

2006 Tribal Energy Review Denver, Colorado United States Department of Energy

October 25, 2006

Presented by:
Larry Ahasteen, Renewable Energy Specialist

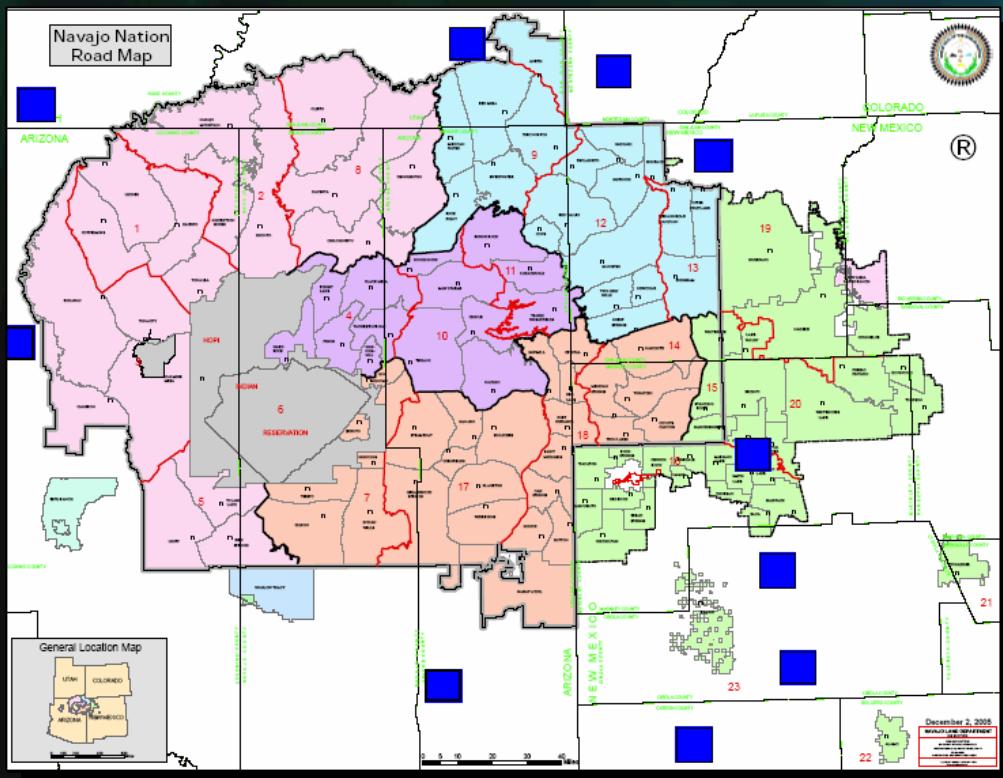
Navajo Niyol (Wind) Project

DE-FG36-05GO15180-A000

NAVAJO TRIBAL UTILITY AUTHORITY



- Project Overview
- Project Location
- Project Participants
- Objectives
- On-going projects
- Project Status
 - Accomplishments
 - Technical or Management Issues
 - Activities Yet to Be Completed
- Future Plans



Navajo Nation

The Navajo Nation is the home of the largest Indian tribe, and sprawls across northeast Arizona, New Mexico and Utah. It has an area of over 27,000 square miles and is situated on the southwestern Colorado Plateau. Very often, the size of the Navajo Nation is compared to that of the state of West Virginia.



The Navajo Tribal Utility Authority is a non-profit enterprise established by the Navajo Nation Council to provide multi-utility services to the Navajo Nation and the Navajo People. Since 1959, NTUA has supplied electricity, water, natural gas, wastewater treatment, and photovoltaic (solar power) services to residents throughout the Navajo Nation which land base spreads across northeastern Arizona, northwestern New Mexico, and southeastern Utah.

NAVAJO TRIBAL UTILITY AUTHORITY

Navajo Tribal Utility Authority

An Enterprise of the Navajo Nation

Kayenta District



Chinle District

Shiprock District

Dilkon District

Fort Defiance District



Dale Luna

Kayenta District Manager

PO Box 37

Kayenta, AZ 86033

1-928-697-3574

KAYENTA CUSTOMERS:

Electric4,087
Water2,366
WW1,029
Solar109

TUBA CITY CUSTOMERS:

Electric2,084
Gas2,942
Water3,409
WW2,070
Solar52



Justin Paul, Jr.

Dilkon District Manager

HC63 Box D

Winslow, AZ 86047

1-928-657-3258

DILKON CUSTOMERS:

Electric3,919
Gas738
Water2,303
WW855
Solar55



Daniel Wauneka

Chinle District Manager

PO Box 549

Chinle, AZ 86503

1-928-674-5670

CHINLE CUSTOMERS:

Electric10,164
Gas1,716
Water5,998
WW2,027
Solar60



Eugene John

Shiprock District Manager

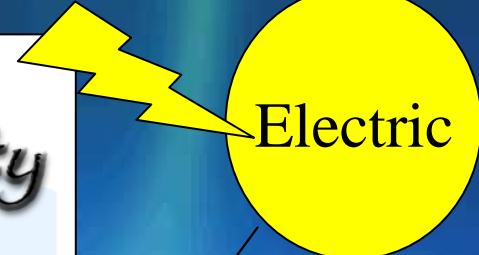
PO Box 1749

Shiprock, NM 87420

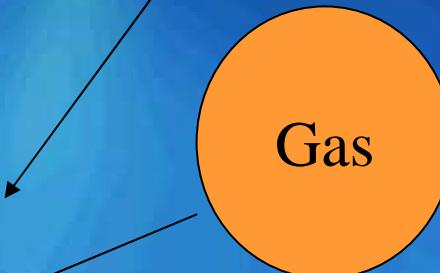
1-505-368-4634

SHIPROCK CUSTOMERS:

Electric7,748
Gas1,762
Water7,556
WW2,461
Solar17



Electric



Gas



Water

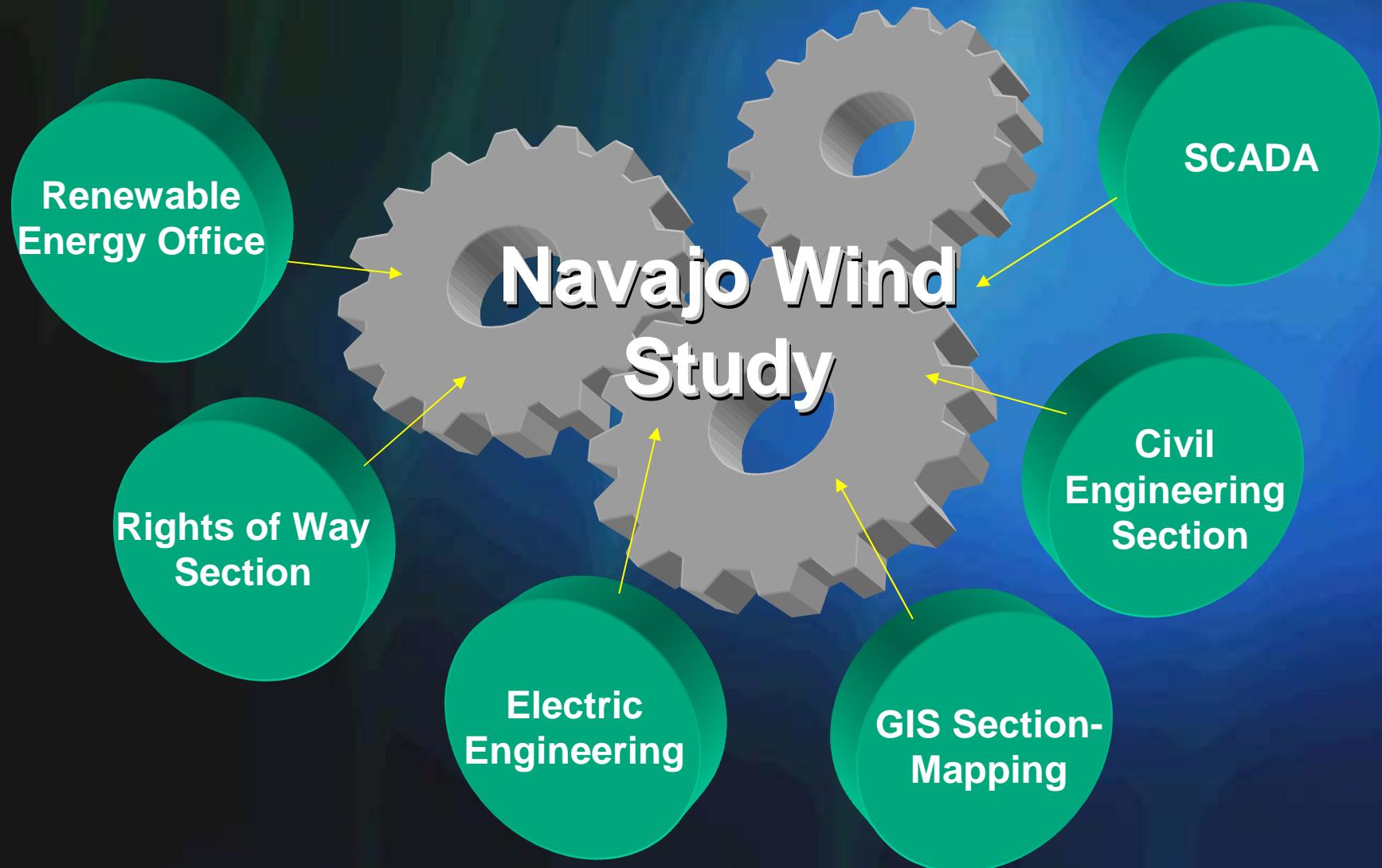


Waste
water



Solar

NTUA Engineering and Technical Section



Navajo Niyol (Wind) Project- Funded by Department of Energy



- NTUA and Navajo Wind Project Team will evaluate six sites with a meteorologist.
- Study will monitor and analyze proposed tribal land within the States of Arizona and New Mexico
- Wind Project Team will coordinate all activities in reviewing and evaluating these proposed sites.
- NTUA primary objective is to evaluate the wind energy potential
- Determine if there are sufficient wind energy resources to generate electric power.

Navajo Wind Project- Project Participants

Dine' Care

National
Renewable
Energy Lab.

Sandia National
Lab.

Navajo Tribal
Utility Authority

Navajo
Businesses

Crownpoint
Technology
Institute

Northern Arizona
University

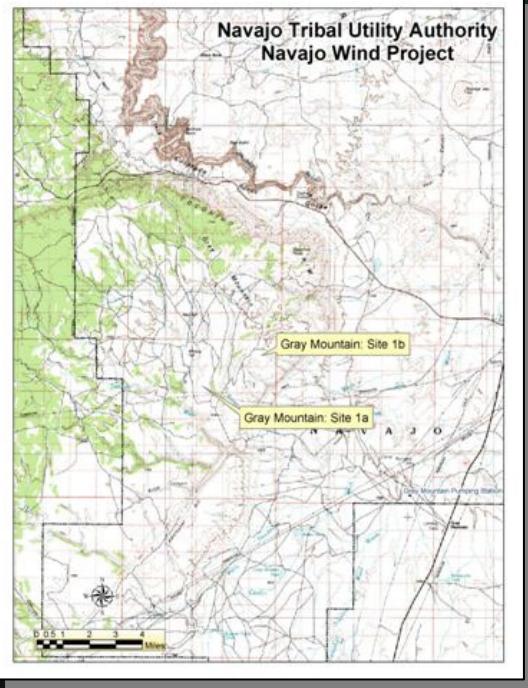
Dine Power
Authority

Navajo Nation
Government

ICOUP



PROGRAM OVERVIEW



1.

The Authority plans consist of the following,

- Expedite the development of wind energy sites
- Implementation of sites plan
- Engineering detail design of a wind farm for the Nation



2

Navajo
Tribal
Utility
Authority

Navajo
Engineering
Construction
Authority

Dine
Power
Authority

Navajo
Nation
Government

Navajo Nation Council directed to all Tribal Programs and Enterprise to develop ,research ,and seek new plans to generate outside revenue for the Nation

3.



NN Council approved a resolution for NTUA to build electric generating facilities to service its load and not depend on off-reservation electric generating facilities



NAVAJO TRIBAL UTILITY AUTHORITY

4



NTUA is proposing to conduct a 24 months comprehensive wind energy resources evaluation an development of a wind farm feasibility study



NAVAJO TRIBAL UTILITY AUTHORITY

5.

The Navajo Nation and NTUA has the experience in carrying out this feasibility project.





The Navajo Nation seeks three primary objectives:

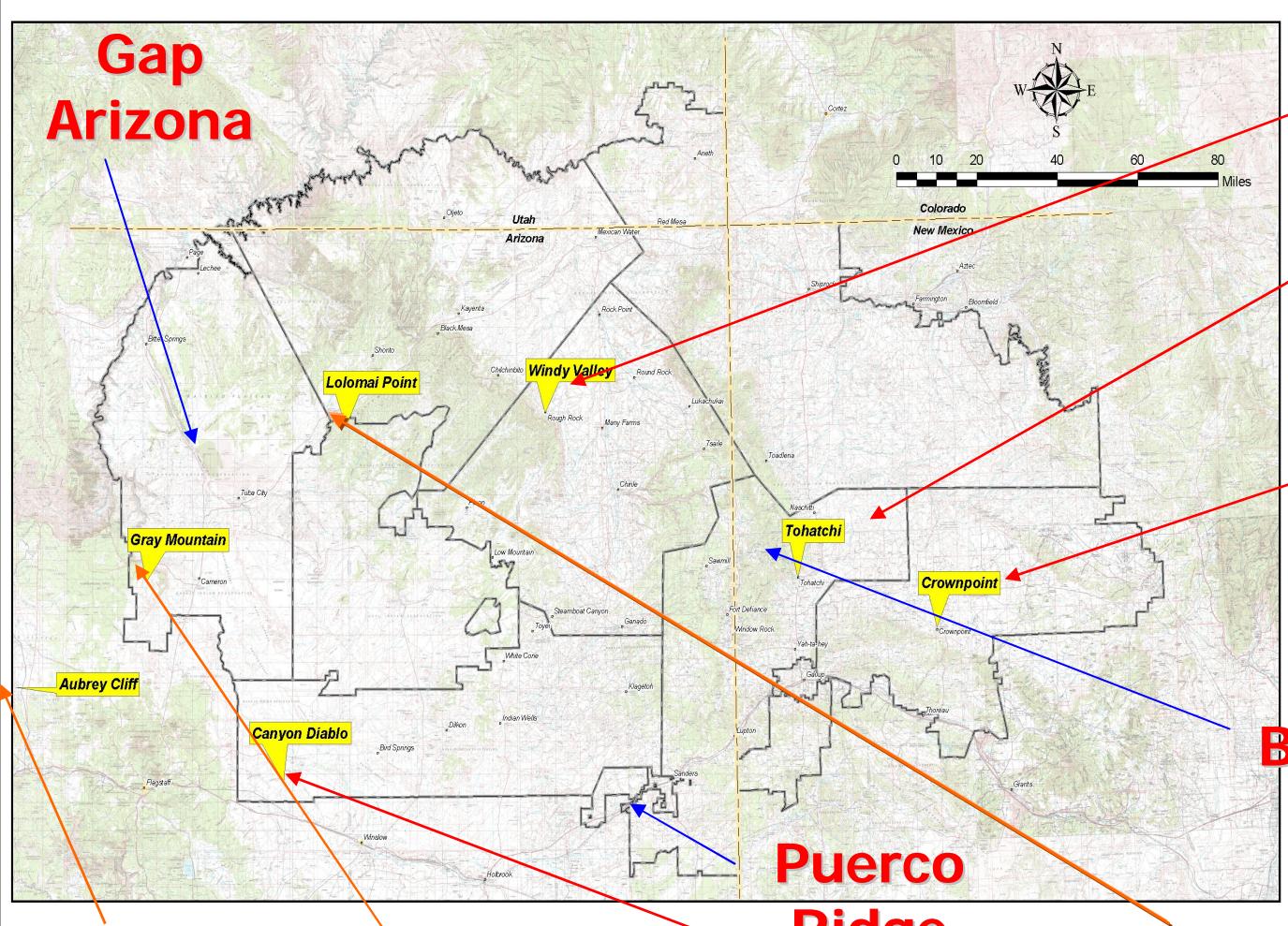
- To make electricity available to all the homes within the Nation, wind energy development will play a key role in this objective; and,
- To open the range of economic development activities that provide long, challenging and prosperous careers for young Navajos.
- To utilize existing Tribal organization, enterprise and manpower on the Navajo Nation to develop this feasibility study.





- ❖ Site Selection
- ❖ Land Agreements
- ❖ Wind Assessment
- ❖ Environmental review
- ❖ Economic Modeling
- ❖ Interconnection Studies
- ❖ Permitting
- ❖ Sales Agreements
- ❖ Financing
- ❖ Turbine Procurement
- ❖ Construction contracts
- ❖ Operation and Maintenance

Niyol (Wind) Development Navajo Nation Process



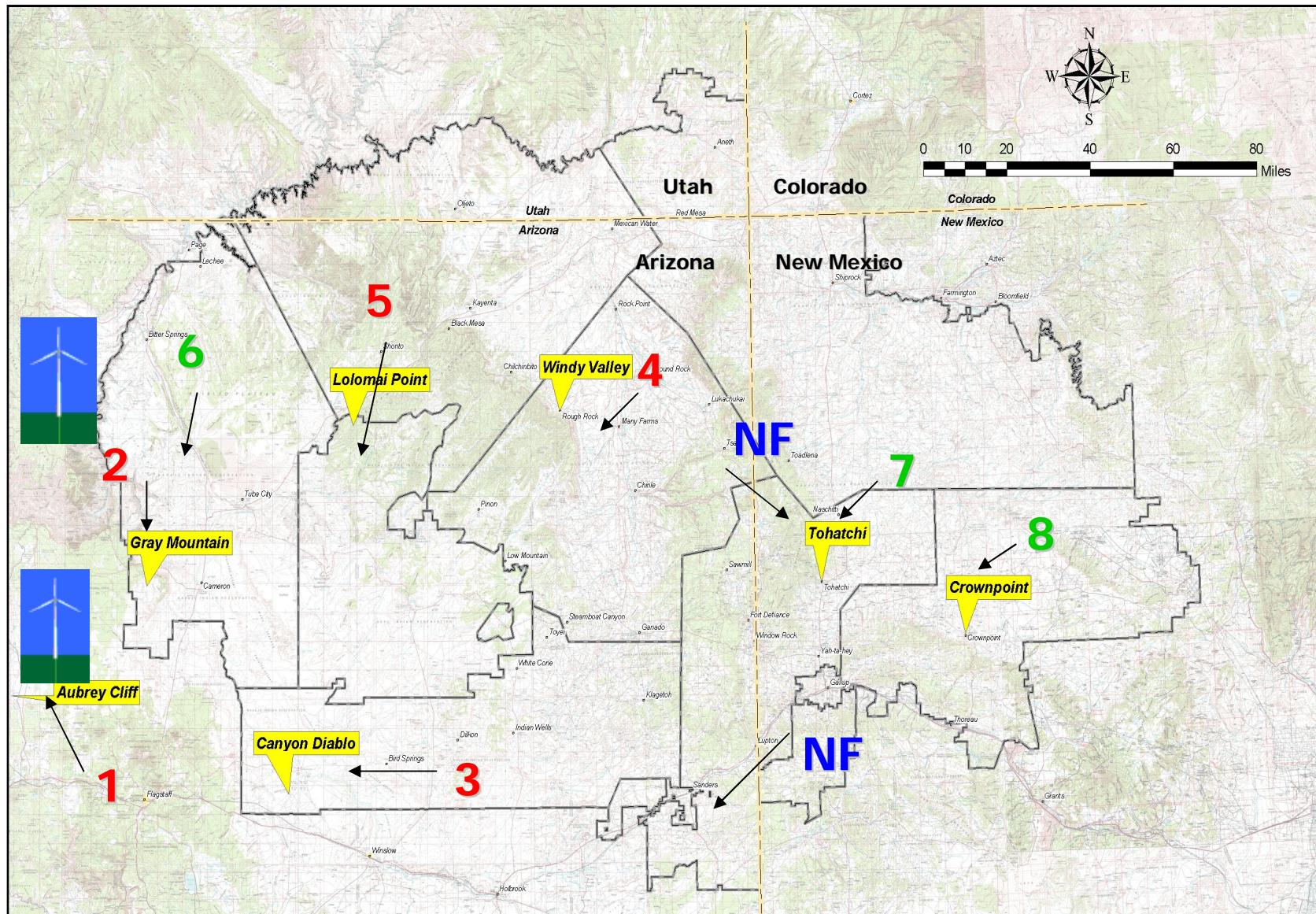
Windy Valley
Tohatchi

Crownpoint

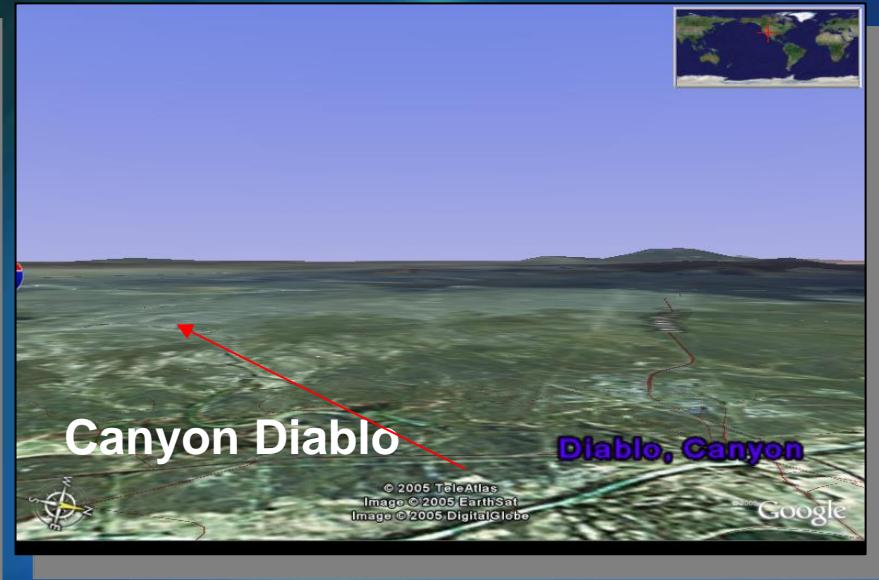
**Deezi
Bluff New
Mexico**

Abrey Cliff
**Gray
Mountain**
**Lolomai
Point**

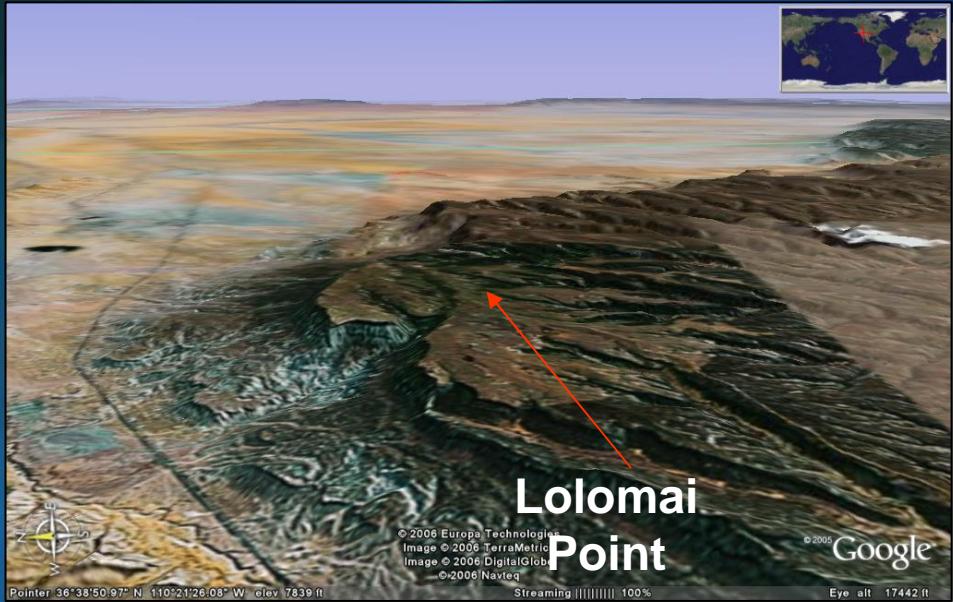
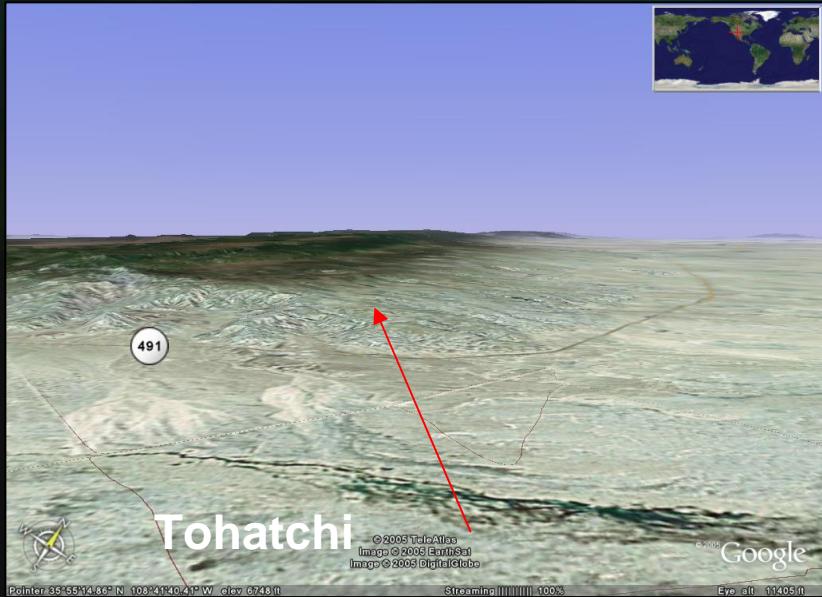
Wind Sites- Navajo Nation



Ranking Wind Sites- Navajo Nation



Wind Sites- Navajo Nation



Wind Sites- Navajo Nation

Gray Mountain Wind Sites



- ✿ Second Wind Site- Met Tower permit needs approval from grazing permittee.
- ✿ Second Wind Site- All clearance were completed ready to be send to tribe land office for approval.
- ✿ Develop new site plans – roads archeological survey- Avian Study
- ✿ Dine Power Authority is exploring to develop this area with-Citizen Energy consultant, Mass.
- ✿ Cameron Chapter supporting resolution was approved-Met Tower Installed-Collecting Wind Data-NTUA

Gray Mountain Wind Site

Gray Mountain Windy Land

Average Annual Wind
Resource 230 ft (70m)
with Land Exclusions
and Transmission

Navajo Reservation Boundary
within Arizona includes:

- Navajo National Monuments
- Navajo Trust Land
- Navajo-Hopi Joint Use Areas

Legend

- Major Roads
- Transmission Lines
- Land Excluded 100%
- Woodlands - Excluded 50%
Does not include
Pinyon-Juniper Woodland

Created by: Grant Brummels

Date of Creation: 9/7/2005

For more information contact:

Dr. Tom Acker

Tom.Acker@nau.edu

Projection:

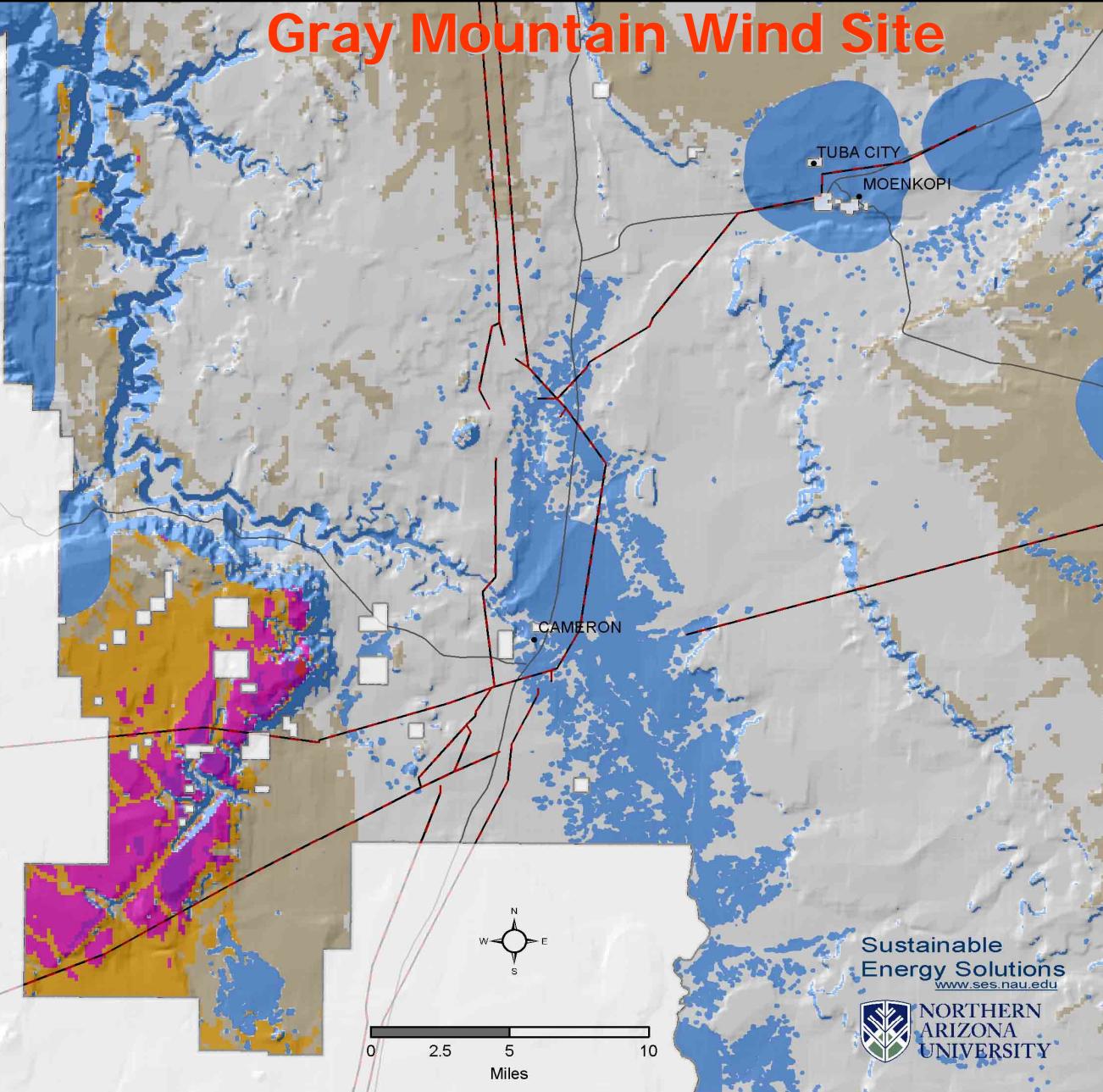
UTM, Zone 12, WGS84

Spatial Resolution of

Wind Resource Data: 200m

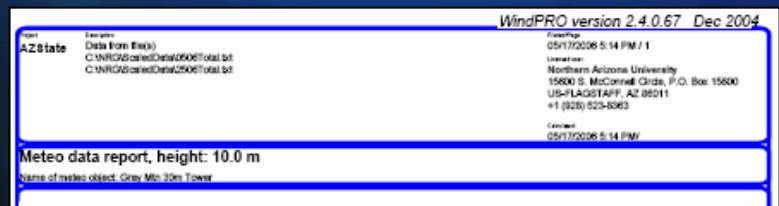
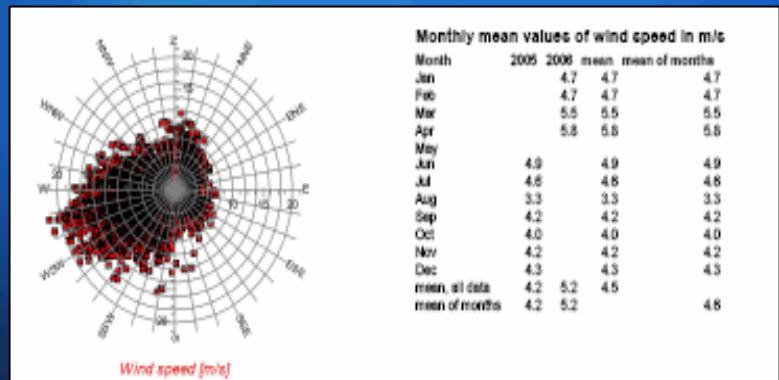
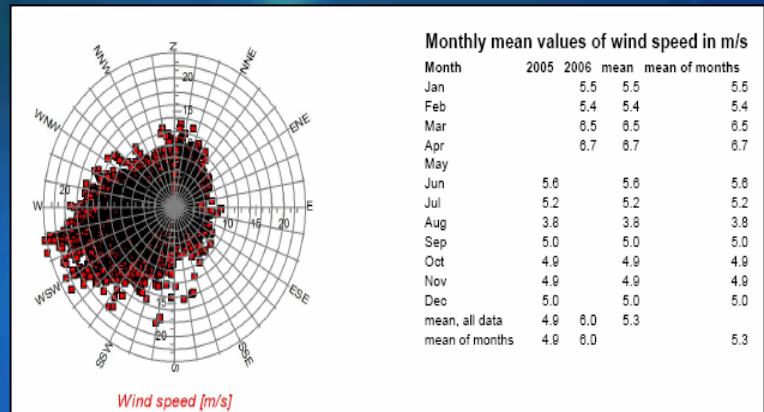
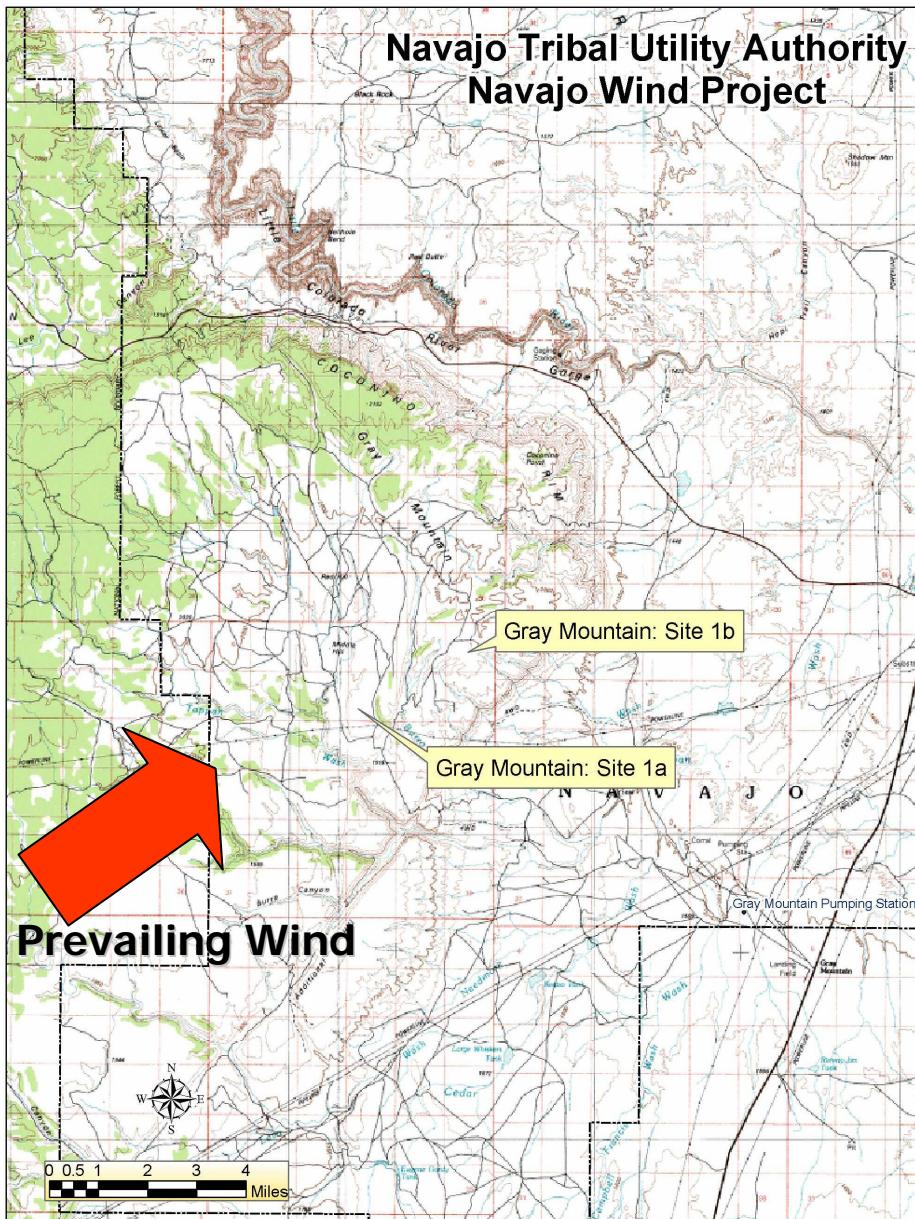
Wind Power Classification

Wind Power Class	Wind Power Density (W/m ²)	Wind Speed (mph)
1 Poor	0 - 200	0.0 - 12.3
2 Marginal	200 - 300	12.3 - 14.1
3 Fair	300 - 400	14.1 - 15.7
4 Good	400 - 500	15.7 - 16.8
5 Excellent	500 - 600	16.8 - 17.9
6 Outstanding	600 - 800	17.9 - 19.7
7 Superb	> 800	> 19.7



Sustainable
Energy Solutions
www.ses.nau.edu

 NORTHERN
ARIZONA
UNIVERSITY



GRAY MOUNTAIN WIND SITE

Gray Mountain Wind Site –Second Tower



Environmental Assessment

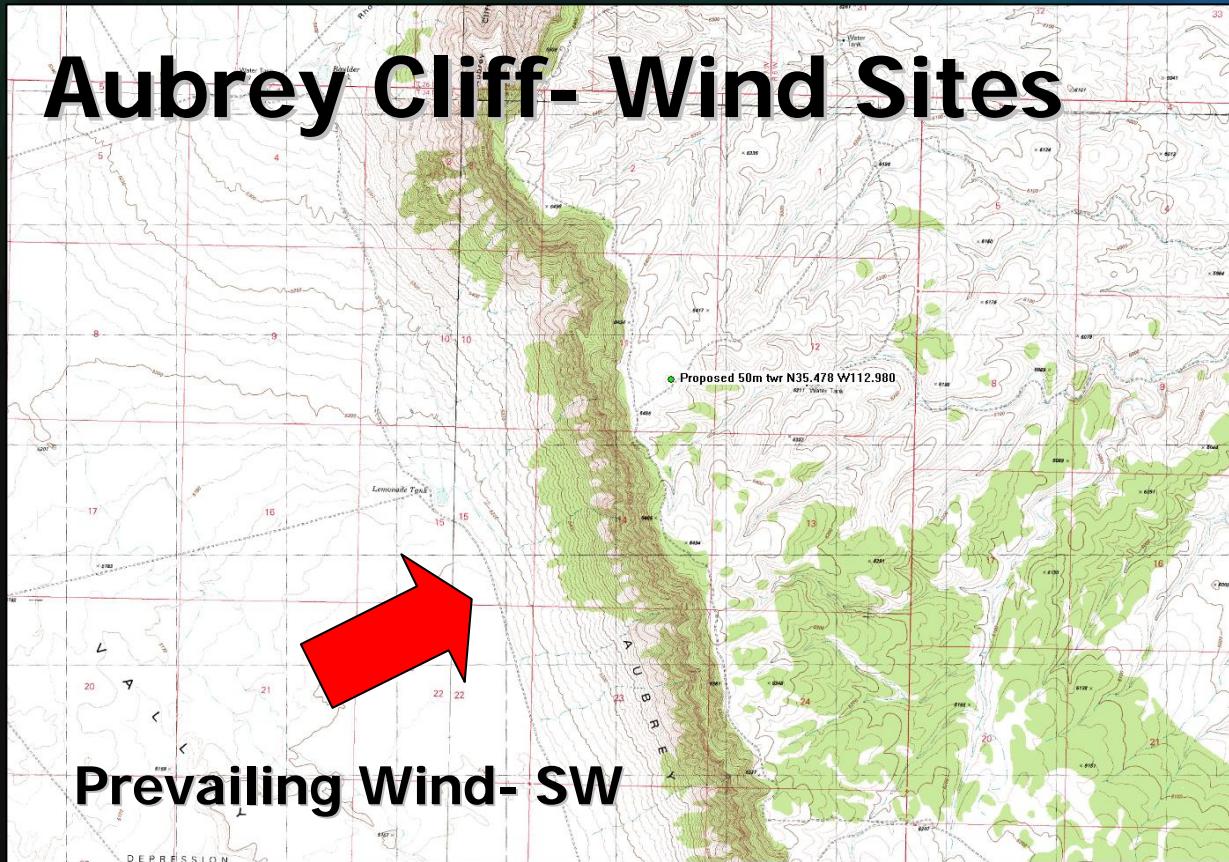
- Survey for cultural inventory was completed for revocable permit
- Biologist surveyed completed for Biological assessment
- Avian studies will be contracted (RFP) in January 2007

Gray Mountain Wind Site –Second Tower



- Legal survey was completed
- Site review for Met Towers completed
- License surveyor completed the surveying for location of permit area
- Legal Description of the area
- Ready for approval by Resource Committee

Aubrey Cliff- Wind Sites



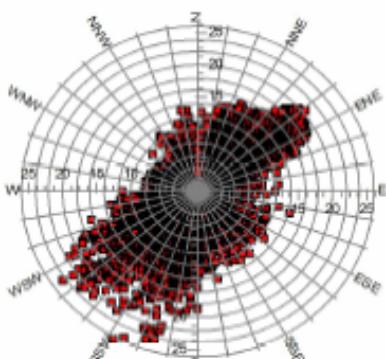
Prevailing Wind- SW

AZState
Description: Data from file(s)
C:\NRG\ScaledData\0511Total.txt

Meteo data report, height: 30.0 m
Name of meteo object: Aubrey Cliffs 30m Tower

PrintedPage
04/04/2006 5:06 PM / 1
Licensed user:
Northern Arizona University
15600 S. McConnell Circle, P.O. Box 15600
US-FLAGSTAFF, AZ 86011
+1 (928) 523-8363

Calculated:
04/04/2006 5:05 PM/



Month	2005		2006	mean of months
	mean	mean	mean	
Jan	8.0	8.0	8.0	8.0
Feb	8.0	8.0	8.0	8.0
Mar	7.4	7.4	7.4	7.4
Apr	6.2	6.2	6.2	6.2
May				
Jun	7.8	7.8	7.8	7.8
Jul	5.1	5.1	5.1	5.1
Aug	4.2	4.2	4.2	4.2
Sep	6.7	6.7	6.7	6.7
Oct	7.6	7.6	7.6	7.6
Nov	7.4	7.4	7.4	7.4
Dec	6.9	6.9	6.9	6.9
mean, all data	6.4	7.7	6.8	
mean of months	6.5	7.4		6.9

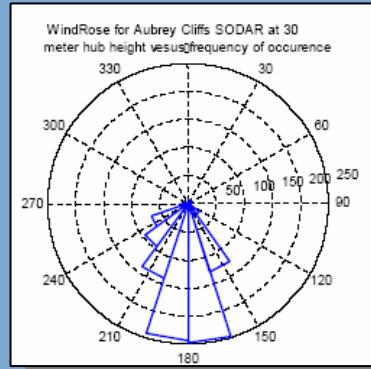
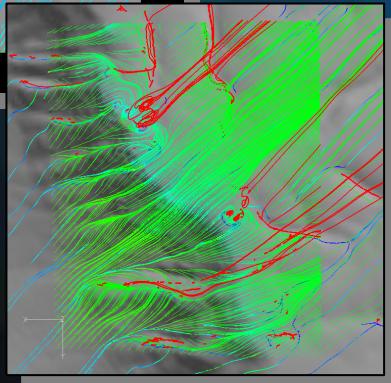
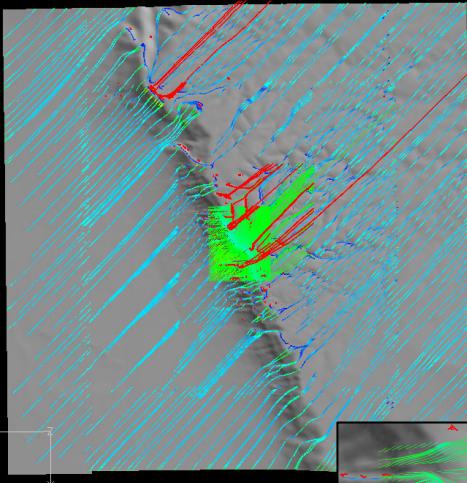
Wind speed [m/s]

Aubrey Cliff- Wind Sites



- ✿ First Wind Site- Met Tower permit was approved by State Land Office- All required approval was completed
- ✿ Five new wind site- All sites are currently in the approval stage.
- ✿ Northern Arizona University will conduct land clearance to these sites.
- ✿ Navajo Tribal Utility Authority-GM Office is exploring to develop this area with Foresight Wind as a Consultant- NTUA Board approval pending
- ✿ Big Boguillas ranch is owned by the Navajo Nation- Land is a Fee Land /State Land-checker board

Aubrey Cliff Wind Site –Sodar Analysis



Surface wind flow test around the Aubrey Cliff area where NTUA wind anemometer and SODAR assessment are currently being tested by Northern Arizona University

Project Location

The monitoring site was located at Deeza Bluff at an elevation of 8970 feet

Project Instrumentation

The instrumentation consisted of an NRG Wind Explorer system including cup anemometer, wind vane and data logger. The instruments were mounted at a height of 124 feet on an existing communications tower. The data consists of 10-minute average wind speed, wind speed standard deviation and wind direction.

Results

Summary

Annual Average Wind Speed & Power Density: **6.8 m/s (15.2 mph) / 289 watts/m²**

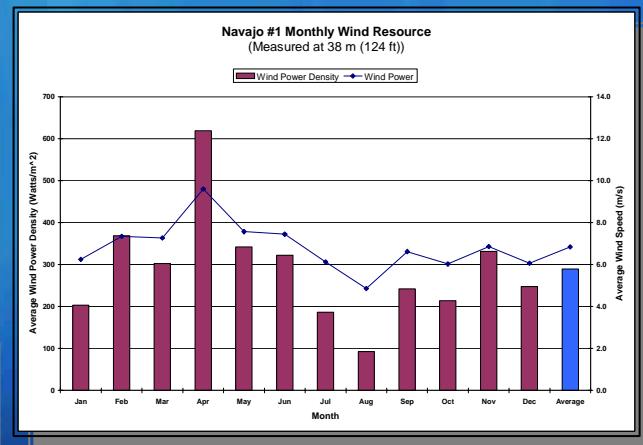
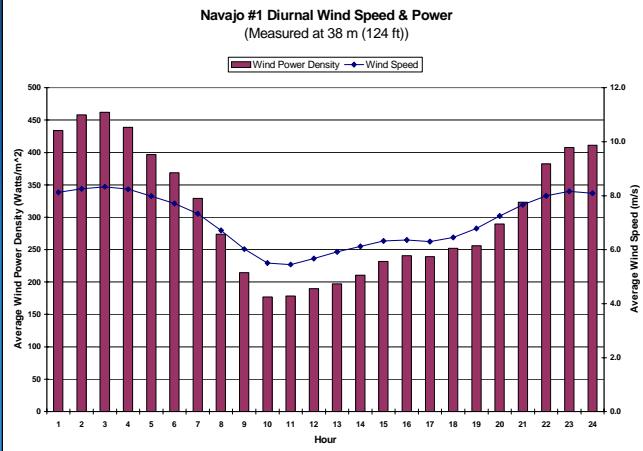
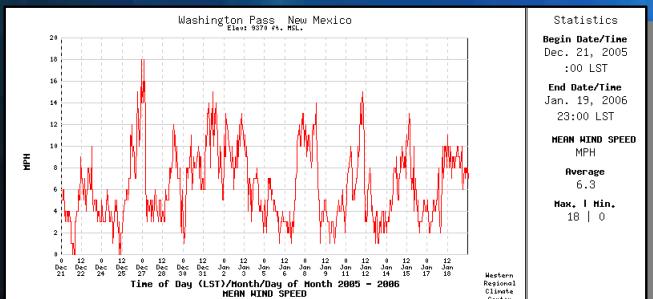
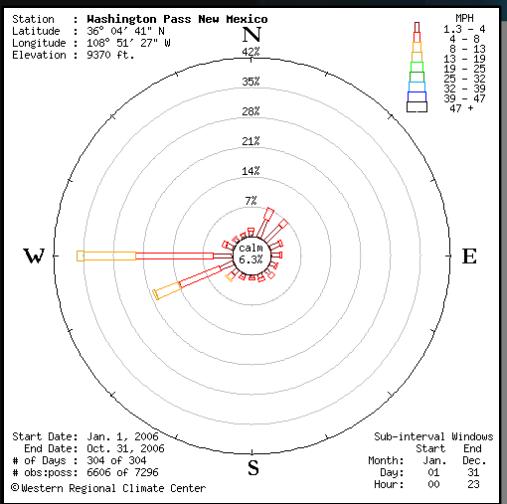
Month with best wind resource: **April**

Average wind speed and power density for best month: **9.6 m/s (21.3 mph) / 619 watts/m²**

Month with worst wind resource: **August**

Average wind speed and power density for worst month: **4.9 m/s (10.9 mph) / 93 watts/m²**

Adjusted Annual Average Wind Speed & Power Density **6.5 m/s (14.4 mph) / 250 watts/m²**



Deezi Bluff, New Mexico



Benefits of Wind Energy for the Navajo Nation

Andrew Mills - Energy and Resources Group, University of California Berkeley

UC Berkeley:
Energy and
Resources Group

Introduction:

NTUA received a Department of Energy grant for a detailed wind farm feasibility study in June 2005. Sites on Navajo may be viable for hundreds of utility scale wind turbines.

Such wind farms will bring skilled jobs for Navajo workers, additional tax revenue to the Navajo government, and can build capacity for numerous Navajo businesses.



Steel Erection of Turbine Towers

NECA and other Navajo businesses install water towers around the Navajo Nation.

The skills used in erecting water towers are similar to the construction skills needed to install the tower sections that support wind turbines.

Gray Mountain:

Many sites around Navajo may be suitable for wind farms, but the best site is on Gray Mountain. The estimated potential is around 450 MW. On-site monitoring will help verify this estimate.

Comparison of Revenue Requirements for a Wind Farm

Revenue Requirement	Private Sector	Joint Venture	Tribal Owner
Wind Power	100%	100%	100%
Transmission	0%	100%	0%
Land Use	0%	0%	100%
Local Jobs	0%	100%	0%
Local Tax Revenue	0%	100%	0%

Various ownership and incentive options exist so that the Navajo Nation can add a wind project to its priorities and preferences. Many are financially viable.

Landowner - Outside company develops and owns wind farm

Joint Venture - Navajo company partners with outside developer, eventually owning part of wind farm

Tribal Owner - Navajo Nation issues bonds to finance project without outside partner

Benefits to Navajo Nation:

Tax Revenues - Wind farms will pay a possessory interest tax and the business activity tax during its operation, amounting to approximately \$0.7 - 1.0 million dollars per year in additional taxes

Jobs - The various boxes explain the tasks involved in building a wind farm. Builders and businesses routinely carry out tasks similar to those needed for wind farms. An 80 MW wind farm would create 80-110 temporary construction jobs and 11-16 full time operations jobs.

Future Opportunities - The skills learned in building one wind farm can be used and improved to establish a sustainable economy all over the West.

Conclusions:

Building a wind farm on Navajo land can bring many benefits to the Navajo economy without disrupting the traditional way of living. The demand for wind energy is increasing tax revenue. Federal incentives and regional demand for renewable energy make wind energy projects financially viable. Based on the preferences of the Navajo Nation, the wind farm can be owned by an outside company or even the tribal government. Many questions remain as to the feasibility of a wind farm on the Navajo Nation, but the prospects are promising.

Electrical Collection System

Transformers are connected at each turbine to a substation with underground cables.



NTUA routinely installs and maintains transformers and substations.

Multiple Land Use

While wind farms cover a large area, the majority of the land remains suitable for other uses, especially agriculture. Only the access roads and turbine bases will reduce the land available for grazing livestock.



Excavation and Foundations

Concrete for the large foundations can be supplied by Navajo concrete suppliers. One supplier has more than thirty years experience building field-mix plants for large construction jobs.



Concrete aggregate, but not cement, is available within the Navajo Nation. Many businesses own the equipment used in excavation.

Roads, Site Prep, Utility Shed

Driveways, able to support a very large weight along with semi-trucks, will need to be built to the highway to each turbine. A utility shed is built to monitor the performance of the wind farm along with housing workers and equipment for routine maintenance.

Acknowledgments:
Law Professor of Texas Tech University provided valuable guidance for this study. Researchers at Northern Arizona University provided oversight, support, and feedback. Andrew Mills is supported by a National Science Foundation Fellowship for studies at UC Berkeley.



Economic Impacts of a Navajo Wind Farm:

Summary of work during Summer 2005 with the Sustainable Energy Solutions group at Northern Arizona University



Over 5000 attendees
and over 290 exhibitors participated



Wind Energy in Indian Country: Turning to Wind for the Seventh Generation- Andrew Mill

Navajo Wind Energy Development Exclusions

An Analysis of Local Benefits for Wind Energy Development on the Navajo Reservation

www.vastu.com



Sustainable Energy Solutions

Introduction

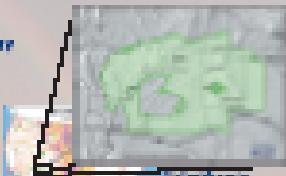
However, levels used within a study can vary with individual studies, where a 10% speed limit change is typical. Information collected from 5000 individual studies could lead the school change class improved a 10% speed limit reduced a 10% speed limit. This positive effect is significant and based on a 10% increase in absolute speed limit. However, this is not the case.

Matchbox

- [View](#)
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100

This position has high impact in the
importance of the next decade.
Technology Recovery (T.R.Y.) offers
R&D Analysis, satellite data in



Most fly traps catch more than just insects. Spiders, centipedes, lizards, and other insects are often caught as well.

Finally, this paper presents
Topographic Condition Index, a
new tool for identifying ridge-
crevices, streams, and other important
landforms for water resource management.



Next Step

1. *Constituents of the human body* (1902)



Grant Brummels- Spatial Analyst-NAU

Navajo Wind Energy Development Exclusions: An Analysis of Land Suitable for Wind Energy Development on the Navajo Reservation



FUTURE PLANS



TASKS TO START IN 2007

- **Tribal Load Assessment- Export Market**
- **Transmission –Interconnection Study**
- **Technology Analysis**
- **Economic Analysis- NAU**
- **Environmental Assessment- Avian Study**
- **Preliminary system design**
- **Long term O&M planning**
- **Investigate Financing Options- Navajo Nation**
- **Resolution to Navajo Nation Council and Oversight Committee**
- **Comprehensive business plan**



VISION: Provide clean Affordable Energy for
the
NAVAJO PEOPLE



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