



Testimony Provided To

Senate Utilities

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March 23, 2021

In Opposition to Senate Bill 279

The Wind Generation Permit & Property Protection Act

Chairman Thompson, Vice-Chairman Petersen, Ranking Member Francisco, and members of the committee,

This afternoon I appear before you on behalf of the Advanced Power Alliance and the forty members of our organization which represent a diverse cross section of the world's leading energy companies, energy investors, energy consumers in the wind, solar, battery storage and green hydrogen industries. Most of these organizations have business interests in Kansas via operating wind farms, wind farms under development, purchase power agreements, development headquarters or manufacturing facilities. TradeWind Energy, now owned by Enel, a tremendous locally grown Kansas success story, was the largest developer of wind projects in the nation in 2017. Our member assets in Kansas span the state from the most densely populated to the least, from the fastest growing to those with the most rapid population decline. Since the first wind farm came online in 2001, the wind energy industry has invested more than \$14 billion private dollars in Kansas and created more than 20,000 direct and indirect jobs in both rural and urban Kansas with several billion dollars of new wind farms under construction. We house the nation's first wind turbine technician certification program which has a 100% job placement rate. **The Advanced Power Alliance stands in strong opposition to SB 279.**

Wind Farm Siting History

The first wind farm was installed in Kansas in 2001 in Montezuma. Wind energy leasing across Kansas continued through the early 2000s. In 2004, a Kansas Wind Energy Siting Taskforce was assembled to discuss siting guidelines. The taskforce was diverse and comprised of local governments, environmental conservation

The Advanced Power Alliance represents a diverse cross-section of the world's leading energy companies, energy investors, energy consumers, and energy advocates.

ABLE Grid
AEP Renewables
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Allete
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Apex Clean Energy
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Blackrock
Blattner Energy, Inc.
BP
Capital Power
Clearway
Duke Energy
EDF Renewables
EDP Renewables
ENEL
EcoPlexus
Exelon
Electric Power Engineers, Inc
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organizations, environmental groups and a few wind developers. In 2005, the taskforce issued siting guidelines which have served as a baseline template for all involved in siting wind farms. The same year, a Kansas county in the Flint Hills banned commercial wind development in the county. A landowner took the County to court and the case went all the way to the Kansas Supreme Court in what became known as the Zimmerman v. Wabaunsee County case. The Supreme Court upheld the county’s decision to ban commercial wind development. In 2006, Governor Kathleen Sebelius issued the “Heart of the Flint Hills” box which effectively halted wind farm development in 16 Kansas counties. Local Kansas utilities agreed to not purchase any wind power from projects developed within the Flint Hills or on native prairie. The Flint Hills box was doubled in sized in May 2011 when Governor Brownback announced the expanded box known as the “Tallgrass Heartland”. All or most of 33 Kansas counties were included in the box which precluded wind development in the areas historically known for native intact prairie. Many wind projects were halted mid-development. Counties that wanted the economic development benefits of wind were overruled and the private property rights of landowners in about one-third of the state were impeded upon. **Whether the siting guidelines are policy, local ordinance or executive action, the wind industry has followed the rules of the road.**

How Wind Projects are Sited

There are three key components to developing a wind farm in Kansas:

- (1) A great wind energy resource & land use compatibility;
- (2) Community/landowner support;
- (3) Environmental Impacts

These three elements work in tandem. Without one, a wind farm will not be developed in a particular location. In general, the places most suitable to place wind projects have these features:

- (1) Strong and consistent winds
- (2) Large, open space, such as agricultural land
- (3) Community acceptance
- (4) Minimal risk to wildlife

After a desktop analysis confirms good wind potential and transmission interconnection, a developer approaches landowners about the possibility of hosting a “Met Tower” to secure 2-3 years-worth of wind speed data. If the data is looking positive, landowner outreach begins for potential leasing. In zoned counties, conversations with the County Commission begin for conditional/special use permitting and road maintenance agreements, county contribution agreements and decommissioning. Half of Kansas counties are unzoned. In those counties, the road maintenance agreement, county contribution agreement and decommissioning agreement must be approved by the County Commission.

Leases are negotiated with individual landowners with deference given to landowner preference for tower placement and setbacks to the best extent possible. Public meetings are held. Landowner meetings are held. In zoned counties, the Planning & Zoning Commission must approve the project before forwarding the project to the County Commission for final consideration along with the three other agreements. Along the way, the project is undergoing separate permitting at the state and federal level related to: FAA



permits, watershed, biological, archeological, historical/cultural review to name a few.

Concerns with SB 279

SB 279 ends the long-standing successful process of siting wind farms in Kansas which gives deference to landowners and local county control. Wind energy leases are signed by willing landowners. They are voluntary. The landowners may sign the lease because of financial benefit, they may sign the lease for environmental concern, they may sign the lease as a gift to their children. The State cannot be in the business of judging whether one person's resistance is more worthy, heart-felt or valid than the support of another.

Setbacks

Counties have instituted setback guidelines or other "rules of doing business" for all forms of business and industries after community consideration and deliberation.

There is no evidence to support the overly restrictive setbacks for public safety benefit.

Typical setbacks across Kansas counties:

- Non-participating property lines: 500 feet or 1.1 times the total turbine height, whichever is greater.
- Residences or occupied structures: 1,000 feet. Pottawattamie County¹ and Pratt County² have some of the most restrictive setbacks at 2,500 feet.
- Roads: 500 feet or 1.1 times the total turbine height, whichever is greater; with some identifying turbine height plus 50 feet.

SB 279 proposes 20 times the system height or 15,840 feet, whichever is greater, any airport, federal wildlife refuge, public hunting area or public park.

This provision is extremely onerous. Restricting distance from *any airport* is too broad and could open small airports up for interpretation under the definition, which could potentially result in elimination of large areas within counties from wind development. Some counties place height restrictions on turbines within a particular radius of a municipal airport (e.g., Pratt County restricts turbines to 200 ft and under within 8 miles of their municipal airport). Most defer to the FAA on airport restrictions. Note detailing of Federal Aviation Administration rules and regulations attached to my testimony. Further, there are many legal references that suggest states are pre-empted from regulating in the space by the Constitution and Federal Law.

Kansas has a "walk-in hunting" program that provides hunting access to private property. The Kansas Department of Wildlife Parks and Tourism contracts with local landowners yearly and these contracts and areas can vary year to year. Yearly walk-in hunting enrollment changes would make it difficult to keep track of all the hunting areas when trying to develop projects.

¹ <https://www.pottcounty.org/DocumentCenter/View/3635/Article-5---Agricultural-Zoning-Districts-PDF>.

² <http://prattcounty.org/DocumentCenter/View/77/Adopted-Pratt-County-Zoning-Regulations-5-7-2012-Reduced-size?bidId=>

There are over 40 state wildlife areas and preserves³, and four national wildlife refuges⁴ in Kansas sprinkled across the state. Additionally, many communities include multiple public parks and areas for recreation. This setback requirement would potentially eliminate large areas of land from development.

Lighting: Sec. 3 (b)

(3) The applicant shall demonstrate that each turbine of the facility will be equipped only with navigational lights that are activated by infrared or other radar technology used to detect nearby aircraft and that such lights will not be activated absent such technology, unless the board has modified this requirement by resolution.

For Aviation detection lighting systems (ADLS), the FAA requires the lighting be activated and flashing if an aircraft is at or below 1,000 feet above the tallest wind turbine and is approaching a three-statute mile (SM; 4.8 kilometers) perimeter around the project. Although the FAA's guidance has been published and ADLS vendors have been certified, this does not mean ADLS can automatically be installed on a project. For each project that is considering using ADLS, a request must be made to the FAA, and the FAA evaluates each request on a turbine-by-turbine basis.⁵ The FAA can deny the ADLS usage on certain turbines due to proximity to airports, low-altitude flight routes, military training areas, or other areas of frequent activity. As a result, states and local communities should allow developers the flexibility to work through the feasibility of such systems on particular wind farms with the FAA. Additionally, ADLS refers to a specific light mitigation technology solution. There are companies working on different technologies to mitigate the nighttime lighting impact, such as light dimming technologies. However, the FAA has not yet certified any light mitigation technology other than ADLS, nor have they provided guidance for how these systems would be implemented, if approved. For wind turbines to comply with FAA determinations and to ensure the safety of the National Airspace System, marking and lighting must be installed in compliance with FAA's conditions and guidance.

Sound Limit: Sec. 3 (a)

(5) This should be clarified to be dBA (A-weighted decibels) and to identify the point of evaluation, such as non-participating residence.

Depending on the point of evaluations, a limit of 40 decibels would unnecessarily restrict landowners who wish to develop wind energy on their land. There is no health evidence to support a sound limit lower than 45 decibels at a dwelling or occupied structure and most counties across Kansas do not restrict wind turbine sound limit below 50 decibels.

Turbine Density: Sec. 3 (b)

(5) The wind turbine density shall not exceed one turbine per square mile. There is no justification for this restriction.

Application requirements: Sec. 3 (b)

³ <https://ksoutdoors.com/Services/Publications/Maps-State-Wildlife-Areas>

⁴ <https://ksoutdoors.com/KDWPT-Info/Locations/National-Refuges-Grasslands-and-Preserves>

⁵ [FAA Advisory Circular 70/7460-1M](#), last updated November 16, 2020. Chapters 13 and 14 is specific to lighting and marking of wind turbines.

(7)(F)(i) Many turbine parts can be salvaged and recycled / reused. The financing plan should be allowed to take salvage value into consideration. It is in a developer /owner's best interest to maximize value by salvaging and reusing materials. The steel, copper and other metal components that make up the bulk of a turbine have salvage value and can be recycled. See ACP's fact sheet on [decommissioning](#).

(7)(G) Fire protection plan. Is this a common requirement for wind energy?

(7)(H) Weather radar assessment: Note information below from NOAA ROC

Sound Study / Modeling: Sec. 3 (c)

(1) Unclear why there is an ambient study required given the establishment of a fixed sound limit.

(A) Short-term attended measurements pursuant to part 3 short-term measurements with an observer present, ANSI S12.9-2013. The study is required to be developed by an expert in accordance with professional standards. Therefore, rather than include this level of detail in the bill, which does not allow an expert to incorporate best available guidance, the sound professional can develop a measurement plan.

(D) data collection performed with a windscreen of the type recommended by the monitoring instrument's manufacturer; This would seem to prohibit the use of oversize or double windscreens which represent an evolving best practice to minimize wind induced microphone noise.

(E) measurements conducted at the nearest properties from the proposed wind turbines that are representative of all residential properties within two miles of any turbine; "representative" seems to acknowledge that measurements at all locations is not reasonable/feasible. This is workable.

(F) omission of any sound measurements when:

(i) The wind velocity is greater than four meters per second at the microphone position; 5 m/s would be more typical.

(2) *Final preconstruction sound reports shall provide A-weighted and C-weighted sound levels for L-10, Leq and L-90.... It is unclear the relevance of C-weighted sound levels.*

(3) *The predictive sound modeling study shall include:*

(A) Observations of all sound measurements conducted in accordance with the standards and specifications of the international organization for standardization for acoustics, attenuation of sound during propagation outdoors, part 2, general method of calculation, ISO 9613-2 1996-12-15; It is unclear what this is trying to convey as this is in the modeling portion of the rule. ISO 9613-2 is the sound modeling standard.

(B) an adjustment to the Leq sound level produced by the model applied in order to adjust for turbine manufacturer uncertainty. Such adjustment shall be determined in accordance with the most recent release of the international electrotechnical commission wind turbines, acoustic noise measurement techniques, IEC 61400 part 11 standard, edition 3.0 2012-11. This provision seems okay, however for projects considering new technology where testing reports are not available at the time of permitting, suggest identifying that a + 2 dBA adjustment addresses this requirement.

Additional Points on Health

Sound and Health:

Peer-reviewed, scientific evidence overwhelmingly finds that properly sited wind turbines do not harm human health. The credible, scientific peer-reviewed literature on this subject is expansive (more than 80 studies worldwide). Health Canada (the Canadian equivalent of the U.S. Department of Health and Human Services) and Statistics Canada published the most comprehensive multi-disciplinary field study to date (including surveys and objective health measurements), which found that self-reported sleep issues, illnesses and stress were “not found to be associated with WTN [wind turbine noise] exposure.”⁶

With respect to objective health measurements, Health Canada and Statistics Canada found, “WTN was not observed to be related to hair cortisol concentrations, blood pressure, resting heart rate or measured sleep (e.g., sleep latency, awakenings, sleep efficiency) following the application of multiple regression models.”⁷ Health Canada’s findings were also published in *Environmental Research*, a professional peer reviewed journal.⁸

A 2019 joint research paper from the Environmental Health Sciences Research Center at the University of Iowa College of Public Health, Iowa Policy Project, and the Iowa Environmental Council⁹ similarly resulted in the following key findings:

- “To date, no peer reviewed scientific journal articles demonstrate a causal link between people living in proximity to modern wind turbines, the noise (audible, low frequency noise, or infrasound) they emit and resulting physiological health effects ...”
- “Given the evidence and confounding factors, and the well-documented negative health and environmental impacts of power produced with fossil fuels, we conclude that development of electricity from wind is a benefit to the environment. We have not seen evidence that wind turbines pose a threat to neighbors. We conclude that wind energy should result in a net positive benefit to human health.”

In 2014, the Massachusetts Institute of Technology (MIT) issued a comprehensive review of scientific literature on wind turbines and human health titled “Wind Turbines and Health: A Critical Review of the Scientific Literature.” The peer reviewed report prepared by a multidisciplinary team with expertise in environmental medicine, epidemiology, acoustics, otolaryngology, clinical psychology, and public health was published online in the *Journal of Environmental and Occupational Medicine*.¹⁰ The report included a literature review of over 160 references. The findings, summarized below, are consistent with the findings of other epidemiological studies related to wind and health, including the Health Canada study:

- Measurements of low-frequency sound, infrasound, tonal sound emission, and amplitude-modulated sound show that infrasound is emitted by wind turbines. The levels of infrasound at customary distances to homes are typically well below audibility thresholds.

⁶ Government of Canada. Wind Turbine Noise and Health Study: Summary of Results, available at: <https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/everyday-things-emit-radiation/wind-turbine-noise/wind-turbine-noise-health-study-summary-results.html>.

⁷ Ibid.

⁸ Feder, K., Michaud, D. S., Keith, S. E., Voicescu, S. a., Marro, L., Than, J., ... van den Berg, F. (2015). An assessment of quality of life using theWHOQOL-BREF among participants living in the vicinity of wind turbines. *Environmental Research*, 142, 227–238. <http://doi.org/10.1016/j.envres.2015.06.043>

⁹ Thorne, Peter S., Osterberg, David, and Johannsen, Kerri. Wind Turbines and Health. <https://www.iowapolicyproject.org/2019docs/190131-Wind-Health.pdf>.

¹⁰ McCunney, Robert J. MD, MPH; Mundt, Kenneth A. PhD; Colby, W. David MD; Dobie, Robert MD; Kaliski, Kenneth BE, PE; Blais, Mark PsyD. Wind Turbines and Health: A Critical Review of the Scientific Literature. *Journal of Occupational and Environmental Medicine*: November 2014 - Volume 56 - Issue 11 - p e108-e130. Available online at: http://journals.lww.com/joem/Fulltext/2014/11000/Wind_Turbines_and_Health_A_Critical_Review_of_the.9.aspx.

- No cohort or case–control studies were in this updated review of the peer-reviewed literature. Nevertheless, among the cross-sectional studies of better quality, no clear or consistent association is seen between wind turbine noise and any reported disease or other indicator of harm to human health.
- Components of wind turbine sound, including infrasound and low frequency sound, have not been shown to present unique health risks to people living near wind turbines.
- Annoyance associated with living near wind turbines is a complex phenomenon related to personal factors. Noise from turbines plays a minor role in comparison with other factors in leading people to report annoyance in the context of wind turbines.

Shadow Flicker and Health:

In 2012, the Massachusetts Department of Environmental Protection in collaboration with the Massachusetts Department of Public Health commissioned a study that included a panel of independent experts to identify any documented or potential health impacts that may be associated with exposure to wind turbines.¹¹ The panel of experts concluded that there is no scientific evidence to suggest that shadow flicker negatively effects health. A 2013 public health study in Oregon reached similar conclusions finding, “Shadow flicker from wind turbines in Oregon is unlikely to cause adverse health impacts in the general population.”¹²

With respect to the very small percentage of the population (approximately three percent of individuals with epilepsy) is known to have a sensitivity to flashing light (i.e. photosensitive epilepsy),¹³ both the Massachusetts and Oregon studies found that even for these individuals, shadow flicker from wind turbines does not pose a risk due to the low rate of flashes per second. This has also been confirmed by the Epilepsy Foundation. The Epilepsy Foundation reports, Generally, flashing lights most likely to trigger seizures are between the frequency of 5 to 30 flashes per second (Hertz).¹⁴ By contrast, as recited in the Massachusetts and Oregon reports, shadow flicker from modern commercial wind turbines occur at “flash” frequencies between 0.3 and 1 Hertz.

See ACP’s fact sheet on [shadow flicker](#).

Conclusion

Under the provisions of SB 279, wind energy development will continue only if a project is on the contiguous acreage of one supportive landowner. There is only one area of the state left with vast tracts of unfragmented acreage - the Flint Hills. The industry has agreed to not develop in the Flint Hills to protect viewshed and the world’s last stand of native Tallgrass Prairie. Otherwise, as the bill is written, the county shall deny a wind project application if the Board finds the developer failed to properly obtain landowner waivers from any applicable setback distances. The bill doesn’t require potentially affected landowners to return documentation to the developer either waiving or not waiving the setback. An opposing landowner could not return a waiver and in the application process, the county commission shall deny the permit.

¹¹ Wind Turbine Health Impact Study: Report of Independent Expert Panel. Prepared for: Massachusetts Department of Environmental Protection Massachusetts Department of Public Health, January 2012. Accessed October 6, 2020: <https://www.mass.gov/doc/wind-turbine-health-impact-study-report-of-independent-expert-panel/download>.

¹² Strategic Health Impact Assessment on Wind Energy Development in Oregon. Public Health Division, Oregon Health Authority. March 2013. Accessed October 15, 2020. Available at: https://www.oregon.gov/oha/ph/HealthyEnvironments/TrackingAssessment/HealthImpactAssessment/Documents/Wnd%20Energy%20HIA/Wind%20HIA_Final.pdf

¹³ Epilepsy Foundation. Photosensitivity and Seizures. Accessed October 6, 2020: <https://www.epilepsy.com/learn/triggers-seizures/photosensitivity-and-seizures>.

¹⁴ Epilepsy Foundation.

Further, for all those landowners who want to have turbines on their ground that are in the swath of the setback requirement of the singular landowner could be denied the opportunity to develop their ground as they so choose.

Lastly, the setback distances shall only be waived if an owner of any such property waives the setback. If the property owner is opposed to the project and doesn't waive the setback requirement, the property owner would by default control the property rights of other landowners within a minimum 1.5-mile radius, with 4,521 acres or a 3-mile radius, which is 18,086 acres – just shy of a full township. Imagine if we added oil wells, cell phone towers, and even homes to these setback requirements?

It has been said that the bill protects landowner rights. This bill flies in the face of a founding principle of our state which fiercely holds tight to the private property rights of the landowners. This is the reason Kansas is last in the nation for state-owned land. This bill does not protect private property rights. It impedes them and usurps local control along the way.

SB 279 was crafted in a vacuum without any input from the industry it seeks to regulate. The wind energy industry is always willing to talk with stakeholders as evidenced by our work nationally, at the state level and locally to responsibly site wind facilities that are embraced by its community and landowner hosts. The industry works diligently to continue to improve the development process with respect to landowners, county leaders, wildlife and conservation groups, environmental groups, the United States military, the Federal Aviation Administration, policymakers and purchasers of wind power. The wind energy industry cannot support a measure that tramples private property rights, usurps local control, undermines long-standing development policies, attempts to override federal regulations, and was crafted to halt wind projects that are in final development stages.

We strongly encourage your opposition to SB 279 and any attempts to move the content of SB 279 into any other legislative vehicle this session.

FAA Statute and Regulatory Passages

Federal Law ([49 USC 44718](#))

Defines the scope of the FAA obstruction evaluation process to promote:

- (1) safety in air commerce;
- (2) the efficient use and preservation of the navigable airspace and of airport traffic capacity at public-use airports; or
- (3) the interests of national security, as determined by the Secretary of Defense.

FAA obstruction evaluation regulations ([14 CFR Part 77](#))

The FAA already evaluates potential issues for individual airports.

77.5 makes clear that the FAA process covers “safety of air navigation.”

(c) Notice received by the FAA under this subpart is used to:

- (1) Evaluate the effect of the proposed construction or alteration on safety in air commerce and the efficient use and preservation of the navigable airspace and of airport traffic capacity at public use airports;
- (2) Determine whether the effect of proposed construction or alteration is a hazard to air navigation;
- (3) Determine appropriate marking and lighting recommendations, using FAA Advisory Circular 70/7460-1, Obstruction Marking and Lighting;
- (4) Determine other appropriate measures to be applied for **continued safety of air navigation**; and
- (5) Notify the aviation community of the construction or alteration of objects that affect the navigable airspace, including the revision of charts, when necessary.

77.9(a) makes clear that the FAA process covers any structure 200 feet above ground level and above (which is all utility scale wind turbines), regardless of its proximity to an airport or runway. Utility scale wind projects are always required to file with the FAA for review given their height.

77.29 defines the specific issues the FAA analyzes (Note: it is clearly very comprehensive and includes everything that would be of concern to a public use airport):

(a) The FAA conducts an aeronautical study to determine the impact of a proposed structure, an existing structure that has not yet been studied by the FAA, or an alteration of an existing structure on aeronautical operations, procedures, and the safety of flight. These studies include evaluating:

- (1) The impact on arrival, departure, and en route procedures for aircraft operating under visual flight rules;
- (2) The impact on arrival, departure, and en route procedures for aircraft operating under instrument flight rules;
- (3) The impact on existing and planned public use airports;

(4) Airport traffic capacity of existing public use airports and public use airport development plans received before the issuance of the final determination;

(5) Minimum obstacle clearance altitudes, minimum instrument flight rules altitudes, approved or planned instrument approach procedures, and departure procedures;

(6) The potential effect on ATC radar, direction finders, ATC tower line-of-sight visibility, and physical or electromagnetic effects on air navigation, communication facilities, and other surveillance systems;

(7) The aeronautical effects resulting from the cumulative impact of a proposed construction or alteration of a structure when combined with the effects of other existing or proposed structures.

FAA procedures implementing the statute and regulations include the follow:

a. The prime objective of the FAA in conducting OE studies is to ensure the safety of air navigation, and the efficient utilization of navigable airspace by aircraft. There are many demands being placed on the use of the navigable airspace. However, when conflicts arise concerning a structure being studied, the FAA emphasizes the need for conserving the navigable airspace for aircraft; preserving the integrity of the national airspace system; and protecting air navigation facilities from either electromagnetic or physical encroachments that would preclude normal operation.

b. In the case of such a conflicting demand for the airspace by a proposed construction or alteration, the first consideration should be given to altering the proposal.

NOAA's National Weather Service
Radar Operations Center
 NEXRAD WSR-88D

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HOW THE ROC ANALYSES WIND TURBINE SITING PROPOSALS

The ROC learns of wind farm developments through both formal and informal methods. Formally, the Department of Commerce's National Telecommunications and Information Administration (NTIA) acts as clearinghouse for developers to voluntarily submit wind farm proposals for review by several federal agencies, including NOAA. This formal process is recognized by the wind industry in the American Wind Energy Association's (AWEA) Wind Siting Handbook (AWEA 2008). Informally, the ROC occasionally receives notifications directly from developers, or learns of wind farm projects from local forecast offices who email news articles or web links to stories about planned wind farms. The ROC typically receives 10 to 15 notifications per month through the NTIA and 1 to 3 per month directly from developers or third parties. The ROC tries to proactively contact the developers if a third party notifies the ROC of a wind project that has the potential to significantly impact a nearby WSR-88D.

Based on the wind farm proposal the ROC receives, the ROC provides a case-by-case analysis of potential wind farm impacts on WSR-88D data and forecast/warning operations. The ROC uses a geographic information system (GIS) database that utilizes data from the Space Shuttle Radar Topography Mission to create a RLOS map with delineated areas corresponding to a turbine height of 160 m AGL. Multiple radar elevation angles are considered for projects close to the radar.

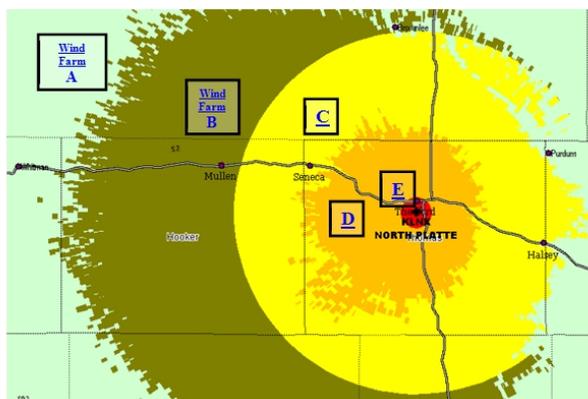
The ROC then performs a meteorological and engineering analysis using: distance from radar to turbines; maximum height of turbine blade tips; the number of wind turbines; radar azimuths impacted; elevation of the nearby WSR-88D antenna; an average 1.0 degree beam width spread; and terrain (GIS database). From this data the ROC determines if the main radar beam will intersect any tower or turbine blade based on the Standard Atmosphere's Refractive Index profile.

Finally, the ROC estimates operational impacts based on amount of turbine blade intrusion into RLOS, number of radar elevation tilts impacted by turbines, location and size of the wind farm, number of turbines, orientation of the wind farm with respect to the radar (radial vs azimuthal alignment), severe weather climatology, and operational experience. The ROC also compares the wind farm to other operational wind farms to estimate impacts.

The ROC has developed a four zone scheme that takes terrain, distance, and the number of elevation angles impacted into account while. The four zones use terminology that communicates to wind farm developers the desired action. These zones, defined below, are: no build, mitigation, consultation and notification.

1. The No Build Zone is a 4 km radius red circle around the WSR-88D. The ROC is requesting that developers do not build turbines in the RLOS within 4 km of the radar due to the potential for serious impacts, including turbine nacelles blocking the radar beam and potential receiver damage if sited in the radar's near field.
2. The Mitigation Zone, orange areas on the map, is the area between 4 km and 36 km where a 160-meter turbine would penetrate more than one elevation angle. Wind farms sited within the mitigation zone have the potential for moderate to high impacts. Therefore, the ROC will work with the developer to get detailed project information, do a thorough impact analysis, and discuss potential mitigation solutions.
3. The Consultation Zone, yellow areas on the map, is the area between 4 km and 36 km where a 160-meter turbine only penetrates the 1st elevation angle or when a 160-meter tall turbine will penetrate more than one elevation angle between 36 km and 60 km. Due to the increased potential for impact to operations the ROC is requesting consultation with the developer to track the project and acquire additional information for a thorough impact analysis.
4. The Notification Zone, green areas on the map, is the area between 36 km and 60 km where a 160-meter tall turbine will only penetrate one elevation angle, or any area beyond 60 km that a 160-meter tall turbine is in the RLOS. Since impacts are typically minimal beyond 60 km and workarounds are available for penetration of only one elevation angle, the ROC is making consultation optional; however, NOAA would still like to know about the project.

The figure depicts an example of the primary categories of wind farm analysis requests/replies.



An example radar line of sight (RLOS) map generated by the NEXRAD ROC for a wind farm analysis. Four hypothetical proposals: W, X, Y, and Z as described in the text are shown.

Wind Farm A: clearly out of the RLOS, would have no impact on the radar data, except in some anomalous propagation conditions, in which case impacts would be low.

Wind Farm B: Notification zone - low impact on the radar data if turbines were built in the western portion of the proposal area. The ROC would suggest that the developer locate most/all wind turbines in the western portion of the proposed area.

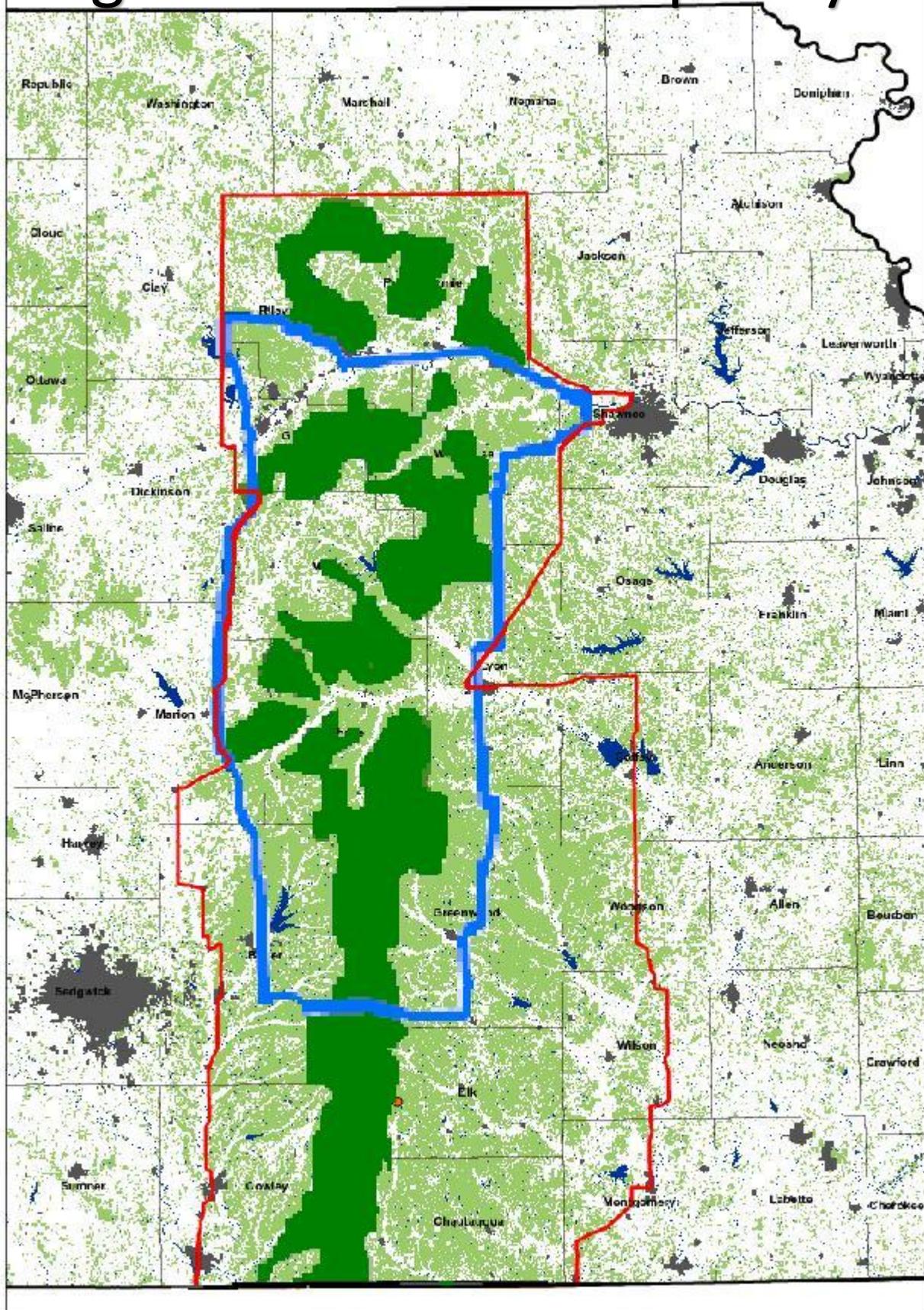
Wind Farm C: Consultation Zone - low impact on the radar data if turbines were built in the western portion of the proposal area. The ROC would suggest that the developer locate most/all wind turbines in the western portion of the proposed area.

Wind Farm D: Mitigation Zone - low to moderate impacts on the radar. The ROC would seek to consult with the developer to determine if there is flexibility to consider impact mitigation techniques and to ensure the developers are aware of potential impact on forecast/warning operations.

Wind Farm E: Encroaches into No-Build Zone. Potentially high impacts on the NEXRAD for the portion of the proposal in the red area. The ROC would seek to consult with the developer to ensure they are aware of the likely impact on forecast/warning operations, the NEXRAD system, and the wind turbines/personnel.

- LINKS**
- INTRODUCTION
 - HOW ROTATING WIND TURBINE BLADES IMPACT THE NEXRAD DOPPLER WEATHER RADAR
 - HOW THE ROC ANALYSES WIND TURBINE SITING PROPOSALS
 - RADAR IMAGERY
 - FREQUENTLY ASKED QUESTIONS (FAQs)
 - ADDITIONAL LINKS AND RESEARCH PAPERS
 - FEEDBACK

Tallgrass Heartland Map May 2011

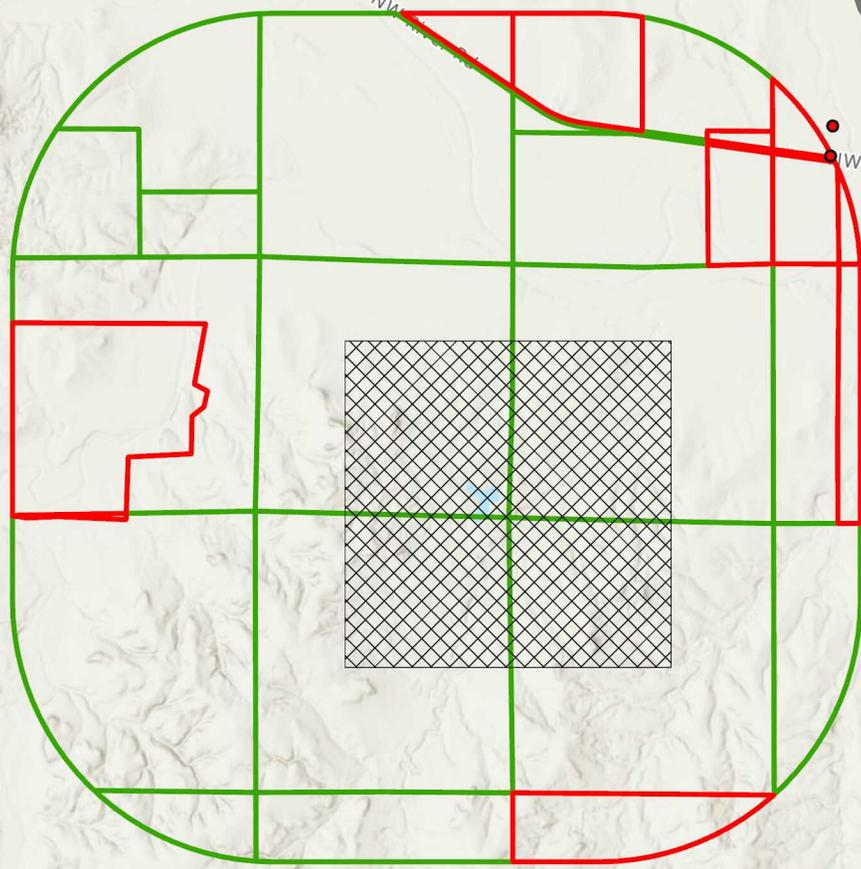


 USFS Legacy
Conservation Area

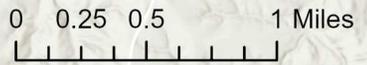
 Original Flint Hills
Moratorium Area

 New Flint Hills
Conservation Area

DRAFT



-  Hypothetical Project Site (1,000 Acres)
-  Nearby Residences
-  Non-Participating Parcels
-  Participating Parcels



DRAFT



Sun City

NW River Rd

Lake City

Sun City Rd

NW

SW Lake City Rd

Dog Crk

1907 ft

1862 ft

-  Hypothetical Project Site (1,000 Acres)
-  Restrictive Setback from Residences - minimum 7,920 feet
-  Nearby Residences
-  Non-Participating Parcels
-  Participating Parcels

0 0.25 0.5 1 Miles

DRAFT



Sun City

NW River Rd

Avia

NW River Rd

Lake City

NW

Sun City Rd

SW Lake City Rd

1862 ft

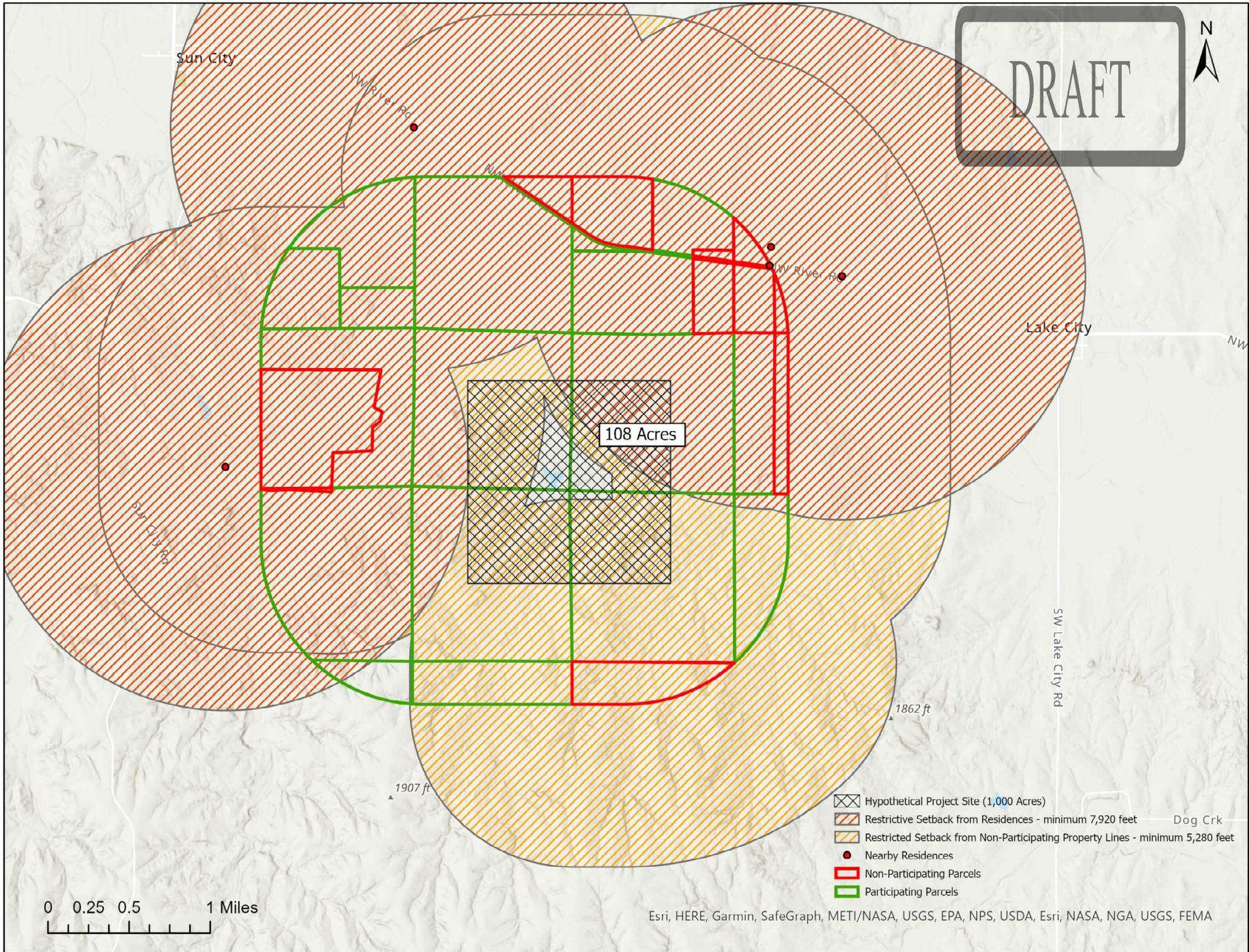
1907 ft

Dog Crk

-  Hypothetical Project Site (1,000 Acres)
-  Restricted Setback from Non-Participating Property Lines - minimum 5,280 feet
-  Nearby Residences
-  Non-Participating Parcels
-  Participating Parcels



DRAFT



Sun City

NW River Rd

Lake City

Sun City Rd

108 Acres

SW Lake City Rd

1862 ft

1907 ft

Dog Crk

- Hypothetical Project Site (1,000 Acres)
- Restrictive Setback from Residences - minimum 7,920 feet
- Restricted Setback from Non-Participating Property Lines - minimum 5,280 feet
- Nearby Residences
- Non-Participating Parcels
- Participating Parcels

0 0.25 0.5 1 Miles