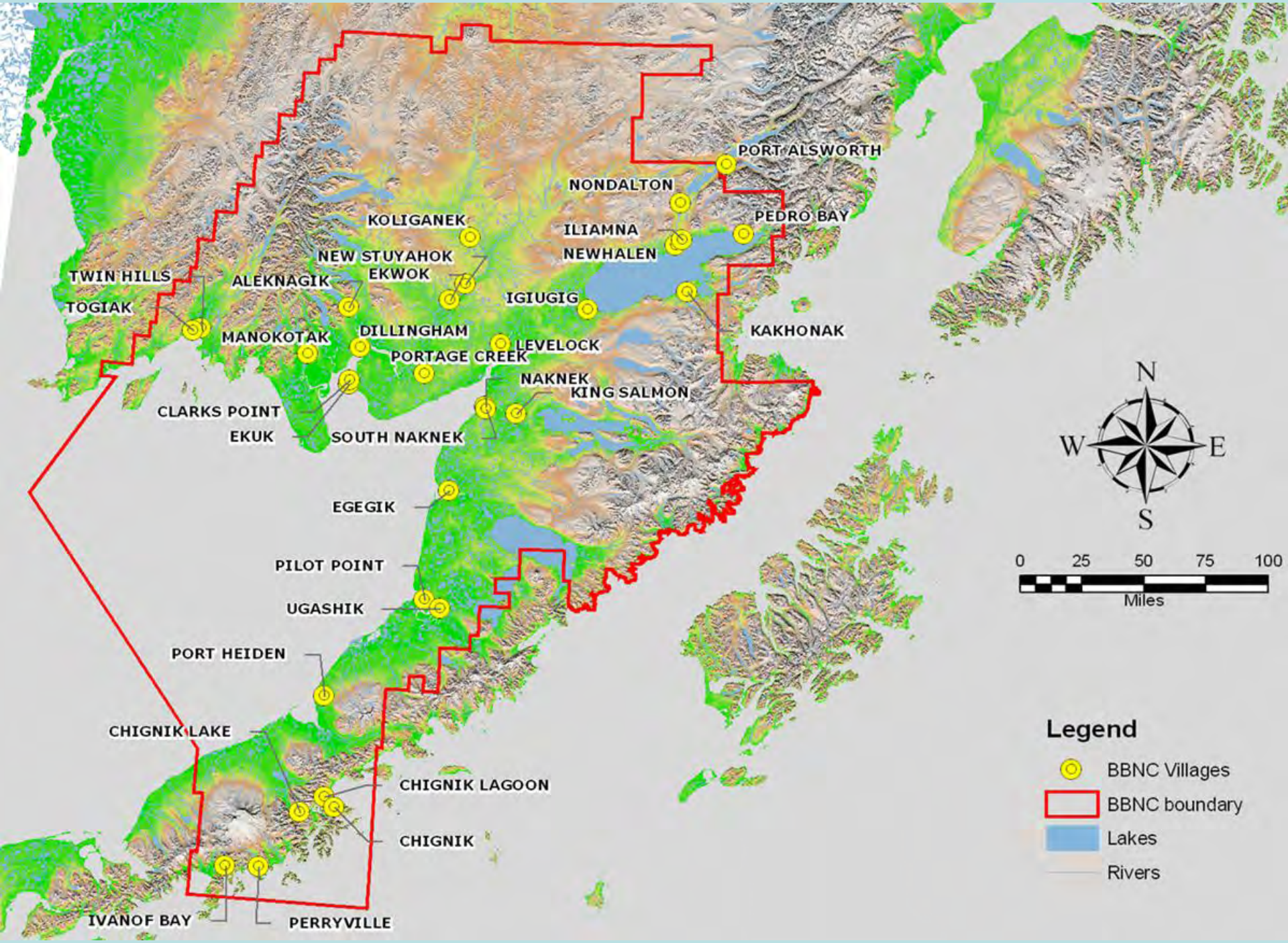
Wind Feasibility Study
Bristol Bay Region, Alaska

October 2003 to March 2007

Doug Vaught, P.E., V3 Energy LLC, Eagle River, AK


PORT ALSWORTH
NONDALTON
PEDRO BAY
ILIAMNA
NEWHALEN
KOLIGANEK
NEW STUYAHOK
EKWOK
TWIN HILLS
ALEKNAGIK
TOGIAK
IGIUGIG
KAKHONAK
MANOKOTAK
DILLINGHAM
LEVELOCK
PORTAGE CREEK
NAKNEK
KING SALMON
CLARKS POINT
EKUK
SOUTH NAKNEK
EGEGIK
PILOT POINT
UGASHIK
PORT HEIDEN
CHIGNIK LAKE
CHIGNIK LAGOON
CHIGNIK
IVANOF BAY
PERRYVILLE
N
W
E
S
0
25
50
75
100
Miles
Legend
BBNC Villages
BBNC boundary
Lakes
Rivers

Bristol Bay villages monitored for wind resource assessments

- Dillingham (two locations)
- New Stuyahok
- Togiak
- Perryville
- Clark’s Point
- Koliganek
- Naknek/King Salmon (two locations)
- Kokhanok

Table 10 50-meter Wind Power Density Site Comparison

	Site	Wind Power Density 50 meters, W/m^2	Wind Power Density 30 meters, W/m^2	Average Wind Speed 30 meters, m/s	Wind Power Class	Wind Class Description
1	Kokhanok	763	690	7.84	6	Outstanding
2	Clark's Point	491	423	6.94	4	Good
3	New Stuyahok	414	232	5.46	4	Good
4	Koliganek	404	320	5.72	4	Good
5	Dillingham - Woodriver	375	272	5.88	3	Fair
6	Dillingham - Kanakanak	374	230	5.78	3	Fair
7	Naknek	368	301	6.22	3	Fair
8	Togiak	311	256	5.68	3	Fair
9	Perryville	240	185	4.60	2	Marginal

Note: Wind Power Class and description based on 50-meter wind power density data

Table 12 30-meter Average Annual Wind Speed Comparison

	Community	Average Wind Speed 30 meters, m/s	Wind Power Density 30 meters, W/m^2	Wind Power Density 50 meters, W/m^2	Wind Power Class	Wind Class Description
1	Kokhanok	7.84	690	763	6	Outstanding
2	Clark's Point	6.94	423	491	4	Good
3	Naknek	6.22	301	368	3	Fair
4	Dillingham - Woodriver	5.88	272	375	3	Fair
5	Dillingham - Kanakanak	5.78	230	374	3	Fair
6	Koliganek	5.72	320	404	4	Good
7	Togiak	5.68	256	311	3	Fair
8	New Stuyahok	5.46	232	414	4	Good
9	Perryville	4.60	185	240	2	Marginal


Kokhanok met tower site

Table 5 Kokhanok Summary Data

Wind power class	Class 6 – Outstanding
Wind speed annual average (30 meters)	7.84 m/s
Maximum wind gust	40.1 m/s (November 2004)
Mean wind power density (50 meters)	763 W/m^2 (calculated)
Mean wind power density (30 meters)	690 W/m^2 (measured)
Weibull distribution parameters	k = 1.64, c = 8.77 m/s
Roughness class	0.00 (smooth)
Power law exponent	0.0725 (very low wind shear)
Turbulence intensity	0.0985 (low)
Data start date	August 12, 2004
Data end date	June 14, 2006

Figure 11 Kokhanok Seasonal Wind Speed Profile

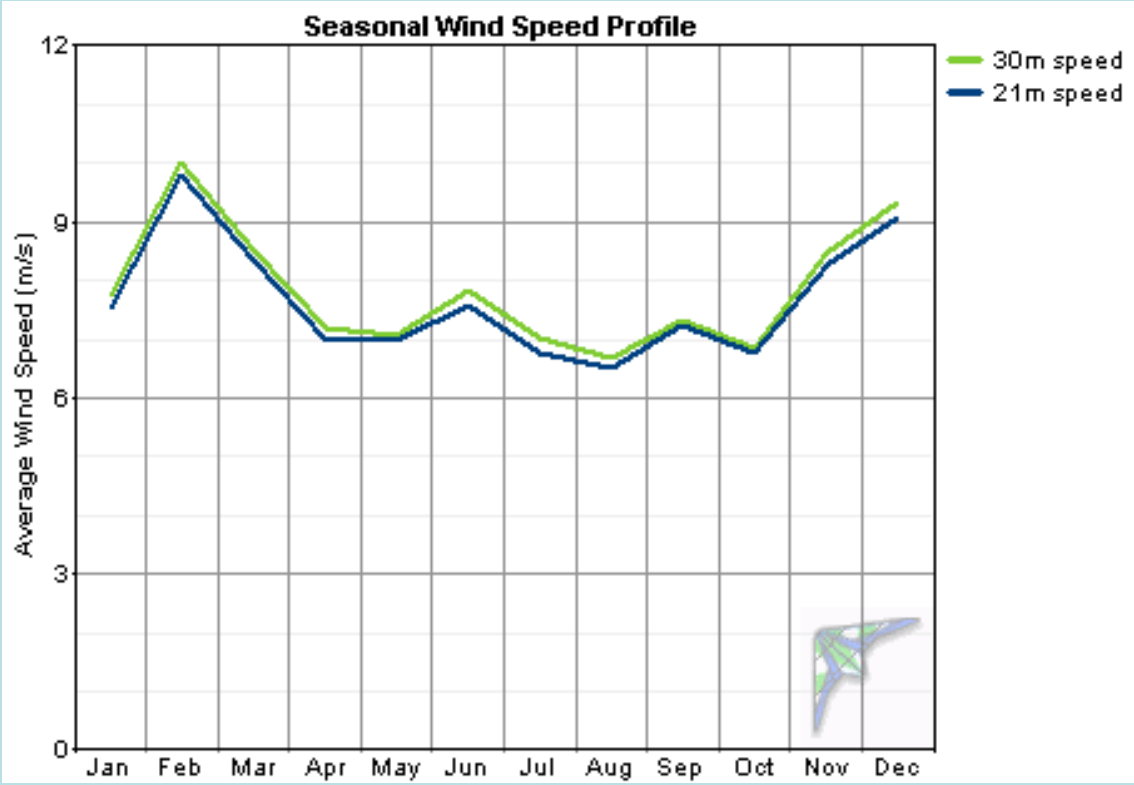
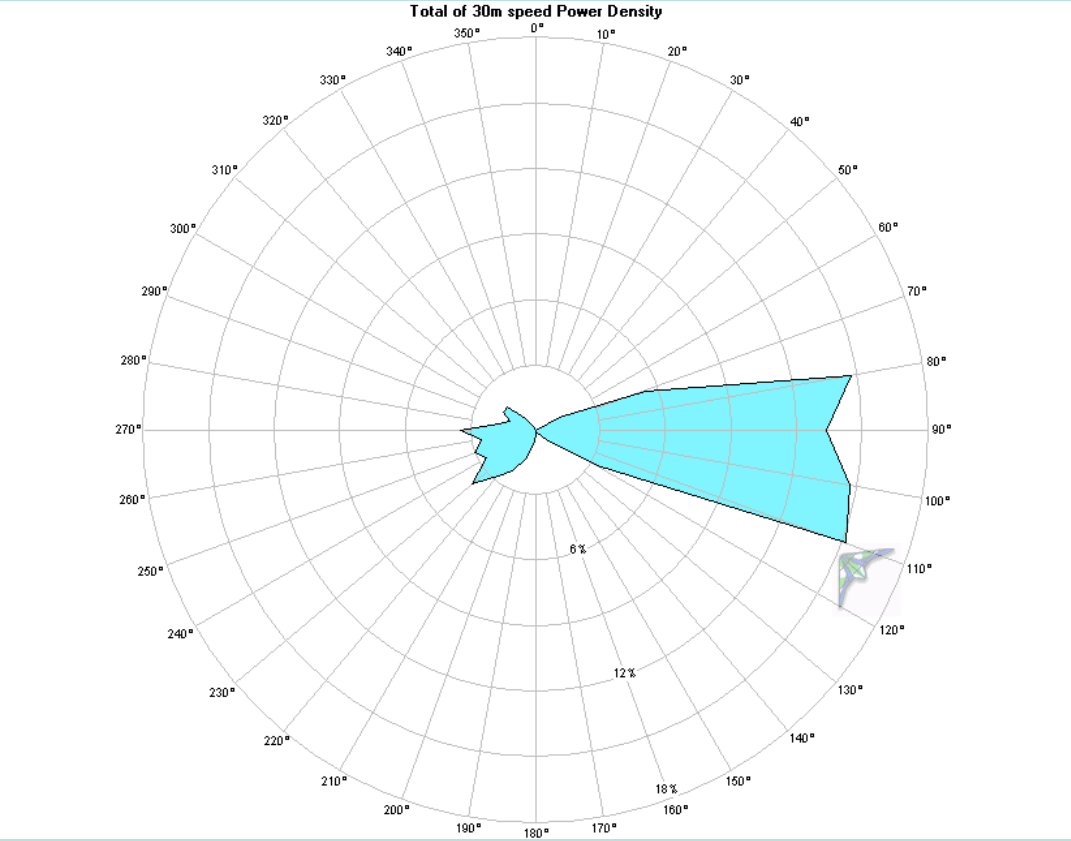


Figure 12 Kokhanok Wind Power Density Rose



Turbine Power Output Comparison (100% availability)

Turbine	Hub Height (m)	Hub Height Wind Speed (m/s)	Time At Zero Output (%)	Time At Rated Output (%)	Average Net Power Output (kW)	Annual Net Energy Output (kWh/yr)	Average Net Capacity Factor (%)
Southwest Skystream 3.7	10.7	7.37	18.8	20.9	0.88	7,711	48.9
Bergey Excel-S	18	7.63	11.5	10.1	3.81	33,376	38.1
Fuhrländer FL30	26	7.80	10.9	6.8	15.1	132,559	45.9
Entegrity eW-15 60 Hz	25	7.78	24.6	10.3	25.3	221,978	39.0
Vestas V15	25	7.78	28.7	6.8	25.3	221,585	33.7
Northern Power NW 100/20	25	7.78	24.6	9.2	37.4	327,963	37.4

Turbine Power Output Comparison (90% availability)

Turbine	Hub Height (m)	Hub Height Wind Speed (m/s)	Time At Zero Output (%)	Time At Rated Output (%)	Average Net Power Output (kW)	Annual Net Energy Output (kWh/yr)	Average Net Capacity Factor (%)
Southwest Skystream 3.7	10.7	7.37	18.8	20.9	0.80	6,963	44.2
Bergey Excel-S	18	7.63	11.5	10.1	3.44	30,141	34.4
Fuhrländer FL30	26	7.80	10.9	6.8	13.7	119,710	41.4
Entegrity eW-15 60 Hz	25	7.78	24.6	10.3	22.9	200,461	35.2
Vestas V15	25	7.78	28.7	6.8	22.8	200,107	30.5
Northern Power NW 100/20	25	7.78	24.6	9.2	33.8	296,173	33.8

Turbine	Annual Energy Output (kW-hr/yr)	Fuel Quantity Avoided (liters)	Fuel Quantity Avoided (gallons)	Fuel Price (USD/gallon) $1.75	$2.00	$2.25	$2.50	$2.75	$3.00	$3.25	Turbine Hub Height (m)
Southwest Skystream 3.7	6,963	2,109	557	$975	$1,114	$1,253	$1,393	$1,532	$1,671	$1,810	10.7
Bergey Excel-S	30,141	9,128	2,411	$4,220	$4,823	$5,425	$6,028	$6,631	$7,234	$7,837	18
Fuhrländer FL30	119,710	36,252	9,577	$16,759	$19,154	$21,548	$23,942	$26,336	$28,730	$31,125	26
Entegrity eW-15 60 Hz	200,461	60,706	16,037	$28,065	$32,074	$36,083	$40,092	$44,101	$48,111	$52,120	25
Vestas V15	200,107	60,599	16,009	$28,015	$32,017	$36,019	$40,021	$44,024	$48,026	$52,028	25
Northern Power NW 100/20	296,173	89,691	23,694	$41,464	$47,388	$53,311	$59,235	$65,158	$71,082	$77,005	25

Notes:

1. Kokhanok electrical energy production efficiency assumed to be 12.5 kW-hr/gal

2. Assumes 90% wind turbine availability with no diversion of power to a thermal or other dump load

3. Assumes linear diesel generator fuel efficiency (i.e., 1:1 tradeoff of wind turbine kW-hr to diesel genset kW-hr)

Final Project Report
Bristol Bay Native Corporation
Wind and Hydroelectric Feasibility Study

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U.S. Department of Energy, Golden, Colorado, Field Office
Tribal Energy Program
March 31, 2007

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Anchorage, Alaska 99501

Final Report Availability

- On Dept. of Energy website: http://www.eere.energy.gov/tribalenergy/
- Bristol Bay Native Corporation – Tiel Smith, Land Resources Manager, 278-3602
- Doug Vaught – V3 Energy LLC, 350-5047