**Eastern Shoshone Tribe and Northern Arapahoe on the Wind River Indian Reservation**

**Renewable Energy Development on Tribal Lands**
**DE-PS36-04GO94003**

**Objectives and Implementation:** The Tribes, through its consultant and advisor, Distributed Generation Systems (Disgen) -Native American Program and Resources Division, of Lakewood CO, assessed and qualified, from a resource and economic perspective, a wind energy generation facility on tribal lands.

The goal of this feasibility project is to provide wind monitoring and to engage in pre-project planning activities designed to provide a preliminary evaluation of the technical, economic, social and environmental feasibility of developing a sustainable, integrated wind energy plan for the Eastern Shoshone and the Northern Arapahoe Tribes, who resides on the Wind River Indian Reservation.

The specific deliverables of the feasibility study are:

1) Assessments of the wind resources on the Wind River Indian Reservation
2) Assessments of the potential environmental impacts of renewable development
3) Assessments of the transmission capacity and capability of a renewable energy project
4) Established an economic models for tribal considerations
5) Define economic, cultural and societal impacts on the Tribe

## Wind Resource Assessment:

The resource assessment for wind energy included a meteorological study utilizing two fifty meter (50 m) meteorological towers for over twelve months in two locations, Sheldon Dome and Bighorn Flat. These areas are located on Tribal Trust Lands. The report for the Sheldon Dome project area is attached in **Appendix 1 Wind Resource Assessment Report**. The data collections for the Big Horn Flats are also attached. There were data collection problem for the Big Horn Flats met tower. The logger failed due to some environmental problems so the data collection was only for 8 months. The average annual wind speed was determined to be 15.8 mph at 50 meters for the project areas. The capacity factors were calculated to be 29% to 32% for various turbines.

## Environmental Impacts:

Disgen utilized Western Ecosystems Technologies, Inc. of Larimer Wyoming to conduct a Preliminary Avian Assessment on the proposed site. WEST, Inc. are leading experts in the area of avian interaction with wind turbines. The report is attached in **Appendix 2**. No potential mitigating issues were identified that would stifle a wind energy project.

## Transmission Capacity:

Disgen utilized the Excel Engineering of Minneapolis, MN to determine the transmission capacity for the three difference transmission system that crosses Wind River Indian Reservation, Tri-State G&T, Pacific Corp and Western Area Power Administration. The report is in **Appendix 3**.

## Economic Models:

Disgen has provided an economic model for tribal consideration. The financial model shows the capital budget for construction of a 23 MW wind energy center at the Sheldon Dome site, operation and maintenance annual costs, and taxation. The financial model and possible financing option is include in **Appendix 4**.

## Economic, Cultural and Societal Impacts:

The Tribes Tribal Historic Preservation Offices have conducted a cultural assessment review of the project and have chosen not to report those results at this time.

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# Appendix 1

**Summary Report**
**Wind Resource and Theoretical Energy Output Projections at the**
**Wind River Indian Reservation**

## Summary

A 50-meter NRG Systems Talltower is installed in February 2007 on the Wind River Indian Reservation in Wyoming and over a full year of meteorological measurements of wind speed at three levels, wind direction at two levels and temperature are collected. The 50.0-meter average wind speed for the entire period from February 2007 until July 2008 is 15.9 miles per hour (mph) or 7.1 meters per second (mps).

## Location

A wind data collection program is initiated on the Wind River Indian Reservation in February of 2007. The Wind River Indian Reservation is located in Fremont County as shown in Figure 1. The wind map for the State of Wyoming is presented in Figure 2. The wind power classification for the Wind River Indian Reservation ranges from less than Class 3 (Fair) in the southeastern portion to Class 6 (Excellent) and Class 7 (Outstanding) in the higher terrain in the far western portion.

## Meteorological Data Collection Program

A 50-meter NRG Systems Talltower is installed in February 2007. The location of the meteorological tower is shown in Figure 3. Two Maximum #40 wind speed sensors are installed at 49.5-meters above ground level (agl) designated as South and West; two Maximum #40 wind speed sensors are installed at 40-meters agl, also designated as South and West; one Maximum #40 wind speed sensor is installed at 30-m agl; one #200P wind direction sensor is installed at 48.5-meters and one #200P wind direction sensor is installed at 37-m agl; and a #110S temperature sensor is installed at 7 feet (2 meters) agl. The sensors are connected to a NRG Symphonie Data Logger which collects the data at 1-second intervals and creates 10-minute averages of each parameter. The tower installation form is presented in Table 1.

## Data Analysis

Meteorological data for the Wind River Indian Reservation Site are obtained routinely via pulling the MMC card from the NRG Symphonie logger, reading the card, and e-mailing the data files. Once received, the data are error-checked and loaded into the data archive. The period of record is February 17, 2007 to July 17, 2008.

## Wind Speed Characteristics

The mean wind speed at the 30-meter level for the entire period of record is 15.2 mph; the mean wind speed for the 40-meter level for the entire period of record is 15.5 mph and 15.4 mph, respectively, for the south and west booms; the mean wind speed for the 50m-level for the entire period of record is 15.8 mph and 15.9 mph, respectively for the south and west booms. The monthly average wind speeds at the 50-meter level for February 2007 to July 2008 are presented in Figure 4 and show a winter maximum and a summer minimum. The diurnal wind speed pattern is presented in Figure 5 which shows a slight increase in daytime wind speeds and a minimum in the early morning and early evening.

The data are summarized in the form of mean hourly values and are presented in Tables 2 through 6. These tables include the monthly average values for wind speed, as well as the data recovery for each month and the entire period of record.

## Wind Shear

Wind shear is the change or increase in wind speed above ground level. The simple wind power law is expressed as:

$$U_2 = U1\,(Z_2/Z_1)^{\text{alpha}}$$

Where $U_2$ and $U_1$ are the wind speeds at the upper and lower levels, $Z_2$ and $Z_1$ are the upper and lower elevations, and alpha is the wind speed power law exponent. The typical value for the wind speed power law exponent is 0.14 (1/7 power law). Depending on terrain and surface roughness, the value may vary between zero and greater than 0.35.

The data collected at the 30-meter level and the 50-meter level are used to determine the wind shear at the tower. Pairs of data are matched for these two parameters when the wind speed at the lower level is greater than or equal to 10 mph (3.5 mps) and the wind direction is between 200 degrees and 350 degrees. This condition eliminates overstating the wind shear when the wind speed at the lowest level of the tower is calm and attempts to avoid any potential tower shadow affects. The calculated wind speed ratio between the two levels is 1.05 which results in a determined power law coefficient or alpha value of 0.10.

## Wind Rose

A wind rose for the site is presented in Figure 6. This wind rose is based on the wind speed and wind direction data collected at the 50-meter level of the tower. The wind rose indicates a predominant west-northwest wind direction.

## Turbulence Intensity

The turbulence intensity (TI) for the site, as calculated from the wind speed data collected at 50-meters above ground level, is presented in Table 7. The TI data indicate the turbulence at this site approaches 10.8% at the critical wind speed bin of 15 mps.

## Peak Wind Speed – Hub Height

The fastest mile wind speed for the site (50-year return period) at 10-meters agl is estimated from Thom as 90 miles per hour (mph). This fastest mile value is used to estimate the peak gust of 109.8 mph at 10-meters agl. Assuming a power law exponent for gusts of 0.11, the predicted peak gust (50-yr return period) at the 80-meter hub height is 138 mph or 61.6 mps.

**Figure 1 - The Wind River Indian Reservation is located in Fremont County in north-central Wyoming**

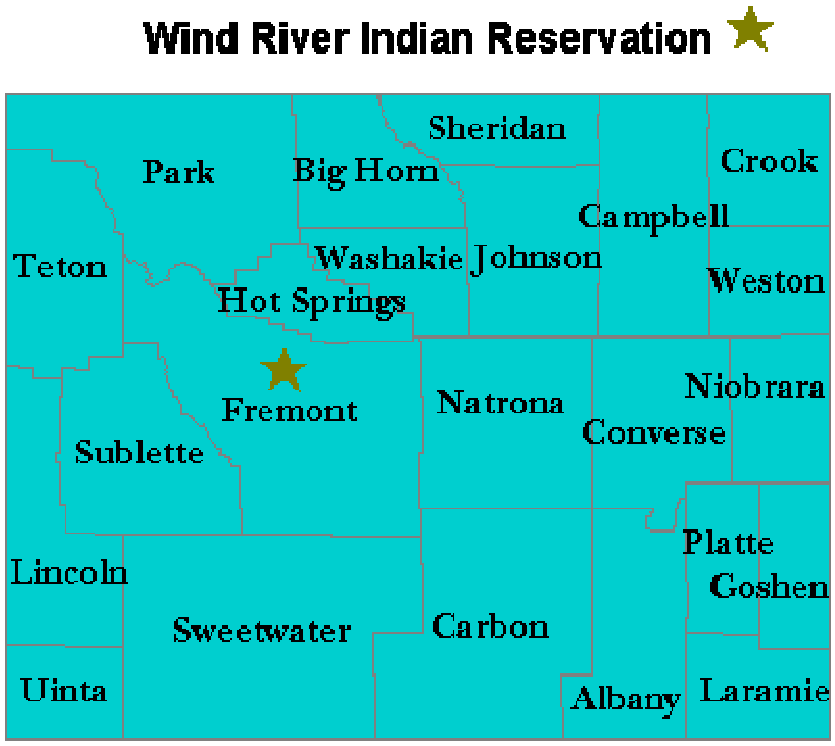


**Figure 2 – Wyoming Wind Map**

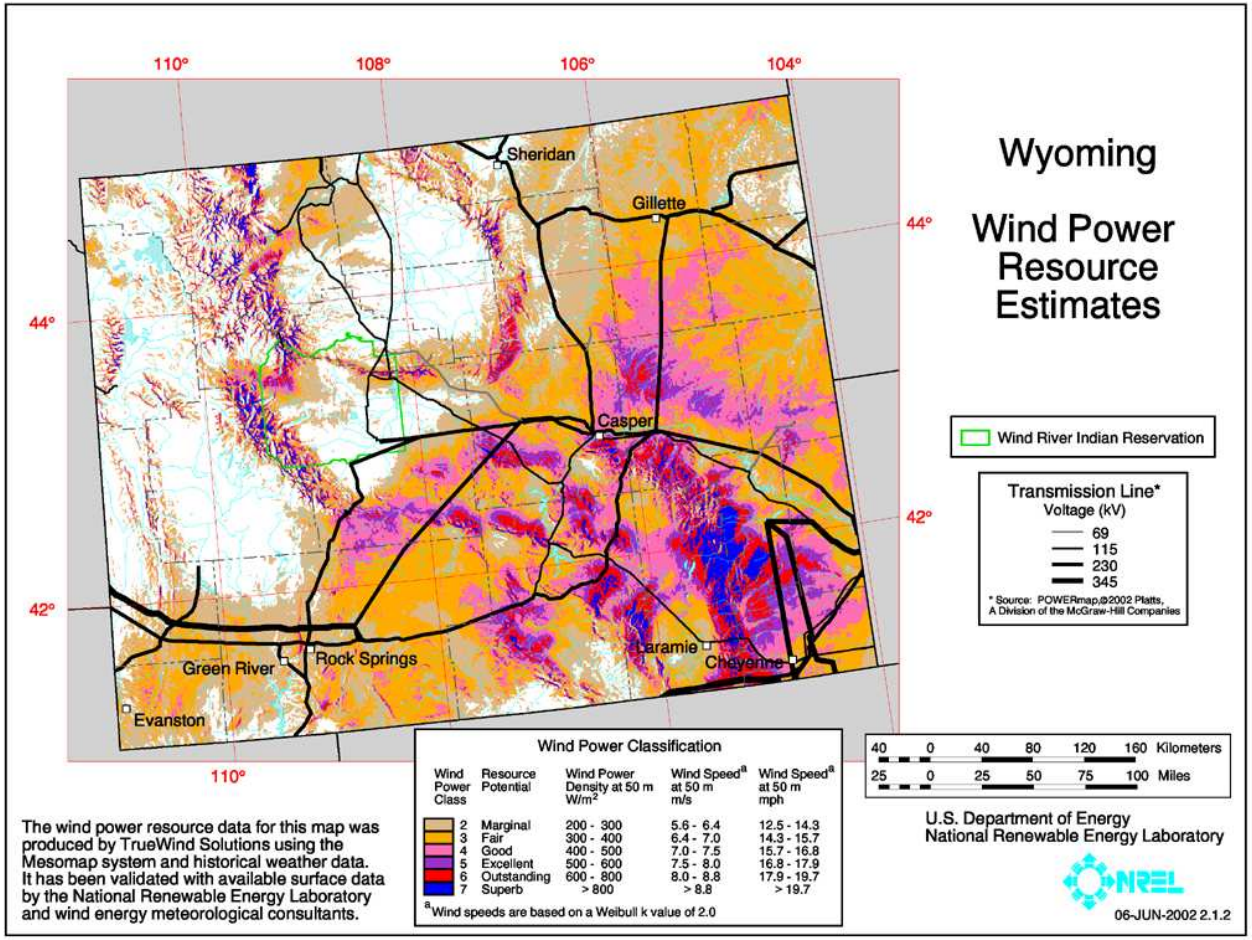


**Figure 3 – Location of the Meteorological Tower at the Wind River Site**

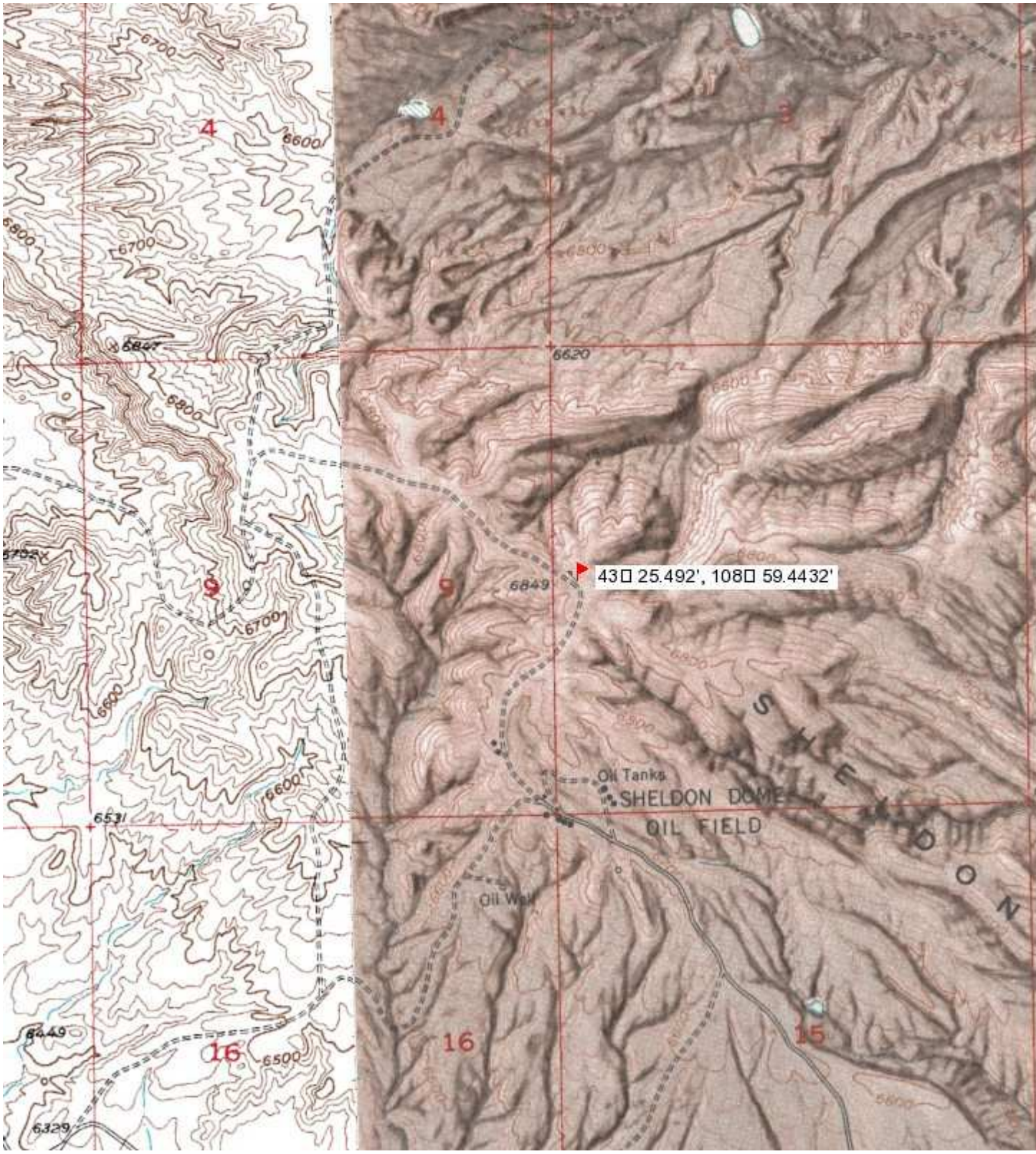


**Table 1**

## Wind Resource Assessment
## Site Information Form

| | | | |
|---|---|---|---|
| **Site Name** | **Sheldon Dome** | **Installation Date** | **2/17/07** |
| **Site Number** | **1376** | **Removal Date** | |
| **State** | **Wyoming** | **Tower Height** | **50-Meters** |
| **Latitude** | **N 43 Deg 25.492'** | **Quad Map** | |
| **Longitude** | **W 108 Deg 59.443'** | **Sec/Town/Range** | |
| **Elevation** | **6,880'** | **Datum** | **WGS84** |
| **UTM** | | | |

| Data Logger & Sensors | Height (agl) | Serial # | Slope | Offset | Terminal Location | Comment |
|---|---|---|---|---|---|---|
| NRG Symphonie | | 1376 | | | | |
| | | | | | | |
| Max 40 | 49.5m | | 1.711 | 0.8 | 1 | South |
| Max 40 | 49.5m | | 1.711 | 0.8 | 2 | west |
| Max 40 | 40m | | 1.711 | 0.8 | 3 | South |
| Max 40 | 40m | | 1.711 | 0.8 | 4 | West |
| Max 40 | 30m | | 1.711 | 0.8 | 5 | South |
| | | | | | | |
| 200P | 48.5m | | | | 7 | South |
| 200P | 37m | | | | 8 | South |
| | | | | | | |
| Temp | 7m | | | | | |
| | | | | | | |

| | | | |
|---|---|---|---|
| **Phone Make/Model** | | **ISP** | |
| **Phone Number** | | **E-Mail Address** | |
| **ESN#** | | **E-Mail Address** | |
| **Serial Number** | | | |
| **Cell Company** | | | |
| **Activation Date** | | | |

| | | | |
|---|---|---|---|
| **Land Owner** | | **Site Rep** | |
| **Address** | | **Address** | |
| **Phone #** | | **Phone #** | |
| **E-Mail** | | **E-Mail** | |

| |
|---|
| **Five anemometers – two at 49.5m; two at 40m; one at 30m; booms point as indicated in comments Above. Wind directions point south ; oriented to true north.** |
| |
| |
| |
| |
| |

**Figure 4- Monthly Average Wind Speed at the 50M Level for February 2007 to July 2008**

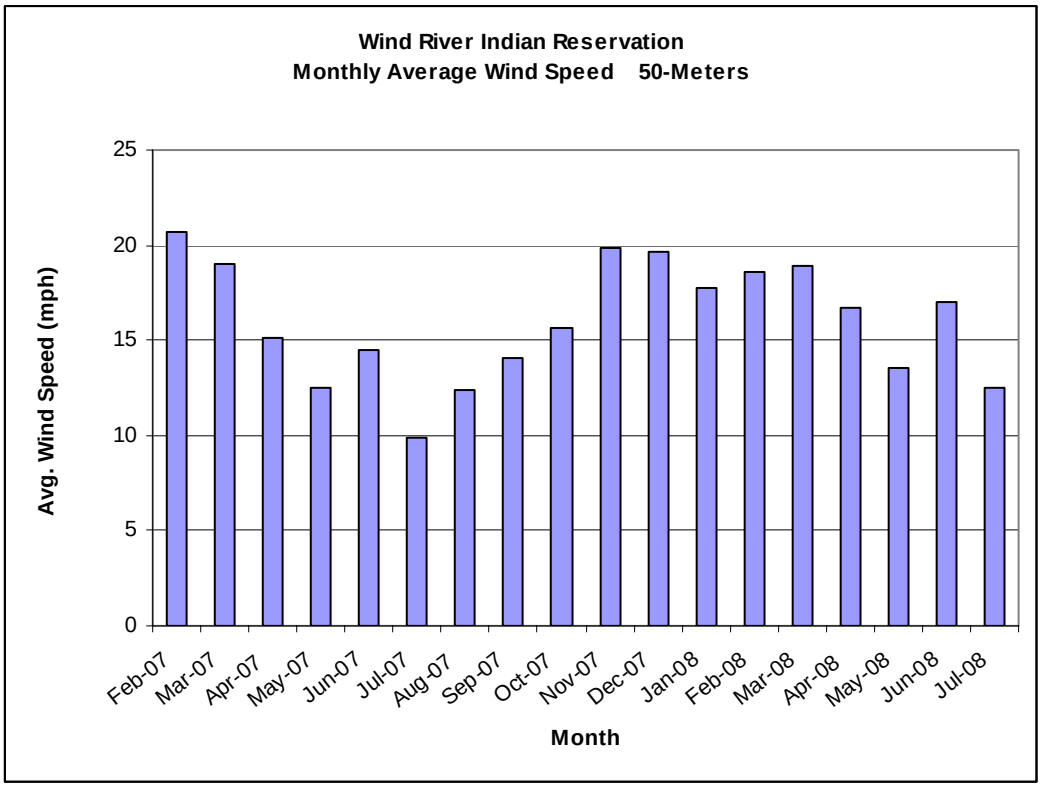



**Figure 5 - Diurnal Wind Speed Pattern**

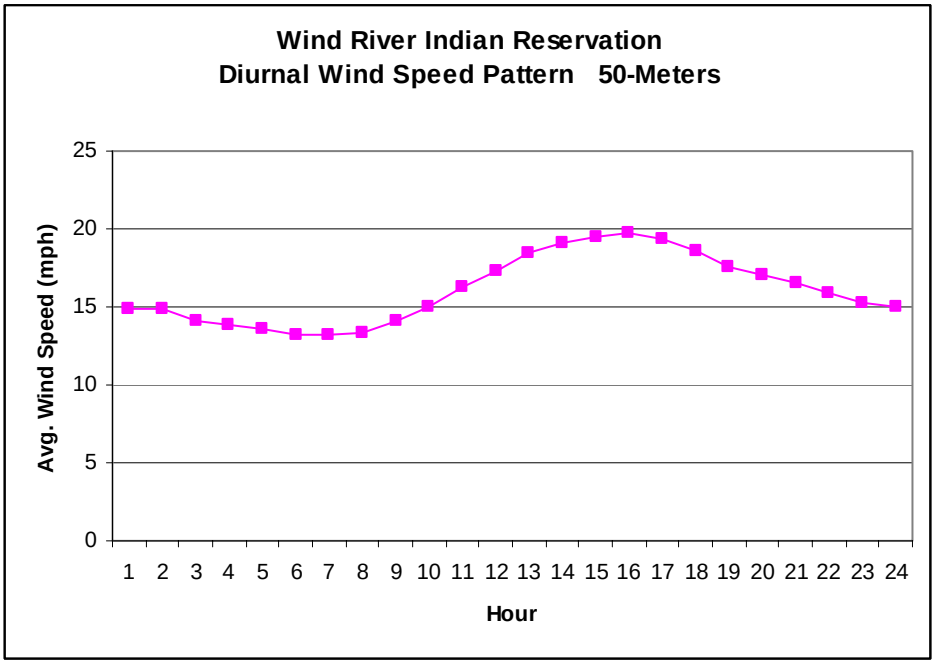


**Table 2– Mean Hourly Wind Speeds (mph) at 30M agl**

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
SHELDON DOME - 30M WIND SPEED (S) (MPH)

02/01/07 - 07/31/08

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 16.3 | 17.5 | 15.9 | 13.7 | 10.8 | 12.1 | 8.0 | 9.6 | 11.8 | 14.3 | 20.8 | 18.7 | 13.7 |
| 02 | 16.2 | 17.5 | 16.0 | 13.9 | 10.2 | 11.6 | 8.4 | 9.9 | 11.5 | 13.7 | 20.3 | 20.5 | 13.7 |
| 03 | 16.7 | 17.3 | 16.0 | 12.3 | 9.5 | 10.4 | 7.5 | 8.9 | 11.5 | 14.5 | 19.0 | 19.7 | 13.1 |
| 04 | 17.2 | 16.8 | 16.0 | 13.3 | 8.7 | 10.2 | 6.7 | 8.3 | 10.9 | 14.8 | 19.2 | 19.7 | 13.0 |
| 05 | 16.1 | 15.8 | 14.9 | 12.8 | 8.9 | 9.9 | 6.9 | 8.6 | 10.6 | 15.2 | 18.2 | 20.3 | 12.7 |
| 06 | 15.0 | 15.4 | 15.0 | 11.8 | 9.4 | 9.4 | 6.5 | 8.0 | 10.0 | 15.0 | 18.0 | 19.5 | 12.3 |
| 07 | 15.5 | 15.1 | 16.4 | 11.5 | 9.8 | 12.0 | 6.5 | 7.9 | 10.5 | 13.9 | 16.1 | 17.3 | 12.5 |
| 08 | 16.1 | 15.1 | 16.4 | 12.6 | 10.5 | 13.0 | 7.1 | 8.9 | 10.9 | 12.8 | 15.9 | 15.1 | 12.8 |
| 09 | 16.2 | 16.0 | 18.0 | 13.8 | 11.7 | 13.7 | 8.3 | 9.7 | 11.7 | 13.0 | 15.0 | 14.6 | 13.6 |
| 10 | 17.5 | 16.4 | 19.1 | 14.3 | 12.8 | 14.8 | 9.3 | 11.5 | 12.6 | 13.8 | 16.7 | 15.7 | 14.6 |
| 11 | 19.0 | 17.5 | 20.0 | 15.4 | 13.1 | 16.5 | 10.7 | 14.1 | 14.0 | 14.1 | 18.0 | 17.4 | 15.8 |
| 12 | 20.1 | 18.7 | 20.9 | 17.3 | 14.8 | 17.3 | 11.6 | 14.3 | 14.6 | 15.0 | 18.8 | 17.8 | 16.8 |
| 13 | 19.4 | 20.5 | 21.7 | 18.8 | 16.1 | 19.0 | 13.6 | 14.9 | 15.8 | 16.3 | 19.4 | 18.4 | 18.0 |
| 14 | 19.1 | 21.8 | 21.9 | 19.8 | 15.6 | 19.4 | 13.9 | 16.8 | 16.4 | 16.9 | 21.2 | 20.0 | 18.6 |
| 15 | 18.3 | 22.7 | 22.1 | 19.9 | 16.2 | 20.7 | 14.6 | 16.2 | 17.4 | 17.5 | 21.0 | 19.5 | 19.0 |
| 16 | 17.3 | 22.4 | 22.9 | 20.3 | 17.5 | 20.8 | 14.7 | 16.6 | 18.6 | 16.8 | 19.5 | 19.1 | 19.2 |
| 17 | 17.1 | 20.4 | 21.9 | 20.1 | 17.1 | 20.8 | 13.9 | 16.9 | 17.9 | 15.7 | 19.1 | 18.4 | 18.6 |
| 18 | 14.9 | 20.2 | 19.5 | 18.6 | 16.6 | 20.0 | 14.1 | 16.0 | 15.1 | 15.0 | 19.1 | 18.9 | 17.6 |
| 19 | 15.2 | 19.6 | 17.6 | 16.9 | 14.4 | 18.2 | 14.4 | 14.0 | 14.4 | 14.4 | 18.7 | 18.7 | 16.5 |
| 20 | 15.6 | 19.8 | 17.7 | 15.4 | 12.6 | 16.6 | 13.5 | 13.2 | 14.3 | 14.8 | 19.7 | 17.7 | 15.8 |
| 21 | 16.1 | 18.7 | 16.9 | 14.7 | 12.8 | 14.4 | 12.1 | 12.8 | 14.2 | 14.4 | 21.1 | 19.5 | 15.4 |
| 22 | 15.6 | 17.9 | 17.0 | 14.8 | 11.1 | 13.8 | 10.2 | 11.3 | 13.5 | 15.3 | 20.0 | 21.1 | 14.8 |
| 23 | 15.9 | 18.0 | 16.0 | 13.7 | 10.4 | 14.1 | 9.3 | 10.6 | 12.9 | 15.6 | 19.6 | 20.4 | 14.3 |
| 24 | 16.3 | 17.6 | 15.2 | 13.2 | 10.4 | 13.2 | 8.6 | 9.9 | 12.7 | 15.1 | 19.5 | 19.6 | 13.9 |
| Mean | 16.8 | 18.3 | 18.1 | 15.4 | 12.5 | 15.1 | 10.4 | 12.0 | 13.5 | 14.9 | 18.9 | 18.6 | 15.2 |
| Good Hours | 720 | 972 | 1488 | 1387 | 1488 | 1440 | 1141 | 744 | 720 | 744 | 720 | 744 | |
| Missing Hours | 24 | 396 | 0 | 53 | 0 | 0 | 347 | 0 | 0 | 0 | 0 | 0 | |

12,308 Hours of Good Data  820 Hours Missing  93.8% Data Recovery

**Table 3 – Mean Hourly Wind Speed (mph) at 40M agl**

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
SHELDON DOME - 40M WIND SPEED (S) (MPH)

02/01/07 - 07/31/08

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 16.8 | 18.0 | 16.3 | 14.2 | 11.0 | 12.6 | 8.1 | 9.8 | 12.3 | 14.8 | 21.3 | 19.1 | 14.1 |
| 02 | 16.7 | 18.1 | 16.5 | 14.3 | 10.4 | 12.1 | 8.6 | 10.0 | 11.9 | 14.2 | 21.0 | 20.9 | 14.1 |
| 03 | 17.2 | 17.9 | 16.4 | 12.6 | 9.7 | 10.7 | 7.5 | 8.9 | 11.9 | 15.0 | 19.6 | 20.1 | 13.4 |
| 04 | 17.6 | 17.2 | 16.4 | 13.7 | 8.8 | 10.5 | 6.6 | 8.4 | 11.3 | 15.4 | 19.8 | 20.1 | 13.3 |
| 05 | 16.6 | 16.2 | 15.4 | 13.1 | 9.1 | 10.0 | 6.9 | 8.8 | 11.0 | 15.8 | 18.8 | 20.8 | 13.0 |
| 06 | 15.3 | 15.8 | 15.4 | 12.0 | 9.5 | 9.5 | 6.4 | 8.0 | 10.2 | 15.6 | 18.6 | 20.0 | 12.5 |
| 07 | 15.8 | 15.4 | 16.6 | 11.5 | 9.8 | 12.0 | 6.3 | 7.8 | 10.8 | 14.4 | 16.7 | 17.4 | 12.6 |
| 08 | 16.5 | 15.5 | 16.5 | 12.5 | 10.3 | 13.0 | 6.8 | 8.7 | 11.0 | 13.1 | 16.3 | 15.2 | 12.8 |
| 09 | 16.5 | 16.2 | 18.1 | 13.8 | 11.6 | 13.7 | 8.1 | 9.6 | 11.7 | 13.2 | 15.2 | 14.8 | 13.6 |
| 10 | 17.7 | 16.4 | 19.1 | 14.3 | 12.8 | 14.9 | 9.2 | 11.4 | 12.7 | 14.2 | 16.8 | 15.9 | 14.6 |
| 11 | 19.0 | 17.5 | 20.0 | 15.5 | 13.1 | 16.6 | 10.7 | 14.2 | 14.1 | 14.2 | 18.1 | 17.5 | 15.8 |
| 12 | 20.1 | 18.8 | 21.0 | 17.4 | 14.8 | 17.5 | 11.6 | 14.3 | 14.7 | 15.2 | 19.0 | 17.9 | 16.9 |
| 13 | 19.4 | 20.9 | 21.8 | 18.8 | 16.2 | 19.2 | 13.7 | 14.9 | 15.9 | 16.5 | 19.7 | 18.5 | 18.1 |
| 14 | 19.1 | 21.9 | 22.0 | 19.8 | 15.7 | 19.5 | 14.0 | 16.9 | 16.5 | 17.1 | 21.5 | 20.1 | 18.7 |
| 15 | 18.4 | 23.0 | 22.3 | 19.9 | 16.3 | 21.0 | 14.7 | 16.3 | 17.5 | 17.7 | 21.3 | 19.8 | 19.2 |
| 16 | 17.6 | 22.8 | 23.1 | 20.5 | 17.6 | 21.0 | 14.9 | 16.7 | 18.8 | 17.1 | 20.0 | 19.5 | 19.4 |
| 17 | 17.4 | 20.8 | 22.3 | 20.3 | 17.2 | 21.1 | 14.1 | 17.1 | 18.2 | 16.2 | 19.7 | 18.7 | 18.9 |
| 18 | 15.3 | 20.7 | 20.0 | 18.9 | 16.9 | 20.3 | 14.4 | 16.4 | 15.5 | 15.5 | 19.7 | 19.3 | 18.0 |
| 19 | 15.6 | 20.2 | 18.1 | 17.4 | 14.9 | 18.8 | 14.8 | 14.5 | 15.0 | 14.9 | 19.2 | 19.2 | 17.0 |
| 20 | 15.9 | 20.5 | 18.2 | 15.9 | 13.0 | 17.4 | 14.0 | 13.7 | 15.0 | 15.3 | 20.3 | 18.1 | 16.4 |
| 21 | 16.5 | 19.3 | 17.5 | 15.1 | 13.3 | 15.1 | 12.5 | 13.2 | 14.7 | 14.9 | 21.9 | 20.0 | 15.9 |
| 22 | 15.9 | 18.4 | 17.5 | 15.2 | 11.4 | 14.4 | 10.5 | 11.7 | 14.0 | 15.8 | 20.8 | 21.7 | 15.3 |
| 23 | 16.3 | 18.5 | 16.4 | 14.1 | 10.6 | 14.7 | 9.5 | 10.9 | 13.4 | 16.0 | 20.3 | 20.9 | 14.7 |
| 24 | 16.9 | 18.1 | 15.6 | 13.6 | 10.7 | 13.7 | 8.8 | 10.2 | 13.1 | 15.5 | 20.0 | 20.1 | 14.2 |
| Mean | 17.1 | 18.7 | 18.4 | 15.6 | 12.7 | 15.4 | 10.5 | 12.2 | 13.8 | 15.3 | 19.4 | 19.0 | 15.5 |

| Good Hours | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 720 | 972 | 1488 | 1387 | 1488 | 1440 | 1141 | 744 | 720 | 744 | 720 | 744 | |

| Missing Hours | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 | 396 | 0 | 53 | 0 | 0 | 347 | 0 | 0 | 0 | 0 | 0 | |

12,308 Hours of Good Data  820 Hours Missing  93.8% Data Recovery

**Table 4 – Mean Hourly Wind Speed (mph) at 40M agl**

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
SHELDON DOME - 40M WIND SPEED (W) (MPH)

02/01/07 - 07/31/08

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 16.7 | 18.0 | 16.2 | 14.0 | 11.2 | 12.5 | 8.0 | 9.6 | 12.2 | 14.8 | 21.2 | 19.0 | 14.1 |
| 02 | 16.5 | 18.0 | 16.4 | 14.1 | 10.5 | 12.1 | 8.5 | 9.8 | 11.8 | 14.3 | 20.9 | 20.8 | 14.0 |
| 03 | 17.0 | 17.8 | 16.4 | 12.5 | 9.7 | 10.7 | 7.4 | 8.8 | 11.7 | 15.0 | 19.6 | 19.9 | 13.4 |
| 04 | 17.3 | 17.2 | 16.3 | 13.5 | 8.8 | 10.5 | 6.4 | 8.2 | 11.1 | 15.5 | 19.7 | 20.1 | 13.2 |
| 05 | 16.4 | 16.2 | 15.4 | 13.0 | 9.2 | 10.0 | 6.8 | 8.6 | 10.8 | 15.8 | 18.8 | 20.6 | 12.9 |
| 06 | 15.2 | 15.8 | 15.3 | 11.9 | 9.7 | 9.5 | 6.3 | 7.8 | 10.1 | 15.7 | 18.6 | 19.9 | 12.5 |
| 07 | 15.6 | 15.4 | 16.6 | 11.3 | 9.9 | 11.9 | 6.0 | 7.5 | 10.6 | 14.4 | 16.7 | 17.4 | 12.5 |
| 08 | 16.2 | 15.3 | 16.4 | 12.2 | 10.4 | 12.8 | 6.5 | 8.4 | 10.7 | 13.1 | 16.3 | 15.1 | 12.7 |
| 09 | 16.2 | 16.0 | 17.9 | 13.6 | 11.7 | 13.6 | 7.8 | 9.3 | 11.4 | 13.2 | 15.2 | 14.8 | 13.4 |
| 10 | 17.5 | 16.2 | 18.9 | 14.1 | 12.9 | 14.8 | 8.9 | 11.2 | 12.5 | 14.2 | 16.6 | 15.8 | 14.5 |
| 11 | 18.7 | 17.2 | 19.8 | 15.2 | 13.1 | 16.5 | 10.4 | 14.0 | 13.9 | 14.2 | 17.9 | 17.4 | 15.7 |
| 12 | 19.8 | 18.5 | 20.7 | 17.1 | 14.8 | 17.4 | 11.3 | 14.2 | 14.5 | 15.1 | 18.8 | 17.8 | 16.7 |
| 13 | 19.1 | 20.6 | 21.6 | 18.6 | 16.2 | 19.0 | 13.4 | 14.7 | 15.7 | 16.3 | 19.5 | 18.3 | 17.9 |
| 14 | 18.8 | 21.6 | 21.8 | 19.5 | 15.7 | 19.4 | 13.7 | 16.7 | 16.3 | 17.0 | 21.3 | 19.9 | 18.5 |
| 15 | 18.2 | 22.6 | 22.1 | 19.7 | 16.3 | 20.7 | 14.4 | 16.1 | 17.3 | 17.7 | 21.1 | 19.7 | 19.0 |
| 16 | 17.4 | 22.5 | 22.8 | 20.2 | 17.7 | 20.8 | 14.6 | 16.5 | 18.6 | 17.1 | 19.9 | 19.3 | 19.2 |
| 17 | 17.2 | 20.6 | 22.0 | 20.2 | 17.2 | 20.9 | 13.8 | 16.8 | 18.0 | 16.2 | 19.6 | 18.6 | 18.7 |
| 18 | 15.3 | 20.4 | 19.9 | 18.8 | 16.9 | 20.2 | 14.1 | 16.1 | 15.3 | 15.6 | 19.6 | 19.2 | 17.9 |
| 19 | 15.5 | 20.0 | 18.0 | 17.3 | 14.9 | 18.7 | 14.7 | 14.3 | 14.9 | 15.0 | 19.1 | 19.2 | 16.9 |
| 20 | 15.8 | 20.3 | 18.1 | 15.7 | 13.1 | 17.3 | 13.9 | 13.6 | 14.9 | 15.5 | 20.2 | 18.0 | 16.3 |
| 21 | 16.3 | 19.1 | 17.4 | 15.1 | 13.4 | 15.0 | 12.5 | 13.0 | 14.6 | 15.0 | 21.7 | 19.9 | 15.8 |
| 22 | 15.8 | 18.3 | 17.3 | 15.1 | 11.6 | 14.3 | 10.4 | 11.5 | 14.0 | 16.0 | 20.6 | 21.5 | 15.2 |
| 23 | 16.1 | 18.4 | 16.3 | 14.0 | 10.8 | 14.6 | 9.4 | 10.7 | 13.4 | 16.1 | 20.1 | 20.7 | 14.7 |
| 24 | 16.7 | 18.1 | 15.5 | 13.5 | 10.8 | 13.6 | 8.6 | 10.0 | 13.0 | 15.6 | 19.8 | 19.9 | 14.2 |
| Mean | 16.9 | 18.5 | 18.3 | 15.4 | 12.8 | 15.3 | 10.3 | 12.0 | 13.6 | 15.4 | 19.3 | 18.9 | 15.4 |
| Good Hours | 720 | 972 | 1488 | 1387 | 1488 | 1440 | 1141 | 744 | 720 | 744 | 720 | 744 | |
| Missing Hours | 24 | 396 | 0 | 53 | 0 | 0 | 347 | 0 | 0 | 0 | 0 | 0 | |

12,308 Hours of Good Data  820 Hours Missing  93.8% Data Recovery

**Table 5 – Mean Hourly Wind Speed (mph) at 49.5M agl**

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
SHELDON DOME - 49.5M WIND SPEED (S) (MPH)

02/01/07 - 07/31/08

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 17.2 | 18.7 | 16.9 | 14.5 | 11.3 | 12.9 | 8.4 | 10.2 | 12.6 | 15.3 | 21.7 | 19.6 | 14.5 |
| 02 | 17.1 | 18.8 | 17.0 | 14.6 | 10.7 | 12.3 | 8.8 | 10.2 | 12.1 | 14.9 | 21.5 | 21.6 | 14.5 |
| 03 | 17.6 | 18.6 | 17.1 | 12.9 | 10.0 | 11.1 | 7.8 | 9.1 | 12.0 | 15.6 | 20.1 | 20.7 | 13.9 |
| 04 | 17.8 | 17.9 | 17.0 | 14.0 | 9.1 | 10.8 | 6.8 | 8.7 | 11.4 | 16.3 | 20.3 | 20.7 | 13.7 |
| 05 | 16.9 | 16.7 | 16.1 | 13.5 | 9.4 | 10.2 | 7.1 | 9.1 | 11.2 | 16.5 | 19.4 | 21.3 | 13.4 |
| 06 | 15.6 | 16.4 | 16.1 | 12.3 | 9.8 | 9.7 | 6.7 | 8.3 | 10.4 | 16.3 | 19.3 | 20.4 | 12.9 |
| 07 | 15.8 | 15.9 | 17.2 | 11.6 | 10.0 | 12.0 | 6.4 | 7.9 | 10.9 | 15.0 | 17.2 | 17.8 | 12.9 |
| 08 | 16.7 | 15.9 | 17.0 | 12.5 | 10.5 | 12.9 | 6.8 | 8.7 | 11.0 | 13.7 | 16.8 | 15.6 | 13.0 |
| 09 | 16.7 | 16.5 | 18.4 | 13.9 | 11.7 | 13.7 | 8.1 | 9.6 | 11.6 | 13.7 | 15.4 | 15.3 | 13.7 |
| 10 | 17.8 | 16.7 | 19.4 | 14.4 | 12.8 | 14.9 | 9.2 | 11.5 | 12.7 | 14.2 | 16.9 | 16.3 | 14.7 |
| 11 | 19.0 | 17.6 | 20.2 | 15.5 | 13.0 | 16.6 | 10.7 | 14.2 | 14.0 | 14.2 | 18.3 | 17.8 | 15.9 |
| 12 | 20.1 | 19.0 | 21.2 | 17.3 | 14.7 | 17.2 | 11.5 | 14.3 | 14.6 | 15.2 | 19.2 | 18.2 | 16.9 |
| 13 | 19.3 | 21.2 | 22.1 | 18.9 | 16.0 | 18.9 | 13.5 | 14.8 | 15.8 | 16.5 | 19.9 | 18.6 | 18.1 |
| 14 | 19.1 | 22.2 | 22.3 | 19.8 | 15.6 | 19.4 | 13.9 | 16.7 | 16.3 | 17.1 | 21.7 | 20.4 | 18.7 |
| 15 | 18.6 | 23.3 | 22.6 | 19.9 | 16.2 | 20.7 | 14.6 | 16.1 | 17.2 | 17.8 | 21.5 | 20.2 | 19.2 |
| 16 | 17.8 | 23.1 | 23.4 | 20.5 | 17.5 | 20.8 | 14.7 | 16.5 | 18.6 | 17.2 | 20.4 | 19.9 | 19.4 |
| 17 | 17.6 | 21.2 | 22.7 | 20.5 | 17.1 | 20.9 | 14.0 | 17.0 | 18.0 | 16.5 | 20.3 | 19.2 | 19.0 |
| 18 | 15.8 | 21.2 | 20.7 | 19.1 | 16.8 | 20.1 | 14.4 | 16.4 | 15.7 | 15.8 | 20.1 | 19.8 | 18.2 |
| 19 | 15.9 | 20.8 | 18.7 | 17.8 | 15.0 | 18.8 | 14.9 | 14.7 | 15.2 | 15.2 | 19.6 | 19.8 | 17.3 |
| 20 | 16.2 | 21.1 | 18.8 | 16.2 | 13.2 | 17.5 | 14.2 | 14.0 | 15.3 | 15.9 | 20.8 | 18.6 | 16.7 |
| 21 | 16.6 | 19.8 | 18.2 | 15.5 | 13.5 | 15.2 | 12.7 | 13.4 | 14.9 | 15.3 | 22.4 | 20.6 | 16.3 |
| 22 | 16.1 | 18.9 | 18.1 | 15.4 | 11.5 | 14.6 | 10.8 | 12.0 | 14.3 | 16.4 | 21.4 | 22.4 | 15.6 |
| 23 | 16.6 | 19.1 | 17.0 | 14.4 | 10.9 | 14.8 | 9.7 | 11.1 | 13.8 | 16.4 | 20.9 | 21.4 | 15.1 |
| 24 | 17.2 | 18.8 | 16.2 | 13.9 | 11.0 | 13.9 | 9.1 | 10.6 | 13.3 | 15.9 | 20.4 | 20.6 | 14.6 |
| Mean | 17.3 | 19.2 | 18.9 | 15.8 | 12.8 | 15.4 | 10.6 | 12.3 | 13.9 | 15.7 | 19.8 | 19.4 | 15.8 |
| Good Hours | 720 | 972 | 1488 | 1387 | 1488 | 1440 | 1141 | 744 | 720 | 744 | 720 | 744 | |
| Missing Hours | 24 | 396 | 0 | 53 | 0 | 0 | 347 | 0 | 0 | 0 | 0 | 0 | |

12,308 Hours of Good Data  820 Hours Missing  93.8% Data Recovery

**Table 6 – Mean Hourly Wind Speed at 49.5M agl**

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
SHELDON DOME - 49.5M WIND SPEED (W) (MPH)

02/01/07 - 07/31/08

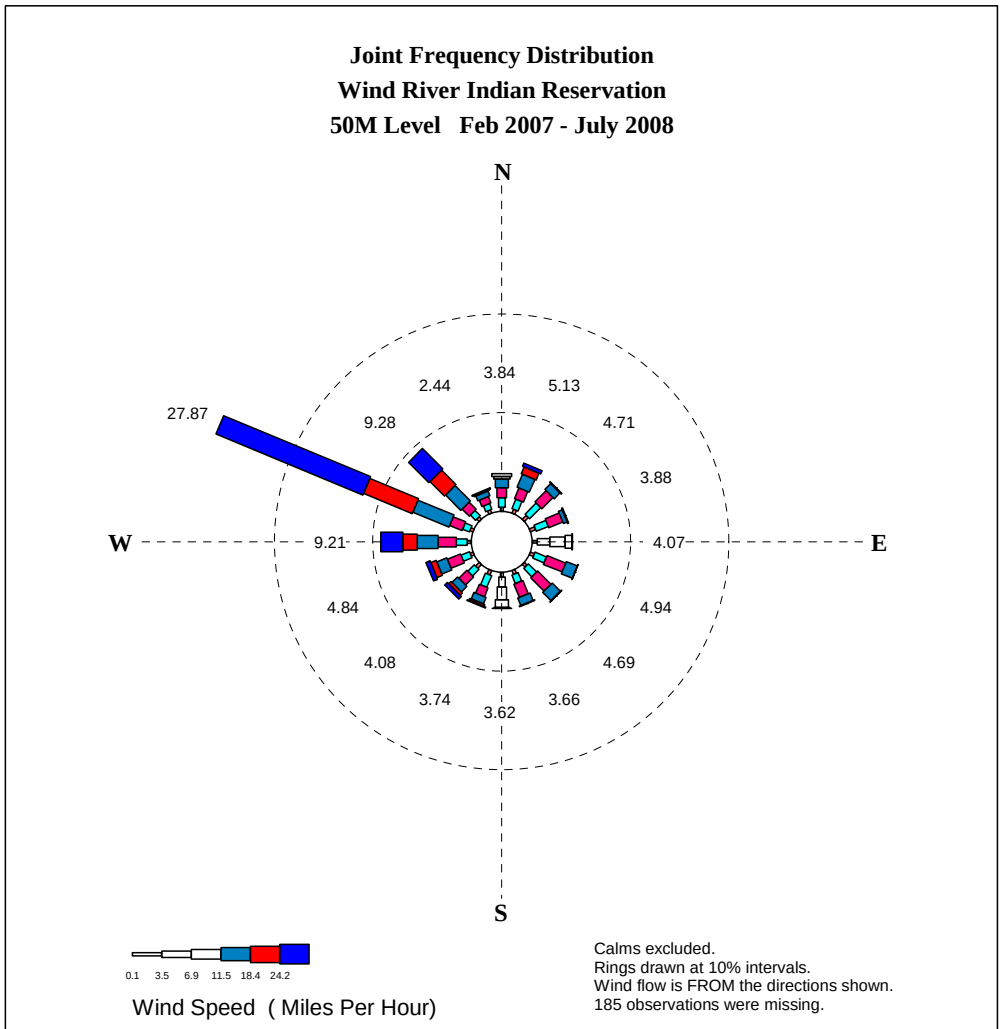
| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 17.6 | 18.8 | 17.0 | 14.7 | 11.5 | 13.2 | 8.5 | 10.2 | 12.8 | 15.3 | 21.8 | 19.8 | 14.7 |
| 02 | 17.5 | 18.9 | 17.1 | 14.8 | 10.9 | 12.6 | 9.0 | 10.3 | 12.4 | 14.7 | 21.6 | 21.7 | 14.7 |
| 03 | 18.0 | 18.7 | 17.1 | 13.1 | 10.2 | 11.3 | 7.9 | 9.3 | 12.3 | 15.5 | 20.2 | 20.8 | 14.0 |
| 04 | 18.2 | 18.0 | 17.1 | 14.1 | 9.3 | 11.0 | 7.0 | 8.8 | 11.6 | 16.1 | 20.4 | 20.8 | 13.8 |
| 05 | 17.3 | 16.9 | 16.2 | 13.6 | 9.6 | 10.4 | 7.2 | 9.2 | 11.3 | 16.4 | 19.5 | 21.4 | 13.5 |
| 06 | 16.1 | 16.5 | 16.1 | 12.5 | 10.0 | 9.9 | 6.8 | 8.3 | 10.6 | 16.1 | 19.3 | 20.5 | 13.1 |
| 07 | 16.3 | 16.1 | 17.3 | 11.7 | 10.1 | 12.2 | 6.4 | 8.0 | 11.0 | 14.8 | 17.3 | 18.0 | 13.0 |
| 08 | 17.1 | 16.1 | 17.0 | 12.6 | 10.5 | 13.1 | 6.8 | 8.7 | 11.0 | 13.4 | 16.9 | 15.8 | 13.1 |
| 09 | 17.0 | 16.6 | 18.4 | 13.9 | 11.8 | 13.9 | 8.1 | 9.6 | 11.6 | 13.4 | 15.6 | 15.5 | 13.8 |
| 10 | 18.2 | 16.7 | 19.4 | 14.3 | 13.0 | 15.1 | 9.2 | 11.4 | 12.7 | 14.3 | 16.9 | 16.6 | 14.8 |
| 11 | 19.4 | 17.6 | 20.2 | 15.5 | 13.2 | 16.8 | 10.7 | 14.2 | 14.1 | 14.3 | 18.2 | 18.0 | 16.0 |
| 12 | 20.5 | 18.9 | 21.2 | 17.4 | 14.9 | 17.6 | 11.7 | 14.5 | 14.8 | 15.2 | 19.1 | 18.3 | 17.0 |
| 13 | 19.7 | 21.1 | 22.1 | 18.9 | 16.3 | 19.4 | 13.7 | 15.0 | 16.0 | 16.5 | 19.9 | 18.7 | 18.3 |
| 14 | 19.5 | 22.2 | 22.2 | 19.8 | 15.8 | 19.7 | 14.1 | 17.0 | 16.6 | 17.2 | 21.6 | 20.5 | 18.9 |
| 15 | 19.0 | 23.2 | 22.5 | 20.0 | 16.4 | 21.1 | 14.8 | 16.4 | 17.6 | 17.9 | 21.5 | 20.4 | 19.3 |
| 16 | 18.2 | 23.1 | 23.3 | 20.5 | 17.8 | 21.2 | 15.1 | 16.8 | 18.9 | 17.4 | 20.5 | 20.1 | 19.6 |
| 17 | 18.0 | 21.2 | 22.7 | 20.5 | 17.4 | 21.3 | 14.2 | 17.2 | 18.4 | 16.6 | 20.3 | 19.4 | 19.2 |
| 18 | 16.3 | 21.2 | 20.7 | 19.3 | 17.1 | 20.6 | 14.6 | 16.7 | 15.9 | 16.0 | 20.3 | 20.0 | 18.4 |
| 19 | 16.4 | 20.9 | 18.8 | 18.1 | 15.3 | 19.3 | 15.2 | 15.0 | 15.6 | 15.4 | 19.8 | 19.9 | 17.5 |
| 20 | 16.7 | 21.2 | 18.9 | 16.5 | 13.5 | 18.1 | 14.7 | 14.2 | 15.6 | 16.0 | 20.9 | 18.8 | 17.0 |
| 21 | 17.1 | 19.9 | 18.2 | 15.7 | 13.7 | 15.8 | 13.2 | 13.6 | 15.2 | 15.4 | 22.5 | 20.8 | 16.5 |
| 22 | 16.6 | 19.1 | 18.1 | 15.7 | 11.9 | 15.1 | 11.0 | 12.2 | 14.6 | 16.5 | 21.5 | 22.5 | 15.9 |
| 23 | 16.9 | 19.2 | 17.1 | 14.6 | 11.1 | 15.3 | 10.0 | 11.3 | 14.1 | 16.5 | 20.9 | 21.5 | 15.3 |
| 24 | 17.6 | 18.9 | 16.3 | 14.1 | 11.2 | 14.2 | 9.2 | 10.7 | 13.6 | 15.9 | 20.5 | 20.8 | 14.8 |
| Mean | 17.7 | 19.2 | 19.0 | 15.9 | 13.0 | 15.8 | 10.8 | 12.4 | 14.1 | 15.7 | 19.9 | 19.6 | 15.9 |

| Good Hours | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 720 | 972 | 1488 | 1387 | 1488 | 1440 | 1141 | 744 | 720 | 744 | 720 | 744 | |

| Missing Hours | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 | 396 | 0 | 53 | 0 | 0 | 347 | 0 | 0 | 0 | 0 | 0 | |

12,308 Hours of Good Data  820 Hours Missing  93.8% Data Recovery

**Figure 6 – Wind Rose for the Wind River Indian Reservation**




PERCENT OCCURRENCE: Wind Speed ( Miles Per Hour)
LOWER BOUND OF CATEGORY

| DIR | 0.1 | 3.5 | 6.9 | 11.5 | 18.4 | 24.2 |
|---|---|---|---|---|---|---|
| N | 0.42 | 0.99 | 0.98 | 0.88 | 0.29 | 0.28 |
| NNE | 0.44 | 1.02 | 1.17 | 1.41 | 0.75 | 0.34 |
| NE | 0.58 | 1.60 | 1.59 | 0.82 | 0.12 | 0.01 |
| ENE | 0.57 | 1.31 | 1.52 | 0.41 | 0.07 | 0.00 |
| E | 0.50 | 1.26 | 1.54 | 0.71 | 0.06 | 0.01 |
| ESE | 0.43 | 1.23 | 2.07 | 1.18 | 0.03 | 0.00 |
| SE | 0.39 | 1.19 | 1.90 | 1.15 | 0.06 | 0.01 |
| SSE | 0.40 | 0.94 | 1.45 | 0.83 | 0.04 | 0.00 |

TOTAL OBS = 12151 MISSING OBS = 185

PERCENT OCCURRENCE: Wind Speed ( Miles Per Hour)
LOWER BOUND OF CATEGORY

| DIR | 0.1 | 3.5 | 6.9 | 11.5 | 18.4 | 24.2 |
|---|---|---|---|---|---|---|
| S | 0.44 | 1.00 | 1.29 | 0.80 | 0.07 | 0.02 |
| SSW | 0.48 | 1.29 | 0.98 | 0.69 | 0.21 | 0.09 |
| SW | 0.53 | 0.92 | 1.13 | 0.81 | 0.31 | 0.38 |
| WSW | 0.35 | 0.93 | 1.44 | 1.09 | 0.60 | 0.44 |
| W | 0.41 | 1.12 | 1.86 | 2.12 | 1.46 | 2.24 |
| WNW | 0.35 | 0.73 | 1.37 | 3.94 | 5.33 | 16.14 |
| NW | 0.36 | 0.75 | 1.00 | 2.18 | 2.08 | 2.91 |
| NNW | 0.38 | 0.61 | 0.69 | 0.53 | 0.12 | 0.12 |

CALM OBS = 0

**Table 7– Turbulence Intensity**

WIND RIVER RESERVATION
SHELDON DOME - 49.5M WIND SPEED (W)

02/17/07 to 07/17/08

Wind Speed Frequency and Concurrent TI

| Wind Speed (mps) | Frequency of Occurrence Hrs | % | Mean Turbulence Intensity |
|---|---|---|---|
| 0-2 | 1975 | 16.3 | 0.306 |
| 3 | 1537 | 12.6 | 0.202 |
| 4 | 1329 | 10.9 | 0.175 |
| 5 | 1156 | 9.5 | 0.158 |
| 6 | 841 | 6.9 | 0.154 |
| 7 | 648 | 5.3 | 0.142 |
| 8 | 608 | 5.0 | 0.129 |
| 9 | 545 | 4.5 | 0.125 |
| 10 | 539 | 4.4 | 0.120 |
| 11 | 512 | 4.2 | 0.116 |
| 12 | 435 | 3.6 | 0.117 |
| 13 | 441 | 3.6 | 0.114 |
| 14 | 384 | 3.2 | 0.110 |
| 15 | 351 | 2.9 | 0.108 |
| 16 | 260 | 2.1 | 0.106 |
| 17 | 184 | 1.5 | 0.103 |
| 18 | 141 | 1.2 | 0.106 |
| 19 | 93 | .8 | 0.100 |
| 20 | 83 | .7 | 0.105 |
| 21 | 36 | .3 | 0.099 |
| 22 | 26 | .2 | 0.094 |
| 23 | 12 | .1 | 0.092 |
| 24 | 6 | .0 | 0.092 |
| 25 | 6 | .0 | 0.101 |
| 26 | 0 | 0.0 | ***** |
| 27 | 1 | .0 | 0.087 |
| 28 | 2 | .0 | 0.096 |
| 29 | 0 | 0.0 | ***** |
| 30 | 1 | .0 | 0.078 |
| Total Hrs | 12152 | | 12152 |

## Hub Height Wind Speeds

Hub height wind speeds at 50-meters, 65-meters, 75-meters, and 80-meters are presented in Table 8. The wind speeds at 50-meters, 65-meters, 75-meters, and 80-meters are based on the 50-meter wind speed adjusted to a higher level using a wind speed power law exponent of 0.10.

**Table 8 – Mean Annual Wind Speeds at the Wind River Indian Reservation for 50-meters, 65-meters, 75-meters, and 80-meters agl**

| Site | Height (Meters) | Shear | Average Wind Speed (mph) |
|---|---|---|---|
| Tower | 50 | ----- | 15.9 |
| Tower | 65 | 0.10 | 16.3 |
| Tower | 75 | 0.10 | 16.6 |
| Tower | 80 | 0.10 | 16.7 |

## Turbine Selection

The four turbines proposed for analysis are the GE 1.5MW (77-m), Gamesa G87, Vestas V-90, and the Dewind 2.0. The potential peak wind speed in excess of 52.5 mps may limit this site to only IEC Class 1 wind turbines. The air density of the site, based on the annual average air temperature and elevation, is 0.98kg/m**3.

## Theoretical Energy Output and Capacity Factor

The single turbine theoretical energy output (gross and net) and the single turbine gross and net capacity factors are presented in Table 9. A loss factor of 8% (i.e. 8% losses for availability, turbulence, line loss, blade contamination) is used to determine a net energy output and the net turbine capacity factor. The theoretical energy calculations are presented in Tables 10 through13. The wind speed frequency distribution for 30-meters above ground level (agl), 50-meters agl, and 80-meters agl is presented in Table 14.

**Table 9 – Theoretical Energy Projections**

| Turbine | Rating (kW) | Hub Height (m) | Gross Output (kWh) | Gross Capacity Factor | Net Output | Net Capacity Factor |
|---|---|---|---|---|---|---|
| GE 1.5 | 1500 | 80 | 4,602,136 | 35.02% | 4,233,965 | 32.22% |
| Gamesa G87 | 2000 | 80 | 6,069,918 | 34.65% | 5,584,324 | 31.87% |
| Vestas V90 | 3000 | 80 | 7,602,427 | 28.93% | 6,994,233 | 26.61% |
| DeWind | 2000 | 80 | 5,526,912 | 31.55% | 5,084,759 | 29.02% |

**Table 10- Theoretical Energy Output Calculation for the GE 1.5MW**

**Site:** Wind River
**Hub Height:** 80-Meters
**Turbine:** GE 77
**Density:** 0.98kg/m**3

| Wind Speed Bin (mps) | Frequency of Occurrence | Number of Hours | Power Curve (kW) | Energy (kWh) |
|---|---|---|---|---|
| 0 | 0.30% | 26 | 0.0 | 0 |
| 1 | 5.50% | 482 | 0.0 | 0 |
| 2 | 8.60% | 753 | 0.0 | 0 |
| 3 | 12.00% | 1,051 | 0.0 | 0 |
| 4 | 10.80% | 946 | 27.0 | 25,544 |
| 5 | 9.20% | 806 | 97.0 | 78,174 |
| 6 | 7.50% | 657 | 192.0 | 126,144 |
| 7 | 5.50% | 482 | 325.0 | 156,585 |
| 8 | 5.00% | 438 | 503.0 | 220,314 |
| 9 | 4.20% | 368 | 734.0 | 270,053 |
| 10 | 4.30% | 377 | 1001.0 | 377,057 |
| 11 | 4.30% | 377 | 1227.0 | 462,186 |
| 12 | 3.60% | 315 | 1379.0 | 434,881 |
| 13 | 3.70% | 324 | 1441.0 | 467,057 |
| 14 | 3.20% | 280 | 1500.0 | 420,480 |
| 15 | 3.20% | 280 | 1500.0 | 420,480 |
| 16 | 2.50% | 219 | 1500.0 | 328,500 |
| 17 | 1.80% | 158 | 1500.0 | 236,520 |
| 18 | 1.50% | 131 | 1500.0 | 197,100 |
| 19 | 1.20% | 105 | 1500.0 | 157,680 |
| 20 | 0.70% | 61 | 1500.0 | 91,980 |
| 21 | 0.70% | 61 | 1500.0 | 91,980 |
| 22 | 0.30% | 26 | 1500.0 | 39,420 |
| 23 | 0.20% | 18 | 0.0 | 0 |
| 24 | 0.20% | 18 | 0.0 | 0 |
| 25 | 0.00% | 0 | 0.0 | 0 |
| 26 | 0.00% | 0 | 0.0 | 0 |
| 27 | 0.00% | 0 | 0.0 | 0 |
| 28 | 0.00% | 0 | 0.0 | 0 |
| 29 | 0.00% | 0 | 0.0 | 0 |
| 30 | 0.00% | 0 | 0.0 | 0 |
| | | 8760 | | |
| | | | Total kWh = | 4,602,136 |
| | | | Gross Capacity Factor = | 35.02% |
| | | | Net Capacity Factor @8% Losses = | 32.22% |

**Table 11 - Theoretical Energy Output Calculation for the Gamesa G87**

**Site:** Wind River
**Hub Height:** 80-Meters
**Turbine:** Gamesa
**Density:** 0.98kg/m**3

| Wind Speed Bin (mps) | Frequency of Occurrence | Number of Hours | Power Curve (kW) | Energy (kWh) |
|---|---|---|---|---|
| 0 | 0.30% | 26 | 0.0 | 0 |
| 1 | 5.50% | 482 | 0.0 | 0 |
| 2 | 8.60% | 753 | 0.0 | 0 |
| 3 | 12.00% | 1,051 | 0.0 | 0 |
| 4 | 10.80% | 946 | 57.7 | 54,589 |
| 5 | 9.20% | 806 | 137.1 | 110,492 |
| 6 | 7.50% | 657 | 258.9 | 170,097 |
| 7 | 5.50% | 482 | 429.2 | 206,789 |
| 8 | 5.00% | 438 | 651.6 | 285,401 |
| 9 | 4.20% | 368 | 918.3 | 337,861 |
| 10 | 4.30% | 377 | 1212.8 | 456,838 |
| 11 | 4.30% | 377 | 1513.2 | 569,992 |
| 12 | 3.60% | 315 | 1761.3 | 555,444 |
| 13 | 3.70% | 324 | 1907.2 | 618,162 |
| 14 | 3.20% | 280 | 1970.2 | 552,286 |
| 15 | 3.20% | 280 | 1991.5 | 558,257 |
| 16 | 2.50% | 219 | 1997.7 | 437,496 |
| 17 | 1.80% | 158 | 1999.5 | 315,281 |
| 18 | 1.50% | 131 | 1999.8 | 262,774 |
| 19 | 1.20% | 105 | 2000.0 | 210,240 |
| 20 | 0.70% | 61 | 2000.0 | 122,640 |
| 21 | 0.70% | 61 | 2000.0 | 122,640 |
| 22 | 0.30% | 26 | 2000.0 | 52,560 |
| 23 | 0.20% | 18 | 2000.0 | 35,040 |
| 24 | 0.20% | 18 | 2000.0 | 35,040 |
| 25 | 0.00% | 0 | 2000.0 | 0 |
| 26 | 0.00% | 0 | 0 | 0 |
| 27 | 0.00% | 0 | 0 | 0 |
| 28 | 0.00% | 0 | 0 | 0 |
| 29 | 0.00% | 0 | 0 | 0 |
| 30 | 0.00% | 0 | 0 | 0 |
| | | 8760 | | |
| | | | Total kWh = | 6,069,918 |
| | | | Gross Capacity Factor = | 34.65% |
| | | | Net Capacity Factor @8% Losses = | 31.87% |

**Table 12 - Theoretical Energy Output Calculation for the Vestas V90**

**Site:** Wind River
**Hub Height:** 80-Meters
**Turbine:** Vestas
**Density:** 0.98kg/m**3

| Wind Speed Bin (mps) | Frequency of Occurrence | Number of Hours | Power Curve (kW) | Energy (kWh) |
|---|---|---|---|---|
| 0 | 0.30% | 26 | 0.0 | 0 |
| 1 | 5.50% | 482 | 0.0 | 0 |
| 2 | 8.60% | 753 | 0.0 | 0 |
| 3 | 12.00% | 1,051 | 0.0 | 0 |
| 4 | 10.80% | 946 | 53.0 | 50,142 |
| 5 | 9.20% | 806 | 142.0 | 114,441 |
| 6 | 7.50% | 657 | 281.0 | 184,617 |
| 7 | 5.50% | 482 | 466.0 | 224,519 |
| 8 | 5.00% | 438 | 714.0 | 312,732 |
| 9 | 4.20% | 368 | 1027.0 | 377,854 |
| 10 | 4.30% | 377 | 1330.0 | 500,984 |
| 11 | 4.30% | 377 | 1656.0 | 623,782 |
| 12 | 3.60% | 315 | 1963.0 | 619,052 |
| 13 | 3.70% | 324 | 2258.0 | 731,863 |
| 14 | 3.20% | 280 | 2539.0 | 711,732 |
| 15 | 3.20% | 280 | 2778.0 | 778,729 |
| 16 | 2.50% | 219 | 2925.0 | 640,575 |
| 17 | 1.80% | 158 | 2983.0 | 470,359 |
| 18 | 1.50% | 131 | 2997.0 | 393,806 |
| 19 | 1.20% | 105 | 3000.0 | 315,360 |
| 20 | 0.70% | 61 | 3000.0 | 183,960 |
| 21 | 0.70% | 61 | 3000.0 | 183,960 |
| 22 | 0.30% | 26 | 3000.0 | 78,840 |
| 23 | 0.20% | 18 | 3000.0 | 52,560 |
| 24 | 0.20% | 18 | 3000.0 | 52,560 |
| 25 | 0.00% | 0 | 3000.0 | 0 |
| 26 | 0.00% | 0 | 0 | 0 |
| 27 | 0.00% | 0 | 0 | 0 |
| 28 | 0.00% | 0 | 0 | 0 |
| 29 | 0.00% | 0 | 0 | 0 |
| 30 | 0.00% | 0 | 0 | 0 |
| | | 8760 | | |
| | | | Total kWh = | 7,602,427 |
| | | | Gross Capacity Factor = | 28.93% |
| | | | Net Capacity Factor @8% Losses = | 26.61% |

**Table 13 - Theoretical Energy Output Calculation for the DeWind 2.0MW**

**Site:** Wind River
**Hub Height:** 80-Meters
**Turbine:** Dewind
**Density:** 0.98kg/m**3

| Wind Speed Bin (mps) | Frequency of Occurrence | Number of Hours | Power Curve (kW) | Energy (kWh) |
|---|---|---|---|---|
| 0 | 0.30% | 26 | 0.0 | 0 |
| 1 | 5.50% | 482 | 0.0 | 0 |
| 2 | 8.60% | 753 | 0.0 | 0 |
| 3 | 12.00% | 1,051 | 0.0 | 0 |
| 4 | 10.80% | 946 | 0.0 | 0 |
| 5 | 9.20% | 806 | 32.5 | 26,192 |
| 6 | 7.50% | 657 | 174.0 | 114,318 |
| 7 | 5.50% | 482 | 344.0 | 165,739 |
| 8 | 5.00% | 438 | 548.5 | 240,243 |
| 9 | 4.20% | 368 | 785.5 | 289,001 |
| 10 | 4.30% | 377 | 1045.0 | 393,631 |
| 11 | 4.30% | 377 | 1326.5 | 499,666 |
| 12 | 3.60% | 315 | 1612.0 | 508,360 |
| 13 | 3.70% | 324 | 1825.5 | 591,681 |
| 14 | 3.20% | 280 | 1943.5 | 544,802 |
| 15 | 3.20% | 280 | 1994.0 | 558,958 |
| 16 | 2.50% | 219 | 2000.0 | 438,000 |
| 17 | 1.80% | 158 | 2000.0 | 315,360 |
| 18 | 1.50% | 131 | 2000.0 | 262,800 |
| 19 | 1.20% | 105 | 2000.0 | 210,240 |
| 20 | 0.70% | 61 | 2000.0 | 122,640 |
| 21 | 0.70% | 61 | 2000.0 | 122,640 |
| 22 | 0.30% | 26 | 2000.0 | 52,560 |
| 23 | 0.20% | 18 | 2000.0 | 35,040 |
| 24 | 0.20% | 18 | 2000.0 | 35,040 |
| 25 | 0.00% | 0 | 2000.0 | 0 |
| 26 | 0.00% | 0 | 0 | 0 |
| 27 | 0.00% | 0 | 0 | 0 |
| 28 | 0.00% | 0 | 0 | 0 |
| 29 | 0.00% | 0 | 0 | 0 |
| 30 | 0.00% | 0 | 0 | 0 |
| | | 8760 | | |
| | | | Total kWh = | 5,526,912 |
| | | | Gross Capacity Factor = | 31.55% |
| | | | Net Capacity Factor @8% Losses = | 29.02% |

**Table 14 – Wind Speed Frequency Distributions (Number of Hours) at 30-Meters, 50-Meters, and 80-Meters Above Ground Level**

| Wind Speed Bin (mps) | Percent Occurrence | | | Number of Hours | | |
|---|---|---|---|---|---|---|
| | 30-Meters | 50-Meters | 80-Meters | 30-Meters | 50-Meters | 80-Meters |
| 0 | 0.80% | 1.10% | 0.30% | 70 | 96 | 26 |
| 1 | 5.70% | 6.60% | 5.50% | 499 | 578 | 482 |
| 2 | 10.50% | 10.50% | 8.60% | 920 | 920 | 753 |
| 3 | 13.60% | 12.40% | 12.00% | 1191 | 1086 | 1,051 |
| 4 | 11.40% | 10.90% | 10.80% | 999 | 955 | 946 |
| 5 | 9.60% | 9.40% | 9.20% | 841 | 823 | 806 |
| 6 | 7.20% | 6.60% | 7.50% | 631 | 578 | 657 |
| 7 | 5.60% | 5.40% | 5.50% | 491 | 473 | 482 |
| 8 | 4.70% | 4.90% | 5.00% | 412 | 429 | 438 |
| 9 | 4.60% | 4.80% | 4.20% | 403 | 420 | 368 |
| 10 | 4.10% | 4.20% | 4.30% | 359 | 368 | 377 |
| 11 | 3.70% | 3.90% | 4.30% | 324 | 342 | 377 |
| 12 | 3.70% | 3.90% | 3.60% | 324 | 342 | 315 |
| 13 | 3.50% | 3.50% | 3.70% | 307 | 307 | 324 |
| 14 | 3.20% | 3.40% | 3.20% | 280 | 298 | 280 |
| 15 | 2.30% | 2.50% | 3.20% | 201 | 219 | 280 |
| 16 | 1.90% | 1.90% | 2.50% | 166 | 166 | 219 |
| 17 | 1.40% | 1.40% | 1.80% | 123 | 123 | 158 |
| 18 | 0.90% | 1.00% | 1.50% | 79 | 88 | 131 |
| 19 | 0.70% | 0.80% | 1.20% | 61 | 70 | 105 |
| 20 | 0.40% | 0.40% | 0.70% | 35 | 35 | 61 |
| 21 | 0.30% | 0.30% | 0.70% | 26 | 26 | 61 |
| 22 | 0.10% | 0.10% | 0.30% | 9 | 9 | 26 |
| 23 | 0.10% | 0.10% | 0.20% | 9 | 9 | 18 |
| 24 | 0.00% | 0.00% | 0.20% | 0 | 0 | 18 |
| 25 | 0.00% | 0.00% | 0.00% | 0 | 0 | 0 |
| 26 | 0.00% | 0.00% | 0.00% | 0 | 0 | 0 |
| 27 | 0.00% | 0.00% | 0.00% | 0 | 0 | 0 |
| 28 | 0.00% | 0.00% | 0.00% | 0 | 0 | 0 |
| 29 | 0.00% | 0.00% | 0.00% | 0 | 0 | 0 |
| 30 | 0.00% | 0.00% | 0.00% | 0 | 0 | 0 |
| | 100% | 100% | 100% | 8760 | 8760 | 8760 |

# Mean Hourly Summaries
# Wind River Indian Reservation

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
SHELDON DOME - 30M WIND SPEED (S) (MPH)

02/01/07 - 12/31/07

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | | 17.4 | 16.5 | 12.1 | 9.5 | 10.1 | 7.2 | 9.6 | 11.8 | 14.3 | 20.8 | 18.7 | 13.2 |
| 02 | | 17.3 | 16.6 | 12.5 | 9.2 | 10.0 | 7.6 | 9.9 | 11.5 | 13.7 | 20.3 | 20.5 | 13.3 |
| 03 | | 15.6 | 16.7 | 11.1 | 8.9 | 9.1 | 7.0 | 8.9 | 11.5 | 14.5 | 19.0 | 19.7 | 12.7 |
| 04 | | 13.4 | 17.2 | 12.5 | 8.3 | 9.5 | 6.1 | 8.3 | 10.9 | 14.8 | 19.2 | 19.7 | 12.7 |
| 05 | | 13.0 | 16.4 | 12.5 | 8.0 | 9.4 | 6.0 | 8.6 | 10.6 | 15.2 | 18.2 | 20.3 | 12.5 |
| 06 | | 11.5 | 16.8 | 11.5 | 8.2 | 8.9 | 5.9 | 8.0 | 10.0 | 15.0 | 18.0 | 19.5 | 12.2 |
| 07 | | 13.0 | 17.3 | 11.8 | 8.4 | 10.4 | 5.8 | 7.9 | 10.5 | 13.9 | 16.1 | 17.3 | 12.0 |
| 08 | | 13.0 | 16.2 | 13.4 | 9.4 | 11.6 | 6.5 | 8.9 | 10.9 | 12.8 | 15.9 | 15.1 | 12.1 |
| 09 | | 14.1 | 17.4 | 15.0 | 11.5 | 12.3 | 7.7 | 9.7 | 11.7 | 13.0 | 15.0 | 14.6 | 12.8 |
| 10 | | 14.0 | 18.6 | 14.9 | 13.0 | 13.6 | 8.1 | 11.5 | 12.6 | 13.8 | 16.7 | 15.7 | 13.8 |
| 11 | | 15.4 | 19.0 | 16.0 | 12.6 | 14.6 | 9.4 | 14.1 | 14.0 | 14.1 | 18.0 | 17.4 | 14.9 |
| 12 | | 20.4 | 20.3 | 17.2 | 14.7 | 15.0 | 10.4 | 14.3 | 14.6 | 15.0 | 18.8 | 17.8 | 16.0 |
| 13 | | 22.3 | 20.9 | 18.0 | 17.0 | 16.4 | 12.5 | 14.9 | 15.8 | 16.3 | 19.4 | 18.4 | 17.2 |
| 14 | | 26.1 | 20.8 | 18.7 | 15.7 | 16.3 | 12.8 | 16.8 | 16.4 | 16.9 | 21.2 | 20.0 | 17.9 |
| 15 | | 25.9 | 21.7 | 18.5 | 16.2 | 18.4 | 12.9 | 16.2 | 17.4 | 17.5 | 21.0 | 19.5 | 18.2 |
| 16 | | 27.1 | 22.7 | 19.0 | 17.8 | 19.2 | 13.2 | 16.6 | 18.6 | 16.8 | 19.5 | 19.1 | 18.6 |
| 17 | | 27.8 | 21.6 | 17.8 | 17.4 | 20.3 | 12.6 | 16.9 | 17.9 | 15.7 | 19.1 | 18.4 | 18.1 |
| 18 | | 26.5 | 19.1 | 17.4 | 16.9 | 19.8 | 12.5 | 16.0 | 15.1 | 15.0 | 19.1 | 18.9 | 17.3 |
| 19 | | 26.7 | 16.6 | 15.8 | 14.3 | 17.4 | 13.5 | 14.0 | 14.4 | 14.4 | 18.7 | 18.7 | 16.2 |
| 20 | | 25.6 | 17.7 | 14.1 | 12.3 | 16.9 | 13.2 | 13.2 | 14.3 | 14.8 | 19.7 | 17.7 | 15.8 |
| 21 | | 22.7 | 16.9 | 12.7 | 11.8 | 15.0 | 12.0 | 12.8 | 14.2 | 14.4 | 21.1 | 19.5 | 15.3 |
| 22 | | 19.7 | 17.2 | 13.3 | 10.5 | 14.4 | 10.5 | 11.3 | 13.5 | 15.3 | 20.0 | 21.1 | 14.9 |
| 23 | | 19.9 | 16.3 | 13.0 | 9.1 | 14.6 | 9.5 | 10.6 | 12.9 | 15.6 | 19.6 | 20.4 | 14.4 |
| 24 | | 19.3 | 15.5 | 12.3 | 8.9 | 12.4 | 8.0 | 9.9 | 12.7 | 15.1 | 19.5 | 19.6 | 13.6 |
| Mean | | 19.7 | 18.2 | 14.6 | 12.1 | 14.0 | 9.6 | 12.0 | 13.5 | 14.9 | 18.9 | 18.6 | 14.8 |
| Good Hours | | 276 | 744 | 667 | 744 | 720 | 744 | 744 | 720 | 744 | 720 | 744 | |
| Missing Hours | | 396 | 0 | 53 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

7,567 Hours of Good Data  449 Hours Missing  94.4% Data Recovery

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
SHELDON DOME - 30M WIND SPEED (S) (MPH)

01/01/08 - 07/31/08

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 16.3 | 17.5 | 15.2 | 15.3 | 12.1 | 14.2 | 9.3 | | | | | | 14.6 |
| 02 | 16.2 | 17.6 | 15.5 | 15.2 | 11.3 | 13.2 | 9.8 | | | | | | 14.4 |
| 03 | 16.7 | 18.0 | 15.3 | 13.4 | 10.2 | 11.7 | 8.5 | | | | | | 13.7 |
| 04 | 17.2 | 18.1 | 14.8 | 14.0 | 9.1 | 11.0 | 7.7 | | | | | | 13.4 |
| 05 | 16.1 | 16.9 | 13.4 | 13.1 | 9.8 | 10.4 | 8.6 | | | | | | 12.8 |
| 06 | 15.0 | 16.9 | 13.2 | 12.1 | 10.7 | 10.0 | 7.6 | | | | | | 12.5 |
| 07 | 15.5 | 15.9 | 15.5 | 11.2 | 11.3 | 13.6 | 7.7 | | | | | | 13.3 |
| 08 | 16.1 | 15.9 | 16.6 | 11.9 | 11.6 | 14.5 | 8.2 | | | | | | 13.9 |
| 09 | 16.2 | 16.8 | 18.7 | 12.8 | 11.9 | 15.2 | 9.4 | | | | | | 14.8 |
| 10 | 17.5 | 17.3 | 19.6 | 13.8 | 12.6 | 16.1 | 11.5 | | | | | | 15.7 |
| 11 | 19.0 | 18.2 | 20.9 | 14.9 | 13.5 | 18.3 | 13.0 | | | | | | 17.1 |
| 12 | 20.1 | 18.1 | 21.5 | 17.4 | 14.8 | 19.6 | 13.7 | | | | | | 18.2 |
| 13 | 19.4 | 19.8 | 22.5 | 19.4 | 15.1 | 21.6 | 15.5 | | | | | | 19.3 |
| 14 | 19.1 | 20.0 | 22.9 | 20.7 | 15.5 | 22.4 | 16.0 | | | | | | 19.8 |
| 15 | 18.3 | 21.4 | 22.6 | 21.2 | 16.2 | 23.1 | 17.8 | | | | | | 20.2 |
| 16 | 17.3 | 20.5 | 23.0 | 21.6 | 17.1 | 22.4 | 17.8 | | | | | | 20.1 |
| 17 | 17.1 | 17.3 | 22.3 | 22.3 | 16.8 | 21.4 | 16.4 | | | | | | 19.3 |
| 18 | 14.9 | 17.6 | 19.9 | 19.6 | 16.3 | 20.1 | 17.2 | | | | | | 18.0 |
| 19 | 15.2 | 16.7 | 18.5 | 17.9 | 14.5 | 19.0 | 16.0 | | | | | | 16.9 |
| 20 | 15.6 | 17.4 | 17.6 | 16.5 | 12.8 | 16.3 | 14.0 | | | | | | 15.9 |
| 21 | 16.1 | 17.0 | 16.9 | 16.6 | 13.9 | 13.8 | 12.2 | | | | | | 15.4 |
| 22 | 15.6 | 17.1 | 16.8 | 16.1 | 11.6 | 13.1 | 9.6 | | | | | | 14.6 |
| 23 | 15.9 | 17.1 | 15.6 | 14.4 | 11.6 | 13.5 | 8.8 | | | | | | 14.2 |
| 24 | 16.3 | 16.9 | 15.0 | 14.1 | 11.9 | 14.0 | 9.8 | | | | | | 14.3 |
| Mean | 16.8 | 17.7 | 18.1 | 16.1 | 13.0 | 16.2 | 11.9 | | | | | | 15.9 |

| Good Hours | | | | | | | |
|---|---|---|---|---|---|---|---|
| 720 | 696 | 744 | 720 | 744 | 720 | 397 | |

| Missing Hours | | | | | | | |
|---|---|---|---|---|---|---|---|
| 24 | 0 | 0 | 0 | 0 | 0 | 347 | |

4,741 Hours of Good Data  371 Hours Missing  92.7% Data Recovery

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
SHELDON DOME - 40M WIND SPEED (S) (MPH)

02/01/07 - 12/31/07

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | | 18.2 | 17.0 | 12.5 | 9.7 | 10.4 | 7.2 | 9.8 | 12.3 | 14.8 | 21.3 | 19.1 | 13.6 |
| 02 | | 18.3 | 17.1 | 12.9 | 9.4 | 10.4 | 7.7 | 10.0 | 11.9 | 14.2 | 21.0 | 20.9 | 13.7 |
| 03 | | 16.3 | 17.1 | 11.4 | 9.2 | 9.3 | 6.9 | 8.9 | 11.9 | 15.0 | 19.6 | 20.1 | 13.1 |
| 04 | | 14.1 | 17.6 | 12.7 | 8.5 | 9.8 | 5.9 | 8.4 | 11.3 | 15.4 | 19.8 | 20.1 | 13.0 |
| 05 | | 13.6 | 16.9 | 12.7 | 8.3 | 9.5 | 5.8 | 8.8 | 11.0 | 15.8 | 18.8 | 20.8 | 12.9 |
| 06 | | 12.0 | 17.3 | 11.6 | 8.3 | 9.0 | 5.8 | 8.0 | 10.2 | 15.6 | 18.6 | 20.0 | 12.4 |
| 07 | | 13.4 | 17.6 | 11.7 | 8.3 | 10.4 | 5.5 | 7.8 | 10.8 | 14.4 | 16.7 | 17.4 | 12.1 |
| 08 | | 13.4 | 16.4 | 13.3 | 9.3 | 11.5 | 6.1 | 8.7 | 11.0 | 13.1 | 16.3 | 15.2 | 12.1 |
| 09 | | 14.2 | 17.4 | 15.0 | 11.4 | 12.3 | 7.4 | 9.6 | 11.7 | 13.2 | 15.2 | 14.8 | 12.8 |
| 10 | | 14.0 | 18.6 | 14.9 | 13.0 | 13.6 | 7.9 | 11.4 | 12.7 | 14.2 | 16.8 | 15.9 | 13.9 |
| 11 | | 15.6 | 19.0 | 16.1 | 12.7 | 14.8 | 9.3 | 14.2 | 14.1 | 14.2 | 18.1 | 17.5 | 15.0 |
| 12 | | 20.6 | 20.4 | 17.4 | 14.8 | 15.1 | 10.4 | 14.3 | 14.7 | 15.2 | 19.0 | 17.9 | 16.1 |
| 13 | | 23.6 | 21.0 | 18.2 | 17.2 | 16.5 | 12.5 | 14.9 | 15.9 | 16.5 | 19.7 | 18.5 | 17.3 |
| 14 | | 26.6 | 20.9 | 18.8 | 15.9 | 16.4 | 12.9 | 16.9 | 16.5 | 17.1 | 21.5 | 20.1 | 18.0 |
| 15 | | 26.4 | 21.8 | 18.6 | 16.4 | 18.6 | 13.0 | 16.3 | 17.5 | 17.7 | 21.3 | 19.8 | 18.4 |
| 16 | | 27.7 | 23.0 | 19.1 | 18.0 | 19.4 | 13.2 | 16.7 | 18.8 | 17.1 | 20.0 | 19.5 | 18.8 |
| 17 | | 28.8 | 22.0 | 18.0 | 17.6 | 20.5 | 12.7 | 17.1 | 18.2 | 16.2 | 19.7 | 18.7 | 18.5 |
| 18 | | 27.6 | 19.7 | 17.8 | 17.3 | 20.2 | 12.7 | 16.4 | 15.5 | 15.5 | 19.7 | 19.3 | 17.8 |
| 19 | | 28.0 | 17.1 | 16.4 | 14.8 | 18.0 | 13.8 | 14.5 | 15.0 | 14.9 | 19.2 | 19.2 | 16.7 |
| 20 | | 26.9 | 18.3 | 14.7 | 12.7 | 17.8 | 13.6 | 13.7 | 15.0 | 15.3 | 20.3 | 18.1 | 16.4 |
| 21 | | 24.0 | 17.7 | 13.1 | 12.3 | 15.8 | 12.4 | 13.2 | 14.7 | 14.9 | 21.9 | 20.0 | 15.9 |
| 22 | | 20.8 | 17.8 | 13.7 | 10.8 | 15.2 | 10.8 | 11.7 | 14.0 | 15.8 | 20.8 | 21.7 | 15.5 |
| 23 | | 20.8 | 16.8 | 13.4 | 9.4 | 15.3 | 9.6 | 10.9 | 13.4 | 16.0 | 20.3 | 20.9 | 14.8 |
| 24 | | 20.2 | 15.9 | 12.6 | 9.1 | 12.9 | 8.0 | 10.2 | 13.1 | 15.5 | 20.0 | 20.1 | 14.0 |
| Mean | | 20.4 | 18.5 | 14.9 | 12.3 | 14.3 | 9.6 | 12.2 | 13.8 | 15.3 | 19.4 | 19.0 | 15.1 |
| Good Hours | | 276 | 744 | 667 | 744 | 720 | 744 | 744 | 720 | 744 | 720 | 744 | |
| Missing Hours | | 396 | 0 | 53 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

7,567 Hours of Good Data  449 Hours Missing  94.4% Data Recovery

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
SHELDON DOME - 40M WIND SPEED (S) (MPH)

01/01/08 - 07/31/08

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 16.8 | 18.0 | 15.6 | 15.7 | 12.3 | 14.9 | 9.6 | | | | | | 15.0 |
| 02 | 16.7 | 18.0 | 15.9 | 15.6 | 11.4 | 13.7 | 10.2 | | | | | | 14.8 |
| 03 | 17.2 | 18.4 | 15.8 | 13.8 | 10.2 | 12.1 | 8.7 | | | | | | 14.1 |
| 04 | 17.6 | 18.4 | 15.1 | 14.5 | 9.2 | 11.2 | 7.8 | | | | | | 13.7 |
| 05 | 16.6 | 17.2 | 13.9 | 13.5 | 9.8 | 10.5 | 8.8 | | | | | | 13.1 |
| 06 | 15.3 | 17.3 | 13.4 | 12.4 | 10.8 | 10.0 | 7.6 | | | | | | 12.7 |
| 07 | 15.8 | 16.2 | 15.7 | 11.2 | 11.2 | 13.6 | 7.6 | | | | | | 13.4 |
| 08 | 16.5 | 16.2 | 16.6 | 11.8 | 11.4 | 14.4 | 8.0 | | | | | | 13.9 |
| 09 | 16.5 | 16.9 | 18.7 | 12.7 | 11.8 | 15.1 | 9.2 | | | | | | 14.8 |
| 10 | 17.7 | 17.4 | 19.6 | 13.8 | 12.5 | 16.1 | 11.6 | | | | | | 15.8 |
| 11 | 19.0 | 18.2 | 20.9 | 14.9 | 13.4 | 18.4 | 13.2 | | | | | | 17.1 |
| 12 | 20.1 | 18.1 | 21.6 | 17.4 | 14.8 | 19.9 | 13.9 | | | | | | 18.2 |
| 13 | 19.4 | 19.8 | 22.7 | 19.5 | 15.1 | 21.9 | 15.8 | | | | | | 19.4 |
| 14 | 19.1 | 20.0 | 23.1 | 20.8 | 15.5 | 22.7 | 16.3 | | | | | | 19.9 |
| 15 | 18.4 | 21.6 | 22.8 | 21.2 | 16.2 | 23.3 | 18.1 | | | | | | 20.4 |
| 16 | 17.6 | 20.8 | 23.2 | 21.7 | 17.2 | 22.6 | 18.1 | | | | | | 20.3 |
| 17 | 17.4 | 17.5 | 22.6 | 22.5 | 16.8 | 21.6 | 16.8 | | | | | | 19.5 |
| 18 | 15.3 | 17.9 | 20.4 | 20.0 | 16.5 | 20.5 | 17.6 | | | | | | 18.4 |
| 19 | 15.6 | 17.0 | 19.0 | 18.4 | 14.9 | 19.6 | 16.8 | | | | | | 17.4 |
| 20 | 15.9 | 17.8 | 18.1 | 17.0 | 13.2 | 17.0 | 14.8 | | | | | | 16.3 |
| 21 | 16.5 | 17.3 | 17.3 | 17.0 | 14.2 | 14.3 | 12.7 | | | | | | 15.8 |
| 22 | 15.9 | 17.4 | 17.1 | 16.6 | 11.9 | 13.6 | 10.0 | | | | | | 15.0 |
| 23 | 16.3 | 17.5 | 16.0 | 14.8 | 11.9 | 14.1 | 9.3 | | | | | | 14.6 |
| 24 | 16.9 | 17.3 | 15.3 | 14.5 | 12.2 | 14.5 | 10.1 | | | | | | 14.7 |
| Mean | 17.1 | 18.0 | 18.3 | 16.3 | 13.1 | 16.5 | 12.1 | | | | | | 16.2 |

| Good Hours | | | | | | | |
|---|---|---|---|---|---|---|---|
| 720 | 696 | 744 | 720 | 744 | 720 | 397 | |

| Missing Hours | | | | | | | |
|---|---|---|---|---|---|---|---|
| 24 | 0 | 0 | 0 | 0 | 0 | 347 | |

4,741 Hours of Good Data  371 Hours Missing  92.7% Data Recovery

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
SHELDON DOME - 40M WIND SPEED (W) (MPH)

02/01/07 - 12/31/07

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | | 18.0 | 16.9 | 12.4 | 9.6 | 10.3 | 7.2 | 9.6 | 12.2 | 14.8 | 21.2 | 19.0 | 13.5 |
| 02 | | 18.1 | 17.0 | 12.8 | 9.3 | 10.3 | 7.6 | 9.8 | 11.8 | 14.3 | 20.9 | 20.8 | 13.6 |
| 03 | | 16.2 | 17.0 | 11.3 | 8.9 | 9.3 | 6.9 | 8.8 | 11.7 | 15.0 | 19.6 | 19.9 | 13.0 |
| 04 | | 14.0 | 17.5 | 12.7 | 8.1 | 9.7 | 5.9 | 8.2 | 11.1 | 15.5 | 19.7 | 20.1 | 12.9 |
| 05 | | 13.5 | 16.8 | 12.6 | 8.2 | 9.4 | 5.8 | 8.6 | 10.8 | 15.8 | 18.8 | 20.6 | 12.8 |
| 06 | | 11.8 | 17.2 | 11.6 | 8.3 | 8.9 | 5.7 | 7.8 | 10.1 | 15.7 | 18.6 | 19.9 | 12.4 |
| 07 | | 13.2 | 17.6 | 11.7 | 8.2 | 10.2 | 5.3 | 7.5 | 10.6 | 14.4 | 16.7 | 17.4 | 12.0 |
| 08 | | 13.4 | 16.3 | 13.1 | 9.1 | 11.3 | 5.9 | 8.4 | 10.7 | 13.1 | 16.3 | 15.1 | 12.0 |
| 09 | | 14.0 | 17.3 | 14.8 | 11.3 | 12.2 | 7.2 | 9.3 | 11.4 | 13.2 | 15.2 | 14.8 | 12.7 |
| 10 | | 13.7 | 18.4 | 14.7 | 12.9 | 13.5 | 7.6 | 11.2 | 12.5 | 14.2 | 16.6 | 15.8 | 13.7 |
| 11 | | 15.4 | 18.8 | 15.9 | 12.6 | 14.6 | 9.0 | 14.0 | 13.9 | 14.2 | 17.9 | 17.4 | 14.9 |
| 12 | | 20.3 | 20.1 | 17.2 | 14.7 | 14.9 | 10.0 | 14.2 | 14.5 | 15.1 | 18.8 | 17.8 | 15.9 |
| 13 | | 23.3 | 20.8 | 17.9 | 17.1 | 16.3 | 12.2 | 14.7 | 15.7 | 16.3 | 19.5 | 18.3 | 17.1 |
| 14 | | 26.1 | 20.8 | 18.4 | 15.8 | 16.2 | 12.6 | 16.7 | 16.3 | 17.0 | 21.3 | 19.9 | 17.8 |
| 15 | | 25.9 | 21.7 | 18.2 | 16.3 | 18.4 | 12.7 | 16.1 | 17.3 | 17.7 | 21.1 | 19.7 | 18.2 |
| 16 | | 27.2 | 22.8 | 18.8 | 18.0 | 19.2 | 13.0 | 16.5 | 18.6 | 17.1 | 19.9 | 19.3 | 18.6 |
| 17 | | 28.3 | 21.8 | 17.8 | 17.5 | 20.4 | 12.4 | 16.8 | 18.0 | 16.2 | 19.6 | 18.6 | 18.3 |
| 18 | | 27.1 | 19.7 | 17.7 | 17.2 | 20.0 | 12.5 | 16.1 | 15.3 | 15.6 | 19.6 | 19.2 | 17.6 |
| 19 | | 27.5 | 17.1 | 16.2 | 14.7 | 17.8 | 13.6 | 14.3 | 14.9 | 15.0 | 19.1 | 19.2 | 16.6 |
| 20 | | 26.4 | 18.3 | 14.5 | 12.8 | 17.6 | 13.5 | 13.6 | 14.9 | 15.5 | 20.2 | 18.0 | 16.3 |
| 21 | | 23.6 | 17.6 | 13.1 | 12.2 | 15.6 | 12.3 | 13.0 | 14.6 | 15.0 | 21.7 | 19.9 | 15.8 |
| 22 | | 20.5 | 17.7 | 13.6 | 10.8 | 15.0 | 10.6 | 11.5 | 14.0 | 16.0 | 20.6 | 21.5 | 15.3 |
| 23 | | 20.5 | 16.7 | 13.2 | 9.3 | 15.1 | 9.5 | 10.7 | 13.4 | 16.1 | 20.1 | 20.7 | 14.7 |
| 24 | | 20.0 | 15.8 | 12.4 | 9.1 | 12.8 | 8.0 | 10.0 | 13.0 | 15.6 | 19.8 | 19.9 | 13.9 |
| Mean | | 20.1 | 18.4 | 14.7 | 12.2 | 14.1 | 9.5 | 12.0 | 13.6 | 15.4 | 19.3 | 18.9 | 15.0 |
| Good Hours | | 276 | 744 | 667 | 744 | 720 | 744 | 744 | 720 | 744 | 720 | 744 | |
| Missing Hours | | 396 | 0 | 53 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

7,567 Hours of Good Data  449 Hours Missing  94.4% Data Recovery

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
SHELDON DOME - 40M WIND SPEED (W) (MPH)

01/01/08 - 07/31/08

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 16.7 | 17.9 | 15.5 | 15.6 | 12.7 | 14.8 | 9.4 | | | | | | 15.0 |
| 02 | 16.5 | 18.0 | 15.7 | 15.4 | 11.8 | 13.8 | 10.0 | | | | | | 14.7 |
| 03 | 17.0 | 18.4 | 15.8 | 13.6 | 10.5 | 12.2 | 8.3 | | | | | | 14.0 |
| 04 | 17.3 | 18.4 | 15.2 | 14.2 | 9.6 | 11.3 | 7.4 | | | | | | 13.7 |
| 05 | 16.4 | 17.2 | 14.0 | 13.4 | 10.2 | 10.5 | 8.5 | | | | | | 13.1 |
| 06 | 15.2 | 17.3 | 13.5 | 12.3 | 11.2 | 10.0 | 7.3 | | | | | | 12.7 |
| 07 | 15.6 | 16.2 | 15.6 | 10.9 | 11.6 | 13.5 | 7.2 | | | | | | 13.3 |
| 08 | 16.2 | 16.1 | 16.5 | 11.5 | 11.7 | 14.3 | 7.6 | | | | | | 13.8 |
| 09 | 16.2 | 16.8 | 18.6 | 12.4 | 12.0 | 15.0 | 8.8 | | | | | | 14.6 |
| 10 | 17.5 | 17.2 | 19.5 | 13.4 | 12.8 | 16.0 | 11.2 | | | | | | 15.6 |
| 11 | 18.7 | 18.0 | 20.7 | 14.6 | 13.6 | 18.3 | 13.0 | | | | | | 16.9 |
| 12 | 19.8 | 17.8 | 21.3 | 17.1 | 14.9 | 19.8 | 13.7 | | | | | | 18.1 |
| 13 | 19.1 | 19.5 | 22.4 | 19.2 | 15.2 | 21.8 | 15.5 | | | | | | 19.2 |
| 14 | 18.8 | 19.7 | 22.8 | 20.6 | 15.6 | 22.5 | 15.8 | | | | | | 19.7 |
| 15 | 18.2 | 21.3 | 22.4 | 21.0 | 16.3 | 23.1 | 17.7 | | | | | | 20.2 |
| 16 | 17.4 | 20.6 | 22.8 | 21.5 | 17.3 | 22.4 | 17.8 | | | | | | 20.1 |
| 17 | 17.2 | 17.4 | 22.3 | 22.4 | 17.0 | 21.3 | 16.3 | | | | | | 19.3 |
| 18 | 15.3 | 17.7 | 20.1 | 19.9 | 16.7 | 20.3 | 17.3 | | | | | | 18.3 |
| 19 | 15.5 | 16.9 | 18.9 | 18.4 | 15.1 | 19.5 | 16.7 | | | | | | 17.3 |
| 20 | 15.8 | 17.7 | 18.0 | 16.9 | 13.5 | 17.0 | 14.8 | | | | | | 16.3 |
| 21 | 16.3 | 17.2 | 17.1 | 16.9 | 14.5 | 14.4 | 12.9 | | | | | | 15.8 |
| 22 | 15.8 | 17.4 | 17.0 | 16.5 | 12.3 | 13.7 | 9.8 | | | | | | 14.9 |
| 23 | 16.1 | 17.5 | 15.9 | 14.7 | 12.2 | 14.0 | 9.2 | | | | | | 14.6 |
| 24 | 16.7 | 17.3 | 15.2 | 14.5 | 12.6 | 14.4 | 10.0 | | | | | | 14.7 |
| Mean | 16.9 | 17.9 | 18.2 | 16.1 | 13.4 | 16.4 | 11.9 | | | | | | 16.1 |

Good Hours

| 720 | 696 | 744 | 720 | 744 | 720 | 397 |
|---|---|---|---|---|---|---|

Missing Hours

| 24 | 0 | 0 | 0 | 0 | 0 | 347 |
|---|---|---|---|---|---|---|

4,741 Hours of Good Data  371 Hours Missing  92.7% Data Recovery

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
SHELDON DOME - 49.5M WIND SPEED (S) (MPH)

02/01/07 - 12/31/07

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | | 18.9 | 17.7 | 12.9 | 9.9 | 10.6 | 7.6 | 10.2 | 12.6 | 15.3 | 21.7 | 19.6 | 14.0 |
| 02 | | 19.0 | 17.8 | 13.3 | 9.6 | 10.6 | 8.0 | 10.2 | 12.1 | 14.9 | 21.5 | 21.6 | 14.1 |
| 03 | | 17.1 | 17.8 | 11.8 | 9.5 | 9.5 | 7.2 | 9.1 | 12.0 | 15.6 | 20.1 | 20.7 | 13.5 |
| 04 | | 14.7 | 18.3 | 13.1 | 8.8 | 10.0 | 6.2 | 8.7 | 11.4 | 16.3 | 20.3 | 20.7 | 13.4 |
| 05 | | 14.1 | 17.7 | 13.0 | 8.6 | 9.6 | 6.1 | 9.1 | 11.2 | 16.5 | 19.4 | 21.3 | 13.3 |
| 06 | | 12.5 | 18.1 | 11.9 | 8.6 | 9.2 | 6.1 | 8.3 | 10.4 | 16.3 | 19.3 | 20.4 | 12.8 |
| 07 | | 13.9 | 18.3 | 12.0 | 8.4 | 10.3 | 5.7 | 7.9 | 10.9 | 15.0 | 17.2 | 17.8 | 12.4 |
| 08 | | 13.9 | 17.0 | 13.4 | 9.3 | 11.4 | 6.2 | 8.7 | 11.0 | 13.7 | 16.8 | 15.6 | 12.3 |
| 09 | | 14.5 | 17.8 | 15.1 | 11.4 | 12.2 | 7.5 | 9.6 | 11.6 | 13.7 | 15.4 | 15.3 | 13.0 |
| 10 | | 14.2 | 18.9 | 15.0 | 13.0 | 13.5 | 8.0 | 11.5 | 12.7 | 14.2 | 16.9 | 16.3 | 14.0 |
| 11 | | 15.8 | 19.3 | 16.2 | 12.6 | 14.6 | 9.3 | 14.2 | 14.0 | 14.2 | 18.3 | 17.8 | 15.1 |
| 12 | | 20.8 | 20.7 | 17.4 | 14.6 | 14.8 | 10.3 | 14.3 | 14.6 | 15.2 | 19.2 | 18.2 | 16.1 |
| 13 | | 23.9 | 21.3 | 18.2 | 17.0 | 16.1 | 12.4 | 14.8 | 15.8 | 16.5 | 19.9 | 18.6 | 17.3 |
| 14 | | 26.9 | 21.2 | 18.8 | 15.8 | 16.1 | 12.8 | 16.7 | 16.3 | 17.1 | 21.7 | 20.4 | 18.0 |
| 15 | | 26.8 | 22.2 | 18.6 | 16.2 | 18.3 | 12.9 | 16.1 | 17.2 | 17.8 | 21.5 | 20.2 | 18.4 |
| 16 | | 28.2 | 23.4 | 19.2 | 17.9 | 19.1 | 13.2 | 16.5 | 18.6 | 17.2 | 20.4 | 19.9 | 18.9 |
| 17 | | 29.4 | 22.5 | 18.2 | 17.4 | 20.2 | 12.6 | 17.0 | 18.0 | 16.5 | 20.3 | 19.2 | 18.6 |
| 18 | | 28.3 | 20.5 | 18.0 | 17.1 | 19.9 | 12.8 | 16.4 | 15.7 | 15.8 | 20.1 | 19.8 | 18.0 |
| 19 | | 28.9 | 17.9 | 16.8 | 14.8 | 17.9 | 13.9 | 14.7 | 15.2 | 15.2 | 19.6 | 19.8 | 17.0 |
| 20 | | 27.8 | 19.1 | 15.1 | 13.0 | 18.0 | 13.8 | 14.0 | 15.3 | 15.9 | 20.8 | 18.6 | 16.8 |
| 21 | | 24.8 | 18.5 | 13.6 | 12.6 | 15.8 | 12.6 | 13.4 | 14.9 | 15.3 | 22.4 | 20.6 | 16.3 |
| 22 | | 21.5 | 18.6 | 14.0 | 11.0 | 15.3 | 11.0 | 12.0 | 14.3 | 16.4 | 21.4 | 22.4 | 15.9 |
| 23 | | 21.5 | 17.6 | 13.7 | 9.6 | 15.4 | 9.8 | 11.1 | 13.8 | 16.4 | 20.9 | 21.4 | 15.2 |
| 24 | | 21.0 | 16.6 | 12.9 | 9.4 | 13.1 | 8.4 | 10.6 | 13.3 | 15.9 | 20.4 | 20.6 | 14.4 |
| Mean | | 21.0 | 19.1 | 15.1 | 12.3 | 14.2 | 9.8 | 12.3 | 13.9 | 15.7 | 19.8 | 19.4 | 15.4 |
| Good Hours | | 276 | 744 | 667 | 744 | 720 | 744 | 744 | 720 | 744 | 720 | 744 | |
| Missing Hours | | 396 | 0 | 53 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

7,567 Hours of Good Data  449 Hours Missing  94.4% Data Recovery

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
SHELDON DOME - 49.5M WIND SPEED (S) (MPH)

01/01/08 - 07/31/08

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 17.2 | 18.6 | 16.1 | 16.1 | 12.7 | 15.1 | 9.9 | | | | | | 15.4 |
| 02 | 17.1 | 18.7 | 16.3 | 15.9 | 11.8 | 14.1 | 10.4 | | | | | | 15.2 |
| 03 | 17.6 | 19.2 | 16.4 | 14.0 | 10.5 | 12.6 | 8.7 | | | | | | 14.5 |
| 04 | 17.8 | 19.1 | 15.7 | 14.8 | 9.5 | 11.6 | 7.9 | | | | | | 14.1 |
| 05 | 16.9 | 17.7 | 14.6 | 13.9 | 10.1 | 10.7 | 8.9 | | | | | | 13.5 |
| 06 | 15.6 | 17.8 | 14.1 | 12.7 | 11.1 | 10.2 | 7.8 | | | | | | 13.1 |
| 07 | 15.8 | 16.7 | 16.2 | 11.2 | 11.6 | 13.8 | 7.6 | | | | | | 13.6 |
| 08 | 16.7 | 16.7 | 16.9 | 11.8 | 11.6 | 14.5 | 7.9 | | | | | | 14.1 |
| 09 | 16.7 | 17.2 | 19.1 | 12.8 | 11.9 | 15.2 | 9.1 | | | | | | 14.9 |
| 10 | 17.8 | 17.6 | 19.9 | 13.8 | 12.6 | 16.2 | 11.4 | | | | | | 15.9 |
| 11 | 19.0 | 18.3 | 21.2 | 14.8 | 13.4 | 18.5 | 13.1 | | | | | | 17.1 |
| 12 | 20.1 | 18.3 | 21.8 | 17.2 | 14.8 | 19.7 | 13.8 | | | | | | 18.2 |
| 13 | 19.3 | 20.0 | 22.9 | 19.5 | 15.1 | 21.7 | 15.6 | | | | | | 19.4 |
| 14 | 19.1 | 20.3 | 23.4 | 20.7 | 15.4 | 22.6 | 16.0 | | | | | | 19.9 |
| 15 | 18.6 | 21.8 | 23.0 | 21.2 | 16.1 | 23.1 | 17.8 | | | | | | 20.4 |
| 16 | 17.8 | 21.0 | 23.4 | 21.7 | 17.1 | 22.5 | 17.6 | | | | | | 20.3 |
| 17 | 17.6 | 17.7 | 22.9 | 22.6 | 16.8 | 21.5 | 16.5 | | | | | | 19.6 |
| 18 | 15.8 | 18.3 | 20.8 | 20.1 | 16.6 | 20.3 | 17.6 | | | | | | 18.6 |
| 19 | 15.9 | 17.5 | 19.6 | 18.7 | 15.2 | 19.6 | 16.9 | | | | | | 17.7 |
| 20 | 16.2 | 18.4 | 18.6 | 17.3 | 13.5 | 17.1 | 15.1 | | | | | | 16.7 |
| 21 | 16.6 | 17.8 | 17.8 | 17.2 | 14.5 | 14.7 | 13.1 | | | | | | 16.2 |
| 22 | 16.1 | 17.9 | 17.7 | 16.7 | 12.1 | 13.9 | 10.3 | | | | | | 15.3 |
| 23 | 16.6 | 18.0 | 16.5 | 15.0 | 12.1 | 14.3 | 9.6 | | | | | | 14.9 |
| 24 | 17.2 | 17.9 | 15.8 | 14.8 | 12.5 | 14.6 | 10.5 | | | | | | 15.0 |
| Mean | 17.3 | 18.4 | 18.8 | 16.4 | 13.3 | 16.6 | 12.2 | | | | | | 16.4 |

Good Hours

| 720 | 696 | 744 | 720 | 744 | 720 | 397 |
|---|---|---|---|---|---|---|

Missing Hours

| 24 | 0 | 0 | 0 | 0 | 0 | 347 |
|---|---|---|---|---|---|---|

4,741 Hours of Good Data  371 Hours Missing  92.7% Data Recovery

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
SHELDON DOME - 49.5M WIND SPEED (W) (MPH)

02/01/07 - 12/31/07

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | | 18.7 | 17.6 | 12.8 | 10.0 | 10.7 | 7.6 | 10.2 | 12.8 | 15.3 | 21.8 | 19.8 | 14.0 |
| 02 | | 18.8 | 17.7 | 13.3 | 9.7 | 10.6 | 8.0 | 10.3 | 12.4 | 14.7 | 21.6 | 21.7 | 14.2 |
| 03 | | 16.9 | 17.7 | 11.8 | 9.5 | 9.6 | 7.3 | 9.3 | 12.3 | 15.5 | 20.2 | 20.8 | 13.5 |
| 04 | | 14.6 | 18.2 | 13.1 | 8.8 | 10.0 | 6.3 | 8.8 | 11.6 | 16.1 | 20.4 | 20.8 | 13.4 |
| 05 | | 14.0 | 17.6 | 13.0 | 8.7 | 9.6 | 6.1 | 9.2 | 11.3 | 16.4 | 19.5 | 21.4 | 13.3 |
| 06 | | 12.3 | 18.0 | 11.9 | 8.7 | 9.2 | 6.1 | 8.3 | 10.6 | 16.1 | 19.3 | 20.5 | 12.9 |
| 07 | | 13.7 | 18.2 | 11.9 | 8.5 | 10.4 | 5.7 | 8.0 | 11.0 | 14.8 | 17.3 | 18.0 | 12.4 |
| 08 | | 13.8 | 16.9 | 13.3 | 9.3 | 11.5 | 6.1 | 8.7 | 11.0 | 13.4 | 16.9 | 15.8 | 12.3 |
| 09 | | 14.2 | 17.7 | 15.0 | 11.5 | 12.3 | 7.5 | 9.6 | 11.6 | 13.4 | 15.6 | 15.5 | 13.0 |
| 10 | | 13.8 | 18.8 | 14.9 | 13.1 | 13.7 | 7.9 | 11.4 | 12.7 | 14.3 | 16.9 | 16.6 | 14.0 |
| 11 | | 15.5 | 19.2 | 16.1 | 12.8 | 14.8 | 9.3 | 14.2 | 14.1 | 14.3 | 18.2 | 18.0 | 15.1 |
| 12 | | 20.5 | 20.5 | 17.4 | 14.9 | 15.1 | 10.3 | 14.5 | 14.8 | 15.2 | 19.1 | 18.3 | 16.1 |
| 13 | | 23.5 | 21.1 | 18.1 | 17.3 | 16.5 | 12.5 | 15.0 | 16.0 | 16.5 | 19.9 | 18.7 | 17.4 |
| 14 | | 26.5 | 21.0 | 18.7 | 16.0 | 16.4 | 13.0 | 17.0 | 16.6 | 17.2 | 21.6 | 20.5 | 18.1 |
| 15 | | 26.4 | 22.0 | 18.5 | 16.5 | 18.6 | 13.0 | 16.4 | 17.6 | 17.9 | 21.5 | 20.4 | 18.5 |
| 16 | | 27.8 | 23.2 | 19.1 | 18.2 | 19.4 | 13.4 | 16.8 | 18.9 | 17.4 | 20.5 | 20.1 | 19.0 |
| 17 | | 29.1 | 22.4 | 18.1 | 17.7 | 20.6 | 12.8 | 17.2 | 18.4 | 16.6 | 20.3 | 19.4 | 18.7 |
| 18 | | 28.0 | 20.4 | 18.0 | 17.5 | 20.3 | 12.9 | 16.7 | 15.9 | 16.0 | 20.3 | 20.0 | 18.2 |
| 19 | | 28.6 | 17.8 | 16.8 | 15.2 | 18.4 | 14.1 | 15.0 | 15.6 | 15.4 | 19.8 | 19.9 | 17.2 |
| 20 | | 27.6 | 19.0 | 15.1 | 13.3 | 18.4 | 14.1 | 14.2 | 15.6 | 16.0 | 20.9 | 18.8 | 16.9 |
| 21 | | 24.6 | 18.4 | 13.6 | 12.8 | 16.4 | 12.9 | 13.6 | 15.2 | 15.4 | 22.5 | 20.8 | 16.5 |
| 22 | | 21.4 | 18.4 | 14.1 | 11.3 | 15.7 | 11.2 | 12.2 | 14.6 | 16.5 | 21.5 | 22.5 | 16.0 |
| 23 | | 21.3 | 17.4 | 13.7 | 9.8 | 15.7 | 9.9 | 11.3 | 14.1 | 16.5 | 20.9 | 21.5 | 15.3 |
| 24 | | 20.8 | 16.5 | 12.9 | 9.5 | 13.3 | 8.5 | 10.7 | 13.6 | 15.9 | 20.5 | 20.8 | 14.5 |
| Mean | | 20.7 | 19.0 | 15.1 | 12.5 | 14.5 | 9.9 | 12.4 | 14.1 | 15.7 | 19.9 | 19.6 | 15.5 |
| Good Hours | | 276 | 744 | 667 | 744 | 720 | 744 | 744 | 720 | 744 | 720 | 744 | |
| Missing Hours | | 396 | 0 | 53 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

7,567 Hours of Good Data  449 Hours Missing  94.4% Data Recovery

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
SHELDON DOME - 49.5M WIND SPEED (W) (MPH)

01/01/08 - 07/31/08

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 17.6 | 18.8 | 16.4 | 16.4 | 13.0 | 15.6 | 10.2 | | | | | | 15.7 |
| 02 | 17.5 | 18.9 | 16.6 | 16.2 | 12.1 | 14.6 | 10.8 | | | | | | 15.5 |
| 03 | 18.0 | 19.4 | 16.5 | 14.3 | 10.9 | 13.0 | 9.1 | | | | | | 14.8 |
| 04 | 18.2 | 19.3 | 16.0 | 15.1 | 9.9 | 12.0 | 8.2 | | | | | | 14.4 |
| 05 | 17.3 | 18.0 | 14.9 | 14.2 | 10.4 | 11.1 | 9.2 | | | | | | 13.8 |
| 06 | 16.1 | 18.1 | 14.3 | 13.0 | 11.3 | 10.6 | 8.0 | | | | | | 13.4 |
| 07 | 16.3 | 17.0 | 16.4 | 11.5 | 11.7 | 14.1 | 7.8 | | | | | | 13.9 |
| 08 | 17.1 | 16.9 | 17.0 | 11.9 | 11.7 | 14.8 | 8.1 | | | | | | 14.3 |
| 09 | 17.0 | 17.5 | 19.1 | 12.9 | 12.0 | 15.4 | 9.4 | | | | | | 15.1 |
| 10 | 18.2 | 17.8 | 20.0 | 13.8 | 12.9 | 16.5 | 11.7 | | | | | | 16.1 |
| 11 | 19.4 | 18.4 | 21.3 | 14.9 | 13.6 | 18.7 | 13.4 | | | | | | 17.4 |
| 12 | 20.5 | 18.3 | 21.9 | 17.4 | 15.0 | 20.2 | 14.1 | | | | | | 18.5 |
| 13 | 19.7 | 20.1 | 23.0 | 19.6 | 15.2 | 22.2 | 16.0 | | | | | | 19.6 |
| 14 | 19.5 | 20.3 | 23.3 | 20.9 | 15.6 | 23.0 | 16.4 | | | | | | 20.1 |
| 15 | 19.0 | 21.9 | 23.0 | 21.4 | 16.3 | 23.6 | 18.3 | | | | | | 20.6 |
| 16 | 18.2 | 21.1 | 23.4 | 21.9 | 17.4 | 22.9 | 18.3 | | | | | | 20.6 |
| 17 | 18.0 | 18.0 | 22.9 | 22.8 | 17.0 | 22.0 | 17.0 | | | | | | 19.9 |
| 18 | 16.3 | 18.4 | 20.9 | 20.6 | 16.8 | 20.9 | 17.9 | | | | | | 18.9 |
| 19 | 16.4 | 17.6 | 19.7 | 19.2 | 15.3 | 20.3 | 17.3 | | | | | | 18.0 |
| 20 | 16.7 | 18.6 | 18.8 | 17.8 | 13.7 | 17.8 | 15.7 | | | | | | 17.1 |
| 21 | 17.1 | 18.0 | 18.0 | 17.7 | 14.7 | 15.2 | 13.7 | | | | | | 16.5 |
| 22 | 16.6 | 18.1 | 17.9 | 17.2 | 12.6 | 14.5 | 10.6 | | | | | | 15.7 |
| 23 | 16.9 | 18.3 | 16.8 | 15.5 | 12.5 | 14.9 | 10.1 | | | | | | 15.3 |
| 24 | 17.6 | 18.1 | 16.0 | 15.3 | 12.9 | 15.1 | 10.7 | | | | | | 15.4 |
| Mean | 17.7 | 18.6 | 18.9 | 16.7 | 13.5 | 17.0 | 12.5 | | | | | | 16.7 |
| Good Hours | 720 | 696 | 744 | 720 | 744 | 720 | 397 | | | | | | |
| Missing Hours | 24 | 0 | 0 | 0 | 0 | 0 | 347 | | | | | | |

4,741 Hours of Good Data  371 Hours Missing  92.7% Data Recovery

MEAN HOURLY VALUES

WIND RIVER RESERVATION
SHELDON DOME - 37M WIND DIRECTION (DEG)

02/01/07 - 12/31/07

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | | 243 | 242 | 205 | 194 | 210 | 142 | 227 | 233 | 218 | 249 | 268 | 220 |
| 02 | | 253 | 228 | 218 | 174 | 201 | 148 | 236 | 236 | 214 | 249 | 265 | 218 |
| 03 | | 243 | 237 | 205 | 183 | 179 | 155 | 228 | 240 | 212 | 245 | 244 | 214 |
| 04 | | 211 | 219 | 227 | 203 | 195 | 173 | 223 | 232 | 215 | 236 | 253 | 217 |
| 05 | | 187 | 232 | 216 | 175 | 226 | 190 | 245 | 203 | 224 | 254 | 241 | 219 |
| 06 | | 197 | 258 | 217 | 153 | 217 | 172 | 197 | 181 | 217 | 227 | 233 | 207 |
| 07 | | 167 | 228 | 195 | 169 | 197 | 153 | 188 | 165 | 206 | 231 | 246 | 197 |
| 08 | | 164 | 233 | 194 | 192 | 174 | 164 | 180 | 167 | 219 | 233 | 215 | 196 |
| 09 | | 165 | 211 | 196 | 197 | 178 | 144 | 177 | 169 | 214 | 226 | 216 | 192 |
| 10 | | 165 | 198 | 196 | 185 | 188 | 153 | 178 | 166 | 210 | 229 | 235 | 193 |
| 11 | | 188 | 198 | 192 | 199 | 190 | 154 | 189 | 174 | 202 | 216 | 221 | 193 |
| 12 | | 218 | 195 | 190 | 209 | 191 | 156 | 195 | 178 | 207 | 208 | 235 | 197 |
| 13 | | 232 | 196 | 187 | 184 | 193 | 159 | 186 | 195 | 180 | 227 | 228 | 195 |
| 14 | | 237 | 195 | 190 | 183 | 197 | 128 | 208 | 205 | 180 | 224 | 220 | 195 |
| 15 | | 248 | 203 | 200 | 187 | 207 | 148 | 216 | 212 | 184 | 235 | 225 | 203 |
| 16 | | 261 | 209 | 181 | 183 | 229 | 130 | 229 | 223 | 195 | 236 | 241 | 208 |
| 17 | | 270 | 216 | 181 | 180 | 228 | 176 | 210 | 227 | 169 | 246 | 250 | 211 |
| 18 | | 283 | 218 | 177 | 191 | 244 | 178 | 206 | 222 | 203 | 261 | 232 | 216 |
| 19 | | 290 | 219 | 187 | 187 | 229 | 186 | 214 | 219 | 204 | 263 | 224 | 216 |
| 20 | | 294 | 236 | 197 | 193 | 245 | 157 | 214 | 223 | 219 | 258 | 233 | 220 |
| 21 | | 293 | 245 | 200 | 222 | 252 | 155 | 222 | 233 | 221 | 253 | 236 | 227 |
| 22 | | 289 | 240 | 197 | 219 | 222 | 168 | 233 | 205 | 210 | 256 | 241 | 222 |
| 23 | | 254 | 234 | 190 | 197 | 232 | 197 | 236 | 227 | 208 | 249 | 235 | 222 |
| 24 | | 268 | 247 | 202 | 169 | 210 | 163 | 210 | 241 | 225 | 256 | 256 | 220 |
| Mean | | 236 | 222 | 197 | 189 | 210 | 160 | 210 | 207 | 207 | 240 | 237 | 209 |
| Good Hours | | 276 | 744 | 666 | 744 | 720 | 744 | 744 | 720 | 744 | 720 | 744 | |
| Missing Hours | | 396 | 0 | 54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

7,566 Hours of Good Data  450 Hours Missing  94.4% Data Recovery

MEAN HOURLY VALUES

WIND RIVER RESERVATION
SHELDON DOME - 37M WIND DIRECTION (DEG)

01/01/08 - 07/31/08

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 242 | 247 | 242 | 233 | 199 | 215 | 245 | | | | | | 231 |
| 02 | 241 | 207 | 239 | 246 | 185 | 220 | 253 | | | | | | 226 |
| 03 | 216 | 232 | 250 | 243 | 206 | 191 | 255 | | | | | | 226 |
| 04 | 220 | 209 | 261 | 232 | 192 | 209 | 288 | | | | | | 226 |
| 05 | 220 | 214 | 231 | 241 | 174 | 222 | 221 | | | | | | 217 |
| 06 | 212 | 214 | 229 | 214 | 187 | 190 | 223 | | | | | | 209 |
| 07 | 211 | 218 | 238 | 198 | 173 | 189 | 165 | | | | | | 201 |
| 08 | 227 | 200 | 227 | 192 | 178 | 198 | 175 | | | | | | 201 |
| 09 | 212 | 213 | 219 | 180 | 192 | 202 | 185 | | | | | | 201 |
| 10 | 232 | 216 | 215 | 199 | 213 | 220 | 183 | | | | | | 213 |
| 11 | 201 | 209 | 219 | 188 | 206 | 217 | 192 | | | | | | 205 |
| 12 | 234 | 211 | 191 | 202 | 186 | 221 | 201 | | | | | | 207 |
| 13 | 208 | 222 | 197 | 209 | 192 | 227 | 219 | | | | | | 210 |
| 14 | 201 | 215 | 209 | 198 | 187 | 237 | 179 | | | | | | 205 |
| 15 | 217 | 228 | 202 | 216 | 175 | 249 | 198 | | | | | | 213 |
| 16 | 213 | 222 | 196 | 185 | 175 | 257 | 203 | | | | | | 207 |
| 17 | 213 | 219 | 192 | 195 | 180 | 243 | 197 | | | | | | 206 |
| 18 | 234 | 206 | 196 | 216 | 150 | 245 | 192 | | | | | | 206 |
| 19 | 252 | 213 | 221 | 238 | 181 | 244 | 197 | | | | | | 222 |
| 20 | 235 | 214 | 251 | 246 | 212 | 220 | 162 | | | | | | 224 |
| 21 | 223 | 238 | 235 | 246 | 183 | 199 | 206 | | | | | | 219 |
| 22 | 223 | 225 | 242 | 265 | 189 | 232 | 195 | | | | | | 226 |
| 23 | 230 | 241 | 249 | 248 | 215 | 221 | 226 | | | | | | 233 |
| 24 | 249 | 254 | 237 | 224 | 193 | 226 | 204 | | | | | | 228 |
| Mean | 224 | 220 | 224 | 219 | 188 | 221 | 207 | | | | | | 215 |
| Good Hours | 720 | 696 | 744 | 720 | 744 | 720 | 397 | | | | | | |
| Missing Hours | 24 | 0 | 0 | 0 | 0 | 0 | 347 | | | | | | |

4,741 Hours of Good Data  371 Hours Missing  92.7% Data Recovery

MEAN HOURLY VALUES

WIND RIVER RESERVATION
SHELDON DOME - 48.5M WIND DIRECTION (DEG)

02/01/07 - 12/31/07

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | | 244 | 241 | 206 | 195 | 210 | 145 | 227 | 233 | 228 | 251 | 267 | 221 |
| 02 | | 254 | 229 | 220 | 173 | 189 | 149 | 237 | 237 | 222 | 255 | 267 | 219 |
| 03 | | 244 | 240 | 204 | 183 | 180 | 158 | 227 | 239 | 212 | 247 | 247 | 215 |
| 04 | | 213 | 221 | 228 | 190 | 197 | 162 | 211 | 234 | 217 | 238 | 257 | 215 |
| 05 | | 191 | 232 | 216 | 184 | 217 | 191 | 234 | 202 | 227 | 255 | 245 | 220 |
| 06 | | 219 | 248 | 228 | 155 | 227 | 186 | 207 | 192 | 217 | 229 | 235 | 212 |
| 07 | | 175 | 230 | 210 | 168 | 198 | 153 | 203 | 181 | 211 | 235 | 259 | 204 |
| 08 | | 168 | 234 | 194 | 188 | 186 | 153 | 179 | 168 | 231 | 243 | 226 | 199 |
| 09 | | 166 | 234 | 197 | 196 | 178 | 143 | 177 | 169 | 222 | 226 | 217 | 195 |
| 10 | | 163 | 199 | 196 | 197 | 188 | 152 | 178 | 178 | 212 | 230 | 234 | 195 |
| 11 | | 188 | 198 | 192 | 200 | 189 | 154 | 189 | 175 | 203 | 218 | 219 | 193 |
| 12 | | 218 | 194 | 190 | 209 | 194 | 155 | 194 | 178 | 208 | 210 | 236 | 198 |
| 13 | | 232 | 194 | 187 | 183 | 193 | 160 | 186 | 196 | 181 | 226 | 229 | 195 |
| 14 | | 238 | 195 | 190 | 184 | 197 | 127 | 208 | 205 | 180 | 224 | 231 | 196 |
| 15 | | 248 | 203 | 200 | 188 | 207 | 147 | 216 | 213 | 183 | 235 | 237 | 204 |
| 16 | | 261 | 210 | 182 | 183 | 229 | 130 | 229 | 223 | 196 | 238 | 241 | 208 |
| 17 | | 271 | 216 | 182 | 180 | 229 | 164 | 222 | 227 | 171 | 249 | 250 | 211 |
| 18 | | 284 | 219 | 177 | 191 | 244 | 167 | 207 | 221 | 205 | 262 | 234 | 216 |
| 19 | | 291 | 230 | 175 | 186 | 229 | 187 | 215 | 220 | 205 | 253 | 227 | 216 |
| 20 | | 295 | 237 | 197 | 192 | 246 | 157 | 203 | 212 | 204 | 261 | 246 | 218 |
| 21 | | 293 | 257 | 200 | 223 | 252 | 155 | 224 | 234 | 218 | 254 | 249 | 229 |
| 22 | | 290 | 241 | 197 | 220 | 223 | 171 | 243 | 205 | 211 | 257 | 242 | 224 |
| 23 | | 255 | 235 | 191 | 197 | 232 | 197 | 226 | 228 | 219 | 255 | 226 | 222 |
| 24 | | 269 | 247 | 203 | 179 | 212 | 175 | 221 | 241 | 226 | 258 | 257 | 224 |
| Mean | | 238 | 224 | 198 | 189 | 210 | 160 | 211 | 209 | 209 | 242 | 241 | 210 |
| Good Hours | | 276 | 744 | 666 | 744 | 720 | 744 | 744 | 720 | 744 | 720 | 744 | |
| Missing Hours | | 396 | 0 | 54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

7,566 Hours of Good Data  450 Hours Missing  94.4% Data Recovery

MEAN HOURLY VALUES

WIND RIVER RESERVATION
SHELDON DOME - 48.5M WIND DIRECTION (DEG)

01/01/08 - 07/31/08

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 239 | 248 | 241 | 234 | 200 | 215 | 244 | | | | | | 231 |
| 02 | 241 | 211 | 239 | 248 | 186 | 219 | 251 | | | | | | 226 |
| 03 | 219 | 232 | 251 | 234 | 209 | 192 | 254 | | | | | | 225 |
| 04 | 224 | 211 | 262 | 234 | 191 | 201 | 286 | | | | | | 226 |
| 05 | 220 | 215 | 220 | 242 | 184 | 224 | 222 | | | | | | 218 |
| 06 | 215 | 214 | 237 | 216 | 185 | 201 | 222 | | | | | | 212 |
| 07 | 224 | 232 | 239 | 199 | 172 | 188 | 178 | | | | | | 206 |
| 08 | 227 | 209 | 238 | 191 | 191 | 198 | 175 | | | | | | 206 |
| 09 | 208 | 208 | 219 | 180 | 191 | 203 | 184 | | | | | | 200 |
| 10 | 233 | 227 | 215 | 200 | 213 | 220 | 182 | | | | | | 215 |
| 11 | 212 | 207 | 209 | 187 | 207 | 216 | 191 | | | | | | 205 |
| 12 | 241 | 209 | 191 | 191 | 187 | 222 | 200 | | | | | | 206 |
| 13 | 208 | 221 | 197 | 209 | 192 | 228 | 217 | | | | | | 210 |
| 14 | 208 | 216 | 209 | 211 | 188 | 238 | 179 | | | | | | 209 |
| 15 | 227 | 228 | 202 | 216 | 175 | 250 | 197 | | | | | | 214 |
| 16 | 215 | 221 | 197 | 186 | 175 | 257 | 203 | | | | | | 208 |
| 17 | 228 | 219 | 192 | 195 | 179 | 243 | 197 | | | | | | 208 |
| 18 | 234 | 207 | 196 | 216 | 150 | 246 | 192 | | | | | | 207 |
| 19 | 256 | 214 | 221 | 238 | 181 | 244 | 197 | | | | | | 223 |
| 20 | 225 | 216 | 252 | 246 | 212 | 221 | 163 | | | | | | 223 |
| 21 | 234 | 239 | 236 | 248 | 183 | 200 | 208 | | | | | | 222 |
| 22 | 226 | 225 | 242 | 265 | 189 | 221 | 194 | | | | | | 225 |
| 23 | 226 | 254 | 249 | 248 | 205 | 222 | 226 | | | | | | 233 |
| 24 | 244 | 256 | 238 | 224 | 190 | 226 | 208 | | | | | | 228 |
| Mean | 226 | 222 | 225 | 219 | 189 | 221 | 207 | | | | | | 216 |
| Good Hours | 720 | 696 | 744 | 720 | 744 | 720 | 397 | | | | | | |
| Missing Hours | 24 | 0 | 0 | 0 | 0 | 0 | 347 | | | | | | |

4,741 Hours of Good Data  371 Hours Missing  92.7% Data Recovery

MEAN HOURLY VALUES

WIND RIVER RESERVATION
SHELDON DOME - TEMPERATURE (DEG)

02/01/07 - 12/31/07

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | | 24.1 | 35.5 | 35.1 | 46.1 | 56.8 | 66.6 | 61.8 | 51.7 | 41.2 | 32.3 | 18.8 | 43.9 |
| 02 | | 24.5 | 34.8 | 34.5 | 45.5 | 55.6 | 65.8 | 61.7 | 51.3 | 40.8 | 32.6 | 18.9 | 43.5 |
| 03 | | 24.7 | 34.2 | 34.2 | 44.8 | 54.8 | 65.1 | 61.1 | 50.6 | 40.6 | 32.2 | 18.7 | 43.0 |
| 04 | | 23.9 | 34.0 | 33.9 | 44.5 | 54.4 | 64.6 | 60.9 | 49.8 | 40.3 | 31.4 | 18.8 | 42.6 |
| 05 | | 22.9 | 33.8 | 33.4 | 44.9 | 55.1 | 64.9 | 60.5 | 49.2 | 39.8 | 30.9 | 18.8 | 42.4 |
| 06 | | 23.2 | 33.6 | 34.5 | 46.9 | 57.6 | 66.9 | 61.3 | 49.0 | 39.3 | 30.8 | 18.5 | 43.2 |
| 07 | | 24.0 | 34.5 | 36.8 | 49.9 | 60.6 | 69.6 | 63.9 | 51.3 | 40.8 | 31.1 | 18.3 | 44.9 |
| 08 | | 26.6 | 37.0 | 40.2 | 53.0 | 63.5 | 72.4 | 67.0 | 54.6 | 43.1 | 33.2 | 19.3 | 47.6 |
| 09 | | 29.2 | 40.5 | 43.2 | 55.5 | 66.5 | 75.8 | 70.1 | 57.7 | 45.9 | 35.3 | 21.3 | 50.4 |
| 10 | | 30.8 | 43.2 | 45.4 | 57.4 | 69.4 | 78.7 | 72.1 | 60.4 | 48.3 | 37.8 | 23.1 | 52.8 |
| 11 | | 32.6 | 45.5 | 47.0 | 59.4 | 71.4 | 81.0 | 73.9 | 62.5 | 50.4 | 39.4 | 25.0 | 54.8 |
| 12 | | 34.4 | 47.0 | 48.8 | 60.2 | 73.5 | 82.3 | 75.4 | 64.2 | 51.4 | 40.8 | 25.2 | 56.1 |
| 13 | | 35.9 | 47.7 | 49.7 | 60.7 | 74.4 | 82.9 | 76.7 | 65.6 | 51.9 | 41.4 | 25.4 | 56.8 |
| 14 | | 36.4 | 47.9 | 50.0 | 61.4 | 74.8 | 82.4 | 76.6 | 66.3 | 51.8 | 41.5 | 24.9 | 57.0 |
| 15 | | 35.7 | 47.4 | 50.0 | 61.2 | 75.0 | 82.0 | 76.0 | 66.2 | 51.2 | 40.4 | 23.7 | 56.5 |
| 16 | | 34.1 | 46.4 | 49.2 | 60.2 | 74.0 | 81.5 | 75.1 | 64.7 | 49.4 | 37.8 | 22.1 | 55.2 |
| 17 | | 31.4 | 44.1 | 47.4 | 58.8 | 72.8 | 80.2 | 73.6 | 62.4 | 46.3 | 35.5 | 20.6 | 53.3 |
| 18 | | 28.8 | 41.2 | 44.8 | 56.7 | 70.8 | 77.9 | 70.7 | 59.3 | 44.8 | 34.8 | 20.2 | 51.2 |
| 19 | | 27.3 | 39.4 | 42.2 | 53.8 | 67.6 | 74.5 | 67.7 | 57.2 | 44.0 | 34.3 | 19.6 | 49.2 |
| 20 | | 26.5 | 38.4 | 40.6 | 51.4 | 64.4 | 71.8 | 66.0 | 56.1 | 43.4 | 33.8 | 19.3 | 47.7 |
| 21 | | 25.9 | 37.9 | 39.6 | 50.0 | 62.7 | 70.2 | 65.2 | 54.7 | 42.8 | 33.5 | 19.0 | 46.7 |
| 22 | | 25.6 | 37.5 | 38.4 | 49.1 | 61.2 | 69.1 | 63.9 | 53.5 | 43.0 | 33.0 | 19.0 | 46.0 |
| 23 | | 25.1 | 37.1 | 37.2 | 48.0 | 59.7 | 67.9 | 63.1 | 52.8 | 42.6 | 32.8 | 18.8 | 45.2 |
| 24 | | 24.3 | 36.6 | 36.4 | 46.6 | 58.7 | 66.9 | 62.4 | 51.9 | 41.7 | 32.2 | 18.7 | 44.4 |
| Mean | | 28.3 | 39.8 | 41.4 | 52.8 | 64.8 | 73.4 | 67.8 | 56.8 | 44.8 | 35.0 | 20.7 | 48.9 |
| Good Hours | | 276 | 744 | 720 | 744 | 720 | 744 | 744 | 720 | 744 | 720 | 744 | |
| Missing Hours | | 396 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

7,620 Hours of Good Data  396 Hours Missing  95.1% Data Recovery

MEAN HOURLY VALUES

WIND RIVER RESERVATION
SHELDON DOME - TEMPERATURE (DEG)

01/01/08 - 07/31/08

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 16.7 | 23.2 | 25.5 | 31.3 | 41.9 | 52.0 | 61.7 | | | | | | 34.4 |
| 02 | 16.6 | 22.8 | 25.0 | 30.9 | 41.3 | 51.2 | 60.6 | | | | | | 33.9 |
| 03 | 16.1 | 23.2 | 24.5 | 30.2 | 40.7 | 50.9 | 60.1 | | | | | | 33.5 |
| 04 | 15.5 | 23.1 | 24.4 | 29.8 | 40.6 | 50.5 | 60.0 | | | | | | 33.2 |
| 05 | 15.2 | 22.6 | 24.3 | 29.5 | 40.5 | 51.1 | 60.2 | | | | | | 33.1 |
| 06 | 14.9 | 22.1 | 24.0 | 30.8 | 42.2 | 53.2 | 62.5 | | | | | | 34.0 |
| 07 | 15.3 | 22.3 | 25.7 | 33.6 | 44.9 | 55.9 | 66.3 | | | | | | 35.9 |
| 08 | 16.3 | 24.7 | 28.5 | 36.7 | 47.2 | 58.3 | 69.4 | | | | | | 38.3 |
| 09 | 18.9 | 27.4 | 31.3 | 39.7 | 49.3 | 60.8 | 72.0 | | | | | | 40.9 |
| 10 | 21.3 | 30.4 | 33.5 | 42.1 | 51.0 | 62.9 | 74.8 | | | | | | 43.2 |
| 11 | 23.0 | 32.5 | 35.3 | 44.0 | 52.8 | 64.4 | 76.8 | | | | | | 45.0 |
| 12 | 23.1 | 33.3 | 36.7 | 45.3 | 53.7 | 65.7 | 78.1 | | | | | | 46.0 |
| 13 | 23.5 | 34.1 | 36.9 | 45.8 | 54.5 | 66.7 | 79.5 | | | | | | 46.7 |
| 14 | 23.1 | 34.1 | 36.6 | 46.0 | 54.3 | 67.1 | 79.7 | | | | | | 46.5 |
| 15 | 21.7 | 33.3 | 36.1 | 45.1 | 54.4 | 66.5 | 79.7 | | | | | | 45.9 |
| 16 | 19.6 | 31.6 | 34.9 | 43.7 | 54.2 | 65.7 | 78.6 | | | | | | 44.7 |
| 17 | 17.9 | 28.6 | 32.5 | 42.1 | 53.0 | 65.0 | 77.7 | | | | | | 43.0 |
| 18 | 17.1 | 26.4 | 30.0 | 39.5 | 51.1 | 63.4 | 75.4 | | | | | | 41.1 |
| 19 | 16.8 | 25.9 | 28.6 | 36.9 | 48.5 | 60.4 | 71.7 | | | | | | 39.2 |
| 20 | 17.4 | 25.2 | 27.7 | 35.3 | 46.9 | 57.6 | 68.7 | | | | | | 37.8 |
| 21 | 17.1 | 24.7 | 27.0 | 34.2 | 45.6 | 56.4 | 66.9 | | | | | | 36.9 |
| 22 | 17.1 | 24.3 | 26.1 | 33.1 | 44.6 | 55.5 | 65.7 | | | | | | 36.1 |
| 23 | 16.8 | 24.2 | 25.5 | 32.8 | 43.9 | 54.1 | 63.9 | | | | | | 35.5 |
| 24 | 17.2 | 24.0 | 25.2 | 32.3 | 43.4 | 53.2 | 62.7 | | | | | | 35.0 |
| Mean | 18.3 | 26.8 | 29.4 | 37.1 | 47.5 | 58.7 | 69.6 | | | | | | 39.2 |

| Good Hours | | | | | | | |
|---|---|---|---|---|---|---|---|
| 720 | 696 | 744 | 720 | 744 | 720 | 397 |

| Missing Hours | | | | | | |
|---|---|---|---|---|---|---|
| 24 | 0 | 0 | 0 | 0 | 0 | 347 |

4,741 Hours of Good Data  371 Hours Missing  92.7% Data Recovery

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
33FT WIND SPEED (MPH)

09/01/06 - 02/28/07

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 11.7 | 17.4 | | | | | | | 13.4 | 14.8 | 12.3 | 12.1 | 13.2 |
| 02 | 12.0 | 16.2 | | | | | | | 11.5 | 12.4 | 10.9 | 11.6 | 12.2 |
| 03 | 12.2 | 15.4 | | | | | | | 10.3 | 11.1 | 9.6 | 11.1 | 11.4 |
| 04 | 11.0 | 14.4 | | | | | | | 9.0 | 10.8 | 9.4 | 10.3 | 10.7 |
| 05 | 9.8 | 12.1 | | | | | | | 7.4 | 10.9 | 10.3 | 9.8 | 10.2 |
| 06 | 10.3 | 11.4 | | | | | | | 7.8 | 10.8 | 10.9 | 9.8 | 10.3 |
| 07 | 10.1 | 10.4 | | | | | | | 8.4 | 10.0 | 9.9 | 10.1 | 10.0 |
| 08 | 9.9 | 10.4 | | | | | | | 9.1 | 9.6 | 10.2 | 10.4 | 10.0 |
| 09 | 10.2 | 10.4 | | | | | | | 10.5 | 9.5 | 9.6 | 11.7 | 10.3 |
| 10 | 9.1 | 10.9 | | | | | | | 11.3 | 8.4 | 9.4 | 10.0 | 9.6 |
| 11 | 8.7 | 12.2 | | | | | | | 11.9 | 9.4 | 8.5 | 10.3 | 9.7 |
| 12 | 8.7 | 11.6 | | | | | | | 11.5 | 11.2 | 9.4 | 11.5 | 10.4 |
| 13 | 8.3 | 14.4 | | | | | | | 10.6 | 10.2 | 9.4 | 11.3 | 10.3 |
| 14 | 8.8 | 13.2 | | | | | | | 9.8 | 10.8 | 8.8 | 10.7 | 10.1 |
| 15 | 8.1 | 15.9 | | | | | | | 12.5 | 10.2 | 8.4 | 9.6 | 10.0 |
| 16 | 8.6 | 16.5 | | | | | | | 14.1 | 9.2 | 8.0 | 9.5 | 10.0 |
| 17 | 9.2 | 16.1 | | | | | | | 14.2 | 8.8 | 7.6 | 9.3 | 9.9 |
| 18 | 9.2 | 15.8 | | | | | | | 12.1 | 8.8 | 9.3 | 9.0 | 10.0 |
| 19 | 9.2 | 15.2 | | | | | | | 14.0 | 9.9 | 10.4 | 8.8 | 10.4 |
| 20 | 10.4 | 16.8 | | | | | | | 13.4 | 10.7 | 11.7 | 9.3 | 11.3 |
| 21 | 11.1 | 19.6 | | | | | | | 12.8 | 11.9 | 13.2 | 11.2 | 12.7 |
| 22 | 11.1 | 20.2 | | | | | | | 13.6 | 13.5 | 13.8 | 13.2 | 13.7 |
| 23 | 11.9 | 20.0 | | | | | | | 14.6 | 14.0 | 14.6 | 13.9 | 14.3 |
| 24 | 12.6 | 20.1 | | | | | | | 15.3 | 13.8 | 14.4 | 13.4 | 14.3 |
| Mean | 10.1 | 14.9 | | | | | | | 11.6 | 10.9 | 10.4 | 10.7 | 11.1 |
| Good Hours | 744 | 360 | | | | | | | 239 | 728 | 687 | 744 | |
| Missing Hours | 0 | 312 | | | | | | | 481 | 16 | 33 | 0 | |

3,502 Hours of Good Data  842 Hours Missing  80.6% Data Recovery

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
98 FT WIND SPEED (MPH)

09/01/06 - 02/28/07

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 13.2 | 18.9 | | | | | | | 14.7 | 16.5 | 14.5 | 14.0 | 15.0 |
| 02 | 13.6 | 18.0 | | | | | | | 12.8 | 14.4 | 13.2 | 13.8 | 14.1 |
| 03 | 13.7 | 17.2 | | | | | | | 11.9 | 13.0 | 11.9 | 13.3 | 13.4 |
| 04 | 12.3 | 16.3 | | | | | | | 10.7 | 12.7 | 12.0 | 12.3 | 12.6 |
| 05 | 11.2 | 13.8 | | | | | | | 8.4 | 13.0 | 12.9 | 11.8 | 12.1 |
| 06 | 11.9 | 12.9 | | | | | | | 8.4 | 12.8 | 13.4 | 12.0 | 12.3 |
| 07 | 11.6 | 12.2 | | | | | | | 9.7 | 12.1 | 12.4 | 12.6 | 12.0 |
| 08 | 11.5 | 12.0 | | | | | | | 10.5 | 11.6 | 12.5 | 12.7 | 12.0 |
| 09 | 12.0 | 12.0 | | | | | | | 12.5 | 11.5 | 12.0 | 13.9 | 12.3 |
| 10 | 10.8 | 12.5 | | | | | | | 13.6 | 10.4 | 11.7 | 12.5 | 11.6 |
| 11 | 10.6 | 14.3 | | | | | | | 13.9 | 11.3 | 10.8 | 12.7 | 11.8 |
| 12 | 10.2 | 13.4 | | | | | | | 13.5 | 13.1 | 11.9 | 13.9 | 12.5 |
| 13 | 9.6 | 16.6 | | | | | | | 12.5 | 12.2 | 12.2 | 13.5 | 12.4 |
| 14 | 10.5 | 15.3 | | | | | | | 11.7 | 12.6 | 11.0 | 13.0 | 12.1 |
| 15 | 9.7 | 18.1 | | | | | | | 14.6 | 12.3 | 10.4 | 11.5 | 11.9 |
| 16 | 10.4 | 18.7 | | | | | | | 16.2 | 11.0 | 10.1 | 11.6 | 12.0 |
| 17 | 10.7 | 17.7 | | | | | | | 15.6 | 10.0 | 9.8 | 11.5 | 11.6 |
| 18 | 10.5 | 17.2 | | | | | | | 13.2 | 9.9 | 11.4 | 10.9 | 11.5 |
| 19 | 10.2 | 16.6 | | | | | | | 15.2 | 10.9 | 12.2 | 10.3 | 11.7 |
| 20 | 11.5 | 17.9 | | | | | | | 14.7 | 11.6 | 13.4 | 10.8 | 12.6 |
| 21 | 12.1 | 21.2 | | | | | | | 14.0 | 13.0 | 14.9 | 12.6 | 14.0 |
| 22 | 12.1 | 21.7 | | | | | | | 14.9 | 14.7 | 15.7 | 14.8 | 15.1 |
| 23 | 13.1 | 21.5 | | | | | | | 16.0 | 15.2 | 16.6 | 15.5 | 15.8 |
| 24 | 14.0 | 21.7 | | | | | | | 16.8 | 15.1 | 16.6 | 15.2 | 16.0 |
| Mean | 11.5 | 16.6 | | | | | | | 13.2 | 12.5 | 12.7 | 12.8 | 12.9 |
| Good Hours | 744 | 360 | | | | | | | 239 | 728 | 687 | 744 | |
| Missing Hours | 0 | 312 | | | | | | | 481 | 16 | 33 | 0 | |

3,502 Hours of Good Data  842 Hours Missing  80.6% Data Recovery

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
161 FT WIND SPEED (WEST) (MPH)

09/01/06 - 02/28/07

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 13.5 | 19.5 | | | | | | | 15.3 | 17.3 | 15.1 | 14.7 | 15.6 |
| 02 | 14.4 | 18.9 | | | | | | | 13.8 | 15.4 | 14.0 | 14.6 | 15.0 |
| 03 | 14.2 | 18.2 | | | | | | | 13.1 | 14.3 | 12.8 | 14.3 | 14.3 |
| 04 | 12.8 | 17.7 | | | | | | | 11.9 | 13.8 | 13.1 | 13.3 | 13.6 |
| 05 | 11.5 | 15.0 | | | | | | | 9.3 | 13.9 | 14.0 | 12.5 | 12.9 |
| 06 | 12.2 | 14.0 | | | | | | | 9.0 | 13.8 | 14.4 | 12.9 | 13.1 |
| 07 | 12.3 | 13.5 | | | | | | | 10.5 | 13.1 | 13.4 | 13.7 | 13.0 |
| 08 | 12.4 | 13.2 | | | | | | | 11.2 | 12.7 | 13.6 | 13.8 | 13.0 |
| 09 | 13.0 | 13.0 | | | | | | | 13.7 | 12.6 | 13.2 | 15.0 | 13.4 |
| 10 | 12.0 | 13.5 | | | | | | | 14.8 | 11.6 | 12.8 | 13.6 | 12.8 |
| 11 | 11.5 | 15.6 | | | | | | | 15.5 | 12.6 | 11.9 | 13.8 | 13.0 |
| 12 | 11.4 | 14.7 | | | | | | | 14.9 | 14.3 | 13.1 | 15.1 | 13.7 |
| 13 | 10.8 | 17.7 | | | | | | | 14.1 | 13.4 | 13.4 | 14.5 | 13.6 |
| 14 | 11.4 | 16.7 | | | | | | | 13.3 | 13.8 | 11.8 | 13.7 | 13.2 |
| 15 | 10.7 | 19.2 | | | | | | | 16.0 | 13.7 | 11.2 | 12.3 | 13.0 |
| 16 | 11.6 | 19.7 | | | | | | | 17.7 | 12.1 | 10.9 | 12.4 | 13.0 |
| 17 | 11.5 | 18.6 | | | | | | | 16.4 | 10.8 | 10.7 | 12.3 | 12.4 |
| 18 | 11.1 | 18.0 | | | | | | | 13.7 | 10.3 | 11.8 | 11.8 | 12.1 |
| 19 | 10.5 | 17.3 | | | | | | | 15.4 | 11.0 | 12.6 | 10.8 | 12.1 |
| 20 | 11.8 | 18.3 | | | | | | | 14.9 | 11.6 | 13.6 | 11.3 | 12.9 |
| 21 | 12.4 | 21.6 | | | | | | | 14.3 | 13.2 | 15.2 | 13.1 | 14.3 |
| 22 | 12.5 | 21.9 | | | | | | | 15.3 | 15.2 | 16.0 | 15.3 | 15.5 |
| 23 | 13.4 | 21.8 | | | | | | | 16.5 | 15.5 | 17.0 | 16.0 | 16.2 |
| 24 | 14.5 | 22.1 | | | | | | | 17.3 | 15.6 | 17.2 | 15.8 | 16.5 |
| Mean | 12.2 | 17.5 | | | | | | | 14.1 | 13.4 | 13.5 | 13.6 | 13.7 |
| Good Hours | 744 | 360 | | | | | | | 239 | 728 | 687 | 744 | |
| Missing Hours | 0 | 312 | | | | | | | 481 | 16 | 33 | 0 | |

3,502 Hours of Good Data  842 Hours Missing  80.6% Data Recovery

MEAN HOURLY WIND SPEEDS

WIND RIVER RESERVATION
161 FT WIND SPEED (SOUTH) (MPH)

09/01/06 - 02/28/07

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 13.4 | 19.4 | | | | | | | 15.6 | 17.4 | 15.3 | 14.7 | 15.6 |
| 02 | 14.3 | 18.9 | | | | | | | 13.9 | 15.5 | 14.1 | 14.7 | 15.1 |
| 03 | 14.2 | 18.1 | | | | | | | 13.2 | 14.5 | 13.0 | 14.4 | 14.4 |
| 04 | 12.9 | 17.5 | | | | | | | 11.9 | 14.0 | 13.4 | 13.5 | 13.8 |
| 05 | 11.6 | 15.1 | | | | | | | 9.3 | 14.1 | 14.3 | 12.8 | 13.1 |
| 06 | 12.2 | 14.1 | | | | | | | 9.0 | 14.0 | 14.7 | 13.2 | 13.3 |
| 07 | 12.1 | 13.6 | | | | | | | 10.6 | 13.3 | 13.7 | 14.0 | 13.1 |
| 08 | 12.4 | 13.3 | | | | | | | 11.4 | 12.8 | 13.8 | 14.0 | 13.1 |
| 09 | 13.0 | 13.0 | | | | | | | 14.0 | 12.7 | 13.5 | 15.3 | 13.6 |
| 10 | 12.1 | 13.6 | | | | | | | 15.2 | 11.7 | 13.0 | 13.9 | 13.0 |
| 11 | 11.6 | 15.8 | | | | | | | 15.9 | 12.8 | 12.1 | 14.0 | 13.2 |
| 12 | 11.5 | 14.8 | | | | | | | 15.2 | 14.6 | 13.4 | 15.3 | 13.9 |
| 13 | 10.9 | 18.0 | | | | | | | 14.4 | 13.7 | 13.6 | 14.7 | 13.8 |
| 14 | 11.4 | 16.8 | | | | | | | 13.6 | 14.1 | 12.1 | 13.9 | 13.3 |
| 15 | 10.8 | 19.4 | | | | | | | 16.3 | 13.9 | 11.4 | 12.4 | 13.2 |
| 16 | 11.7 | 19.9 | | | | | | | 17.8 | 12.3 | 11.0 | 12.5 | 13.1 |
| 17 | 11.6 | 18.7 | | | | | | | 16.4 | 11.0 | 10.8 | 12.5 | 12.6 |
| 18 | 11.1 | 18.3 | | | | | | | 13.7 | 10.5 | 12.1 | 11.9 | 12.2 |
| 19 | 10.4 | 17.4 | | | | | | | 15.4 | 11.2 | 12.7 | 10.9 | 12.2 |
| 20 | 11.6 | 18.2 | | | | | | | 15.0 | 11.9 | 13.7 | 11.4 | 12.9 |
| 21 | 12.3 | 21.6 | | | | | | | 14.5 | 13.3 | 15.4 | 13.1 | 14.4 |
| 22 | 12.4 | 21.7 | | | | | | | 15.5 | 15.3 | 16.3 | 15.3 | 15.6 |
| 23 | 13.3 | 21.7 | | | | | | | 16.9 | 15.7 | 17.2 | 16.1 | 16.3 |
| 24 | 14.3 | 22.1 | | | | | | | 17.6 | 15.7 | 17.4 | 15.8 | 16.5 |
| Mean | 12.2 | 17.5 | | | | | | | 14.2 | 13.6 | 13.7 | 13.8 | 13.8 |
| Good Hours | 744 | 360 | | | | | | | 239 | 728 | 687 | 744 | |
| Missing Hours | 0 | 312 | | | | | | | 481 | 16 | 33 | 0 | |

3,502 Hours of Good Data  842 Hours Missing  80.6% Data Recovery

MEAN HOURLY VALUES

WIND RIVER RESERVATION
98 FT WIND DIRECTION (DEG)

09/01/06 - 02/28/07

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 193 | 191 | | | | | | | 149 | 171 | 214 | 217 | 195 |
| 02 | 193 | 196 | | | | | | | 169 | 189 | 206 | 228 | 200 |
| 03 | 210 | 196 | | | | | | | 140 | 171 | 234 | 239 | 206 |
| 04 | 237 | 199 | | | | | | | 160 | 185 | 247 | 243 | 220 |
| 05 | 256 | 198 | | | | | | | 202 | 209 | 267 | 257 | 239 |
| 06 | 248 | 235 | | | | | | | 207 | 208 | 272 | 272 | 245 |
| 07 | 233 | 245 | | | | | | | 220 | 226 | 274 | 279 | 250 |
| 08 | 256 | 280 | | | | | | | 252 | 232 | 273 | 274 | 260 |
| 09 | 237 | 255 | | | | | | | 280 | 216 | 266 | 263 | 249 |
| 10 | 247 | 259 | | | | | | | 281 | 234 | 270 | 267 | 257 |
| 11 | 217 | 256 | | | | | | | 290 | 241 | 262 | 252 | 247 |
| 12 | 228 | 256 | | | | | | | 292 | 246 | 258 | 261 | 252 |
| 13 | 229 | 205 | | | | | | | 264 | 226 | 247 | 266 | 239 |
| 14 | 203 | 266 | | | | | | | 258 | 240 | 231 | 267 | 240 |
| 15 | 222 | 270 | | | | | | | 266 | 238 | 231 | 245 | 240 |
| 16 | 228 | 268 | | | | | | | 243 | 234 | 222 | 256 | 239 |
| 17 | 220 | 228 | | | | | | | 251 | 217 | 214 | 246 | 227 |
| 18 | 198 | 237 | | | | | | | 194 | 216 | 240 | 236 | 222 |
| 19 | 179 | 224 | | | | | | | 192 | 198 | 222 | 222 | 206 |
| 20 | 194 | 192 | | | | | | | 168 | 183 | 217 | 228 | 201 |
| 21 | 172 | 199 | | | | | | | 150 | 168 | 217 | 200 | 187 |
| 22 | 186 | 208 | | | | | | | 163 | 157 | 216 | 206 | 191 |
| 23 | 182 | 207 | | | | | | | 148 | 161 | 214 | 193 | 187 |
| 24 | 191 | 216 | | | | | | | 159 | 167 | 237 | 201 | 198 |
| Mean | 215 | 229 | | | | | | | 213 | 205 | 240 | 242 | 225 |
| Good Hours | 744 | 360 | | | | | | | 239 | 725 | 687 | 723 | |
| Missing Hours | 0 | 312 | | | | | | | 481 | 19 | 33 | 21 | |

3,478 Hours of Good Data  866 Hours Missing  80.1% Data Recovery

MEAN HOURLY VALUES

WIND RIVER RESERVATION
161 FT WIND DIRECTION (DEG)

09/01/06 - 02/28/07

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 188 | 193 | | | | | | | 150 | 172 | 215 | 221 | 196 |
| 02 | 172 | 196 | | | | | | | 174 | 183 | 207 | 234 | 197 |
| 03 | 196 | 195 | | | | | | | 141 | 174 | 225 | 235 | 202 |
| 04 | 218 | 194 | | | | | | | 162 | 175 | 267 | 253 | 220 |
| 05 | 223 | 200 | | | | | | | 175 | 202 | 269 | 270 | 232 |
| 06 | 229 | 241 | | | | | | | 202 | 213 | 279 | 276 | 245 |
| 07 | 243 | 237 | | | | | | | 220 | 223 | 277 | 283 | 252 |
| 08 | 239 | 264 | | | | | | | 263 | 222 | 276 | 279 | 256 |
| 09 | 231 | 273 | | | | | | | 269 | 206 | 274 | 269 | 249 |
| 10 | 228 | 256 | | | | | | | 286 | 238 | 263 | 273 | 253 |
| 11 | 221 | 256 | | | | | | | 287 | 242 | 270 | 260 | 251 |
| 12 | 232 | 266 | | | | | | | 298 | 250 | 265 | 252 | 254 |
| 13 | 213 | 232 | | | | | | | 271 | 244 | 256 | 258 | 243 |
| 14 | 227 | 276 | | | | | | | 249 | 245 | 236 | 254 | 245 |
| 15 | 222 | 279 | | | | | | | 237 | 254 | 237 | 264 | 248 |
| 16 | 224 | 276 | | | | | | | 246 | 250 | 234 | 258 | 245 |
| 17 | 239 | 265 | | | | | | | 250 | 232 | 242 | 252 | 244 |
| 18 | 206 | 252 | | | | | | | 194 | 219 | 236 | 230 | 223 |
| 19 | 201 | 229 | | | | | | | 192 | 214 | 228 | 242 | 220 |
| 20 | 210 | 211 | | | | | | | 169 | 187 | 220 | 231 | 209 |
| 21 | 191 | 205 | | | | | | | 153 | 181 | 218 | 197 | 194 |
| 22 | 193 | 210 | | | | | | | 164 | 159 | 219 | 190 | 190 |
| 23 | 193 | 208 | | | | | | | 149 | 164 | 221 | 198 | 192 |
| 24 | 192 | 216 | | | | | | | 160 | 171 | 240 | 203 | 200 |
| Mean | 214 | 235 | | | | | | | 211 | 209 | 245 | 245 | 227 |
| Good Hours | 744 | 360 | | | | | | | 239 | 725 | 687 | 744 | |
| Missing Hours | 0 | 312 | | | | | | | 481 | 19 | 33 | 0 | |

3,499 Hours of Good Data  845 Hours Missing  80.5% Data Recovery

MEAN HOURLY VALUES

WIND RIVER RESERVATION
TEMPERATURE (DEG)

09/01/06 - 02/28/07

| Hour | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 21.0 | 34.4 | | | | | | | 57.3 | 50.0 | 39.8 | 30.4 | 36.5 |
| 02 | 18.6 | 31.2 | | | | | | | 55.2 | 47.3 | 37.0 | 28.6 | 34.2 |
| 03 | 18.3 | 29.5 | | | | | | | 52.5 | 45.5 | 35.8 | 27.8 | 32.9 |
| 04 | 17.7 | 28.4 | | | | | | | 50.8 | 44.4 | 35.1 | 27.2 | 32.1 |
| 05 | 17.3 | 27.8 | | | | | | | 49.5 | 43.3 | 34.4 | 26.6 | 31.4 |
| 06 | 17.1 | 26.9 | | | | | | | 48.7 | 42.5 | 33.4 | 26.3 | 30.8 |
| 07 | 17.0 | 26.2 | | | | | | | 47.9 | 41.8 | 32.9 | 25.9 | 30.3 |
| 08 | 16.6 | 26.1 | | | | | | | 46.7 | 40.9 | 32.9 | 25.5 | 29.8 |
| 09 | 16.5 | 25.7 | | | | | | | 46.5 | 40.3 | 32.0 | 25.4 | 29.4 |
| 10 | 16.0 | 25.4 | | | | | | | 46.0 | 39.7 | 31.5 | 24.5 | 28.8 |
| 11 | 15.4 | 25.7 | | | | | | | 45.4 | 39.4 | 31.2 | 24.3 | 28.5 |
| 12 | 14.9 | 25.8 | | | | | | | 44.9 | 39.1 | 30.8 | 23.9 | 28.2 |
| 13 | 14.3 | 26.3 | | | | | | | 44.8 | 38.7 | 30.5 | 24.0 | 28.0 |
| 14 | 14.9 | 26.5 | | | | | | | 44.6 | 38.1 | 30.7 | 23.8 | 28.0 |
| 15 | 14.7 | 26.8 | | | | | | | 44.5 | 37.2 | 30.9 | 23.3 | 27.7 |
| 16 | 14.7 | 27.5 | | | | | | | 46.1 | 38.4 | 31.5 | 23.2 | 28.2 |
| 17 | 15.6 | 28.7 | | | | | | | 49.2 | 40.7 | 33.2 | 23.5 | 29.6 |
| 18 | 17.5 | 30.7 | | | | | | | 52.9 | 43.2 | 35.6 | 25.3 | 31.9 |
| 19 | 18.9 | 32.7 | | | | | | | 56.2 | 45.4 | 38.1 | 28.1 | 34.2 |
| 20 | 20.8 | 34.1 | | | | | | | 57.8 | 47.2 | 40.4 | 30.6 | 36.2 |
| 21 | 21.4 | 35.8 | | | | | | | 59.3 | 48.6 | 42.2 | 32.3 | 37.6 |
| 22 | 22.0 | 37.3 | | | | | | | 60.2 | 49.5 | 43.0 | 33.3 | 38.5 |
| 23 | 23.0 | 38.0 | | | | | | | 60.2 | 50.1 | 43.3 | 33.7 | 39.0 |
| 24 | 22.7 | 37.6 | | | | | | | 59.9 | 50.1 | 42.5 | 32.2 | 38.4 |
| Mean | 17.8 | 29.8 | | | | | | | 51.1 | 43.4 | 35.4 | 27.1 | 32.1 |
| Good Hours | 744 | 360 | | | | | | | 239 | 744 | 687 | 744 | |
| Missing Hours | 0 | 312 | | | | | | | 481 | 0 | 33 | 0 | |

3,518 Hours of Good Data  826 Hours Missing  81.0% Data Recovery

**Eastern Shoshone Tribe and Northern Arapahoe**
**on the Wind River Indian Reservation**

**Renewable Energy Development on Tribal Lands**
**DE-PS36-04GO94003**

# Appendix 2

# Biological Screening Report

## Sheldon Dome and Stagner Mountain Potential Wind Power Projects

## Wind River Reservation, Wyoming

**- Draft- August 28, 2007**

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# Introduction

When exploring prospective wind power sites, knowledge of wildlife and other biological resource issues helps the wind industry identify and avoid potential ecological problems early in the development process. The Eastern Shoshone and Northern Arapaho Nations are currently examining the feasibility of constructing a wind power project on two potential sites in the Wind River Reservation, Wyoming (Figure 1). The purpose of this report is to describe biological resources present within and surrounding the proposed project areas, and to compare site characteristics with those at other wind power projects where post-construction wildlife studies are publicly available. The area evaluated for potential biological resources includes proposed project areas and a two mile buffer (evaluation areas). This report focuses on the following potential areas of concern:

- Raptors
  1. Identify areas of potentially high nesting density
  2. Identify areas of potentially high prey density
  3. Examine topography to determine the potential for high use and potential nest locations
  4. Determine the species likely to occur in the area
  5. Determine the potential for migratory pathways
- Candidate, Proposed, Threatened, Endangered, and USFWS Birds of Conservation Concern
  1. Identify the potential occurrence of federally listed or state protected species through existing literature and database searches
  2. Evaluate the suitability of habitat at the wind plant site for protected species
- Sensitive Species and USFWS Issues (using existing state wildlife agency information)
  1. Determine if site is considered a critical winter or parturition area or other highly valuable habitat for game and non-game wildlife (birds and bats)
  2. Examine habitat during site visits to determine the potential for use by sensitive species
- Migratory Birds
- Bats
  1. Determine the proximity to potential feeding sites and hibernacula
  2. Determine species likely to occur in the area
- Wetlands
  1. Determine the potential for wetlands at the site through a cursory site visit and examination of available data
- USFWS PII Score

# Study Area

The two project areas are located on the Wind River Reservation. The proposed projects are preliminary, and the number and locations of turbines have not been determined.

**Sheldon Dome.** The project is located within the Wyoming Basin ecoregion (Omnerik 1987). The Wyoming Basin is characterized by broad valleys of grasslands and sagebrush, interspersed with mountain ranges. The proposed project area is dominated sparse stands of Wyoming sagebrush and broken grasslands (Figures 2-4). The area is dry with cold winters and relatively warm but short summers. The average annual precipitation is 7.2 inches, with an average high winter temperature of 25.6 F and an average summertime high of 88.1 F.

The proposed project would be located along a relatively broad, northwest – southeast running ridge. Some rim rock is present along some ridges. No perennial streams or lakes are present. The nearest water sources are a few stock tanks located within 2 miles of the project area. Elevation of the project area ranges from approximately 6700 – 7000 ft.

The project area is relatively undeveloped, and the primary land use in the area is grazing. Some active oil and natural gas wells are present within the evaluation area.

**Stagner Mountain.** The Stagner Mountain project is also located within the Wyoming Basin ecoregion (Omnerik 1987). The proposed project area is dominated grasslands and silver sagebrush (Figures 5-7). Side slopes in the project area contain coniferous forests, cliffs and rock outcrops. The area is dry with cold winters and relatively warm but short summers. The average annual precipitation is 7.2 inches, with an average high winter temperature of 25.6 F and an average summertime high of 88.1 F.

The proposed project would be located along a relatively stark ridge that is east – west in orientation. The ridge overlooks Boysen Reservoir and the Wind River Canyon. The nearest water sources are a few stock tanks and the Wind River, located within 2 miles of the project area. Elevation of the project area ranges from approximately 6700 – 7500 ft.

The project area currently has some development in the form of a Federal Aviation Administration (FAA) radar station, a power line and some radio towers. Cattle grazing is the current land use.

# Methods

Biological resources within the project and evaluation areas were identified through a search of existing data and a site visit. The project area was examined from the ground on June 12-13, 2007. During the site visit, biological features and potential wildlife habitat including plant communities and topographic features were identified.

Several sources of available data were used to identify biological resources within the project area, including requesting data from the Wyoming Game and Fish Department (WGFD), the U.S. Fish and Wildlife Service (USFWS), Wyoming Natural Diversity Database (WYNDD), The Wind River Reservation and searching published literature, field guides, etc. The Wyoming Game and Fish Department declined to comment on the project because the Wind River Reservation is outside of their jurisdiction. Correspondence was received from WYNDD dated July 13, 2007 (Appendix A). At this time, no official correspondence has been received from the USFWS or the Wind River Reservation

After biological resources within the project area were identified, we compared the physical and habitat characteristics, as well species occurrence at the proposed project to other wind projects throughout the U.S., with a special emphasis on projects where post-construction wildlife studies have been conducted (Erickson et al. 2001 and 2002, NWCC 2004).

# Results

## *Raptor Issues*

**Nesting density and species breeding in area.** Potential nesting habitat for raptors in the Sheldon Dome project area is limited. The only areas of suitable habitat are a few outcrops located along the primary ridges, as well as some scattered conifer trees present within the evaluation area.

Potential nesting habitat is more prevalent within the Stagner Mountain project. A power line crosses the project area, which provides good nesting habitat for raptors. Other nesting habitat present near the project includes scattered coniferous forests and cliff habitat on the edges of the ridge and within Wind River Canyon.

Based on the range maps available from the Cerovski et al. (2004) and habitat within the project area, above ground nesting species most likely to breed in the proposed project and surrounding areas include the golden eagle (*Aquila chrysaetos*), ferruginous hawk (*Buteo regalis*), prairie falcon (*Falco mexicanus*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*) and American kestrel (*Falco sparverius*). The rim rock and cliffs provide suitable nesting habitat most of these species. Additionally, a few scattered trees are present in the project area that could provide suitable nesting habitat. The ferruginous hawk may also form nests on shallow rock outcrops or on the bare ground. Due to the presence of steep cliffs in Wind River Canyon, the potential exists for the peregrine falcon to nest within the Stagner Mountain evaluation area.

Turkey vultures (*Cathartes aura*) may occur within the project during the breeding season and may nest within the Stagner mountain project area. One red-tailed hawk nest and one ferruginous hawk nest were observed during the Stagner mountain visit (Figure 5) on a power line (Figure 8) and a nest platform (Figure 9). No nests were observed at

Sheldon Dome. The burrowing owl may nest within prairie dog burrows in the Stagner Mountain project area (Cerovski et al. 2004).

Raptors may also occur within the project areas outside of the breeding season, including golden eagle (*Aquila chrysaetos*), ferruginous hawk, red-tailed hawk and rough-legged hawk (*Buteo lagopus*) (WYNDD 2007).

To date, no correlation has been found between nesting densities within two miles of wind turbines and raptor fatality rates (Erickson et al. 2002). The project with the highest nesting density within two miles of wind turbines is Foote Creek Rim in Wyoming, and the majority of nests were occupied by red-tailed hawks. No red-tailed hawks were found as fatalities at Foote Creek Rim (Erickson et al. 2002). However, raptors nesting close to turbine locations may be at increased risk of collision or disturbance.

**Potential for prey densities.** White-tailed prairie dog (*Cynomys leucurus*) colonies are present within the proposed Stagner mountain project area. Although not observed during the site visit, the potential exists for white-tailed prairie dog colonies to also be present at the Sheldon Dome project. Less obvious species of small mammals are also likely present within and surrounding the project areas, such as lagomorphs (rabbits) and ground squirrels.

Based on the apparent presence of prairie dog colonies in portions of the Stagner project area, a sufficient prey base is present to serve as hunting areas for raptors in this project. Although no prairie dog colonies were observed at Sheldon Dome, other prey species may be present that could provide a prey base for hunting raptors.

**Does the topography of the site increase the potential for raptor use?** The proposed projects have varied topography, with some ridges being relatively steep with defined edges. At other wind power facilities located on prominent ridges with defined edges (e.g., rims of canyons, steep slopes), raptors often fly along the rim edges, using updrafts to maintain altitude while hunting, migrating or soaring (Johnson et al. 2000, Hoover and Morrison 2005). Turbines are often placed on prominent ridges in order to use higher wind speeds and updrafts that raptors also use. At Foote Creek Rim, raptors most often used areas within 50 m of the rim edge (Johnson et al. 2000). Topography in the both projects has some potential to influence raptor use, and ridges containing steep topography that are perpendicular to the wind are expected to receive higher levels of raptor use versus surrounding areas.

## *Federal Endangered Species*

The USFWS describes 13 species protected under the Federal Endangered Species Act as having some potential to occur within Freemont or Hot Springs Counties, or as potentially being affected by water depletions to the South Platte River (Table 1). Of these 13 species, only the bald eagle is likely to occur within either project area.

**Table 1. Threatened or Endangered Species listed by the USFWS as occurring within Hot Springs and Freemont Counties, or that may be affected by upstream activities (Appendix B).**

| Species | Status | Primary Habitat | Potential for occurrence – Sheldon Dome | Potential for occurrence – Stagner Mountain |
|---|---|---|---|---|
| Bald Eagle | De-listed | Large bodies of fish bearing water | Low Potential. Evaluation area lacks water. May occasionally fly through project area | Medium Potential. Wind River provides suitable habitat, and prairie dog colonies provide potential hunting areas. |
| Black-footed Ferret | Endangered | Prairie Dog Colonies | Very Low. The project area has been block-cleared for wild black-footed ferrets by the USFWS. | Very Low. The project area has been block-cleared for wild black-footed ferrets by the USFWS. One historical record for black-footed ferrets is present within two miles of the project area (Figure 10). |
| Canada Lynx | Threatened | Coniferous Forests | Very Low. Project lacks suitable habitat. | Very Low. Project lacks suitable habitat. |
| Desert Yellowhead | Proposed for listing | Barren outcrops of the Split Rock Formation | Very Low. Only known to occur in one location in Freemont County. | Very Low. Only known to occur in one location in Freemont County. |
| Eskimo Curlew | Endangered | South Platte River | Very Low. If project will cause water depletions, then impacts to this species will need to be addressed. | Very Low. If project will cause water depletions, then impacts to this species will need to be addressed. |
| Gray Wolf | Experimental – Non essential | Habitat Generalist | Low. Project located outside of current range, but potential exists for dispersing individuals to occur. | Low. Project located outside of current range, but potential exists for dispersing individuals to occur. |
| Grizzly Bear | Threatened | Mountains of Greater Yellowstone Region | Low. Project located outside of current range, but potential exists for dispersing individuals to occur. | Low. Project located outside of current range, but potential exists for dispersing individuals to occur. |
| Interior Least Tern | Endangered | South Platte River | Very Low. If project will cause water depletions, then impacts to this species will need to be addressed. | Very Low. If project will cause water depletions, then impacts to this species will need to be addressed. |
| Pallid Sturgeon | Endangered | South Platte River | Very Low. If project will cause water depletions, then impacts to this species will need to be addressed. | Very Low. If project will cause water depletions, then impacts to this species will need to be addressed. |
| Piping Plover | Threatened | South Platte River | Very Low. If project will cause water depletions, then impacts to this species will need to be addressed. | Very Low. If project will cause water depletions, then impacts to this species will need to be addressed. |

**Table 1, continued. Threatened or Endangered Species listed by the USFWS as occurring within Hot Springs and Freemont Counties, or that may be affected by upstream activities (Appendix B).**

| Species | Status | Primary Habitat | Potential for occurrence – Sheldon Dome | Potential for occurrence – Stagner Mountain |
|---|---|---|---|---|
| Ute ladies'-tresses orchid | Threatened | Areas of low vegetation near permanent water sources | Low. Project lacks permanent water sources. | Low. Project lacks permanent water sources. |
| Western Prairie Fringed Orchid | Threatened | South Platte River | Very Low. If project will cause water depletions, then impacts to this species will need to be addressed. | Very Low. If project will cause water depletions, then impacts to this species will need to be addressed. |
| Whooping Crane | Endangered | South Platte River | Very Low. If project will cause water depletions, then impacts to this species will need to be addressed. | Very Low. If project will cause water depletions, then impacts to this species will need to be addressed. |

**Bald Eagle.** The Stagner Mountain project area provides limited nesting habitat for bald eagles, however, they likely utilize the area for hunting, when moving throughout home ranges, and during migration. The bald eagle is documented as nesting along the Wind River within 2 miles of the Stagner mountain site, and it is likely that bald eagles utilize the Wind River and surrounding areas for hunting throughout the year (Figure 10). Due to the presence of prairie dog colonies within the project area, there is increased potential for bald eagles to utilize the area while hunting.

Some potential also exists for bald eagles to form communal winter roosts near the proposed project area. The ridge where turbines would be placed lacks mature coniferous forest that could be used as winter roost locations, however, suitable forests are present just off the ridge within Wind River Canyon.

The Sheldon Dome site generally lacks suitable nesting, hunting and roosting habitat for bald eagles. However, it is likely that bald eagles occasionally fly through the Sheldon Dome project area during migration.

## *Sensitive Species and USFWS Issues*

At this time, no official correspondence has been received from the USFWS stating their potential concerns with the proposed project. Many biologists in Wyoming are typically concerned with the potential effects of energy development on greater sage-grouse (*Centrocercus urophasianus*) and big game winter ranges. The proposed project occurs within winter ranges for pronghorn (*Antilocapra americana*) and mule deer (*Odocoileus hemionus*). Although the project is not within mapped ranges for big horn sheep (*Ovis canadensis*), this species is known to utilize the Wind River Canyon and the project area. Crucial winter ranges are thought to be important to big game winter survival, especially during severe winters. The proposed project areas are not listed as crucial ranges.

The proposed project areas also contain potentially suitable habitat for greater sage-grouse. During the site visit, one group of eight male greater sage-grouse was observed on the Stagner Mountain site. No greater sage-grouse were observed at Sheldon Dome, however, suitable nesting or foraging habitat is present within and surrounding the project area, and the potential exists for leks to occur within two miles of the project areas. Although this species is not protected under the Endangered Species Act, the greater sage-grouse has shown significant population declines over the last few decades. The USFWS recently expressed concern over the potential for greater sage-grouse to avoid wind turbines, and recommended wind turbines is placed at least 5 miles from any known greater sage-grouse leks (USFWS 2004).

The USFWS is also expected to be concerned with the potential direct (fatalities) and indirect (fragmentation and avoidance) impacts of the proposed project on birds and bats. Other species that are considered sensitive by some biologists have been recorded within two miles of the Stagner Mountain project area. While these species typically do not receive special protection, some biologist has expressed concern over the status of their populations. A map showing the species locations can be found in Figure 10.

## *Migratory Birds*

Most species of migratory birds are protected by the Migratory Bird Treaty Act. The USFWS lists several species as birds of conservation concern within the Northern Rockies Bird Conservation Region (USFWS 2002). These species do not receive special protection (unless they are also listed by the USFWS), but have been identified as vulnerable to population declines in the area by the USFWS (2002). Due to the presence of native habitat in the project area, some of these species are likely to breed or winter within or adjacent to the project area, such as ferruginous hawk, golden eagle and loggerhead shrike (*Lanius ludovicianus*) (WYNDD 2007). For more information on the presence of birds of conservation concern in the project area, see Appendix C (USFWS PII score).

Although many species of songbirds migrate at night and may collide with tall man-made structures, no large mortality events on the same scale as those seen at communication towers have been documented at wind power facilities in North America (NWCC 2004). Large numbers of songbirds have collided with lighted communication towers and buildings when foggy conditions and spring or fall migration coincide. Birds appear to become confused by the lights during foggy or low ceiling conditions, flying circles around lighted structures until they become exhausted or collide with the structure (Erickson et al. 2001). Most collisions at communication towers are attributed to the guy wires on these structures, which wind turbines do not have. Additionally, the large mortality events observed at communication towers have occurred at structures greater than 500’ in height (Erickson et al. 2001), likely because most birds migrate at elevations of 900’ or higher (Young et al. 2004). Modern wind turbines are well below 900’ in height. Migrating songbirds and other species are likely more at risk of turbine collision when ascending and descending from stopover habitats. Due to the presence of the Wind

River near the Stagner Mountain project, some potential exists for greater numbers of songbirds and other species to migrate through the areas and some potential exists for greater stopover events.

The average overall bird fatality rate at wind power projects in the U.S. is 2.3 bird fatalities per turbine per year or 3.1 bird fatalities per MW per year (NWCC 2004). Overall bird fatality rates documented at the Foote Creek Rim Wind Project were 1.5 per turbine per year (Young et al. 2003).

## *Bats*

Species documented as occurring within the same latitude and longitude block of the project area include (Cerovski et al. 2004): western small-footed myotis (*Myotis ciliolabrum*), long-eared myotis (*Myotis evotis*), little brown myotis (*Myotis lucifugus*), long-legged myotis (*Myotis volans*), eastern red bat (*Lasiurus borealis*), Silver-haired bat (*Lasionycteris noctivagans*), Hoary Bat (*Lasiurus cinereus*), big brown bat (*Eptiscus fuscus*), spotted bat (*Euderma maculatum*), Townsend's big-eared bat (*Corynorhinus townsendii*), and pallid bat (*Antrozous pallidus*). The Townsend's big-eared bat has been documented within two miles of the proposed project area (WYNDD 2007).

The proposed Sheldon Dome project area generally lacks habitat features that attract foraging bats: water and trees. The Sheldon Dome project also appears to lack any roosting features that may attract bats. However, it is likely that bats migrate through the project area.

The proposed Stagner Mountain project site contains more habitat features that could attract bats. While the proposed ridge is an open grassland, located just off the ridge are mature coniferous forests, cliffs and potential caves that could provide potential roosting and foraging habitats for bats.

Bat casualties have been reported from most wind power facilities where post-construction fatality data are available. Reported estimates of bat mortality at wind power facilities have ranged from 0.01 – 47.5 per turbine per year (0.9 – 43.2 bats / MW / Year) in the U.S. with an average of 3.4 per turbine or 4.6 per MW (NWCC 2004). Bat fatality rates at Foote Creek rim were 1.34 per turbine per year (Young et al. 2003). Most of the bat casualties at wind power facilities to date are non-hibernating migratory species that conduct long-distance migrations between summer breeding and wintering areas, namely the hoary bat, eastern red bat and silver-haired bat (Johnson 2005). A recent report documented from 25 – 38 bat fatalities per turbine during a 6 week study period at wind power facilities in West Virginia and Pennsylvania. Most of the species killed were eastern red bat, hoary bat, and eastern pipistrelle (*Pipistrellus subflavus*) (Kerns et al. 2005). The West Virginia and Pennsylvania sites are located on prominent forested ridges in the Appalachian Mountains. The causes of the relatively high number of migratory bat deaths at wind power facilities are not well understood (Johnson 2005). Kerns et al. (2005) hypothesized that bats may have been attracted to turbines by

ultrasound emissions, ephemeral increases in food sources, or bats may have investigated turbines for roosting sites or to glean insects from turbine blades. Researchers also theorized that clearings made in the forest for turbines and roads may have created attractive foraging areas for bats (Kerns et al. 2005).

At Foote Creek Rim, Wyoming, of 260 bats captured in mist nets in the vicinity of the wind farm, 81% were bats in the genus *Myotis*, with long-legged myotis (*Myotis volans*) and little brown bat being the most prevalent, yet members of this genus comprised only 6 (5%) of the 123 turbine collision mortalities during the study (Gruver 2002). Low mortality of *Myotis* and other bats in the area (i.e., big brown and silver-haired bat) occurred even though these species were documented within the wind plant. Although hoary bats comprised 88.1% of the fatalities, species other than hoary bats were responsible for 95% of all identifiable calls recorded at turbines with a bat detector.

## *Wetlands*

Information concerning wetlands is based on field observations. Wetlands appeared to be rare in the project areas, and are limited to a few spring and well locations.

## *USFWS PII Score*

The USFWS issued "Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines" in 2003. Application of the guidelines is voluntary. The guidelines are meant to assist the USFWS and the wind energy industry to locate projects to minimize or avoid wildlife impacts by providing a standardized approach to evaluate proposed project areas against other reference areas.

WEST personnel visited the proposed wind project area and completed the field portion of the interim guidelines (i.e., physical attribute checklist, ecological attractiveness checklist). Once in the office, WEST completed the remaining worksheets (i.e., species occurrence and status checklist) for determining the Potential Impact Index (PII) scores (Appendix C). The reference areas used for the evaluation were the Foote Creek Rim Wind Project and Hutton Lake National Wildlife Refuge.

The PII for the Sheldon Dome project was 130 and the Stagner Mountain project was 195. In contrast, the PII for the Foote Creek Rim was 133 and 205 for Hutton Lake National Wildlife Refuge. The Interim Guidelines state that a reference site should be selected such that it has a "maximum negative effect on wildlife." The Hutton Lake National Wildlife Refuge was selected for the reference site because it was a wildlife refuge located within Wyoming, would likely have a higher PII score than the project site, and have a high potential for negative impacts on wildlife. Foote Creek Rim was evaluated because it is an existing wind facility located in Wyoming.

Hutton Lake National Wildlife Refuge is publicly available land located in Wyoming but with more species, "better" habitat characteristics for some threatened and/or endangered species, serves a major migratory corridor and stopover habitat for birds and other

species, and is comprised largely of native habitat. In addition, the USFWS did not have any existing data on other PII scores within the state for comparison.

## Conclusions

The potential for several biological resources to occur in the project areas were examined. Due to differences in topography and surrounding habitat, potential for occurrence differed between the two project sites. The potential for occurrence was considered low for some resources. The proposed projects have a relatively low potential for species protected under the Endangered Species Act to occur in the area, with the exception of the bald eagle. Both sites lacked any signs of wetlands.

The potential for other resources to occur was greater. Overall, the Stagner mountain site appeared to have more potential for biological resources than the Sheldon Dome site. Due to the presence of a steep ridge that could concentrate migrating and hunting raptors, the presence of a prey base in the form of prairie dog colonies, and the presence of suitable nesting habitat near the project, the Stagner Mountain site may have some characteristics that could lead to a greater potential for raptor fatalities. The Sheldon Dome area appeared to lack prairie dog colonies and highly suitable nesting habitat, and may have a lower potential for impacting raptors.

Both sites have potential for greater sage-grouse to occur on-site. Much debate has occurred recently regarding the potential impacts of wind power projects on prairie grouse. Under a set of voluntary guidelines, the USFWS has taken a precautionary approach and recommends wind turbines be placed at least five miles from known lek locations. The USFWS argues that because species such as greater sage-grouse evolved in open grassland or sage-brush habitats with little vertical structure, placement of tall man-made structures such as wind turbines in occupied greater sage-grouse habitat may result in a decrease in habitat suitability (USFWS 2004). Many researchers have hypothesized that greater sage-grouse avoid areas near power lines due to the tendency of power lines to create good perches for hunting raptors. Researchers have documented the negative effects of natural gas development and road traffic on nesting sage-grouse in Wyoming (Lyon and Anderson 2000, Holloran 2005). The creation of roads in the project area may negatively impact greater sage-grouse. Current research does not examine the level of avoidance of tall vertical structures by greater sage-grouse, however, the potential exists for greater sage-grouse to avoid areas near turbines.

The proposed projects will likely result in the mortality of some bat species during migration, including hoary bats and silver-haired bats. The vast majority of bat fatalities documented at the Foote Creek Rim and other projects occurred during the fall migration, and were composed of hoary bats and silver-haired bats (Young et al. 2003). Bat fatality rates observed at Foote Creek Rim were 1.34 per turbine per year, compared to a national average of 3.4 per turbine per year. The magnitude of these fatalities and the degree to which other bats species will be affected is difficult to determine. The Sheldon Dome project lacks habitats that may attract bats, such as water sources and trees. However,

potential caves, forests and rocky areas near the Stagner Mountain project area provide potential roosting and hibernacula. Studies conducted at other wind projects, including Foote Creek Rim, have documented use of the area by resident or breeding bats during the summer, however, these species are very rarely found as casualties at wind projects (Gruver 2002, Johnson 2005). We are unaware of any wind power facility located in areas containing mine shafts or caves that could provide roost sites for large numbers of wintering or breeding bats. Because few resident or breeding bat species have been documented as casualties at other wind projects, it is unclear if large numbers of resident or winter bat fatalities would occur if a wind power project is sited near a relatively large and well used hibernacula or maternity colony.

Similar to Foote Creek Rim, the proposed project contains some features that may result in increased raptor use or use by other species. Baseline studies at Foote Creek Rim were able to identify localized areas of high use in the project area, and small shifts in turbine locations likely reduced the potential impacts of the proposed project on raptors. If the proposed project proceeds, baseline studies can be utilized to identify high wildlife use areas to help design a wind project that reduces impacts to wildlife.

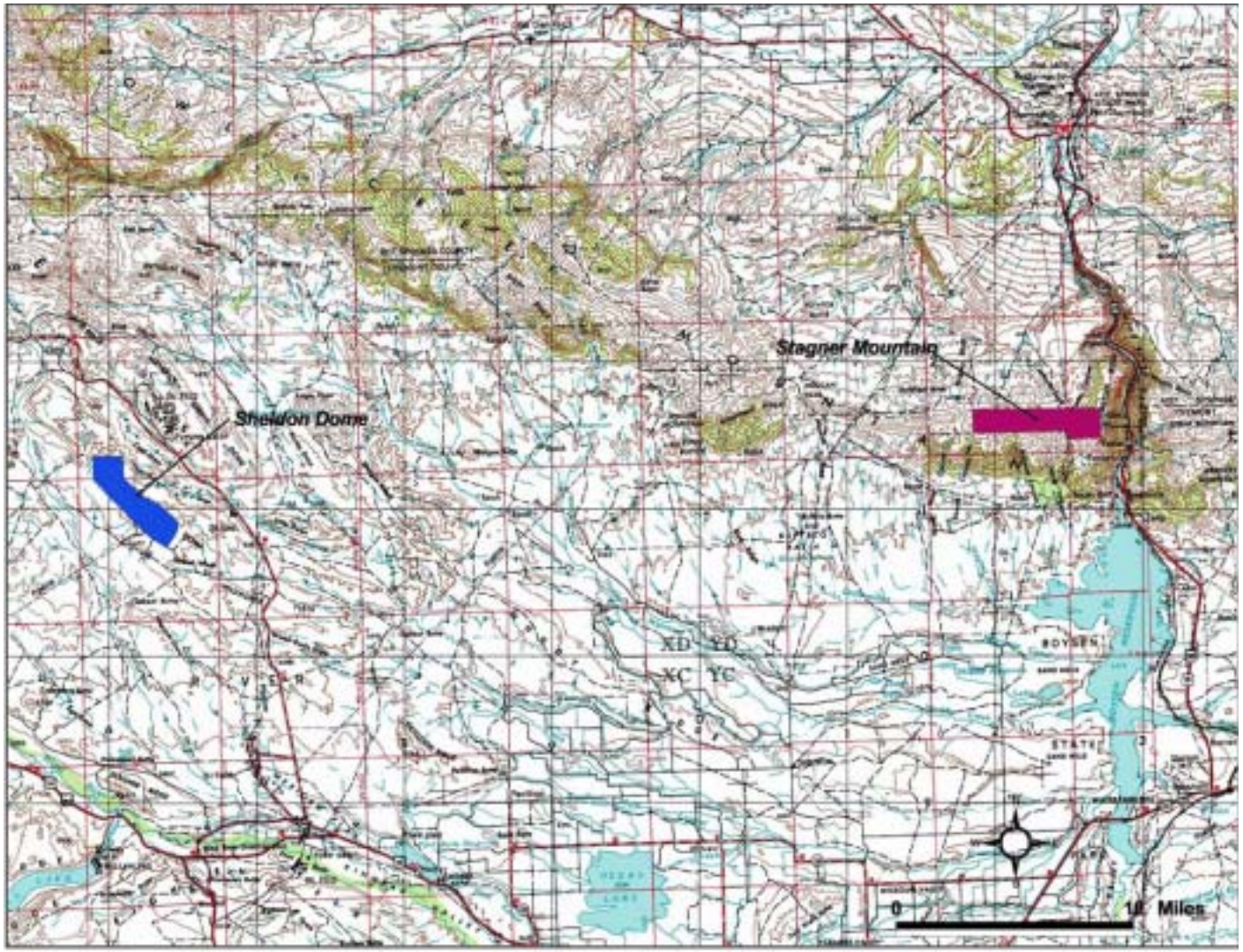


**Figure 1. A map of the proposed project area.**

**Figure 2. Photographs of the Sheldon Dome site and surrounding landscape.**

**Figure 3. More photographs of the Sheldon Dome project and surrounding areas.**

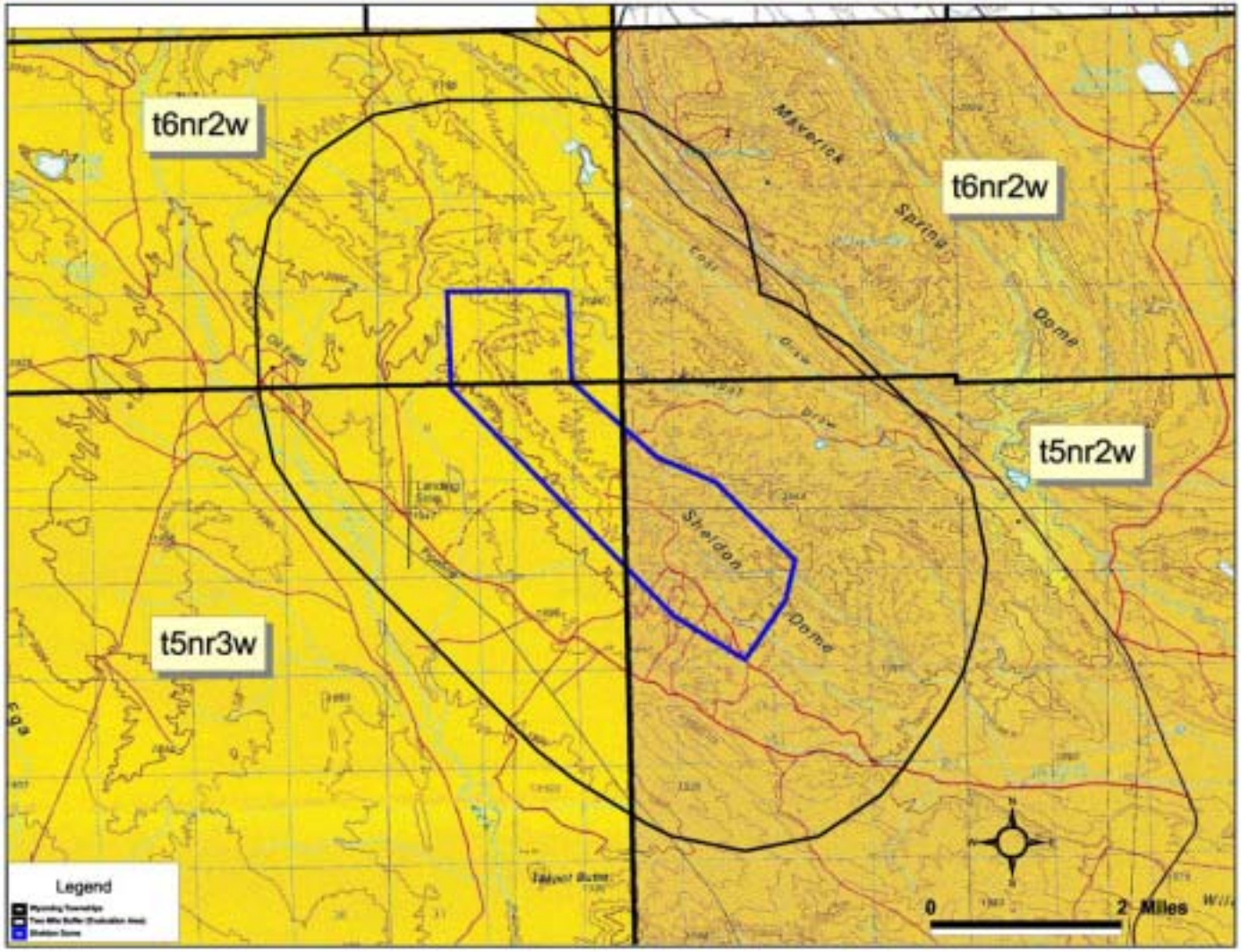


**Figure 4. A topographic map of the Sheldon Dome project area.**

**Figure 5. Photographs of the Stagner Mountain project and surrounding areas.**

**Figure 6. More photographs of the Stagner Mountain Project and surrounding areas.**

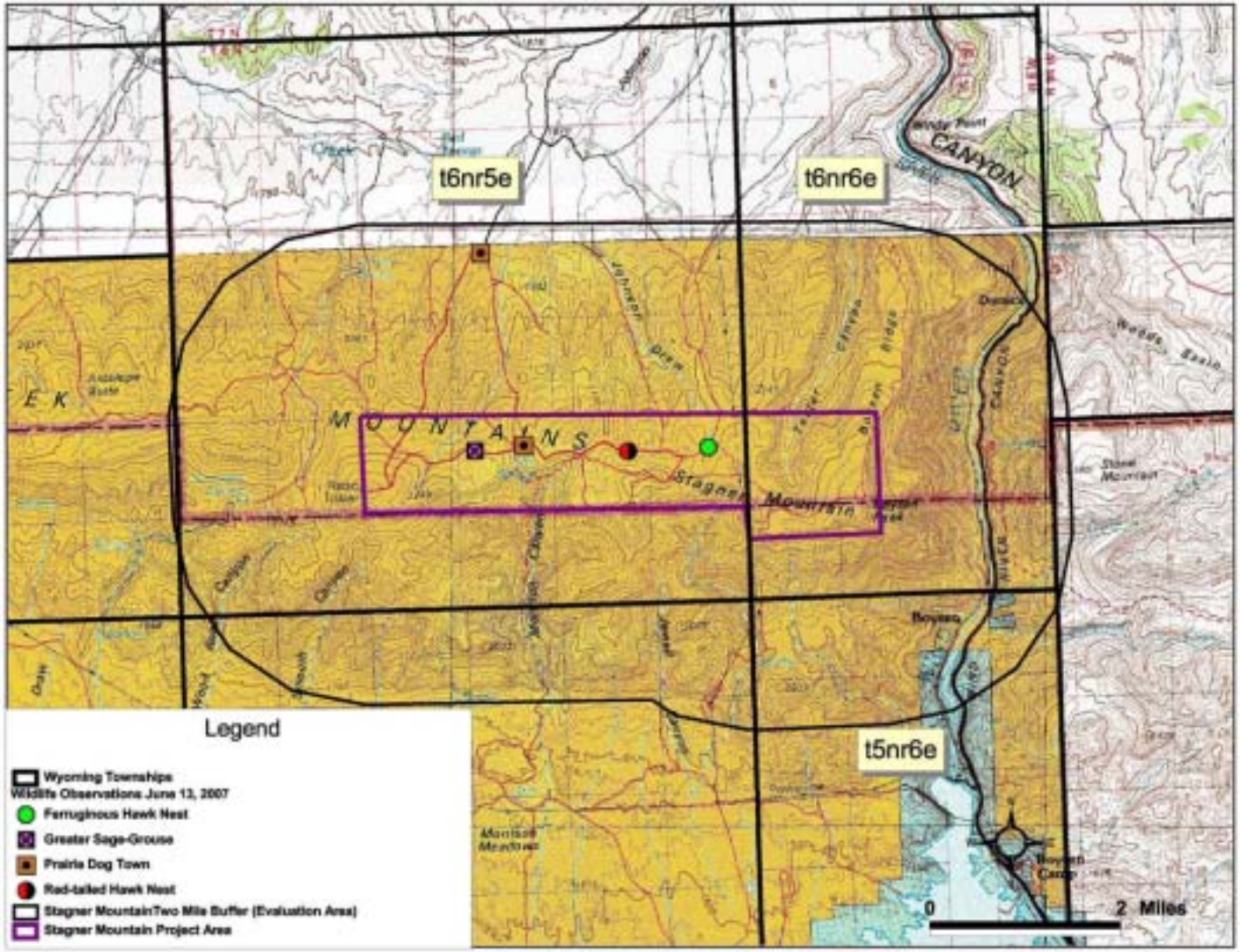


**Figure 7. A topographic map of the Stagner Mountain project area.**

**Figure 8. A photograph of a ferruginous hawk nest located on a power line within the Stagner Mountain project area.**

**Figure 9. A photograph of a red-tailed hawk nest on a platform within the Stagner Mountain project area.**

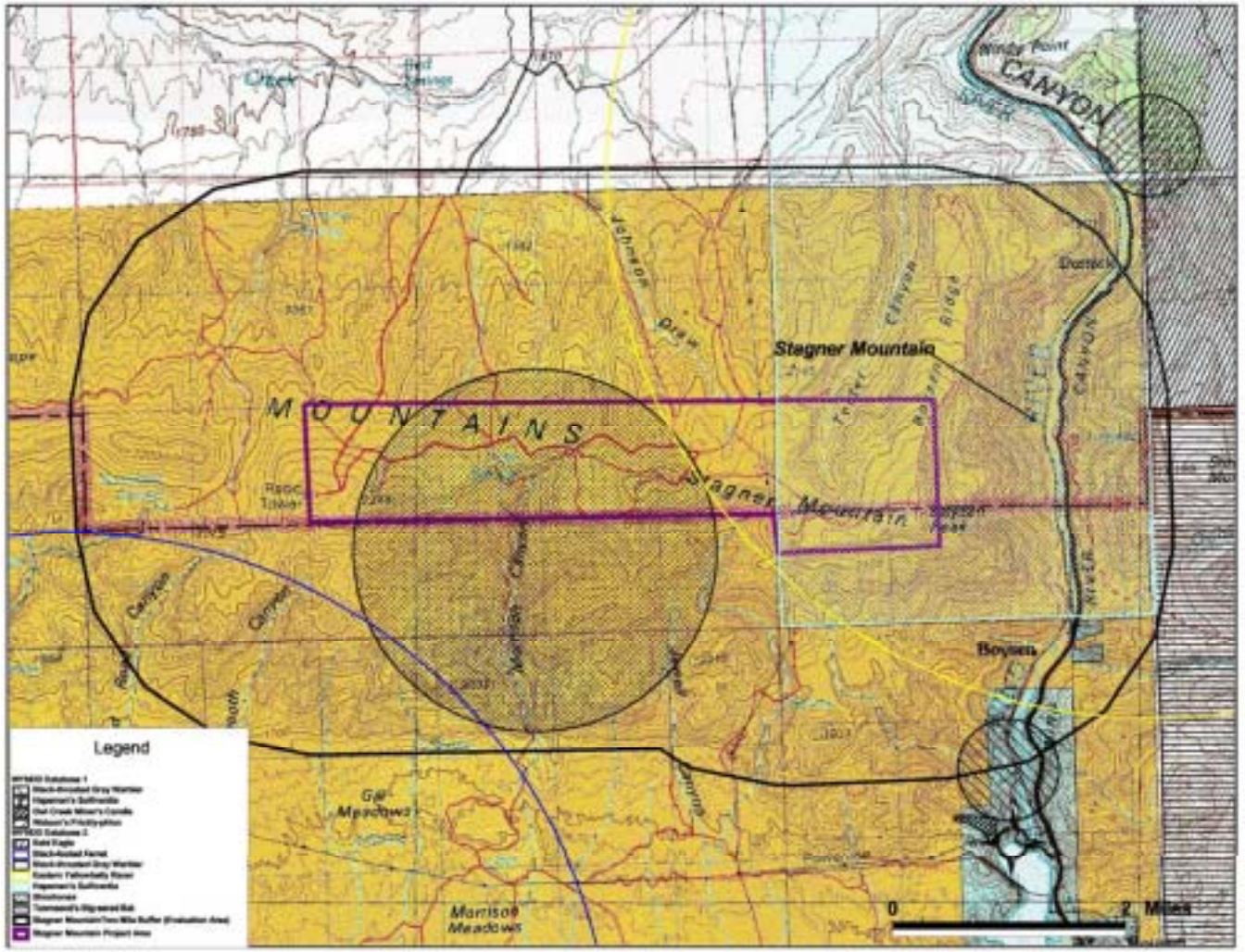


**Figure 10. Wildlife records from the WYNDD (2007) within two miles of the Stagner Mountain project area. No records were present within two miles of the Sheldon Dome project.**

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Appendix A – Correspondence from WYNDD concerning the proposed project areas.

## Rhett Good

**From:** Melanie Arnett [Arnett@uwyo.edu]
**Sent:** Friday, July 13, 2007 1:20 PM
**To:** Rhett Good
**Subject:** data request results
**Attachments:** summary_supplement.xls; Shapefiles.zip

UNIVERSITY OF WYOMING
**Wyoming Natural Diversity Database**
Department 3381 • 1000 E. University Avenue • Laramie, WY 82071
(307) 766-3023 • fax (307) 766-3026 • e-mail: arnett@uwyo.edu • www.uwyo.edu/wyndd

Rhett Good
WEST, Inc.
2003 Central Avenue
Cheyenne, WY 82001

13 July 2007

Dear Rhett,

Attached are the results of your request for documented rare species occurrences in the northern half of the Wind River Indian Reservation, Fremont and Hot Springs Counties, Wyoming. A buffer of townships within 4 miles of the requested areas was also queried to provide adequate information for the appropriate application of these data (records distinguished by “Request” or “Buffer” in the Area field). An additional field, Eval_Area was included to distinguish between the Sheldon Dome area and the Stagner Mtn area.

Data are in the form of ArcView shapefiles in UTM Zone 12 NAD27. **The source.shp file now also contains data sensitive records as township polygons and may be considered complete data for this request; the eorep.shp file is included as a source of additional information for records in the source.shp file.** The shapefiles are attached in a .zip file. Because some email systems filter out emails with .zip attachments, please reply as soon as possible and let me know if you received this email and the attached data.

A summary of your results may be found in the Excel spreadsheet "summary_supplement.xls", which contains two worksheets:

1) a summary of your results by species and area (buffer or request, Sheldon Dome or Stagner Mtn) - if the species appears more than once it is because it is found in more than one area
2) a supplement for potentially truncated observation data in the source shapefiles

Please download a copy of our Data Dictionary at http://uwadmnweb.uwyo.edu/WYNDD/ if you have questions regarding file naming conventions, the definition of fields included in your shapefiles, or our data sensitive policy. We are currently in the process of altering our download protocol for source shapefiles so if you have questions please feel free to call me. Additional information about abbreviations in the shapefiles may also be obtained from the Codes and Definitions portion of this website.

Comments from our botanist, Bonnie Heidel (307-766-3020, bheidel@uwyo.edu), and zoologist, Doug Keinath (307-766-3013, dkeinath@uwyo.edu), will be forwarded to you as soon as they have an opportunity to review the requested area and formulate responses. These files provide further information regarding potential species occurrences in the area as well as habitat information. We have no documentation of vegetation communities that we track in the area of interest.

Recommended citation:
Wyoming Natural Diversity Database. 2007. Data compilation for R. Good, completed July 13, 2007. Unpublished

report. Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.

WYNDD would benefit greatly from the sharing of any new information on species locations that result from your project. Please contact us about our data trading policy, which would help your organization reduce costs while improving and updating our database.

We will send you a bill under separate cover for $99.75 (Tier 2 Data Request: 12 Townships x 625 taxa = 7500 (if between 6250-62500 then multiply by 0.0133 for fee)).

Thank you for your data request. Please do not hesitate to call if you have any questions about the search. We ask that you not disseminate these data without our permission.

Sincerely,

**Melanie Arnett**
Database Specialist
Wyoming Natural Diversity Database
University of Wyoming
217 Wyo Hall, Dept. 3381
1000 E. University Ave
Laramie, WY 82071-3381
Phone: 307.766.2296
Email: arnett@uwyo.edu
Web: http://www.uwyo.edu/wyndd

# ZOOLOGICAL COMMENTS

**Wyoming Natural Diversity Database**

**Prepared for:** Rhett Good - WEST, Inc.
**Date:** 16 July 2007
**Project Description:** Screening report for two potential wind projects (Sheldon Dome and Stagner Mtn) in portions of the northern half of the Wind River Indian Reservation, Fremont and Hot Springs Counties

## HABITAT NOTES:

Towns: The Stagner Mtn site is between Thermopolis and Shoshoni and the Sheldon Dome site is approximately 35 miles east-southeast of Dubois.
Water: Teapot Wash, Fivemile Creek and Dry Creek intersect the Sheldon Dome site. Wind River, Stagner Creek, Gold Creek, Cottonwood Creek, and Big Wind River intersect the Stagner Mtn site.
Habitat: The Sheldon Dome site consists primarily of Wyoming Big Sage Steppe and Desert Shrub, with ribbons of Basin Rock & Soil and Shrub Riparian. The Stagner Mtn site consists primarily of Juniper, with some Mixed-Grass Prairie on the fringes. Other community types surrounding the sites include Douglas-fir, Forest Riparian, Greasewood, Irrigated Crops, Limber Pine, Mountain Big Sage, Open Water, and Saltbush.
Approximate Elevation: Sheldon Dome site: 6,200 - 7,000 ft.; Stagner Mtn site: 4,500 - 7,500 ft.

## ZOOLOGY COMMENTS:

**Please report new occurrences of any of these species to WYNDD so that our database continues to be current and useful to future requesters. Thank you!**

These data represent what we currently have in our Biotics database as well as our informed opinion about what might occur in the request area if local habitat is appropriate (**species documented in our Biotics database are presented in bold face type**). Please note that absence of a species occurrence in our database is not proof that the species in question does not exist there. It is highly possible that people have never looked for, or reported, information on the species in question in the request area. Our data for private land is particularly sparse, so absence of observations on private parcels should be viewed with caution. Also, please note that (in general) only animals likely to breed or winter near the project area have been included in this list. Other animals, particularly migratory birds, may use portions of the study area in other seasons. Finally, this list includes only species that we actively track in our database, the full list of which can be found on our website (http://uwadmnweb.uwyo.edu/wyndd/).

Prepared by: Melanie Arnett, Database Specialist, arnett@uwyo.edu
Direct questions to: Doug Keinath, Zoologist; dkeinath@uwyo.edu

**Bold = Documented in our Biotics database**. * = Documented in buffer area only.

| Sensitive BIRDS Documented or Potentially in Request Area | | | | |
|---|---|---|---|---|
| **Common Name** | **Scientific Name** | **Heritage Rank** | **Management Status** | **Habitat Notes** |
| **Common loon Stagner Mtn*** | **Gavia immer** | **G5/S1B/S2N** | **S-USFS R4, WGFD CWCS, WGFD NSS1** | **Nests on medium to large lakes not disturbed by humans. During migration found on ponds, lakes and reservoirs** |
| Clark's grebe | Aechmophorus clarkii | G5/S1B | WGFD CWCS, WGFD NSS4 | Ponds, lakes, and reservoirs |
| American white pelican (Breeding colonies) | Pelecanus erythrorhynchos | G3/S1B | WGFD CWCS, WGFD NSS3 | Ponds, lakes, rivers, and reservoirs |
| American bittern | Botaurus lentiginosus | G4/S3B | S-USFS R2, WGFD CWCS, WGFD NSS3 | Marshes and vegetated shorelines, esp. cattails and bulrushes |
| Snowy egret | Egretta thula | G5/S3B | WGFD CWCS, WGFD NSS3 | Ponds, lakes, and reservoirs |
| Black-crowned night-heron | Nycticorax nycticorax | G5/S3B | WGFD CWCS, WGFD NSS3 | Marshes and wooded streams |
| White-faced ibis | Plegadis chihi | G5/S1B | WY BLM SSL, WGFD CWCS, WGFD NSS3 | Marshes, wet meadows, and vegetated shorelines |
| **Trumpeter swan Sheldon Dome*** | **Cygnus buccinator** | **G4/S2** | **USFWS ESA Listing Denied, WY BLM SSL, S-USFS R2, S-USFS R4, WGFD CWCS, WGFD NSS2** | **Ponds, lakes, streams** |
| Tundra swan | Cygnus columbianus | G5/S2N | | Ponds, lakes, and reservoirs |
| Ring-necked duck | Aythya collaris | G5/S4B | | Rivers, lakes, reservoirs |
| Harlequin duck | Histrionicus histrionicus | G4/S1B | S-USFS R2, S-USFS R4, WGFD CWCS, WGFD NSS3 | Rapid mountain streams and rivers |
| **Bufflehead Sheldon Dome*** | **Bucephala albeola** | **G5/S2B** | | **Lakes, ponds, rivers, reservoirs** |
| **Common goldeneye Sheldon Dome*** | **Bucephala clangula** | **G5/S3B** | | **Lakes, rivers, and reservoirs** |
| Osprey | Pandion haliaetus | G5/S3B | | Wooded areas along lakes and rivers |
| **Bald eagle Sheldon Dome* Stagner Mtn** | **Haliaeetus leucocephalus** | **G4/S3B/S5N** | **USFWS ESA Threatened (T, AD), WGFD CWCS, WGFD NSS2** | **Wooded areas usually along rivers, lakes, reservoirs. Sometimes in open country** |
| **Northern goshawk Sheldon Dome*** | **Accipiter gentilis** | **G5/S3** | **USFWS ESA Listing Denied, WY BLM SSL, S-USFS R2, S-USFS R4, WGFD CWCS, WGFD NSS4** | **Open montane conifer forest or aspen** |
| **Ferruginous hawk Sheldon Dome*** | **Buteo regalis** | **G4/S4B/S5N** | **WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS3** | **Open grasslands and shrublands** |
| **Golden eagle Sheldon Dome* Stagner Mtn*** | **Aquila chrysaetos** | **G5/S3B** | | **Open grasslands and shrublands esp. around cliffs and canyons** |
| **Merlin Sheldon Dome*** | **Falco columbarius** | **G5/S4** | **WGFD CWCS, WGFD NSS3** | **Open woodlands, grasslands, and shrublands sometimes in cities in winter** |
| American peregrine falcon | Falco peregrinus anatum | G4/T3/S2 | USFWS ESA Delisted (DM), WY BLM SSL, S-USFS R2, S-USFS R4, WGFD CWCS, WGFD NSS3 | Mountainous zones or cliffs near large lakes and rivers |
| **Greater sage grouse Sheldon Dome*** | **Centrocercus urophasianus** | **G4/S4** | **USFWS ESA Petitioned, WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS2** | **Sagebrush basins and foothills, generally close to water** |
| Virginia rail | Rallus limicola | G5/S3B | WGFD CWCS, WGFD NSS3 | Densely vegetated marshes, esp. cattails and bulrushes |
| Sandhill crane | Grus canadensis | G5/S3B/S5N | WGFD CWCS, WGFD NSS3 | Meadows, marshes, shorelines, and grain fields |

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|---|---|---|---|---|
| Whooping crane | Grus americana | G1/SAB/S1N | USFWS ESA Endangered (E, EXPN) | Wet meadows, marshes, and shorelines |
| Snowy plover | Charadrius alexandrinus | G4/SA | | Sandy beaches and shores of alkaline ponds |
| Piping plover | Charadrius melodus | G3/SA | USFWS ESA Threatened (T) | Sandy beaches |
| **Mountain plover Stagner Mtn*** | **Charadrius montanus** | **G2/S2** | **USFWS ESA Listing Denied, S-USFS R2, WGFD CWCS, WGFD NSS4** | **Sparse shortgrass or mixed grass prairie. Also in short-sagebrush plains. Often associated with prairie dog towns.** |
| Black-necked stilt | Himantopus mexicanus | G5/S3B | | Marshes, ponds, and shores |
| American avocet | Recurvirostra americana | G5/S3B | | Marshes, ponds, and shores, esp. alkaline areas |
| Long-billed curlew | Numenius americanus | G5/S3B | WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS3 | Meadows, pastures, shorelines, and marshes |
| Red-necked phalarope | Phalaropus lobatus | G5/S3N | | Ponds, shorelines, and wet meadows |
| Ring-billed gull (Breeding colonies) | Larus delawarensis | G5/S2 | | Lakes, reservoirs, fields, garbage dumps, and wet meadows |
| California gull (Breeding colonies) | Larus californicus | G5/S2B | | Lakes, reservoirs, wet meadows, fields, and garbage dumps |
| Herring gull (Breeding colonies) | Larus argentatus | G5/SA | | Lakes, reservoirs, wet meadows, and fields |
| Caspian tern | Sterna caspia | G5/S1 | WGFD CWCS, WGFD NSS3 | Lakes, reservoirs, and rivers |
| Common tern | Sterna hirundo | G5/S1 | | Lakes and reservoirs |
| Forster's tern | Sterna forsteri | G5/S1 | WGFD CWCS, WGFD NSS3 | Lakes, reservoirs, and marshes |
| Black tern (Breeding colonies) | Chlidonias niger | G4/S1 | S-USFS R2, WGFD CWCS, WGFD NSS3 | Ponds, lakes, reservoirs, and marshes |
| Black-billed cuckoo | Coccyzus erythropthalmus | G5/S2 | | Deciduous woods and thickets, usually along large streams |
| Yellow-billed cuckoo | Coccyzus americanus | G5/S1 | USFWS ESA Candidate (C), WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS2 | Deciduous woods and thickets, usually along large streams |
| **Short-eared owl Sheldon Dome*** | **Asio flammeus** | **G5/S2** | **S-USFS R2, WGFD CWCS, WGFD NSS4** | **Open grasslands, meadows, marshes, and farmland, especially around tall grass or weeds** |
| Western screech owl | Otus kennicottii | G5/S2 | | Deciduous bottomlands and aspen stands |
| Eastern screech owl | Otus asio | G5/S3 | | Wooded river and stream bottoms, usually with cottonwoods |
| Northern pygmy-owl | Glaucidium gnoma | G5/S2 | WGFD CWCS, WGFD NSS4 | Coniferous forest |
| **Burrowing owl Stagner Mtn*** | **Athene cunicularia** | **G4/S3** | **WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4** | **Plains and basins, often associated with prairie dog towns** |
| Great gray owl | Strix nebulosa | G5/S2 | S-USFS R4, WGFD CWCS, WGFD NSS4 | Coniferous forest with nearby open area |
| Calliope hummingbird | Stellula calliope | G5/S3 | | Meadows, parks, open woodlands, and willow and alder thickets, usually in montane conifer forest |
| Lewis' woodpecker | Melanerpes lewis | G4/S2 | S-USFS R2, WGFD CWCS, WGFD NSS3 | Open, mature ponderosa pine forest and recently burned forest |
| Williamson's sapsucker | Sphyrapicus thyroideus | G5/S2 | | Old-growth conifer forest, especially a mixture of spruce and lodgepole pine |
| American Three-toed Woodpecker | Picoides dorsalis | G5/S3 | S-USFS R2, S-USFS R4, WGFD CWCS, WGFD NSS4 | Old-growth conifer forest, especially spruce-fir and ponderosa pine or recently burned forest |
| Loggerhead shrike | Lanius ludovicianus | G4/S3 | WY BLM SSL, S-USFS R2 | Open country with scattered trees and shrubs |
| Eastern phoebe | Sayornis phoebe | G5/SA | | Wooded streams |
| Ash-throated flycatcher | Myiarchus cinerascens | G5/S3B | WGFD CWCS, WGFD NSS3 | Juniper woodlands |

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|---|---|---|---|---|
| Juniper titmouse | Baeolophus ridgwayi | G5/S1 | WGFD CWCS, WGFD NSS3 | Juniper woodlands |
| **Pygmy nuthatch Sheldon Dome*** | **Sitta pygmaea** | **G5/S2** | **WGFD CWCS, WGFD NSS4** | **Mature ponderosa pine forest** |
| **Canyon wren Stagner Mtn*** | **Catherpes mexicanus** | **G5/S2S3** | | **Rocky canyons and cliffs** |
| **Winter wren Sheldon Dome*** | **Troglodytes troglodytes** | **G5/SA** | | **Brushy stream-sides in conifer forest** |
| **American dipper Sheldon Dome*** | **Cinclus mexicanus** | **G5/S4** | | **Fast flowing rocky streams mostly in mountains, moves to lower elev. streams and rivers in winter** |
| Eastern bluebird | Sialia sialis | G5/S2 | | Open woodlands |
| **Sage thrasher Sheldon Dome*** | **Oreoscoptes montanus** | **G5/S5** | **WY BLM SSL, WGFD CWCS, WGFD NSS4** | **Tall sagebrush and greasewood** |
| **Black-throated gray warbler Stagner Mtn** | **Dendroica nigrescens** | **G5/S2** | | **Juniper woodlands** |
| Townsend's warbler | Dendroica townsendi | G5/SA | | Conifer forest, usually mature spruce-fir. Other pines during migration. Usually high in the trees. |
| Blue Grosbeak | Guiraca caerulea | G5/S3B | | Thickets, stream sides, woodland edges |
| Dickcissel | Spiza americana | G5/S1 | WGFD CWCS, WGFD NSS4 | Tall grass |
| Sage sparrow | Amphispiza belli | G5/S3 | WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4 | Medium to tall sagebrush shrubland |
| Baird's sparrow | Ammodramus bairdii | G4/S1B?/SZN | WY BLM SSL, WGFD NSS4 | "Mid-grass" prairie and meadows? |
| Grasshopper sparrow | Ammodramus savannarum | G5/S4 | S-USFS R2, WGFD CWCS, WGFD NSS4 | |
| Clay-colored sparrow | Spizella pallida | G5/S3B | | Brushy riparian areas and brushy woodland edges |
| **Brewer's sparrow Sheldon Dome*** | **Spizella breweri** | **G5/S5** | **WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4** | **Sagebrush foothills and medium-height sagebrush in basins. Also, mountain mahogany hills.** |
| McCown's longspur | Calcarius mccownii | G5/S2 | S-USFS R2, WGFD CWCS, WGFD NSS4 | Sparsely vegetated shortgrass prairie |
| Chestnut-collared longspur | Calcarius ornatus | G5/S1 | S-USFS R2, WGFD CWCS, WGFD NSS4 | Medium height grass, especially meadows around ponds |
| Bobolink | Dolichonyx oryzivorus | G5/S2 | WGFD CWCS, WGFD NSS4 | Tall grass, usually with overlooking perch |
| **Black-rosy finch Sheldon Dome*** | **Leucosticte atrata** | **G4/S1B/S2N** | **WGFD CWCS, WGFD NSS4** | **Above timberline, usually near cliffs, rocky areas and snowfields. Can be found in open country and towns in the winter.** |
| White-winged crossbill | Loxia leucoptera | G5/S2 | | Conifer forest with an abundance of cones, especially mature spruce on high ridges |

## Sensitive MAMMALS Documented or Potentially in Request Area

| Common Name | Scientific Name | Heritage Rank | Management Status | Habitat Notes |
|---|---|---|---|---|
| Dwarf shrew | Sorex nanus | G4/S4 | WGFD CWCS, WGFD NSS3 | Historically, found in alpine rubble slopes and conifer forests above 4,000 m. Sometimes found in prairie and pinyon-juniper at lower elevations. |
| Western small-footed myotis | Myotis ciliolabrum | G5/S3 | WGFD CWCS, WGFD NSS3 | Found in montane forests, sage steppes, and shortgrass prairie. Roosts: caves, mines |

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|---|---|---|---|---|
| **Long-legged myotis Stagner Mtn*** | **Myotis volans** | **G5/S3** | **WGFD CWCS, WGFD NSS2** | **Found in conifer and deciduous forests. Roosts include tree and rock crevices, snages and buildings.** |
| **Long-eared myotis Stagner Mtn*** | **Myotis evotis** | **G5/S4** | **WY BLM SSL, WGFD CWCS, WGFD NSS2** | **Found in conifer forests, especially ponderosa pine. Forage over water holes and possible openings in conifer forest. Roosts: caves, buildings, mines.** |
| Silver-haired bat | Lasionycteris noctivagans | G5/S3 | WGFD CWCS, WGFD NSS4 | Occur in a wide variety of habitats across Wyoming. Roosts: trees, caves, mines, houses. |
| **Hoary bat Stagner Mtn*** | **Lasiurus cinereus** | **G5/S4** | **WGFD CWCS, WGFD NSS4** | **Widespread and mobile, hoary bats are found in shrublands, grasslands, and aspen-pine forests near roosting habitat. Roosts: deciduous trees.** |
| Spotted bat | Euderma maculatum | G4/S3 | WY BLM SSL, S-USFS R2, S-USFS R4, WGFD CWCS, WGFD NSS2 | Cliff roosting, generally near perennial water in a variety of habitats (including desert, shrub-steppe, and evergreen forest). |
| **Townsend's big-eared bat Stagner Mtn** | **Corynorhinus townsendii** | **G4/S2** | **WY BLM SSL, S-USFS R2, S-USFS R4, WGFD CWCS, WGFD NSS2** | **Hibernates and day-roosts in caves and mines and will use buildings as day roosts. Typical habitat includes desert shrublands, pinyon-juniper woodlands, and dry conifer forests, generally near riparian or wetland areas.** |
| Uinta ground squirrel | Spermophilus armatus | G5/S3S4 | WGFD CWCS, WGFD NSS6 | Found in grasslands, sage, open areas in forests, and tundras. Usually occur at higher elevations than the Wyoming ground squirrel. |
| **Wyoming pocket gopher Stagner Mtn*** | **Thomomys clusius** | **G2/S2** | **WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4** | **Dry upland areas (ridgetops, etc.) characterized by loose, gravel-like soil. Endemic to Wyoming, they are often observed near Bidger's Pass.** |
| Black-tailed prairie dog | Cynomys ludovicianus | G4/S2 | USFWS ESA Listing Denied, S-USFS R2, WGFD CWCS, WGFD NSS3 | Shortgrass prairie, usually with loose, sandy soils. Can form large, dense colonies. |
| White-tailed prairie dog | Cynomys leucurus | G4/S3 | USFWS ESA Listing Denied, WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4 | Found in grassland and shrub-grass communities, often with loose, sandy soils. Colonies are usually not as large or dense as black-tailed prairie dog colonies. |
| Olive-backed pocket mouse | Perognathus fasciatus | G5/S4 | WGFD CWCS, WGFD NSS3 | Dry habitats ranging from gravelly soils to sandy areas of short grass prairies to sand dunes. |
| **Gray wolf Sheldon Dome*** | **Canis lupus** | **G4/S1** | **USFWS ESA Threatened (T, EXPN)** | **Formerly thought to be extinct in Wyoming, reintroduction in the Yellowstone area has lead to a viable population in that portion of the state. The gray wolf occupies a variety of habitats in that area, often associated with ungulate herds, such as elk.** |
| Fisher | Martes pennanti | G5/S1 | S-USFS R4, WGFD CWCS, WGFD NSS3 | Fishers are found in a variety of conifer forests, preferring mature stands with a dense overstory canopy. |
| **Black-footed ferret Stagner Mtn** | **Mustela nigripes** | **G1/S1** | **USFWS ESA Endangered (E, EXPN), WGFD CWCS, WGFD NSS1** | **Black-footed ferrets always occur in or near prairie dog colonies, generally on short or mixed-grass prairie.** |
| North American wolverine | Gulo gulo luscus | G4/S2 | USFWS ESA Listing Denied, S-USFS R2, S-USFS R4, WGFD CWCS, WGFD NSS3 | Wolverine are rare and wide ranging, occurring mainly in the mountainous regions of western Wyoming. Given their large ranges, they can be found in a wide variety of habitats in these areas, particularly boreal conifer forests. |

**Bold = Documented in our Biotics database**. * = Documented in buffer area only.

| Sensitive HERPTILES Documented or Potentially in Request Area | | | | |
|---|---|---|---|---|
| **Common Name** | **Scientific Name** | **Heritage Rank** | **Management Status** | **Habitat Notes** |
| **Tiger salamander Stagner Mtn*** | **Ambystoma tigrinum** | **G5/S4** | **WGFD CWCS, WGFD NSS4** | **Tiger salamanders can be found in fairly moist environments ranging from rodent burrows to window wells to burrows in sand dunes. Larvae found in intermittent streams, ponds, and lakes.** |
| Boreal western toad (Northern Rocky Mountain population) | Bufo boreas boreas | G4/T4/S1 | WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS1 | Boreal toads can be found in and near permanent (or semi-permanent) montane wetlands that have shallow areas for breeding and egg laying (strictly above 8,000 feet). |
| **Northern leopard frog Sheldon Dome* Stagner Mtn*** | **Rana pipiens** | **G5/S3** | **WY BLM SSL, S-USFS R2, WGFD CWCS, WGFD NSS4** | **Found near permanent water in areas up to about 9,000 feet. Lower elevation sites are usually swampy cattail marshes and higher ones tend to be beaver ponds.** |
| Columbia spotted frog (Statewide) | Rana luteiventris | G4/S3 | WY BLM SSL, S-USFS R2, S-USFS R4, WGFD CWCS, WGFD NSS4 | Spotted frogs can be found in ponds, wetlands, and small streams from mountain foothills to high elevation conifer forest, particularly where these water bodies are permanent. |
| Spiny softshell turtle | Trionyx spiniferus | G5/S4 | | The spiny softshell turtle prefers permanent lakes and larger streams at elevations below 6000 feet. |
| Milk snake | Lampropeltis triangulum | G5/S3 | WGFD CWCS, WGFD NSS2 | Milk snakes can be found in woodlands along escarpments in prairie communities below about 6,000 feet. |
| **Eastern yellowbelly racer Stagner Mtn** | **Coluber constrictor flaviventris** | **G5/T5/S4** | **WGFD CWCS, WGFD NSS4** | **The eastern yellow belly racer is found in woodland communities in the plains and foothills zones, usually in the vicinity of water.** |

Appendix B – USFWS Endangered Species List for Freemont and Hot Springs Counties, Wyoming.

U.S. Fish & Wildlife Service

**Mountain-Prairie Region**

# Endangered Species

## *WYOMING*

**Federally listed and proposed (P), endangered (E), threatened (T), experimental (X), and candidate (C) species and habitat in Wyoming by county updated December 2006**

For additional information contact: U.S. Fish and Wildlife Service, Wyoming Field Office, 5353 Yellowstone Road, Cheyenne, Wyoming 82003, telephone 307-772-2374.

SYMBOLS:
* Water depletions in the Colorado River Yampa River, and Green River may affect the species and/or critical habitat in downstream reaches in other states.
▲ Water depletions in the South Platte River may affect the species and/or critical habitat in downstream reaches in other states.
© There is designated critical habitat for the species within the county.

| Species | Scientific Name | Status |
|---|---|---|
| ***ALBANY*** | | |
| Bald Eagle ▲ | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Canada Lynx | *Lynx canadensis* | T |
| Eskimo Curlew ▲ | Numenius borealis | E |
| Interior Least Tern ▲ | *Sternula antillarum* | E |
| Pallid Sturgeon ▲ | *Scaphirhynchus albus* | E |
| Piping Plover ▲ | *Charadrius melodus* | T |
| Preble's Meadow Jumping Mouse © | *Zapus hudsonius preblei* | T |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| Western Prairie Fringed Orchid ▲ | *Platanthera praeclara* | T |
| Whooping Crane ▲ | *Grus americana* | E |
| Wyoming Toad | *Bufo baxteri* | E |
| ***BIG HORN*** | | |
| Bald Eagle | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Canada Lynx | *Lynx canadensis* | T |
| Gray Wolf | *Canis lupus* | X |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| ***CAMPBELL*** | | |
| Bald Eagle | *Haliaeetus leucocephalus* | T |

| | | |
|---|---|---|
| Black-footed Ferret | *Mustela nigripes* | E |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| ***CARBON*** | | |
| Bald Eagle | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Blowout Penstemon | *Penstemon haydenii* | E |
| Bonytail * | *Gila elegans* | E |
| Canada Lynx | *Lynx canadensis* | T |
| Colorado Pikeminnow * | *Ptychocheilus lucius* | E |
| Eskimo Curlew ▲ | Numenius borealis | E |
| Humpback Chub * | *Gila cypha* | E |
| Interior Least Tern ▲ | *Sternula antillarum* | E |
| Pallid Sturgeon ▲ | *Scaphirhynchus albus* | E |
| Piping Plover ▲ | *Charadrius melodus* | T |
| Razorback Sucker * | *Xyrauchen texanus* | E |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| Western Prairie Fringed Orchid ▲ | *Platanthera praeclara* | T |
| Whooping Crane ▲ | *Grus americana* | E |
| ***CONVERSE*** | | |
| Bald Eagle ▲ | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Eskimo Curlew ▲ | Numenius borealis | E |
| Interior Least Tern ▲ | *Sternula antillarum* | E |
| Pallid Sturgeon ▲ | *Scaphirhynchus albus* | E |
| Piping Plover ▲ | *Charadrius melodus* | T |
| Preble's Meadow Jumping Mouse © | *Zapus hudsonius preblei* | T |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| Western Prairie Fringed Orchid ▲ | *Platanthera praeclara* | T |
| Whooping Crane ▲ | *Grus americana* | E |
| ***CROOK*** | | |
| Bald Eagle | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| ***FREMONT*** | | |
| Bald Eagle ▲ | *Haliaeetus leucocephalus* | T |
| | | |

| | | |
|---|---|---|
| Black-footed Ferret | *Mustela nigripes* | E |
| Canada Lynx | *Lynx canadensis* | T |
| Desert Yellowhead © | *Yermo xanthocephalus* | P |
| Eskimo Curlew ▲ | Numenius borealis | E |
| Gray Wolf | *Canis lupus* | X |
| Grizzly Bear | *Ursus arctos horribilis* | T |
| Interior Least Tern ▲ | *Sternula antillarum* | E |
| Pallid Sturgeon ▲ | *Scaphirhynchus albus* | E |
| Piping Plover ▲ | *Charadrius melodus* | T |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| Western Prairie Fringed Orchid ▲ | *Platanthera praeclara* | T |
| Whooping Crane ▲ | *Grus americana* | E |
| ***GOSHEN*** | | |
| Bald Eagle ▲ | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Colorado Butterfly Plant | *Gaura neomexicana ssp. coloradensis* | T |
| Eskimo Curlew ▲ | Numenius borealis | E |
| Interior Least Tern ▲ | *Sternula antillarum* | E |
| Pallid Sturgeon ▲ | *Scaphirhynchus albus* | E |
| Piping Plover ▲ | *Charadrius melodus* | T |
| Preble's Meadow Jumping Mouse | *Zapus hudsonius preblei* | T |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| Western Prairie Fringed Orchid ▲ | *Platanthera praeclara* | T |
| Whooping Crane ▲ | *Grus americana* | E |
| ***HOT SPRINGS*** | | |
| Bald Eagle | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Canada Lynx | *Lynx canadensis* | T |
| Gray Wolf | *Canis lupus* | X |
| Grizzly Bear | *Ursus arctos horribilis* | T |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| ***JOHNSON*** | | |
| Bald Eagle | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Canada Lynx | *Lynx canadensis* | T |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |

| | | |
|---|---|---|
| ***LARAMIE*** | | |
| Bald Eagle ▲ | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Gray Wolf | *Canis lupus* | T |
| Colorado Butterfly Plant © | *Gaura neomexicana ssp. coloradensis* | T |
| Eskimo Curlew ▲ | Numenius borealis | E |
| Interior Least Tern ▲ | *Sternula antillarum* | E |
| Pallid Sturgeon ▲ | *Scaphirhynchus albus* | E |
| Piping Plover ▲ | *Charadrius melodus* | T |
| Preble's Meadow Jumping Mouse © | *Zapus hudsonius preblei* | T |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| Western Prairie Fringed Orchid ▲ | *Platanthera praeclara* | T |
| Whooping Crane ▲ | *Grus americana* | E |
| ***LINCOLN*** | | |
| Bald Eagle | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Bonytail * | *Gila elegans* | E |
| Canada Lynx | *Lynx canadensis* | T |
| Colorado Pikeminnow * | *Ptychocheilus lucius* | E |
| Gray Wolf | *Canis lupus* | X |
| Grizzly Bear | *Ursus arctos horribilis* | T |
| Humpback Chub * | *Gila cypha* | E |
| Razorback Sucker * | *Xyrauchen texanus* | E |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| ***NATRONA*** | | |
| Bald Eagle ▲ | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Eskimo Curlew ▲ | Numenius borealis | E |
| Interior Least Tern ▲ | *Sternula antillarum* | E |
| Pallid Sturgeon ▲ | *Scaphirhynchus albus* | E |
| Piping Plover ▲ | *Charadrius melodus* | T |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| Western Prairie Fringed Orchid ▲ | *Platanthera praeclara* | T |
| Whooping Crane ▲ | *Grus americana* | E |
| ***NIOBRARA*** | | |
| | | |

| | | |
|---|---|---|
| Bald Eagle ▲ | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Eskimo Curlew ▲ | Numenius borealis | E |
| Interior Least Tern ▲ | *Sternula antillarum* | E |
| Pallid Sturgeon ▲ | *Scaphirhynchus albus* | E |
| Piping Plover ▲ | *Charadrius melodus* | T |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| Western Prairie Fringed Orchid ▲ | *Platanthera praeclara* | T |
| Whooping Crane ▲ | *Grus americana* | E |
| ***PARK*** | | |
| Bald Eagle ▲ | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Canada Lynx | *Lynx canadensis* | T |
| Gray Wolf | *Canis lupus* | X |
| Grizzly Bear | *Ursus arctos horribilis* | T |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| ***PLATTE*** | | |
| Bald Eagle ▲ | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Eskimo Curlew ▲ | Numenius borealis | E |
| Interior Least Tern ▲ | *Sternula antillarum* | E |
| Pallid Sturgeon ▲ | *Scaphirhynchus albus* | E |
| Piping Plover ▲ | *Charadrius melodus* | T |
| Preble's Meadow Jumping Mouse © | *Zapus hudsonius preblei* | T |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| Western Prairie Fringed Orchid ▲ | *Platanthera praeclara* | T |
| Whooping Crane ▲ | *Grus americana* | E |
| ***SHERIDAN*** | | |
| Bald Eagle | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Canada Lynx | *Lynx canadensis* | T |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| ***SUBLETTE*** | | |
| Bald Eagle ▲ | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| | | |

| | | |
|---|---|---|
| Bonytail * | *Gila elegans* | E |
| Canada Lynx | *Lynx canadensis* | T |
| Colorado Pikeminnow * | *Ptychocheilus lucius* | E |
| Eskimo Curlew ▲ | Numenius borealis | E |
| Gray Wolf | *Canis lupus* | X |
| Grizzly Bear | *Ursus arctos horribilis* | T |
| Humpback Chub * | *Gila cypha* | E |
| Interior Least Tern ▲ | *Sternula antillarum* | E |
| Kendall Warm Springs Dace | *Rhinichthys osculus thermalis* | E |
| Pallid Sturgeon ▲ | *Scaphirhynchus albus* | E |
| Piping Plover ▲ | *Charadrius melodus* | T |
| Razorback Sucker * | *Xyrauchen texanus* | E |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| Western Prairie Fringed Orchid ▲ | *Platanthera praeclara* | T |
| Whooping Crane ▲ | *Grus americana* | E |
| ***SWEETWATER*** | | |
| Bald Eagle | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Bonytail * | *Gila elegans* | E |
| Colorado Pikeminnow * | *Ptychocheilus lucius* | E |
| Humpback Chub * | *Gila cypha* | E |
| Razorback Sucker * | *Xyrauchen texanus* | E |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| ***TETON*** | | |
| Bald Eagle | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Canada Lynx | *Lynx canadensis* | T |
| Gray Wolf | *Canis lupus* | X |
| Grizzly Bear | *Ursus arctos horribilis* | T |
| ***UINTA*** | | |
| Bald Eagle | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Bonytail * | *Gila elegans* | E |
| Colorado Pikeminnow * | *Ptychocheilus lucius* | E |
| Humpback Chub * | *Gila cypha* | E |
| Razorback Sucker * | *Xyrauchen texanus* | E |

| | | |
|---|---|---|
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| ***WASHAKIE*** | | |
| Bald Eagle | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Canada Lynx | *Lynx canadensis* | T |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |
| ***WESTON*** | | |
| Bald Eagle | *Haliaeetus leucocephalus* | T |
| Black-footed Ferret | *Mustela nigripes* | E |
| Ute Ladies'-tresses | *Spiranthes diluvialis* | T |

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Appendix C – USFWS PII Scores

# POTENTIAL IMPACT INDEX CHECKLISTS

# PHYSICAL ATTRIBUTE CHECKLIST

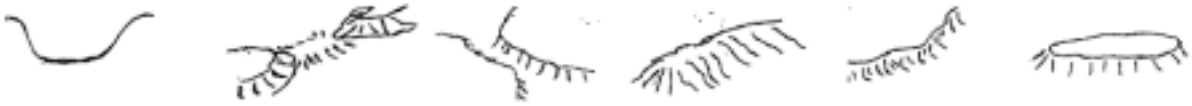
| Physical Attribute | | | | Site: Sheldon Dome | Foote Creek Rim | Hutton Lake NWF | Stagner Mountain |
|---|---|---|---|---|---|---|---|
| Topography | Mountain Aspect* | Side | W | X | X | X | |
| | | | E | X | X | X | |
| | | | N | | | X | X |
| | | | S | | | X | X |
| | | Top | | | | | |
| | | Foothill | W | | | | |
| | | | E | | | | |
| | | | N | | | | |
| | | | S | | | | |
| | Valley* | | | | | X | |
| | Pass* | | | | | | |
| | Gap* | | | | | | |
| | Ridge* | | | X | X | | X |
| | Bluff* | | | | | | |
| | Butte* | | | | | | |
| Wind* Direction | S | | | X | X | X | X |
| | N | | | | | | |
| | E | | | | | | |
| | W | | | X | X | X | X |
| | Updrafts* | | | X | X | X | X |
| Migratory* Corridor Potential | Latitudinal (N ↔ S) | | | | | X | X |
| | Longitudinal (E ↔ W) | | | | | | |
| | Wide Approaches (>30 km)* | | | | | X | X |
| | Funnel Effect* | Horizontal | | | | | X |
| | | Vertical | | | | | |
| Site Size (acres) & Configuration* | <640 | | | X | X | X | X |
| | >640 <1000 | | | X | X | X | X |
| | >1000 <1500 | | | X | X | X | X |
| | Turbine Rows not Parallel to Migration | | | X | X | X | X |
| Infrastructure To Build | Transmission | | | X | X | X | X |
| | Roads | | | X | X | X | X |
| | Buildings* | | Storage | X | X | X | X |
| | | | Maintenance | X | X | X | X |
| | | | Daily Activity | X | X | X | X |
| | Substation | | | X | X | X | X |
| Increased Activity* | | | | X | X | X | X |
| | | | Totals | 17 | 16 | 21 | 20 |

PHYSICAL ATTRIBUTE CRITERIA - 36 categories, max $\sum = 36$, ($p = 0.25$).

Topography - Terrain characteristic within the ecological influence of the proposed wind farm, generally, but not restricted to ± 8 km.

Mountain Aspect - Aspect of topography for site of proposed development. Multiple categories may be checked.

Valley Pass Gap Ridge Bluff Butte



Wind Direction - Compass direction *from* which prevailing winds approach. Multiple categories may be checked.

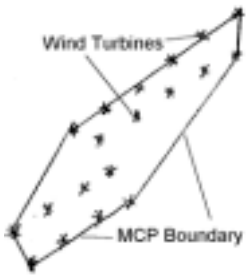
Updrafts - Do updrafts/upslope winds prevail?

Migratory Corridor Potential - Subjective estimate of area to be a potential avian/bat migratory corridor based strictly on topographical characteristics. Multiple categories may be checked.

Wide (>30 km) - Terrain characteristics of approaches to site from each migratory direction, i.e., a large plain, river corridor, long valley. The larger the area that migrant birds/bats are drawn from, the more may be at risk

Funnel Effect - Is the site in or near an area where migrant birds/bats may be funneled (concentrated) into a smaller area, either altitudinally, laterally, or both?

Site Size & Configuration – Size is estimated as if a minimum convex polygon (MCP) were drawn around peripheral turbines.




Successive boxes are checked to convey relationship of larger size = increased impact to birds/bats, *e.g.*, a 700 acre site will have 2 categories checked while a 1200 acre site will have all 3 categories checked.

Configuration of turbine rows is usually perpendicular to prevailing wind direction. Rows aligned perpendicular or oblique to route of migration intuitively presents more risk to birds than rows aligned parallel to movement.

Buildings – Building are categorized by relative size and visitation frequency, *i.e.,* structures that are visited daily are usually larger and present more impact than those that are not. If a "Daily Activity" building is required, all Building categories are checked. If a maintenance structure is required, Storage is also checked.

Increased Activity - Will any type of human activity increase? Sites in urban-suburban or otherwise developed areas (oil, gas, mines) will have less impact on vertebrate wildlife than those in remote or undeveloped areas.

Avian Species of Special Concern Checklist
(Complete prior to SPECIES OCCURRENCE & STATUS CHECKLIST)

| | **Site** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Birds (*n* = 28)** | Sheldon Dome | | | Foote Creek Rim | | | Hutton NWF | | | Stagner Mountain | | |
| **Occurrence**[1] | **B** | **M/W** | **∑** | **B** | **M/W** | **∑** | **B** | **M/W** | **∑** | **B** | **M/W** | **∑** |
| Swainson's Hawk | X | X | 2 | X | X | 2 | X | X | 2 | X | X | 2 |
| Ferruginous Hawk | X | X | 2 | X | X | 2 | X | X | X2 | | X | 2 |
| Golden Eagle | X | X | 2 | X | X | 2 | X | X | X2 | | X | 2 |
| *Peregrine Falcon* | | | | | | | | X | X1 | | X | 2 |
| Prairie Falcon | X | X | 2 | X | X | 2 | | | | X | X | 2 |
| Yellow Rail | | | | | | | | | | | | |
| American Golden-Plover | | | | | | | | X | 1 | | X | 1 |
| Snowy Plover | | | | | | | | | | | X | 1 |
| Mountain Plover | X | | 1 | X | | 1 | | | | | | |
| Solitary Sandpiper | | | | | | | | X | 1 | | X | 1 |
| Upland Sandpiper | | | | | | | | X | 1 | | X | 1 |
| Whimbrel | | | | | | | | X | 1 | | X | 1 |
| Long-billed Curlew | | | | | | | | X | 1 | | X | 1 |
| Marbled Godwit | | | | | | | | X | 1 | | X | 1 |
| Sanderling | | | | | | | | X | 1 | | X | 1 |
| Wilson's Phalarope | | | | | | | X | X | 2 | | X | 1 |
| Yellow-billed Cuckoo | | | | | | | | | | | X | 1 |
| Flammulated Owl | | | | | | | | | | | | |
| Black Swift | | | | | | | | | | | | |
| Lewis's Woodpecker | | | | | | | | | | | X | 1 |
| Williamson's Sapsucker | | | | | | | | | | X | X | 2 |
| Red-naped Sapsucker | | | | | | | | | | X | X | 2 |
| White-headed Woodpecker | | | | | | | | | | | | |
| Loggerhead Shrike | X | X | 2 | X | X | 2 | X | X | X2 | | X | 2 |
| Pygmy Nuthatch | | | | | | | | | | | X | 1 |
| Virginia's Warbler | | | | | | | | | | | | |
| Brewer's Sparrow | X | X | 2 | X | X | 2 | X | X | 2 | | X | 1 |
| McCown's Longspur | | | | X | X | 2 | X | X | 2 | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Subtotals | 7 | 6 | 13 | 8 | 7 | 15 | 7 | 15 | 22 | 8 | 21 | 29 |
| Total | | | 13 | | | 15 | | | 22 | | | 29 |

Avian Species of Special Concern Checklist (28 species, max $\sum = 56$)

Column totals of this list are added to appropriate cells in the SPECIES OCCURRENCE & STATUS CHECKLIST. The species in this list are the birds of conservation concern for BCR 10 – Northern Rockies. Species occurrence was based on habitat, range maps available from (Cerovski et al. 2004), Johnson et al. 2000, and personal experience with each area.

In addition to species lists (rows), season of occurrence is also indicated (columns). "B" indicates breeding or summer occurrence and "M/W" indicates presence during migration or as wintering species. If occurrence within or in the vicinity ($\leq$ 7 km) of a proposed site is confirmed or suspected, an "X" is entered.

Bat Species Of Special Concern Checklist
(Complete prior to SPECIES OCCURRENCE & STATUS CHECKLIST)

| | **Site** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bats (*n* = 5)** | Sheldon Dome | | | Foote Creek Rim | | | Hutton NWF | | | Stagner Mountain | | |
| **Occurrence** | **B** | **M/W** | **∑** | **B** | **M/W** | **∑** | **B** | **M/W** | **∑** | **B** | **M/W** | **∑** |
| Myotis, Long-eared | | | | | | | | | | X | X | 2 |
| Myotis, Fringed | | | | | | | | | | | | |
| Bat, Townsend's Big-eared | | | | | | | | | | X | X | 2 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Subtotals | | | | | | | | | | | | |
| Total | | | 0 | | | 0 | | | 0 | | | 4 |

Bat Species Of Special Concern Checklist (3 species, max $\sum = 6$).

Column totals of this list are added to appropriate cells in the SPECIES OCCURRENCE & STATUS CHECKLIST. Bats listed in this table are listed by the Rawlins BLM as sensitive. Species occurrence was based upon available data from WYNDD, WGFD WOS, Gruver 2002, and Clark and Stromberg 1987.

In addition to species lists (rows), season of occurrence is also indicated (columns). "B" indicates breeding or summer occurrence and "M/W" indicates presence during migration or as wintering species. If occurrence within or in the vicinity ($\leq$ 7 km) of a proposed site is confirmed or suspected, an "X" is entered.

SPECIES OCCURRENCE & STATUS CHECKLIST

| Species | | Site | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sheldon Dome | | | Foote Creek Rim | | | Hutton NWF | | | Stagner Mountain | | |
| | **Occurrence** | **B** | **M/W** | **∑** | **B** | **M/W** | **∑** | **B** | **M/W** | **∑** | **B** | **M/W** | **∑** |
| Threatened & Endangered | Bald Eagle | | X | 1 | X | X | 2 | | X | 1 | X | X | 2 |
| | Wyoming Toad | | | | | | | X | X | 2 | | | |
| | Ute ladies'-tresses orchid | | | | | | | | | | | | |
| | Colorado Butterfly Plant | | | | | | | | | | | | |
| | Grizzly Bear | | | | | | | | | | | | |
| | Gray Wolf | | | | | | | | | | | | |
| | Black-footed Ferret | | | | | | | | | | | | |
| | Blow-out Penestemon | | | | | | | | | | | | |
| | Desert Yellowhead | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Candidate* | Canada Lynx | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Special Concern* | Birds (max ∑=58) | 7 | 6 | 13 | 8 | 7 | 15 | 7 | 15 | 22 | 8 | 21 | 29 |
| | Bats (max ∑=6) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 4 |
| Golden Eagle* | | X | X | 2 | X | X | 2 | X | X | 2 | X | X | 2 |
| Sage Grouse* | | X | X | 2 | X | X | 2 | | | | X | X | 2 |
| Bats* | | X | X | 2 | X | X | 2 | X | X | 2 | X | X | 2 |
| | Subtotals | 10 | 10 | 20 | 12 | 11 | 23 | 10 | 19 | 29 | 14 | 27 | 41 |
| | Total | | | 20 | | | 23 | | | 29 | | | 41 |

SPECIES OCCURRENCE & STATUS CHECKLIST (15 categories, max ∑ = 90)

Checklist totals for each column in "Avian Species of Special Concern List" and "Bat Species of Special Concern List are inserted in this checklist.

Threatened & Endangered Species - Species include in the Federal List of Endangered and Threatened Species for Wyoming.

Candidate Species - Species being investigated for inclusion in the Federal List of Endangered and Threatened Species for Wyoming.

Species of Special Concern – This list is comprised of the Birds of Conservation Concern for the Northern Rockies Bird Conservation Region.

Golden eagles are included in this checklist because of special protective status afforded under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d). Sage grouse are included because of recent (*ca.* Y2K) concern over population declines range wide (citation). Bats (other than bat Species of Special Concern) are included due to generally unknown impacts of wind farms on individual and populations.

ECOLOGICAL ATTRACTIVENESS CHECKLIST

| Ecological Attractor | | | Site: Sheldon Dome | Site: Foote Creek Rim | Site: Hutton NWF | Site: Stagner Mountain |
|---|---|---|---|---|---|---|
| Migration Route* | | Local | | | X | X |
| | Continental* | N | X | X | X | X |
| | | S | X | X | X | X |
| | | E | | | | |
| | | W | | | | |
| Ecological Magnets* | | Lotic System | | | | |
| | | Lentic System | | | X | |
| | | Wetlands | | | X | |
| | | Native Grassland | X | X | X | X |
| | | Forest | | | | X |
| | | Food Concentrated | | X | X | X |
| | | Energetic Foraging | | | | |
| | Vegetation/ Habitat | Unique | | | | |
| | | Diverse | | | | |
| Significant Ecological Event* | | | | | | |
| Site of Special Conservation Status* | | | | | X | |
| Total | | | 3 | 4 | 9 | 6 |

ECOLOGICAL ATTRACTIVENESS CRITERIA - 16 categories, max$\sum$ = 17

Migration Route - Indicates predominate direction of movement of seasonal migrations. Multiple categories may be checked.

Local - Some avian populations move only altitudinally & direction may be East-West (sage grouse, owls, bald eagles).

Continental - Some migratory corridors experience mass movements in only one season/direction annually (*e.g.*, Bridger Mountains autumn eagle migration).

Ecological Magnets - Special, unique, unusual, or super ordinary habitats or conditions within the vicinity of the site that may attract vertebrate wildlife. Lotic systems include small perennial or seasonal creeks to major rivers. Lentic systems include stock ponds to lakes. Multiple categories may be checked.

Vegetation/Habitat - Unique or exceptionally diverse vegetation or habitat in the vicinity may indicate exceptional diversity and abundance of avian species or bats.

Significant Ecological Event - Special, unique, unusual, or super ordinary events that occur or are suspected to occur in the vicinity of the site, *e.g.*, up to one third of the Continental population of Trumpeter Swans visit Ennis Lake, < 4 km from a proposed Wind Resource Area; the Continental migration of shorebirds passes over (many stop) @ Benton Lake National Wildlife Refuge) and up to 2000 golden eagles pass over the Bridger Mountains in autumn. If unknown but suspected a "?" is entered. Specifics regarding the cell are then addressed in the appropriate box of the SITE SPECIFIC COMMENTS sheet to focus follow-up investigation and assist in definition of study objectives.

Site of Special Conservation Status - Any existing or proposed covenants, conservation easements, or other land development limitations intended to conserve, protect, or enhance wildlife or habitat. This criterion is weighted (2 entered if true) because of previous financial or other investment in ecological values. Specifics regarding the easement are then addressed in the appropriate box of the SITE SPECIFIC COMMENTS sheet to focus follow-up attention.

POTENTIAL IMPACT INDEX

| | Site | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Sheldon Dome | | Foote Creek Rim | | Hutton NWF | | Stagner Mountain | |
| **Checklist (*p*)[1]** | ∑ | ∑/*p* | ∑ | ∑/*p* | ∑ | ∑/*p* | ∑ | ∑/*p* |
| Physical (36 checks = 36/143 = 0.25) | 17 | 68 | 16 | 64 | 21 | 84 | 20 | 80 |
| Species Occurrence & Status (0.63) | 23 | 37 | 23 | 36 | 29 | 46 | 41 | 65 |
| Ecological (0.12) | 3 | 25 | 4 | 33 | 9 | 75 | 6 | 50 |
| Totals | | 130 | | 133 | | 205 | | 195 |

[1]Proportion of total (143) checklist scores.

SITE SPECIFIC COMMENTS

| Checklist | Site: Sheldon Dome | Site: Foote Creek Rim | Site: Hutton NWF | Site: Stagner Mountain |
|---|---|---|---|---|
| Physical | One northwest – southeast running ridge | Long-running north-south rim perpendicular to the wind | Relatively flat wetland complex in the Laramie Valley | East – West running ridge above Wind River |
| | | | | |
| | | | | |
| Species Occurrence | Species expected are typical of sagebrush and grassland habitats | Species present are typical of grassland and sagebrush habitats | Many shorebirds stop here during migration | A mix of species present in sagebrush and grasslands |
| | | | Other waterbirds breed here. | Due to presence of forests, other species present |
| | | | | Presence of Wind River increases species migrating here |
| Ecological | Area lacks water and wetlands | Prairie Dog colonies present | Wetlands and prairie dogs are present | Prairie Dog colonies present |
| | | Area lacks water and wetlands | This site is a National Wildlife Refuge | Forests present on side of ridge |

**Eastern Shoshone Tribe and Northern Arapahoe**
**on the Wind River Indian Reservation**

**Renewable Energy Development on Tribal Lands**
**DE-PS36-04GO94003**

# Appendix 3

# 2012 WIND RIVER BASIN GENERATION ADDITION STUDY

## Prepared by
## Excel Engineering, Inc.

## For
## Disgen Development Services LLC

Principal Contributor:
John Wetzel

## June 8, 2009

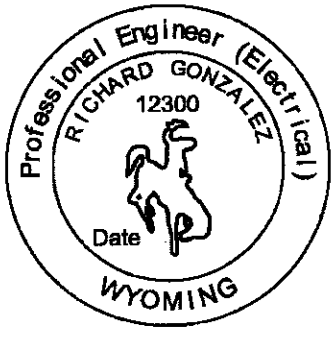
I hereby certify this plan, specification, or report was prepared by me or under my direct supervision in accordance with applicable standards of practice, and that I am a duly Licensed Professional Engineer under the Laws of the State of Colorado.

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the Laws of the State of Wyoming.

The information in this document is based upon the knowledge and information available at the time it was prepared. This certification is not a guaranty or warranty, expressed or implied.

Richard Gonzalez
Registration Number 41395
June 8, 2009

Richard Gonzalez
Registration Number 12300
June 8, 2009

## PURPOSE

The purpose of this study is to determine if specific maximum amounts of new generation can be added at three locations on the existing electric transmission system in the Wind River Basin of Wyoming. The proposed generation amounts and locations are:

1. 30 MW at the Burris 69 kV substation
2. 90 MW at the Boysen 115 kV substation
3. 200MW at a new substation located between Thermopolis and Riverton on the existing Thermopolis – Riverton 230 kV line.

The analysis was performed as a screening-level analysis, considering only transmission and generation facilities as represented in the selected WECC power system model. This is an "out-of-queue-order" evaluation; no existing near-by queued generation interconnection requests (if any exist) were taken into consideration.

## RESULTS

The results of this study show:

1. Up to 23 MW of new generation can be added near Burris
2. 90 MW of generation can be added at the Boysen substation
3. 200 MW of new generation can be added on the existing Thermopolis – Riverton 230 kV line.

None of these proposed additions would require any additional power system improvements beyond those directly associated with the proposed generation interconnection to the existing transmission facilities.

## PROCEDURE

This study uses a 2012 WECC base case with the Wind River Basin adjusted with local hydroelectric generation maximized to represent Heavy Spring conditions. Figure 1 is a map of the Wind River basin showing the approximate locations of the proposed new generation sites.

CRITERIA

For system intact conditions, bus voltages between 0.95 and 1.05 per unit (95% to 105% of nominal bus voltage) were considered acceptable. Transmission line and transformer loadings less than 100% of maximum seasonal ratings were acceptable.

For single contingency (N-1) outage conditions, bus voltages between 0.90 and 1.10 per unit were considered acceptable. Transmission line loadings less than 100% of thermal rating and transformer loadings of less that 100% of maximum rating were considered acceptable.

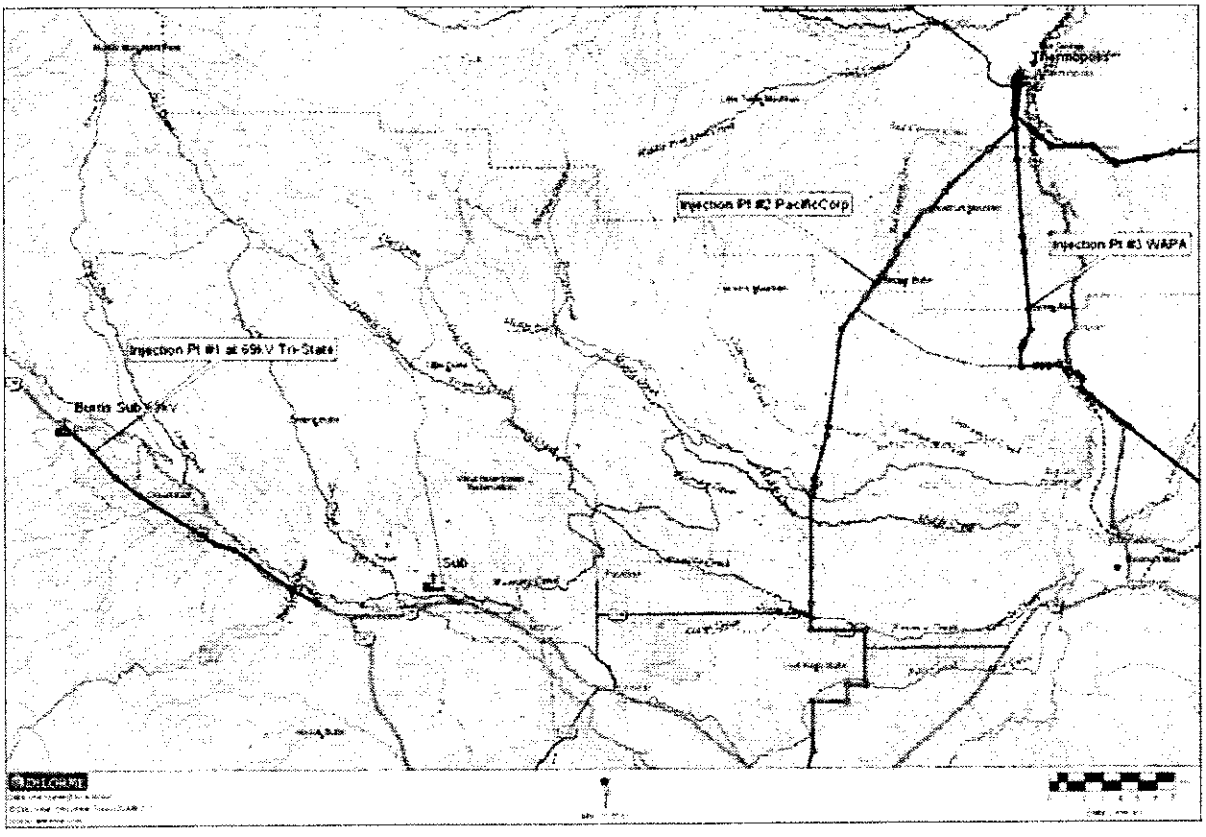



Figure 1: Wind River Basin proposed generation locations

A series of single contingency outages, consisting of all non-radial lines and transformers in the Wind River Basin with operating voltages 69 kV and higher, was tested against each new case that was developed. System Criteria violations for each scenario were captured.

For each proposed site, several levels of generation were tested, from 0 MW up to the maximum proposed generation level at each site. These levels of generation were tested to determine if new system criteria violations would occur at levels less than the proposed maximum level. These three sites were tested independently; no "simultaneous" scenarios were examined.

**SITE 1: BURRIS 69 kV**

The existing Burris 69 kV substation is located on a radial 69 kV line owned by Tri-State G&T and connected to the 115 kV system through two 115/69 kV transformers at WAPA's Pilot Butte substation. Since the radial line is not included in the existing WECC models, the proposed new generation was modeled at the Pilot Butte 69 kV bus. 2 MW of existing hydroelectric generation are also located on the Pilot Butte 69 kV bus.

Table 1 shows the criteria violations that presently exist on the local system plus one new violation that will occur when the total generation on the Pilot Butte 69 kV bus is equal to or greater than 25 MW; since the total existing generation is 2 MW, no more than 23 MW of new generation can be added. The outage of one of the existing Pilot Butte transformers (transformer #2) overloads the remaining transformer when more than 25 MW of generation is injected into the Pilot Butte 69 kV bus. The column for Case A has no new generation added, so the criteria violations shown are existing problems. Per cent loadings are shown in the table.

Two sets of generation schedules were studied: new generation was scheduled to the North by offsetting generation at Yellowtail, and generation was scheduled to the south by offsetting generation at Jim Bridger.

Figure 2 shows the worst case outage condition at the Pilot Butte 69 kV bus with 25 MW on the 69 kV bus (2 MW of existing hydroelectric and 23 MW of new Burris generation).

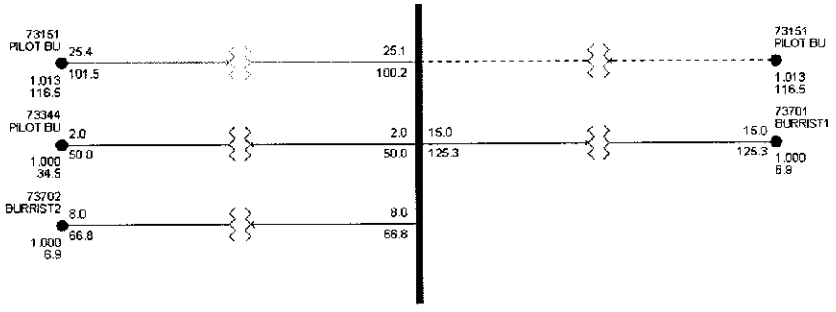



Figure 2: Pilot Butte 69 kV bus, 25 MW of generation, outage of transformer #2
[upper # = MW loading, lower # = % of line or transformer rating]

There were no other system problems due to the addition of generation near Pilot Butte.

Table 1: New Generation at Burris

(Pilot Butte 69 kV

| | | Burris Generation North | 0 MW | 15 MW | 23 MW | 30 MW | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Burris Generation south | 0 MW | | | | 15 MW | 23 MW | 30 MW |
| Case definition | criteria | monitored element | Case a | Case b | Case c | Case d | Case e | Case f | Case g |
| OUTAGE: YELOWTLP230. YELLOW 230.0 1 | high-flow > 98 | BASIN___115.-NAHNEJEN115. | 99.91 | ok | ok | ok | 99.12 | 98.70 | 98.33 |
| OUTAGE: YELOWTLP230. YELLOW 230.0 1 | high-flow > 98 | LOVELL__115.-NAHNEJEN115. | 114.15 | 110.49 | 108.55 | 106.85 | 113.33 | 112.90 | 112.52 |
| OUTAGE: CASPERPP115. CASPER 69.0 1 | high-flow > 100 | CASPERPP115.-CASPERPP69.0 | 139.98 | 139.94 | 139.92 | 139.90 | 139.96 | 139.95 | 139.95 |
| OUTAGE: CASPERPP115. CASPER 69.0 2 | high-flow > 100 | CASPERPP115.-CASPERPP69.0 | 138.75 | 138.71 | 138.69 | 138.68 | 138.73 | 138.72 | 138.72 |
| OUTAGE: MIDWEST230. MIDWES 69.001 | high-flow > 100 | MIDWEST_230.-MIDWEST_69.0 | 140.53 | 140.41 | 140.35 | 140.30 | 140.49 | 140.47 | 140.45 |
| OUTAGE: MIDWEST230. MIDWES 69.002 | high-flow > 100 | MIDWEST_230.-MIDWEST_69.0 | 102.25 | 102.17 | 102.13 | 102.09 | 102.22 | 102.20 | 102.19 |
| OUTAGE: PILOT BU115. PILOT 69.0 2 | high-flow > 100 | PILOT BU115.-PILOT BU69.0 1 | ok | ok | 100.20 | 128.04 | ok | 100.16 | 128.02 |

Table 2: New Generation at Boysen

| | | Boysen Generation North | 0 MW | 30 MW | 60 MW | 90 MW | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Boysen Generation south | 0 MW | | | | 30 MW | 60 MW | 90 MW |
| BOYSEN.sav case definition | criteria | monitored element | Case Ba | Case Bb | Case B c | Case Bd | Case Be | Case Bf | Case Bg |
| OUTAGE: YELOWTLP230. YELLOW 230.0 1 | high-flow > 98 | BASIN___115.-NAHNEJEN115. | 100.17 | ok | ok | ok | 98.35 | ok | ok |
| OUTAGE: YELOWTLP230. YELLOW 230.0 1 | high-flow > 98 | LOVELL__115.-NAHNEJEN115. | 114.29 | 106.63 | 98.87 | ok | 112.34 | 110.28 | 108.23 |
| OUTAGE: CASPERPP115. CASPER 69.0 1 | high-flow > 100 | CASPERPP115.-CASPERPP69.0 | 139.95 | 139.91 | 139.89 | 139.88 | 139.95 | 139.96 | 139.99 |
| OUTAGE: CASPERPP115. CASPER 69.0 2 | high-flow > 100 | CASPERPP115.-CASPERPP69.0 | 138.72 | 138.68 | 138.66 | 138.65 | 138.72 | 138.73 | 138.76 |
| OUTAGE: MIDWEST230. MIDWES 69.0 1 | high-flow > 100 | MIDWEST_230.-MIDWEST_69.0 2 | 140.49 | 140.30 | 140.14 | 140.02 | 140.45 | 140.43 | 140.42 |
| OUTAGE: MIDWEST230. MIDWES 69.0 2 | high-flow > 100 | MIDWEST_230.-MIDWEST_69.0 1 | 102.22 | 102.10 | 101.99 | 101.90 | 102.19 | 102.18 | 102.17 |

Table 3: New Generation on Thermopolis - Riverton 230 kV line

| | | Generation Scheduled North | 0 MW | 100 MW | 150 MW | 200 MW | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Generation Scheduled south | 0 MW | | | | 100 MW | 150 MW | 200 MW |
| NEWDIS case definition | criteria | monitored element | Case Ta | Case Tb | Case Tc | Case Td | Case Te | Case Tf | Case Tg |
| OUTAGE: YELOWTLP230. YELLOW 230.0 1 | high-flow > 98 | BASIN___115.-NAHNEJEN115. | 104.48 | ok | ok | ok | 100.34 | 98.19 | ok |
| OUTAGE: YELOWTLP230. YELLOW 230.0 1 | high-flow > 98 | LOVELL__115.-NAHNEJEN115. | 118.57 | ok | ok | ok | 114.18 | 111.95 | 109.69 |
| OUTAGE: CASPERPP115. CASPER 69.001 | high-flow > 100 | CASPERPP115.-CASPERPP69.0 | 139.77 | 139.47 | 139.53 | 139.47 | 139.63 | 139.61 | 139.62 |
| OUTAGE: CASPERPP115. CASPER 69.002 | high-flow > 100 | CASPERPP115.-CASPERPP69.0 | 138.55 | 138.26 | 138.31 | 138.26 | 138.41 | 138.39 | 138.40 |
| OUTAGE: MIDWEST230. MIDWES 69.001 | high-flow > 100 | MIDWEST_230.-MIDWEST_69.0 | 140.31 | 139.53 | 139.47 | 139.23 | 140.03 | 139.96 | 139.93 |
| OUTAGE: MIDWEST230. MIDWES 69.002 | high-flow > 100 | MIDWEST_230.-MIDWEST_69.0 | 102.10 | 101.58 | 101.55 | 101.40 | 101.92 | 101.87 | 101.85 |

## SITE 2 - BOYSEN 115 kV

The existing Boysen – Thermopolis 115 kV line runs through a canyon starting just north of the Boysen substation. Placing a new substation in this canyon would be extremely difficult and expensive, so the new generation was modeled at the Boysen 115 kV bus.

Table 2 shows all criteria violations in the Wind River Basin for existing conditions (no new generation, Case Ba) and with incremental amounts of generation added at Boysen and scheduled to the North and the South. There are no new criteria violations due to the addition of generation up to the 90 MW level of interest at the Boysen 115 kV bus, and the existing overloads are reduced slightly by the new generation.

In all cases, the existing Boysen hydroelectric generation is maximized to represent Heavy Spring runoff conditions.

## SITE 3 – NEW TAP ON THE THERMOPOLIS – RIVERTON 230 kV LINE

A new injection point was modeled on Pacificorp's existing Thermopolis – Riverton 230 kV line, and incremental amounts of new generation (100 MW, 150 MW and 200 MW) were modeled at the new point with power scheduled to both the North and the South.

Table 3 shows all criteria violations in the Wind River Basin. Existing violations are shown in the column under Case Ta, where there was no new generation on the Thermopolis – Riverton 230 kV line. The other cases show a slight improvement in the overloads as generation is increased.

There are no new loading or voltage problems due to the addition of generation on the Thermopolis – Riverton 230 kV line.

## CONCLUSIONS

In the 2012 time frame, up to 23 MW of new generation can be added at the Pilot Butte 69 kV bus, 90 MW of generation can be added to the Boysen 115 kV bus, and 200 MW can be added at a new substation on the Thermopolis – Riverton 230 kV line. These conclusions are based on the power system modeling performed, simulating the Year 2012 Heavy Spring conditions considered most relevant to this type of screening-level analysis. Evaluation of other scenarios, such as future year conditions, different regional generation patterns, or consideration of any queued generation additions not represented in the model could result in significantly different results.

See Appendices A, B, and C for lists of single contingency outages, monitored buses and monitored transmission elements.

## ADDITIONAL CONSIDERATIONS

This study investigates the amount of generation that can be added at points in the Wind river Basin. Actual transmission costs associated with delivery of power to specific customers may vary. For example, if new generation is located on Tri-State's 69 kV line near Burris, delivery to a customer other than Tri-State or WAPA may require transmission arrangements with both Tri-State and WAPA, which may add significant costs to the customer.

Also, on the electrical system near the Wind River Basin, there are three constricted transmission paths which may be affected by new generation, depending on how power is scheduled. Some of these schedules may be beneficial in reducing path flows.

Table 4 shows some typical changes in flows on the "TOT4A", "TOT4B" and "Yellowtail South" Paths that are dependent on schedules from the new proposed sites. These are presented only as typical possible flow changes, as other generation in the Wind River Basin can also influence the flows on these paths.

Table 4: Path Flow Changes

| LOCATION | GENERATION | SCHEDULE | MVA CHANGE | MVA CHANGE | MVA CHANGE |
|---|---|---|---|---|---|
| | | | TOT 4A | TOT 4B | YT SOUTH |
| BURRIS | 23 | NORTH | -5.7 | 2.1 | 10.6 |
| BURRIS | 23 | SOUTH | -12.8 | 8.8 | 2.4 |
| BOYSEN | 90 | NORTH | -18.3 | 41.4 | 42.9 |
| BOYSEN | 90 | SOUTH | -46.5 | 82.1 | 10.5 |
| TH-RIVERTON | 200 | NORTH | -52.4 | 15.7 | 82.9 |
| TH-RIVERTON | 200 | SOUTH | -116.2 | 53.5 | 14.5 |

From this table it is seen that the modeled power deliveries reduce loading on the TOT4A path, and increase loadings on the TOT4B and Yellowtail South paths. Whether the observed increases are problematic or not depends on the degree of loading on these interfaces caused by other transmission system usages, and their scheduling priorities (firm vs. non-firm).

Appendix A: Single Contingency Outages

1. ALCOVA 115.0 RADERVIL 115.0 1
2. ANT MINE 230.0 TEKLA 230.0 1
3. ANT MINE 230.0 YELLOWCK 230.0 1
4. BADWATER 230.0 SPENCE 230.0 1
5. BADWATER 230.0 THERMOPL 230.0 1
6. BASIN 115.0 NAHNEJEN 115.0 1
7. BASIN 115.0 WORLANTP 115.0 1
8. BGEORGE 115.0 LOVELL 115.0 1
9. BGEORGE 115.0 MEETSETP 115.0 1
10. BGEORGE 69.0 BGEORGE 115.0 1
11. BGEORGE 69.0 GLENDLTP 69.0 1
12. BLGS PHA 230.0 YELOWTLP 230.0 1
13. BOYSEN 115.0 COPPERMT 115.0 1
14. BOYSEN 115.0 HARRSBRG 115.0 1
15. BOYSEN 115.0 THERMOPL 115.0 1
16. BUFBASIN 69.0 CMTDUM 69.0 1
17. BUFFALO 230.0 CARR DRA 230.0 1
18. BUFFALO 230.0 KAYCEE 230.0 1
19. BUFFALO 230.0 SHERIDAN 230.0 1
20. BUFFBILL 69.0 BUFFBLPP 69.0 1
21. BUFFBILL 69.0 HEART MT 69.0 1
22. BUFFBILL 69.0 N. CODY 69.0 1
23. CARR DRA 230.0 BARBERCK 230.0 1
24. CARR DRA 230.0 DRYFORK 230.0 1
25. CARR DRA 230.0 WYODAK 230.0 1
26. CARTERMT 115.0 MEETSETP 115.0 1
27. CARTERMT 115.0 THERMOPL 115.0 1
28. CARTERMT 69.0 CARTERMT 115.0 1
29. CARTERMT 69.0 CMTDUM 69.0 1
30. CASPERPP 115.0 CASPERLM 115.0 1
31. CASPERPP 115.0 CASPERPP 69.0 1
32. CASPERPP 115.0 CASPERPP 69.0 2
33. CASPERPP 115.0 REFNRYTP 115.0 1
34. CASPERPP 230.0 CASPERPP 115.0 1
35. CASPERPP 230.0 CLAIMJPR 230.0 1
36. CASPERPP 230.0 DAVEJOHN 230.0 1
37. CASPERPP 230.0 MIDWEST 230.0 1
38. CASPERPP 230.0 RIVERTON 230.0 1
39. COPPERMT 115.0 RADERVIL 115.0 1
40. DAVEJO&1 230.0 DAVEJOHN 230.0 1
41. DAVEJO&1 230.0 SPENCE 230.0 1
42. DAVEJOHN 115.0 DAVEJTPN 115.0 1
43. DAVEJOHN 115.0 DAVEJTPS 115.0 1
44. DAVEJOHN 230.0 DAVEJOHN 115.0 1
45. DAVEJOHN 230.0 DIFICULT 230.0 1
46. DAVEJOHN 230.0 HARTZOG 230.0 1
47. DAVEJOHN 230.0 LAR.RIVR 230.0 1
48. DAVEJOHN 230.0 STEGALL 230.0 1
49. DAVEJOHN 230.0 YELLOWCK 230.0 1
50. DUTONBAS 115.0 ERVAYBAS 115.0 1
51. FRANNIE 230.0 GARLAND 230.0 1
52. FRANNIE 230.0 YELOWTLP 230.0 1
53. GARLAND 230.0 OREBASIN 230.0 1
54. GARLAND 69.0 LOVELL 69.0 1
55. GARLAND 69.0 POWELLTP 69.0 1
56. GLENDLTP 69.0 HEART MT 69.0 1
57. GOOSE CK 230.0 SHERIDAN 230.0 1
58. GOOSE CK 230.0 YELOWTLP 230.0 1

59. GRASS CK 230.0 OREBASIN 230.0 1
60. GRASS CK 230.0 THERMOPL 230.0 1
61. HDOME 115.0 HDOME 69.0 1
62. HDOME 115.0 JIMRDYTP 115.0 1
63. HDOME 69.0 CMTDUM 69.0 1
64. HEART MT 69.0 N. CODY 69.0 1
65. JIMREADY 115.0 JIMRDYTP 115.0 1
66. KAYCEE 230.0 MIDWEST 230.0 1
67. LOVELL 115.0 NAHNEJEN 115.0 1
68. LOVELL 115.0 YELLOWBR 115.0 1
69. LOVELL 115.0 YELLOWBR 115.0 2
70. LOVELL 69.0 LOVELL 115.0 1
71. MIDWEST 230.0 CLAIMJPR 230.0 1
72. MIDWEST 230.0 MIDWEST 69.0 1
73. MIDWEST 230.0 MIDWEST 69.0 2
74. MUSTANG 230.0 SPENCE 230.0 1
75. N. CODY 69.0 RALSTON 69.0 1
76. OREBASIN 230.0 OREBASIN 69.0 1
77. PILOT BU 115.0 HARRSBRG 115.0 1
78. PILOT BU 115.0 PILOT BU 69.0 1
79. PILOT BU 115.0 PILOT BU 69.0 2
80. PILOT BU 115.0 WINDRIVT 115.0 1
81. POWELLTP 69.0 RALSTON 69.0 1
82. RADERVIL 115.0 ERVAYBAS 115.0 1
83. RIVERTON 115.0 RIVERTON 230.0 1
84. RIVERTON 115.0 WINDRIVT 115.0 1
85. RIVERTON 230.0 THERMOPL 230.0 1
86. RIVERTON 230.0 WYOPO 230.0 1
87. RMRK PHA 161.0 YELOWTLP 161.0 1
88. SHERIDAN 230.0 TONGRIVR 230.0 1
89. TCAPS 115.0 JIMRDYTP 115.0 1
90. TCAPS 115.0 THERMOPL 115.0 1
91. THERMOPL 115.0 WORLANTP 115.0 1
92. THERPACE 115.0 THERMOPL 115.0 1
93. THERPACE 115.0 THERMOPL 115.0 2
94. THERPACE 115.0 THERMOPL 230.0 1
95. THERPACE 115.0 THERMOPL 230.0 2
96. THERPACE 115.0 WORLAND 115.0 1
97. WINDRIVR 115.0 WINDRIVT 115.0 1
98. WORLAND 115.0 WORLANTP 115.0 1
99. WYODAK 230.0 DONKYCRK 230.0 1
100. WYODAK 230.0 HUGHES 230.0 1
101. WYODAK 230.0 OSAGE 230.0 1
102. WYODAK 230.0 WYODAK 69.0 1
103. WYODAK 230.0 WYODAK 69.0 2
104. YELLOWBR 115.0 YELLOWBR 230.0 1
105. YELLOWBR 115.0 YELLOWBR 230.0 2
106. YELLOWBR 230.0 CROS PHA 230.0 1
107. YELOWTLP 230.0 YELLOWBR 230.0 1
108. YELOWTLP 230.0 YELOWTLP 161.0 1
109. RIVERTON 230.0 DISGEN 230.0 1
110. THERMOPL 230.0 DISGEN 230.0 1

Appendix B: Monitored Buses

ANT MINE 230.00
BADWATER 230.00
BUFFALO 230.00
CARR DRA 230.00
CASPERPP 230.00
CASPERPP 115.00
DAVEJO&1 230.00
DAVEJOHN 230.00
DAVEJOHN 115.00
FRANNIE 230.00
GARLAND 230.00
GOOSE CK 230.00
GRASS CK 230.00
KAYCEE 230.00
MIDWEST 230.00
OREBASIN 230.00
RIVERTON 230.00
SHERIDAN 230.00
SPENCE 230.00
THERMOPL 230.00
THERPACE 115.00
WORLAND 115.00
WYODAK 230.00
YELLOWCK 230.00
YELOWTLP 230.00
YELOWTLP 161.00
CLAIMJPR 230.00
BASIN 115.00
BGEORGE 69.000
BGEORGE 115.00
BOYSEN 115.00
BUFFBILL 69.000
CARTERMT 69.000
CARTERMT 115.00
COPPERMT 115.00
GARLAND 69.000
GLENDLTP 69.000
HDOME 115.00
HEART MT 69.000
JIMREADY 115.00
LOVELL 69.000
LOVELL 115.00
N. CODY 69.000
PILOT BU 115.00
POWELLTP 69.000
RADERVIL 115.00
RALSTON 69.000
RIVERTON 115.00
TCAPS 115.00
THERMOPL 115.00
WINDRIVR 115.00
WINDRIVT 115.00
WORLANTP 115.00
YELLOWBR 115.00
YELLOWBR 230.00
JIMRDYTP 115.00
DUTONBAS 115.00
ERVAYBAS 115.00
NAHNEJEN 115.00
PILOT BU 69.000
BUFFBLPP 69.000
HARRSBRG 115.00
BUFBASIN 69.000
HDOME 69.000
CMTDUM 69.000
MEETSETP 115.0

Appendix C: Monitored elements:

ALCOVA 115.0 RADERVIL 115.0 1
ANT MINE 230.0 TEKLA 230.0 1
ANT MINE 230.0 YELLOWCK 230.0 1
BADWATER 230.0 SPENCE 230.0 1
BADWATER 230.0 THERMOPL 230.0 1
BASIN 115.0 NAHNEJEN 115.0 1
BASIN 115.0 WORLANTP 115.0 1
BGEORGE 115.0 LOVELL 115.0 1
BGEORGE 115.0 MEETSETP 115.0 1
BGEORGE 69.0 BGEORGE 115.0 1
BGEORGE 69.0 GLENDLTP 69.0 1
BLGS PHA 230.0 YELOWTLP 230.0 1
BOYSEN 115.0 COPPERMT 115.0 1
BOYSEN 115.0 HARRSBRG 115.0 1
BOYSEN 115.0 THERMOPL 115.0 1
BUFBASI N69.0 CMTDUM 69.0 1
BUFFALO 230.0 CARR DRA 230.0 1
BUFFALO 230.0 KAYCEE 230.0 1
BUFFALO 230.0 SHERIDAN 230.0 1
BUFFBILL 69.0 BUFFBLPP 69.0 1
BUFFBILL 69.0 HEART MT 69.0 1
BUFFBILL 69.0 N. CODY 69.0 1
CARR DRA 230.0 BARBERCK 230.0 1
CARR DRA 230.0 DRYFORK 230.0 1
CARR DRA 230.0 WYODAK 230.0 1
CARTERMT 115.0 MEETSETP 115.0 1
CARTERMT 115.0 THERMOPL 115.0 1
CARTERMT 69.0 CARTERMT 115.0 1
CARTERMT 69.0 CMTDUM 69.0 1
CASPERPP 115.0 CASPERLM 115.0 1
CASPERPP 115.0 CASPERPP 69.0 1
CASPERPP 115.0 CASPERPP 69.0 2
CASPERPP 115.0 REFNRYTP 115.0 1
CASPERPP 230.0 CASPERPP 115.0 1
CASPERPP 230.0 CLAIMJPR 230.0 1
CASPERPP 230.0 DAVEJOHN 230.0 1
CASPERPP 230.0 MIDWEST 230.0 1
CASPERPP 230.0 RIVERTON 230.0 1
COPPERMT 115.0 RADERVIL 115.0 1
DAVEJO&1 230.0 DAVEJOHN 230.0 1
DAVEJO&1 230.0 SPENCE 230.0 1
DAVEJOHN 115.0 DAVEJTPN 115.0 1
DAVEJOHN 115.0 DAVEJTPS 115.0 1
DAVEJOHN 230.0 DAVEJOHN 115.0 1
DAVEJOHN 230.0 DIFICULT 230.0 1
DAVEJOHN 230.0 HARTZOG 230.0 1
DAVEJOHN 230.0 LAR.RIVR 230.0 1
DAVEJOHN 230.0 STEGALL 230.0 1
DAVEJOHN 230.0 YELLOWCK 230.0 1
DUTONBAS 115.0 ERVAYBAS 115.0 1
FRANNIE 230.0 GARLAND 230.0 1
FRANNIE 230.0 YELOWTLP 230.0 1
GARLAND 230.0 OREBASIN 230.0 1
GARLAND 69.0 LOVELL 69.0 1
GARLAND 69.0 POWELLTP 69.0 1
GLENDLTP 69.0 HEART MT 69.0 1
GOOSE CK 230.0 SHERIDAN 230.0 1
GOOSE CK 230.0 YELOWTLP 230.0 1
GRASS CK 230.0 OREBASIN 230.0 1
GRASS CK 230.0 THERMOPL 230.0 1
HDOME 115.0 HDOME 69.0 1
HDOME 115.0 JIMRDYTP 115.0 1
HDOME 69.0 CMTDUM 69.0 1
HEART MT 69.0 N. CODY 69.0 1
JIMREADY 115.0 JIMRDYTP 115.0 1
KAYCEE 230.0 MIDWEST 230.0 1
LOVELL 115.0 NAHNEJEN 115.0 1
LOVELL 115.0 YELLOWBR 115.0 1
LOVELL 115.0 YELLOWBR 115.0 2
LOVELL 69.0 LOVELL 115.0 1
MIDWEST 230.0 CLAIMJPR 230.0 1
MIDWEST 230.0 MIDWEST 69.0 1
MIDWEST 230.0 MIDWEST 69.0 2
MUSTANG 230.0 SPENCE 230.0 1
N. CODY 69.0 RALSTON 69.0 1
OREBASIN 230.0 OREBASIN 69.0 1
PILOT BU 115.0 HARRSBRG 115.0 1
PILOT BU 115.0 PILOT BU 69.0 1
PILOT BU 115.0 PILOT BU 69.0 2
PILOT BU 115.0 WINDRIVT 115.0 1
POWELLTP 69.0 RALSTON 69.0 1
RADERVIL 115.0 ERVAYBAS 115.0 1
RIVERTON 115.0 RIVERTON 230.0 1
RIVERTON 115.0 WINDRIVT 115.0 1
RIVERTON 230.0 THERMOPL 230.0 1
RIVERTON 230.0 WYOPO 230.0 1
RMRK PHA 161.0 YELOWTLP 161.0 1
SHERIDAN 230.0 TONGRIVR 230.0 1
TCAPS 115.0 JIMRDYTP 115.0 1
TCAPS 115.0 THERMOPL 115.0 1
THERMOPL 115.0 WORLANTP 115.0 1
THERPACE 115.0 THERMOPL 115.0 1
THERPACE 115.0 THERMOPL 115.0 2
THERPACE 115.0 THERMOPL 230.0 1
THERPACE 115.0 THERMOPL 230.0 2
THERPACE 115.0 WORLAND 115.0 1
WINDRIVR 115.0 WINDRIVT 115.0 1
WORLAND 115.0 WORLANTP 115.0 1
WYODAK 230.0 DONKYCRK 230.0 1
WYODAK 230.0 HUGHES 230.0 1
WYODAK 230.0 OSAGE 230.0 1
WYODAK 230.0 WYODAK 69.0 1
WYODAK 230.0 WYODAK 69.0 2
YELLOWBR 115.0 YELLOWBR 230.0 1
YELLOWBR 115.0 YELLOWBR 230.0 2
YELLOWBR 230.0 CROS PHA 230.0 1
YELOWTLP 230.0 YELLOWBR 230.0 1
YELOWTLP 230.0 YELOWTLP 161.0 1

**Eastern Shoshone Tribe and Northern Arapahoe**
**on the Wind River Indian Reservation**

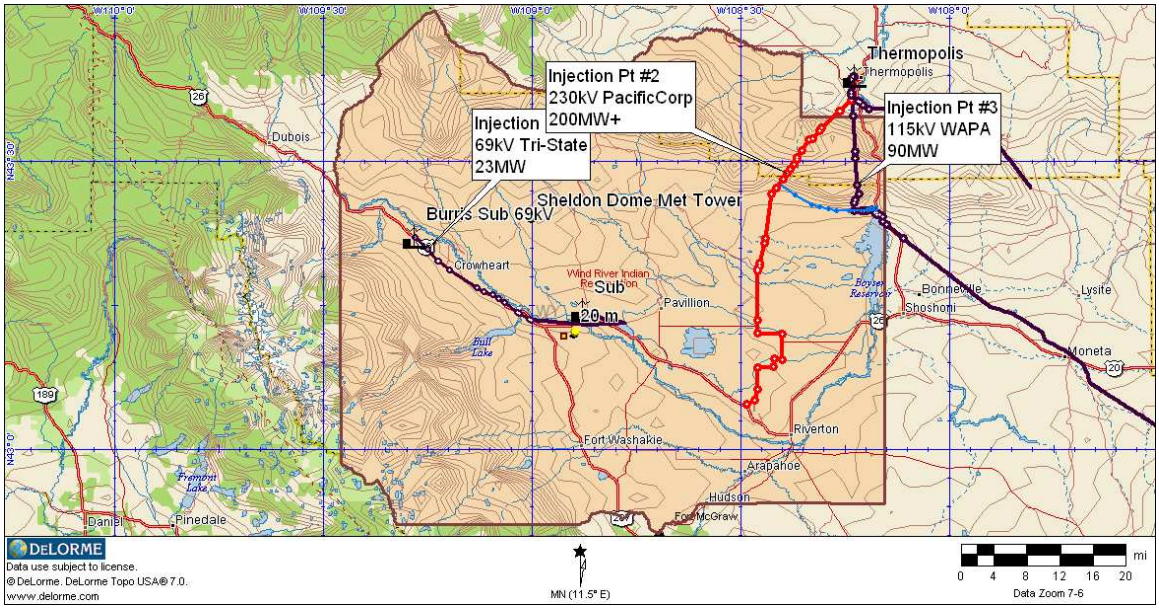
**Renewable Energy Development on Tribal Lands**
**DE-PS36-04GO94003**

# Appendix 4

# Economics and Development Options

## Background

Distributed Generations Systems, Inc. was contracted to conduct a wind energy feasibility study for Eastern Shoshone Tribe and Northern Arapahoe Tribe on the Wind River Indian Reservation located within the State of Wyoming. This wind energy study assessed the feasibility of a commercial wind facility on lands selected and entrusted by the Wind Rivers Tribes in areas called Sheldon Dome and Bighorn Flats.




The wind resource at Sheldon Dome (SD) and Bighorn Flats (BF) proved to be on the low side for the Wyoming market. The average wind speed was 15.8 mph at 50m and the capacity factors ranged from 30 to 32% for various wind turbines (Wind Resource Assessment Report). Most of the wind energy development is located in southeast corner of Wyoming where capacity factors range in the mid 40 percentile. The nearest transmission line to both SD and BF is the Tristate Generation and Transmission 69kV line running from the Burris substation to the Pilot substation. The transmission report indicates a 23MW capability, currently.

DISGEN has performed a preliminary economic evaluation for a proposed wind energy project using a 22 MW project as basis for the analysis and a commercially available wind turbine. This section will discuss options that the Tribe may pursue in developing wind energy on Tribal lands. These options include Tribal Ownership, Land Lease, Joint Venture, and No Action.

**Project Assumptions:**

| | |
|---|---|
| Size: | 23. MW, 11 Wind Turbines, Suzlon S88 2100kW |
| Gross Capacity Factor: | 34.6% |
| Total Capital Cost: | $48,100,000 (Estimated) |
| Project Area: | Tribal Trust Lands on Sheldon Dome |
| Energy Prices: | $45.00 per MWh (Targeted) escalating at 2.5% annually for 20 years. |
| Taxes: | Tribe is tax-exempt. No Sales taxes, |
| Interconnection | 69kV Line, Tri-State Generation and Transmission, Bighorn Electric Coop is a member. |

**1. Tribal Ownership**

The attached preliminary set of economics demonstrates the initial energy prices that the Tribe must obtained to make a wind energy project viable as owners. The economics were completed using the assumption that the tribe has the financial resources to develop and own a wind energy project without incurring any debt. Approximately $48,100,000 of available funds would be needed to completely construct a 23 MW wind energy project interconnected to the 69kV line. The Tribe should expect to spend a least $900,000 to $1,500,000 on the pre-construction and development activities. These pre-construction activities include conducting an environmental assessment, federal permitting, procuring wind turbines, procuring a power purchase agreement, interconnection activities and accessing funds.

Using all of these assumptions, the preliminary project economics indicates that the project would need a beginning contract price of $ 0.045 per kWh to make it economically viable to construct under a Tribal ownership scenario in which the tribe would break-even (0% IRR). In the normal financial market today, investors are looking at minimum of 9% IRR for a project without debt. So the beginning price for a tribal project to make 9% IRR is $0.085 per kWh. In the Wyoming market, it really unlikely that any utility will accept this price.

**2. Passive Participants (Land Lease)**

If the Tribe wishes to pursue commercial wind energy project as a passive participant by leasing the project area to a developer then the project economics change. A developer or investor with a tax appetite can utilized the available federal production tax credit, which has an enormous economic benefit to the project. Unfortunately, Tribes are unable to take advantage of the tax credit since Tribes are tax-exempt. In this scenario, the Tribe can lease trust land to the project owner and get a royalty payment when the project is in operation. The project owner/developer will finances the project and reap the tax benefit and also incurs any state tax liabilities.

If the Tribe is able to negotiate a lease agreement to develop a 23MW (11 turbines) wind project using the acquired wind data and capacity factors, gross revenue share, and TERO fees. The tribal economic benefit from a 23 MW wind project could be as follows;

a. Most private wind energy developers negotiate a land easement agreement with land owners that has annual royalty payment for gross energy production at 3.5%. For a 23 MW project using the capacity factor of 34%, the annual lease payment would start at $95,000 to the Tribe and escalate to $147,000. The economic benefit to Tribe during the life of the power purchase agreement, 25 years, the total economic benefit would be at least $2,900,000.
b. If the Tribal Employment Rights Office (TERO) is applied then the tax of 2% of the capital project cost ($48,100,000) would be as much as $962,000 to the Tribe. If the wind farm is conducted on the reservation, the TERO tax applies at 2% of gross revenue, so the estimated revenue from the gross sales would be about $54,000.
c. At least 40-60 short term construction jobs would be available to tribal members.
d. At least 2-3 potential permanent jobs would be available to tribal members for caretaking the wind farm.
e. No out of pocket funding toward the project is required from the Tribe.

Other benefits that could be included;

f. Develop tribal experience in renewable energy and to position the Tribe to participate in their energy development. Unlike other fossil fuel resources, the wind resource will be available after the land lease has expired.
g. If negotiated, the project owners could sell the project to Tribe once lease expires.

The land lease option may be attractive to the Tribes if the annual cash flow is acceptable and that no out-of-pocket funding will be needed to complete the project. The Tribes have to keep in mind that additional taxes and fees to the project could make the project to expensive to finance.

### 3. Joint Venture (Market Position Development)

If the Tribe wishes to participate in the development and preconstruction activities for this wind energy project then the Tribe would need to commit resources to the activities with the goal of attracting a willing investment partner to use the production tax credits.

In this scenario, the Tribe would continue to receive the economic benefits of the land lease scenario and jobs but with an option to be proactive in the development of their own lands and possible ownership of the project over time. The ownership capability is greatly increased when the Tribe actively participates in the development work.

The Tribe would need to commit personnel to facilitate and manage the development activities. The cost for the development activities would be approximately $900,000 to $1,500,000 to complete the pre-development work for at 23MW project. The development activities in the following:

1. Continued Wind Resource Assessment. Investor strongly advises the wind sites to gather wind data for at least 3 years.
2. Interconnection Studies. These studies are required from the utility and FERC to facilitate the interconnection of the wind facility. These studies cost between $150,000 to $300,000 and take over 8 months to perform.
3. Environmental Assessment per NEPA Regulations. Since the project site is on federal trust land, it is necessary to gather the required studies to complete a Environmental Assessment document. Under federal rules these NEPA studies will have to be completed prior to any financing.
4. Acceptable Financing Structures.
5. Power Purchase Agreement procurement
6. Wind Turbine Equipment procurement
7. Geotechnical Activities
8. Facilitating Federal involvement such as Bureau of Indian Affairs, US Dept of Fish and Wildlife and the EPA.

### 4. No Action

If the Tribe chooses not to participate in the development of the wind energy project at this time, then no action is needed.

**Wind River, 23MW, no Taxes**

## Project Assumptions

| | | | | | |
|---|---|---|---|---|---|
| Turbine Manufacturer | | Suzlon | | | |
| Turbine Type | | S88 | | | |
| Number of Turbines | | 11 | | | |
| KW Rating | kW | 2,100 | | | |
| Capacity Installed | MW | 23.10 | assume | | |
| Turbine Price (including tower) | $ | 2,900,000 | $ | 1,381 | $/kW |
| | | | | | |
| Gross Annual kWh per Turbine | kWh | 6,320,401 | | | |
| Net Output as Percent of Gross | % | 89.0% | | | |
| Net Annual kWh per Turbine | kWh | 5,625,157 | | | |
| Availability | % | 97.0% | | | |
| Annual Production to Meter per Turbine | kWh | 5,456,402 | | | |
| Total Annual Production to Meter | MWh | 60,020 | | | |
| Net Capacity Factor | % | 29.66% | | | |
| Annual Decrease In Availability | % | 0.00% | | | |
| | | | | | |
| Project Life | years | 25 | | | |
| 1st Year of Operation | yyyy | 2011 | | | |
| 1st Month of Operation | number | 1 | | | |
| 1st Year Percent for Operating Costs | % | 100.0% | | | |
| 1st Year Percent for kWh Production | % | 100.0% | | | |
| Base Year for Capital Costs | yyyy | 2011 | | | |
| | | | | | |
| Construction Loan Closing | mm/dd/yy | 09/01/09 | | | |
| Permanent Loan Closing | mm/dd/yy | 10/01/10 | | | |
| | | | | | |
| Initial Spare Parts | $ | 100,000 | | | |
| Initial O&M/Mgt. Payment | no. of mo. | 3 | | | |
| Percent of 1st Year Interest | % | 25.0% | | | |
| Base Construction Cost per Turbine | $ | 650,000 | 650,000 | $310 / kw | |
| Construction Contingency | % | 7% | | | |
| | | | | | |
| First Year in Financial Model | | 2011 | | | |
| Final Year in Financial Model | | 2035 | | | |
| | | | | | |
| Electricity Purchaser | | Begin | End | | |
| | | | | | |
| IOU Purchaser | | 12/1/2011 | 12/31/2032 | ??? | |
| Avoided Cost Purchaser | | 1/1/2033 | 11/30/2036 | ??? | |
| | | | | | |
| Contract Term | yrs | 20 | | | |

| IOU Purchaser | | **PRODUCTION PER CONTRACT TERM** | | |
|---|---|---|---|---|
| | | | Begin | End |
| Phase 1 | % | 50% | 2011 | 2030 |
| Phase 2 | % | 25% | 2011 | 2030 |
| Phase 3 | % | 25% | 2011 | 2030 |

**need to fix production %:** **cannot be = 0% as currently modeled**

## Energy Sale Prices

20 yr After Tax ROR 10yr ROR

8.4%

| **Base Energy Prices** | Begin Yr. | End Yr. | Contract Pricing | Avoided Cost | |
|---|---|---|---|---|---|
| Tranche 1 | 2011 | 2035 | 7.900 | 3.00 | cents/kWh |
| Tranche 2 | 2036 | 2050 | 0.00 | 0.00 | cents/kWh |
| Tranche 3 | 2051 | 2051 | 0.00 | 0.00 | cents/kWh |
| Capacity Payment | 2052 | 2052 | 0.00 | 0.00 | $/kW-yr |

**Escalation of Contract Energy Prices**

| | | | | |
|---|---|---|---|---|
| Tranche 1 | Yrs Starting: | 2011 | 2028 | 2032 |
| | Rate | 2.5% | 2.5% | 2.5% |
| Tranche 2 | Yrs Starting: | 2011 | 2028 | 2032 |
| | Rate | 2.5% | 2.5% | 2.5% |
| Tranche 3 | Yrs Starting: | 2011 | 2028 | 2032 |
| | Rate | 2.5% | 2.5% | 2.5% |
| Capacity Payment | Yrs Starting: | 2011 | 2028 | 2032 |
| | Rate | 2.5% | 2.5% | 2.5% |

**Escalation of Avoided Cost Energy Prices**

| | | | | |
|---|---|---|---|---|
| Tranche 1 | Yrs Starting: | 2011 | 2028 | 2032 |
| | Rate | 2.5% | 2.5% | 2.5% |
| Tranche 2 | Yrs Starting: | 2011 | 2028 | 2032 |
| | Rate | 2.5% | 2.5% | 2.5% |
| Tranche 3 | Yrs Starting: | 2011 | 2028 | 2032 |
| | Rate | 2.5% | 2.5% | 2.5% |
| Capacity Payment | Yrs Starting: | 2011 | 2028 | 2032 |
| | Rate | 2.5% | 2.5% | 2.5% |

**Base Year (EOY)** 2011

## Debt Financing

### Senior Loan

| | | Amortized | Cover. Ratios - Senior Debt | |
|---|---|---|---|---|
| % Debt (if amort) or Coverage Ratio | | 0% | Minimum | Average |
| Fixed Interest Rate | | 6.00% | 1.02 | 1.02 |
| Amortization Period (Years) | | 20 | | |
| Interest Only Period (Years) | | | | |
| | | | Average Life (Years) | |
| Total Term | | 20 | N/A | |
| Variable Coverage Ratio | Yrs Starting: | 2011 | 2007 | 2010 |
| | Percent | | | |
| Initial Loan Fee | 1.00% | | | |
| Annual Agency Fee | $ - | | | |

### Other Debt

| | Amortized | Cover. Ratios - Total Debt | |
|---|---|---|---|
| % Debt (if amort) or Coverage Ratio | 0% | Minimum | Average |
| Interest Rate | 8.25% | 1.02 | 1.02 |
| Term (Years) | 15 | | |
| Interest Only Period (Years) | 1 | | |
| Total Term | 16 | Average Life (Years) | |
| | | N/A | |

### Debt Service Reserve

| | | |
|---|---|---|
| Debt Service Reserve (% of Annual) | | 50% |
| Initial DSR (% of 1st Year Debt Service) | | 50% |
| % of Cash Flow to Fund Reserve | | 50% |

### Construction Debt

| | | |
|---|---|---|
| Construction Loan? | (Yes/No) | No |
| Amount | % of Cost | 71% |
| Interest Rate | % | 6.5% |
| Commitment Fee on Unused Funds | % | 0.5% |
| Initial Loan Fee | % | 1.0% |

Wind River, 23MW, no Taxes

## Operations and Maintenance Expenses

| | | | | |
|---|---|---|---|---|
| Base Year | | 2010 | | |
| Operations & Maintenance Fee Options | | | | |
| Cents/kWh (escalating) | cents | 0.00 | | |
| Fixed Annual Pmt (escalating) | $ | 5,000 | | |
| Fixed Annual Pmt per Turbine (escalating) | $ | 25,000 | | |
| Percent of Revenues | % | 0.00% | | |
| % of Total O&M Subordinated | % | 0.00% | | |
| 1st Year/Month Fees Begin | | 2011 | 1 | |
| Landowner Pymt Options | | | | |
| Fixed Annual Pymt | $ | | Yr 1 Landowner Fee: | 69,323.59 |
| Per kW (esc) | $ | 0.00 | # of kW: | 23,100 |
| % of Revenues (fixed) | % | 0.00% | $/kW (esc): | 3.00 |
| % of Revenues (variable) | | Year | Percent | |
| Applied to Yrs Starting | | 2011 | | |
| Applied to Yrs Starting | | 2022 | | |
| Applied to Yrs Starting | | 2020 | | |
| Minimum Annual Pymt | $/Turbine | | | |
| | | 1 | | |
| Standby Electric Rate (escalating) | $/kWh | 0.050 | | |
| Standby Electric Consumption | kWh | 289,080 | | |
| Interconnect Fee to Utility (fixed $/KW-yr) | $ | - | | |
| Insurance/kW (escalating) | $ | 7.50 | | |
| Administration (esc) | $ | - | | |
| Audit/Legal/Miscellaneous (esc) | $ | 30,000 | | |
| Management Oversight Expense (esc) | $ | 75,000 | | |
| Tribal Educational Trust | $ | - | | |
| Other Expense (% of rev) | % | 0.0% | | |
| Other Expense (constant) | $ | - | | |
| Other Expense Subordinated (esc) | $ | - | | |
| Developer Subordinated Fee (% of rev) | % | 0.0% | | |

| | | |
|---|---|---|
| Interest Rate (Income) on Debt Resv/Cash | | 2.0% |
| Accrued Interest as a % of Cash Interest Pymt | | 100% |
| Working Capital Requirement as % of 1st Year Expenses | | 8.0% |
| Capital Costs & General Inflation | (all years) | 2.0% |
| Operating Expense Escalation | (all years) | 2.0% |
| Book Life of Project | years | 25 |
| Amortization Period for Intangible Assets | years | 5 |

## Income & Other Taxes

**Income Taxes**

| | Federal | WY | | |
|---|---|---|---|---|
| Tax Rates | 0.00% | 0.00% | Yr Placed in Service | 2011 |
| | | | Short first yr? | No |
| At-Risk Limitations? | No | No | 1st Year Percent | 100.0% |
| Utilize Tax Losses? | No | No | | |

| | Depr Methods | | | | | |
|---|---|---|---|---|---|---|
| | Code | Type | Yrs or DB% | DB/SL Yrs | Book Life | D/A |
| Facility Costs | 1 | MACRS | 5 | | 25 | D |
| Interconnect Costs | 2 | SL | 20 | | 25 | D |
| Loan Expenses | 3 | SL | 20 | | 20 | A |
| Organizational Costs | 4 | SL | 5 | | 5 | A |

| | | | | | |
|---|---|---|---|---|---|
| 1st Yr PTC | cents/kWh | - | ITC | 0 | 1=yes, 0=no |
| PTC Base Year | yyyy | 2011 | 30% | $ 13,450 | k |
| Last Year of PTC | yyyy | 2020 | | | |
| PTC Annual Escalation | % | 1.5% | | | |

**Property Taxes**

| | | |
|---|---|---|
| Cost of Equipment | 44,834,500 | turbines and blades exempt |
| Assessed Value as Percent | 0.0% | 50% abatement |
| Mil Rate ($ per $1000) | 21.800 | |
| Decr in Prop Value/Yr | 12.5% | |
| Min. Mil Rate (% of orig.) | 20% | |

**Sales Taxes**

| | |
|---|---|
| Rate | 0.00% |

Wind River, 23MW, no Taxes

## Internal Rates of Returns/Development Fees

**Internal Rates of Return**

| | Returns | | ApproxUnleveragedReturns |
|---|---|---|---|
| Years | Pre-tax | After-tax | Pre-tax |
| 5+ | | | |
| 10+ | | | |
| 15+ | 5.9% | 5.9% | 6.1% |
| 20+ | 8.4% | 8.4% | 8.6% |
| 25+ | 8.8% | 8.8% | 9.0% |
| 30+ | 8.8% | 8.8% | 9.0% |

**Development Fees**

| | | | | | |
|---|---|---|---|---|---|
| Base Development Fee | % of cost | 2.5% | of first | 200 | MW |
| Additional Development Fee | % of cost | 0.0% | all over | 200 | MW |

## Sources and Uses of Funds

**Wind River, 23MW, no Taxes**

| SOURCES | | Unit Price | Units | Percent | Amount | |
|---|---|---|---|---|---|---|
| | Senior Loan | | | 0.0% | | |
| | Other Debt | | | 0.0% | | |
| | Equity | | | 100.0% | 48,090,010 | |
| | Total Sources | | | 100.0% | 48,090,010 | |
| **USES** | | | | | | |
| 1.0 | **Wind Turbine Cost** | | | | | |
| 1.01 | Wind Turbines and Towers | 2,750,000 | 11 | 62.9% | 30,250,000 | |
| 1.02 | Extended Warranty | 108,000 | 11 | 2.5% | 1,188,000 | |
| 1.03 | Shipping and Packing | 200,000 | 11 | 4.6% | 2,200,000 | |
| 1.04 | Sales Tax | 0 | 11 | 0.0% | 0 | |
| | Subtotal | | | 69.9% | | 33,638,000 |
| 2.0 | **Balance of Construction** | | | | | |
| 2.01 | Base Construction Cost | 650,000 | 11 | 14.9% | 7,150,000 | |
| 2.02 | Low Voltage Ride Through | 670,000 | 1 | 1.4% | 670,000 | |
| 2.03 | Substation | 2,600,000 | 1 | 5.4% | 2,600,000 | |
| 2.04 | SCADA | 94,000 | 1 | 0.2% | 94,000 | |
| 2.05 | Construction Interest | | | 0.0% | | |
| 2.06 | Construction Contingency | | | 1.4% | 682,500 | |
| 2.07 | Sales Tax | | | 0.0% | 0 | |
| | Subtotal Construction | | | 23.3% | | 11,196,500 |
| 3.0 | **Working Capital and Initial Operating Expenses** | | | | | |
| 3.01 | Working Capital Funding | | | 0.1% | 47,667 | |
| 3.02 | Spare Parts | | | 0.2% | 100,000 | |
| 3.03 | First Half -Year Insurance Premium | | | 0.2% | 86,625 | |
| 3.04 | Initial Operations and Management Fee | | | 0.1% | 71,400 | |
| 3.05 | Other Initial Operating Expense | | | 0.9% | 445,517 | |
| | Subtotal Working Capital and Initial Operating Expenses | | | 1.6% | | 751,209 |
| 3.0 | **Lender Transaction Expenses** | | | | | |
| 3.01 | Legal Expenses | | | 0.0% | | |
| 3.02 | Construction Loan Fee | | | 0.0% | - | |
| 3.03 | Permanent Loan Fee | | | 0.0% | - | |
| 3.04 | Lender Consulting Expenses | | | 1.5% | 721,350 | |
| 3.05 | Other Lender Costs | | | 0.0% | - | |
| 3.06 | Title Insurance | | | 0.0% | 5,000 | |
| 3.07 | Other | | | 0.0% | - | |
| 3.08 | Initial Debt Reserve Funding | | | 0.0% | - | |
| 3.09 | First Year Agency Fee | | | 0.0% | - | |
| | Subtotal Lender Transaction Expenses | | | 1.5% | | 726,350 |
| 4.0 | **Equity Financing and Other Expenses** | | | | | |
| 4.01 | Equity Consulting Expenses | | | 0.0% | - | |
| 4.02 | Development Costs | | | 0.0% | - | |
| 4.03 | Legal Expenses | | | 0.3% | 150,000 | |
| 4.04 | Organizational Costs | | | 0.0% | 5,000 | |
| | Subtotal Equity Financing and Other Expenses | | | 0.3% | | 155,000 |
| 5.0 | **Development Costs and Fees** | | | | | |
| 5.01 | Developer Development Cost Reimbursement | | | 0.7% | 350,000 | |
| 5.02 | Other Development Cost Reimbursement | | | 0.2% | 100,000 | |
| 5.03 | Base Development Fee | | | 2.4% | 1,172,927 | |
| 5.04 | REC Sales | | | 0.0% | | |
| 5.05 | Project Construction Management | | | 0.0% | - | |
| 5.06 | Land Owner Installation Fee | 1 | 23 | 0.0% | 23 | |
| 5.07 | Development Contingency | | | 0.0% | - | |
| | Subtotal Development Costs and Fees | | | 3.4% | | 1,622,950 |
| | **Total Budget** | | | 100.0% | | 48,090,010 |

## Income Statement

**Wind River, 23MW, no Taxes**
**0**

| | Closing | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| **Operating Revenue** | | | | | | | | |
| Capacity Sales | | | | | | | | |
| Electricity Sales | | 4,742 | 4,860 | 4,982 | 5,106 | 5,234 | 5,365 | 5,499 |
| Total Revenues | | 4,742 | 4,860 | 4,982 | 5,106 | 5,234 | 5,365 | 5,499 |
| **Operating Expenses** | | | | | | | | |
| Operations & Maintenance | | 286 | 291 | 297 | 303 | 309 | 315 | 322 |
| Landowner Payments | | - | - | - | - | - | - | - |
| Interconnect and Electricity Consumption | | 15 | 15 | 15 | 16 | 16 | 16 | 17 |
| Insurance | | 177 | 180 | 184 | 188 | 191 | 195 | 199 |
| General and Administrative | | - | - | - | - | - | - | - |
| Audit, Legal, Miscellaneous | | 31 | 31 | 32 | 32 | 33 | 34 | 34 |
| Property Taxes Trust land | | - | | | | | | |
| Management | | 77 | 78 | 80 | 81 | 83 | 84 | 86 |
| Lender Agency Fee | | - | - | - | - | - | - | - |
| Other | | - | - | - | - | - | - | - |
| Total Operating Expenses | | 584 | 596 | 608 | 620 | 632 | 645 | 658 |
| **NET OPERATING INCOME** | | 4,157 | 4,264 | 4,374 | 4,486 | 4,602 | 4,720 | 4,841 |
| Depreciation | | | | | | | | |
| Amortization | | | | | | | | |
| Subordinated Developer Fee | | | | | | | | |
| Interest Income | | (21) | (43) | (44) | (45) | (46) | (47) | (48) |
| Interest Expense | | | | | | | | |
| **PRETAX INCOME** | | 4,178 | 4,307 | 4,418 | 4,531 | 4,648 | 4,767 | 4,889 |
| Production Tax Credit | | | | | | | | |
| Tax Provision | | | | | | | | |
| **NET INCOME** | | 4,178 | 4,307 | 4,418 | 4,531 | 4,648 | 4,767 | 4,889 |



## Income Statement

**Wind River, 23MW, no Taxes**
**0**

| | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **Operating Revenue** | | | | | | | | |
| Capacity Sales | | | | | | | | |
| Electricity Sales | 5,636 | 5,777 | 5,922 | 6,070 | 6,221 | 6,377 | 6,536 | 6,700 |
| Total Revenues | 5,636 | 5,777 | 5,922 | 6,070 | 6,221 | 6,377 | 6,536 | 6,700 |
| **Operating Expenses** | | | | | | | | |
| Operations & Maintenance | 328 | 335 | 341 | 348 | 355 | 362 | 369 | 377 |
| Landowner Payments | - | - | - | - | - | - | - | - |
| Interconnect and Electricity Consumption | 17 | 17 | 18 | 18 | 18 | 19 | 19 | 19 |
| Insurance | 203 | 207 | 211 | 215 | 220 | 224 | 229 | 233 |
| General and Administrative | - | - | - | - | - | - | - | - |
| Audit, Legal, Miscellaneous | 35 | 36 | 37 | 37 | 38 | 39 | 40 | 40 |
| Property Taxes Trust land | | | | | | | | |
| Management | 88 | 90 | 91 | 93 | 95 | 97 | 99 | 101 |
| Lender Agency Fee | - | - | - | - | - | - | - | - |
| Other | - | - | - | - | - | - | - | - |
| Total Operating Expenses | 671 | 684 | 698 | 712 | 726 | 741 | 756 | 771 |
| **NET OPERATING INCOME** | 4,965 | 5,093 | 5,224 | 5,358 | 5,495 | 5,636 | 5,781 | 5,929 |
| Depreciation | | | | | | | | |
| Amortization | | | | | | | | |
| Subordinated Developer Fee | | | | | | | | |
| Interest Income | (50) | (51) | (52) | (54) | (55) | (56) | (58) | (59) |
| Interest Expense | | | | | | | | |
| **PRETAX INCOME** | 5,015 | 5,144 | 5,276 | 5,411 | 5,550 | 5,692 | 5,839 | 5,988 |
| Production Tax Credit | | | | | | | | |
| Tax Provision | | | | | | | | |
| **NET INCOME** | 5,015 | 5,144 | 5,276 | 5,411 | 5,550 | 5,692 | 5,839 | 5,988 |

## Income Statement

**Wind River, 23MW, no Taxes**
**0**

| | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|
| | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| **Operating Revenue** | | | | | | | | |
| Capacity Sales | | | | | | | | |
| Electricity Sales | 6,867 | 7,039 | 7,215 | 7,395 | 7,580 | 2,951 | 3,024 | 3,100 |
| Total Revenues | 6,867 | 7,039 | 7,215 | 7,395 | 7,580 | 2,951 | 3,024 | 3,100 |
| **Operating Expenses** | | | | | | | | |
| Operations & Maintenance | 384 | 392 | 400 | 408 | 416 | 424 | 433 | 442 |
| Landowner Payments | - | - | - | - | | | | |
| Interconnect and Electricity Consumption | 20 | 20 | 21 | 21 | 21 | 22 | 22 | 23 |
| Insurance | 238 | 243 | 247 | 252 | 257 | 263 | 268 | 273 |
| General and Administrative | - | - | - | - | | | | |
| Audit, Legal, Miscellaneous | 41 | 42 | 43 | 44 | 45 | 45 | 46 | 47 |
| Property Taxes Trust land | | | | | | | | |
| Management | 103 | 105 | 107 | 109 | 111 | 114 | 116 | 118 |
| Lender Agency Fee | - | - | - | - | - | - | - | - |
| Other | - | - | - | - | | | | |
| Total Operating Expenses | 786 | 802 | 818 | 834 | 851 | 868 | 885 | 903 |
| **NET OPERATING INCOME** | 6,081 | 6,237 | 6,397 | 6,561 | 6,729 | 2,082 | 2,139 | 2,197 |
| Depreciation | | | | | | | | |
| Amortization | | | | | | | | |
| Subordinated Developer Fee | | | | | | | | |
| Interest Income | (61) | (62) | (64) | (66) | (67) | (21) | (21) | (22) |
| Interest Expense | | | | | | | | |
| **PRETAX INCOME** | 6,142 | 6,299 | 6,461 | 6,627 | 6,796 | 2,103 | 2,160 | 2,219 |
| Production Tax Credit | | | | | | | | |
| Tax Provision | | | | | | | | |
| **NET INCOME** | 6,142 | 6,299 | 6,461 | 6,627 | 6,796 | 2,103 | 2,160 | 2,219 |



## Income Statement

**Wind River, 23MW, no Taxes**
**0**

| | 2034 | 2035 | | | | | |
|---|---|---|---|---|---|---|---|
| | 24 | 25 | | | | | |
| **Operating Revenue** | | | | | | | |
| Capacity Sales | | | | | | | |
| Electricity Sales | 3,177 | 3,257 | | | | | |
| Total Revenues | 3,177 | 3,257 | | | | | |
| **Operating Expenses** | | | | | | | |
| Operations & Maintenance | 450 | 459 | | | | | |
| Landowner Payments | | | | | | | |
| Interconnect and Electricity Consumption | 23 | 24 | | | | | |
| Insurance | 279 | 284 | | | | | |
| General and Administrative | | | | | | | |
| Audit, Legal, Miscellaneous | 48 | 49 | | | | | |
| Property Taxes Trust land | | | | | | | |
| Management | 121 | 123 | | | | | |
| Lender Agency Fee | - | - | - | - | - | - | - |
| Other | | | | | | | |
| Total Operating Expenses | 921 | 940 | | | | | |
| **NET OPERATING INCOME** | 2,256 | 2,317 | | | | | |
| Depreciation | | | | | | | |
| Amortization | | | | | | | |
| Subordinated Developer Fee | | | | | | | |
| Interest Income | (23) | (23) | | | | | |
| Interest Expense | | | | | | | |
| **PRETAX INCOME** | 2,279 | 2,340 | | | | | |
| Production Tax Credit | | | | | | | |
| Tax Provision | | | | | | | |
| **NET INCOME** | 2,279 | 2,340 | 0 | 0 | 0 | 0 | 0 |

## Cash Flow Statement

**Wind River, 23MW, no Taxes**
**0**

| | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|
| **PRETAX INCOME** | | 4,178 | 4,307 | 4,418 | 4,531 | 4,648 | 4,767 | 4,889 |
| **Increased by:** | | | | | | | | |
| Book Depreciation | | | | | | | | |
| Book Amortization | | | | | | | | |
| Subordinated Expenses | | | | | | | | |
| Accrued Interest Expense | | | | | | | | |
| **Cash Flow before Debt Service, Reserves & Taxes** | | 4,178 | 4,307 | 4,418 | 4,531 | 4,648 | 4,767 | 4,889 |
| **Decreased by:** | | | | | | | | |
| Interest Payments | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Principal Payments | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Cash Flow before Reserves & Taxes** | | 4,178 | 4,307 | 4,418 | 4,531 | 4,648 | 4,767 | 4,889 |
| Debt Reserve Releases (Additions) | | | | | | | | |
| Equity Investment | (48,090) | | | | | | | |
| **PRETAX CASH FLOW** | (48,090) | 4,178 | 4,307 | 4,418 | 4,531 | 4,648 | 4,767 | 4,889 |
| Production Tax Credit | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Income Tax Benefit (Payment) | | | | | | | | |
| **AFTER-TAX CASH FLOW** | (48,090) | 4,178 | 4,307 | 4,418 | 4,531 | 4,648 | 4,767 | 4,889 |



## Cash Flow Statement

**Wind River, 23MW, no Taxes**

| | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| **PRETAX INCOME** | 5,015 | 5,144 | 5,276 | 5,411 | 5,550 | 5,692 | 5,839 | 5,988 |
| **Increased by:** | | | | | | | | |
| Book Depreciation | | | | | | | | |
| Book Amortization | | | | | | | | |
| Subordinated Expenses | | | | | | | | |
| Accrued Interest Expense | | | | | | | | |
| **Cash Flow before Debt Service, Reserves & Taxes** | 5,015 | 5,144 | 5,276 | 5,411 | 5,550 | 5,692 | 5,839 | 5,988 |
| **Decreased by:** | | | | | | | | |
| Interest Payments | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Principal Payments | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Cash Flow before Reserves & Taxes** | 5,015 | 5,144 | 5,276 | 5,411 | 5,550 | 5,692 | 5,839 | 5,988 |
| Debt Reserve Releases (Additions) | | | | | | | | |
| Equity Investment | | | | | | | | |
| **PRETAX CASH FLOW** | 5,015 | 5,144 | 5,276 | 5,411 | 5,550 | 5,692 | 5,839 | 5,988 |
| Production Tax Credit | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Income Tax Benefit (Payment) | | | | | | | | |
| **AFTER-TAX CASH FLOW** | 5,015 | 5,144 | 5,276 | 5,411 | 5,550 | 5,692 | 5,839 | 5,988 |

## Cash Flow Statement

**Wind River, 23MW, no Taxes**

| | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|
| **PRETAX INCOME** | 6,142 | 6,299 | 6,461 | 6,627 | 6,796 | 2,103 | 2,160 | 2,219 |
| **Increased by:** | | | | | | | | |
| Book Depreciation | | | | | | | | |
| Book Amortization | | | | | | | | |
| Subordinated Expenses | | | | | | | | |
| Accrued Interest Expense | | | | | | | | |
| **Cash Flow before Debt Service, Reserves & Taxes** | 6,142 | 6,299 | 6,461 | 6,627 | 6,796 | 2,103 | 2,160 | 2,219 |
| **Decreased by:** | | | | | | | | |
| Interest Payments | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Principal Payments | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Cash Flow before Reserves & Taxes** | 6,142 | 6,299 | 6,461 | 6,627 | 6,796 | 2,103 | 2,160 | 2,219 |
| Debt Reserve Releases (Additions) | | | | | | | | |
| Equity Investment | | | | | | | | |
| **PRETAX CASH FLOW** | 6,142 | 6,299 | 6,461 | 6,627 | 6,796 | 2,103 | 2,160 | 2,219 |
| Production Tax Credit | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Income Tax Benefit (Payment) | | | | | | | | |
| **AFTER-TAX CASH FLOW** | 6,142 | 6,299 | 6,461 | 6,627 | 6,796 | 2,103 | 2,160 | 2,219 |



## Cash Flow Statement

**Wind River, 23MW, no Taxes**

| | 2034 | 2035 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|
| **PRETAX INCOME** | 2,279 | 2,340 | | | | | |
| **Increased by:** | | | | | | | |
| Book Depreciation | | | | | | | |
| Book Amortization | | | | | | | |
| Subordinated Expenses | | | | | | | |
| Accrued Interest Expense | | | | | | | |
| **Cash Flow before Debt Service, Reserves & Taxes** | 2,279 | 2,340 | | | | | |
| **Decreased by:** | | | | | | | |
| Interest Payments | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Principal Payments | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Cash Flow before Reserves & Taxes** | 2,279 | 2,340 | 0 | 0 | 0 | 0 | 0 |
| Debt Reserve Releases (Additions) | | | | | | | |
| Equity Investment | | | | | | | |
| **PRETAX CASH FLOW** | 2,279 | 2,340 | | | | | |
| Production Tax Credit | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Income Tax Benefit (Payment) | | | | | | | |
| **AFTER-TAX CASH FLOW** | 2,279 | 2,340 | | | | | |