



WIND FARM PROJECT
NASA GRC Plum Brook Station

GREEN FORUM

July 16, 2009

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Wind Farm at Glenn's Plum Brook Station

~ an FY11 Strategic Institution Investment project ~



*A Strategic Partnership
between NASA and the
Wind Energy Industry*

*Turning \$1M NASA
Investment into 20 MW of
Electrical Power*

- Meeting Executive Order 13423 for Renewable Energy for the AGENCY
 - Achieving AGENCY-WIDE target of 7.5% electrical power usage from renewable sources by 2013 with 20% of the Wind Farm
- Ability to Negotiate a Reduced Electric Utility Rate due to In-Kind Use of NASA Property
 - ~2000 Acres of PBS property – Consistent with Glenn Master Plan
- Wind Energy Developer to be the Owner/Operator of the Wind Farm
 - A Win-Win Business Case for NASA and Developer



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Plum Brook Station
Master Plan Overview

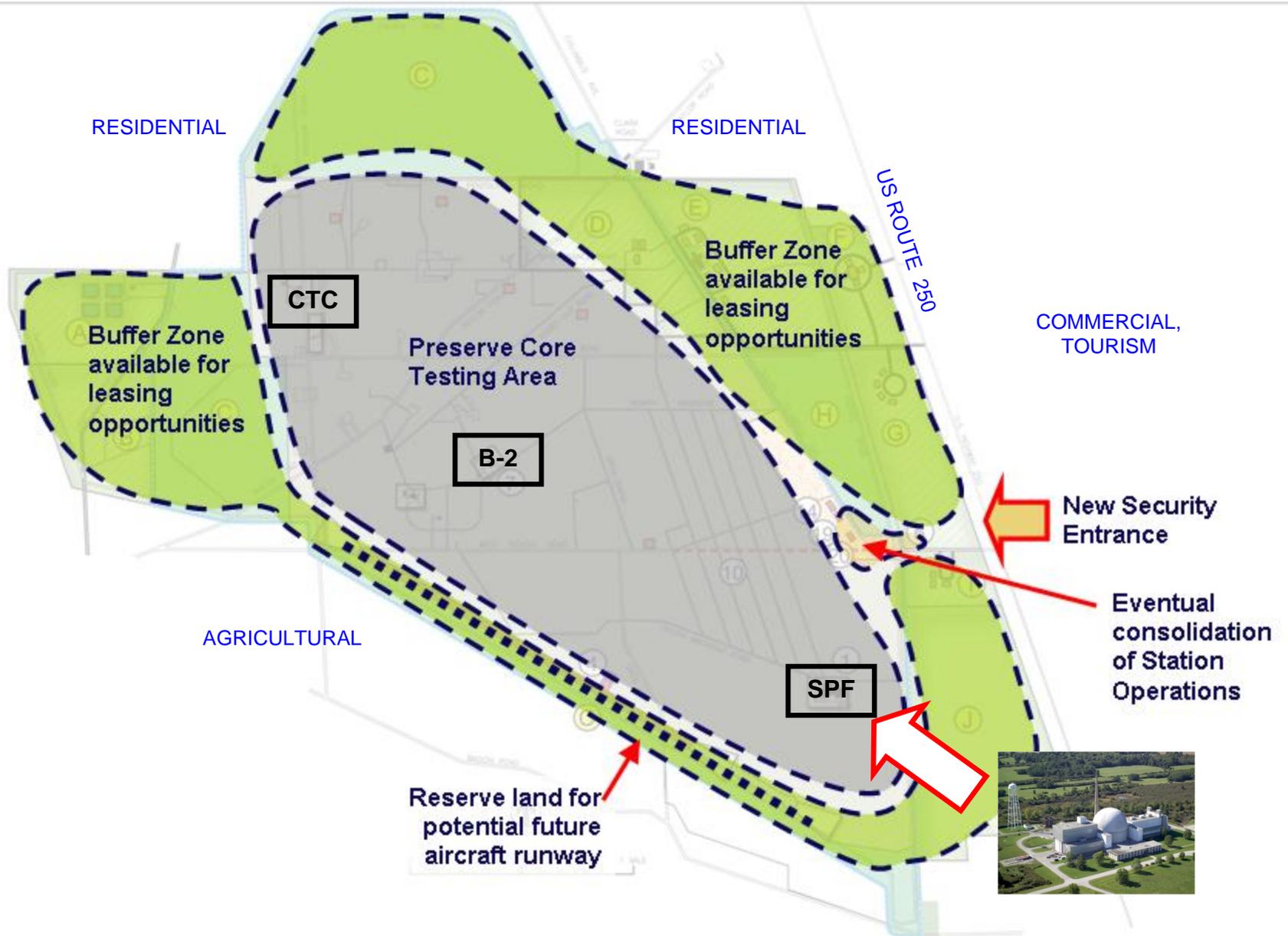
Dave Taylor

July 16, 2009

Aerial View of Plum Brook Station



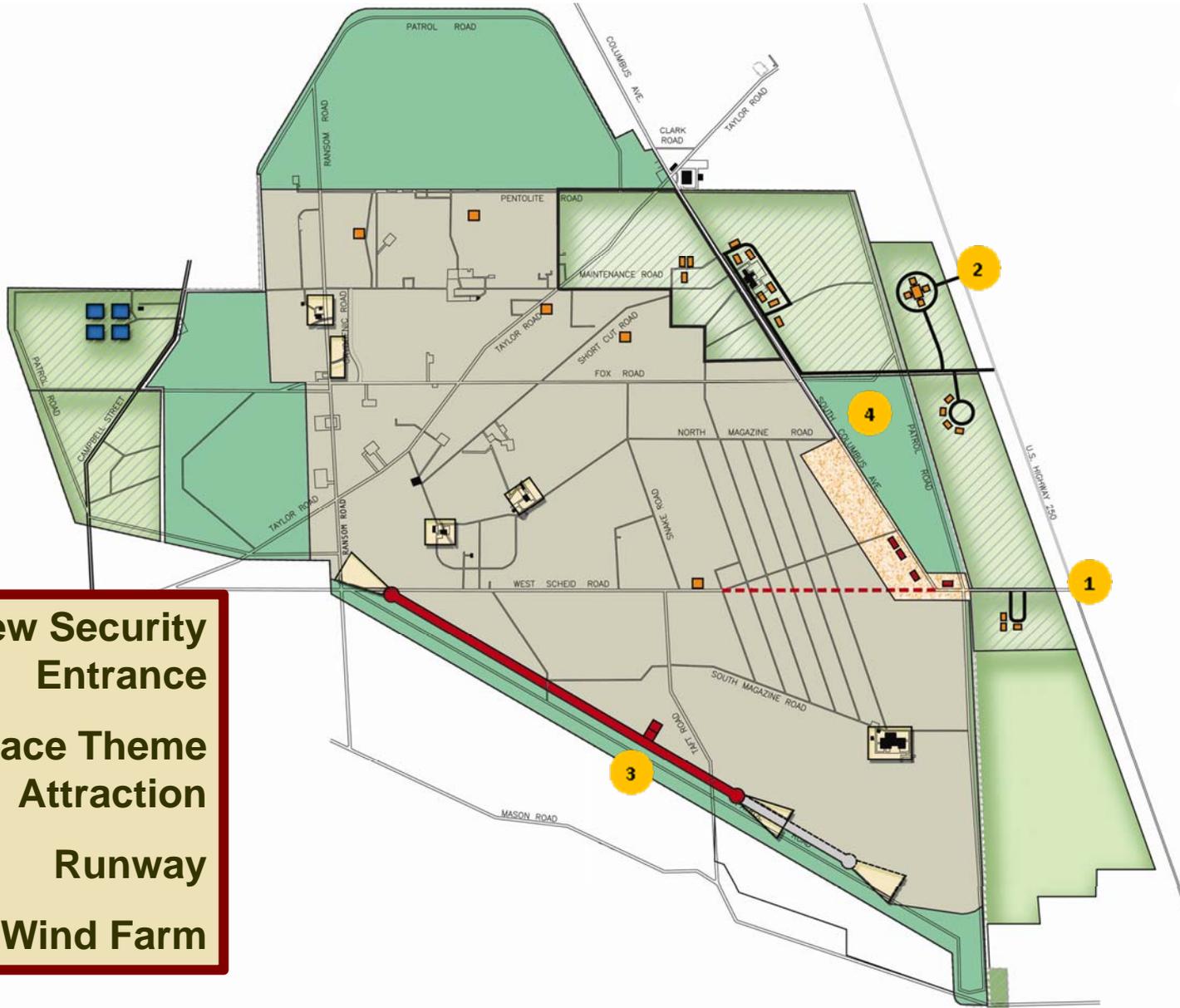
Plum Brook Station Campus Master Plan Concept



GRC Plum Brook Station Master Plan



- 1 New Security Entrance
- 2 Space Theme Attraction
- 3 Runway
- 4 Wind Farm





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**Renewable Energy Regulatory
Requirements**

Richard Danks

July 16, 2009

TOPICS

- **ENERGY POLICY ACT 2005**
- **EO 13423**
- **NASA STATUS**
- **WIND FARM PROJECTED CONTRIBUTION**

ENERGY POLICY ACT 2005

- **RENEWABLE ENERGY CONSUMPTION:**
 - **GRADUATED REQUIREMENT:**
 - **3% electric energy from renewable sources 2007 – 2009**
 - **5% electrical energy from renewable sources 2010 – 2012**
 - **7.5% electrical energy from renewable sources 2013 +**



EO 13423

STRENGTHENING FEDERAL ENVIRONMENTAL, ENERGY and TRANSPORTATION MANAGEMENT

- **AGENCY REQUIREMENTS:**
 - [E]nsure that (i) at least half required renewable energy comes from new sources, and (ii) to the extent feasible, implement renewable energy generation projects on agency property for agency use.
- **2.2.2.1 RENEWABLE ENERGY SOURCES**
 - Renewable energy source must be in service after January 1, 1999
- **2.2.11 Wind Energy**
 - All sources of wind energy are included
- **Renewable energy produced on Federal land receives double credit.**



COMPARING REQUIREMENTS

Comparison of EO13423 and EPACT 2005 Renewable Energy Goals

	2007-2009	2009-2012	2013 onward	Can Include new non-electrical?	New or old source?
EO13423 <i>new</i> renewable energy sources <i>minimum</i> requirements	1.5%	2.5%	3.75%	Yes	No, exclusively new
EPACT 2005 total minimum renewable energy requirements	3%	5%	7.5%	No	Yes



NASA ANNUAL REPORT to the DEPT of ENERGY FY 2007

- In FY 2007 NASA used 56000 MWh from renewable sources = 3.6 % of total consumption
- Exceeds EAct 2005 requirement through 2009

<i>Renewable Energy Requirement</i>	<i>Renewable Electricity Use (MWH)</i>	<i>Total Electricity Use (MWH)</i>	<i>Percentage</i>	<i>FY 2007 Goal Target</i>
Eligible renewable electricity use as a percentage of total electricity use	56,575.8	1,610,501.4	3.6%	3.0%



NASA RENEWABLE REQUIREMENT 2010 - 2013

Basis: 2007 total NASA electric consumption = 1600k MWh

5.0% renewable requirement = 80k MWh

7.5% renewable requirement = 120k MWh

Estimated generation capacity of PBS Wind Farm

Assume: 2000 acres available
100 acres per wind turbine = 20 units @ PBS
2.5 MW generating capacity per turbine =
50 MW total capacity
26% average availability factor

Then: 8760 hrs/yr x 50 MW x 0.26 = 114k MWh per yr

Yield: **Approx 95% of total NASA requirement for 2013**

2007 NASA RENEWABLE SOURCES

SOLAR/PV

GRC PV projects
2kW West Area
12 kW Bldg 8

1-4. RENEWABLE ENERGY GENERATED ON FEDERAL OR INDIAN LAND WHERE RECS ARE RETAINED BY THE GOVERNMENT
(New renewable energy is from projects placed in service after January 1, 1999)

Renewable energy project types in service during FY 2007, by age and source	Number of Projects	Annual Energy Produced	Energy Produced on Federal or Indian Land and Used at a Federal Facility
Electricity from New <u>Solar</u> projects (MWH)	11	205.1	205.1
Electricity from New <u>Wind</u> projects (MWH)	0	0.0	0.0
Electricity from New <u>Biomass</u> projects (MWH)	0	0.0	0.0
Electricity from New <u>Landfill Gas</u> projects (MWH)	0	0.0	0.0
Electricity from New <u>Geothermal</u> projects (MWH)	0	0.0	0.0
Electricity from New <u>Hydro/Ocean</u> projects (MWH)	0	0.0	0.0
Electricity from Old <u>Solar</u> projects (MWH)	0	0.0	0.0
Electricity from Old <u>Wind</u> projects (MWH)	0	0.0	0.0
Electricity from Old <u>Biomass</u> projects (MWH)	0	0.0	0.0
Electricity from Old <u>Landfill Gas</u> projects (MWH)	0	0.0	0.0
Electricity from Old <u>Geothermal</u> projects (MWH)	0	0.0	0.0
Electricity from Old <u>Hydro/Ocean</u> projects (MWH)	0	0.0	0.0
Natural Gas from Landfill/Biomass (Million Btu)	0	0.0	0.0
Renewable Thermal Energy (Million Btu)	1	196.0	196.0
Other Renewable Energy (<u>Wind/Mechanical</u>) (Million Btu)	2	8.3	8.3
Total New Renewable Electricity (MWH)	11	205.1	205.1
Total Old Renewable Electricity (MWH)	0	0.0	0.0
Non-Electric Renewable Energy (Million Btu)	3	204.3	
Total Renewable Energy Generation (Million Btu)	14	904.1	

100% new

100% new

THERMAL WIND



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Status of Current Studies

Robert Puzak

July 16, 2009

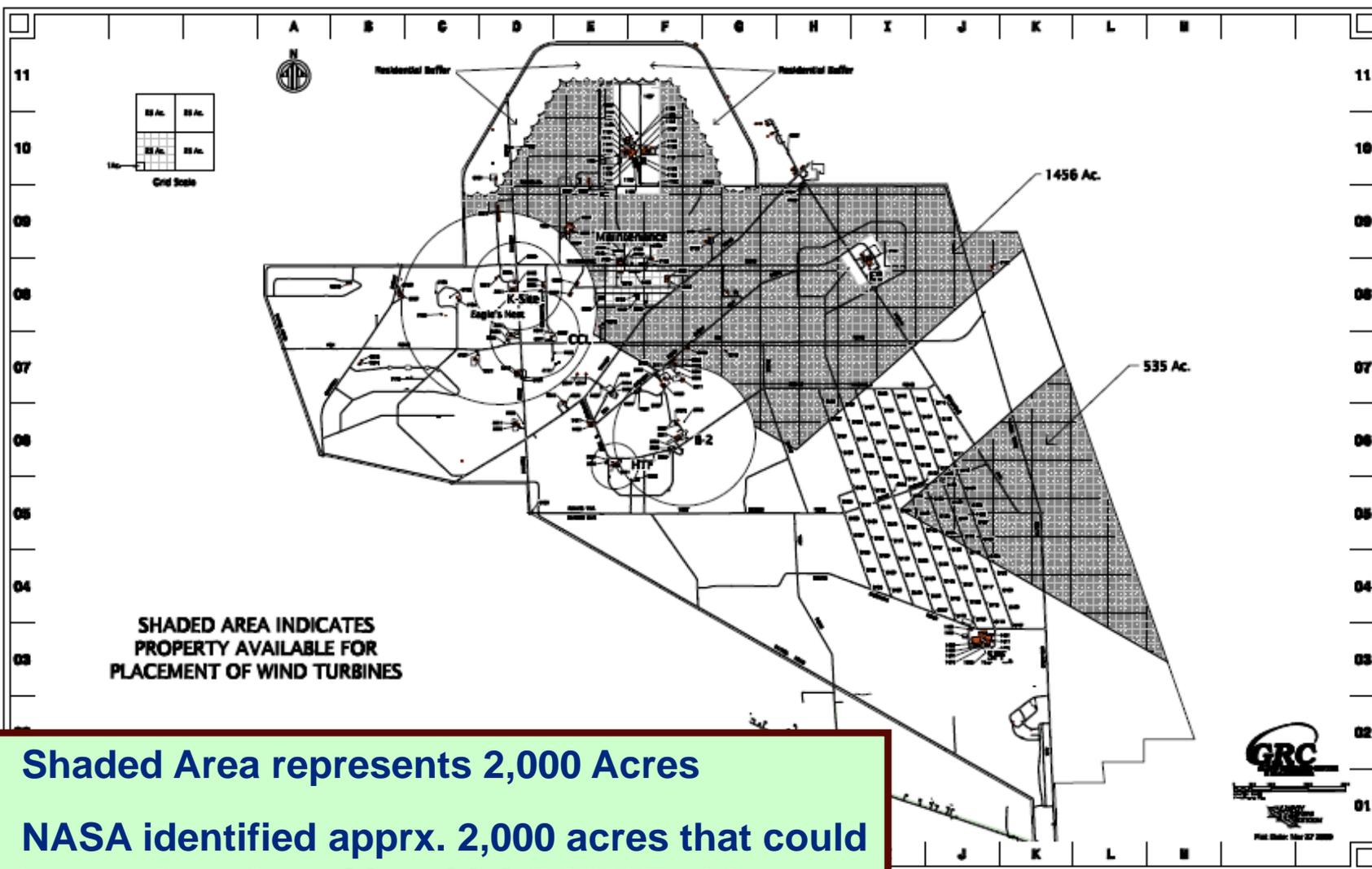
Wind Farm Project Current Status



- **RFI posted on FedBizOpps requesting information from potential developers**
 - Received about 10 responses

- **NASA is performing the following Studies:**
 - National Environmental Policy Act (NEPA) Study
 - Encroachment Study
 - Wind Monitoring
 - Electrical Grid Study
 - Property Appraisal

Plum Brook Station



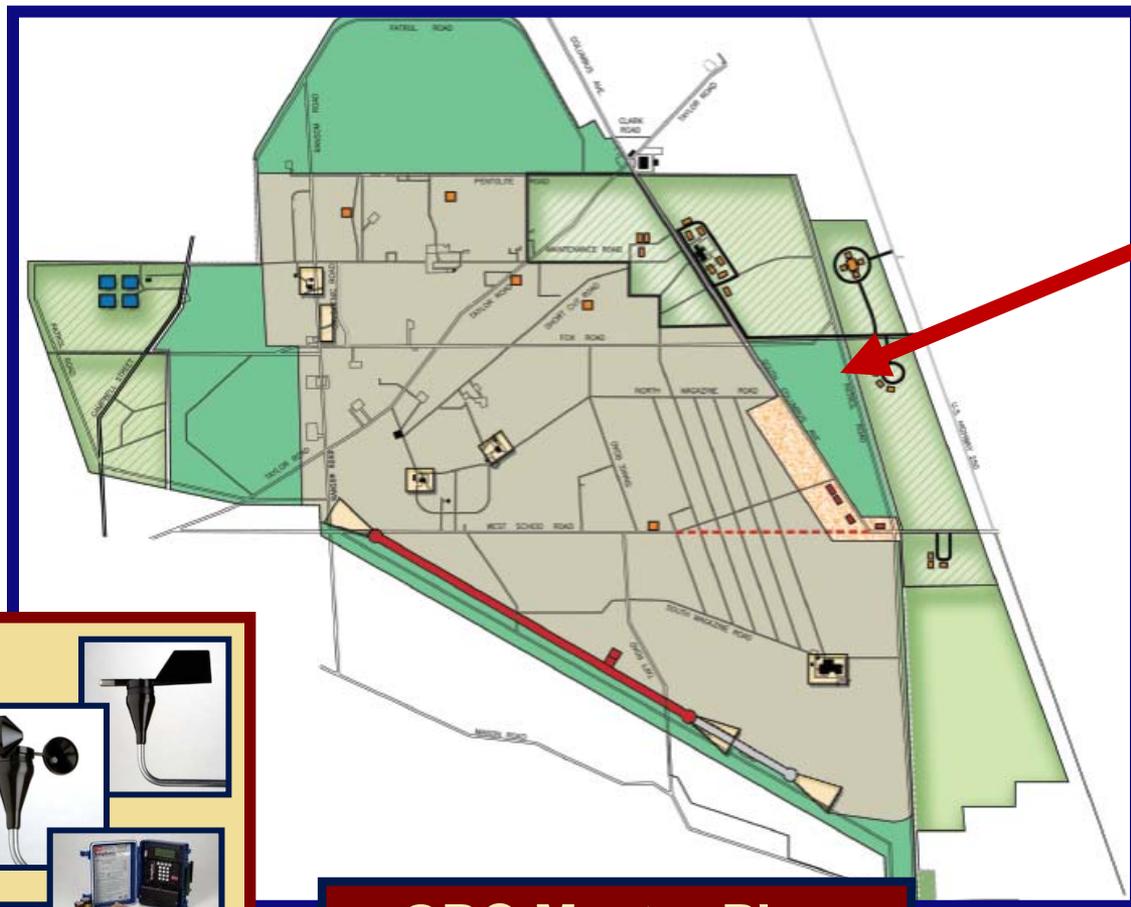
- Shaded Area represents 2,000 Acres
- NASA identified approx. 2,000 acres that could be used to place 20 to 30 2.5 MW Turbines



Wind Farm Project Current Status

- **Initiated Studies:**
 - **NEPA Study being performed by SAIC**
 - **Environmental Assessment (EA)**
 - Reviews all impacts: wildlife, electromagnetic, ice/snow, noise, light flicker, endangered and/or threatened species, etc.
 - Also includes the recommendations of the Ohio Dept. of Natural Resources as directed under the Ohio Power Siting Board
 - Draft EA and Finding Of No Significant Impact (FONSI) -- September 25
 - 30-Day Public Comment Period -- Start October 16
 - Preliminary Final Draft -- December 18
 - **Encroachment Study being performed by Johnson McAdams and Baker Corporation**
 - Reviewing FAA requirements on existing runways in the area and any impacts on future runway at Plum Brook
 - This includes: the physical obstruction of the wind turbine, any airport related electromagnetic compatibility issues, flight pattern, etc.
 - Complete by November 2009

Wind Monitoring – Green Energy Ohio



GRC Master Plan



- Green Energy Ohio performed an 18-month study of wind conditions
- 50 m temporary meteorological tower installed 8/21/07
- Measurements taken at 30, 40 & 50 Meters



Data Summary

Categorized as a Class 1 Site based on 50 meter yearly wind speed average of 5.0 m/sec and wind power density of 126.6 W/m²

Plum Brook Summary Statistics (1/1/08 – 12/31/08)

	30 m	40 m	50 m
Average Wind Speed [m/s]	4.0	4.5	5.0
Cubic Average Wind Speed [m/s]	4.8	5.2	5.8
Prevailing Wind Direction	N/A	SSW	SSW
Turbulent Intensity [std dev / m/s]	0.24	0.21	0.19
Wind Power Density [W/m ²]	73.4	94.8	126.6
Wind Shear Exponent	30 m to 40 m	40 m to 50 m	
	0.4566	0.5108	

Wind Shear component much higher than the nominal 0.143 expected for clear, topographical level land



Data Conclusion and Next Steps

Average Wind Shear Measured for Plum Brook and a few of GEO's Other Monitoring Sites

	Plum Brook		Bowling Green		Toledo Zoo		Port Clinton	
Height	30 m to 40 m	40 m to 50 m	30 m to 40 m	40 m to 50 m	40 m to 60 m	60 m to 80 m	38 m to 73 m	73 m to 100 m
Wind Shear Exponent	0.46	0.51	0.32	0.65	0.37	0.34	0.31	0.39

- Because of the high wind shear component, extrapolation of the data from lower heights to higher heights would underestimate the power density and potential wind power output
- GEO concluded that the trees are interfering with the data
- Clearing land in the southwest quadrant (prevailing winds) to see how the data will change
- Continue study until June 2010 and let the developer obtain their own data at their selected location and height



Wind Farm Project Current Status, cont'd

- **Initiated Studies, cont'd:**

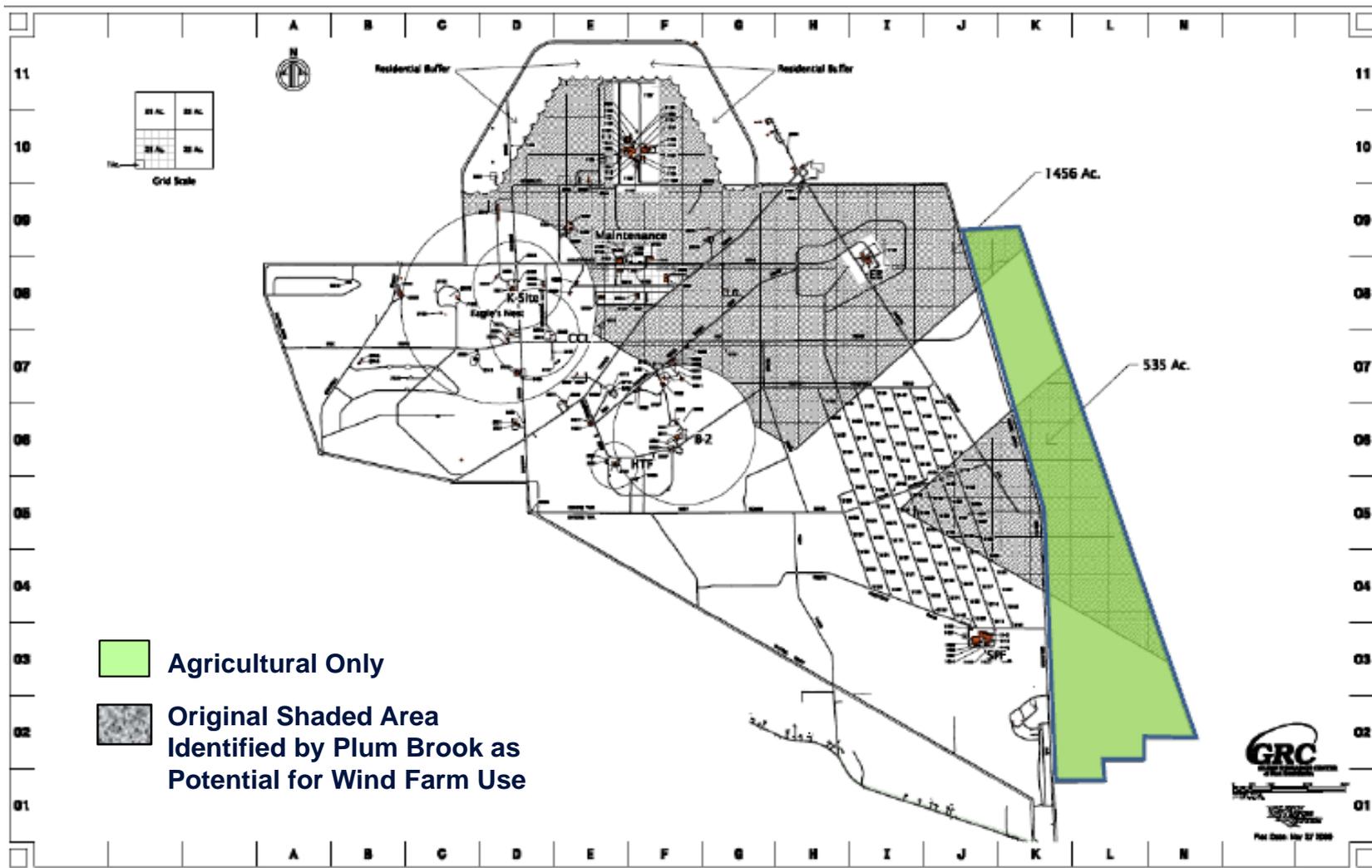
- **Electrical Grid Study**

- Reviewing the feasibility of tying into the local Plum Brook NASA-owned grid or the Midwest Independent System Operators (MISO) -controlled grid
- NASA did complete an MISO Ad Hoc Application
 - This in an informal study between First Energy, NASA, and MISO
- Complete by October 2009

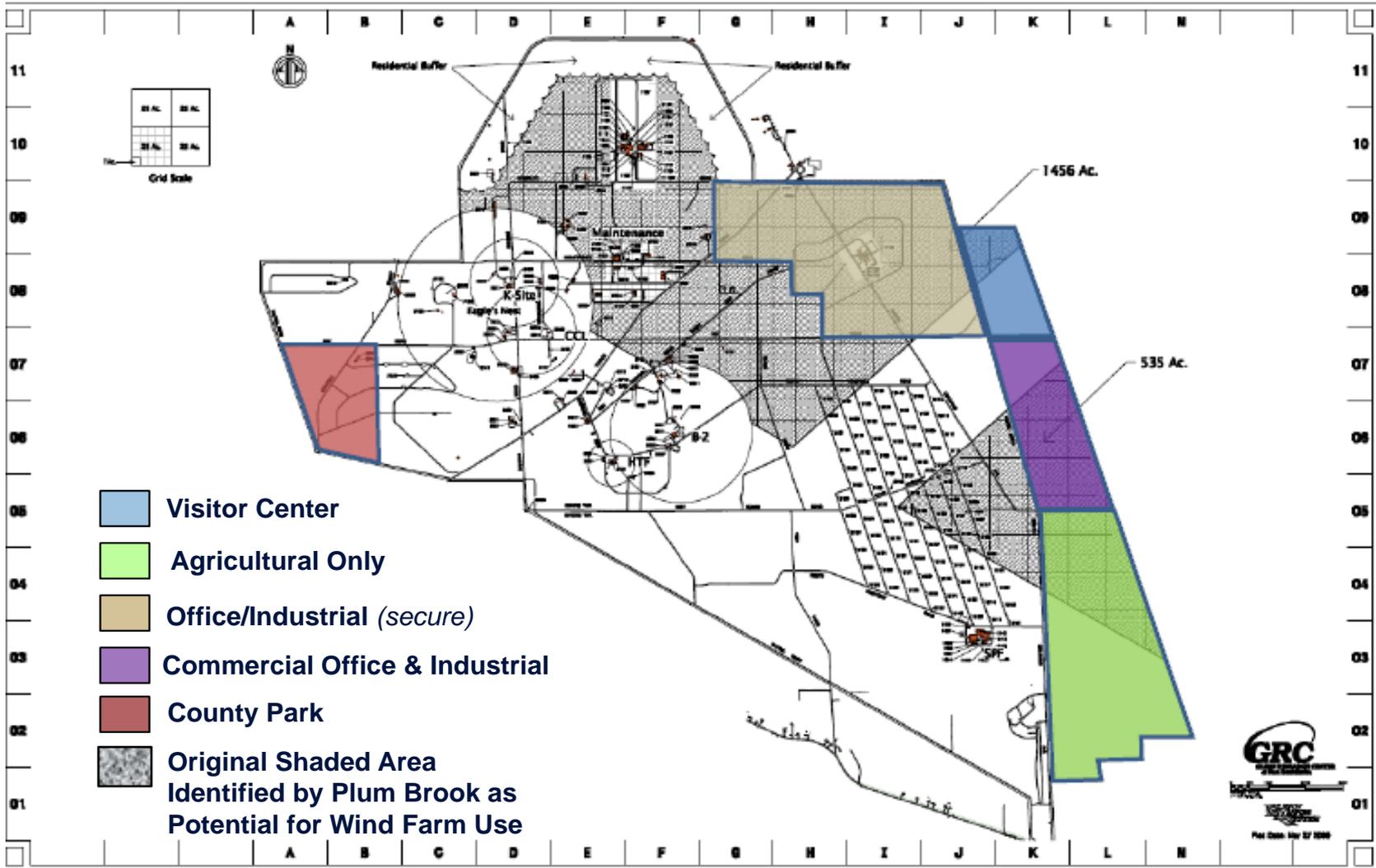
- **Appraisal Study being performed by Jones Lang LaSalle**

- 3 Appraisals of the proposed property
 - As it currently exists
 - The Master Plan Concept
 - As a Wind Farm with aspects of the Master Plan
- Complete by December 2009

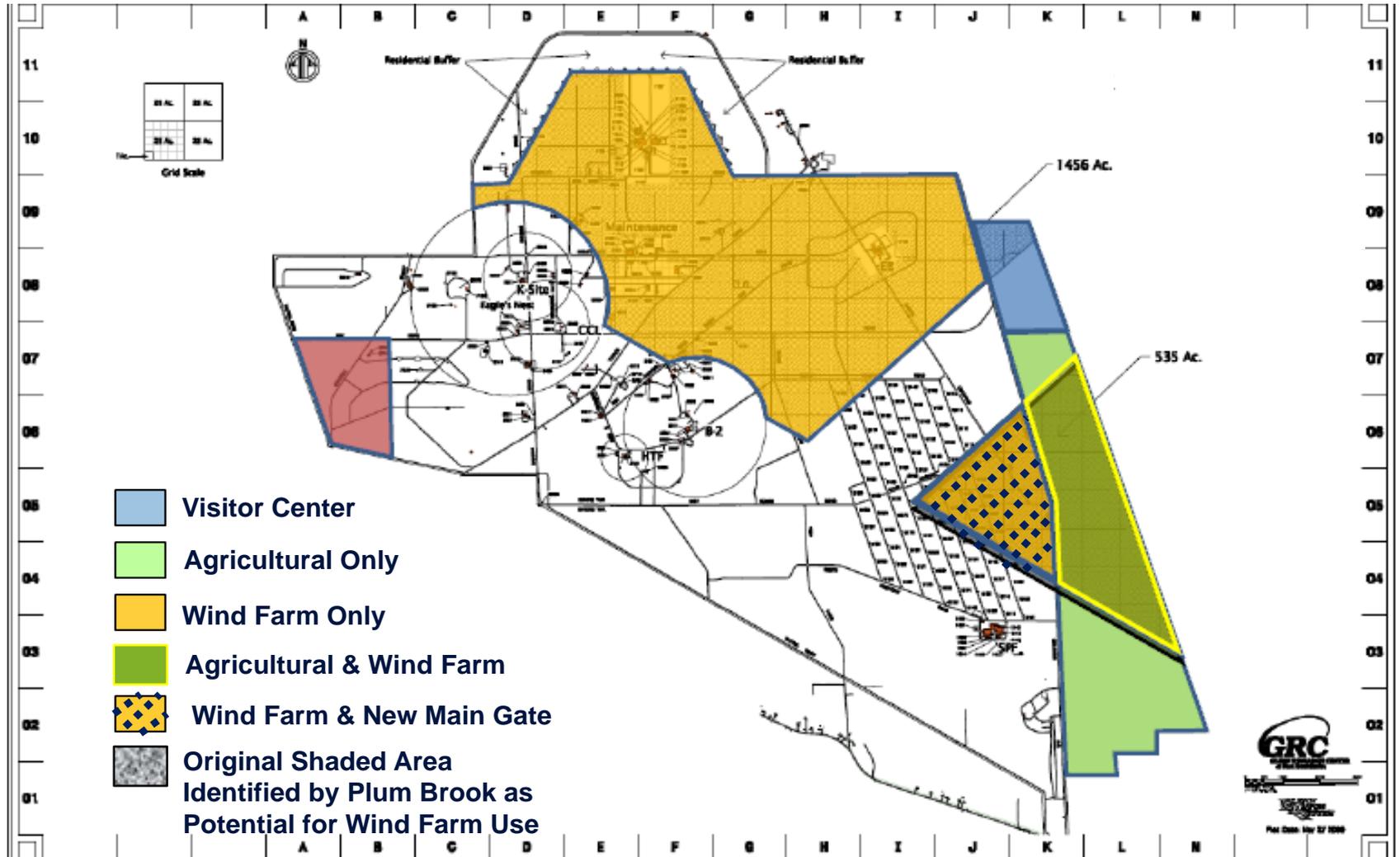
GRC Plum Brook Station Land Use Strategy 1



GRC Plum Brook Station Land Use Strategy 2



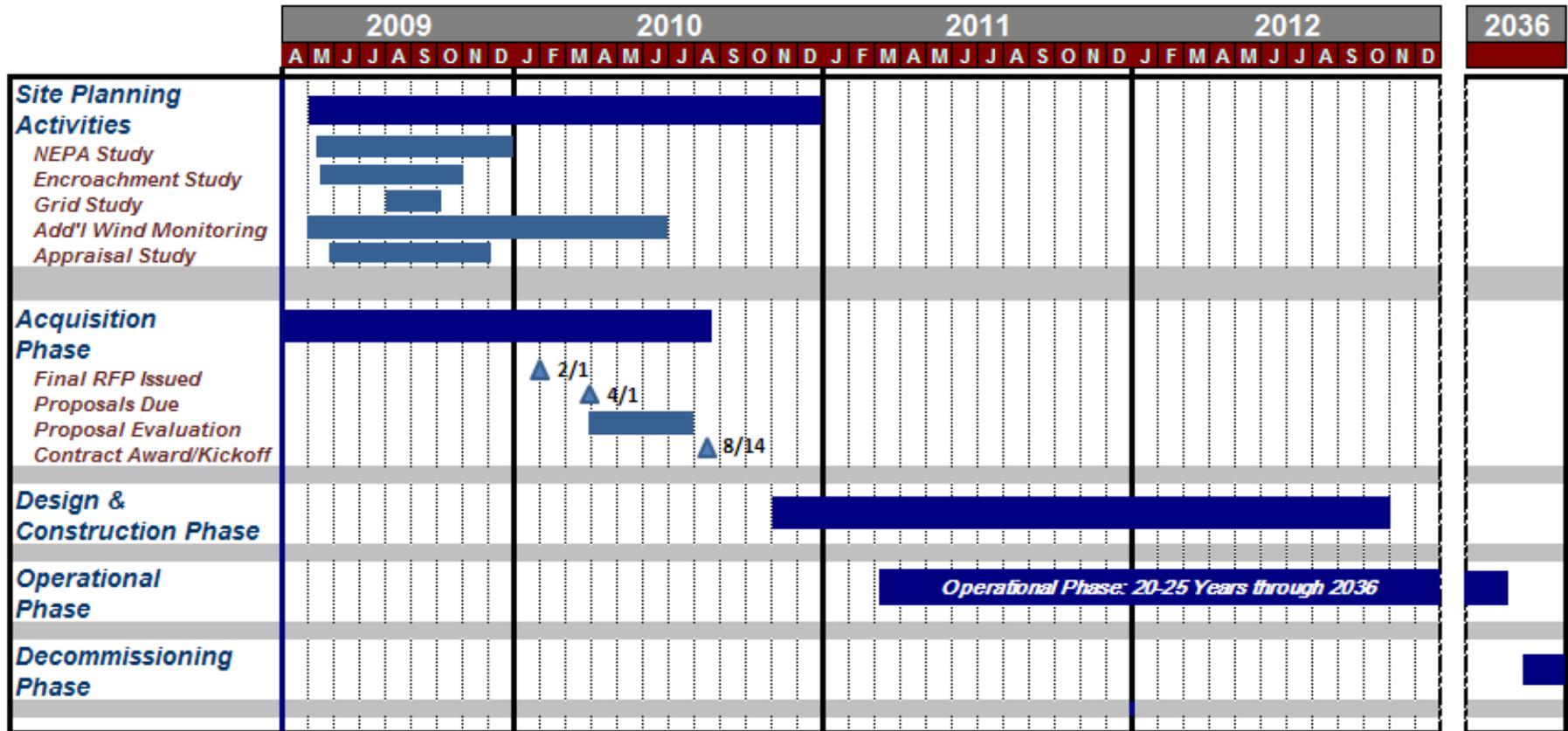
GRC Plum Brook Station Land Use Strategy 3





Proposed Schedule

GRC FY11 Strategic Institutional Investment Proposal --- Wind Farm Proposal



As of 7/16/09