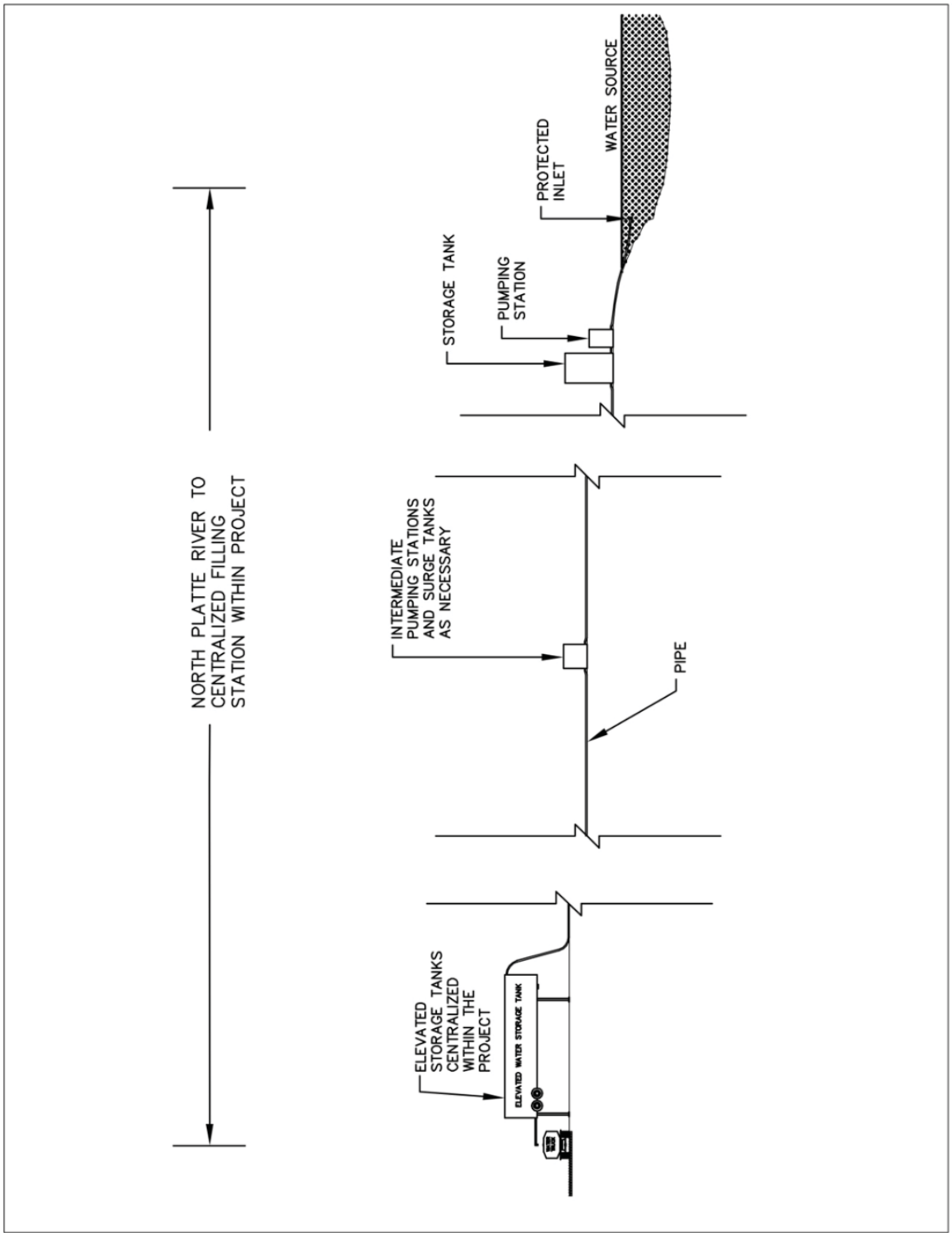


Figure L-2-4: Typical Water Extraction Facility with Pipeline to Filing Station



L-3. Electrical One-Line Diagrams

The electrical diagrams for the example project layout are included below.

Figure L-3-1: Example Layout General Total Project One-Line Diagram

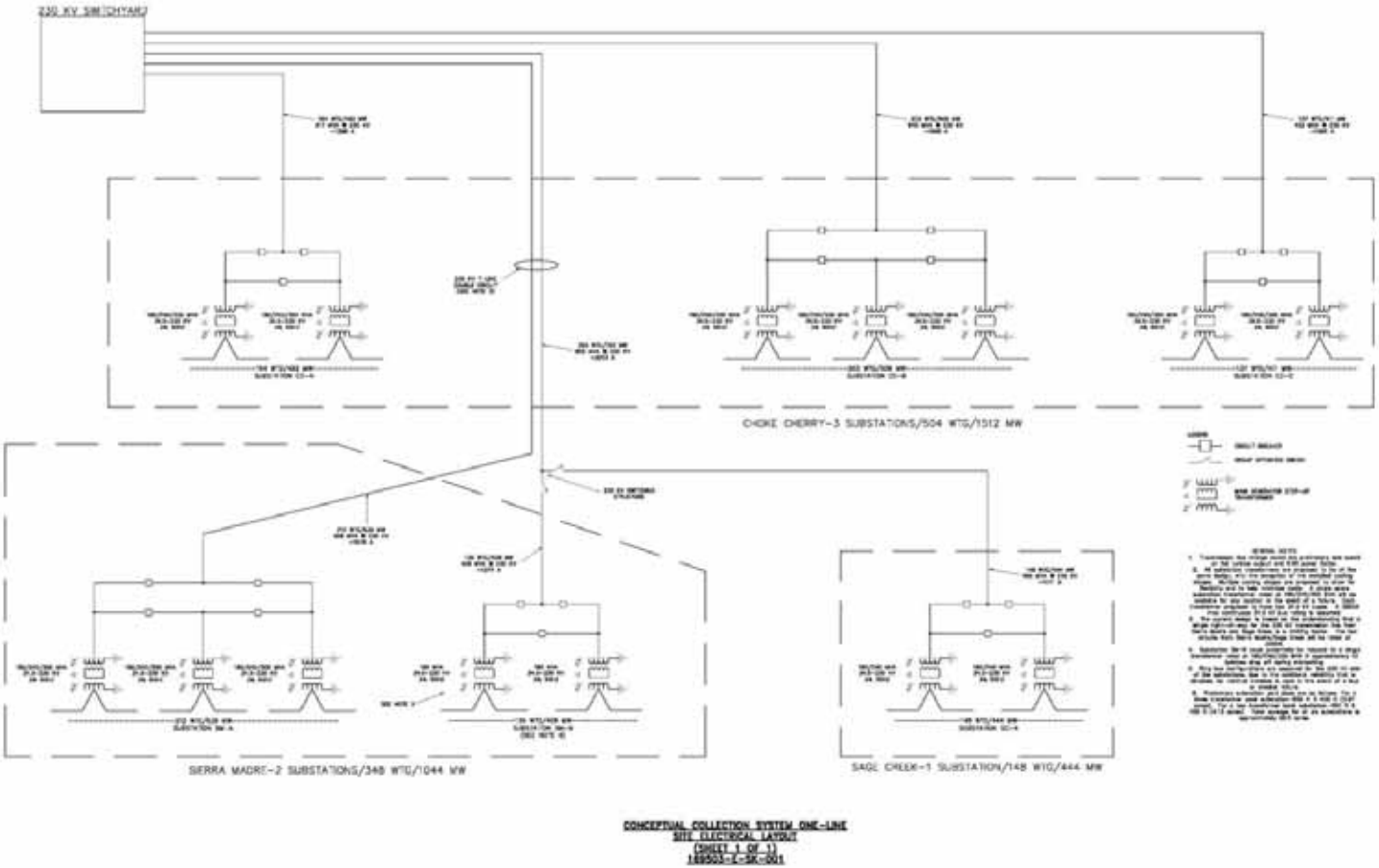


Figure L-3-2: Example Layout One-Line Diagram – Substation CC-A (1)

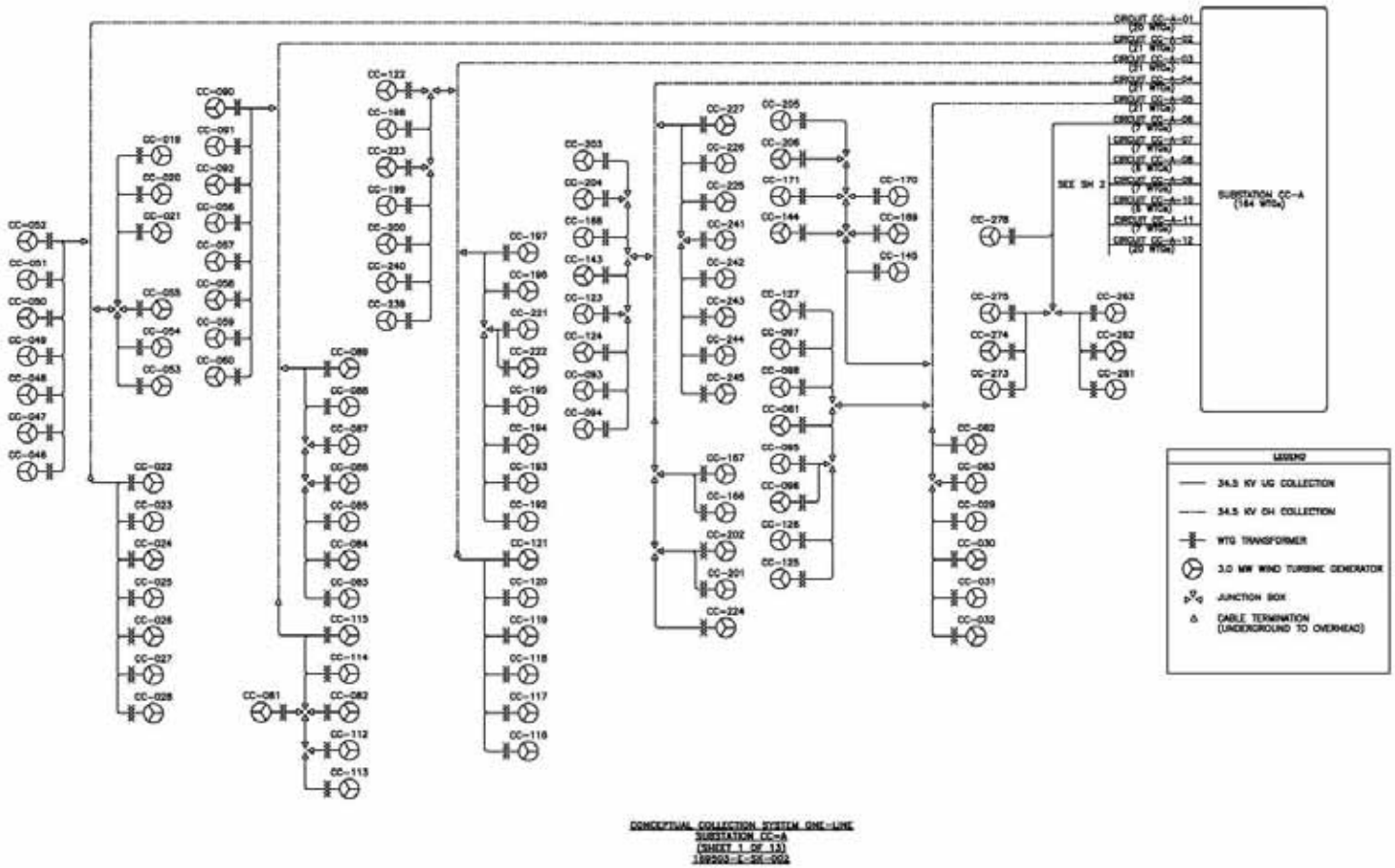


Figure L-3-3: Example Layout One-Line Diagram – Substation CC-A (2)

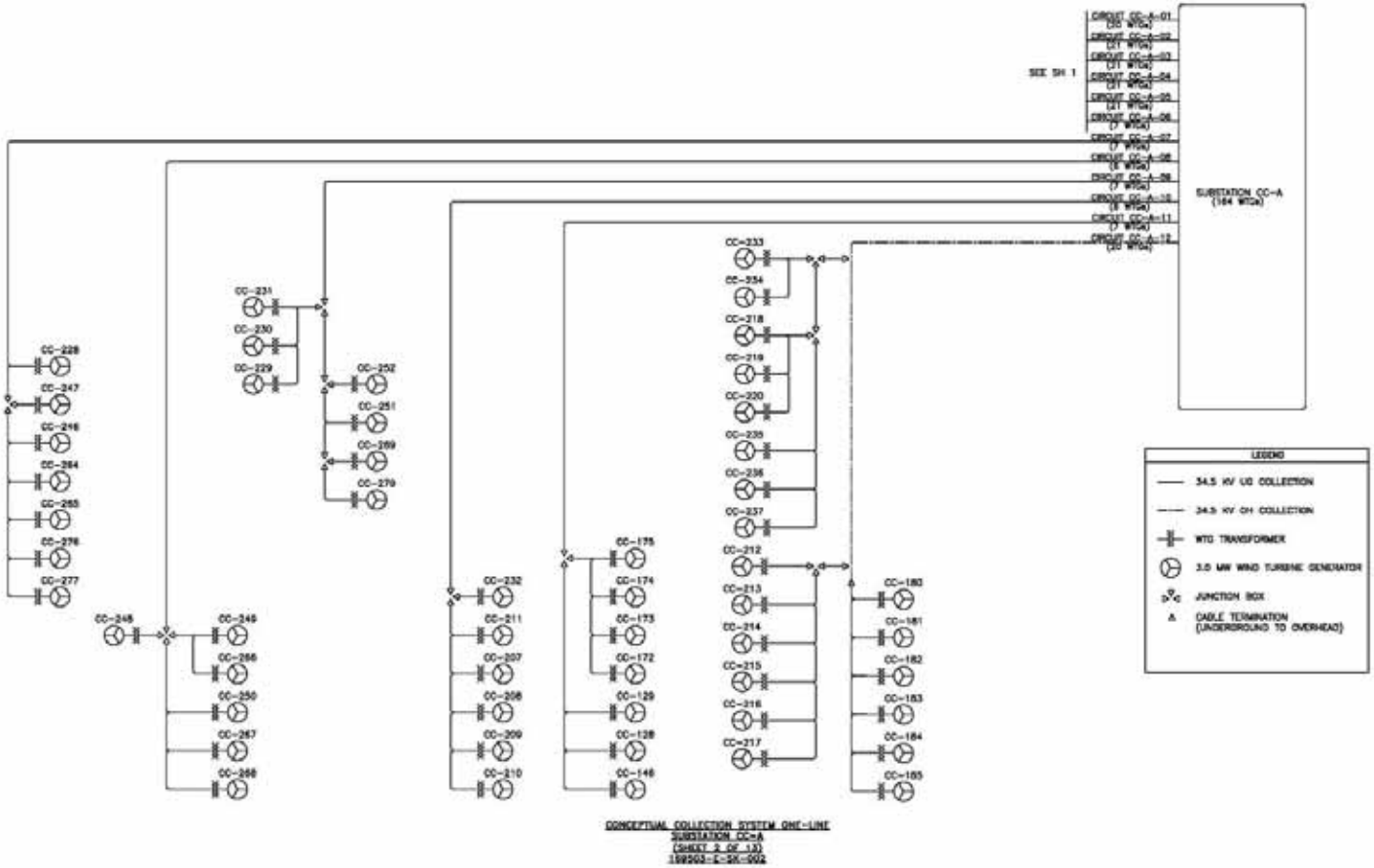


Figure L-3-4: Example Layout One-Line Diagram – Substation CC-B (1)

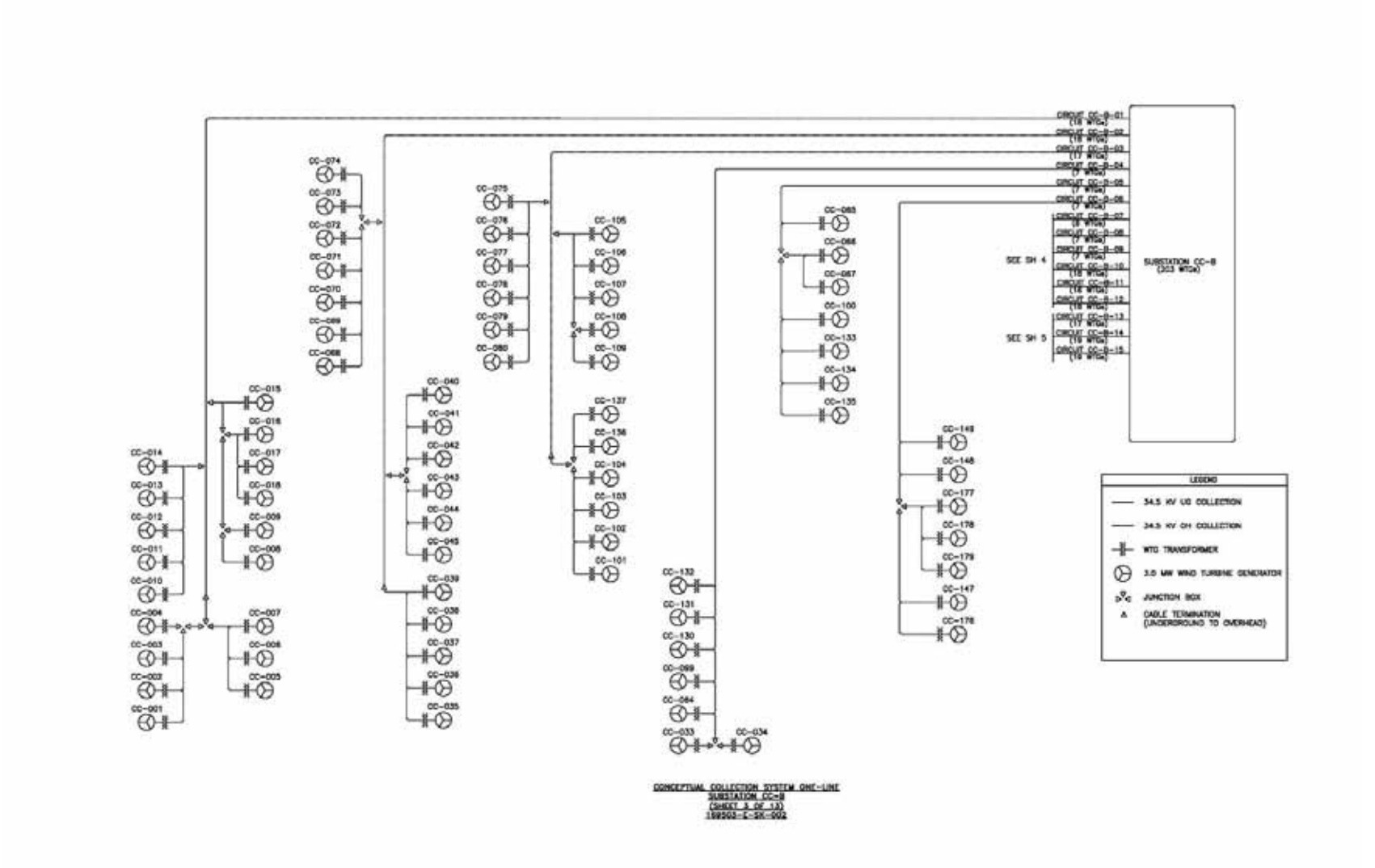


Figure L-3-5: Example Layout One-Line Diagram – Substation CC-B (2)

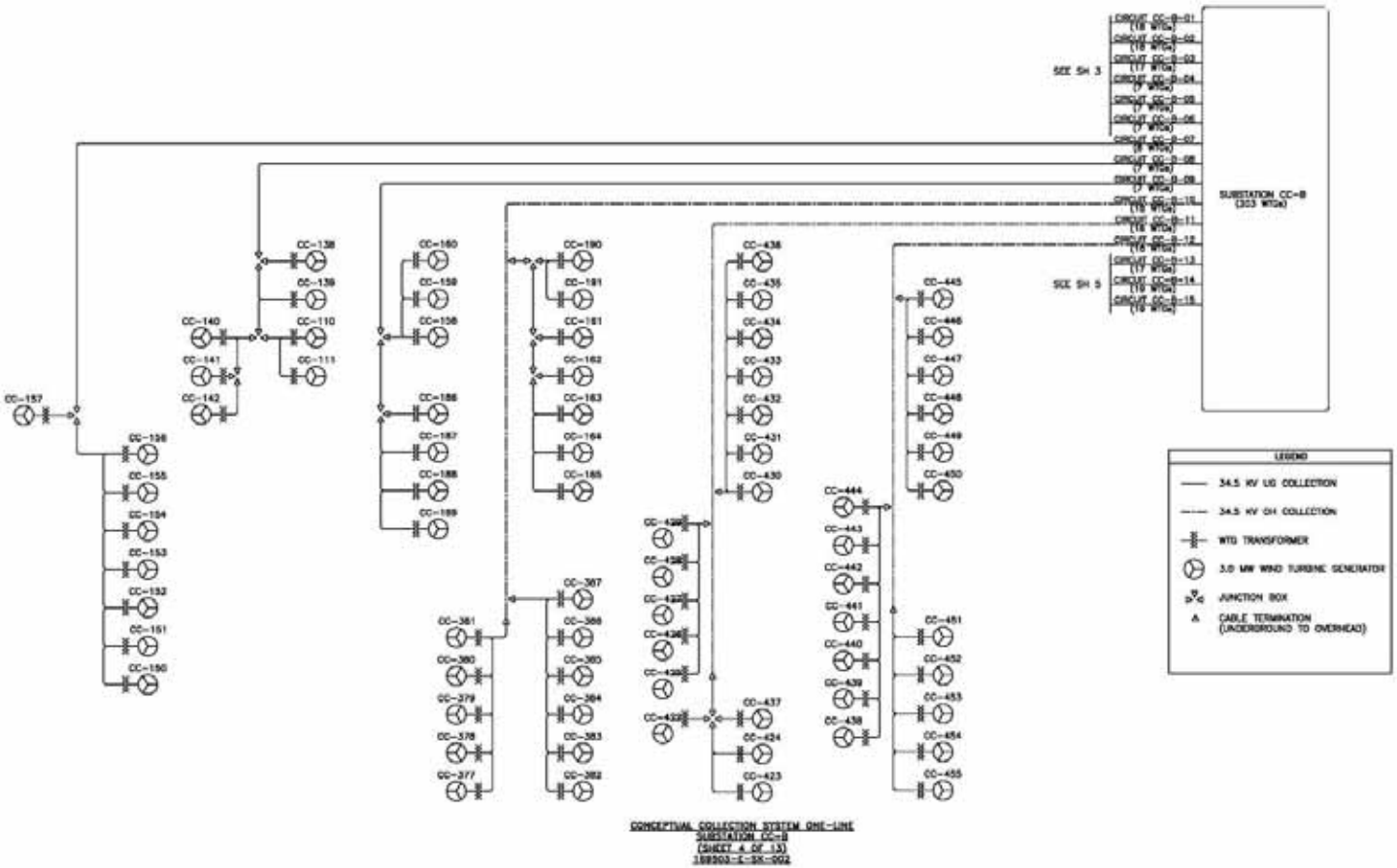


Figure L-3-6: Example Layout One-Line Diagram – Substation CC-B (3)

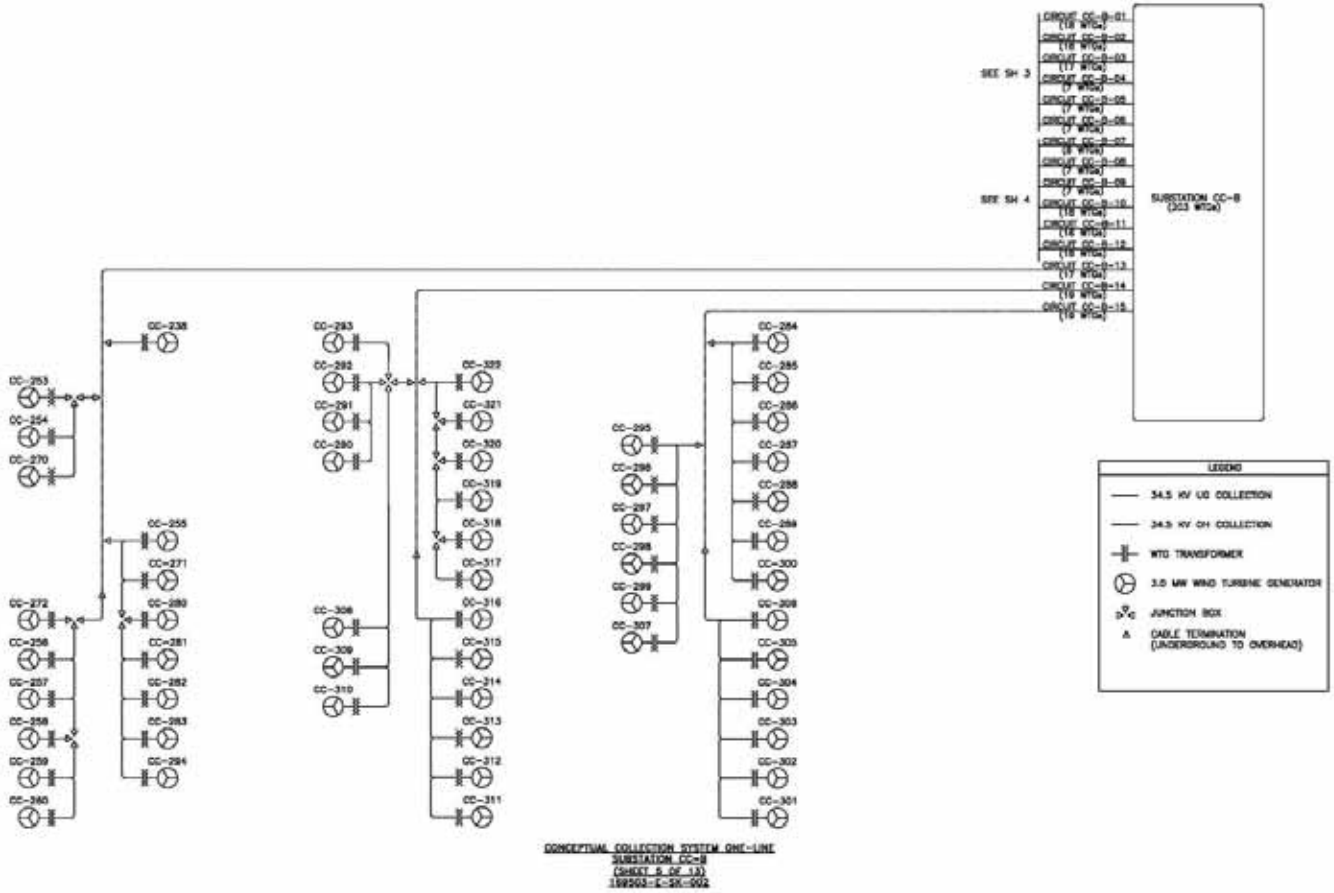


Figure L-3-7: Example Layout One-Line Diagram – Substation CC-C (1)

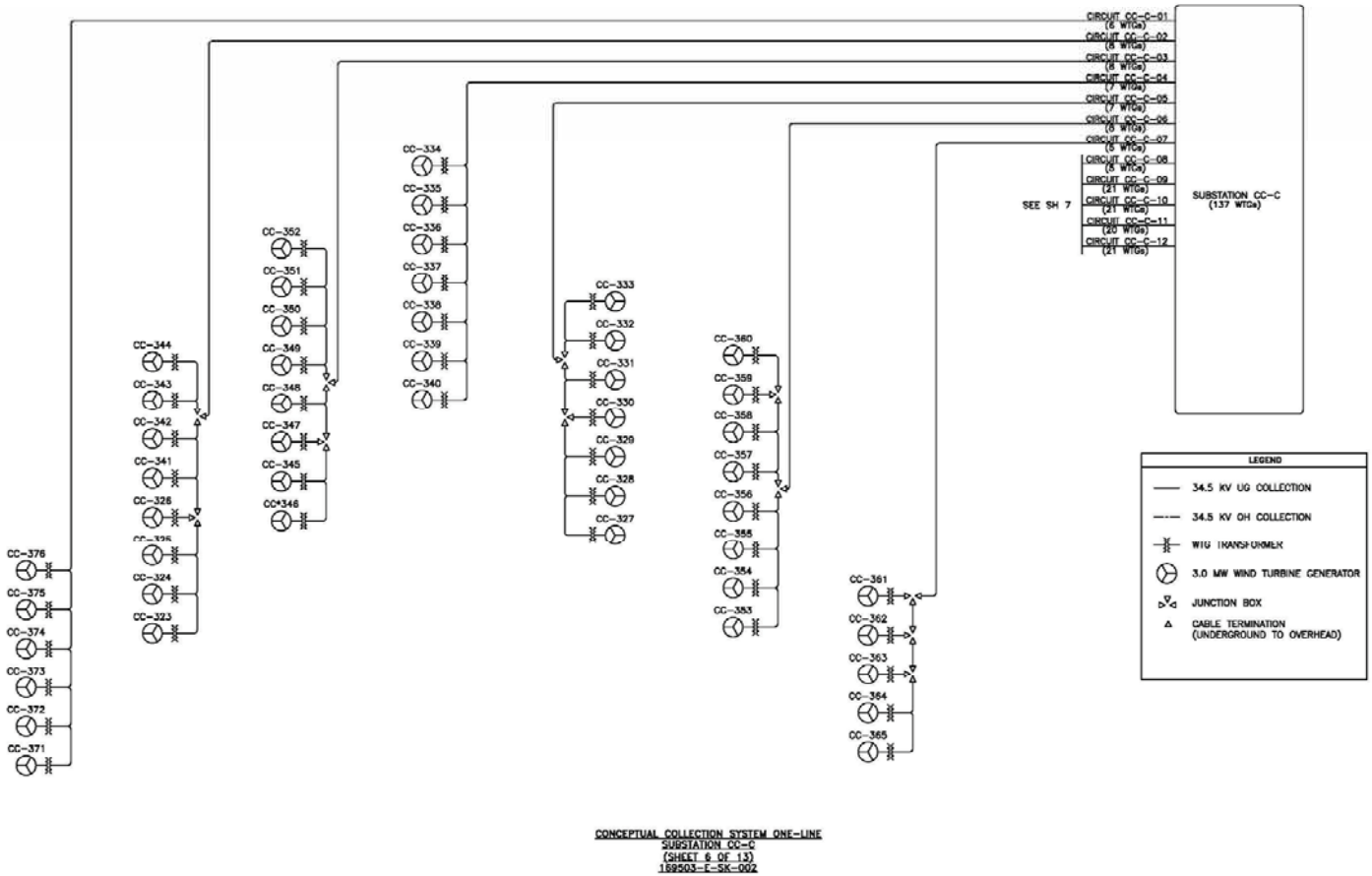


Figure L-3-8: Example Layout One-Line Diagram – Substation CC-C (2)

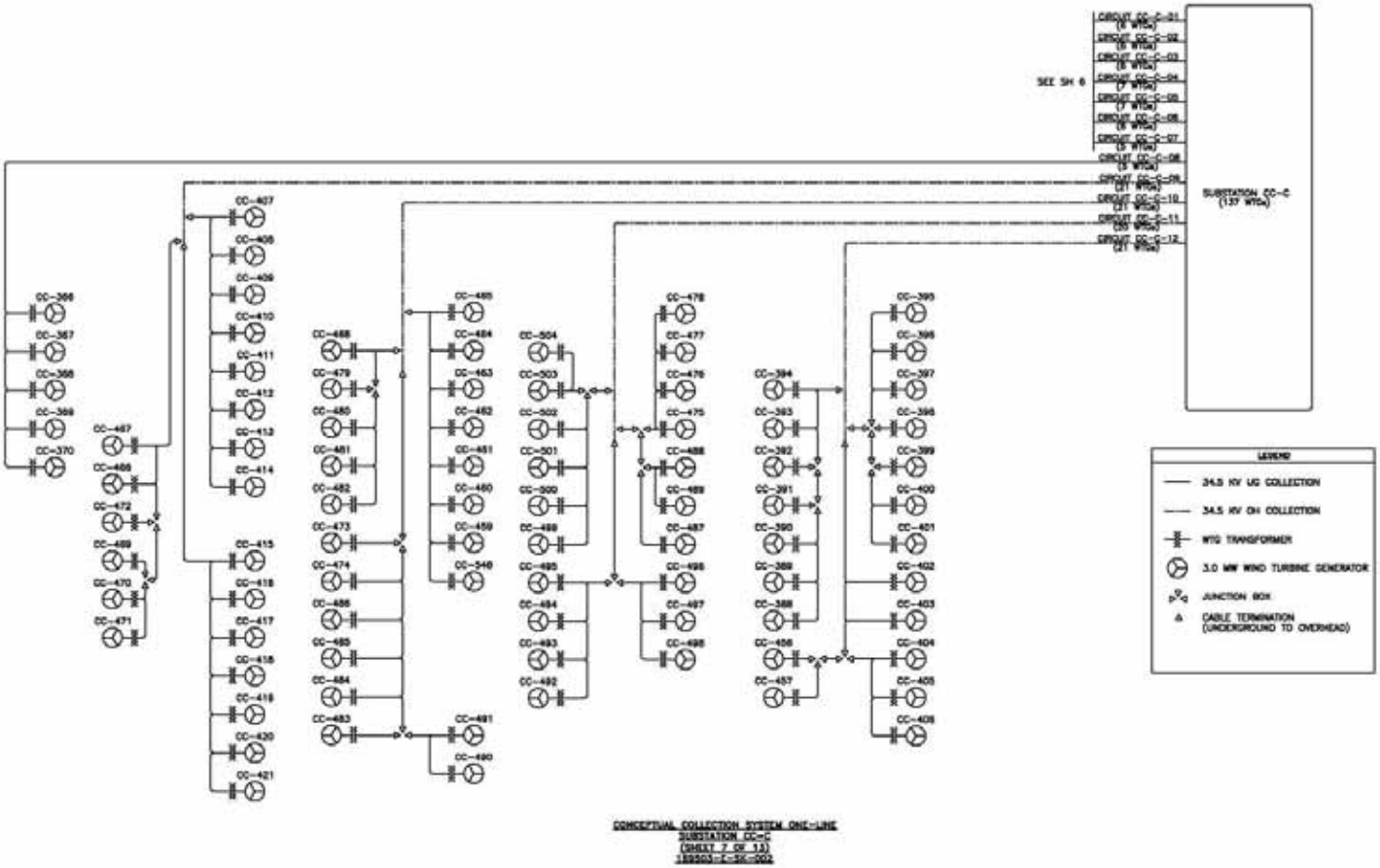


Figure L-3-9: Example Layout One-Line Diagram – Substation SM-A (1)

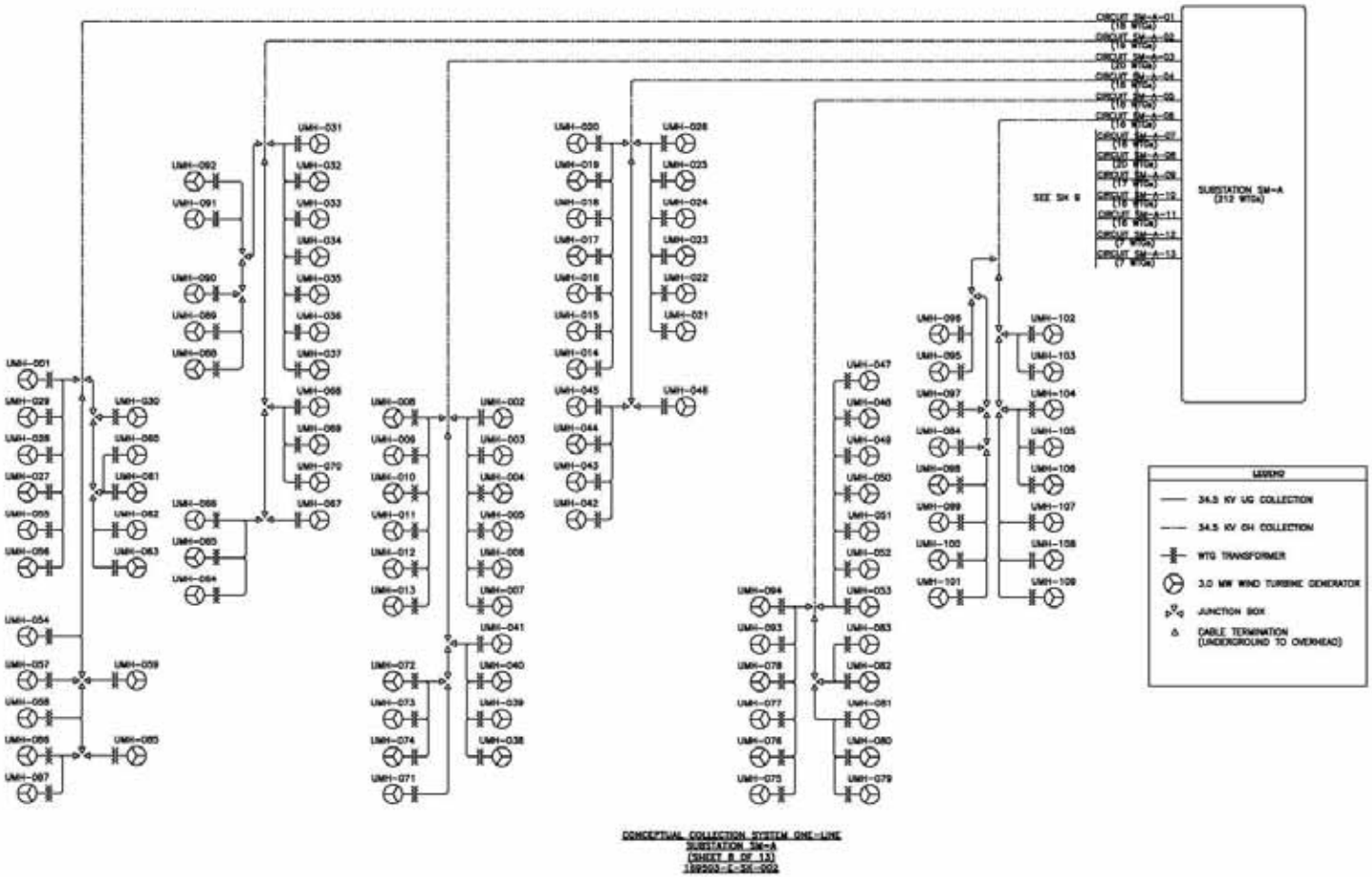


Figure L-3-10: Example Layout One-Line Diagram – Substation SM-A (2)

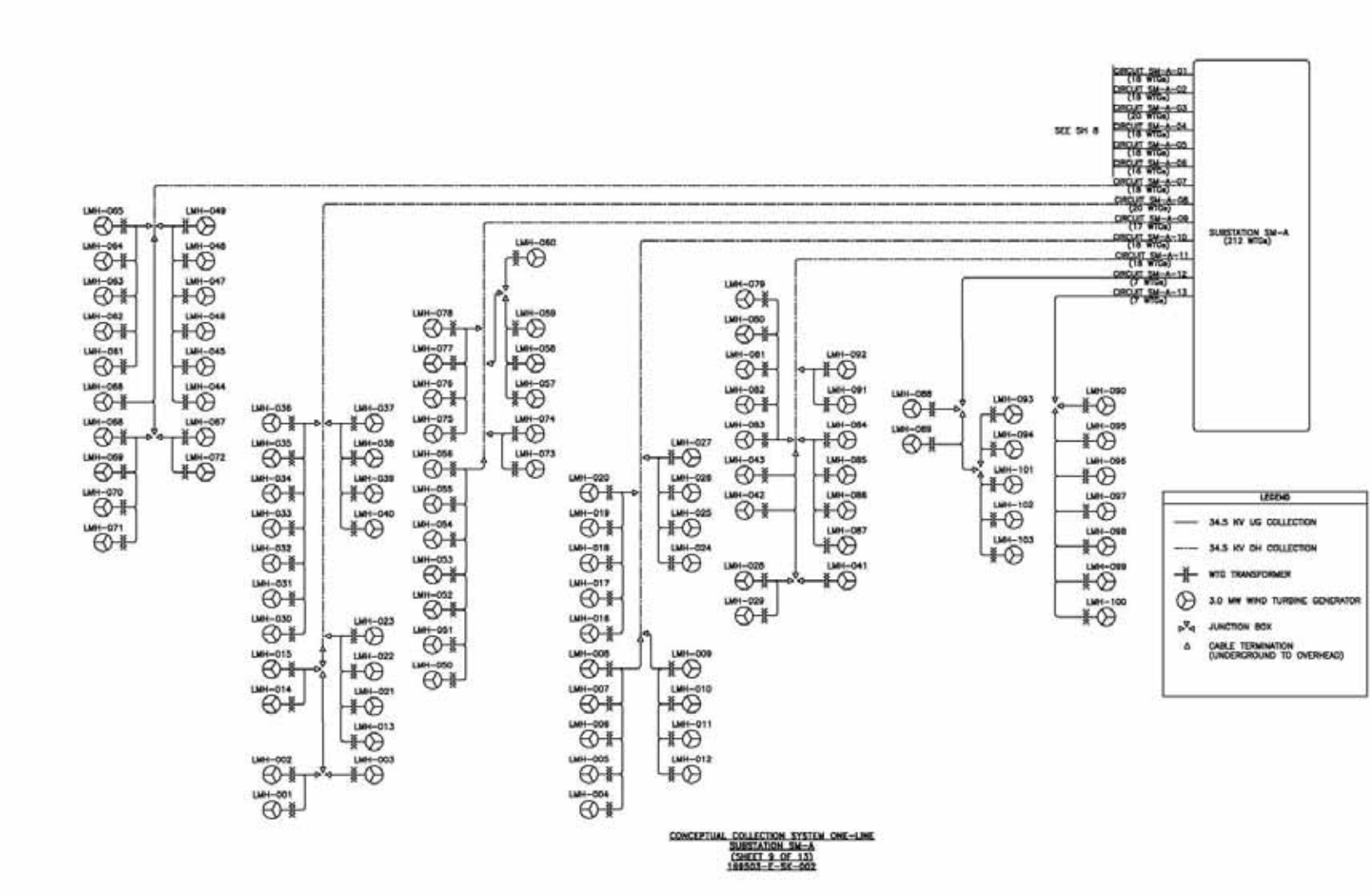


Figure L-3-11: Example Layout One-Line Diagram – Substation SM-B (1)

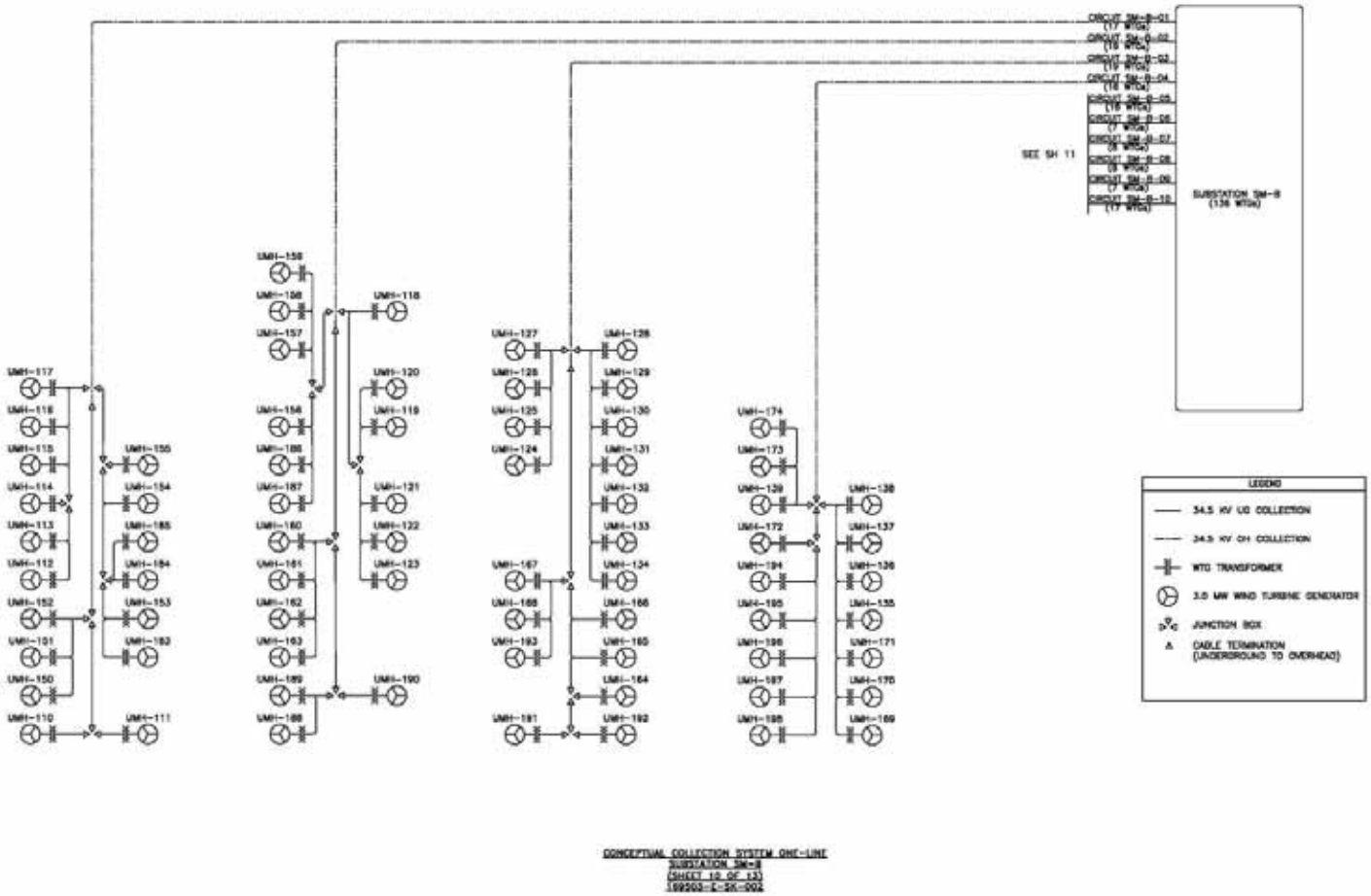


Figure L-3-12: Example Layout One-Line Diagram – Substation SM-B (2)

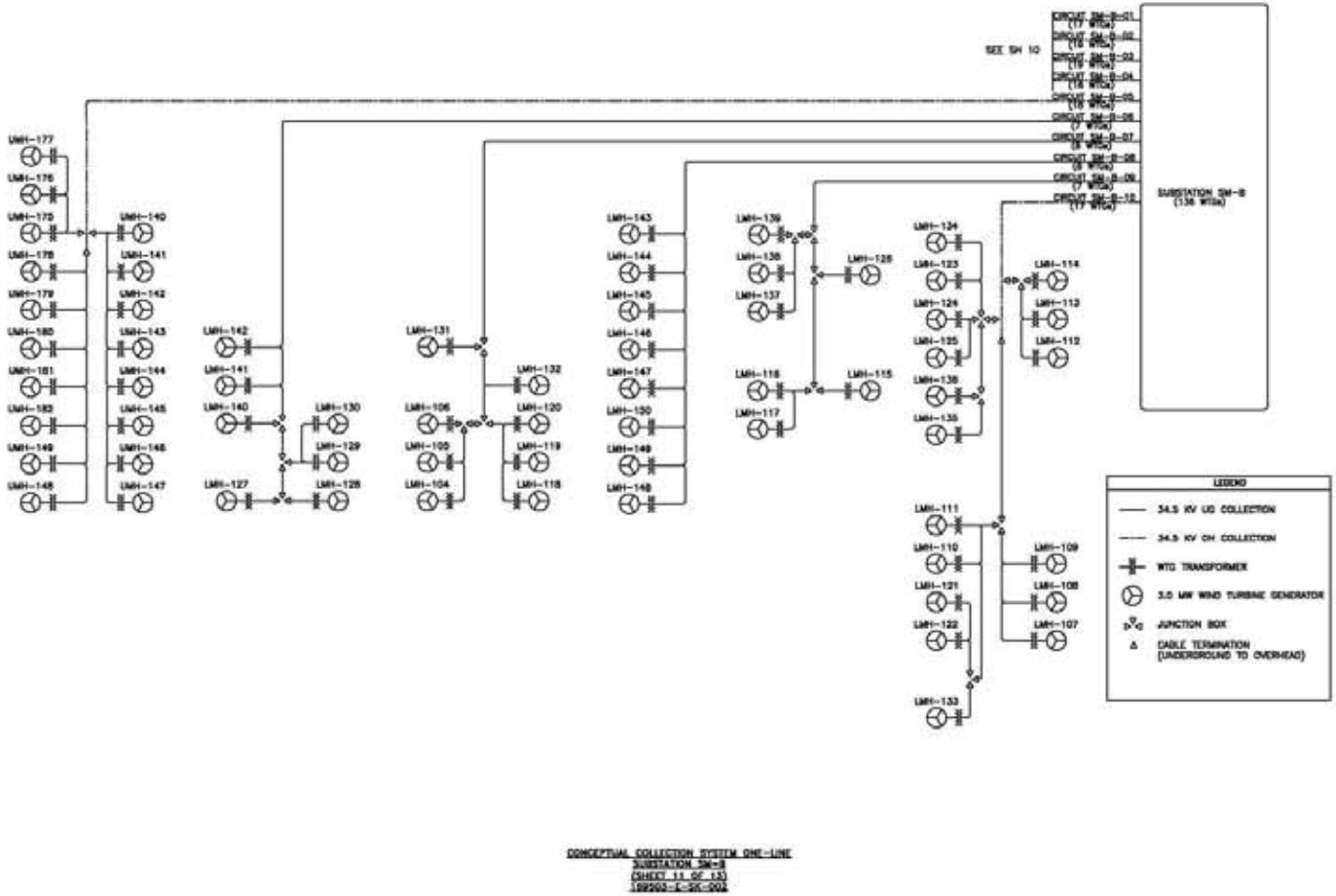
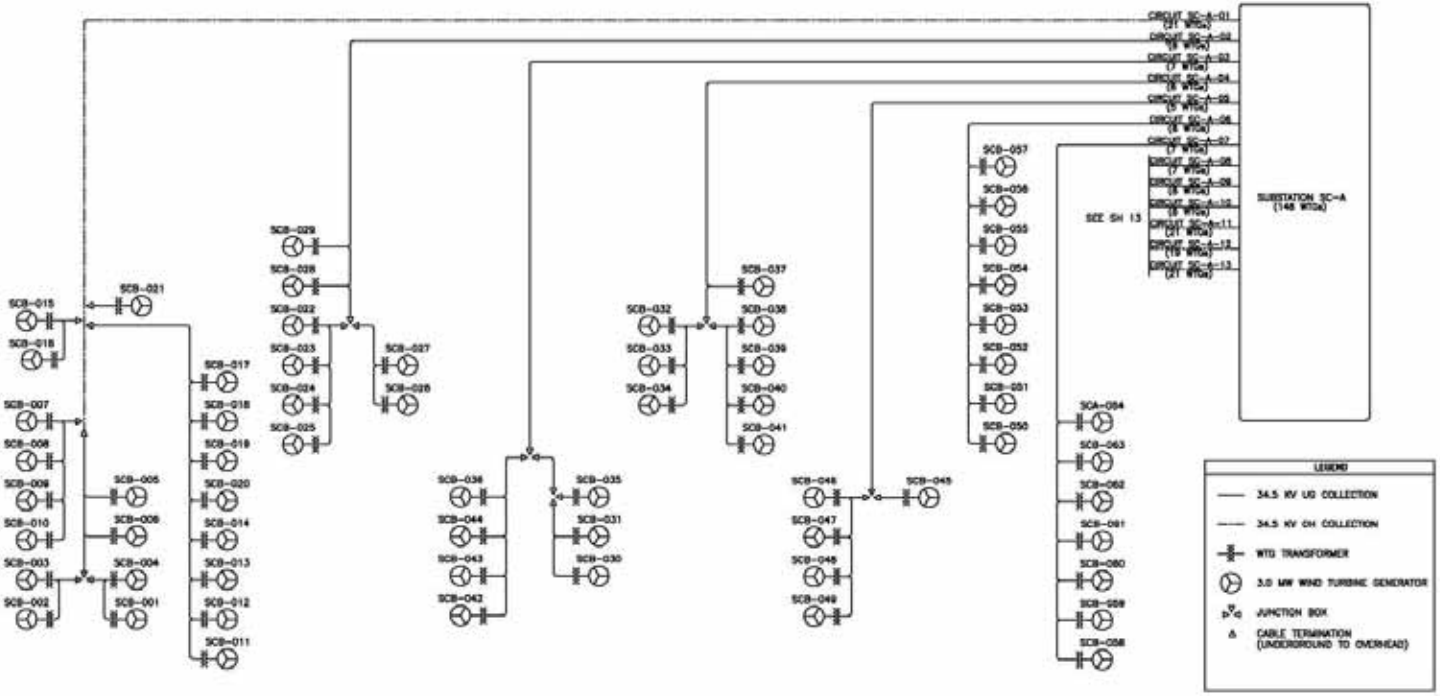
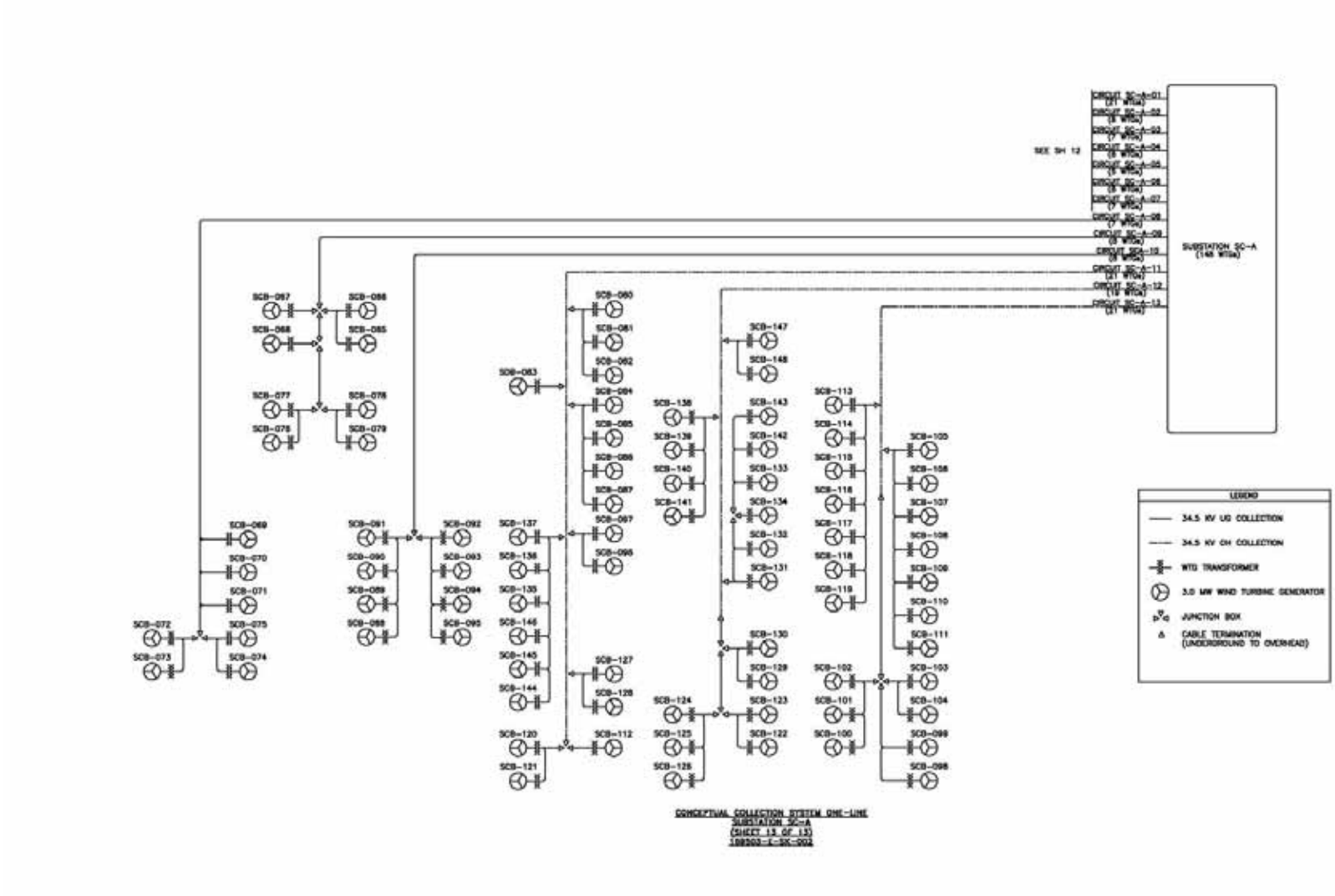


Figure L-3-13: Example Layout One-Line Diagram – Substation SCB (1)



CONCEPTUAL COLLECTION SYSTEM ONE-LINE
SUBSTATION SC-A
(SHEET 12 OF 13)
100303-E-SK-002

Figure L-3-14: Example Layout One-Line Diagram – Substation SCB (2)



L-4. Disturbance Estimate

Table L-4-1 summarizes the initial and long-term surface disturbances of the example layout. The disturbance values presented in the table are expected averages; PCW will develop a more accurate disturbance estimate for the final design once the requirements of the ROD are known.

Table L-4-1. Project Disturbance Estimate

Chokecherry and Sierra Madre Disturbance Calculations

Project Element	Project Requirement		Initial Disturbance				Long-Term Disturbance			
	Number or Miles		Width or Area (per Facility)		Project Total		Width or Area (per Facility)		Project Total	
Wind Turbines										
Chokecherry	504	ea.	1.62	ac.	816	ac.	0.18	ac.	91	ac.
Sierra Madre	496	ea.	1.62	ac.	804	ac.	0.18	ac.	89	ac.
Wind Turbine Subtotal	***1,000***	***ea.***			***1,620***	***ac.***			***180***	***ac.***
Roads										
Long-Term Features										
Haul Road	59	mi.	120	ft.	852	ac.	40	ft.	284	ac.
Arterial Road	93	mi.	90	ft.	1,018	ac.	24	ft.	271	ac.
Turbine Road	220	mi.	80	ft.	2,136	ac.	16	ft.	427	ac.
Expanded Turning Radii	649	ea.	0.1	ac.	69	ac.	0.01	ac.	6.0	ac.
Transmission Line Access	28	mi.	60	ft.	204	ac.	16	ft.	54	ac.
Met Tower Access	0.7	mi.	60	ft.	5	ac.	16	ft.	1.3	ac.
Facility Access Roads	2.4	mi.	60	ft.	17	ac.	16	ft.	5	ac.
Temporary Construction Features										
Turnarounds	100	ea.	1.0	ac.	100	ac.	0	ac.	0	ac.
Crane Erection/Teardown Area	33	ea.	2.6	ac.	85	ac.	0	ac.	0	ac.
Crane Paths	21	mi.	40	ft.	102	ac.	0	ft.	0	ac.
Emergency Egress Roads	5.1	mi.	60	ft.	37	ac.	0	ft.	0	ac.
Water Extraction Facility Access Road	7.4	mi.	60	ft.	54	ac.	0	ft.	0	ac.
Roads Subtotal					***4,678***	***ac.***			***1,049***	***ac.***
Electrical System										
Underground Collection System (34.5 kV)										
Single Circuit	220.9	mi.	0	ft.	0	ac.	0	ft.	0	ac.
Two Circuit	40.1	mi.	12	ft.	58	ac.	0	ft.	0	ac.
Three Circuit	8.6	mi.	24	ft.	25	ac.	0	ft.	0	ac.
Four Circuit	3.4	mi.	36	ft.	15	ac.	0	ft.	0	ac.
Five Circuit	2.2	mi.	48	ft.	13	ac.	0	ft.	0	ac.
Six Circuit	1.3	mi.	60	ft.	9.4	ac.	0	ft.	0	ac.
Seven Circuit	0.2	mi.	72	ft.	1.4	ac.	0	ft.	0	ac.
Cross Country (total circuit length)	18.4	mi.	12	ft.	27	ac.	0	ft.	0	ac.
Overhead Collection System (34.5 kV)										
Overhead Collection Poles	947	ea.	0.1	ac.	78.3	ac.	0.00331	ac.	3.1	ac.
Overhead Transmission System (230 kV)										
Tangent Structures	281	ea.	0.1	ac.	16	ac.	0.01	ac.	1.5	
Deadend Structures	32	ea.	2.0	ac.	64	ac.	0.01	ac.	0.3	
Electrical System Subtotal					***307***	***ac.***			***5***	***ac.***
Support Facilities										
Long-Term Facilities										
Collection Substations - 1 Transformer	0	ea.	40	ac.	0	ac.	2.0	ac.	0	ac.
Collection Substations - 2 Transformers	4	ea.	40	ac.	160	ac.	4.2	ac.	17	ac.
Collection Substations - 3 Transformers	2	ea.	40	ac.	80	ac.	5.1	ac.	10	ac.
Interconnection Substation	1	ea.	40	ac.	40	ac.	5.7	ac.	6	ac.
Rail Facility/Delivery Staging Area	1	ea.	250	ac.	250	ac.	250	ac.	250	ac.
Operations Center	1	ea.	0	ac.	0	ac.	10	ac.	10	ac.
Maintenance Buildings	2	ea.	40	ac.	80	ac.	10	ac.	20	ac.
Permanent Met Towers	12	ea.	2	ac.	24	ac.	0.02	ac.	0	ac.
Temporary Construction Facilities										
Trailer Complex/Laydown	1	ea.	160	ac.	160	ac.	0	ac.	0	ac.
Laydown Yards	4	ea.	80	ac.	320	ac.	0	ac.	0	ac.
Water Extraction Facility	1	ea.	5	ac.	5	ac.	0	ac.	0	ac.
Electrical System Subtotal					***1,119***	***ac.***			***313***	***ac.***
TOTAL PROJECT DISTURBANCE AREA					***7,724***	***ac.***			***1,547***	***ac.***

L-5. Disturbance and Material Estimates

The tables below provide the estimates and breakdowns for the initial disturbance and quantities of major materials required to build the example layout of the Project. These amounts are average values intended for evaluation purposes. Final quantity estimates will be determined during the detailed design of each project aspect, and updated quantity estimates will be provided for each scope of work of subsequent PODs.

Table L-5-1. Initial Disturbance by Year

Year	Initial Disturbance
Year 1	1,334 ac
Year 2	1,707 ac
Year 3	2,193 ac
Year 4	2,284 ac
Year 5	207 ac
TOTAL	7,724 ac

Table L-5-2. Material Estimate – Aggregate by Use

Design Element	Width or Area	Thickness	Example Layout Requirement	Resulting Amount
Haul Road	40 ft	12 in	59 mi	458,000 CY
Arterial Road	24 ft	10 in	93 mi	365,000 CY
All Other Roads	16 ft	8 in	220 mi	88,000 CY
Rail Facility/Delivery/Staging Area	250 ac	12 in	1	403,000 CY
Construction Trailer Complex/Laydown Area	150 ac	8 in	1	172,000 CY
Additional Laydown Areas	80 ac	8 in	4	344,000 CY
Substations	25 ac	8 in	7	51,600 CY
Permanent Met Towers	3 ac	8 in	12	200 CY
Operations Center/Maint. Buildings	20 ac	12 in	3	48,400 CY
Concrete	0.4 CY per CY concrete		624,000 CY	250,000 CY
TOTAL AGGREGATE CALCULATION				2,701,000 CY
TOTAL AGGREGATE AMOUNT FOR PLANNING				**2,800,000 CY**

Table L-5-3. Material Estimate – Concrete by Use

Design Element	Quantity	Example Layout Requirement	Resulting Amount
Wind Turbine Foundations	600 CY	1,000	600,000 CY
Transmission Structures (various types)	varies	313	16,200 CY
Substation Foundations – 1 transformer	300 CY	0	0 CY
Substation Foundations – 2 transformers	600 CY	4	2,400 CY
Substation Foundations – 3 transformers	800 CY	2	1,600 CY
Interconnection Substation	1200 CY	1	1,200 CY
Operations Center Foundation	300 CY	1	300 CY
Maintenance Building Foundation	500 CY	2	1,000 CY
Met Tower Foundation	50 CY	12	600 CY
TOTAL CONCRETE CALCULATION			624,000 CY
TOTAL CONCRETE AMOUNT FOR PLANNING			**630,000 CY**

Table L-5-4. Material Estimate – Water by Year, Use, and Source

Use	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
Project Use From Platte River Watershed						
Concrete	0.1 ac-ft	11.6 ac-ft	21.8 ac-ft	20.1 ac-ft	5.4 ac-ft	**59.0 ac-ft**
Road Construction	9.8 ac-ft	8.7 ac-ft	18.6 ac-ft	21.1 ac-ft	1.2 ac-ft	**59.3 ac-ft**
Dust Control	24.3 ac-ft	54.9 ac-ft	74.6 ac-ft	114.0 ac-ft	74.0 ac-ft	**341.7 ac-ft**
Revegetation	0.0 ac-ft	1.8 ac-ft	1.7 ac-ft	3.6 ac-ft	4.0 ac-ft	**11.2 ac-ft**
Other	0.2 ac-ft	0.2 ac-ft	0.4 ac-ft	0.4 ac-ft	0.0 ac-ft	**1.1 ac-ft**
TOTAL	**34.4 ac-ft**	**77.2 ac-ft**	**117.1 ac-ft**	**159.2 ac-ft**	**84.6 ac-ft**	**472.4 ac-ft**
Project Use From Little Snake River Watershed						
Concrete	0.0 ac-ft	0.0 ac-ft	0.0 ac-ft	0.0 ac-ft	0.0 ac-ft	**0.0 ac-ft**
Road Construction	0.0 ac-ft	7.3 ac-ft	0.0 ac-ft	0.0 ac-ft	0.0 ac-ft	**7.3 ac-ft**
Dust Control	0.0 ac-ft	18.3 ac-ft	25.2 ac-ft	0.0 ac-ft	0.0 ac-ft	**43.5 ac-ft**
Revegetation	0.0 ac-ft	0.0 ac-ft	1.4 ac-ft	0.0 ac-ft	0.0 ac-ft	**1.4 ac-ft**
Other	0.0 ac-ft	0.1 ac-ft	0.0 ac-ft	0.0 ac-ft	0.0 ac-ft	**0.1 ac-ft**
TOTAL	**0.0 ac-ft**	**25.8 ac-ft**	**26.6 ac-ft**	**0.0 ac-ft**	**0.0 ac-ft**	**52.4 ac-ft**
Total Project Use						
Concrete	0.1 ac-ft	11.6 ac-ft	21.8 ac-ft	20.1 ac-ft	5.4 ac-ft	**59.0 ac-ft**
Road Construction	9.8 ac-ft	16.0 ac-ft	18.6 ac-ft	21.1 ac-ft	1.2 ac-ft	**66.7 ac-ft**
Dust Control	24.3 ac-ft	73.2 ac-ft	99.8 ac-ft	114.0 ac-ft	74.0 ac-ft	**385.2 ac-ft**
Revegetation	0.0 ac-ft	1.8 ac-ft	3.1 ac-ft	3.6 ac-ft	4.0 ac-ft	**12.5 ac-ft**
Other	0.2 ac-ft	0.3 ac-ft	0.4 ac-ft	0.4 ac-ft	0.0 ac-ft	**1.3 ac-ft**
TOTAL	**34.4 ac-ft**	**102.9 ac-ft**	**143.7 ac-ft**	**159.2 ac-ft**	**84.6 ac-ft**	**524.7 ac-ft**

Table L-5-5. Material Estimate by Year

Year	Aggregate	Concrete	Water
Year 1	1,038,000 CY	500 CY	34.4 ac-ft
Year 2	443,000 CY	122,800 CY	102.9 ac-ft
Year 3	602,000 CY	229,000 CY	143.7 ac-ft
Year 4	579,000 CY	214,000 CY	159.2 ac-ft
Year 5	38,000 CY	57,000 CY	84.6 ac-ft
TOTAL CONSTRUCTION USE	**2,702,000 CY**	**624,000 CY**	**524.7 ac-ft**

Appendix M. Significant Changes from March 2009 POD

PCW has advanced the development of the Project significantly since the original Plan of Development was submitted in March 2009. For the convenience of the reviewer, Table M-1 below lists some of the most significant development approach changes to the Project between this document and the March 2009 POD that are relevant to the environmental evaluation of the Project. PCW also listed information from two other documents (the December 2009 PCW Response and Data on BLM Alternatives (PCW 2009) and the April 2010 Applicant Proposed Alternative & BLM Response Letter (PCW 2010)) which relate mostly to the Project layout alternatives. Not all changes between the PODs are listed due to the volume of numbers and assumptions effected by the conceptual changes described.

Table M-1. Summary of Applicant Committed Measures

Topic	March 2009 POD	December 2009 Alternatives Response	April 2010 APA Letter	Updated POD
POD Approach	Discussed specific project layout; potential disturbance zone (PDZ) defined; specific lengths and quantities provided.	Not specified	Not specified, although description of APA layout was clear that the layout was only conceptual.	"Hybrid" approach taken where Project parameters and requirements defined in this POD, detailed design in site-specific PODs (Section 1.4); range of quantities given, specific values only provided for example layout (Chapter 8)
Schedule	Project facilities built over 3 years (Section 1.7)	Three-year construction used for all estimates.	Per BLM request, PCW evaluated a four-year total construction schedule as an alternative.	Five-year construction schedule evaluated (Section 4.4.1) to be responsive to Draft EIS (BLM 2011) See Section 1.5
Roads	Single road design (Section 2.1.2.1, Table 8)	Maintained consistency with March 2009 POD.	Maintained consistency with March 2009 POD.	Multiple road classifications defined, tables and descriptions added. (Section 3.11.1)
Project Layout	Layout shows turbines in Chokecherry and on top of Miller Hill only (Section 2.1.2.5, Figure 18)	Conceptual layouts developed for BLM-specified alternatives.	PCW submitted an Applicant Proposed Alternative, and an example layout. Page 2 of letter specified the layout would be adjusted as more data obtained.	Turbines removed from Sage Grouse Core Area (version 3), added below Miller Hill and in Sage Creek Basin area (Chapter 8 for example)
Site	Potential development area included all of TOTCO (Section 2.2)	Development areas varied by alternatives.	Development area excludes portion of TOTCO within Sage Grouse Core Area, version 3 (in Nov. 2010 update letter)	Development area excludes portion of TOTCO within Sage Grouse Core Area, version 3 (Section 7.1.2)
Wind Turbine Models	Six listed wind turbine models under consideration by PCW, largest overall tip height listed was 410 ft. (125 m) (Section 3.1)	Expanded list of turbine models provided, Section VI of letter specified PCW not limited to only these models.	PCW clarified again that all commercial wind turbine models were under consideration.	No specific model listed, instead PCW specified envelope of potential turbine sizes; maximum tip height discussed is 525 ft. (160 m) (Section 3.1.6)
Wind Turbine Foundations	Foundations estimated with 400 CY of concrete and shown as 20 ft. deep (Section 3.1.1)	Maintained consistency with March 2009 POD.	Maintained consistency with March 2009 POD.	Foundations could have up to 600 CY of concrete and depth is likely 10 ft. or less (Section 3.9.1)
Rail Facility	Rail facility incorrectly called an "intermodal rail facility", stated development contingent upon turbine choice, site listed as north of I-80 (Section 3.5.1)	Site from March 2009 POD shown on maps but not specifically discussed.	Site from March 2009 POD shown on maps but not specifically discussed.	Rail facility not contingent upon turbine choice, primary site south of I-80 (Section 3.6)
Staging Areas	Specified 10 staging areas (Section 3.5.2)	Number of staging areas varied by alternative.	Specified 6 staging areas	Final number not determined, but example layout called for 3 staging areas outside the rail facility and trailer complex (Section 8.10)

Topic	March 2009 POD	December 2009 Alternatives Response	April 2010 APA Letter	Updated POD
Operations and Maintenance Buildings	Single O&M building at rail facility or near CIG Plant (Section 3.5.4)	Site from March 2009 POD shown on maps but not specifically discussed.	Site from March 2009 POD shown on maps but not specifically discussed.	Separate Operations Center and maintenance buildings, three in total, different locations (Section 3.7)
Collection Substations	Total of three collection substations, plus the interconnection substation (Section 4.1)	Substations varied by alternative.	Total of four substations, plus interconnection substation.	Number of collection substations required not specified. Example layout has six collection substations plus interconnection station (Section 8.5)
Underground Collection Cables	Specifies three-phase cables buried 6.5 ft. (although Figure 40 shows single phase cable). (Section 4.1.2)	Cable type not discussed.	Cable type not discussed.	Specified single-phase cable buried 3 ft. (Section 3.2.2)
Internal Transmission Line	Discussion of one double-circuit 230kV line for all generation to interconnection substation (Section 4.1.6). Steel monopole structures the only type considered (Section 4.1.5). Line routed across basin between Sierra Madre and Chokecherry independent of any road.	Transmission circuits and structures not discussed. Route for proposed action same as March 2009 POD, but alternatives show route along WY71/CC401 and then across Chokecherry.	Transmission circuits and structures not discussed. Routed along haul road.	Current layout expectations require a minimum of five total transmission circuits, likely developed as two double-circuit lines and one single-circuit line from the various collection substations (Section 8.6). System and equipment limitations may require the use of additional circuits. Wooden H-frame, steel lattice, and steel monopole structure types considered (Section 3.4). Routed along haul road.
Roads	Access to the project will be provided by proposed and existing local and resource roads. Primary access to the project will be from I-80 and Wyoming Highway 71 (WY71) and will traverse private property and BLM-administered lands. There are six access points to the Chokecherry site and four access points to the Sierra Madre site. (Section 5.1)	Not specifically discussed, but maps shown haul road concept (see Updated POD description).	Not specifically discussed, but maps shown haul road concept (see Updated POD description).	To accommodate all of the deliveries for the Project, the haul road will be constructed from the Rail Facility through Chokecherry on the north and into Sierra Madre. The Haul Road will provide the access to the major project facilities including the substation, operation and maintenance facility, and the project laydown locations. The only location where the haul road will impact public roads is a single crossing of CC401 (Sage Creek Road). (Section 3.11.1.1)
Construction	Two 10-hour shifts expected (Section 6.1)	Maintained consistency with March 2009 POD.	Maintained consistency with March 2009 POD.	Single sift expected except during limited periods if needed (Section 4.4.2)

Appendix N. Sage-Grouse Conservation Plan

The Chokecherry and Sierra Madre Wind Energy Project Sage-Grouse Conservation Plan

Developed by

Power Company of Wyoming LLC

555 17th St., Suite 2400
Denver, CO 80202

August 2012

Power Company of Wyoming LLC

Contents

1. Introduction
2. Conservation Status
3. Conservation Strategy
4. Goals and Objectives
5. Conservation Measures
6. Conclusion
7. References

Appendix 1: Sagebrush-Associated Species and Other Species of Interest

Appendix 2: Greater Sage-Grouse Monitoring Report for the Chokecherry and Sierra Madre Wind Energy Project

1. INTRODUCTION

A sensible clean energy project

Power Company of Wyoming LLC (PCW) is proposing to build one of the world's most significant renewable energy projects. Located in wind-rich Carbon County, Wyoming, the **Chokecherry and Sierra Madre (CCSM) Wind Energy Project** will generate 2,000-3,000 megawatts (MW) of clean, renewable power – enough to support approximately 800,000 U.S. households. This estimated $4 billion to $6 billion investment in America's electric system will produce significant supplies of cost-effective clean energy while generating hundreds of good jobs, millions in tax and royalty revenue, and other economic benefits.

The wind project will be situated on portions of the 320,000-acre Overland Trail Ranch (Ranch), owned and operated by The Overland Trail Cattle Company LLC (TOTCO). The nation's best, highest-capacity onshore wind resources are found across the Ranch, which consists of an approximately 50/50 mix of privately owned land interspersed with federal land managed by the Bureau of Land Management (BLM). The wind energy project's utilization of approximately 50% BLM-managed land aligns with federal energy policies and objectives, including the goal outlined in Section 211 of the 2005 Energy Policy Act to develop 10,000 MW of renewable energy projects on federal land managed by the Department of the Interior by 2015; and the Department's goal of developing 10,000 MW of renewable energy on federal land by 2012.

Moreover, although the wind energy project will be located on portions of the private and BLM-managed land on the Ranch, it will result in less than 1% long-term surface disturbance on the Ranch, leaving 99% of the Ranch's vegetation communities intact and available for dedication to wildlife management and conservation.

The CCSM Wind Energy Project will deliver inherent environmental benefits to people and to plant and animal species; wind energy development is recognized as an important component in the nationwide effort to reduce greenhouse-gas emissions and climate effects from burning fossil fuels for energy. For example, the CCSM Wind Energy Project's estimated clean energy generation will reduce carbon dioxide (CO_2) emissions by approximately 7 million metric tons per year, equivalent to taking over 1 million cars off the road. Further, unlike traditional power plants, a wind farm can generate electricity day after day, year after year, decade after decade without creating odors or pollution, without creating toxic waste, and without the need to mine, drill or deliver ongoing fuel supplies.

Finally, the strength of the wind resource and the size of the wind energy project contribute to the strategy set out in the BLM's FPEIS on Wind Energy Development "of extracting the maximum potential wind energy from a given site [which] will minimize the overall environmental impacts." In fact, the wind project's nameplate capacity of up to 3,000 MW is about equal to the nameplate capacity of all the wind plants currently operating in California

(2,965 MW) combined. However, PCW's wind energy project will produce an estimated 30% more energy annually than all of California's current wind plants due to Wyoming's better wind resources and today's opportunities to deploy next-generation wind turbine technology.

A responsible development plan

At the same time, PCW is working to assure that the wind project itself is developed in an environmentally responsible manner. In particular, the CCSM Wind Energy Project will be developed in a way that complements and furthers federal, state and local goals to conserve the greater sage-grouse (*Centrocercus urophasianus*; hereafter sage-grouse). This will be achieved by implementing science-based conservation measures for sage-grouse that will reduce or eliminate current threats as well as protect, restore and enhance habitat of sage-grouse and other species of interest on the Ranch and within the Project Site. These conservation measures will insure that vital seasonal and year-long habitats on the Ranch are managed responsibly for the benefit of the sage-grouse.

Greater sage-grouse

The sage-grouse is considered a sagebrush-obligate species because it depends on sagebrush (*Artemisia* spp.) for a significant portion of its life-history needs (Patterson 1952). Its association with sagebrush is so strong that its overall range closely mirrors that of sagebrush in the western United States and southern Canada (Schroeder et al. 2004). Across their range, sage-grouse have adapted to a wide variety of sagebrush habitat types that naturally vary with regard to vegetative composition, habitat fragmentation, fire frequency and landscape features (e.g., topography). Sage-grouse use other habitat types in their life-cycle, particularly plant communities rich in forbs and insect abundance – such as riparian meadows and agricultural areas – during the brooding season. Their use of these other habitat types often relies on the availability of water resources and proximity to adjacent native sagebrush habitats (Braun 1998).

The sage-grouse is a species known to be vulnerable to various land management activities occurring on the landscape. Despite a population decline of 3.1 percent per year from 1967 to 2007 across its range, trends in recent years indicate that some sage-grouse populations have stabilized or increased with an average decline over the past decade of 1.4 percent (U.S. Fish and Wildlife Service 2008; Western Association of Fish and Wildlife Agencies 2008). The range of the species has been subdivided into seven Management Zones based on vegetation characteristics, and over 50 percent of the known population of sage-grouse occurs in three of those areas, one of which, Management Zone II, includes the Ranch and Project Site (see Connelly et al. 2004; Stiver et al. 2006). The primary threats known today to affect sage-grouse in Management Zone II include energy development, disease, predation and habitat fragmentation, while secondary threats include fire, invasive plant species, pesticide/herbicide use, and grazing and habitat conversion (Service 2008).

To date, peer-reviewed studies specific to wind development and sage-grouse are lacking, and additional research is needed to determine what effects may be occurring and to what degree (Service 2003; Manville 2004; Governor's Sage-Grouse Conservation Team 2004; Strickland 2005; Southwest Wyoming Sage-grouse Working Group 2007; Wyoming Game and Fish Department [WGFD] 2009). Several planning documents and environmental assessments have listed wildlife effects anticipated from wind energy development, but the most common studies about the effect of wind facilities on birds in grassland and shrub-steppe habitats document mortality at specific facilities. A much smaller set of studies document behavioral responses (e.g., changes in flight behavior) or effects on breeding bird density or distribution. Due to the lack of specific wind-related research, studies of other developments involving similar infrastructure components and disturbances have been used to provide some insight into effects of wind energy development on wildlife (Manville 2004; Strickland 2004).

Candidate conservation agreement with assurances

In April 2010, PCW and TOTCO submitted an application to the U.S. Fish and Wildlife Service (Service) for an Enhancement of Survival Permit, as provided for under the Endangered Species Act (ESA). PCW and TOTCO's application included a Candidate Conservation Agreement with Assurances and associated conservation plan (collectively CCAA) addressing primarily sage-grouse, which is a candidate species under the ESA. A CCAA is a voluntary agreement between the Service and a non-federal property owner who agrees to manage lands or waters to remove threats to candidate or proposed species, with assurances that the property owner's conservation efforts will not result in future regulatory obligations that exceed those agreed to at the time the agreement is signed; it authorizes take through a section 10 permit if the species is later listed.

To support the CCAA development and to better understand how to develop the Project in a manner that will conserve sage-grouse and other wildlife species across the Ranch and surrounding areas, PCW implemented an intensive monitoring and research program to better understand sage-grouse use of the Ranch and Project Site and the benefits of conservation measures.[1] Analysis of the data collected to date through PCW's monitoring program is presented in Appendix 2. Currently PCW is partnering with the WGFD, U.S. Forest Service (USFS), and the University of Missouri to continue to evaluate sage-grouse use of the Ranch and

[1] The monitoring began in 2010 with the tagging of 40 hen sage-grouse using state-of-the-art global positioning system telemetry. Field researchers support the effort by visiting many of the locations the birds have visited to record habitat characteristics that will enable the identification of important areas for sage-grouse. In 2011, the number of tagged hen sage-grouse was expanded from 40 to 55. In addition, the monitoring program was expanded through funds provided by the National Wind Coordinating Collaborative allowing the tagging of 70 male sage-grouse to evaluate how the male portion of the population uses resources within the Project Site.

surrounding land. These comprehensive monitoring efforts include evaluating lek attendance, nesting and brood-rearing success, seasonal habitat use patterns, and several other parameters.

PCW has incorporated a robust monitoring program into its proposed CCAA. The purpose of the CCAA monitoring program would be to gather scientific data on sage-grouse response to various treatments, including the conservation projects and wind energy development, and to establish the conservation uplift anticipated under the CCAA.

The CCAA process itself provides for a detailed technical review and analysis of past, present and future management activities and the conservation activities that will be implemented to conserve and enhance the species and habitats discussed in the CCAA. Using baseline habitat models developed from extensive field mapping and vegetation classification, habitat service metrics and GIS modeling, the CCAA utilizes Habitat Equivalency Analysis (HEA) to evaluate the effects to habitat from wind development and the positive effects to habitat from the conservation measures. The conservation measures and commitments outlined in the CCAA will reduce or eliminate current threats, and protect, restore and enhance the habitat of the species on the Ranch while offsetting effects from wind energy development and ultimately providing a net conservation benefit to sage-grouse. The CCAA is presently being reviewed by the Service's Wyoming Ecological Services Field Office.

Conservation Plan

The remainder of this document outlines in more detail how PCW will implement conservation measures to improve seasonal habitats for sage-grouse under this document, the Conservation Plan (Plan). These measures will have ancillary benefits to BLM sensitive species and other species including sagebrush obligates, grassland endemics, avian species, big game species and aquatic species (**Appendix 1**).

As part of its wind development proposal, PCW commits to implement this Plan. In addition, PCW has entered into a contract with TOTCO under which TOTCO agrees to cooperate with PCW in the implementation of this Plan on Ranch lands and to implement those portions of the Plan that relate to Ranch operations. Finally, PCW will continue to pursue the CCAA described above with the Service, which will provide additional benefits to sage-grouse and other species.

2. CONSERVATION STATUS

In response to petitions to list the sage-grouse as endangered or threatened, the Service completed a 12-month status review in 2005. At that time, the Service determined that listing the sage-grouse was not warranted (70 Federal Register [FR] 2244) and that the sage-grouse did not require protection under the Endangered Species Act of 1973 (ESA). That finding was challenged in the U.S. District Court, District of Idaho. In December 2007, the Court remanded the case to the Service. Initiation of a new status review was announced on February 26, 2008

(73 FR 10218). The 2008 status review took into consideration relevant new information that became available after 2005; however, the Service still found that the sage-grouse did not require protection under the ESA.

In April 2008, separate petitions to list the western greater sage-grouse subspecies (73 FR 23170) and the Mono Basin Area population (73 FR 23173) were filed. The Service found that these petitions presented substantial new information which indicated that listing of the greater sage-grouse under the ESA may be warranted. Status reviews were initiated for both populations. An Interim Status Update was issued on October 31, 2008, along with notice that a 12-month finding (listing decision) would be published by February 26, 2010 (Service 2008). On March 5, 2010, the Service issued their listing decision which found that listing the sage-grouse (rangewide) is warranted but precluded by higher priority listing actions and that listing the western subspecies of sage-grouse is not warranted based on a determination that the western subspecies is not a valid taxon and thus is not a listable entity under the ESA (75 FR 13909).

The determination of whether a species is threatened or endangered requires the Service to evaluate the likelihood of the future persistence of the species, as outlined in the guidelines set forth by the Service in its Policy for Evaluation of Conservation Efforts (PECE) standards. In order to predict future conditions, the Service must consider the future effects (both positive and negative) of ongoing and anticipated human actions. Section 4(b) (1) (A) of the ESA (16 United States Code 1531 et seq.) requires the Service to make a listing determination after taking into account future conservation efforts intended to have positive effects on species (e.g., conservation plans). The PECE is intended to guide the Service in the evaluation of such voluntary efforts.

In addition, Section 4(a) (1) (B) of the ESA states that the Service must evaluate whether any species is an endangered species or a threatened species because of any of five factors:

1. The present or threatened destruction, modification, or curtailment of its habitat or range;
2. overutilization for commercial, recreational, scientific, or educational purposes;
3. disease or predation;
4. the inadequacy of existing regulatory mechanisms; or
5. other natural or human-made factors affecting its continued existence and threats to the species or its habitat.

This Plan was prepared to consider the five listing factors as they relate to the Ranch and Project Site. PCW has implemented conservation measures to minimize or eliminate threats to sage-grouse and its habitat. Section 3 evaluates these conservation measures in relation to the Service's listing criteria.

3. CONSERVATION STRATEGY

PCW recognizes the importance of both species conservation and providing clean, renewable and reliable energy sources for the American public. This Plan demonstrates how the development of clean, renewable wind energy can be balanced with species conservation by implementing science-based conservation measures (Sage-Grouse National Technical Team 2011) that:

1. Minimize effects to all sage-grouse habitat types (nesting, brood-rearing, and winter habitats) important to the conservation of the species and other wildlife species;
2. Provide, enhance, and conserve habitats on the Ranch and in the Project Site to support conservation of sage-grouse populations; and
3. Allow for rapid recovery of the species and its habitat from effects related to the Project.

This Plan addresses threats to sage-grouse and other species; evaluates opportunities for project designs that will avoid, minimize and mitigate effects in high-quality sage-grouse habitat; and sets the standard for development of renewable wind energy resources in an environmentally responsible manner. As part of its conservation commitment, PCW has committed to no development within core sage-grouse population areas identified by the State of Wyoming under the Governor's Executive Order 2011-5 (EO 2011-5 Version 3 map). Areas within the Ranch and outside of the Project Site will be managed to further minimize or reduce threats to sage-grouse and its habitat through the implementation of conservation measures.

4. GOALS AND OBJECTIVES

Conservation and enhancement of sage-grouse and the sagebrush ecosystem will be a primary objective in the future management of the Ranch and Project Site (BLM 2011). Conservation measures can be implemented to conserve current sage-grouse populations across the Ranch and Project Site. This is largely possible because the land and water resources on the Ranch provide the flexibility to enhance and conserve approximately 500 square miles of sage-grouse habitat.

More than 70 percent of this area, including the best sage-grouse habitat on the Ranch, will not be affected by the Project and less than 1% of the Ranch lands will be subject to long-term disturbance. To provide conservation benefits for the sage-grouse and other species of interest (**Appendix 1**), PCW will implement the conservation measures discussed in Section 5 of this Plan.

5. CONSERVATION MEASURES

Effects associated with the Project will be eliminated, minimized, or mitigated by implementation of this Plan on the Ranch and within the Project Site in accordance with the following strategy:

1. Identify conservation strategies and measures to eliminate and minimize the potential threats to sage-grouse;
2. Identify locations throughout the Ranch where habitat conditions will be improved for sage-grouse and other wildlife species;
3. Develop standardized monitoring methods to measure the success of various conservation projects for application at other candidate sites on the Ranch; and
4. Monitor sage-grouse populations throughout the Ranch to assess population trends and behavioral response to conservation projects and wind development activities.

Implementation of conservation measures and monitoring efforts on the Ranch and within the Project Site will occur in a sequenced manner and will include both pre- and post-wind energy development activities. The conservation measures that will be implemented will minimize or remove some existing threats to sage-grouse survival and productivity. These measures are detailed in the following paragraphs.

Vegetation Mapping and Habitat Evaluation - High-resolution vegetation mapping (4 square-meter resolution) was used to evaluate sage-grouse habitat across the Ranch and Project Site. Over 500 vegetation transects were established to quantify a series of vegetation attributes (e.g., sagebrush cover and height, forb abundance, residual grass cover, etc.). This detailed information will be used to evaluate the present level of habitat modification to help determine the scale and location of conservation measures needed to eliminate or minimize threats to sage-grouse.

Land Management - Since the early settlement of the Ranch, various disturbances have occurred on the Ranch and Project Site that may have altered and reduced the quantity and quality of habitat for sage-grouse. These activities include direct conversion of native habitats to agriculture, vegetation management, fire (both natural and prescribed), livestock grazing and associated fencing, water improvement projects, oil and gas development, construction of access roads within the Ranch, installation of anthropogenic facilities (residences, barns, and other outbuildings), and invasion of noxious weeds. Most conversion activities have occurred as part of past management actions on the Ranch and are primarily related to agricultural operations and oil and gas activities. Currently, no active conversion of sage-grouse habitat occurs on the Ranch, and many of the current management actions benefit sagebrush habitat and the species using that habitat, including sage-grouse (e.g. intensive management and rotating pastures)

Core Area Protection - Habitat quality across the Ranch and Project Site was evaluated under the framework of the State of Wyoming's Core Area Strategy as set forth in EO 2011-5. Habitat within the core sage-grouse population areas is identified as the highest quality habitat. No wind resource development will occur in core sage-grouse population areas as set forth in EO 2011-5 Version 3 map.

Monitoring - Under this Plan, PCW will work cooperatively with BLM and WGFD to continue to monitor sage grouse populations within the Ranch to assess population trends and behavioral response to the implemented conservation measures and wind development activities during pre-construction, construction and for five years post-construction. Monitoring will include annual lek counts in accordance with approved WGFD protocols and a continuation of PCW's GPS telemetry study. The August 2012 Greater Sage-grouse Monitoring Report for the Project, Appendix 2, presents the results of the monitoring conducted to date.

Fence Marking and Removal – Fence collisions have been identified as a primary source of mortality for sage-grouse and other bird species (Christiansen 2009). During field monitoring, numerous fences across the Ranch and within the Project Site were identified as potential collision risks, and several collisions were documented along these fences. PCW has removed 10 miles of woven wire and barbed wire fences in high-use areas around sage-grouse leks, nesting areas and brood-rearing habitats. An additional 16 miles of barbed wire fence were marked with reflective bird diverters. No collisions have been documented on the fences that have been marked with diverters; however, fence collisions continue to account for sage-grouse mortalities across the Ranch and Project Site. In 2011, several fence collisions were observed on unmarked fences, including a fence collision of a male sage-grouse within 500 feet of a marked fence.

In accordance with BLM Instruction Memorandum 2012-043 (BLM 2011), PCW will:

1. Evaluate the need for proposed fences, especially those within 1.25 miles of leks that have been active within the past 5 years and in movement corridors between leks and roost locations. PCW will consider deferring fence construction unless the objective is to benefit sage-grouse habitat, improve land health, promote successful reclamation, protect human health and safety, or provide resource protection. If a new fence is constructed, then, where appropriate, mitigation (e.g., proper siting, marking, etc.) will be applied to minimize or eliminate potential effects to sage-grouse as determined in cooperation with the BLM and WGFD (Stevens 2011).
2. To improve visibility, PCW will mark existing fences that have been identified as a collision risk. Prioritizing fences within 1.25 miles of a lek, fences posing higher risks to sage-grouse include those:
    (a) On flat topography;
    (b) Where spans exceed 12 feet between T-posts;

(c) Without wooden posts; or

(d) Where fence densities exceed 1.6 miles of fence per section (640 acres).

Bird Diverters on Meteorological Towers – Similar to fences, guy wires on meteorological monitoring towers pose a collision risk for greater sage-grouse and other bird species. To remove and reduce this risk, PCW has installed bird diverters on the guy wires of all 30+ meteorological towers located throughout the Project Site.

Water Tank Escape Ramps –PCW has worked in collaboration with the Saratoga High School Future Farmers of America chapter to construct metal mesh escape ramps that have been installed in many of the water tanks on the Ranch. Escape ramps reduce the risk of drowning to sage-grouse and other species. PCW will continue to install escape ramps in water tanks across the Ranch where there is an identified risk to wildlife.

Habitat Improvements – PCW is implementing measures to improve sage-grouse habitat conditions. Through enhanced rangeland management and utilizing the flexibility provided by the land and water resources throughout the Ranch, measures are being taken to create and improve nesting and brood-rearing habitats. These measures include enhanced riparian and wetland resource management, maintenance and enhancement of native understory plants, revegetation of burned areas and fallow agricultural fields, sagebrush treatments, and numerous other vegetation enhancement opportunities. The following are the habitat improvement measures specific to the Ranch and Project Site:

- Wildfire Emergency Stabilization and Burned Area Rehabilitation – Wildfire, particularly in low-elevation Wyoming big sagebrush systems, has resulted in significant habitat loss primarily because of subsequent invasion by cheatgrass and other exotic plant species (BLM 2011). PCW will work with BLM to prioritize stabilization and burned area re-vegetation projects to (1) maintain unburned intact sagebrush habitat when at risk from adjacent threats; (2) stabilize soils; (3) reestablish hydrologic function; (4) promote biological integrity; (5) promote plant resiliency; (6) limit expansion or dominance of invasive species; and (7) reestablish native species.

  For example, in 2010, a 170-acre wildfire occurred within sage-grouse habitat in the Chokecherry area of the Project Site. Following the fire, PCW seeded portions of the burned area to stabilize soils, reduce the risk of non-native plant invasion, and encourage use by sage-grouse and other wildlife species. Seed mixtures used were designed to maximize sage-grouse foraging opportunities during summer brood-rearing periods to enhance brood survival within the Project Site.

- Water Improvement Projects – The primary objective of all water development conservation projects will be to modify water sources to create and enhance natural free-flowing water and wet meadow habitats that are used by sage-grouse for summer and late

brood-rearing habitat. Water developments are known to improve sage-grouse brood-rearing habitat (Autenrieth et al. 1982; Hanf et al. 1994). The specific locations of water improvement conservation projects will be determined following pre-construction sage-grouse monitoring to identify viable water sources that are in or adjacent to habitat that is likely to be used by sage-grouse for brood rearing and will continue for the life of the Project.

Water source modifications may include installation of upland "bubblers" and water diversions to create and enhance natural free-flowing water, enhance wet meadow habitat and flood bottomland draws. "Bubblers" will be supplied with water from both artesian wells and other wells actively pumped by windmills. Other water sources to be developed will be supplied through water diversion pipelines from existing reservoirs and stock tank pipeline networks. Water improvement projects will be completed in a manner to minimize standing water and discourage use by mosquitos, which might carry West Nile virus.

- Agricultural Field Enhancements – There are approximately 2,023 acres of unused agricultural fields in the eastern portion of the Ranch that are currently dominated with either monocultures of crested wheatgrass (*Agropyron cristatum*) and other introduced grass species, or native bunchgrass communities and encroaching shrubs typical of sagebrush steppe habitats. Sage-grouse lek counts and additional observations have identified two active leks within or adjacent to these relict agricultural fields, and surrounding sagebrush habitat is being used for nesting and early brood-rearing habitat. Additional observations have been made during monitoring that sage-grouse are using hayfields (i.e., alfalfa and hay grass species) in the Ranch and the surrounding areas at increased rates during brood-rearing. The primary objectives of the agricultural field enhancement conservation projects are to develop water sources on the eastern portion of the Ranch and establish conditions suitable for year round use as breeding, nesting, brood-rearing, and wintering habitat. This will include, as appropriate, planting of additional sagebrush and/or establishment of high-value forage and cover sources in the relict agricultural fields.

- Removal and Reclamation of Unnecessary Roadways – The primary objectives of the road closure and enhancement conservation projects are to minimize the extent of habitat fragmentation due to the road network across the Ranch. As such, selected roads would be closed and, where practicable, abandoned roadbeds would be reclaimed. Road closure and abandonment effectively increase habitat patch sizes by providing contiguous habitats and removing conduits used by predators and invasive species.

  Road closures would target two-track roads that experience periodic yet irregular patterns of vehicular activity across the Ranch. Monitoring efforts have resulted in several observations of grouse mortality on or near two-track roads which serve as conduits and

hunting areas for predators. To reduce the effects of roads on the Ranch, selected existing roads will be closed to enhance greater sage-grouse nesting, brood-rearing, and winter habitat. The value of the habitat adjacent to the roadbed would improve in quality due to the removal of the associated traffic, effectively eliminating any buffer zones previously associated with that road.

- Noxious and Invasive Plant Species Control – The primary objectives of the control of noxious and invasive plant species conservation projects are to limit the spread of weedy species into native habitats, promote the establishment of native plant species, and to provide suitable sage-grouse habitat. Sage-grouse prefer native and diverse vegetation cover and well established sagebrush communities. Noxious and invasive plant species often have a competitive advantage over native species and readily establish, thus decreasing plant diversity and reducing sage-grouse habitat quality. Herbicide application or other appropriate treatments will be used for noxious and invasive plant species control. Control measures will be followed by native vegetation seeding. This conservation measure will include the development of protocols for utilization of agricultural chemicals on the Ranch.
- Conservation Easement – In conjunction with construction of the Project and the commencement of commercial operations, proposed conservation easements will be placed on approximately 26,000 acres of private land owned by TOTCO and leased to PCW. This private land is located on the Ranch adjacent to the Project and is land designated as Sage Grouse Core Area. The proposed conservation easements will preserve important sage-grouse habitat and will ensure that wind development activities will be prohibited in perpetuity on these private lands. Because these lands are located in the checkerboard, the easements will have the impact of preventing wind development on the surrounding BLM lands as well.

Suspension of Hunting – The suspension of sage-grouse hunting on the Ranch, in areas where no public access is permissible, would reduce direct mortality of sage-grouse. Suspension of hunting would only be limited to sage-grouse. Sage-grouse hunting on the Ranch was suspended in 2010 and will remain suspended throughout the life of the Project. Based on observations from the sage-grouse monitoring effort, seven tagged sage-grouse (one in 2010 and six in 2011) have been harvested in surrounding areas where public access is allowed. An additional three sage-grouse mortalities may have potentially resulted from hunting (as determined by the date of lost global positioning system transmission and last known location). No tagged sage-grouse have been harvested in areas of the Ranch where public access is not permissible.

Predator Control – During sage-grouse monitoring efforts, predation has been identified as the primary effect to sage-grouse populations on and surrounding the Ranch and within the Project Site. Control measures will be a coordinated effort between PCW, private landowners and the appropriate agencies to reduce predation on sage-grouse. Predation management activities will

be performed by PCW operations and/or contract personnel (U.S. Department of Agriculture – Animal and Plant Health Inspection Service) using currently approved techniques, under the direction of and in cooperation with the Service, WGFD and BLM.

6. CONCLUSION

PCW recognizes the importance of both species conservation and providing clean, renewable and reliable energy sources for the American public. PCW aims to maintain and/or increase sage-grouse abundance and distribution by conserving, enhancing or restoring the sagebrush ecosystem upon which populations depend in cooperation with federal, state and local agencies and working groups (Sage-grouse National Technical Team 2011).

This Conservation Plan demonstrates how the development of renewable energy sources can be balanced with species conservation. Under the conservation program, PCW will conserve the current sage-grouse population within the Project Site and, at the same time, allow 2,000 to 3,000 MW of renewable energy to be developed. In particular, the CCSM Wind Energy Project will be developed in a way that complements and furthers federal, state and local goals to conserve the sage-grouse. This Conservation Plan promotes sustainable sage-grouse populations and conservation of habitat through environmentally responsible planning and by incorporating the following principles (BLM 2011):

1. Protection of unfragmented habitats (PCW's commitment to no development within sage-grouse core population areas [EO 2011-5, Version 3 map]);
2. Minimization of habitat loss and fragmentation (CCSM Wind Energy Project long-term footprint is less than 2,000 acres); and
3. Management of habitats to maintain, enhance or restore conditions that meet sage-grouse life history needs (implementation of conservation measures).

This conservation program will address threats to sage-grouse and will set the standard for the development of renewable resources in an environmentally responsible manner. This will be achieved by implementing science-based conservation measures for greater sage-grouse that will reduce or eliminate current threats as well as protect, restore and enhance habitat of sage-grouse and other species of interest on the Ranch and within the Project Site.

7. REFERENCES

Autenrieth, R.E. 1981. Sage-grouse management in Idaho. Idaho Department of Fish and Game, Wildlife Bulletin 9, Boise, Idaho.

Bureau of Land Management. 2008. Record of Decision and Approved Rawlins Resource Management Plan for Public Lands Administered by the Bureau of Land Management Rawlins Field Office. December 2008.

———. 2010. BLM Wyoming Sensitive Species Policy and List. March 31, 2010.

———. 2011. Instruction Memorandum No. 2012-043: Greater Sage-Grouse Interim Management Policies and Procedures. Washington, D.C.

Braun, C.E. 1998. Sage-grouse Declines in Western North America: What Are the Problems. Proceedings of the Western Association of State Fish and Wildlife Agencies 78:139–156.

Christiansen, T. 2009. Fence Marking to Reduce Greater Sage-grouse (*Centrocercus urophasianus*) Collisions and Mortality near Farson, Wyoming – Summary of Interim Results. Wyoming Game and Fish Department.

Connelly, J.W., S.T. Knick, M.A. Schroeder, and S.J. Stiver. 2004. Conservation Assessment of Greater Sage-grouse and Sagebrush Habitats. Western Association of Fish and Wildlife Agencies. Unpublished Report. Cheyenne, Wyoming.

Hanf, J.M., P.A. Schmidt, and E.B. Groshens. 1994. Sage-grouse in the high desert of central Oregon: Results of a study 1988–1993. U.S. Department of the Interior, Bureau of Land Management, Series P-SG-01, Prineville, OR.

Governor's Sage-Grouse Conservation Team. 2004. Greater Sage-grouse Conservation Plan for Nevada and Eastern California. Reno, NV. Available online at http://www.ndow.org/wild/conservation/sg/resources/WGAsage-grousereport.pdf. Accessed December 2011.

Manville, A.M., II. 2004. Prairie grouse leks and wind turbines: U.S. Fish and Wildlife Service justification for a 5-mile buffer from leks; additional grassland songbird recommendations. Division of Migratory Bird Management, USFWS, Arlington, VA, peer-reviewed briefing paper.

Patterson, R.L. 1952. The Sage Grouse in Wyoming. Sage Books, Inc., Denver, Colorado.

Rowland, M.M., M.J. Wisdom, L.H. Suring, and C.W. Meinke. Greater sage-grouse as an umbrella species for sagebrush-associated vertebrates. Biological Conservation 129: 323-335.

Sage-grouse National Technical Team. 2011. A report on National Greater Sage-Grouse Conservation Measures. December 21, 2011. Available online at http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/im_attachments/2012.Par.52415.File.dat/IM%202012-044%20Att%201.pdf. Accessed December 2011.

Schroeder, M.A., C.L. Aldridge, A.D. Apa, J.R. Bohne, C.E. Braun, S.D. Bunnell, J.W. Connelly, P.A. Deibert, S.C. Gardner, M.A. Hilliard, G.D. Kobriger, S.M. McAdam, C.W. McCarthy, J.J. McCarthy, D.L. Mitchell, E.V. Rickerson, and S.J. Stiver. 2004. Distribution of Sage-Grouse in North America. The Condor 106:363–376.

Southwest Wyoming Local Sage-grouse Working Group. 2007. Southwest Wyoming Sage-grouse Conservation Assessment and Plan.

Stevens, B.S. 2011. Impacts on Fences on Greater Sage-Grouse in Idaho: Collision, Mitigation, and Spatial Ecology (Master's Thesis). University of Idaho, Moscow, Idaho.

Stiver, S.J., A.D. Apa, J.R. Bohne, S.D. Bunnell, P.A. Deibert, S.C. Gardner, M.A. Hilliard, C.W. McCarthy, and M.A. Schroeder. 2006. Greater sage-grouse comprehensive conservation strategy. Western Association of Fish and Wildlife Agencies. Unpublished report. Cheyenne, Wyoming.

Strickland, D. 2004. Non-fatality and habitat impacts on birds from wind energy development. In Proceedings of the Wind Energy and Birds/Bats Workshop: Understanding and Resolving Bird and Bat Impacts. May 18–19, 2004, edited by S.S. Schwartz, pp. 34–38. RESOLVE, Inc. Washington, D.C. Available online at http://www.awea.org/pubs/documents/WEBBProceedings9.14.04%5BFinal%5D.pdf. Accessed December 2011.

———. 2005. Methods and metrics for understanding indirect impacts from wind projects. In Proceedings of the Onshore Wildlife Interactions with Wind Developments: Research Meeting V. Lansdowne, VA November 3–4, 2004, edited by S.S. Schwartz, pp. 49–51. Prepared for the Wildlife Subcommittee of the National Wind Coordinating Committee by RESOLVE, Inc., Washington, D.C. Available online at http://www.nationalwind.org/events/wildlife/2004-2/proceedings.pdf. Accessed December 2011.

U.S. Fish and Wildlife Service (Service). 2003. Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines. Washington, D.C. Available online at http://www.fws.gov/habitatconservation/wind.pdf. Accessed December 2011.

———. 2008. Greater sage-grouse interim status update. October 31, 2008.

Western Association of Fish and Wildlife Agencies. 2008. Greater sage-grouse population trends: an analysis of lek count databases 1965-2007. Sage and Columbian sharp-tailed grouse technical committee, Western Association of Fish and Wildlife Agencies.

Wyoming Game and Fish Department (WGFD). 2006. Sagebrush Ecosystems and Species. Available online at http://gf.state.wy.us/wildlife/nongame/LIP/Sagebrush/index.asp. Accessed December 2011.

———. 2009. DRAFT – Recommendations for Wind Energy Development in Crucial and Important Wildlife Habitat. October 2009. Available online at http://gf.state.wy.us/downloads/pdf/Finalpublicwindenergyrecommendtaionsdraft10.pdf. Accessed December 2011.

APPENDIX 1

Sagebrush-Associated Species and Other Species of Interest

Common name	*Scientific Name*	BLM Sensitive
Big Game		
Elk	*Cervus canadensis*	N
Mule Deer	*Odocoileus hemionus*	N
Pronghorn	*Antilocarpa americana*	N
White-tailed deer	*Odocoileus virginianus*	N
Eagles and raptors		
Bald eagle	*Haliaeetus leucocephalus*	Y
Ferruginous hawk	*Buteo regalis*	Y
Golden eagle	*Aquila chrysaetos*	N
Northern harrier	*Circus cyaneus*	N
Peregrine falcon	*Falco peregrinus*	Y
Prairie falcon	*Falco mexicanus*	N
Swainson's hawk	*Buteo swainsoni*	N
Western burrowing owl	*Athene cunicularia hypugaea*	Y
Fish		
Bluehead sucker	*Catostomus discobolus*	Y
Colorado River cutthroat trout	*Oncorhynchus clarki pleuriticus*	Y
Flannelmouth sucker	*Catostomus latipinnis*	Y
Roundtail chub	*Gila robusta*	Y
Herpetiles		
Common sagebrush lizard	*Sceloporus graciosus*	N
Great Basin spadefoot	*Spea intermontana*	Y
Greater short-horned lizard	*Phrynosoma hernandesi*	N
Prairie rattlesnake	*Crotalus viridis*	N
Northern leopard frog	*Rana pipiens*	Y
Mammals		
Merriam's shrew	*Sorex merriami*	N
Northern grasshopper mouse	*Onychomys leucogaster*	N
Olive-backed pocket mouse	*Perognathus parvus*	N
Pygmy rabbit	*Brachylagus idahoensis*	N
Sagebrush vole	*Lemmiscus curtatus*	N
Spotted ground squirrel	*Spermophilus spilosoma*	N
Swift fox	*Vulpes velox*	Y
White-tailed jack rabbit	*Lepus townsendii*	N
White-tailed prairie dog	*Cynomys leucurus*	Y
Wyoming ground squirrel	*Spermophilus elegans nevadensis*	N
Wyoming pocket gopher	*Thomomys clusius*	Y

Common name	*Scientific Name*	BLM Sensitive
Birds		
Baird's sparrow	*Ammodramus bairdii*	Y
Brewer's blackbird	*Euphagus cyanocephalus*	N
Brewer's sparrow	*Spizella breweri*	Y
Columbian sharp-tailed grouse	*Tympanuchus phasianellus columbianus*	Y
Green-tailed towhee	*Pipilo chlorurus*	N
Lark sparrow	*Chondestes grammacus*	N
Loggerhead shrike	*Lanius ludovicianus*	Y
Mountain plover	*Charadrius montanus*	Y
Sage sparrow	*Amphispiza belli*	Y
Sage thrasher	*Oreoscoptes montanus*	Y
Vesper sparrow	*Pooecetes gramineus*	N

Sources: Rowland et al. 2006, WGFD 2006, BLM 2008, BLM 2010

APPENDIX 2

Greater Sage-Grouse Monitoring Report for the Chokecherry and Sierra Madre Wind Energy Project

Greater Sage-Grouse Monitoring Report for the Chokecherry and Sierra Madre Wind Energy Project

Prepared for

Power Company of Wyoming, LLC

Prepared by

SWCA Environmental Consultants

August 2012

TABLE OF CONTENTS

Page
1.0 INTRODUCTION 1
2.0 SAGE-GROUSE MONITORING STUDY 2
Location 2
Landscape 4
Monitoring Areas 7
Chokecherry Treatment Area 7
Eastside Control Area 7
Jack Creek Control Area 8
Sierra Madre Treatment Area 8
Sage Creek Basin Control Area 8
Local Sage-Grouse Populations 10
3.0 LEKS 10
Lek Counts 10
4.0 DATA 11
GPS Data Management 11
Capture and Tagging 12
5.0 HEN SURVIVAL AND PRODUCTIVITY 13
Survival 13
2010-2011 13
2011-2012 15
Productivity 18
Nest Success 18
Proximity of Nests to Leks 22
Brood Monitoring 22
6.0 MOVEMENT PATTERNS 23
Movement Across the Ranch and Surrounding Areas 23
Weekly Distances Traveled By Hens 24
7.0 REFERENCES 27

LIST OF TABLES

Table **Page**
Table 1. Surface Ownership within the Ranch 4
Table 2. 10-year average (2001-2010), 3-year peak (2008-2010) and 2010-2012 average male lek attendance for all of Wyoming and for the Ranch. 11
Table 3. Annual tagged bird distribution, capture distribution, and mortality on the Ranch. 12
Table 4. Monitoring area distribution of tagged sage-grouse on the Ranch. 13
Table 5. Cohorts of tagged sage-grouse hens released into monitoring population in 2010. 14
Table 6. Seasons used in models of weekly survival of tagged sage-grouse hens 14
Table 7. Models of weekly sage-grouse probability of survival compared in Program MARK. 15
Table 8. Estimates of probability of survival in hens tagged in 2010 based on top-ranked model S(season+weight). 15
Table 9. Cohorts of tagged sage-grouse hens released into monitoring population in 2011. 16

Table 10. Seasons used in models of weekly survival of tagged sage-grouse hens.....16
Table 11. Models of weekly sage-grouse probability of survival compared in Program MARK. 17
Table 12. Estimates of probability of survival in hens tagged in 2010 based on top-ranked model S(season+[earlyandlatebroodrearingcombined]). 17
Table 13. The probability of nest survival across the Ranch and the surrounding areas from 2010-2012. 18
Table 14. The probability of nest survival for initial nest and renest attempts across the Ranch and the surrounding areas from 2010-2012. 19
Table 15. The probability of nest survival for initial nest and renest attempts across the Ranch and the surrounding areas from 2010-2012. 21
Table 16. Seasonal ranges for female sage-grouse across the Ranch and the surrounding areas.24
Table 17. Pairwise comparisons of mean weekly distance traveled among seasons. 25
Table 18. Pairwise comparisons of mean weekly distance traveled among seasons. 26

LIST OF FIGURES

Figure **Page**
Figure 1. Surface ownership across the Ranch and the surrounding areas. 3
Figure 2. Vegetation communities occurring in the northern portion of the Ranch and the surrounding areas. 5
Figure 3. Vegetation communities occurring in the southern portion of the Ranch and the surrounding areas. 6
Figure 4. Map of Ranch boundary and occupied leks within each Project area based on 10-yr average occupancy. 9
Figure 5. Estimated annual nest survival probability of sage-grouse across the Ranch and the surrounding areas. Bars represent 95% confidence intervals. 19
Figure 6. Influence of nest attempt on the estimated nest survival probability of sage-grouse across the Ranch and the surrounding areas. Bars represent 95% confidence intervals. ..20
Figure 7. Influence of monitoring area on the estimated nest survival probability of sage-grouse across the Ranch and the surrounding areas. Bars represent 95% confidence intervals.....21
Figure 8. Frequency of nest distance from last lek visited to nest initiation.....22
Figure 9. Mean weekly distance traveled averaged among all tagged sage-grouse, April 10, 2010 through March 31, 2011.....25
Figure 10. Mean weekly distance traveled averaged among all tagged sage-grouse, April 10, 2010 through March 31, 2011.....26

LIST OF APPENDICES

Appendix	Title
A	2010-2012 Lek Data
B	Greater Sage-Grouse Monitoring Protocols

1.0 INTRODUCTION

The extent and distribution of sagebrush (Artemisia spp.) communities throughout western North America have declined as a result of widespread degradation, fragmentation, or total loss (Braun 1998, Knick et al. 2003), which has presented challenges for population management of greater sage-grouse (Centrocercus urophasianus; hereafter, sage-grouse), a sagebrush obligate species (Call and Maser 1985, Connelly et al. 2000, Knick et al. 2003, Crawford et al. 2004, Dahlgren et al. 2006) . Sage-grouse habitat typically consists of a mosaic of sagebrush patches of varying densities and heights that include abundant native grass cover (Natural Resources Conservation Service [NRCS] 2005). The species requires different habitat components within the broader sagebrush ecosystem seasonally for spring male courtship displays (i.e., lekking), summer nesting, early and late brood-rearing, and winter foraging (Connelly et al. 2004).

Rangewide and regional sage-grouse population decreases and increases have been noted since the 1920s. Decreases have been attributed to overhunting (1920s and 1930s) and to loss of habitat quality and quantity (1960s and 1970s), while population increases were noted in the intervening decades (1940s and 1950s) (see Connelly and Braun 1997). More recently, the rangewide population of sage-grouse has declined by an annualized 3.1 percent over the past 40 years (U.S. Fish and Wildlife Service [USFWS] 2008). The rate of decline, however, has slowed over the last two decades to an average annual rate of 1.4 percent (Western Association of Fish and Wildlife Agencies [WAFWA] 2008). This finding was similar to that of Connelly et al. (2004), who found that between 1986 and 2003 the annual rate of decline slowed to 0.37 percent rangewide (from 3.5 percent in the 1965-1985 period).

The Power Company of Wyoming, LLC (PCW) and the Overland Trail Cattle Company (TOTCO) recognize the importance of both species conservation and providing clean, renewable and reliable energy sources for the American public. PCW and TOTCO, in collaboration with the USFWS, South Central Local Sage-grouse Working Group, Wyoming Sage-grouse Working Group (WSWG), Bureau of Land Management (BLM), and Wyoming Game and fish Department (WGFD), have developed a Sage-grouse Conservation Plan with goals and objectives of implementing science-based conservation measures for the sage-grouse and other selected species. These measures will reduce or eliminate current threats, and protect, restore and enhance the habitat of the species on the Overland Trail Ranch (the Ranch) and the Chokecherry and Sierra Madre Wind Energy Development Project (Project) area. The conservation measures consist of management of vital seasonal and year-long habitats on lands owned or controlled by PCW and TOTCO and also include monitoring of sage-grouse within the Ranch and adjacent areas to assess the success of the conservation measures. The Conservation Plan demonstrates how the development of clean, renewable energy sources can be balanced with species conservation.

The Conservation Plan provides technical review and analysis of past, present, and future management activities and the activities that would be implemented to conserve and enhance sage-grouse and their habitats. As part of the Conservation Plan, a sage-grouse telemetry study is being conducted in concert with annual lek count surveys and evaluations of seasonal habitat use in order to validate the success of proposed and future conservation projects over time, refine sage-grouse associations with various sagebrush habitat components, and identify seasonal habitat uses throughout The Overland Trail Ranch (the Ranch). This effort is necessary and a critical component to understanding the short- and long-term impacts of the Project on sage-grouse within and surrounding the Ranch. This monitoring provides invaluable data on the effects of the various

conservation measures developed to offset the potential impacts of the Project on sage-grouse distribution, movements, and behaviors.

2.0 SAGE-GROUSE MONITORING STUDY

LOCATION

The Ranch is located south of the Town of Rawlins and west of the Town of Saratoga in Carbon County, Wyoming. the Ranch comprises approximately 310,716 acres generally located within Townships (T) 16 through 21 North (N), Ranges (R) 84 through 90 West (W) (Figure 1). Most of the Ranch is characterized by a checkerboard land ownership pattern (alternating private-public sections [one square mile] in a 40-mile band centered on the railroad) as a result of land grants provided under the Union Pacific Act of 1862 to help finance the transcontinental railroad that passes near the Town of Rawlins. Interstate 80 (I-80) runs just above and below the northern boundary of the Ranch, State Route 71 (Sage Creek Rd.) traces a portion of the western boundary, and State Route 130 parallels the eastern boundary. Medicine Bow National Forest lies to the south. Approximately half of the land (160,295 acres) is private and approximately half (159,380 acres) is BLM and State of Wyoming lands (Table 1). The Overland Trail Cattle Company (TOTCO) holds grazing allotments on the BLM lands, which are administered by the Rawlins Field Office, and the State lands, which are administered by the Wyoming Office of State Lands and Investments (WOSLI). In addition, the enrolled lands include certain contiguous federal and state lands over which either TOTCO and/or PCW have control. These lands include grazing allotments and federal lands outside of the boundaries of the Ranch where PCW has a right-of-way grant from the BLM for wind energy site testing and monitoring.

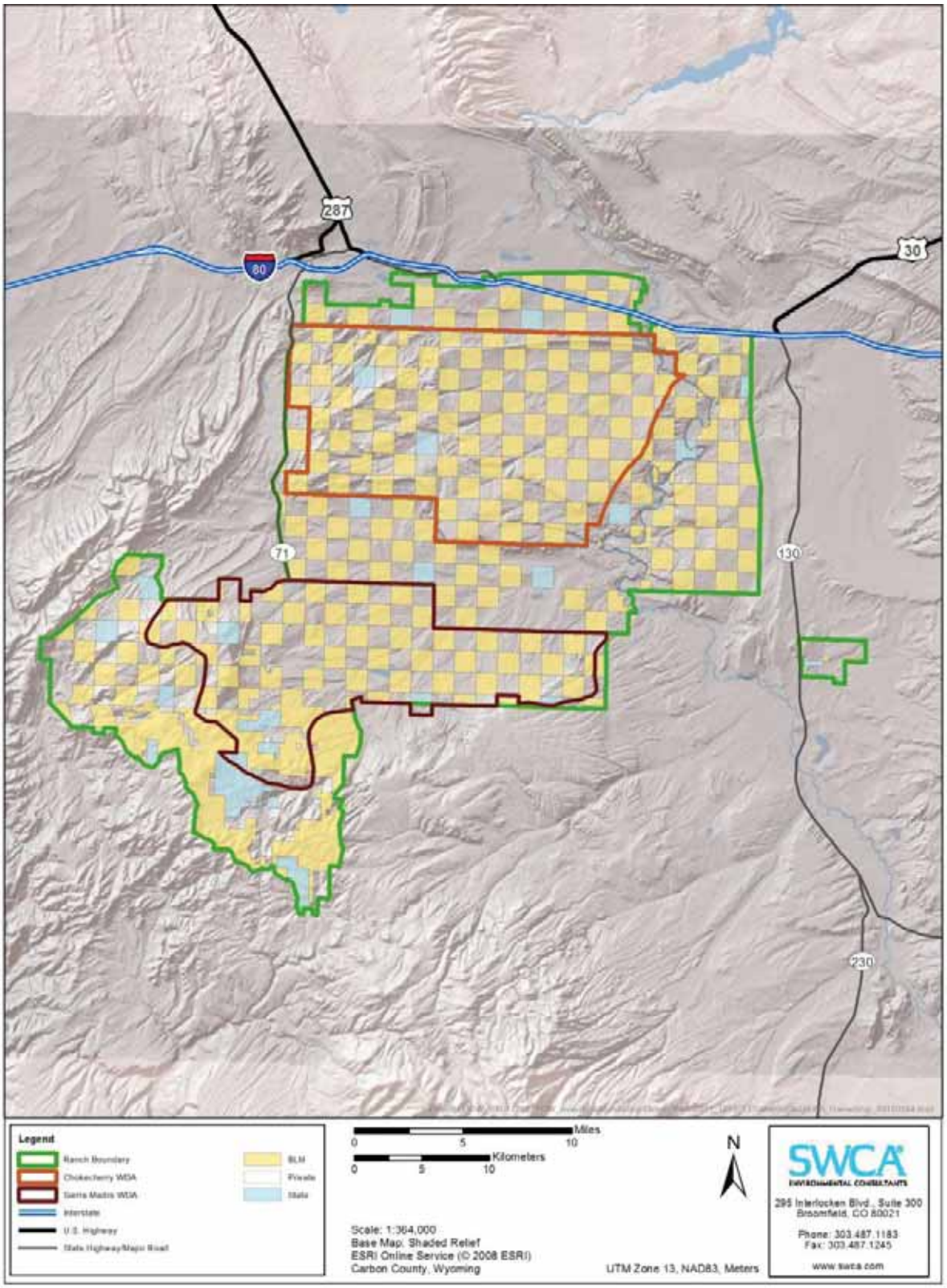


Figure 1. Surface ownership across the Ranch and the surrounding areas.

Table 1. Surface Ownership within the Ranch.

Surface Ownership	Acres
Private	160,925
Federal (BLM)	142,365
State	17,015
TOTAL	**320,305**

LANDSCAPE

The Ranch is characterized by a central basin that transitions to foothills and mesas to the south and southwest, and escarpments and rolling terrain composed of dissected, horizontally layered sedimentary formations to the north and northeast. Elevations range from approximately 6,200 feet at the North Platte River to approximately 8,500 feet at Miller Hill, increasing southerly to the Sierra Madre mountain range.

Annual precipitation increases with elevation and ranges from 9 to 12 inches per year, with the majority of precipitation falling between April and October (Western Regional Climate Center [WRCC] 2008). Average monthly temperatures range from 33.3°F to 54.9°F between November and April with the coldest temperatures occurring in January, and 59.6°F to 83.3°F between May and October with the hottest temperatures during July (WRCC 2008; NRCS 2001). Growing seasons range from 103 to 167 days, beginning in late April and ending in early October (NRCS 2001).

Soils on the Ranch are developed from a wide variety of parent material derived from sedimentary and igneous origins, which include alluvium and residuum of limestone, sandstone, and shale, and colluvium of granite (NRCS 2004). Subsurface textures are predominantly loamy or sandy soils, while surface textures range from silty clays to coarse sands. Many physiographic features occur throughout the Ranch but dominant features are hills, ridges, escarpments, plateaus, stream terraces, and alluvial fans (NRCS 2004).

Vegetation cover on the Ranch is typical of Wyoming Basin and Southern Rockies ecoregions, defined by rolling sagebrush steppe, salt desert shrub basins, and foothill shrublands (Chapman et al. 2004) (Figure 2 and Figure 3). Rolling sagebrush steppe communities are dominated by various densities of Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) at higher elevations, with areas of silver sagebrush (*Artemisia cana*) in the lowlands and black sagebrush (*Artemisia nova*) in exposed, rocky soils. Sagebrush steppe communities are interspersed with bunchgrass/rhizomatous grass communities and allied shrubs, and generally have relatively low forb cover. Salt desert shrub basins are characterized by sparse vegetation cover of cushion plant communities with dominant shrub cover of Gardner's saltbush (*Atriplex gardneri*), shadscale (*Atriplex confertifolia*), and black greasewood. Perennial streams throughout salt desert shrub basins are typically surrounded by basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) and riparian communities dominated by willows (*Salix* spp.), sedges, and rushes. Foothill shrubland communities are dominated by montane deciduous shrubland consisting of mountain big sagebrush, snowberry (*Symphoricarpos* spp.), serviceberry (*Amelanchier* spp.), and mountain mahogany (*Cercocarpus* spp.), surrounded by extended groves of quaking aspen (*Populus tremuloides*), low-growing common juniper (*Juniperus communis*), and patches of limber pine (*Pinus flexilis*).

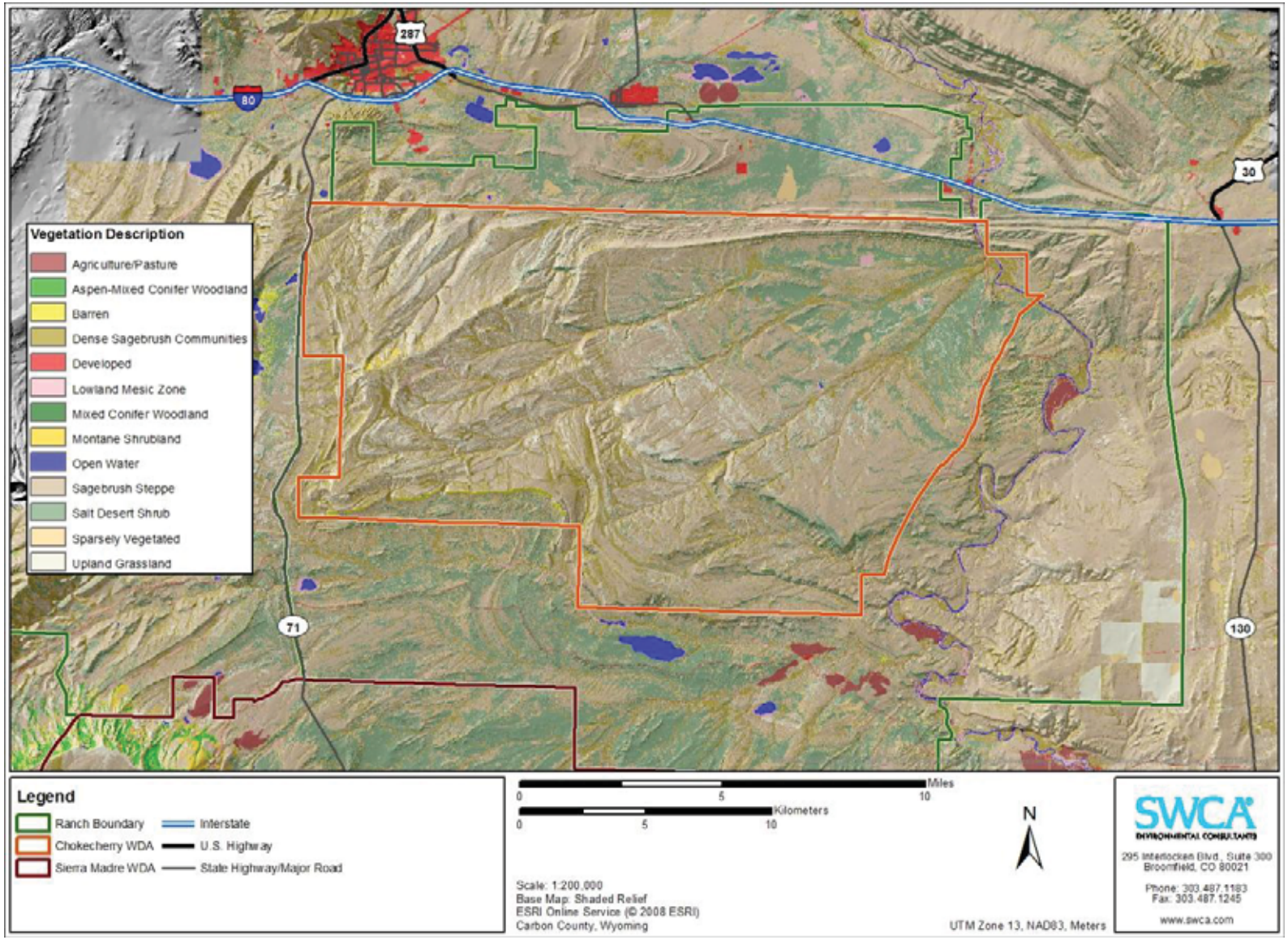


Figure 2. Vegetation communities occurring in the northern portion of the Ranch and the surrounding areas.

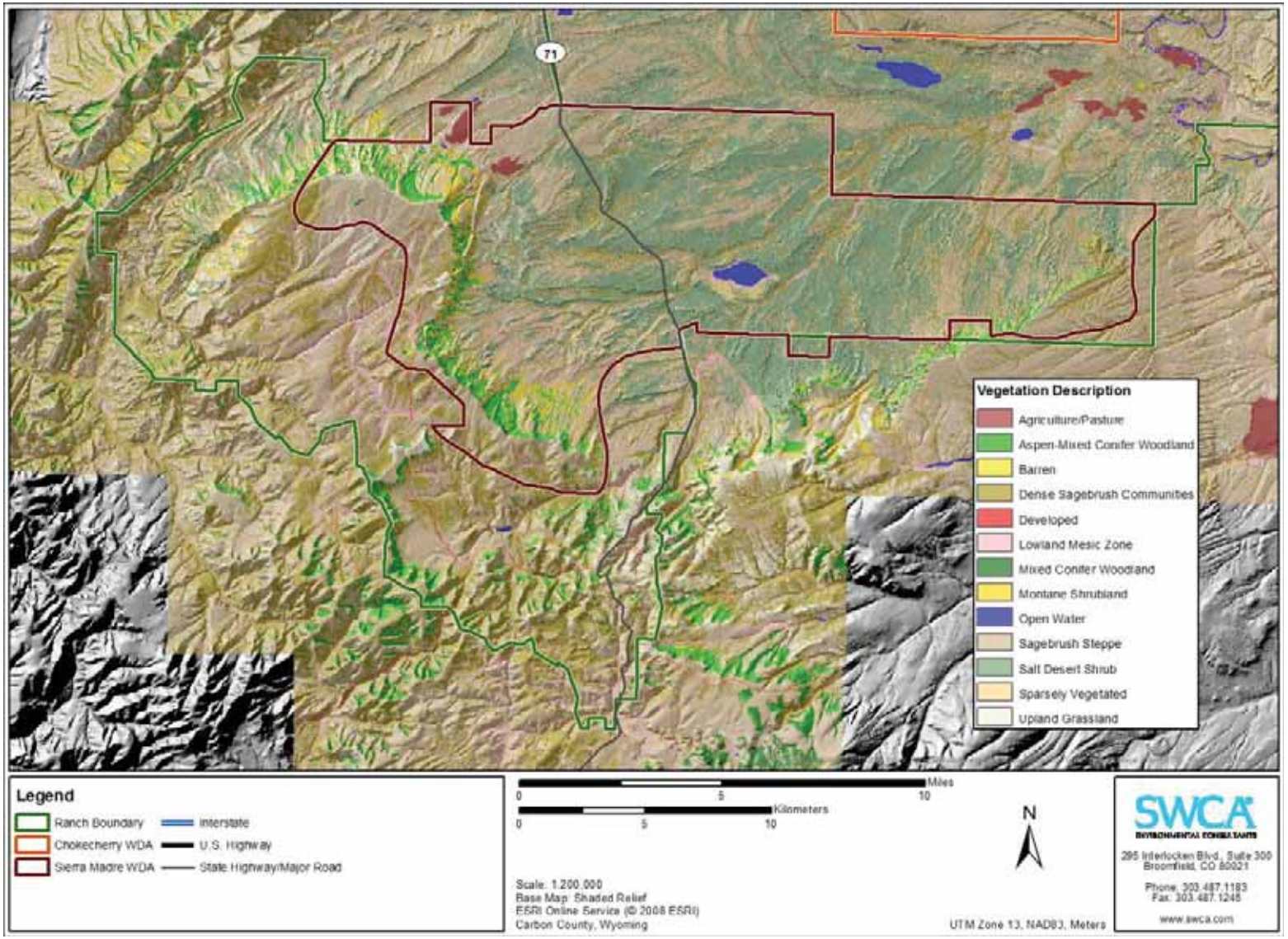


Figure 3. Vegetation communities occurring in the southern portion of the Ranch and the surrounding areas.

MONITORING AREAS

The study design for sage-grouse monitoring will follow a before-after control-impact (BACI) design (Smith 2002). This will allow for a stronger inference regarding the success of proposed conservation measures, particularly due to those measures that seek to reduce sage-grouse mortality and improve productivity by enhancing nesting and brood-rearing habitat. For this monitoring effort, the impact area will be located within 4 miles of the wind development areas (WDA) shown on Figure 4; however, control sites may include areas outside the 4-mile buffer. Based on this design, a subset of sage-grouse will be captured within the WDA, the Ranch and areas outside the Ranch boundaries. Following a true BACI design, the monitoring area includes an array of control and treatment areas (Figure 4). Control areas were selected to include Core Area sage-grouse habitat outside (approximately 4 miles) of the WDA (*Eastside*, *Sage Creek Basin*, and *Jack Creek Control Areas*). Treatment areas were selected to include areas within and immediately adjacent to the WDA (*Chokecherry* and *Sierra Madre Treatment Areas*).

All monitoring areas, including the areas across the Ranch, currently have active grazing leases and cattle operations. TOTCO manages the Bolten/Pine Grove Allotment to provide period growing season rest from grazing by increasing stocking density and shortening the grazing period. There are two areas of summer and winter ranges on the Ranch, and two separate grazing rotations. The grazing rotation for these herds allows rest for upland communities in spring and early summer, and hot season rest for riparian communities. Stocking rates and movement between various pastures within the allotments fluctuate yearly based on forage availability and resource conditions. Other conservation measures (i.e., range improvements) within the Ranch managed allotments have been and are currently being implemented to improve rangeland and sage-grouse habitat. Leases and allotments outside of TOTCO control may be managed differently and grazing practices and other land management practices may have additional effects on sage-grouse and its habitat.

Chokecherry Treatment Area

The Chokecherry Treatment Area includes the entire Chokecherry wind development area (WDA) proposed for development. This area is topographically diverse with escarpments, benches, and rolling terrain cut by ephemeral drainages. Vegetation is typical of high-desert sagebrush steppe and generally limited by precipitation (7-8 inches annual precipitation). This treatment area includes 14 sage-grouse leks, 11 active and 3 inactive. TOTCO controls all grazing leases within this monitoring area and grazing management will consider sage-grouse behavior and habitat use.

Eastside Control Area

The Eastside Control Area is located immediately east of the Chokecherry WDA, east of the North Platte River. As a control, this area is located entirely in sage-grouse Core Area (South Rawlins Core Area). The terrain is relatively flat with increased slopes trending towards the River. Vegetation is predominantly Wyoming big sagebrush steppe and the area is severely limited by precipitation (less than 7 inches annual precipitation). Areas along Pass Creek are highly developed for agriculture (i.e., hay meadows). This control area includes 11 sage-grouse leks, 6 active and 5 inactive. TOTCO controls a portion of grazing leases within this monitoring area; grazing practices and other land management practices on other grazing leases may influence sage-grouse behavior and habitat use.

Jack Creek Control Area

The Jack Creek Control area is located south and southeast of the Sierra Madre WDA and entirely within sage-grouse Core Area (South Rawlins Core Area). This area receives more precipitation than areas to the north (9-12 inches annual precipitation) and includes many water features. The vegetation is predominantly dwarf sagebrush communities (black sagebrush and low sagebrush [*Artemisia arbuscula*] assemblages) with draws of dense big sagebrush. This control area includes 9 sage-grouse leks, 8 active and 1 inactive. TOTCO does not control the grazing leases within this monitoring area; grazing practices and other land management practices on these leases may influence sage-grouse behavior and habitat use.

Sierra Madre Treatment Area

The Sierra Madre Treatment Area includes the entire Sierra Madre WDA proposed for development. This area includes three physiographically unique landscapes driven by geology, precipitation, and elevation. Dominant vegetation types change moving east to west, increasing in elevation. Vegetation is predominantly salt desert scrub in the lower basins, sagebrush and montane shrubland along the foothills, and mountain big sagebrush and mesic meadows atop Miller Hill. Precipitation increases with elevation with 7-9 inches annual precipitation at lower elevations and 12-14 inches annual precipitation at higher elevations. This treatment area includes 16 leks, 8 active and 8 inactive. TOTCO controls the majority of grazing leases within this monitoring area; grazing practices and other land management practices on additional leases may influence sage-grouse behavior and habitat use.

Sage Creek Basin Control Area

The Sage Creek Basin Control Area is located south and southwest of the Sierra Madre WDA and entirely within sage-grouse Core Area (South Rawlins Core Area). Physiographically, this area is very similar to the Sierra Madre Treatment area and dominant vegetation types include salt desert scrub, sagebrush and montane shrubland, and mountain big sagebrush and mesic meadows. This treatment area includes 3 active leks. TOTCO controls the majority of grazing leases within this monitoring area; grazing practices and other land management practices on additional leases may influence sage-grouse behavior and habitat use.

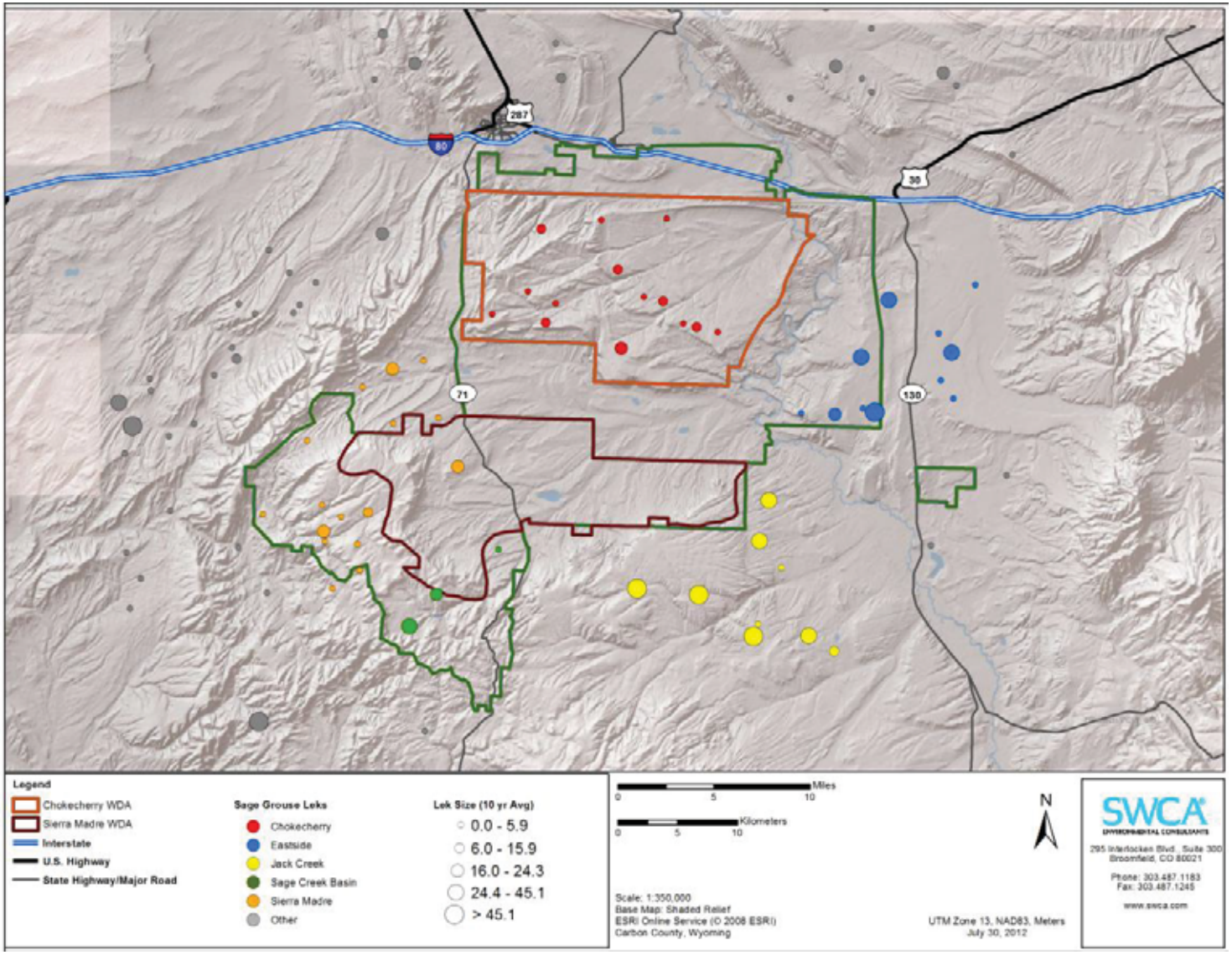


Figure 4. Map of Ranch boundary and occupied leks within each Project area based on 10-yr average occupancy.

LOCAL SAGE-GROUSE POPULATIONS

Sage-grouse use different strategies driven by available habitat and resources that generally result in resident and migratory sage-grouse in local populations (Connelly et al. 2000). Resident populations are typically found in areas that support seasonal habitat for all life stages. Migratory populations move between seasonal habitats and typically occur during spring migration peaks (back to leks), summer migration peaks (nesting to brood-rearing), and autumn migration peaks (back to winter habitat) (Schroeder et al. 1999, Connelly et al. 2004, Becker et al. 2009). Migratory movement distances generally range from 6 to 21 miles, greatly increasing their annual home ranges (Schroeder et al. 1999, Connelly et al. 2000).

Sage-grouse populations on the Ranch include both resident and migratory sage-grouse. Resident populations occur in the Chokecherry Treatment Area, the Eastside Control Area, and the Jack Creek Control area (Figure 4). These areas provide seasonal habitat to support lekking and nesting, brood-rearing, and wintering birds. Although migratory sage-grouse occur in all monitoring areas, the Sierra Madre Treatment Area and Sage Creek Basin Control Area do not provide winter habitat for sage-grouse and thus local populations must migrate to suitable habitat, such as Chokecherry, Eastside, and Jack Creek, for winter use. Primary migratory pathways in and surrounding the Ranch include:

- Jack Creek Control Area and Sage Creek Basin Control Area (Spring/Autumn);
- Chokecherry Treatment Area and Sierra Madre Treatment Area (Spring/Summer/Autumn); and,
- Eastside Treatment Area (Summer/Autumn).

Migration in sage-grouse is not only driven by seasonal habitat and available resources, but influenced considerably by fidelity to their breeding, summering, and wintering areas (Becker et al. 2009). Sage-grouse populations within the Ranch demonstrate considerable fidelity, returning to leks visited in previous years. Similar movement patterns and site selection are also observed for nesting, brood-rearing, and wintering habitat.

3.0 LEKS

Annual lek counts are conducted through ground surveys to monitor sage-grouse populations within the Ranch and the surrounding area. The objectives of these surveys are to determine lek activity and occupancy, in addition to documenting the attendance of sage-grouse observed on a particular lek for each year (lek counts). These data provide short- and long-term trend information for both sage-grouse populations and changes in habitat throughout the Ranch. In 2010, 35 leks (25 active and 10 inactive or undetermined) identified in coordination with the WGFD and occurring within a 4-mile buffer of the Ranch boundaries were surveyed pursuant to this monitoring program. Survey efforts were increased from 35 leks to 53 leks in 2011 and 2012 by inclusion of an additional 18 leks (36 active and 17 inactive or undetermined).

LEK COUNTS

Ground-based lek counts were conducted within and surrounding the Ranch from 2010-2012 (Appendix A), following guidance from WGFD (Appendix B). Not all leks were surveyed each year due to time, weather and accessibility constraints; however, most of the non-surveyed leks had either historically low attendance or no activity. Surveyed leks were counted at least one time (typically

three times) during the lekking season and data were reported to the appropriate WGFD field office. Overall 26 out of 35 leks were observed in 2010, 45 out of 53 leks in 2011, and 48 out of 53 leks in 2012.

Lek attendance is declining across the state of Wyoming, including leks in and surrounding the Ranch (Table 2). In Wyoming, the 10-yr average (2001-2010) male lek attendance was approximately 17.1 birds per lek with a 3-yr peak count (2008-2010) of 22.6 birds per lek; however, 2010 (14.9 birds per lek) and 2011 (12.4 birds per lek) peak counts indicate that lek attendance is declining. Comparable trends for leks in and surrounding the Ranch were also observed, suggesting that lek attendance is also declining on leks surrounding the Project area. Male lek attendance on the Ranch leks was approximately 15.5 birds per lek (10-yr average) with a 3-yr peak count (2008-2010) of 19.0 birds per lek. Annual peak counts (2010-2012) suggest that male lek attendance in the Project area is declining (Table 2).

Table 2. 10-year average (2001-2010), 3-year peak (2008-2010) and 2010-2012 average male lek attendance for all of Wyoming and for the Ranch.

Area	10-year Average	3-year Peak	2010 Peak	2011 Peak	2012 Peak
Wyoming	17.1	22.6	14.9	12.4	NA
Ranch	15.5	19.0	13.5	10.2	9.8

NA = WGFD lek data for 2012 are not available

4.0 DATA

A sage-grouse monitoring effort to refine sage-grouse associations with various sagebrush habitat components has been established in order to validate the success of proposed and future conservation projects over time. Individual sage-grouse have been captured and fitted with GPS Platform Terminal Transmitters (PTT) in an effort to gain a better understanding of the distribution, range and movement patterns of sage-grouse on the Ranch. These units record approximate location, along with approximate altitude, heading, and speed to allow for identification of migratory pathways and overall use of the landscape. All of these data further provide information that is useful in determining demographic trends, habitat use, and seasonal use areas.

Due to the size of the Ranch and annual ranges of sage-grouse, five regions were defined for monitoring areas (see Monitoring Areas). In each of these areas, historical lek activity, lek observations, and seasonal use patterns were used to identify capture locations. Capturing and tagging efforts were designed to create an even distribution of tagged birds over each region to gain insight into the range and habitat the grouse are using on the Ranch and the surrounding areas.

GPS DATA MANAGEMENT

PTTs communicate with the Advanced Research and Global Observation Satellite (ARGOS) global satellite-based location and data collection system. Data programs vary by the life history stage of sage-grouse and are programmed to record bird locations every 2 to 6 hours, depending on the stage. PTTs batch location data and upload data through ARGOS every 3 to 5 days. Data are compiled into a geospatial database that enables tracking of individual sage-grouse through time. Data include tag identification number, date, time, location (Universal Transverse Mercator (UTM) coordinates),

movement data, and engineering data. This information is used to further describe seasonal movement patterns, habitat use, lekking behavior, nest and brood success, and survival.

CAPTURE AND TAGGING

Sage-grouse capture and tagging was performed in order to identify sage-grouse distributions and habitat use across the Ranch. To increase the likelihood of success, capture sites were located in proximity to leks that have historically high lek attendance or in areas that have seasonally high use. Consequently, tagging efforts occurred in spring (March-May) to coincide with sage-grouse lekking and autumn (September-October) to align with autumn use areas. As of August 9, 2012, 157,118 GPS locations have been collected across the Ranch and the surrounding areas (Table 3). Capture protocols described by Giesen et al. (1982) and Wakkinen et al. (1992) were used for all sage-grouse capture activities on the Ranch and surrounding areas (Appendix B). Both adult and juvenile greater sage-grouse were captured and equipped with PTT using a simple leg-hoop harness system. Data collected are used to model sage-grouse range, movement patterns, lek and habitat use, survival rates, and seasonal habitat use areas in and surrounding the Project area.

In 2010, 56 sage-grouse were captured and tagged in order to maintain 40 PTT across the Ranch and the surrounding areas (Table 3). In an effort to maximize the number of GPS locations, two tagging periods (spring and autumn) were used to deploy all PTT and redeploy PTT that had been recovered from sage-grouse mortality events. As a result, 41,310 GPS locations were collected throughout the year. The monitoring effort was increased to 60 PTT in 2011 and 57 sage-grouse (33 in spring and 24 in autumn) were captured and tagged to seasonally maintain 50 PTT across the Ranch and the surrounding areas (Table 3). Consequently, 64,794 GPS locations were collected during 2011. The same monitoring effort continues in 2012 and 30 birds were captured and tagged during spring, resulting in 46,660 GPS locations to date.

Table 3. Annual tagged bird distribution, capture distribution, and mortality on the Ranch.

Year	# of Birds with PTT		# of Birds Captured/Tagged			# of Mortalities Between Seasons			GPS Locations
	Spring	Autumn	Spring	Autumn	Total	Spring	Autumn	Total	
2010	40	40	40	16	56	16	19	35	41,310
2011	54	50	33	24	57	28	26	54	64,794
2012	54	-	30	-	30	13	-	13	46,660
Total	**148**	**90**	**103**	**40**	**143**	**57**	**45**	**102**	**152,764**

Capture sites were widely distributed to ensure an even distribution of tagged birds across the Ranch and to include all landscapes and various sagebrush communities (Table 4). Distribution was focused on the five monitoring areas (see Monitoring Areas – Figure 4) to maintain equal sample sizes in each monitoring area and support the BACI design. Following each tagging season (spring or autumn), approximately 10 tagged sage-grouse occur in each monitoring area and seasonal tagging efforts are used to redistribute PTT when sage-grouse mortality events occur. This results in an even distribution of GPS locations for each monitoring area.

From spring 2010 to spring 2011, 35 sage-grouse mortality events occurred across the Ranch and the surrounding areas (Table 3). In an effort to reach the distribution goals, 16 PTT were redeployed in autumn 2010 and 33 PTT were redeployed in spring 2011 (Table 4). From spring 2011 to spring 2012, 54 sage-grouse mortality events occurred across the Ranch and the surrounding areas (Table 3). Therefore, 24 PTT were redeployed in autumn 2011 and 30 PTT were redeployed in spring 2012 (Table 4).

Table 4. Monitoring area distribution of tagged sage-grouse on the Ranch.

Monitoring Area	2010		2011		2012		Subtotal		TOTAL
	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	
Chokecherry	8	1	8	4	4	-	20	5	25
Eastside	9	1	5	0	6	-	20	1	21
Jack Creek	0	8	7	9	10	-	17	17	34
Sierra Madre	8	4	6	5	6	-	20	9	29
Sage Creek Basin	15	2	7	6	4	-	26	8	34
TOTAL	**40**	**16**	**33**	**24**	**30**	**-**	**103**	**40**	**143**

5.0 HEN SURVIVAL AND PRODUCTIVITY

SURVIVAL

Weekly survival rates for adult and yearling female sage-grouse were estimated using known fate models with Pollock's staggered entry design in Program MARK (Version 6.0) (Pollock et al. 1989, White and Burnham 1999). An information theoretic approach (Burnham and Anderson 2002) was used to evaluate the relative support for candidate models, which represented hypotheses about spatial and temporal factors affecting sage-grouse survival. These variables included the control/treatment area, age of the grouse, and time-varying variables (monthly and seasonally).

2010-2011

Weekly probability of survival for hens tagged in 2010 (N=55) was estimated from April 1, 2010 through April 1, 2011. During this time period there were 35 sage-grouse mortality events. There were 9 cohorts of tagged birds in 2010 (Table 5). The staggered entry design accounted for birds being tagged and released into the monitored population in different weeks.

Table 5. Cohorts of tagged sage-grouse hens released into monitoring population in 2010.

Cohort Number	Capture Period (2011)	Calendar Week	Tagged Birds (N)
1	4/10-4/11	15	4
2	4/12-4/16	16	17
3	4/21-4/25	17	11
4	4/26	18	7
5	9/9-9/11	37	3
6	9/16-9/17	38	5
7	9/22-9/24	39	3
8	9/28-9/29	40	2
9	10/14-10/17	42	3

Two covariates were considered in the models: age (juvenile or adult) at time of tagging and weight at time of tagging. These covariates appear to be independent, as there is no significant difference in weight between adult (mean = 1.516 kg) and yearling birds (mean = 1.456 kg) (two sample t-test, df=50, t=-1.059, P=0.295). Differences among seasons were also considered. Seasons used in the analysis are defined in Table 6.

Table 6. Seasons used in models of weekly survival of tagged sage-grouse hens.

Season	Time Period	Weeks
Lekking	4/1 - 5/15	6
Nesting	5/15 - 6/15	4
Early Brood Rearing	6/15 - 7/15	4
Late Brood Rearing	7/15 - 9/15	9
Early Autumn	9/15 - 10/15	5
Late Autumn	10/15 - 12/15	8
Winter	12/15 - 4/1	16

Models were compared using Akaike information criterion (AICc) in Program MARK. This metric weighs the explanatory value of parameters against the total number of parameters to find the most parsimonious model (i.e., there is a penalty for models that include parameters that provide little additional model fit). Models compared and their relative AICc scores are provided in Table 7. The top performing models accounted for differences among seasons as defined in Table 6. Age and weight covariates each explained a small amount of variation in the model, ranking slightly higher than the seasonal model without covariates. The top performing model was variation in probability of survival among seasons with bird weight as a covariate. The models suggest that season and sage-grouse weight had a large influence on weekly survival (Table 7)

Table 7. Models of weekly sage-grouse probability of survival compared in Program MARK.

Model	AICc	Δ AICc	AICc Weights	Model Likelihood	No. Para-meters	Deviance
{S(season+weight)}	299.4727	0	0.33196	1	7	285.4015
{S(season+age)}	300.0487	0.576	0.24889	0.7498	7	285.9775
{S(season+weight+age)}	300.5671	1.0944	0.19206	0.5786	8	284.4755
{S(season)}	301.7163	2.2436	0.10812	0.3257	7	287.6451
{S(.)}	1672.784	1373.311	0	0	1	1670.782
{S(kilograms)}	1673.14	1373.668	0	0	2	1669.133
{S(age)}	1673.349	1373.876	0	0	2	1669.341

Annual probability of survival for female sage-grouse between April 1, 2010 and April 1, 2011 was 38%. Based on the top model (S[season+weight]), estimated weekly survival probability varied considerably between seasons (Table 8). The likelihood of survival for female sage-grouse was highest during early brood rearing (100%) and lowest during winter (67%). Additional seasons with higher probability of survival included lekking (97%) and nesting (95%). Additional seasons with lower probability of survival included late brood rearing (79%), late autumn (84%), and early autumn (92%).

Table 8. Estimates of probability of survival in hens tagged in 2010 based on top-ranked model S(season+weight).

Season	Time Period	Weekly Probability of Survival (95% CIs)	Seasonal Probability of Survival	Annual Probability of Survival
Lekking	4/1/2010-5/15/2010	0.9949 (0.9641-0.9993)	0.9696	0.3745
Nesting	5/15/2010-6/15/2010	0.9879 (0.9520-0.9970)	0.9525	
Early Brood Rearing	6/15/2010-7/15/2010	1.0000 (0.9999-1.0000)	1.0000	
Late Brood Rearing	7/15/2010-9/15/2010	0.9734 (0.9456-0.9872)	0.7845	
Early Autumn	9/15/2010-10/15/2010	0.9832 (0.9493-0.9946)	0.9192	
Late Autumn	10/15/2010-12/15/2010	0.9775 (0.9508-0.9899)	0.8337	
Winter	12/15/2010-4/2/2011	0.9757 (0.9554-0.9869)	0.6745	

2011-2012

Weekly probability of survival for hens tagged in 2010 that survived until 2011 (N=21) or tagged in 2011 (N=57) was estimated from April 2, 2011 through April 1, 2012. During this time period there were 54 sage-grouse mortality events. There were 9 cohorts of tagged birds in 2011 (Table 9). The staggered entry design accounted for birds being tagged and released into the monitored population in different weeks.

Table 9. Cohorts of tagged sage-grouse hens released into monitoring population in 2011.

Cohort	Capture Period (2011)	Calendar Week	Tagged birds (N)
1	4/2 (from 2010)	14	21
2	4/6	15	2
3	4/11-4/16	16	9
4	4/17-4/23	17	12
5	4/25-4/28	18	9
6	5/1	19	1
7	9/7-9/9	37	7
8	9/11-9/16	38	13
9	9/20	39	4

Two covariates were considered in the models: age (yearling or adult) at time of tagging and weight at time of tagging. Differences among seasons were also considered. Seasons used in the analysis are defined in Table 10.

Table 10. Seasons used in models of weekly survival of tagged sage-grouse hens.

Season	Time Period	Weeks
Lekking	4/1 - 5/15	6
Nesting	5/15 - 6/15	4
Early Brood Rearing	6/15 - 7/15	4
Late Brood Rearing	7/15 - 9/15	9
Early Autumn	9/15 - 10/15	5
Late Autumn	10/15 - 12/15	8
Winter	12/15 - 4/1	16

Models were compared using Akaike information criterion (AICc) in Program MARK. Models compared and their relative AICc scores are provided in Table 11. The top performing models accounted for differences among seasons as defined in Table 10. Age and weight covariates may explain a small amount of variation in the model, but were not included in the top model. The top performing model was variation in probability of survival among seasons with early and late brood rearing seasons having the same probability of survival. The models suggest that season has a large influence on weekly survival (Table 11)

Table 11. Models of weekly sage-grouse probability of survival compared in Program MARK.

Model	AICc	Δ AICc	AICc Weights	Model Likelihood	No. Para-meters	Deviance
{S(season[EarlyAndLateBrood RearingCombined])}	448.7368	0	0.3546	1	6	436.6886
{S(season)}	449.9236	1.1868	0.1959	0.5524	7	435.8593
{S(season+kilogram)}	451.364	2.6272	0.09534	0.2689	8	435.2814
{S(season+age)}	451.9028	3.166	0.07282	0.2054	8	435.8201
{S(season+kilogram+age)}	453.3785	4.6417	0.03482	0.0982	9	435.2751
{S(cohort)}	453.6933	4.9565	0.02975	0.0839	9	435.5899
{S(.)}	456.1527	7.4159	0.0087	0.0245	1	454.1504
{S(age)}	458.0088	9.272	0.00344	0.0097	2	454.0019
{S(cohort+week1 different)}	466.8827	18.1459	0.00004	0.0001	18	430.4878
{S(t)}	501.1899	52.4531	0	0	52	393.9437

Annual probability of survival for female sage-grouse between April 1, 2010 and April 2, 2011 was 25%. Based on the top model (S[season[earlyandlaterbroodrearingcombined]), estimated weekly survival probability varied considerably between seasons (Table 12). In general, the probability of survival was low for each season. The likelihood of survival for female sage-grouse was highest during early brood rearing (91%) and lowest during early autumn (67%). Additional seasons with higher probability of survival included lekking (87%), late autumn (86%), and nesting (85%). Additional seasons with lower probability of survival included late brood rearing (82%) and winter (77%).

Table 12. Estimates of probability of survival in hens tagged in 2010 based on top-ranked model S(season+[earlyandlatebroodrearingcombined]).

Season	Time Period	Weekly Probability of Survival (95% CIs)	Seasonal Probability of Survival	Annual Probability of Survival
Lekking	4/1/2011-5/15/2011	0.9763 (0.9443-0.9901)	0.8660	0.2456
Nesting	5/15/2011-6/15/2011	0.9598 (0.9180-0.9807)	0.8485	
Early Brood Rearing	6/15/2011-7/15/2011	0.9777 (0.9590-0.9879)	0.9137	
Late Brood Rearing	7/15/2011-9/15/2011	0.9777 (0.9590-0.9879)	0.8161	
Early Autumn	9/15/2011-10/15/2011	0.9242 (0.8798-0.9530)	0.6742	
Late Autumn	10/15/2011-12/15/2011	0.9817 (0.9568-0.9924)	0.8625	
Winter	12/15/2011-4/1/2012	0.9839 (0.9666-0.9923)	0.7709	

PRODUCTIVITY

Nests and broods of tagged sage-grouse are monitored to determine the reproductive success and evaluate population dynamics of sage-grouse on the Ranch and the surrounding areas.

Nest Success

Potential nesting locations of sage-grouse are identified initially from the GPS locations gathered from tagged hens. Potential nest locations are verified visually (7-10 days following initiation) by using radio telemetry and triangulation techniques. Sage-grouse hens typically incubate between 24-27 days (Schroeder 1997). Nesting hens are thereafter monitored weekly to determine nest fate (e.g., successful, depredated, or abandoned) and continually monitored using GPS data (Coates and Delehanty 2010) (Appendix B). The Mayfield Method (Mayfield 1961, 1975) of estimating nesting success and maximum likelihood estimator models were used to analyze nest success because there is no source of bias associated with nest survival when both nest initiation date and nest abandonment date are known (Hensler and Nichols 1981).

Sage-grouse attempted 39 nests in 2010, 52 nests in 2011, and 46 nests in 2012 that included 13, 21, and 16 successful nests, respectively (Table 13). Nest success for sage-grouse across the Ranch and the surrounding areas was greatest in 2011 (Figure 5). The probability of a nest being successful was approximately 31.5% for 2010, 40.1% for 2011, and 32.6% for 2012 (Figure 5).

Table 13. The probability of nest survival across the Ranch and the surrounding areas from 2010-2012.

Year	Nests	Successful Nests	Probability of Nest Survival (26 day incubation period)	95% CIs
2010	39	13	0.3154	0.0110775
2011	52	21	0.4012	0.0089456
2012	46	16	0.3255	0.0240238

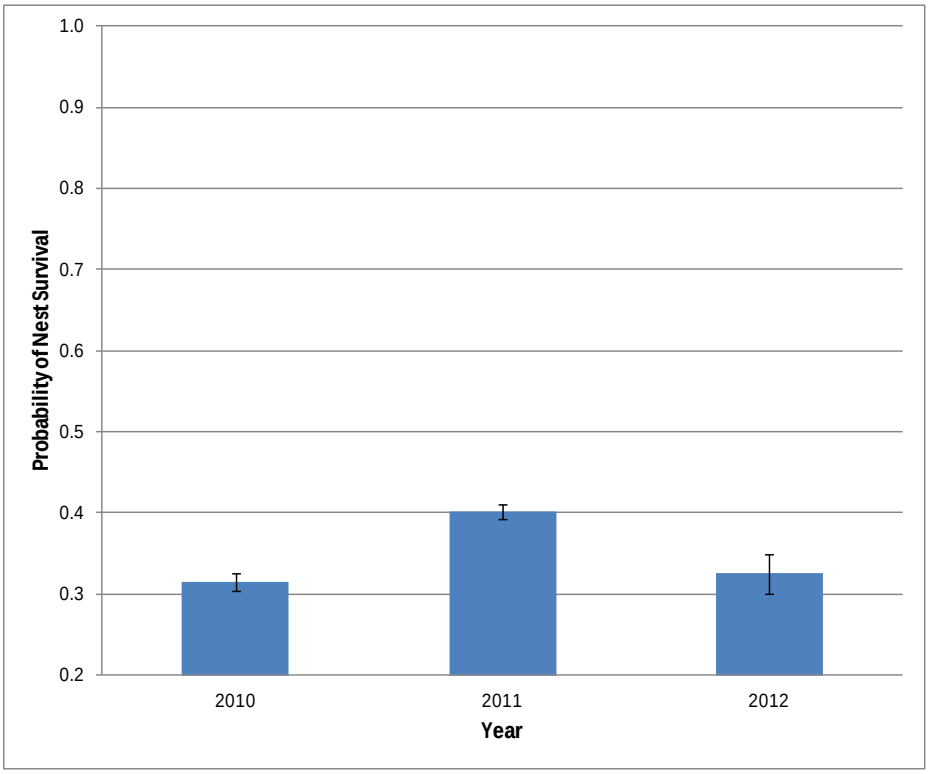


Figure 5. Estimated annual nest survival probability of sage-grouse across the Ranch and the surrounding areas. Bars represent 95% confidence intervals.

Increased nest success in 2011 may be a result of increased number of successful second nest attempts (Figure 6). Precipitation from 2010 to 2011 was unseasonably, high leading to more abundant resources that may have resulted in more nesting birds and higher nest success. In 2011, 16 sage-grouse attempted second nests with 5 nests reaching hatch (Table 14). Nest attempts were significantly lower in 2010 and 2012 (Figure 6), with second nest survival probabilities of 21.3% and 31.2%, respectively (Table 14).

Table 14. The probability of nest survival for initial nest and renest attempts across the Ranch and the surrounding areas from 2010-2012.

Year	Nest Attempt	Nests	Successful Nests	Probability of Nest Survival (26 day incubation period)	95% CIs
2010	Initial	34	11	0.3273	0.01375
	Renest	5	2	0.2133	0.09925
2011	Initial	41	16	0.3787	0.01201
	Renest	11	5	0.4807	0.04731
2012	Initial	36	12	0.3287	0.01308
	Renest	10	4	0.3121	0.04962

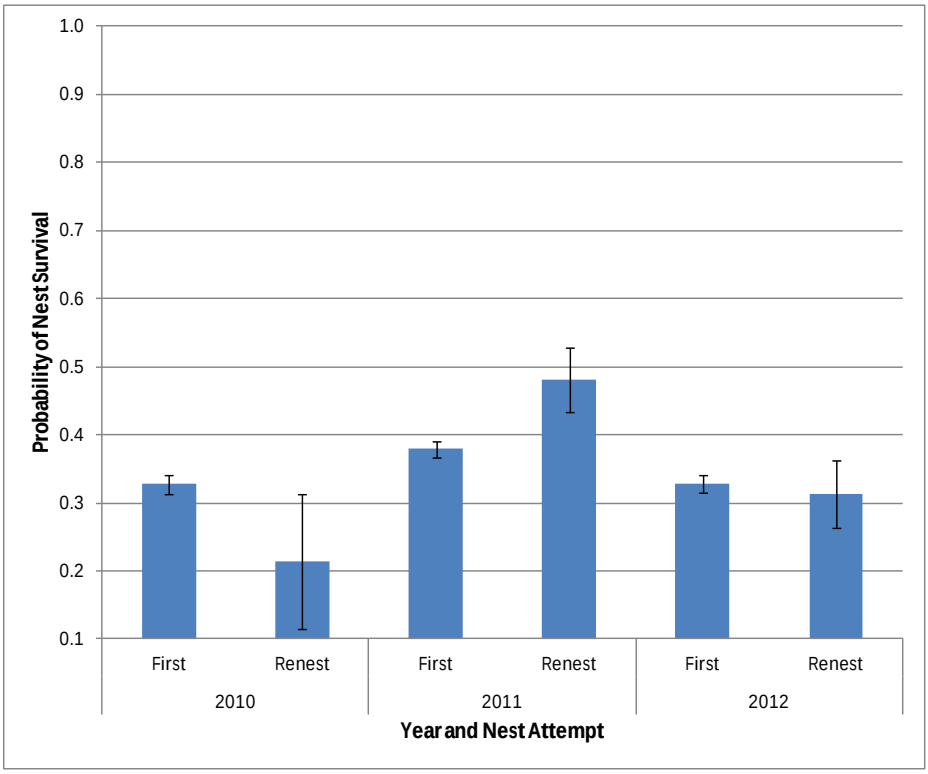


Figure 6. Influence of nest attempt on the estimated nest survival probability of sage-grouse across the Ranch and the surrounding areas. Bars represent 95% confidence intervals.

Nest success varied considerably across the different monitoring areas (Chokecherry, Eastside, Jack Creek, Sierra Madre, and Sage Creek Basin) (Table 15 and Figure 7). In 2010, nest success was highest in the Chokecherry and Sierra Madre Treatment areas (62.4 and 55.8%, respectively) and considerably lower in the control areas (Eastside – 16.4% and Sage Creek Basin – 21.0%) (Table 15). However, the following years (2011 and 2012) had considerably more variability and confounding patterns (Figure 5). In 2011, nest success was stable across much of the Ranch and the surrounding areas (ranging from 24.5 to 55.0%), although nest success was highest in the Sierra Madre Treatment area (55.0%) and lowest in the Jack Creek Control area (24.5%). Nest success was lowest overall for 2012, with each area having significantly lower nest success than in 2011. Sage Creek Basin had the highest nest success in 2012 (43.4%; Table 15), which may be a result of more available nutrients and vegetative cover (higher elevation with more precipitation) during a drought year.

Table 15. The probability of nest survival for initial nest and renest attempts across the Ranch and the surrounding areas from 2010-2012.

Year	Monitoring Area	Nests	Successful Nests	Probability of Nest Survival (26 day incubation period)	95% CIs
2010	Chokecherry	9	6	0.6242	0.0740
	Eastside	10	2	0.1637	0.0430
	Jack Creek	-	-	-	-
	Sierra Madre	4	2	0.5575	0.1359
	Sage Creek Basin	17	4	0.2098	0.0259
2011	Chokecherry	11	4	0.3941	0.0438
	Eastside	9	4	0.4092	0.0573
	Jack Creek	10	2	0.2452	0.0430
	Sierra Madre	14	8	0.5501	0.0453
	Sage Creek Basin	8	3	0.3748	0.0608
2012	Chokecherry	12	4	0.3516	0.0392
	Eastside	7	2	0.2262	0.0650
	Jack Creek	8	3	0.3083	0.0608
	Sierra Madre	8	2	0.2452	0.0555
	Sage Creek Basin	11	5	0.4342	0.0473

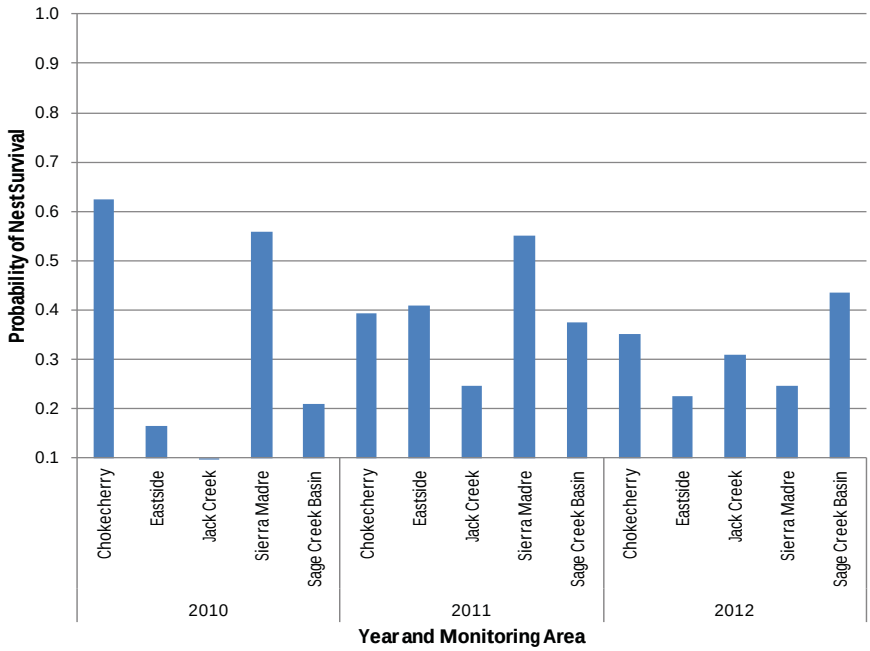


Figure 7. Influence of monitoring area on the estimated nest survival probability of sage-grouse across the Ranch and the surrounding areas. Bars represent 95% confidence intervals.

Proximity of Nests to Leks

The majority of sage-grouse were captured in proximity to a lek, and many hens visited multiple leks after tagging and prior to nest initiation. Each hen may have visited multiple leks before or after tagging, so it is unknown at which lek each hen successfully mated. Of the tagged hens with known lek and nest locations (N = 138 nests), 5% nested within 0.25 mile, 95% nested within 5 miles, and 99% nested within 8 miles of the lek last visited prior to nesting (Figure 8). The farthest distance between nest and lek last visited was 19.5 miles. Sage-grouse seasonal range during the breeding and nesting is centered and localized around leks they visit during reproduction (see Movement Across Ranch and Surrounding Areas below). The majority of all tagged sage-grouse (approximately 95%) nested within 5 miles of the lek last visited (Figure 8).

Brood Monitoring

Sage-grouse hens typically incubate between 24-27 days (Schroeder 1997); therefore, a hatch date can be determined within 1-3 days of actual hatch. Toward the end of the incubation period (3 days of the predicted hatch date), females are located each day to collect data on incubation period, nest success, and brood size. Once a tagged-hen has had a successful hatch, it is important to determine brood size as soon as possible to reduce possible bias due to brood-mixing and/or chick mortality within a given brood (Dahlgren et al. 2010b). Each hen and her brood are monitored weekly to determine both brood size and habitat use during early and late brood-rearing (Appendix B).

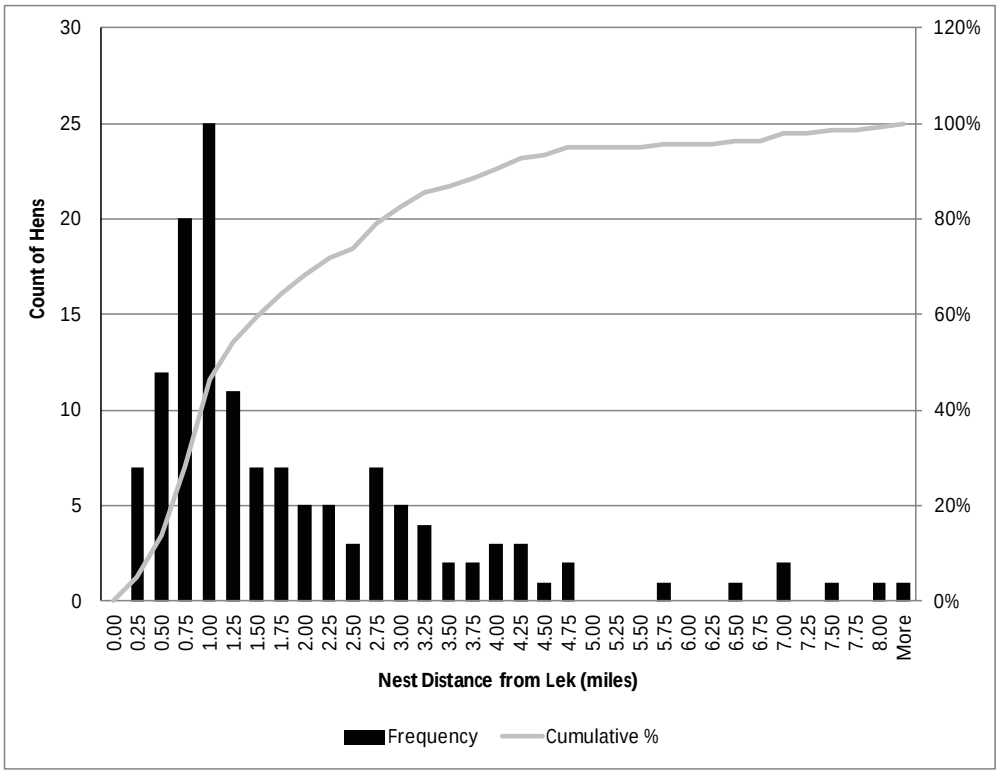


Figure 8. Frequency of nest distance from last lek visited to nest initiation.

6.0 MOVEMENT PATTERNS

Seasonal range size of female sage-grouse by season and weekly movement patterns are determined to assess movement patterns across the Ranch and the surrounding areas.

MOVEMENT ACROSS THE RANCH AND SURROUNDING AREAS

To assess seasonal ranges, we used a 90% fixed kernel estimator with least squares cross validation smoothing options (Kernohan et al. 2001, Gitzen et al. 2006, Beyer 2012) to estimate and evaluate size, distribution and shape of seasonal ranges. Range analysis suggests shifted home ranges between seasons. Range size and space use of female sage-grouse differed among seasons (Table 16). In 2010, average seasonal range of all female sage-grouse was approximately 79,096 acres. In 2011, the value was considerably larger (100,006 acres); however, the number of tagged sage-grouse increased 3-fold between the 2010 and 2011 season to provide a more robust and even distribution of tagged hens in the Project area. An increase in seasonal range may be an artifact from increasing the number of tagged sage-grouse and gaining better insight on range size and distribution. Nesting seasonal range covered the smallest area (38,733 acres) while Late Autumn (163,437 acres) and Winter (124,229 acres) seasonal ranges were substantial larger than other life stages (Table 16). Similar patterns were observed in 2011, where the Late Brood Rearing seasonal range covered the smallest area (54,481 acres) and Late Autumn (182,397 acres) and Winter (153,787 acres) seasonal range were considerably larger than all other stages. Range size and distributions suggest that the sage-grouse across the Ranch and the surrounding areas use different areas in different seasons, and that sage-grouse are moving more and using broader landscapes in late autumn and winter months.

Seasonal range distribution of sage-grouse differed among seasons (Table 16). Sage-grouse leks are widely distributed across the Ranch and the surrounding areas. During this time, sage-grouse tend to localize near larger active leks and move to and from a selected lek location daily. Sage-grouse hens tend to nest within 5 miles (95% of all nest attempts) of the lek they last visited (see Proximity of Nests to Lek; Figure 8). During nesting and early brood rearing, sage-grouse home ranges are small and localized near their nest location. Sage-grouse increase their range from late brood rearing to winter. The birds have a more diffuse distribution across the landscape in winter and they use larger areas. It does not appear that sage-grouse are sedentary during late autumn and winter months, but rather increase their movement and range in search of available resources, suitable habitat, and protection from winter conditions.

Table 16. Seasonal ranges for female sage-grouse across the Ranch and the surrounding areas.

Year	Life History Stage	Acres	Square Miles
2010	Lek	65,049	102
	Nest	38,733	61
	Early Brood Rearing	59,581	93
	Late Brood Rearing	50,222	78
	Early Autumn	52,421	82
	Late Autumn	163,437	255
	Winter	124,229	194
	AVERAGE	**79,096**	**124**
2011	Lek	97,073	152
	Nest	65,541	102
	Early Brood Rearing	67,292	105
	Late Brood Rearing	54,481	85
	Early Autumn	79,471	124
	Late Autumn	182,397	285
	Winter	153,787	240
	AVERAGE	**100,006**	**156**

WEEKLY DISTANCES TRAVELED BY HENS

To assess weekly movement patterns, movement distances for each tagged sage-grouse were summed and averaged by season (i.e. lekking, nesting, early brood rearing, late brood rearing, early autumn, late autumn, and winter). The distance moved each week was calculated for each hen by summing the straight line distance between all positions collected in a 7-day period. Field observations suggest that the birds do not generally travel in straight lines, so the calculated distances traveled should be interpreted as the minimum known travel distance. Furthermore, there may be some bias in the distances traveled due to the number of points collected per day changing over the study period; days with more points could potentially have greater distances traveled.

During the time period April 10, 2010 (lekking) through March 31, 2011 (end of winter), tagged hens moved significantly different weekly distances among seasons (i.e., lekking, nesting, early brood rearing, late brood rearing, early autumn, late autumn, or winter) (ANOVA, df=6, F=8.0031, P<0.0001). Hens traveled farthest during the late autumn and winter seasons and reduce their movement distance considerably during the nesting and early brood rearing seasons (Figure 9). Pairwise comparisons of mean weekly distance moved among seasons (Tukey-Kramer HSD, significance level P<0.05) suggest that tagged hens moved significantly more during the late autumn than any other season, except winter (Table 17). Highest variability in weekly movement occurred during the lekking and winter seasons.

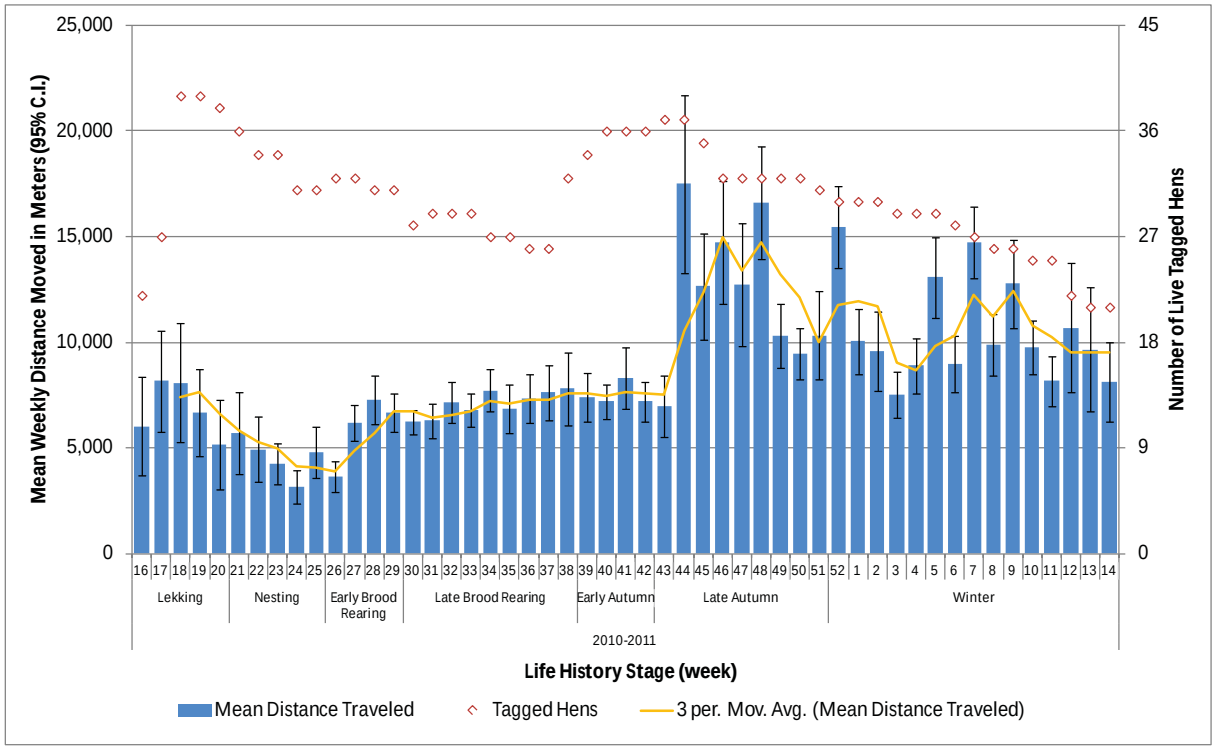


Figure 9. Mean weekly distance traveled averaged among all tagged sage-grouse, April 10, 2010 through March 31, 2011.

Table 17. Pairwise comparisons of mean weekly distance traveled among seasons.

Season (p<0.05) *	Weekly Distance Traveled (m)	Standard Deviation
Late autumn (**A**)	14,338	2,932
Winter (**AB**)	10,622	3,860
Late brood rearing (**BC**)	7,794	413
Early autumn (**BC**)	7,711	619
Lekking (**BC**)	6,806	3,544
Early brood rearing (**BC**)	6,650	1,834
Nesting (**C**)	5,596	709

*Seasons not sharing the same letter are significantly different (***p<0.05**)

Similar movement patterns were observed from April 1, 2011 through March 31, 2012 (ANOVA, df=6, F=46.7545, P<0.0001). Hens traveled farthest during the winter, lekking, and late autumn seasons and reduce their movement distance considerably during the nesting and early brood rearing seasons (Figure 10). Pairwise comparisons of mean weekly distance moved among seasons suggest that tagged hens moved significantly more during winter, lekking, and late autumn than during other seasons (Table 18). The same analysis indicated that there was no significant difference in weekly movement among early autumn, late brood rearing, nesting, and early brood rearing seasons.

Highest variability in weekly movement occurred during the lekking season. However, variability in weekly movement among grouse within a season was far less in 2011-2012 than it was in 2010-2011.

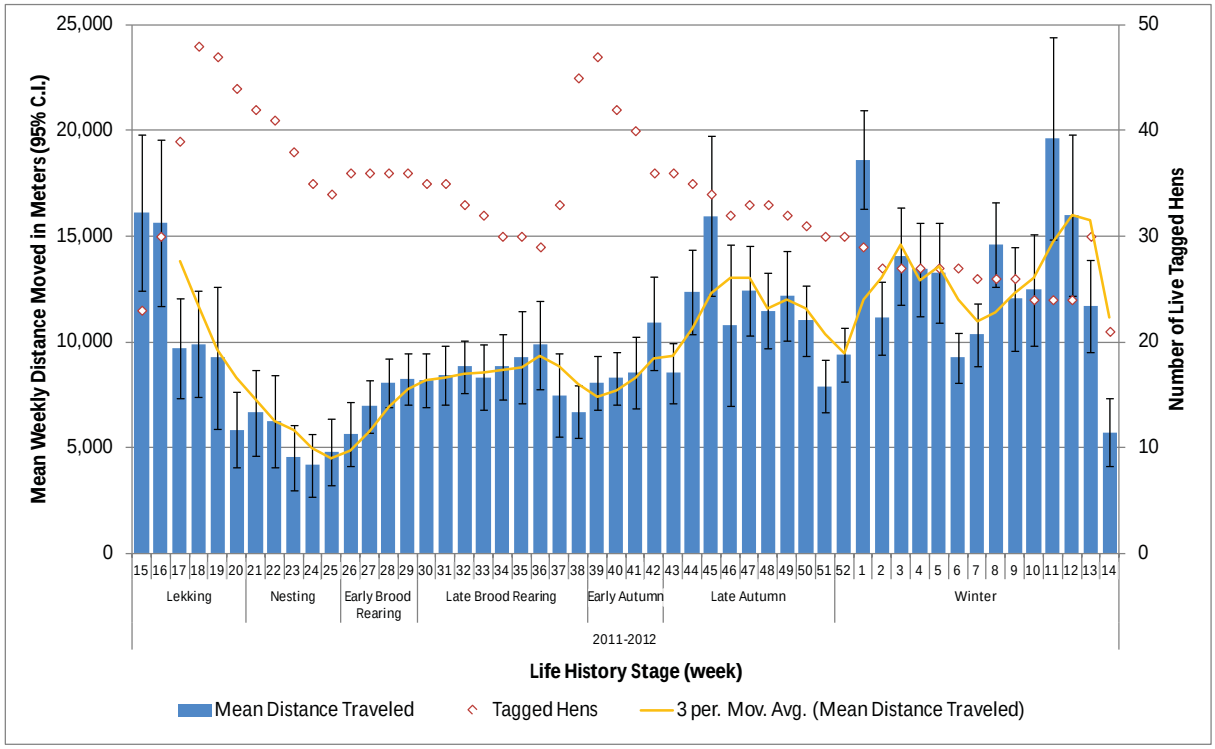


Figure 10. Mean weekly distance traveled averaged among all tagged sage-grouse, April 10, 2010 through March 31, 2011.

Table 18. Pairwise comparisons of mean weekly distance traveled among seasons.

Season (*p*<0.05) *	**Weekly Distance Traveled (m)**	**Standard Deviation**
Winter (**A**)	12,396	330
Lekking (**A**)	12,205	777
Late Autumn (**A**)	11,200	386
Early Autumn (**B**)	7,557	460
Late Brood Rearing (**B**)	7,358	364
Nesting (**B**)	6,447	333
Early Brood Rearing (**B**)	5,990	498

*Seasons not sharing the same letter are significantly different (***p<0.05**)

7.0 REFERENCES

Autenrieth, R.E., W. Molini, and C.E. Braun. 1982. Sage grouse management practices. Western States Sage Grouse Committee, Technical Bulletin 1, Twin Falls, Idaho, USA.

Becker, J.M., J.D. Tagestad, C.A. Duberstein, and J.L. Downs. 2009. Sage-Grouse and Wind Energy: Biology, Habits, and Potential Effects of Development. PNNL-18567, Pacific Northwest National Laboratory, Richland, Washington.

Beyer, H.L. 2012. Geospatial Modelling Environment (version 0.7.1.0). (software). Available online at: http://www.spatialecology.com/gme.

Braun, C.E. 1998. Sage grouse declines in western North America: what are the problems? Proceedings of the Western Association of State Fish and Wildlife Agencies 78: 139-156.

Bureau of Land Management (BLM). 2004. National Sage-Grouse Habitat Conservation Strategy. U.S. Department of Interior, Bureau of Land Management, Washington, D.C.

Bureau of Land Management (BLM). 2010. Sensitive species policy and list. U.S. Bureau of Land Management, Wyoming State Office. Available online at: http://www.blm.gov/pgdata/etc/medialib/blm/wy/resources/efoia/IMs/2010.Par.41285.File.dat/wy2010-027atch2.pdf. Accessed July 2012.

Bureau of Land Management (BLM). 2011. Instruction Memorandum No. 2012-043: Greater Sage-Grouse Interim Management Policies and Procedures. Washington, D.C.

Burnham, K. P., and D. R. Anderson. 2002. Model selection and multi-model inference: A practical information theoretic approach. 2nd edition. Springer-Verlag, New York, NY.

Call, M.W. and C. Maser. 1985. Wildlife habitats in managed rangelands – the Great Basin of southeastern Oregon. General Technical Report PNW-187. U.S. Department of Agriculture, U.S. Forest Service, Pacific Northwest Forest and Range Experiment Station.

Chapman, S.S., S.A. Bryce, J.M. Omernik, D.G. Despain, J. ZumBerge, and M. Conrad. 2004. Ecoregions of Wyoming (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,400,000).

Christiansen, T. 2008. Hunting and sage-grouse: A technical review of harvest management on a species of concern in Wyoming. Wyoming Game and Fish Publication.

Christiansen, T. 2009. Fence Marking to Reduce Greater Sage-grouse (Centrocercus urophasianus) Collisions and Mortality near Farson, Wyoming – Summary of Interim Results. Wyoming Game and Fish Department.

Coates, P.S., and J.D. Delehanty. 2010. Nest predation of greater sage-grouse in relation to microhabitat factors and predators. Journal of Wildlife Management 74(2): 240-248.

Connelly, J.W., and C.E. Braun. 1997. Long-term changes in sage grouse (Centrocercus urophasianus) populations in western North America. Wildlife Biology 3: 229-234.

Connelly, J.W., M.A. Schroeder, A.R. Sands, and C.E. Braun. 2000. Guidelines to manage sage grouse populations and their habitats. Wildlife Society Bulletin 28: 967-985.

Connelly, J.W., S.T. Knick, M.A. Schroeder, and S.J. Stiver. 2004. Conservation Assessment of Greater Sage-grouse and Sagebrush Habitats. Western Association of Fish and Wildlife Agencies. June 2004. 610 pp.

Connelly JW, CE Braun, MA Schroeder, and CA Hagen. 2007. Setting the record straight: a response to "Sage-Grouse at the Crossroads." Rangelands 29(6):35–39.

Crawford, J.A., R.A. Olson, N.E. West, J.C. Mosley, M.A. Schroeder, T.D. Whitson, R.F. Miller, M.A. Gregg, and C.S. Boyd. 2004. Ecology and management of sage-grouse and sage-grouse habitat. Journal of Range Management 57(1): 2-19.

Dahlgren, D.K., R. Chi, and T.A. Messmer. 2006. Greater sage-grouse response to sagebrush management in Utah. Wildlife Society Bulletin 34(4): 975-985.

Dahlgren, D.K., T.A. Messmer, E.T. Thacker, and M.R. Guttery. 2010b. Evaluation of brood detection techniques: Recommendations for estimating greater sage-grouse productivity. Western North American Naturalist 70(2): 233-237.

Gitzen, R. A., J. J. Millspaugh, and B. J. Kernohan. 2006. Bandwidth selection for fixed kernel analysis of animal range use. Journal of Wildlife Management 70:1334-1344.

Hanf, J.M., P.A. Schmidt, and E.B. Groshens. 1994. Sage grouse in the high desert of central Oregon: Results of a study 1988–1993. U.S. Department of the Interior, Bureau of Land Management, Series P-SG-01, Prineville, OR.

Hensler, G.L. and J.D. Nichols. The Mayfield method of estimating nesting success: a model, estimators and simulation results. Wilson Bulletin 93(10: 42-53.

Kernohan, B. J., R. A. Gitzen, and J. J. Millspaugh. 2001. Analysis of animal space use and movements. Pages 125-166 in J. J. Millspaugh and J. M. Marzluff, editors. Radio Tracking and Animal Populations. Academic Press, San Diego, California, USA.

Knick, S.T., D.S. Dobkin, J.T. Rotenberry, M.A. Schroeder, W.M. Vander Haegen, and C.van Riper, III. 2003. Teetering on the edge or too late? Conservation and research issues for avifauna of sagebrush habitats. The Condor 105: 611-634.

Mayfield, H.F. 1961. Nesting success calculated from exposure. Wilson Bulletin 73: 255-261.

Mayfield, H.F. 1975 Suggestion for calculating nest success. Wilson Bulletin 87: 456-466.

Natural Resources Conservation Service (NRCS). 2001. Climate Information for Carbon County in the State of Wyoming. Natural Resources Conservation Service, U.S. Department of Agriculture. Available online at: http://www.wcc.nrcs.usda.gov/cgibin/climchoice.pl?state=wy&county=56007. Accessed July 2012.

Natural Resources Conservation Service (NRCS). 2004. Ecological Site Descriptions. Natural Resources Conservation Service, U.S. Department of Agriculture. Available online at: http://esis.sc.egov.usda.gov/Welcome/pgReportLocation.aspx?type=ESD. Accessed July 2012.

Natural Resources Conservation Service (NRCS). 2005. Sage-grouse (Centrocercus spp.). Fish and Wildlife Habitat Management Leaflet 26:1-25. U.S. Department of Agriculture Natural Resources Conservation Service and Wildlife Habitat Council.

Patterson, R.L. 1952. The sage grouse in Wyoming. Sage Books, Inc., Denver, Colorado.

Pollock, K.H., S.R. Winterstein, C.M. Bunck, and P.D. Curtis. 1989. Survival analysis in telemetry studies: the staggered entry design. Journal of Wildlife Management 53(1): 7-15.

Schroeder, M.A. 1997. Unusually high reproductive effort by sage-grouse in a fragmented habitat in north-central Washington. Condor 99: 933-941.

Schroeder MA, JR Young, and CE Braun. 1999. Sage Grouse (*Centrocercus urophasianus*). In The Birds of North America, No. 425, A Poole and F Gill (eds). The Birds of North America, Inc., Philadelphia, Pennsylvania.

Schroeder, M.A., C.L. Aldridge, A.D. Apa, J.R. Bohne, C.E. Braun, S.D. Bunnell, J.W. Connelly, P.A. Deibert, S.C. Gardner, M.A. Hilliard, G.D. Kobriger, S.M. McAdam, C.W. McCarthy, J.J. McCarthy, D.L. Mitchell, E.V. Rickerson, and S.J. Stiver. 2004. Distribution of Sage-Grouse in North America. The Condor 106:363–376.

Smith, E.P. 2002. BACI design. Pp 141-148 in A.H. El-Shaarawi and W.W. Piegorsch eds. Encyclopedia of Environmetrics, Volume 1. John Wiley & Sons, Ltd., Chichester, England.

State of Wyoming. 2008a. Executive Order 2008-2, Greater Sage-Grouse Core Area Protection. Office of the Governor, State of Wyoming, Cheyenne, Wyoming.

State of Wyoming. 2008b. Stipulations for Development in Core Sage-Grouse Population Areas. Office of the Governor, State of Wyoming, Cheyenne, Wyoming.

Stiver, S.J., A.D. Apa, J.R. Bohne, S.D. Bunnell, P.A. Deibert, S.C. Gardner, M.A. Hilliard, C.W. McCarthy, and M.A. Schroeder. 2006. Greater Sage-grouse Comprehensive Conservation Strategy. Western Association of Fish and Wildlife Agencies. Unpublished Report. Cheyenne, Wyoming.

U.S. Fish and Wildlife Service (USFWS). 2008. Greater sage-grouse interim status update. October 31, 2008.

U.S. Forest Service (USFS). 2011. Forest Service Manual, Rocky Mountain Region (Region 2), Denver, CO, Supplement 2600-2011-1. Available online at: http://www.fs.usda.gov/detail/r2/landmanagement/?cid=stelprdb5350842. Accessed July 2012.

Western Association of Fish and Wildlife Agencies (WAFWA). 2008. Greater sage-grouse population trends: an analysis of lek count databases 1965-2007. Sage and Columbian sharp-tailed grouse technical committee, WAFWA.

Western Regional Climate Center (WRCC). 2008. Western United States Historical Climate Summaries. Available online at: http://www.wrcc.dri.edu/Climsum.html. Accessed July 2012.

White, G. C., and K. P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study 46:120-139.Wyoming Game and Fish Department (WGFD). 2005. Comprehensive wildlife conservation strategy for Wyoming. Available online at: http://www.wildlifeactionplans.org/pdfs/action_plans/wy_action_plan.pdf. Accessed July 2012.

Wyoming Game and Fish Department (WGFD). 2011. Sage Grouse Core Management and Connectivity Areas Version 3. Available online at: http://wgfd.wyo.gov/web2011/wildlife-1000382.aspx. Accessed July 2012.

Wyoming Sage-grouse Working Group (WSWG). 2003. Wyoming greater sage-grouse conservation plan. Available online at: http://gf.state.wy.us/wildlife/wildlife_management/sagegrouse.asp. Accessed July 2012.

APPENDICES

APPENDIX A – 2010-2012 LEK DATA

Lek	District	10-year Average	3-year Max	2010 Max	2011 Max	2012 Max
1784314	Laramie	29.6	21	ND	20	1
1785042	Laramie	0	ND	ND	ND	18
1785102	Laramie	4.3	19	ND	ND	ND
1785282	Laramie	0	ND	ND	0	0
1785331	Laramie	0	ND	ND	44	50
1785362	Laramie	8.9	31	ND	41	43
1786163	Laramie	28.1	26	ND	18	19
1786252	Laramie	0	0	ND	45	63
1885223	Laramie	1.8	0	ND	ND	0
1983074	Laramie	67.4	52	ND	24	20
1983302	Laramie	45.1	59	ND	0	0
1983323	Laramie	96.1	59	ND	0	0
1984014	Laramie	54.3	65	ND	0	0
1984172	Laramie	29.6	23	32	35	23
1984294	Laramie	30.7	32	ND	0	0
1984312	Laramie	0.0	0	6	5	7
1984332	Laramie	20.8	27	45	25	21
1985352	Laramie	52.6	55	ND	ND	0
2083292	Laramie	0.0	ND	ND	0	0
2084341	Laramie	31.6	23	17	14	11
Bridger Pass	Lander	0.0	0	ND	0	0
Chokecherry	Lander	4.6	4	4	0	0
Chokecherry Bench	Lander	14.7	28	5	5	0
Deadman Creek	Lander	23.8	48	47	42	32
Eagle Creek	Lander	0.0	0	ND	ND	ND
East Muddy Divide	Lander	0.0	0	ND	0	0
Emigrant Creek	Lander	0.1	0	0	0	0
Grove Meadow	Lander	5.3	11	2	0	5
Hillside	Lander	1.9	3	3	0	0
Hugus Draw	Lander	15.7	23	2	0	0
Iron Springs Draw	Lander	12.9	34	12	0	0
Junction	Lander	15.9	29	15	14	13
Little Beaver	Lander	16.8	14	ND	ND	14
Little Sage Creek	Lander	23.3	38	16	19	19
Little Sage Reservoir	Lander	6.6	25	0	0	0

Lek	District	10-year Average	3-year Max	2010 Max	2011 Max	2012 Max
Liitlefield	Lander	0.0	0	ND	ND	0
Littlefield Canyon	Lander	0.0	0	ND	0	ND
McKinney Crossing	Lander	8.7	10	6	6	8
Miller Creek	Lander	0.0	0	ND	0	ND
Miller Hill	Lander	17.7	14	14	0	10
Overland Trail	Lander	0.0	0	ND	0	ND
Rawlins Reservoir	Lander	14.3	17	10	8	7
Sage Creek Basin	Lander	57.9	41	41	20	25
Sage Creek Ranch	Lander	35.8	45	45	28	32
Sheep Mountain	Lander	4.6	0	0	0	0
Smith Draw	Lander	0.0	0	0	ND	0
Smith Rim	Lander	2.3	4	0	0	0
South Hugus	Lander	0.0	0	ND	0	0
Stoney Creek	Lander	0.0	0	ND	ND	0
Upper Hugus	Lander	1.8	3	3	0	0
Upper Iron Springs	Lander	23.2	27	16	20	21
West Junction	Lander	0.0	0	ND	0	0
Wild Horse Canyon	Lander	12.1	20	10	17	8
	Average	**15.5**	**19.0**	**13.5**	**10.2**	**9.8**

APPENDIX B – MONITORING PROTOCOLS

Greater Sage-Grouse Monitoring Protocols
For the Chokecherry and Sierra Madre Wind Energy Project

Several methodologies are being used to monitor greater sage-grouse (*Centrocercus urophasianus*) populations across The Overland Trail Ranch (the Ranch) and the surrounding areas before during, and after construction of the Chokecherry and Sierra Madre Wind Development Project (Project). Lek counts occur annually to determine trends in sage-grouse populations within and surrounding the Project area. A GPS telemetry study has been initiated to track sage-grouse response to energy development and conservation measures as implemented. Habitat is being monitored annually to develop relationships between sage-grouse activity and various vegetative habitat components. This information will be incorporated into habitat equivalency assessment (HEA) models to refine associations between vegetation characteristics and sage-grouse habitat service. This document serves as the protocol guideline to complement the conservation measures outlined in the Conservation Plan. Specific methodologies for this effort and study design are provided below.

Lek Counts

A lek count is a census technique used to quantify numbers of sage-grouse attending a lek. Standardized techniques are necessary to ensure consistent documentation of the data, which enables accurate dataset comparisons to be made between survey years. The following guidelines are adapted from the Wyoming Game and Fish Department's (WGFD) Greater Sage-Grouse Lek Survey and Count Methodology (Connelly et al. 2004) and Wyoming Sage-Grouse Definitions (WGFD 2006) (Attachment A).

Lek counts are conducted between 1 April and 7 May after the peak of sage-grouse mating activity; however this time period may vary based on annual climatic conditions. The period between late April and early May is typically when the number of males in attendance is greatest due to younger males joining the leks to strut after the majority of the breeding has occurred. Optimal weather conditions for conducting lek counts are clear and calm mornings. Wind speeds during lek counts should be less than 20 mph with zero precipitation as these factors may greatly reduce lek activity. Temperature variations appear to have very little impact on lek activity. Lek counts may only be conducted from the ground as data from aerial lek counts are not reliable to monitor population trends.

Attendance at each lek are counted a minimum of three times, with each count separated by a 7 to 10 day interval. Lek counts typically occur between 30 minutes before sunrise and one hour after sunrise, and all leks within a complex (i.e. within 2.5 kilometers of each other) should be counted together on the same morning, if practicable. Leks should be approached cautiously so as not to disturb courtship or mating activities. Whether approaching a lek in a truck, ATV, or on foot, a large buffer should be left around the lek and binoculars or a spotting scope should be used to obtain an accurate count. If a lek appears to be unoccupied, observers should walk through the potential strutting area and document any signs of recent sage-grouse activity (e.g., fresh piles of sage-grouse droppings, feathers, tracks, etc.).

Additional lek surveys will be initiated from global positioning system (GPS) data retrieved from tagged sage-grouse hens (see GPS Data Management below). Early morning movement patterns and visitation rates of sage-grouse hens into areas not previous identified as a lek will be identified as a potentially new or previously unidentified lek and will be field-checked through ground surveys. An

approximate GPS location will be recorded and a survey will be conducted from the ground approximately one hour before sunrise by driving within hearing distance of the potential lek. On calm mornings, breeding male sage-grouse (i.e., booming) may be heard at a distance of approximately 1 mile. If booming is heard, the observers would approach the lek on foot and all openings or areas of less dense sagebrush would be searched for displaying male sage-grouse with binoculars and/or a spotting scope.

If a potential new lek or satellite lek is encountered, observers will document the location of the lek from a distance using a GPS unit and specific site directions so as to not disturb activities at the lek. Observers may then return after the breeding season to record a more accurate GPS location and to delineate the boundaries and center point of the new lek (see below).

Lek Delineation and Center Point

Lek perimeters are variable and may change slightly from day to day or between breeding seasons. Lek perimeter delineations should be conducted near the end of the breeding season each year to capture these potential shifts in individual lek boundaries. Documenting these shifts is important as agencies can make more precise recommendations on best management practices for an area based on accurate lek perimeters. The following guidelines are adapted from the Wyoming Game and Fish Department's (WGFD) Protocol for Mapping Lek Perimeters (Tessman 2007) (Attachment A).

Lek perimeter delineations should only be conducted by observers who are familiar with an individual lek. Typically, this should be the observer who conducted three or more lek counts for at least one season for the individual lek. This ensures the observer is familiar with the general boundaries of the lek for that season. Lek perimeters should be delineated after birds have left the lekking grounds for the day so that courtship or mating activities are not disturbed. Based on the observer's knowledge of the individual lek and evidence of sage-grouse activity, the perimeter of the lek is delineated and waypoints are typically collected approximately every 10 meters to accurately capture the shape of the lek perimeter. After the perimeter has been delineated, the centroid will be calculated for the newly mapped perimeter in ArcGis.

GPS units will gather locations using the Universal Transverse Mercator (UTM) coordinate system and map datum set to NAD 83 to maintain consistency with previously collected data. Observers should document their waypoint naming convention to ensure consistency when identifying all waypoints taken for an individual lek.

Fence Collision Observations

Through incidental observations on the Ranch, fence collisions have caused mortality in areas of increased sage-grouse use, especially around large leks. SWCA ecologists are working in collaboration with Power Company of Wyoming LLC (PCW) and operation managers of the Ranch to determine suitable fence locations for a fence marking program. The fence marking program is a conservation measure identified in PCW's and The Overland Trail Cattle Company's (TOTCO) Conservation Plan to reduce sage-grouse mortality by providing adequate visibility on the top wire of "problem" fences that are used for livestock containment and property lines. Previous studies suggest that fence markers may reduce fence collisions by up to 70% compared to unmarked sections (Christiansen 2009). Incidental observations of fence strikes will be continued through this conservation effort and documented with photographs and written accounts.

SWCA ecologists will further use sage-grouse use and movement pattern data, acquired during sage-grouse monitoring efforts, to identify which fences throughout the Ranch are "problem" fences. "Problem" fence locations will be identified in a GIS layer and maps will be provided to TOTCO for future fence marking and fence removal efforts. Fence markers are designed to move in the wind, reflecting the sunlight with its bright orange and green reflector tape that remains glowing after dark for 10 to 12 hours. Fence markers will be installed on the top wire of "problem" fences (one between each post) since very few collisions have been documented for lower wires (Christiansen 2009).

Capturing and Tagging

Sage-grouse capture and tagging will be performed in order to identify sage-grouse distributions and habitat use across the Ranch. To increase the likelihood of success, capture sites are located in proximity to leks that have historically high lek attendance or in areas that have seasonally high use. Consequently, tagging efforts occurred in spring (March-May) to coincide with sage-grouse lekking and autumn (September-October) to align with autumn use areas. Capture protocols described by Giesen et al. (1982) and Wakkinen et al. (1992) were used for all sage-grouse capture activities on the Ranch and surrounding areas. Approximately 50 tags were deployed at any time during the study period. These protocols include spotlighting and hoop-netting techniques, and employ the use of all terrain vehicles (ATVs) to increase the effectiveness of the capturing effort. Both adult and juvenile greater sage-grouse were captured and equipped with PTT using a simple leg-hoop harness system. Sage-grouse capture takes place nocturnally, beginning approximately one hour after sunset and continuing until dawn. It is critical to allow sufficient time for sage-grouse to settle in at their roosting sites. Data collected are used to model sage-grouse range, movement patterns, lek and habitat use, survival rates, and seasonal habitat use areas in and surrounding the Project area.

GPS Transmitters

Individual sage-grouse are fitted with a GPS Platform Terminal Transmitter (PTT) (30 gram Solar/Argos PTT-100, Microwave Telemetry, Inc.). Each PTT unit consists of a 12-channel GPS receiver accurate to ± 15 meters. Solar units are equipped with a photovoltaic cell to recharge internal batteries which increases the life of the unit to 3-5 years. These units record approximate location, along with approximate altitude, heading, and speed to allow for identification of migratory pathways and overall use of the landscape. Each unit is 2.45 inches in length, 0.87 inches in width, and 0.85 inches in height. Units are finished with a sand texture and camouflage to minimize visibility by predators.

Capturing

Two technicians are generally needed for sage-grouse capture, and responsibilities are divided between driving, spotlighting, and netting. If available, roosting sites and/or lek locations are identified as potential capture sites where searching for roosting sage-grouse should take place. Searching involves circling the roosting site and/or lek location at slow, steady speeds (1-4 miles per hour) while continually scanning the area with a high-powered spotlight (e.g., 3-million candle power) to locate white eye shine and/or bird movement (Figure 1). Mobile searching should be interspersed with periods of stopping and scanning the area with binoculars to locate roosting sage-grouse, especially on hillsides and areas adjacent to drainages. These locations provide a greater likelihood for locating roosting sage-grouse because they are either adjacent to areas used

for daily foraging, provide a greater vantage point to spot predators, or have reduced vegetation structure in order to flee from predators.

Figure 1. A male sage-grouse spotlighted during nighttime.

Once a sage-grouse is spotted, capture should occur quickly so as to decrease the chances of flushing the spotlighted bird. The operator of the ATV should take over the spotlight and keep the beam focused on the targeted bird, while the second technician dismounts from the ATV and gathers the net. Once the netter is in position to one side of the ATV, both the operator and the netter should slowly approach the targeted bird, while the ATV operator keeps the beam fixed on the bird. At approximately 20 meters from the bird, the netter should slowly move away from the side of the ATV and continue to approach the bird while the ATV operator keeps the bird within the spotlight beam. Once the netter is at a comfortable distance, they should advance and gently place the net over the bird, all the while staying out of the spotlight beam. Slow but direct movement of the net on top of the sage-grouse should not only be sufficient but will also ensure that the bird is kept within the netting and not hit by the rim supporting the netting. Interruption of the spotlight beam may allow the bird to adjust to its surrounding and typically results in spooking and flushing the bird.

Once the bird has been successfully netted, it is imperative for the netter to immediately secure the net by holding down the support rim of the net and gently holding the netted bird to prevent it from spreading or flapping its wings. Once the sage-grouse has calmed, the other technician can remove the bird from the net by securing it with both hands. Placing a small cloth bag or something similar over the head of the sage-grouse generally helps keep the bird calm while attaching the PTT.

Tagging

PTTs are attached behind the wings using a simple leg-hoop harness system made of natural tubular Teflon ribbon (Rappole and Tipton 1991). Elastic material is integrated into the harness design, allowing for the harness to expand during growth of the sage-grouse. This design is preferable to a backpack design because it does not interfere with feathers used in mating displays and can be deployed quickly with minimal stress to individual birds. During the tagging process, each sage-grouse is weighed and properly identified for age and sex (Beck 1975; Bihrle 1993; Attachment B). Once the vitals have been recorded, the PTT is positioned on the upper rump/lower back in alignment with the legs. The harness is then looped around each leg and pulled through the attachments on the transmitter and copper bushings, and secured with forceps (Figure 2). The transmitter should be adjusted at this stage so that there is approximately one centimeter of

forgiveness in the harness before securing the harness and compressing the bushings. While releasing the sage-grouse, all lights and headlamps should be turned off and the bird should be slowly released away from all hazards (e.g., ATVs, technicians, structures, etc.). The PTT identification number and radio frequency should be recorded before the sage-grouse is released.

Figure 2. Transmitter being attached to the rump of a sage-grouse hen.

GPS Data Management

Data collected by the PTT will be relayed via satellite and downloaded weekly by a geographic information system (GIS) specialist. Data are compiled in a geospatial database to enable tracking of individual sage-grouse over time. PTTs are programmed with 3 different programming cycles. PTTs relay locations to Advanced Research and Global Observation Satellite (Argos) satellites every 3 to 5 days and are equipped with a mortality sensor and ground tracking transmitter which emits radio frequencies (i.e. radio telemetry) to allow for the daily collection and further investigation of vital rates, particularly clutch size, hatching rate, nest success, chick survival and hen survival. The life of each transmitter is expected to be 3-5 years. Following the analysis of data collected from the first three seasons of sage-grouse observations, the best possible programming cycle will be recalculated and used to reprogram recovered PTT and new PTT for future monitoring efforts (Table 1).

Table 1. Argos Program and Duty Cycle for the GPS PTTs.

Annual Start Date (mm/dd)	Annual End Date (mm/dd)	Receiver Start Hour (local time)	Receiver End Hour (local time)	Hour Step	TX Duty Cycle (Transmit every x days)	Ground Track ON?
Program 1 (2010)						
03/01	05/20	0	18	6	5	Yes
05/21	07/31	6	20	2	4	Yes
08/01	02/28	4	20	4	5	No
Program 2 (2010)						
09/16	02/28	4	20	4	5	Yes
03/01	09/15	0	18	6	5	No
Program 3 (2011-2012)						
04/04	08/31	0	21	3	3	Yes
09/01	11/15	0	20	4	5	Yes
11/16	03/31	0	20	4	5	No

Data collected by the PTT will provide insight to seasonal habitat uses by sage-grouse and their movement patterns. Seasonal usage in the first 3 years of the monitoring will serve a pre-development baseline to which future use of the wind development area can be compared.

Radio Telemetry

Sage-grouse throughout the Ranch have been fitted with PTT that can be tracked on the ground using ultra high frequency (UHF) radio telemetry and the "loudest-signal method" (Springer 1979). This dual location ground tracking system allows sage-grouse tracking using radio telemetry with greater efficiency.

Locating Search Area and Signal

Each PTT uploads GPS locations every three to five days that include individual bird locations and movement paths. From this data, general bird locations are determined and radio telemetry tracking can commence within proximity to each GPS location and/or bearing. Due to environmental conditions and topographic features of the Ranch, radio telemetry typically needs to take place within approximately one kilometer of the target PTT to locate signal on the receiver. The function of the receiver is to locate a signal, amplify it, and make it audible to the user. The audible sound comes in the form of a steady pulse of blips. The signal has two cycle periods differentiated by the strength (i.e., the wavelength amplitude) of the blip. The first cycle emits six strong blips followed by a second cycle which emits 12 to 13 weak blips, always maintaining the same cadence.

General techniques to locate UHF signals are:

- Enter the correct PTT UHF frequency into the receiver and listen for static noise being transmitted from the receiver (If no static noise is being transmitted, rotate the SQL dial counter-clockwise until it is being transmitted);
- Position antennae parallel to ground, high and away from any obstructions (e.g., vehicles, metal objects, GPS units, cell phones, etc.);
- Point antennae and listen for a signal for at least 10 seconds every 45˚ direction;
- If a signal (blip) is detected , identify the bearing of the loudest blip, which is the general direction of the PTT;
- If no signal is located, relocate to a different position closer to the GPS bearing (i.e., elevated ground away from dense vegetation);
- If locating a signal in mountainous or hilly terrain, locate the highest point within the surrounding area to optimize the likelihood of locating a signal.

Determining Signal Direction and Distance

Located signals are generally weak indicating a greater distance between transmitter and receiver; however, as the distance between transmitter and receiver decreases, the amplitude of the signal will increase. Once the signal has been located, the receiver operator should move in the direction of the strongest or only signal available. After moving 50 meters (m) toward the location, the operator should stop and search for the signal again listening for any changes in the blip amplitude. The operator should repeat this process, continually moving in the direction of the strongest blip.

Location accuracy is significantly increased by employing two technicians to triangulate the PTT location (Figure 3). Once a signal is located, one operator shall locate from that position, while the second operator should move out to a position approximately 45˚ and 500 m away from that position. Both operators will begin to triangulate the PTT location by creating two vectors that intersect at the approximate PTT location. Two-way radios will assist in this operation to allow each operator to communicate their respective locations and vector bearings.

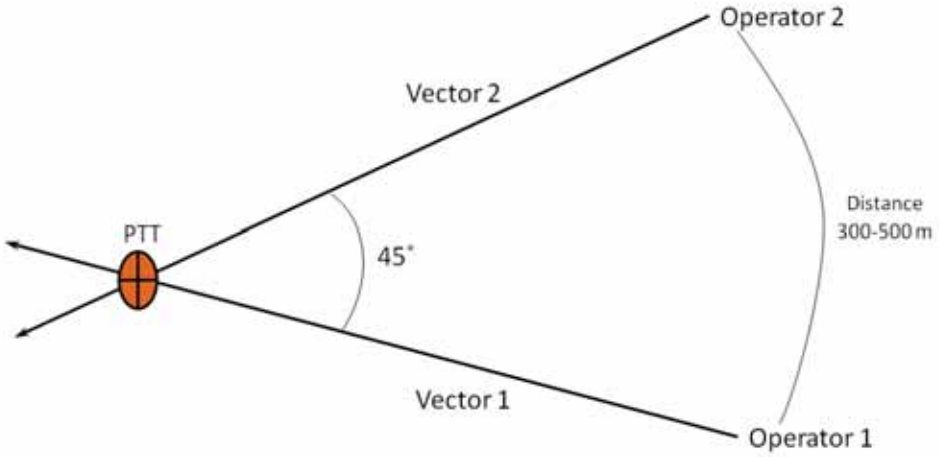


Figure 3. Triangulation with Radio Telemetry

Attenuation and Squelch

Attenuation (ATT) is a receiver function that controls the amplitude of wavelengths identified by the receiver, which is a useful tool to approximate the distance from the transmitter. If a signal is transmitted with the ATT function activated, the operator has identified the correct vector and is

likely within 500 m from the PTT location (Table 2). nce the signal is identified using the ATT function, the squelch (SQL) function can be used to refine the PTT location vector.
Squelch (SQL) is a receiver function that suppresses the audio output of the receiver and makes it more sensitive to the input signal. This function allows the user to more accurately identify the vector of the target by narrowing the bandwidth of the input signal and making the receiver more sensitive to the direction of the antenna. The SQL has a range level between 1 (widest range) and 9 (narrowest range). Once an operator has a strong ATT signal, than the PTT location is close enough use the SQL function. Beginning at level 1, the operator should continue to move along the vector while simultaneously increasing SQL (Table 2). Once a signal is located at level 8 and/or 9, the PTT location is most likely less than 10 m.

Table 2. Range of Different Radio Functions

Range (meters)	VFO/CW	ATT	SQL*	SQL Level
1000+	O	X	X	OFF
700	O	X	X	OFF
500	O	X	X	OFF
400	O	O	X	OFF
300	O	O	X	OFF
200	O	O	X	OFF
100	O	O	X	OFF
75	O	O	O	1
50	O	O	O	1-2
25	O	O	O	2-4
20	O	O	O	5-6
15	O	O	O	7-8
10	O	O	O	9

*ATT is activated during all SQL searches; O = in range; X = out of range

Approaching PTT Location

The operator should continually be looking for the movement or shape of sage-grouse while searching for the GPS PTT location. Once the operator is within 50 m of the target, they shall begin "glassing" the area for any visual cues. It is important to try and cause the least amount of disturbance to the sage-grouse and its surroundings, and unless the objective is to flush the sage-grouse, a GPS location should be recorded and the area left immediately.

Factors Affecting Signal

Signal bounce is the result of a radio transmission being deflected off of different surfaces and generally occurs in topographically diverse terrain, deep draws, and areas of dense vegetation (White and Garrott 1990). If the signal is being located in multiple directions, it is likely the result of signal bounce. The most effective way to overcome signal bounce is using the ATT function and triangulating the location until all signals appear to be coming from the same location (White and Garrott 1990).

If no signal is located, then it is likely that the bird has moved out of the range of the receiver. Including the movement path with a GPS point location helps determine general movement patterns. However, at greater distances the signal is very weak and may not be heard while the PTT is transmitting in its weak cycle period. It is critical to listen for a minimum of 30 seconds before trying a new direction because the signal may not be audible again until it has cycled back to the stronger cycle period. In addition, each PTT is programmed with a unique duty cycle (the time period of transmitting UHF signal). It is important to be aware of the PTT cycle program and ensure the survey is conducted within the active UHF duty cycle.

Nest Monitoring

Nests of GPS-tagged hens are monitored to determine the reproductive success and help evaluate population dynamics of sage-grouse on the Ranch. Potential nesting sites are identified initially from ARGOS GPS data gathered from tagged hens. GPS locations are verified visually by locating the potential nest site using radio telemetry (Schroeder 1997). Nesting hens are thereafter monitored every 1-3 days to determine nest fate (e.g., successful, depredated, or abandoned) and continually monitored using GPS data (Coates and Delehanty 2010).

Technicians are able to locate nest sites more effectively on the ground by using standardized radio telemetry techniques (see Radio Telemetry). Locating a nest site requires extreme caution so as to avoid flushing or creating any unnecessary stress to nesting hens (Dahlgren et al. 2010a). This is accomplished by approaching the potential nest site to within approximately 20 m, locating the nest by glassing the base of sagebrush and other potential nest shrubs using binoculars and/or spotting scopes, and circling the potential site while continually checking the base of shrubs until the nesting hen/nest is found, maintaining approximately 20 m (Popham and Gutierrez 2003). Visual contact on a nesting hen can be difficult at this distance but the strength of the radio blip and the squelch using radio telemetry will help determine distance and direction of the potential nest site. The nest location (UTM), host shrub (i.e., the shrub type in which the nest bowl is under), nest structure (e.g., number of openings, canopy height, etc.), aspect and slope, landscape and surrounding vegetation, and nearest lek are recorded for each nest. A photopoint, including distance and direction to nest, is established at each nest site. Follow-up observations will continue to monitor nest status and ultimately nest fate from the established photopoint.

The nest bowl and surrounding area are inspected as soon as the nesting hen has abandoned the nest. GPS data and field observations are used to determine when nests have been abandoned. Incubation periods for sage-grouse generally range from 24 – 27 days (Schroeder 1997). A nesting hen is defined as successful if ≥ 1 egg is cleanly cracked open and a dried membrane is visible inside the eggshell. Often successfully hatched eggs will be arranged orderly in the nest and the majority of the eggshell will still be intact. Hatched eggshells are counted to determine clutch size. Conversely, eggs that have been depredated are generally smashed and scattered away from the nest bowl. Large peck holes in intact eggs likely indicate an avian depredation (e.g., raven), while eggs that are completely smashed and strewn about are likely caused by terrestrial mammals (e.g., badgers, ground squirrels, coyotes). Any evidence such as tracks, scat, and/or hair surrounding the nest may be used to help identify the species responsible for the depredation. Nests are defined as abandoned when the clutch was intact but eggs were cold and the nesting hen was not on the nest (Moynahan et al. 2007). GPS data are used to confirm that nesting hens had not returned to abandoned nest sites.

Brood Monitoring

Sage-grouse hens typically incubate between 24-27 days (Schroeder 1997); therefore, a hatch date can be determined within 1-3 days of actual hatch. Toward the end of the incubation period and within 3 days of the predicted hatch date, females are located each day to collect data on incubation period, nest success, and brood size. Once a tagged-hen has had a successful hatch, it is important to determine brood size as soon as possible to reduce possible bias due to brood-mixing and/or chick mortality within a given brood (Dahlgren et al. 2010b). Each hen and her brood are monitored weekly to determine both brood size and habitat use during early and late brood-rearing.

GPS data are used to determine the location of tagged hens, which are subsequently located in the field using radio telemetry (See Radio Telemetry). Flush counts are used to determine brood size (Dahlgren et al. 2010b). Observers approach the brood during the day (typically morning and/or evening) and attempt to flush the brood hen. Once the brood hen is flushed, the observer slowly proceeds in a spiral pattern (approximately 2-5 m spacing between each rotation) around the last observed location of the brood hen for approximately 20 minutes**,** in an attempt to flush the remaining brood. Two observers are generally used on all approaches to increase the likelihood of flushing the entire brood. Flushed birds are counted as either adults or juveniles, based on size. If more than one adult is flushed while following a tagged brood hen, than it is considered a potential mixed brood.

Habitat Monitoring

Habitat monitoring provides land managers the opportunity to document current conditions, establish trends, evaluate land treatments, determine restoration success, and assess overall habitat health to support sage-grouse populations (Connelly et al. 2003). It is necessary to determine the quality and quantity of sage-grouse habitat in order to make sound management decisions (Connelly et al. 2000). Habitat requirements for sage-grouse, especially breeding hens, change seasonally and are closely associated with changing life history stages (e.g., breeding, brood-rearing, wintering). Breeding habitats, late brood-rearing habitats, and non-breeding habitats are analyzed to evaluate habitat utilization by sage-grouse hens.

Nest Sites

At each nest site, two bisecting 60-m transects are established radiating in the four cardinal directions from the nest bowl (i.e., four 30 m transects in each cardinal direction from the nest bowl). A series of vegetation attributes are determined along each transect, including measurements of visual obstruction (VOR), canopy cover and height of vegetation cover types, and sagebrush density. The sampling frequency for each vegetation attribute is specific to each site and is identified in Table 3. Specific protocols for each vegetation attribute are described below.

Surrounding each nest, randomly available sites at multiple scales are selected to determine whether sage-grouse select nest sites based on specific, microsite characteristics or broader, landscape level differences. To assess microsite characteristics, three random sites are selected between 10 - 30 m from the nest bowl. Azimuth and distance are randomly selected for each site and the nearest sagebrush (i.e., the “host” shrub) is identified as the center point. For each random site, two bisecting 10-m transects are established radiating in the four cardinal directions from the “host” shrub and VOR and canopy cover and height of vegetation cover types are recorded (Table 3).

To assess habitat selection at a broad scale, two random sites are selected at 250 and 500 m away from the nest bowl. Azimuths are randomly selected for each broad scale site and the nearest sagebrush (i.e., the "host" shrub) at 250 and 500 m is identified as the center point. For each random site, two bisecting 60-m transects are established radiating in the four cardinal directions from the "host" shrub and the same vegetation attributes are collected as at the nest site (Table 3).

Table 3. Vegetation Attributes Measured at Each Site

Habitat Selection	Site	Vegetation Attribute	*n*	Transect Location (m)										
				0	1	2	3	4	5	10	15	20	25	30
Nest	*Nest bowl*	VOR	9	O	O	O	O	O	O	O		O		O
		Canopy Cover /Height	11	O	O	O	O	O	O	O	O	O	O	O
		Sagebrush Density	3							O		O		O
	Random (R)1, R2, and R3	VOR	6	O	O	O	O	O	O					
		Canopy Cover /Height	6	O	O	O	O	O	O					
		Sagebrush Density	0											
	R250 and R500	VOR	4	O						O		O		O
		CC/Height	7	O					O	O	O	O	O	O
		Sagebrush Density	3							O		O		O
Hen/Brood	*Bird (GPS point)*	VOR	4	O						O		O		O
		Canopy Cover /Height	7	O					O	O	O	O	O	O
		Sagebrush Density	3							O		O		O
	R50, R250, and R500	VOR	4	O						O		O		O
		Canopy Cover /Height	7	O					O	O	O	O	O	O
		Sagebrush Density	3							O		O		O

*O – indicates that a specific vegetation attribute is recorded at this transect location.

Hen and Brood Sites

GPS locations acquired from tagged sage-grouse (*see* **Capturing and Tagging**) are used to determine vegetation sampling locations for brood-rearing hens. These locations are further separated into hen and brood sites. *Hen sites* include tagged sage-grouse that did not nest successfully and are not actively rearing a brood. *Brood sites* include tagged sage-grouse that successfully nested and are actively rearing a brood. Each week, daytime use GPS locations are randomly selected for each sage-grouse using Hawth's Tools in ArcGis. Vegetation measurements are made for each tagged sage-grouse before sampling a second site for the same tagged sage-grouse (i.e., simple random sampling of birds). These efforts are completed until at least 3 hen and brood site measurements for each tagged sage-grouse have been recorded.

At each hen and brood site, two bisecting 60-m transects are established radiating in the four cardinal directions from the nest bowl (i.e., four 30 m transects in each cardinal direction from the nest bowl). A series of vegetation attributes are determined along each transect, including measurements of VOR, canopy cover and height of vegetation cover types, and sagebrush density. The sampling frequency for each vegetation attribute is specific to each site and is identified in Table 3. Specific protocols for each vegetation attribute are described below.

To assess habitat selection at a broad scale, three random sites are selected at 50, 250, and 500 m away from the randomly selected hen and brood GPS location. Azimuths are randomly selected for each broad scale site and the nearest sagebrush (i.e., the "host" shrub) at 50, 250 and 500 m is identified as the center point. For each random site, two bisecting 60-m transects are established radiating in the four cardinal directions from the "host" shrub and the same vegetation attributes are collected as at the nest site (Table 3).

Winter Use Areas

GPS data collected during winter months will provide inferences to the various winter habitat components selected for by sage-grouse. Vegetation transects will be established to identify shrub cover, density, and height and used to determine potential relationships between winter habitat and shrub characteristics. GPS data will also contribute to determining locations for conservation measures aimed at enhancing winter habitat service.

Vegetation Sampling Protocols

Visual Obstruction (VOR)

A modified Robel pole delineated in 1.27 cm increments (Robel et al. 1970, Benkobi et al. 2000) is used to estimate VOR for two different strata. First, the Robel pole is partitioned into four segments, each with 18 increments (a total of 22.86 cm per segment). Facing the nest bowl (center point), the number of increments are recorded as obstructed for each segment if greater than 50% of the increment is obstructed when viewed from a distance of 4 m and a height of 1 m. Second, two heights are recorded for the lowest and tallest increments in each segment that are entirely obstructed, regardless of the segment (most often this is the same value).

Canopy Cover and Height

Canopy cover of the surrounding vegetation is estimated using a 0.1 m^2 Daubenmire frame placed parallel to the transect (Daubenmire 1959). Within each frame, cover class (Table 4) is determined for the following vegetation cover types: sagebrush (further divided into leafy or decadent), shrubs, forbs, bunchgrass species, rhizomatous grass species, and bare ground/litter. Plant functional groups were used to reduce data to a meaningful management level and allow comparisons among sites with varying species compositions (Boyd and Bidwell 2002; Davies and Bates 2010). In addition, the tallest height for each present vegetation cover type within the Daubenmire frame is recorded.

Table 4. Daubenmire Cover Class and Canopy Cover %.

Cover Class	Canopy Cover (%)	
	Range (%)	Midpoint (%)
0	0-1	0.5
1	1-5	3
2	5-25	15
3	25-50	37.5
4	50-75	62.5
5	75-95	85
6	95-100	97.5

Sagebrush Density

Sagebrush density is estimated using the point-centered-quarter method at each 10 m interval (Cottam and Curtis 1956). From the sampling location, the area is divided into four equal quadrants surrounding a center point. For each quadrant, the distance is measured from the center point to the nearest sagebrush and the nearest sagebrush greater than 20 cm in height. Two sagebrush categories are established to determine an overall sagebrush density and a density for sagebrush that potentially provides greater cover for sage-grouse.

Forb Diversity

In addition to quantitative vegetation measurements, a qualitative vegetation worksheet, which includes a list of plant genera and species common to the surrounding landscapes, is used to gather a more detailed view of the diversity of plants in the general area. This provides additional information not captured by the Daubenmire method and helps determine the diversity of various vegetation types.

Bird Mortality

Mortality of tagged sage-grouse is initially identified with Argos data. Sage-grouse locations and movement patterns are continually analyzed and bird mortalities are identified as multiple GPS recordings at a single UTM (typically greater than one day at the same location). In addition, the PTTs are programmed to indicate the cessation of movement, which activates the mortality signal. When mortality occurs, efforts will be made to recover the PTT as quickly as possible (see Radio Telemetry) to determine the cause of the mortality and to redeploy the PTT as quickly as possible following the mortality event. Any tagged sage-grouse that experience mortality would be collected in the field if possible to determine cause of death and, when necessary, undergo testing for diseases or parasites. Prior to collection of dead sage-grouse, a series of photos would be taken of the carcass and any evidence surrounding the dead bird to help determine cause of death. It is extremely challenging to locate a dead bird quick enough to recover a carcass due to high scavenging rates on the Ranch and the surrounding areas. Thus, bird recovery and determination of mortality is often rare.

Incidental Observations

Incidental wildlife observations encountered in the field will be logged into a database daily. A GPS waypoint is created at the point of each observation and tagged with a four letter code created from the common name of each species being recorded (similar to the Audubon system for birds; Table 5). The four character date code will follow the four letter species code using only the month and day. For multiple recordings of one species on the same date a suffix “-2”, “-3” and so on will be added to the code. For example, a Northern Leopard Frog found on 9/27 would have the code “NLFR0927”. A second sighting that same day would have the code “NLFR0927-2”. Observations of all passerine birds and any other animal species that may not be specified in the table should be recorded.

Table 5. Common species codes for wildlife on the Ranch.

GPS Code	Common Name
BADG	Badger
SWFO	Swift Fox
REFO	Red Fox
COYO	Coyote
BOBC	Bobcat
ELK	Elk
PRON	Pronghorn
MUDE	Mule Deer
WTDE	White-tailed Deer
COTT	Cottontail species
WTPD	White-tailed Prairie Dog
BTPD	Black-tailed Prairie Dog
LTWE	Long-tailed Weasel
MARM	Marmot
LECH	Least Chipmunk
RESQ	Red Squirrel
TLGS	Thirteen-lined Ground Squirrel
GRSQ	Ground Squirrel species
WORA	Wood Rat
TISA	Tiger Salamander
NLFR	Northern Leopard Frog
BCFR	Boreal Chorus Frog
WGSN	Wandering Garter Snake
GASN	Garter Snake species
PRRA	Prairie Rattlesnake
BULL	Bull snake
RTHA	Red-tailed Hawk
NOHA	Northern Harrier
SWHA	Swainson's Hawk
FEHA	Ferruginous Hawk
PRFA	Prairie Falcon
BAEA	Bald Eagle
GOEA	Golden Eagle
GSGR	Greater Sage-Grouse

Feature Classes

In post processing development, incidental observations will be grouped into feature classes for spatial data analysis (Table 6). Feature classes will help show distribution and habitat use of sensitive and common species across the Ranch. For example, pronghorn, mule deer, and elk will be grouped into the class ungulates since their individual data is not of concern on the Ranch but as a group, ungulate grazing and wintering concentration areas may be useful for future applications. Prey mammals, such as prairie dogs, hares, and marmots may be used to correlate where raptor nest

locations or hunting areas may occur. Greater sage-grouse will have its own feature class since data on individuals is of concern.

Table 6. Featured Classes for grouping GPS waypoint species.

Featured Class
Predatory Mammal Point
Prey Mammal Point
Ungulate Point
Reptile Point
Amphibian Point
Passerine Bird Point
Raptor Point
Sage-grouse Point
Nest Point
Water Resource Point
Cultural Resource Point

Reporting

Locations obtained through both GPS and radio telemetry efforts will be analyzed to determine relationships between sage-grouse spatial and temporal use of habitats and various habitat characteristics (e.g., sagebrush cover, sagebrush height, forb cover, grass cover, etc.), as measured through concurrent vegetation monitoring efforts. These relationships will provide additional information on the potential changes in habitat use in response to the wind development project and habitat improvement projects, and will be used to refine nesting, brood-rearing, and winter habitat models to more accurately assess the quality of habitats throughout the assessment area.

Telemetry, vegetation monitoring, vital rate, and habitat quality data would be analyzed to refine the understanding of sage-grouse use of the habitats in the assessment area as well as those areas outside the assessment area that sage-grouse will use. A variety of standard statistical and spatial analyses will be completed to identify the factors that determine use of any area by sage-grouse and to provide stakeholders with a better understanding of the success of various conservation and habitat improvement projects. Analyses will also be completed to demonstrate the relative use of the wind development areas to enable a better understanding of how the individuals in the assessment area and the populations a s a whole respond following wind project development.

References

Ammann, G.A. 1944. Determining the age of pinnated and sharp-tailed grouse. Journal of Wildlife Management 8:170–171.

Benkobi, L., D. W. Uresk, G. Schenbeck, and R. M. King. 2000. Protocol for monitoring standing crop in grasslands using visual obstruction. Journal of Range Management 53:627-633.

Bihrle, C. 1993. Upland game identification - A basic guide for aging and sexing the bird in your hand. North Dakota Outdoors 56(3):9-23.

Boyd, C.S., and T.G. Bidwell. 2002. Effects of prescribed fire on shinnery oak plant communities in western Oklahoma. Restoration Ecology 10: 324-333.

Christiansen, T. 2009. Fence marking to reduce greater sage-grouse (*Centrocercus urophasianus*) collisions and mortality near Farson, Wyoming – Summary of Interim Results. Wyoming Game and Fish Department. October 26, 2009.

Coates, P.S. 2007. Greater sage-grouse (*Centrocercus urophasianus*) nest predation and incubation behavior. Ph.D. Dissertation, Idaho State University, Pocatello, ID.

Coates, P.S., and J.D. Delehanty. 2010. Nest predation of greater sage-grouse in relation to microhabitat factors and predators. Journal of Wildlife Management 74(2): 240-248.

Connelly, J.W., M.A. Schroeder, A.R. Sands, and C.E. Braun. 2000. Guidelines to manage sage grouse populations and their habitats. Wildlife Society Bulletin 28: 967-985.

Connelly, J.W., K.P. Reese, and M.A. Schroeder. 2003. Monitoring of greater sage-grouse habitats and populations. College of Natural Resources Experiment Station. Station Bulletin 80, contribution No. 979, University of Idaho, Moscow, ID. 54 pp.

Connelly, J.W., S.T. Knick, M.A. Schroeder, and S.J. Stiver. 2004. Conservation Assessment of Greater Sage-grouse and Sagebrush Habitats. Western Association of Fish and Wildlife Agencies. June 2004. 610 pp.

Cottam, G., and J. T. Curtis. 1956. The use of distance measures in phytosociological sampling. Ecology 37:451-460.

Dahlgren, D.K., T.A. Messmer, and D.N. Koons. 2010a. Achieving better estimates of greater sage-grouse chick survival in Utah. Journal of Wildlife Management 74(6): 1286-1294.

Dahlgren, D.K., T.A. Messmer, E.T. Thacker, and M.R. Guttery. 2010b. Evaluation of brood detection techniques: Recommendations for estimating greater sage-grouse productivity. Western North American Naturalist 70(2): 233-237.

Daubenmire, R. F. 1959. A canopy-coverage method of vegetation analysis. Northwest Science 33:43-64.

Davies, K.W, and J.D. Bates. 2010. Vegetation characteristics of mountain and Wyoming big sagebrush plant communities in the Northern Great Basin. Rangeland Ecology and Management 63: 461-466.

Giesen, K.M., T.J. Schoenberg, and C.E. Braun. 1982: Methods for trapping sage grouse in Colorado. - Wildlife Society Bulletin 10: 224-231.

Gutierrez, R.J., and G.P. Popham. 2003. Greater sage-grouse (Centrocercus urophasianus) nesting success and habitat use in northeastern California. Wildlife Biology 9(4): 328-333.

Hansen, C., M. Rumble, J. Millspaugh, and N. Wojcik. 2010. Greater sage-grouse (*Centrocercus urophasianus*) hen and brood site vegetation sampling protocol. *Unpublished Report*.

Moynahan, B.J., M.S. Lindberg, J.J. Rotella, and J.W. Thomas. 2007. Factors affecting nest survival of greater sage-grouse in northcentral Montana. Journal of Wildlife Management 71(6): 1773-1783.

Rearden, J. D. 1951. Identification of waterfowl nest predators. Journal of Wildlife Management 36:87-98.

Rappole, J.H. and A.R. Tipton. 1991. New harness design for attachment of radio transmitters to small passerines. Journal of Field Ornithology 62(3): 335-337.

Robel, R. J., J. N. Briggs, A. D. Dayton, and L. C. Hulbert. 1970. Relationships between visual obstruction measurements and weight of grassland vegetation. Journal of Range Management 23:295-298.

Rumble, M., J. Millspaugh, C. Hansen, and N. Wojcik. 2010. Greater sage-grouse (*Centrocercus urophasianus*) nest vegetation sampling protocol. *Unpublished Report*.

Schroeder, M.A. 1997. Unusually high reproductive effort by sage-grouse in a fragmented habitat in north-central Washington. Condor 99: 933-941.

Springer, J. T. 1979. Some sources of bias and sampling error in radio triangulation. Journal of Wildlife Management 43(4): 926-935.

Tessman, S.A. 2007. Handbook of biological techniques. 3rd edition. Wyoming Game and Fish Department, Cheyenne, Wyoming 659 pp.

Wakkinen, W.L., Reese, K.P., Connelly, J.W. & Fischer, R.A. 1992: An improved spotlighting technique for capturing sage grouse. - Wildlife Society Bulletin 20: 425-426.

White, G.C., and R.A. Garrott. 1990. Analysis of Wildlife Radio-tracking Data. Academic Press, San Diego, CA. 383 pp.

Wyoming Game and Fish Department (WGFD). 2006. Wyoming Sage-grouse Definitions (Revised). Wyoming Game and Fish Department, Cheyenne, Wyoming. Revised December 16, 2009. 4 pp.

ATTACHMENT A

Greater Sage Grouse Lek Survey & Count Methodology

Developed by Western Association of Fish and Wildlife Agencies and locally adapted by the Wyoming Game and Fish Department, 2004

Definitions:

Lek Survey: A monitoring technique to identify new sage grouse leks and to determine whether known leks are active.

Lek Count: A census technique that documents the actual number of male sage grouse observed on a particular lek. Lek count data are primarily used to develop indices to relative population levels and provide short and long term trend information for both populations and changes in occupied range.

Lek Survey Methodology:

1. Searches should be conducted from early April to early May (April 1 – May 7). (Survey season corresponds to peak male attendance as established by the WGFD for documenting population trends.)

2. Surveys for new leks should be conducted a minimum of three (3) times (with subsequent surveys 7-10 days apart).

3. Surveys for new leks should be conducted throughout suitable habitat. New leks can be located by the discovery of concentrated tracks/droppings/feathers at all times of the day when conducting other field activities. Return visits to such sites during the morning strutting hours must be made to confirm the location as a lek.

4. Surveys to confirm the activity of a lek may require only one visit if grouse are identified on the lek.

   NOTE To designate a known lek as inactive requires either an absence of birds on the lek during multiple ground visits under ideal conditions throughout the strutting season or a ground check of the exact lek site late in the strutting season that fails to find any sign (droppings/feathers) of strutting activity.

5. Surveys can be conducted from the ground or from an aircraft.

Lek surveys can be conducted from the ground by driving along roads in suspected or known breeding habitat and stopping every ½ mile to listen for sounds of breeding grouse. Ground searches can be conducted from an hour before to an hour after sunrise. In less accessible areas, searches can be made from a mountain bike, trail motorcycle, 4-wheel all-terrain vehicle, horseback, or on foot. On a calm morning, breeding sage grouse may be heard at a distance of 1.5 km (about 1 mi). All openings or areas of less dense sagebrush should be searched for breeding birds with binoculars or a spotting scope.

Helicopters or fixed-wing airplanes can be used for aerial surveys. Suspected breeding habitat should be flown on north - south transects with lines about one km (.6 mi) apart. Aerial searches are biased toward finding larger leks; small leks (<15 birds) are more difficult to detect. Calm, clear mornings are a prerequisite to aerial searches. Winds over 15 mph and more than scattered cloud cover should be sufficient to cancel search flights. Cocks can be observed from the air at distances greater than one km (0.6 mi) in early morning sun, but cloud cover greatly reduces observability. Under conditions of marginal light, transect width should be narrowed. High winds not only make traveling a straight transect difficult, but also affect strutting behavior. Fewer cocks will strut continuously, and flushing distance appears to be greater under windy conditions.

Transects should be flown at about 100-150 meters (300-450 ft) above ground level. Whenever possible, two observers should be used in addition to the pilot so that one observer is always looking away from the sun regardless of the direction the aircraft is flying. Surveys should begin at the east edge of the survey area and work west to minimize the possibility of the plane flying over leks prior to them being observed. Special attention should be paid to old lakebeds, stock-watering areas, and other relatively open sites largely surrounded by sagebrush with 15 to 25% canopy cover. Lek searches from an aircraft should be conducted from ½ hour before to one hour after sunrise.

6. If a new lek is identified, the location should be accurately determined and recorded in UTMs using NAD83 datum. It is advisable to record/map the perimeters of new leks. Surveyor(s) should not disturb grouse to GPS lek locations. If a lek is active, the surveyor(s) should make the best estimate of the lek location and return later to confirm.

Lek Count Methodology:

1. Counts should be conducted during the month following the peak of mating activity, which is usually in early April in Wyoming (April 1 – May 7). Research has shown that the highest numbers of male sage grouse are observed during this period. The increased number of males is due to young males showing up later in the strutting season even though most of the breeding has already occurred.

2. Counts should be conducted from the ground. Counts from fixed-winged aircraft are not accurate enough to be used for monitoring population trends.

3. Counts should be made as close to sunrise as possible and may extend for one-half hour after sunrise. The phase of the moon may affect use patterns of leks. During a full moon, grouse may display at night and consequently terminate activities earlier in the morning.

4. Counts should be conducted a minimum of three (3) times each year for each lek (at least one count every 7-10 days.)

5. Optimum weather conditions for counts are clear, calm days. Wind speeds should be less than 20 mph due to the fact that high winds reduce lek activity. Temperature seems to have little effect on lek activity. Weather conditions should be recorded each time lek observations are made.
The location of each lek should be accurately determined and recorded in UTMs using NAD83 datum. Observer(s) should not disturb grouse to obtain lek locations. If a lek is active, the observer(s) should make the best estimate of the lek location and return later to confirm.

7. Data should be recorded on the standardized statewide reporting form with the following format:

						Location				GPS				
Date	Time	Observer	Males	Females	Unk	QQ	Sec	Twn	Rng	N	E	Grouse	Sign	Comments

<u>Annual status</u> - Each year a lek will be determined to be in one of the following status categories:

Active. Any lek that has been attended by male sage grouse during the strutting season. Presence can be documented by observation of birds using the site or by signs of strutting activity.

Inactive. Leks where it is known that there was no strutting activity through the course of a strutting season. A single visit, or even several visits, without strutting grouse being seen is not adequate documentation to designate a lek as inactive. This designation requires either an absence of birds on the lek during multiple ground visits under ideal conditions throughout the strutting season or a ground check of the exact lek site late in the strutting season that fails to find any sign (droppings/feathers) of strutting activity.

Unknown. Leks that have not been documented either active or inactive during the course of a strutting season.

Based on annual status a lek may be put into one of the following categories for management purposes:

Occupied Lek. A lek that has been active during at least one strutting season within the last ten years. Management protection will be afforded to occupied leks.

Unoccupied Lek. (Formerly termed "historical lek") There are two types of unoccupied leks, "destroyed" or "abandoned". Management protection will not be afforded to unoccupied leks.

> **Destroyed lek**: A formerly active lek site and surrounding sagebrush habitat that has been destroyed and no longer capable of supporting sage-grouse breeding activity. A lek site that has been strip mined, paved, converted to cropland or undergone other long-term habitat type conversion is considered destroyed. Destroyed leks do not require monitoring unless site is reclaimed to suitable sage-grouse habitat.
>
> **Abandoned lek**: A lek in otherwise suitable habitat that has not been active during a consecutive ten-year period. Before a lek is designated "abandoned" it must be confirmed as "inactive" (see above criteria) in at least four non-consecutive strutting seasons spanning the ten years. Once designated "abandoned", the site should be surveyed at least once every ten years to determine whether or not the lek has been reoccupied.

Undetermined lek. Any lek that has not been documented as being active in the last ten years but does not have sufficient documentation to be designated unoccupied. Management protection will be afforded to undetermined leks until their status has been documented as unoccupied.

Other Important Surveys:

The recommended surveys to document sage grouse use in sagebrush habitat where no breeding complexes are known, are 0.5 mile spaced transect surveys conducted by foot or vehicle (ATV). Sage grouse signs, such as droppings or feathers, should be noted.

Sage grouse brood rearing
- Document location of hens with chicks (number) during June 1 to July 30 using GPS equipment

Locating Sage-Grouse Winter Concentration Areas

Introduction

The following section is an excerpt from a draft (02/04/04) chapter of the WGFD's Wyoming Handbook of Biological Techniques concerning monitoring of sage-grouse.
Unlike breeding populations and production, there are no widely accepted methods for assessing winter populations. In part, this is because birds may be spread out over large areas during mild winters but concentrated in a relatively small proportion of the area in severe winters.

Methodology

Probable winter use areas can be searched, during periods of deep snow and cold temperatures from December 1 to February 30, by 4-wheel drive vehicle, snowmobile, or on foot to document sage-grouse winter habitat. Aerial surveys using either a fixed-wing aircraft or helicopter may also be effective in identifying sage-grouse winter habitats and can often be done in conjunction with surveys for other wildlife (e.g. elk trend counts/classifications). North-South transects flown about one minute of longitude apart are recommended. This transect width is not designed to allow complete coverage of an area for "census" purposes. Rather, it is designed to be able to cover significant acreage and determine relative distribution/habitat use patterns. Not every group of grouse will be seen.

Tracks/sign should be recorded along with observations of live birds. Under good conditions (sunlight and fresh, uncrusted snow cover) grouse tracks are quite easy to see at 300 feet or lower level. Tracks are usually seen in groups, the individual tracks tend to wander in a "snakelike" pattern rather than a straight line, and the bird's abdomens plow the snow.

Data collected should include at least approximate flock size and location. In addition, cover type (including sagebrush species present), topography, and snow depth data are also valuable but may not be possible to obtain from the aerial observations. The WGFD's Sage-Grouse Observation Form may be used in this effort. Data should be acquired over a series of years with different snow conditions to give a more complete picture of winter grouse distribution.

ATTACHMENT B

Determining Greater Sage-Grouse Age and Sex from the Northern Prairie Wildlife Research Center (NPWRC) Identification Guide

DETERMINING AGE

For all species except pheasant, the key to age is hidden in the wing, specifically the outer three large feathers, called primaries (Figure 1). For identification purposes, these feathers are numbered. The outermost primary is number 10, the next one in is nine, the third one is eight, and so on. Each species has 10 primary feathers.

Figure 1. For all our upland game species except pheasants, the key to determining whether the bird is an adult or young-of-the-year is the appearance of the outer three primary wing feathers. The outermost large wing feather is numbered 10. The next one in is number nine, the next one is eight, and so on. While this is a sharptail wing, the numbers of the feathers are the same for all species.

A good general rule for determining age is to look at the underside of the number nine and 10 primaries. Pull back some of the small cover feathers so you can see the "quill" part of the primary feather (Figure 2). If the quill part is blue and soft, that indicates the feather is still growing.

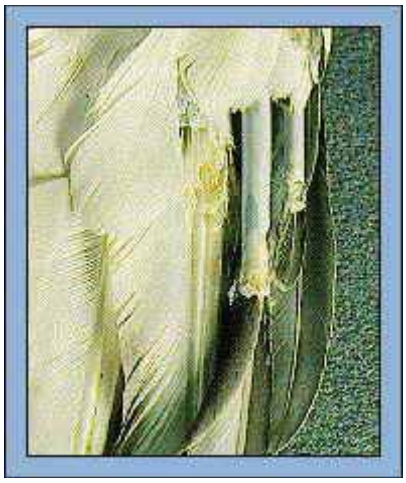


Figure 2. This photo shows the underside of a sage grouse wing. You can judge this bird as an adult, because the ninth and 10th primaries are still growing, as evidenced by the bluish "quill" section. If the eighth or seventh primaries look like the feathers in this photo, and the ninth and 10th primaries are not growing, the bird is a juvenile.

Later in the season, when all feathers are completely grown, the "quill" part of the outer primaries will be white and hard. When this occurs, gauging the appearance of the outer three primaries will tell you if the bird is a juvenile or adult (Figure 3). Then you have to look at the wear and contour between eight and nine and 10.

Figure 3. This photo shows the outer three primaries of an adult sage grouse. Note the rounded tips and smooth edges.

To check the wear of the outer primaries, look at the top-side of the wing. If the ends of the outer two feathers are somewhat rounded and smooth, then the bird is likely an adult. If the ends are more pointed and frayed, the bird is likely a juvenile (**Figure** 4).

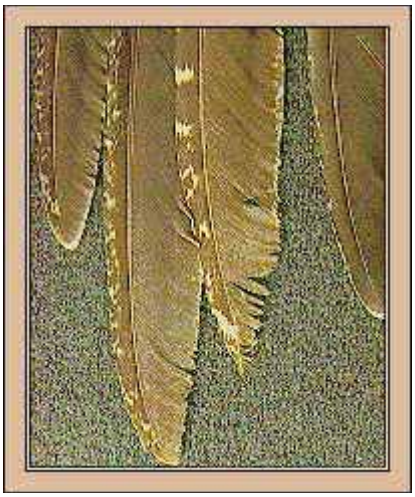


Figure 4. The outer three primaries shown here are attached to the wing of a juvenile sage grouse. Note the pointedness and frayed edges on the eighth and ninth primaries. Also note the specks and more mottled coloring of the juvenile wing, compared to the adult.

DETERMINING SEX

If you put an adult hen and an adult male sage grouse side-by-side, the male is the bigger one. However, size comparison is not often available, so you need to look at feathers to determine sex. The key feathers for determining sex of sage grouse are found under the tail (Figure 5). These feathers are black with white tips, but the female feathers differ from those of the male.

Figure 5. The feathers that can tell you whether a sage grouse is a male or female are found underneath the tail. The white rachis or spine on the black feathers with white tips indicates this bird is a female.

The photo below shows feathers from the underside of the tail of male and female sage grouse (Figure 6). The male feather is all black, with a solid white tip. The rachis or spine of the female feather is white. In addition, the female feather also has white or buff-colored specks in the black area.

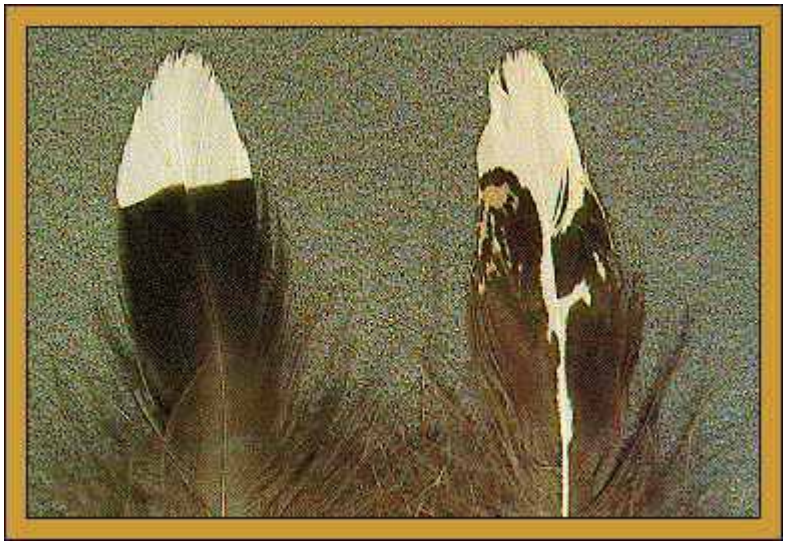


Figure 6. A close-up of feathers taken from the underside of male and female sage grouse tails.